The future of crop yield monitoring without MODIS

NOAA's Satellite Applications Symposium Series: Land/Agriculture

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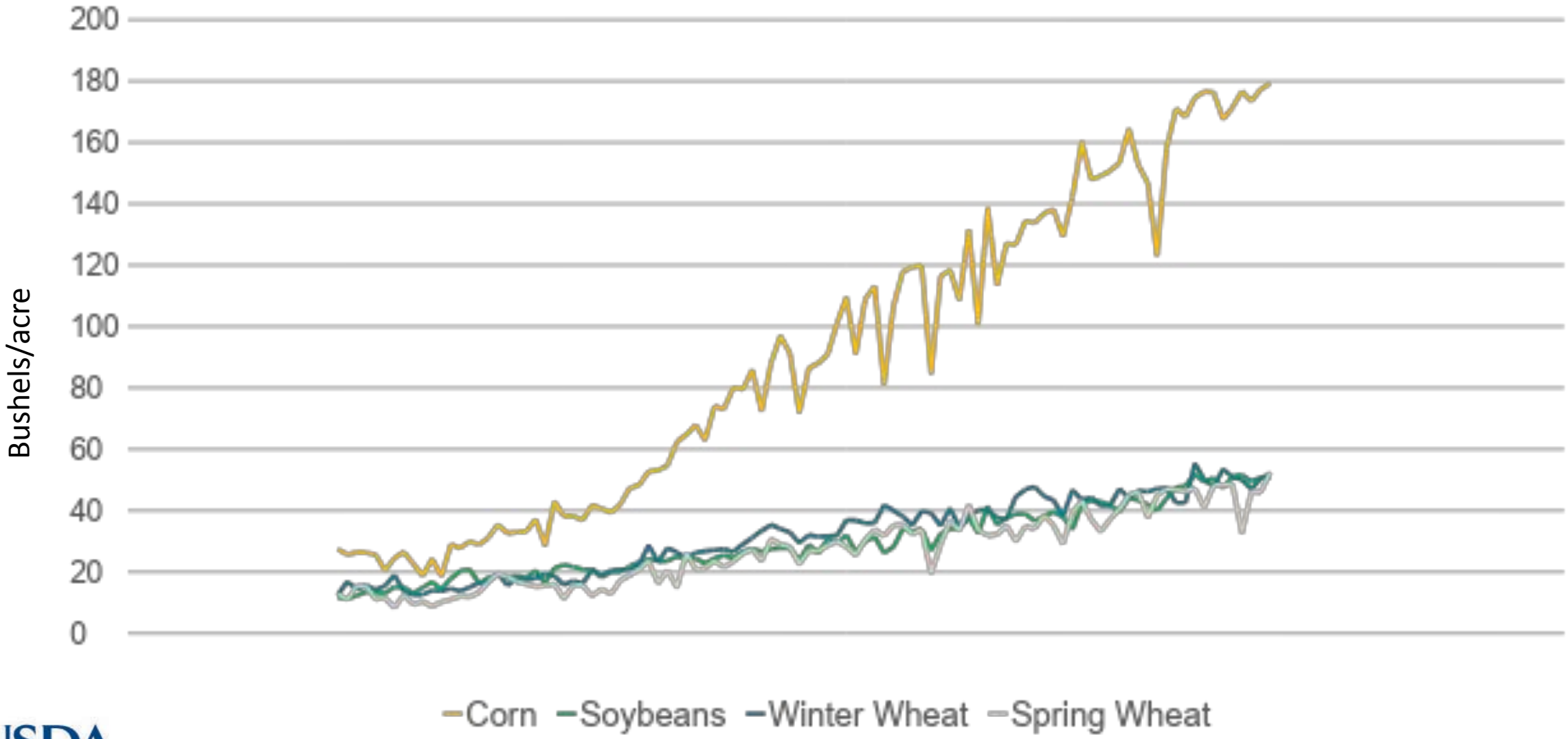
May 20, 2025 | College Park, Maryland

100-year crop yield trends over the United States



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NASS Monthly Crop Production reports

Crop Production

ISSN: 1936-3737

Released August 12, 2024, by the National Agricultural Statistics Service (NASS), Agricultural Statistics Board, United States Department of Agriculture (USDA).

Special Note

NASS reviewed planted and harvested acreage estimates in this report for barley, corn, cotton, dry edible beans, oats, peanuts, rice, sorghum, soybeans, sugarbeets, and wheat (winter, other spring, and Durum) using all available data, including the latest certified acreage from the Farm Service Agency (FSA). All States in the estimating program for these crops were subject to review and updating. Detailed estimates can be found on pages 6, 8, 9, 11, 12, 13, 15, 16, 18, 22, 25, 26, 29, and 30.

Corn Production Down 1 Percent from 2023
Soybean Production Up 10 Percent from 2023
Cotton Production Up 25 Percent from 2023
Winter Wheat Production Up 1 Percent from July Forecast

Corn production for grain is forecast at 15.1 billion bushels, down 1 percent from 2023, which if realized would be the third highest production for grain on record for the United States. Based on conditions as of August 1, the yield is forecast at a record high 183.1 bushels per acre, up 5.8 bushels from last year's final estimate of 177.3 bushels. Total planted area, at 90.7 million acres, is down 1 percent from the previous estimate and down 4 percent from the previous year. Area harvested for grain is forecast at 82.7 million acres, down 1 percent from the previous forecast and down 4 percent from the previous year.

Soybean production for beans is forecast at a record high 4.59 billion bushels, up 10 percent from 2023. Based on conditions as of August 1, yields are expected to average a record high 53.2 bushels per acre, up 2.6 bushels from 2023. Area harvested for beans in the United States is forecast at 86.3 million acres, up 1 percent from the previous forecast and up 5 percent from 2023.

All cotton production is forecast at 15.1 million 480-pound bales, up 25 percent from 2023. Based on conditions as of August 1, yields are expected to average 840 pounds per harvested acre, down 59 pounds from 2023. Upland cotton production is forecast at 14.6 million 480-pound bales, up 24 percent from 2023. Pima cotton production is forecast at 553,000 bales, up 75 percent from 2023. All cotton area harvested is forecast at 8.63 million acres, up 34 percent from 2023. All cotton planted area totaled 11.2 million acres, down 4 percent from the previous forecast but up 9 percent from 2023.

All wheat production for grain is forecast at 1.98 billion bushels, down 1 percent from the previous forecast but up 9 percent from 2023. Based on August 1 conditions, yields are expected to average 52.2 bushels per harvested acre, up 0.4 bushel from the previous forecast and up 3.6 bushels from 2023. Area harvested for grain is forecast at 37.9 million acres, down 2 percent from the previous forecast but up 2 percent from 2023.

Winter wheat production is forecast at 1.36 billion bushels, up 1 percent from the July 1 forecast and up 9 percent from 2023. As of August 1, the United States yield is forecast at 53.2 bushels per acre, up 1.2 bushels from last month and up 2.6 bushels from last year's average yield of 50.6 bushels per acre. Area expected to be harvested for grain or seed totals 25.6 million acres, down 1 percent from the *Acreage* report released on June 28, 2024, but up 4 percent from 2023.

Hard Red Winter production, at 776 million bushels, is up 2 percent from last month. Soft Red Winter, at 342 million bushels, is down less than 1 percent from the July forecast. White Winter, at 243 million bushels, is up 4 percent from last month. Of the White Winter production, 19.3 million bushels are Hard White and 224 million bushels are Soft White.

Durum wheat production is forecast at 76.9 million bushels, down 14 percent from the previous forecast but up 30 percent from 2023. Based on August 1 conditions, yields are expected to average 38.1 bushels per harvested acre, down 4.6 bushels from the previous forecast but up 1.1 bushels from 2023. Area expected to be harvested for grain or seed totals 2.02 million acres, down 4 percent from the *Acreage* report but up 26 percent from 2023.

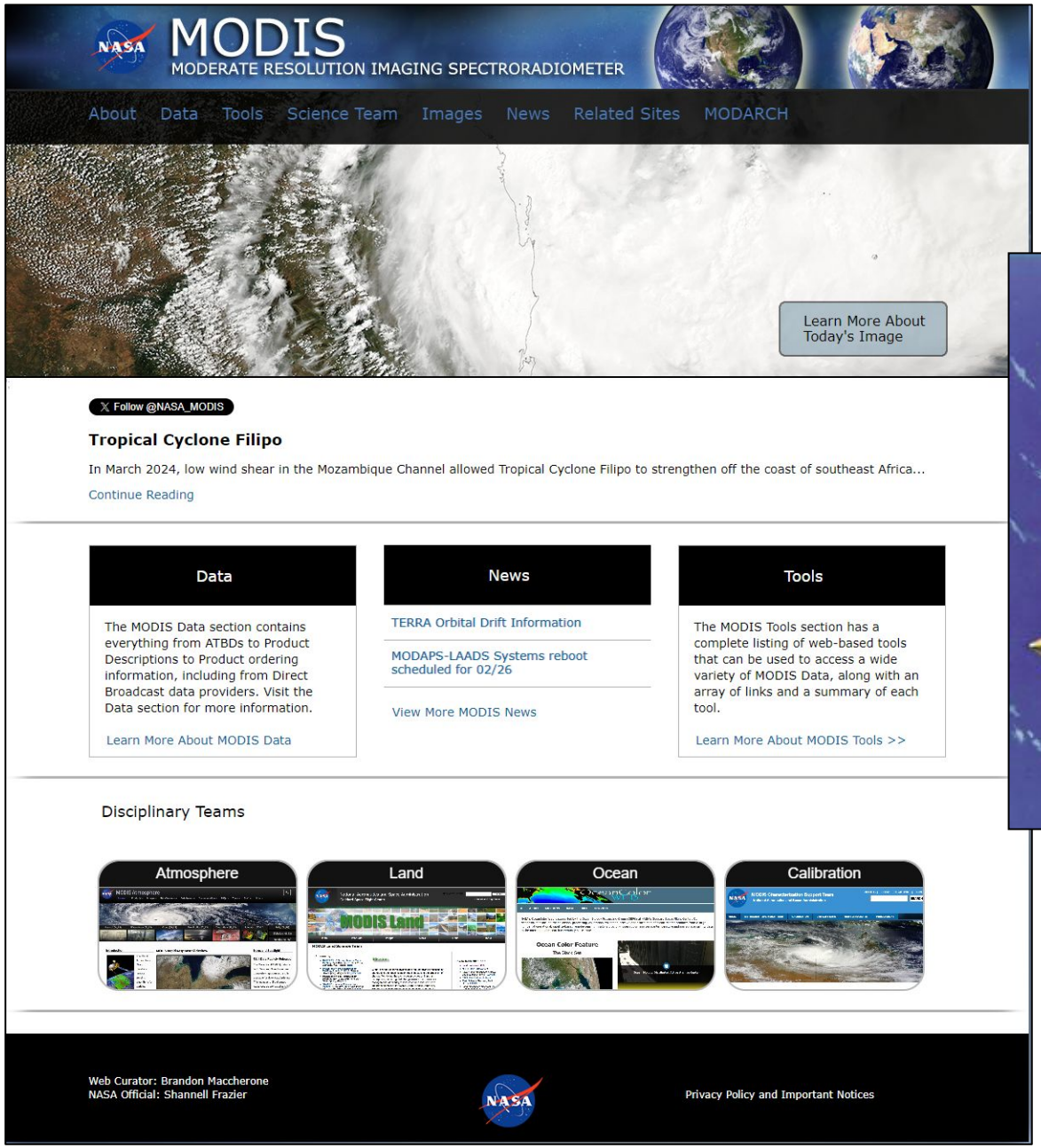
Other spring wheat production for grain is forecast at 544 million bushels, down 6 percent from the previous forecast but up 8 percent from last year. Based on August 1 conditions, yields are expected to average 52.6 bushels per harvested acre, down 0.5 bushel from the previous forecast but up 6.6 bushels from 2023. If realized, the United States yield would be a record high. Area harvested for grain or seed is expected to total 10.3 million acres, down 5 percent from the *Acreage* report released on June 28, 2024, and down 6 percent from 2023. Of the total production, 499 million bushels are Hard Red Spring wheat, up 7 percent from 2023.

This report was approved on August 12, 2024.

