WEDNESDAY 17 March 2004: WATER-LAND-ATMOSPHERE INTERACTIONS

Dr Nick A Chappell, University of Lancaster: **Introduction to coupling meteorology and hydrology.**

The two disciplines of meteorology and hydrology are well established. Recent evidence would suggest that considerable mutual benefit can be gained where the two academic communities work together. Hydrological science is benefiting from greater meteorologist or meteorological input in several key areas. The increased use of Global Climate Models (GCMs) that require land-surface properties averaged over areas 100 x 100 km2 is beginning to stimulate hydrologists to address the description of processes of evaporation and runoff generation over much larger scales than before. Greater understanding of the spatio-temporal dynamics of rainfall, because of its critical control of runoff processes, is improving rainfall descriptions for applied issues such as land-use impacts on river behaviour and flood prediction. The increasing availability of rainfall radar is allowing improved real-time forecasting of floods in developed areas, and in filling gaps in rain gauge networks in developing regions. Similarly, new hydrological findings are increasingly informing meteorological studies. There is an increasing awareness of the over-simplification of land-surface characteristics and flows within current GCMs and this has stimulated the involvement of hydrologists in providing basic data for data-sparse tropical regions and in addressing taxing scale issues in established temperate research sites. The humid tropics are a particularly important region for the behaviour of the global climate, and new hydrological research on runoff processes in the tropics is giving new insights into the descriptions of these processes in GCMs. Other tropical studies are improving our understanding of evaporation processes and providing much more realistic data to run GCMs or indeed evaluate their predictions. This presentation illustrates these issues using some of the latest studies from around the world and aims to introduce the following presentations which address synergistic meteorology-hydrology research in much more detail.

Dr David Grimes, University of Reading:**Application of satellite-based rainfall estimates to river flow forecasting in Africa**

River flow forecasting on a time scale of days is important for river management and flood warning. A major requirement is real time catchment rainfall data. In Africa ground-based observations are rarely available in time to be used as input to an operational rainfall-runoff model and other approaches must be found. In this research we have investigated the use of satellite-derived rainfall estimates for flow forecasting for a sub catchment of the Senegal river. We show that the satellite estimates are at least as useful as rain gauge data even if they could be available in real time. Further the quality of the rainfall estimates can be improved by incorporating meteorological information such as storm type and the phase of African Easterly Waves

Professor Nigel Arnell, School of Geography, University of Southampton: **Hydrological**

change from climate model simulations
Many of the major impacts of climate change are likely to be felt through changes in water resources, and therefore many studies have attempted to estimate potential changes in hydrological regimes. There are, however, many uncertainties, and these broadly fall into three areas: simulating future climate with climate models, creating scenarios for climate change from climate models, and simulating the hydrological response of a given climate change scenario. This presentation focuses on the second and third uncertainties. Climate models simulate runoff and in principle it is possible to use these estimates directly. However, Global Climate Models operate at too coarse a spatial scale for catchment-scale hydrological simulations, and the quality of the climate model runoff is determined partly by the quality of the land surface parameterisation within the model but largely by the simulated large scale climate. Regional climate models operate at a more appropriate spatial scale, but the quality of the simulated runoff is still dependent on the simulated large scale climate. The vast majority of impact assessments therefore do not use climate model runoff directly, but rather use a variety of techniques to create climate scenarios to feed into "off-line" catchment hydrological models. These different techniques have the potential to produce different changes in hydrological regime from the same ultimate driving climate change scenario. Hydrological simulations are also uncertain: different models may generate different sensitivities to change, and for a given catchment model different parameter sets may result in different impacts of climate change. These issues will be illustrated using examples from southern Africa and the UK

Dr Peter Cox, Hadley Centre: **GCM land-surface schemes: limitations and developments.**
Land-surface schemes provide the lower boundary conditions to the General Circulation Models (GCMs) used in climate prediction and weather forecasting, calculating the surface fluxes of heat, water and some trace gas species (such as CO2), and updating the surface conditions which control these fluxes (e.g. soil temperature, soil moisture, snow cover). The way in which the land-surface is represented by such schemes is known to affect both the projections of climate change for the 21st century and the accuracy of numerical weather forecasts. As a result a great deal of research effort over the last two decades has been devoted to improving land-surface schemes for both applications. This talk will summarise the current status of land-surface schemes in GCMs, particularly highlighting recent developments in the representation of hydrology, the carbon cycle and trace gas emissions. Some priorities for further improvement will be suggested based on the remaining limitations in the current generation of land-surface schemes.

Dr Eleanor Blyth, CEH Wallingford **Land-surface evaporation: how observations inform the models**

Modelling the evaporation from the land surface is crucial for many areas of decision making and as input to other environmental models. Yet any model of this diverse, heterogeneous and complex system will necessarily involve some data. This will either be used at the conceptual stage to define the appropriate model to be used, or at the calibration stage to define the values of the parameters in the model. The data that has been available for informing evaporation models has changed over the past decade: from measuring fluxes and soil moisture changes over areas of 1m to 100m, to satellite observations and scintillometers measuring evaporation and soil moisture changes over areas of 5km to 50km. In addition the models have improved so that other observations can start to be used, such as river flow. This presentation explores the subject of using observations to inform evaporation models; the problems, new initiatives and possibilities for the future.

Dr Mike Bonell, UNESCO: **Rainfall-runoff processes in the tropics: latest findings and links with synoptic climatology**
Following a review of storm runoff generation processes at the hill slope scale within closed tropical forests, possible links with tropical synoptic climatology-rainfall characteristics will be briefly covered. Some reference will also be made to the impacts of land use change (tropical forest conversion) on the storm runoff generation process.