Virtual Water Values (ViWA)

High-resolution monitoring system for water-related SDGs:

Dr. Heike Bach, VISTA Geoscience Remote Sensing GmbH, Munich
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Isabella Fritz, VISTA Geoscience Remote Sensing GmbH, Munich

ViWA – Virtual Water Values

Water use efficiency (WUE) links food and energy production to water consumption **(water-food-energy nexus)**

Research goals

- **find out** how efficiently and sustainably water is used by agriculture globally and regionally and where and how both can be improved
- **develop** a new real time monitoring/modelling system for global agricultural WUE and sustainable water availability based on the latest COPERNICUS Sentinel satellite data streams
- **analyze** trade-offs in impact scenarios of agricultural WUE on global agricultural trade
- **assess** the sustainability of proposed solutions for global (mainly agricultural) and regional water use.

More information: https://viwa.geographie-muenchen.de/project-information/point-of-departure/

Overview

Sentinel2 satellite data and project scope

Methods

- Preprocessing satellite imagery
- Deriving crop specific vegetation parameters

Results

- Leaf Area Images ensembles – simulated and remote sensed
- Water Use Efficiency status

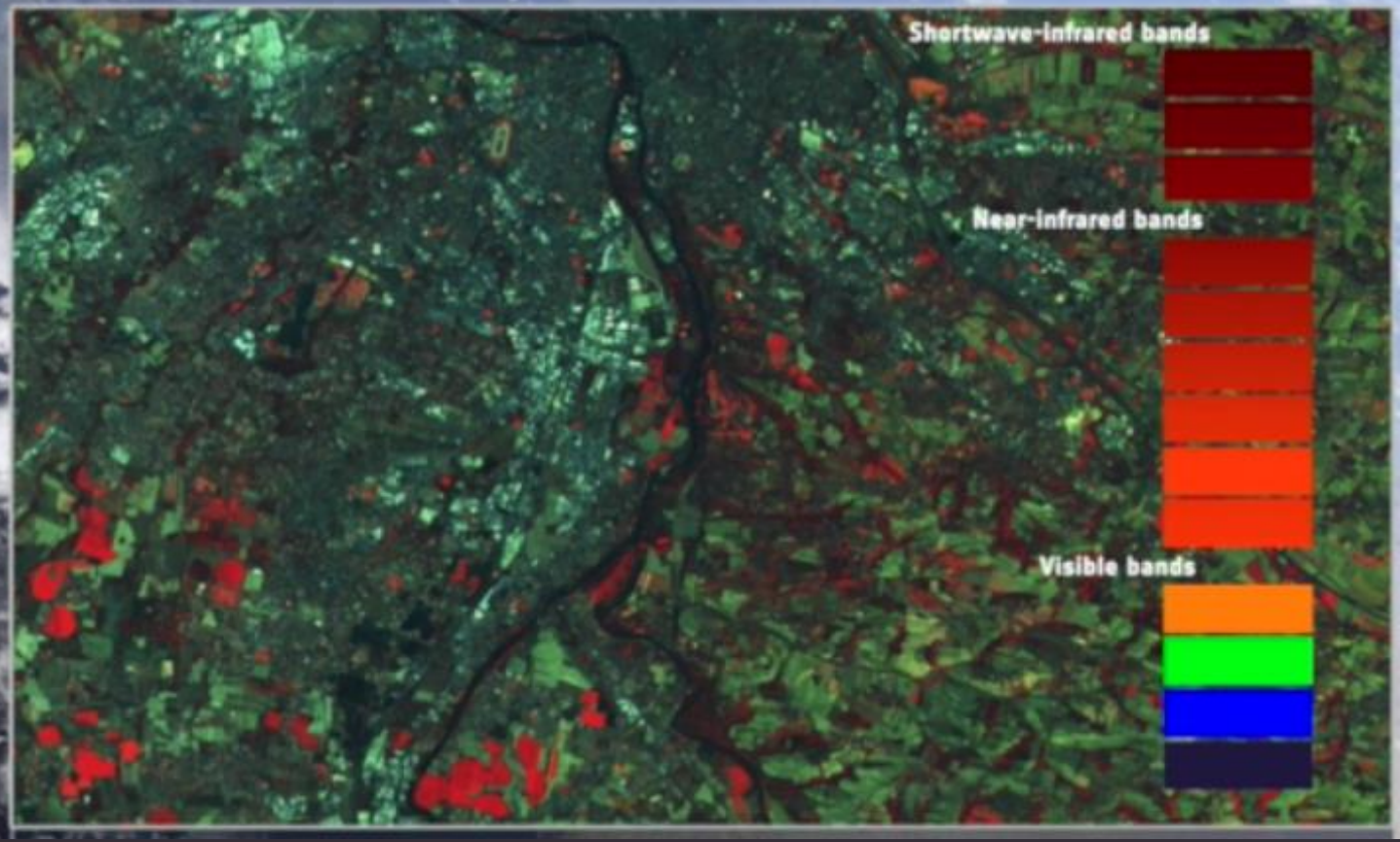
Project Exploitation and Enhancements

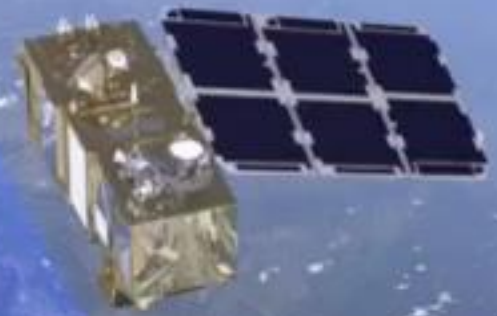
- YPSILON – predictive yield by satellite
- VariableRain – irrigation advice service

Project Conclusion

The Big Data Revolution

Copernicus is the largest producer of EO data in the world





The Big Data Revolution

Copernicus is the largest producer of EO data in the world

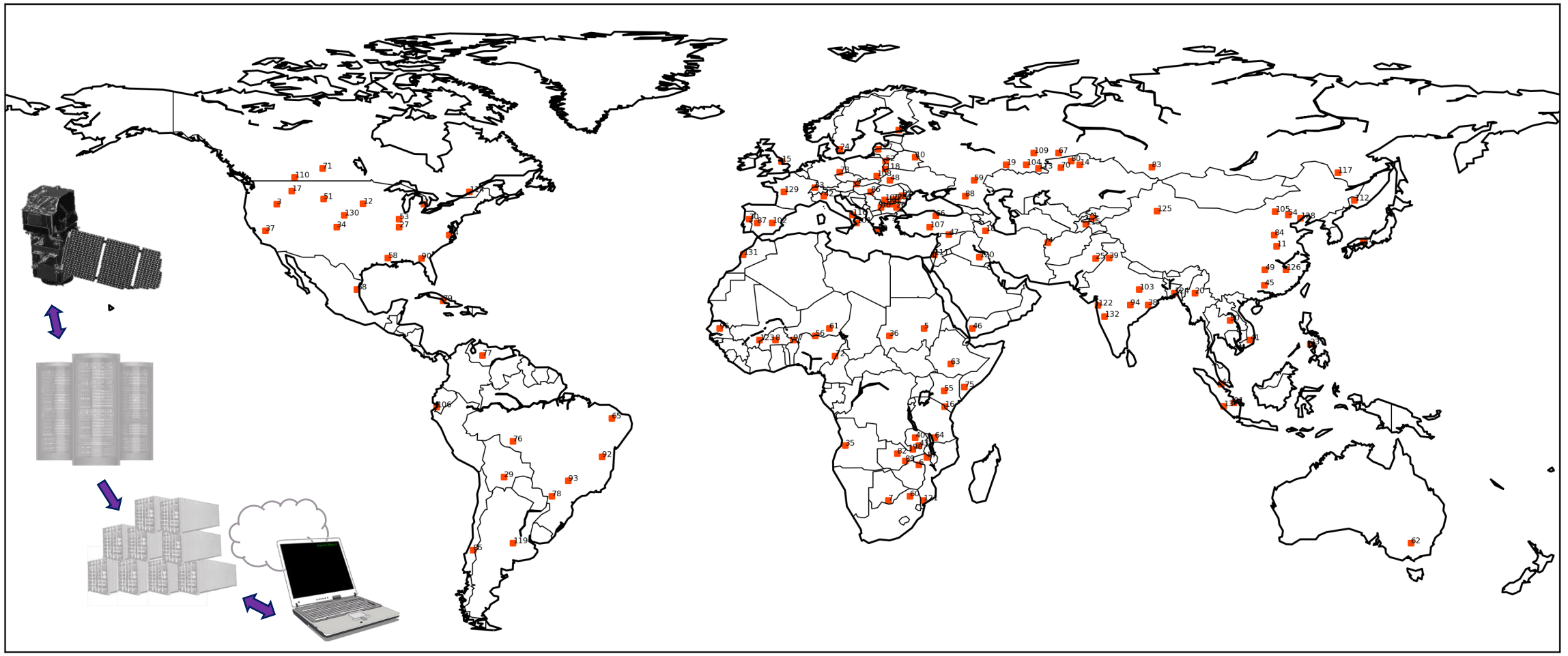
Daily Data Production Sentinels	15 TB
Daily Data Dissemination Sentinels	150 TB