Secretary of Agriculture
Designate
Jason Hafemeister

Agricultural Statistics Board
Chairperson
Lance Honig

Moderate Resolution Imaging Spectroradiometer



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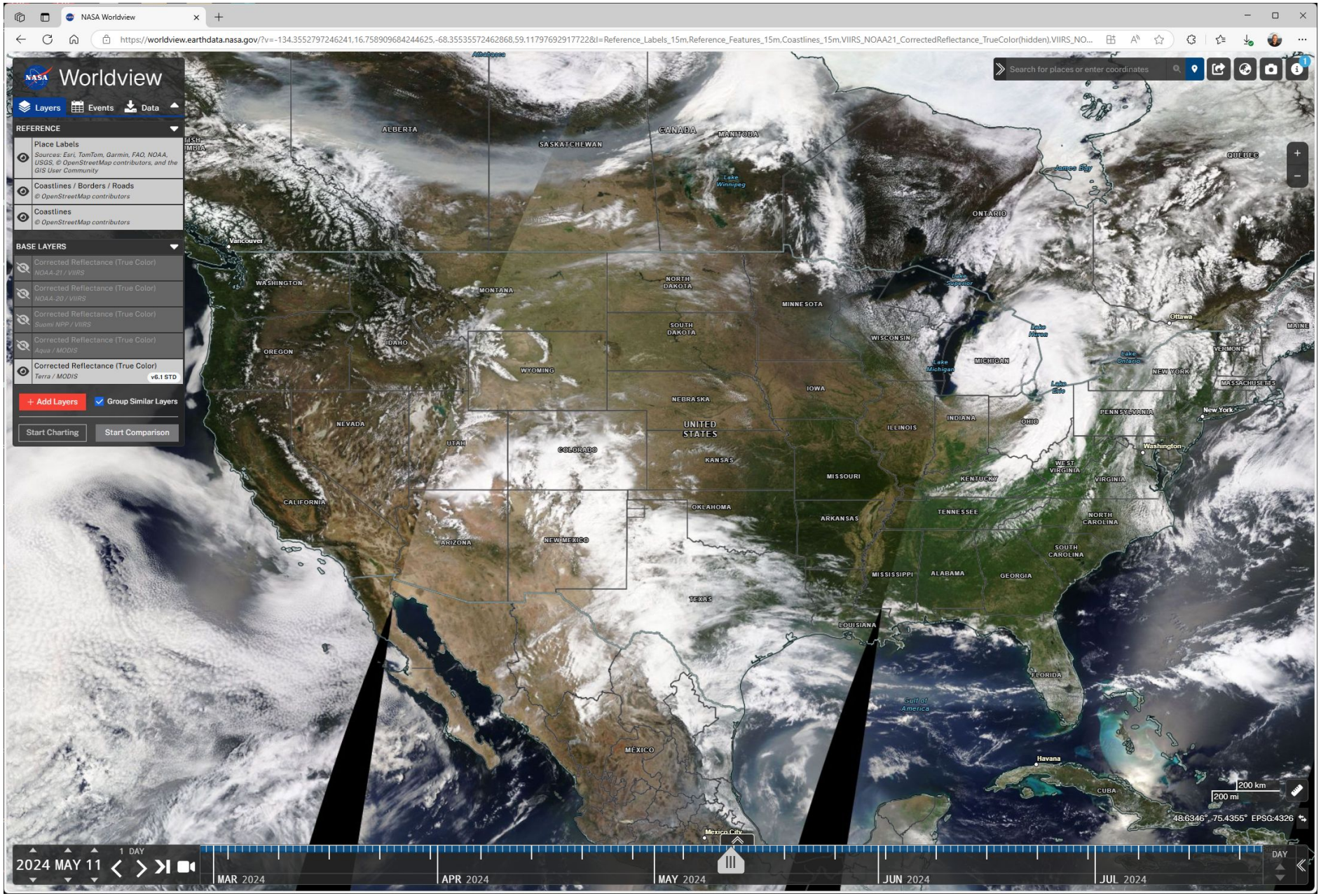
Daily observations from Terra MODIS



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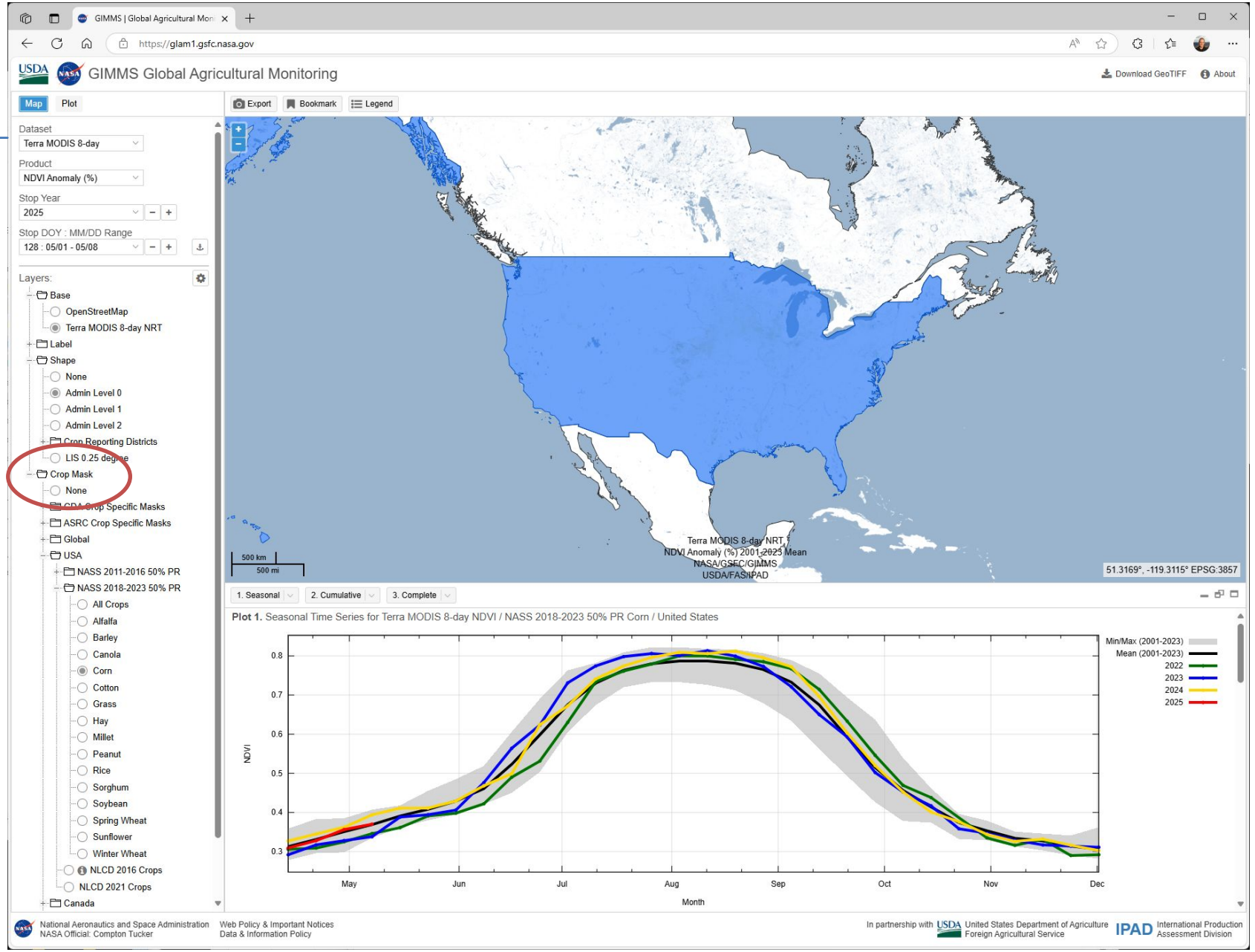
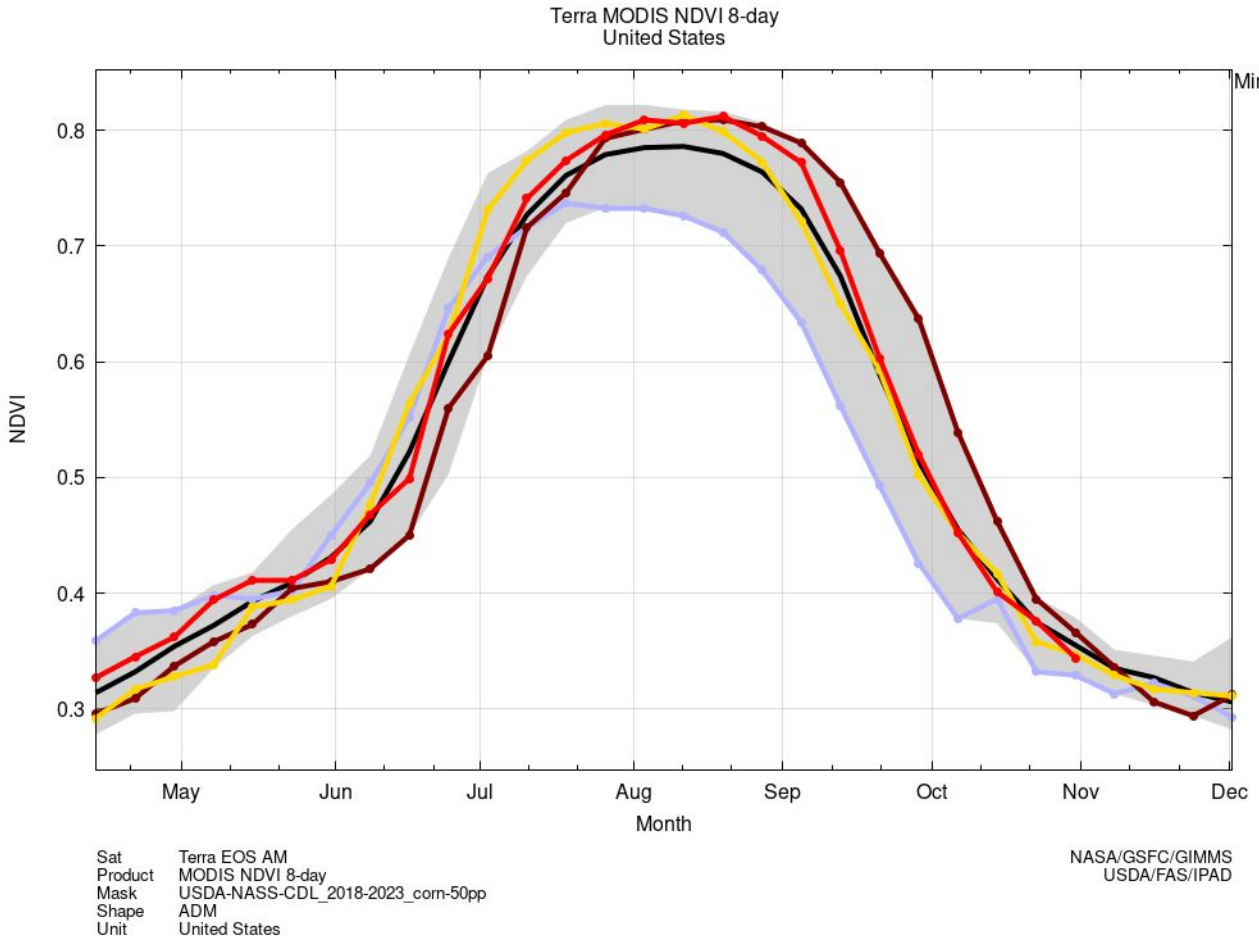
GIMMS Global Agricultural Monitoring (GLAM)

