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On the use of gridded daily temperature data to calculate the extended spring indices phenological models

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Models that predict the timing of recurrent biological events play an important role in supporting the systematic study of phenological changes at a variety of spatial and temporal scales. One set of such models are the extended Spring indices (SI-x). These models predicts a suite of phenological metrics ("first leaf" and "first bloom," "last freeze" and the "damage index") from temperature data and geographic location (to model the duration of the day). The SI-x models were calibrated using historical phenological and weather observations from the continental US. In particular, the models relied on first leaf and first bloom observations for lilac and honeysuckle and on daily minimum and maximum temperature values from a number of weather stations located near to the sites where phenological observations were made.

In this work, we study the use of DAYMET (http://daymet.ornl.gov/) to calculate the SI-x models over the continental USA. DAYMET offers daily gridded maximum and minimum temperature values for the period 1980 to 2012. Using an automatic downloader, we downloaded complete DAYMET temperature time series for the over 1100 geographic locations where historical lilac observations were made. The temperature values were parsed and, using the recently available MATLAB code, the SI-x indices were calculated. Subsequently, the predicted first leaf and first bloom dates were compared with historical lilac observations. The RMSE between predicted and observed lilac leaf/bloom dates was calculated after identifying data from the same geographic location and year.

Results were satisfactory for the lilac observations in the Eastern US (e.g. the RMSE for the blooming date was of about 5 days). However, the correspondence between the observed and predicted lilac values in the West was rather week (e.g. RMSE for the blooming date of about 22 days). This might indicate that DAYMET temperature data in this region of the US might contain larger uncertainties due to a more complex terrain. Further work is being conducted to try to explain these results and to provide a holistic evaluation of the potential of creating continuous SI-x products over the continental US at 1km from DAYMET data.