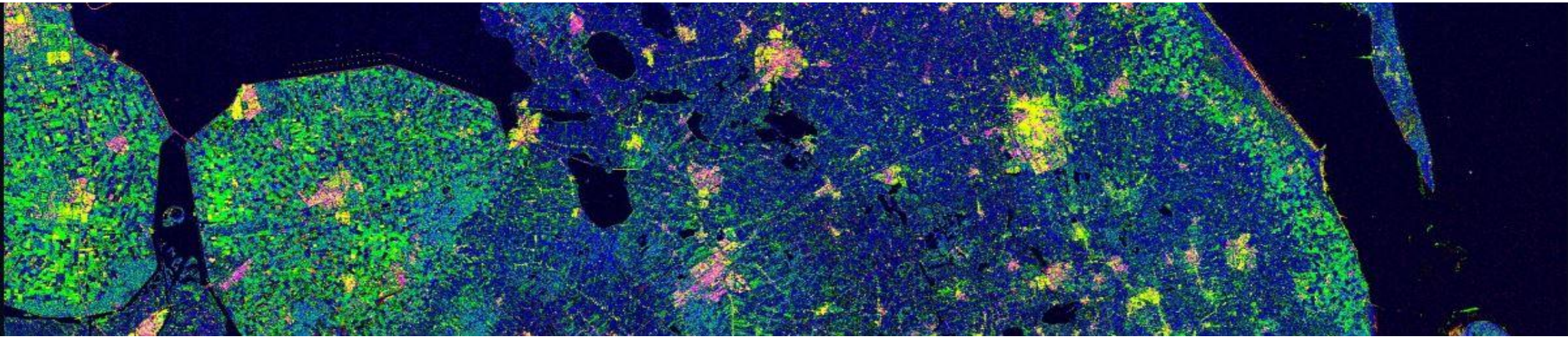

Winter Wheat and Oil Seed Rape Yield Estimations Using Multi-Source Data Fusion and Crop Growth Models in Bavaria, Germany

Presented By: Maninder Singh Dhillon

Ph.D. Topic: **Potential of Remote Sensing for the Modelling of Crop Yields from Long Term Remote Sensing Time Series (2001-2019)**

First supervisor
Prof. Dr. Tobias Ullmann

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Second supervisor
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Advisory member
Prof. Dr. Andreas Nüchter

Informatics VII : Robotics and Telematics

Ph.D. Topic: **Potential of Remote Sensing for the Modelling of Crop Yields from Long Term Remote Sensing Time Series (2001-2019)**

Recent News

CLIMATE NOW

Climate Now: How can we feed the world with a warming planet?

As climate change alters our weather systems, how can the agricultural industry adapt to a warming world?

01/07/2022

ITALY

'Tragic situation': Rice paddies dry up in Italy amid record drought

The future of Italian risotto in the Po Valley is in peril as paddy fields dry up and turn salty amid a historic drought.

