Geophysical Research Abstracts
Vol. 14, EGU2012-4831, 2012
EGU General Assembly 2012

Spatial differences in the Holocene precipitation change within the Asian monsoon region - a model data comparison

A. Dallmeyer (1), M. Claussen (1,2), Y. Wang (3,4), U. Herzschuh (3,4)

(1) Max-Planck-Institute f. Meteorology, KlimaCampus Hamburg, Germany (anne.dallmeyer@zmaw.de), (2) Meteorological Institute, University of Hamburg, KlimaCampus Hamburg, Germany, (3) Alfred Wegener Institute for Polar and Marine Research, Potsdam, Germany, (4) Institute of Earth and Environmental Science, University of Potsdam, Potsdam, Germany

The Asian monsoon incorporates the Indian and East Asian monsoon systems that differ with respect to formation and seasonal migration. Whereas the Indian summer monsoon system is embedded in the seasonal progression of the Intertropical Convergence Zone, the East Asian summer monsoon is determined by a planetary subtropical front and its interplay with the mid-latitude westerlies and the tropical circulation including the Indian monsoon flow. Most of the annual rainfall can be related to the summer monsoon in the Indian monsoon region and to spring and summer precipitation in the East Asian monsoon region.
At mid-Holocene (6000 years before present), the cyclic variations in the Earth's orbital configuration led to differences in the incoming solar radiation by approx. 5% more (less) insolation to the northern hemisphere during summer (winter). As monsoon circulations are primarily induced by the seasonal and latitudinal differences in incoming solar radiation, this insolation forcing is supposed to result in a strengthening of the Asian summer monsoon and an increase in precipitation due to an intensification of the land-sea thermal gradient. This precipitation increase is often stated to reflect the annual precipitation signal and therefore climate modelling analysis are often confined to the summer season. However, climate reconstructions as portray of annual precipitation changes do not show an overall increased precipitation in the Asian monsoon region during mid-Holocene (Wang et al. 2010) and suggest differences in the response of the Indian and East Asian monsoon system to the insolation forcing (e.g. Maher and Hu, 2006).
In this study, we compare results of high-resolution global climate model simulations with a standardised set of moisture-reconstructions for the Asian monsoon domain at mid-Holocene. Using the climate model results, we investigate the role of seasonal precipitation changes in the annual signal and assess the atmospheric mechanisms leading to the reconstructed differences in the moisture pattern between the Indian and East Asian monsoon region. According to the model, the enhancement of the summer monsoon system is responsible for the increase in annual precipitation in most parts of the Indian monsoon domain during mid-Holocene. The East Asian monsoon region exhibits local inhomogeneities in the annual precipitation signal. The sign of this signal depends on the balance of decreased pre-monsoon precipitation related with the mid-latitudinal westerly wind circulation and increased monsoon precipitation at mid-Holocene compared to present-day. Our results highlight the importance of including the pre-monsoon season in climate studies of the Asian monsoon system and point out the complex response of this system to insolation changes.

References:

Maher, B.A, and Hu, M.: A high-resolution record of Holocene rainfall variations from the western Chinese Loess Plateau: antiphase behaviour of the African/Indian and East Asian summer monsoons. The Holocene 16:309–319, 2006.

Wang, Y.B., Liu, X.Q, and Herzschuh, U.: Asynchronous evolution of the Indian and East Asian Summer Monsoon indicated by Holocene moisture patterns in monsoonal central Asia. Earth-Sci. Rev. 103(3-4):135-153. doi: 10.1016/j.earscirev.2010.09.004, 2010.