

Big Earth Observations and Artificial Intelligence for Food Security Monitoring

27th May 2021



Beyond – Center of EO Research and Satellite Remote Sensing



National Observatory of Athens –
Institute of Astronomy, Astrophysics,
Space Applications and Remote Sensing

<https://datalab.csd.auth.gr/regain>

#REGAINDataWeek



The team

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The Big Picture

The demand for food is expected to increase significantly in the coming years

- Need for a balanced productivity and effective food security management **at large scales**

Timely and detailed mapping of crops' extent and productivity assessment

- Continuous area monitoring and large scale mapping, **at the parcel level**, through the processing of **big satellite data of high spatial resolution**.

The current food system is wasteful and needs to transform to a new, **regenerative and restorative system**.

- This work contributes to the **environmental protection dimension of circular economy**, exploiting big Earth data for the timely extraction of crop-specific knowledge at very large scales and high spatial resolution.

We produce

- Nationwide **paddy rice maps** in South Korea, based on which we estimate the **biomass and expected yield** at the field level.
- **Challenges:**
 - Manage big satellite data and scale for a nationwide application.
 - Cope with scarce labelled data to train supervised machine learning algorithms.
- **Solutions**
 - Distributed ML
 - Semi-supervised learning
 - High Performance Data Analytics

Copernicus 4 Food Security

- Food Security is really complex problem and comprises several different components
- The evolution of Earth Observation in terms of **spectral, spatial and temporal resolution** allows for the timely and effective monitoring of the land
- **Sentinel missions** - High Resolution optical and radar imagery
 - 5 day revisit time
 - 10 and 20 m spatial resolution



Food Security in South Korea

The problem

Overproduction of rice

The impact

Large storage costs

Underproduction of other major grains

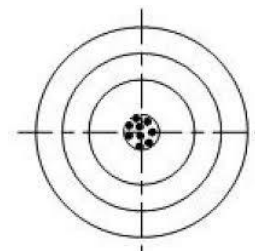
High dependence on imports



EO based Food Security monitoring

Challenges

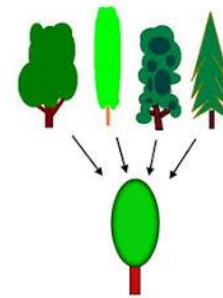
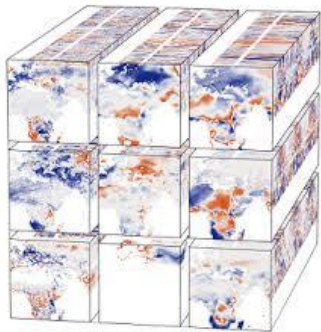
- Large-scale application - National and International scales
- Exhaustive monitoring (vs sample based statistics)
- High thematic accuracy to enable evidence-based decision making
- Open and re-useable tools
- Method transferability



EO based Food Security monitoring

Requirements

- Big Data Management (TBs of data)
- Distributed processing
- Low dependence on ground truth information
- High generalization of machine learning modeling



