Quantifying Ecosystem Services

UF Herbert Wertheim College of Engineering
Department of Electrical & Computer Engineering
UNIVERSITY of FLORIDA

The Team

University of Florida
Department of Electrical and Computer Engineering

The Principal Investigators

Alina Zare (Engineering)

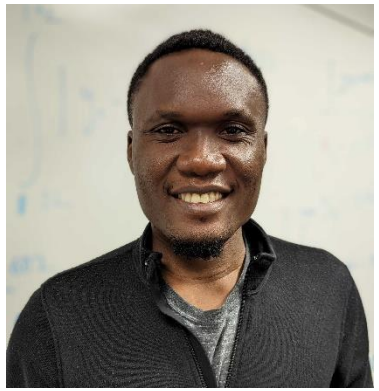
Joel Harley (Engineering)

Jose Dubeux (IFAS)

Lincoln Zotarelli (IFAS)

Students

Daniel Alabi (Eng.)



Pankaj Chand (Eng.)

Wooyhun Eum (Eng.)

Jack Harling (IFAS)

The Team

University of Florida
Department of Electrical and Computer Engineering

The Principal Investigators

Alina Zare (Engineering)

Joel Harley (Engineering)

Jose Dubeux (IFAS)

Lincoln Zotarelli (IFAS)

Students

Alston Lippert (IFAS)

Hrishikesh Mahajan (Eng.)

Ayush Sharma (IFAS.)

G. Austin Simon (Eng.)

The Team

University of Florida
Department of Electrical and Computer Engineering

The Principal Investigators

Alina Zare (Engineering)

Joel Harley (Engineering)

Jose Dubeux (IFAS)

Lincoln Zotarelli (IFAS)

Students

Zhihui Tian (Eng.)

John Upchurch (IFAS)

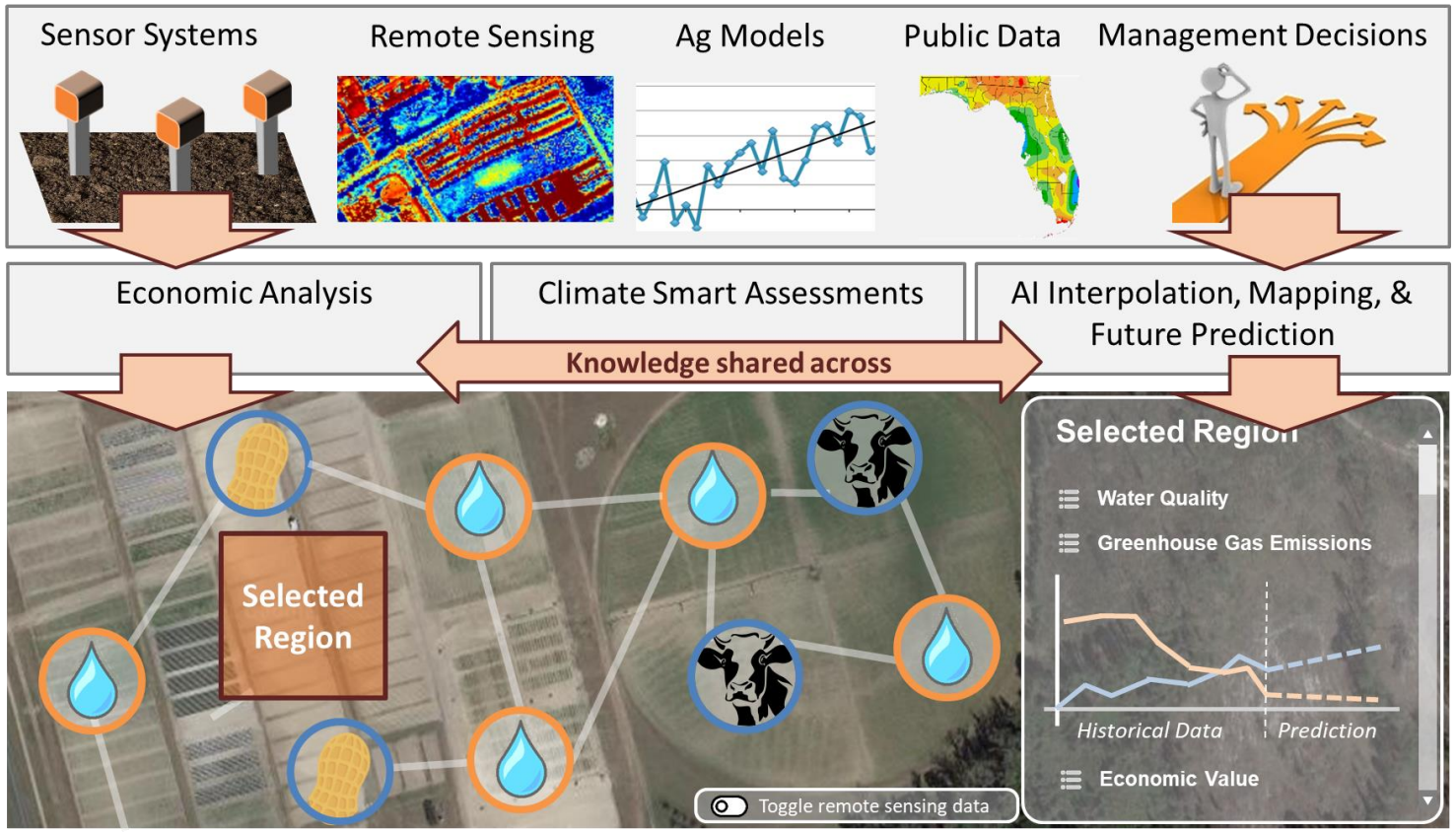
Vijay Vignesh P (Eng.)

Funding

- **VoLo Foundation**
  - $50,000 for hiring students to collect data
- **Florida State Legislature**
  - $1.2M for equipment, data, and student effort to gather data and build artificial intelligence systems
- **Synergizes with other current and future efforts at UF**
  - Other efforts supported by the state legislature (e.g., nutrient recommendations)
  - Related efforts by the UF Center for Coastal Solutions

Goals

- **Long-term goal**
  - AI-HARVEST: A Hub for Agricultural Reporting and Verification of Ecosystem Services through Sensing Technologies.



Goals

- **Long-term goal**
  - AI-HARVEST: A Hub for Agricultural Reporting and Verification of Ecosystem Services through Sensing Technologies.
  - **Quantify** and **map** ecosystem services throughout the state of Florida
  - **Create a tool** to inform producers and stakeholders about how lands contribute to climate smart objectives
    - Help economic experts to assign value to the ecosystem services