All global landmass is observed every 5 days at 10m resolution

This has never happened before

Big data and project scope

ViWA
Virtual Water Values



vista

food security tep

http://foodsecurity-tep.net

Data from 2016 to 2018

~ 150 Sentinel2 Tiles [10 000km²]

~ 36 000 Satellite Images

~ 100 Terrabyte

Fully automatic processing of satellite data using our in-house process chains

ViWA
Virtual Water Values

Optical satellite data

Atmospheric correction

Cloud classification

Land use classification

Retrieval of plant parameters

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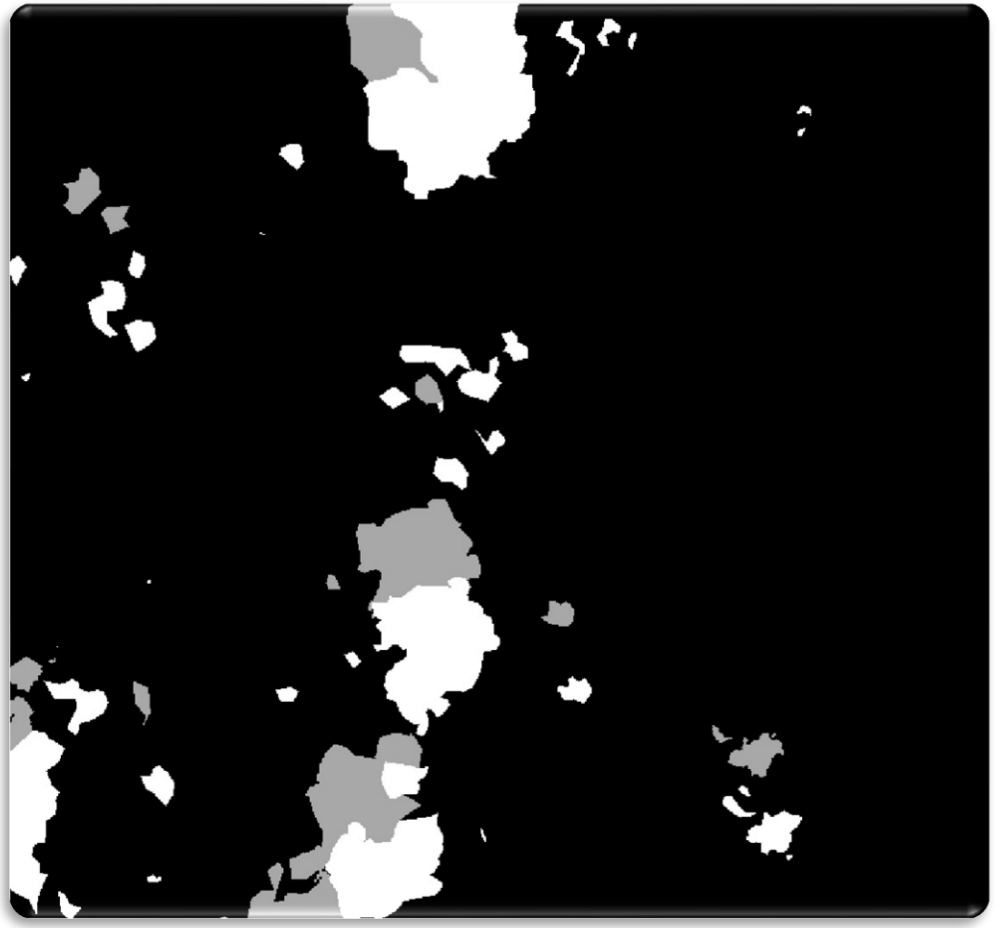

Fully automatic processing of satellite data using our in-house process chains

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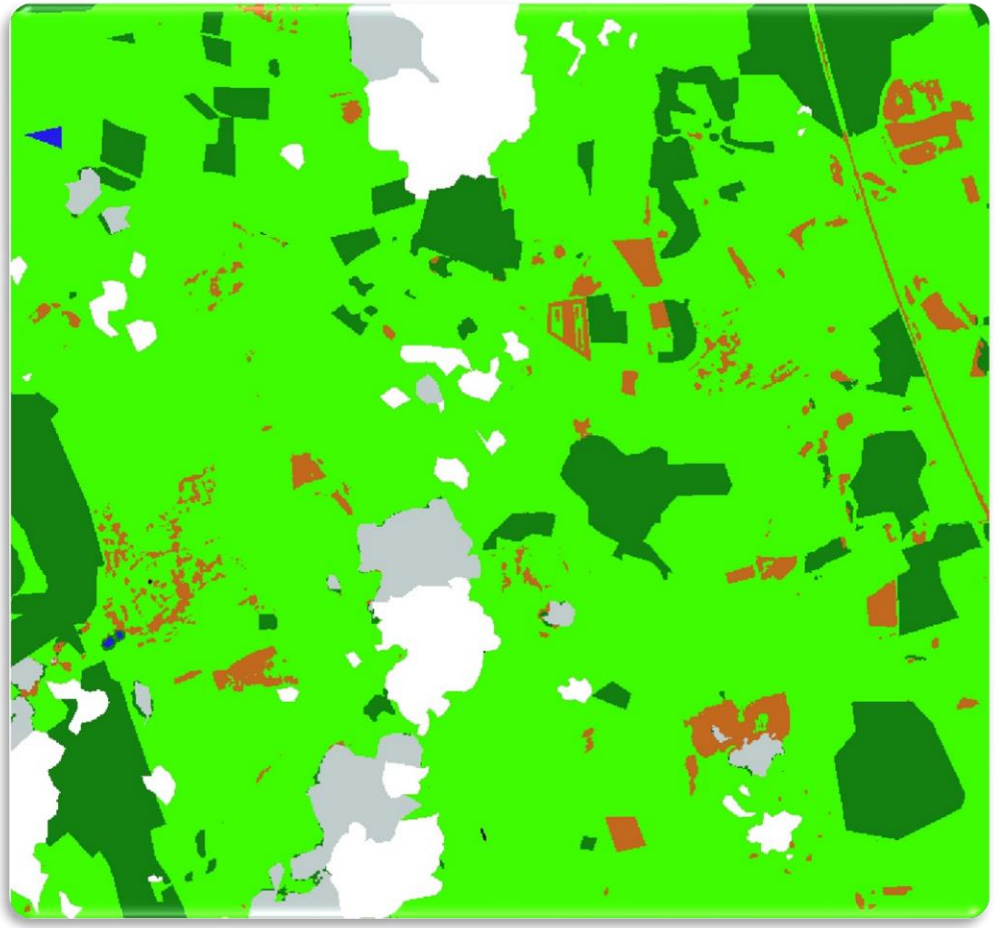

