Geophysical Research Abstracts
Vol. 19, EGU2017-3653, 2017
EGU General Assembly 2017

Impact of external forcing on simulated hydroclimate from interannual to multicentennial timescales

Pedro Roldán, Jesús Fidel González-Rouco, and Camilo Melo-Aguilar
Institute of Geosciences IGEO (UCM-CSIC), Universidad Complutense de Madrid, Spain

During the last millennium, external forcing experienced important changes in different timescales. It has been demostrated that these changes had an impact on climate. In particular, changes in solar activity, volcanic eruptions and emissions of greenhouse gases are related to short-term and long-term changes in global temperatures, with situations of higher total external forcing generally related with higher global and hemispherical temperatures, and conversely with situations of lower forcing. This connection is clearly observed in climate simulations from different models and in proxy-based reconstructions. The changes in external forcing can also explain certain changes in atmospheric dynamics and hydroclimate, although in this case it is in general more difficult to trace causality arguments.

Analyses based on simulations from two different models (ECHO-G and CESM-LME) have been performed, to assess the impact of external forcing on climate in timescales ranging from interannual to multicentennial. Various climatic variables have been analysed, including temperature, sea level pressure, surface wind, precipitation and soil moisture. For interannual timescales, composites have been defined with the years before and after the main volcanic eruptions of the last millennium as well as the minima of solar activity during this period. For longer timescales, a Principal Component analysis has been performed, to try to separate the signal of external forcing from that of internal variability. This has been done for the whole millennium and for the pre-industrial period, to assess the difference between natural and anthropogenic forcing. For multicentennial timescales, composites for the Medieval Climate Anomaly (MCA; ca. 950-1250), the Little Ice Age (LIA; ca. 1450-1850) and the 20th Century have been compared. These three periods were respectively characterised by higher, lower and higher forcing. This allows to assess the contribution of external forcing to the evolution of climate over longer time intervals.

These analyses have shown that external forcing is an important factor in the evolution of the simulated hydroclimate of the last millennium. In the short-term, it has been observed that volcanic eruptions and other situations of extreme forcing significantly alter the global precipitation in the subsequent years. In the long-term, variations of external forcing can be related to changes in atmospheric dynamics and in hydroclimate. However, this impact is not homogeneously distributed. There are areas where hydroclimate is mainly influenced by the external forcing and other areas more influenced by internal variability, with spatial decorrelation being higher in precipitation or drought related variables than in temperature. The regional sensitivity to external forcing of hydroclimate is model and, to a lesser degree, simulation dependent.