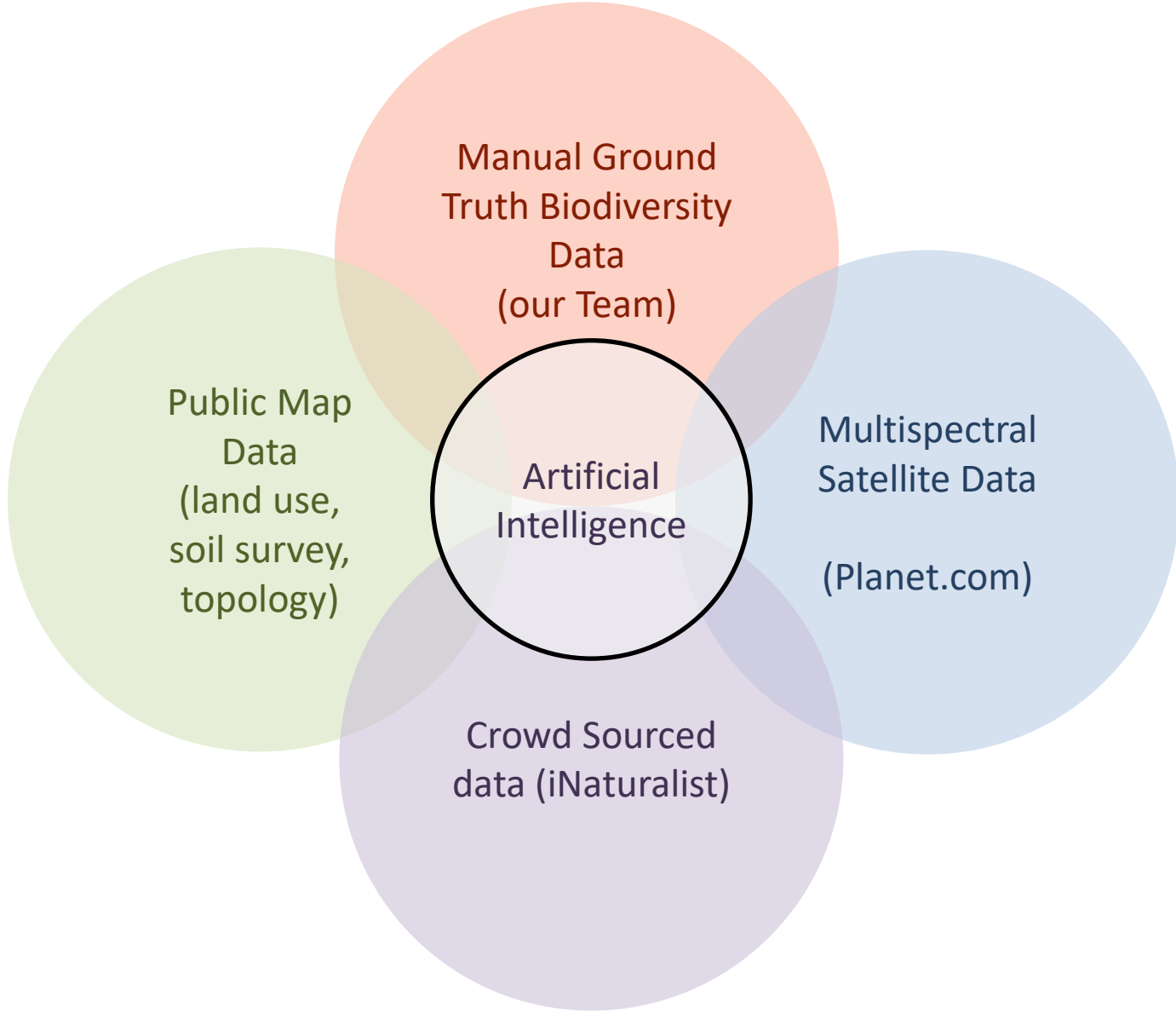
Goals

- **Long-term goal**
  - AI-HARVEST: A Hub for Agricultural Reporting and Verification of Ecosystem Services through Sensing Technologies.
  - **Quantify and** map ecosystem services throughout the state of Florida
  - **Create a tool** to inform producers and stakeholders about how lands contribute to climate smart objectives
    - Help economic experts to assign value to the ecosystem services
- **This year's goal**
  - Create a map of plant biodiversity across the state of Florida

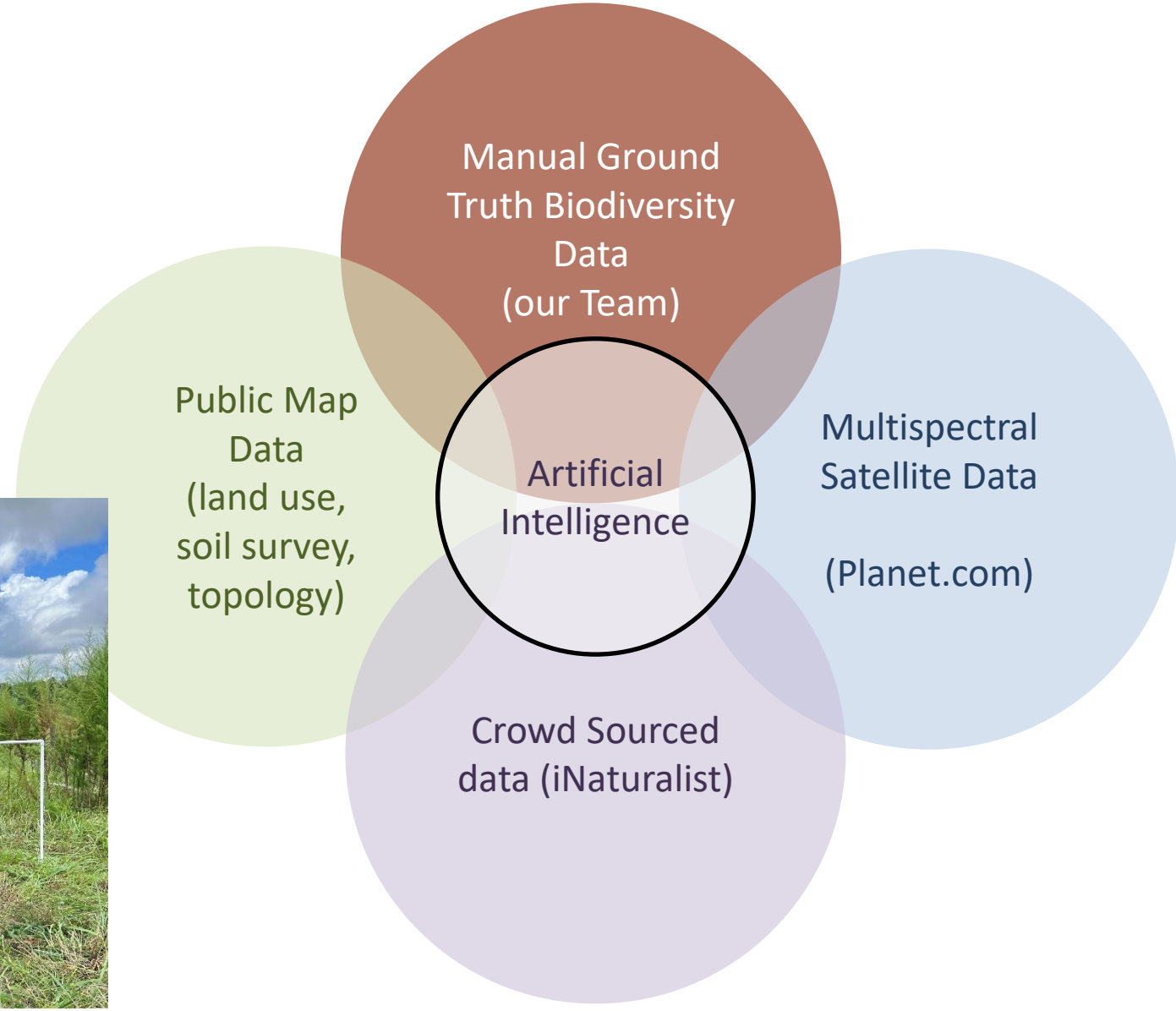
Our Approach

- **Communicate with stakeholders**
- **Collect “ground truth” biodiversity data across the state of Florida**
- **Identify datasets that can be used for mapping biodiversity**
  - In general, more data = better
- **Design artificial intelligence to identify biodiversity across Florida**
- **Create a framework to extend to other ecosystem services**