Fully automatic processing of satellite data using our in-house process chains

ViWA
Virtual Water Values

Optical satellite data

Atmospheric correction

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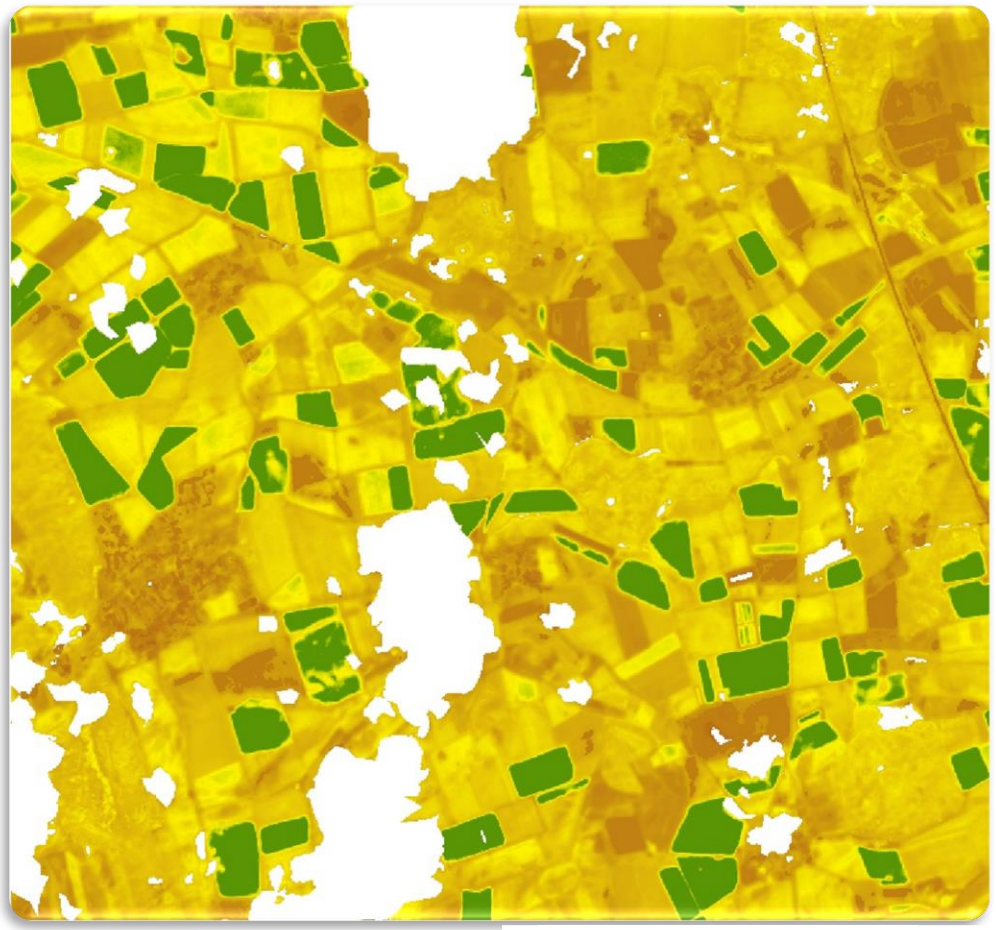
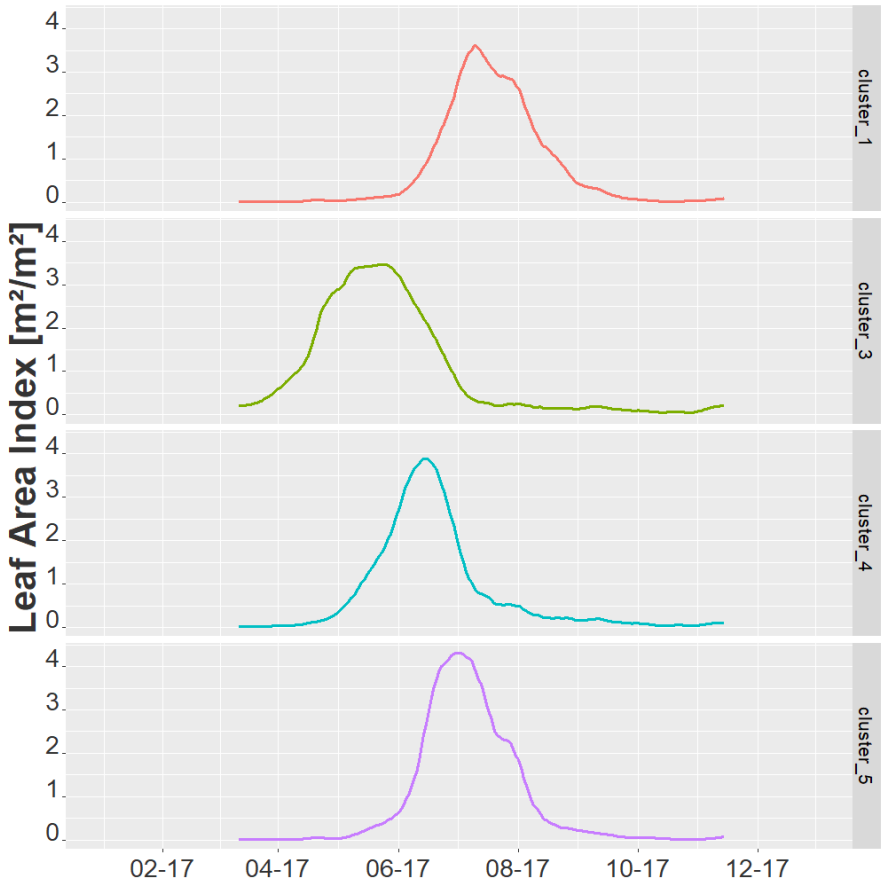


Crop classification

Tile 37TGL(Russia – Southern District)

