

Influence of global warming on Eurasian snow cover teleconnection to the Indian monsoon rainfall using a large ensemble AGCM experiment

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Relationship with Eurasian snow cover (ESC) and Indian summer monsoon rainfall (ISMR) is an extensively discussed aspect in terms of monsoon forecasting. Previous studies have found a strong negative correlation with the winter snow cover of western Eurasian region and ISMR. A weakening of this negative correlation has been observed recently but the reasons behind this are inconclusive, especially due to the limited observational record of snow amount. Influence of global warming on the change in snow-monsoon teleconnection has been widely discussed and suggested to have impacts on typical monsoon behavior such as the inverse relationship with ENSO. Therefore, this study was carried out to investigate the influence of anthropogenic global warming on the snow-monsoon relationship using a large ensemble experiment with and without human influence on the climate, using MRI-AGCM.

Carefully conducted correlation and composite analysis showed that the global warming has a possible weakening effect on the ESC-ISMR inverse relationship. This impact seems to be inflicted upon the ISMR with a modulation in the summer walker circulation anomaly over the South/South-East Asian region. Based on the correlation analysis, the impact of the global warming was shown to be less than the change observed from the observation-based analysis. Therefore, recent (after 1990) and past (before 1990) time slices were analyzed using correlation and composite based methods to observe any apparent deviations. Both ensemble simulations with and without human influence showed a similar decrease of the negative relationship with a westward shift of the rising anomalies associated with Indian ocean walker circulation during recent heavy snow years. This result was consistent with observations, suggesting a low-frequency variation of the circulation patterns associated with the ESC-ISMR relation due to the stochastic nature of the processes occurs from the natural variability, independent from global warming. Based on these results, we speculate that although an apparent weakening impact from global warming has occurred, more dominant low-frequency variability might be the reason for the significant reduction of ESC-ISMR correlation during recent decades.

Keywords: Indian monsoon, Eurasian snow cover, Teleconnections, Global warming