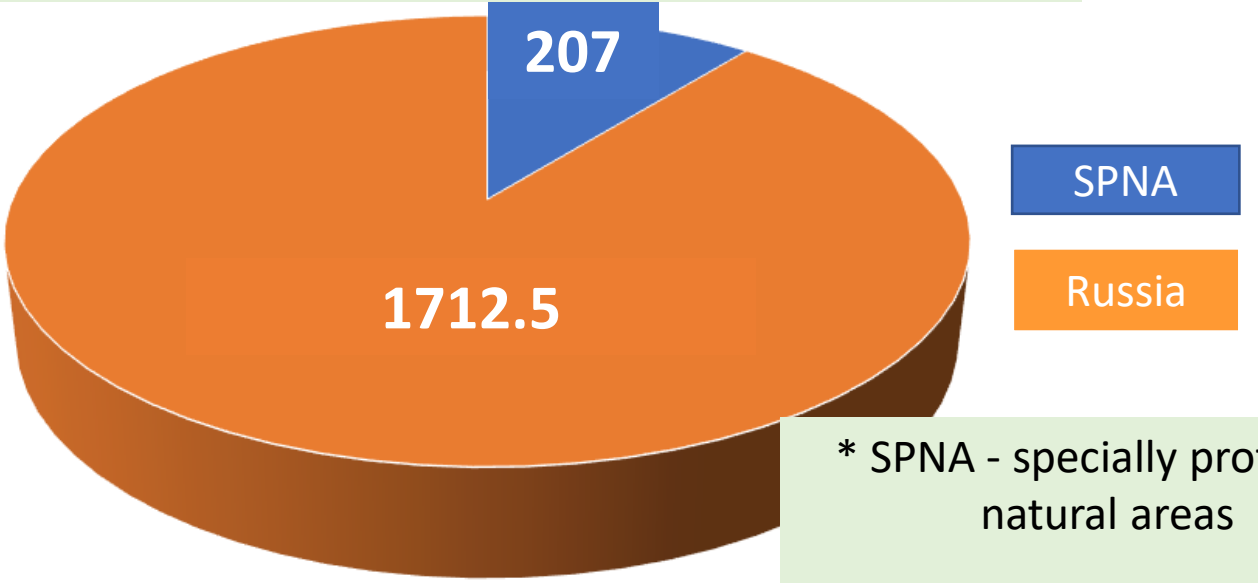
ECOLOGY FOR EVERYONE: PROBLEMS AND METHODS OF NATURE CONSERVATION AND RESTORATION

Dear readers!

With the accumulation of knowledge about the state of nature in our country and in the world, the question whether people can continue to live peacefully on the Earth not paying attention to the huge violations in nature as consequences of our activity becomes more and more acute. We all need to realize that our life on the Earth depends on nature, i.e. on its ability to maintain an optimal climate, hydrological regime, biological diversity and soil fertility at all levels of biosphere – from local to global.

These problems cannot be solved by nature reserves and other environmental organizations for the following reasons: their areas are too small, a significant part of their Biota (natural population) is inferior, they are surrounded by huge arrays of economic territories, incapable to fully realize the ecosystem functions of the Biosphere, which determine our life on the Earth, by modern methods of nature management.

Total area (million ha) of SPNAs* in Russia



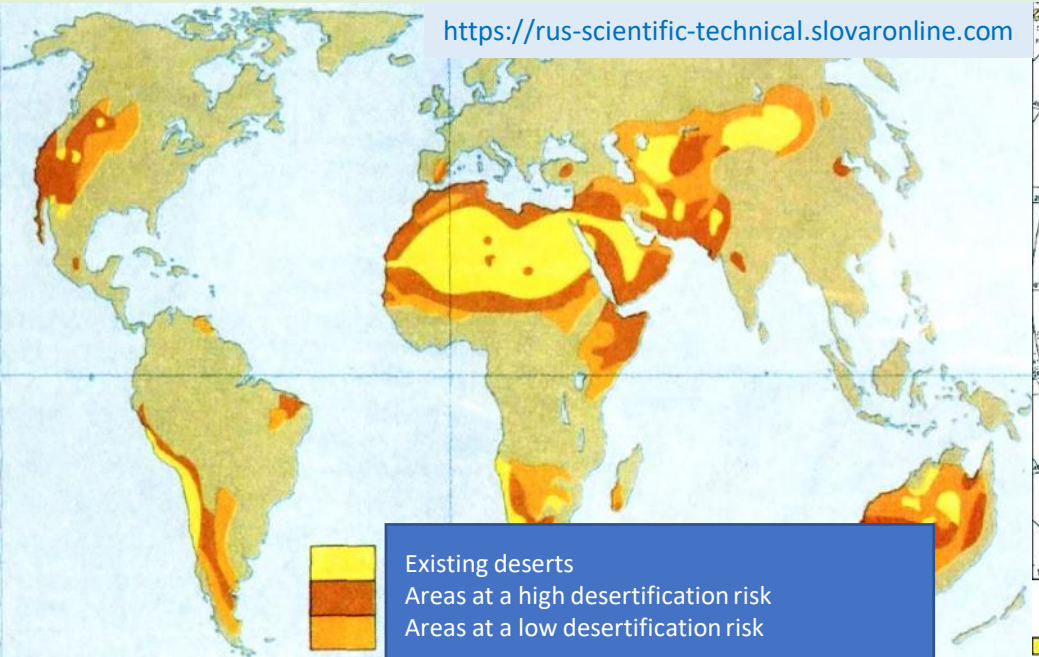
* SPNA - specially protected natural areas

The problem of saving life can only be solved by restoring nature at all its levels : from the individual to the biosphere.

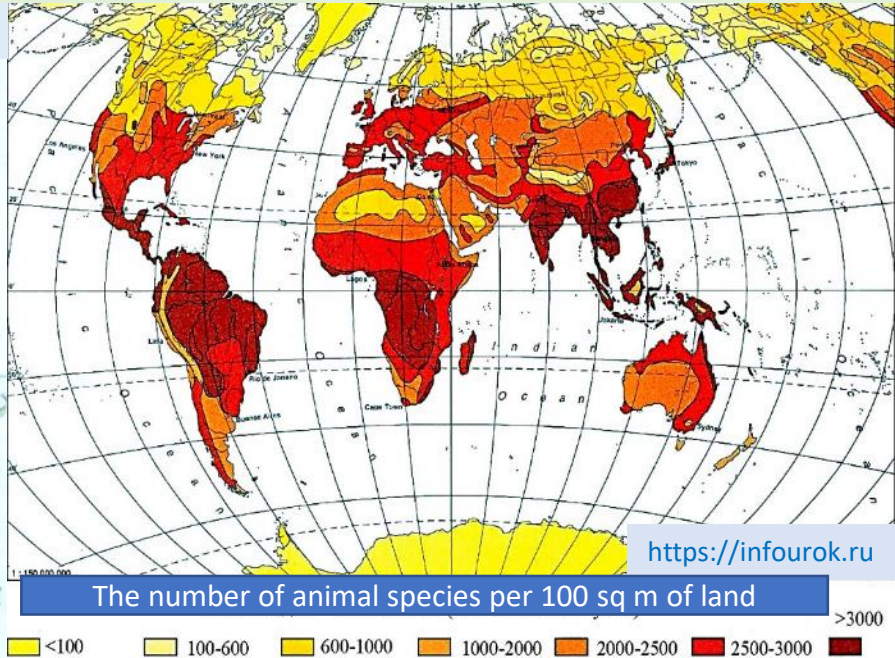
As the first step **every person should learn ecological alphabet;** ***the second step*** **is implementation of the knowledge gained. For this, we offer a series of presentation lectures on the basics of two sciences: biosystem ecology and historical ecology. In them we want to explain the dangers that threaten the sustainable existence of people on the Earth and the importance of the contribution of each person to the preservation of nature.**

OUR GENERAL PROBLEM IS THAT MODERN the Earth BIOSPHERE CANNOT IMPLEMENT ECOSYSTEM FUNCTIONS NECESSARY FOR SUSTAINABLE EXISTENCE OF MANKIND: it cannot maintain an optimal climate, hydrological, temperature conditions, soil fertility, maximum productivity and, biodiversity, and prevent global warming

Desert Offensive



Animal biodiversity



Biosphere (ancient Greek. βιος – life and σφαῖρα – sphere, ball) – the shell of the Earth, inhabited by living beings and under their influence. Its function is the maintenance of an activity of organisms or other objects.