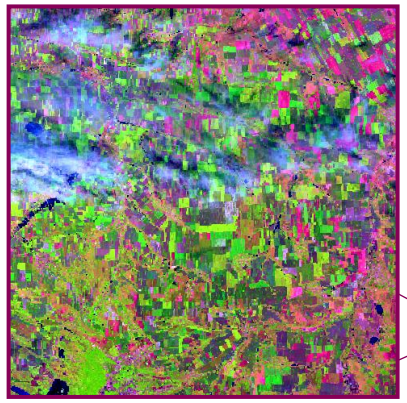


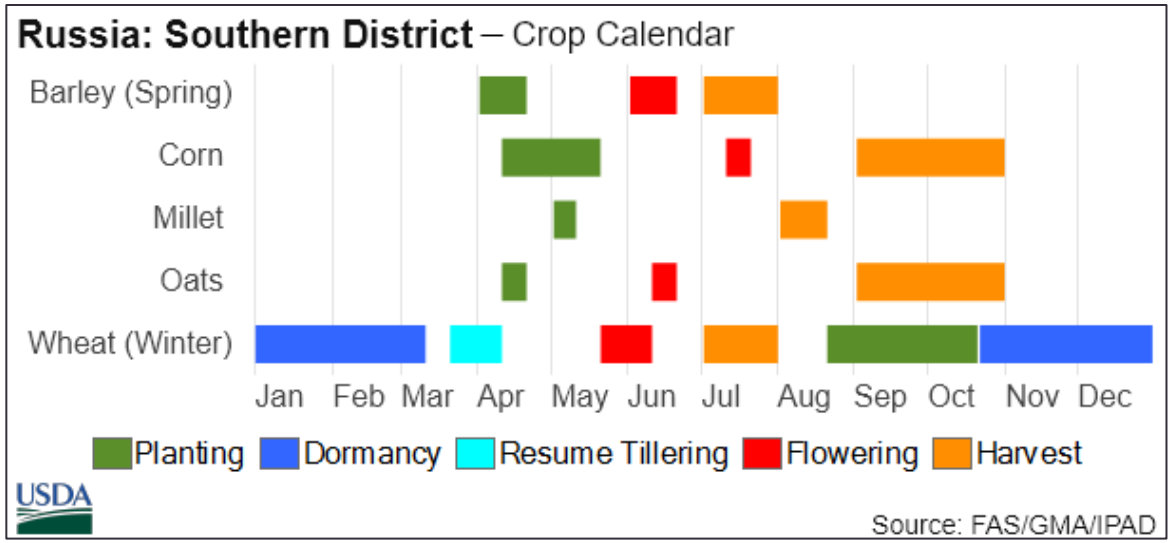
Maize

Winter Wheat

Spring Barley

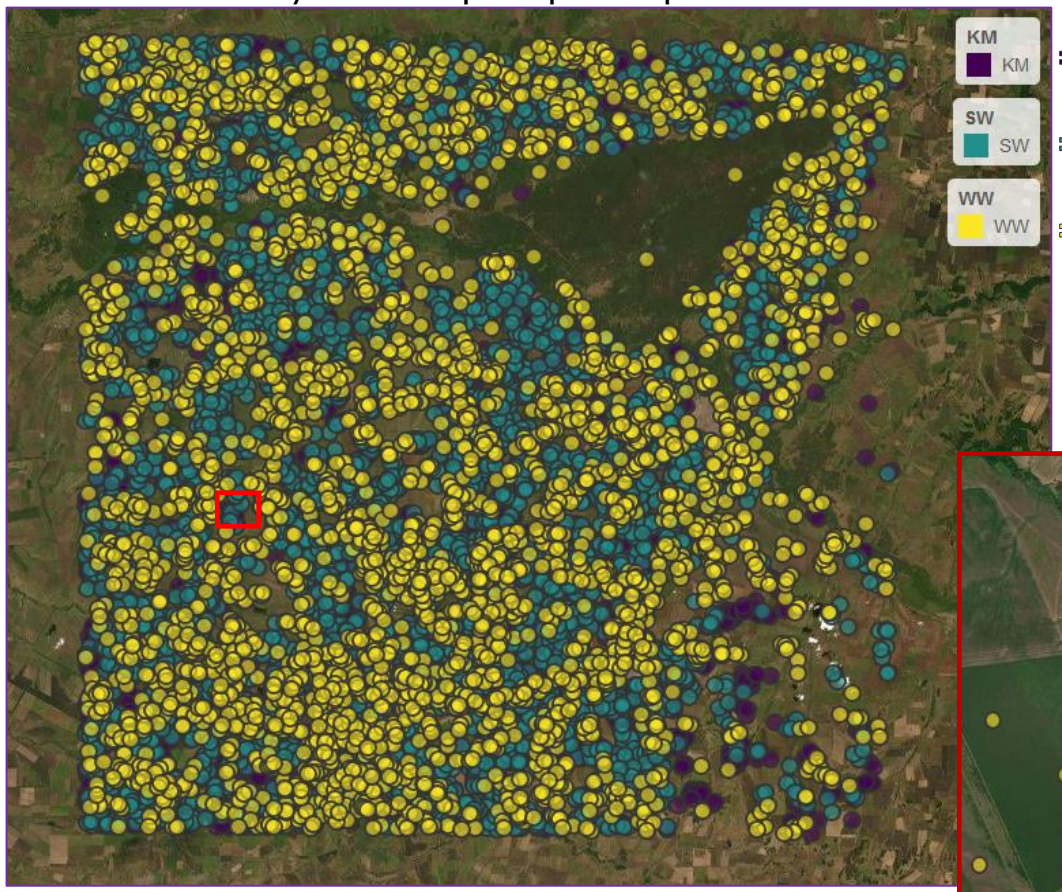
Spring Wheat





Crop specific retrieval of vegetation parameters

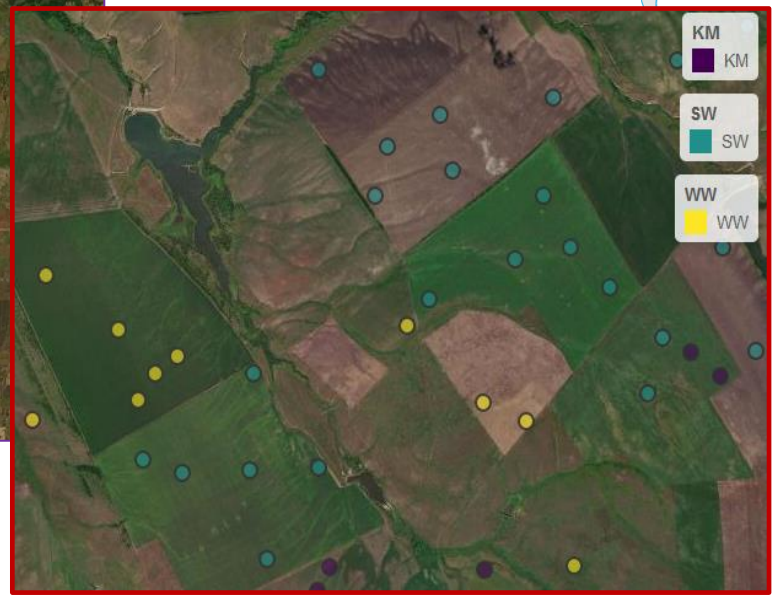
Tile 39UWU (Russia – Volga District)
~ 10000 randomly selected pixel per crop



= Maize

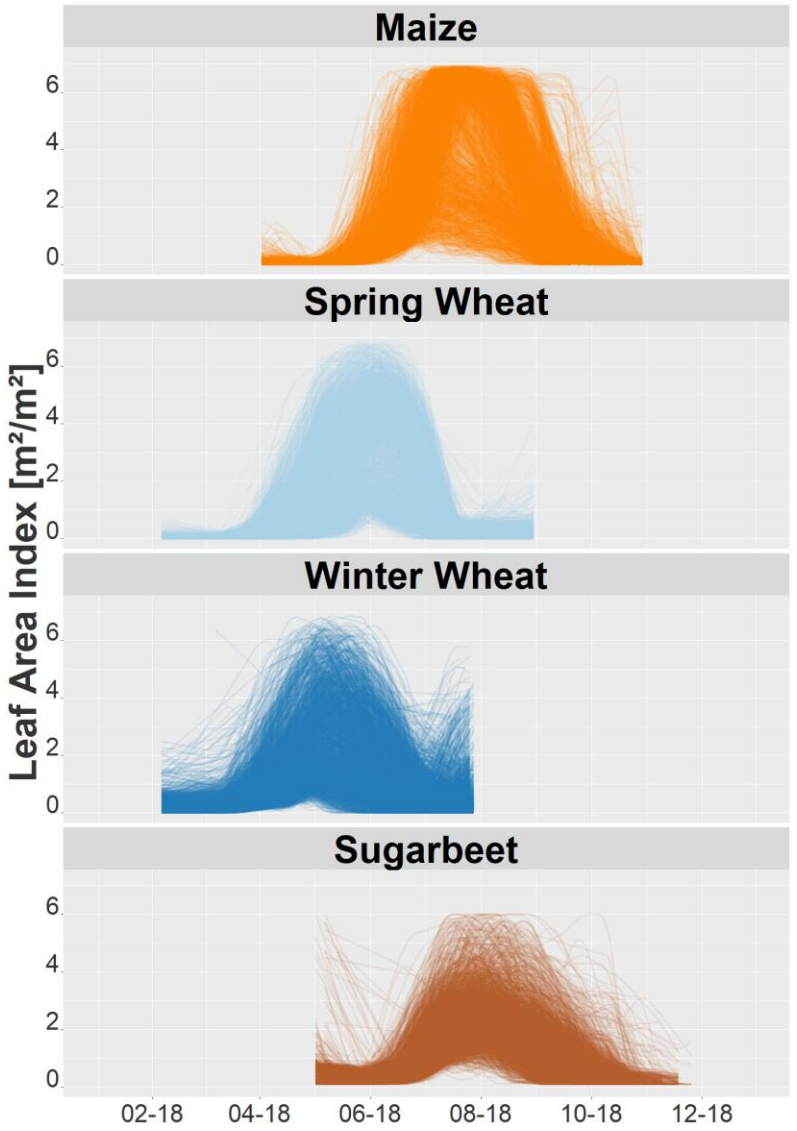
= Spring Wheat

= Winter Wheat



Location of the pixels assigned to the different crops

Leaf Area Index results



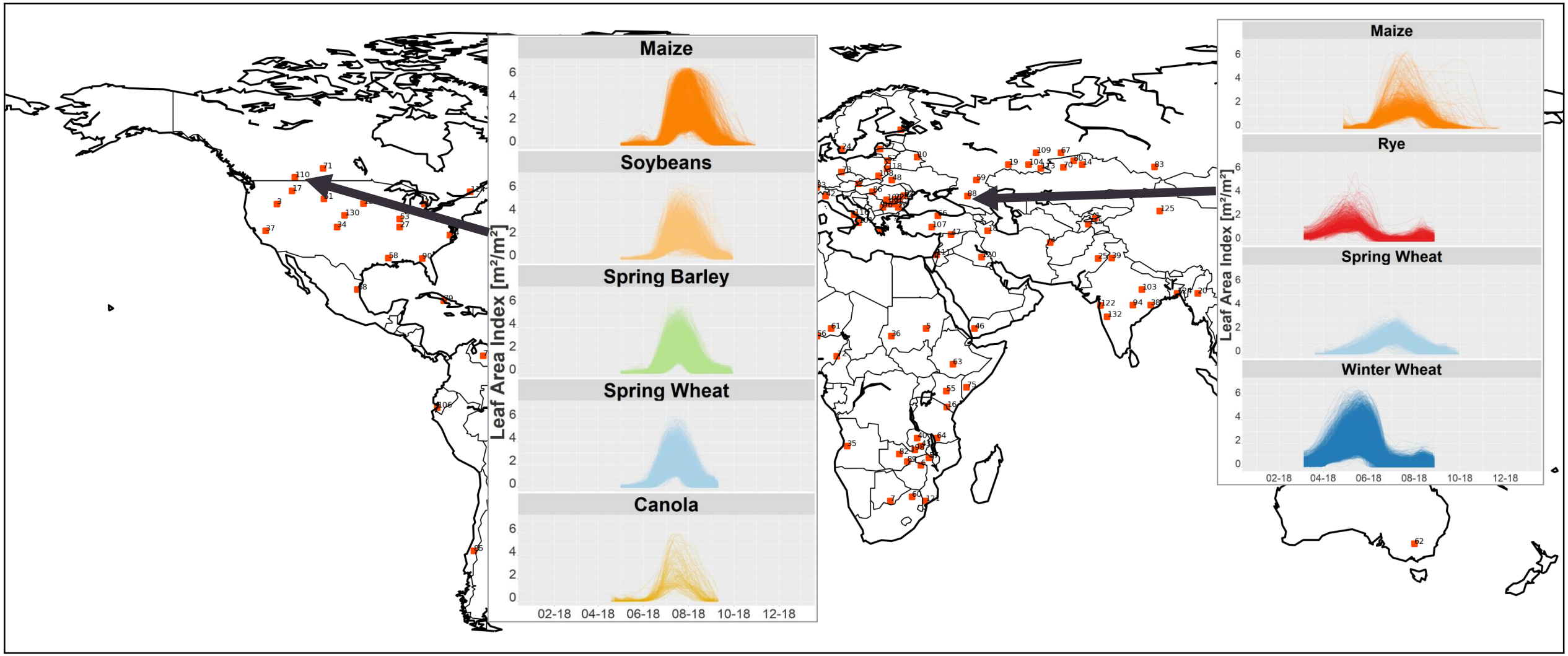
Tile 11TNJ (USA – Idaho)

Retrieval of vegetation parameter time series for each selected pixel.