05/08/2022

CHINA

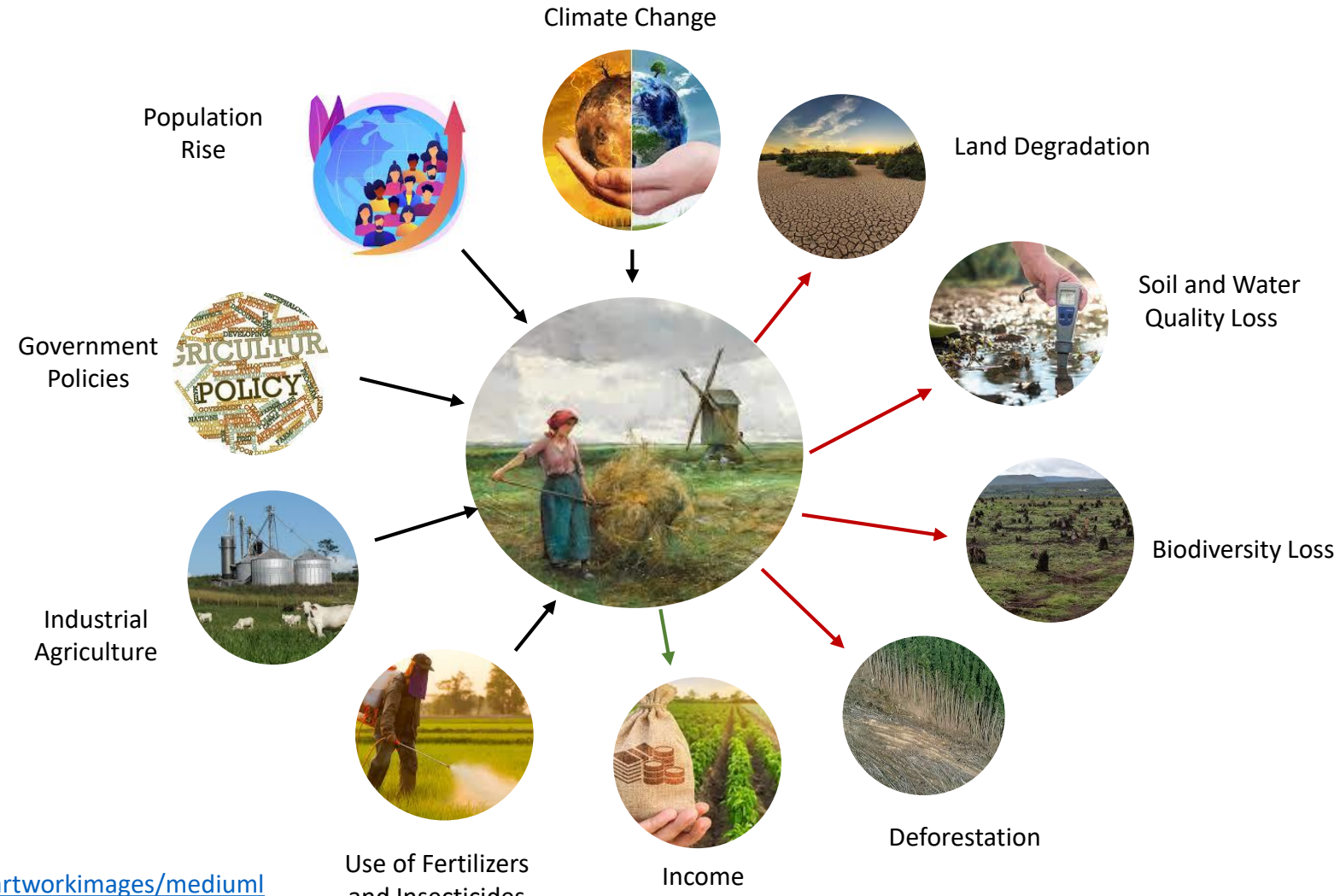
China declares drought emergency amid record-breaking heatwave

Industrial and agricultural hubs in central China suffer as the drought continues and an estimated one million people in rural areas are expected to face drinking water shortages.