Our Data

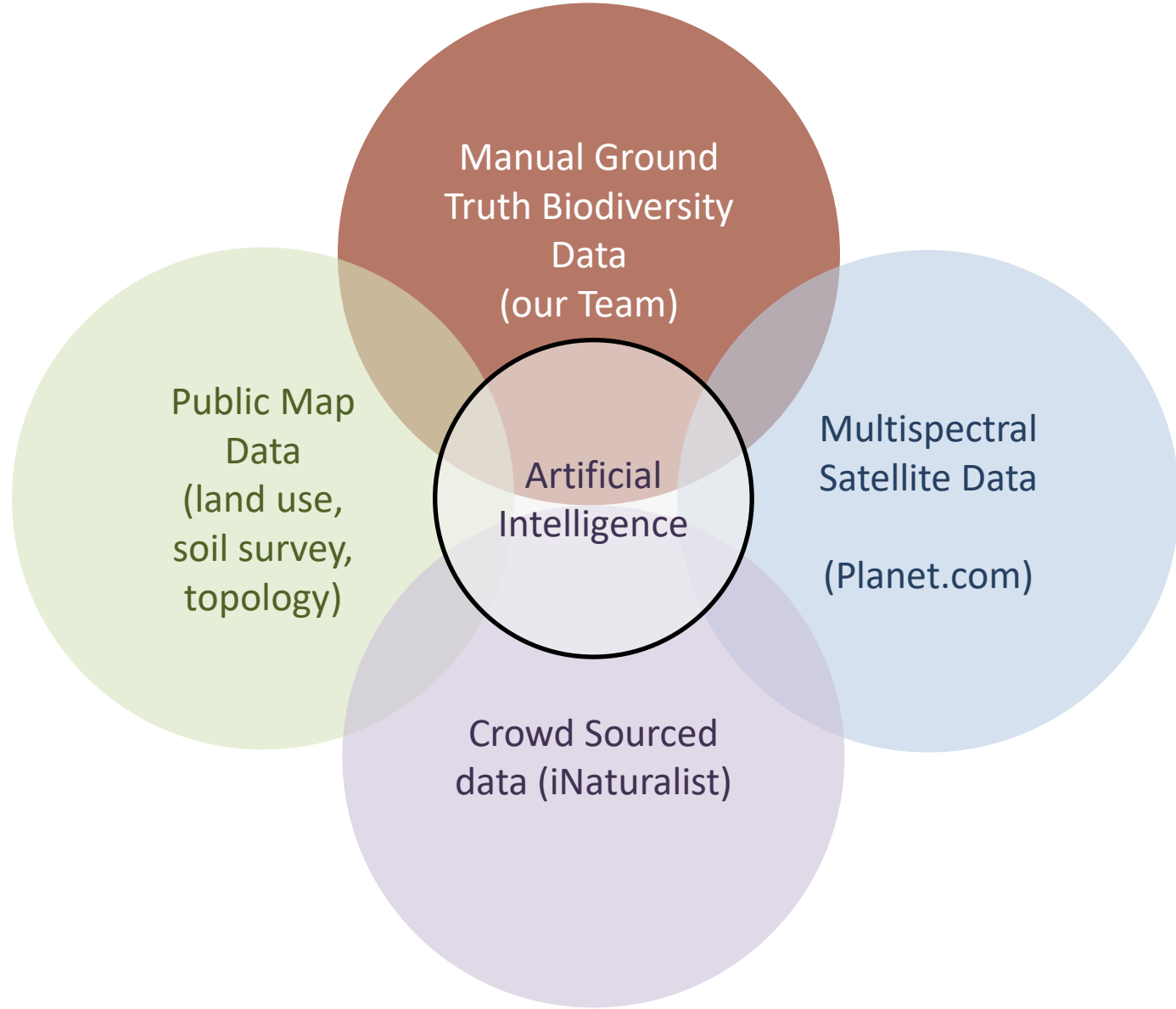

Manual Ground Truth Biodiversity Data (our Team)
Public Map Data (land use, soil survey, topology)
Artificial Intelligence
Multispectral Satellite Data (Planet.com)
Crowd Sourced data (iNaturalist)

Our Data


Manual Ground Truth Biodiversity Data (our Team)
Public Map Data (land use, soil survey, topology)
Artificial Intelligence
Multispectral Satellite Data (Planet.com)
Crowd Sourced data (iNaturalist)

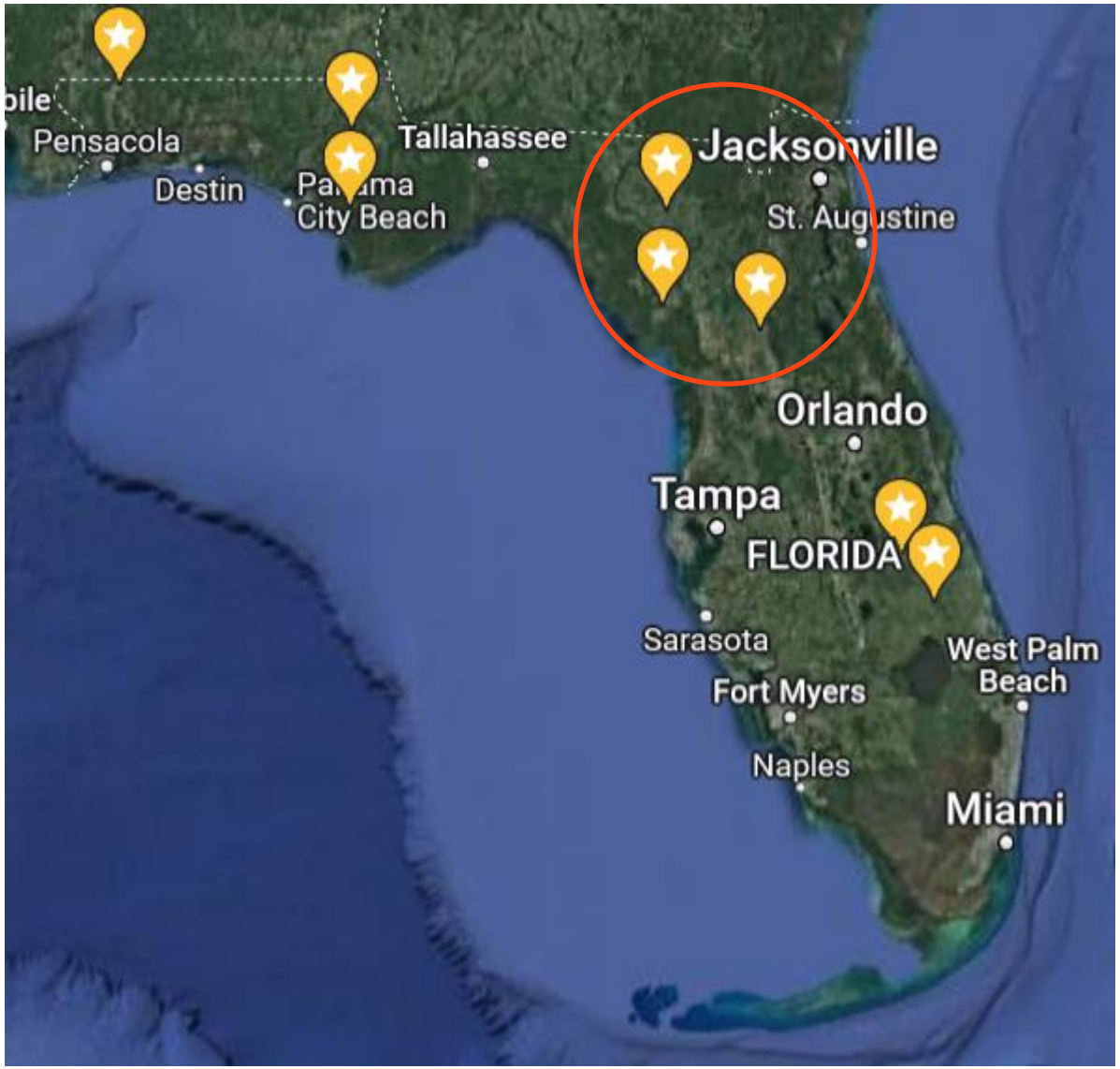
Our Data

- **Data we collect**
  - Plant species presence
  - Plant species ranking
  - Spectroradiometer data for each plant species
  - Sampled across land uses
    - Although focus on pastureland
  - Drone hyperspectral data