***Obstacles to the implementation of ecosystem functions by the modern the Earth's biosphere*:**

1) millennia-old anthropogenic changes in living cover of *the Earth* that prohibited the full-fledged life of people on a large part of the land.

2) the minimum share of specially protected areas: reserves, wildlife reserves, national parks (about 9% of all inhabited land), their small areas and the mismatch of their areas with the needs of the natural population that has been preserved on them, the loss of natural species and their complexes in them due to previous nature management.

WAYS TO SOLVE THE PROBLEM

1) development and implementation of environmental management methods based on the natural laws of the Biosphere functioning;
2) participation of the population in the restoration of natural ecosystems in the regions as the beginning of the path to the restoration of the natural functions of the Biosphere as a whole.

“... Man is preceded by forests and accompanied by deserts... ” A.Humboldt

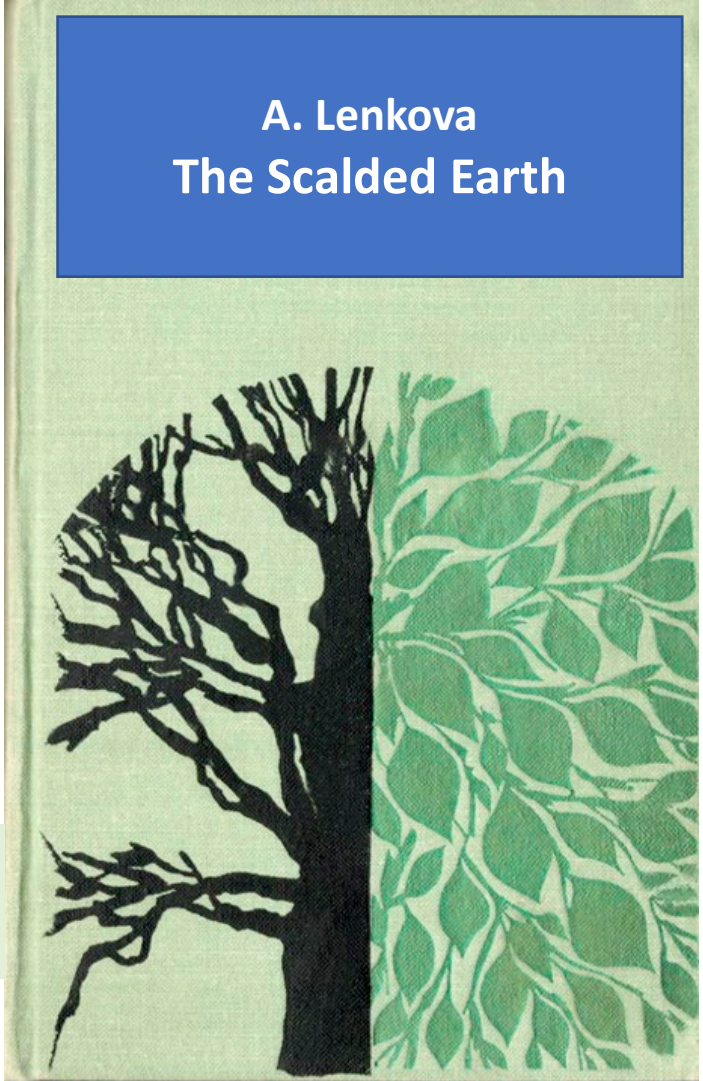
ECOLOGY FOR ALL:

problems that we need to solve, sciences that will help to do this

LIFE OF NATURE WITHOUT HUMAN, HISTORY OF ITS DESTRUCTION BY HUMAN AND THE NEED FOR ITS RESTORATION BY HUMAN

“It would not be an exaggeration to say that people – inhabitants of the one planet Earth – behave like bad tenants in a communal apartment... everyone fully uses all its amenities, but no one will take care of the condition of the house, even if the roof is about to collapse... “ A. Lenkova (1975).

The author deals with the most diverse aspects of modern environmental management. The reader will find out what threats individual elements of nature – forests, animals, air, and water – are exposed to.



"At the beginning of 16th century human released goats on the island of St. Helenawere where there was a lot of green food and no predators. In a short time, animals propagated having eaten all the young trees, green shoots, and even bark of old trees. The goats destroyed the forest as meticulously as if they were preparing a gloomy stage design for a battle against Napoleon Bonaparte. They were just in time! Five years before his exile, there were already no trees on the island. " A. Lenkova. The Scalded Earth.

To the left – native vegetation of St. Helena island: moist mountain forests, consisting mainly of endemic tree ferns and black cabbage trees (*Melanodendron integrifolium*), preserved better than other plant communities of the island (photo from britainstreasureislands.com)
To the right – eroded semi-desert terrain, into which turned a significant part of the island after the destruction of forests (photo by Paul Tyson from bbc.com)

"In nature, everything is in harmony – everything is in excess and nothing is superfluous, in this ideal system there are no internal disturbances of a catastrophic order. For example, with an increase in herds of antelopes, they overpluck the grass of the African savannah. Antelopes weakened from hunger are an easy prey for lions... lion breeding intensifies, while herds of antelopes decrease. During this period, the green cover is restored again and the whole cycle is repeated. ”

THE NEED TO DEVELOP NEW APPROACHES TO SOLVING THE PROBLEMS OF CONSERVATION AND RESTORATION OF NATURE

Protected forests: stable microclimate, high biodiversity, and high productivity.

Timber industry areas: soil erosion, drainage / waterlogging, decline in biodiversity and productivity.

