NOAA
National Environmental Satellite, Data, and Information Service

NOAA's Satellite Applications Symposium Series: Land and Agriculture Improving Terrestrial Land Monitoring Capabilities Through New Satellite Technology
Tuesday May 20, 2025, 900 AM - 340 PM EDT

LEO Update: Low Earth Orbit Observations for Agriculture and Drought Monitoring

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Outline

- Background- Remote sensing in Agriculture
  - Types of applications
- Meteorological Drought
- Examples of sources of LEO time series of vegetation indices for drought monitoring

Remote Sensing in Agriculture

- Remote sensing of agriculture is one of the oldest applications dating back to 1970's:
  - Acreage estimates
  - Crop type identification
  - Crop yield estimation
  - Crop condition estimation: abiotic and biotic stress due to droughts, heat, nutrition, pests, disease, pollution etc.
  - Soil type, moisture, composition
  - Phenology
  - Inundation due to floods, drainage
  - Agriculture meteorology (Photosynthetically active radiation, surface temperature, humidity etc.)
  - Precision agriculture
- Over 50 years of global LEO satellite observations for agriculture from NOAA, NASA, USGS, other international agencies, commercial.

SNPP, NOAA20, NOAA21

Launched into Low Earth Orbit—512 miles (824 kilometers)

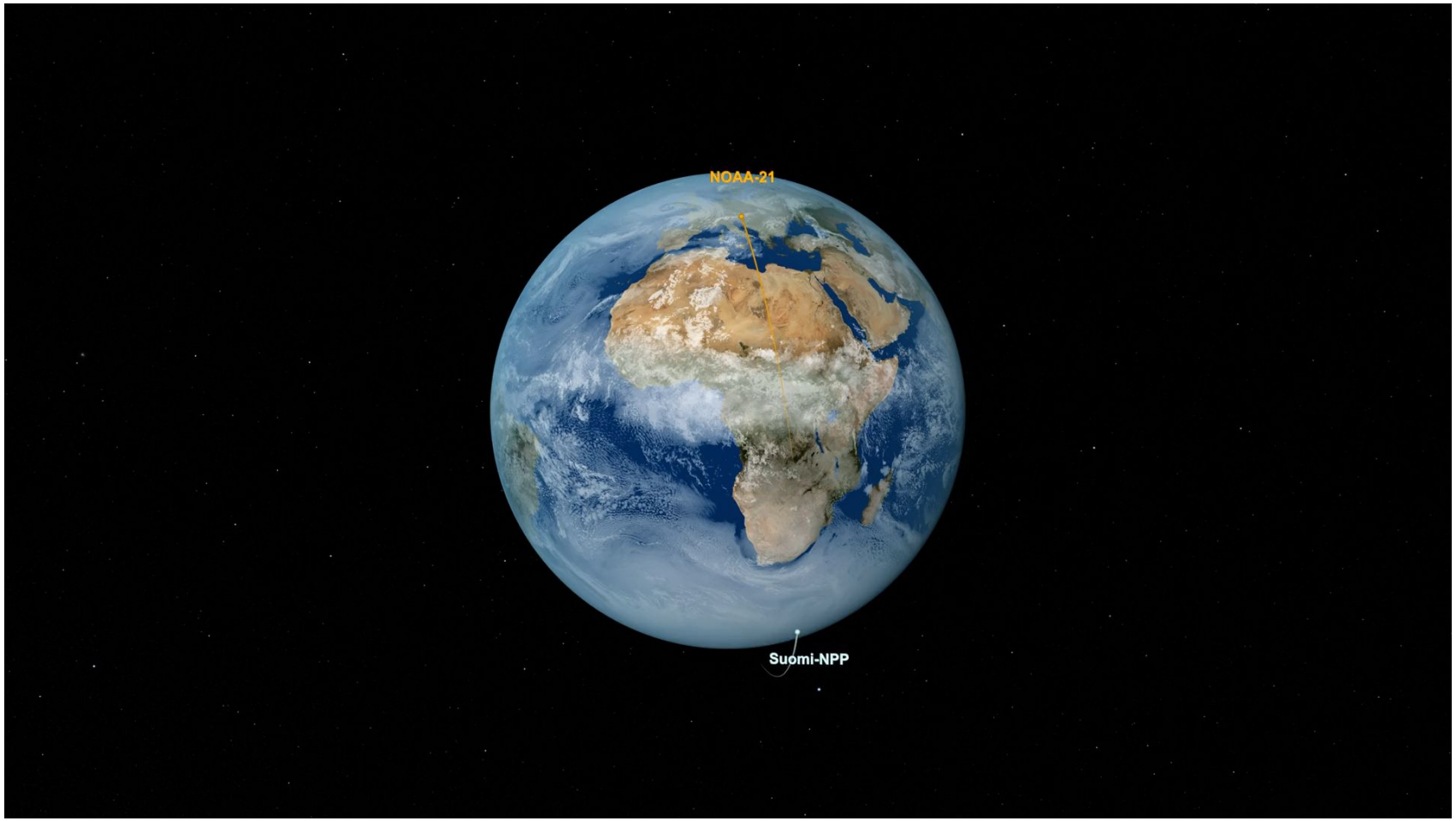
14x Orbits Earth 14 times pole-to-pole with SNPP

