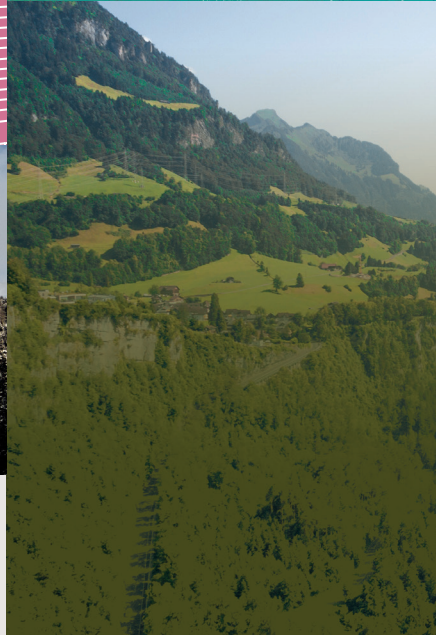
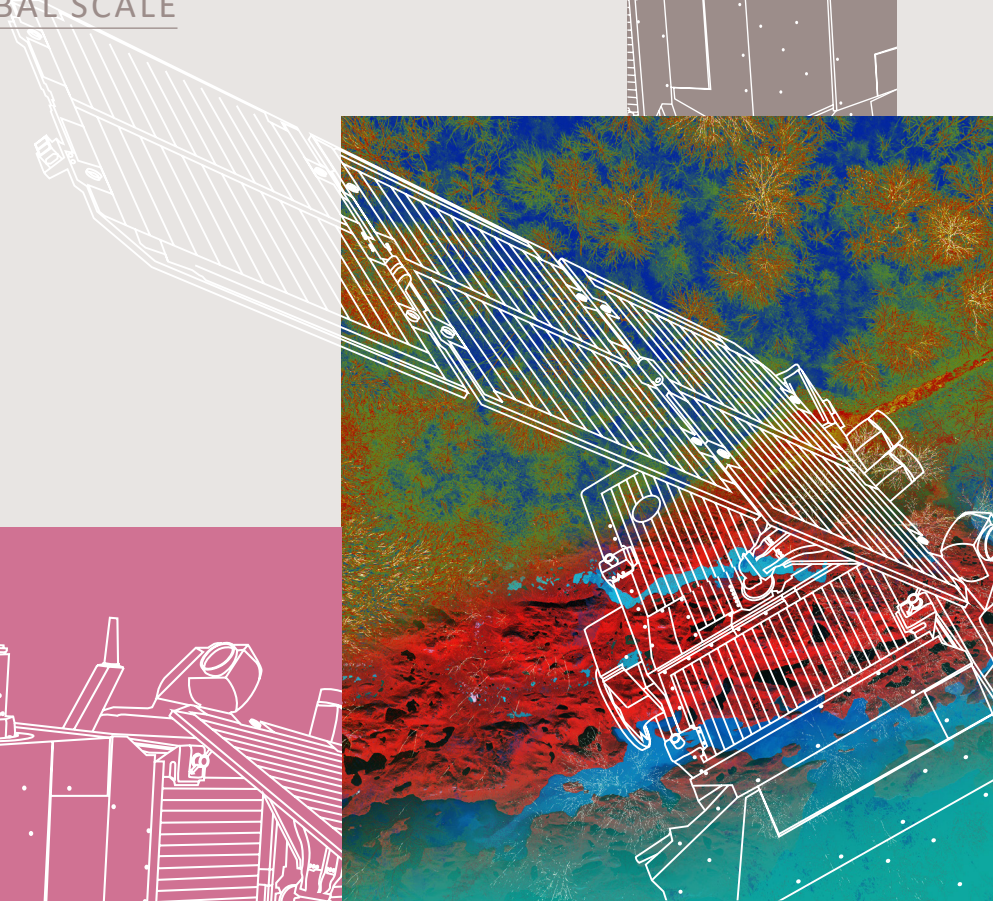


GLOBDIVERSITY PROJECT

WITH RS-ENABLED EBVs KEY CHARACTERISTICS OF
BIODIVERSITY CAN BE OBSERVED AND MONITORED
WITH SATELLITES ON A GLOBAL SCALE





The GlobDiversity project aims to demonstrate how satellite remote sensing can contribute to monitoring Essential Biodiversity Variables (EBVs) – a concise set of harmonized biodiversity observations to inform indicators for policy-making. It is the first fully funded project focused on engineering the EBV concepts from satellite data into usable data products. They include Land Surface Phenology (LSP), ecosystem Fragmentation (FRAG) and Canopy Chlorophyll Content (CCC).

