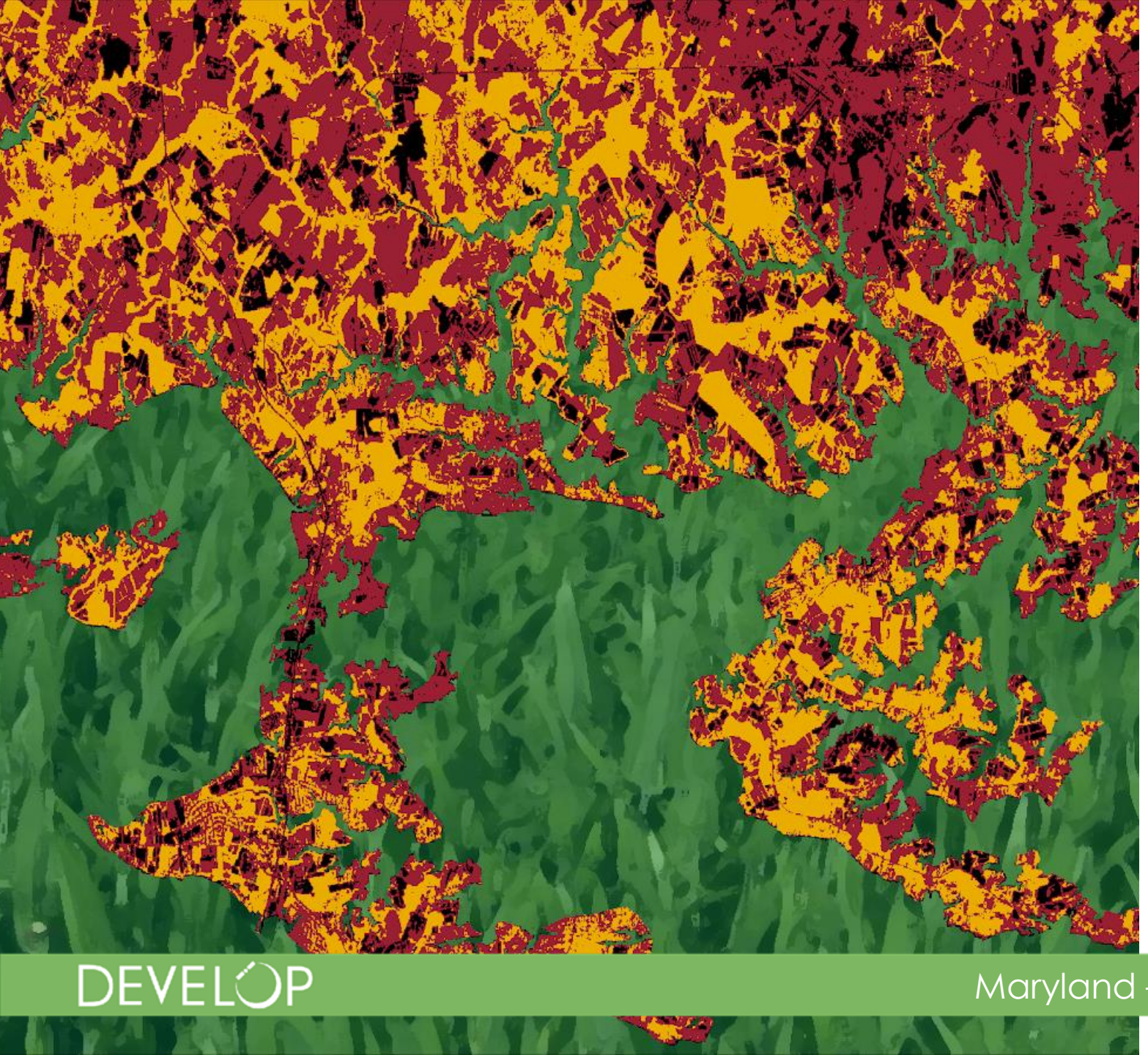

National Aeronautics and Space Administration

Chesapeake Bay Agriculture & Food Security III

Quantifying Wintertime Agricultural Land Use and Springtime Management of Winter Cover Crops using Landsat and Sentinel to Support Environmental Conservation in Maryland