THE NEED TO DEVELOP NEW APPROACHES TO SOLVING THE PROBLEMS OF CONSERVATION AND RESTORATION OF NATURE

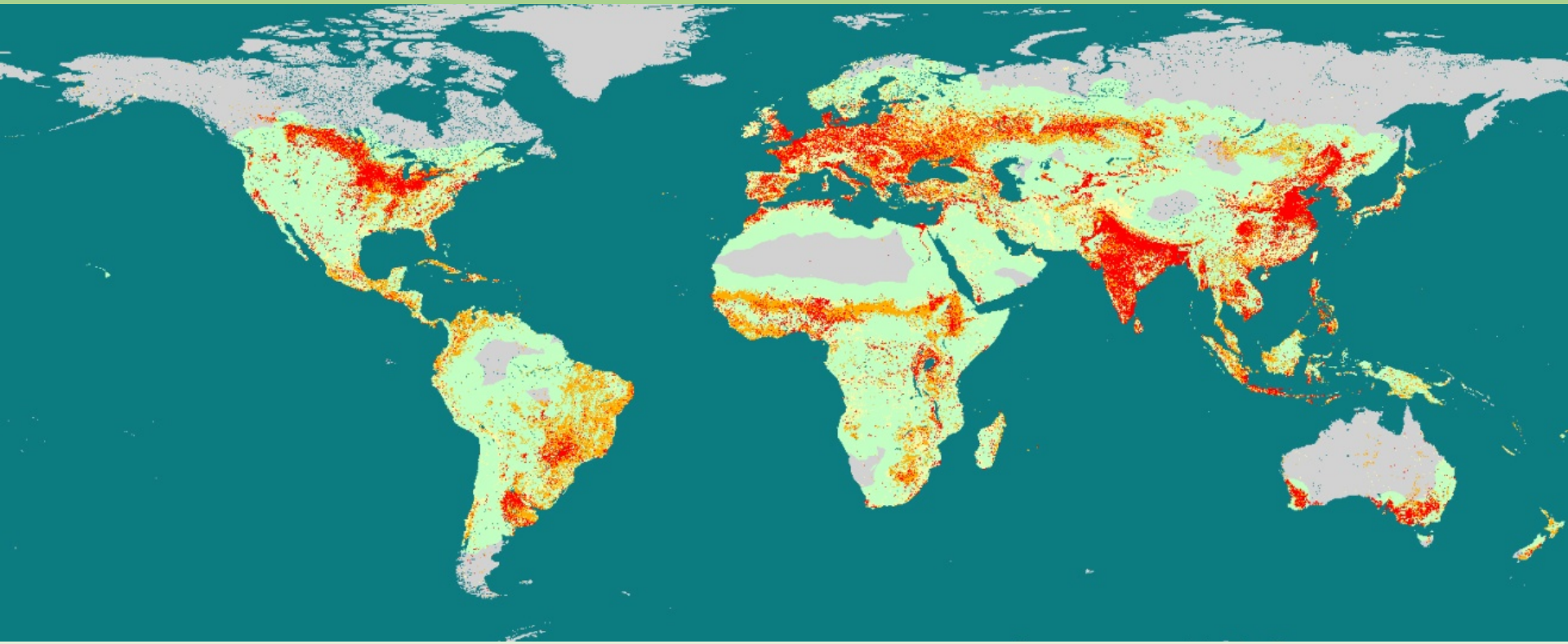
due to adverse climate changes, hydrological and temperature conditions, reduction of biodiversity and biological productivity as a result of nature management

Protected steppes with regulated grazing of wild ungulates: high biodiversity and high productivity, soil richness and favorable moisture regime.

Cattle pastures: destruction of vegetation and soil cover, growth of ravines, desiccation of soils, decline in productivity, reduction of biological diversity.

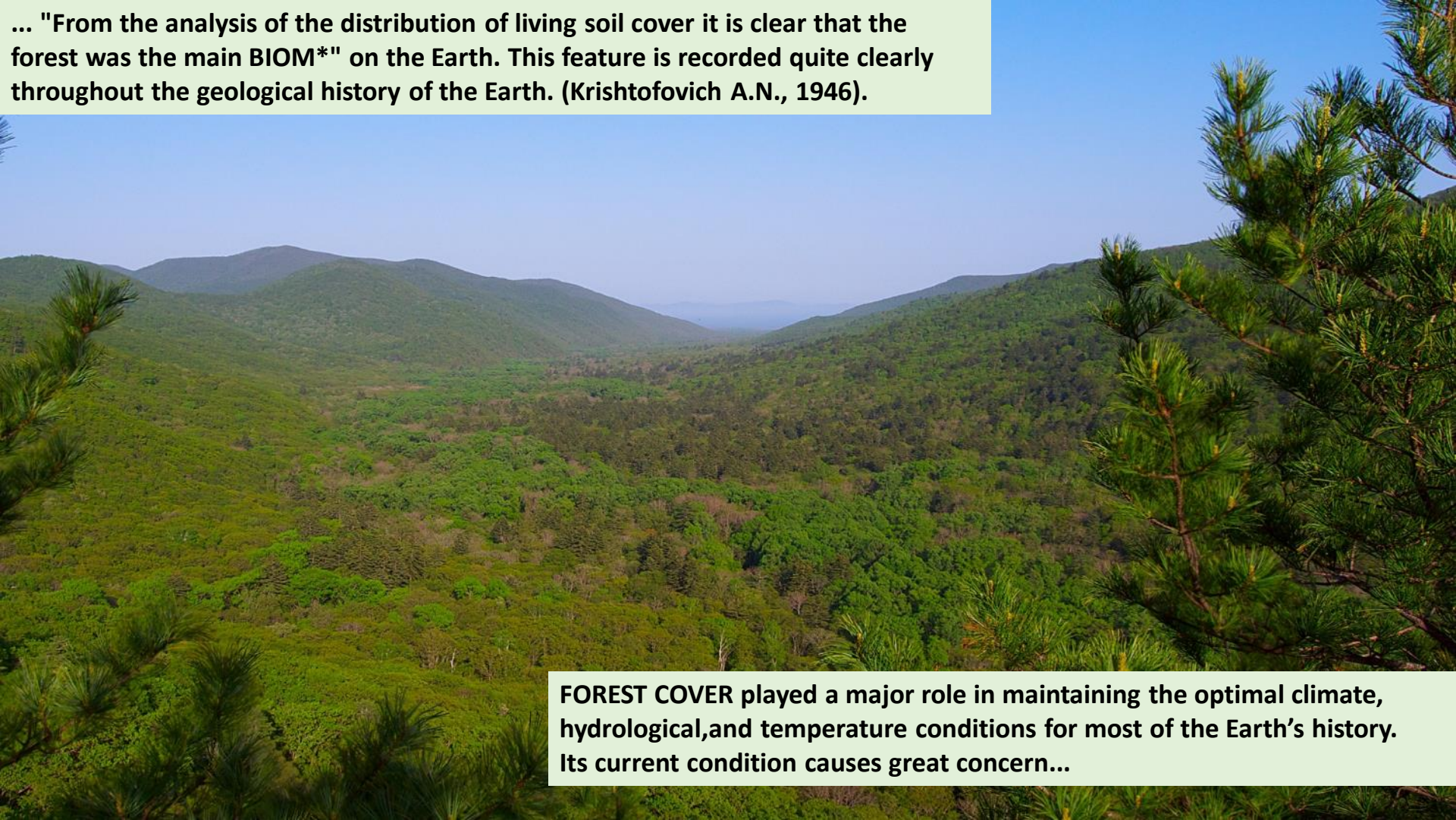
MODERN LAND USE IS POSSIBLE ONLY ON A SMALL PART OF THE EARTH SURFACE

(data for 2000)



- Areas with a high population density, deprived of natural cover due to intensive farming and a large number of roads.
- Complexes of transformed and natural areas (only partial cultivation is possible)
- Areas with low development intensity and low population density (farming is not expedient).
- Areas without permanent settlements (deserts, tundras)

... "From the analysis of the distribution of living soil cover it is clear that the forest was the main BIOM*" on the Earth. This feature is recorded quite clearly throughout the geological history of the Earth. (Krishtofovich A.N., 1946).



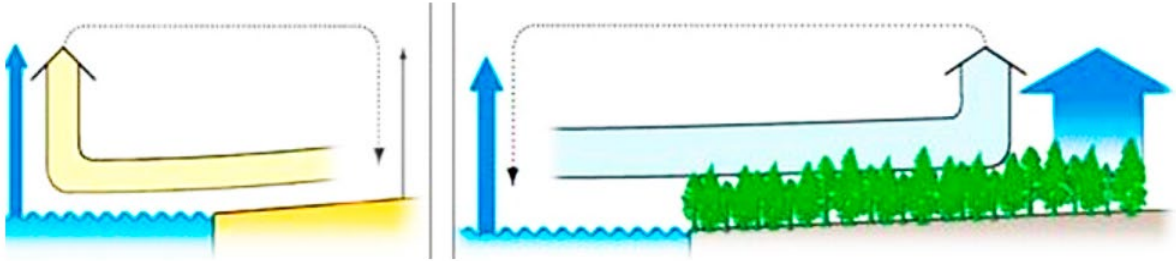
FOREST COVER played a major role in maintaining the optimal climate, hydrological,and temperature conditions for most of the Earth's history. Its current condition causes great concern...

