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The Seine system: Introduction to a multidisciplinary approach of the functioning of a regional river system

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Abstract

The Seine basin (France) is dominated by the megalopolis of Paris (10 millions inhabitants), surrounded by intensive agricultural areas: it represents an important example of regional territory strongly affected by anthropogenic activity. In the scope of the PIREN-Seine program, an interdisciplinary study of this basin was conducted. This paper introduces a special issue of the Science of the Total Environment devoted to the results of this program. It summarizes the main features of the Seine river system, the physical characteristics of its drainage network and its watershed, and the nature and spatial distribution of human activities. The scientific approaches used for the study of the system are described, emphasizing the role of material budgeting, mathematical modeling and historical reconstruction. Some functional characteristics of the Seine watershed and drainage network are summarized, showing that the system is now essentially controlled by anthropogenic constraints.

Keywords: Seine River; Regional system; Interdisciplinary program; Anthropogenic activity; Autotrophy; Heterotrophy

1. Introduction

A few decades ago, the emerging concern about climate change introduced a planetary dimension into ecological research previously restricted to the study of well delimited, reasonably homogeneous, local ecosystems. Dealing with the problems of global atmosphere homeostasis required gumming out local heterogeneities of continental surfaces and to aggregate large collections of systems into single compartments. Today, between the ecosystem and the global level exists a gap in our understanding of the world at the regional scale, that ecologists, or more generally environmentalists, are urgently faced to fill in. The object of their study should no more be an isolated ecosystem but regional territories made of a mosaic of interacting ecosystems. The basic mechanisms involved in ecosystem functioning are often well known at the local scale. However, the difficulty lies in the integration of this knowledge at the large scale, because the heterogeneity of continental systems prevents straightforward extrapolation of local flux measurements to the global scale, and because processes occurring at the interface between the mosaic sub-systems play a major role.

An analysis of material fluxes at the planetary scale reveals the growing impact of humans through their agricultural, domestic and industrial activity, as compared to the fluxes generated by purely natural processes. Whereas ecosystem ecology could ignore human activity, or consider it only as an external constraint, regional environmental sciences investigate human territories made of a mosaic of interacting ecosystems many of which were created by man. Natural and artificial processes that ensure the circulation of biogenic elements,

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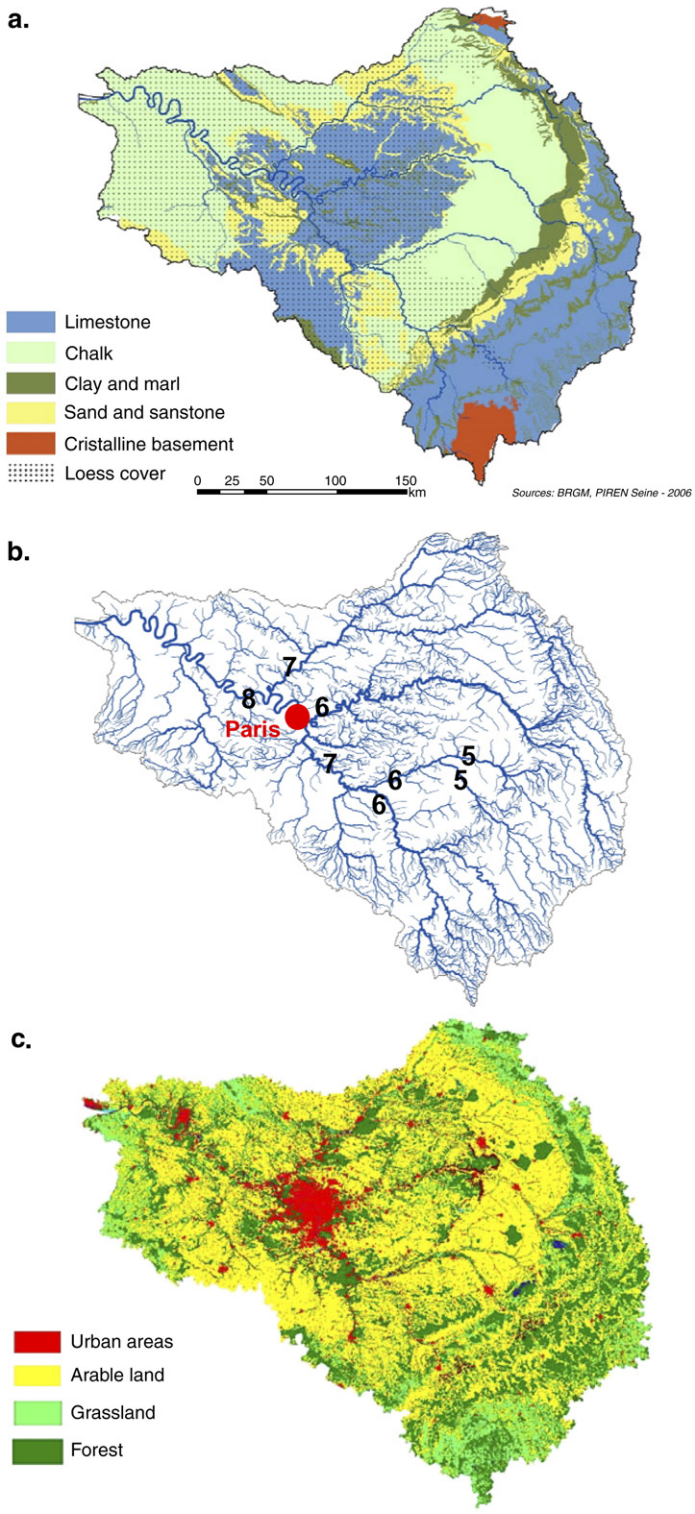

Fig. 1. General geographical features of the Seine basin. a. Lithological and geological structure. b. Drainage network of the Seine River system. c. Land use in the Seine basin (Corine Land Cover, 2000). d. Distribution of population density in the Seine basin (data by administrative 'cantons', Institut National de la Statistique et des Etudes Economiques (INSEE, 1999)). e. Cattle density (in Large Cattle Unit per km^2; data by administrative canton, Recensement de l'Agriculture, 2000).