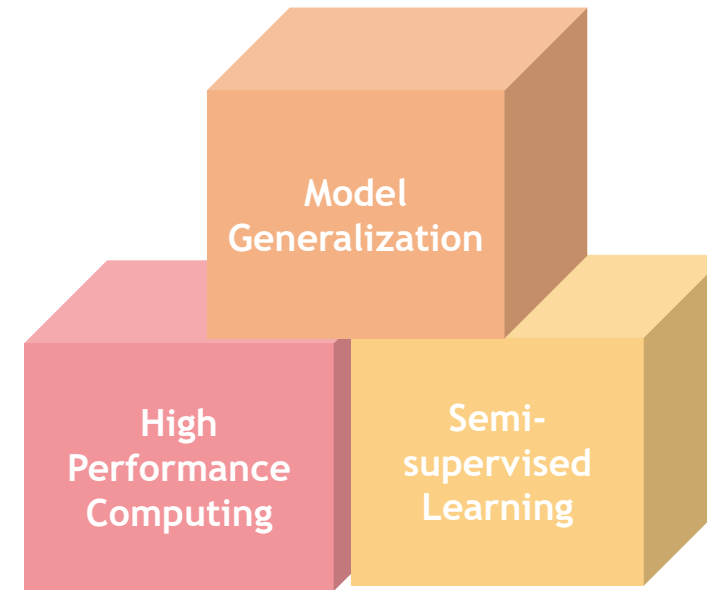
EO based Food Security monitoring

Challenges

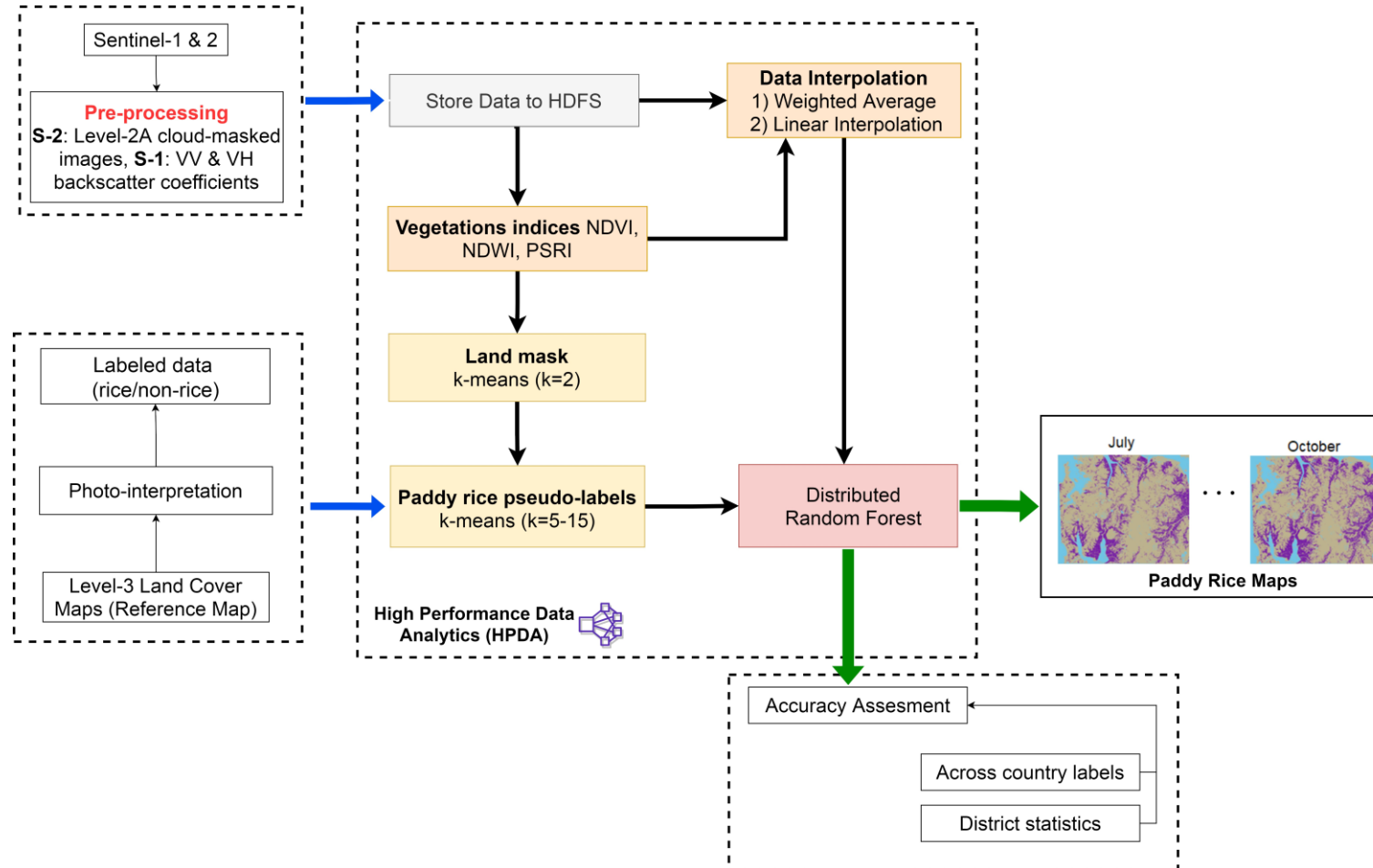


- 01 Interoperability
- 02 Exhaustiveness
- 03 Transferability
- 04 Scalability
- 05 Reliability