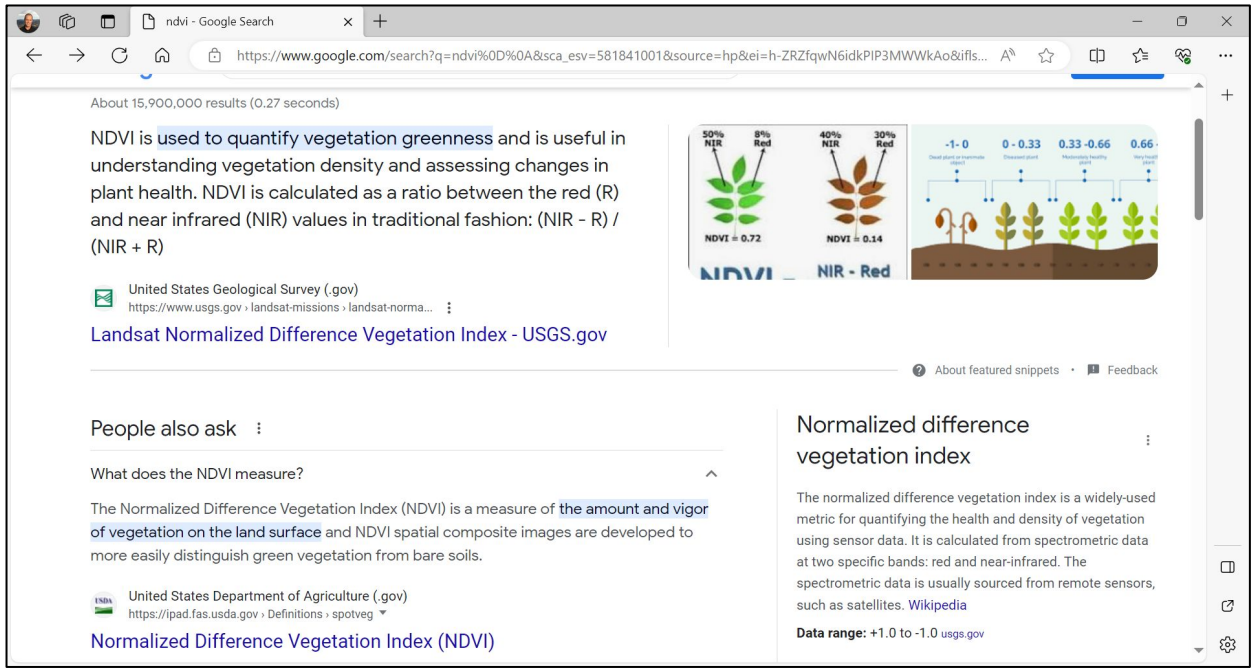
Terra MODIS 8-day 250-meter
Aqua MODIS 8-day 250-meter
NPP VIIRS 8-day 500-meter
NOAA-20 VIIRS 8-day 500-meter
Sentinel-3 OLCI 10-day 300-meter

glam1.gsfc.nasa.gov

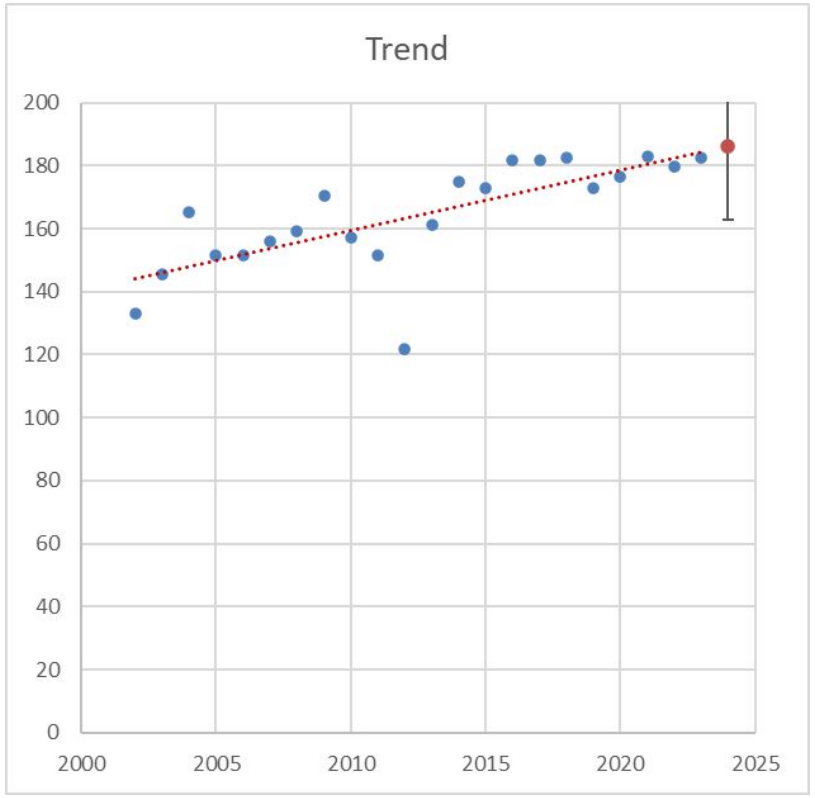


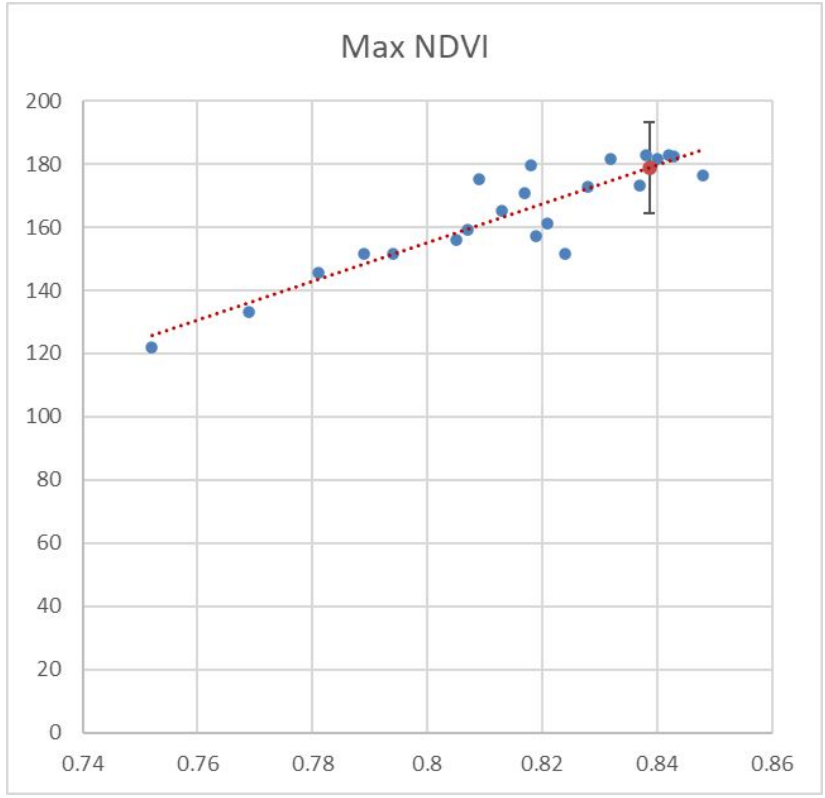
Normalized Difference Vegetation Index (NDVI)

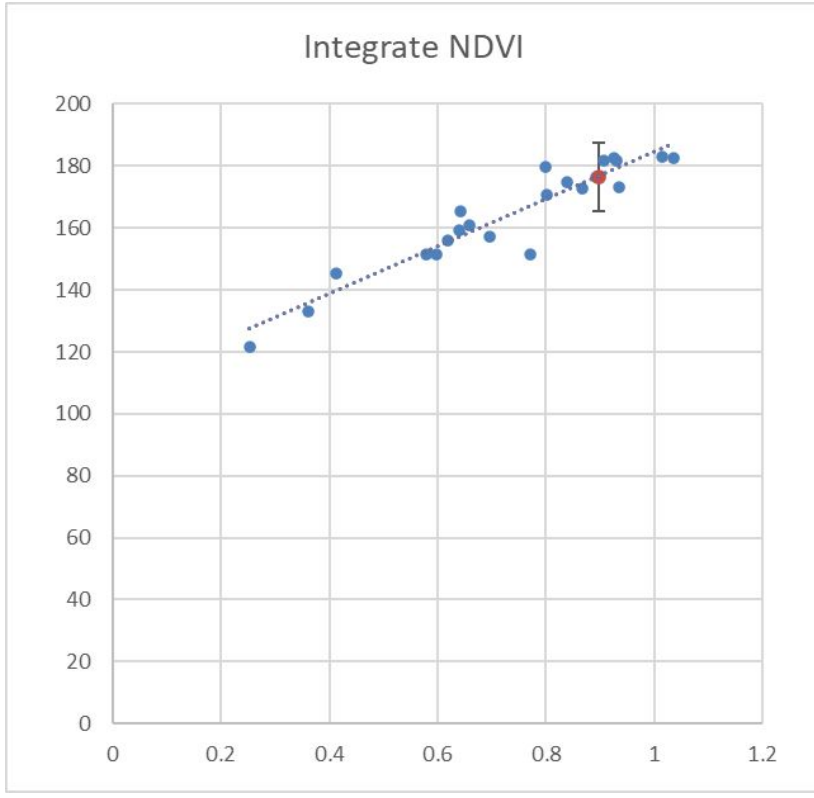




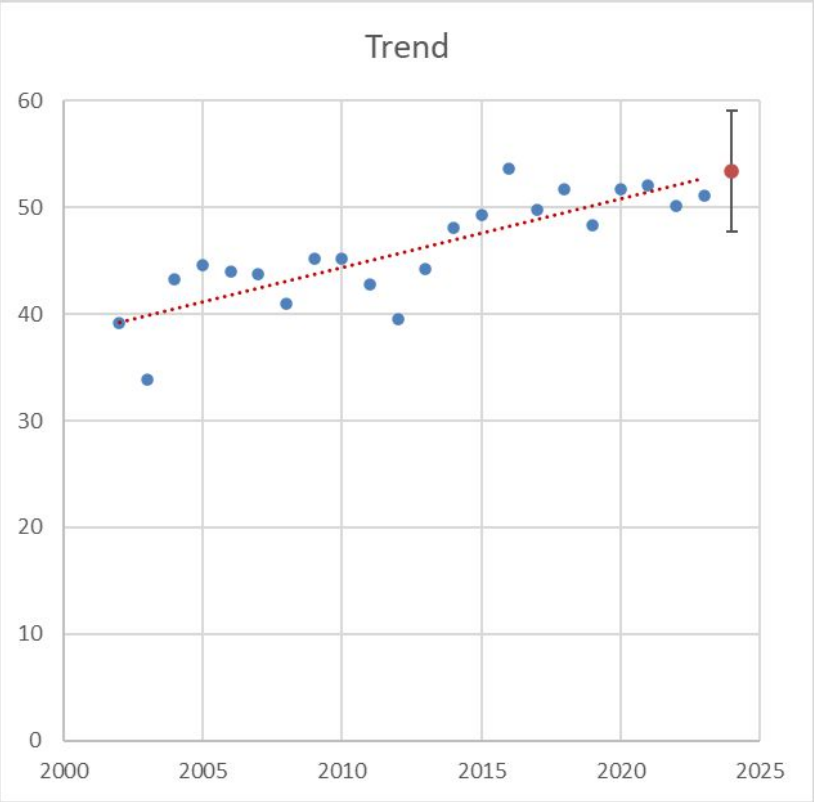
Corn yield models basics (Corn Belt)