21/08/2022

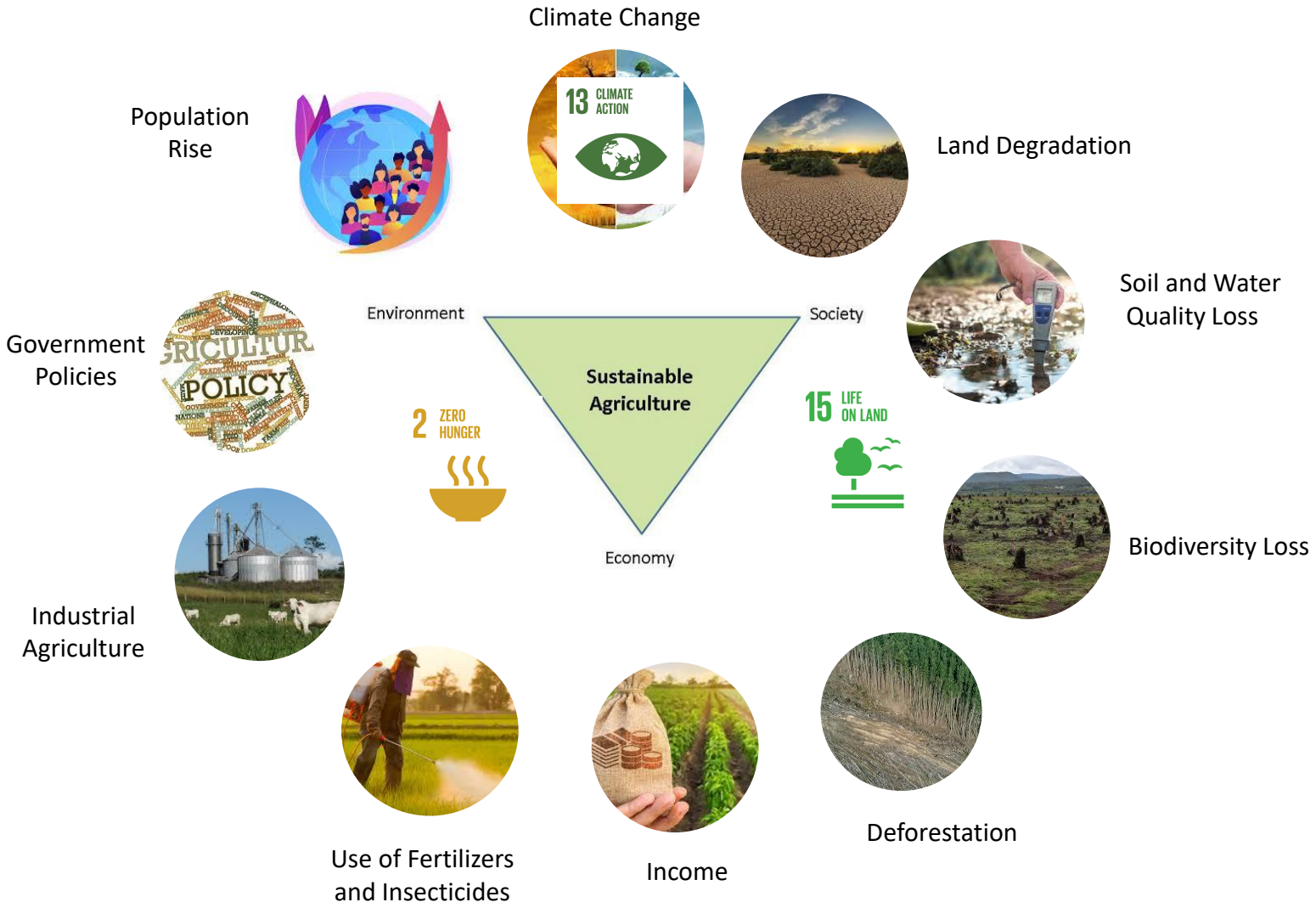
Source: www.euronews.com

Importance of Agriculture



Source: https://images.fineartamerica.com/images/artworkimages/mediumlarge/1/agriculture-julien-dupre.jpg, https://www.bing.com/images/

Sustainable Agriculture



Potential of Remote Sensing

Satellite Remote Sensing

Landsat
30m, 16 days

MODIS
250/500/1000m,
1/8/16 days

Sentinel 2
10m, 5-6 days

Population Rise

Climate Change

Land Degradation

Soil and Water Quality Loss

Government Policies

Environment

Society

Sustainable Agriculture

Economy

2 ZERO HUNGER

15 LIFE ON LAND

Biodiversity Loss

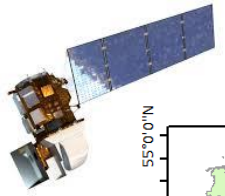
Industrial Agriculture

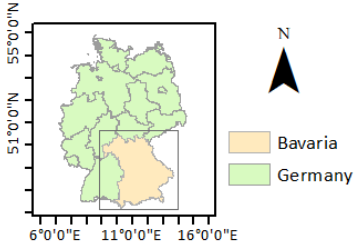
Use of Fertilizers and Insecticides

Income

Deforestation

Data Fusion and Crop Yield Modelling





Landsat
30m, 16 days

Sentinel 2
10m, 5-6 days

MODIS
250/500 m, 1/8/16 days

1

Data Fusion

STARFM

2

Crop Models

LUE

WOFOST

2 ZERO HUNGER

Winter Wheat

15.04. 2019-31.06. 2019

15 LIFE ON LAND

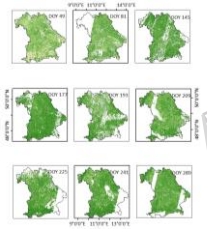
Oil Seed Rape

15.02. 2019-20.04. 2019

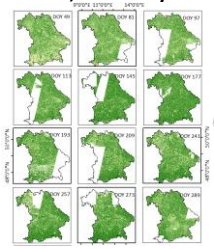
The potential of new synthetic data sets in crop yield prediction is still underexplored

- Best Spatial Scale (?)
- Best Temporal Scale (?)

