Trends in flow intermittence for European and Mediterranean Rivers

HydroSciences Montpellier

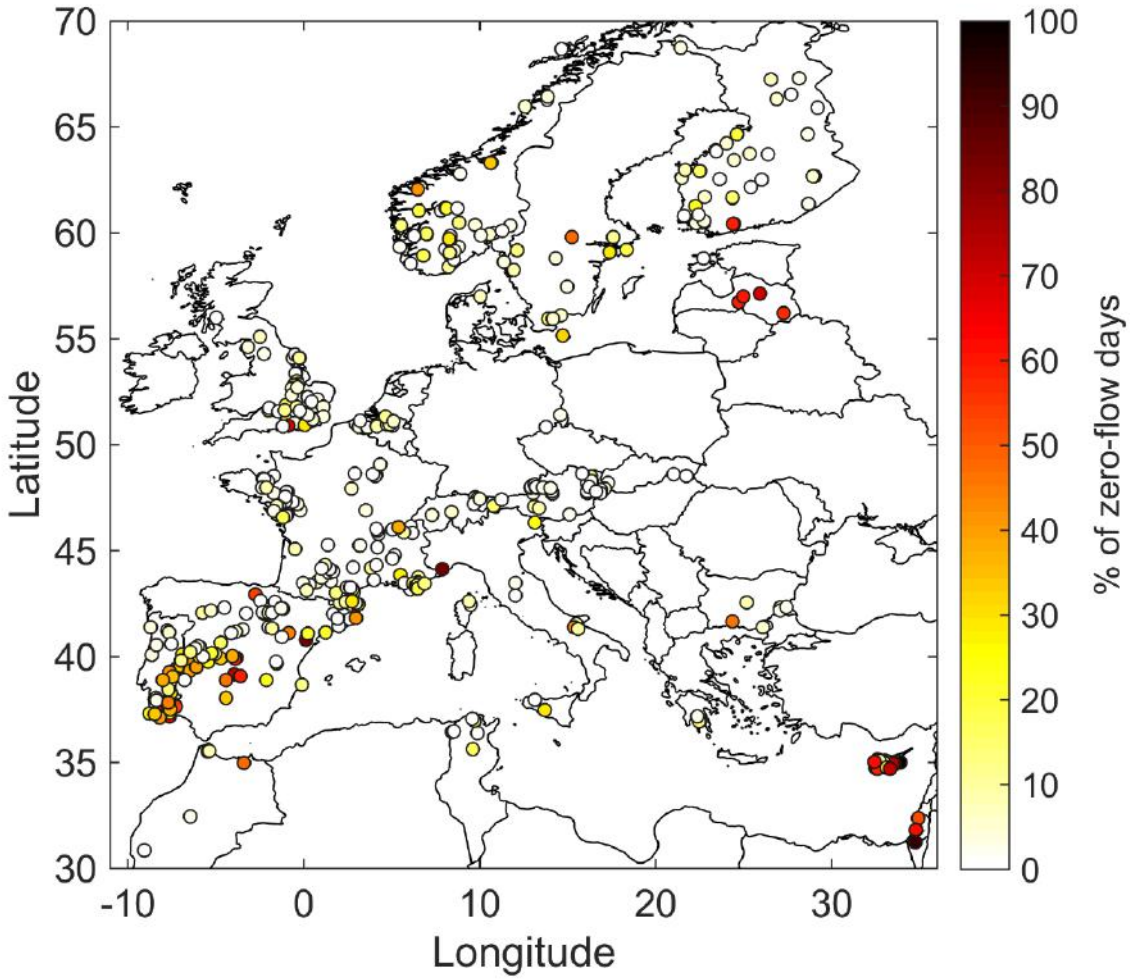
Med 2020

Introduction | | | | | Conclusion

Intermittent rivers are found in many countries across Europe and the Mediterranean, but little is known about the temporal evolution of intermittence and its relationships with climate variability

A database has been built in the EU-COST SMIRES action ("Science and Management of Intermittent Rivers & Ephemeral Streams") with 452 intermittent streams over Europe, North Africa and Middle East

- Trend detection in intermittence characteristics
- Relation with climate with SPEI (Standardized Precipitation Evapotranspiration index) and climate indices of large scale circulation



How to define a zero-flow day ?

