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On the problems of water quality in Russia and some approaches to their solution

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Abstract An overview of water resources in Russia is presented in terms of the problem of water scarcity. It is shown that physical water scarcity, defined as insufficient resources to satisfy demand, is a feature of water security in very few regions of Russia, whereas most regions have enough water to meet industrial, agricultural and household needs, as well as environmental constraints. Inadequate water quality creates, to a larger extent than physical availability of water, the most serious water scarcity problem in the country. A synopsis of some water quality problems in Russia is presented. As the predictable consequence of increasing anthropogenic impact, many water bodies in the industrial and urbanized regions of Russia are badly polluted. The main sources of surface water pollution, as well as changes in the relative contributions of these sources over the last two decades, are analysed. As a specific concern, the problem of drinking water supply and sanitation is presented. A rising gap between the research and engineering communities is considered as one of the reasons for the water quality problems and bridging this gap is one of the main research challenges in water quality management in Russia. Two examples of effective implementation of research findings into practice are demonstrated: (1) new modelling tools for water quality prediction, and (2) new technology for monitoring of organic xenobiotics.

Key words water quality; anthropogenic pollution; water supply and sanitation; modelling; monitoring

WATER SCARCITY IN WATER-RICH RUSSIA: TWO DIMENSIONS OF THE PROBLEM

Perceptions of water security today are influenced by ideas about water deficit. Physical scarcity of water, defined as inadequate resources to satisfy demand, is widely understood as the defining feature of water insecurity in many countries; however, *ex facte*, it is not the case for Russia. Russia is one of the water-richest countries in the world. Renewable water resources total about 4300 km^3 (second only to Brazil which has the largest share of the world's total freshwater resources), equivalent to 29 000 m^3 for every person in the country. Thus Russia has far more water than the 1700 m^3 per person minimum threshold that hydrologists treat as the amount needed to support industries and households, grow food and maintain the environment. However, there is a large mismatch between distribution of water resources and population. The majority of Russian water resources are concentrated in the great rivers of the sparsely populated Siberia and Far East, Baikal Lake (almost a quarter of the world's supply of freshwater) and mountain regions. As a result, only 8% of the renewable water is in areas with 80% of the population.

The Russian economy uses freshwater resources ineffectively. The economic productivity of water – measured as unit of GDP produced with every cubic metre of water – is around US$10, i.e. half of that in USA and three times lower than in Germany (Danilov-Danilyan, 2009). Today the Russian economy uses in total not more than 1.5% of available water resources, i.e. about 62.5 km^3; industry accounts for 58% of water consumption; 18% is used for domestic purposes and 24% for agriculture (Water Strategy of Russian Federation, 2009). Moreover, the total water withdrawal for all purposes is about 60% of that in the later Soviet time and continues to decline now, albeit slower (Fig. 1).

In spite of the uneven spatial distribution of water resources and their consumptive use, there is and will remain (at least in the near future) more than enough water in Russia for domestic purposes, for agriculture and for industry. However, water insecurity exists in the most populated regions of Russia, e.g. in the European part of the country where 80% of population is concentrated. The insecurity is caused by inadequate water quality which is, in addition to the physical availability of water, the second dimension of water scarcity and creates the most serious water-related problem in Russia.