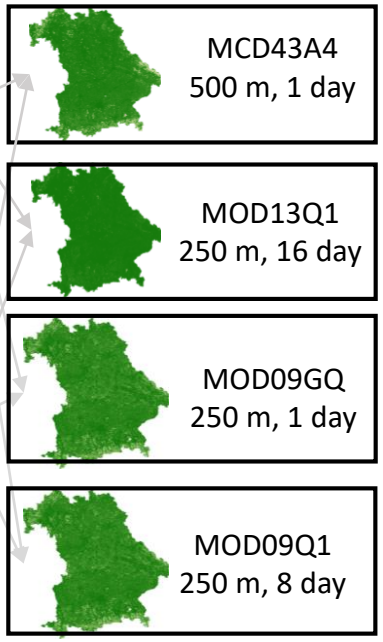
Spatiotemporal Data Fusion

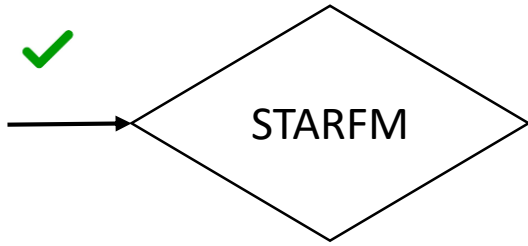


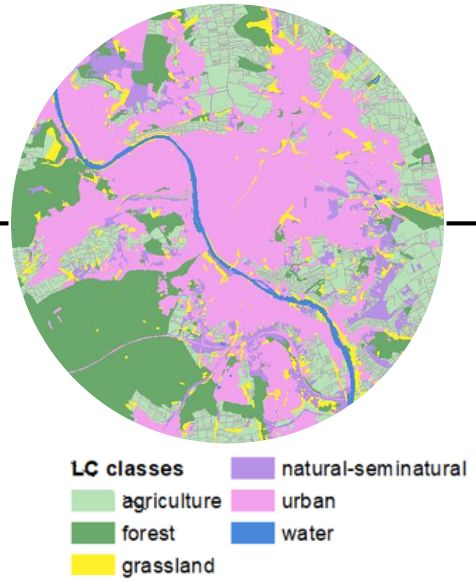
Landsat (n=9)
30m, 16 days

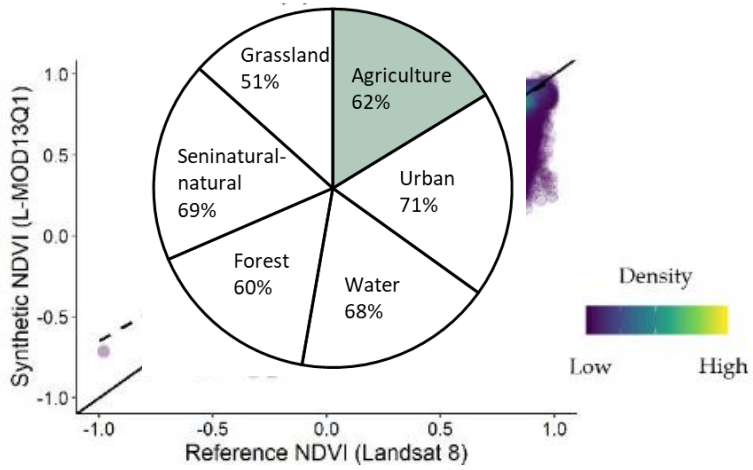


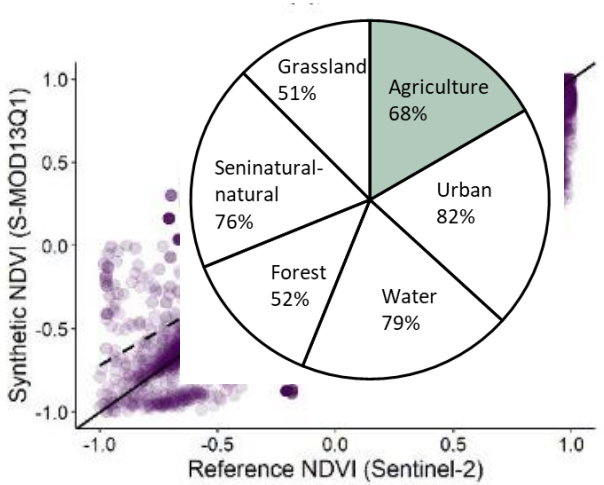
Sentinel 2 (n=13)
10m, 5-6 days





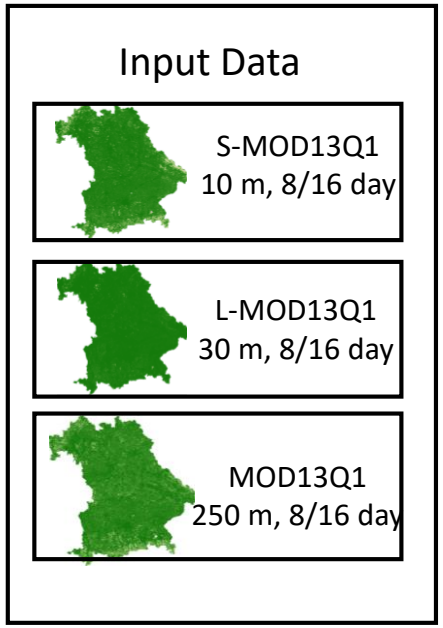


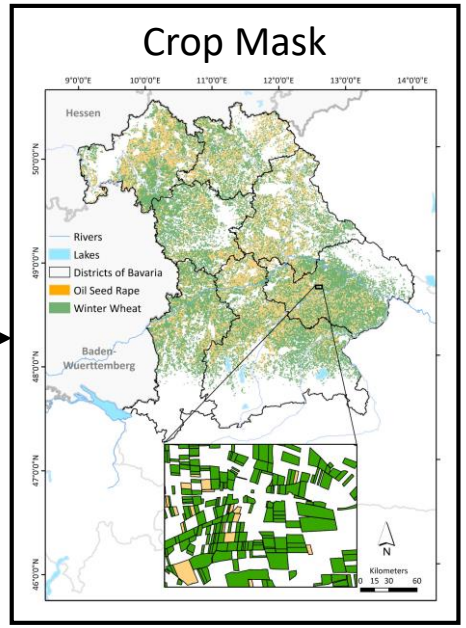