Non-homogeneous data sources : potential errors in metadata and zeros in place of missing data: screening of the time series to verify if the smallest reported daily discharge < 10 $L.s^{-1}$ (series that do not meet this criteria are removed)

Due to different rating curve precision in different countries, instead of using zeros, a threshold of 10^{-4} $m^3.s^{-1}$ (0.1 $L.s^{-1}$) is considered to identify days with river discharge equal to zero

Two metrics are considered :

1. The duration of the longest no-flow event
2. The total duration of no-flow days

For annual, summer (April to September) and winter (October to March) time periods

Methods

Clustering of rivers based on directional statistics[1] of zero-flow dates

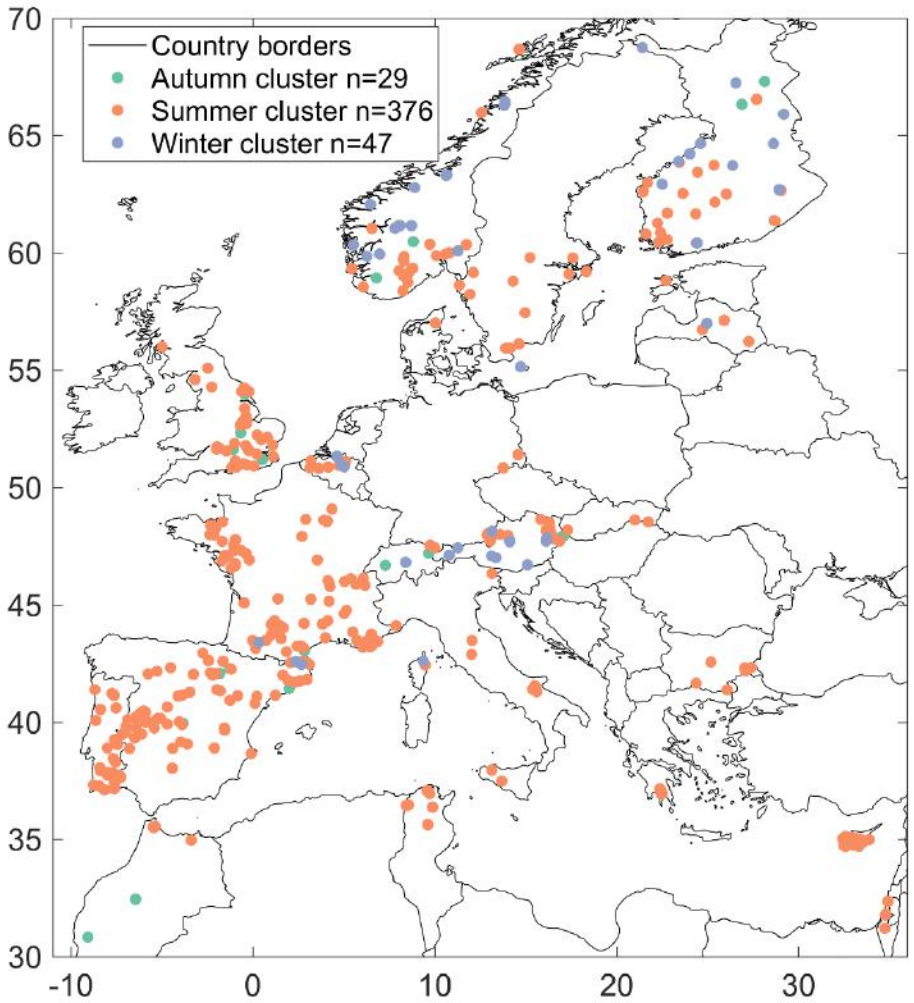
Mann-Kendall test for trend detection, with the pvalues adjusted with the False Discovery Rate procedure[2] to detect regional significant trends

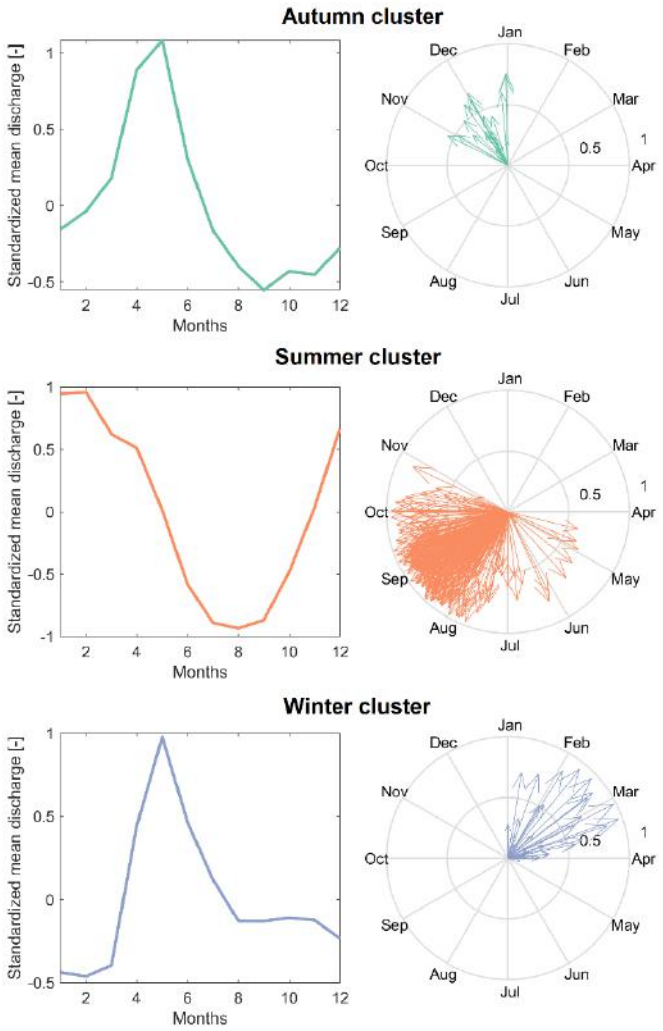
Sperman rank correlation with SPEI and climate indices

