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Data Collection and HPC Ingestion of Historical Satellite Images from IBM Pairs GeoScope

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Baseline for :Developing predictive models for Nitrogen flows
Monitoring the Growth and Health of Crops Using MODIS Satellite Imagery

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Introduction

IBM Environment Intelligence Suite (EIS)

- IBM EIS (IBMpairs) enables access to
  - **Petabytes data**
  - **Geospatial-temporal**
  - **Different sources & tim**e.
- Queried datasets
  - As **zip** files
  - **geoTIFFS** & **json files**
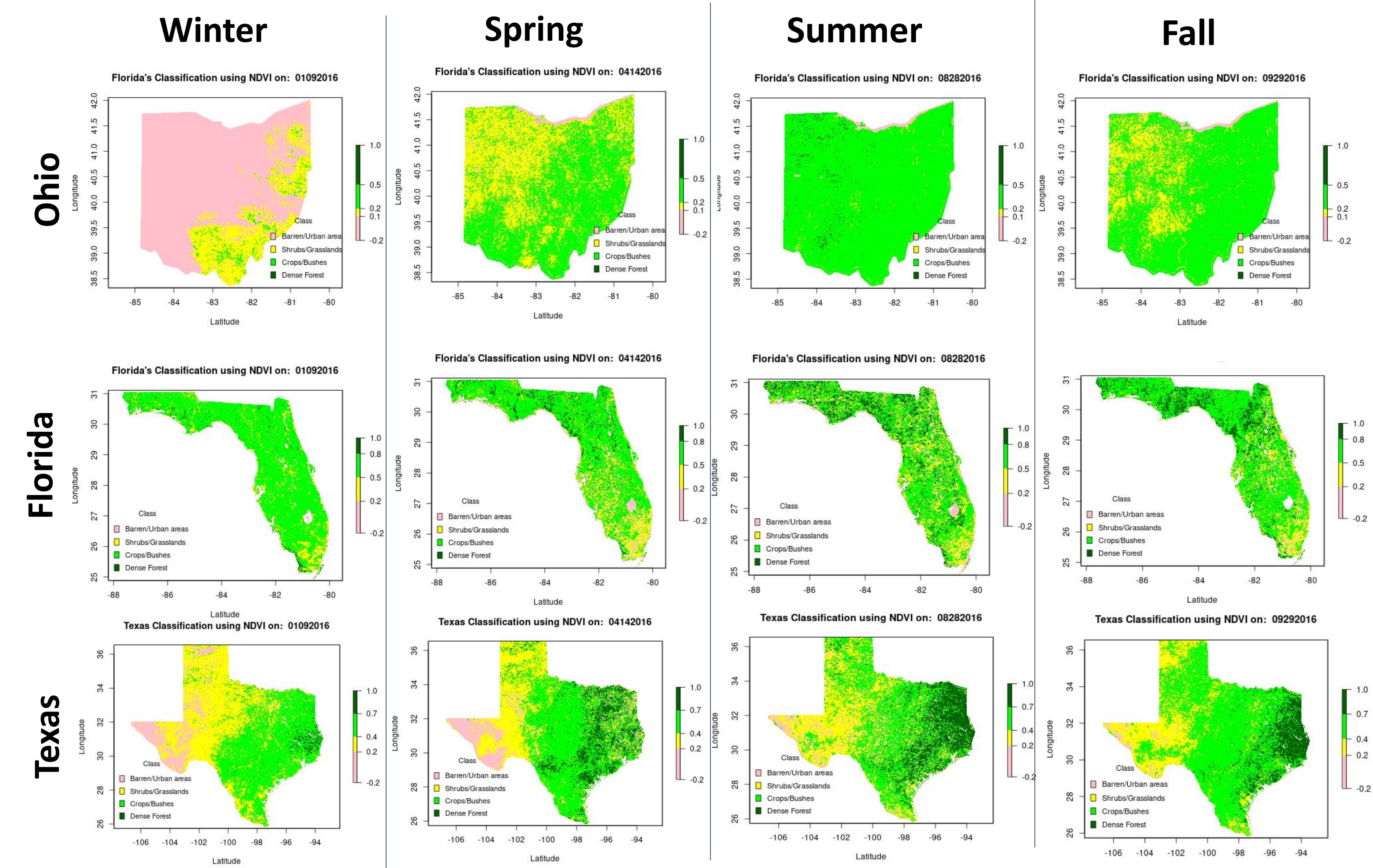 - Explored, FAIRified
  - Ingested into HPC CRADLE
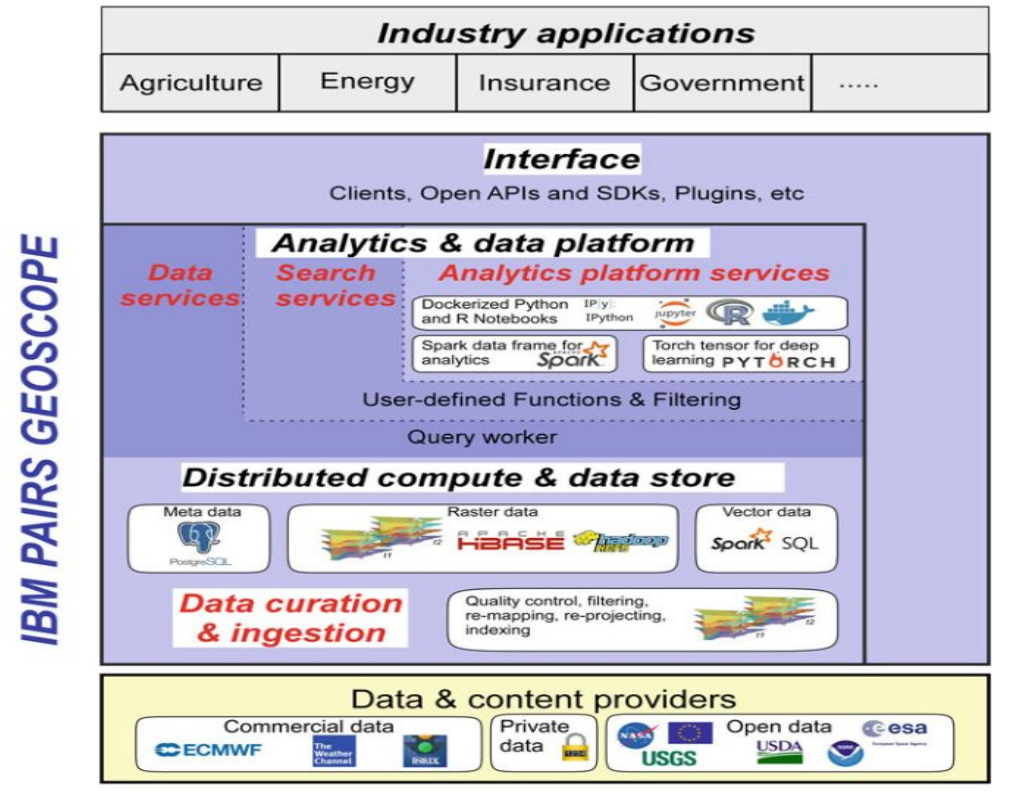
Moderate Resolution Imaging Spectroradiometer (MODIS)

