Geophysical Research Abstracts, Vol. 9, 07001, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-07001

Importance of stream temperature to climate change impact on water quality

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The sensitivity of water quality to climate change was assessed in the Seine River (France), with the biogeochemical model RIVERSTRAHLER, which describes the transformations and fluxes of C, N, P and Si between the main microbiological populations, the water column and the sediment. Point and diffuse sources are prescribed, stream temperature undergoes a sinusoidal annual cycle constrained by observations, and runoff is calculated by a physically-based land surface model. The reference simulation, using meteorological forcing for 1985-1991, gives very satisfactory results. The climate change simulated by a GCM under the emission scenario A2 was used to simulate the related changes in runoff and stream temperature. To this end, a statistical analysis was undertaken of the relationships between the air and water temperatures in the Seine watershed over 1993-1999, including more than 100 points that correctly sampled the variability of the tributaries. Most of stream temperature variance was explained by the one of lagged air temperature, with parameters that depended on stream order, so that stream temperature changes could be approximated by air temperature changes. The resulting impact of climate change on water quality is controlled by the warming of the water column, which enhances algal growth in spring and the loss factors responsible for phytoplankton mortality in late summer. In contrast, increased seasonal contrasts in river discharge have a negligible impact on river water quality.