BIOTIC PUMP OF ATMOSPHERIC MOISTURE is an environmental theory that explains the global role of natural forest cover in maintaining an optimal climate and hydrological regime on the Earth

“To ensure the normal functioning of forest ecosystems, we need an active mechanism (pump) that transport moisture deep into the continents at a speed determined by the needs of the ecological community. The energy consumption for the active injection of moisture to inland from the ocean should significantly exceed hydraulic power of river flow. Therefore, the mechanism of moisture transport deep into the continents can be built only on the basis of high energy consumption of solar energy.

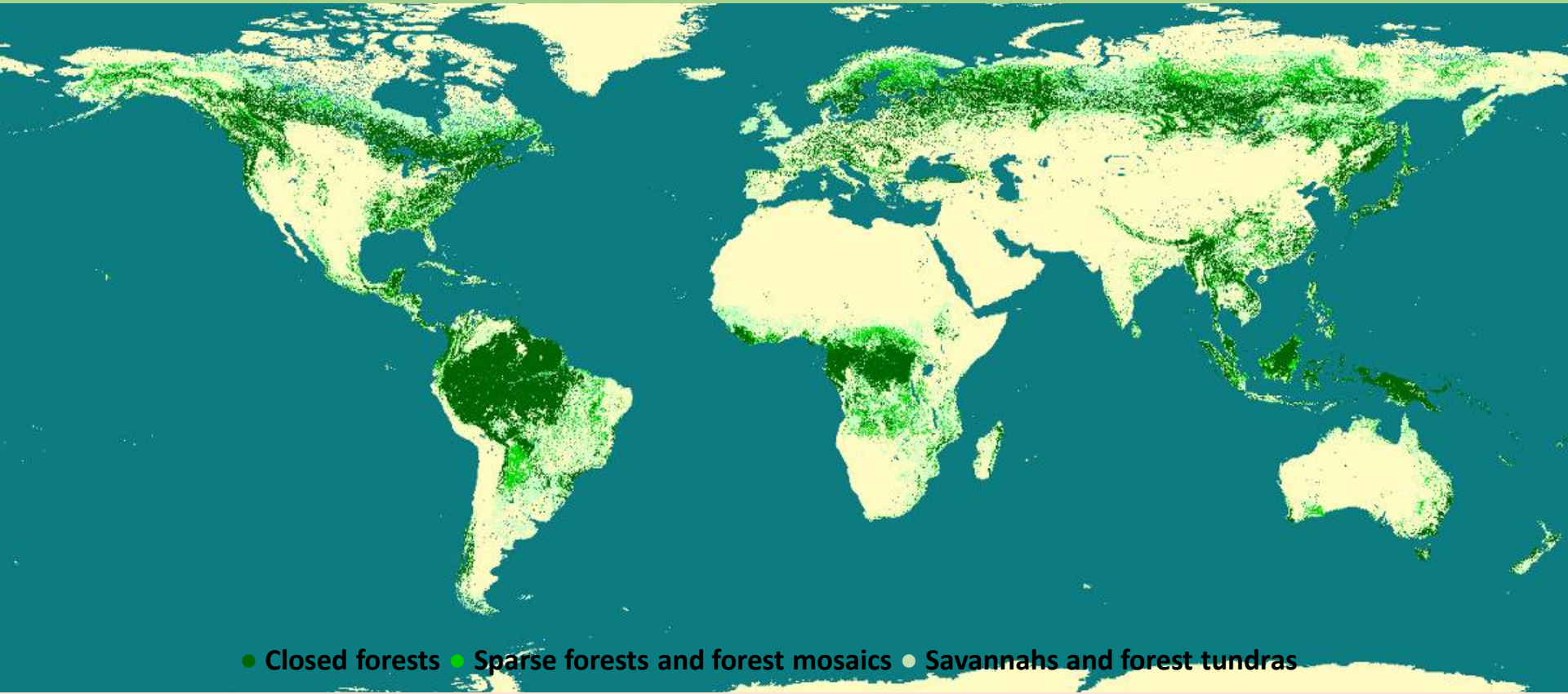
This mechanism was created on land during evolution in the form of forest – a continuous vegetation cover of tall trees that closely interact with other organisms of the ecological community. The forest regulated both the inland accumulation of moisture in the geological past and itssustainable conservation in subsequent periods of life on land. ”

V. G. Gorshkov, A. M. Makarieva Biotic pump of atmospheric moisture, its relationship with global atmospheric circulation, and its role on the water cycle on land ”Gatchina, 2006



Scheme (V.G. Gorshkov). If forests are cut down, the wind will not blow from the ocean and rain will not fall over the land.

MODERN FOREST COVER:
DISTRIBUTION OF FORESTS BY CROWN DENSITY (2000)



The modern forest cover of the Earth, constantly decreasing due to logging and fires, cannot provide the hydrological regime necessary for the sustainable existence of mankind.

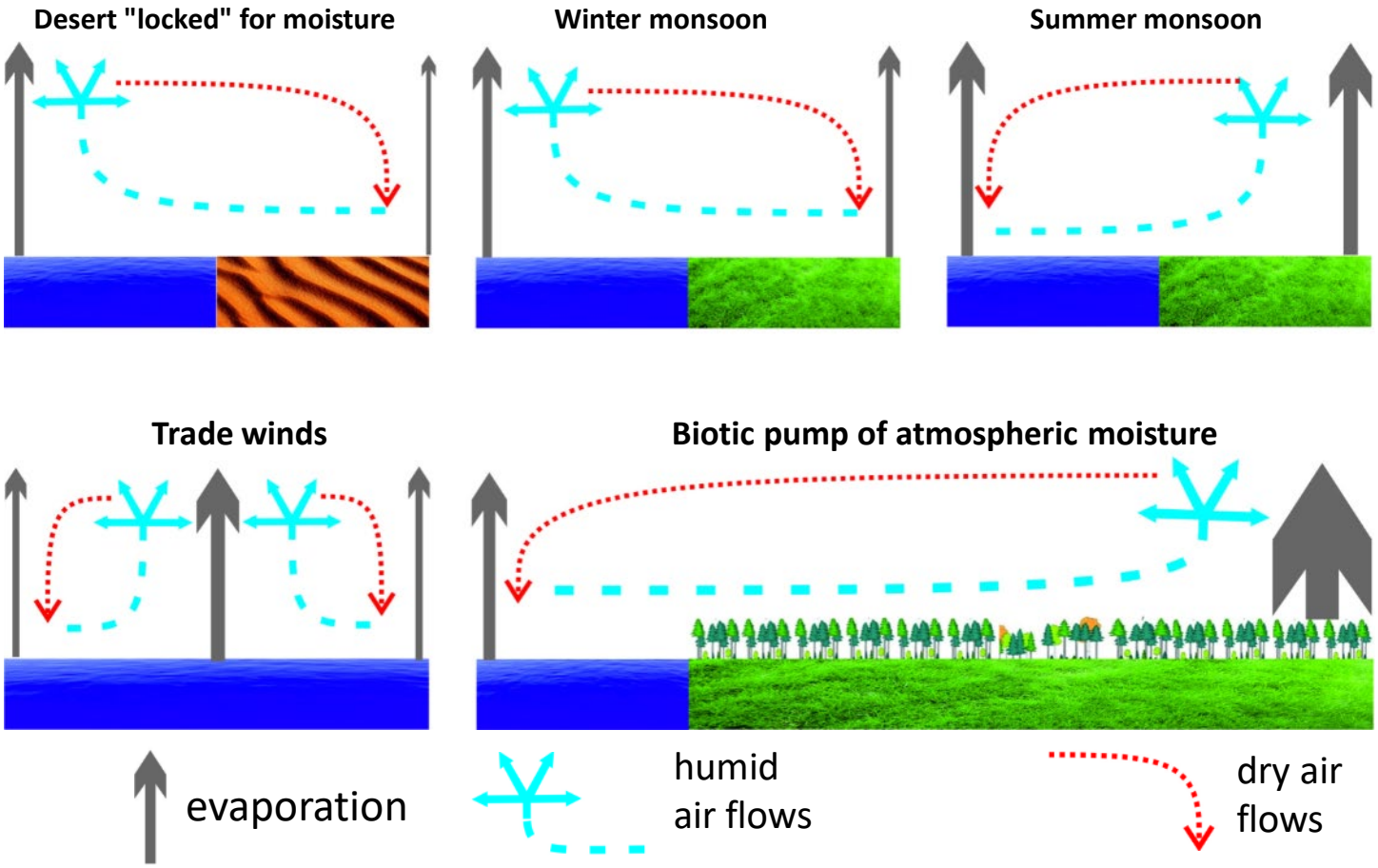
BIOTIC PUMP OF ATMOSPHERIC MOISTURE –

new ecological theory explaining the global role of natural forest cover in maintaining the optimal climate and hydrological regime on the Earth

