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CONTENTS

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BIOSPHERIC ORGANIZATION AS A "CONTINENTS – OCEANIC BASINS" SYSTEM

ABSTRACT. The functional characteristics of the biosphere are reflected in its binominale frame: continents – oceanic basins. The river-basin land, on the one hand, and pericontinental oceanic waters on the other hand, are the main components of the homeostatic mechanism of the biosphere. In the Archean and Early-Middle Proterozoic, seawater biofiltration did not exist. In the Late Proterozoic and part of the Early Paleozoic, biofiltration started to develop and the oceans have become the main heat-engine of the Earth. Today, the maximum concentration of productive phytoplankton and zooplankton – filter bio-systems – is in the pericontinental oceanic zones. This is a response to the maximal flow of nutrients from the land carried mainly with river flow. This is the main signal of a direct link between terrestrial and oceanic ecosystems. The feedback is the atmospheric precipitation induced by heat and moisture flows and carried from the oceans to the land within its primary river-basin part. These links are experiencing anthropogenic destabilization due to some misplaced priorities of sustainable development and its implementation.

KEY WORDS: biosphere, homeostasis, biospheric organization, frame of the biosphere, river-basin land, phytoplankton, biofiltration, anthropogenic destabilization.

INTRODUCTION

The influence of organic life on the global dynamics was discussed in the works of J. Lamarck (1744–1829), G. Cuvier (1769–1832), C. Lyell (1797–1875), J. Reclus (1830–1905), and F. Richthofen (1833–1905), V.V. Dokuchaev (1846–1903), and others. G. Marsh (1801–1882) have not only pointed to the anthropogenic disturbance of the balance of the living nature, but also the extermination of its most important part – the forest vegetation, i.e., anthropogenic land abiotization. Eduard Suess (1831–1914) suggested the term "biosphere" for the space with an abundance of organic life on the continents. V.I. Vernadsky identified the biosphere basing not on the phase criterion, as has been done before him (stone, water, gas, live), but included into the biosphere the sphere of the active life. This sphere embraces the lower atmosphere, most of the hydrosphere, and upper layers of the lithosphere. "Living matter penetrates the entire biosphere and largely creates it" [Vernadsky, 1980, p. 58]. In 1926, he formulated perhaps the most important law of the geological development: "Life is not a random occurrence in the external surface of the Earth. It is closely connected with the structure of the Earth's crust (the atmosphere-hydrosphere-lithosphere system, in the terminology of the first half of the XIX–XX centuries – S.G.), it is part of its mechanism and this part performs the functions of the greatest importance, without which it could not have existed" [Vernadsky, 1967, p. 212].

Today it is generally accepted that the biosphere is part of the geospace, which supports life due to the specific conditions and biogeochemical and biogeophysical impact of planetary biota on the abiotic substance. V.I. Vernadsky has termed the processes of biotic regulation as "organization of the biosphere" and the associated processes – biogeochemical.

THE FRAME OF THE BIOSPHERE

We will apply this term to the system "continents – oceanic basins." The continental crust is thick (30–40 km), consists of three-layers: the upper sedimentary, deeper granite (metamorphic-granite), and basalt (granulite-basic) at the base. According to Budyko et al. [1985], sedimentary layer of the continents consists of (in wt. %) clayey and shale (43.1 %), followed by sandy (21.0 %), carbonate (18.7 %), volcanic (14.6 %), siliceous (1.8 %) rocks and evaporites (0.8 %). The clay matter, carbonate, and siliceous rocks substances of rocks initially are almost entirely the products of biogeochemical reworking of matter. Sands are formed under different conditions. Their formation is a priori can be attributed equally to the action of biogeochemical processes and metamorphoses, not associated with the manifestations of living matter. Evaporites are chemogenic formations. ***Thus, about 75 % of the sedimentary rock layers of the continents are formed with the participation of living matter, i.e., they are the result of biotic and biogeochemical processes.***

The granite-metamorphic layer is composed of gneisses, schists, marbles, and diabase. The igneous rocks are dominated by granites. The Kola superdeep (12262 m) borehole in the rocks of this layer and below the surface to a depth of 7 km has uncovered the Proterozoic sandstones, dolomites, and diabase. Below lie the Archean (2.86 billion years of age) paragneiss (with marked predominance) and amphibolites. Paragneiss is metamorphosized clay rocks. The original clay matter is likely the result of activity of prokaryotes that formed mats on the land surface and were much more common in the Precambrian than now. "Though the amount of living matter is lost in comparison to the mass of abiotic and biogeochemical matter in the biosphere, the biogenic rocks (i.e., formed by living matter) make up a large part of its mass and extend far beyond the biosphere. Given the phenomena of metamorphism, they are transformed, losing all traces of life, into the granitic envelope and go beyond the biosphere. The granite shell of the Earth is the area of former biospheres" [Vernadsky, 1980, p. 215]. Geochemist T. Barth (1962] wrote: "first sediment – then granite." Potassium-rich metamorphic rocks and granites exhibit direct connection with strata of primary sedimentary clay composition [Marakushev et al., 1971]. ***Thus, the geological formations of the granitic layer are mostly old sedimentary rocks and the products of the past biogeochemical reworking*** [Sidorenko et al., 1980].

Below 6 km, the section of this borehole continues in paragneisses interbedded with amphibolites. The composition and origin of the lower granulite-basic layer of the continental crust have been mainly attributed to the deep transformation of mantle rocks of the oceanic crust; however, the details of the Kola superdeep borehole did not confirm this notion. The oceanic crust is thin (6–8 km) and consists of three layers: the thin upper sedimentary (a few hundred meters thick), middle basalt, and lower oceanic. The lower two layers are mainly mantle rocks. ***Thus, the continents have biogenic-geodynamic origin and the oceanic basins are of mantle-geodynamic one***.

THE OCEANIC BASINS ARE REPLACED BY THE CONTINENTS

Back in 1896, relying on the paleo-geographic data, V.P. Amalitsky (1860–1917) concluded that in the Phanerozoic (the last 550 million years), the continental area was expanding due to reduction in the size of the world's oceans [Simakov, 2004, pp. 162–164]. Thus, as far back as in the end of the XIX century, scientist have identified the main planetary geo-historical feature inherent, as established later, in the entire phase of geological development of the planet, although in a somewhat complicated form.

The mechanism of transformation of the oceanic crust into the continental was discovered a few decades ago. The process involves the entire solid part of the Earth, i.e., lithosphere, together with asthenosphere that relates to the upper mantle. This change takes place in the subduction and collision mobile belts [Khain, Koronovsky, 2007]. First include the land adjacent to the oceanic border and the adjacent oceanic strip with deep trenches and island arcs along the trenches (though not in all places). The development of such structures occurs first, through the lithosphere downwarping (first stage) and the formation of many-kilometers thick rock, mainly of sedimentary and volcanic-sedimentary origin. At the second stage, downwarping gives place to uplift (inversion). Subduction of the oceanic plate to the deep-sea trench creates a powerful lateral pressure on the island arcs or similar coastal structures. The rocks are crushed into folds, and part of them is subjected to metamorphism, metasomatism, and remelting. Volcanism and deep magmatic processes intensify. The third stage (of intensive uplift) involves formation of fold mountain structures such as the Andean Cordillera mountain belt. Each complete cycle took 200–400 million years in the Phanerozoic; in the Precambrian, the cycle was longer. The subduction mobile belts of the Pacific Ring of Fire represent one of the examples of recent geologic transformation of the oceanic crust into the continental.

The collision type of transformation of the oceanic crust into the continental is inherent in the mobile belts of the Earth, where the oceanic lithosphere is located between two converging continental lithospheric plates. Here, the stages of subsidence, inversion, and uplift of the crust also take place. Within the downwarping segments of the crust, many-kilometers thick layers of sedimentary rock are accumulating and subjected to endogenous transformation, including folding under the pressure on the both sides of the continental plates. Later, the warped zone undergoes inversion and uplift with the formation of the collision fold mountain type like the Alpine-Himalayan mountain belt.

The continental crust is thicker and more stable and geologically far more diverse than the oceanic. The latter is less stable, with numerous faults and volcanoes, some submarine. Plumes are the places of particularly active volcanism, such as Iceland. There, subglacial volcanic activity is stimulated by excessive load of meltwater periodically accumulated in the craters. Excess water is a signal for the eruption and the formation of subglacial streams of enormous power. When the water load is removed, the eruption fades. Some scientists believe that the preventive evacuation of water from subglacial volcanic vents can prevent the eruption.

The trend of replacement of the oceanic crust by the continental one means that the evolution trends of abiotic and live matter are opposite. Abiotic matter releases the excess crystal-chemical energy inherent in the inert matter of mantle origin. Biotic matter becomes more complex and increases its energy potential associated with mineral associations of the granite-metamorphic layer and especially of the sedimentary, rock-rich, layer (clay, fossil fuels, and guano et al.), where the solar energy is deposited mainly due to the biotic factors. Both trends are coordinated and go with increasing speed, which, in particular, allows us to see the global ecosystem in the system "living matter – geospheres" (atmosphere, hydrosphere, lithosphere). Intensification of movement of biological matter indirectly affects the activity of the internal forces of the Earth, directed at the transformation of the oceanic lithosphere into the continental one [Gorshkov, 1975].

Consequently, the system "continents – oceanic basins" is a "calling card" of the existence of the global ecosystem, i.e., the biosphere of the planet Earth. At the same time it is the evidence of the existence of the planetary regulatory pressure of living matter on the forces of abiotic matter, the fact repeatedly pointed to by V.I. Vernadsky.

CONTINENTS ARE THE MAIN FOOTHOLD OF LIFE

What are the implications of the oceans being replaced by the continents for living matter? Below is a list of the main, mostly positive consequences: a) enhanced complexity of geographical conditions to which the biota usually responds with increase of biodiversity; b) greater terrestrial ecosystems' supply of photosynthetic radiation and greater intensity of biogeochemical and biogeophysical processes; c) strengthening of catastrophic events, including major meteorite disasters; d) concentration of almost all the planetary biomass (about 98 %); the biomass (not considering its anthropogenic reduction) per unit land area is higher than that in the ocean by two orders of magnitude; e) speciation outbreaks follow the great extinctions; growth of biocoenotic and biological diversity and of genetic pool of the planet; f) the existence of the most complex rain-forest biological communities with, according to various estimates, from 0.5 to 3 million species.

Let us turn to the figures. The potential terrestrial photosynthetic production is 180 billion tons of organic matter (dry weight) or 82 billion tons of carbon equivalent [Bazilevich et al., 1971]. This is the net primary productivity of the biosphere undisturbed by anthropogenic activity. In modern conditions, the terrestrial net primary productivity is 45 billion tons of carbon equivalent [Lisitzin, 2004].

The last satellite measurements have shown that the primary productivity of the ocean reaches 103 billion tons of carbon equivalent. According to Hampicke by the mid-1970s, the terrestrial phytomass decreased due to human activity by 41.5 %; soil humus decreased by 18 %. By the turn of the second and third millennia, 50 % of the terrestrial phytomass has been lost [Kondratiev, Krapivin, 2004]. The assessment of the total terrestrial phytomass is 466 billion tons C_{org}, which comprises 42.7 % of the potential C_{org} in 1090 estimated by N.I. Bazilevich et al. [1971]. According to FAO [FAO Production Yearbook, 2012], in the XXI century, the speed of deforestation comprises 6 million ha per year. By multiplying this estimate by 14 years and 86 t/ha of C_{org} (the calculated average phytomass per hectare of forest), we obtain a 7.2 billion tons decrease of the terrestrial phytomass due to deforestation for the period 2001–2014. ***From this, the terrestrial phytomass assessment in the beginning of 2015 is 459 billion tons C_{org}, i.e., 42.1 % of the potential.***

HOMEOSTATIC PROPERTIES OF THE RIVER-BASIN LAND

Numerous publications substantiated understanding of the river basins as the ecosystems of direct links and feedback. The pioneering work on basic climate geomorphology is important for understanding homeostatic features of the organization of the biospheric mechanism [Tricart et Caillex, 1965], as well as work on the isolation of the so-called dense biosphere (humid and semi-humid areas), sparse biosphere (semi-arid and arid areas), and bare biosphere (glaciers, snow, etc.) [Caillex, Tricart, 1959] This terminology is well suited for characterization of areas with different homeostatic functions discussed in this paper. The term dense biosphere identifies the territory of a well-developed and almost continuous vegetation cover. This is typical of river basins with dense river network (Fig. 1), if we do not consider their intensive use.

On the schematic map "Organization of the biosphere" (Fig. 2), the terrestrial formations include: river-basin system (a – fully functional, b – weakened by cryogenic processes) or dense biosphere, and the territories of various degrees of aridity; the latter include desert-aeolian territorial system, as well as transitional systems between the river-basin and desert-aeolian, subjected to aridity to varying degrees. This is the sparse biosphere. One can also see some river sections that intersect, in varying degrees, arid territory. Here, as a rule, they lose part of the river flow. The schematic map (Fig. 2) is divided into two parts. Its oceanic part is a copy of the map "Filtering capacity of zooplankton" created by A.P. Lisitzin. The part that reflects the land was developed by S.P. Gorshkov. The map was included in the oral report by A.P. Lisitzin, S.P. Gorshkov, and V.I. Byshev at the jubilee session "150th anniversary of the birth of V.I. Vernadsky" (May 7, 2013) at the Faculty of Geography of the Lomonosov Moscow State University.

Large river basins represent landscape and geological bodies covering part of the

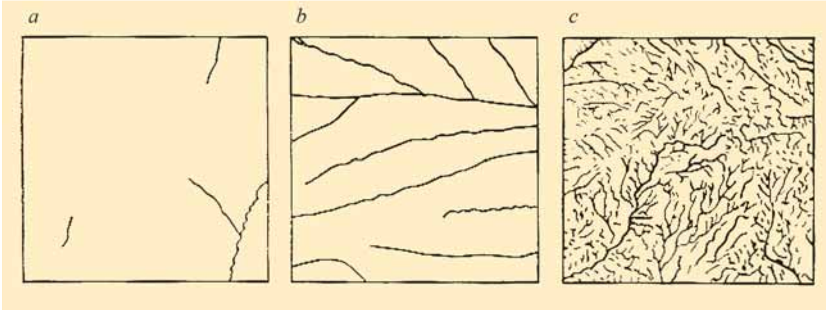

Fig. 1. The difference in the density of the hydrological network of three catchment areas located in the areas of:

a – arid climate in the south-east of the state of Nevada; b – semiarid climate in the west of the state of Kansas; c – humid climate in eastern Indiana [Gorshkov, 1982]

subsurface space within the zone of active water exchange, associated with the river discharge of the basin. A large river basin has three functional components which are as follows:

1) The system of catchment areas of small rivers with relatively homogeneous landscape and geological conditions within each. Catchment areas may differ from each other

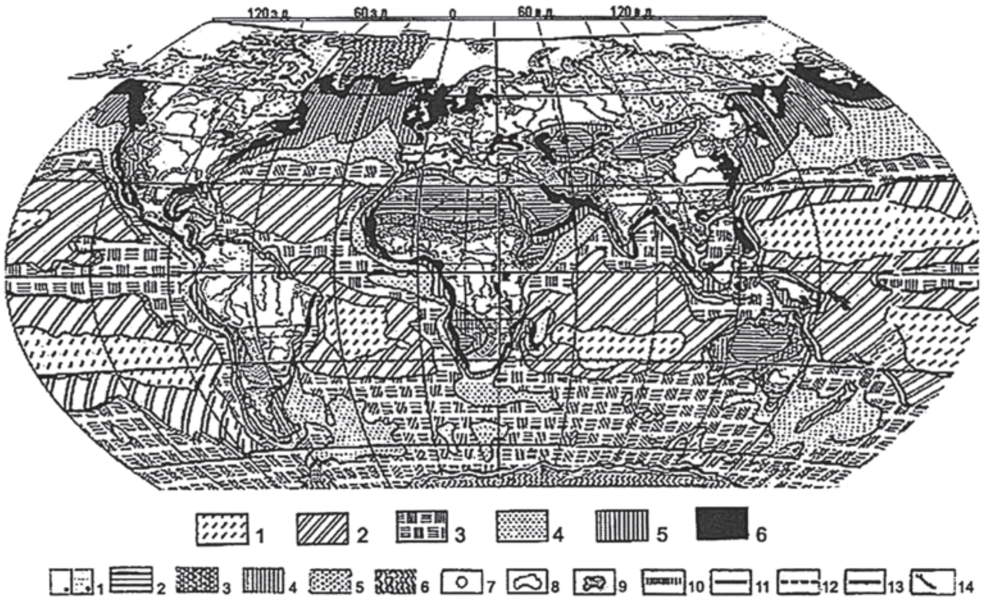

Fig. 2. Model of the biospheric structure. Authors A.P. Lisitzin (ocean) and S.P. Gorshkov (land). Ocean: The top row of characters. The biomass of meristic zooplankton biofilter in the layer 0–100 m (mg/m^3):

1 – < 25; 2 – 25–50; 3 – 50–100; 4 – 100–200; 5 – 200–500; 6 – > 500. Land: The bottom row of characters. Terrestrial systems: 1 – river-basin (transformed by biota) a) adequate; b) weakened by cryogenic processes; 2 – desert-aeolian (slightly transformed by biota); 3–5 – transition between the river-basin and desert-aeolian systems: 3 – subjected to strong anthropogenic desertification; 4 – affected by anthropogenic desertification; 5 – replaced river-basin systems through anthropogenic desertification; 6 – glacial-nival (practically not transformed by biota); 7 – urban industrial and transportation hubs; 8–9 – aquatic system: 8 – lakes with a natural water level; 9 – lakes with anthropogenically altered water level; 10–13: boundary between land and oceanic systems (shore): 10 – accumulative; 11 – abrasive; 12 – abrasive-accumulative; 13 – relatively stable; 14 – boundary of the cryolithozone.

by their zonal-geographical or altitudinal-belt features. Being quite similar in these criteria, they can be identified as adjacent cells in the hierarchical structure of the basin. The network of catchment areas carries flows of organic-mineral matter to the valley network.

2) The valley network as a system of large valleys in conjunction with the main valley. They combine discharge from the catchment areas and valley network elements, and the lower reaches of the valley serve the main integrator of the signal for the entire river basin.

3) The mouth part is the area where the integral signal of the river basin is combined with the signal of the adjacent oceanic part [Gorshkov, 2001]. According to A.P. Lisitzin [2004], it is the marginal filter. We will discuss this below.

At the global level, the homeostatic structure of habitat is mainly identified through analysis of the interaction of the two main components of the biosphere, i.e., the continental and large-island area, on the one hand, and the world's oceans, on the other (see Fig. 2). They are connected through the global water cycle and thermal redistribution, which are, in turn, largely functionally connected with river discharge to the ocean (direct link). The response to the signal from the land is the transfer of atmospheric moisture and heat from the ocean to the most humid terrestrial segment, i.e., to the river basins of the external discharge (feedback). This is largely provided by the advection of warm oceanic waters to the cold oceanic segments and vice versa, which dramatically increases the area of suitable habitat on the earth.

The figures of the annual water exchange between the ocean and the land are as follows. Evaporation from the surface of the planet is 577 thousand km^3 (505 thousand km^3 from the surface of the ocean and 72 thousand km^3 from the land). Precipitation falling within the area of the external river discharge is estimated at 95 thousand km^3; river discharge from these areas is 42 thousand km^3 [World..., 1974]. The area of the river basins with the external discharge have the area of about 103 million km^2 and are characterized by the presence of the great rivers that are absent only in Australia. The figure is obtained by subtracting the areas of Antarctica (14 million km^2) and Greenland (2 million km^2) from the total area of the external discharge of 119 million km^2, since iceberg discharge prevails there [World..., 1974]. Water of the rivers of the external discharge, as a rule, represent the channels of information between the river basins with the dense biosphere and the ocean, even if in transit they run through territories with the sparse biosphere. The land of river basins possesses several distinct homeostatic functions.

Anti-destructive homeostatic function. The highest efficiency of the creative action of the dense biosphere is inherent in wet tropics. Here, "all geomorphological dynamics changes due to the intermediate position of the "dense biosphere"" [Cailleux, Tricart, 1959, p. 43]. In hot humid climate, annual rainfall may exceed 2000 mm. It rains almost daily. Nothing on the planet can compare with the mighty manifestations of life in rain forest. "On one hectare here you can put 42 000 species of insects, 750 species of trees, and 1500 species of other life forms" [Newman, 1989, p. 25]. Density of rain forest is three to four times greater than the density of temperate forest. The soil, due to its highly porous structure, absorbs almost completely moisture which reaches it. Therefore, the planar surface runoff and soil erosion caused by it are practically absent. In the valleys of small rivers, destruction and creep of loose mass occurs [Tricart, Cailleux, 1965].

Under these conditions, "most of the rivers even during floods carry only 5–10 % of their maximum sediment load" [Cailleux, Tricart, 1959, p. 50]. The composition of river suspended material is mainly silty-clay. Runoff of dissolved matter in most of the rivers exceeds that of suspended sediment [Cailleux, Tricart, 1959; Corbel, 1964]. According to the data on the mineral runoff of local rivers, the speed of natural denudation in hot wet climatic conditions for mountainous areas and plains is 0.092 and 0.021 mm/yr, respectively [Corbel, 1964]. These facts indicate weak denudation and a broad manifestation of the biogeochemical weathering almost universally in these conditions [Tricart, Cailleux, 1965].

In the temperate zone, in the presence of the dense biosphere, biogeochemical weathering is less active in winter and can be combined with freezing of soils and rocks. During snowmelt and heavy rainfall, subsurface runoff is active; in some locations, it reaches the surface. Slope processes are weakened and rivers have a negative balance of deposits, i.e., the input of deposits from the slopes and from other sources is lower that the carrying capacity of the river. On the plains, rivers often flow as a single channel, forming meanders, and accumulate interlayer (perstrative) alluvium of the normal type [Gorshkov, 1982]. In the humid plains of the forest and steppe zones of the temperate zone, the denudation speed is estimated at approximately 0.030 mm/yr [Dedkov et al., 1977]. The overall speed of natural denudation in the mountains of the temperate zone is assessed at 110 mm/yr [Corbel, 1964].

In the permafrost zone of the subarctic and temperate zones, the dense biosphere is weakened, although due to the low evaporation, drainage system is also dense. The territories are characterized by high level of waterlogging and lake percentage. The upland areas are covered by stone seas and solifluction flows. These permafrost formations feed the rivers by water in summer because of subsurface ice melting. Overall, sparse forests, forest-tundra, and southern and typical tundra with polar day regime during short summer and, further south, summer with very short white nights on the depositional plains, can be rightly perceived as the "dense biosphere," i.e., having closed vegetation cover. This situation does not exist on the denudation plateaus and mountains, dominated by stone seas (kurums) and permanent snow and glaciers in some elevated places. Vegetation is localized in the bottoms of the valleys and on bottom parts of the slopes [Gorshkov, 1982].

Even in the area of island permafrost, small rivers are usually pushed by soliflual or block flows to warmer and steep slopes. The positive sediment balance is associated with the large rivers of the permafrost zone, for example, Indigirka. This is not true for Ob and Yenisei, whose large part of the flow is outside the permafrost zone. The natural denudation of the mountains and plains of the cold zone is assessed at 0.385 and 0.018 mm/yr, respectively [Corbel, 1964]. The first figure is true for the mountains with active glacial activity. However, in the areas with only ground icing and subsurface ice, e.g., on the Central Siberian Plateau, the figures should be an order of magnitude less, somewhere in the range of 0.030–0.040 mm/yr [Lisitzin, 1974].

Thus, the areas with the dense biosphere have a combination of seemingly two opposites: a) their weakened denudation manifested in underutilization of the sediment load of rivers, and b) thoroughly dissected by rivers network surface. The second feature is particularly noticeable in the humid parts of the temperate zone. Here, due to the lower density of the tree canopy, approximately 5 % and 15 % of the rainfall is involved in the surface and subsurface runoff, respectively. Fig. 1c shows a dense river network in an area with coniferous-deciduous forests in the state of Indiana, USA, in the temperate zone [Gorshkov, 1982].

Environment-forming homeostatic function. At relatively high rainfall during the growing season, there is a rapid return of the bulk of the moisture to the atmosphere. This return is due to transpiration and evaporation from natural canopy, i.e., due to evapotranspiration. The share of evaporation in evapotranspiration on bare surfaces is low due to projective cover close to 100 %. A perfect example is the zone of equatorial tropical rain forests with almost daily precipitation. The high speed of the water cycle is a consequence of the maximum, among photosynthetic organisms, leaf area size of the local forest communities and the tiered structure of projective cover. This provides for a high share of biological and physical evaporation of moisture from the vegetation canopy. Here, 80–90 % by weight of precipitation returns to the atmosphere after a few hours. Only 10–20 % of the precipitation is absorbed into the soil, enters runoff, and then, in about a month, the atmosphere [Krenke, Zolotokrylin, 1984].

The share of physical evaporation of rainfall intercepted by canopy of broadleaved evergreen, broadleaved deciduous, and conifer forests is estimated at 13 %, 19 %, and up to 22 %, respectively [Diego et al, 2010.]. Overall, the geosystems of the equatorial rain forests support year-around the most suitable for producers, and, consequently, for the entire wildlife habitat, conditions. They reduce the surface temperature. The lowest average monthly temperature is + 25 °C; the highest is + 27 °C. The moisture content in the soil and underlying rocks is optimal. On plains, excess moisture content in soil and groundwater on the clearings, meadows, and arable lands leads to waterlogging, and in the mountains – to catastrophic landslides.

One of the most important indicators of the environment-forming homeostatic function of the dense biosphere during the growing season is surface temperature as an indicator of the release of sensible heat. Evaporation (latent heat flux) accounts for 2.47 MW/ha, 1.23 MW/ha, and 1.00 MW/ha in the zones of tropical rain forest, summer-green forest, and taiga, respectively. These figures are 0.91 MW/ha for meadows, pastures, and steppes, 1.18 MW/ha for arable land, and 0.61 MW/ha for land not used in agriculture. The average estimates were made for the land area of 13.31 billion hectares (i.e., without Antarctica and Greenland) [Krenke, Zolotokrylin, 1984].

Water-regulating homeostatic function. This function was studied by O.I. Krestovsky [1986]. Using the river basin in the subzones southern taiga of European Russia as an example, it has been established that on clear-cut areas, the speed of snow melting, the size of runoff, and flood levels increase. At the same time, the lowest river water-level and groundwater recharge decrease. Transpiration falls to the minimum. During the juvenile and young forest phases, river discharge decreases rapidly and falls to the minimum; at the same time, transpiration increases to the maximum. With forest maturing, runoff increases and transpiration falls. Flood peak becomes lower, the water level in low-water period higher, and groundwater recharge reaches the ordinary level. ***The characteristics of river discharge and groundwater balance in catchment areas follow the physiological phases of forest vegetation*** [Krestovsky, 1986].

Adaptive-reduction homeostatic function. This function is most commonly manifested in the river basins of the temperate zone. Here, during the vegetation period, there is a sufficient heat period for large-scale farming, despite the presence of snow cover in winter. In such conditions, deforestation of catchment areas and establishment of meadows, arable land, and settlements is accompanied by rapid snowmelt, increasing surface runoff, abnormally high and rapid floods, reduced groundwater recharge and their runoff, increase of sheet and gully erosion and sediment discharge to hydrographic network, and transformation of small river valleys into gulches, which represents a response to a sharp decrease of the normal rate of their discharge in summer. A quick response of the catchment areas of small rivers to the events listed above is partially carried into the network of large valleys as abnormally high floods, low summer and winter dry-weather periods, as well as the increased sediment load in all parts of the river basin. It changes from the dense dendritic to the truncated-primitive [Nezhihovsky, 1971]. ***In general, agricultural development not only significantly reduces the water-regulating function of the dense biosphere, but also leads to a reduction in the release of its***

latent heat flow, i.e., to the weakening of the thermal and moisture regulating potential of the territory. Facts of degeneration of small rivers due to deforestation by arable land, plantations, pastures, and land with man-maid structures are well known in the eastern and in the central parts of the United States.

FRAGMENTARY HOMEOSTASIS OF ARID LAND

The stability of the processes of external dynamics in the areas of the dense biosphere contrasts the unstable high activity of exogenous processes in the areas of semi-arid, arid, and hyper-arid climate. In the sparse biosphere of the temperate and hot zones there is intense denudation (although not always). In endorheic areas (30 million km^2), the area of nearly 1.2 million km^2 is associated with the bulk of the Volga River basin with the dense biosphere. The land of varying degrees of aridity, not included in endorheic areas, occupies 18–20 million km^2. Dry steppe and semi-arid parts of the temperate zone are characterized by low levels of projective cover. Thus, V.N. Zolotokrylin [2003] assumed in his studies in the Central Asia and Kazakhstan 40–50 % and 30–40 %, for dry steppes and semi-deserts, respectively, as representative indicators of cover. Such areas are subjected to strong surface runoff, gulling, mudflows, deflation, corrasion, thermal and frost weathering, and infiltration pull of mineralized water to the surface with the formation of accumulative salt crusts (caliche, carbonic calcium gypsum, drywall, silcretes). Gullies and ravines represent repositories for sometimes tumultuous streams. Vast inclined relief can be covered by water current several times a year. Most of the sediment is usually deposited in the form of deluvium, proluvium, and valley alluvium. The bulk of the discharge products remain at the locale denudation bases. These include small erosional networks, and sometimes also the belt of channel-floodplain complexes of large rivers. Sediment influx into a permanent river network, as a rule, is small; it is often only 10 % [Pots, 2001]. Therefore, the natural rate of denudation within the semi-arid and arid areas, defined using data on river mineral discharge, is underestimated. Denudation degradation of plains in such conditions has been estimated at 0.011 mm/yr, while in the mountains it is 0.228 mm/yr [Corbel, 1964]. The rate of degradation of surface slopes by sheet erosion in dry steppes within plains is 0.020 mm/yr; in the desert zone of the Colorado Plateau it is 0.11 mm/yr, and on the hills in the semi-desert area in the state of New Mexico, USA, composed of loose sediments, it is 0.48 mm/yr [Gorshkov, 1982]. Some sites in the states of Kansas and Nevada, USA, represent examples of the level of sparseness of the river network in the semi-arid dry-steppe and arid semi-desert conditions of the temperate belt (see. Fig. 1a and 1b) where sparse and sporadic river networks differ from those in the dense biosphere. Local rivers feed mainly from occasional rainfall and snowmelt. In areas with the sparse biosphere and extra-arid and almost bare deserts, where rain falls every few years, the sand in the surface layer is moved by dust storms. During such storms, silt and finer particles often migrate with the air masses many hundreds of kilometers away, and sometimes even farther. On its way, aeolian fertilization affects the euphotic layer of the Atlantic Ocean and, in the end, the heavily washed soils of wet subtropics of Florida and the Amazon [Gorshkov, 2001]. Thus, the areas of the sparse biosphere that possess homeostatic characteristics occur only on the land along large transit rivers with forest corridors, sufficiently water-rich river deltas, irrigated land, oases, reservoir borders, freshwater lakes, and also in well-verdured cities. ***The water-land objects listed above have higher water supply, green cover, and latent heat flow compared with arid and semi-arid areas. Water-land objects make up the fragments of natural-anthropogenic ecological frame of the areas with dry climates.***

PRODUCTION-BIOFILTRATION HOMEOSTATIC MECHANISM OF THE OCEANS

Below, we provide the fragments from the "Living Ocean" concept by A.P. Lisitzin [2004] that represents a major contribution to the study of the biosphere, in particular, to understanding of the biogeochemical and biogeophysical mechanisms in the system "continents – oceanic basins."

The flow into the mouths of rivers that run into the ocean is associated with the biogeochemical mechanism in the river-basin terrestrial part: 1.75 billion tons of sediment and 2.7 billion tons dissolved matter per year [Gorshkov, 2001]. Only 7–10 % of the sediment immediately reaches the ocean. Its bulk (at least 16.7 billion tons) is deposited in the marginal filter [Lisitzin, 2004], i.e., in deltas and estuaries. On the river-ocean boundary, i.e., within the marginal filter, gravitational sorting of clastic material, coagulation and flocculation of the finest particles and colloids, and deposition of 90–93 % of sediment transformed in these ways, take place. Significant water clarification enhances phytoplankton photosynthesis and the formation of organic matter [Lisitzin, 2004]. In addition, the ocean receives: with direct underground runoff from land – 1 billion tons of dissolved substances in clastic form, 2.4 billion tons of moraine material from shelf glaciers, 1 billion tons of shore abrasion products, 2 billion tons of aeolian dust, and 1 billion tons of dumping [Gorshkov, 2001].

In the pericontinental upper active layer of the ocean, there is the densest concentration of phytoplankton and plankton crustaceans-biofilters. During feeding, they strain suspensions that practically do not sediment from water. The suspensions aggregate in digestive tracts of crustaceans into pellets, i.e., aggregates of silty and sandy fractions, and quickly sediment. The rate of sedimentation of the pellets is 500–600 m/day, compared with 0.07–2 m/day for fine particles prior to their involvement in the biofiltration. Organisms-biofilters also involve dissolved matter into pellets. The entire volume of the oceans, from the surface to the bottom, is completely subjected to biofiltration over six months.

The deposited pellets disintegrate. Only 5 % of the newly formed suspension reaches ocean floor; less than one percent is incorporated into the bottom sediments. The main part of the original material is returned to the water – to the deep ocean reserve, and, then, through upwelling – to the top active layer [Lisitzin, 2004]. Oceanic biosystems operate due to repeated use of biogenic and biophilic elements. This mechanism is a consequence of the fact that river discharge from land supplies only 15 % of necessary biogenic elements [Lisitzin, 2004]. Only the repeated recovery of biogens in the active layer and the underlying ocean waters in the system "producer-consumer-decomposers" provides higher bio-productivity of the world's oceans, compared with the continents [Gordeev, 2012].