www.GlobDiversity.net

Remote Sensing-enabled Essential Biodiversity Variables

LAND SURFACE PHENOLOGY



BACKGROUND AND RATIONAL

Land Surface Phenology (LSP) characterizes reoccurring events in the annual vegetation activity profile using remote sensing. LSP provides vital data on ecosystem functioning and biodiversity, and hence is increasingly used to study global change processes. The University of Zurich developed an LSP algorithm which computes phenological metrics from a double logistic model applied pixel-by-pixel to merged Sentinel-2 and Landsat 8 surface reflectance data to create a Normalized Difference Vegetation Index (NDVI) time series (Figure 1). The model was found to be robust against outliers and irregularly distributed observations, and was therefore selected to characterize LSP across different biomes. Results were quality tested to exclude non-vegetated areas and regions without seasonal vegetation activity.

ALGORITHM SPECIFICATIONS

Quality and classification layers were used to flag cloud, snow, cloud shadow, water and other invalid pixels, and the merged time series was resampled to the Sentinel-2 spatial resolution of 10 m. Natural vegetation in biomes with a seasonal NDVI profile, such as savannah, tundra, and temperate forests, can be processed. In contrast, biomes without a recurring profile in vegetation activity, for instance tropical rain forests, arable land and desert, are excluded. LSP metrics can be extracted from a yearly NDVI time series, or for shorter periods if a seasonal cycle is present. Finally, metrics including Start of Season

(SOS), End of Season (EOS) and NDVI amplitude, among others, are defined using the midpoint-method (50% of the amplitude) (Figure 1).

VALIDATION AND APPLICATIONS

Product validation used phenocam vegetation index time series of Green Chromatic Coordinates (GCC) processed with the LSP algorithm, across four study sites in temperate and tundra biomes. In general, a strong agreement was found between SOS values derived from phenocam and satellite vegetation index time series, while EOS values were more divergent. This is apparent for our temperate forest site in the Bavarian Forest National Park (Figure 2), which shows a good correspondence between the LSP metrics SOS derived from phenocam GCC, satellite GCC and satellite NDVI time series. In contrast, values for the LSP metric EOS are more variable between the different time series assessed; this is most likely the result of senescence being more spatially heterogeneous than green-up. Products were generated for the years 2017 and 2018 across 10 pilot sites distributed around the globe, as well as for the whole countries of Senegal and Finland. Results derived for the Kytalyk National Park are shown in Figure 3. Here, the products were successfully used in conjunction with a habitat suitability model to identify vegetation types relevant for the conservation of the endangered Siberian white crane. The LSP algorithm is available under open-source licences and ready for download and use.