- **DETAILS ABOUT THE BIOTIC FOREST PUMP: "... passive geophysical flows of moisture evaporated from oceans and transported to continents rapidly decay with any movement of air masses (monsoons, trade winds, atmospheric fronts). The experimentally determined attenuation length is several hundred km, which is much less than the linear dimensions of the continents. Therefore, passive geophysical moisture flows from the oceans to land do not compensate for river runoff from inland, evenly distributed over the river basin.**
- **This means that there is no geophysical explanation for the development of forests in the territories of the continents with an area of tens of millions of square kilometers, such as the forests along the Amazon river, in the equatorial Africa and Siberia.**
- **To ensure the proper functioning of such systems, we need an active mechanism – a PUMP, transporting moisture inland at a speed determined by the needs of BIOTA.**

- **The energy costs associated with the active injection of moisture from the ocean to land should significantly exceed the capacity of river runoff. Therefore, the mechanism of moisture transport inland can only be built on the basis of high-efficiency solar energy consumption." This mechanism arose on land during the formation of a forest cover, which includes all the diversity of living creatures and the ecotopes transformed by them.**
- **FOREST REGULATED ACCUMULATION OF MOISTURE IN THE GEOLOGICAL PAST AND WILL REGULATE SUSTAINABLE PRESERVATION OF THIS MOISTURE IN THE NEXT PERIODS OF LIFE ON THE EARTH** *(Gorshkov V.G., Makarieva A.M. 2006.)*

Features of the circulation of the Earth's atmosphere (explanations to fig. – see next slide)



Gorshkov V.G., Makarieva A.M. ***006.*** http://www.bioticregulation.ru/

EXPLANATIONS TO THE FEATURES OF CIRCULATION OF THE EARTH ATMOSPHERE:

GEOPHYSICALLY CONDITIONED CIRCULATION

DESERT CIRCULATION: land evaporation is close to zero, surface air comes from land to the ocean all year round.

CIRCULATION IN MONSOON CLIMATE AREAS

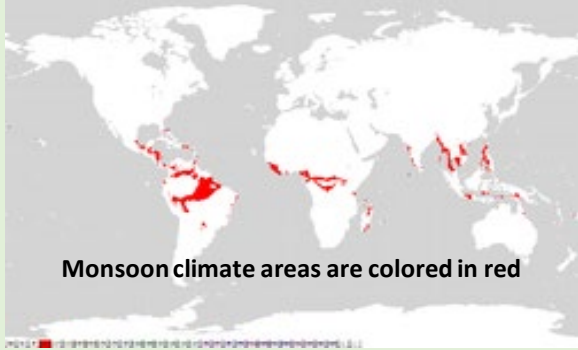
Monsoons are steady winds, periodically changing their directions; in summer, they blow from the ocean, in winter, they blow from inland; they are characteristic of tropical areas and some coastal countries with the moderate climate (Far East).

WINTER MONSOONS: evaporation over the ocean is greater than over land, since the ocean warmer than land; surface humid air comes from inland to the ocean;

SUMMER MONSOONS: evaporation over land is greater than over the ocean, as the land surface is warmed up more than the ocean surface; surface humid air comes from the ocean to inland.

CIRCULATION OVER OCEANS

TRADE WINDS: evaporation above the equator is greater than over the tropics due to difference in solar radiation flows. Airflows near oceans spread from the tropics to the equator all year round.



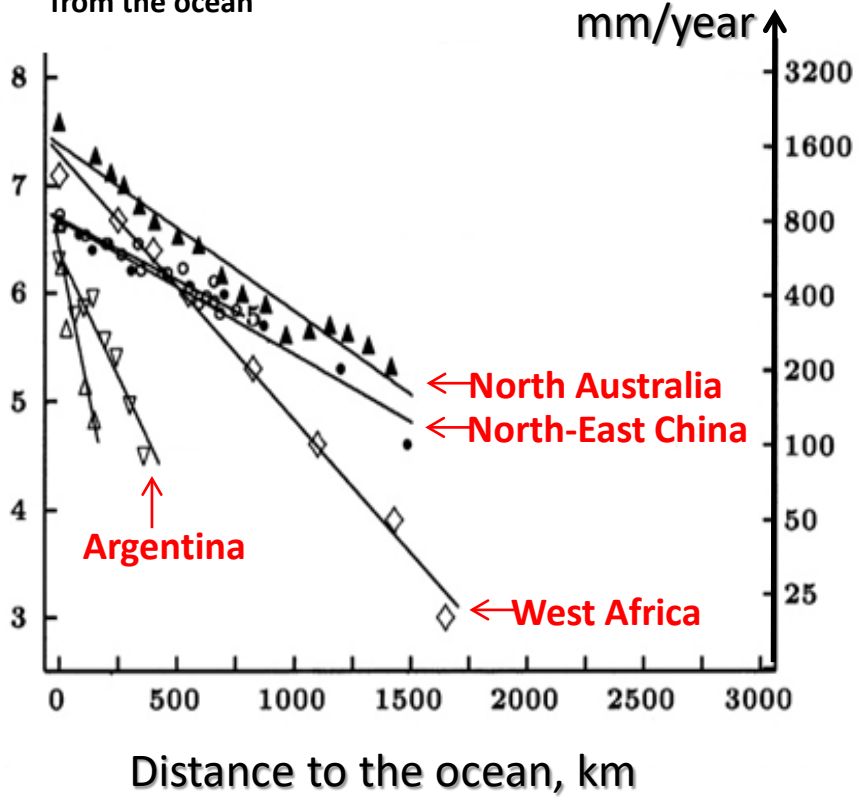
BIOTICALLY PRECONDITIONED CIRCULATION

BIOTIC PUMP OF ATMOSPHERIC MOISTURE: evaporation over the canopy of the natural forest, regulated by transpiration of trees, always surpasses evaporation over the ocean so as to ensure the flow of humid air from the ocean towards inland, fully compensating for river flow in the entire river basin.

