LAI retrieval and validation using Sentinel-2

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In the framework of Remote Sensing for Essential Biodiversity Variables (RS4EBV)

To develop methods to map and monitor EBVs from Sentinel-2 in support of biodiversity conservation

The potential of high-resolution multispectral satellite imageries (RapidEye, 2015), (Sentinel-2, 2016) for retrieval of LAI is considered
Leaf area index (LAI)

LAI as a Key structural characteristic

- Modeling of vegetation productivity evapotranspiration
- Quantitative analysis In global ecology
- Controlling biological and physical processes
- Exchange of energy and nutrient
- Vegetation abundance Vegetative development
LAI Estimation

Field & Laboratory

Remote Sensing

Statistical Approach

Physical Approach
Study area

Location: 53°30’ N, 6°10’ E
Field Measurements

- Field works were performed for two subsequent years
- July 2015: 30 plots were measured in Schiermonnikoog, NL
- July 2016: 20 plots were measured in Schiermonnikoog, NL

LAI, canopy height, canopy percentage, .. Leaf chlorophyll content, ..
Vegetation cover and distribution of sample points

Legend
- Sample Points
  - Agriculture
  - Bare Sand
  - Bare mud flat
  - Forest
  - Green Beach
  - High Shrub
  - Water
  - High matted grass
- Low Hippophae Shrub
- Low Salix Shrub
- Low matted grass
- Roads
- Settlement
- Tussock grass
- Herbs

Coordinate System: RD New
Projection: Double Stereographic
Datum: Amersfoort
False Easting: 155,000.0000
False Northing: 463,000.0000
Central Meridian: 5.3876
Scale Factor: 0.9999
Latitude Of Origin: 52.1562
Units: Meter
Schiermonnikoog, The Netherlands
Recording coordinates in each subplot

Recording grass structure and species abundance
Measuring above canopy radiation for calculation of Leaf Area Index (LAI)

Chlorophyll measurement
spectral response to LAI variation
Method

Model parameterization

Sensitivity analysis

For Official Use

Forward modeling (PROSAIL)

LUT

Predicted LAI

Model inversion (LUT search)

Sentinel-2 Reflectance

Measured LAI

Validation

LAI MAP
Sensitivity analysis of RapidEye and Sentinel-2 to LAI variations
Measured and Estimated LAI using RapidEye 6-8-2015

$R^2 = 0.35$ RMSE 1.644
LAI map for the Schiermonnikoog, using the RapidEye image
$R^2 = 0.48$ RMSE 1.35
LAI map for the Schiermonnikoog, using the Sentinel-2 image
Conclusions & Recommendations

- The Obtained results can be further improved by accurate calibration/parametrization of models (more Sampling)

- As the results of the sensitivity analysis revealed higher accuracy was observed using Sentinel-2 data

- Field data collection is extremely important and is the only way to validate the RS products

- The field data used for validations need to be standardized! (Protocols)

- Time and cost limit the data collection (extension of networks)
Field measurements for validation of Sentinel-2 data Pretoria, SA 22-11-2016