Geophysical Research Abstracts
Vol. 21, EGU2019-9779, 2019
EGU General Assembly 2019

Understanding the potential of groundwater teleconnections to forecast hydrological extremes

William Rust (1), Ian Holman (1), Ron Corstanje (1), John Bloomfield (2), and Mark Cuthbert (3)

(1) Cranfield University, Centre for Environment and Agricultural Informatics, United Kingdom (roncorstanje@cranfield.ac.uk), (2) British Geological Survey, United Kingdom (jpb@bgs.ac.uk), (3) Cardiff University, School of Earth and Ocean Sciences, United Kingdom (CuthbertM2@cardiff.ac.uk)

Groundwater teleconnections is a growing area of research seeking to detect and understand relationships between wide-scale ocean-atmosphere oscillations and groundwater response. Such relationships can yield important predictive information on groundwater variability and extremes for future years or decades. However, due to the complex non-linear relationships between large-scale climate systems and regional to local-scale rainfall, ET and groundwater; detecting wide-scale evidence of such groundwater teleconnections, and their influence on drought and groundwater flooding, has been difficult. Here, we present the biggest groundwater teleconnection study to date, using an improved wavelet-based methodology to (1) quantify the strength of annual to multi-annual cyclical behaviour in monthly groundwater levels in 60 UK reference boreholes; (2) Analyse rainfall and ET to assess the contribution of teleconnections for these periodicities, and (3) evaluate how indicative these cycles are of groundwater extremes in the UK. Our results are the first to quantify the relative strength of seasonal and extra-seasonal variance in monthly groundwater levels, indicating that ∼7-year cycles in Chalk (limestone) and sandstone groundwater levels are often comparable to seasonality in defining total groundwater level variability. We demonstrate that the ∼7 year periodicity in groundwater results from a rainfall-based teleconnection with the North Atlantic Oscillation; documenting a clear alignment with every major recorded instance of groundwater drought (and recent instances of groundwater flooding) in the UK. An understanding that the severity of groundwater drought, and to some extent flooding, is enhanced on a 7-year cycle, produced through a teleconnection, provides significant opportunity for forecasting of future groundwater extremes. This understanding will becoming increasingly critical given the expected increased pressure on groundwater resources as a result of climate change, particularly in the UK and Europe.