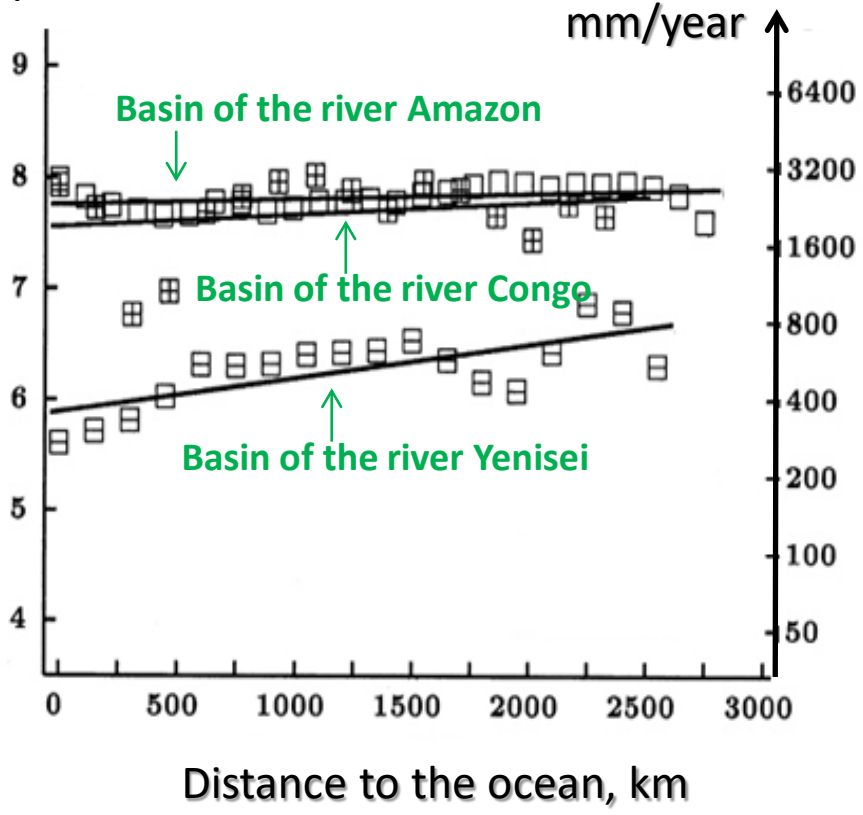
NORMAL FUNCTIONING OF BIOTIC PUMP IS POSSIBLE IF FOREST COVER REACHES THE OCEAN BORDERS.

The functioning of the biotic pump: in forestless (a) and forest areas (b)

A. Without forests – precipitation decreases rapidly with distance from the ocean



B. With forests – rainfall does not depend on distance from the ocean



Gorshkov, Makarieva, 2006. http://www.bioticregulation.ru/

EXPLANATIONS TO THE FUNCTIONING OF THE BIOTIC PUMP ON TREELESS FORESTS (A) AND FOREST TERRITORIES (B) graphs on the previous slide

"Forest life depends on soil moisture, so it is necessary to maintain it at a constant and optimal level.

High soil moisture content allows forests to maintain a stably high developmental capacity even under variable rainfall patterns. In natural forests at high latitudes* dry periods during the growing season... do not lead to a decrease in vapotranspiration** …, while evapotranspiration of open ecosystems – savannas, meadows or shrubs, unable to maintain high soil moisture content – drops sharply during the dry season."

"We summarized the data on the precipitation in three vast continental regions with a length of about 2.5 thousand kilometers... occupied by natural forests: the basins of Amazon, Congo, and Yenisei rivers and found that the distribution of precipitation in the basins of the first two rivers is independent of the distance from the ocean, precipitation in the Yenisei basin, and even increases towards inland.... (*Gorshkov, Makarieva, 2006*) ***Thus, we come to the unambiguous conclusion:*** **ALL THE LARGEST RIVER BASINS ARE THE RESULTS OF THE EXISTENCE OF FOREST BIOTIC PUMPS THAT TRANSPORT MOISTURE FROM OCEANS AND SEAS TOWARDS INLAND**.

Forest biotic pumps provide optimal soil moisture for all living creatures, maximum biota productivity, limited only by the absorbed flux of solar radiation, and full compensation of river runoff, determined by the high soil moisture content provided by the forest cover.

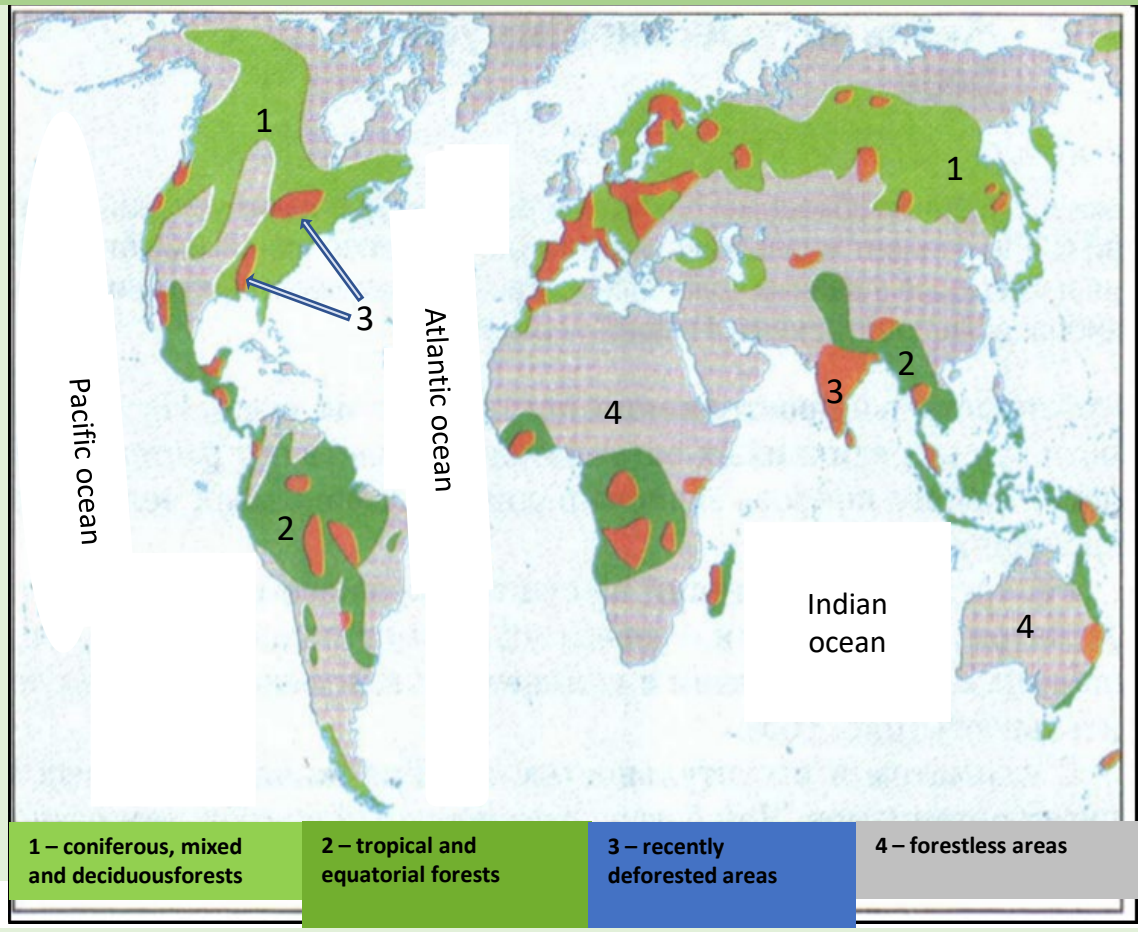
****HIGH LATITUDES* is *the conventional name of the circumpolar regions of the globe, limited to approximately 65° north and south latitude.* *** *EVAPOTRANSPIRATION is total evaporation of water by plants and soil surface from a unit area per unit time*.

CONSEQUENCES OF FOREST DESTRUCTION. The comparison of Australia and Western Europe

"... In Australia the forest-covered river basin ceased to exist 50-100 thousand years ago, when people settled the continent. After the destruction of forests on the coastal strip, the width of which exceeded the critical dimensions of the biotic pump, the territory turned into desert...".

