Geophysical Research Abstracts
Vol. 20, EGU2018-8342, 2018
EGU General Assembly 2018

PhaenOPT – a satellite based phenological monitoring service in the federal state of Thuringia, Germany

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The ongoing climate change has multiple influences on the environment. As a result of the rising annual mean temperatures the first bloom of many plants is continuously shifted towards winter - in Thuringia nowadays up to 14 days compared to the time interval 1961-1990. Temporal changes of this climate impact indicator have negative effects, e.g. on the human health and to agriculture. To monitor the development of climate impact indicators the Thuringian parliament started a monitoring program in 2016.

The main objective of the joint research project “PhaenOPT” is to develop, describe and monitor different climate impact indicators on a regular basis with satellite data. Furthermore in-situ measurements are linked with satellite data, to implement remote sensing analyses in a federal state institute and to establish a web-based information service.

For our purposes annual phenological in-situ observations of the German Weather Service (DWD) as well as satellite time series from the NASA MODIS sensor are used to study climate influenced changes of phenological parameters of plants. Therefore the MODIS long time series of the 250 m NDVI/EVI product (MOD/MYD13Q1) is applied to develop a process chain which extracts the annual cycle of these two vegetation indices. Towards the end of the project the processing chain is transferred to Sentinel-3 (OLCI) data. The software TIMESAT (Jönsson and Eklundh, 2004) is applied to the MODIS datasets to model the phenological parameters of the growing season (begin, end, duration) for each natural geographic unit of Thuringia and for each season since 2000.

To calibrate the parameters used in and verify the results of TIMESAT the annual phenological point data of the DWD is used. This free available datasets are collected consistently with identical standards since the mid-20th century and are an indispensable basis for climate research. The datasets are interpolated to the extent of Thuringia by regression kriging using the R package automap (Hiemstra et al., 2008). Furthermore, additional crowd sourced data from the smartphone application MySeasons will be collected to densify the existing phenological data basis.

The acquisition and processing of the data (in-situ observations as well as satellite data) have been automated and are provided in an operational processing chain leading to a web-based geospatial data infrastructure. Users are able to work with the resulting data in an interactive client and compare modelling outputs with in-situ observations without the need to process any data. Furthermore this service for the Thuringian population will visualize direct impacts of the climate change to the environment.

As a result of this project it is possible to process large-scale remote sensing data into information for specific phenological phases with an automated approach. Plant specific phenological phases are linked with NDVI/EVI thresholds of satellite data to directly obtain phenological information. We also derive long-term developments of climate impact indicators from the satellite time series data.