- **Terra (morning)** & **Aqua (Afternoon)**.
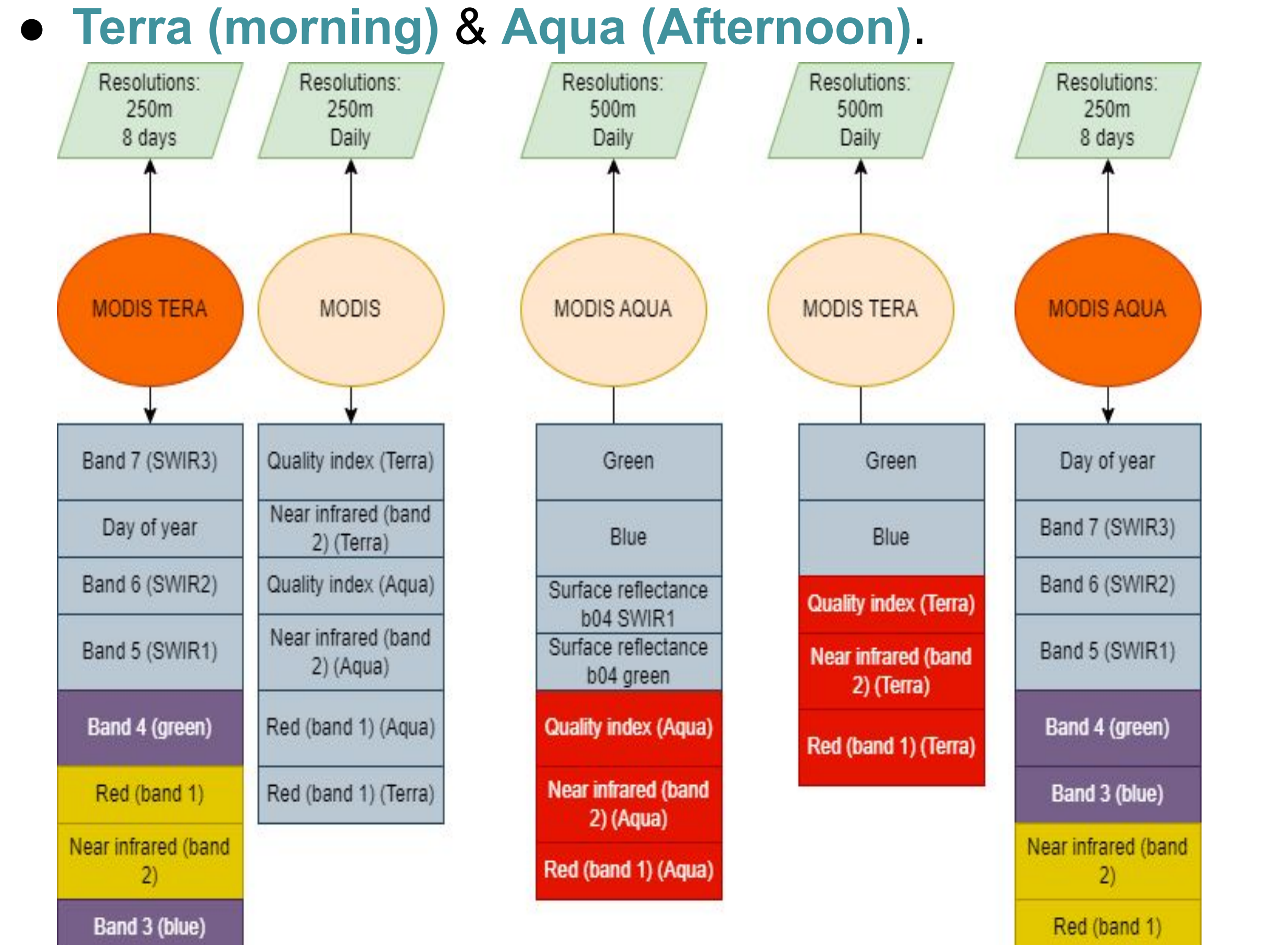