2x Images entire globe twice a day

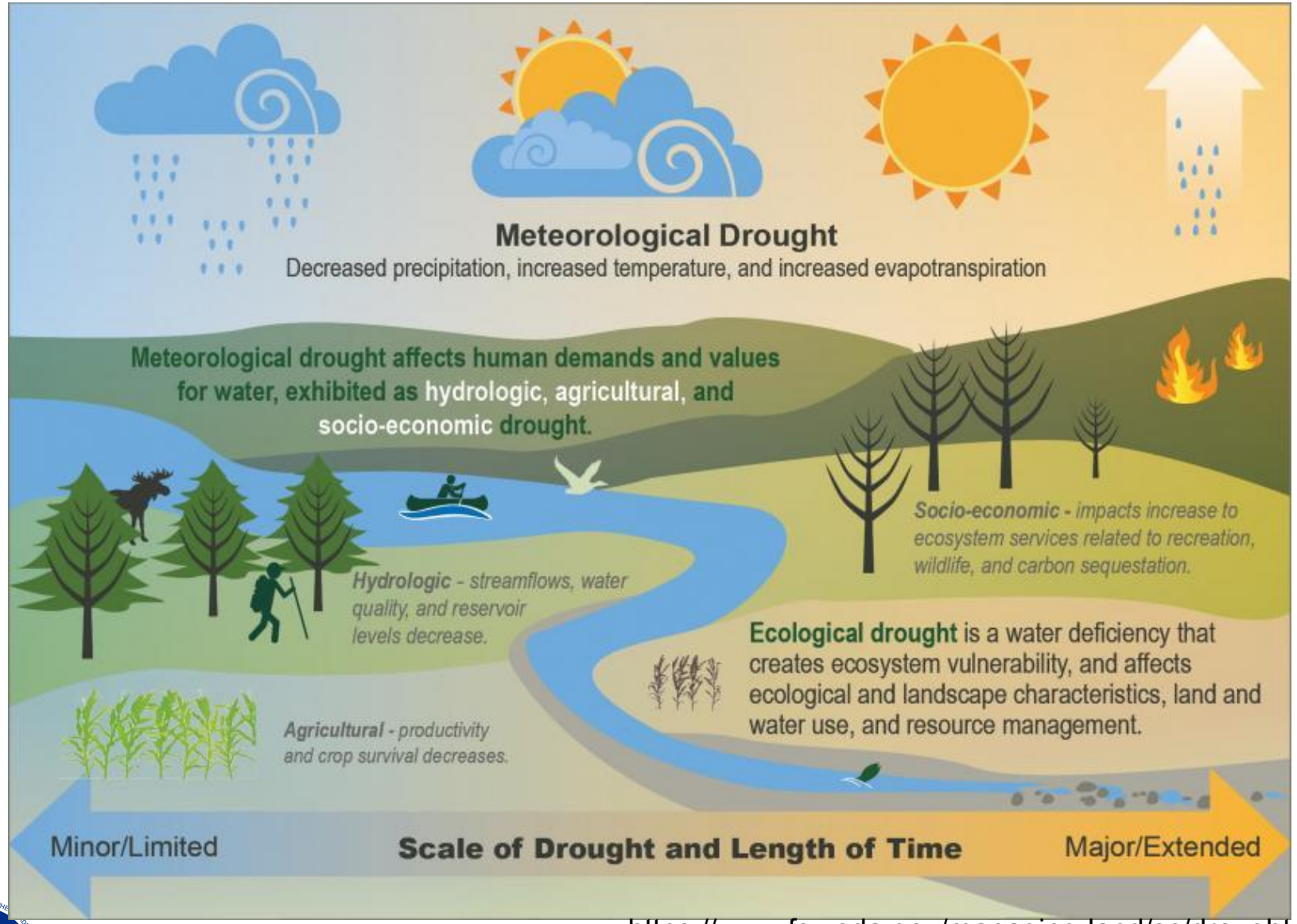
State of the art instrumentation to collect data on Earth's atmosphere, lands, and oceans

