Proceedings of 8 ICSHMO, Foz do Iguaçu, Brazil, April 24-28, 2006, INPE, p. 1519-1520.

ANTARCTIC OSCILLATION AND THE DUST WEATHER FREQUENCY IN NORTH CHINA

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Extended Abstract

Dust storms are disastrous weather phenomena frequently occurring during spring (March-April-May) in North China. In recent years, studies of Asian dust storms have been made through large-scale field observations, remote sensing, numerical modeling, and land-surface process studies. However, the climate factors and the mechanisms related to the dust storm variability in North China remain unclear. The main motivation for this study is to further explore the connection between the Antarctic Oscillation (AAO) and the dust weather frequency (DWF) in North China through atmospheric large-scale teleconnections.The linkage between AAO to DWF in North China is addressed. Here DWF denotes the number of days of dust weather events including dust haze, blowing dust and dust storm in one year. It is found that the interannual variation of AAO plays a significant role in the dust-related atmospheric circulation during boreal spring. AAO and DWF correlate well, with positive AAO tending to decrease DWF in North China. Both AAO-DJF and AAO-MAM are in negative phase in 1950s and in positive phase in 1990s. To the contrary, the AAO indices in DJF or MAM were in the reverse phase after mid 1970. The correlation coefficients between DWF and AAO indices are –0.35 and –0.46 respectively for DJF and MAM. The correlation is significant at 99% from a standard students t-test. When the linear trend is removed, the correlations are –0.30 and –0.21 respectively (significance level is 95%). The relationship between AAO and the dust climate is therefore quite significant on both interannual and decadal time scales. The correlation between DWF and SLP for DJF and MAM have been analysed for 1954-2001. The positive correlation at high latitudes in both hemispheres and the negative correlation at middle and low latitudes are quite pronounced. The distribution of the positive value in the whole Antarctic and the negative value in SH mid and high latitudes are the AAO pattern. The Arctic Oscillation (AO) pattern is also quite remarkable in the Northern Hemisphere, but the AO pattern is much weaker in boreal spring. In conclusion, DWF correlates well with AAO-DJF and AAO-MAM. Many studies show that the DWF is strongly related to cold temperature anomalies in winter. In North China, low temperature in winter (DJF) causes a deeper frozen earth

and more sandy soil resulting in serious desertification when higher temperatures set in. It is found that AAO-DJF is significantly positive correlated to surface air temperature in North China. Other climatic factor closely related to DWF is spring precipitation. Strong AAO-MAM years are concurrent with positive precipitation anomalies in most part of North China. These changes provide the moisture condition that restrains the occurrence of dust weather and the DWF decreases. Two possible mechanisms for the AAO-DWF coupling are identified, one is related to a meridional teleconnection pattern from the Antarctic to the Arctic. Strong AAO (DJF) is concurrent with enhanced westerlies in SH and enhanced westerlies in mid to high latitudes in NH, preventing cold anomalies from the polar region to enter Asia. Another possible mechanism is linked to a regional circulation pattern in the Pacific Ocean which may change in the intensity of the Aleutian Low and the Siberian High.

Keywords Antarctic Oscillation, Dust weather frequency, Linkage, North China