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Sensitivity of phenology models to the selection of driving meteorological datasets

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Plant phenology focuses on the annual repetitive development phases of the terrestrial vegetation. Since the date of the onset and the cessation of vegetation growth define the possible time period for photosynthesis, plant phenology strongly affects the carbon cycle of the ecosystems. Phenology has a serious impact on the climate system through the carbon-, water- and energy cycle. Observations indicate changes in the phenological cycle of the vegetation worldwide that are clear indicators of climate change. Warming climate can be associated with more intense carbon uptake, but it can also negatively affect production. Current studies clearly indicated that the phenological cycle is not properly represented in the Earth System Models which means that further research is needed.

Meteorological variables affecting the state of the environment, such as temperature and precipitation, also play a key role in the development of vegetation. Phenology models of different complexity were developed to quantify the timing of the onset of vegetation growth based on meteorological data. The sensitivity of the models to the source meteorological datasets is rarely studied. The aim of the present study is to quantify the sensitivity of widely used phenology models to the selection of the driving meteorological dataset.

Two phenology models were used to evaluate the different databases. One is the so-called Growing Degree Day (GDD) method, which calculates the onset date based on the degree day logic. The GDD model is further divided into simple thermal forcing model and thermal model, where the latter includes chilling requirement as well. The second method uses minimum temperature, photoperiod and vapor pressure deficit and calculates a so-called Growing Season Index (GSI) which is used to estimate onset date

Considering the meteorological data, three different datasets were used. The ERA5 is a reanalysis database, which is the product of the European Centre for Medium-Range Weather Forecasts (ECMWF). The CarpatClim and the FORESEE (Open Database FOR ClimatE Change-Related Impact Sudies in CEntral Europe) are observation based, gridded datasets for the larger Carpathian Region (Central Europe).

In any modelling exercise aiming at simulating the stages of phenology, observations are essential. In the present study the phenological observation data is originating from satellite data and field observations. The first means the third generation Normalized Vegetation Index (NDVI3g)

disseminated by GIMMS (Global Inventory Modeling and Mapping Studies), and the latter means the PEP725 phenology dataset and field observations from the botanical garden of Eötvös Loránd University, located in Budapest.