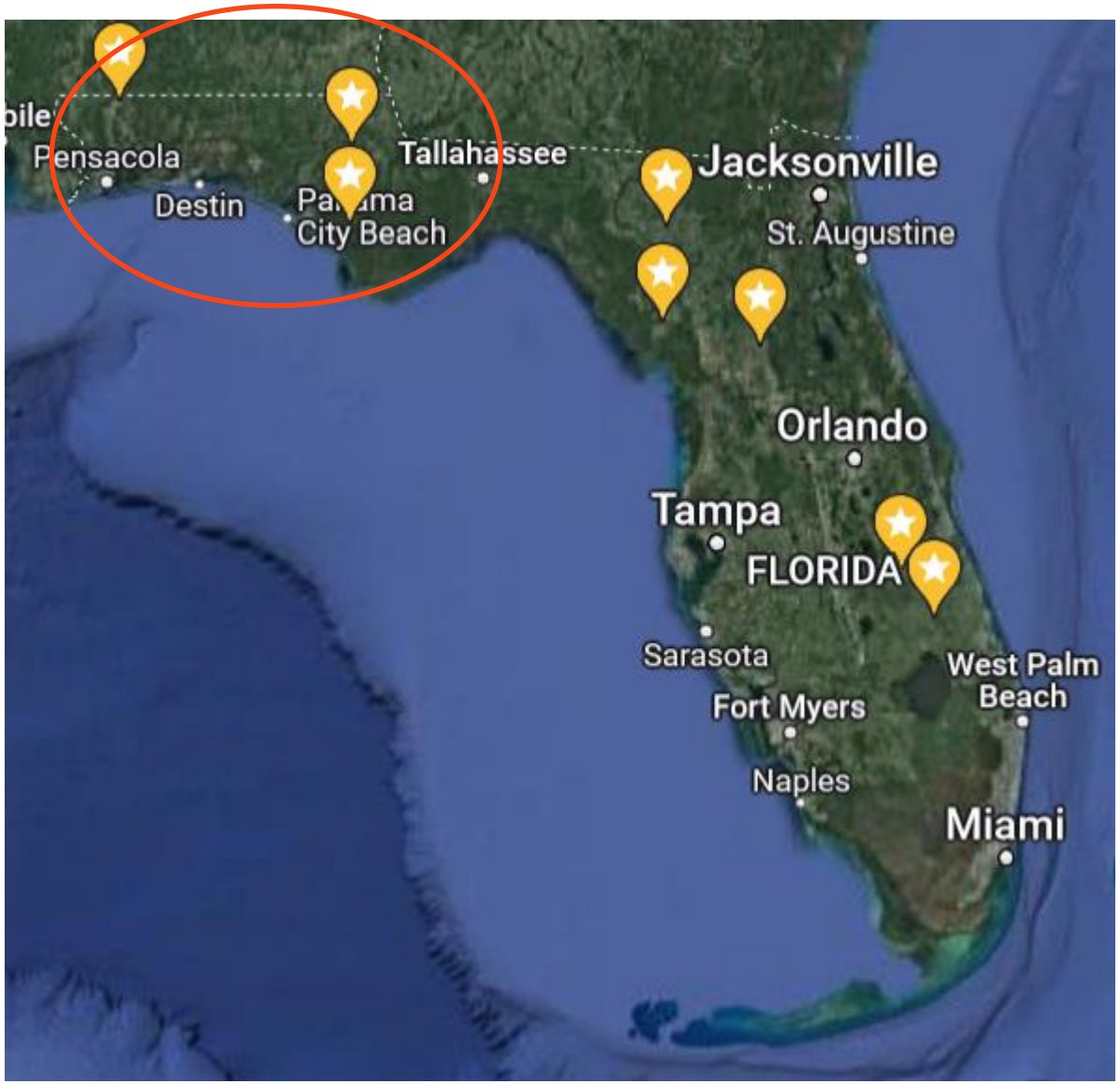
Teams

- **Team 1:**
  - ***Students:***
    - Pankaj Chand (engineering)
    - Woohyun Eum (engineering)
    - Alston Lippert (IFAS)
    - Ayush Sharma (IFAS)
  - ***Partners:***
    - Lynetta Usher Griner - Usher Land and Timber Inc (Chiefland)
    - Randall Dasher - Dasher Farms (McAlpin)
    - Steve Howell - Ocala Bull LLC (Anthony)



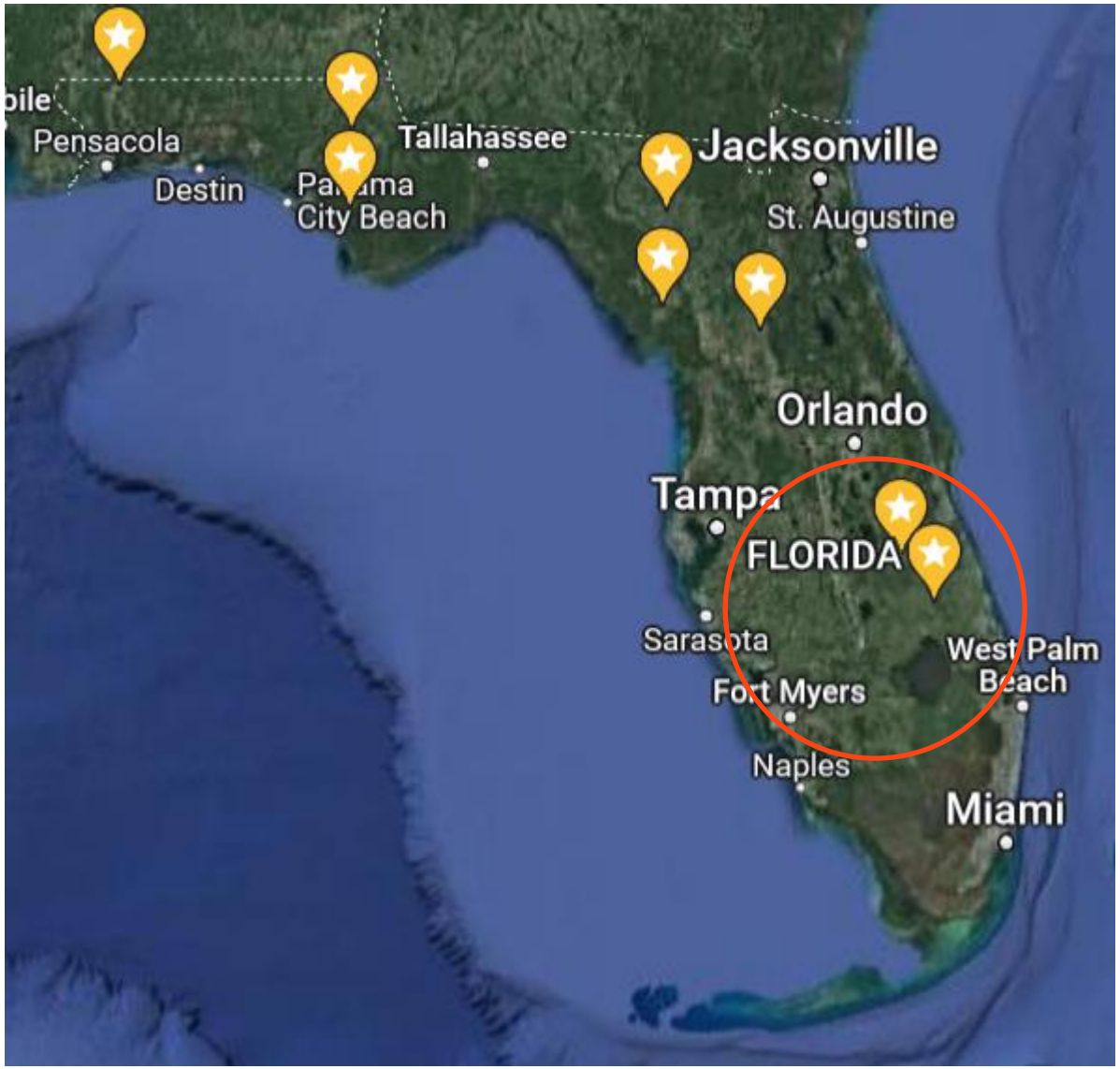
Teams

- **Team 2:**
  - ***Students:***
    - Jack Upchurch (IFAS)
    - Daniel Alabi (engineering)
    - G. Austin Simon (engineering
  - ***Partners:***
    - Mack Glass - Cherokee Farms (Marianna)
    - Burlin Findley - Wild Boar Farms (Jay)
    - Michael Archibald (speaking with Calvin Winder on his behalf) -

