DEVELOPING VEGETATION PRIORS FOR MULTIPLY WITH META-ANALYSIS AND PHENOLOGICAL STUDY

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Abstract

Estimating land surface parameters from remote sensing is considered an ill posed-problem; most of the times fewer observational information is available than required for accurately retrieving these parameters, leading to larger uncertainties. In order to improve upon this, additional prior information can be used within a Data Assimilation (DA) approach, such as in a MULTIPLY (and it's predecessor EO-LDAS) framework to constrain such retrievals [1]. MULTIPLY will use a variety of RS sources and Radiative Transfer Models (RTMs) to retrieve land surface parameters. The role of priors in this framework is to provide additional information in the case of absent or highly uncertain observations. We are therefore developing several priors, such as phenological statistics/models, and plant trait relationships. These will be developed from meta-analysis and in-situ data collection.

Introduction

Plant traits describe an ecological perspective on biodiversity, functioning, relationships and communities. Plant traits also relate and equate to many earth observation (EO) land surface vegetation parameters used. Currently however, there are many obstacles in using these EO parameters:

- **Static priors are used, too little information for operational use**
- **There are large Inconsistencies between products**
- **EO products tend to have one product per satellite instrument**
- **the uncertainties are unknown**

However, we plan to solve these shortcomings within the MULTIPLY project using data assimilation techniques. Data assimilation frameworks use priors and/or observation data to reduce uncertainty by constraining retrievals or providing a base value where none is present.

MULTIPLY Project

MULTIPLY - MULTIscale SENTINEL land surface information retrieval Platform

"develop and enable application of a practical, flexible, user-friendly platform to provide the scientific community with a tool to generate land surface products and its associated uncertainties and exploit these for data-intensive science."

The MULTIPLY DA system uses physical models (Radiative Transfer Models) of how irradiance is reflected by the Earth's surface, depending on the land surface properties. We believe that the use of physical models allows for consistent coupling of information from different wave lengths, information from different spatial and temporal resolutions and the quantification of uncertainties .

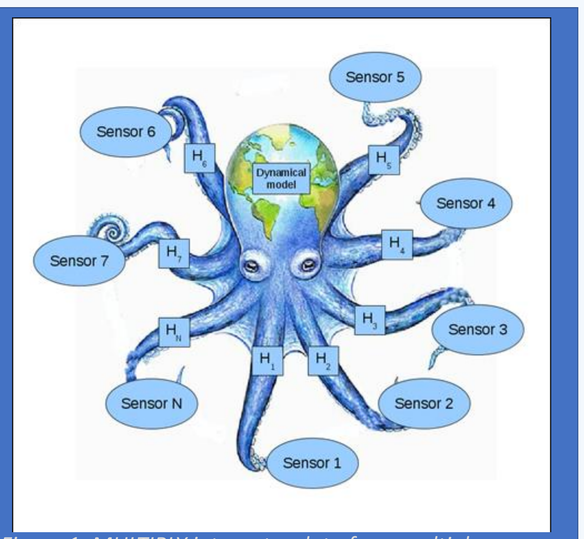

Figure 1: MULTIPLY integrates data from multiple sensors uses data assimilation.

Objectives

Scientific Questions

1. What are the trade-offs and responses between different biophysical plant traits around peak biomass?
2. Are trait-trait relationships stable from through the entire growing season and do these relationships vary from the relationship established at the peak biomass?

Sub-Objectives

1. Collect Observation Data for MULTIPLY to create priors
2. Create vegetation priors which are robust and relevant in different ecosystems and seasons