Methodology
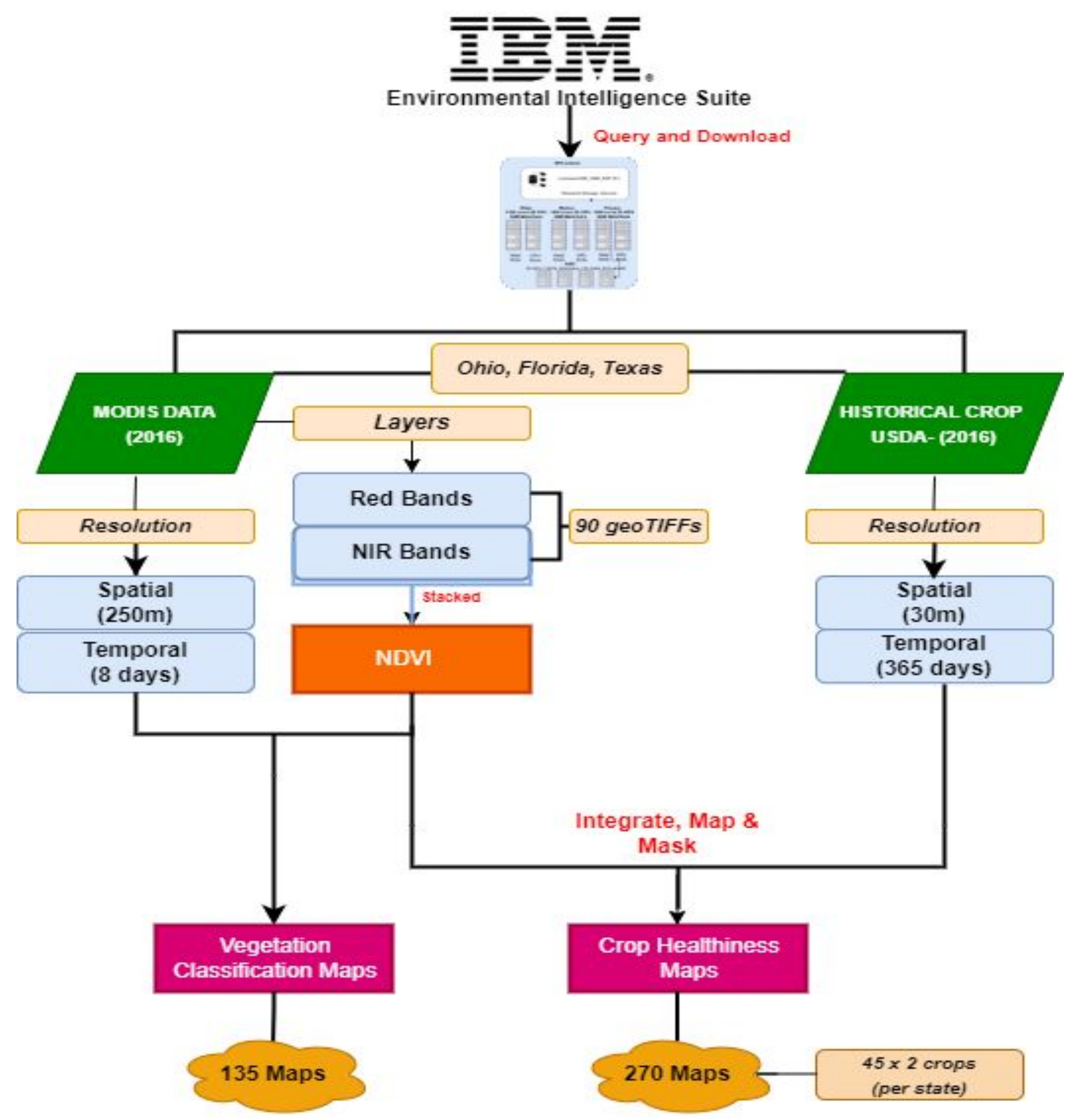
Vegetation Classification