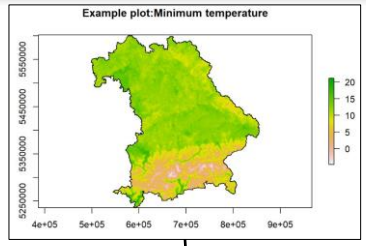
Source: Dhillon et al. 2022

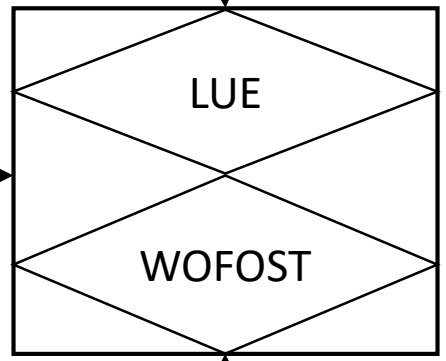
Crop Yield Modelling

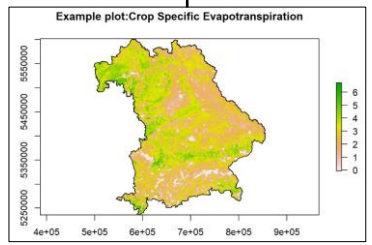




Data source: InVeKos Data

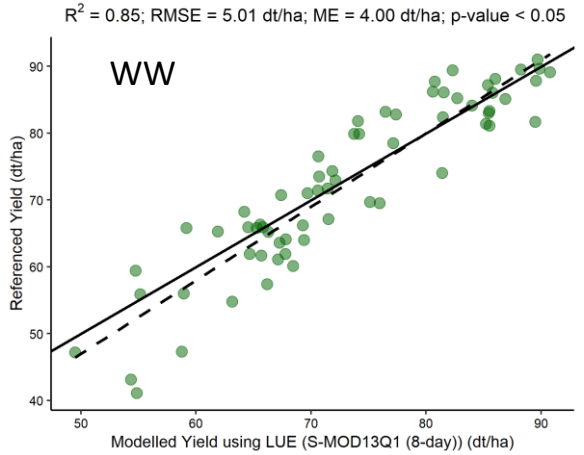


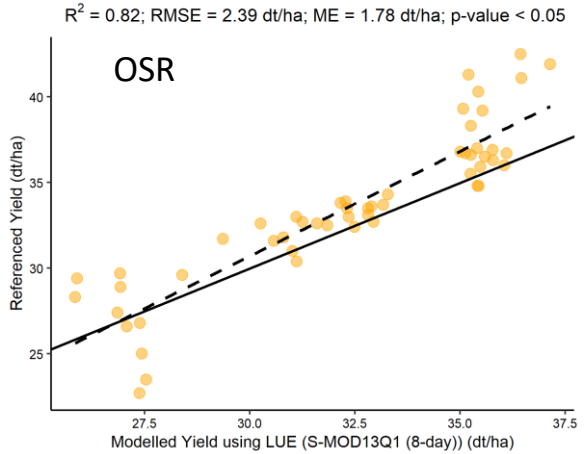




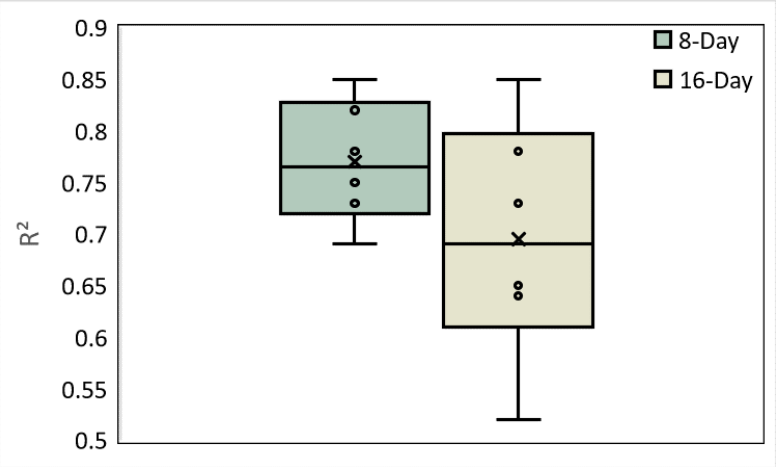
Data Integration and Validation

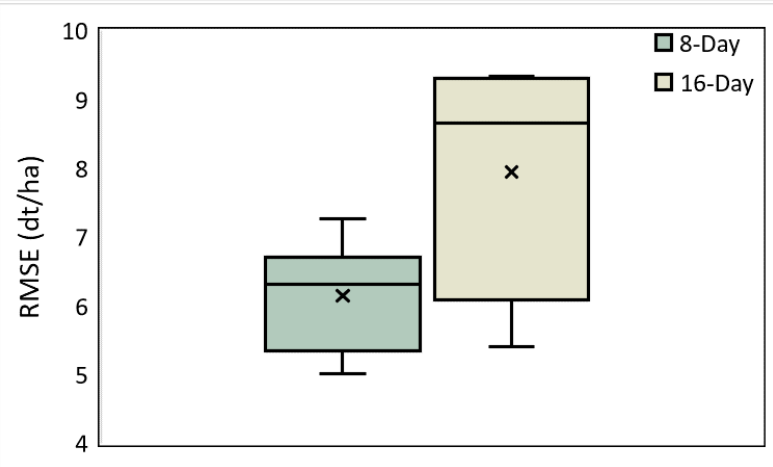
BayernAtlas