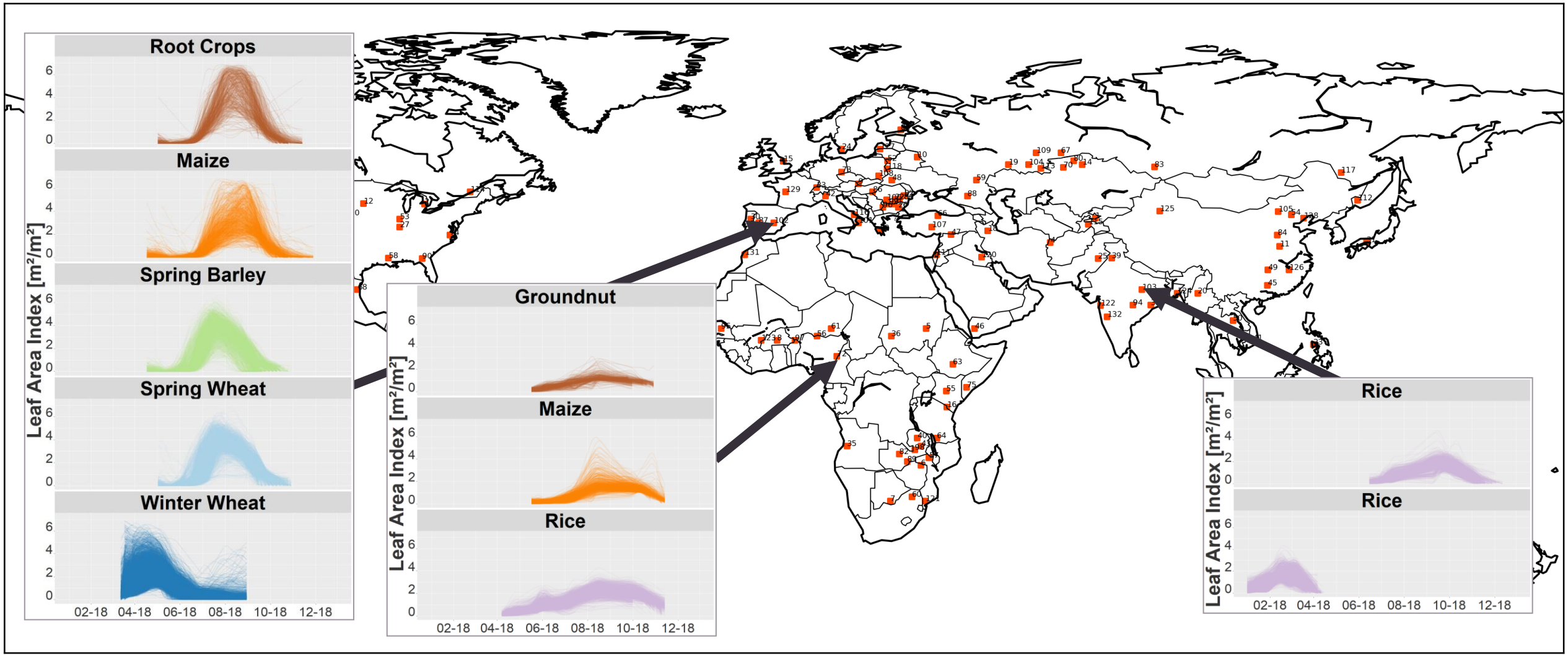
Leaf area index [m^2/m^2] as a measurement for leaf area per surface area.

Ensembles of LAI curves due to crops growing in different conditions: Varying qualities of soil, irrigation, micro climates.

Remote sensed cropspecific Leaf Area Index ensembles



Remote sensed cropspecific Leaf Area Index ensembles

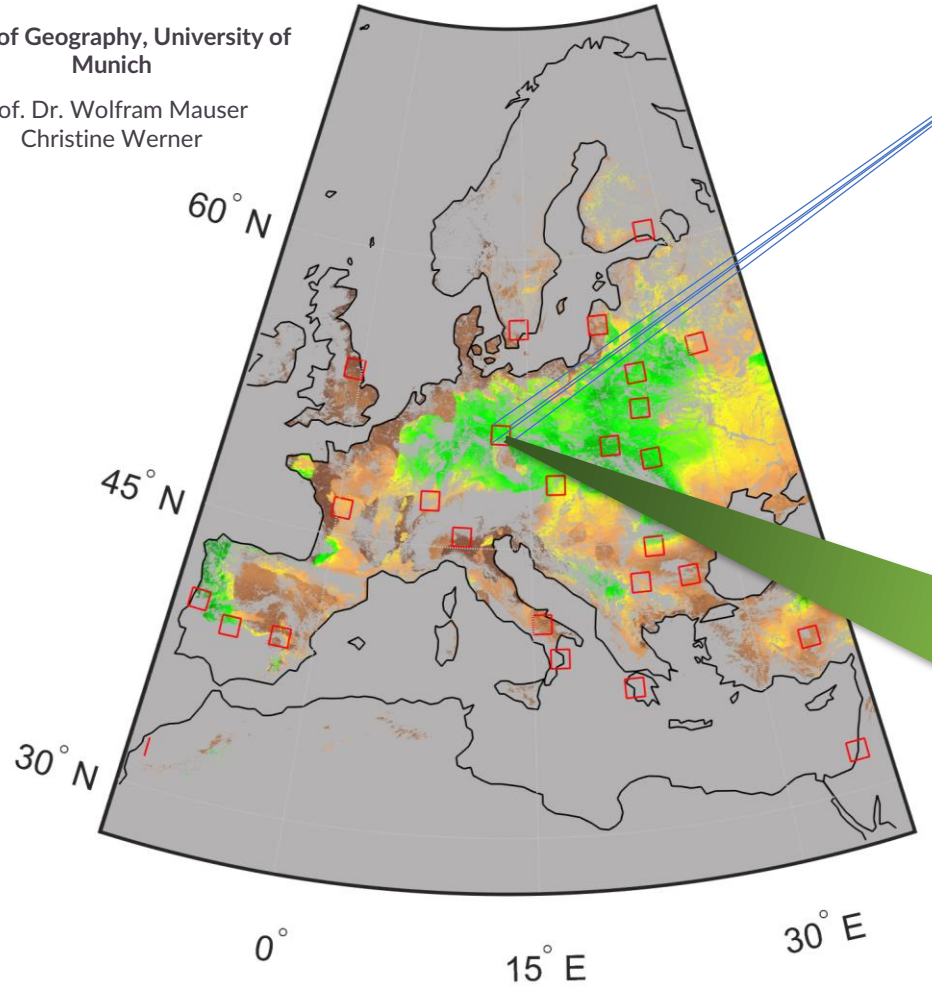


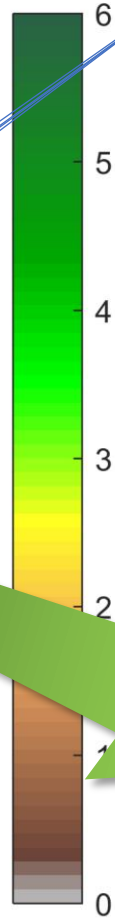
PROMET - global scenarios and link to satellite observation

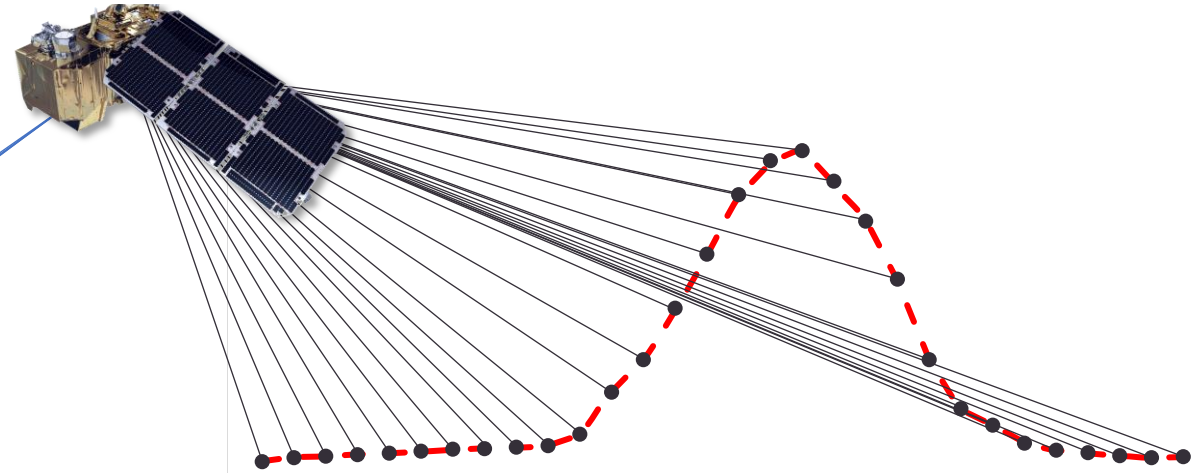
LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

Dept. of Geography, University of Munich

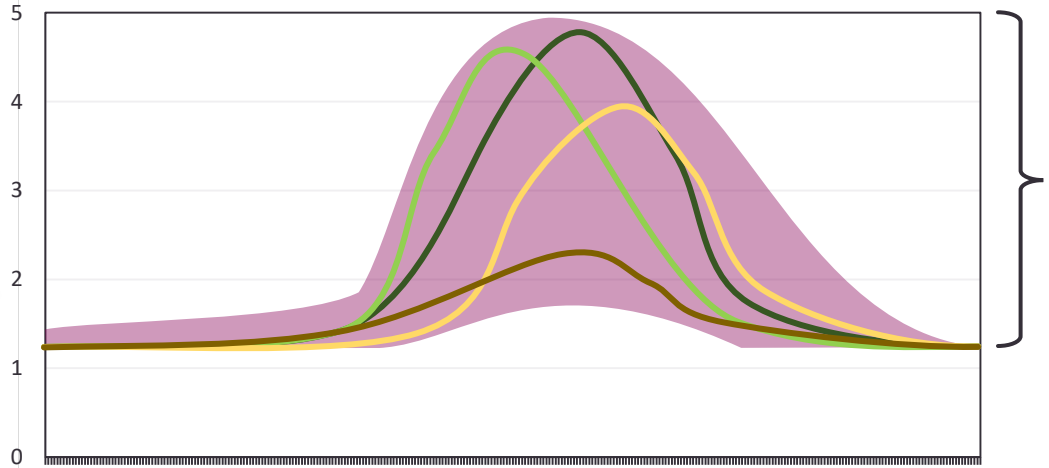
Prof. Dr. Wolfram Mauser
Christine Werner