Winter　Spring　Summer　Fall

Ohio

Florida

Texas

Vegetation Index

- **MODIS Satellite Images (red and NIR bands)** were used to classify **Ohio, Florida and Texas.**
- Classification is done with the calculated NDVI.
  - **Shrubs/Grasslands**
  - **Crops/Bushes**
  - **Dense Forest+**
  - **Barren/Urban areas**

$$NDVI = \frac{NIR - Red}{NIR + Red}$$

Normalized Difference Vegetation Index

Crop Heathiness

Winter　Spring　Summer　Fall

Ohio

Florida

Texas

- **MODIS & Historical Crop data** helps to monitor the health of crops in time series across the year
  - **0.5 < index < 1: Very healthy**
  - **0.2<index<0.5: Healthy**
  - **0.1< Index < 0.2 : Stressed or dying**
  - **Index < 0.1 : Dead**
- **Ohio**: **Corn** and **Soybeans** were studied
- **Florida**: **Oranges** and **Sugarcane** were studied
- **Texas**: **Cotton** and **Corn** were studied
- The greenness of the crops vary with **seasons**, **location** and **crop type.**

NDVI Growth of Corn and Soybeans in 2016, Ohio

NDVI Growth of Sugarcane and Orange in 2016, Florida

NDVI Growth of Cotton and Corn in 2016, Texas

Trends in the growth of some crops across Ohio, Florida and Texas in 2016

Conclusion

- **Gains**
  - Valuable insights into monitoring growth of crops
  - D**aily achievable**
  - Monitoring metrics can be used to predict the flow of N and P.
- **Next**
  - Integrate other datasetst
  - Predictive models for Nitrogen-Based Fertilizers (NBF).
  - Explore other bands in the MODIS datasets
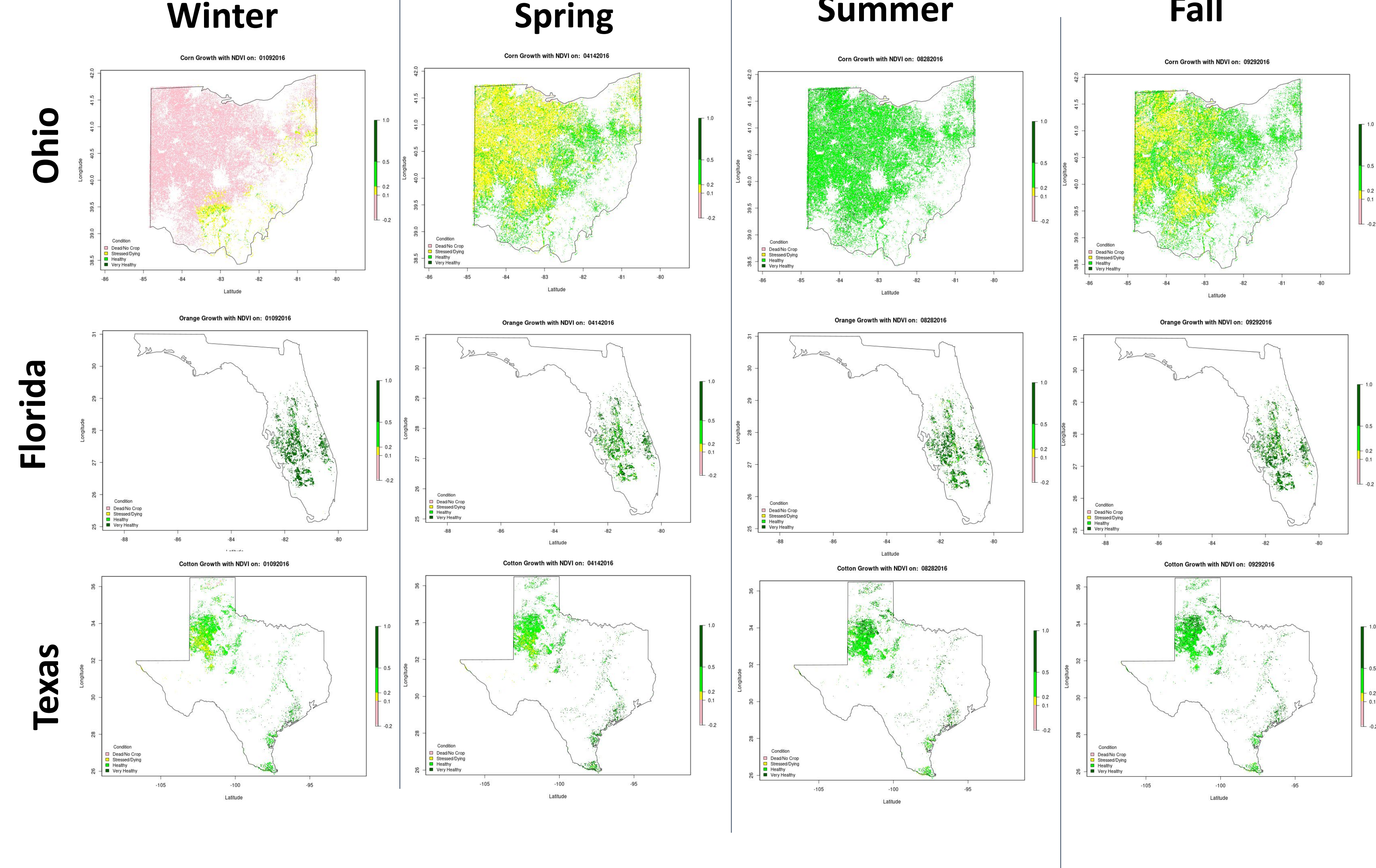 - IBM EIS in building efficient technology for NBF.

