

Water and Climate - abstract

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Scientific research programs and materials have engaged with climatic changes for many years now. The whole process of these changes, however, was reduced almost exclusively to the question of so-called greenhouse gases. Many scientists claim that the connection of changes in the water (hydrological) cycles with climate changes is great but has so far been insufficiently studied. While attention thus far has focused on the impact of climate changes on the water cycle, the altered paradigm recommends concentrating attention on the impact of changes in the water cycle on climate changes.

The urban revolution is associated last but not least with sewerage. Our modern cities and more and more villages, are paved and their surfaces are reinforced with impermeable materials. The shortage of space and the need for comfort caused rainfall over cities or urban spaces to be perceived as a kind of burden. So, rainwater began to be perceived more as wastewater, which is carried away by public sewerage, in most cases along with sewage water. So now nearly all rainwater from the cities of Europe is carried away from the paved and roofed areas by rainwater outfall systems to rivers and eventually to the seas. According to estimates, more than 20 billion m³ of rainwater are sluiced away each year from the European continent. Over the past 50 years, then, more than 1000 billion m³ — that is, 1000 km³ — of rainwater, which in the past saturated the ecosystem and soil, filled out the stocks of groundwater, replenished springs and through its evaporation, moistened the climate, has been sluiced away from the European continent. The rapid outflow from paved urban environments with sewerage systems contributes to the higher occurrences of flooding threatening populations downstream. The most serious fact, however, is that, for a long time, we have been drying out the environment in which we live. We are causing a long-term drop in groundwater supplies, a growth in temperatures in city structures, a fall in atmospheric humidity, a start of civilizational diseases typical for urban environments, etc.

If solar radiation on a hot summer day falls on a surface well stocked with water, the majority of the solar energy is consumed in evaporation (60-80%) – dissipates into latent heat, which is not itself accompanied by increase in temperature. If the sun's rays fall on a drained area, most of the solar radiation (60-80%) is converted into sensible heat. Large-scale draining and removing of vegetation is connected with the release of a colossal amount of heat and with the formation of so-called 'hot plates' on land. Sensible heat released from just 10 km² of drained country (a small town) for a sunny day is comparable with the installation power of all the power plants in the Slovak Republic

(6,000 MW). A fall in evaporation by 1 mm per day over the total area of the Slovak Republic (49,000 km²) leads to release of perceptible heat of around 35,000 GWh for one sunny day. This is an amount of heat larger than the annual power production of all the power plants in the Slovak Republic.

Drainage leads to the fact that towns, while growing, change the microclimatic conditions of the original territory (the same applies to the deforested and drained agricultural land). They are becoming hot islands over which a hot climatic umbrella is growing. These "islands" are slowly changing the flow of clouds over their territory and in their surroundings. Particularly in the summer, they push precipitation to the cooler, e.g. mountain regions, which consequently increases the risk of extreme torrential rains in those regions and floods which threaten mountain valleys as well as populations in the lowlands downstream on rivers. Trends in precipitation in Slovakia during the 20th century show that the annual sum of precipitation has fallen by 5.6%; however in the mountains it rains more often and more intensively but in the lowlands the volume of rain is less than in the past. Spatial concentration in the fall of precipitation is accompanied by a concentration in the time division of this precipitation, i.e. periods of "drought" are lengthening and the timeframe in which the majority of precipitation falls is getting shorter. The described mechanism causes numerous long-lasting climatic changes of regional and continental significance. According to observations, the annual total precipitation in the 20th century increased by 10 to 40% over northern Europe, while in the Mediterranean it decreased by 20%. The occurrence of extreme heatwaves and intensive showers increased over most of the landmass, serious dry spells have affected vast regions of Europe, Asia, Canada, western and southern Africa and eastern Australia. The number of heavy floods (100-200 year floods) also increased significantly during the second half of the 20th century.

Drainage of developed land is accompanied by a drop of functional vegetation. Functional vegetation fulfills the function of a valve between the ground and the atmosphere. It protects the ground from overheating, and thus drying out, and optimizes the amount of evaporation through the help of transpiration of the many pores (stomata) on the leaves. Vegetation well stocked with water thus has a significant cooling effect and air-conditioning capability. Under the influence of the negative impact of drainage and the loss of permanently functional vegetation on the regime of rainfall and on the distribution of temperatures, we have gradually become victims of degradation and desertification of vast areas of once fertile land.

Good news is that water missing from the continents can be returned back through the rainwater which constantly circulates in the water cycle. We can return the lost water back to the continents by keeping rainwater on a massive scale in the places where it falls (extensive rainwater harvesting program), particularly in those areas where the influence of human activity is causing a drying out. The continents, with retained rainwater, will stabilize thermally and climatically and the extremes in the weather – particularly floods and drought – will be mitigated. Increasing the water-holding capacity of the land and catching precipitation in the places where it falls are themselves effective anti-flood (and anti-erosion) measures. Natural disasters will obviously always occur, but excluding

other external factors, the level of economic and civilization damage caused by the weather will be reduced.

This paradigm is not founded on new, revolutionary knowledge; its newness arises more from thinking through of existing knowledge to its logical consequences. Despite this fact, we are convinced that it is a pioneering work, that it radically changes water-management practice and may be a great inspiration for further research and for the scientific community. If it is correct, it opens the possibility of a constructive solution to many of the problems associated with climatic changes.

Michal Kravcik, 2007



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