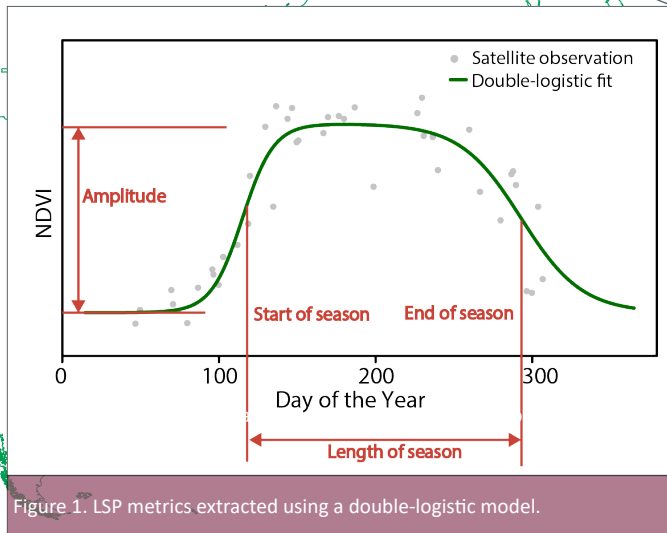
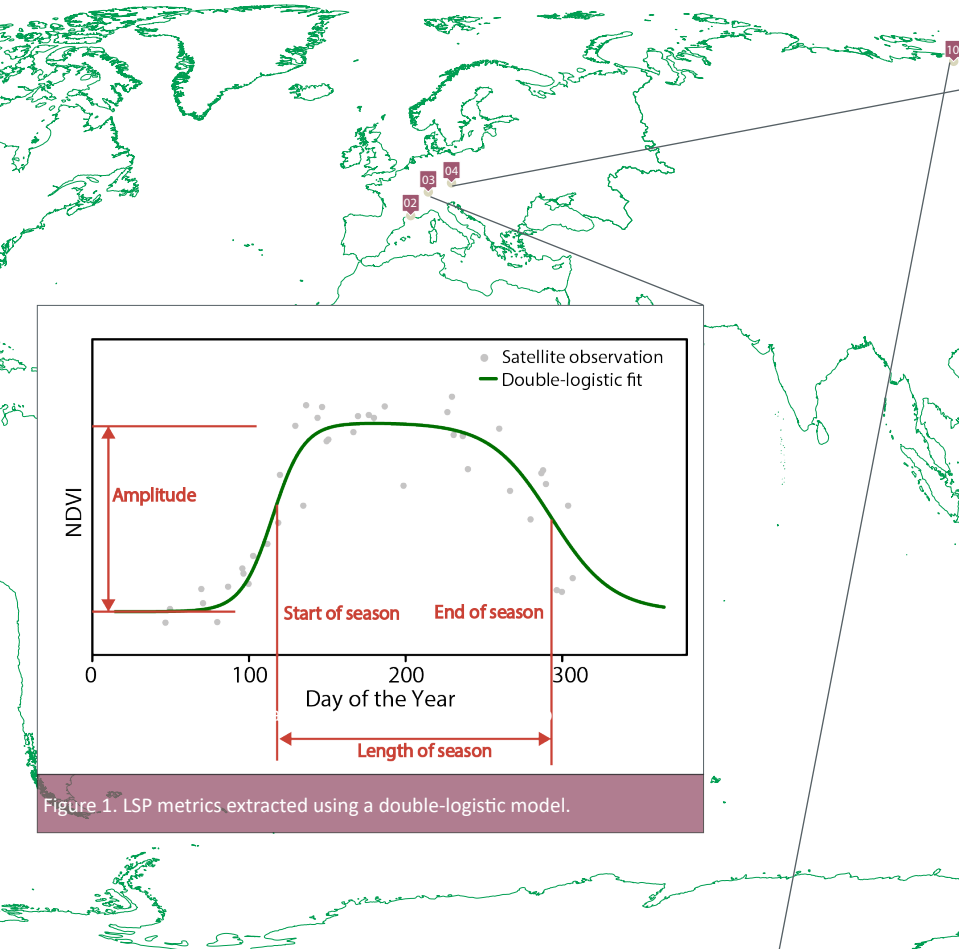


Figure 1. LSP metrics extracted using a double-logistic model.

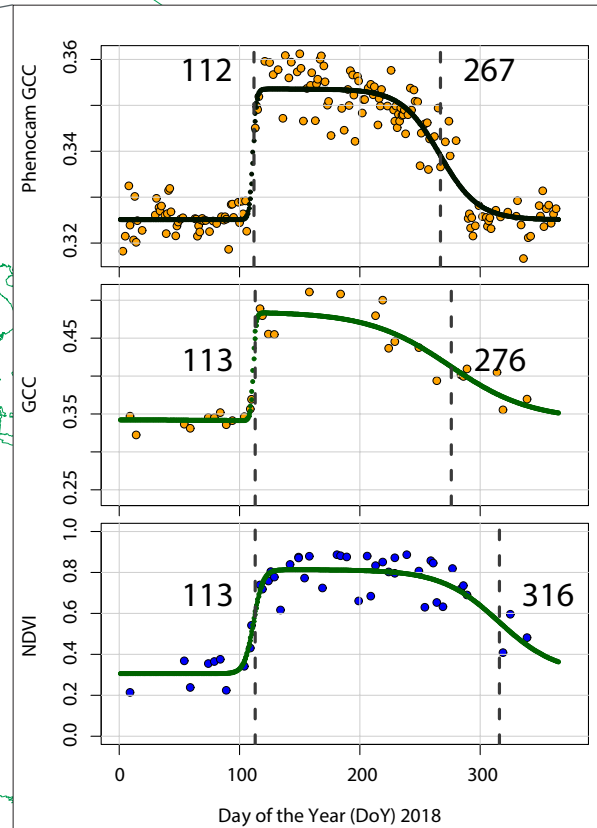


Figure 2. Phenocam GCC and satellite-based NDVI time series for the validation of temperate forest site Bavarian Forest NP (GER).