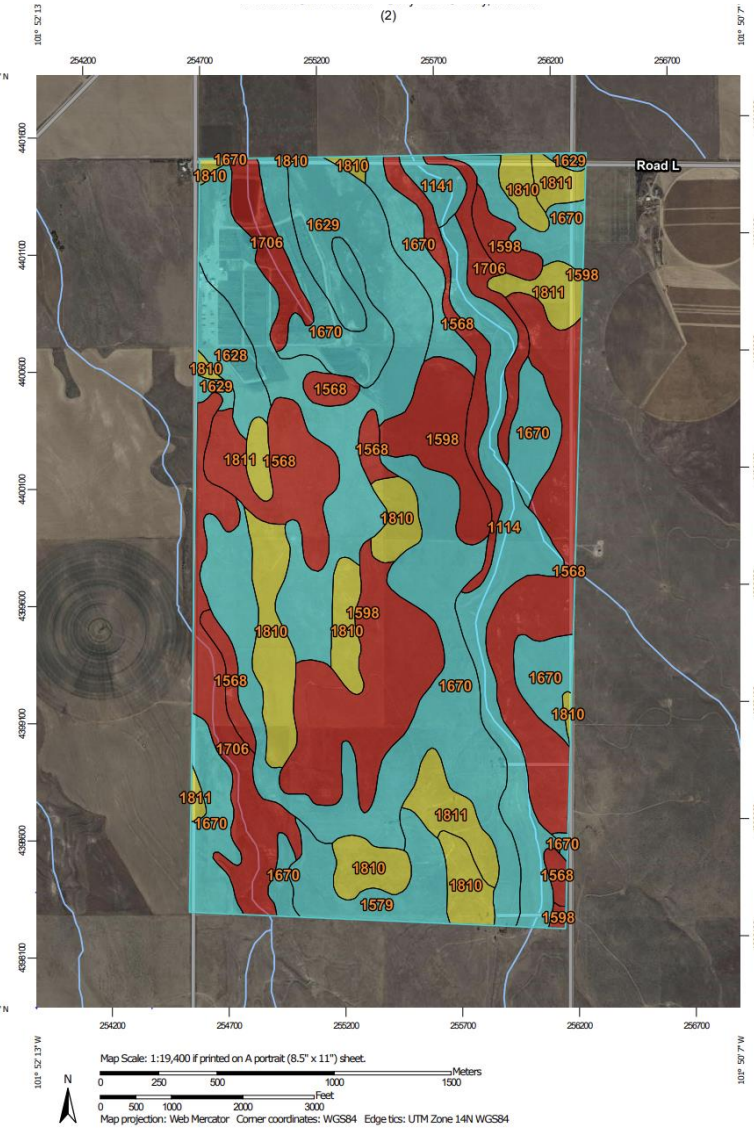


Teams

- **Team 3:**
  - ***Students:***
    - John Harling (IFAS)Hrishikesh Mahajan (engineering)
    - Vijay Vignesh P (engineering)
    - Zhihui tian (engineering)
  - ***Partners:***
    - Mike Adams - Adams Ranch
      - Okeechobee county location
      - Osceola county location
    - Jim Strickland
      - Did not visit yet due to Hurricane damage



Our Data



ıne County, Kansas

-Bankard loamy fine sand, occasionally flooded

Unit Setting
National map unit symbol: 17l62
Elevation: 2,500 to 5,900 feet
Mean annual precipitation: 16 to 20 inches
Mean annual air temperature: 52 to 55 degrees F
Frost-free period: 135 to 210 days
Farmland classification: Farmland of statewide importance

Unit Composition
Bankard and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