Leaf area index for different scenarios on each pixel



Ensemble Corridor with
≈ 250 Management-Scenarios

PROMET - global scenarios and link to satellite observation

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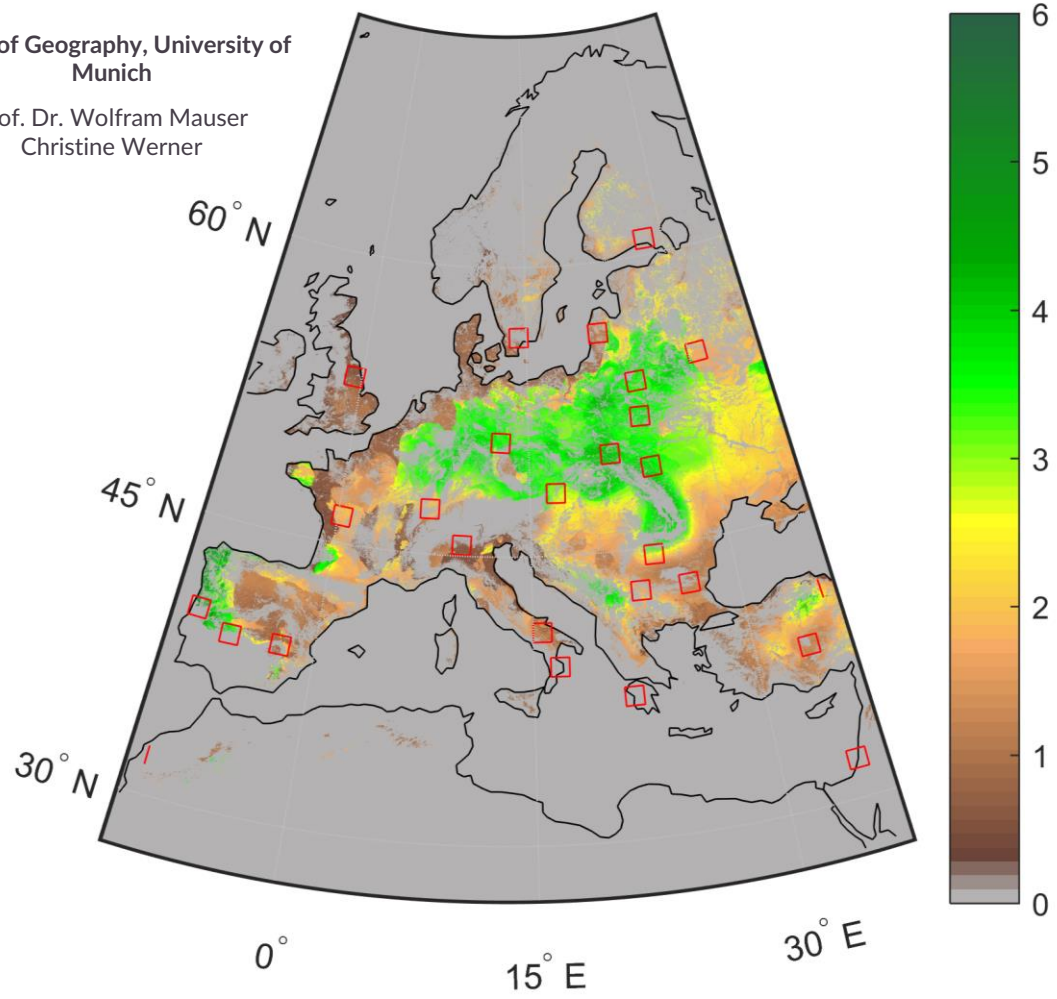
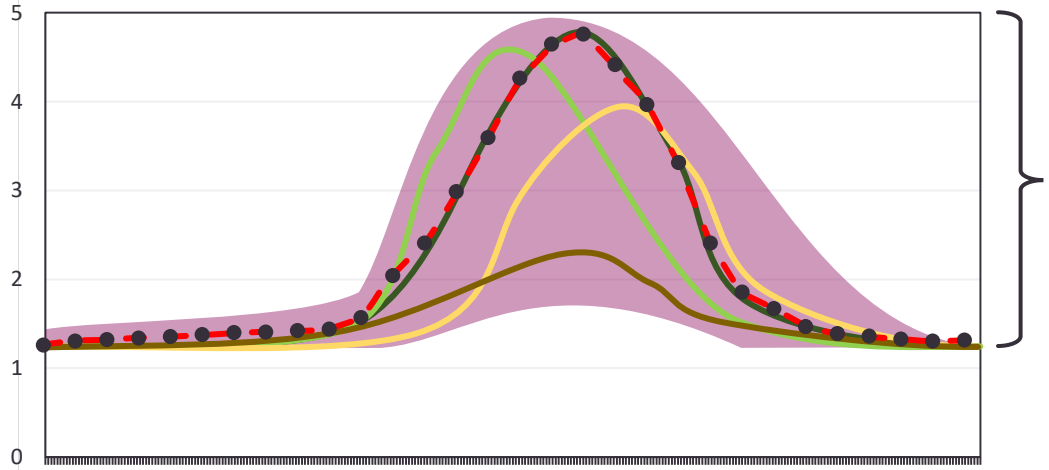


By comparing modelled vegetation growth with Sentinel Earth Observation data the most realistic scenario can be determined among the simulations contained in the ensemble.

5-day time-series

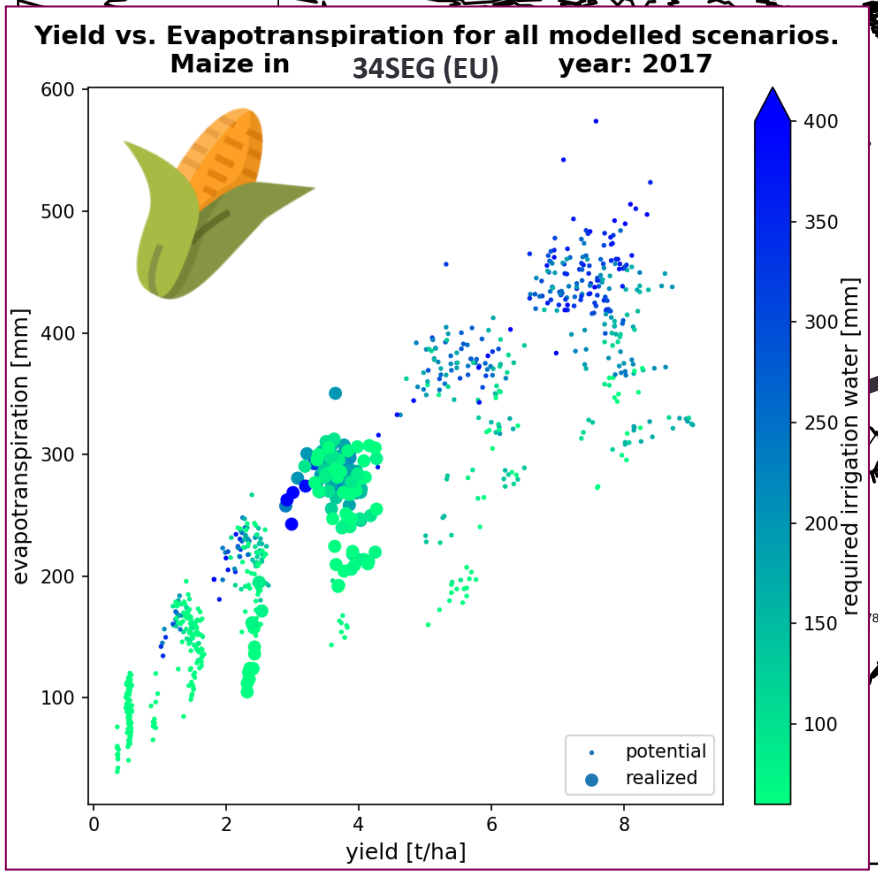
Leaf area index for different scenarios on each pixel



Ensemble Corridor with ≈ 250 Management-Scenarios

Satellite derived information determine present status of water use efficiency in PROMET model scenarios