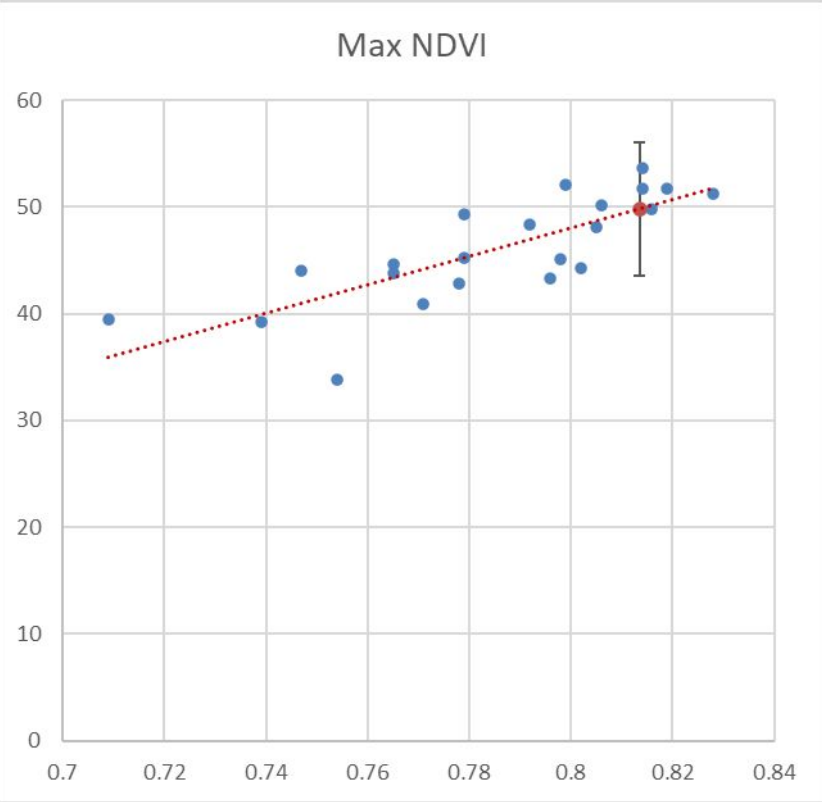


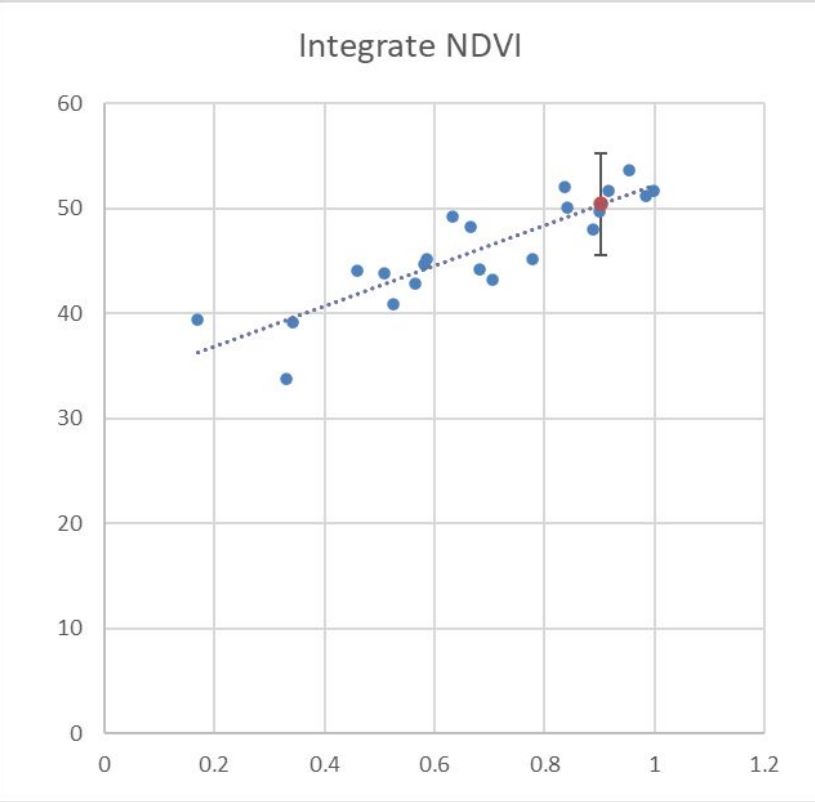




Soybean yield model basics (Corn Belt)







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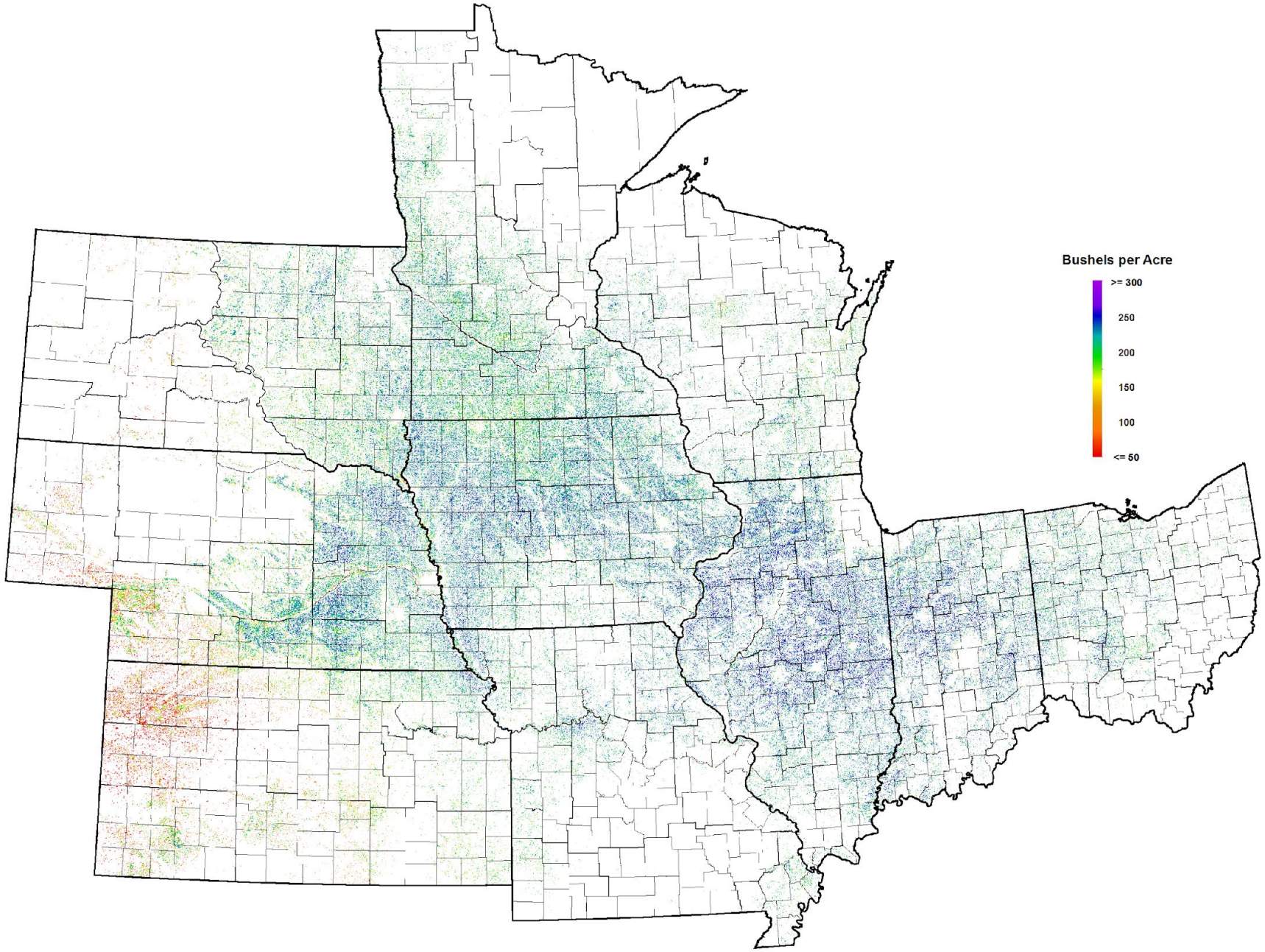
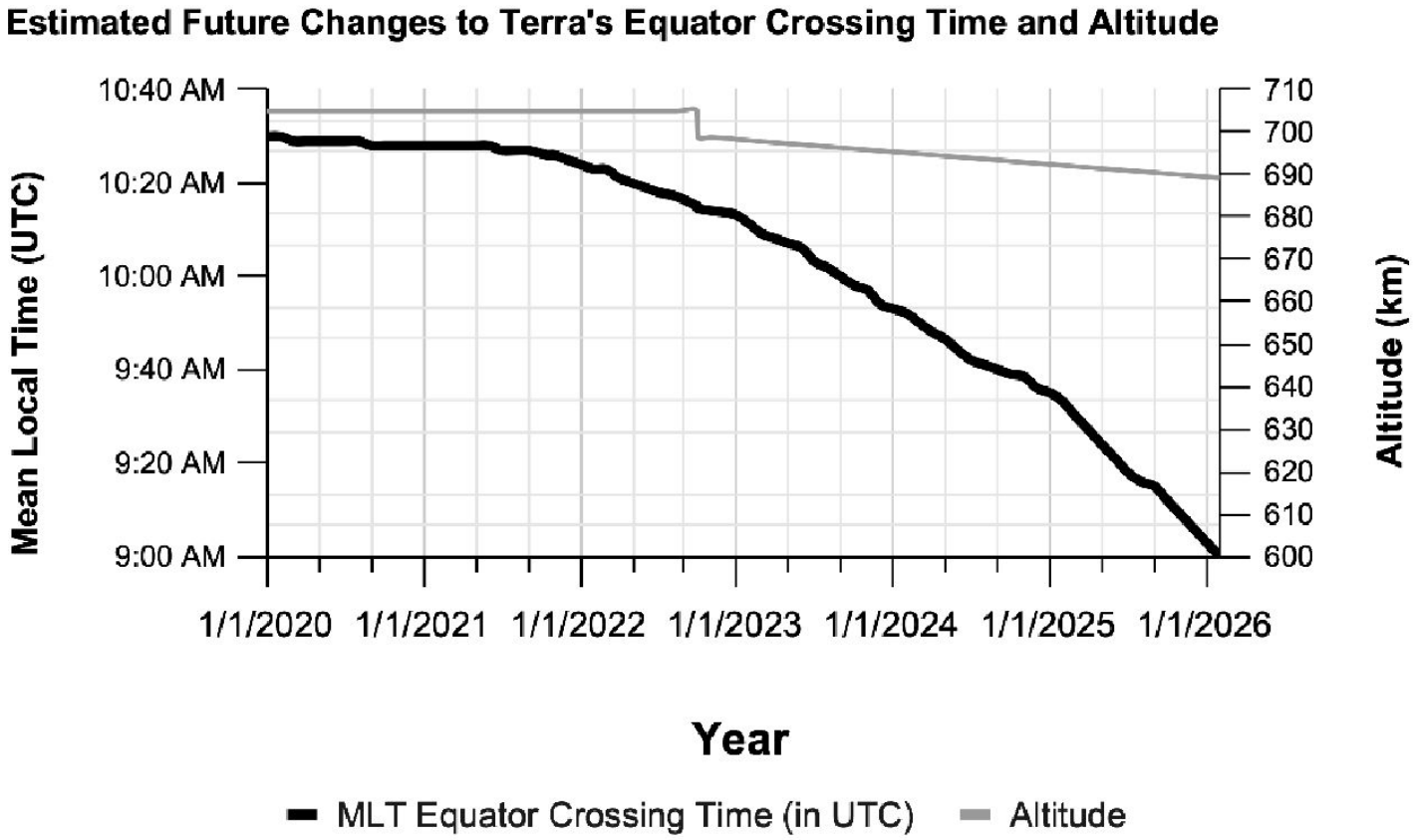
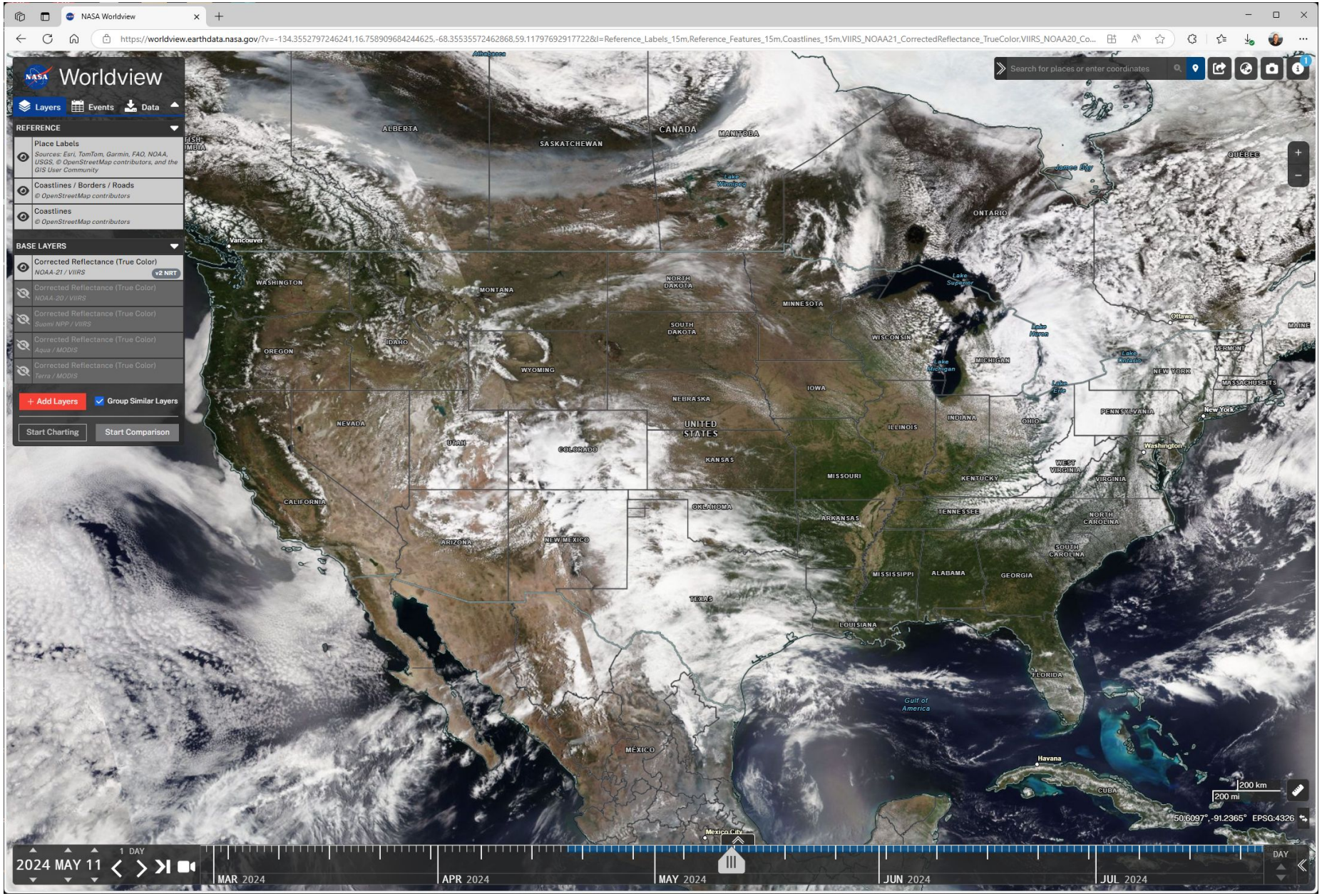
MODIS-based 2024 corn yield map