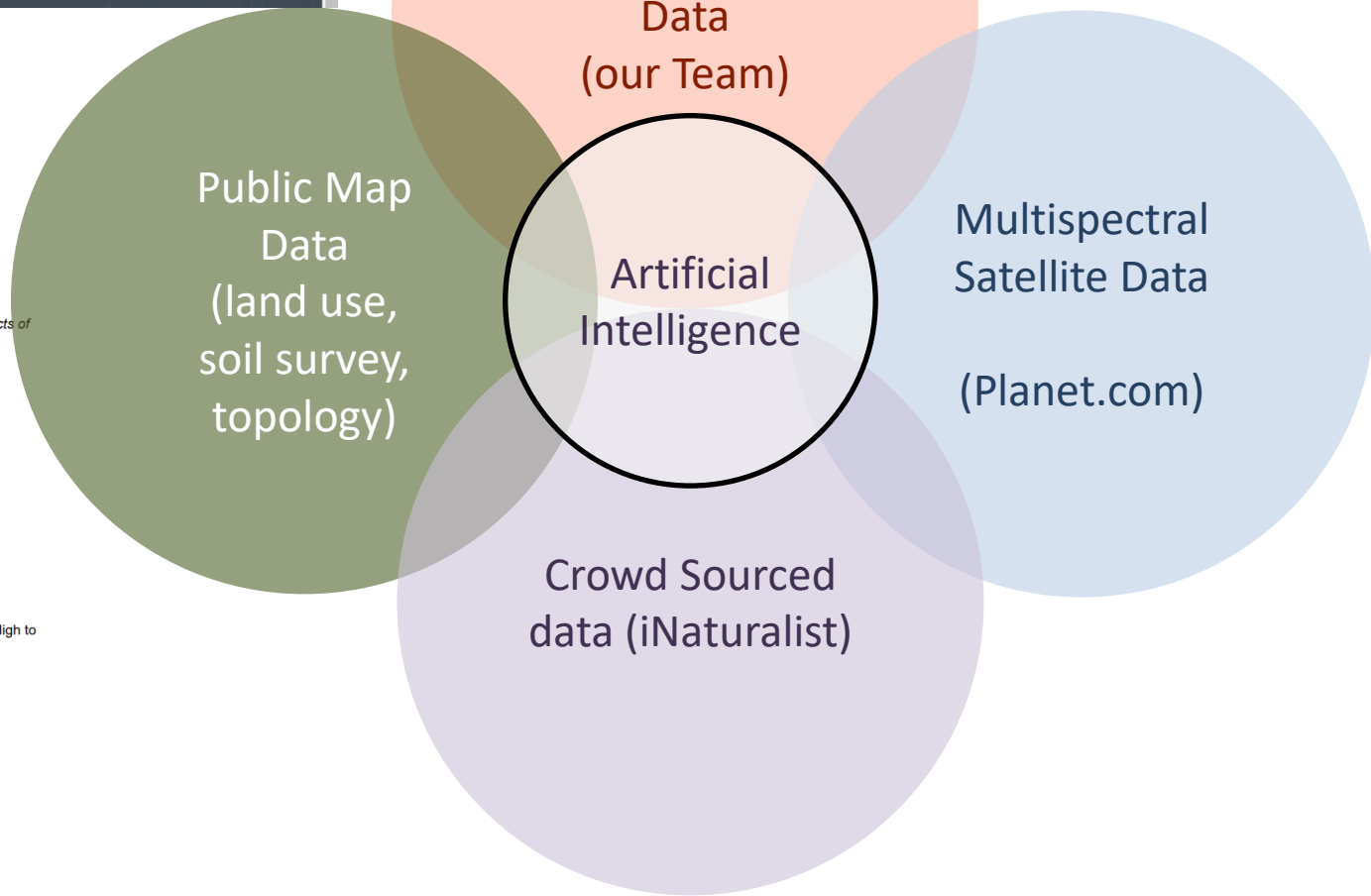
ːription of Bankard

ıtting
Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium

ɪpical profile
A - 0 to 6 inches: loamy fine sand
C - 6 to 60 inches: fine sand

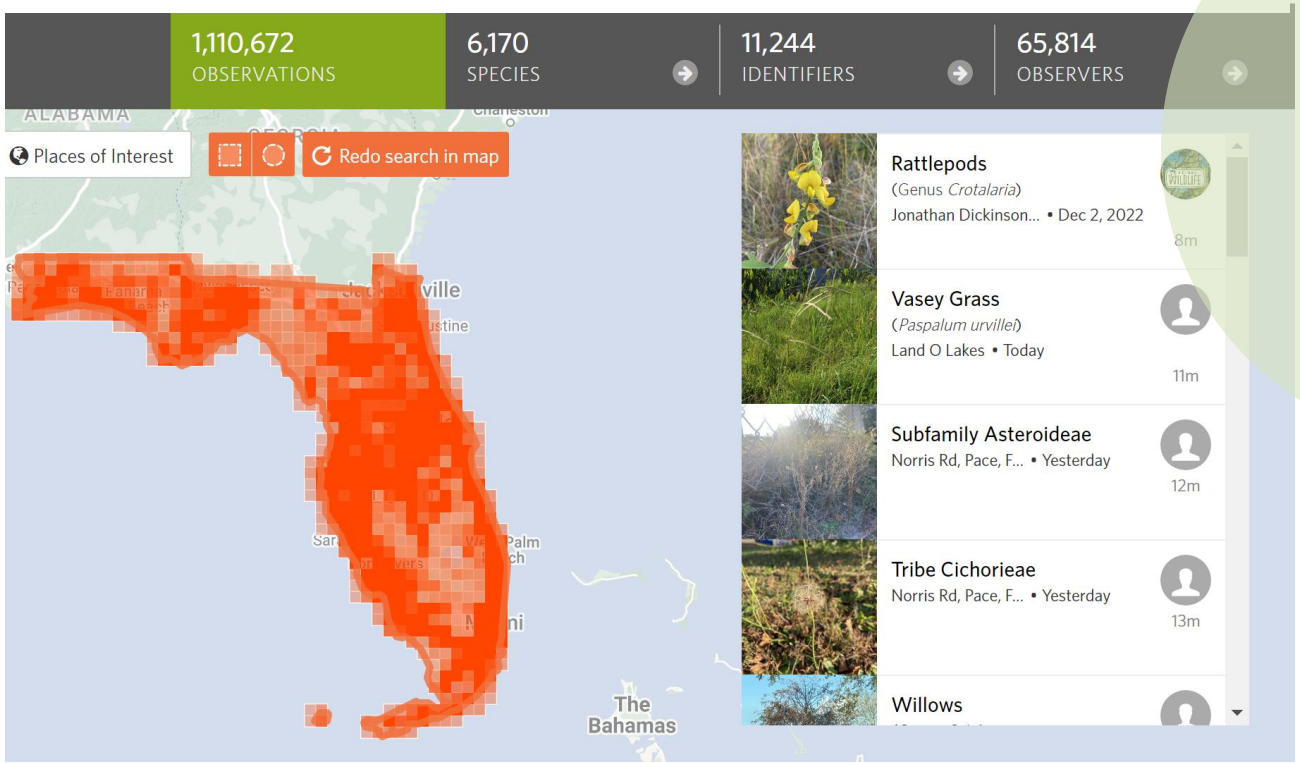
operties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: NoneOccasional
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water supply, 0 to 60 inches: Moderate (about 6.7 inches)

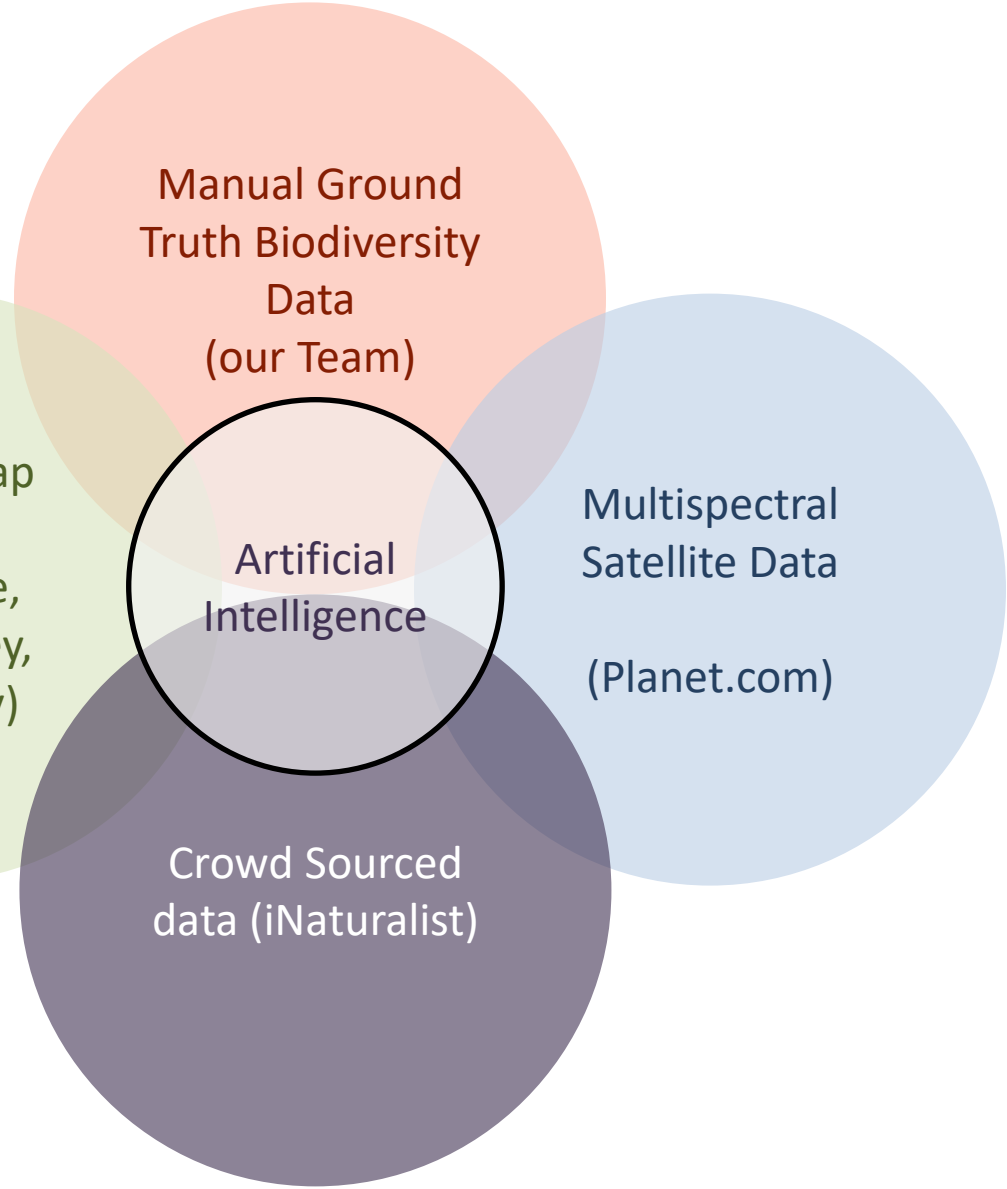
ɪerpretive groups
Land capability classification (irrigated): 4w
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A
Ecological site: R072XY107KS - Sandy Lowland
Hydric soil rating: No



Our Data

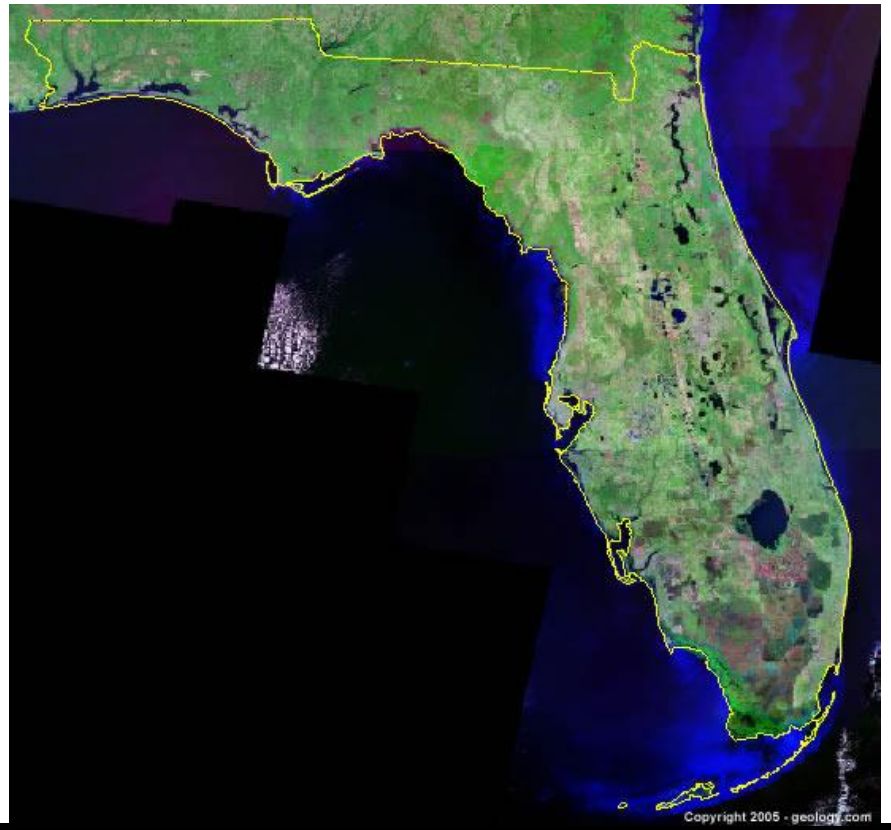
University of Florida
Department of Electrical and Computer Engineering