ViWA
Virtual Water Values



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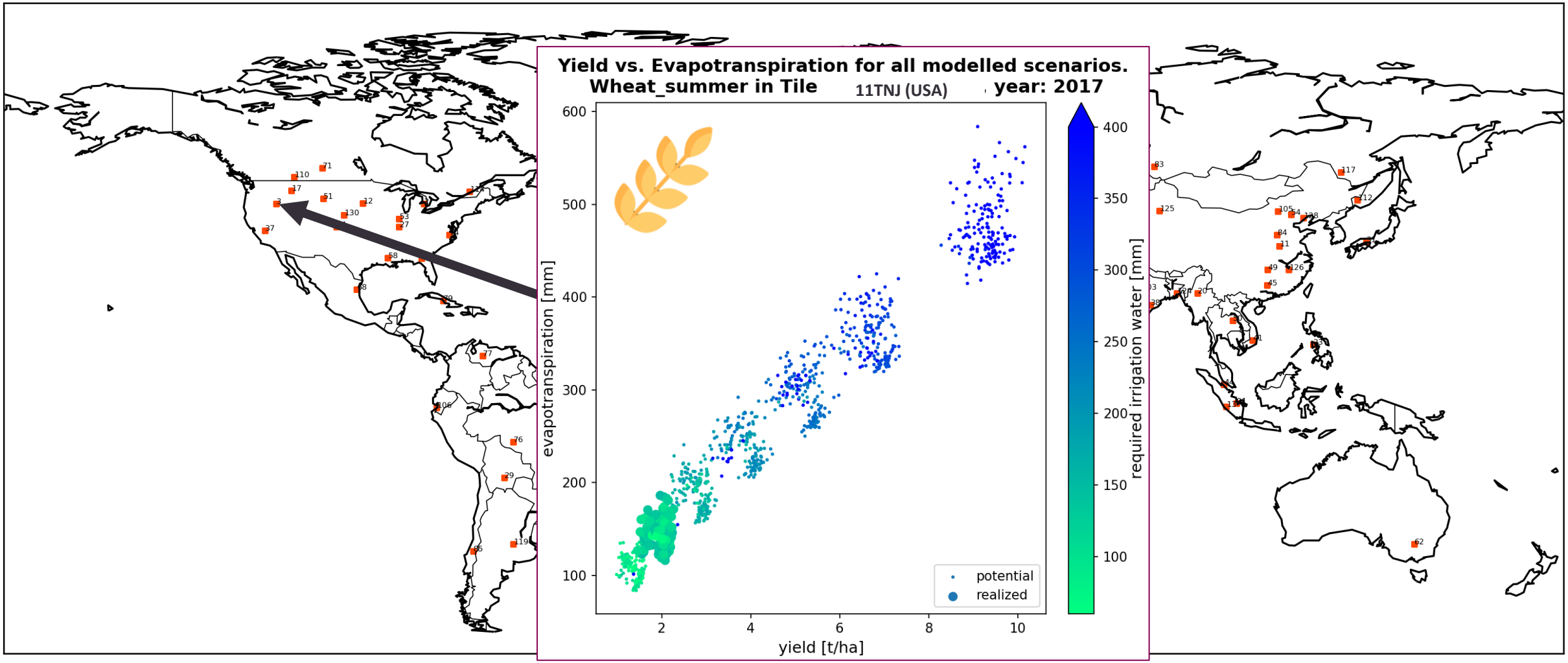

Satellite derived information determine present status of water use efficiency in PROMET model scenarios

ViWA
Virtual Water Values

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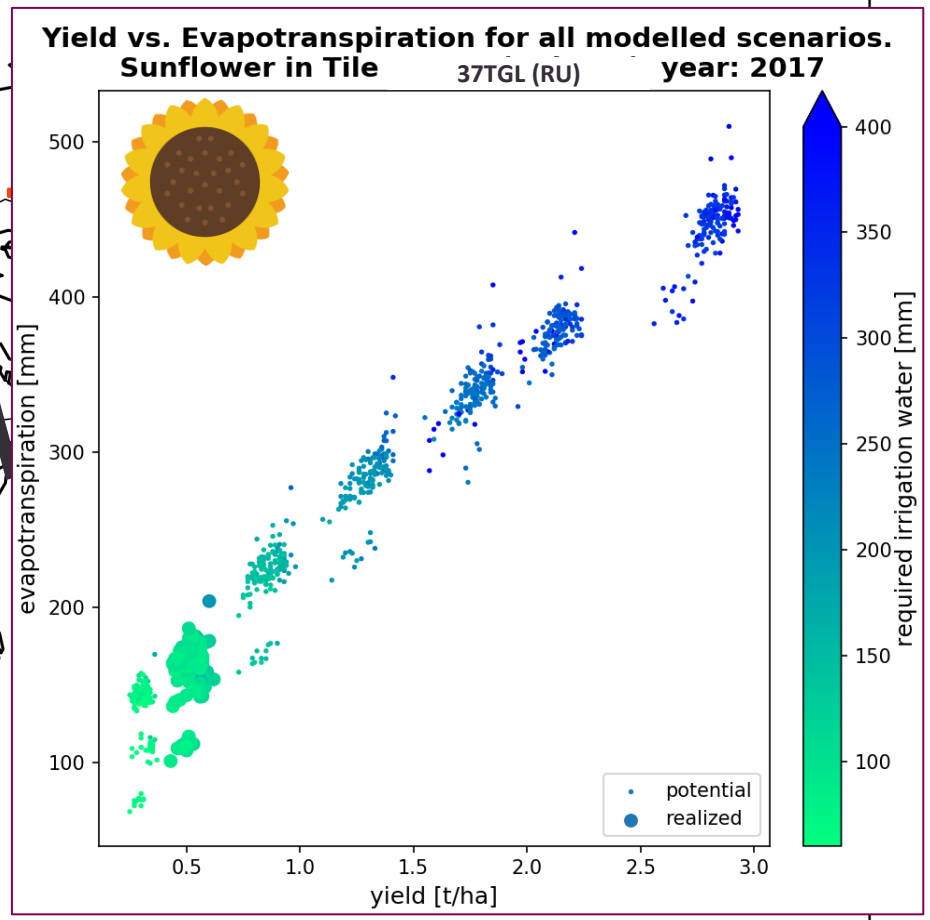
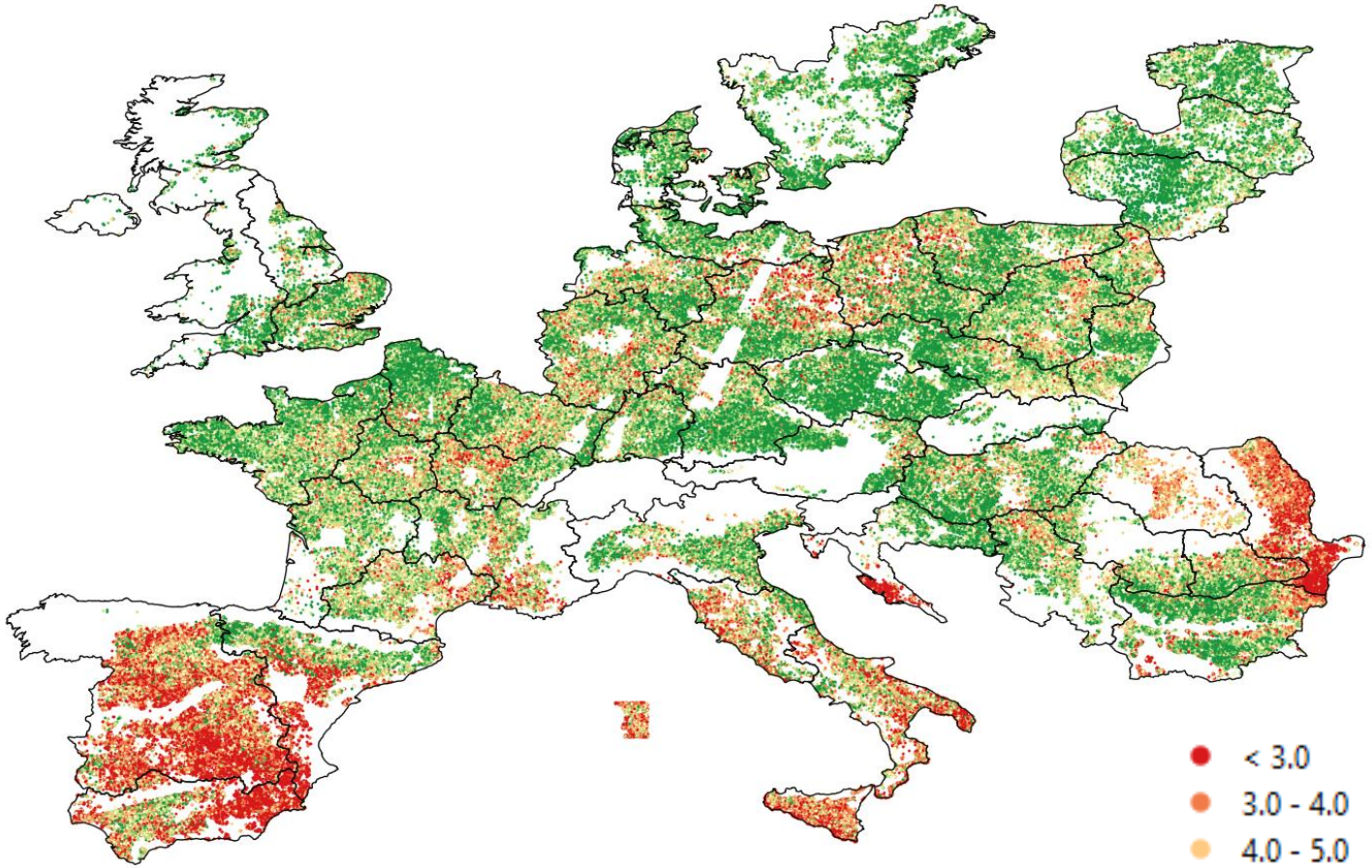
food security tep

http://foodsecurity-tep.net



Exploitation of algorithms and tools created in ViWA with YPSILON (Yield Prediction by Satellite)