Interdisciplinary Approach & EWD/DCI

Predictive models with allow to track, estimate and predict N and P flows in watersheds and
  - Estimate how **CASFER technologies with impact the migration of nutrients to water**

Therefore this project is strongly connected to CASFER mission and it **involves thrust 1, thrust 2 and thrust 3**
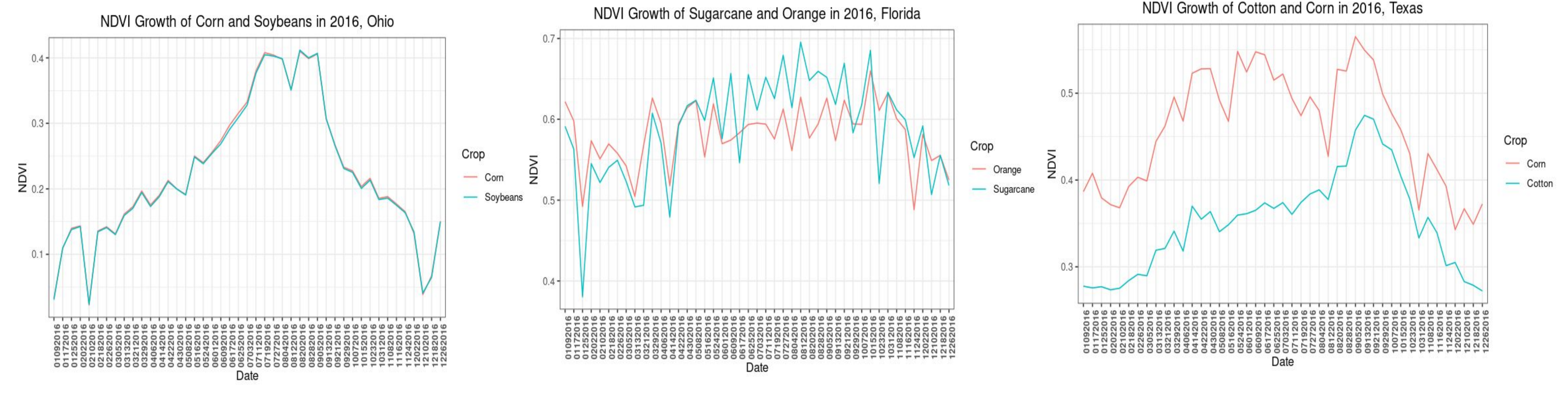
- ACS Seed Program for low income high school students
- Undergraduate Students
  - Mentoring of high school students by Graduate students
  - Training, onboarding and integration
- Training and development of educational material for students from other universities/thrusts
- Data Science Bootcamps

Acknowledgement

References

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- Zhan, X., Sohlberg, R. A., Townshend, J. R. G., DiMiceli, C., Carroll, M. L., Eastman, J. C., et al. (2002). Detection of land cover changes using MODIS 250 m data. Remote Sensing of Environment, 83, 336−350.

Thrust Interactions

Thrust 1

Thrust 2　　Thrust 3