[1]*Burn, D.H., 1997. Catchment similarity for regional flood frequency analysis using seasonality measures. Journal of Hydrology, 202, 212-230.*

[2]*Wilks, D.S., 2016. The stippling shows statistically significant grid points: how research results are routinely overstated and overinterpreted, and what to do about it. Bulletin of the American Meteorological Society, 97, 2263–2273.*

Regional patterns

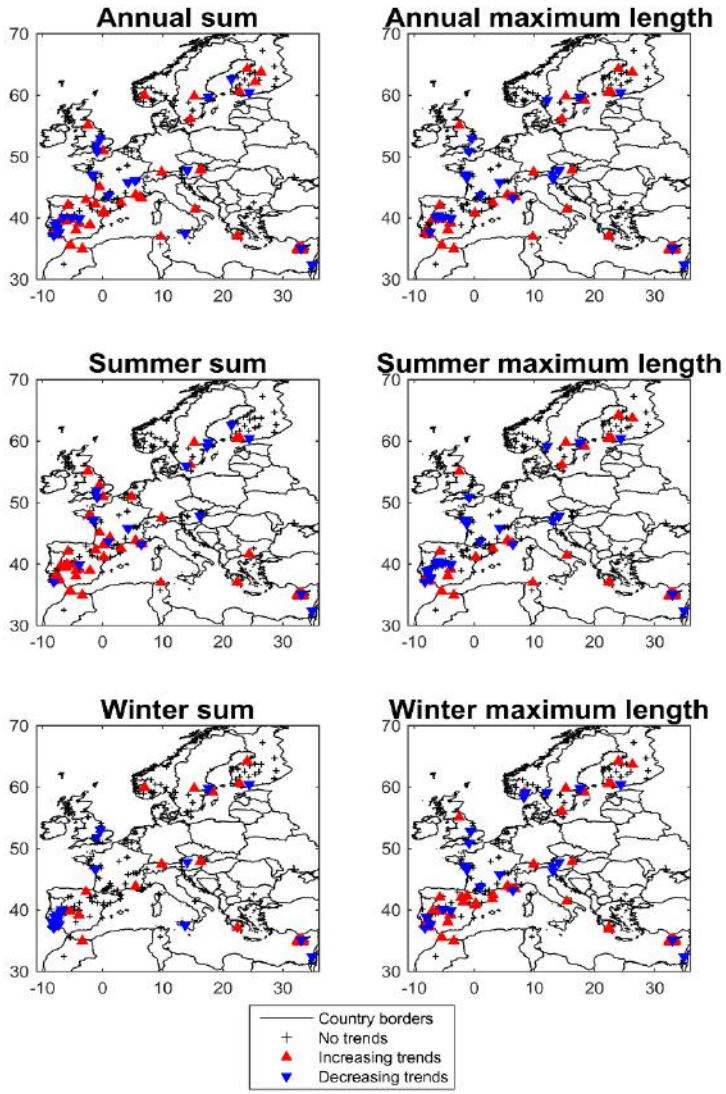




Three main seasonal patterns of occurrence : during extended summer for the majority of stations, autumn and winter for snow-driven catchments

Trends are detected in southern Europe towards an earlier occurrence of zero-flow during summer periods