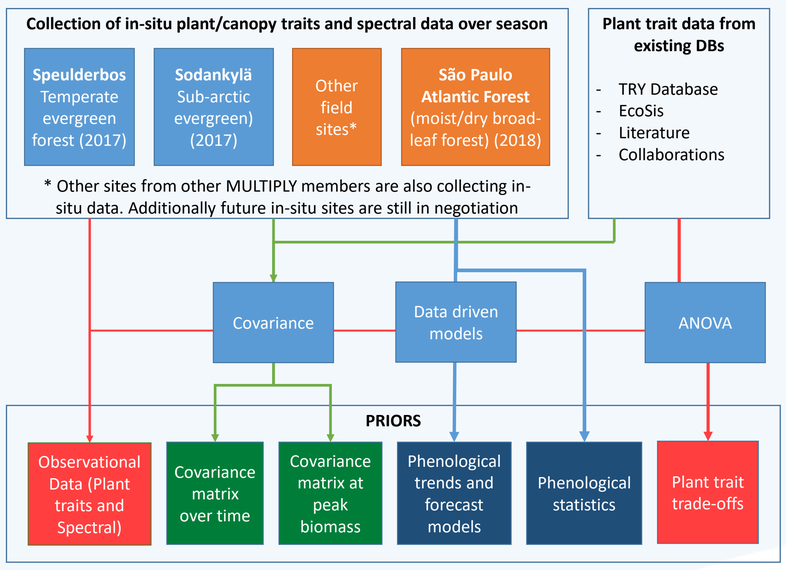

Figure 2: Overall methods and data used to create vegetation priors for MULTIPLY interface

Methods

Two main types of data are needed to create priors:

1) Spectral reflectance data (350-2500 nm)
2) Plant traits (see Table below)

These are collected via two groups

- Group 1: Existing databases with or without spectral measurements (TRY, EcoSis, literature)
- Group 2: Fieldwork where plant trait and spectral data are collected simultaneously (see field sites)

Plant Traits Collected	
LAI (Leaf Area Index)	Leaf water content
Plant/canopy height	Leaf chlorophyll a/b
Leaf angle (LAD/LIDF)	Leaf carotenoids
Leaf Thickness	Leaf Phenolics
Plant Growth Form	Total carbon (leaf/canopy)
Leaf Shape/Type	Leaf Nitrogen
Leaf mass per area	Leaf phosphorus
Specific Leaf Area	Leaf lignin
Leaf dry matter content	Non-structural carbohydrates (NSC)

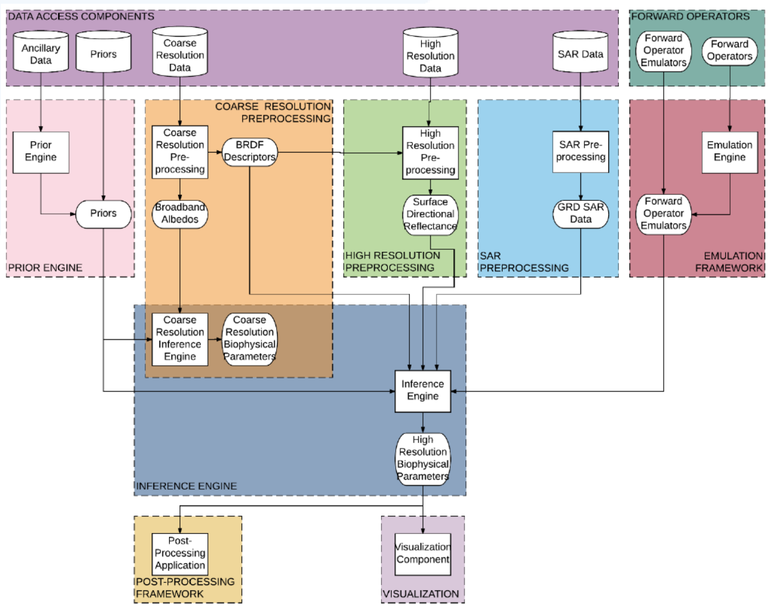

Figure 3: MULTIPLY framework

2017 Field Sites

Speulderbos

Located: The Netherlands (**52°15'03.9"N 5°41'24.2"E**)
Ecosystem: Temperate Evergreen Forest
Main Species: Douglas fir (*Pseudotsuga menziesii*)
Collection time: 04-2017 – 09-2017
Spectral Instrument Used: RS-3500

Figure 4: (left) fresh growth on fir tree, (right) view from top of observation tower.

Sodankylä

Located: Lapland Finland(**67°21'43.1"N 26°38'04.7"E**)
Ecosystem: Sub-arctic heath evergreen forest
Main Species: Scots Pine (*Pinus Sylvestris*)
Collection time: 06-2017 – 08-2017
Spectral Instrument Used: ASD FieldSpec Pro

Figure 5: (from left to right) 1) Field site Forest 2) Observation tower with spectrometer 3/4) Ground moss and lichen at site, 5) view of canopy from PAR sensor

Future

- Finish sampling at other field sites (mid-2018)
- Process plant samples to derive all needed plant traits
- Process and correct spectral data
- Develop prior engine
- Run priors against controls to measure performance

Acknowledgements

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References

[1] (Lewis et al., 2012)

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