Terra orbital drift impacts on overpass timing

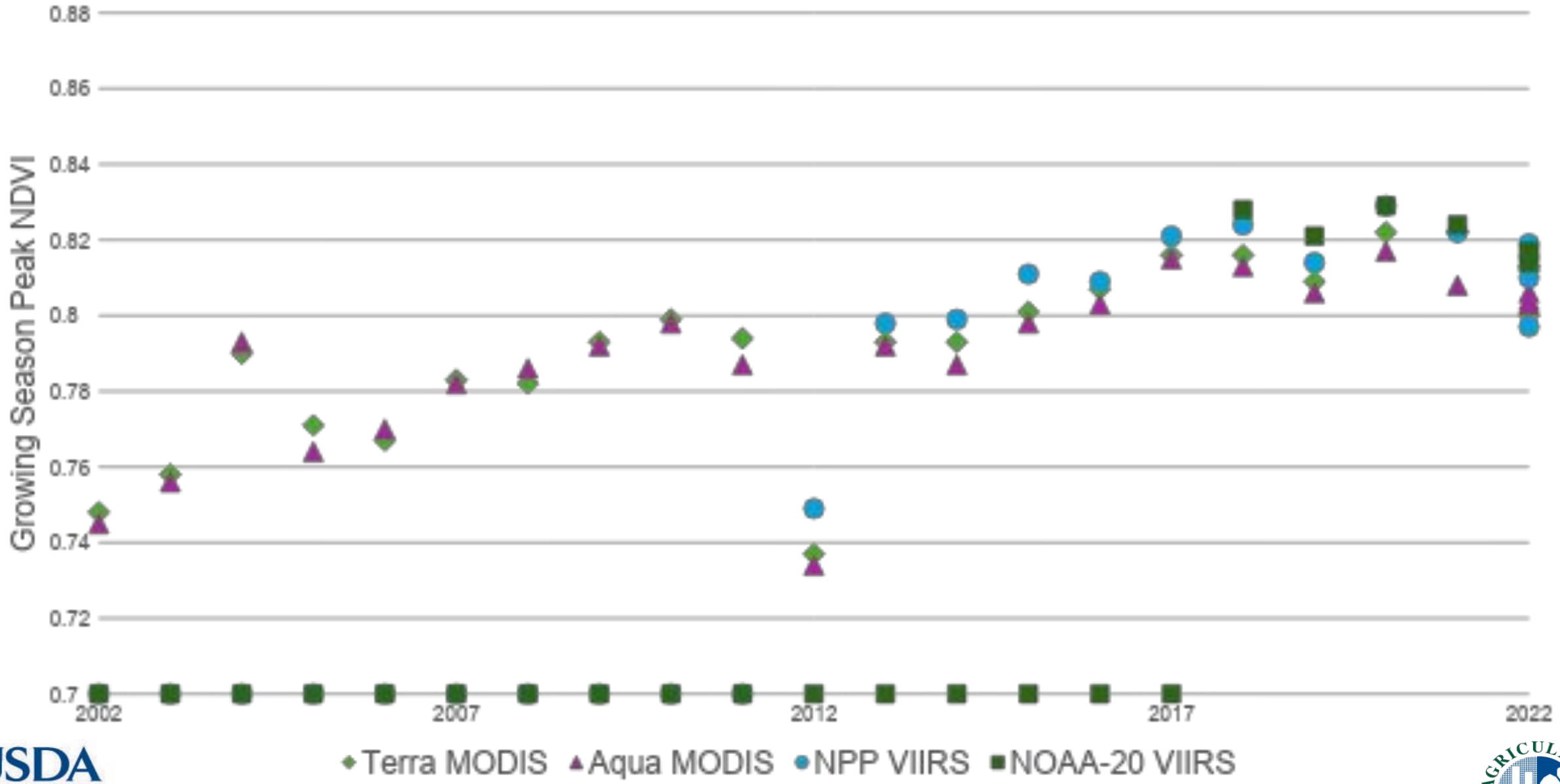


Daily observations from NOAA-21 VIIRS



worldview.earthdata.nasa.gov

Seasonal peak NDVI of MODIS vs VIIRS (over US Corn Belt)



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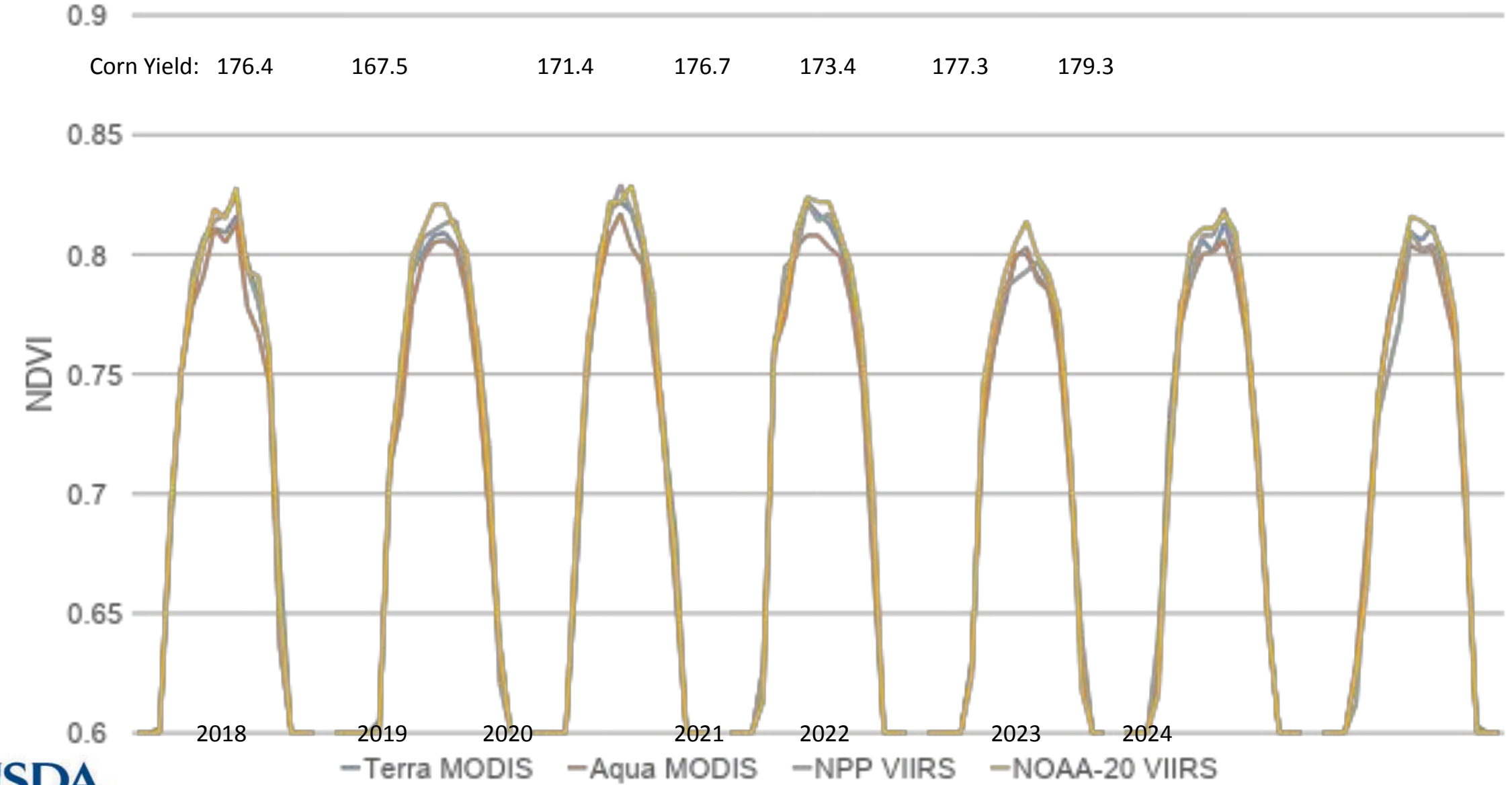
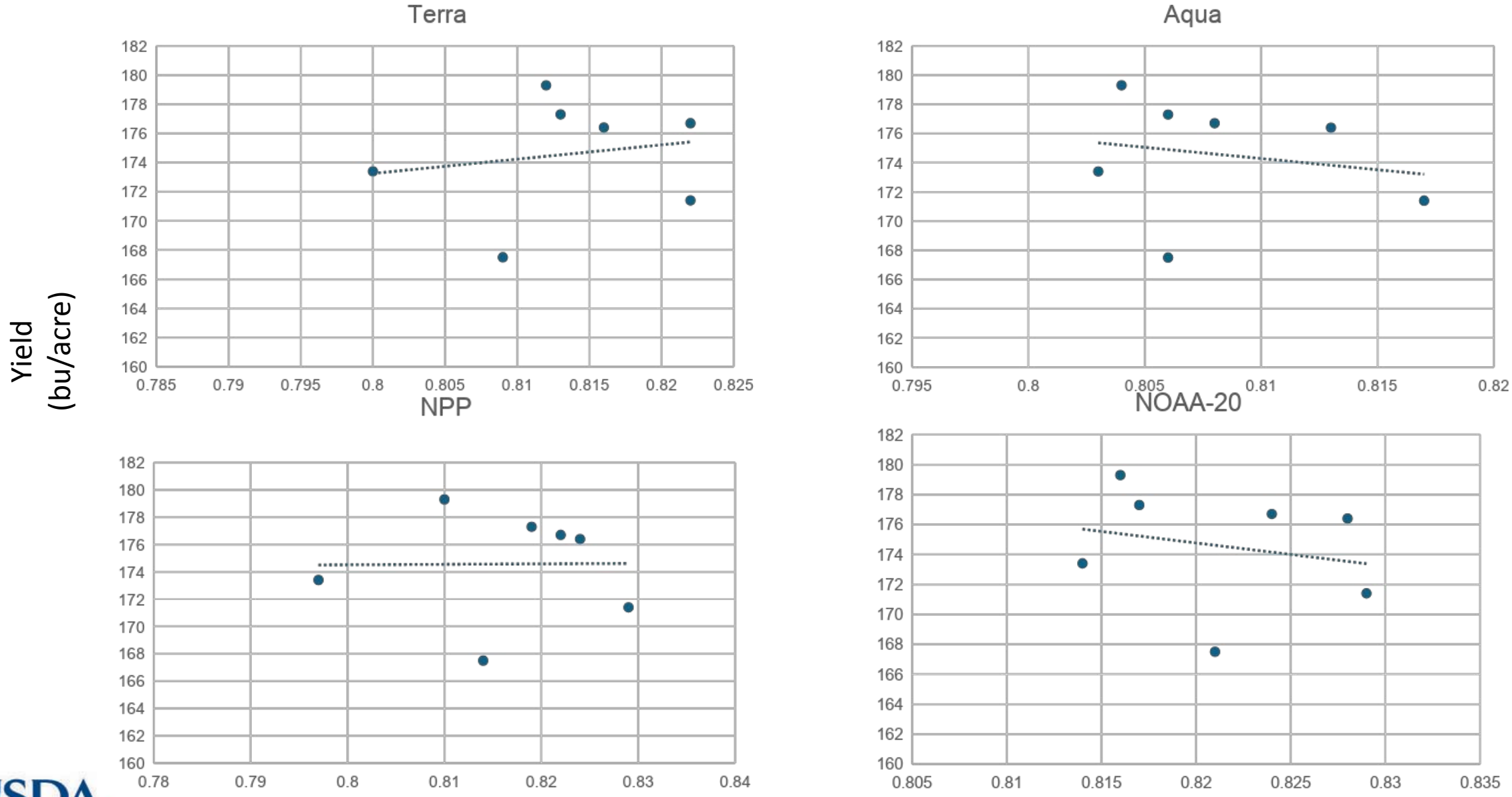
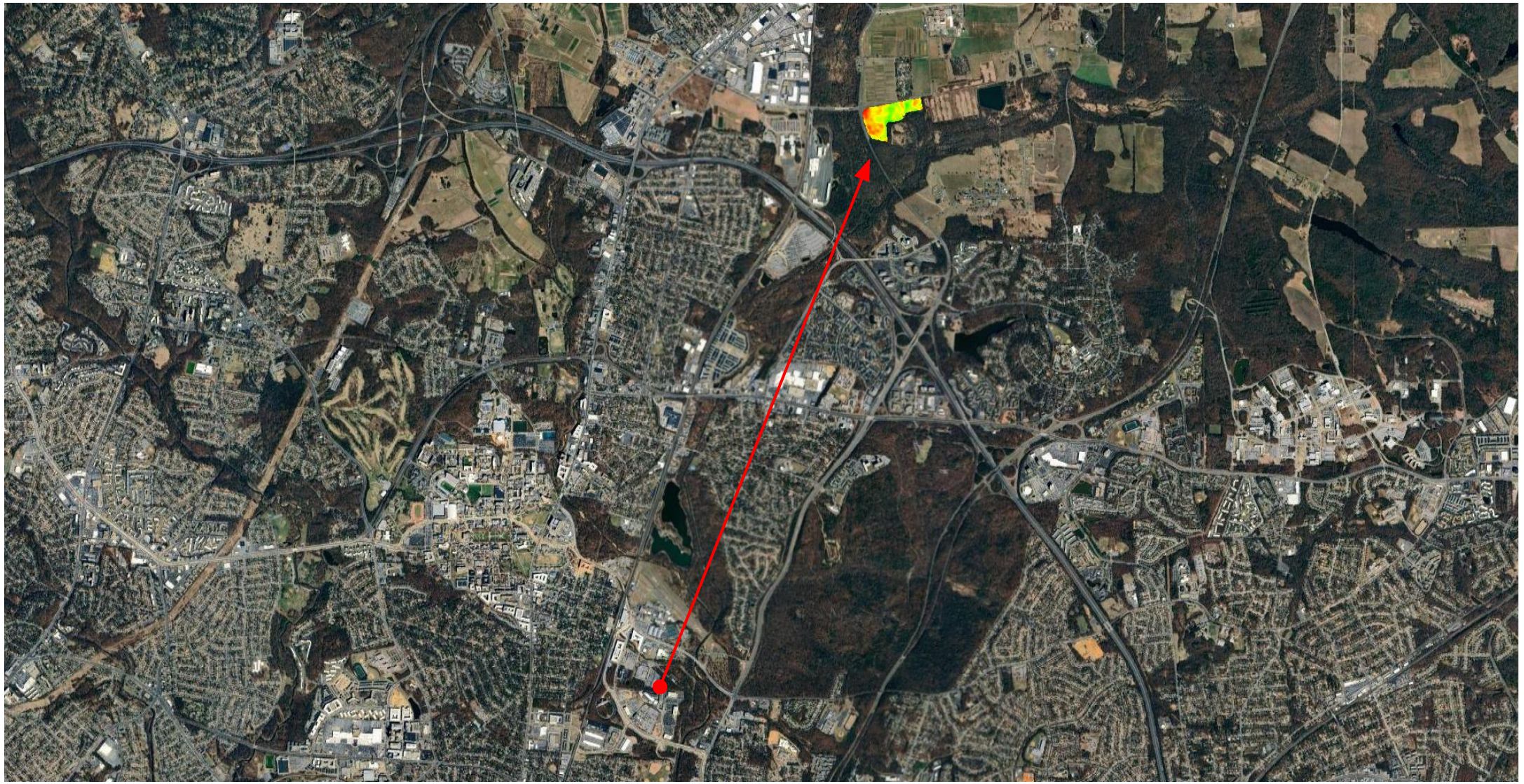
8-day NDVI time series comparison (over Corn Belt)