PILOT SITES

01

Toolik Lake
Tundra, Alaska, USA

02

La Camargue
Mediterranean, France

03

Lägern
Temperate, Switzerland

04

Bavarian Forest NP
Temperate, Germany

05

Kruger NP
Tropical, South Africa

06

Udzungwa Mountains NP
Tropical, Tanzania

07

Aldabra
Deserts, Seychelles

08

Lambir
Tropical, Borneo

09

Danum Valley
Tropical, Borneo

10

Kytalyk
Tundra, Siberia, Russia

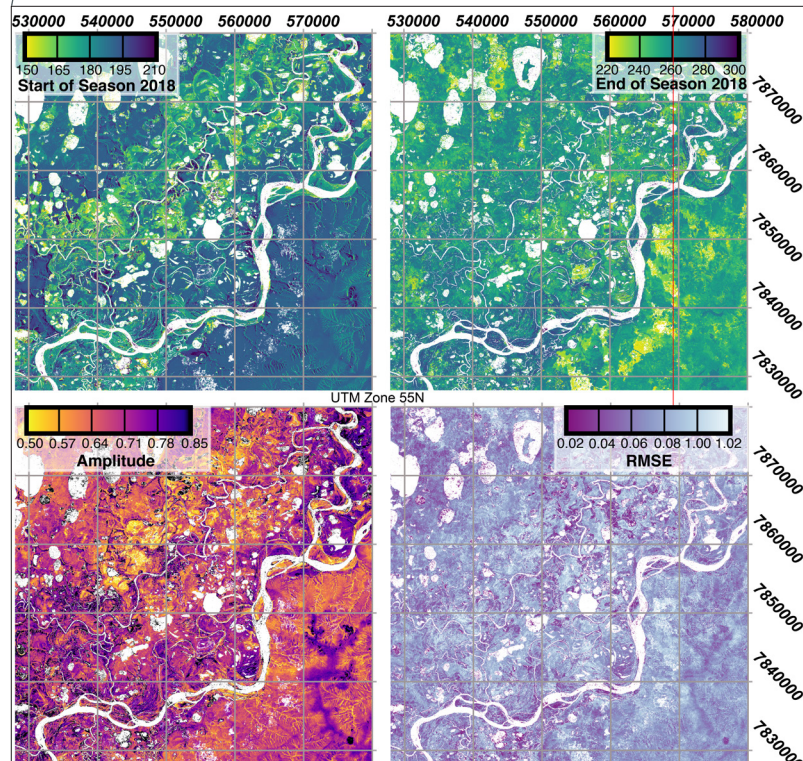


Figure 3. LSP metrics SOS, EOS, Amplitude and Root Mean Square Error (RMSE) extracted for the Kytalyk NP tundra site. White pixels indicate invalid pixels, mostly due to water.

COMPLETED TASKS WITHIN THE GLOBDIVERSITY PROJECT

01

REQUIREMENT ANALYSIS

RS-enabled EBVs were defined and their satellite observation requirements to track changes in terrestrial biodiversity at global scales were characterized; results are detailed in the Satellite Observation Requirements document available on the GEO BON website.

02

PRODUCT BENCHMARKING

A trade-off analysis of published algorithms and a proof of concept of selected algorithms for engineering RS-enabled EBV products was successfully carried out.

03

ALGORITHMS PROTOTYPING

Selected RS-enabled EBVs algorithms were successfully prototyped and are now available in GitHub repositories. Results are detailed in the Algorithm Technical Baseline Document available on the GEO BON website.

04

CONSERVATION APPLICATIONS

The core RS-enabled EBVs were applied in conservation-oriented use cases which focused on ecosystem modelling, invasive species monitoring, habitat health assessment and fragmentation analyses. The outcomes are exhaustively described in the User Hand Book.



The European Space Agency (ESA) is Europe's gateway to space. Its mission is to shape the development of Europe's space capability.

GlobDiversity focuses on the development and engineering of RS-enabled EBVs.

If you would like to know more get in touch at info@globdiversity.net; or if you would like to know more about the GlobDiversity project then visit www.globdiversity.net