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Water Policy Article

Riverine quality at the Anthropocene: Propositions for global space and time analysis, illustrated by the Seine River

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Abstract. The control of riverine quality (water, particulates) by human-related pressures is now a major feature of the Anthropocene era. A set of general typologies and approaches to address the complex relationships between pressures, environmental impacts and some of the related social responses is proposed here on the basis of various examples, among others the Seine basin. Riverine quality management is described through a dozen major types illustrated by river fluxes and riverine quality trends ($\geqslant$10 years). A successful restoration cycle, still seldom documented, is used as an example of the decomposition of the multiple social, societal and hydrological inertia and time lags, generally spanning several decades. Human impacts can also be described by finer temporal analysis, over hourly to year-on-year scales, and spatial analysis including classical longitudinal profiles, stream-order ranking and sediment pathways. The Seine river example illustrates the pressures from intensive agriculture, industrialisation, hydrological regulation and urbanisation with the impact of the World's second largest treated urban sewer discharge (from 8 million people in greater Paris).The impacts of the Paris megalopolis are much more widely spread than might be expected and include retro-impacts (in upstream reaches), distal (>100 km) and external impacts (outside of watershed). They are illustrated by specific spatial distributions of indicators of each particular phenomenon (organic pollution, metal contamination, xenobiotic occurrence, nitrate pollution, eutrophication). Although not comprehensive (acidification and salinization are not addressed here), such typologies should facilitate the comparisons between basins and phenomena at the regional and global scales.

Key words. River water quality; space-time analysis; global typology; Seine basin; Anthropocene.

Introduction

The anthropogenic forcing of the Earth Surface System is now equivalent or even greater than the natural one. The term Anthropocene has recently been used to qualify this fundamental change in the Earth's System, particularly regarding the climate (Crutzen and Stoermer, 2000). Although these authors identify Watt's invention of the steam engine (1784) as its starting point, another key date – 1950 – has been suggested (Meybeck, 2001a and c) for its full development, i.e. the point at which most indicators of human impacts (land use, dam construction, urban development, CO_2 increase, fertiliser use, nuclear energy impacts) show a sudden increase on most continents and/or have reached a global extension (Mackenzie and Mackenzie, 1995). This date is also the reference for ^{14}C dating (the so called Before Present ages).

Continental aquatic systems (CAS), here including soil water, streams and rivers, groundwater, lakes and estuaries, have been continuously modified since the early developments of agriculture, through land-use change, irrigation and navigation, the carrying of urban, mining and industrial wastes. These CAS modifications, including the creation of new types of aquatic systems such as canals, irrigation ditches, reservoirs, the alteration of natural hydrological regimes and the general degradation

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