The primary productivity of the oceans, as mentioned above, is 103 billion tons of Corg/yr, while that of the continents is about 45 billion Corg/yr, i.e., about 2/3 of the primary productivity is associated with the ocean. The phytoplankton and zooplankton biomass is 25.0 billion tons and 1.5 billion tons, respectively; at the same time phytoplankton regenerates 660 times annually, while zooplankton – only 2.5 times.

The maps by A.P. Lisitzin [2004] "Primary Production of the Ocean" and "Zooplankton Systems Filtering Capacity" show: a) the highest primary productivity of phytoplankton and zooplankton systems filtering capacity are associated with waters adjacent to the continents; b) the lowest primary productivity of phytoplankton and zooplankton systems filtering capacity are associated with the oceanic areas in tropical zones, isolated from any major land fragments and with an extreme deficit of meteoric precipitation. The adjacent subequatorial waters have higher parameters than the above-mentioned ranges. Probably the tropical habitats suffer from the absence of any significant flow of nutrients from rain moisture, in contrast to the adjacent equatorial waters receiving such "manna from heaven."

The influence of even a short-term influx of biogenic substances from the outside causes equally rapid growth of phytoplankton. A similar, in term of rate and scale, decrease of the fertilization effect adequately returns phytoplankton and the associated pyramid of heterotrophs to the previous lower level of productivity. Such was the case during the two largest in the past decade (in 1998 and 2010) floods on the river Yangtze. The data of oceanographic observations show that the total primary productivity in the East China Sea after the floods could provide fishery catches approximately three times higher than in their absence. Icebergs from glaciers in Antarctica, drifting in the Southern Ocean, supply fresh water, dust, and mineral particles to the surface waters of the ocean along the paths of their movement. It affects the phytoplankton growth conditions. Satellite observations and computerized data on the movement of icebergs in the Weddell Sea from October to March in 1999–2004 pointed to the likelihood of increased phytoplankton biomass by about one-third in the euphotic layer along the paths of movement. The settled volcanic ash from the eruption in August 2008 in the Aleutian Islands caused one of the largest phytoplankton blooms in the northern zone of the subarctic Pacific Ocean. ***Thus, the production-biofiltration activity of the ocean is the direct result of biogenic substances inflow capacity (P and Si). The main supplier of nutrients is river flow. A smaller role is played by upwelling.***

Critical factors for the growth of phytoplankton include also sunlight and seawater temperature. Each factor acts individually, but their effect is integrated. The most critical factor is the availability of Si, followed by the water temperature and light. According to G.P. Erhard and J. Sezhen [1984], the increase in the primary and, consequently, the gross productivity in the ocean terminates as soon as the oxygen content in the water stops growing and starts decreasing. A more dynamic aquatic environment is richer because it contains more oxygen. These conditions are, in particular, characteristic of coastal and shallow water as sources of seafood.

Excessive amount of biogenic substances causes biogeochemical poisoning of waters. This fact urges refinement of the assessments that diminish the importance of terrestrial sources of nutrients as a leading factor in the effect of the direct link and feedback within the biogeochemical connection between the continents and the oceans. The statement that the primary productivity of the oceans is more than twice the production of the continents clearly follows from the fact there is an extremely rapid repeated recycling of nutrients in the ocean compared with the continents. At the same time, in the most productive pericontinental waters, biofiltration capacity is more than 20 times higher than that in the oceanic deserts (see. Fig. 2).

Ocean is the main heat engine of the Earth. The most important turning point in the evolution of living and abiotic matter is associated with the energy balance of the ocean in the late Proterozoic – early Cambrian. During this period, animals-biofilters, first plankton followed by benthos, emerged in the ocean and, possibly, in other bodies of water. This is evidenced by the presence of numerous pellets in the deposits of this age. Prior to this age-interval, deep penetration of sunlight into water bodies of the Earth was prevented by turbidity. Its elimination by organisms-biofilters radically reduced the albedo of the ocean and other bodies of water, making them deeply penetrated by sunlight. Due to this factor, the primary productivity of phytoplankton had increased many times, and at the end of the Proterozoic – early Cambrian, the great skeletal explosion took place. It was promoted by a dramatic increase in the oxygen content of the aqueous environment, especially in the oceans [Barskov, 2010].

The established homeostasis in the biosphere was repeatedly interrupted during glaciation phases and the fall of giant meteorites. This was precisely the case during the cold peak of the last ice age when the mean global temperature was 5 °C lower than today and sea levels fell to the level –90 m, or even lower: –120 m. The loss of terrestrial phytomass was 50 % or greater. The atmosphere contained only half of the main biogen – CO_2. Dust pollution over the Andes and the Himalayas was up to 100 times or greater higher than at present; over the Antarctica, it was 30 times higher. This was established from the ice cores from boreholes in the mountain and continental glaciers. Despite the environmental stress, the biosphere stability was sufficient for restoration of the full homeostatic mechanisms.

Now the world ocean has the highly productive and efficient biofiltration pericontinental margin. This is the main mechanism supporting the high clarity of global waters and, accordingly, its main function as the Earth's main heat engine. The ocean is the main redistributor of moisture and heat on the planet in the ocean-land system, where the main share of the thermal and moisture flow on land is associated with the dense biosphere of river basins. At the same time, most of the river-basin land is the main supplier of the ocean nutrients – biogens. They represent fuel that is constantly supplied to the biogeochemical system of the ocean.

The solar radiant energy entering the upper boundary of the Earth's atmosphere is 342 W/m^2. The albedo of the Earth is about 30 %. The Earth Mother Gaia functions due to the remaining 70 % of the radiant solar energy. At the same time, 19 % of operational energy is intercepted and consumed in the atmosphere and 51 % is distributed between the oceanic surface (38 %) and land (13 %) [Kononovich, Moroz, 2001].

Specificity of the redistribution of heat and moisture on the planet is most dependent on the state of the oceanic biogeochemical mechanism. This is evidenced by a comparison of the previously mentioned key figures for the water balance of the Earth (evaporation from the surface is 577 000 km^3/yr, including 505 000 km^3/yr from the oceans) with the scale of the dynamics of the oceanic currents. The thermal and moisture transfer by the oceanic currents is estimated at much higher levels: 21 million km^3/yr. This number seems valid, because, for example, the Kuroshio Current transfers 1 400 000 km^3/yr, Gulfstream – 900 000 km^3/yr, and the California current – 500 000 km^3/yr [Oceanographic Encyclopedia, 1974].

The figures confirm that the ocean is rightly referred to as the heat engine of the Earth. This function is provided by the biogeochemical processes on land and in the ocean. "If not for biofiltration, the waters of the world would have had different thermal properties. The main heat engine of the Earth – the ocean – would have had less capacity than it possesses" [Gorshkov, 2007, p. 53].

The danger of disturbance of the homeostatic properties of the ocean. This section widely cites a brilliant book "Plankton. Composition. Ecology. Pollution" by G.P. Erhard and J. Sezhen, which was published in Paris in 1978, and translated into Russian in 1984. The last 9th and 10th chapters contain information about the dangers associated with the flow of pollutants into the ocean and discuss ways to confront the degradation of the global area.

The ocean is subjected to the following contamination dangerous for its inhabitants: 1. hydrocarbon pollution; 2. chemical pollution (mercury, lead, cadmium, pesticides, acids, alkalis, and detergents); 3. organic waste pollution; 4. bacterial and viral pollution; 5. radioactive pollution; 6. thermal pollution; 7. synthetic plastic material pollution. The negative impacts on the ocean include also the destruction of the coasts.

"In 1972, the Convention on the Prevention of Marine Pollution was signed in Oslo. According to this document, it must not be disposed into the sea from vessels and aircraft: a) halogenated hydrocarbons and other substances capable of forming them as a result of interaction with seawater, with the exception of non-toxic and that can be decomposed into harmless components; b) organic silicon compounds and other substances capable of forming them; c) carcinogenic substances; d) mercury and its derivatives; e) plastic not capable of biodegradation and floating on the surface of the ocean, or suspended in the water layer and which can be an obstacle for navigation, fisheries, or any other legitimate uses of the marine environment" [Erhard, Sezhen, 1984, p. 206].

Below also is the excerpt from S. Bertino addressed to all the people: "The sea is to some extent a part of us. Thanks to it, we live; thanks to it, there is the ongoing development of our civilization; thanks to it, it rains, and warmth replaces cold; and in a few years thanks to it, people who suffer today from malnutrition will receive proteins, whose lack is already beginning to be felt today. So let us take care of the ocean and stop our reckless actions, leading to the destruction of life on the Earth. ***Tomorrow, and possibly already today, it may be too late to do anything."***

"So let us not delay, immediately starting now, the protection of plankton of lakes, rivers, and seas, this veritable "sea manna". Without it, all the diverse underwater world could not exist, and without it, life on the Earth would be impossible at all" [Erhard, Sezhen, 1984, p. 211–212].

The destruction of rain forests and their replacement with plantations of palm oil for biodiesel production in the so-called green economy is detrimental to biodiversity. The concept of sustainable growth, developed by the United Nations in 1983–1987, is now in need of serious revision. Thus, the issue of anthropogenic greenhouse warming, which contradicts the laws of physics must be fully closed: the colder atmosphere is not capable to additionally warm a warmer underlying surface due to thermal long-wave radiation emitted from the Earth to space. This only occurs with the Earth's adequate redistribution of the absorbed radiant solar energy in the areas of temperature inversion, i.e., where the air mass warmer than the underlying surface.

Production of bio-diesel and bio-ethanol from crops leads to an increase of market prices for food. Hence, these aspects of the green economy are not conducive to the achievement of one of the most important objectives of sustainable development – alleviation of poverty and poorness. A positive factor in this struggle is the construction of nuclear power plants and hydroelectric power plants in poor countries.

Also, we must realize that in the event of a significant interception of river flow of nutrients by hydrotechnic structures, discharge diversion mechanisms, and irrigation systems, the negative impacts may be associated not only with the bioresource potential of the ocean. A major reduction of the capacity of heat engine of the Earth, whose functions are performed by the oceans, is very probable. Some dangerous activities in this respect are already taking place.

The discharge of the Colorado River in the southwestern United States and northwestern Mexico is completely allocated. The second in China, in terms of river water content, the Yellow River most of the year, sometimes for ten months, does not reach the mouth. The flow of the Indus, Euphrates, Tigris, Jordan, Dnieper, Black Irtysh, and several other rivers is reduced by one-half or more. The main factor of the irretrievable river discharge consumption is irrigation. Because of it, the ocean loses about 10 % of river water. This is a cause for reduction of the flow of nutrients into the ocean, and in the near future threatens to weaken the functions of the pericontinental production-biofiltration continental margin. The direct link between the land, particularly its river-basin system, and the ocean, especially its pericontinental production-biofiltration margin, should be managed at the regional and global levels, because its state is one of the most important factors in the development of nature and humanity, and therefore their sustainable development.

CONCLUSION

The functional characteristics of the biosphere are manifested in its two-element organization (continents – oceanic basins) and in the major functional components of the homeostatic mechanism, among which are the river-basin land and the pericontinental production-biofiltration oceanic margin. From 3.8 billion to about 0.67 million years ago, the ocean was turbid and cold; the development of living organisms in its waters and on land was delayed at the level prokaryotes (bacteria and cyanobionts), and only in the range of 1.5–1.7 billion years ago, eukaryotes (nuclear organisms) – plants appeared. The transformation of the ocean that started 0.67 billion years ago and continued over the next hundred million years or a little longer was accompanied by the great skeletal explosion. Due to the emergence of planktonic crustaceans, the production-biofiltration mechanism in the world ocean was launched. The ocean became clear and turned into an intense absorber of solar heat.

The emergence and development of the Earth's main heat engine of biogeochemical and biogeophysical genesis was accompanied by increased advection of heat and moisture transfer across the globe. This expanded the boundaries of the biosphere in the Paleozoic by several times and led to the formation of a complex mechanism of biospheric organization. The geo-history of the biosphere had alternating phases of homeostasis and bifurcation. They corresponded to the manifestations of the planetary impacts, favorable and adverse for the development of the global ecosystem. The adverse impacts include glaciation eras and falls and explosions of large cosmic bodies.

Now, planetary conditions are favorable for the functioning of the biosphere. However, the uncontrolled development of the civilization represents a powerful destabilizing factor. It is necessary to protect the production-biofiltration mechanism of the biosphere. Cutting off the flow of biogenic substances carried by river flow (or replace it, or dilute it) from the ocean by dams is unacceptable. Abiotization of land, especially its deforestation, must be halted and reversed. The irrigation of land should be conducted in a reasonable manner, which will improve the state of the hydrologic cycle and land cover. It is time to stop all armed conflicts and to reallocate funds to peaceful sectors of the economy. Population explosion, typical of poor countries, is the cause of destruction of their life-support systems. While the world is divided into the rich north (golden billion) and the poor south, it is impossible to stop the destruction of the biospheric mechanism.

The human union with nature, according to J. Reclus, is only possible in the world of social peace and harmony. Meanwhile, the mankind is faced with increasingly complex and difficult to control challenges, one of which is the need for management of the system "river-basin land – pericontinental production-biofiltration oceanic margin," which determines the stability of the Earth's main heat engine. ■

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THE GROSSER ALETSCHGLETSCHER DYNAMICS: FROM A "MINIMAL MODEL" TO A STOCHASTIC EQUATION

ABSTRACT. Mountain glaciers manifest oscillations at different time-scales. Apart from synchronous reaction to lasting changes, there is asynchronism between climatic forcing and observed anomalies of the glaciers. Based on general theories on the laws of temporal dynamics relating to massive inertial objects, the observed interannual changes of glacier length could result from the accumulation of small anomalies in the heat/water fluxes. Despite the fact that the original model of the dynamics of mountain glaciers is deterministically based on the physical law of conservation of water mass, the model of length change is interpreted as stochastic; from this perspective, it is the Langevin equation that incorporates the action of temperature anomalies and precipitation like random white noise. The process is analogous to Brownian motion. Under these conditions, the Grosser Aletschgletscher (selected as an example) is represented by a system undergoing a random walk. It was shown that the possible range of variability covers the observed interval of length fluctuations.

KEY WORDS: glacier dynamics, climate change, the Grosser Aletschgletscher, the Langevin equation.

INTRODUCTION

Mountain glaciers demonstrate oscillations at different time scales. Apart from synchronous reaction to lasting changes, observed anomalies of glacier length and other parameters could be derived from accumulation of small heat/water flux anomalies of opposite signs. Their residual effect forms a response much like a random walk. This effect reflects the general mechanism of functioning of "massive" inertial objects under the influence of noise, which follows from the concept of Brownian motion [Gardiner, 1996]. Note that this assumption cannot be precisely proven. However, it is possible to determine whether the results of observations contradict or agree with this hypothesis.

A glacier model should be based on three-dimensional dynamics of a viscous-plastic body (see e.g. [Cuffey & Paterson, 2010]). However, this approach is not yet effective. Specific information about the parameters of a glacier (which vary for various glaciers) and features of underlying rocks and relief are not often available. This led to the development of simple, integrated models of glaciers [Oerlemans, 2008; Harrison, 2013].

The study of this problem is within the framework of the mathematical "minimal model" of the dynamics of mountain glaciers [Oerlemans, 2008]. However, the absence of needed parametrizations restricts across-the-broad application and, thus, only one glacier was studied. It is the Grosser Aletschgletscher, located in the Bernese Oberland region, Switzerland. The principle position of the theory [Oerlemans, 2008] is that a glacier has always an equilibrium profile due to the balance of mass budget variations and movement of ice. It means, in particular, that the length (*L*) and mean ice thickness (H_m) are linked as follows: $H_m = \alpha\sqrt{L}/(1+\mu\nu)$ (see [Cuffey & Paterson, 2010] for the explanation of the parabolic form of this function), where α, μ, and ν are parameters of the glacier. This simple function between glacier length and ice thickness is derived by assuming perfect plasticity, which is not fully appropriate when dealing with short-term variations in the glacier front position. Under such conditions, the mass conservation equation is transformed into an equation describing the change of length of the glacier [Oerlemans, 2008]:

$$\frac{dL}{dt} = \frac{2(1+\mu\nu)}{3\alpha}\left(-0.5\beta\nu L^{3/2} + \frac{\alpha\beta}{1+\mu\nu}L + \beta\left(b_0 - E\right)L^{1/2}\right). \quad (1)$$

It was additionally assumed that the slope of the bed is constant (ν) (β_0 is the altitude of the upper point of the glacier) and mass balance is described by a linear function of the height (h): $B = \beta(h - E)$, where E is the equilibrium-line altitude and β is the parameter of the glacier. Mass balance is approximated by a linear function which is far simpler than it is actually observed on glaciers, but several glaciers demonstrate this type of linear dependence [Kunachovich et al, 1996; Oerlemans, 2008; Fluctuations...].

MATERIALS AND METHODS

As previously proposed, the origin of long-lasting glacier anomalies could be interpreted based on the theory of Brownian motion. It argues that multi-scale stochastic dynamics of a system is formed through interaction of its fast and slow components. Positive and negative fast anomalies do not cancel each other out and their residual effects accumulate slowly to form a large deviation from the initial state. However, negative feedbacks, which usually exist in the system, prohibit large deviations; therefore, the steady state regime of slow chaotic oscillations is being realized. K. Hasselmann [1976] used this mechanism to describe and reproduce the stochastic behavior of several geophysical processes.

The random time evolution of a Brownian particle position (one-dimensional) $x = x(t)$ approximately satisfies the Langevin equation [Gardiner, 1996]:

$$\frac{dx}{dt} = -\omega x(t) + \vartheta(t). \quad (2)$$

Here, ω^{-1} is characteristic time of the system. Autocorrelation function of the force $\vartheta(t)$ is approximated by:

$$\left\langle \vartheta(\xi)\vartheta(\zeta)\right\rangle = \sigma^2 \exp\left(-\frac{|\xi-\zeta|}{\tau_\vartheta}\right), \quad (3)$$

where ξ and ζ are different moments and <...> denotes the ensemble average value. The acute form of the autocorrelation curve is assumed to be approximated by the δ-function curve. It is consistent with the property of the discussed physical problem, $\tau_\theta << \omega^{-1}$. As a result, a time series of $x = x(t)$ is expressed by the Ornstein-Uhlenbeck process [Gardiner, 1996].

The solution of the task depicted by equations (2) and (3) shall be discussed later. Now let us emphasize that in order to simulate a stochastic process $x = x(t)$, parameters ω and τ_θ should be chosen. This can be done using two methods. The first one is a standard statistical method and allows us to evaluate the parameters based on observations. Examples of its successful utilization are presented in [Oerlemans, 2008].

In the second method, deterministic equations reflecting conservation laws ("first principia") could be used for estimation of parameters of the equivalent stochastic model. This approach is much more reliable because it allows us to estimate parameters against a background change (e.g. climate change). This approach will be described below for investigation of the glacier length variations.

Let us develop the stochastic model based on the deterministic equation (1) which will be reduced to (2). Let us emphasize that the "forces" disturbing the dynamics of the glacier, fluctuate very rapidly compared to its slow response.

Dividing both sides of equation (1) by $\sqrt{L}$ and using $y=\sqrt{L}$, we have:

$$\frac{dy}{dt}=-\frac{(1+\mu\nu)\beta\nu}{6\alpha}y^2+\frac{\beta}{3}y+ \\ +\frac{(1+\mu\nu)\beta(b_0-E)}{3\alpha}. \qquad (4)$$

It is a Riccati equation, which can be simplified using the linearization procedure. It can be done with confidence because change of L is typically small compared to its averaged value L_0. Indeed, it equals to only 6 % for the Grosser Aletschgletscher, 8 % for the Nigardsbreen Glacier, 4 % for the Glacier de Bosson, 5 % for the Brikdalsbreen Glacier, 19 % for the South Cascade Glacier, etc. It should be emphasized that these data include not only fluctuations but a detected strong negative trend associated with global warming [Fluctuations...]. Thus, the simplified form of the equation is as follows:

$$\frac{d\Delta y}{dt}=-\lambda\Delta y+\eta, \qquad (5)$$

here, η is defined as $\eta = -cE_0\Delta E$, where E_0 is scale of variation of the equilibrium-line altitude, and ΔE is a dimensionless value; therefore, $\Delta E \approx 1$. Other coefficients are denoted using the parameters of the glacier:

$$\lambda=\frac{(1+\mu\nu)\beta\nu y_0-\alpha\beta}{3\alpha}. \\ c=\frac{(1+\mu\nu)\beta}{3\alpha} \qquad (6)$$

For the studied Grosser Aletschgletscher: b_0 = 3900 m, μ = 10, ν = 0.1, α = 3 $m^{1/2}$, β = 0.007a^{-1}, L_0 = 22000 m [Oerlemans, 2008]. Respectively, c = 0.002 $a^{-1}m^{-1/2}$ and the characteristic time of the glacier length change, $\lambda^{-1} \approx 50$ years.

Interannual values of E are not correlated [Dobrovolski, 1992]. Therefore, the autocorrelation function of the force $\eta(t)$ is approximated by equation (3) and we can assume that $\tau_\eta = 1\ a$. Because $\tau_\eta << \lambda^{-1}$, ΔE can be estimated as a δ-correlated random process (white noise). In this case, equation (5) can be interpreted as the Langevin equation (see above), describing a slow increment of the glacier length due to the summation of many "fast" changes of the altitude of the equilibrium line.

It is well known that the solution of equations (5 and 3) is a stochastic process, and its variance is given by:

$$\sigma^2_{\sqrt{\Delta L}}=\frac{\tau_r\sigma^2_\eta}{\lambda}\left(1-e^{-2\lambda t}\right), \qquad (7)$$

if $t \ll \lambda - 1$, expression (7) is reduced to:

$$\sigma^2_{\sqrt{\Delta L}}=2\tau_r\sigma^2_\eta t. \qquad (8)$$

The corresponding spectral curve displays a red-noise continuum. On the other hand, when $t \gg \lambda^{-1}$, the variance is defined as:

$$\sigma^2_{\sqrt{\Delta L},st}=\frac{\tau_r\sigma^2_\eta}{\lambda}, \qquad (9)$$

where $\sigma^2_{\sqrt{\Delta L},st}$ is constant, characterizing the steady state conditions. The corresponding spectral curve displays a white-noise continuum.

Returning to the Grosser Aletschgletscher variability, let us calculate variance of its length. Application of equations (7) or (8) requires information about the initial undisturbed state of the glacier. However, assuming that the glacier has been always in disturbed state, we will apply expression (9) estimating the upper limit of variance. In fact, the answer to the question posed in the paper (about the role of stochastic forcing) depends on the variance calculated by expression (9): can the real behavior of the glacier be statistically described using this value of variance?

RESULTS

In order to use expression (9), the equilibrium-line altitude (E_0) has to be determined. It depends on climate condition of the region, but establishing this function is a complex problem [Six & Vincent, 2014].

We will estimate E_0 using different techniques. Firstly, we can do it by taking into account the averaged adiabatic lapse rate in the atmosphere (~ 0.0065 K/m) (see [Oerlemans, 2008]). It is clear that decrease of temperature along the glacier does not necessarily coincide with the lapse rate value; however, it cannot lead to a large error. The equilibrium-line altitude changes were estimated based on the range of interannual standard deviations of temperature (typically it equals ~2 °C for the extratropical belt). Considering the fact that in many regions (e.g. the Alps) the contribution of variation of precipitation to the change of glacier length is practically the same as the contribution of temperature variations, E_0 was estimated to be of the order of 600 m.

Several studies have shown that the snowline altitude at the end of the hydrological year is a good indicator of the equilibrium-line altitude. Therefore, to estimate E_0, we calculated the budget of snow along the profile of the glacier. We used the output data from the UBRIS (University of Bristol, Great Britain) integrations for simulation of the current climate (50 years) [PMIP2 Data Base]. In order to calculate the glaciological values, the model data (2.5 × 2.5°) have been downscaled to the Bernese Alps territory. It was performed using the method of detalization, utilizing gridded information about height, tilt, and orientation of the slopes, type of the surface, and closing the horizon [Kislov, Surkova, 2009]. The equilibrium-line altitude was determined as the height where the difference between the precipitation sum during the accumulation season and the layer of melted water during the ablation season was closest to zero (delineation of the ablation and accumulation periods were carried out based on time when the temperature reaches 0 °C [12]). The value of E_0 obtained as standard deviation of a set of values calculated for 50 years of a numerical experiment was 160 meters. Of course, the accuracy of this downscaling procedure cannot be high. Therefore, this result should be treated with caution.

Data of the UBRIS model, detailed for the Bernese Alps territory, were again used for calculating E_0, but utilizing another method, developed previously for determination of the snow boundary position on plains [Kislov, 1994]. This method is based on the dimensional and similarity theory; the input values are monthly mean temperature and water vapor pressure. The value of E_0 obtained as standard deviation of a set of values of boundary height calculated for 50 years of a numerical experiment was 300 meters.

Finally, the data of the UBRIS model, detailed for the Bernese Alps territory, were again used for calculating E_0, but utilizing another method, where the equilibrium-line altitude was calculated based on a regression equation where independent variables are precipitation sum during the cold season and the mean altitude of the isotherm 0 °C during the warm period. This equation was solved based on monitoring of 52 glaciers of the mid-latitude zone [Greene et al, 1999]. The value of E_0 was calculated at 700 meters.

Despite the fact that all the methods are not very reliable, the estimation of E_0 (was estimated to be of the order of a few hundred meters) is credible, because it was obtained using four very different independent approaches.

DISCUSSION

The above-mentioned values of E0 allow to determine the range of variance $\sigma_\eta^2 = 0.1 – – 1.0$ma–2. This also allows us to calculate (using expression (9)) $\sigma^2_{\sqrt{\Delta L},st}$ (it is, practically, the assessment of standard deviation: $\sigma_{\Delta L,st}$). It was equal to 5–50 m (depends on the σ_η^2 range).

Now let us consider the Grosser Aletschgletscher observation data [Fluctuations...]. Over the last 50 years, the glacier has been retreating (reduction of its length is about 1.5 km (Fig. 1)) exceeding the internal variability (this is typical of many glaciers [Reichert et al, 2002]). Apparently, the reason of such behavior is progressive warming observed in the Alps region during several decades (actually, since the middle of the XIX sentury, since the last phase of the Little Ice Age). The temporal behavior of the glacier has been gradually adapting to long-lasting dynamics of external forcing. Possible future glacier retreat is evaluated in [Jouvet, 2011].

Fig. 2 shows variation of glacier length and temporal behavior of the North Atlantic oscillations (NAO) index during the cold season [Climate Prediction Center]. NAO is an important indicator of cyclonic activity in Western Europe, which can be considered an indicator of interannual variability of meteorological regime. For the Alps region, high NAO indexes denote the situation when winter precipitation is below the normal value while the temperature anomaly is positive; therefore, in such a year, glaciers retreat [Beniston, 2006]. However, positive NAO indexes more often coincide with positive anomalies of glacier length (coefficient of correlation equal to 0.3) (Fig. 2), but the opposite situation is also common. Such asynchronism between forcing and response is an indirect consequence of the Brownian theory.

Let us compare the Grosser Aletschgletscher length deviations from the trend line and the values of standard deviation calculated by expression (9) (using $E_0 \approx 450$ m – the arithmetical average of all mentioned estimates). It is clear that the deviations fall within the range ±2std (Fig. 2). The closeness of the calculated theoretical $\sigma_{\Delta L,st}$ to the range of empirical fluctuations could indicate the correctness of the Brownian approach.

Thus, based on the general laws on temporal dynamics relating to massive inertial objects, the observed interannual changes of the Grosser Aletschgletscher length could result from the accumulation of small heat/water flux anomalies. Under these conditions, the Grosser Aletschgletscher is represented by a system undergoing a random walk. Its

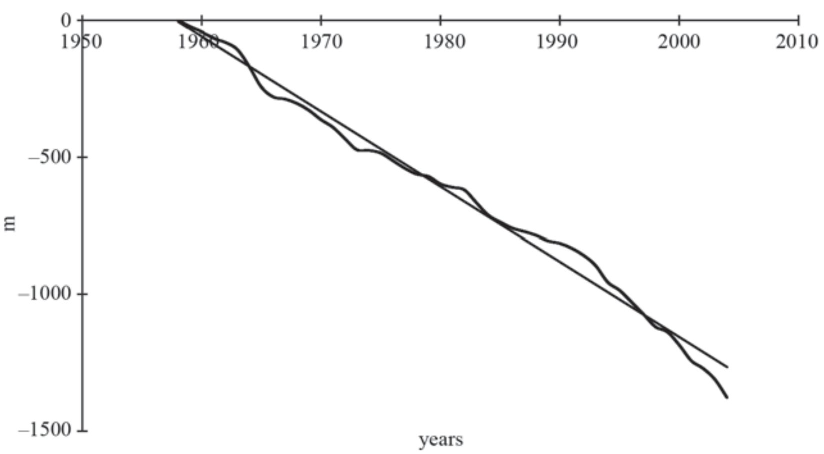

Fig. 1. Observation changes of the Grosser Aletschgletscher length (1958 to 2004, solid line) and a linear trend line (straight line)

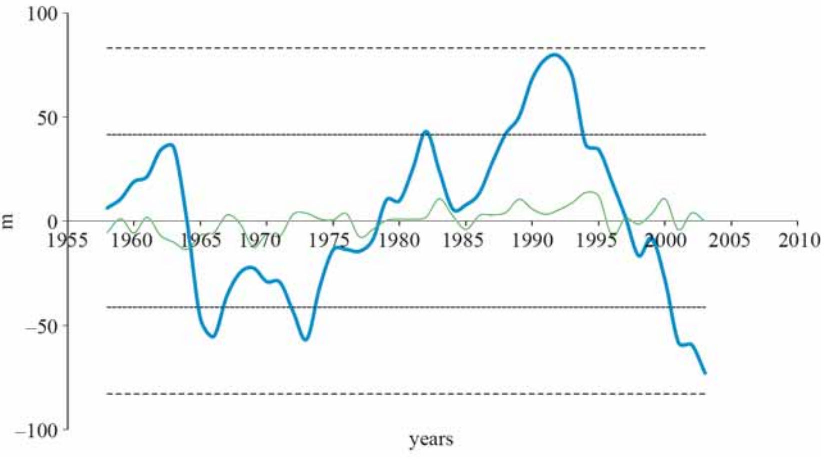

Fig. 2. The Grosser Aletschgletscher length deviations (blue line) from the trend line (*L-Ltrend*), theoretical assessment of the range of length variations (±1 std (small dots) and ±2 std (dashed lines)), and NAO index variations (green line) (values increased 10 times)

irregular interannual fluctuations do not practically correlate with external events.

CONCLUSION

The model was developed to investigate the response of glaciers to climatic forcing. This model is based on the so-called "minimal model" of the dynamics of mountain glaciers. We used as example the Grosser Aletschgletscher. The theoretical results have been interpreted from the stochastic viewpoint, despite the fact that the original model is deterministically based on the physical law of conservation of water mass.

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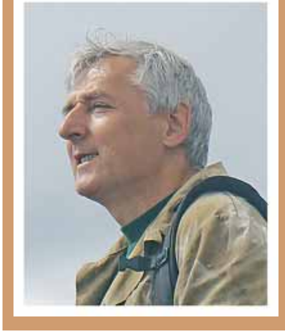

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THE CITIES OF THE AMERICAS IN MODERN TIMES: A CASE STUDY ON TOPONYMY

ABSTRACT. During the 19th and 20th centuries many Italian migrants set out for the Americas, where peoples from other European countries, such as Spain, Portugal, France, Germany, England, Ireland etc. had already established themselves. We have to make a distinction between the migration typology of North and of South America. In North America the origin of the migrants was predominantly England and France, while in South America the first migrants were mainly Spanish and Portuguese.
Different reasons should explain place names in the United States of America: (i) early presence of tribes and villages (a) Loan Translations, (b) Folk-etymologies; (c) Terms associated with Native American Culture and History, etc. (ii)place names referring to saints and religious sites, and names of distinguished persons (San Francisco, Washington respectively; (iii) the languages of the colonists and their place of origin (English, Spanish, French etc); (iv) classical and literary references (we can mention Athens in Georgia (a university city), Athens in Ohio (another university city); (v) mangling of European city names (in Maryland a patent was made out early as 1677 for a place to be called by the common English name Burleigh. Later it was spelled Berlin, although still accented on the first syllable); (vi) artificial assemblages (The name Losantville derives from L (Delaware-English Licking), os the Latin "mouth", anti, the Greek άντί, in front of" and ville, the French town).

KEY WORDS: United States of America, toponymy, naming history

INTRODUCTION

During the 19th and 20th centuries many Italian migrants set out for the Americas, where peoples from other European countries, such as Spain, Portugal, France, Germany, England, Ireland etc., had already established themselves. These first migrants founded several towns and villages and established themselves in sites, which had been inhabited for many centuries by local populations. They found a situation almost similar to that of the ancient migrants, like the Phoenicians, Greeks and Romans who came to new lands, where they met local tribes, who of course spoke different languages and inhabited cities with often unpronounceable names.

We have to make a distinction between the migration typology of North and of South America. In North America the origin of the migrants was predominantly England and France, while in South America the first migrants were mainly Spanish and Portuguese. The treaty of Tordesillas (7th June 1494) divided the newly discovered lands outside Europe between Portugal and Castile (Spain) along a meridian of 370 leagues west of the Cape Verde islands. Later this line was changed a little. The lands to the east would belong to Portugal and the lands to the west to Castile. On 4 May 1493 the Aragonese-born Pope Alexander VI (Rodrigo Borgia) decreed in the bull *Inter caetera* that all lands west and south of a pole-to-pole line 100 leagues west and south of any of the islands of the Azores or the Cape Verde Islands should belong to Castile. So the Portuguese occupied the present Brazil and the Spanish the other parts of

South America, also extending their power to Central America and a part of the present Southern United States.