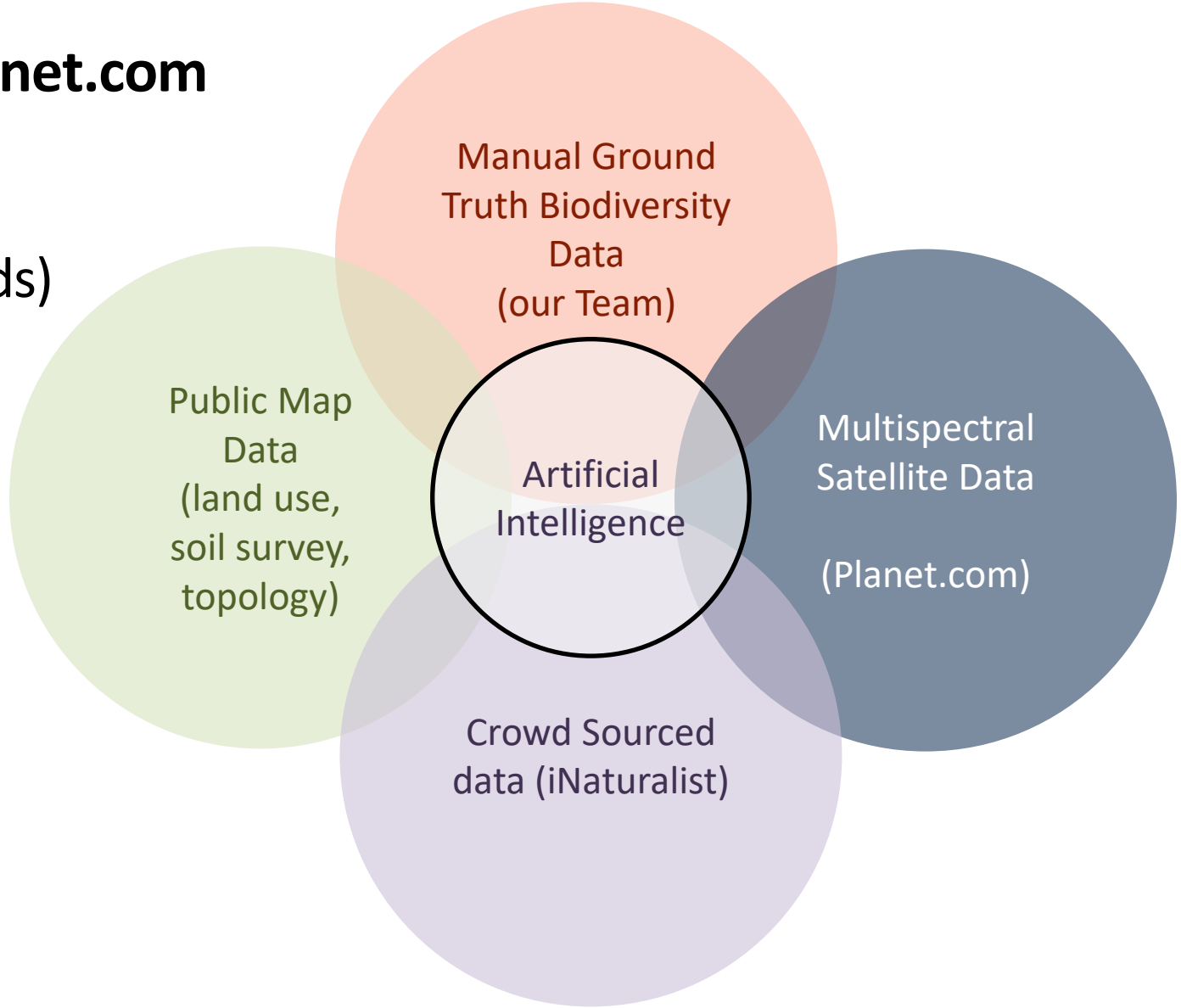




Our Data

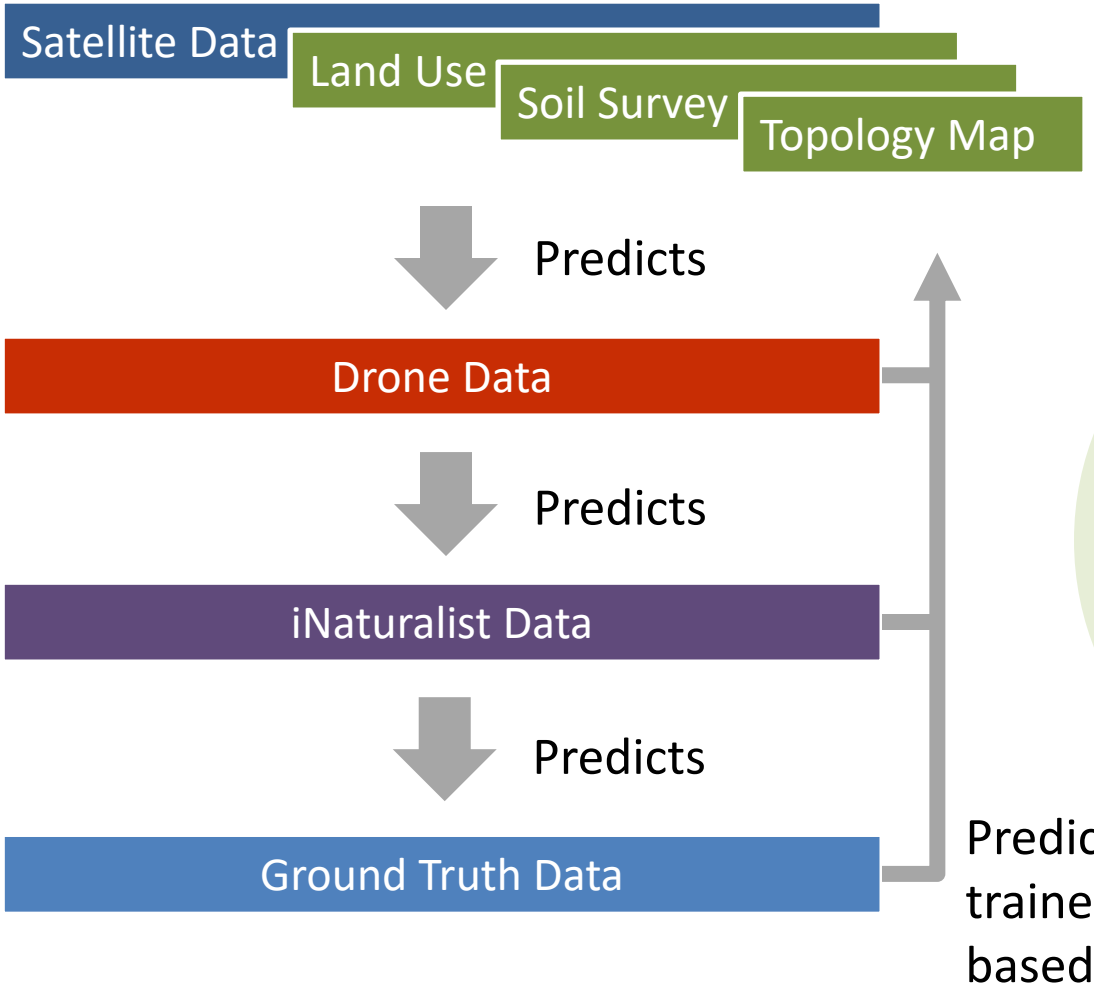
- **Collaboration Established with Planet.com**
  - Skysat: 50 cm resolution (5 bands)
  - PlanetScope: 3 m resolution (8 bands)

