Spatial correlation for phenological responses to climate

*Joseph Percival[1], Narumasa Tsutsumida[1]

1. Graduate School of Global Environmental Studies, Kyoto University

Phenological and climate data are highly variable across time and space, and have been shown to display both spatial and temporal non-stationarity. In time series analysis, such variability in the time domain may be described in one variable by autocorrelation, or between two or more variables by cross-correlation and cross-partial correlation expressions using time lags. In spatial analysis, this variability may be captured by creating local models using approaches such as geographically weighted modeling techniques that utilize spatially weighted kernel functions. Although many previous studies regarding phenology focus on how phenological events respond to climate temporally, it is apparent that the spatial relations which may also influence such events have not yet been thoroughly considered. Hence this study demonstrates how spatial and temporal effects may be included in statistical analyses of phenological responses to climate data by including geographically weighted modeling techniques in time series analysis of NDVI values, temperature, and precipitation. This study uses monthly climate and phenological data from the CRUTS and GIMMS3g time series data sets over the last three decades. Cross correlation and cross partial correlation between the three variables are observed to find time lags that display higher positive and negative correlation coefficients; following this, geographically weighted correlation and partial correlation techniques are applied to the lagged data. It is expected that this will allow for a more careful examination of the relationship between temperature, precipitation, and NDVI.

Keywords: phenology, geographically weighted approach, time series, spatial relation