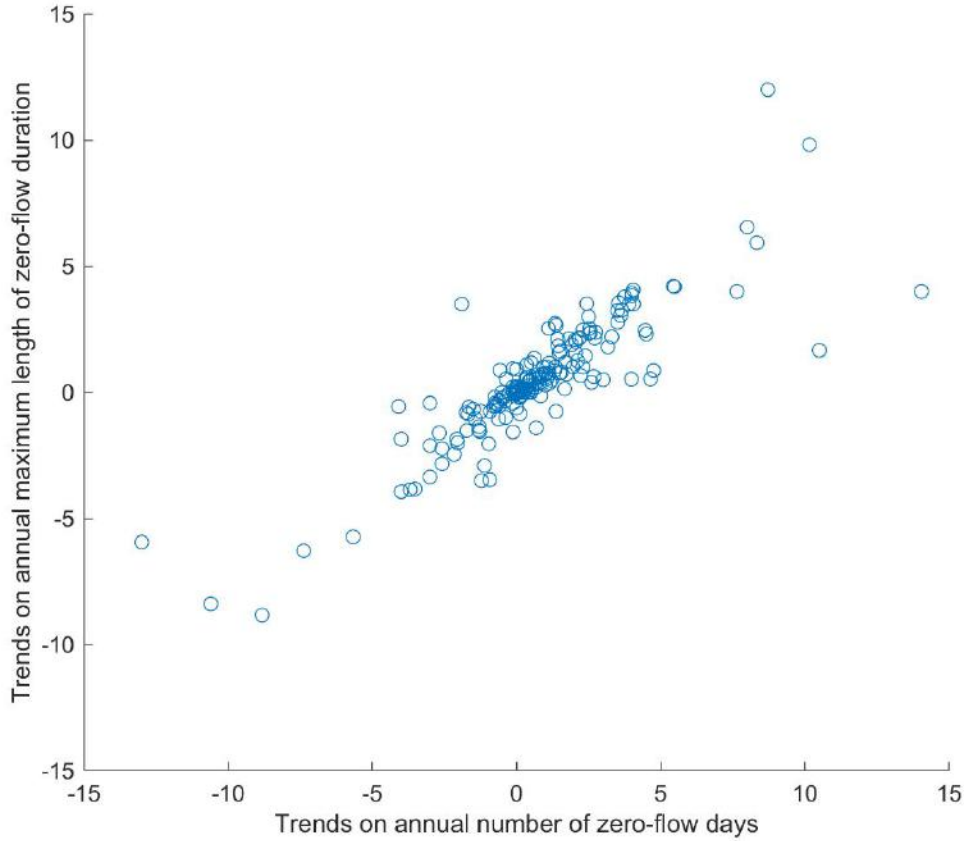
Trend analysis



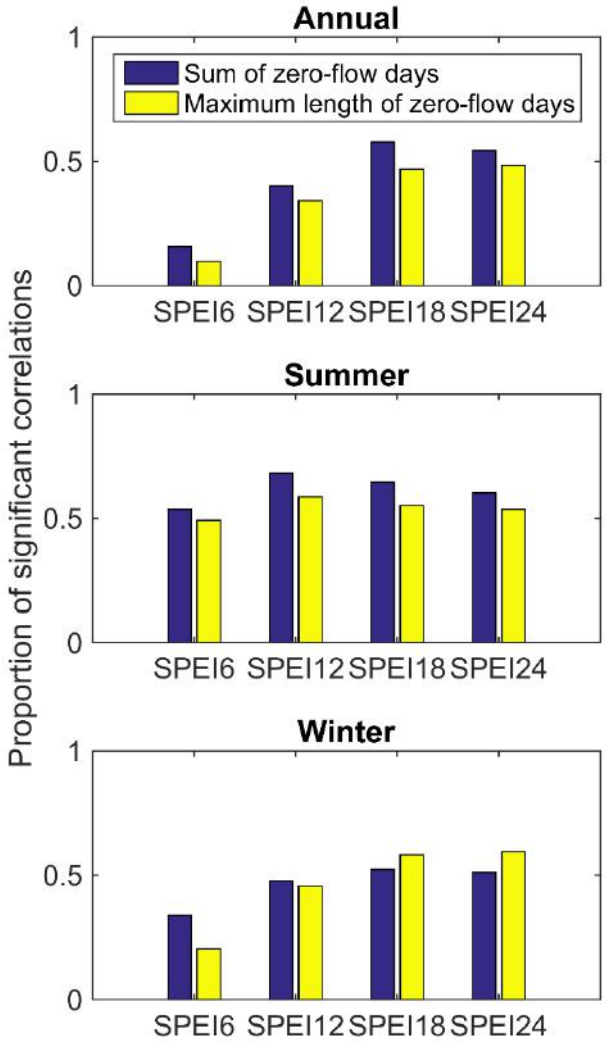
Trends are detected in 34% of rivers : with 23% increasing trends, 10% negative trends

