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Long-term Assessment of Spring's Onset in North America

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Long-term conventional assessments of the start of the growing season (onset of spring) are limited by the available historically recorded phenological data. In order to conduct such work, many studies have used available phenological data to first develop models, typically driven by air temperatures. Once validated, such models extend the possible spatial coverage and temporal range of phenological assessments of environmental change, given the greater availability of meteorological data. One set of phenological models which have been successfully applied to assess the impact of environmental change on the onset of the spring season across temperate regions around the Northern Hemisphere are the Spring Indices (SI). A limitation of SI models was that since they were designed to simulate the growth of specific plants, they did not produce output in locations where the plants don't grow successfully, most specifically in areas where warm winter weather provide inadequate chilling. In this paper we report development of an extended form of the Spring Indices (abbreviated SI-x) which retain the utility and accuracy of the original SI (now abbreviated SI-o), but can be extended to areas previously not possible. When applied to North America over the past century, SI-x output reveals important temporal and spatial regional patterns for the onset of spring across the continent.