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Characterizing spatial and temporal patterns of intermittent rivers

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Intermittent rivers (IRs) support high biodiversity due to their dynamic alternations between terrestrial and aquatic phases. They represent a large proportion of the river network. However the current knowledge on these ecosystems is limited.

The international research project "Intermittent River Biodiversity Analysis and Synthesis" (IRBAS, www.irbas.fr) aims to collect and analyze data on IR biodiversity from France, Spain, North America and Australia. These activities ultimately should help in identifying relationships between flow regime components and ecological responses. The IRBAS project will provide guidelines for policy-makers and resource managers for effective water and habitat management, restoration and preservation.

This work examines one of the aspects in the IRBAS project: studying the large-scale spatial distribution of IRs as well as the year-to-year variability of zero-flow events. IRs were described by two variables: the frequency of periods without flow (FREQ) per time period (months or years) and the total number of zero-flow days (DUR) in a specified time window (month or year).

Daily discharge data from more than 1700 gauging stations with no significant human influence on flow were collected from France, Spain, Australia and conterminous United States. A minimum length of 30 years of data starting from 1970 was required with less than 5% of missing data. Climate data for France and Australia were also collected.

A classification of perennial versus intermittent rivers was defined, with 455 stations out of the 1684 considered "intermittent", i.e. the gauging station records had, on average, at least 5 zero-flow days per year.

The analysis of the subset of IRs showed that:
- Greater than 50% of the IRs in the database is located in Australia, where only 35% of the stations are considered perennial. In Spain the proportion of IRs reaches 25%. The proportion of intermittent rivers in France (7%) is certainly underestimated as a consequence of the monitoring strategy, i.e. gauging stations have been primarily installed to measure perennial flows of medium size basins and most of the IRs remain ungauged. This is also true in the US where $\sim$ 7% of the current and historical gage network is on intermittent rivers.
- Intermittence of rivers demonstrates high seasonality which varies from one country to another.
- Links between climate variability and intermittence are not straightforward. No relation was found between annual DUR and annual precipitation in France whereas DUR was significantly correlated with precipitation in Australia. Potential evapotranspiration was correlated with DUR for France, but not for Australia, where the results were more obscure.
- No spatially coherent trends in flow intermittence were identified in Spain, France or the USA. Significant trends according to the Mann Kendall test were found in Australia and results suggest trends in yearly DUR consistent with observed changes in rainfall in Western Australia during the last few decades. The El Nino cycle is one of the possible sources of variability in intermittency patterns.