Solutions



Workflow



Big data management

HPDA

Distributed Storage



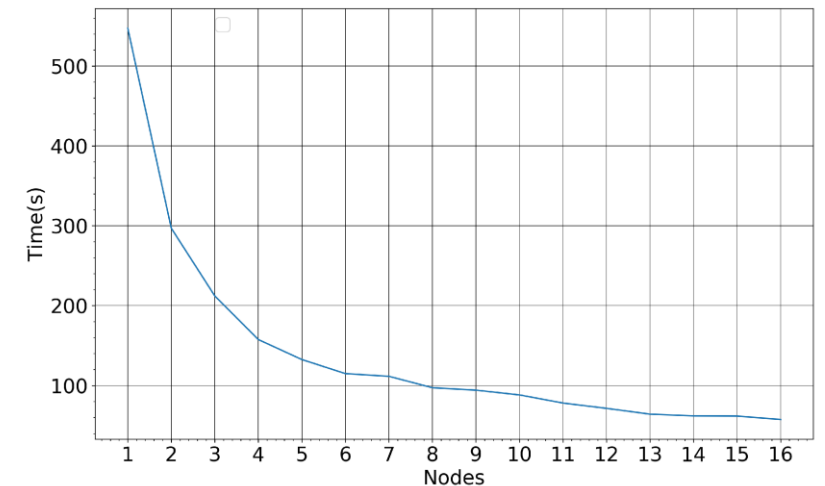
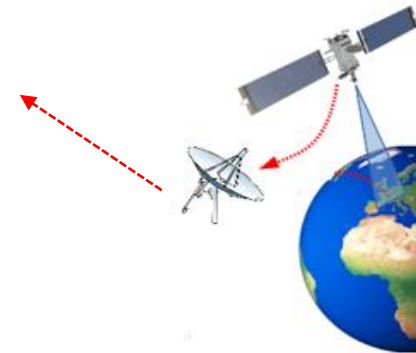
Sentinel-1 and Sentinel-2 time series imagery results TB of data. HPDA was used to process and analyze effectively Big Data via Apache Hadoop