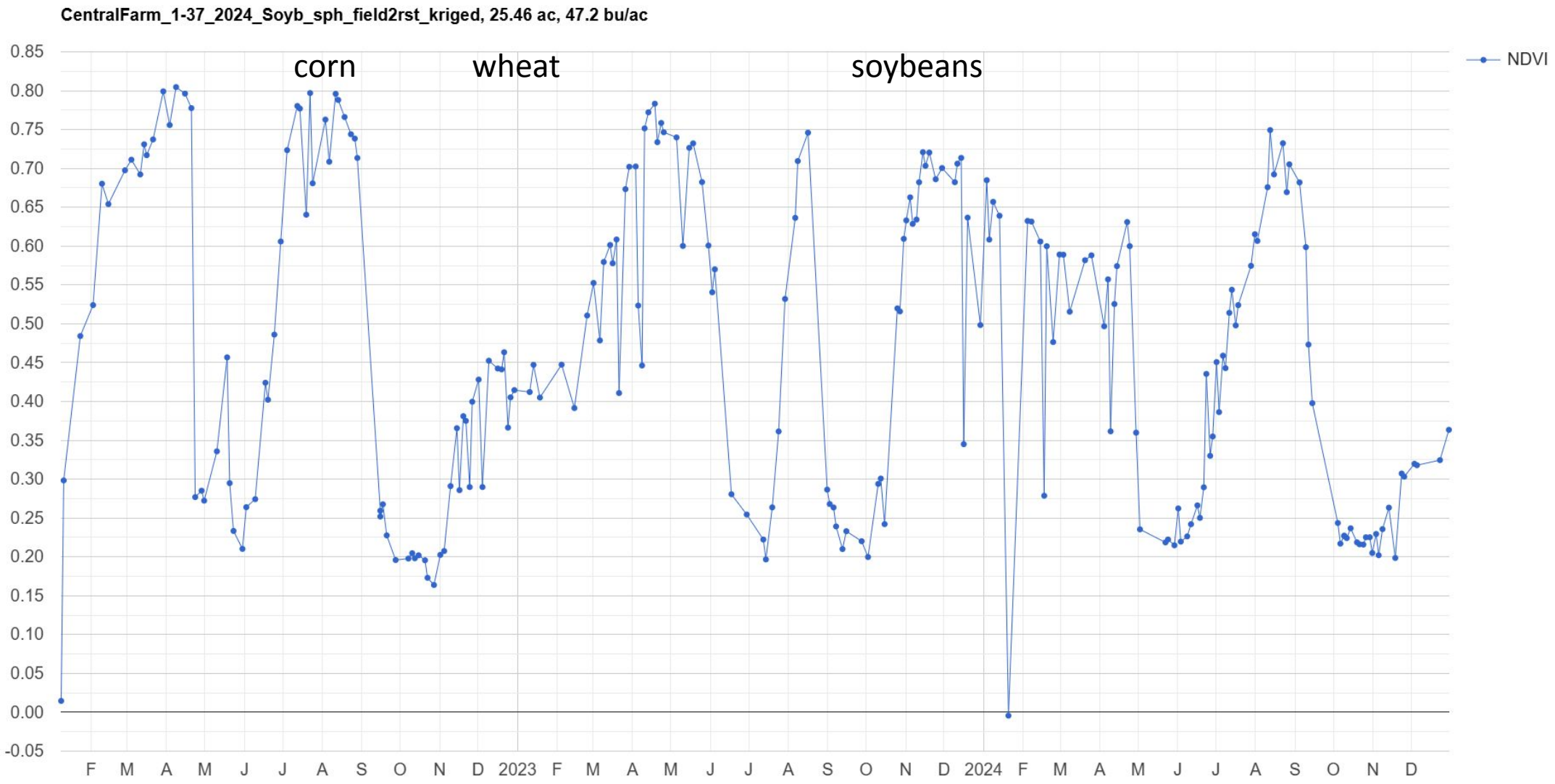
2018 - 2024 NDVI vs Corn Yield by sensor