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Callum Wayman

The Chesapeake Bay

- Watershed spans **6 states** and is fed by more than **150 rivers and streams**
- Home to over **3,000 species** of flora and fauna
- Generates over **$3 billion** in revenue via commercial fishing
- Serves as a major tourist attraction and **recreational site**

credits: Esri (1), Chesapeake Bay Program (2-4)

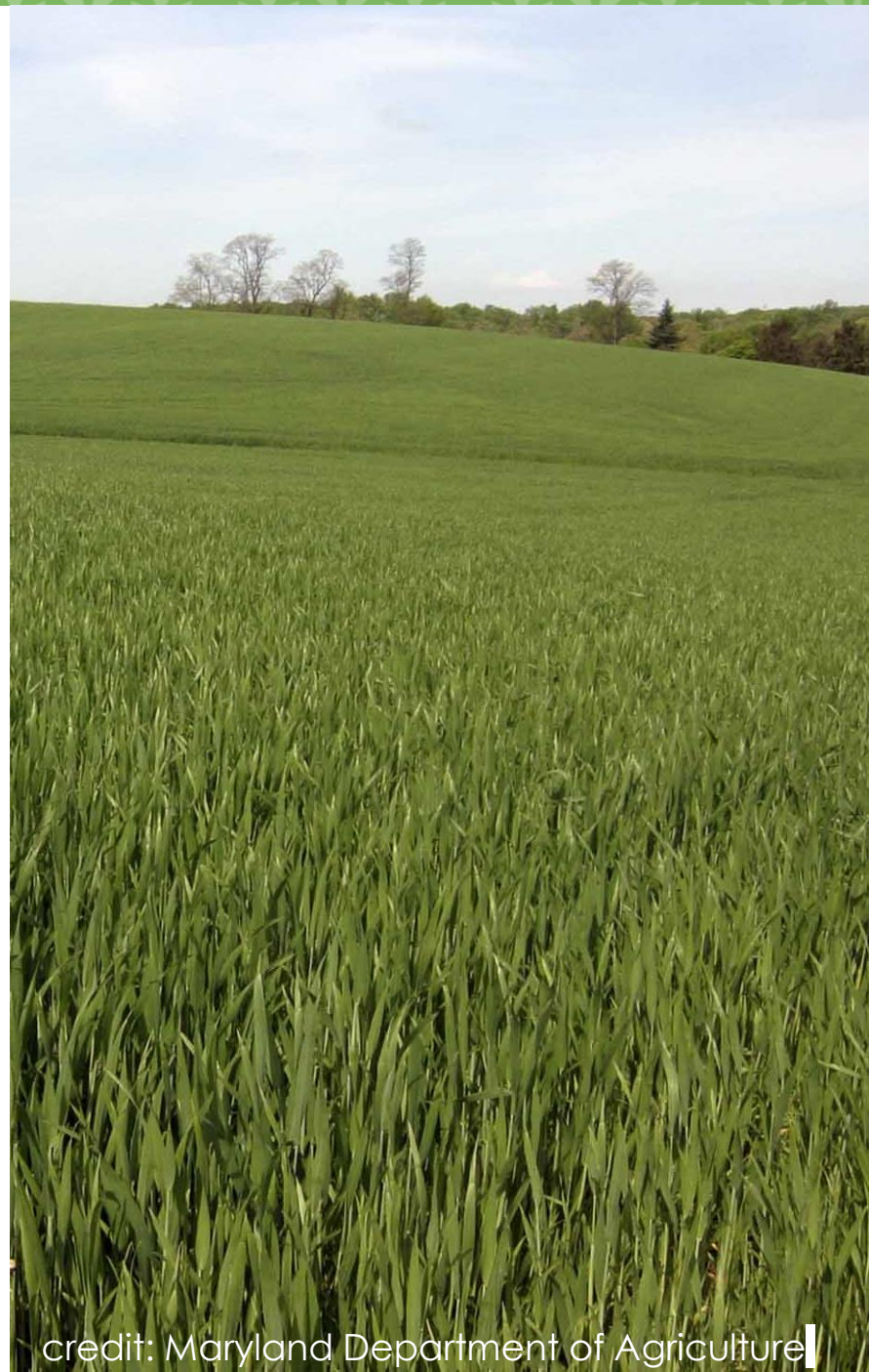
Community Concerns

- **Population** growth, **land-use** changes, **agricultural** production
- **Nutrient runoff** and **sediment** accumulation
- Excess **nitrogen**, **phosphorous**, and other nutrients
- Low **water quality**

