

Study on decadal influencing of the teleconnection pattern EA and SCAND on major atmospheric circulation systems of the northern China dust storms during the past 65 years (1954-2018)

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Frequent cold-air attacks with less precipitation and aired surface conditions are mainly direct causes of more dust storm occurrences over the dust-source-areas during winter-spring season. In this study, the observation records of the horizontal visibility at 65 stations dotted in northern China (35°-45°N, 94°-120° E) for 65 years (1954-2018) were collected and used to investigate the frequencies of dust storm (DS) and severe dust storm (SDS) events during the term of February-June. As a whole, declining trends were appeared for both DS and SDS during the past several decades. A dust storm frequently occurrence term is confirmed from 1950s to 1970s, with decadal means of 7.1 and 2.5 events for both DS and SDS. From 1980s to 2010s, the DS and SDS decreased significantly with decadal means of 3.8 and 1.1 events, separately. The 1970s is the most frequent dust storm decade, during which 81 DS events have been recorded. Oppositely, the 1990s is the most infrequent decade with totally 25 DS events. Comparing spring precipitation and snow events of the previous winter, the precipitation anomaly of the 1970s is -13.3% and for 1990s, it is 15.9%. Decadal mean of the prior winter snow events are 3.6 and 4.8 respectively for 1970s and 1990s. That means 1970s has less than normal precipitation during winter-spring. The climate was dry. In turn, it had more precipitation during the 1990s, the climate was wet and the dust storm decreased.

By comparing the major atmospheric circulation systems relating to frequent and infrequent dust storm springs, it has been identified that a weak West Pacific subtropical high (WPSH), a strong North Polar vortex (NPV) and a strong and western position East Asian trough (EAT), in general, corresponding to less precipitation and dry climate, and then, a frequent dust storm spring. Contrarily, it is opposite.

Indices of the atmospheric teleconnection pattern EA and SCAND (also named EU1) were issued on the website of the Climate Prediction Center of USA. Influence of these two teleconnection patterns on the major atmospheric circulation systems and dust storms was studied in this work. Analyzed outcomes indicate that the EA has a closely positive connection with the WPSH and the westerly for winter-spring season. A strong WPSH is benefit to the sea vapor transportation for the dust source regions where located in northern China, bring more rainfalls to there. Additionally, a strong westerly over Eurasia confines the extension of the NPV, and the cold air from the Polar decreases, corresponding to an infrequent DS spring. It is opposite when the EA is weak. The SCAND displays a significantly negative relationship with the westerly and a converse variation trend with the DS frequency. The westerly not only has an impact on the NPV, but also affects the EAT as well. The westerly may become weak when the SCAND is strong, at the same term, the meridionality varied big and the polar cold air attacks may increase, lead to more DS weathers. The EAT may becomes strong and moves to more western position while the westerly is weak. This EAT condition is unfavorable to the vapor transferred to the focused area from the East Sea, results in less precipitation and dry climate, DS may increase during the springtime. Conversely, the westerly may become strong when the SCAND is in weak phases. The NPV, in general, is weak and the cold air attacks decrease. The EAT varies weak and move to eastern than normal position, favoring to the vapor transportation and more rainfall moistening the surface soil, the DS may decrease.

Keywords: Dust storm, Teleconnection pattern, Atmospheric circulation, Northern China