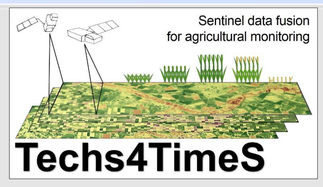
# Techs4TimeS – innovative techniques for the generation and evaluation of Sentinel time series

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## Aims of the project

1. 1) To develop a software library for the generation of consistent time series of optical satellite data at so far unique spatial and temporal resolution (Sentinel-2 scale): The focus will be set on the optimization of the computation time and the improvement of currently used methods. The library is also foreseen as a basis for tests in other application fields.
2. 2) Implementation and demonstration of the developed library using the example of a robust and large-scale calculation of the biophysical parameters LAI and FAPAR by Sentinel-2 and Sentinel-3 (alternatively RapidEye, Landsat, and MODIS) data sets: An optimization is done by a systematic comparison of several approaches.
3. 3) Implementation of an application service for estimating crops yields.

## Study site

The Techs4TimeS project will be implemented on the TERENO test site Demmin in Mecklenburg-Western Pomerania (Figure 1). One field campaign was conducted in collaboration with the calibration and validation facility DEMMIN (DLR) during the vegetation period 2014. Subcontractor is DLR-Neustrelitz. Further field work is planned for 2015.

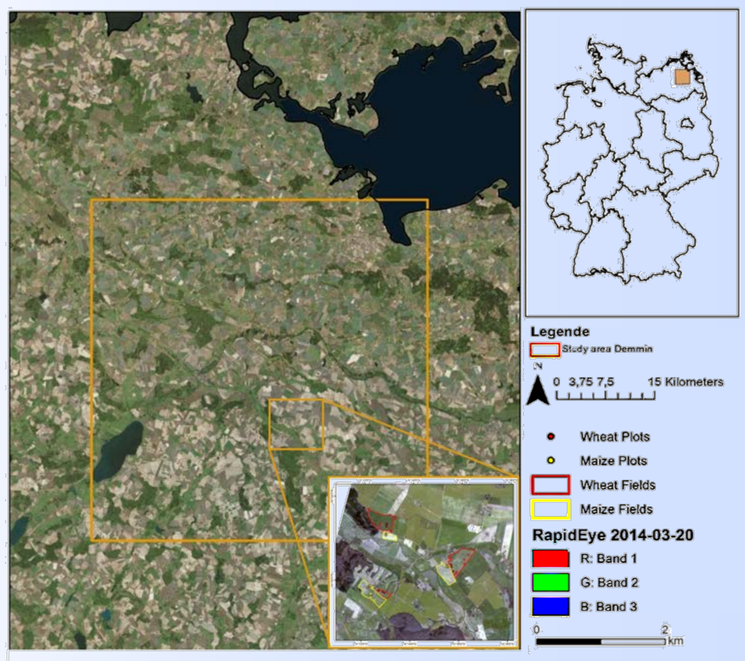


Fig. 1: Study area near Demmin. Four (2x2) RapidEye tiles covering the DLR calibration and validation facility DEMMIN

## Data Fusion

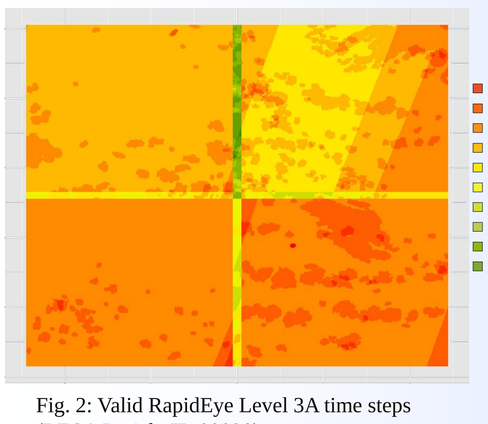


Fig. 2: Valid RapidEye Level 3A time steps (RESA Projekt ID 00028)

The generation of high-resolution time series is usually hampered by reduced temporal coverage and atmospheric disturbance (clouds). The resulting variability in observation times (Figure 2) significantly reduces the consistency of large area observations and can negatively impact on subsequent applications. In order to solve the problem, the project will develop generic algorithms for multi-sensor (S2/3) data fusion. Figure 3 shows first tests of the fusion algorithm STARFM [1] for predicting daily Landsat data from MODIS observations.

