INTEGRATE: An integrated data-model study of interactions between tropical monsoons and extra-tropical climate variability and extremes

Call: Climate Predictability and Inter-Regional Linkages
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In order to predict the evolution of inter-regional linkages this century, it is crucial to understand how they have evolved in the past. This is particularly important because extremes such as drought are modulated by decadal variability. Our study is motivated by recent identification of multidecadal links between 2000-year reconstructions of Tibetan Plateau precipitation and Northern Hemisphere temperature. We will go far beyond this initial finding by combining insights gained from coupled climate models and observations (instrumental, tree-ring and documentary records) to identify large-scale modes that link the variability of tropical monsoons and northern extratropical climates on multiple timescales. We will (i) better understand the teleconnections between monsoon and extratropical regions (with particular emphasis on the Arctic), (ii) evaluate the ability of climate models to reproduce observed behaviour including regional extremes, (iii) explore mechanisms that drive the observed behaviour and understand how the linkages may evolve under future climate change using simulations with a hierarchy of models. Paleoclimate records, including temperature sensitive tree-ring records from the Eurasian Arctic and precipitation-sensitive series from the Asian monsoon regions provide a unique opportunity to identify associations on annual to multidecadal timescales. CMIP5 and CMIP6 "control" and "last millennium" runs will be used to assess simulated unforced variability and response to forcings such as volcanoes and to consider SST and atmospheric circulation patterns associated with periods of extremes in the monsoon, extratropical and Arctic regions. New simulations with imposed anomalies (e.g. sea or land surface temperatures in particular regions) in conjunction with external forcing will be designed to explore the roles of basin-wide changes or land-surface interactions in generating and synchronising decadal variability. Implications for future climate change will be considered using model simulations and our improved understanding of mechanisms.