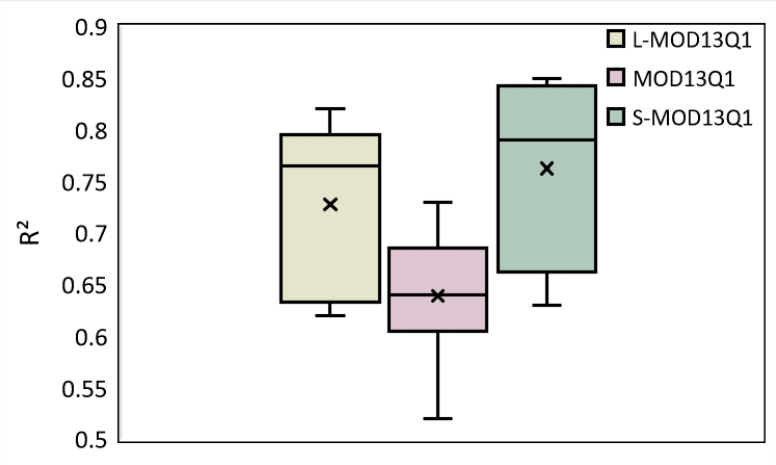


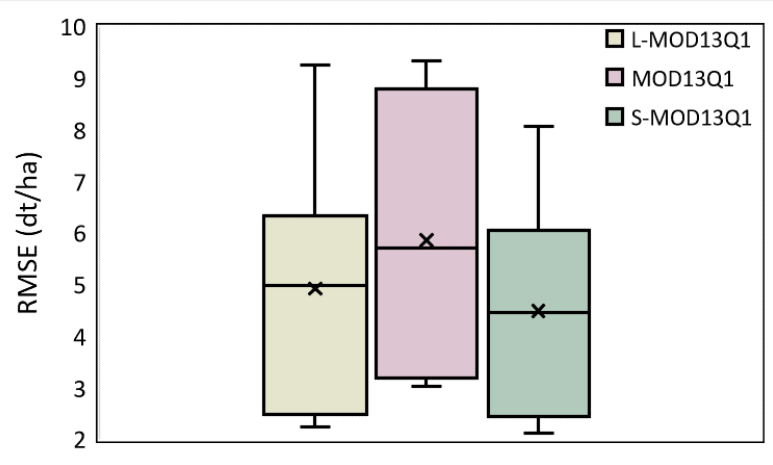


Best Spatial and Temporal Scales



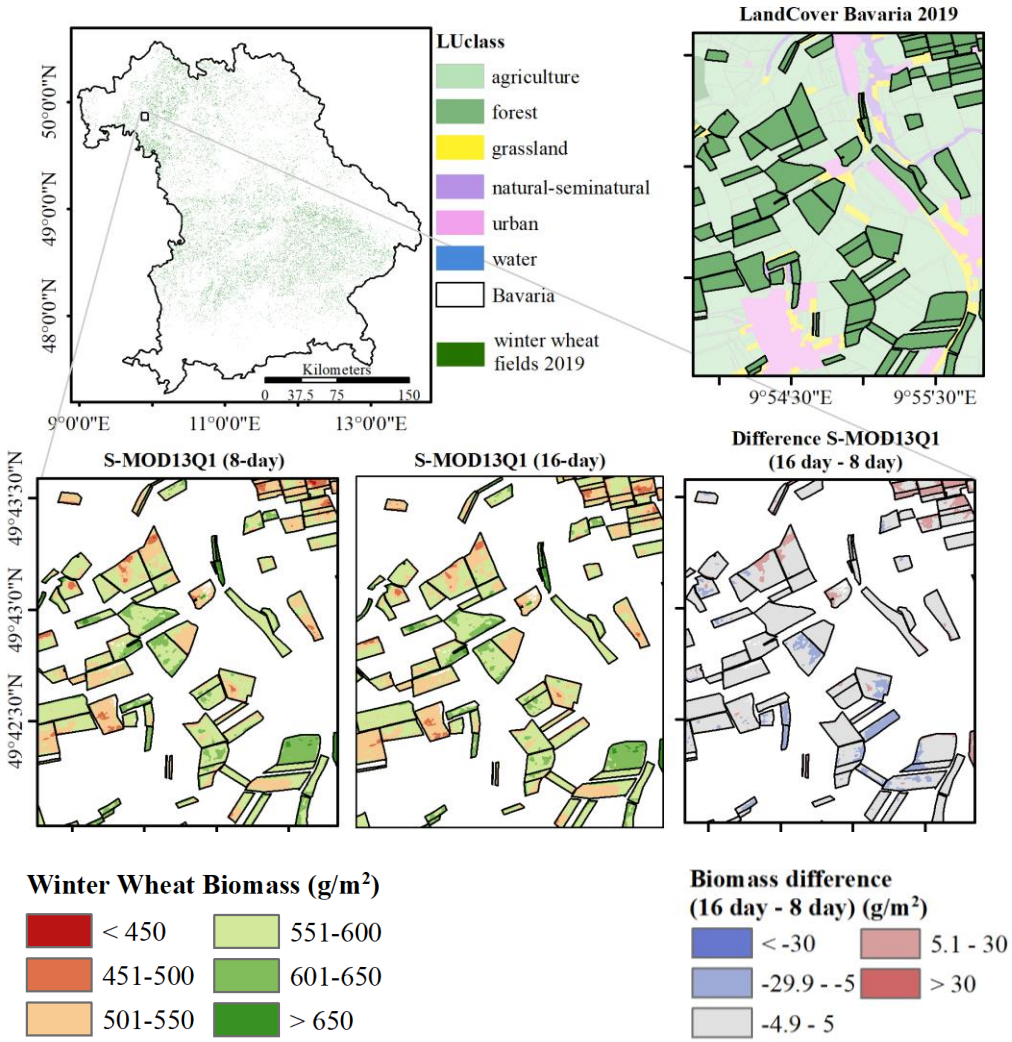


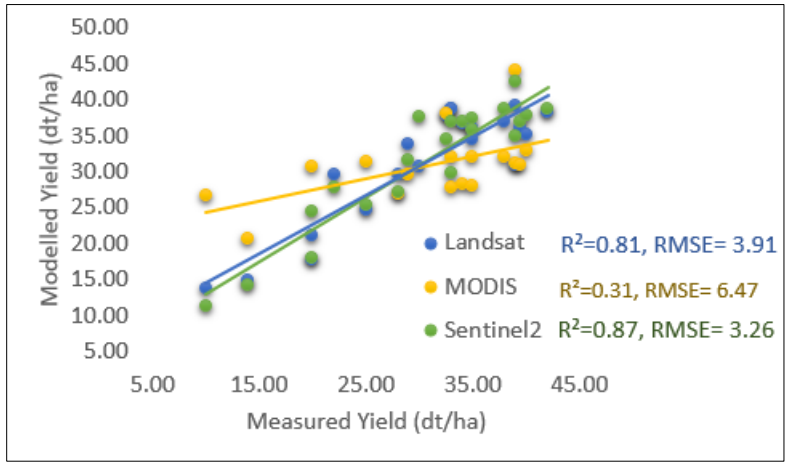


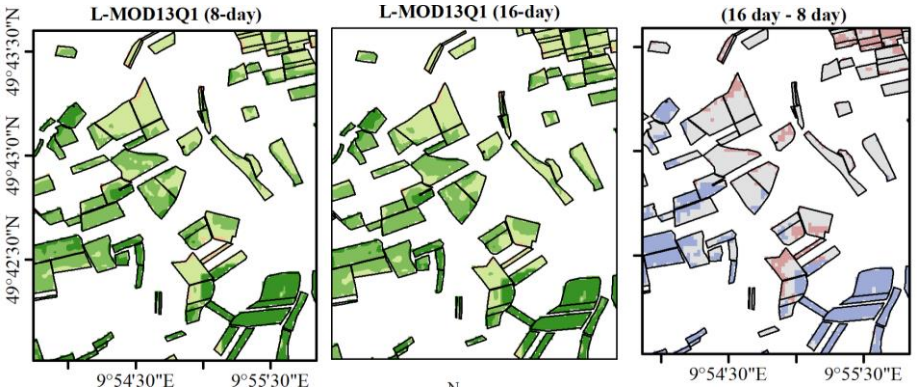


Source: Dhillon et al. 2022b

Visualization of Crop Biomass on Field Scale







Source: Dhillon et al. 2022b

Conclusions, Limitations and Outlook

Conclusions

- Both L-MOD13Q1 and S-MOD13Q1 are suitable for agricultural monitoring.
- The spatial resolution of 30 m and low storage capacity makes **L-MOD13Q1** more **prominent** and **faster** than that of S-MOD13Q1 with the 10-m spatial resolution.
- The 8-day products of S-MOD13Q1 and L-MOD13Q1 in combination with the LUE are more prominent for predicting crop yields on a regional scale than the 16-day products.