credits: Chesapeake Bay Program

Cover Crops

- Planted during **autumn** in between regular crop growing seasons
- Protect against **erosion and nutrient runoff**
- Primary cover crops are **wheat, rye, barley, and triticale**
- Effectiveness depends upon **management practices**



credit: Maryland Department of Agriculture

Partners

Maryland Department of Agriculture, Office of Resource Conservation

USDA, Agricultural Research Service

USGS, Eastern Geographic Science Center

US EPA, Chesapeake Bay Program

credit: Hans on Pixabay

Objectives

- **Analyze** cover crop vegetation density in enrolled fields across Maryland
- **Finalize** a graphical user interface by adding a time series analysis to visualize NDVI values of fields on various days throughout spring
- **Provide** an interactive tool which bolsters conservation efforts for the Chesapeake Bay via remote sensing technology

Study Area/Study Period

State of Maryland with Landsat 8 OLI Composite Image Overlaid

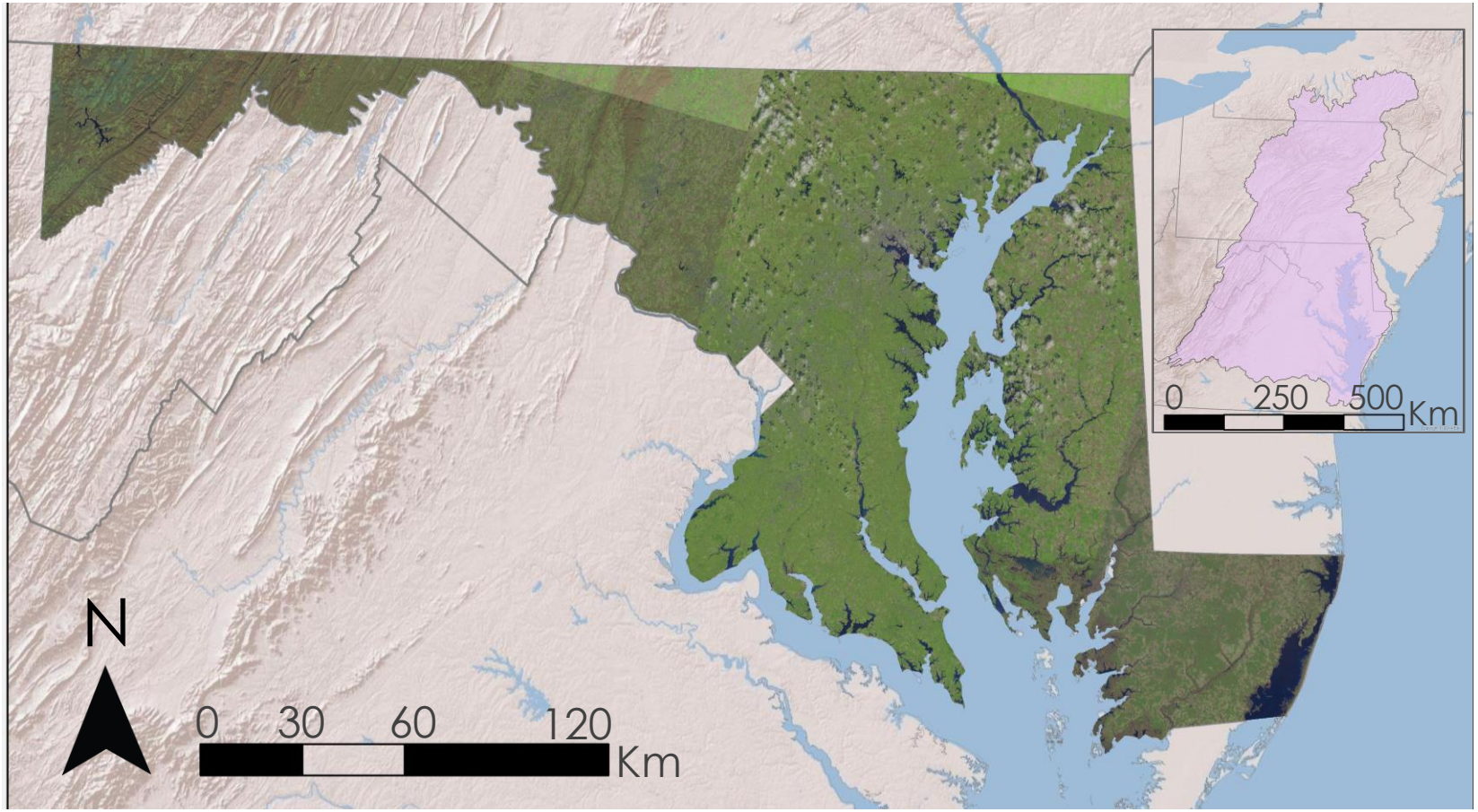


Image: World Shaded Relief (ESRI), Landsat 8 OLI (NASA)

Study period (2014 to 2019):

Winter (Dec 15 to Jan 31)

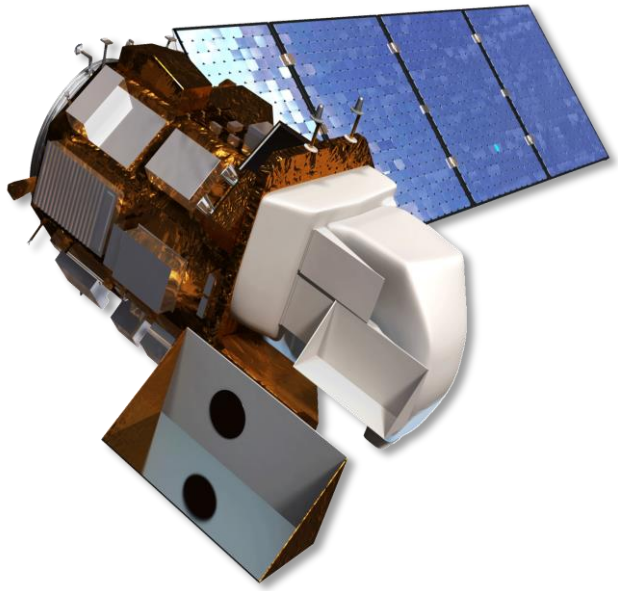
Spring (March 1 to April 15)*

*Spring extended to May 1 for MDA biomass program

Calibration data collected from 2006 through 2012

Earth Observations

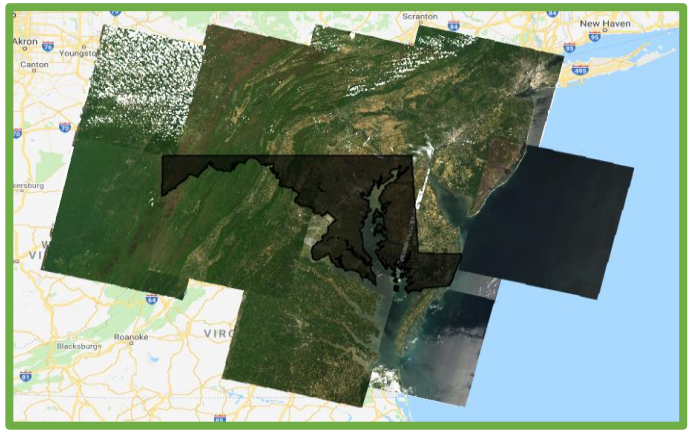
Landsat 5
Thematic Mapper
Resolution: 30 m
Frequency: 16 days



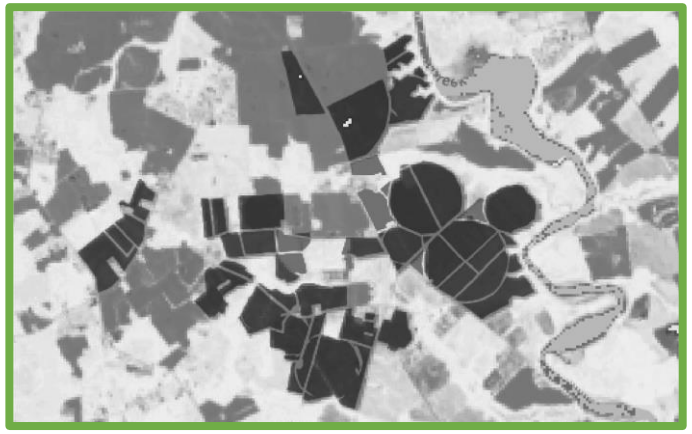
Landsat 8
Operational Land
Imager
Resolution: 30 m
Frequency: 16 days

