Geophysical Research Abstracts,
Vol. 11, EGU2009-5787, 2009
EGU General Assembly 2009

Uncertainties in future projections of extreme precipitation in the Asian monsoon regions

A. G. Turner (1) and J. M. Slingo (2,1)

(1) NCAS-Climate, University of Reading, United Kingdom (a.g.turner@rdg.ac.uk), (2) Met Office, Exeter, United Kingdom

The seasonal cycles of the South and East Asian monsoons bring regular and dramatic changes to these regions. While the mean summer monsoon rainfall seems reasonably stable over the recent observed record, projections under enhanced greenhouse gas forcing are uncertain. The uncertainty is even greater for extremes of monsoon rainfall and here we examine two aspects of this in climate change scenarios of the 3rd Coupled Model Intercomparison Project (CMIP3) database.

A previous study using the HadCM3 coupled model has shown significant increases in subseasonal precipitation extremes (e.g., 95th and 99th percentiles) of the Asian summer monsoons under doubled carbon dioxide conditions. However, the spatial distribution of changes to these precipitation extremes are strongly linked to projected changes in the mean. Given the large spread in climate change projections of the mean monsoon in the current state-of-the-art models, such information is therefore of limited use for informing impacts studies. Comparing control and 1%/year increasing CO2 (1pctto2x) integrations, we show that this strong relationship between the spatial pattern of change to mean monsoon rainfall and that of subseasonal rainfall extremes holds for the CMIP3 models. Indeed, around 80% of the variance in the pattern of change to the 90th subseasonal percentile of rainfall over India can be explained by the mean change in a given model.

Using HadCM3 we show that the change in magnitude of the heaviest monsoon rainfall events due to anthropogenic greenhouse warming is predictable based on purely thermodynamic arguments relating surface temperature increase (the local climate sensitivity) and moisture-holding capacity of the atmospheric column (through the Clausius-Clapeyron relation). Given that there is rather less uncertainty in projections of temperature over the monsoon regions, this offers some potential for predictability in the degree of change of the worst rainfall extremes. Similar calculations in daily data obtained from the CMIP3 archive show that some models reveal only these thermodynamic changes to the heaviest monsoon rainfall, while others have an additional dynamic component. The suggestion from the multi-model database is thus that using local climate sensitivity may give us a lower bound on the level of increase of the heaviest monsoon rainfall. This study also highlights the need to clarify the mechanisms involved in mean monsoon change, whether dynamic, thermodynamic, or a combination of both.