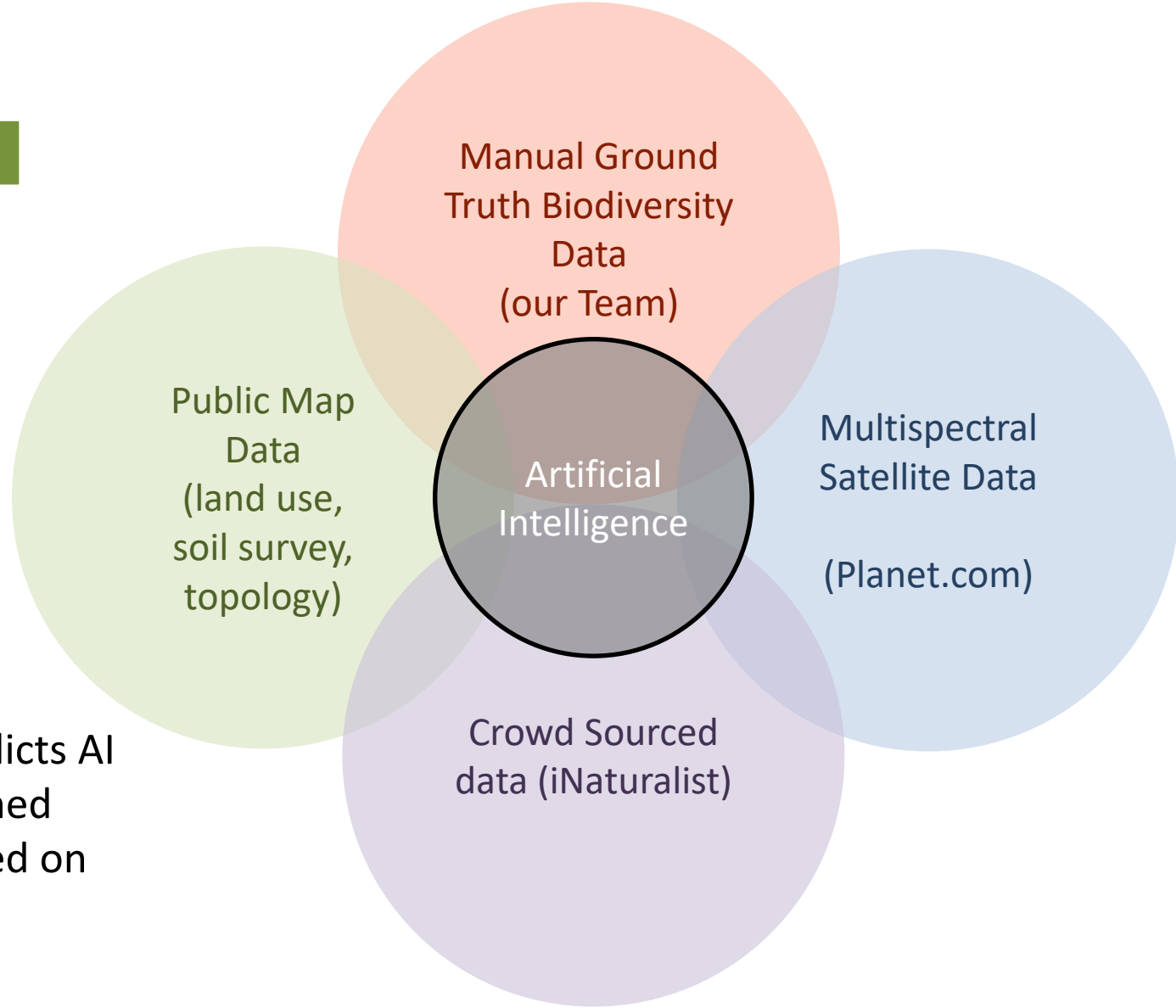




Our Proposed AI

University of Florida
Department of Electrical and Computer Engineering





Our Proposed AI

University of Florida
Department of Electrical and Computer Engineering

Satellite Data

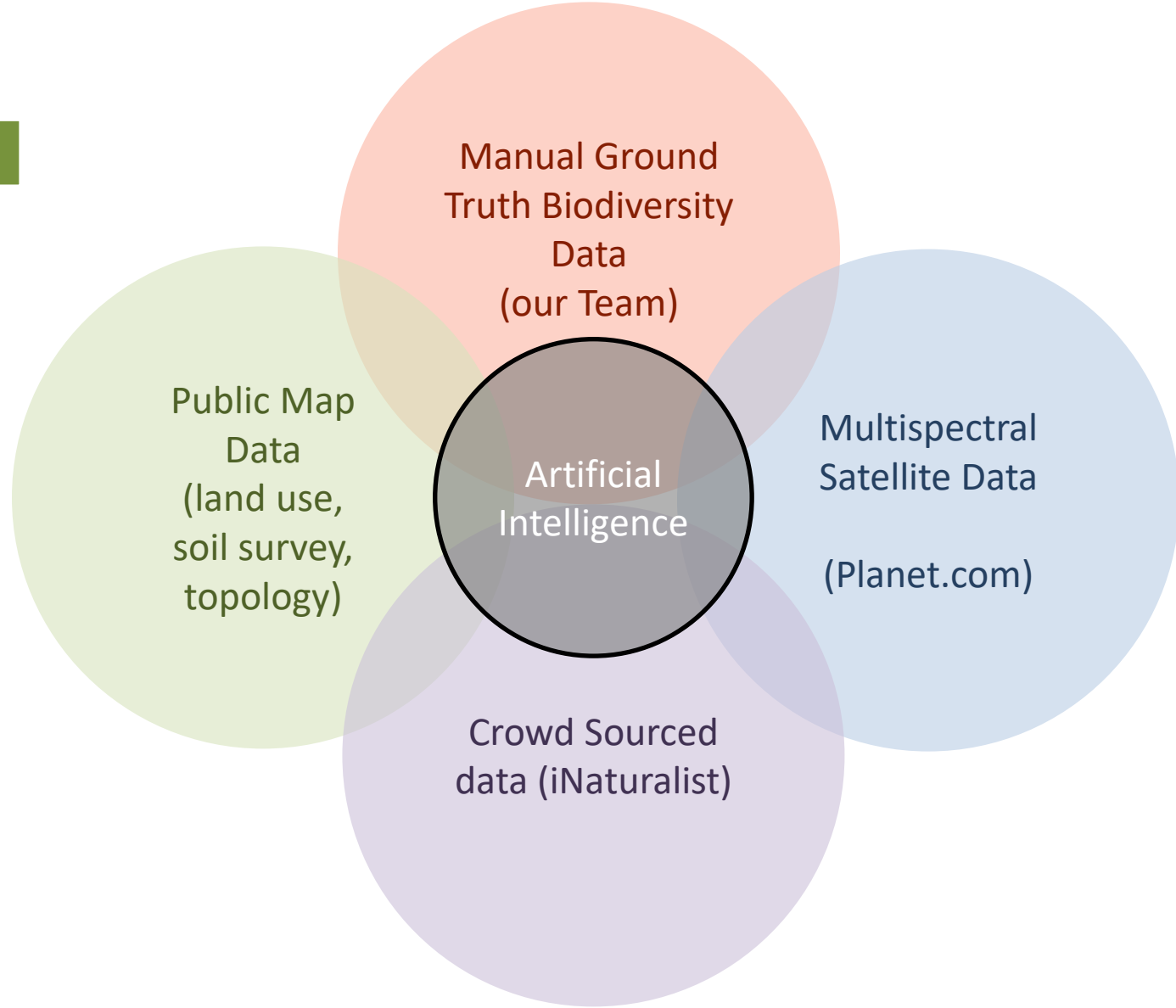
Land Use

Soil Survey

Topology Map

Predicts

Biodiversity richness and species rank



The Future

- **Next Steps**
  - Planned stakeholder meeting in March
    - Would like to have a prototype / mock-up of the AI system
- **How we aim to expand this project (additional years of funding)**
  - Extending will be much easier and faster (many lessons learned in the initial year)
  - Aim for more ecosystem services (carbon sequestration, water quality, etc.)
  - Collaborate with economics experts to study how incentive programs can created for smart agriculture processes

Conclusion

- **Project is on track**
  - Collected first ground truth data
  - Identified and collected supplementary data
  - Working on artificial intelligence systems next
  - Starting to build systems for measuring other ecosystem services
    - Quantifying soil carbon is next