Sentinel-2
MultiSpectral
Instrument
Resolution: 10 - 20m
Frequency: 5 days

Methodology



NASA and ESA Satellite Imagery

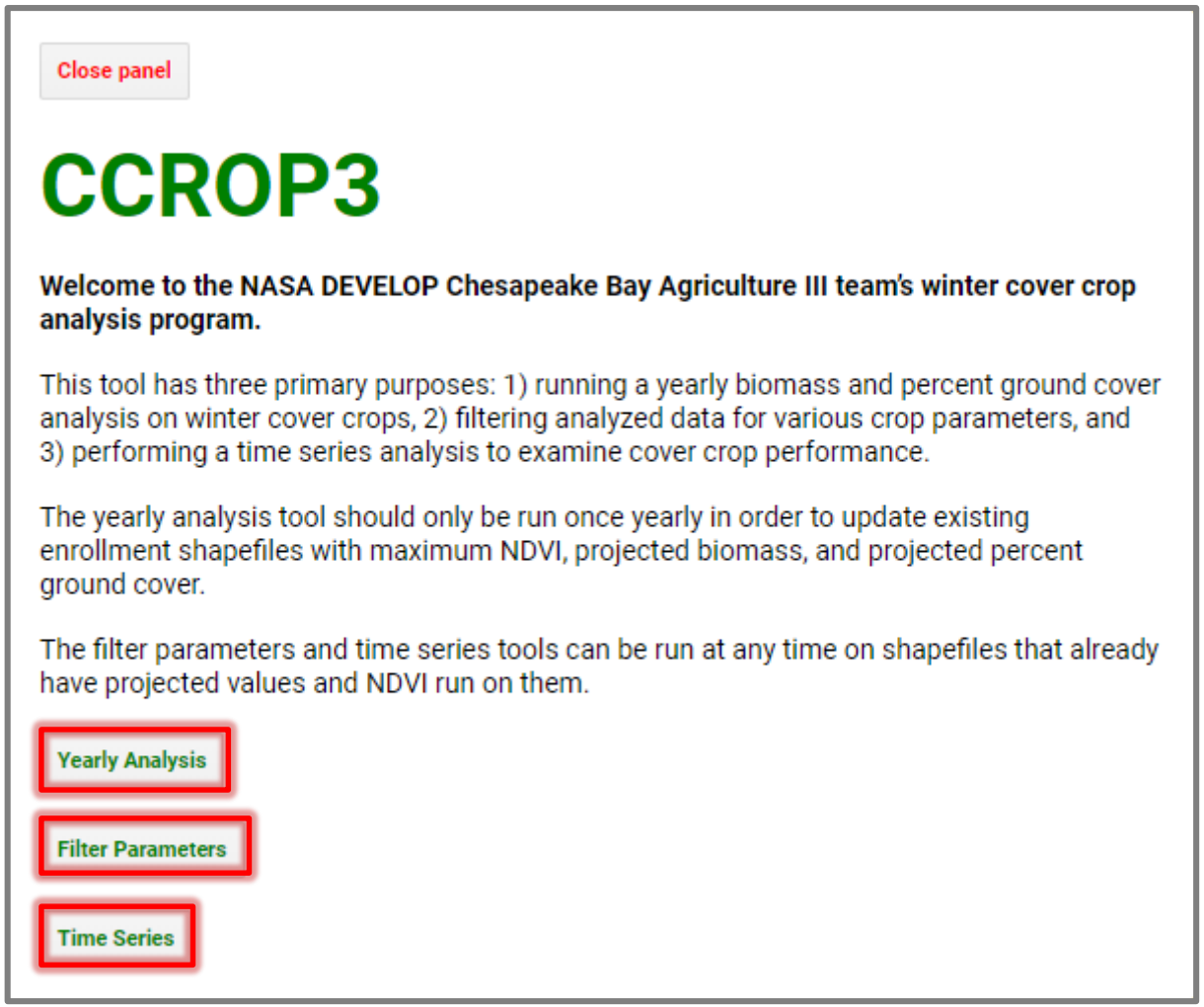


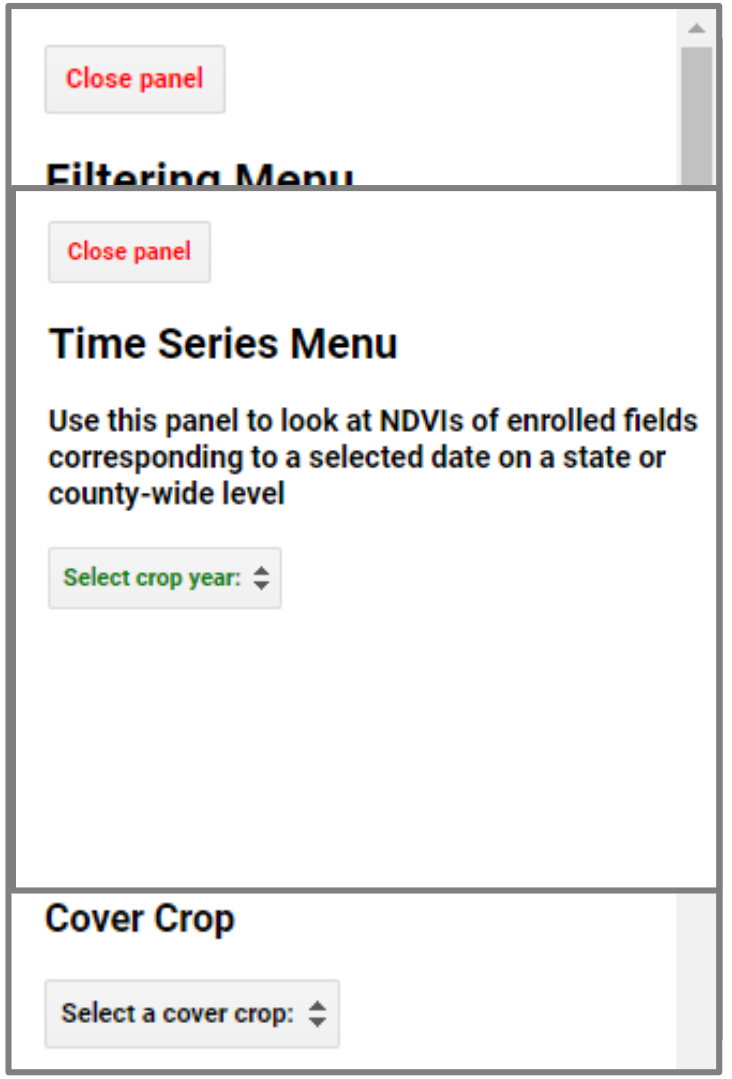
MDA Shapefiles and Agronomic Data

Satellite imagery used to compute winter/spring time series of NDVI for each field

- NDVI converted to biomass and percent ground cover
- Filter data based on provided agronomic parameters
- Time series shows NDVI distribution per day

Graphical User Interface (GUI)