USDA Beltsville Agricultural Research Center (BARC) - Field #37

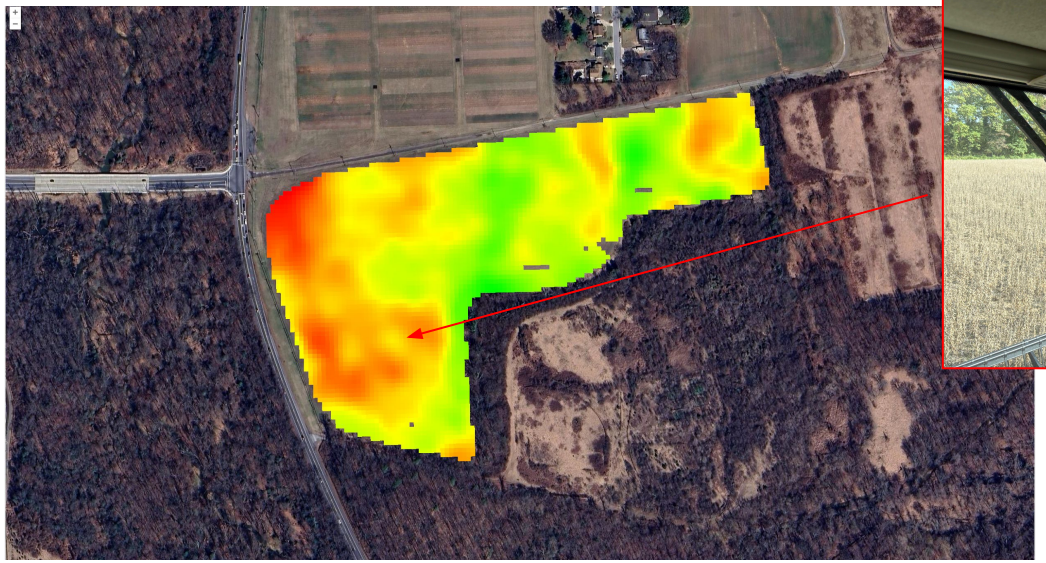


Sentinel-2 10m 3-year NDVI time series over Field #37

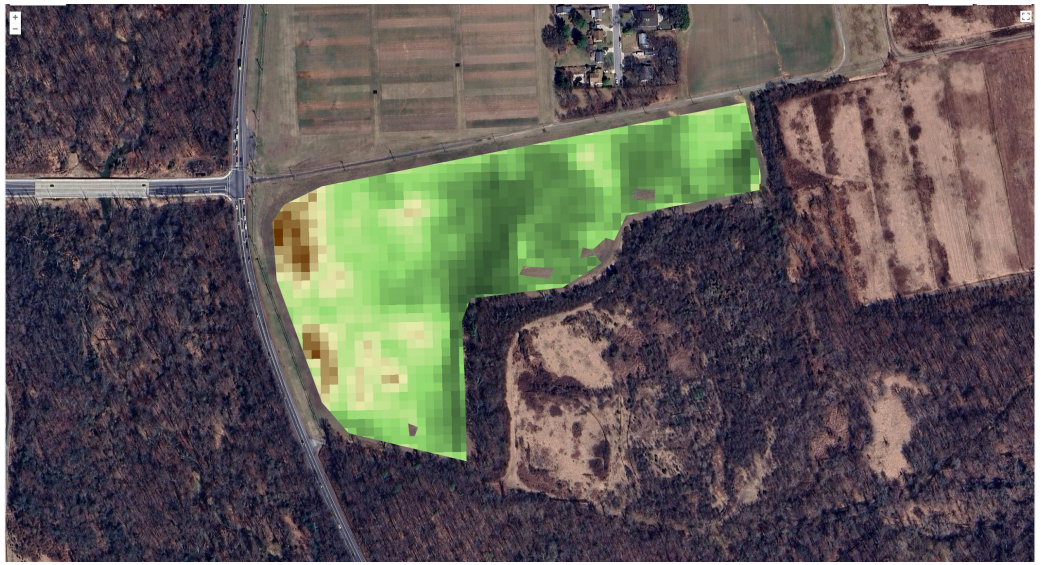


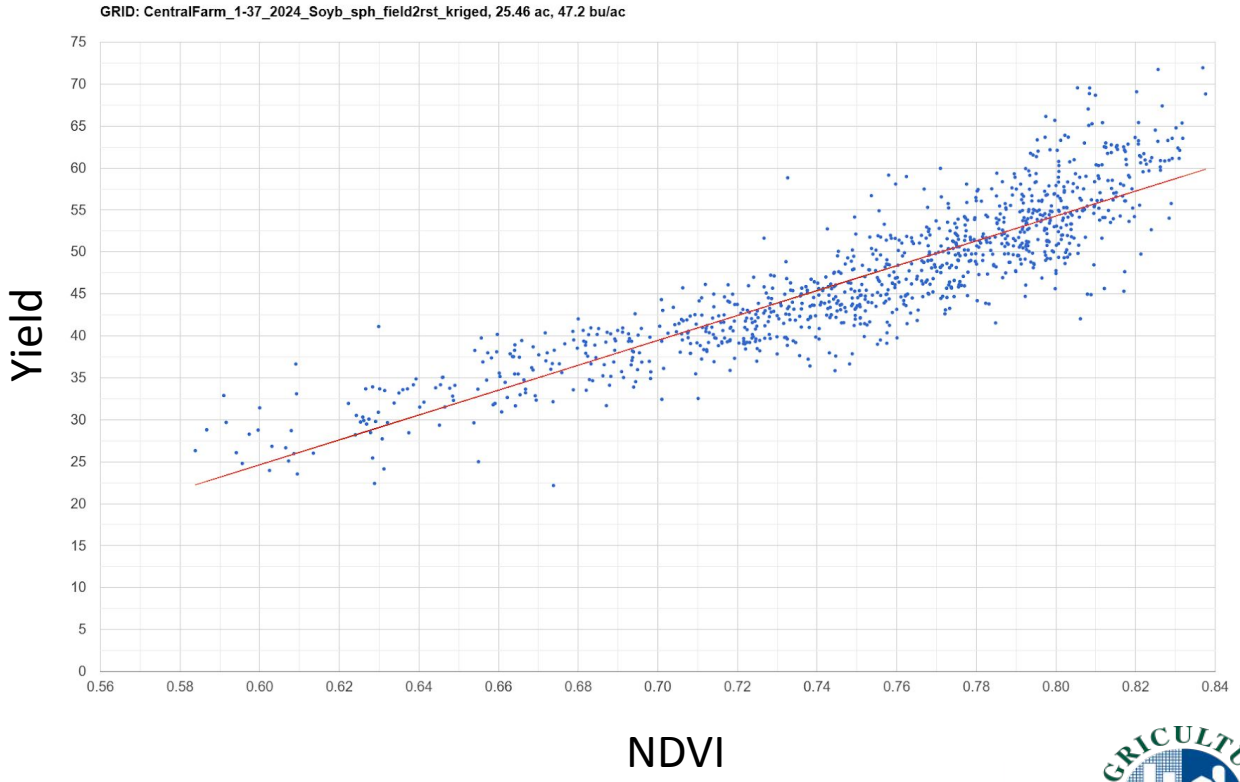
BARC soybean field #37, 2024

Yield



NDVI

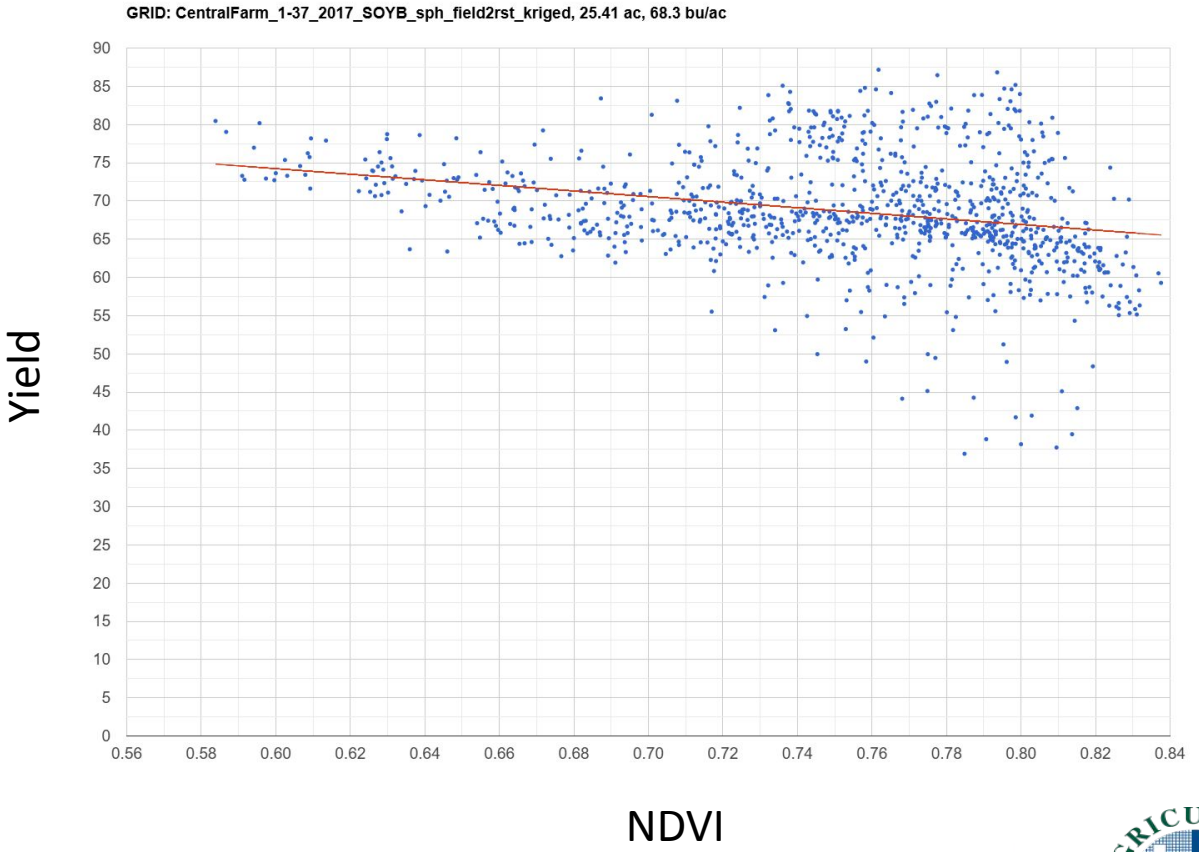




BARC soybean field #37, 2017

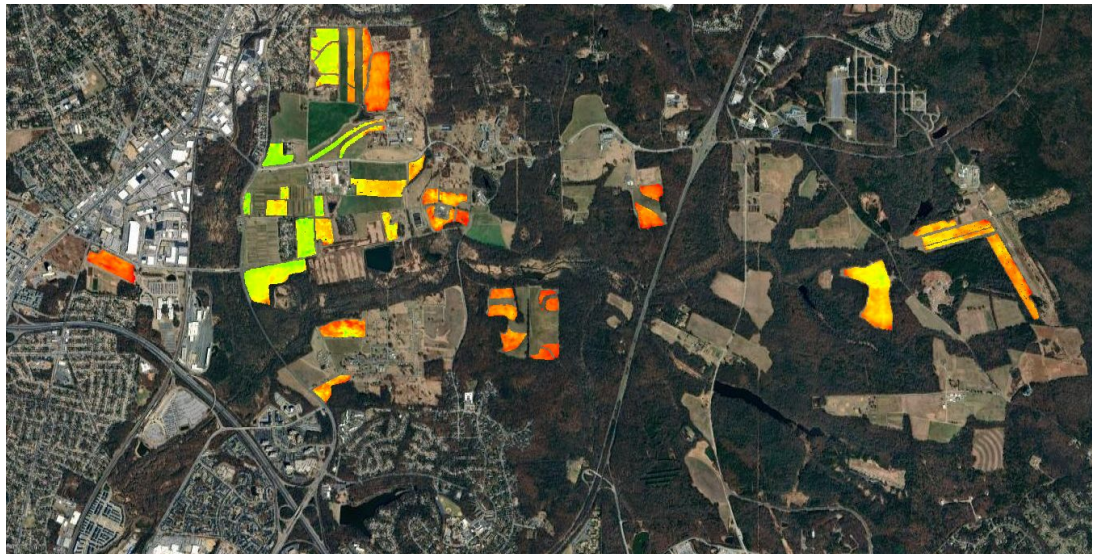
Yield

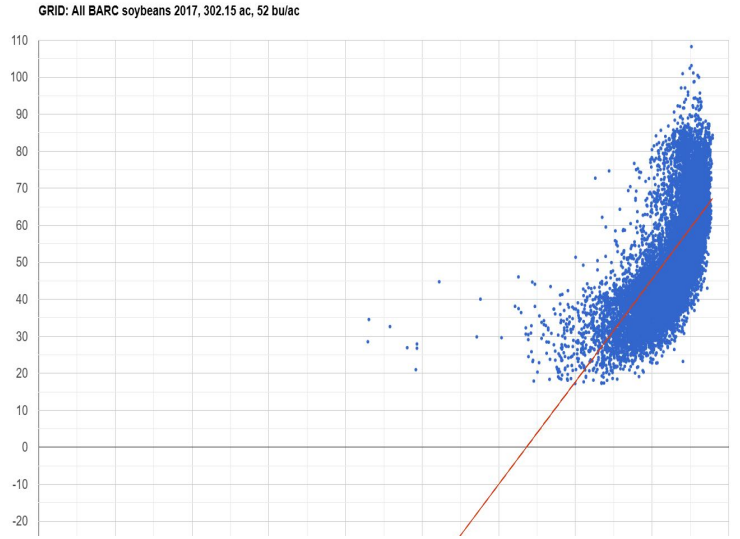
NDVI



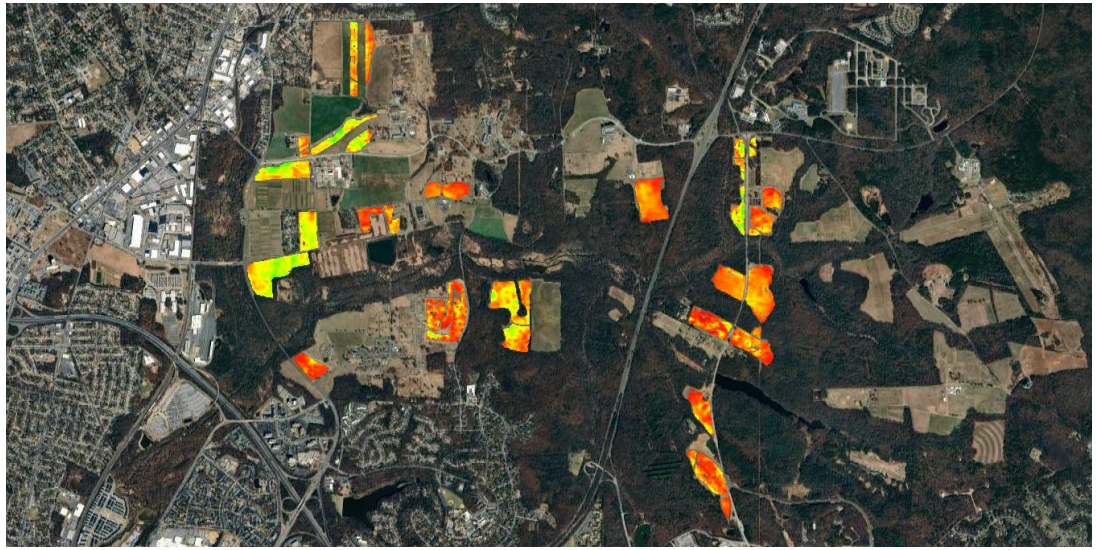
All BARC Soybeans fields combined

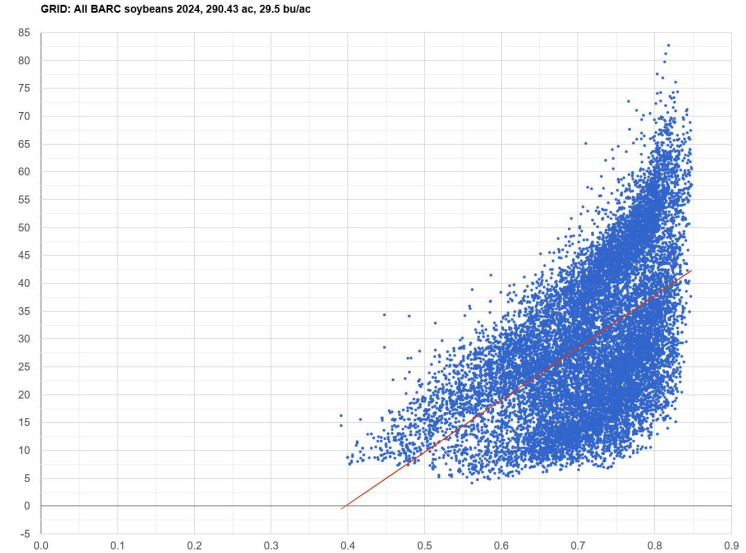
2017





2024





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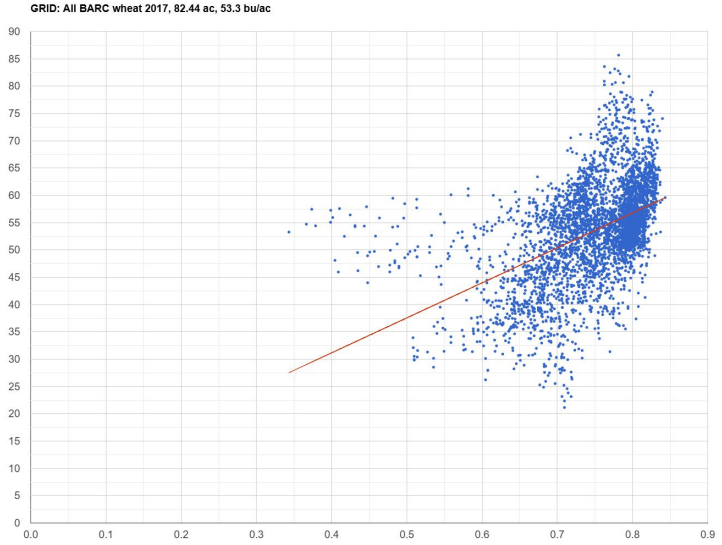
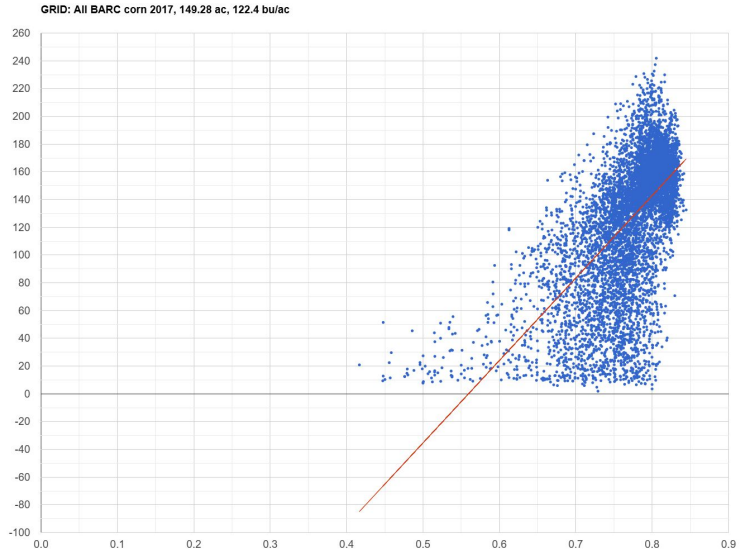
All BARC Wheat and Corn

wheat

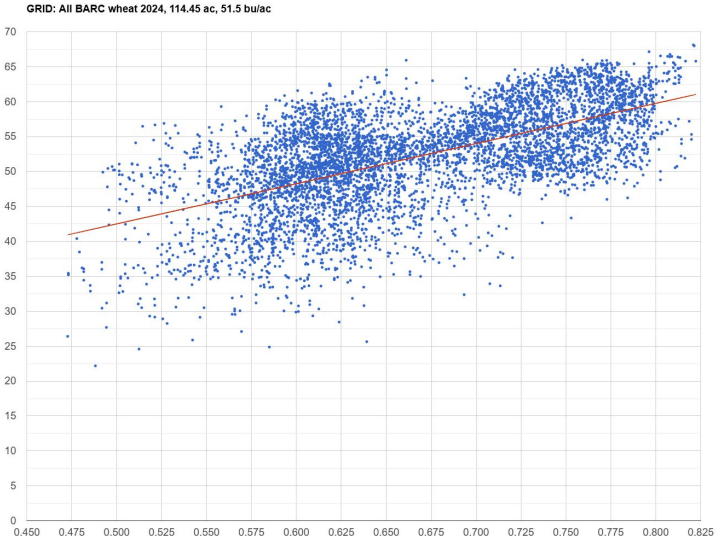
corn

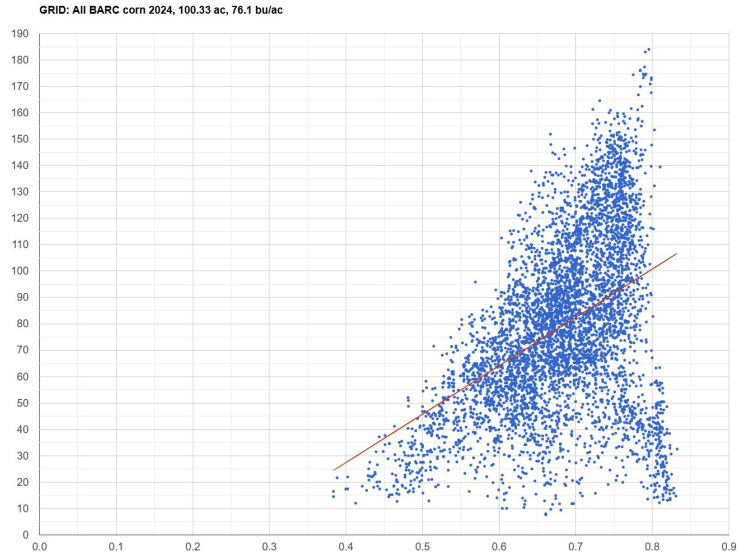