The French occupied some territories of the North America, Canada (Québec) and of the Southern United States (Louisiana).Due to the common origins of their language, many Italian migrants preferred to settle in South America, although many of them settled in Canada and in the United States.

THE PLACE NAMES

I want to say first of all that there is no necessary relation between the place names and the origin of the migrants. Even if we can find such a relation, it is only apparent, because people have mostly forgotten the origin and etymology of these place names. Scholarly research is needed to shed light upon the most obscure of such relations. Who knows e.g. that the name Los Angeles derives from the expression *El Pueblo de Nuestra Señora de los Ángeles de Porciúncula de Asís* (literally "The Town of Our Lady the Queen of Angels of the Porziuncola of Assisi") and that Buenos Aires derives from *Ciudad de la Santísima Trinidad y Puerto de Nuestra Señora de los Buenos Aires* (literally "City of The Holy Trinity and Harbour of Our Lady of the Fair Winds") after Our Lady of Bonaria (the Patron Saint of Sardinia). More difficult in a sense is the origin of the name San Francisco, which derives from a mission, *Mission San Francisco de Asís* (Mission Dolores). The village was founded in 1779 by the Franciscan Friars. There is another curious and less-held opinion, referred to by George R. Stewart [2008, p. 263f]: "One of the places where the Americans first settled was at Yerba Buena, so called because of a mint-like plant growing there. This little adobe-built village stood on Yerba Buena Cove which offered a good anchorage near the inner tip of the peninsula between San Francisco Bay and the ocean. Nearby were also the Mission and Presidio of San Francisco. The village, however, had the other name, was well contended, and might eventually have grown into a large city without changing it. After the America occupation, however, a new spirit of enterprise sprang up in California, and some developers, among them the enterprising native Mariano Guadalupe Vallejo, planned a new town farther up the bay, Vallejo's wife had been Francisca Benicia Carillo, and the new town was to be named San Francisco in her honour (they said). But the more alert of the Americans of Yerba Buena suddenly saw through this subterfuge. Obviously these wily promoters were trying by means of a name to make the world think that their new town was the chief place on the Bay... On January 23, 1847, the Alcade... issued an explicit statement....."to prevent confusion and mistakes in public documents.. it is hereby ordered that the name of San Francisco shall hereafter be used in all official communications". The disappointed promoters, thus forestalled, took another of Señora Vallejo names, and founded Benicia, which (for lack of a good name or other reasons) never flourished".

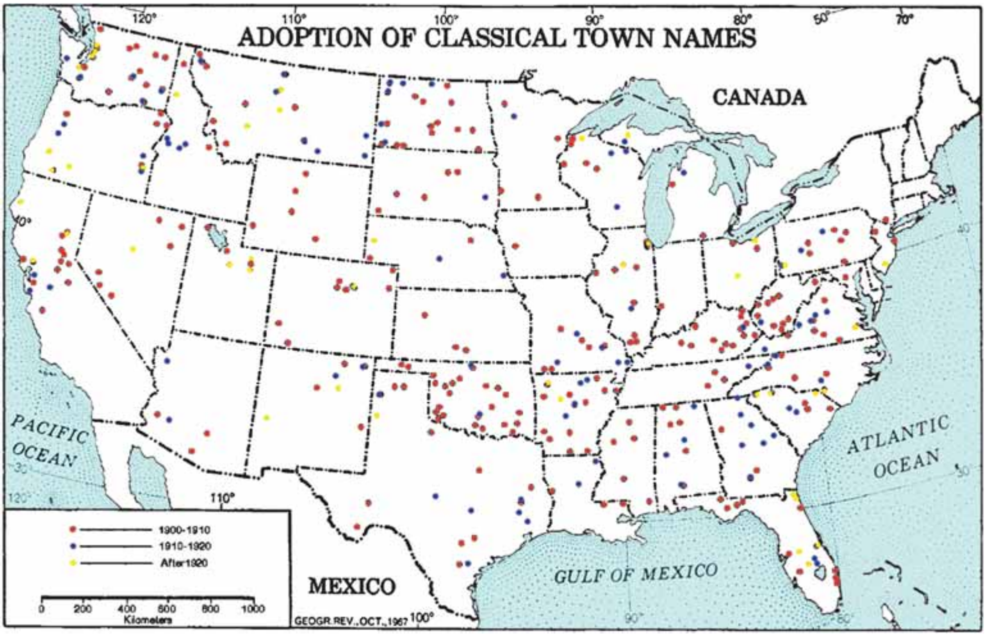
Such a reference clearly explains the difficulties in giving places names in the New World, due to different powers: (i) of the Church with its missions; (ii) of the colonizers, e (iii) of a prominent local personality.

THE NAMING

Different reasons should explain place names: (i) early presence of tribes and villages; (ii) place names referring to saints and religious sites, and names of distinguished persons (iii) the languages of the colonists and their place of origin; (iv) classical and literary references; (v) mangling of European city names; (vi) artificial assemblages.

Early presence of tribes and village

William Bright [2004] lists a long list of Native American place names divided into several types:



(From Oneto, 1978)

a) Loan Translations, which "are terms that, instead of attempting to reproduce the sounds of an American Indian original, attempt to reproduce the meaning". "For instance, the name *Black Hills* in South Dakota represents a loan translation from Lakhota (Sioux) *pahá-sapa*, literally "hill(s)-black". In many cases, French or Spanish acts as an intermediary language in translating a native American name into English. For example, the place name Des Plaines in Illinois is an English adaptation of a French name – not with the apparent meaning "of the plains" but rather des pleines 'of the maple trees'...which is in turn a translation of an Algonquian original";

b) Folk-etymologies. For example, the place name Seneca, applied to an Iroquoian nation of New York, was derived from a word which meant 'wood-eaters' and was applied by white settlers as a placename, with the spelling and associations to Roman philosopher and dramatist Seneca. "This process of folk-etymology has sometimes taken place first in French or Spanish, with the result then being passed into English";

c) Terms associated with Native American Culture and History. The names are not based directly on Indian Names, but rather refer to cultural items associated with Native American Culture. For example, *Fence*, occurring in Michigan and Wisconsin, refers to traditional fish-weirs built by Indians or to brush enclosures used to trap game [Bright, 2004, p. 5, Vogel, 1991, p. 115]; *calumet* "Indian pipe"' found as placename in Illinois, is from a dialectal French word[1];

d) Invented words: "Especially in areas close to political boundaries, placenames have often been invented by combining parts of names already in use – which may, of

[1] The word *calumet* derives from the ancient Greek κάλαμος, which means cane. In Latin, *calamus* and in Arabic القلم (Al-Qalam, which is also the name of the Sura 068 (LXVIII). The name means *cane*, but also all that is made of cane, like the pen. As Bright notes [2004, p. 11], *Calumet* was understood as a word for "Indian pipe", borrowed from a Norman French dialect word, related to Standard French *chalumeau* 'type of flute'.

course, have Indian origin. As well-known example is Texarkana, which combines the words Texas, Arkansas[2], and Louisiana; the first two come from native American sources" [Bright, 2004, p. 5];

e) Bogus words. "Some placenames have been coined from non-Native American elements to resemble Indian words..." as that of a "small stream in new Mexico" which "is called Beechatuda Draw...Other examples represent more deliberate attempts to mystify; again in New Mexico, the placenames Zuzax, supposedly referring to an obscure Indian tribe, was actually a complete invention" [Bright, 2004, p 5f];

f) Traditional Native American Placenames: for example, the name of the city Chicago probably means 'wild onion place', Tucson, 'black (mountain) base'. We do not know whether an ostensible Indian placename may have a European source. Galice is the name of an Athabaskan Indian tribe, a settlement and a creek in Oregon, but some scholars guess that it is a French surname [Bright, 2004, p. 9];

g) Native American Derivations: some are names of prominent Indian individuals, such as *Seattle* and *Spokane*. Seattle derives from the name Sealth, a Dkhw'Duw'Absh (Duwamish) chief, also known as Sealth, Seathle, Seathl, or See-ahth. Seattle is in King County (Washington) and in Alaska (on Hagemeister Island: Seattle Creek D-6 in US Geological Survey), the name Spokane comes from the Spokane dialect of Salishan; the Native American Name is *spoqín*(meaning "children of the sun" in Salishan). "The place name also occurs, for example, in Alaska (Juneau C-6), Ore. [Oregon] (Curry Co.), and S. Dak. [South Dakota][3] a name applied to a New England Algonquian group, which probably means 'at the big hill'. This name also occurs in Maine, Illinois, which refers to an Indian people; etc. The name of the State of Canada, is taken from French, which took in turn from a word meaning 'settlement, town' in Laurentian. The word has been applied as a placename in many parts of the United States, as New York (Fulton County), Maine (Cumberland County), and Wisconsin (Buffalo County) (Custer Co.)" [Bright, 2004, p. 459];

h) Pidgin Derivations: mixed languages between Native American people and European immigrants, such as the trade language of the Chinook Jargon of the Pacific Northwest, which contains elements of many Native American languages (especially Chinookan and Salishan) as well as French and English: these names may come from pidgin, which in turn takes them from a Native American language: e.g. *Skookum*, occurring in many northwestern placenames, which means 'strong, powerful', or they may come from pidgin, but have their ultimate origin in a European language, as e.g. *Siwash* occurring in many northwestern placenames. It represents the Chinook Jargon word for 'Indian', borrowed from French *sauvage*;

i) Transferred Derivations: I) common nouns used in English are often carried from one region to another; II) For example *Milwaukee*, transferred from Wisconsin to Oregon, and *Chicago*, as applied to Port Chicago in California, were originally Algonquian placenames. Some North American names are borrowed from Latin American sources: *Mexico*, *Lima*, and *Peru* are frequent in the

[2] A village and tribe, Arkansea, are recorded in a French context in 1673. The French added the *s* as a plural to indicate members of a tribe. After the region was Amercanized (early 19th century) an approximation of the French pronunciation was kept, and the name Arkansaw was used in the Act creating the territory. The French pronunciation now prevails for the state, but Arkansas City keeps the second syllable accentuation, and Arkansaw uses the older spelling (Stewart George R., 1970, p. 22).

[3] The names of many States of the United States of America refer to some Native American Peoples, such as Dakota, which means 'allies', 'friendly' [Bright, 2004, p. 131], Michigan, which comes from an Old Ojiwa (Algonquian) word * meshi-gami 'big lake' [Bright, 2004, p. 283], Idaho, which comes from the Kiowa-Apache (Athabaskan) word *ídaahę* 'enemy' [Bright, 2004, p. 177], Ohio, from Seneca (Iroquoian) *ohi:yo*, a proper name derived from *ohi:yo:h* 'good river' [Bright, 2004, p. 344], Oklahoma: the name of this State, coined by Allen Wright, a Choctaw scholar, means 'red people' from Choctaw (Miskogean) *oklah* 'people' and homma 'red'. This placename was transferred to other states (e.g. Illinois, St. Clair County; Massachusetts, *Dukes County*; and Oregon, *Clatsop County*), Massachusetts.

United States [Bright 2004, p. 10]; III) Some names which are thought to be of Indian origin have European origins: as noted above, *Calumet* (Illinois, Michigan),understood as a word for 'Indian pipe' is borrowed by English from a Norman French dialect word;

j) Dubious Native American Terms, which may be: (i) Complete inventions, as the name Lake Itasca coined by Henry R. Schoollcraft, who gave imaginary Indian names to several counties in Michigan: Itaska comes from an ungrammatical Latin phrase: *veritas caput*, while the correct Latin is verum caput (= true head(waters); (ii) Names derived from literary works, like Henry Wadsworth Longfellow's Hiawatha; (iii) Some place names are based on English words that are supposedly literal translations of Native American concepts, but they may be of varying authenticity: e.g. *Medicine Lodge Mountains* (Kansas) may translate a Native American term or may not; the new settlers could simply have coined the term *pipestone*, as a common name, as in *Pipestone Creek* (Wisconsin), which is supposed to translate an Algonquian word for a type of stone from which the Indians made pipe-bowls. The term pipestone was later applied as a placename [Bright, 2004, p. 11]; (iv) Some cases have still dubious origin;

k) Adopted European Names: Some names reflect cases where English has borrowed an Indian personal name, which was borrowed in turn from a European language: it is e.g. the case of Stanislaus (river and county in California), which is the English adaptation of Estanislao, the Spanish baptismal name of an Indian, who became famous for his successful raids on Spanish missions[4]; other names are simply loan translations; some placenames are only ambiguously of Indian origin;

l) English < Spanish/French < Indian: we can recognize many placenames which are borrowings from Spanish or French common manes: e.g.: *Abalone Point* (California) reflects California Spanish *aulón(es)*, from Rumsen *aulon*; Temescal Canyon (California), from Mexican Spanish *temescal* 'sweathouse', from Aztec *temaaxcalli*; *Temetate Creek* (California), from the Mexican Spanish word *temetate* 'stone grinding-slab', perhaps from Aztec *temetlatl*; names borrowed by English through Spanish from Latin America, like Mexico (Missouri) and Lima (Ohio, originally from Lima, in Peru); *Quebec* and *Ontario*, which derive from Iroquoian or Algonquian languages that are spoken in both Canada and the United States; l) Hybrid Indian Names: e.g. Texarkana, as noted above, and *Clackamette* (Oregon, from *Clackamas* plus *Willamette*).

In Latin America few names stand for native peoples. The Spanish conquistadores almost thoroughly killed off the native cultures and peoples[5]. In addition, in Latin America, the empires of the Aztecs, Incas and the Maya culture occupied large territories, except for Brazil and Argentina, where many native tribes lived. I can quote for example the place names of Nazatlán (which in the uto-aztec language means "place of deer"); Tecuala, a Castillian word for a Tertuallan word, which means "many wild animals; Tamazuchele (Tam-uxum-tzale), which comes from a Huastec language and means "Place of the Government". It was the Huastec capital in about the 15th century. The place name of Caracas comes from the name of the local native people. The place name of Lima comes from the *aymara* language (*lima-limaq*, "yellow flower") or from *quechua* language (*rimaq*, "speaker") for its river, the Rímac. The name Tegucigalpa shows an evident native origin, particularly Nahuatl. The name Managua originates from the term *Mana-ahuac*, which in the indigenous *Nahuatl* language translates to "adjacent to the water" or site "surrounded by water".

[4] Estanislao (c. 1798–1838) was an indigenous *alcalde* of Mission San José and leader of the Lakisamni tribe of the Yokut people of Northern California. He led bands of Native Americans against the Mission establishments.

[5] The names of some states of the United States are Spanish, such as Montana, Nevada etc.

Placenames referring to distinguished persons, saints and religious features

The city and the State of Washington were named after the *pater patriae* George Washington[6]. Another President of the United States, Abraham Lincoln[7], was commemorated in the United States when he was still only a Springfield lawyer, and he, who became the second hero of the nation, was not a soldier: in 1853 three men laying out a site in Illinois hired him to prepare some papers, and called the place Lincoln [Stewart, 2008, p. 299].

After the discovery of the Americas, many missions were founded by the different Christian Churches, according to the tasks of the Society of Jesus founded by Ignatius of Loyola. The Society had the task of limiting the spread of the Non-Catholic Christian Churches, after the Catholic Counter-Reformation of the Council of Trent (between 1545 and 1563). Many religious structures and cities were founded by missionaries and explorers in the Americas, especially in the areas where the Spanish colonizers established themselves. California was one of the most culturally, politically and linguistically diverse areas in pre-Columbian North America. One-third of all native Americans in what is now the United States lived in California (from 100,000 to 300,000), divided into many tribes, such as the Cumash, Pomo and Salinan. The first European expedition landed in California was led by Portuguese captain João Rodrigues Cabrilho, in 1542, on behalf of the Spanish Empire. After him California was explored by Francis Drake in 1579. Sebastián Vizcaíno explored and mapped the coast of California in 1602 for New Spain. From 1769 Spanish Franciscan missionaries founded little villages on paramount areas of the Northern Spanish California in the strict sense of the word (the present Baja California). After the independence of Mexico from Spain the titles of these Californian missions were transferred to the Mexican government and suddenly were no longer used and abandoned. Since the early 20th century the region, because of its strategic position, was claimed by the English, French and Russians. In 1812 Russia founded Fort Ross. In 1847 the large-scale immigration of gold prospectors from the United States triggered off a war with Mexico. At the end of this war the region was split between these two States: Baja California passed to Mexico and the western part of Alta California became the 31st US State of California, on September 9, 1850.

The name *California* is most commonly believed to have derived from a fictional paradise peopled by Black Amazons and ruled by Queen Calafia. The story of Calafia is recorded in a 1510 work *The Adventures of Esplandián* written by the Spanish writer Garci Rodriguez de Montalvo. Montalvo describes the kingdom of Queen Calafia, as a remote land inhabited by griffins and other strange beasts, but rich in gold (Chapter CLVII of *The Adventures of Esplandián*): "Know ye that at the right hand of the Indies there is an island called California, very close to that part of the Terrestrial Paradise, which was inhabited by black women without a single man among them, and they lived in the manner of Amazons. They were robust of body with strong passionate hearts and great virtue. The island itself is one of the wildest in the world on account of the bold and craggy rocks" [Putnam, 1917, p. 306][8].

Both in Baja California and in Alta California many names of cities and villages refer to names of saints and religious symbols. The

[6] The name of family was Wassington. Sir William de Wassinton, a knight who held a village under King Henry II. Later the family name was merely Washington, and a John Washington was wounded at Agincourt. One of his descendants at eighth remove, another John, came to Virginia, and a great-grandson of this latter John was named George [Stewart, 2008, p. 164].

[7] The place name Lincoln in Argentina (founded on July 19, 1865) was chosen as a tribute to the recently assassinated16th- President of the United States (1861 to 1865), and enactor of the Emancipation Proclamation.

[8] Several states of United States have Spanish names, such as Nevada, Arizona, Florida. Other names are French, such as Louisiana. Louisiana was named after Louis 14th, King of France from 1643 to 1715. Once part of the French Colonial Empire, the Louisiana Territory stretched from present-day Mobile Bay to just north of the present-day Canada border, and included a small part of what is now south-western Canada.

capital of California is named Sacramento, like the homonymous river[9]. In 1808, explorer Gabriel Moraga during a journey to search out sites for the construction of missions, was the first foreigner to see the river clearly and named it *Rio de los Sacramentos*, or "River of the Blessed Sacrament". The Sacramento river meets the San Joachim river[10] in the Sacramento-San Joaquin River delta or California Delta.The Swiss immigrant John Sutter Sr., his son, John Sutter Jr. and James W. Marshall founded Sacramento city, which grew quickly thanks to the protection of Sutter Fort, which was established by Sutter in 1839. Many names of the cities of California are saints' names, like Santa Rosa, San Mateo, Santa Marta, San Diego, Santa Barbara[11], San Francisco, Los Angeles[12], Santa Catalina[13], San Pedro[14] etc. In Latin America the names of saints and religious symbols are numerous: I do not think there is any need to list these names: Asunción, São Paulo, many Santiago, San Antonio, Santa Cruz, San Fernando, San Juan, San Antonio, Veracruz, Santo Domingo de Guzman, San Cristobal las Casas etc.

From 1769 until the independence of Mexico in 1820, Spain sent missionaries and soldiers to Alta California who created a series of missions run by Franciscan priests. They also operated *presidios* (forts), *pueblos* (settlements), and *ranchos* (land grant ranches), along the southern and central coast of California. Father Junípero Serra founded the first missions in Spanish upper *Las Californias* starting with Mission San Diego de Alcalá in 1769. Through the Spanish and Mexican eras they eventually comprised a series of 21 missions to spread Christianity among the local Native Americans, linked by *El Camino Real* ("The Royal Road"). The missions introduced European technology, livestock, and crops.

The Spanish Franziscaners and also other missionaries became friendly with the natives of the region (Timucúa, Calusa and Apalache). In the 17th century Francisco de Pareja, a Franciscan friar worked a long time in Georgia and in the mission of San Agustín. He wanted to spread Spanish culture and the Catholic faith. Before1675the territory of Florida had four missions, named "provinces".

The Mormons also had an influence in naming places in North America [Meinig, 1965, pp. 191–220] "The Mormons gave no more Biblical names than other people, but they had a treasure-store in the Book of Mormon, Joseph Smith had recorded many names, some the same as those of the Bible, others like them but a little different. So, besides Desert, towns sprang up for Moroni the angel, Alma and Nephi the prophets, and Lehi the king, and many others" [Stewart, 2008, p. 262]. According to the custom of the Mormons, several towns, such as St. John and St. George, were named not for any apostle or any dragon-slayer, but for John Rowberry and George A. Smith, good Mormon Church officials.

Saint Laurence Gulf, in Canada, was named by Jacques Cartier, whose ship on August 7, 1535, was caught in a "stormy and contrary wind". Because he found by good chance anchorage in a bay and his ship was safe, in thankfulness and piety he named it after St. Lawrence, whose day it was.

It is well known that name of the Brazil's former capital Rio de Janeiro (from 1763 to 1960) recalls the date of anchorage by the European explorers who first encountered Guanabara Bay on 1st January 1500, by a Portuguese expedition under Gaspar de Lemos, the captain of a ship in Pedro Cabral's fleet, or under Gonçalo Coehlo. The Florentine

[9] From 1777 to 1849 Monterey was the first capital of California. In Mexico another Monterrey (with two *r*) is situated close to the US boundary.
[10] After the name of the father of the Virgin, according to the tradition.
[11] San Diego (after the name of the explorer Sebastían Viscaíno's flagship) and Santa Barbara became the names of missions, and then of the cities [Stewart, 2008, p. 29].
[12] Los Angeles and San Francisco have been discussed above.
[13] Santa Catalina, who is St. Catherine, patron of Christian philosophers.
[14] San Pedro was chosen because on November 28th, the day of San Pedro on the calendar, the place was discovered. But this was not the day of the great St. Peter, keeper of the keys, but of a lesser one, martyred in Constantinople.

explorer Amerigo Vespucci participated as observer in the same expedition.

Pilgrims is a name commonly applied to early settlers of the Plymouth Colony in present-day Plymouth, Massachusetts, United States, with the men commonly called Pilgrim Fathers.

The name of Amerigo Vespucci, as it is well known, led to naming all America, while the name of Cristobal Colon (or Columbus) led to naming many states and cities in both Americas.

Boston's early European settlers had first called the area *Trimountaine* but later renamed it *Boston* after Boston, Lincolnshire, England, from which several prominent colonists had come. The renaming, on September 7, 1630 was by Puritan colonists from England who had moved over from Charlestown earlier that year in quest of fresh water. Most often the settlers asked for the name of a place where some of them had lived. Cambridge was named because of the college founded there. The name was Cambridge instead Oxford because Cambridge was the more Puritan of the two English universities.

Latin America is rich in religious names of saints and signs. Almost all catholic saints are represented, for the custom of naming the places after the saint whose name day fell on the day of the foundation or discovery. The complete name of La Paz is *Nuestra Señora de La Paz*. The name commemorated the restoration of peace following the insurrection of Gonzalo Pizarro and fellow conquistadors four years earlier against Blasco Núñez Vela, the first viceroy of Peru. Other names are for example: San Juán, San Pedro de Lloc, in Peru; Trinidad, Conception, Santa Corazon in Bolivia; Sãn Manuel, Sãn Miguel, Santa Filomena, Sãn Felix, Santa Maria, Santa Cruz, Santa Rosa in Brazil;Santo Domingo de Guzmán, in the Dominican Republic, Rosario and Santa Fe in Argentina.On the nameYucatán, Fray Toribio de Motolinía wrote: "Hay en estas montañas [de Nueva España o hasta el Gulfo dulce] mucha cera y miel, en especial en Campeche; dicen que hay allí tanta miel y cera y tan buena como en Safi, que es en África. A este Campeche llamos los Españoles al principio cuando vinieron a esta terra, *Yucatán*, y de este nombre se llamó esta Nueva España, Yucatán. Mas tal nombre no se hallará en todas estas tierras, sino che los Españoles se engañaron cuando allí allegaron, porque hablando con los Indios de aquela costa, a lo que los Españoles preguntaban, los Indios respondían: "*tectetán, tectetán*", que quiere decir: "no te intiendo, no te intiendo". Los cristianos corrompiendo el vocablo y no entendiendo lo que los Indios decían, dijeron: "*Yucatán* se llama esta tierra", y lo mismo fue en un cabo que allí hace la tierra, al cual también llamaron cabo de Cotoch; y cotoch en aquela lemgua quiere decir "casa". [Toribio de Motolinía, 1985, p. 332]. This is an example of a misunderstanding of a native American by a European. The European mistakes the expression "*tectetán, tectetán*", which means "I do not know" for a place name.

The work of Fray Toribio de Motolinía is a proof of the evangelical mission of the Franciscans in Latin America, but also of the native place names and languages. Fray Toribio de Motolinía frequently translates the native place names with Spanish terms. Cordoba in Argentina was inhabited by native Comechingones. In 1577 the Lieutenant Governor, Don Lorenzo Suárez de Figueroa, planned the first layout of the city as a grid of seventy blocks. In 1599, the religious order of the Jesuits arrived in the settlement. Another Cordoba is in Andalusia, Spain. Some place names in the Americas are linked to sacred cities such as Betlem (in Brazil Belém), Jerusalem, which was included in the Phelps and Gorham Purchase. It was first settled around 1791. Among the earliest settlers were the evangelist Jemima Wilkinson and her congregation.

On February 28, 1681, Charles II granted a land charter to William Penn to repay a debt of £16,000 owed to William's father, Admiral William Penn. The King named it Pennsylvania in honour of William Penn "brotherhood of Penn". Since Penn, an early Quaker, was a scholar of the classics, he took the name of the State capital Philadelphia from Attalus II, King of Pergamon and the founder of the modern-day Turkish city Antalya, surnamed Philadelphus "the brother-loving, brotherly". Penn must have thought of the literary meaning of the Greek word φιλαδέλφεια, as St. Paul used it in Romans: "Be kindly affectionate one to another with brotherly love, outdo yourself to respect one another". Philadelphia was laid out four-square, like the heavenly Jerusalem. According to Quaker use, the streets were named, beginning at the eastern boundary: First Street, and so successively, making the numbers into names. It was the custom of Quakers to call Sunday, First Day [Stewart, 2008, p. 104 f.].

Languages of colonists and their place of origin

After the discovery of the Americas the first colonists came from various regions of Europe. Since the Mediterranean Sea had lost its importance to the advantage of the Atlantic, the colonists were predominantly English, French, Dutch, Spanish and Portuguese, from the major European Powers of that time. Although Spain, France, Sweden, and the Netherlands all had competing claims to the region, none of these prevented the English from becoming the first European power to successfully colonize the Mid-Atlantic coastline. In 1607 the English colonizers of the London Company entered Chesapeake Bay and founded Jamestown on the James river (after King James I): it was the first English colony in the United States, named Virginia, after Queen Elizabeth I, sometimes called The Virgin Queen.

The Thirteen Colonies, as of 1775, founded between 1607 (Virginia) and 1732 (Georgia), stretched from New England to the northern border of the Floridas (British East and West Florida). They were dominated by Protestant English-speakers.

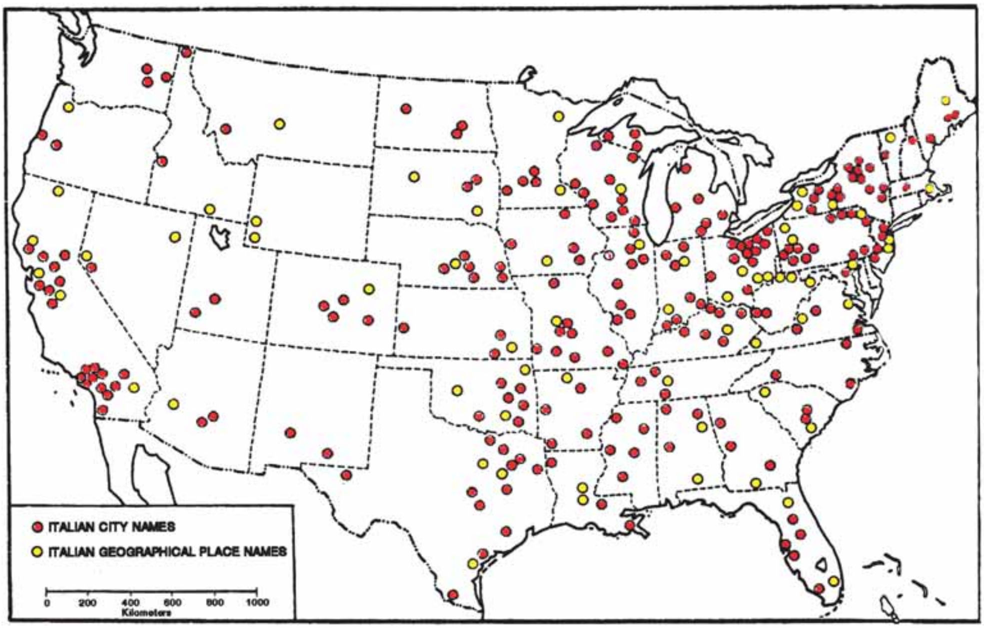
Earlier expeditions had been made by the Spanish to what is now Georgia (1526–27); in Georgia (between 1568 and 1684), South Carolina (1566–87), North Carolina (1567–68)[15] and Virginia (1570–71); and by the French in South Carolina (1562–63). The Spanish founded the colony of Spanish Florida in 1565, while the French were establishing settlements in what is now Canada (Charlesbourg-Royal briefly occupied 1541–43; Port Royal in 1605).The non-English European colonization of the Americas was also underway in New Netherlands, New France, Essequibo, colonial Brazil, Barbados, the Viceroyalty of Peru, and New Spain.

In the early18th century, England had consolidated its colonial power, enlarging it in the North American territories. Due to a political and religious crisis, many English political dissidents and victims of religious persecution moved to the new colonies of America: the majority of them were puritans, jailbirds and adventurers.

New Amsterdam (Dutch: *Nieuw-Amsterdam*) was a 17th-century Dutch settlement established at the southern tip of Manhattan Island, which served as the seat of the colonial government in New Netherland territory. It was renamed New York on September 8, 1664, in honour of the then Duke of York (later James II of England) after it was traded to the English along with the rest of the Dutch colony in exchange for control of the Spice Islands.

At the end of the Seven Years' War (1756–1763) when the French ambitions of power in America had been cancelled, the Britannic Empire had spread over the whole of Canada and the territories to the east of the Mississippi. The English colonies were thirteen, approximately gathered in four main areas: in the north, New England, with

[15] *Carolinas*, named in honour of King Charles I of England, were divided into SC and NC in 1729. The capital of North Carolina is Charlotte. Charlotte and its resident county received its name in honour of Charlotte of Mecklenburg-Strelitz, who had become queen consort and wife of George III; the capital of South Carolina is Raleigh named for Sir Walter Raleigh, sponsor of Roanoke, the "lost colony" on Roanoke Island in present-day Dare County. *Dare County* is named in honour of Virginia Dare, the first English child born in America.



(Sorce: Zelinski, 1967)

Rhode Island, New Hampshire, Connecticut, Massachusetts, where the descendants of the original religious migration lived; in the Middle, the Mid-Atlantic, with Maryland, Delaware, New Jersey, Pennsylvania, New York, where the English were intermixed with the successors of the German, Dutch and Irish colonists who landed on these coasts in the 17th century; finally the southern colonies: North Carolina, South Carolina, Georgia[16] and Virginia where the agricultural aristocracy, of Anglican persuasion, used slaves caught in Africa on a massive scale.

In spite of the remarkable Italian presence in the United States, Italian place names there are very few. Of 40,487 place names listed in the *United States Official Postal Guide*, only 325 (0.8 per cent) are Italian geographical names. But not all of them are of a clear attribution. Perhaps about another hundred place names have tenuous links with Italy [Oneto, 1978, pp. 737–752].

The Italian place names (except for classical names) are 57 Etna, 54 Rome, 14 Syracuse, 8 Rubicon, besides a hundred others, mostly vanished over the centuries [Oneto, 1978, p. 742]. The asset of many Italian names was their brevity, like Como, Elba, Lodi, Milan etc. The name of Sicily is to be found inland, in Louisiana. We do not know if the name Ravenna is associated with its Italian namesake. Perhaps it derives from the word *ravine*, which got confused in its pronunciation: the city, in Texas, is situated between two ravines [Oneto, 1978, p. 750].

Classical and literary references

In the Unites States in particular, there are city names referring to classical cities: we can mention Athens in Georgia (a university city), Athens in Ohio (another university city). Ancient Greece, particularly Athens, replaced Cambridge and Oxford as an ideal of culture

[16] Georgia was named after King George II of Great Britain. The name of its capital, Atlanta, was coined by J.E. Thomson, railroad-builder, for the terminus of the Western & Atlantic Railroad, from 'Atlantic' apparently under the assumption that this was the feminine form, thus conforming to the general idea that names of towns fittingly end in *a*. In Idaho the name commemorates the battle of 1864. In Minnesota the name is applied fancifully, because the undulating plain was thought to resemble the Atlantic Ocean [Stewart, 1970, p. 27].

and learning. Sparta stood for valour and moral integrity. The place name Rome is very widespread in the United States: in Georgia, Illinois, Indiana, Iowa, Kentucky, New York, Ohio, Pennsylvania, Tennessee, Wisconsin and Texas. This was because Rome had austerely cast off the rule of its kings, adopted republican institutions, and set out upon a glorious career. But some classical names were reproduced more or less accidentally. Mantua in New Jersey came from a local tribal name meaning "frog", but assumed the exact spelling of the birthplace of Virgil. On his epitaph are the following verses: *Mantua me genuit, Calabrirapuere, tenet nunc Parthenope;/ cecini pascua, rura, duces*[17]: several towns in United States were called Augusta from Queen Augusta, George II's wife, but this name evoked Roman foundations, such as Augusta Agrippina (Cologne), Augusta Taurinorum (Turin), Augusta Treverorum (Trier), etc. In 1748 the Virginia Assembly authorized the town of Alexandria. The name was for the Alexander family, local plantations owners, but was also that of many ancient cities founded by Alexander the Great [Stewart, 2008, p. 183].