ViWA Virtual Water Values



Winter Wheat Yield 2020 t/ha

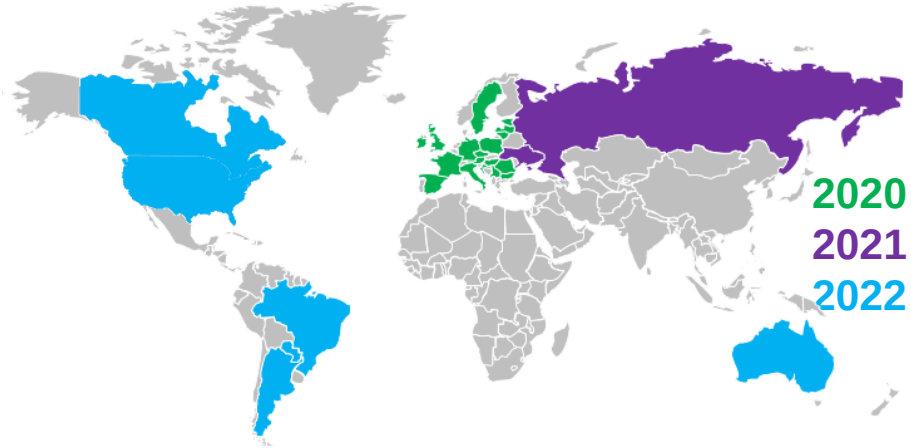
https://ypsilon.services/

1) On National & Province level:

- Yield forecast
- Harvest pace

2) On Regional level (2.500-25.000 km²) for milling, crush, ethanol, compound feed plant:

- Yield forecast
- Harvest pace



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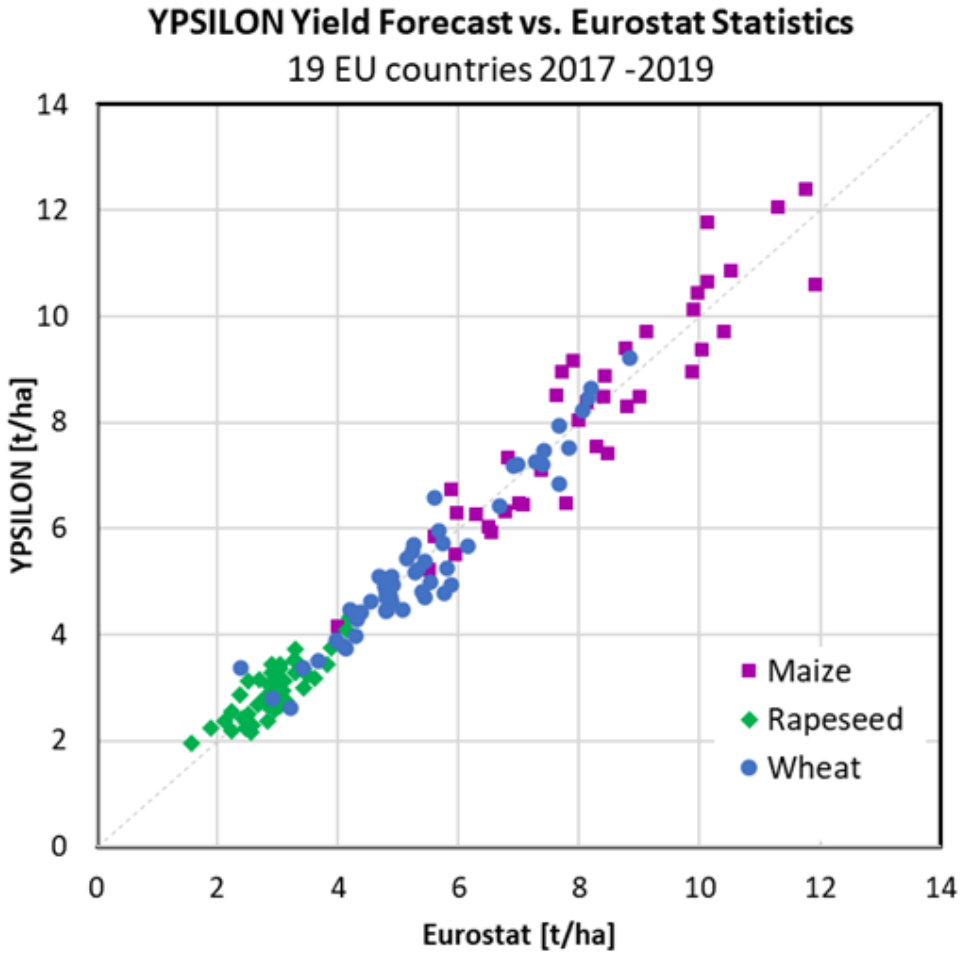

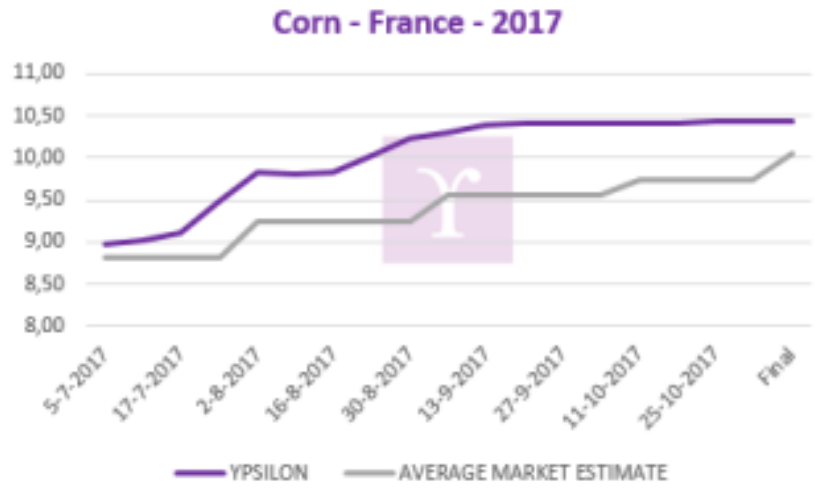

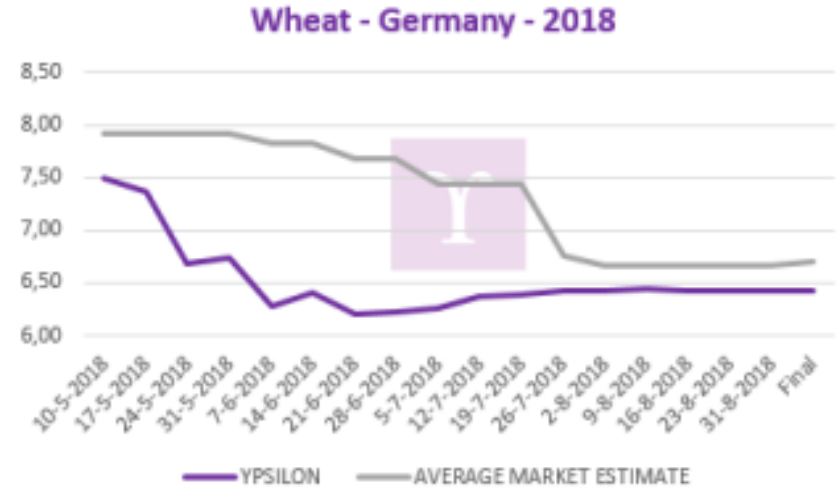

https://ypsilon.services/

Irrigation Advice: Management of Scarce Water Resources

Reservoir volume
25th May 2018 = 3.6 Mio m³
25th May 2017 = 5.3 Mio m³
30th May 2016 = 5.5 Mio m³

Challenge:
satisfying crop water demand during the whole wheat season with lower water level in the main dam in 2018

Solution:
Simulation of **crop water demand** based on the actual development of biomass used for weekly site specific or sectoral irrigation advice

Results:
- Reduced water use (-30%) still resulting in sufficient irrigation water for all pivots despite lower water availability
- Even increased yield (+25%) in comparison with 2017
  e.g. from 7.3 to 9.1 t/ha measured for two pivots

Conclusion

Key Statements for 6.4. and 6.5:
Increasing water efficiency and improving water management are critical to balancing the competing and growing water demands from various sectors and users.

- **Global Challenge of SDG 6 requires a Global Monitoring System.**
- **Satellite data is maybe the only objective, global monitoring instrument.**
- **Continental yield forecasts are a derived service based on ViWA developments (YPSILON)**
- **Regional applications for improved water use efficiency like irrigation management can further enhance ViWA results**

Thank you for your attention!




www.vista-geo.de

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Dr. Anton Frank

Funded by

ViWA Virtual Water Values

Federal Ministry of Education and Research

ViWA is a collaborative project of the funding program "Global Resource Water (GROW)" in the framework program FONA (Research for Sustainability) of the German Ministry for Education and Research (BMBF).

FONA Forschung für Nachhaltige Entwicklung BMBF