**S1**. Environmental variables calculated to explain spatial patterns of salinity.

*Topography*: We calculated, for each river reach, total catchment area, river reach elevation, active channel width, valley width index (i.e. active channel width/floodplain width in [Fernandez et al., 2012](#_4d34og8) [3]), distance from river reach to river mouth, and river reach sinuosity from the same 5 m DEM from which Virtual Watersheds were built.

*Climate*: We calculated mean temperature, precipitation and real and potential evapotranspiration in the draining catchment and in the hillslopes adjacent to each river reach. These variables were derived from monthly averages (1980 - 2006) calculated in a 1 km grid map by means of interpolation procedure based on data recorded from multiple weather stations distributed across the Spanish river network. These variables were originally developed to be implemented into the Integrated System for Rainfall-Runoff modelling (in Spanish SIMPA model; [1]) by the Centre for Hydrographic Studies (CEDEX, Ministry of Public works and Ministry of Agriculture and Environment, Spain) for the assessment of water resources in natural regime at a national level.

*Land uses*: We calculated the area occupied by urban, agriculture, pasture, broadleaf forest, conifers, plantations and shrubs in the draining catchment and in the hillslopes adjacent to each river reach from the SIOSE classification (1:25000; [2]) of land uses.

*Geology*: We estimated the area occupied by calcareous, conglomerate, sedimentary and siliceous rocks, as well as average rock hardness, conductivity and permeability in the draining catchment and in the hillslopes adjacent to each river reach. These variables were derived from the geologic map at scale 1:1000000 developed by the Geological and Mining Institute of Spain. Rock hardness, conductivity and permeability were calculated using procedures described in [Fernandez et al., 2012](#_4d34og8) [3] and [Snelder et al., 2008](#_17dp8vu) [4]. Rock conductivity (i.e. defined as hydrochemistry in [Snelder et al., 2008](#_17dp8vu) [4]) informs on mineral salts contained in catchment soil while rock hardness (i.e. defined as erosion resistance in [Snelder et al., 2008](#_17dp8vu) [4]) is a measure of the erosion resistance of the soil, which affects the sediment supply, and consequently, the channel morphology, the bed sediment and suspended solids among others. Rock permeability, which informs on water ability to flow through the catchment soil, affects the response of the catchment to rainfall and the water interaction with soil sediments (i.e. dilution of mineral salts contained in rocks).

*Anthropic pressures*: We measured the distance of each river reach to effluent discharges (dangerous substances, industrial and urban effluents with loads > 2000 inhabitants equivalent), weirs and dams using ESRI's ArcPy Python module [5]. Effluent discharge data was obtained from the Hydrographic Confederations and Water Agencies databases. Weirs and dams data was obtained from DATAGUA database obtained from the Ministry of Agriculture and Fisheries, Food and Environment digital cartography ([www.mapama.gob.es](http://www.mapama.gob.es)). We used a 500 m buffer to locate and label anthropic pressures information to our river network. Due to computational limitations, we only identified pressures located at a maximum distance of 5000 m upstream each river reach. For distances > 5000 m, a distance of 5000 m was considered.

The assignment of these variables to each river reach was performed using NetMap tools.

**References**

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