The towns of Troy in Michigan and New York states had been overcome only by base stratagems, and had perished nobly in flames. Of course the reference is to Homer's works.

Hiawatha, the poem of Longfellow, has already been mentioned. The name of Seneca Lake (after the Roman philosopher Seneca) became for the Dutch Sinneken and in various other forms and then passed to English with the forms Sinnegar or Senniky. This name shows all the forms in which a name can be passed from language to language – by transference, translation, and false etymology [Stewart, 2008, p. 184]. A Commission established on July 3, 1790 stated that regions to be settled by veterans should bear military names: Lysander, but not Hannibal, because he fought against the Republic, not for it, and also they should bear the names of the heroes of the Roman Republic, including Cato, Camillus, Cicero, Manlius, and Marcellus. After that, they admitted Aurelius and Romulus, an emperor and a king. They added also four more republican heroes – Scipio, Sempronius, Tully, and Fabius. The last ten names mingled Latin, Greek, and English poets, philosophers and warriors: Ovid was followed by Milton, Locke, Homer, Solon, Hector, Horace and Ulysses. Then came Dryden and Virgil, with Cincinnatus at the end for a final republican gesture. In using both Tully and Cicero they even named two places for the same man: Marcus Tullius Cicero [Stewart, 2008, p. 185 ff.].

The place name Utica in New York, in 1798, comes from an idea of Erastus Clark, graduate of Dartmouth College with classical training, who suggested naming this city in honour of the Roman Utica in North Africa, one of the last cities to hold out against Julius Caesar. Other classical names are, for example: Phoenix, from the mythical bird, and Memphis, after the ancient Egyptian capital.

According to Zelinsky [1967, p. 464], "the most persuasive evidence pleading the American's image of himself as the reincarnated Athenian or Roman is the number, range, and persistence of classical place-names...no other territory colonized by Europeans has anything in its toponymy even faintly resembling the United States situation, with the marginal exception of a few score Brazilian names". Also, many place names derive from the plays of William Shakespeare, such as *The merchant of Venice*, *The two gentlemen of Verona* and *Romeo and Juliet*. The place names are, for example, Modena, Rialto, Verona. In Florida two neighbouring cities are called Romeo and Juliet [Oneto, 1978, p. 750].

Place names can be transported by migrants to other areas of the world, as Italian emigrants did in Argentina, Brazil, the United States and Australia and in many other countries. Flavia Cristaldi [2015, p. 51 f.] points to the Italian colonists in

[17] Translation: "Mantua begat me, the Calabri (= Salentum people) took me away, now Naples keeps me; I sing of pastures, fields, commanders".

(Source: Zielinski, 1967)

Rio Grande do Sul, who created a new landscape of vineyards, and to many towns (Nova Bassano, Nova Brescia, Nova Milano, Nova Padova, Nova Treviso, Nova Roma do Sul, São Joao do Põlesine o Vale Vêneto), which recalled Italian cities and regions; but, since the towns had no religious associations, their names changed.

However, the contribution of Italian migrants to naming towns in Americas was limited, in spite of the paramount contribution of Italians in peopling Americas. We can document a town named New Napoli close to Vineland in the county of Cumberland, in New Jersey [Tuccimei Paolo, 1910, pp. 336–342], but in the United States the town of Naples, founded in 1905, was so named because its seaside location resembled that of the Italian city The central street of this town is called the Toledo [Oneto, 1978, p. 750]. Another town, Nuevo Torino,is situated in Las Colonias, Santa Fe, Argentina. Nova Trento was founded in Brazil on August 8th, 1892 by migrants coming from Trentino, Italy, when this region was ruled by the Austrian-Hungarian Empire.

Mangling of European city names

I would like to give only two significant examples.

In Maryland a patent was made out early as 1677 for *a place* to be called by the common English name Burleigh. Later it was spelled Berlin, although still accented on the first syllable. So also the towns in New England thus spelled and pronounced were more likely from some Burland or Birling, because not until well after 1700 did the present German capital grow to be a place of enough importance to be well known in the colonies [Stewart, 2008, p. 115].

The name Verona, which is in the Shakespeare's comedy *Romeo and Juliet*, is a deformation of Vernon, in California, and of the family name Veronica, in Nebraska [Oneto, 1978, p. 750].

Artificial assemblages

On the Ohio River a town grew up opposite the mountain of Licking Creek. Its name combines a translation with an adoption of the Delaware *mahoning,* "at the salt lick". The name Losantville derives from *L* (Delaware-English Licking), *os* the Latin "mouth", *anti*, the

Greek άντί , in front of" and *ville*, the French town [Stewart, 1970, p. 186]. The development of factories at the end of the 19th century and the beginning of the 20th led to the creation of new artificial names, such as Weslaco (from the W.E. Steward Land Company), Latexo (from Louisiana-Texas Orchards), Alcoa (from Aluminium Company of America; Gamerco (from Gallup American Coal Company. The suffix *-co* indicates a company town (Stewart Georg R., 1970, p. 363). About 1870 a steamboat plying the Red Rivers and thus serving territory in three states was named the *Texarkana*, (see above) The name was used for some locally manufactured bitters [Stewart, 1970, p. 363 f.]

CONCLUSION

The reading of the names of cities in the United States is how to read the history: names of cities and villages inhabited by indigenous peoples; names of settlers who gave the names of their hometowns. But also names related to culture and literature. In no country in the world do we find such a mixture of place names mainly due to the stratification of relatively quickly migrations. ■

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THE JEOPARDIZED SITUATION OF ELECTRONIC WASTE IN BANGLADESH: CAN CUSTOMIZED POLICY APPROACH SOLVE THE CHALLENGE?

ABSTRACT. Electronic waste (e-waste) is one of the fastest-growing pollution problems worldwide given the presence if a variety of toxic substances which can contaminate the environment and threaten human health, if disposal protocols are not meticulously managed. In Bangladesh almost 2.7 million metric tons of e-waste generated per year. Of this amount only 20 to 30 percent is recycled and the rest of the waste is released in to landfills, rivers, drains lakes, canals, open spaces which are very hazardous for the health and environment. Since Bangladesh is in the stream of rapid technological advancement, it is seldom to take necessary steps to avoid the future jeopardized situation because of e-waste. The current practices of e-waste management in Bangladesh suffer from a number of drawbacks like the difficulty in inventorisation, unhealthy conditions of informal recycling, inadequate legislation and policy, poor awareness and reluctance on part of the corporate to address the critical issues. The paper highlights the associated issues and strategies to address this emerging problem, analyses the policy and its gaps. Therefore, this paper also suggest that e-waste policy development may require a more customized approach where, instead of addressing e-waste in isolation, it should be addressed as part of the national development agenda that integrates green economy assessment and strategic environmental assessment as part of national policy planning. Finally this work also suggests some alternative strategies and approaches to overcome the challenges of e-waste.

KEY WORDS: E-waste, Bangladesh, Policy, Strategy and Approach.

INTRODUCTION

Electronic waste or e-waste – waste from electronic and electrical equipment is a rapidly growing market, with 72 billion tons estimated to be generated annually worldwide by 2017 [Arora R., 2008]. Obviously, the digital (r)evolution has resulted in a significant increase in the quantity of e-waste but the quality of the waste has also changed with the use of hazardous substances. With massive growth of electronics and hardware sector, the demand of the electronics products has been enhanced manifold. Faster change of features in the electronics devices and availability of the improved products forcing the consumers to dispose the electronics products rapidly. This has caused generation of e-waste alarmingly.

Like other parts of the world, Bangladesh is also facing serious crisis due to growing generation of e-waste. The main challenge in Bangladesh is to create awareness of the environmental, social and economic aspects of e-waste among the public, consumers, producers, institutions, policy makers and legislators. It is observed in recent years that large volume of e-waste is being exported from western countries to Asian countries for disposal. It seems the recycling business in western countries is becoming economically non-viable due to rising cost of manpower and availability of input materials for running the plant in full capacity. The western countries are, therefore, compelled to find out alternative destinations for disposal, where the labour cost is comparatively low and the environmental laws are not enforced so strictly.

E-waste is hazardous in nature due to presence of toxic substances like Pb, Cr, Hg, Cd and flame retardants (polybrominated biphenyls and polybrominated diphenylethers etc.). E-waste disposal mixed with solid municipal waste is posing a greater threat for environmental degradation in the developing countries like Bangladesh, where formal recycling technology is not available and non-formal operators are extracting precious metals through crude means for easy money. The extraction of metals in nonformal units is carried out by dipping printed circuit board (PCBs) in the acidic/alkaline solutions and heating/burning of PCB. These processes are harmful to the workers and to the environment, which are the major concern of e-waste management in developing countries like Bangladesh [Agamuthu P., Victor D., 2011].

While the human rights and environmental concerns emanating from the trans-boundary movements of toxic wastes and hazardous products have attracted considerable attention from scholars, activists, governments, and multilateral organizations such as the United Nations, the relatively newer dimension to this problem relates to electronic wastes otherwise referred to as 'e-wastes' in trendy parlance, which has received paltry scholarly attention thus far. Apart from urging a reconceptualisation of the electronic waste dimension to the global waste challenge in regulatory and trade terms, the underpinning thrust of this essay is that developing countries should find pragmatic ways of handling electronic waste because of their often toxic and hazardous substances that pollute the environment, expose people to diseases, and invariably violate a whole range of human rights.

GLOBAL SITUATION OF E-WASTE

In the 1990s, governments in the European Union (EU), Japan, the United States (US) and some other industrialized countries began to tighten the regulatory framework against electronic wastes and simultaneously commenced the setting up of electronic waste retrieval and recycling systems. However, not all industrialized countries had the capacity to deal with the steep quantity of the electronic and electrical wastes they generated.

Consequently, therefore, such industrialized countries began exporting their predicament to developing countries where laws to protect workers and the environment are non-existent, inadequate or unenforced. It was also cheaper to 'recycle' waste in developing countries, as for instance, the cost of breaking down or recycling of electronics in the US is 26 times more than the cost in Nigeria. In this most populous African country, labour costs are much lower while safety and environmental regulations are ignored or corruptly negotiated. Krueger described the general scenario this way: 'in the late 1980s the average disposal cost for one tone of hazardous waste in Africa was between $US2.50 and $US50, while in the OECD it ranged from $US100 to $US2000 [Babu et al. 2007].' Electronic waste (or 'e-waste') is the term used to cover all types of electrical and electronic equipment that has or could enter the waste stream. Although electronic waste is a general term, it has assumed technical usage as a term covering any household or business item with circuitry or electrical components with power or battery supply. These may consist of electrical and electronic equipment and accessories that are non-operational or whose life cycles are extinguished. Obsolete electrical and electronic equipment include computers, televisions, audiovisual recorders, mobile phones, printers and other electronic goods such as air conditioners, electronic toys, washing machines, sewing machines, lawn mowers, elevators, kitchen equipment, therapeutic equipment, surveillance equipment, mobile radio transmitters, refrigerators, and their accessories. Although China and India used to be the 'dumping grounds' for such discarded global electronic wastes, several studies have exposed illegal exporting of electronic wastes from developed countries to African countries, and several Asian and Pacific countries, over the past few decades. Further levels of internally generated electronic wastes are rising across the developing world as well, a result of increased electronic goods consumption stemming, *inter alia*, from upward indices of material wealth in the so-called Third World countries [Dennis V., Agamuthu P., 2012].

Understandably, while the age of information superhighway has brought about many benefits, rising consumption of electrical and electronic equipment coupled with increasingly rapid obsolescence due to unrelenting technological advances, and diminishing product lifetimes has led to significant increases in global electronic wastes levels. Although exact data are difficult to come by because of the often clandestine nature of the trans-boundary movements of toxic wastes and hazardous products, researchers estimate that some 50 million tons of electronic waste is produced annually around the world, of which only ten percent is recycled [Babu, B.R. et a; 2007]. The UNEP study of 2009 warns that by 2020, electronic waste in South Africa and China will have soared by 200–400 percent from 2007 levels and by 500 percent in India. Statistics also suggest that the United Kingdom alone is responsible for producing some 1 million tons per year of electronic wastes while the United States dumps between 300 and 400 million electronic items per year, and yet, less than twenty percent of those electronic wastes are properly recycled. This mounting crisis is compounded by low recycling rates, and illegal trans-boundary movement from developed to developing countries. At the same time, there is a significant increase in demand for electrical and electronic equipment from within developing countries, thus further contributing to future potential increases in electronic wastes [Widmer, R., 2010].

Individual demand for electrical and electronic equipment is rising at a considerable pace across developing countries, driven primarily by growing disposable incomes and the quest for the monetary values of components retrieved from obsolete electrical and electronic equipment. Empirical studies show that because discarded electronics contain precious materials such as copper, gold and silver, many informal recycling yards have sprung up in developing countries where workers are paid low wages to extract these valuable metals from these waste products. Demand in the poorer countries of Africa and Asia for electronic waste has steadily grown as informal scrap yards found they could extract valuable substances such as copper, iron, silicon, nickel and gold, during the recycling process. A mobile phone, for example, is 19 percent copper and eight percent iron [Chung S., 2012].

Despite this growing demand for, and saturation rates of, electronic and electrical equipment across the African continent, many people are unable to afford new electronic devices. The resultant quest for cheaper second-hand electrical and electronic equipment, coupled with low labour costs for reparation and refurbishment, has thus led to a strong electronic re-use market in developing countries, and is clearly strong across much of the developing world. Taking Nigeria as case study, for instance, the Standards Organization of Nigeria (SON) declared that within the first quarter of 2010 alone, it destroyed over 30 container shipments estimated at three hundred million Naira (approximately two million US dollars). Ghana is reported to have imported 31,400 metric tons of used electrical appliances in 2010 alone, 75 percent more than what was imported in 2009, with the United Kingdom accounting for more than half the quantum of imports into that country [UNEP, 2007]. In Tanzania, the World Bank asserts that over the last decade, personal computer penetration rates has risen ten-fold, while the number of people who own mobile phones has increased by over a hundred percent. Furthermore, reports commissioned by the Sustainable Electronic Wastes Project (StEP), a UN initiative that facilitates multimodal responses to the electronic wastes problem, indicate that electronic and electrical equipment markets remain unsaturated, particularly for ICT products, across the majority of the countries surveyed, indicating further future growths in electronic and electrical equipment penetration across the developing world. This scenario is assuredly going to result in higher levels of domestic electronic wastes generation annually, due to the reduced lifespan of second-hand electrical and electronic equipment [Sthiannopkao S., Wong M.H., 2012].

As would be expected, a substantial portion of the demand for second-hand electrical and electronic equipment in the developing world is met by discarded equipment from government agencies and companies. In Kenya, for example, this source stream of electrical and electronic equipment was found to contribute up to twenty percent of the stock of second-hand ICT equipment in the country as of 2009. Much of the remaining demand for secondhand electrical and electronic equipment in developing countries is met by imports from developed countries [Robinson, B., H., 2009]. However, estimates from Greenpeace International, 2008, an independent international non-governmental organization that acts to transform attitudes and actions in order to protect and conserve the environment and to promote peace indicate that between 25 and 75 per cent of second-hand electrical and electronic equipment imported into Africa arrived in an unusable condition, beyond repair. In summing up this segment, it becomes discernible that the electronic waste problem is a global concern because of the nature of the generation, distribution and dumping of wastes in the globalised world economy [Mo, H., Wen, Z., & Chen, J., 2009]. While it is hard to calculate overall amounts of electronic wastes, it is beyond question that hefty quantities end up at locations where dispensation takes place at very rudimentary levels. This engenders concerns in relation to capacity building, resource efficiency and also the shorter and longer term apprehensions about the perils to human beings and the environment. Certainly, there is a lengthy and often complex sequence of processes in the electronic waste menace, starting from an idea that an info-tech expert has conceived for making a new invention, then the fabrication of that product, leading to its commercialization, procurement and, ultimately, it's dumping by the consumer after the product's life span or usefulness. These are the issues that throw up the questions around waste management beyond its confinement as a legal issue *simpliciter* [Xianbing, 2006].

STATUS OF E-WASTE IN BANGLADESH

Bangladesh is developing with the increasing of technology usage. Sustainable and safe use of technology is a big challenge for Bangladesh. The wastes from electronic goods come to Bangladesh as curse. People consume and dump the useless products without any consideration of environmental damages and sustainability. Moreover, every year significant number of scrap ships is imported to Bangladesh by importer legally and/illegally. These ships are broken in ship breaking yard located mainly in southern part of Bangladesh. During ship breaking, many heavy metals and toxic pollutants emit to environment and oil spills to land and water bodies. As Bangladesh has binding to import scrap ships, thus illegal import and trade off of e-waste is happening by importer to make profit and hence, e-waste vulnerability of Bangladesh is increasing. The scrap ships are carrying large volume of toxics

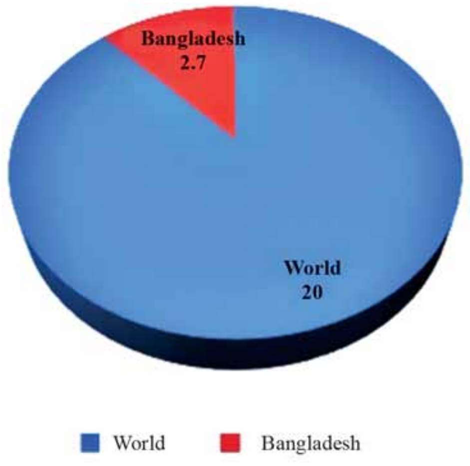

Fig. 1. E-waste generation: Bangladesh Vs World (in million MT)

products and electrical & electronic waste, includes: antiques, barometers, clothes irons, electronics, lamps/light bulbs, light switches, paint (Latex), pesticides, television sets, thermometers, mirrors, washing machines, calculators, desktop liquid crystal display (LCD) monitors, laptop, LCD monitors, neon lights, sewer pipes, etc.

Bangladesh is one of the highly e-waste generating countries in the world. Almost 2.7 million metric tons of e-waste is generated per year (Fig. 1), in contrast, it is stated in the report "From e-waste to Resource" that in the world volume of e-waste generated per year is 20 million metric tons. However, according to UNEP projections, 2010, an estimated 20–50 million tons of e-waste is being generated annually in the world. According to yearly generation figures, it is clear that ship breaking yard occupied highest (2.5 million metric tons) position. Wastes from television sets have taken the second highest (0.182 million metric tons) position with an exponentially increasing rate (Fig. 2). No inventory has been made to assess the extent of e-waste problem in Bangladesh [Ahmed FRS and Pervez m., 2011].

The goods below generates e-wastes in Bangladesh [Abir M., Shanoor R., 2011];

- Total number of PCs, TVs and Refrigerators in the year 2006 was 600,000, 1,252,000 and 2,200,000.
- The total number of TV sets users is roughly 10.3 million at the end of the year 2008.
- Every year around 59, 85,000 TV sets become scrape and generated 88,357.14 metric tons of e-waste.
- The total number of mobile phone active subscribers in Bangladesh was 58.36 million at the end of May 2010.
- Each year more than 2.8 million tons of electronic waste (it includes e-waste from 'ship breaking 'yard) generated in Bangladesh.
- E-waste generated from ship breaking yards about 2.5 million metric tons in a year.
- POPs: from ship breaking sites, PCB, Dioxin, Furan
- 10,504 metric tons of toxic e-waste by cell phone sets within last 21 years.
- Within the last 10 years IT sector generated 35,000 metric tons of e-waste in Bangladesh.

According to an estimate, more than 500 thousand computers were in use in 2004 and this number has been growing at 11.4 per cent annually. Even if the figure of 500 thousand were taken as the baseline, that many PCs would contain approximately 15.323 tons of

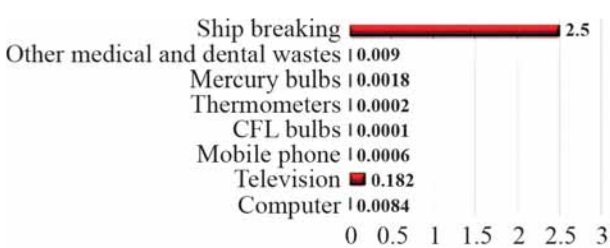

Fig. 2. Generation of e-waste (in tons) in Bangladesh

waste (% 27.2 kg/PC for 5 year obsolescence) in 2010 containing deadly plastics, lead, mercury etc [Gibson K., Tierney J.K., 2006]. The quantity of e-waste (PC and Cell phone) to be generated has been estimated by following two methods suggested in. The first method, Market Supply Method A. (MA) assumes that the average lifetime of an electronic product is approximately five years and after that these are discarded and come to the waste stream. The second method, Market Supply Method B (MB) assumes that all the products are not disposed at the same time; rather they are disposed in varying quantities over successive years. Here weighted average method is used to show the product disposal trend. For PCs the growth rate is considered to be 11.4 per cent and for cell phones a 100 % growth rate is considered annually.

TRANSBOUNDARY ISSUES OF E-WASTE: SOCIAL AND LEGAL CONCERN

The demand for used electrical and electronic equipment within developing countries runs in tandem with the demand for non-serviceable or near end-of-life products. Trans-boundary shipments of electronic wastes occur due to costly environmental and social standards for electronic wastes recycling in, for example, European Union (EU) countries, the US and Japan. Against the backdrop of the 'Not-In-My-Back-Yard (NIMBY)' syndrome, for instance, waste disposal facilities are shrinking in most industrialized countries as a result of stricter environmental regulation, yet, such wastes are ending up as illegal shipments which are effectively liberating developed countries of the electronic wastes problem, at the expense of the human residents in the recipient developing world [Nnorom, I.C. and O. Osibanjo, 2008].

When the problem of this so called electronic wastes 'dumping' began to gain attention, it was Bangladesh who were one of the main receivers. In recent times, however, studies are finding that such shipments were being exported beyond Asia to some African countries, with high volumes received by Bangladesh, Ghana and Nigeria in particular. The scale of these illegal transboundary shipments of electronic wastes is growing; estimates from 2010 indicate that 40 percent of electronic wastes from Europe alone are being exported to Asia and Africa [BAN, 2006]. In Nigeria, for example, estimates of the number of computer imports found to be non-functioning range from 75 to 95 per cent of each shipment [Herat S., 2008]. Not a few commentators have identified the growing phenomenon of hazardous and electronic wastes dumping in developing countries from the industrialized world as a direct consequence of economic globalisation. While globalization has indeed being identified as transforming trade, finance, labour, migration, technology, communication, and governance, there can be no shying away from the reality that one of its negative collateral effects since the 1990s has been the reduction in the power of national governments in the face of global free market and technological advancements that have taken their regulation out of the reach of many governments.

While international economic and financial integration is rapidly occurring as a result of increased trade and capital, technology and information flows, the production and sale of consumer goods *vis-á-vis* up-to-date technology is heavily and disproportionately weighed against developing countries. And even though technological diffusion and advances in communications are occurring quite rapidly, very vast portions of the developing world are left out. This is the sort of atmosphere that leaves the developing world in the dire strait of incapacity to outrightly and effectively uproot the menace of dumping of wastes within their respective jurisdictions.

Although celebrated as the offshoot of the free market system that has characterized economic and trade liberalization since the 1990s, the commodification of waste, whether legal or illegal, cannot be 'free trade' in the fullest sense, but smacks of some form of oppression – predation, exploitation, or coercion – unquestionably translating the so-called economic liberation theory of free market and globalization into nightmarish experiences for environmental and human rights protection in developing countries like Bangladesh. Environmental justice theorists have extended the philosophical issues here by contending that treating others fairly also involves recognizing their membership in the moral and political community, promoting the capabilities needed for their functioning and flourishing, and ensuring their inclusion in political decision-making. Moreover, they maintain that distribution, recognition, capabilities, and participation are interrelated and interdependent – one can therefore not pursue one dimension of justice in isolation. Other writers have posited that within the context of toxic waste dumping, those who end up living closest to dumping sites and thus bearing the greatest adversities of toxic wastes are the poor, the homeless, street children and other vulnerable people at the lowest rungs of society. This reality manifests the deeper social problem of the environmental injustices that serve as catalysts for the human rights violations associated with the dumping of wastes.

ENVIRONMENT, HEALTH AND HUMAN RIGHT CONCERN OF E-WASTE

Several scholars across geo-cultural divides have argued that linking human rights with environmental issues creates a rights-based platform to environmental protection that places the people harmed by environmental degradation or pollution at its centre. The articulation of the rights of human beings thus creates the opportunity to secure those rights through juridical bodies at the international and domestic fora. This has particular implications for those human groups that are most vulnerable to environmental harm and least able to access political remedies within their own meager means. The connectivity between human rights and the environment reveals that human rights abuses often lead to environmental harm, just as environmental degradation or pollution often causes egregious human rights violations. With more than one hundred national constitutions recognizing and protecting the right to a safe, clean and healthy environment, and virtually all international and regional human rights treaty monitoring bodies also recognizing the direct linkage between environmental harm and human rights norms, it is safe to posit that interjecting the electronic waste discourse from a rights-based perspective at this juncture is neither out of place nor abstract [Terazono A., 2006]. In her seminal work produced on behalf of the World Health Organization in 2002, Shelton had proffered sweeping validation for the inclusion of a rights-based approach to every discourse on environmental health in the following words:

First, the emphasis on rights of information, participation, and access to justice encourages an integration of democratic values and promotion of the rule of law in broad-based structures of governance. Experience shows better environmental decision-making and implementation when those affected are informed and participate in the process: the legitimacy of the decisions exercises a pull towards compliance with the measures adopted. Another benefit of a rights-based approach is the existence of international petition procedures that allow those harmed to bring international pressure to bear when governments lack the will to prevent or halt severe pollution that threaten human health and well-being. In many instances, petitioners have been afforded redress and governments have taken measures to remedy the violation.

In other instances, however, the problem appears to be the result of a combination of governmental lack of capacity and lack of political will. The pollution may be caused by powerful enterprises whose business and investment are important to the state or the state may have inadequate monitoring systems to ensure air or water quality. Even in these instances, however, petition procedures can help to identify problems and encourage a dialogue to resolve them, including by the provision of technical assistance [Barba-Gutierrez, Y., B. Adenso-Diaz, et al., 2008].

The non-functioning computers that arrive into most developing countries i.e. Bangladesh are sold as scrap, smashed up and discarded, a common practice within electronic wastes receiving countries that often lack capacity in the handling and recycling of the hazardous materials within the electronic wastes. Instead, manual dismantling, open burning to recover materials, and open dumping of residual fractions occurs. In Bangladesh, this is predominantly carried out by some disorganized informal and very few formal electronic wastes recycling sector. Consequently, relatively more hazardous material is introduced into informal electronic wastes burning and dumping grounds across many developing countries like Bangladesh, with higher implications for the environment and human health.

Electronic wastes present severe environmental and health challenges for the countries saddled with the task of processing them, by reason of both the quantity and inherent dangers of toxicity. Electronic wastes can contain more than a thousand assorted substances, many of which are lethal. These may be in form of heavy metals or chemicals such as mercury, lead, cadmium, chromium, magnetic properties and antimony (flame retardants), including polybrominated biphenyls, polyvinyl chloride, polychlorinated biphenyls, and polybrominated diphenyl ethers. Perhaps the most hazardous components of electronic wastes are the mercury-containing components, batteries, printed circuit boards, CRTs, and the plastics which contain the brominated flame retardants. Accidental leakages and evaporation of these substances occur at the electronic wastes dumping sites, and results in the contamination of surrounding natural resources including, soil, crops, water, livestock and fish. Empirical studies at ship yard of Chittagong, Bangladesh revealed lead, mercury, cadmium, arsenic, antimony trioxide, polybrominated flame retardants, selenium, chromium, and cobalt contents in soil samples at rates far higher than average [Huisman, J., & Stevels, A., 2004]. Of course, when the electronic wastes are burnt, further toxic substances can be inadvertently generated. Beyond the environmental degradation concerns, the hazardous materials found in electronic wastes pose a significant risk to human health. After all, empirical research has established that people who break electronic wastes open often suffer radiation, nausea, headaches, respiratory failure among other health problems. However, it is not only the people working directly with electronic wastes who are susceptible to their harmful effects but also people living in the ambience of the waste dumps, and those indirectly affected through resulting contamination of the food chain, soils and rivers [Brigden K., 2005].

These people are exposed to the hazardous substances through dermal exposure, dietary intake, dust inhalation or particle intake, with the latter two sources found to be particularly significant [Ahmed FRS, 2011]. Other expert studies state that exposure to chemicals from e-waste – including lead, cadmium, mercury, chromium and polybrominated biphennyls – could injure the human brain and nervous system, distress the kidneys and liver, and lead to birth defects. The Minamata disease in Japan between 1954 and 1965; the Love Canal incident, near Niagara Falls in the US; the Koko incident of 1988 in Nigeria; the Thor Chemicals diseases of the early 1990s in South Africa; the disastrous Trafigura dumping of hazardous wastes incident in Ivory Coast, in 2006, are among the numerous pointers to the grave consequences that unscrupulous waste dumping could have on human beings, jeopardizing their livelihood, liberty and very existence [Akenji et al., 2011]. The essence of the above is to demonstrate that the totality of human rights guarantees and particularly the right to life, the right to development, and the entire gamut of economic, social and cultural rights cannot be realized in the absence of the right to a healthy environment.

CURRENT POLICY AND LEGISLATION AND GAPS

Bangladesh adopted its National Environmental Policy in the year of 1992 for regulation of all activities that pollute and destroy the environment. The Environment conservation act, 1995, with aim to regulate, conserve and enhance the quality of environment and to control, prevent and mitigate pollution. Medical Waste Management Rules, 2008 addressing the waste management issues for the medical sector including E-waste.

The latest initiative is Electrical and Electronic Waste (Management and Handling) Rules, 2011 which has the following features: These rules apply to every producer(s), dealer(s), collection centre(s), refurbisher(s), dismantler(s), recycler(s), auctioneer(s) consumer(s) or bulk consumer(s) involved in the manufacture, sale, purchase and processing of electrical and electronic equipment or components. It defines Responsibilities of the producer, Responsibilities of dealers, Responsibilities of refurbisher, Responsibilities of collection centers, Responsibilities of consumer or bulk consumer, Responsibilities of dismantler, Responsibilities of recycler/ reprocessor.

It describes Procedure for grant of authorization, Power to suspend or cancel an authorization, Procedure for registration/ Environmental Clearance/Renewal, Procedure for storage of e-waste, Transportation of e-waste, Accident reporting and follow-up, Liability of the producer, collection centre, transporter dismantler and recycler of e-waste, The collection, storage, transportation, segregation, refurbishment, dismantling recycling and disposal of e-waste.

The different schedules of the rules are as Schedule-1 Listing E-waste categories. Schedule-2: Listing the products covered under the categories given in schedule-I, Schedule-3: Deals about threshold limits for use of certain hazardous substances and Schedule-4: Discusses about authorities and corresponding responsibility.

There is no legal permission in the rules of Bangladesh to trade off e-waste and its disposal and management. Bangladesh is a signatory to the Basel Convention prohibiting trans-boundary movement of hazardous waste. Import of any kind of waste requires government permission. There is no comprehensive electronic waste (e-waste) policy, although it is briefly mentioned just as an action item in the country's ICT policy. The government established the Department of Environment (DoE) in 1977 under the Environment Pollution Control (EPC) Ordinance, 1977. Then in 1989, as pollution and environment got more attention, the Ministry of Environment and Forest was established as the apex body. The National Environmental Policy, highlighting the regulation of all activities that pollute and destroy the environment, came into effect in 1992. The subsequent Environment Conservation Act (ECA), 1995, authorized the DoE to undertake any activity necessary to conserve and enhance the quality of the environment and to control, prevent and mitigate pollution. The DoE was also mandated to give clearance on environmental issues for any new project. The subsequent rules under the ECA, the Environment Conservation Rules of 1997, divided industries and projects into different categories depending upon the pollution load and likely impact on the environment. There are some provisions and mandatory rules to build a waste management system within the industry sectors. However, e-waste does not require any compliance under the Act or Rules. The government is now preparing a solid waste management policy which may cover e-waste. At the same time, the Medical Waste Management Rules, 2008, address waste management issues for the medical sector, including e-waste.

CONFRONTATION OF E-WASTE

The e-waste development trends indicate that a key advantage of Bangladesh is the development of e-waste related policy including waste reduction initiatives such as Extended Producer Responsibility (EPR). This legislation provides Bangladesh with the policy framework to tackle e-waste issues in a formal manner as well as fast-track the lessons learned from developed countries in e-waste legislation and management. Nevertheless, e-waste policy development may also pose a disadvantage if it is adopted from developed countries without customizing it to local socio-economic conditions and challenges. Furthermore, some developing countries are considering adopting technologies that have been implemented in developed countries where proper infrastructure is in place to manage e-waste. However, the economic, environmental and social situation in a number of these developing countries are different compared to the developed countries, hence, the need for adapting, implementing, and scaling up appropriate technologies that are more suited to the local conditions. This is consistent with studies on applying EPR policies in developing countries which have discovered certain challenges and limitations in EPR policy implementation. The first challenge is for the governments to collect funds from producers or imports if the goods are smuggled into the country or if the small shop-assembled products have a large share of the market [Gottberg A., 2006].