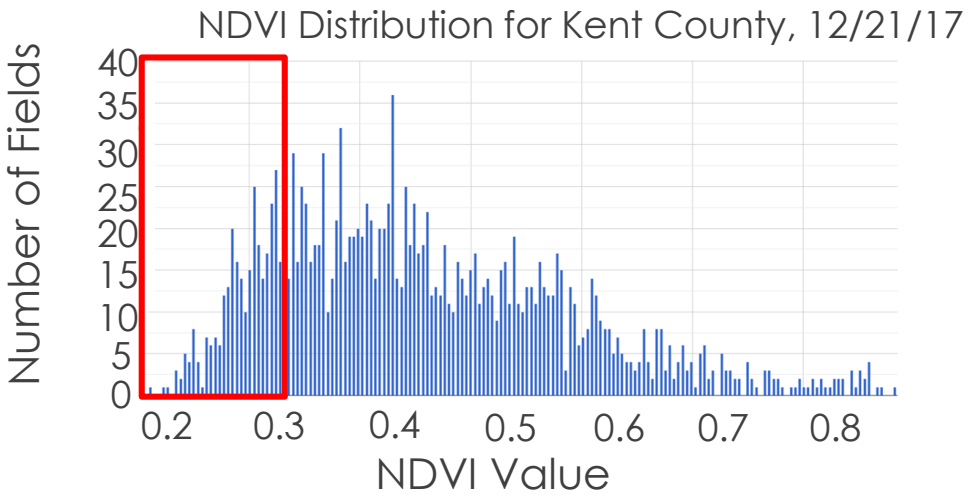


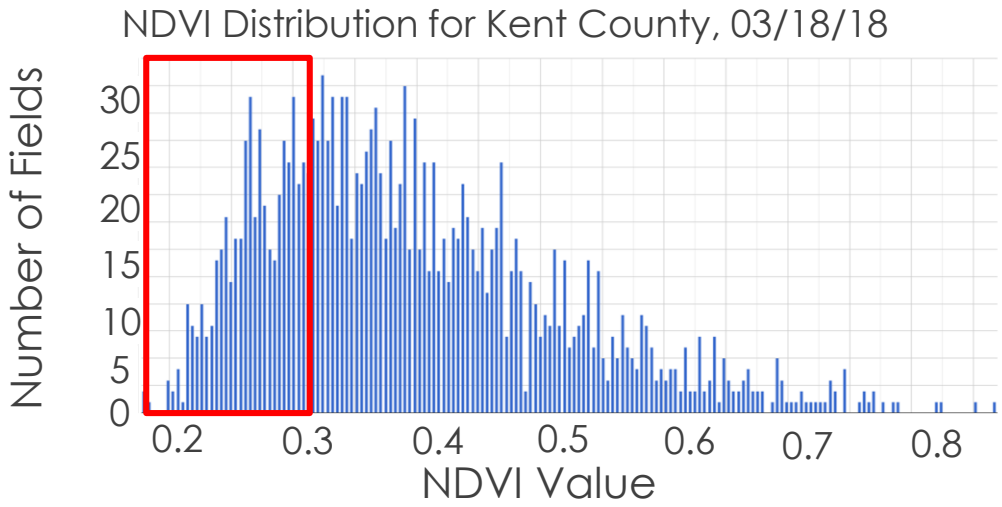
Results – Time Series Display

Subset of field NDVI Values, December 21, 2017

Subset of field NDVI Values, March 18, 2018

Results – Histogram Output





December 21: 8% low NDVI fields out of 1665 total observed fields

March 18th: 22% low NDVI fields out of 1665 total observed fields

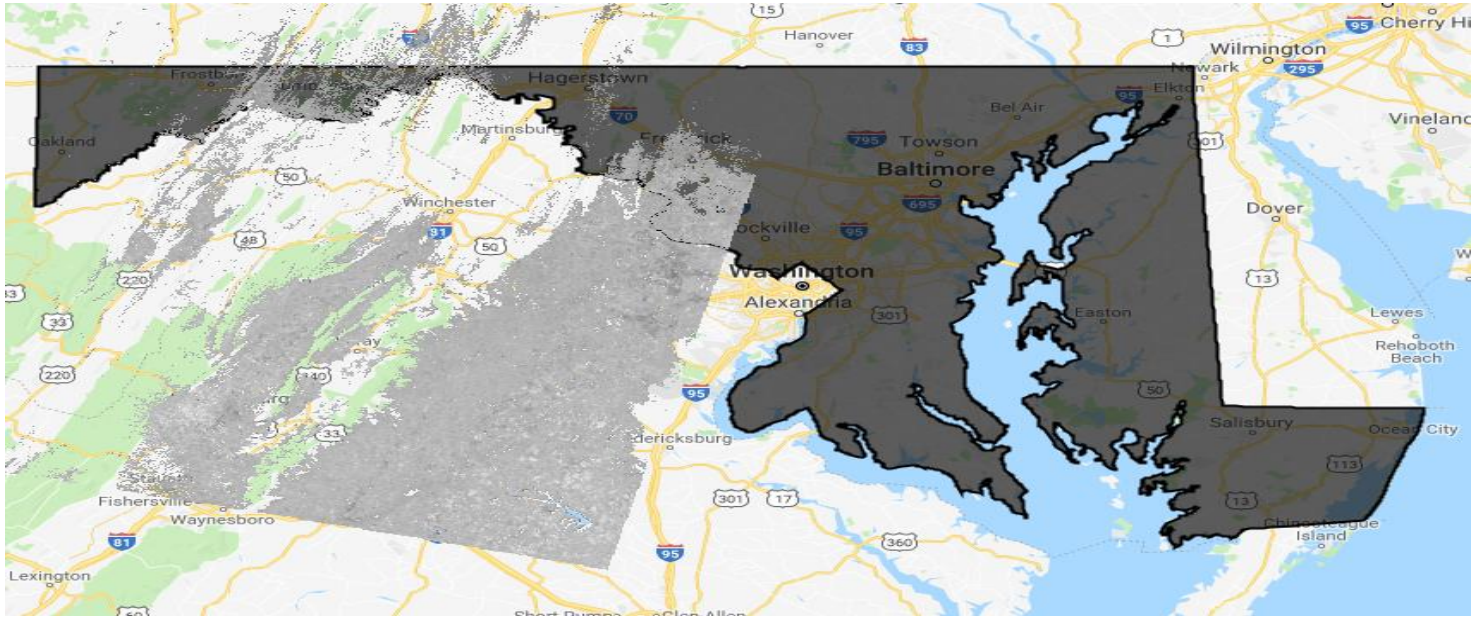
Conclusions

- CCROP3 **visualizes** vegetation density for all enrolled cover crop fields.
- NDVI values calculated over time can be used to **explore** cover crop termination dates.
  - Cecil County: 10% low (December) ➡ 21% low (March)
  - Kent County: 8% low (December) ➡ 22% low (March)
  - Talbot County: 7% low (December) ➡ 11% low (March)
  - Washington County: 11% low (December) ➡ 15% low (March)