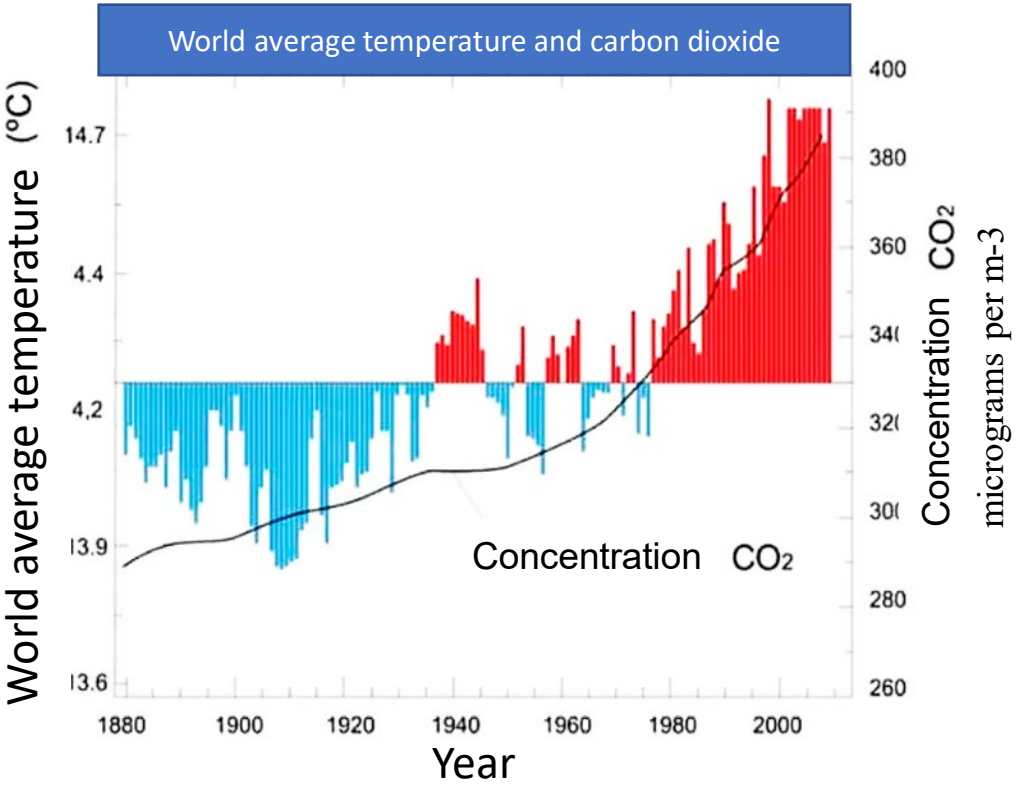
"... A modern record deforestation rate was first registered in Western Europe, all areas of which are less than 600 km away from the coastal line of the ocean and inland seas – the attenuation lengths of geophysical moisture flows from the ocean towards inland. Therefore, the complete destruction of natural forests in Western Europe did not lead to complete desertification, however, catastrophic floods, droughts and fires became more frequent " (Gorshkov, Makarieva, 2006).

http://www.bioticregulation.ru/



BIOTIC PUMP AND GLOBAL WARMING

The task of restoring normal operation of **BIOTIC PUMP OF ATMOSPHERIC MOISTURE** on the Earth is directly related to another global task – preventing climate warming. **GLOBAL WARMING** of climate is a process of gradual increase in the average annual temperature of the surface layer of the Earth's atmosphere and the oceans. For thousands, millions, and tens of millions of years, the climate has changed under the influence of natural processes: continental drift and land glaciation, variations in the Earth's orbit, ice ages, solar and volcanic factors, and oceanic "cycles" that redistribute energy between the atmosphere and the ocean. These natural climate changes did not lead to the destruction of the Earth's biota, but stimulated its further development.



Over the past 140 years, the Earth's surface temperature has increased by more than a degree.

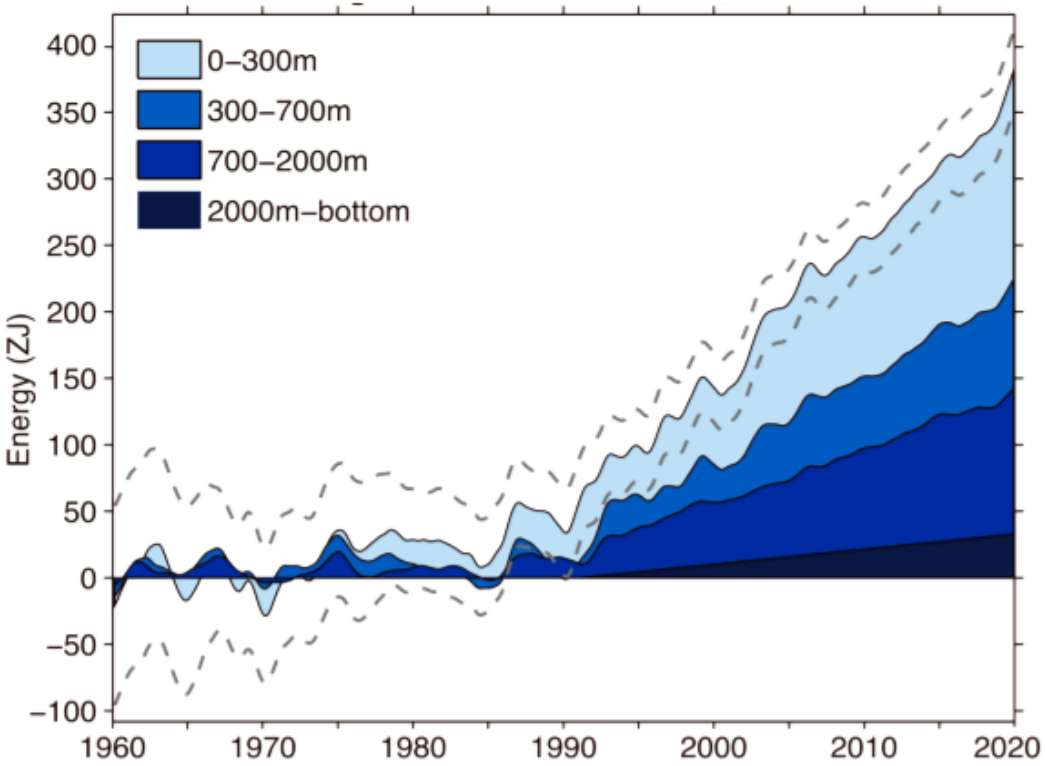
zen.yandex.ru

BIOTIC PUMP AND GLOBAL WARMING

However, massive deforestation and combustion of coal and then gas and oil products in increasing volumes by HUMAN is the root cause of global warming. The warming of the atmosphere also led to the heating of the upper layers of the ocean, the dominant part of the Earth's climate system in terms of heat capacity. When we obtained the data that unequivocally showed that the main part of the Earth – the ocean – is “warming”, scientists made a firm conclusion about the presence of global warming.

Antarctica, the Ross Sea (brown.edu)

World Ocean Temperature Change 1960-2019 (Purkey and Johnson, 2010; with data update by Cheng, 2017)

