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Influence of Extratropical Thermal Forcings on the Asian Summer Monsoons

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The capability of an extratropical thermal forcing to affect the remote tropical climate has been suggested in studies analysing paleoclimatic data, twentieth century observations and numerical simulations. The Intertropical Convergence Zone (ITCZ) has been the most studied feature and the general picture emerging from these studies is that the ITCZ tends to shift toward the warmer hemisphere. However, there is evidence supporting the idea that other features of the tropical climate might be affected by such an extratropical influence. In particular, the Asian Summer Monsoons (ASM) stand out as some of such possibly affected systems.
This study investigates, through numerical simulations, the response of the ASM to a series of extratropical thermal forcings. Three sets of experiments are performed, varying the extratropical forcing. In the first set the forcing consists of warming of the Northern Hemisphere (NH) extratropics (poleward of 40°) and cooling of the Southern Hemisphere extratropics. In the second and third experiments, the former forcing is divided into its northern and southern components to asses their relative roles in affecting the Asian summer climate. In all the cases realistic boundary surface conditions are used.
The numerical configuration consists of an Atmospheric General Circulation Model (ICTP-AGCM) coupled to Slab Models for Ocean and Land. The relative roles of the atmosphere, tropical Sea Surface Temperatures (SSTs) and continental surface temperatures are investigated in a series of experiments designed to separate these influences.
We find that the imposed extratropical forcings generate a response in the ASM. This response is strongest over central China and South-eastern Asia, while over India the forced behaviour is weak and limited in spatial extension. When a NH extratropical warming is imposed we find that a precipitation dipole-like pattern is generated, with wet (dry) conditions over central China (South-eastern Asia). This precipitation dipole structure is exacerbated when the tropical SSTs are not allowed to react to the remote extratropical forcing, suggesting that the atmospheric dynamics behaviour is weakened by the surface oceanic thermodynamic response. The relative roles of the land surface temperatures and the hemispheric components of the forcing are also investigated.
As many events in the past, the future warming scenario has an important extratropical signature and, therefore, these type of experiments can aid in the understanding of the physical mechanisms responsible for the ASM's behaviour under such forcing signals.