Distributed Processing

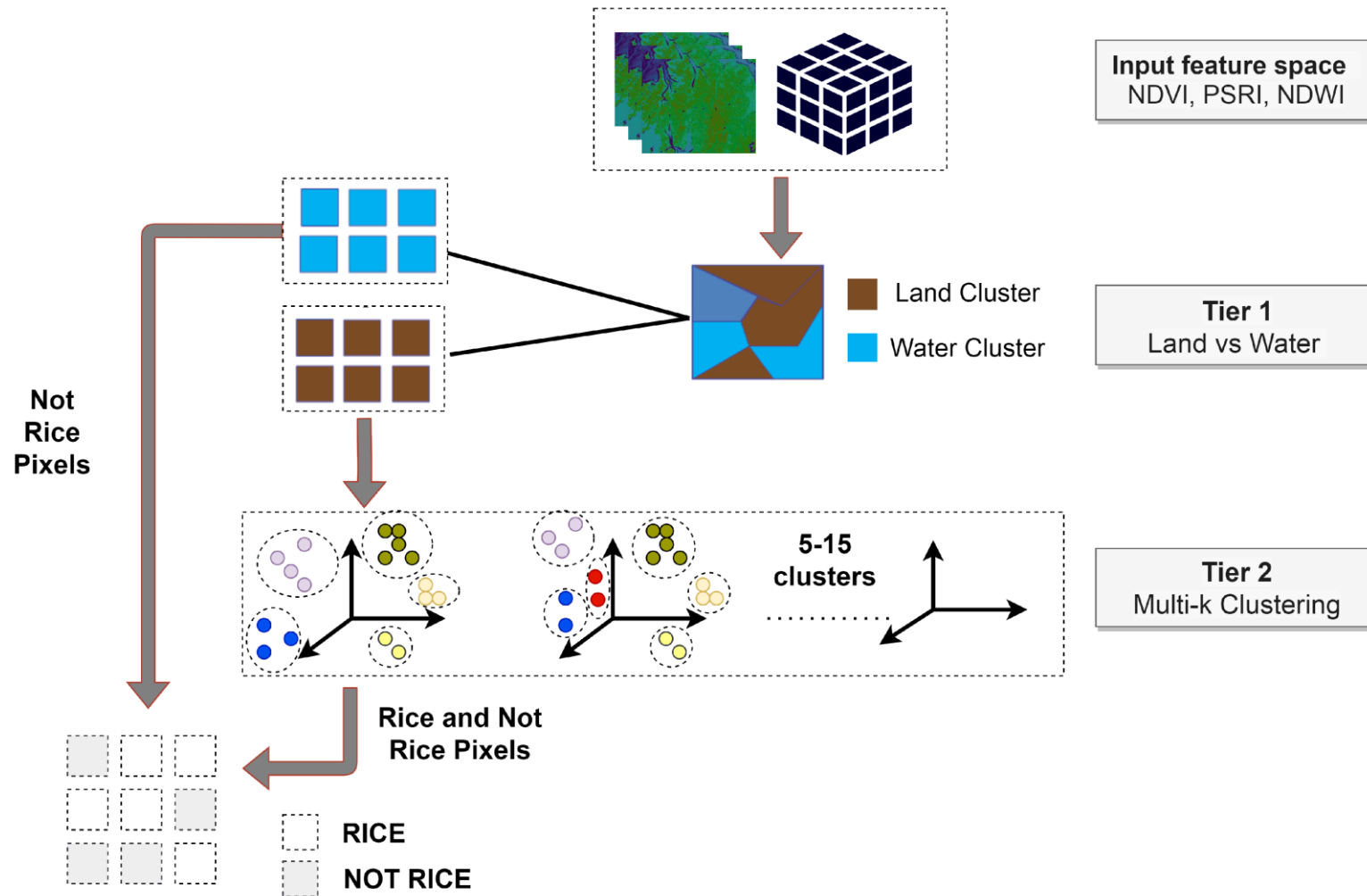


Utilize the HPDA module to perform distributed clustering and supervised classification for the large-scale application of the outputs

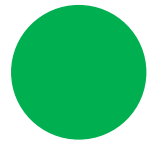
Copernicus Hub (Sentinel-1/2)



