UNIVERSITY OF BIRMINGHAM, SCHOOL OF GEOGRAPHY, EARTH & ENVIRONMENTAL SCIENCES
PhD studentship in collaboration with CENTRE FOR ECOLOGY AND HYDROLOGY (CEH)

Development of droughts in Europe: from observations to inter-model comparisons

Supervisors:
David M. Hannah and Christel Prudhomme (CEH)

Project Description:
Drought is a recurrent natural hazard with very significant impacts on socio-economic activities, food-water-energy security, and ecosystems. Drought events develop slowly and cover large spatial domains (region to continental scale). While lack of rainfall is a well known driver of droughts, the mechanisms behind severe droughts remains largely unexplained in particular because droughts and their impacts (i.e. meteorological, agricultural and hydrological) are often considered independently, not as part of the same integrated process. Improving understanding of the physical processes and expression of droughts through the entire water cycle is vital because such knowledge has potential to improve modelling of future drought and, thus, human preparedness and management of these extreme events. ***This PhD project aims to investigate the spatio-temporal developments of historical droughts in Europe and to assess how the latest generation of global hydrological models reproduce continental scale drought patterns***.

The project will make timely use of the most up-to-date and extensive pan-European hydroclimatological datasets available, including observations (e.g. EWA and E-OBS) and modelled data, in particular the EU-FP6 WATCH and WaterMIP products. Using a range of recognised drought concepts (e.g. Standardised Precipitation Index, Palmer Drought Severity Index and Regional Drought Index) and a suite of statistical analyses techniques (e.g. spectral and spatial analysis) applied to rainfall, soil-moisture, sub-surface and runoff deficits time series, the development of droughts throughout the entire water cycle will be characterised for the first time at a continental scale in terms of severity-area-duration and from a multi-model ensemble. The hydroclimatological time series and historical drought catalogues will be used as benchmarks against which modelled drought episodes will be compared.

The outcomes of this research will provide a major step towards understanding the onset, duration and severity of droughts as hydroclimatologically integrated events, necessary before accurate drought projections can be achieved, and will provide valuable feedback about which drought conditions are best and least-well reproduced by different models. The work will contribute to international research programmes such as UNESCO and HYPEX.

Training: This student will gain skills in hydrology, climatology, management of large data sets, GIS, computer programming and multivariate statistical analysis. Importantly, not only will the student enhance existing and gain new skills in these areas, but also develop the academic capability to bridge the gap between atmospheric and hydrological sciences, and blue-skies and operational research. Transferable skills (conference presentation, time management etc.) will be developed too. He/she will benefit from working as part of a multidisciplinary team, exposure to the research culture of a NERC Centre and from participating in a large and active graduate research school within the School of Geography, Earth and Environmental Sciences in Birmingham.

Some Relevant Papers by Supervisors:

Fleig, A. K., L. M. Tallaksen, H. Hisdal, and D. M. Hannah: Regional hydrological drought in north-western Europe: linking a new Regional Drought Area Index with weather types. *Hydrological Processes*, **25,** 1163-1179.

Fleig, A. K., L. M. Tallaksen, H. Hisdal, K. Stahl, and D. M. Hannah: Inter-comparison of weather and circulation type classifications for hydrological drought development. *Physics and Chemistry of the Earth*, **35,** 507-515.

Hannaford, J., B. Lloyd-Hughes, C. Keef, S. Parry, and C. Prudhomme: Examining the large-scale spatial coherence of European drought using regional indicators of precipitation and streamflow deficit. *Hydrological Processes*, **25,** 1146-1162.

Hannah, D. M., S. Demuth, H. A. J. van Lanen, U. Looser, C. Prudhomme, G. Rees, K. Stahl, and L. M. Tallaksen: Large-scale river flow archives: importance, current status and future needs. *Hydrological Processes*, **25,** 1191-1200.

Lavers, D., C. Prudhomme, and D. M. Hannah: Large-scale climate, precipitation and British river flows Identifying hydroclimatological connections and dynamics. *Journal of Hydrology*, **395,** 242-255.

Lavers, D., C. Prudhomme, and D. M. Hannah: Large-scale climatic influences on precipitation and discharge for a British river basin. *Hydrological Processes*, **24,** 2555-2563.

Applications Forms: Mrs G. Coldicott, School of Geography, Earth and Environmental Sciences, University of Birmingham, Edgbaston. Birmingham. B15 2TT. Tel. (0121) 414 6935. Email: g.coldicott@bham.ac.uk

Informal Enquires: David M. Hannah. Email: d.m.hannah@bham.ac.uk; Christel Prudhomme chrp@ceh.ac.uk