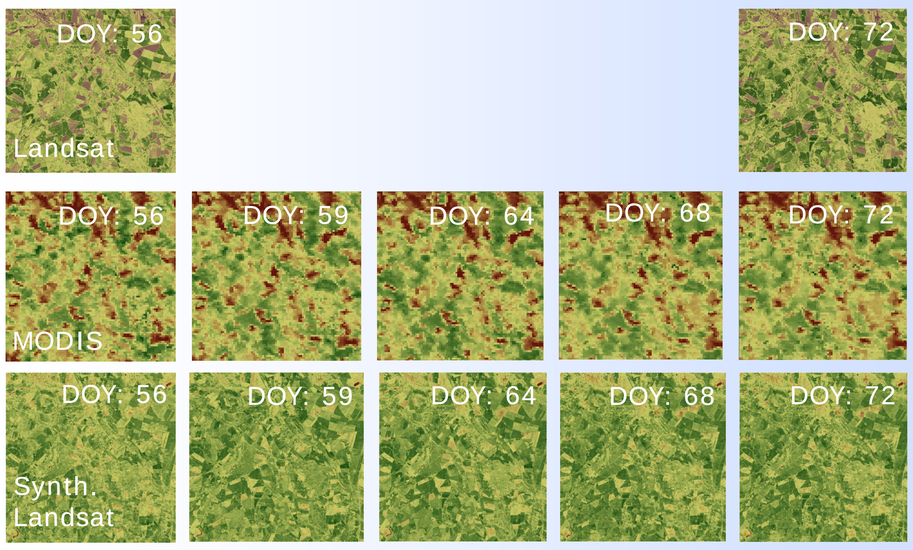


Fig. 3: Example of data fusion between MODIS Terra and Landsat 8.

## Biophyiscal Parameters

FAPAR and LAI maps will be derived using statistical methods (empirical regressions and the percentile approach after [2], and radiative transfer modelling. The focus is set on the minimization of computation efforts for mapping extensive areas. For validation, two field campaigns are envisaged.

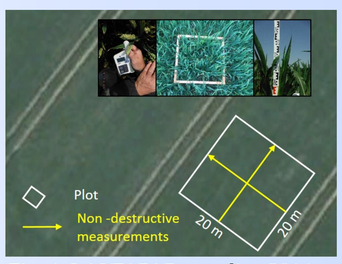


Fig. 4: LAI/FAPAR sampling 2014

Three wheat and three maize fields were selected, on which LAI, FAPAR, vegetation height and chlorophyll were measured with three repetitions every week 2014 (Fig. 4).

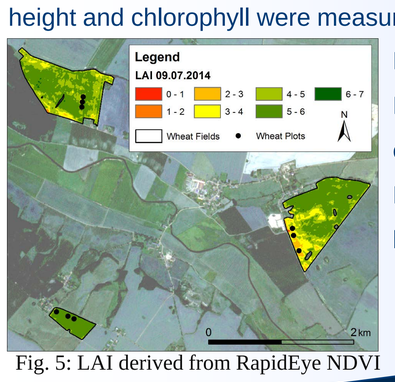


Fig. 5: LAI derived from RapidEye NDVI

Destructive sampling served for the calibration of the LAI-2000 and AccuPAR LP-80 devices. Further campaigns in 2015 will optimize data collection. Figure 5 shows first results of a regression model based on field LAI and RapidEye spectral data.