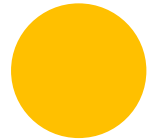
Semi-supervised learning



EO based services



Rice Paddy Mapping



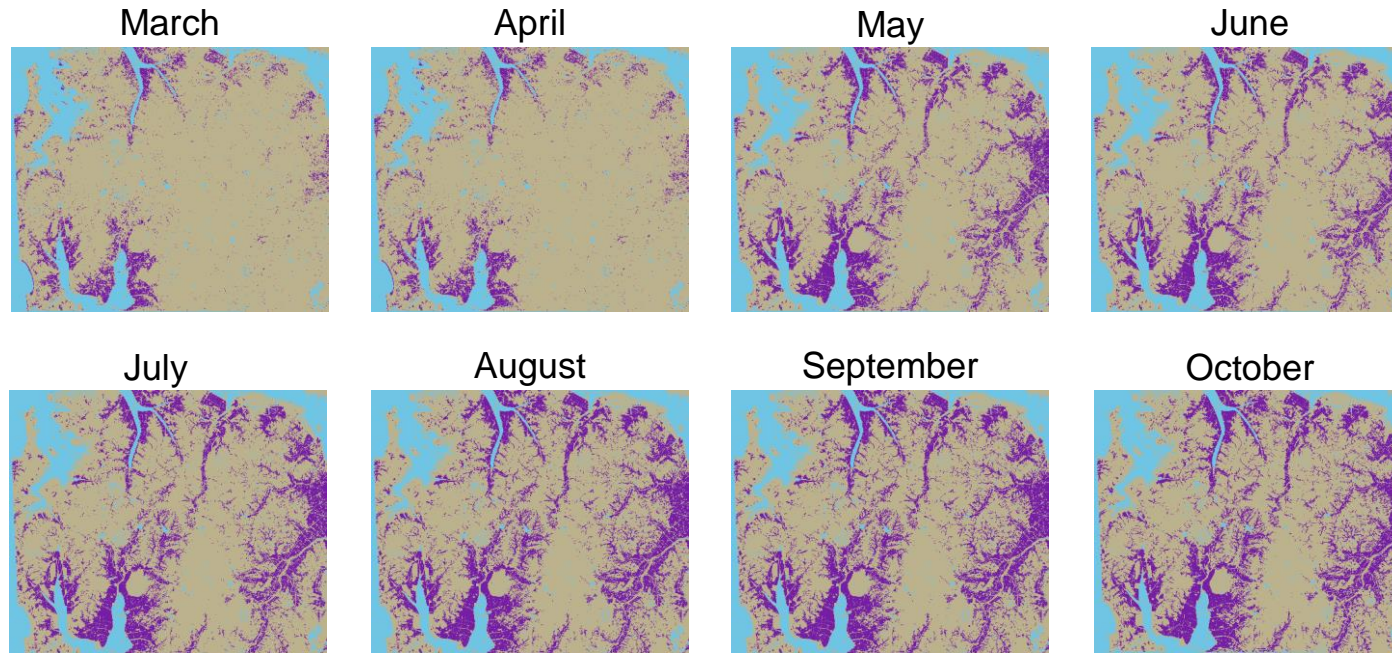
Rice Status Indicator



Biomass and Yield Indicators

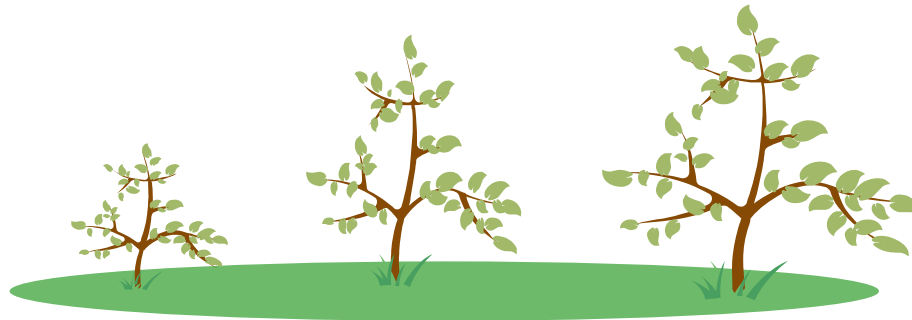
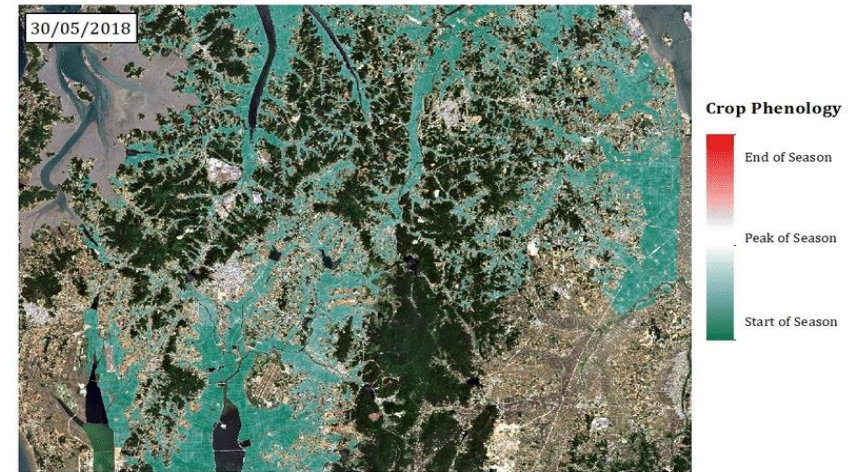
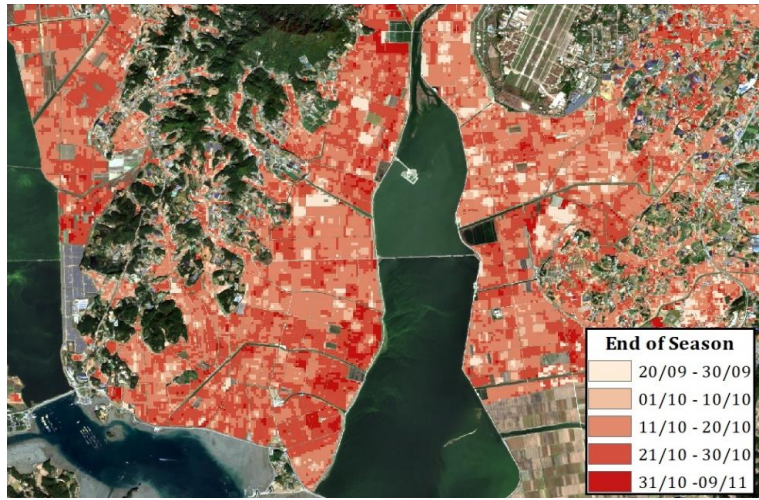
EO based services