The second challenge is the systems that create incentives for collectors and recyclers to over-report the amount of e-waste collected to gain extra subsidies from the fund. The third challenge is the competition between the formal and informal recycling sector to gain access to e-waste. One of the key areas for consideration is that the role of the informal e-waste recycling sector in developing countries compared to developed countries. This is because the informal sector in many developing countries is active in the e-waste recycling chain. These informal recyclers are motivated by the precious materials contained in the e-waste stream and its market value [Schmidt, M., 2005]. In countries such as India and China, where significant amounts of e-waste recycling are taking place, informal collectors achieve very high collection efficiencies. In fact informal collection of e-waste does not have any major adverse impacts on the environment. Instead they lead to high collection rates and many economical and social benefits to the poor section of the community. The informal sector is also involved in the second stage of the e-waste recycling chain—dismantling pre-processing. Even here there are no major impacts on the environment; instead there are more economic and social benefits to the poor community [Chatterjee S., and Kumar K., 2009]. The last stage of the e-waste recycling chain where processes/techniques are necessary to extract the valuable components such as metals is where the current environmental impacts are present. Most of the informal recyclers utilize low efficiency processes resulting in major health and environmental impacts. For example backyard recycling practices (BRT) utilized by informal recyclers to extract raw materials from printed wire boards, wires and other metal bearing components have very low material recovery rates and also result in major environmental impacts [Kojima M., 2009].

Prohibiting and imposing fines on informal recycling have not helped in countries like Bangladesh. This is due to the fact that informal recycling is undertaken by the poor people and as such the government is unable to impose heavy fines as they cannot pay it. These governments then attempt to regulate the informal e-waste recycling sector by licensing them. However, the effectiveness of such a scheme depends a lot on the responsibility of the disposer of e-waste. The challenge is how to deal with the e-waste disposer who receives more money from unlicensed informal recyclers than from the licensed recyclers [Manomaivibool, 2009]. A study argues that generally the disposers of e-waste are relatively richer than the recyclers; hence, the government can afford to place a heavy fine on them. However, the issue is governments of Bangladesh are unable to impose fines on e-waste disposers of developed countries where most of the e-waste originates [Kahhat, R., et al., 2008]. It argues that the emergence and growth of the informal sector in developing countries like Bangladesh is the result of intricate interactions between economic incentives, regulation gaps, industrial interdependence and the social reality and prediction that informal sector may remain an influential recycling force for years to come. They suggested the whole informal recycling chain must be thoroughly investigated for which steps are environmentally harmless and should remain and which steps of the material mass flow should be changed for better downstream environmental and recycling performance [Lindhqvist Thomas., 2000].

ENTANGLEMENT OF E-WASTE POLICY

The policy implications of the e-waste development trends for Bangladesh is that e-waste policy makers should cautiously adopt e-waste policy taking into account the local socio-economic conditions and its potential effectiveness in addressing challenges related to the informal sector. E-waste policy makers should consider supplementing legislative instruments with economic and social initiates such as integrating e-waste management as part of a national green growth strategy and integrating strategic environmental assessment (SEA) into the e-waste policy planning process. This would allow Bangladesh to integrate the informal sector into the country's economic development as well as enable positive social benefits to the informal e-waste sector. Furthermore, e-waste policy makers should also consider establishing an e-waste information system (EIS) that forms the foundation for effective decision making related to e-waste issues in the country as well as establishing a phased national e-waste register for the informal sector. This also enables an effective decision support system to tackle basic issues related to e-waste flow. The specific solutions recommended for Bangladesh are:

The first recommendation is the integration of e-waste into the national development agenda via policy planning tools such as green economy assessment (GEA) and SEA. The conventional approach of replicating models from developed countries no matter how successful they are in those counties needs to be reexamined as e-waste issues in developing countries are complex and intricately linked to the informal sector as well as socio-economic-political dynamics. Policy planning tools such as GEA and SEA are expected to enhance e-waste integration of stakeholder considerations, green economy credentials and environmental sustainability in e-waste policy development. The GEA is a system of super streaming national economic policies patterns towards sustainable investment, production and consumption so that economic growth results in both environmental and social growth. The GEA is a paradigm shift from the current traditional 'black economy' based on fossil fuels to a 'green economy' based on renewable energy sources and sustainable production and consumption. The application of GEA for e-waste policy planning would provide the opportunity for the e-waste sector to be integrated as part of a national green growth policy where potentially the government becomes the largest investor and consumer of green e-waste infrastructure and products. This may provide the necessary economic incentive signals for a more environmental responsible e-waste production sector once the government becomes the market and driver to green the supply chain.

Furthermore, GEA would enable the rebranding of the e-waste sector from the current polluting image to a more green opportunity reflection of economic growth for Bangladesh. Meanwhile, SEA is a system of incorporating environmental considerations into policies, plans and programmes (PPP). The SEA was initially promoted as an extension of Environmental Impact Assessment (EIA) principles and practice to PPP where it added value by analyzing PPP at an early stage, thus setting the context and framework for EIAs at the Project level. The application of SEA for e-waste policy planning is especially important in the integration of the environmental considerations during the spatial distribution of e-waste infrastructure and facilities at a regional and a national level. This would enable the cumulative assessment and development of cross-sectoral strategies to prevent improper siting and pollution loading on environmental sensitive areas and environmental sensitive receptors based on the existing carrying capacity of the ecosystem. Furthermore, SEA would also enable the formal integration of alternative scenarios and stakeholder participation in e-waste policy planning which may include options on preventive deep structure economic, environmental and social strategies to tackle root-cause problems in the current e-waste management situation of Bangladesh.

The second recommendation is the establishment of national e-waste database systems coupled with a decision support system to collate, update and disseminate data and information on e-waste. Typically, developing countries like Bangladesh lack an e-waste database or a one off e-waste inventory is only conducted as part of a development in an international funded study. Nevertheless, without a continual systematic e-waste information system, Bangladesh would be in essence operating blindly as they lack the decision support system to guide e-waste policy development in a sustainable manner. The e-waste database system is expected to function as a virtual knowledge hub for agencies, organizations, industries and stakeholders for the purpose of coming together and building and enhancing knowledge on e-waste.

The third recommendation is the establishment of a phased national informal sector e-waste register with the purpose of registering and formally recognizing and tracking the informal sector. The biggest challenge of the informal sector is, whether small or large scale is their anonymity to the national authorities which then makes management and regulation fuzzy. Previous attempts to use the carrot or the stick in regulating the e-waste sector has proven less than successful as their identity is often obscure and their numbers considerable. Therefore, an e-waste register without imposing conditions in the initial stage is expected to bring the informal sector into the fold of the formal sector via a soft approach without being perceived as antagonistic, but at the same allows the national governments to monitor the activities of these interim informal sectors. Consequently, the functionality of the e-waste register for the informal e-waste sector can be enhanced by designing it to be an initial soft non-threatening initiative coupled with a GEA incentivization to facilitate the move towards registration and semi-formalization as a means to obtain the economic benefits of formal recognition. A similar approach was adopted by the Japanese government for lead acid battery recycling as well as the Malaysian government for partial e-waste recyclers. This is expected to promote the informal e-waste sector for the necessary administrative, economic and social recognition incentives to operate in a environmentally and socially responsible manner. Finally, a key aspect of e-waste policy development for Bangladesh may require a paradigm shift in perception of e-waste from an informal sector's economic, social and environment problems to a perception of e-waste as a potential opportunity for green economy growth and informal sector mainstreaming.

WAY FORWARD TO ALTERNATIVE STRATEGY AND APPROACH

The electronic industry has revolutionized the world over last decades as electrical and electronic products increasingly have become an essential part of everyday human life worldwide. While no one can categorically quantify how much electronic wastes are presently being circulated globally or how much of this waste is hazardous, what is definite is that, if not properly managed, electronic wastes have the potential of threatening human health and the environment. Waste experts, as well as industrialists, environmentalists, and governments, increasingly agree that the response is to generate as little waste as possible in the first place, through the related concepts of cleaner production and eco-efficiency. Cleaner production generates less waste, and reuses and recycles more of what it is produced. Eco-efficiency uses fewer raw materials and there is an upward consensus that industrial societies could cut consumption of them by 90 per cent, while still greatly improving living standards. Although a wide range of environmentally-effective technologies are now available to mitigate emissions and provide public health, environmental protection and sustainable development benefits, and commentators readily subscribe to the sweeping measures and standards adopted against the problem of electronic waste in Europe and the US as the pathway to solve the problem in Bangladesh, the capacity of Bangladesh to procure such technologies or the skills to operate and maintain them are limited. It is therefore reasonable to suggest that solving the e-waste problem in Bangladesh must necessarily entail a multi-pronged approach. While many governments in developing countries are increasingly becoming conscious of the crisis of electronic wastes and aiming to tackle it, others have not domesticated the respectively applicable Basel, Bamako, or Waigani treaties as part of their municipal laws. However, for developing countries, it would appear that the 2006 Nairobi Declaration on Environmentally Sound Management of Electronic and Electrical Waste and more recently by the Bamako Declaration on the Environment for Sustainable Development, 2010, would seem to suggest that the challenges confronting the continent is more than what could be sacrificed on the altar of political expediency. The latter instrument, for the first time, sought a multidimensional approach to the problem by appealing to the involvement of 'young people, civil and national assemblies, government institutions and other stakeholders constructively in supporting measures aimed at environmental management.' [Lindhqvist Thomas., 2000].

Today, several developing countries are drawing up policies regarding electrical and electronic equipment; some are focusing on the age of imported electrical and electronic equipment, for example Ghana is considering a ban on electrical and electronic equipment that is older than five years, while Uganda has banned second-hand electrical and electronic equipment from entering the country, while Nigeria is developing its own guidelines to ensure environmentally sound management of e-waste, and is in discussions with a UK-based waste from electrical and electronic equipment recycler to establish a facility in Lagos. Nevertheless, global, regional and national policies focusing on banning or regulating imports, or practices such as open burning have so far been weakly enforced, and have not enabled effective and significant management of electronic wastes treatment. Furthermore, transnational export/import tariffs do not make a distinction between second-hand or unserviceable electrical and electronic equipment and brand new electrical and electronic equipment, which complicates the system of restraining or curbing the illegal import of electronic wastes. Perhaps instead of bans on imports and on informal electronic wastes recycling practices, it is being suggested that both should be more efficiently controlled, and that it is especially vital to include the informal sector within decisions and resulting actions. The risks to the environment and human health connected with informal electronic wastes practices within developing countries could potentially be reduced significantly through the use of better dismantling methods. With particular regard to electronic wastes, for example, modern recycling plants can recover or re-use equipment material, leaving only a tiny portion as waste. The envisaged future is one in which societies have reduced to a sustainable level the e-waste-related burden on the ecosystem that results from the design, production, use and disposal of electrical and electronic equipment. One further way forward will be to transfer the global problem of e-wastes to the individual scale in order to increase individual involvement. Actions, targeting the different social classes, should be taken to raise awareness levels through the available means. After all, as experiences from Jordan, Thailand, and China show, separating waste at generation sources has proven to be much easier and more cost effective than at later stages.

In terms of regulations, since achieving a complete universal approach to the problem of e-waste is proving to be thorny, Bangladesh should develop its own legal and policy framework on transboundary movements and management of e-wastes similar to the Administrative Measures on Control of Pollution Caused by Electronic Information Products (known as 'China RoHS') of 2006 and the Ordinance on the Administration of the Recovery and Disposal of Waste Electronic and Electrical Products (known as 'China WEEE') of 2009 [Wagner, T.P., 2009]. In policy terms, one path less taken by developing countries is subscription to the Poverty-Environment Initiative (PEI) of the United Nations Development Programme (UNDP) and the UNEP. The PEI supports country-led efforts to mainstream poverty-environment linkages into national development planning and provides financial and technical assistance to government partners to set up institutional and capacity strengthening programmes and carry out activities to address the particular poverty-environment context. Regrettably, less than 50 developing countries are current partakers of this initiative. The above makes it critical that approaches and responses to the phenomenon of hazardous electronic wastes begin to integrate proper conceptualization along with the poverty question in many developing countries. Warnings are emerging that global warming, climate change, and depletion of the ozone layer are all indications of the limit of the Earth's capacity to assimilate wastes. These wastes, in whichever form they come, have direct linkages to the desperate quest for survival and livelihood in several countries, developed and developing alike [Yoshida, 2009].

While legal frameworks and policy initiatives are indeed veritable components of appropriate responses to the menace of electronic wastes in developing countries, there is no gainsaying the fact that strategic responses must bring all actors to the table. The bottom-line of the contention here is that all the actors along the product-disposal chain share responsibility for the environmental impacts of the whole product system. The greater the ability of each stratum of actor(s) to influence the environmental impacts of the product system, therefore, the greater the share of responsibility for addressing those impacts should be. The actors contemplated within the framework of this discussion are the product manufacturers, the suppliers, and the consumers. Manufacturers should reduce the life-cycle environmental impacts of their products through their influence on product design, material choices, manufacturing processes, product delivery, product system support, and product disposal mechanisms. Suppliers should have a significant influence by providing manufacturers with environmentally friendly materials and components. Consumers should affect the environmental impacts of products in a number of ways, namely, by way of purchase choices (i.e. choosing environmentally friendly products), adopting good maintenance culture and environmentally-conscious operation of electronic products, and careful end-of-life disposal special care in disposing of household electronics containing toxic substances and returning them to proper facilities where possible.

CONCLUSION

Solid waste management, which is already a big challenge for Bangladesh, is becoming more complicated by the invasion of e-wastes. There exists an urgent need for a detailed assessment of the current and future scenarios including quantification, characteristics, existing disposal practices, environmental impacts etc. Institutional infrastructures, including e-waste import, collection, transportation, treatment, storage, recovery and disposal, need to be established, at national and/or regional levels for the environmentally sound management of e-wastes. Establishment of e-waste collection, exchange and recycling centers should be encouraged in partnership with private entrepreneurs and manufacturers. E-waste policy development may require a paradigm shift in perception from a problematic waste issue to an opportunistic green growth solution for Bangladesh. Consequently, this paper suggests that e-waste policy development may require a more customized approach where instead of addressing e-waste in isolation it should be addressed as part of the national development agenda that integrates GEA and SEA as part of the national policy planning.

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EXTREME MAXIMUM AND MINIMUM AIR TEMPERATURE IN MEDİTERRANEAN COASTS IN TURKEY

ABSTRACT. In this study, we determined extreme maximum and minimum temperatures in both summer and winter seasons at the stations in the Mediterranean coastal areas of Turkey. In the study, the data of 24 meteorological stations for the daily maximum and minimum temperatures of the period from 1970–2010 were used. From this database, a set of four extreme temperature indices applied warm (TX90) and cold (TN10) days and warm spells (WSDI) and cold spell duration (CSDI). The threshold values were calculated for each station to determine the temperatures that were above and below the seasonal norms in winter and summer. The TX90 index displays a positive statistically significant trend, while TN10 display negative non-significant trend. The occurrence of warm spells shows statistically significant increasing trend while the cold spells shows significantly decreasing trend over the Mediterranean coastline in Turkey.

KEY WORDS: Extremes, Mediterranean, climate change, maximum and minimum temperatures.

INTRODUCTION

Extremes are defined with the maximum and minimum measurements of atmospheric variables that can be expected to occur at a certain place and time [Rohli and Vega, 2012] that established a long period of observations.

As well as this, the classification of extreme events, extreme impacts and disasters is affected by the measured physical attributes of weather or climatic variables or the vulnerability of social systems.

Robust of record-breaking heatwaves and coldwaves occur each year somewhere on the earth. Extreme events have been experienced in many part of Mediterranean basin during the past decade. The life and socioeconomic effected of extremes temperature have examined by the researchers [e.g. Watson et al. 1997; Parry, 2000].

Today, when we talk about extreme temperature, comes to mind high degrees or heatwaves. Because perception of communities on climate change or variability, strongly affected by seasonal extremes. Today, especially after 1970s, we experienced extremely hot conditions. But for example, 1960s and 1970s is known two cold decades [Kukla et al, 1977]. This variability is effect to the community perception today and past. But in reality, we know that our era is interglacial period as named "Holocene" and about 11k years, temperature is rising in big scale.

Especially, 2003 and 2007 summers experienced warm years in European countries, Balkan Peninsula and Turkey [Schär et al., 2003; Beniston & Diaz 2004; Busuioc et al., 2007; Ünal et al., 2012; Acar Deniz, 2013; Acar Deniz and Gönençgil, 2015]. As an example Metoffice [www.metoffice.gov.uk]: *The "heatwave" of 2003; More than 20,000 people* *died after a record-breaking heatwave left Europe sweltering in August 2003. The period of extreme heat is thought to be the warmest for up to 500 years, and many European countries experienced their highest temperatures on record. World Meteorological Organization (WMO) and cited by the MetOffice is "when the daily maximum temperature in more than five consecutive days exceeds the average maximum temperature by 5 °C(9°F), the normal period being 1961–1990".*

In simpler terms, a heat wave is a prolonged (long-term) period of excessively hot weather, which may be accompanied by high humidity. Luterbacher et al. [2004] indicate that the summer of 2003, should be the hottest year in at last 500 years.

Severity and spatial scale of the heatwaves are an important effect on environmental, social, economic and health. In particular, because the Mediterranean basin is sensitive to climate change, the human activities in this area have a greater effect. Beniston et al. [2007] suggest that regional surface warming causes the frequency, intensity and duration of heat waves that increases over European continent. Also, the authors postulate that by the end of the twenty first century, especially central Europe countries will suffer the same number of hot days as are currently experienced in southern Europe. The intensity of extreme temperatures increases in southern Europe more rapidly than in central Europe.

Current studies also aim to explain the temperature anomalies in the Mediterranean region [Unkasevic and Tosic, 2013; Unkasevic and Tosic, 2009; Beniston et al., 2007; Baldi et al, 2006; Kostopoulou and Jones, 2005]. Hertig et al. [2010] suggests that mostly insignificant trends for the 5th percentile of minimum temperatures in winter during the period 1961–1990. They have analyzed significant increases of the 5th percentile of minimum temperatures occurred mainly at stations in the central-northern Mediterranean area with values of more than 2 °C in some cases (e.g. Palermo, Italy or Istanbul, Turkey).

In summer 2010, many cities in eastern Europe recorded extremely high values of daytime (for example, Moscow reached 38.2 °C), nighttime (Kiev reached 25 °C), and daily mean (Helsinki reached 26.1 °C) temperatures and during the same period, parts of eastern Asia also experienced extremely warm temperatures, and Pakistan was hit by devastating monsoon floods [Barripedro et al., 2011].

In addition, the 95th percentile of maximum temperature trend is recorded with mostly in the western Mediterranean area and such trend conversely decreases in the eastern Mediterranean region [Acar Deniz and Gönençgil, 2015]. Moreover, projections show that heatwaves will become more intense, frequent and longer-lasting.

Finally, extreme hot and cold events could be important the understanding of Mediterranean climate variability because this region of climate vulnerability to global climate change.

Also, Tourism are agriculture main economic activity in this area and chancing climate should effect directly these economic activity. Because of that, we chose this study area and examine the chancing extreme climate conditions. The aim of this study is to analyze the maximum and minimum temperature indices during the hottest months of the year (June-July-August) and coldest months of the year (December, January and February). In this study, we examine the experience of winter and summer extreme hot and cold days and also warm and cold spell durations in the Mediterranean seacoast line of Turkey. The objective of this study is to define Turkey's winter and summer extreme temperature variability and trend patterns over 1965–2014 periods.

DATA AND METHOD

The study area is spread southern part of Anatolian Peninsula, Turkey. The temperature records are collected based on daily maximum and minimum temperatures data provided by Turkish State Meteorological Service [http://

www.mgm.gov.tr], winter and summer seasons. Namely, these are air temperature data recorded from 24 stations in Turkey during the period of 1965–2014 (Table 1). Locations of these selected stations are shown in Fig. 1.

Table 1. List of stations with their latitudes, longitudes and altitudes

Station name	Latitude	Longitude	Altitude (m)
Dalaman	36,77	28,79	12
Fethiye	36,62	29,12	3
Antalya	36,90	30,79	64
Alanya	36,55	31,98	6
Anamur	36,06	32,86	2
Silifke	36,38	33,93	10
Mersin	36,78	34,60	7
Adana	37,00	35,34	23
Iskenderun	36,59	36,15	4
Antakya	36,20	36,15	104
Finike	36,30	30,14	2
Kaş	36,20	29,65	153
Köyceğiz	36,97	28,68	24
Manavgat	36,78	31,44	38
Mut	36,65	33,43	340
Erdemli	36,62	34,33	7
Ceyhan	37,01	35,79	30
Dörtyol	36,82	36,19	29
Islahiye	36,08	35,94	4
Kale	36,24	29,97	25
Gazipaşa	36,27	32,30	21
Yumurtalık	36,76	35,79	34
Karataş	36,56	35,38	22
Samandağ	36,08	35,94	4

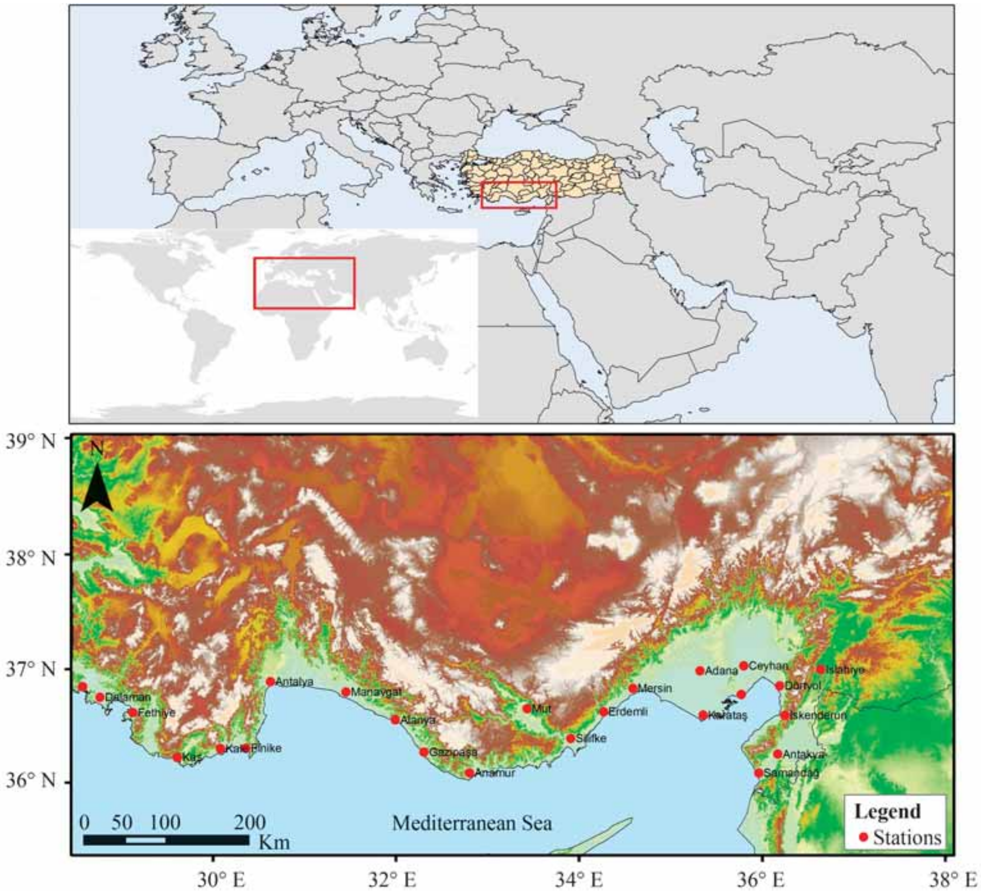

Fig. 1. The geographical distribution of meteorological stations.

In the recent years, various indices have been used in extreme event studies. Used climate change indices for temperature recommended by WMO–CCL/CLIVAR list of over 50 climate change indices [Alexander et al., 2006; Frich et al., 2002; Klein Tank and Können, 2003]. The list internationally concur trends in indices of climate extremes are calculated on the basis of daily minimum and maximum temperature series.

We selected 4 indices of climate extremes to be extracted from daily maximum and minimum temperature. These climate indices (hot and cold days, warm and cold spell duration) are defined as days with maximum temperature (TX) and minimum temperature (TN) anomalies above and below a certain percentile of TX (90) and TN (10) anomalies and warm and cold spell durations. The temperature indices were selected for this study and their description are shown in Table 2.

The temperatures indices based on station-related thresholds that hot (cold) day is defined as a day when the daily maximum (minimum temperature) exceeds (fall behind) 90^{th} (10^{th}) percentiles. The temperature indices describe warm and cold extremes in summer and winter seasons. As well as this, a linear trend in the warm days and cold night is determined with Mann-Kendall rank correlation test. According to Mann-Kendall test τ is a value that indicates magnitude of the observations. N is the number of observations in the sample and n is the number of data points. The P statistic is calculated by;

$$P = \sum_{i=1}^{N-1} n_i .$$

Mann Kendall test statistic τ is calculated as follows;

$$\tau = \frac{4P}{N(N-1)} - 1.$$

The value of the test statistics is normal for all N values larger than 10. The significance test is calculated as follows;

$$\tau_{(t)} = 0 \pm t_g \frac{(4N+10)}{9N(N-1)},$$

where t_g value is the requested probability point in the normal distribution (two sided). A positive value of τ indicates an upward trend; a negative value of τ indicates a downward trend [Mann, 1945; Kendall, 1975].

The values of $u(t)$ and $u'(t)$ are used to determine the trend in the time series. Similarly to the calculation of progressive rows of statistics $u(t)$, the retrograde rows of statistics $u'(t)$ are computed backwards starting from the end of series. $u(t)$ is significant at a desired level of significance, one can decide whether it is an increasing or decreasing trend depending on whether $u(t) > 0$ or $u(t) < 0$.

This study focuses on observed trends in warm days and warm spell duration and cold night and cold spell duration indices in summer and winter seasons during 1965–2014 in Mediterranean coastline of Turkey.

Cold spell duration index (CSDI), annual count of days with at least 6 consecutive days when $TN < 10^{th}$ percentile. Let TN_{ij} be the daily minimum temperature on day i in period j and let TN_{in} 10 be the calendar day 10^{th} percentile

Table 2. Definitions of the minimum and maximum air temperature indices used in this study

ID	İndicator name	Definations	Units
TX90p	Warm days	Percentage of time when daily max temperature > 90^{th} percentile	Days
TN10p	Cool nights	Percentage of time when daily max temperature < 10^{th} percentile	Days
WSDI	Warm spell duration index	Count of days w at least 6 cons. days w tmax > 90th percentile	Days
CSDI	Cold spell duration index	Count of days w at least 6 cons. days w tmin < 10th percentile	Days

centered on a 5-day window for the base period 1961–1990. Then the number of days per period is summed where, in intervals of at least 6 consecutive days:

$TN_{ij} < TN_{in}10.$

Warm spell duration index (WSDI), annual count of days with at least 6 consecutive days when $TX > 90^{th}$ percentile. Let TX_{ij} be the daily maximum temperature on day *i* in period *j* and let TX_{in} 90 be the calendar day 90^{th} percentile centered on a 5-day window for the base period 1961–1990. Then the number of days per period is summed where, in intervals of at least 6 consecutive days:

$TX_{ij} > TX_{in}90.$

RESULTS

Turkey is one of the rapidly urbanizing countries in the developing countries of the world. According to the results of the 2007 census the population of Turkey increased from 70.586.256 in 2007 to 77.695.904 in 2014 [TUIK, ABPRS 2007–2014]. Antalya, Adana and Mersin are rapidly urbanizing cities in the Mediterranean region of Turkey (Fig. 2).

We have slightly modified their original categories by considering city sizes, urban–rural characteristics in the stations, located in Mediterranean coastline of Turkey. Based on these considerations, the classification of stations and the number of stations within these classes are given in Table 3.

Table 3. Classification of Mediterranean coast stations (population size)

Population size	Classification	Station number	%
⩽ 20000	Rural	1	4.2
20000 ⩽ *P* < 100000	Medium urban	9	37.5
100000 ⩽ *P* < 500000	Urban	10	41.7
P ⩾ 500000	Large urban	4	16.7

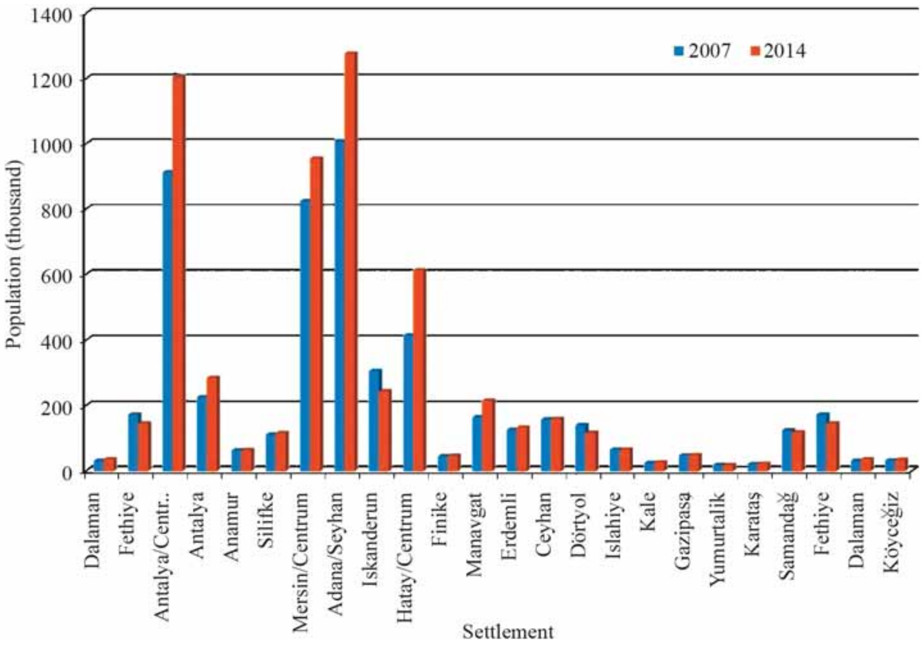

Fig. 2. Population of stations located in the Mediterranean region in 2007 and 2014 [TUIK, 2015].

One station is rural, 9 are medium urban, 10 and 4 settlements are respectively urban and large urban stations characterized by a high rate of population increase. The large urban stations (Antalya, Adana, Mersin, Hatay) constitute about 16.7 % of the total, which is the same based on both classifications. Most of the stations are very likely to have been affected by rapid urbanization, and thus subject to both urban heat island effects.

A set of 4 temperature indices related to the frequency of warm days (TX90), cold nights (TN10), warm spell duration index (WSDI) and cold spell duration index (CSDI) calculated for each station. In winter, low-frequency fluctuations increasing and non-significant decreasing trend are obtained in minimum temperatures. According to the result of test statistics obtained from the M-K rank correlation test, apparent increasing trends in winter minimum air temperature series are found to be statistically significant at 7 stations. Significant positive trends are evident over the highly urbanization areas in Turkey such as, Antalya and Mersin (Fig. 3).

In summer, increasing trends are obtained in maximum air temperatures all of the stations, except Adana and Ceyhan. Maximum temperatures have tended to increase in study area. These stations are located in touristic area of Turkey. Warming trends in the stations have shown approximately since the 1990s (Fig. 4).

Winter minimum extreme variability for the TN10 index is calculated and illustrated Mann-Kendall tests over Mediterranean coastline stations of Turkey. This index represents the number of days where minimum temperature is smaller than the 10th percentile of daily minimum temperatures during the period of data. The number of cold winter nights in Mediterranean coastline during the 1966–2014 with linear regression is present in figure 5. There has been generally decreasing rates in cold day frequency in winter. By the mid-1990s the extreme cold days display to increase progressively. As in figure 5, there is statistically decreasing trend at the beginning of 2013s (Fig. 5).

TX90 represents the number of days where TX is bigger than the 90th percentile of daily maximum temperature during the period of data. We identify that significant increasing trend in hot extremes in Mediterranean coastlines of Turkey. Our research results suggest that there are increases in hot days (TX90th) the period of 1966–2014. It is worthwhile to note that the frequency of cool day is relatively less with the areas of highest temperature recorded compared with the

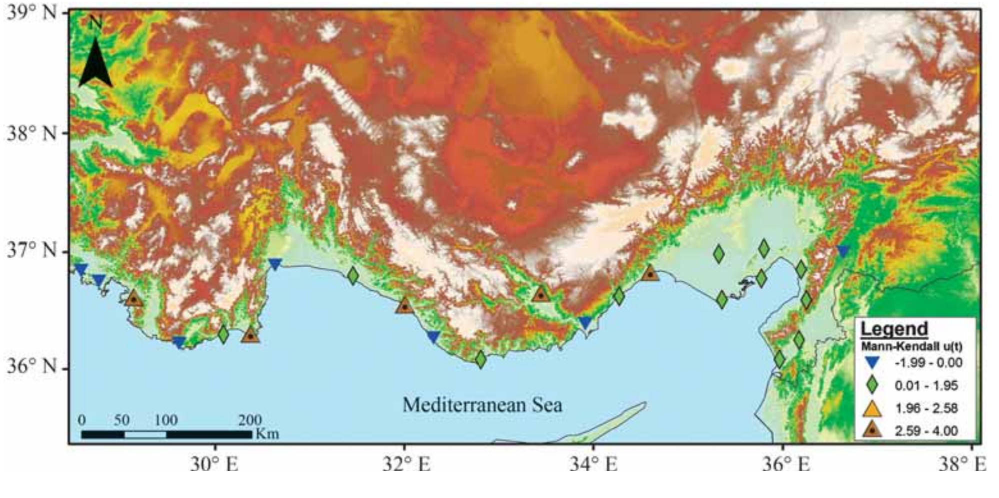

Fig. 3. Spatial distribution of winter minimum temperature trends of Mediterranean coastline of Turkey from Mann-Kendall test statistics *u*(*t*).

