Moisture budget decomposition and mechanisms behind monsoon response in the mid-holocene and future climate scenario

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The mid-Holocene is a warm period that occurred around 6,000 years ago, in which orbital changes determined the warming of the Northern Hemisphere. This enhanced the inter-hemispheric thermal contrast in boreal summer, to a similar degree of what the future climate scenario rcp8.5 projected for 2100. Although these two experiments have been constrained by different external forcing, they result in a similar precipitation response in the monsoon regions. Here, we analyse monsoon characteristics and dynamics in common model simulations of the mid-Holocene and the rcp8.5 from the PMIP3 and CMIP5 archive.

Results suggest that the Northern Hemisphere summer monsoon extent in the future climate scenario will not exceed the simulated shift in the mid-Holocene. Only the Indian monsoon is expected to strengthen because the significantly higher mean temperature in the rcp8.5 than the mid-Holocene. Decomposing the moisture budget into thermodynamic, dynamic components and transient eddy components allows us to identify mechanisms leading the monsoon response in the two climates. Mechanisms behind monsoon response in the rcp8.5 are different among monsoon systems (African, Indian and North American monsoon) but mainly they are related to changes in the thermodynamic contribution (e.g. the increase of specific humidity with temperature increase). On the contrary, changes in the moisture budget dynamic component (e.g. Walker - Hadley cell changes) determine monsoon response in the mid-Holocene.

Key words: Monsoon, mid-Holocene, RCP8.5, moisture budget