Limitations

- Unavailability of crop yield information at field level for validation
- Uncertainties in the validation data

Outlook

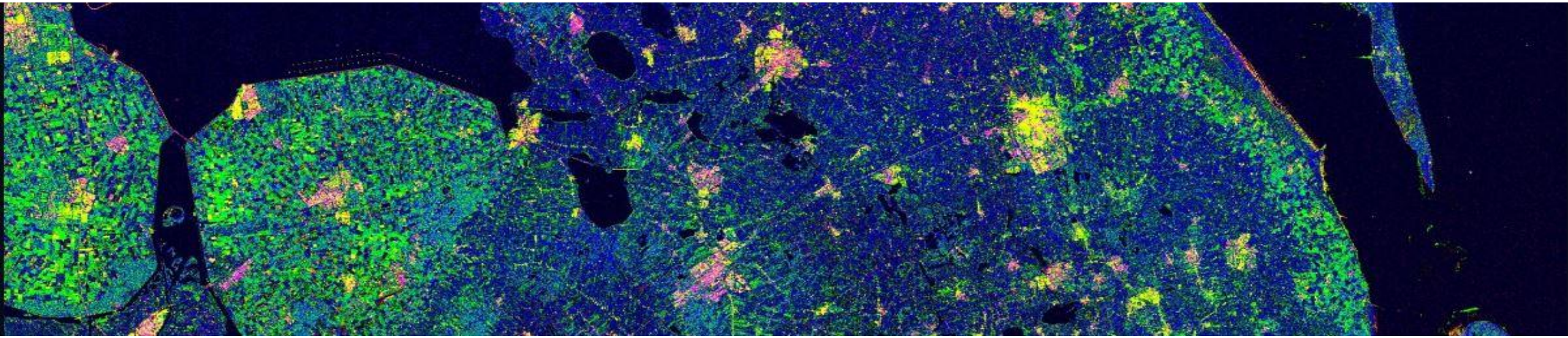
- The methodology could integrate Sentinel-1 and machine/deep learning algorithms.
- It could be applied to other geographical locations and tested for more crops for long-term time series.

Source: Dhillon et al. 2022, 2022b

PhD Manuscripts

1. Dhillon, M.S.; Dahms, T.; Kuebert-Flock, C.; Borg, E.; Conrad, C.; Ullmann, T. **Modelling Crop Biomass from Synthetic Remote Sensing Time Series: Example for the DEMMIN Test Site, Germany**. *Remote Sens.* **2020**, *12*, 1819. https://doi.org/10.3390/rs12111819 (Published)
2. Dhillon, M.S.; Dahms, T.; Kübert-Flock, C.; Steffan-Dewenter, I.; Zhang, J.; Ullmann, T. **Spatiotemporal Fusion Modelling Using STARFM: Examples of Landsat 8 and Sentinel-2 NDVI in Bavaria**. *Remote Sens.* **2022**, *14*, 677. https://doi.org/10.3390/rs14030677 (Published)
3. Dhillon, M.S.; Dahms, T.; Kübert-Flock, C.; Joel, A.; Rummler, T.; Steffan-Dewenter, J.; Ullmann, T. **Spatiotemporal rop Yield Modelling Using Multisource Data Fusion: Examples of Winter Wheat and Oil Seed Rape in Bavaria**.*Geographies.* **2022b**. (Submitted)
4. Dhillon, M.S.; Dahms, T.; Kübert-Flock, C.; Joel, A.; Rummler, T.; Steffan-Dewenter, J.; Ullmann, T. **Integration of random forest and crop modelling improves the yield prediction of winter wheat and oil seed rape**.*Frontiers in Remote Sensing.* **2022c**. (Accepted)
5. Dhillon, M.S.; Dahms, T.; Kübert-Flock, C.; Joel, A.; Rummler, T.; Steffan-Dewenter, J.; Ullmann, T. **Spatiotemporal Fusion Modelling in Crop Yield Prediction: Use of Landsat 5, 7, and 8 NDVIs in Bavaria from 2001 to 2019**. *Remote Sens.* **2022d**. (Submitted)
6. Dhillon, M.S.; Dahms, T.; Kübert-Flock, C.; Joel, A.; Rummler, T.; Steffan-Dewenter, J.; Ullmann, T. **Impact of Landuse Diversity on crop yields of Bavaria, Germany**. **2022/23**. (In Preparation)

Source: Dhillon et al. 2022b



Thank You

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