Paddy Rice Mapping



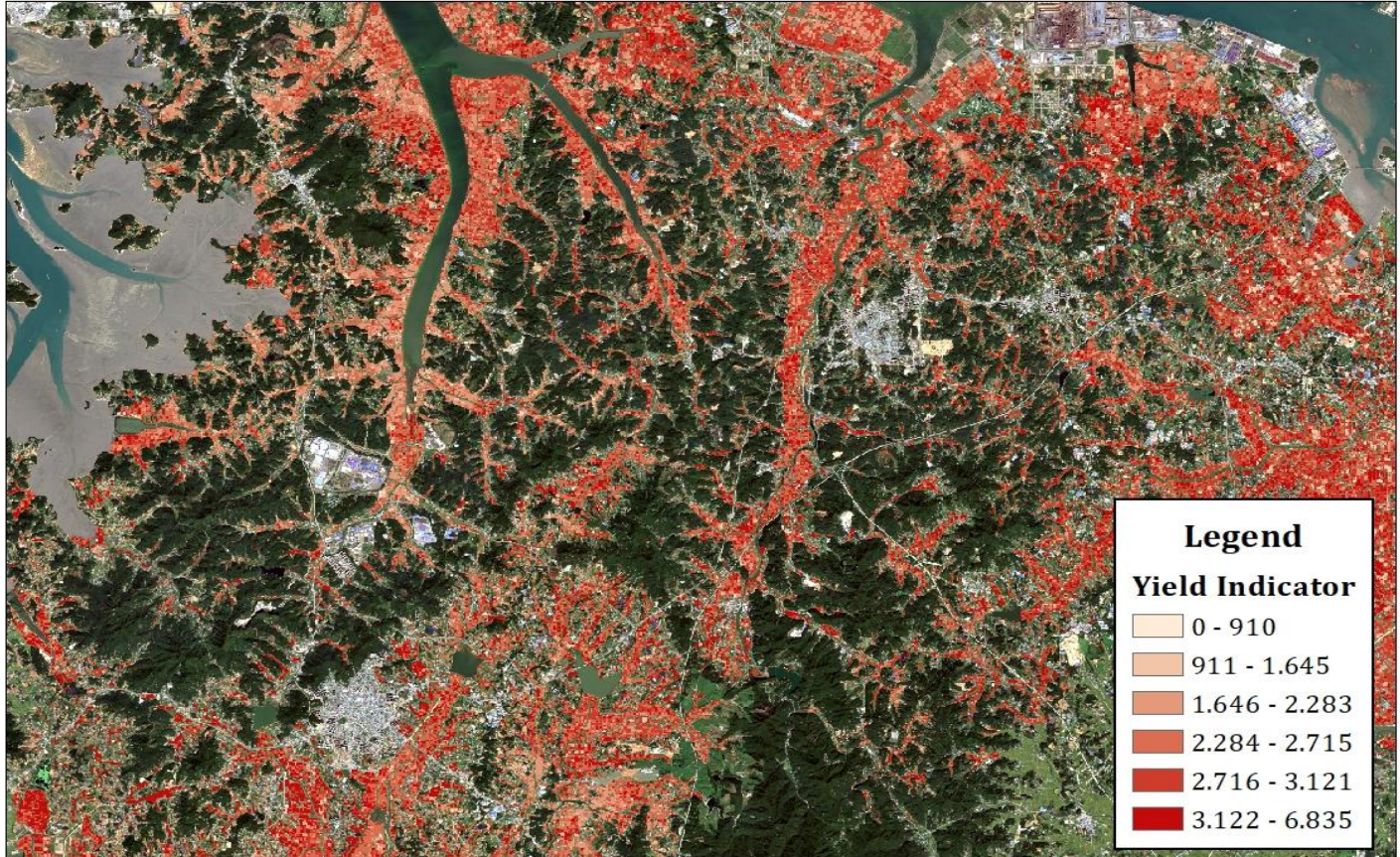
EO based services

Rice Status Indicator



EO based services

Yield Indicator



**It is a capital mistake
to theorize before
one has data.**

Sherlock Holmes

.DATAWEEK
JOIN.LEARN.SHARE.GET VALUE



Thank you!



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