SCHOOL OF GEOGRAPHY AND THE ENVIRONMENT

UNIVERSITY OF OXFORD

21st century drought scenarios for the UK

Muhammad Rahiz* & Mark New
School of Geography & the Environment, University of Oxford | South Parks Road OX1 3QY
*Email: muhammad.rahiz@ouce.ox.ac.uk

Introduction:

This research describes the ongoing PhD project on "*Droughts in future climate change in the UK*". The objectives of the research are to :

(a) Further our knowledge on the behaviour of drought indices,
(b) Characterize 21st century droughts and their spatial coherence in the UK,
(c) Investigate the physical mechanisms that influence droughts

Core methodology:

The drought severity index (DSI; Philips and McGregor, 1998) and standardized precipitation index (SPI; McKee *et al.*,1993) are applied to UKMO/UKCP09's 5km x 5km monthly observed rainfall dataset from 1916-2006 on a 3-, 6-, 12-, 24-, and 48-month timescales to reflect inter- and intra-annual droughts. Data from the National River Flow Archive from seven benchmark catchments in England are used to examine the timeseries of river flow and drought indices in terms of correlation and variability. The application of indices is then repeated for data (1950-2100) from the 11-member HadRM3-PPE-UK experiment for historical and medium (SRESA1B) emissions scenario.

Results: [1] Evaluation of indices

There is a difference in the frequency of "droughts" simulated by the DSI and SPI with the DSI generating more drought events (10 %) at 3-, 6- and 12-month timescales. Over 24- and 48-month timescales, significant difference exists with SPI showing hardly any signs of droughts. Although there is low correlation between the timeseries of SPI and DSI, both are able to reproduce patterns of river flow well especially at 6, 12-month timescales.

Figure 1a illustrates the relatively strong but negative correlation between DSI-6 and river flow data for the Thames hydrometric region while Figure 1b shows the variability of their timeseries. It can be seen that there is good agreement between DSI-6 and river flow, suggesting that meteorological-based drought indices such as the DSI are able to reproduce patterns of hydrological droughts.

Figure 1a

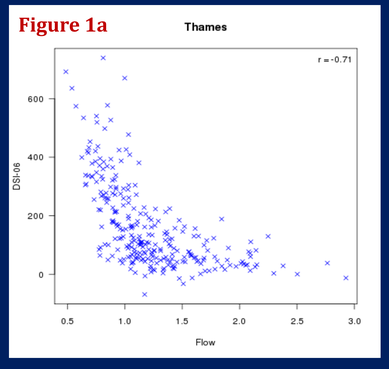
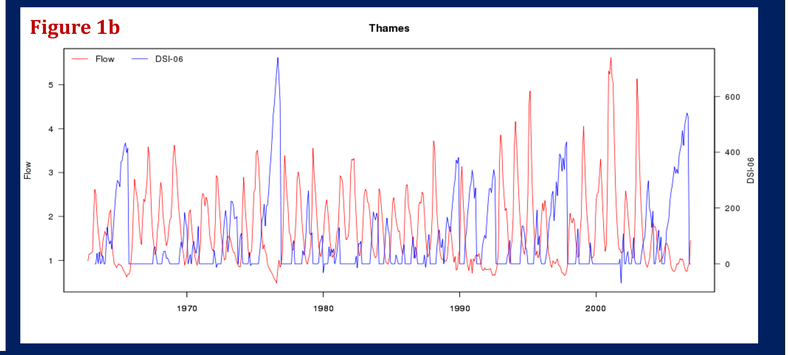


Figure 1b



Results: [2] Model evaluation

Figure 2 shows the annual precipitation bias between each member of the HadRM-PPE-UK and the observed dataset taken from the respective 1961-1999 period.
There is a strong underestimation of precipitation over NW Scotland and along the west coast of Great Britain and overestimation over much of England, especially central England.