- The MDA can use GUI outputs to **support agronomic analysis.**
  - Tables, histograms, shapefiles, etc.

credit: NASA Earth Observatory

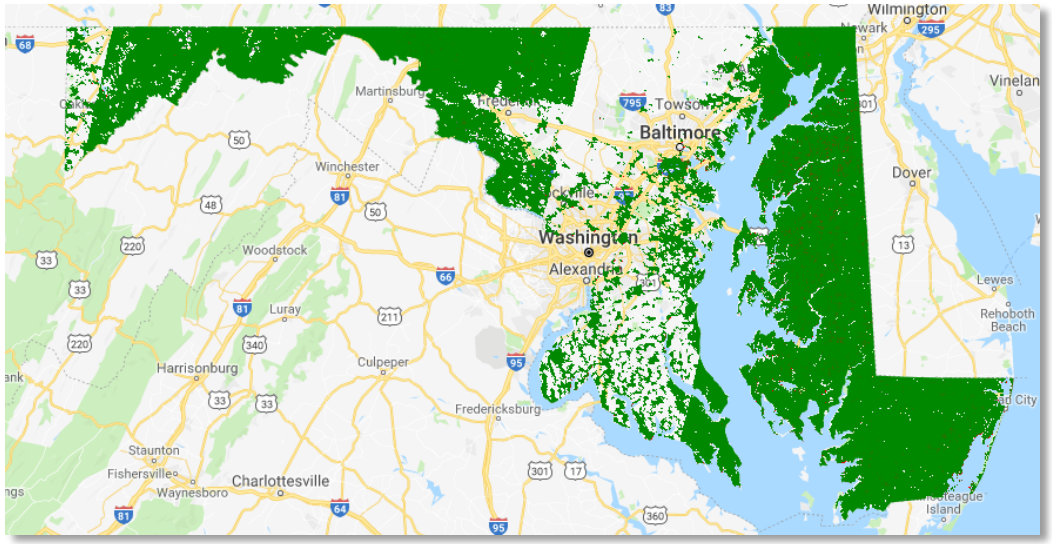
Uncertainties/Limitations

- Sentinel-2 **surface reflectance** is not yet implemented into GEE
- Spatial/temporal satellite **limitations**
- **Differentiating** between cover crops and harvest crops/weeds
- **Accuracy** of biomass/percent ground cover conversions
- Update and **maintain** GUI



Future Work

- Sentinel/Landsat integration for **continuous time series**
- **Expand** to other Chesapeake watershed states
- **Alternative analysis variables** (EVI, red edge, nitrogen)



Credit: NASA, Esri, DEVELOP team

ACKNOWLEDGEMENTS

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