Using NCEP/NCAR Reanalysis Data to Study the Potential Predictor for the Timing of Spring Onset in North and Northeastern China

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Growing season length is one of the most notable climate indices for studying climate change and is also considered as one of the indicators for monitoring changes in climatic extremes. Many studies have reported an extended growing season at mid-high latitudes, mainly due to an earlier onset of spring. The timing of the spring season has a large influence on natural ecosystems and human activities such as agricultural planning, including spring sowing and cultivation of plantation and poultry, and spring tourism. Therefore, predicting the onset of spring is of significant socioeconomic importance. In this study, the sea level pressure (SLP) and wind at 850 hPa from NCEP/NCAR reanalysis data are used to study the atmospheric circulation pattern in East Asia during winter/spring transition time and potential predictor for the timing of spring onset in North and northeastern China.

Climatic changes in the onset of spring in northern China associated with changes in the annual cycle and with a recent warming trend were firstly quantified using a recently developed adaptive data analysis tool, the Ensemble Empirical Mode Decomposition. The study was based on a homogenized daily surface air temperature (SAT) dataset for the period 1955--2003. The annual cycle here is referred to as a refined modulated annual cycle (MAC). The results show that spring at Beijing has arrived significantly earlier by about 2.98 d $(10\ yr)^{-1}$, of which about 1.85 d $(10\ yr)^{-1}$ is due to changes in the annual cycle and 1.13 d $(10\ yr)^{-1}$ due to the long-term warming trend. Variations in the MAC component explain about 92.5% of the total variance in the Beijing daily SAT series and could cause as much as a 20-day shift in the onset of spring from one year to another. The onset of spring has been advancing all over northern China, but at different rates between the east and west parts of the region. These differences are somehow unexplainable by the zonal pattern of the warming trend over the whole region, but can be explained by opposite changes in the spring phase of the MAC, i.e. advancing in the east while delaying in the west. In the east of northern China, the change in the spring phase of MAC explains 40%--60% of the spring onset trend and is attributable to a weakening Asian winter monsoon, measured from NCEP/NCAR reanalysis SLP data.

The average SLP in Siberia (55^{o}--80°N, 50^{o}--110°E), an index of the strength of the winter monsoon, could serve as a potential short-term predictor for the onset of spring in the east of northern China. A “predictor" calculated from the SLP data in February has potential for predicting spring onset at stations in North China around the Bohai Sea. For a “predictor" calculated from the SLP data in March, a significant positive correlation exists everywhere in northeastern China. These results suggest that in the east part of northern China (east to 110°E), spring onset can be predicted to some extent by the previous monthly Siberian High index defined in the paper.

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