2017





2024



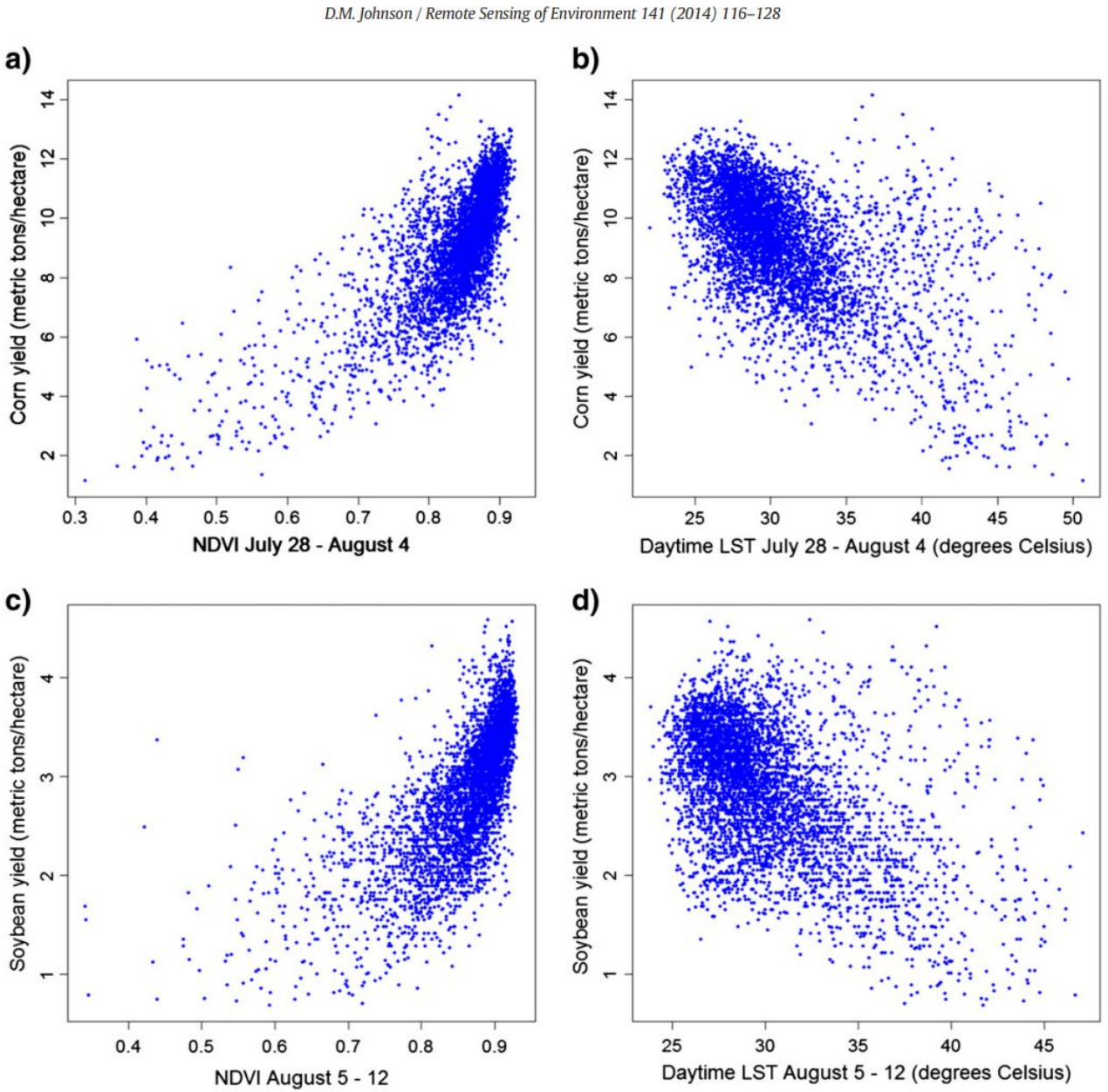


Peak NDVI

Peak NDVI

Is any of this new?

Normalized Difference Vegetation Index



Land Surface Temperature!!!

Yielding on Yield?

Terra and Aqua MODIS truly at end of life and drifting out of proper orbit

- but MODIS-like imagery is already available via VIIRS

Contemporary NDVI-based crop yield models are struggling

- must look beyond the red and near-infrared reflectance channels
- need to reinvigorate research leveraging thermal data

VIIRS offers opportunities

- thermal bands at 750m instead of MODIS's 1km
- complete daily global coverage

GEO-XO will offer additional opportunities

- products must be
  - generated consistently
  - ready-to-use and easy-to-use
  - available with low latency

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