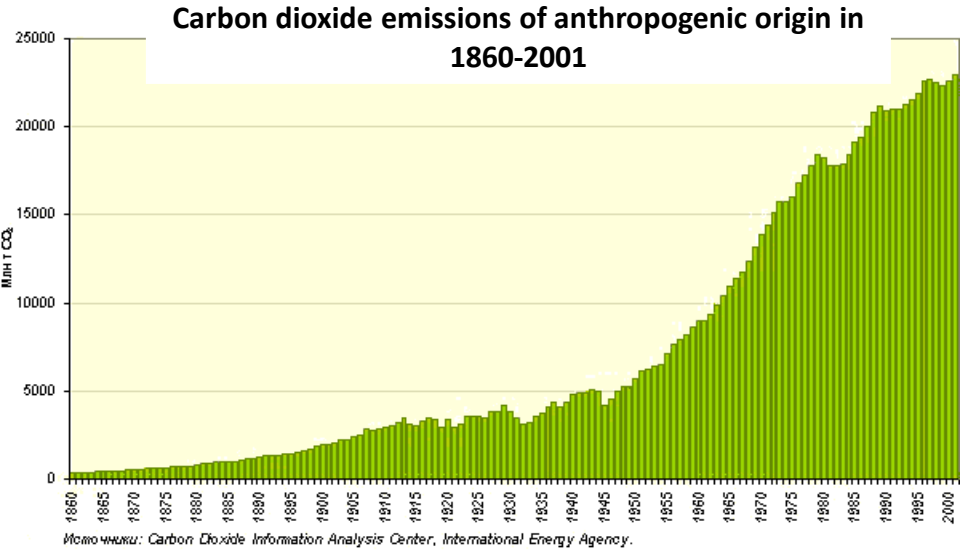


Gray dashed lines – confidence interval

https://bezotxodov.ru/jekologija/problemy-mirovogo-okeana

BIOTIC PUMP AND GLOBAL WARMING

CURRENT CONTENT OF CARBON IN TERRESTRIAL ECOSYSTEMS IS DIRECTLY RELATED NOT ONLY TO THE PAST INFLUENCE OF CLIMATIC FACTORS, BUT ALSO TO ANTHROPOGENIC TRANSFORMATION OF FORESTS. Throughout the history of mankind, forests have always been a source of food, raw and construction materials, and fuel. Forests were cut down to build settlements and to use this land for agriculture.**THE HISTORY OF MANKIND IS THE HISTORY OF THE GRADUAL DEFORESTATION OF THE PLANET**. Recent studies have shown that in the last 500 years, anthropogenic impacts on forests have been more significant factor than climate change due to geophysical processes, whereas the current carbon content in terrestrial ecosystems is mainly preconditioned by land use during 20th century (Kaplan a al., 2012).



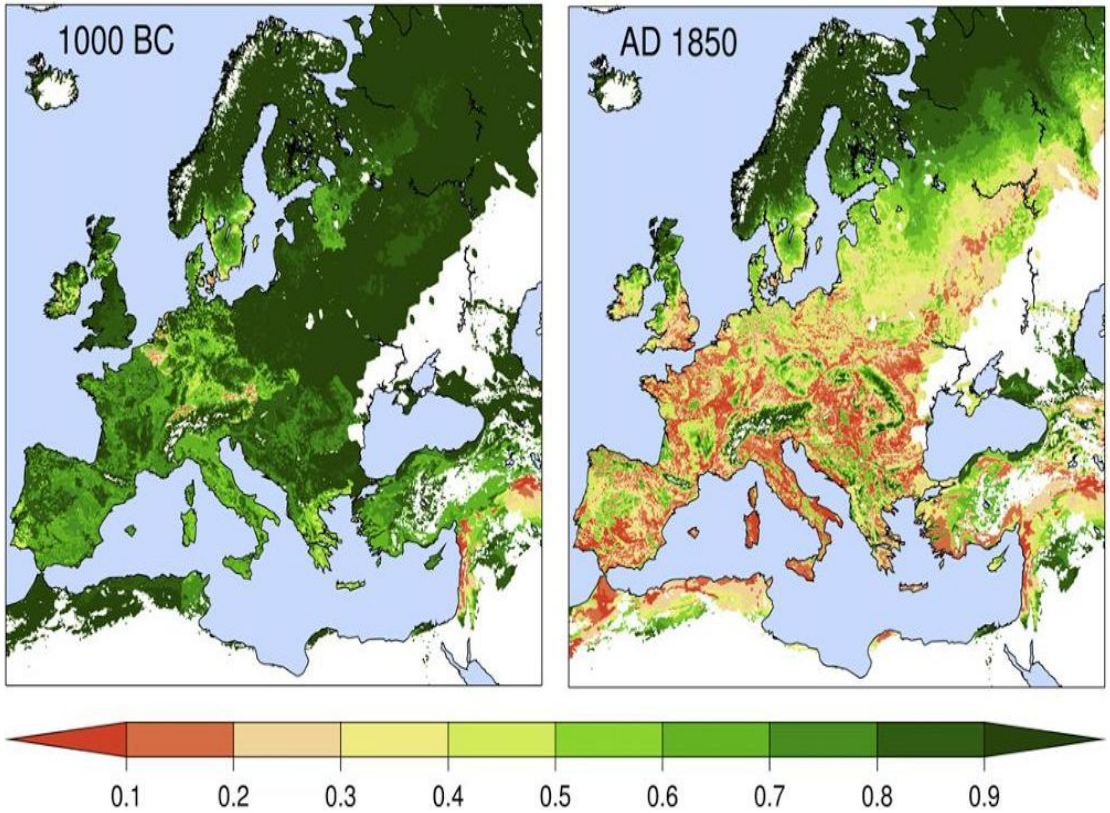
BIOTIC PUMP AND GLOBAL WARMING

WE, OUR PLANET AS A WHOLE, AND RUSSIA IN PARTICULAR, ARE LOSING FORESTS. Forest conservation and cultivation is the main way of atmospheric carbon binding, which allows at least partially balancing the enormous carbon dioxide emissions into the atmosphere when burning natural fuels (IPCC, 2013; Second Evaluation.., 2014;*Kokorin et al*., 2013).

Facepla.net first told about this immeasurably hardworking man in 2012. Jadav Payeng single-handedly turned 550 hectares of barren sand on the shores of the Brahmaputra (one of the largest waterways in South Asia) into a green jungle.

Through his tireless efforts Jadav received the title of “the Forest Man of India."

ESTIMATES OF THE FOREST AREA IN EUROPE 1000 YEARS BC AND IN 1850
(Kaplan a al., 2009)



The proportion of forest areas

Two thousand years ago forests covered 80% of Europe, whereas today this indicator is 34% (including the Russian forests). In Western Europe, deforestation peaked in the Middle Ages. The forests were cut down for agricultural needs, and by 1700 in Europe there were already about 100 million hectares of arable land. During 20th century, the area of arable land increased by 80 million hectares (Williams, 2006), in some places forests completely disappeared.

Reconstruction of the World Forest Area shows that at the beginning of the Holocene (10 thousand years ago), the forest area in the World was almost 6 billion hectares, or about 45% of the land (*Williams*, 2006). Increasing anthropogenic activity led to the fact that this area decreased to 4 billion hectares; by the beginning of 21st century almost 2 billion hectares of forests disappeared and the deforestation rate reached its maximum (more than 7 million hectares/year) (Global Assessment.., 2015). According to FAO estimates, if forest areas continue reducing at the same rate, in 800 years they will completely disappear.

CONCLUSION

Atmospheric Moisture Biotic Pump Theory, created by V. G. Gorshkov and A. M. Makarieva, at the global level develops the ideas of famous ecologists (Vernadsky, 2012; Odum, 1975) about what role plays **living matter** in changing our planet from the moment of the inception **of life** on it.

Restoring natural forest cover with all its inhabitants still living on the Earth (animals, plants, mushrooms, and representatives of other kingdoms) will significantly restore the ecosystem functions necessary for a sustainable existence **of mankind**.

Restoring natural forest cover normalizes the hydrological and temperature conditions; it will allow restoring a more favorable climate (by reducing droughts and floods), increasing productivity and biodiversity, and, in part, reducing global warming.

Solution to the problem of **natural forest cover restoration** can be found when the Earth's population will recognize the need for active action at different levels of the Earth's Biosphere: from the level of a particular settlement to the level of the planet as a whole.

The scientific basis for active actions is developed and improved in the sciences of the modern life of Nature (**ecology of biosystems**)and of the past life of Nature (**historical ecology**).

The techniques and methods of ecology of biosystems are aimed at assessing the state and making forecasts for the further development of various objects: from the organism (individual) to the totality of living things on the Planet.

Historical ecology develops methods for the reconstruction of living cover and the history of the fundamental destructive changes in nature caused by human in the past millennia.

The basics of ecology of biosystems and historical ecology are presented in the following presentation lectures.

Small island of preserved natural forests

Northern Ural, Pechora-Ilych nature reserve, Komi Republic

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