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Teleconnections between Eurasian snow cover and the Maldives monsoon rainfall

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Anomalous snow cover over Eurasia can influence monsoon circulation through changes in surface energy balance. Much of the research on the snow-monsoon relationship has focused on the Indian or Chinese monsoon, without examining possible links between the snow-monsoon relationship and summer rainfall over other parts of Asia. Although the Maldives lies in the Indian Ocean (southwest of India), the Asian monsoon flow influences the circulation patterns over the Maldives. However, no previous studies have directly examined possible relationships between Eurasian snow and Maldives monsoon rainfall (MMR: June-September). This paper describes a first attempt to explore the possible relationships between Eurasian snow cover (ESC) and the MMR.

The possible relationships between Eurasian snow and the rainfall over the Maldives has been investigated using composite and correlation analyses. The relationship between ESC and monsoon rainfall was also examined using lag-lead correlations. Anomalies of an area-weighted MMR index have been correlated with anomalies of ESC for October-December of the previous year and January-May of the current year. Correlations have also been carried out between MMR and snow cover anomalies for winter (December-January), spring (March-May) and with snowmelt (snow cover difference between February and May). The time series were de-trended to minimize the influence of trends on the strength and significance of the correlations between variables.

Relatively very weak correlations were found between the MMR and ESC anomalies for January-May of the current year and October-December of the previous year. The highest correlation between MMR and ESC (r = -0.15, insignificant at 5% level) was found for the month of February. Significant positive correlations were found between ESC in subsequent months, with the highest correlation (r = 0.80) between April and May, significant at the 1% level. Correlations between MMR and snow cover anomaly for winter, spring and the snowmelt period are -0.02, -0.02 and -0.18, respectively. Very weak correlation coefficients (insignificant at 5% level) between MMR and snow cover variables suggest that there is no teleconnections between MMR and winter/spring snow cover and snowmelt. Composites of monsoon rainfall averaged for the years of high and low snow cover in winter, spring and the snowmelt period also show different patterns of monsoon rainfall. The results of lag-lead correlation between the MMR anomaly and snow cover variables show an inverse relationship with the spring snow cover. However, the only significant inverse correlation is at lag -6, with a correlation coefficient of -0.51. Furthermore, winter snow cover shows strong inverse correlation with the MMR at lag +1, with a correlation coefficient of -0.34. Although the snowmelt period does not show a significant inverse relationship with MMR, it shows a strong positive correlation at lag -6 (r = 0.38).

Lack of a consistent inverse relationship between the ESC variables (over different months and seasons) and MMR contradicts the findings of previous studies on the winter/spring snow cover relationship with Asian rainfall, as well as with Indian rainfall, where a strong significant inverse relationship has been found. Weak relationships found between MMR and winter/spring snow cover and snowmelt could be due to the data period used here (1979-2007). The correlation coefficients computed between winter snow cover anomalies and all-India summer monsoon rainfall for the same period used by Bamzai and Shukla (1999) in their 1973-94 study, and for the same period used for the Maldives region (1979-2007), confirms this. The same correlation coefficient (-0.34)

was obtained as found by Bamzai and Shukla (1999) for the 1973-94 period. However, the correlation coefficient dropped to -0.18 for the 1979-2007 period, suggesting that the inverse relationship between ESC and monsoon has weakened over the more recent time period.