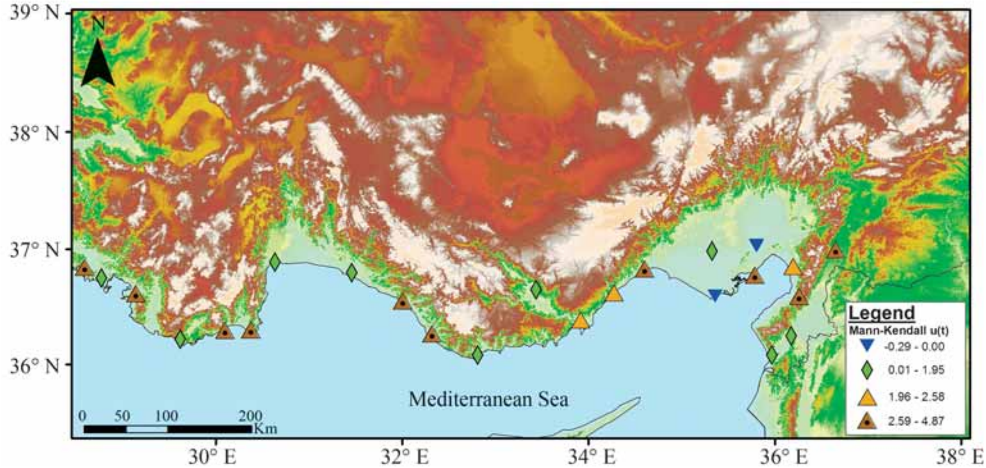

Fig. 4. Spatial distribution of summer maximum temperature trends of Mediterranean coastline of Turkey from Mann-Kendall test statistics *u*(*t*).

low temperature/high temperature in the Mediterranean coastline. The hot extremes ($TX90^{th}$) appear during the mid-1990s over the Mediterranean. Most of the warmest days experienced in Mediterranean coast line in 2012, 2007, 2008, 2010, 2000, 1998 and 2003, respectively. Hot day frequency appears for last decade (Fig. 6).

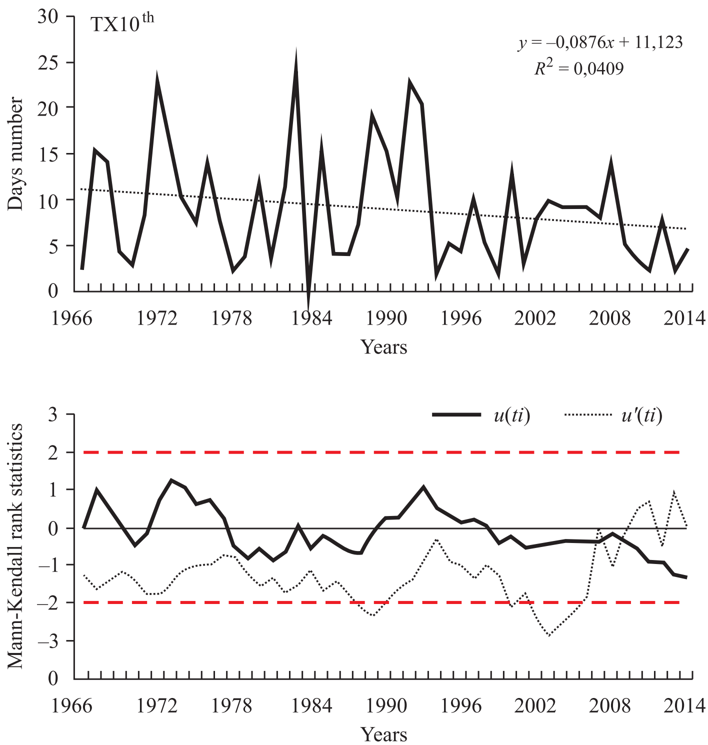

Fig. 5. $TN10^{th}$ temperature indices time series and Mann-Kendall statistics over Mediterranean coastline stations.

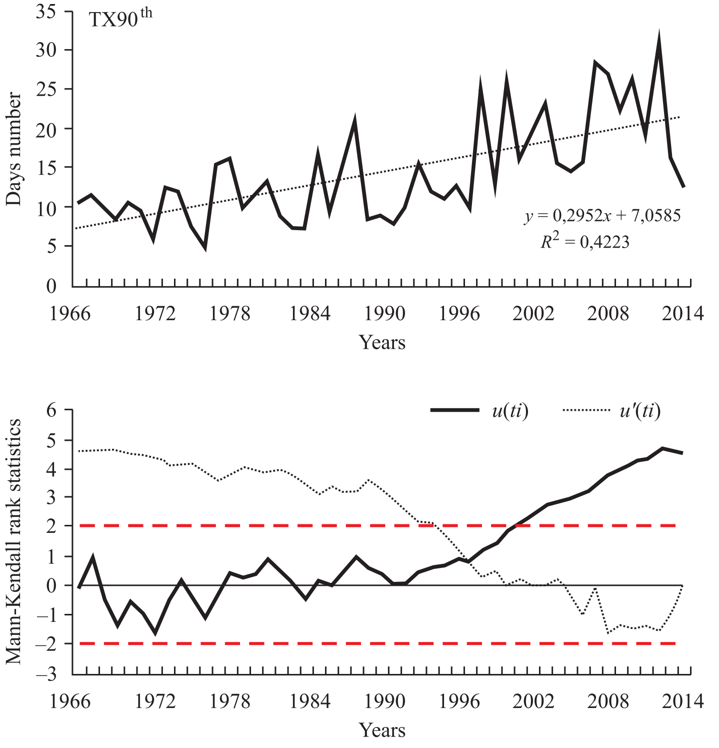

Fig. 6. TX90th temperature indices time series and Mann-Kendall statistics over Mediterranean coastline stations.

Our results indicate that cold spell duration in recent decades show a decreasing trend in over the Mediterranean coastline stations. The recent warming over the Mediterranean coastlines in winter is accompanied by an increase rather than a decrease in the cold spell duration. The pronounced warming between 2000 and 2014 is primarily associated with an increase the heat waves episodes over the Mediterranean and Middle East. At stations have been included a cold period of 1965–1990. But the stations show a decreasing trend in recent decades. In, 1967, the coldest year have experienced since records of the stations in Mediterranean coasts of Turkey. The most severe extreme cold years have experienced in 1972, 1990, 1967, 1992 and 1973, respectively. However, severe cold weather has been observed 1983, 1985, 1989, 1993, 1997, 2005 and 2008 in winter. Extreme cold spell has experienced in January and February 1967 and 1972, in December and January 1973, in January 1990 and the end of the January and beginning of the February in 1992 (Fig. 7).

WSDI represents the number of days with TX is greater than the 90th percentile of the daily maximum temperatures (least 6 consecutive days) occurring during the period. The frequency of summer warm spells shows increases throughout most in Mediterranean cost of Turkey. Mediterranean coast display a steady warm year, particularly from around 2000 onward. 2012, 2007, 1998, 2010 and 2000 years have experienced the hottest year, respectively (Fig. 8).

The 2003 summer season is a hot year on the Mediterranean coast but count of days under (e.g. 5 days İskenderun, Yumurtalık, Erdemli) or over 6 consecutive days (e.g. 14 days in Mersin, 15 days in Dörtyol). In this leads to the understanding that hot days haven't experienced in Mediterranean coast or less that happened.

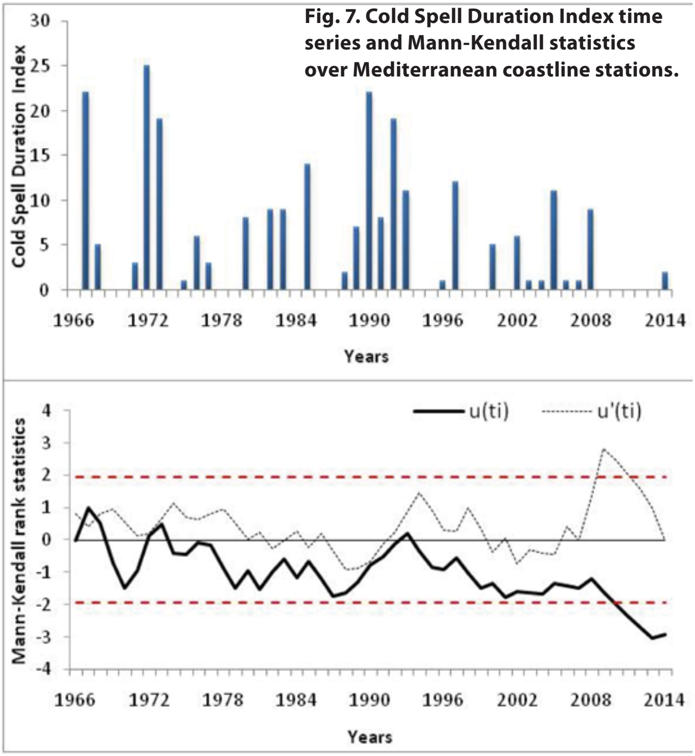

Fig. 7. Cold Spell Duration Index time series and Mann-Kendall statistics over Mediterranean coastline stations.

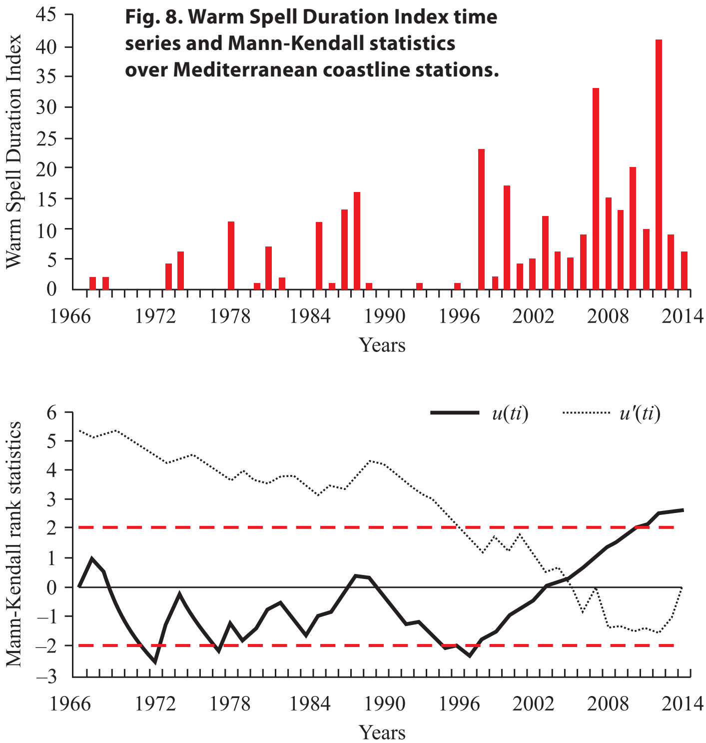

Fig. 8. Warm Spell Duration Index time series and Mann-Kendall statistics over Mediterranean coastline stations.

CONCLUSION

This research examines recent trends and variations in the frequency of winter cold and summer warm spell over Mediterranean coastline of Turkey. The threshold values were calculated for each station to determine the temperatures that were above and below the seasonal norms in winter and summer. According to these thresholds, especially summer and winter extremes in recent years, a significant increase in the number of hot days has been observed. similar to global and European trends [Perkins et al., 2012; Frich et al., 2002; Baldi et al., 2006; Unkasevic and Tosic, 2013]. Many of the aforementioned cold spell trends are generally not significant for the 1966–2008 periods. Stations display generally insignificant cold spell trends. Cold spells predominated until 1990, and afterwards, warm spells prevailed in study area.

In conclusion, there have been reductions in the frequency of winter cold spells decreased and increased in the frequency of warm spells over the Mediterranean coastlines of Turkey during the 1966–2014 periods. In addition, frequencies of cold spells decreased and warm spells toward increased may be a regional demonstration of rising temperatures in equatorial region and rapidly due to urbanization. Warm spells are expected to mostly follow summer mean warming in Mediterranean coastline of Turkey.

Trend in indices reflect an increase in both maximum and minimum temperature. Percentile based spatial change shows that the TN in winter will become warmer as the increase of TX in summer. The change in TX90 threshold temperature is higher than TN10 in study area. The occurrence of TN10 trend significantly decreases while for TX90 there is slight increase. The increasing trend in the TX90 is greater in magnitude. The occurrence of year to year cold spells trend significantly decreases while for warm spells there is slight increase. The increasing trend in the warm spells is greater in magnitude.

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INEQUALITIES OF POPULATION ACCESIBILITY TO HEALTH CARE SERVICES IN THE BOTOSANI COUNTY (ROMANIA)

ABSTRACT. The population access to health care services is conditioned on the offer of medical services, which being unevenly distributed determines a limited access of the population, especially in rural areas. The inequalities in the distribution of health resources in Botosani County show a different accessibility levels to health services, depending on the living environment, but also on some financial, educational and social aspects. Using statistical data in the period 2000–2013 and spatial analysis, this paper focuses on the assessing and interpretation of the population accessibility indicators to health services in Botosani county – a small county located in the NE part of the Romania, and which is part of the poorest region of the Romanian country, in order to highlight the inequalities outlined in the county between the rural and urban areas. The inequalities of population accessibility to health care services are due to the lack of medical facilities, the poor quality of transport infrastructure and the lack of income.

KEY WORDS: inequalities, health care services, spatial and temporal accessibility, indicators of accessibility to health services, Botosani county.

INTRODUCTION

The accessibility to health care is a multidimensional concept and can be defined as theability of a population to achieve health care services. It varies across space because neither health professionals nor residents are uniformly distributed [Luo and Wang, 2003].

According to the European Observatory glossary produced on Health Systems and Policies, availability of health care is defined by the World Health Organisation (WHO) in 1998 as "measuring the proportion of the population with the access to medical services".

The optimum access to health care means a state of affairs characterized by the provision of care and timely intervention of medical staff or paramedical authorized in situations that require the presence of the provider of health services to the home or place in which the patient is.

The accessibility, after Penchansky and Thomas [1981] as cited in Black M. et al. [2005] and updated by Oliver and Mossialos [2004] as cited in Black M. et al. [2005], is measured by availability, acceptability and addressability (socio-economic, ethnic, age, sex, costs) and geographical or spatial and physical accessibility.

The geographical accessibility measuring the level to which services are available and accessible to the population, being linked to the distribution of health care infrastructure in a specific region and the actual offer of the services and facilities [Final report..., 2008].

The geographical accessibility varies according to local conditions of transport, as local topography. Geographical accessibility is calculated as physical distance, in kilometers, between the residence and the nearest available medical service, but also to the nearest hospital or ambulance station. The calculation of these distances is done either in line, or in the existing line access routes (roads, highways, paths etc.) and is the time used to accede to a medical facility. There is no consensus on what constitutes "away" for a health care service, but usually it is considered that an optimal distance from a primary health care service should not be more than 5–7 km and a larger hospital 25–35 km [Jordan et al., 2004]. It is considered a great distance to a medical facility may adversely affect health status [Guagliardo, 2004, cited Black M. et al., 2000].

More important than the distances, is the travel time required to access health services, which describes the temporal accessibility. There are international standards for maximum travel time to health care: 30 minutes for primary care, emergency health services, or general care for adults and children, and 90 minutes for general surgery [Department of Health, 2007; Fortney et al., 2000].

Inequalities in spatial accessibility to health care are pronounced in many emergingcountries but also persist in developed countries where medically underserved areas are often encountered in rural areas [Joseph and Bantock, 1982, Fryer et al., 1999, Robst and Graham, 2004].

It considers that access to health is a precondition for active participation in society. At EU level there are two approaches to the development of universal access: tackling "needs and nothing more necessary" and addressing "equality" [Busse R. Wörz Foubister M.T. et al., 2006].

Such equal access has come to be recognized as being as essential to public health as individual health status [Aday and Andersen 1974; Culyer and Wagstaff 1993; Oliver and Mossialos, 2004].

In the year 1974, Marck Lalonde emphasize that health can be influenced by four categories of factors including: economic development (50 %), genetic heritage, the lifestyle and the public health system, the main role in evaluating the quality of health returning to the quality of health services (15–20 %).

Because the Romanian health system is underfunded, as well as the health systems in Eastern European countries, the recent evaluations of the Romanian health system shows that it "has all the rankings red flashlight in European public health systems" [Deak, 2012].

In the last years the standard of living of the population has decreased continuously which is reflected in health care outcomes.

The inequalities in socio-economic development of the regions of Romania also influences health sector [Dragomiristeanu, 2010]. The limited state budget for health is responsible for the poor quality of health services system in Romania as a whole and the Botosani county. So that, a major concern of the Ministry of Health in Romania is to improve the access to health care services, especially for the rural population.

The differences between the richer regions and poorer, rural and urban, but also between people with high incomes compared to those with lower incomes are quite obvious for highlighting access to health services. [Gwatkin, 2001; Victoraetal, 2003].

Spatial accessibility to health service locations is usually measured through addressing the geographical barriers like travel distance or time [Cromley and McLafferty, 2012; Guagliardo, 2004].

Most existing measures of spatial accessibility are based on the potential interaction between health care providers (e.g., primary care physicians, cancer treatment centers, hospitals, etc.) and population in needs, or offer and request [Guagliardo, 2004; Higgs, 2005; Wang, 2012].

A basic method is to measure average travel distance to nearest providers [Fryer Jret al., 1999; Goodman et al., 1992]. This method applies the straight line distance between the population point and the location of the health provider. However, travel routes are rarely straight lines in reality. It also cannot fully represent clusters of health providers in an urban setting and ignores the availability dimension of access.

Another study by Arcury et al. [2005] shows that a shorter distance between patients and physicians can increase the frequency of regular family physical exams. Other studies also confirm that early detection of disease and treatment is negatively associated with the spatial separation between medical services and patients [Campbell et al., 2000; Meyer, 2012; Monnet et al., 2006; Onega et al., 2008].

Last but not least, access to health care services is determined by the supply and demand, as this purely economic relationship functioning in health care systems.

The supply to health services characterized the access by: spatial distribution of these services; availability of staff working in these services; the quality of existing facilities; training of human resources; availability periods (program) and organizational services; type of transport, arrangements for physical access and the time required to travel. The demand affects access by individuals' attitude towards the disease, their knowledge of available services and the financial and cultural aspects of community members.

Moreover, access is also affected by timing and outcomes, and the receipt of good quality service when an individual needs it. Finally, equity in access needs to be considered for all groups in society who may differ in terms of need, socio-economic status, culture, language, and religion [Sara Allin and al., 2007].

Geographic Information System (GIS) plays an increasingly important role in understanding and analyzing accessibility to health care services, in particular, the capacity of the GIS to highlight the spatial dimensions of accessibility. GIS enables researchers to store and manage sensitive yet complicated information for both patients and health service locations [Bullen et al., 1996; Gu et al., 2010; Verter and Lapierre, 2002], measure access to health services for populations in need [Curtis et al., 2006; Lou and Wang, 2005; Wang, 2006; Wang, 2012], and analyze the evolving spatial distribution patterns of health facilities [Gesler and Albert, 2000; Higgs, 2005; Kurland and Gorr, 2012; Pedigo and Odoi, 2010; Ross et al., 1994].

In this paper we analyze the geographical accessibility of population to health care services in Botosani county in terms of distance and time required for a patient to receive health care services and according to the distribution of health resources.

The highlighting of the inequalities in people's access to health services can be for the local authorities a starting point or a premise for development and modernization of transport network that would provide a easy access to health care facilities.

DATA AND METHODOLOGY

The methodology of research work includes two types of analysis:

1. Quantitative Analysis, consist of the analysis of statistical data from INSSE databases, and data provided by the Public Health Department Botosani in the period between 2000–2013, on which we calculated by standardization and aggregation the health care services index.

To calculate the health care services index we used a total of 10 indicators which refer to the number and type of health facilities and the number and types of health staff in Botosani county:

- number of hospitals/1000 inhabitants,
- number of general practician offices/1000 inhabitants,
- number of medical dispensaries and polyclinics/1000 inhabitants,
- number of beds/1000 inhabitants,
- number of pharmacies/1000 inhabitants,
- number of dental offices/1000 inhabitants,
- number of doctors/1000 inhabitants,
- number of nurses/1000 inhabitants,
- number of pharmacists/1000 inhabitants,
- number of dentists/100 0inhabitants.

This set of indicators was chosen to synthesize expressly health resources of the Botosani county, depending on available statistics data.

This index was calculated at the national level [Dumitrache, 2004; Dumitrache L., Dumbrăveanu D., 2008] and has values between 0 and 1, the values close to 1 showing better health services and the values close to 0 indicating poor health services. Based on this index we can outline a pattern of distribution of health care services in the Botosani county.

The accessibility's indicators to health care services were calculated based on distances and travel/driving times estimated using computer of Romania's road map available on Google in 2015, and they were verified on the field works with a personal car. The distances travel to the general practician offices were calculated from the house of patients to the general practician office, located usually in the center of the administrative unit. The distances of the travel to the nearest hospital were calculated like average distances from the center of the administrative units to the nearest hospital. But, it does not always express the real distance because the patients may find themselves closer to or further from health care provider or it is not always located just in the center of the commune. So, from this point of view the study has some gaps, for which we took into account the patients' average distance travel to an administrative unit.

In calculating the travel/driving times we taken into account the quality of the infrastructure of road and the weather conditions, that in winter increases the time necessary for a patient in order to access the health facilities. The winter meteorological conditions (blizzards, ice, fog) make that the roads become impassable and inaccessible for cars and means of public transport, making it impossible to move patients from rural areas to hospital, so that the travel time is doubles.

Also, often has been considered the available type of transport (car, means of transportation, or without transportation) and the average speed of transport in optimal weather or bad weather. The means of transport have a main role, because it facilitates the access to health care unit, for example a patient will get faster to general practician office if he uses a car than on foot.

Some limits of this study appear in the measurement of temporal accessibility, because we can not quantify the waiting time of a patient who needs health care. Sometimes, this waiting time has a major impact on the indvidual's health status.This can be materialized by waiting time of a means of transport needed to travel to the nearest medical facility or waiting time in front of the general practician office which can varies depending on the doctor's schedule or the number of patients.

2. The spatial analysis of the data consisted in mapping the spatial and temporal accessibility indicators and health care services index to highlight the poor areas served by health services in Botosani. For this type of analysis we are using GIS technique: SIGEP © which implies that the population of a village or administrative unit uses the same health care unit [Black M. et al., 2005], located usually in the center of the administrative unit or village.

This method is used for highlighting the shortage areas on access to health care services, beyond certain thresholds of time and distance, which is important for local and national authorities in finding solutions to improving access.

RESULTS AND DISCUSSIONS

Health care services index

Botosani County is located in the northeastern part of the Romania country and has a population of 412626 inhabitants (2.1 % of the total population) distributed in 78 administrative units, including 7 towns and 71 communes. It is the subject of this study because is located in one of the most disadvantaged regions of the country: the NE region. Material deprivation is a reality in Botosani county as also in the northeastern part of the country [Zamfirand all., 2015] and determines the population's uneven access to health services.

The low level of economic development and unemployment are barriers in access to health care facilities. The county's health resources are the four hospitals, 164 general practician offices, 1 ambulance station and emergency unit, 1 doctor per 679 inhabitants (3.2 doctors/1000 inhabitants), 1 nurse per 195 inhabitants (5.08 nurses/1000 inhabitants).

The unequal distribution of health resources and the poor quality of transport network in Botosani County (with only 56 % of the transport network in good condition) influence the population unequal access to health services.

In the last years the standard of living of the population has decreased continuously which is reflected in health care outcomes. A growing number of people have not opportunities to call the health services provided by private medical units and sometimes even to travel to the general practician offices if they are located at long distances. The public medical network shows large gaps, the main reason being the lack of funds and financial jams faced by most of hospitals.

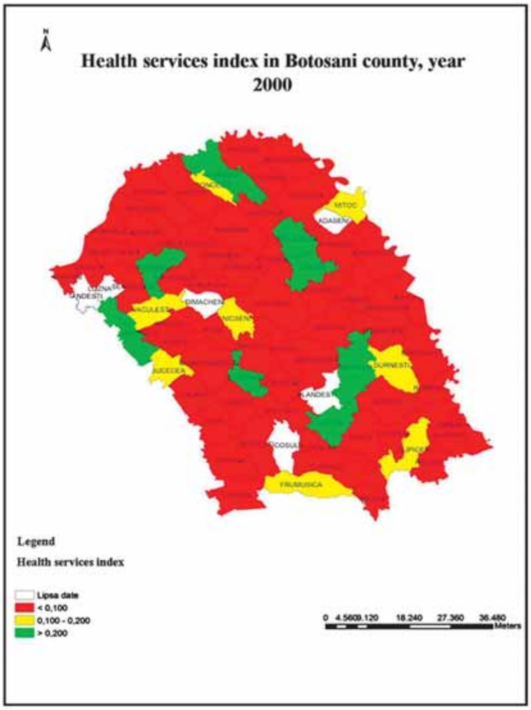
To express synthetically the quality of healthcare infrastructure in Botosani we calculated the health care services index by standardizing and aggregating health services indicators presented in the methodology part.

In 2012, the health care services index has an average value of 0.138 at county level, slightly up compared to 2000 (0.081), but below the national average of this index (0.310).

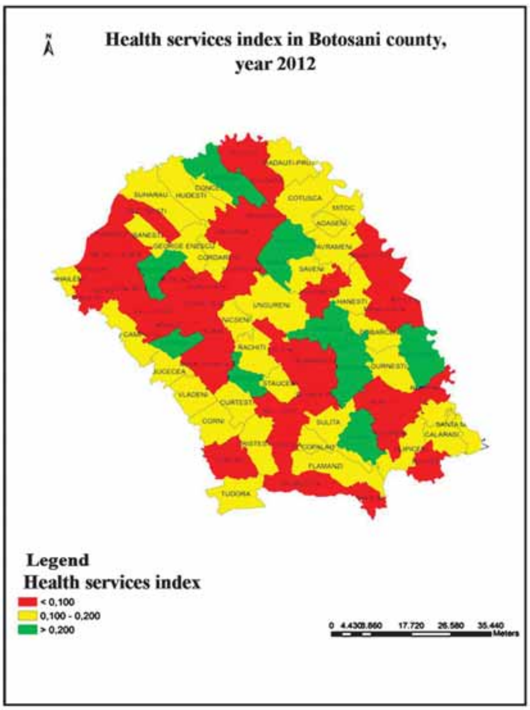
In the representation of health care services we have established three classes of index values, so lead to the shaping of health care service areas.

From the mapping representation (Fig. 1), in the 35 administrative units the health services index is rather low (values under 0.100, marked on red in the map), which indicates the poor quality of health care services and highlights those administrative units that are poorly served by health services (the NV part of the Botosani County). The two maps show that the good covered area of health care services are the urban areas, and some communes (marked on green in the maps, where the health care index has values over 0.200). This outlines a pattern of distribution of health care resources that are better represented in urban areas (hotspots areas) and poorer in rural areas (shortage areas).

The downward trend of health care services index in some administrative units is the fact that the so-called reform process of the health services has not proven to be efficiently, leading to the cancellation of public hospitals, the occurrence of private specialized medical offices, where the population access to health services is limited by the reduced income and the decreasing of the medical staff.



a



b

Fig. 1. The health services index in Botosani county, in 2000 (a) and 2012 (b)

The low coverage with medical facilities in some areas of the county reflects on people's access to health care services, which is just prevented by the lack of medical facilities or that they are located far from the patient.

The accessibility factors of health care services

The access to the health services in Botosani county is influenced by several factors (Fig. 2):

– physical-geographical factors: the relief, the weather conditions(forecasts);

– socio-economic factors: the transport network (the quality of roads, type of transport), which means the time needed for traveling the distance to fulfill the request for medical services, or to use the services of an establishment providing health services, conditioned by the quality of transport network and the weather conditions, lack of financial resources.

– health factors: the health resources (number of medical units, number of beds, number of medical staff).

In Botosani county, the analysis of physical-geographical factors is simple because the county's hilly relief is not a barrier to access the health facilities but the weather conditions may influence access to health services only in winter (snowstorm).

A limiting factor for access to health services in Botosani county is the quality of road network with only 56 % in good conditions (unpaved rural roads that become impracticable in winter) which determine higher times of transportation (travel time) for administrative units situated far away from urban centers providing health services (travel distance).

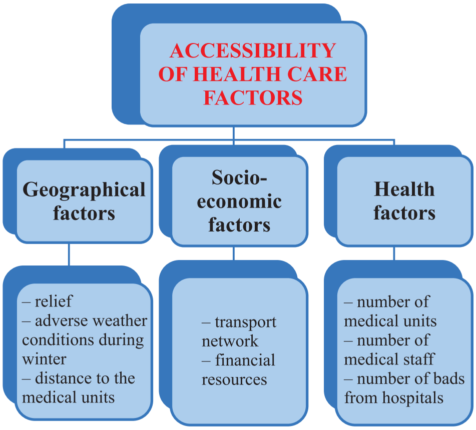


Fig. 2. The factors influencing the accessibility of health care services

THE ANALYSIS OF SPATIAL ACCESSIBILITY

In appreciation of spatial accessibility to health services, a main role is held by transport infrastructure development. Most times, a long distance can be corrected or adjusted by the existence of a well-developed transport infrastructure (eg. paved road between the two points or proper development of a communication network that emergency services can reach the namely place). Regarding the quality of roads one can say that in many administrative units of the Botosani county there are not paved road, and in a quarter of communes the distance from the nearest paved road is over 5 km. So, from the 650 km of county roads, only 56 % are in good condition.

The spatial accessibility of public health services was analyzed taking into account the average distance, that the patient has to cover up to the nearest medical unit (general practician office, hospital, permanent center, emergency unit).

In order to calculate the distances we considered the straight line distance between the nearest health care provider (which usually is located in the center of administrative units in the Botosani county) and the house of the patient who has health care needs.

Average distance from GP office is 4.8 km, which is above the average value recorded in Romania (4.2 km)[1] [Ciutan, 2008, p. 29].

These distances were calculated using road distance calculator available on Romania's road map (on the website: http://pe-harta.ro/distante-rutiere.html) provided by Google in 2015.

From the map below (Fig. 3) we can see that 27 communes (32.6 % of total county population) are located at less than 4 km distance from a GP office, 28 communes (34.89 % of total county population) are located between 4–6 km from a GP office, 23 communes (32.5 % of total county population) are situated more than 6 km from a GP office (in some communes the access to health care services provided by GP offices is a longer distance of 7.8 km like in Santa Mare commune or 12 km like in Ripiceni).

Communes situated farther than the average value of 4.8 km from the GP office can be considered disadvantaged in terms of accessibility to primary health care.

The distance to the nearest hospital is an average of 21.9 km in Botosani county, which is close to the national average value calculated for this indicator in Romania (22 km)[2] [Ciutan, 2008, p. 30].

From the analysis of the map (Fig. 4) according to this indicator we can make the following remarks: 16 administrative units (which includes 35 % of county's population) are situated less than 10 km from the nearest hospital (urban centers and the surrounding villages); 45 administrative units (48.5 % of county's population) are located between 10–30 km from the nearest hospital; 13 administrative units (14 % ofcounty's population) are located between 31–50 km from the nearest hospital, (mainly communes in the SE of the county); and 4 administrative

[1] Marius Ciutan, Aspects of health service delivery in rural areas, Health Management, 2008, p. 29.
[2] Marius Ciutan, Aspects of health service delivery in rural areas, Health Management, 2008, p. 30.

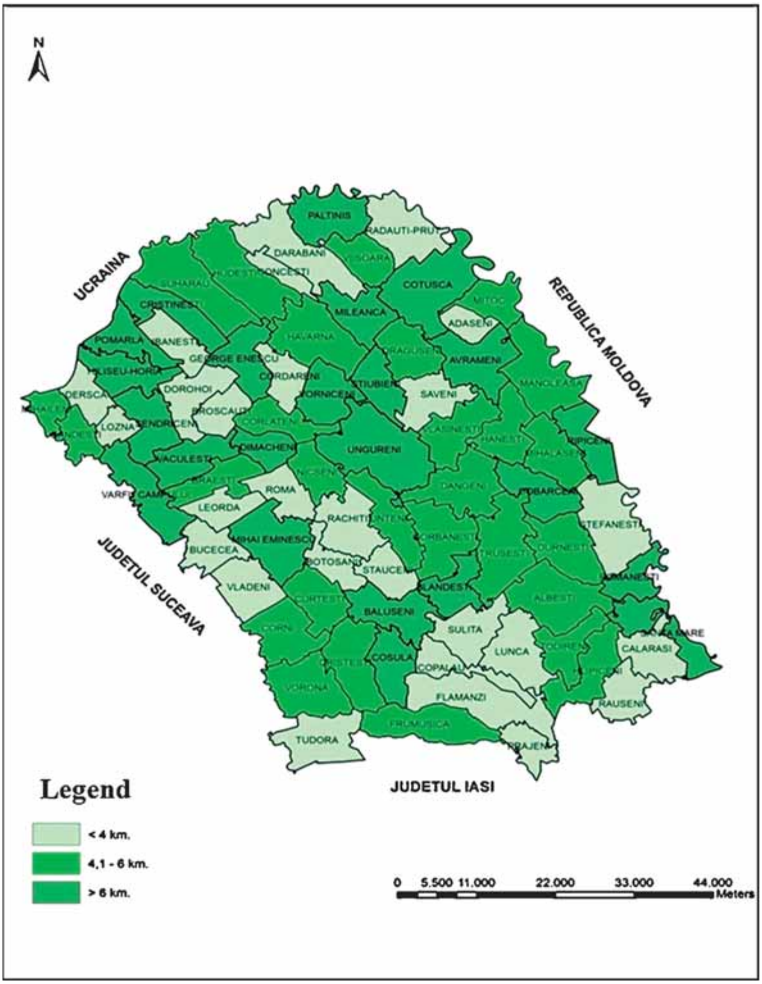


Fig. 3. Distribution of administrative units in Botosani county by average distance to GP office

units (2,5 % of county's population) are situated more than 50 km from the nearest hospital (Răuseni, Româneşti, Santa Mare, Călăraşi).

