Tropical Climate and Rainfall Variability

"Understanding climate variability in the tropics, which form arguably the most important part of the global hydrological system, is of key benefit to many of the world's developing nations."

1400 Introduction (Charlie Williams, Andy Turner, Eric Guilyardi)
1405 MJO Interactions / Teleconnections in the Tropics (Adrian Matthews)
1425 Scale Interactions in the Tropical Atmosphere (Steve Woolnough)
1445 Tropical Pacific Climate Change and ENSO (Mat Collins)
1505 Modelling the Tropical Hydrological Cycle from NWP to Climate (Sean Milton)
1525 Open discussion: The big meteorological issues in tropical climate and variability
1600 Close

MJO Interactions & Teleconnections in the Tropics

Adrian Matthews (a.j.matthews@uea.ac.uk)

The Madden-Julian oscillation (MJO) is the primary mode of tropical variability on intraseasonal time scales. It directly affects rainfall over large areas of the tropics and modulates the tropical monsoon circulation. The MJO interacts strongly with the ocean, and can act to trigger El Nino events. Through teleconnections beyond the Tropics, the MJO is a source of potential predictability for global weather on medium-range time scales. An overview of the large-scale interactions and teleconnections within the tropical MJO will be presented, with an emphasis on theoretical understanding of the MJO structure.

Adrian Matthews is a Reader in the School of Environmental Sciences and School of Mathematics, University of East Anglia. His research interests are in tropical meteorology and weather and climate modelling.

Scale Interactions in the Tropical Atmosphere

Steve Woolnough (s.j.woolnough@reading.ac.uk)

This talk will introduce a few examples of scale interactions associated with convection in the tropical atmosphere and discuss some of the issues raised by them. It will introduce the Cascade project and its approach to tackling some of these issues.

Steve Woolnough is a Senior Research Fellow in NCAS-Climate at the University of Reading. He completed his PhD in 1997 when he joined what is now the NCAS-Climate Tropical Group. He spent 18 months at the Met Office in the Convection Group before returning to NCAS-Climate. He is now leading the Cascade Project and manager of the Tropical Group.

Tropical Pacific Climate Change and ENSO

Mat Collins (matthew.collins@metoffice.gov.uk)

On the face of it, projecting the behaviour of ENSO in a warmer world looks like one of the most challenging problems in climate prediction, involving interactions between many dynamical, physical and even biological processes and feedbacks. The Fourth Assessment Report of the IPCC (2007) concluded that "there is no consistent indication …of discernible changes in projected ENSO amplitude or frequency in the 21st century". However, since the publication of the IPCC report, there is a growing body of observational, theoretical and modelling evidence that supports the hypotheses of significant modification of tropical Pacific mean climate and ENSO variability as a result of global climate change. Increasing greenhouse gases lead to a general reduction in convective rainfall in the tropics, which manifests as a weakening of the Pacific trade winds and commensurate reduction in east-west temperature gradient at both the surface and in the sub-surface near the thermocline. Changes in mean conditions destabilise a mode of ENSO variability in which sub-surface thermocline variability plays an increasingly important role, leading to larger amplitude events. Changes in atmospheric processes and non-linearities in equations governing ENSO dynamics may further modify the dynamics of ENSO and its teleconnections, though the presence of significant natural interdecadal fluctuations in ENSO variability complicate the picture. The preparation of a new set of coupled atmosphere-ocean models, in which it will be possible to better evaluate improvements in the physics of ENSO, present an opportunity to test these hypotheses of changes in mean climate and variability. Although is the sensitivity of ENSO to increasing greenhouse gases really the top-level policy-relevant problem to be looking at?

Mat Collins is Manager of Ensemble Climate Change Prediction at the Met Office Hadley Centre. His main job is to produce ensembles of climate model simulations to feed into probabilistic projections but he manages to do a bit of ENSO work on the side.

Modelling the Tropical Hydrological Cycle from NWP to Climate

Sean Milton (sean.milton@metoffice.gov.uk)

Accurate prediction of the tropical hydrological cycle is a key element of weather and climate prediction at the Met Office, encompassing extreme precipitation events on timescale of a few days (Tropical Cyclones) to intraseasonal variability (MJO) and tropical-extratropical teleconnections at longer timescales. Large-scale systematic biases in climate predictions of the tropical hydrological cycle are evident even at short forecast ranges (1-5 days). This suggests that considerable uncertainty in the hydrological cycle at climate timescales arises from the representation of local dynamical and parameterized physical processes and not just circulation errors. This study looks at the performance of the tropical hydrological cycle in the global NWP version of the Met Office Unified Model (MetUM) during 1994-2009 against a wide range of observational datasets from planetary scale climatologies (GPCP, TRMM) down to regional and local scale (in-situ) data. The character of modelled vs. observed precipitation is assessed across a number of timescales from intra-seasonal to diurnal and aspects of the regional hydrology on the scale of large river basins is assessed using runoff data from the model and the river gauge networks (GRDC). The Asian Monsoon is used further to highlight model deficiencies and outline some recent improvements.

Sean Milton leads the Global Model Development & Diagnostics team at the Met Office investigating systematic errors in global NWP models on the 1-15 day prediction timescale and working closely with model development teams to improve model formulation. Interests include Energy and Water cycles, representation of convection and the land surface in models, and developing seamless prediction systems.