Geophysical Research Abstracts
Vol. 18, EGU2016-14863-1, 2016
EGU General Assembly 2016

Multiresolution analysis and classification of river discharges in France and their climate forcing over the Euro-Atlantic area using Wavelet transforms and Composite analysis

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The context of climate change underlines the importance of better understand the complexity of the links between large climate fluctuations and their local expressions especially hydrological variables such as rainfall, surface or ground water streams.

Assessing how those variables will respond to climate forcing is difficult both from a temporal and a spatial point of view. Several past and actual studies aim at predicting how the hydrological variable will vary in time in response to the own variability of large scale fields (e.g pressure, temperature, winds..) and/or how this variability is translated spatially (with various attempts at classifications).

However most of those studies do not take into account two temporal and one spatial fact: First, the links between climate fields and local variables aren't the same for all time scales of variability, e.g, high frequency discharge variability may not be forced by the same large scale field as the low frequency one. Additionally those forcings may not be stationary. Secondly, most studies about the links between climate fields and local variables rely on correlation studies between climate indices and the local variables. Those indices have a well-defined shape and do not necessarily transpose the real physical state of those forcings.
The present study is mainly split in two parts that take into account the above mentioned temporal and spatial characteristics of discharges. The first part relies on assessing the main scales of variability of river discharge time series measured at 152 stations in France. A spatial classification of all 152 stations was then conducted using wavelet clustering. This allows taking into account the multi scale characteristics of discharges as well as their non-stationarity. The classification is compared with previous major one.
The second part focuses on climate forcings of discharges. Composite analysis is used to link discharges to large climate scale fields, i.e geopotential heights and meridional and zonal winds in the Euro-Atlantic area both for the winter and summer seasons for each station. The links are studied at different time scales of variability using multiresolution analysis. This allows assessing the large scale pattern that partly explains each scale of variability within the discharges. A cluster analysis is done on the obtained composite maps. A comparison is then realized between this classification and the one established in the first part of this study in order to test if stations that have similar time scales of variability also share the same climate forcings.