The patients from the 17 administrative units situated in the SE of the county (which represents 16.5 % of the county's population) travel a longer distance to the nearest hospital, outlined a disadvantaged area in the county.

The average distance traveled to the nearest ambulance station. In Botosani county there is only one ambulance station located in Botosani town, which is supplemented by an emergency unit. The distance to the nearest ambulance station has an average value of 39.5 km, well above the national average of 20 km, so that the optimal access to this health service can not be provided.

The spatial distribution of administrative units after this distance indicates: 14 administrative units travel less than 20 km to the nearest ambulance station (administrative units located near the Botosani city); 24 administrative units travel between 20–40 km to the nearest ambulance station; 29 administrative units travel between 40–60 km to the nearest ambulance station.

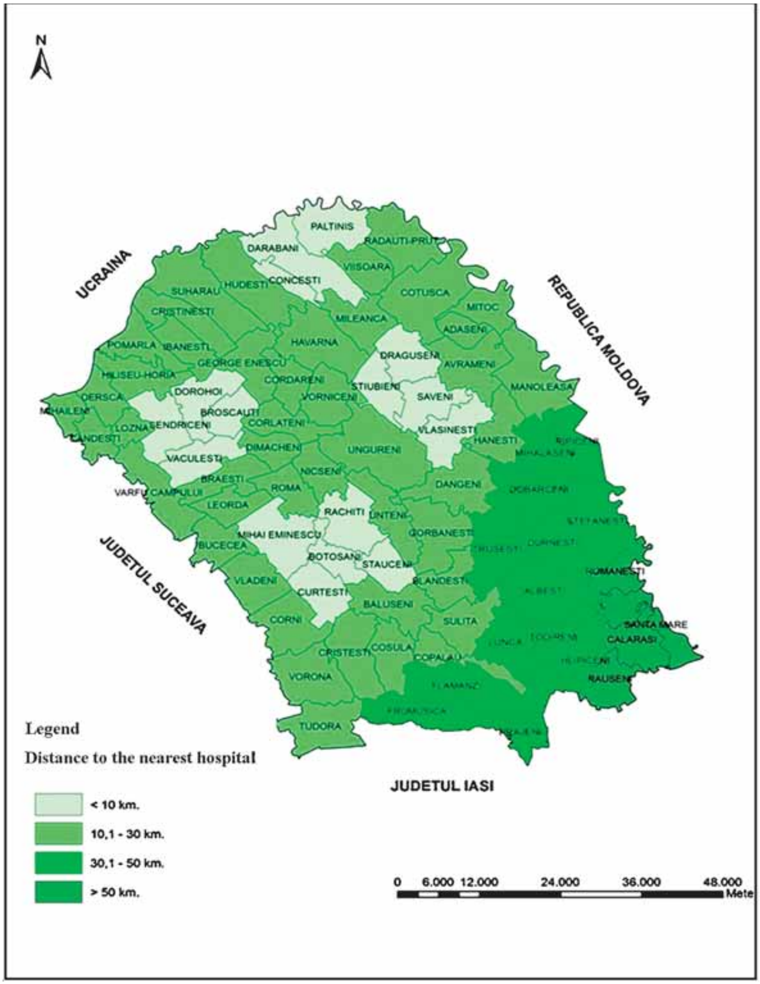


Fig. 4. Distribution of administrative units in Botosani county by average distance to the nearest hospital

The patients from11 administrative units (8.79 % of county's population) located in the N and SE part of the Botosani county travel a longer distance than 60 km to the nearest ambulance station).

The long distance to the nearest ambulance station means long travel time and some risk to the patients' health status.

In traveling these distances should be considered not only the necessary means of transport (car, minibus), but also the costs of transport which increase with the distance, and depending on the costs of fuels (gasoline, diesel).

It may be noted that the statistical indicators are almost identical to the average distances to the nearest hospital or to the nearest ambulance, explaining this by close historical relations between the location of ambulance stations and hospitals.

Due to the unequal distribution of health care resources and different distances traveled by patients to health care providers, a part of the population can not get access to health services, which can have consequences on population's health status by the occurrence of diseases or even deaths.

The analysis of temporal accessibility

The travel time, which depends on the type of transport that the patient has available, is more important to highlight the accessibility of health care.

The temporal accessibility was analyzed according to the time that the patients need in order to cover the distance to the nearest medical unit.

The calculation of this parameter (***travel/ drivetime***[3]) is difficult to perform and should be individualized depending on local and specific conditions such as type of road access (paved road, gravel, unimproved etc.), condition of road access (dismantled, impractical in winter condition or raining etc.), communication systems (telephony etc.), organization of ambulance, the type of transport (pedestrian travel, personal car or means of public transport), etc. [Ciutan, 2008, p. 96].

Travel time is influenced by type of health care sought; pacients will travel further for specialty health care needs than for primary health care [Basu J., Friedman B., 2001] and for complex medical cases than for simpler health problems.

Because the travel time is an indicator difficult to quantify in terms of actual data (requires assessment on site), we tried an analysis in terms of the following indicators:

- travel time by the patient walking to the GP office;
- travel time by the patient walking to the GP office in winter;
- driving time by car / means of urban public transport to the GP offices,
- driving time by car / means of urban public transport to the hospital,
- driving time by car / means of urban public transport to the hospital, in winter.

Travel time by the patient walking to the GP office. Depending on the distance calculated by a GP office and because we are knowing that a patient walks 1 km in 15 minutes we can calculate the travel time to the GP offices closest to all administrative units of the county.

The average walking time to the GP office averages to 72 minutes per county. The cartographic representation shows that the time required for a patient to reach the GP office varies between 45–90 minutes or more, being determined by the long distance to the GP office. Thus, there are communes where walking time to the nearest GP office exceeds 100 minutes (1 hour and 30 minutes) such as communes Mileanca, George Enescu, Sendriceni, Vorniceni Cristineşti, Santa Mare, Ripiceni Coşula,Coţuşca (Fig. 5).

The values calculated for Botosani county are above the maximum travel time to healthcare, which is 30 minutes for primary health care.

Travel time by walking to the GP offices in winter. In winter the walking time to the GP office can double due to the impracticable roads, that can be covered with snow; glazed frost or snow storm conditions are hampering the walking.

The average walking time to the GP office in winter averages to 144 minutes. The patients from 51 administrative units travel the distance in 120 minutes, but in some cases more than 200 minutes.

Travel time by car/means of public transport to the GP offices was calculated taking into account the fact that 1 km is traveled by car with the average speed of 40km/hour in 1,2 minutes.

The average driving time for the patients from the administrative units of the Botosani

[3] Marius Ciutan, National School of Health Management, Proposal for developing a strategy to target a state program focused on improving access to basic health services in underserved areas, 2008, pp. 96.

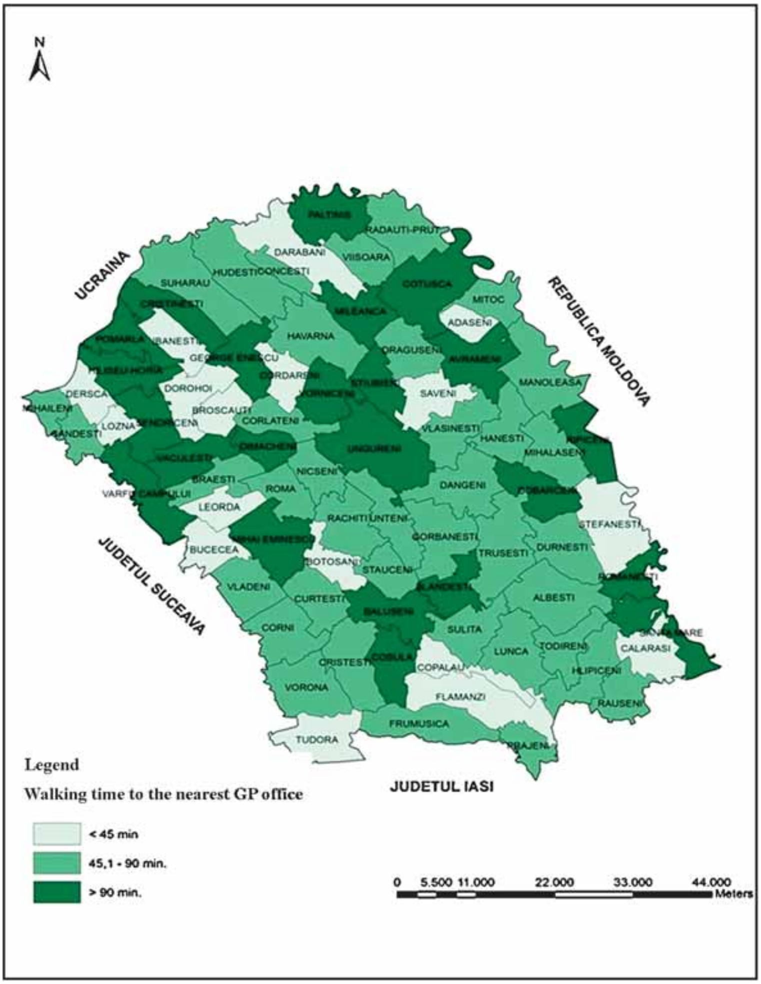


Fig. 5. Distribution of administrative units in Botosani county by average walking time to the GP office

county, is 4.8 minutes, but in some communes it is up to 8 or more minutes (for the patients from 13 administrative units).

Travel/driving time by car to the nearest hospital was calculated taking into account the transport networks, the quality of county roads and weather conditions. Considering that hospital facilities are located only in urban areas, the patients from the rural areas are forced to use their personal car for transportation or means of public transport (bus, minibus). In summer the average driving time for patients who go to a hospital is 24.2 minutes, at the county level. In Botosani county this driving time varies between 24–50 minutes, morefor patients incommunes situated in the SE part of the county, the farthest from Botosani County Hospital. For patients who do not have a car, the access to healthcare services can be prevented by waiting time of the means of public transport to move towards the hospital.

Travel time by car to the nearest hospital in winter. In winter the driving time of patients to hospital units increases due to weather conditions and difficult county roads, with an average travel time of 40 minutes (at the county level), for 14 administrative units from SE just over 60 minutes. In bad weather, the

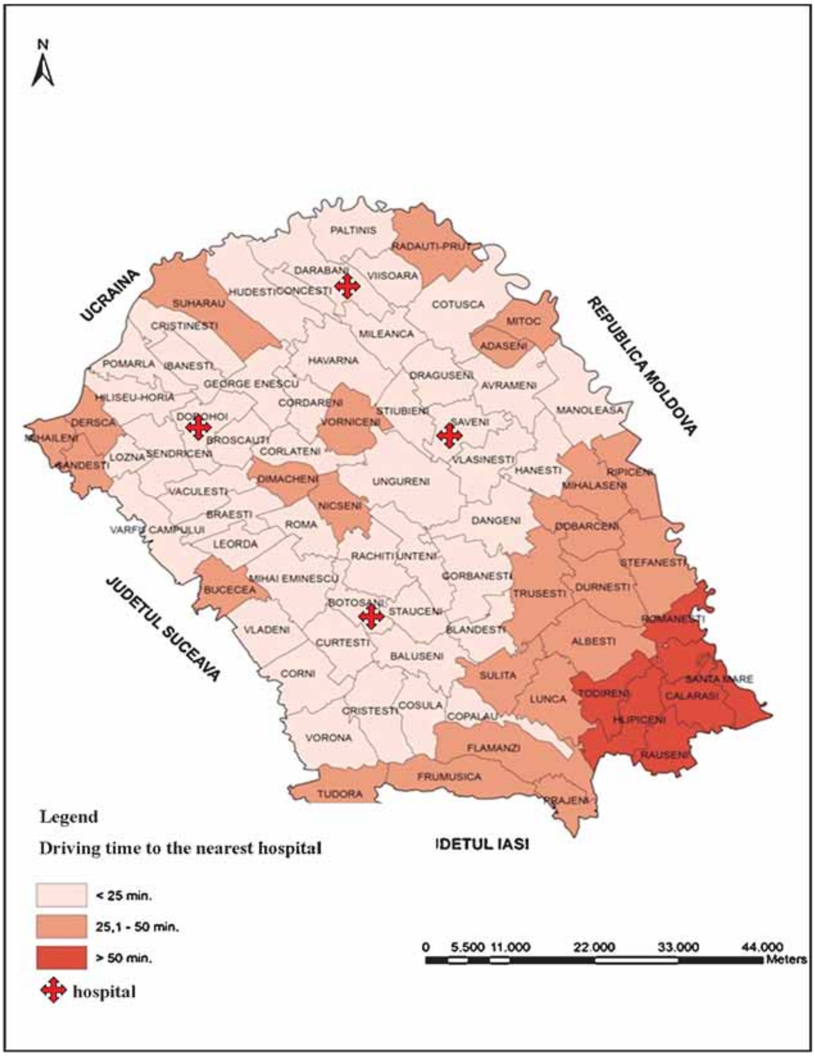


Fig. 6. Distribution of administrative units in Botosani county by average driving time to the nearest hospital

roads become impracticable and inaccessible for cars and means of public transport, making it impossible to move from rural areas to the hospital.

Travel time by car to the nearest ambulance station. At the county level, the driving time to the ambulance station is 42 minutes, a long time considering that there are patients suffering from chronic diseases and who are dependent on medical services. For the communes situated in the SE part of the county the driving time to reach the ambulance station is 60 minutes.

The long time access to health services is determined by the poor quality of county roads, 44 % of which are in mediocre condition and poor functionality.

The inequalities in travel time reflects on the population health outcomes, that may occur through worsening diseases if access to health services is not made in optimal time or badly, these may cause even deaths.

CONCLUSIONS

The analysis of available data shows that in rural areas, hospitals and ambulance stations are located at a distance over 30 km for the half of communes, so that it can not ensure better access of the population to hospital or emergency services. The time required for a patient to receive health services from hospital or ambulance station is also large enough for the rural population (over40 minutes).

The long distances to health care provider units and the long time needed to benefit on health care services determines the low accessibility to health care services in Botosani county which is caused by:

– the poor quality of transport networks of Botosani county, which causes long travel time to healthcare providers (even longer in winter),

– the poor quality and insufficient health care resources, which determines the long distance traveled by patients to the health care providers,

– the adverse weather conditions in winter, which determine difficult county roads, thus increasing the time needed to travel to the nearest medical facility/hospital / ambulance station,

– the insufficient financial and material resources, which is expressed by poverty and material deprivation, thus constituting a barrier to public access to health care.

The low accessibility of the population to health care services overlaps with urgent needs areas and high deprivation areas, which is reflecting on the population health outcomes.

There are strategies to improve the transport network in the Botosani county, but they should be correlate with the improvement of health infrastructure, so that these would reduce the inequalities in people's access to health services.

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APPLICATION OF REMOTE SENSING DATA FOR THE ASSESSMENT OF THE UJUK MOUNTAIN BOREAL FORESTS (THE TYVA REPUBLIC, RUSSIA)

ABSTRACT. This paper discusses some issues related to assessment and monitoring of forests in southern Siberia. This study aims to evaluate the response of southern boreal forests to climate warming at local scale. Estimating the impacts of climate change on mountain boreal forests requires a more complete accounting of tree growth/climate interaction. We used both remote sensing and field data. Field measurements were made from the upper to lower timberline of dark deciduous forest in 2005 and 2012. The remote sensing datasets were generated from LANDSAT scenes of different dates (19.08.1988, 25.06.1992 and 18.08.2011). For estimation of forests changes, we used values of NDVI (Normalized Difference Vegetation Index) and NBR (Normalized Burn Ratio).

KEY WORDS: climate change, mountain forests, cedar sapling, wildfires, boreal forest dynamics.

INTRODUCTION

Tyva is situated within the boundary latitude of boreal forests in the southern part of Southern Siberia Mountains. The forests are located in a transitive zone between the boreal and arid zones, and present great interest for study. These boreal forests represent a unique natural biome; they are located in mountain chains and are composed of cedar or mixed larch-cedar stands.

Mixed-conifer forests are common throughout the mountain zone. Landscape plays an important role for trees survival under harsh climatic conditions. North-facing slopes have closed-canopy Larch (*Larix sibirica Ledeb*.), Siberian Pine (*Pinus sibirica Du Tour*), and Spruce (*Picea obovata Ledeb*.) stands; whereas south-facing slopes have more open Larch (*Larix sibirica Ledeb*.) stands. For mountain forests of Tyva, cedar forests have crucial importance in the formation of stable mountain forest ecosystems and they perform very important ecological functions (climate-controlling, water-regulating, anti-erosion, and soil-protective) in the specific conditions of the Central Asia.

The most important feature of the modern climate is global warming. Climate warming is detected from meteorological observations. This paper discusses some issues related to changes in the vegetation cover occurring under the influence of current climatic trends a forecast for its dynamics in boreal forest. Assessment of the impacts of climate change on mountain boreal forests requires a more complete accounting of tree growth/climate interactions.

Specifically, this paper discusses some issues related to changes in the vegetation cover occurring under the influence of current trends of climate change and its dynamics of the Ujuk Mountain range.

MATERIALS AND METHODS

Study area

The test area is located in southern boreal forests in Central Tuva (Fig. 1). The Ujuk Mountain range is the southern branch of the Western Sayan Mountains. Larch (*Larix sibirica*) and Siberian Pine (*Pinus sibirica*) cover most of this mountain range, however other Spruces (*Picea obovata*) can also be found in patches in the area. Deciduous stands such as Birches (*Betula pendula, Betula microphylla*) and poplar (*Populus laurifolia*) cover the areas at lower elevation. The forests represent a low-height (15 m), woody vegetation ecosystem at the dry timberline (285 mm mean precipitation). The sample plots of the transect were established at randomly selected sites of varying altitudes (900 and 1700 m a.s.l.). Within the study sites, forest types are confined to a fairly definite range in elevation, including a narrow belt consisting of Larch and Birch (900–1200 m) and light and mixed coniferous (1200–1400 m) and dark-coniferous species (1400–1700 m). The complex relief of the mountains causes strong climatic contrasts between the sunny and dry south-facing slopes and the shaded and wetter north-facing slopes. Increase of active temperature has been an important factor for mountain coniferous forests growth in the recent decades.

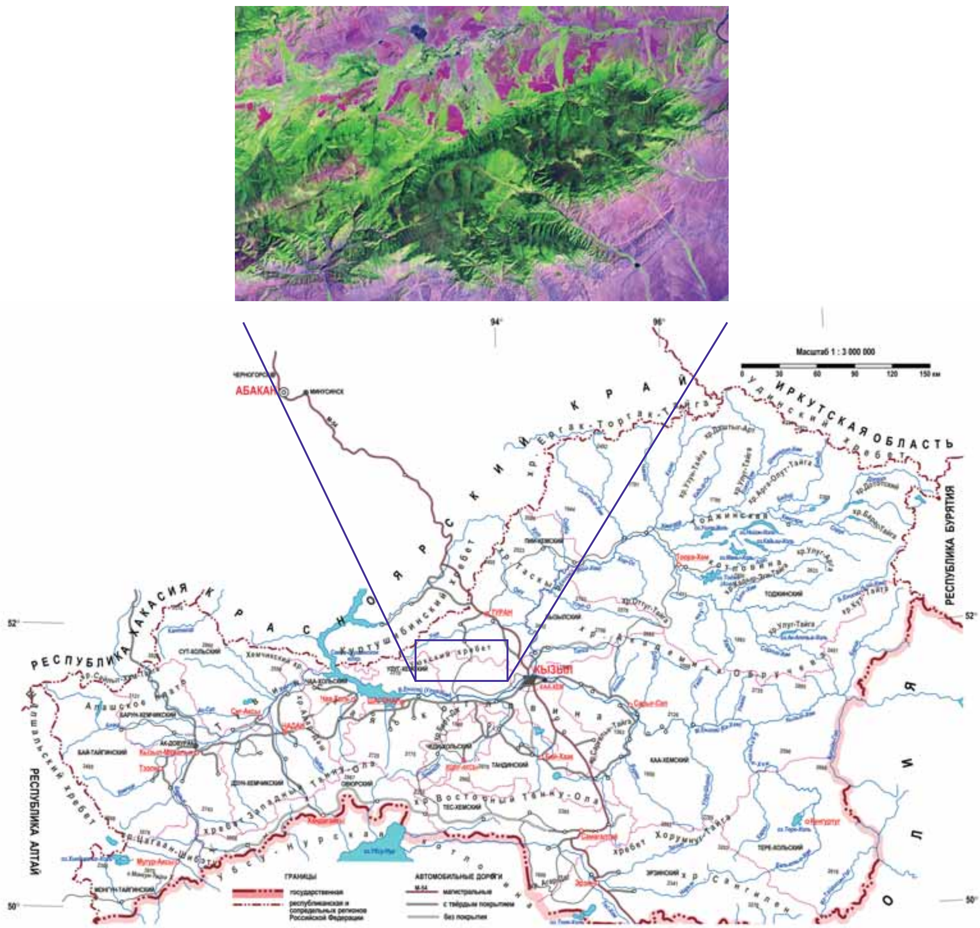

Fig. 1. Location map of study area — Ujuk Mountain range. Map of the Republic of Tyva: based on the [Atlas..., 2005]

Meteorological data were obtained from the Turan station (52.15°N, 93.92°E, 862 m a.s.l.), the annual total precipitation is 306 mm (near of the Ujuk Mountain range). Mean annual temperature is –4.1 °C with sharp seasonal and daily fluctuations. The mean temperature of the coldest month of January is –29.8 °C. The temperature of the hottest month of July is +16.9 °C. Precipitation is about 300 mm per year depending on altitude and mainly falls in summer (70 %).

According to the Turan weather station, the sum of effective temperature ($\Sigma T > 5$ °C) was 2178.9 °C and active temperature ($\Sigma T > 10$ °C) — 2017.1 °C in 2011–2013. The sum of effective temperatures was 1841 °C and sum of active temperatures — 1487 °C according to "Types of mountain forests of Southern Siberia" (1980).

Methods

Remote sensing method. LANDSAT multispectral images represent an important tool for analysis, estimation, and monitoring of boreal region forests. LANDSAT–5, 7 (TM/ETM +) satellite images were used in this study. Free-of-charge satellite images were obtained from the GLCF (Global-Land-Cover-Facility) homepage: http://www.glcf.umiacs.edu/data/. The satellite images were taken on 19.08.1988, 25.06.1992 and 18.08.2011.

Vegetation Indices (VIs) represent combinations of surface reflectance at two or more wavelengths designed to highlight a particular property of vegetation. The Normalized Difference Vegetation Index (NDVI) is one of the most frequently used VIs. NDVI was calculated for the study area. This index was applied to monitor the quality of the environment and its changes. NDVI is defined as the ratio of the difference between the spectral reflected near-infrared band and visible band and the sum of both (Rouse et al., 1974):

$$NDVI = NIR - RED / NIR + RED,$$

where NIR and RED are the spectral values of the two channels of the LANDSAT range reflected in the near-infrared and red parts of the spectrum, respectively. The main feature of the NDVI index is that it allows identifying areas with problem vegetation. The forest dynamics was successfully traced by satellite imagery taken at intervals of several years.

In the process of determination of the boundaries of the burned areas, we have used the Normalized Burn Ratio (NBR) to assess the areas of fire. NBR (LANDSAT imagery) was used to highlight the burned areas and to index the severity of a burn. The formula for the NBR is very similar to that of NDVI except that it uses the near-infrared and the short-wave infrared 2 spectrums (Key, Benson, 1999):

$$NBR = NIR - SWIR2 / NIR + SWIR2,$$

where NIR and SWIR2 are the spectral values of the two channels of the LANDSAT range reflected in the near-infrared and medium infrared part of the spectrum, respectively. For a given area, NBR is calculated from an image just prior to the burn and a second NBR is calculated for the image immediately following the burn. The burn extent and severity is assessed by taking the difference between these two index layers:

$$\Delta NBR = NIR_{prefire} - NIR_{postfire}.$$

Field method. Traditionally, forest dynamics monitoring is performed with the help of field studies. Our field measurements were made from the upper to lower timberline of dark deciduous forest in 2005 and 2012 (Fig. 1a). We used the monitored sample plots in the transects. The sample plots of the transects were established at randomly selected sites of varying altitudes (between 900 and 1700 m a.s.l.).

From four to eight plots were established every 100–400 meters in each altitudinal interval. To identify the pattern of shoot elongation, cedar saplings were sampled in about 100 plots across the transects. The height growth patterns of cedar saplings at the low and upper dark-tree line and the below and above the dark-tree line boundaries were examined over their life span, using leader shoot elongation measurements.

RESULTS AND DISCUSSION

Satellite imagery integrates changes in all parts of the range; therefore, at least some field assessment is usually necessary. The ground-based data on cedar saplings at below of the low and above of the upper boundaries of dark coniferous forests were examined, using leader shoot elongation measurements. The annual shoot elongation measurements of cedar saplings show that good elongation (5–13 cm) is observed in the lower part of forest at 980–1200 m a.s.l.; at 1200–1400 m a.s.l. it is 3–10 cm; and at 1400–1680 m a.s.l. the average growth is 4 –11 cm (Fig. 2a). The annual shoot elongation of cedar saplings decreases with the increase of the elevation of the mountain range (r2 = 0.3; p = 0.0024). The average age of saplings is 21 yrs and the maximum is 49 yrs, which coincides with the beginning of climate warming in the region (Fig. 2b). Negative impacts of climate warming were recorded at 1300–1680 m a.s.l. in wet exposures (eastern, northern, northeastern), where the boreal forest does not have time to adapt to the new moisture conditions, which leads to it is being covered with lichen, thus, leading to oppression.

To detect changes below the low and above the upper dark-tree lines, we carried out calculation of the normalized vegetation index NDVI images. Image differencing (dNDVI) is one of the most accurate methods of change detection. Figure 3 presents the NDVI images for 19.08.1988 (a), 25.06.1992 (b), and 18.08.2011 (c). A lighter area stands out on the dNDVI image (Fig. 3d) surrounded by the dark strip on the lower part of the northern macroslope of the range, which corresponds to the expanding cedar saplings below the coniferous forests. The NDVI values corresponding to the expansion of the lower dark-tree line are 0.2–0.3. The width of the zone of expansion ranges from 0.6 to 2.3 km. White tones correspond to the areas with altered vegetation; in the central part of the range, burned areas clearly stand out (a white spot in the middle of the range). The results also indicate negative trend values of NDVI. In 2011 (Fig. 3c), the forests' area decreased in proportion to the burned area.

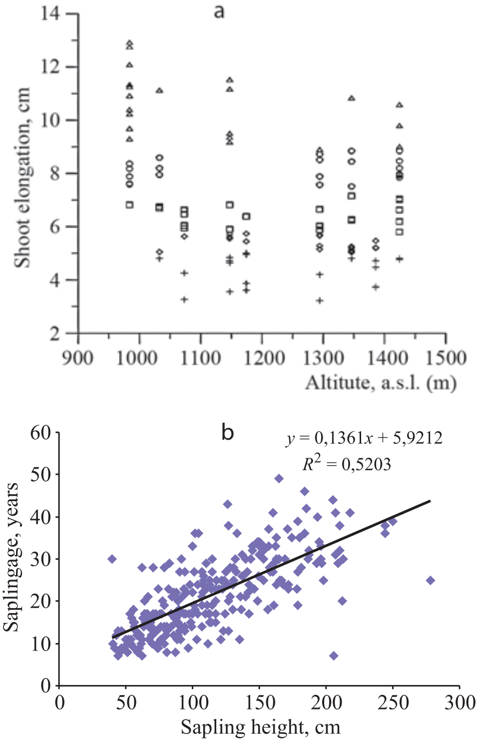

Fig. 2. The dependence of the (a) shoot elongation on altitude and (b) the age of cedar sapling on height

However, NDVI is inaccurate where fires occur after vegetation has died as well as in the areas that had little vegetation before the disturbance. The NBR differencing bands NIR and SWIR2 have high accuracy in detection of forest harvest. The difference between pre-fire and post-fire NBR is now the primary method for mapping large remote burned areas.

Figure 4 presents a collection of the NBR images for the years 19.08.1988 (a), 25.06.1992 (b), 18.08.2011 (c), and dNBR (d), where the boundaries of burned areas are clearly distinguished. The autumn of 2007 was marked by extreme heat, drought, and disasters brought by nature fires (forests, steppe, and tundra). Therefore, due to wildfire, forest areas had a marked decrease.

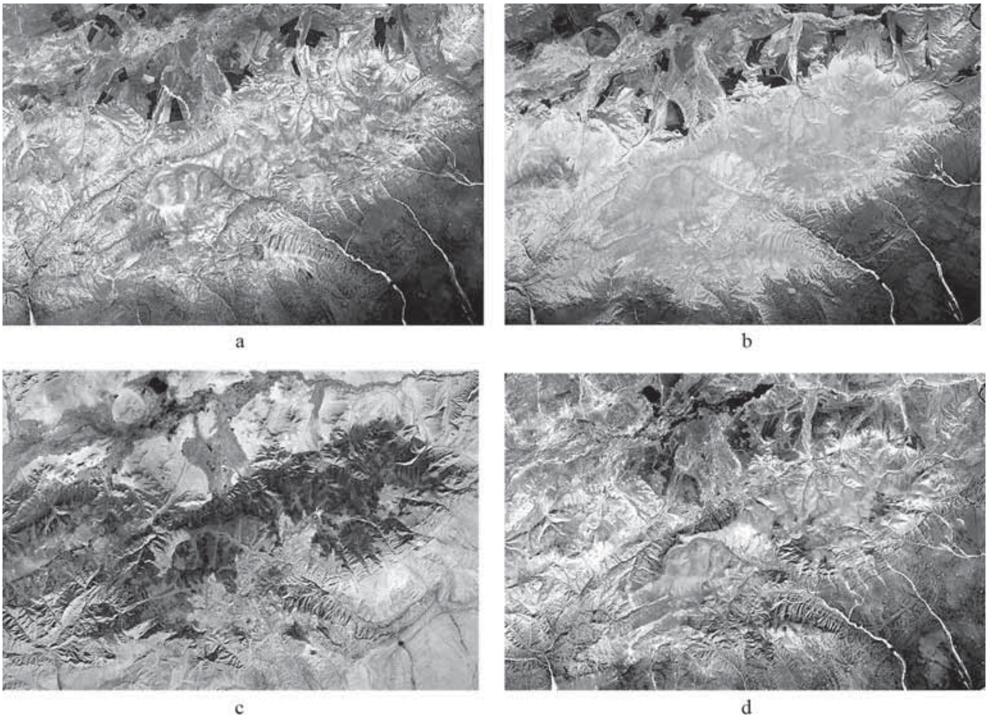

Fig. 3. The NDVI images: 19.08.1988 (a), 25.06.1992 (b), 18.08.2011 (c), dNDVI (d)

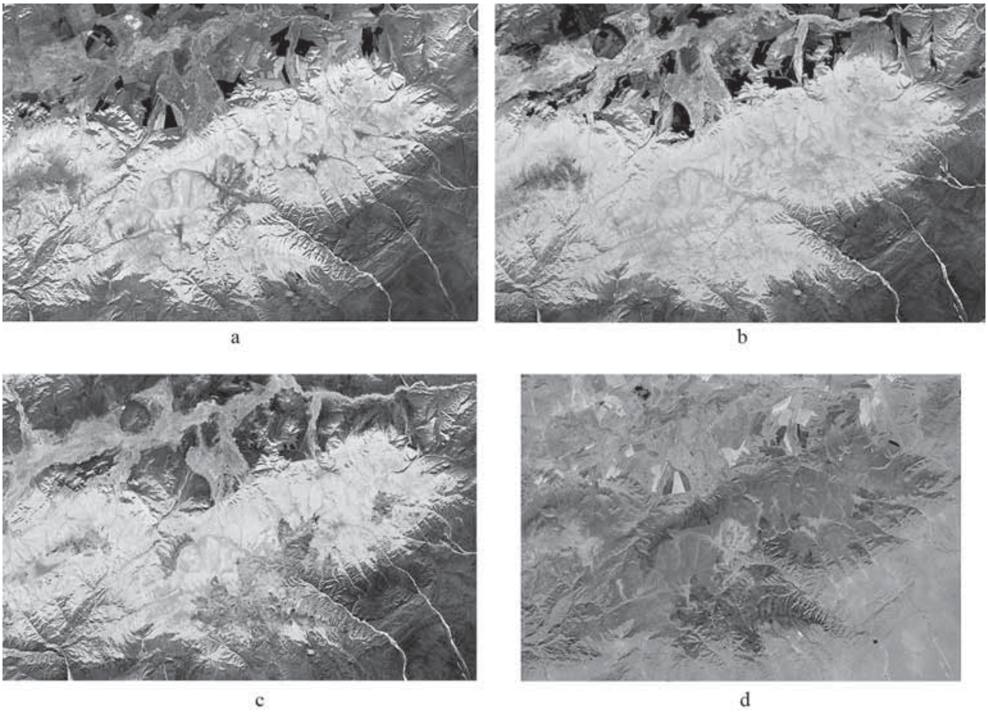

Fig. 4.The NBR images: 19.08.1988 (a), 25.06.1992 (b), 18.08.2011 (c), dNBR (d)

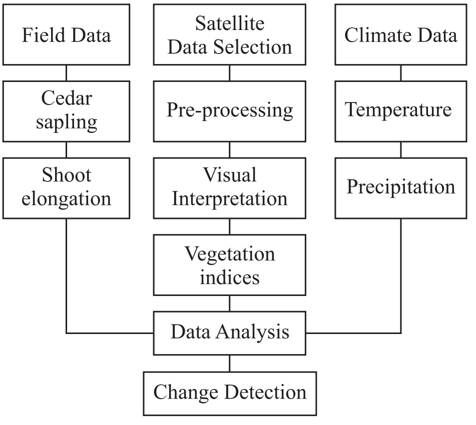

Fig. 5. Workflow for change analysis

Wildfire growth has modified mountain forests in the study period. The extreme weather conditions were observed in the Tyva Republic in 2007 with anomaly mean temperature of 2.98 °C. In 23 years (from 1988 to 2011) in the entire territory of the Ujuk Mountain range, there were 21362 hectares of burned area.