## Conceptual Workflow

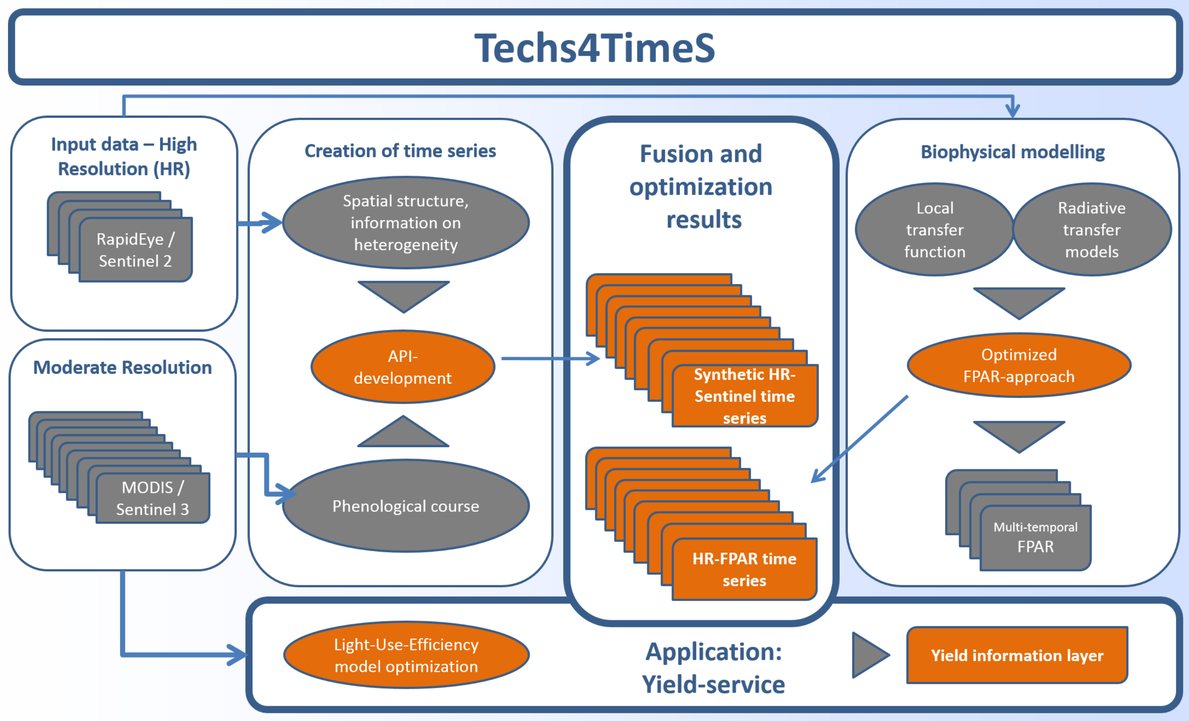


Fig. 6: Conceptual Workflow of the Techs4TimeS project

## Towards a Crop Yield Service

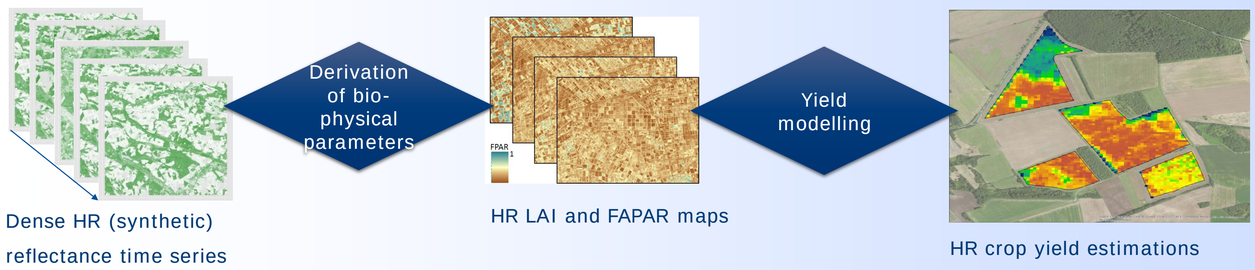


Fig. 7: The high resolution (HR) time series of biophysical parameters will be used for the specification of a yield service.

The green spin company focuses on embedding the new time series in crop yield products. This company deals with the estimation of crop yield information, which aid in the evaluation of field-specific, long-term harvest potentials and management optimization. Feasibility studies will show to which extent the biophysical parameters derived from high resolution time series can improve the accuracy of yield estimation products (Figure 7).

## Cooperation Perspective

Techs4Times intends to link its generic approach of generating high-resolution time series with applications of the Copernicus initiatives of the DLR (Copernicus Center Bavaria) aiming at the cooperation between science and economy. The gained experiences on high resolution FAPAR/LAI time series and yield modeling may contribute to e.g. the Core Mapping Service BioPar or the Core Information Service CGM, or the MARS program. Also targeted cooperation with neighbored BMWi projects such as PhenoS, or those working on agricultural mapping (incl. grassland), in particular with SAR data (Sentinel-1) are expected to have positive effects.

## References

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[2] P. Sellers, S. Los, C. Tucker, C. Justice, D. Dazlich, G. Collatz, D. Randall (1996): Revised Land Surface Parameterization (SiB2) for Atmospheric GCMs. Part II: The Generation of Global Fields of Terrestrial Biophysical Parameters from Satellite Data. Journal of Climate, 9, 706-737.

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