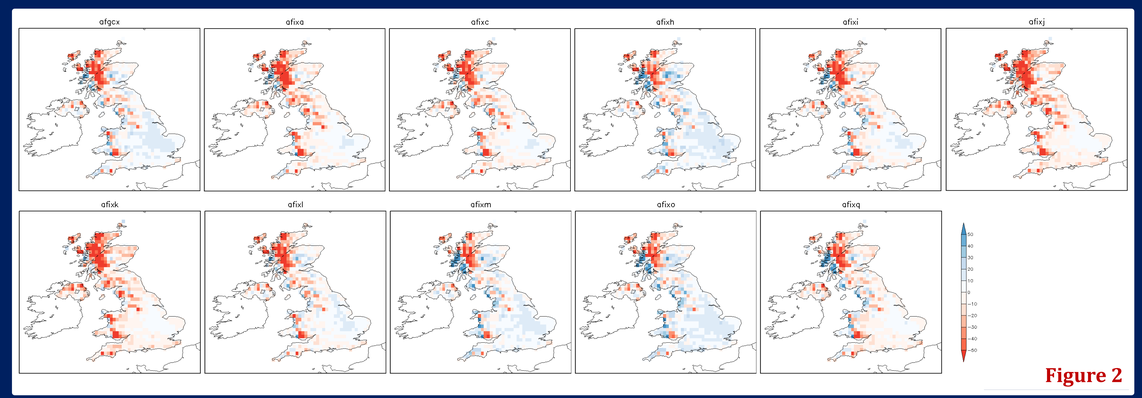


Figure 2

Results: [3] Drought scenarios for the 21st century

Figure 3 shows the change in spatial extent of 21st droughts relative to the 1960-1999 period using DSI-6. In most cases, there is a clear north-south divide in drought extent with much of England and Wales being most affected. Members *afixk* and *afixl* project an increase and decrease in droughts, respectively.

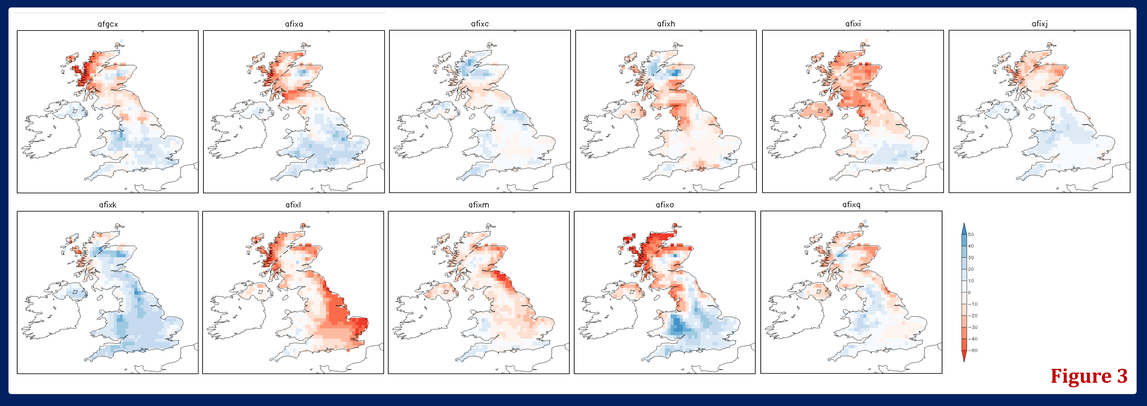


Figure 3

Further work:

Work is in progress to examine the spatial coherence of droughts and the decay distance for both the 20th and 21st centuries. This is examined by taking the fraction of time in which the years corresponding to the 90th percentile of the DSI-6 timeseries at a reference grid is common to that of all other grids.

References:

Philips and McGregor (1998) The utility of a drought index for assessing the drought hazard in Devon and Cornwall, South West England. *Meteorological Applications*, 5(4):359-372
McKee et al. (1993) The relationship of drought frequency and duration to time scales. In *Proceedings of the 8th Conference of Applied Climatology,* 17-22 January, Anaheim, *CA*. American Meteorological Society, Boston, MA. 179-184.