The diagram of the overall work-flow adopted in the present study is presented in Figure 5.

CONCLUSIONS

The general approach used in this investigation is as follows. We calculated the local rates of changes based on the LANDSAT data. The time series analysis was performed with a series of images, related to the change of the Ujuk Mountain range forests.

We assessed changes of the forest ecosystems dynamics in the Tyva Republic under the influence of climate impact in the recent decades. Increasing air temperature during vegetation period was an important factor for coniferous forests. Climate change impacts mountain boreal forests in various ways, including: change of the timberline of dark coniferous forests, especially at the bottom and top borders; with increased wildfire occurrence and area burned.

Research of the forest ecosystems dynamics (changes of vegetation index of the Ujuk Mountain Range) was based on long–term of data (1988–2013) of LANDSAT data. We used NDVI (Normalized Difference Vegetation Index) and NBR (Normalized Burn Ratio) vegetation indices.

Thus, it can be concluded that the vegetation indices are effective for information on shift trends of dark deciduous forest, even in the growing season. These indices clearly distinguished change of boreal forests (shift at the lower tree-line of the dark deciduous forest) caused by the natural stress factors (climate change) and anthropogenic impacts (fire). dNDVI can be used to measure the expansion of the dark deciduous forest with the onset of climate warming in the region. The 2002 and 2007 fire seasons led to seriously damaged forest area.

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Main publications: Peculiarities of climate in the Tyva Republic in the 20th and 21st centuries (2015); Estimation of burned areas of the Ujuk Mountain Range using LANDSAT data analysis (2013).

PUBLIC HEALTH INDEX IN THE RUSSIAN FEDERATION FROM 1990 TO 2013 IN COMPARISON WITH OTHER COUNTRIES

Today, health is an indicator of progress and social and economic development. There are many different methods for measuring public health. Public health research shows different trends. We proposed and used an integral index – the Public Health Index (PHI), which integrates objective indicators of public health: infant mortality rate, life expectancy at birth for men and for women. We consider these are the most important indicators to characterize public health [Prokhorov, Tikunov, 2001] and other, which is confirmed by a number of further experiments. These indicators have several important advantages: there are data for almost all countries, they do not require expert assessment, and they are reliable. We have calculated PHI for Russia, which allowed us to obtain the dynamics of public health in Russia over 24 years – from the end of the Soviet period and the beginning of the transition to a new model of socio-economic development (1992) until the end of 2013. This index clearly illustrates changes in public health. Therefore, for the calculations we used an array of data for 266 countries and regions of Russia, considered as a single data set for 24 years, which comprises 6384 territorial units with the abovementioned three parameters. The initial data can be found as file INITDATA on the website of the World Data Centre for Geography (icsu-wds.ru).

For the calculation, we used the evaluative algorithm developed by one of the authors [Tikunov 1985, 1997]. It includes normalization of the initial indicators by the formula:

$$\hat{x}_{ij} = \frac{\left| x_{ij} - \mathring{x}_j \right|}{\left| {}_{\max/\min} x_j - \mathring{x}_j \right|},$$

$$i = 1,2,3,\ \ldots,\ n;\ \ j = 1,2,3,\ \ldots,\ m,$$

where $\mathring{x}$ is the worst value (for each indicator, in terms of their impact on the health of the population in the countries and regions of Russia [the maximum infant mortality rate, lowest life expectancy]; these values can be found on the website in the file X0); ${}_{\max/\min}x$ are the values most different from the $\mathring{x}$ values of parameters; n is the number of territorial units (6384 for the entire time period); m is number of indicators used for the calculations (3).

If the normalized values $\hat{x}_{ij}$ are considered as reduced to the comparable form to obtain PHI, they can be simply summed.

$$\hat{S}_i = \sum_{j=1}^{m} \frac{\left| x_{ij} - \mathring{x}_j \right|}{\left| {}_{\max/\min} x_j - \mathring{x}_j \right|},$$

$$i = 1,2,3,\ \ldots,\ n;\ \ j = 1,2,3,\ \ldots,\ m.$$

The obtained values $\hat{S}$ characterize the estimated position of the countries and regions of Russia and are presented on the website under the name RAN1MR as a simplified version of the calculations.

The algorithm can be more strict despite the fact that ranking is carried out by comparing all territorial units on a conditional basis, characterized by the values of $\mathring{x}$. However, in this case it is done using the Euclidean distance as a measure of proximity of all territorial units to the conditional basis (the worst-case values $\mathring{x}$ throughout a range of indicators). Then, we processed the array using principal component analysis for the purpose of orthogonalization and a "convolution" system of indicators. The algorithm with various modifications is described in the book [Tikunov, 1997].

According to our calculations, there are no significant differences between the simplified and complete algorithms, which, among other things, have leveled out in the resulting maps with the step scale. Thus, Table 1 shows fragments of the calculation results (using the simplified algorithm), relating to the upper part of the PHI ranked series, the lowest part, and the middle part, where the majority of Russian regions occur. The graphs of PHI for some countries and groups of Russian regions are presented in Fig. 1 and Figs 2–4, respectively. Figs 5–10 show the maps for selected years.

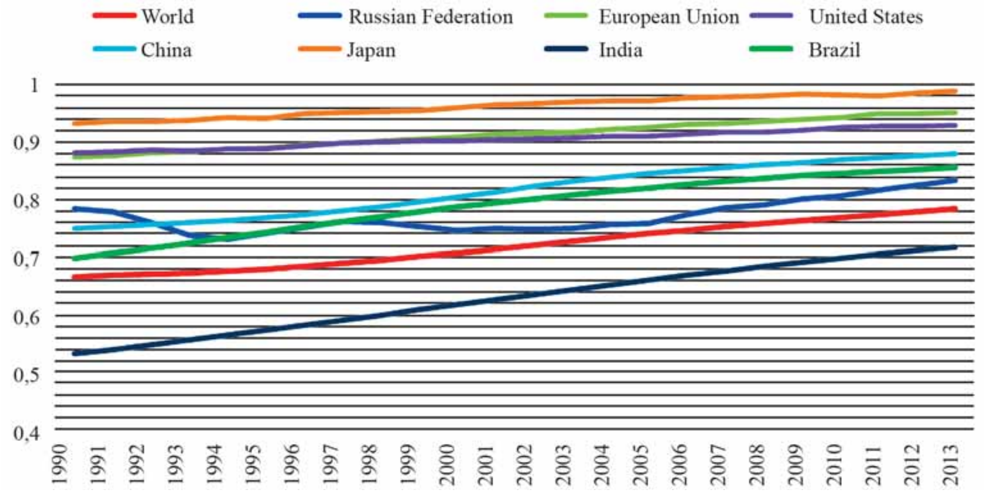

Fig. 1. PHI in selected countries

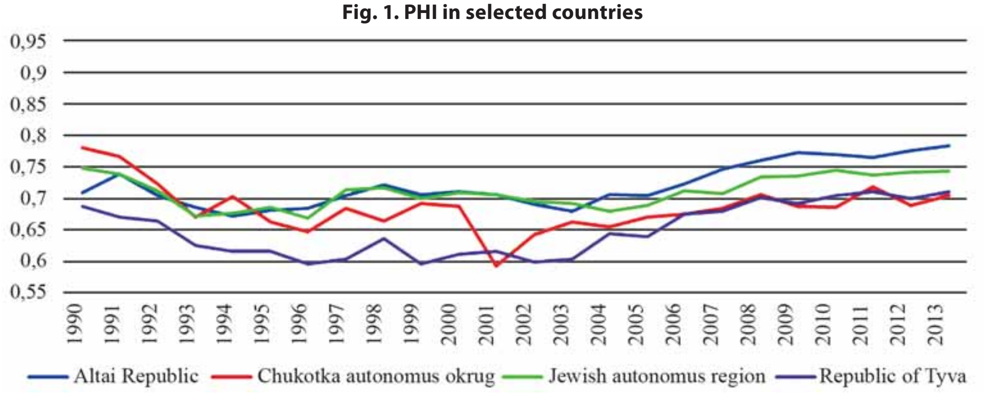

Fig. 2. Group of Russian regions with low PHI values

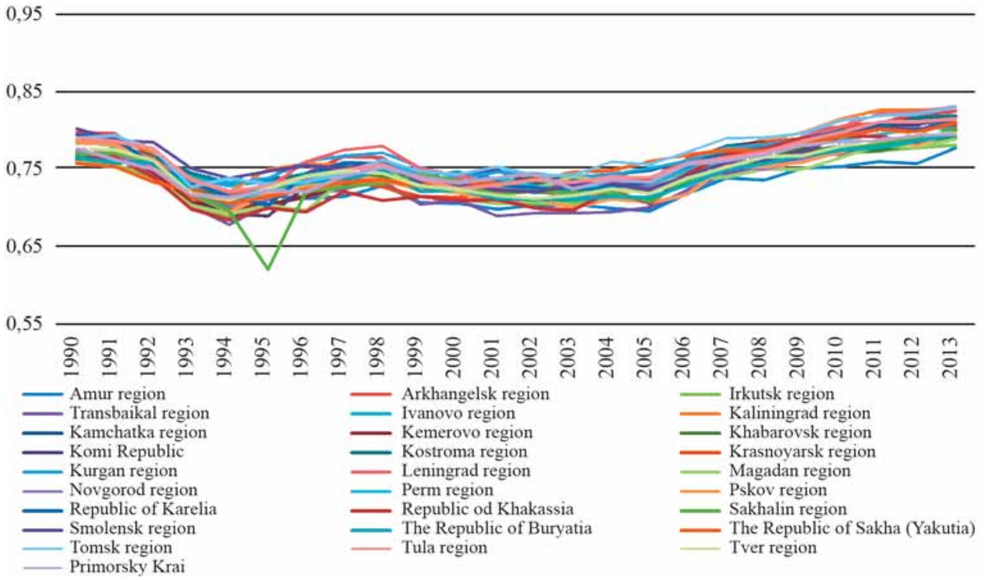

Fig. 3. Group of Russian regions with average PHI values

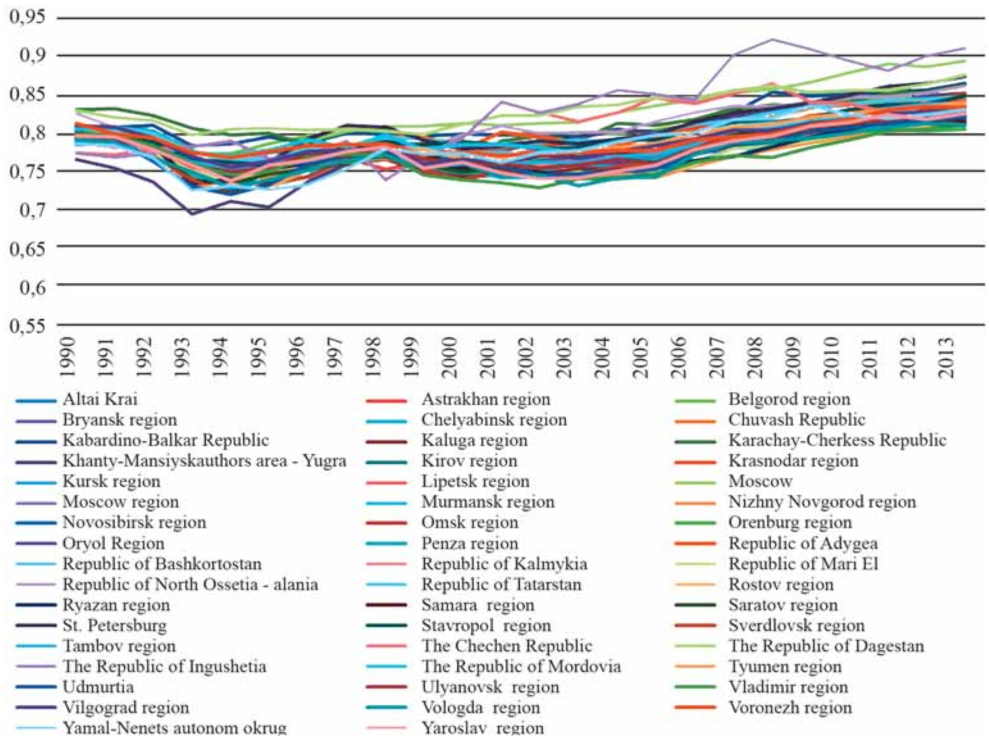

Fig. 4. Group of Russian regions with high PHI values

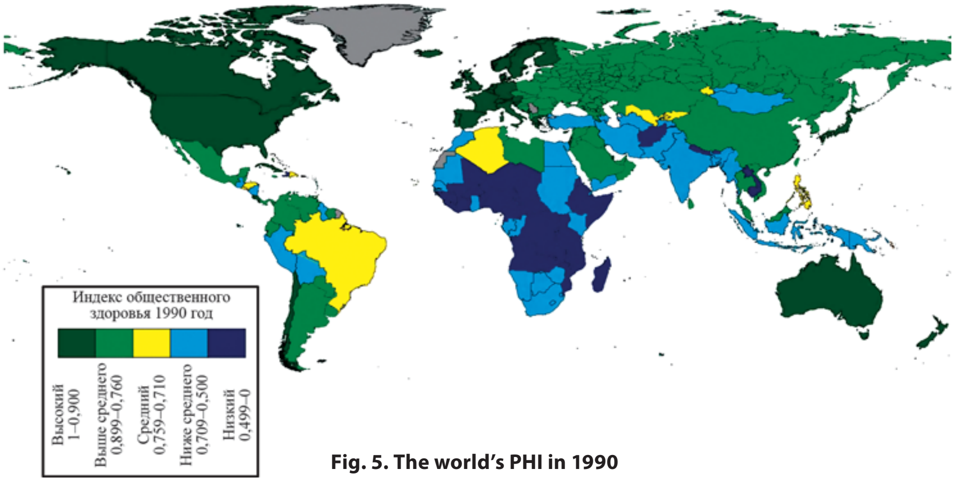

Fig. 5. The world's PHI in 1990

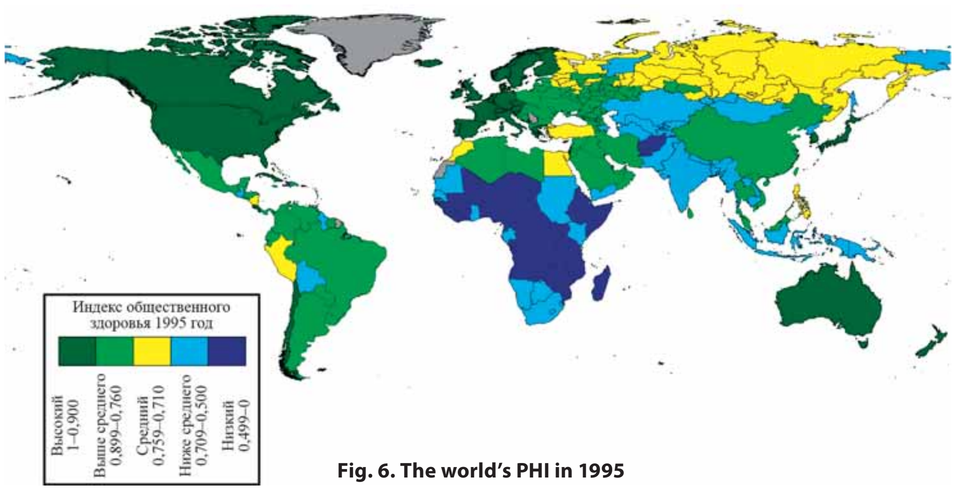

Fig. 6. The world's PHI in 1995

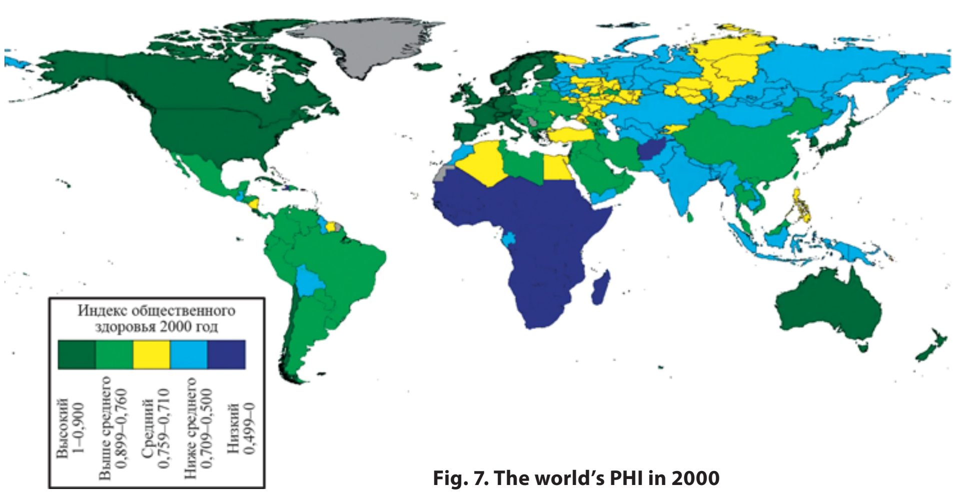

Fig. 7. The world's PHI in 2000

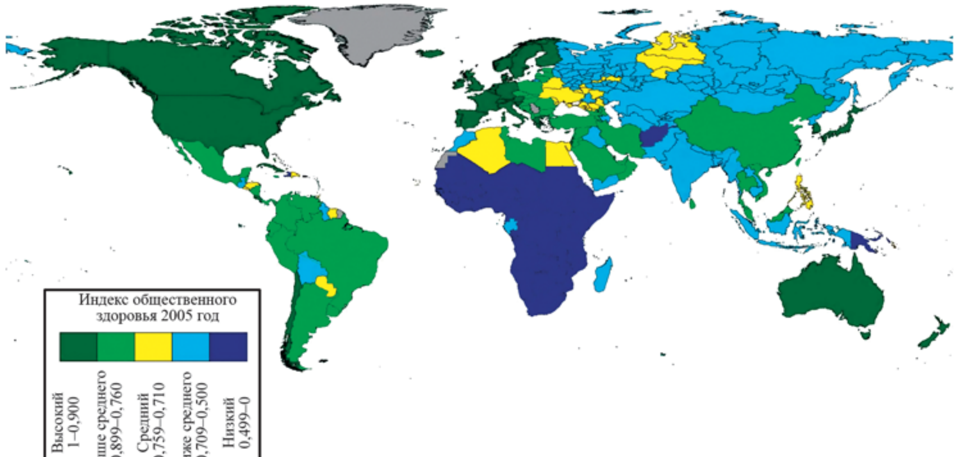

Fig. 8. The world's PHI in 2005

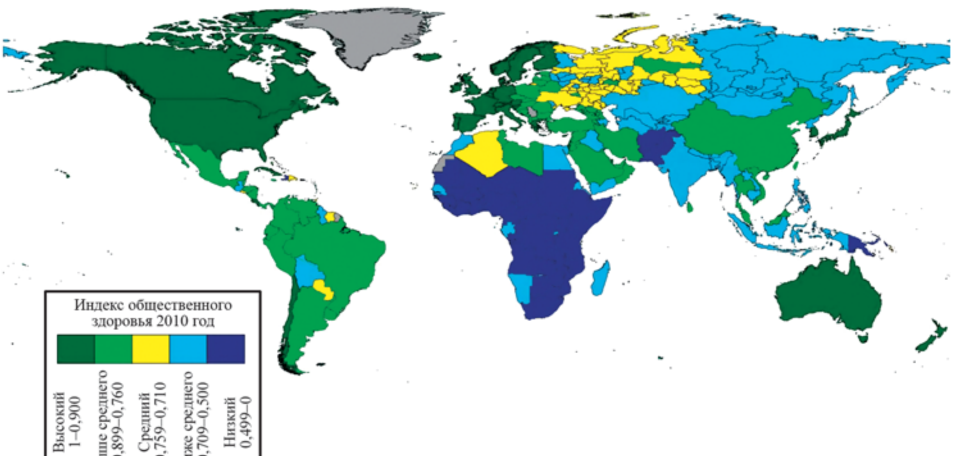

Fig. 9. The world's PHI in 2010

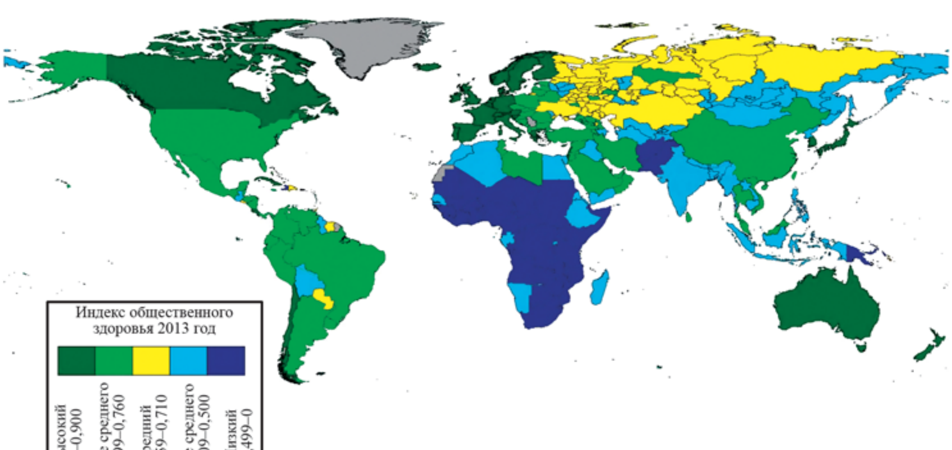

Fig. 10. The world's PHI in 2013

Fig. 1 shows a graph of PHI of the world, the European Union, and several countries. As can be seen from the graph, growth of the index is a worldwide trend. Dynamics of growth is much higher in developing countries. Russia stands out from the general trend. The events of the 1990s have affected the level of public health and sustainable growth is observed only after 2001.

Detailed changes in the level of public health of the Russian Federation are shown in Figs 2–4. Three groups were isolated: regions with low, medium, and high PHI. Fig. 2 shows that the regions-outsiders were most seriously affected after the fall of the Soviet Union and only in recent years reached the same level that existed before the 1990s. In the group of the regions with average PHI (Fig. 3), general dynamics is clearly visible. The lowest level of public health in the group is observed in 1994 followed by a slight increase. The economic crisis of 1998 led to fall of the index. Sustained growth of public health in this group began in 2003. The group with high PHI (Fig. 4) is more resistant to changes in the economic and political situation in the country.

Figs 5–10 show the spatial changes in PHI at intervals of several years. These maps show regions of the world that do not follow the worldwide trend of sustainable growth of public health: the former Soviet republics and African countries.

More detailed analysis of the public health index is given in other work of the authors [Tikunov, Chereshnya, 2015].

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Table 1. Public Health Index

Rating	Index	Year	Country, RF region
1	0,990	2013	Japan
2	0,988	2013	Iceland
3	0,986	2012	Japan
4	0,985	2012	Iceland
5	0,984	2009	Japan
6	0,984	2010	Japan
7	0,981	2008	Japan
8	0,980	2011	Japan
9	0,980	2013	Switzerland
10	0,979	2007	Japan
11	0,979	2012	Switzerland
12	0,979	2011	Switzerland
13	0,979	2011	Iceland
14	0,978	2013	Singapore
15	0,977	2006	Japan
16	0,976	2011	Spain
17	0,976	2012	Spain
18	0,976	2013	Spain
19	0,976	2013	Italy
20	0,975	2012	Italy
21	0,974	2011	Italy
22	0,974	2012	Singapore
23	0,974	2013	Australia
24	0,973	2010	Switzerland
25	0,973	2010	Iceland
26	0,973	2004	Japan
27	0,973	2011	France
28	0,973	2013	Luxembourg
29	0,972	2013	Israel
30	0,972	2005	Japan
…….	…….	…….	…….

Contiinue Table

Rating	Index	Year	Country, RF region
1683	0,834	2013	Russian Federation
1684	0,834	2008	Jamaica
1685	0,834	2009	Nicaragua
1686	0,834	1992	Croatia
1687	0,834	1997	Lebanon
1688	0,834	2005	Latvia
1689	0,834	1997	Macedonia, FYR
1690	0,834	2009	Belarus
1691	0,834	2001	Vietnam
1692	0,834	2013	Volgograd region
1693	0,834	2002	Mauritius
1694	0,834	2001	Sri Lanka
1695	0,834	2006	Grenada
1696	0,834	2001	Venezuela, RB
1697	0,834	2009	Krasnodar region
1698	0,834	1999	Syrian Arab Republic
1699	0,834	2013	St, Vincent and the Grenadines
1700	0,834	2008	Belarus
1701	0,834	2013	Voronezh region
1702	0,833	2009	Tonga
1703	0,833	2009	Cabo Verde
1704	0,833	2012	Penza region
1705	0,833	2006	Colombia
1706	0,833	1991	Karachay-Cherkess Republic
1707	0,833	2011	West Bank and Gaza
1708	0,833	2002	Ecuador
1709	0,833	2007	Karachay-Cherkess Republic
1710	0,833	1998	Lithuania
1711	0,833	2008	St, Petersburg
1712	0,833	2004	Maldives

Contiinue Table

Rating	Index	Year	Country, RF region
1713	0,833	1998	Bahamas, The
1714	0,833	2011	Tambov region
1715	0,833	1996	Argentina
1716	0,833	2003	Bulgaria
1717	0,832	1991	Bahrain
1718	0,832	2006	Jordan
1719	0,832	1994	Poland
1720	0,832	2007	Latvia
1721	0,832	2012	Ukraine
1722	0,832	2008	Tonga
1723	0,832	1994	Barbados
1724	0,832	1991	Uruguay
1725	0,832	2008	Iran, Islamic Rep,
1726	0,832	2012	El Salvador
1727	0,832	2007	Belgorod region
1728	0,832	2010	Stavropol region
1729	0,832	2013	Moscow region
1730	0,832	1992	Slovak Republic
1731	0,832	2012	Chuvash Republic
1732	0,832	2010	Honduras
1733	0,832	2012	St, Vincent and the Grenadines
1734	0,832	2007	Brazil
1735	0,832	2002	St, Lucia
1736	0,832	2000	Saudi Arabia
......	......	......	......
2060	0,816	2011	Russian Federation
2061	0,816	2012	The Chechen Republic
2062	0,816	2001	Thailand
2063	0,816	2012	Kostroma region

Contiinue Table

Rating	Index	Year	Country, RF region
2062	0,816	2001	Thailand
2063	0,816	2012	Kostroma region
2064	0,816	2005	West Bank and Gaza
2065	0,816	1999	Tonga
2066	0,816	1994	Bulgaria
2067	0,816	2010	Ulyanovsk region
2068	0,816	2013	Tula region
2069	0,816	1999	Sri Lanka
2070	0,816	1992	Antigua and Barbuda
2071	0,816	2003	The Chechen Republic
2072	0,816	2005	St, Vincent and the Grenadines
2073	0,816	1999	Ecuador
2074	0,816	2005	Cabo Verde
2075	0,816	2010	Novosibirsk region
2076	0,815	2007	Stavropol region
2077	0,815	2013	Chelyabinsk region
2078	0,815	1997	Estonia
2079	0,815	2010	Yaroslavl region
2080	0,815	1999	Mauritius
2081	0,815	1997	Saudi Arabia
2082	0,815	2003	Moscow
2083	0,815	2013	Republic of Karelia
2084	0,815	2008	Stavropol region
2085	0,815	2012	Republic of Bashkortostan
2086	0,815	1997	Oman
2087	0,815	2009	The Republic of Mordovia
2088	0,815	2000	Grenada
2089	0,815	2011	Kursk region

Contiinue Table

Rating	Index	Year	Country, RF region
2090	0,815	1997	Vietnam
2091	0,815	2004	Brazil
2092	0,815	2013	Nizhny Novgorod region
2093	0,815	1994	Venezuela, RB
2094	0,815	2009	Rostov region
2095	0,815	2000	Libya
2096	0,815	2011	Republic of Bashkortostan
2097	0,814	2006	St, Petersburg
2098	0,814	2010	Omsk region
2099	0,814	2000	Latvia
2100	0,814	2007	Krasnodar region
2101	0,814	2013	Kazakhstan
2102	0,814	2004	Samoa
2103	0,814	2010	Kaliningrad region
2104	0,814	1992	Bahamas, The
2105	0,814	2000	Jordan
......	......	......	......
2741	0,792	2004	Republic of Kalmykia
2742	0,792	2008	Russian Federation
2743	0,791	1994	Belize
2744	0,791	1999	Belgorod region
2745	0,791	1993	Vietnam
2746	0,791	2003	Republic of Tatarstan
2747	0,791	2009	Leningrad region
2748	0,791	1993	Jordan
2749	0,791	2010	Vladimir region
2750	0,791	2005	Stavropol region
2751	0,791	2013	Khabarovsk region
2752	0,791	1995	Belize

Contiinue Table

Rating	Index	Year	Country, RF region
2753	0,791	1991	Oryol Region
2754	0,791	1999	St, Petersburg
2755	0,791	1992	Mexico
2756	0,791	2004	Krasnodar region
2757	0,791	2005	Ukraine
2758	0,791	2002	Ukraine
2759	0,791	2000	Belgorod region
2760	0,791	1992	Belize
2761	0,791	1990	Kaluga region
2762	0,791	1994	The Republic of Ingushetia
2763	0,791	1994	The Chechen Republic
2764	0,791	2008	Kirov region
2765	0,791	2002	El Salvador
2766	0,791	1997	The Republic of Ingushetia
2767	0,791	1997	The Chechen Republic
2768	0,791	1993	Belize
2769	0,791	2010	Ivanovo region
2770	0,791	2005	Republic of Kalmykia
2771	0,791	2009	Moldova
2772	0,791	2001	Karachay-Cherkess Republic
2773	0,791	2006	Saratov region
2774	0,791	2008	Tomsk region
2775	0,791	1992	Moscow
2776	0,791	1992	Samara region
2777	0,790	2009	Krasnoyarsk region
2778	0,790	2004	Republic of Tatarstan
2779	0,790	2007	Yaroslavl region

Contiinue Table

Rating	Index	Year	Country, RF region
2780	0,790	1992	Chelyabinsk region
2781	0,790	2009	Trinidad and Tobago
2782	0,790	2007	Tomsk region
2783	0,790	1996	Tunisia
2784	0,790	1999	Belarus
2785	0,790	1990	Tomsk region
2786	0,790	1990	Tula region
2787	0,790	2009	Republic of Khakassia
2788	0,790	2008	Suriname
2789	0,790	1991	Belize
2790	0,790	2001	Paraguay
2791	0,790	2001	Ukraine
2792	0,790	2002	St. Petersburg
2793	0,790	1996	Moscow
2794	0,790	2008	Vologda region
2795	0,790	2009	Komi Republic
......	......	......	......
6324	0,294	1997	Zambia
6325	0,293	1990	Malawi
6326	0,292	1996	Mozambique
6327	0,292	1993	Zambia
6328	0,291	1996	Zambia
6329	0,289	1992	Niger
6330	0,289	1995	Zambia
6331	0,289	1994	Zambia
6332	0,288	1999	Angola
6333	0,283	1998	Rwanda
6334	0,281	1993	South Sudan
6335	0,279	2006	Sierra Leone
6336	0,277	1998	Angola
6337	0,276	1991	Nige

Contiinue Table

Rating	Index	Year	Country, RF region
6338	0,276	1994	Liberia
6339	0,276	1995	Mozambique
6340	0,267	1997	Angola
6341	0,266	1992	South Sudan
6342	0,264	1990	Niger
6343	0,263	2005	Sierra Leone
6344	0,261	1994	Mozambique
6345	0,259	1996	Angola
6346	0,259	1993	Liberia
6347	0,253	1995	Angola
6348	0,251	1991	South Sudan
6349	0,249	1994	Angola
6350	0,248	1993	Mozambique
6351	0,247	2004	Sierra Leone
6352	0,247	1992	Liberia
6353	0,245	1993	Angola
6354	0,243	1992	Angola
6355	0,242	1991	Angola
6356	0,241	1997	Rwanda
6357	0,241	1990	Angola
6358	0,240	1991	Liberia
6359	0,240	1990	Liberia
6360	0,237	1990	South Sudan
6361	0,237	1992	Mozambique
6362	0,231	2003	Sierra Leone
6363	0,227	1991	Mozambique
6364	0,221	1990	Rwanda
6365	0,218	1990	Mozambique
6366	0,216	2002	Sierra Leone
6367	0,200	2001	Sierra Leone
6368	0,197	1996	Rwanda

Contiinue Table

Rating	Index	Year	Country, RF region
6369	0,186	2000	Sierra Leone
6370	0,174	1991	Rwanda
6371	0,174	1999	Sierra Leone
6372	0,163	1998	Sierra Leone
6373	0,153	1997	Sierra Leone
6374	0,152	1990	Sierra Leone
6375	0,146	1991	Sierra Leone
6376	0,145	1996	Sierra Leone
6377	0,141	1992	Sierra Leone
6378	0,141	1992	Rwanda
6379	0,140	1995	Sierra Leone
6380	0,138	1993	Sierra Leone
6381	0,138	1994	Sierra Leone
6382	0,134	1995	Rwanda
6383	0,122	1993	Rwanda
6384	0,093	1994	Rwanda

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