These trends are mostly detected in the summer, for the Mediterranean region

Similar trends are found between extreme and mean duration of zero-flow events



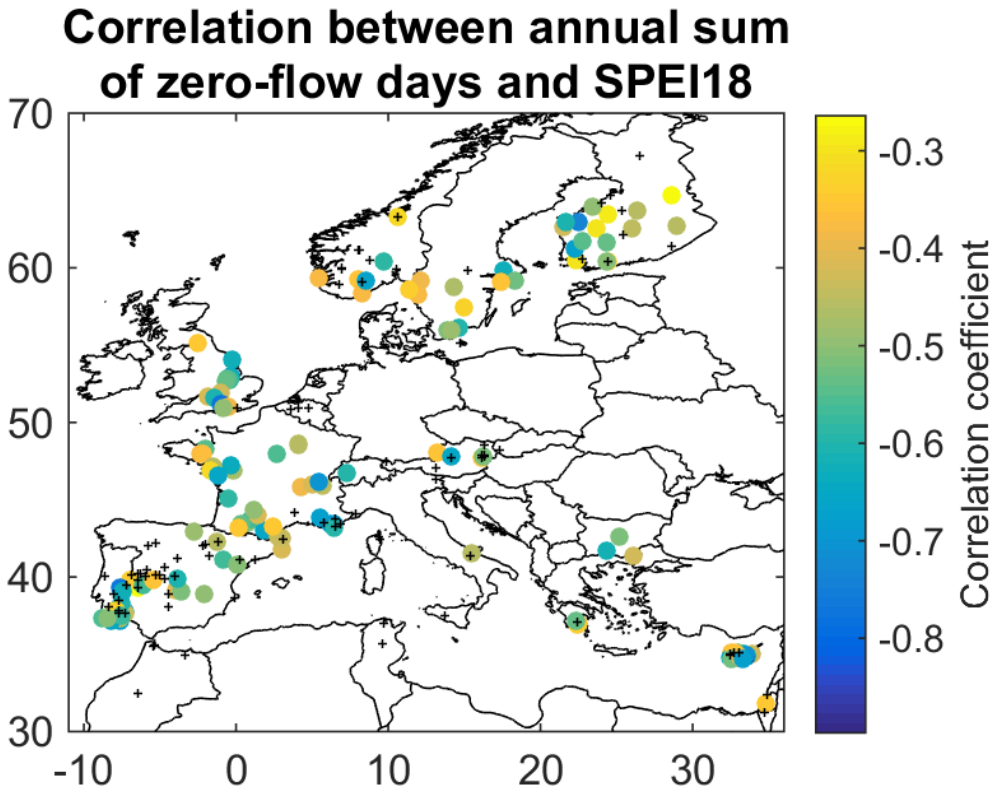
Links with climate



Significant correlations with SPEI in more than 50% of stations : zero-flow days are linked with negative SPEI anomalies

Strong spatial variability of the correlation strength, highlighting the important influence of catchment properties

The North Atlantic Oscillation (NAO), the Atlantic Multi-decadal Oscillation (AMO), are related to intermittence in about 20% of rivers, mostly in northern Europe



Conclusions - perspectives

Significant trends are detected in about 30% of stations, with most of detected trends towards an increasing number of zero-flow days, that tends to occur earlier in the season

Strong association of zero-flow days with negative SPEI anomalies, indicative of a Precipitation-Evapotranspiration deficit

Due to projected changes in the atmospheric evaporation demand, these trends are likely to amplify

Strong spatial variability of intermittence patterns, thus regional conclusions/predictions should be interpreted with caution. There is a need to deepen the analysis of the interplays with catchment characteristics and groundwater

Need to account for water use and water regulation at small scales, including their temporal changes. The definition of “altered river regime” varies from a country to another

SMIRES Science and Management of Intermittent Rivers and Ephemeral Streams

HyMeX

A collaborative effort recently published in:

Tramblay Y., Rutkowska A., Sauquet E., Sefton C., Laaha G., Osuch M., Albuquerque T., Alves M.H., Banasik K., Beaufort A., Brocca L., Camici S., Csabai Z., Dakhlaoui H., DeGirolamo A., Dörflinger G., Gallart F., Gauster T., Hanich L., Kohnová S., Mediero L., Ninov P., Parry S., Quintana-Seguí P., Tzoraki O., Datry T., 2020. Trends in flow intermittence for European rivers, **Hydrological Sciences Journal**, *https://doi.org/10.1080/02626667.*2020.1849708