Sends more than 2,000 gigabytes of data to Earth every day

NOAA-21 flies ~50 minutes/half an orbit, ahead of NOAA-20. Suomi NPP orbits between the two, about 25 minutes away from each.



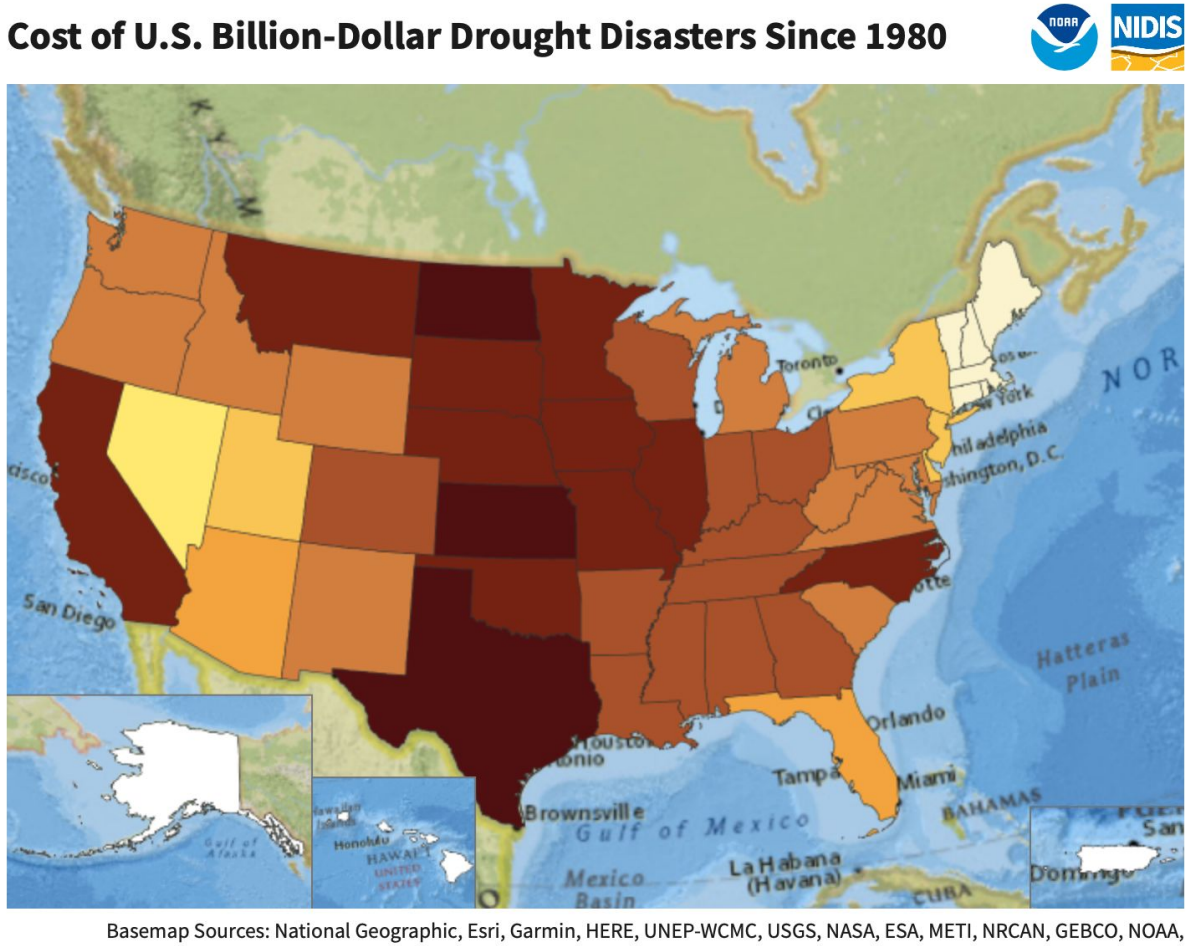
Types of Drought

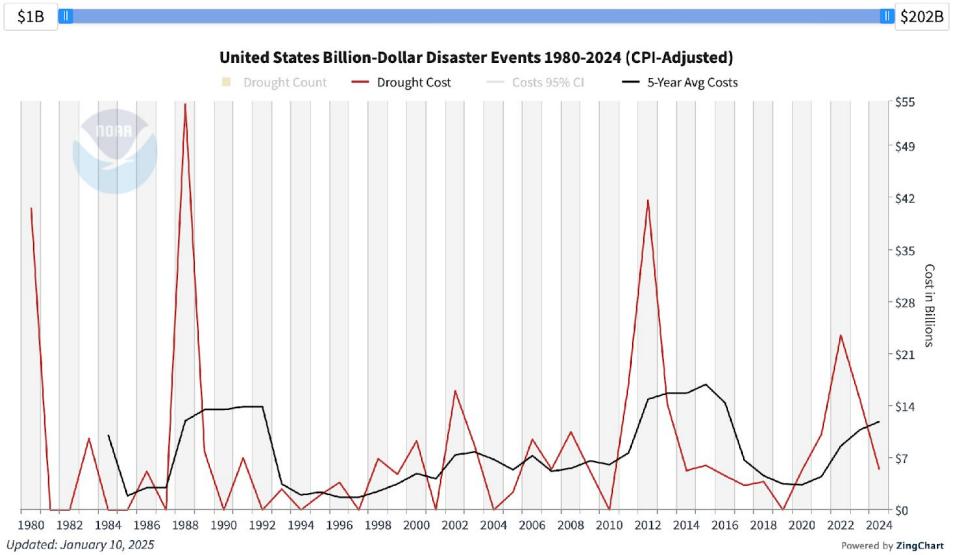


https://www.fs.usda.gov/managing-land/sc/drought

- **Hydrological drought:** Reduced water in streams, lakes, and reservoirs.
- **Agricultural drought:** Reduced crop survival and productivity.
- **Socio-economic drought:** Reduced supply of economic goods (such as food and timber), such that these are unable to meet demands.
- **Ecological drought:** Ecosystem effects of drought, which can increase ecosystem vulnerability to other disturbances, and can affect a variety of plants and animals in forests and rangelands.

Economic Impacts of Droughts in the US





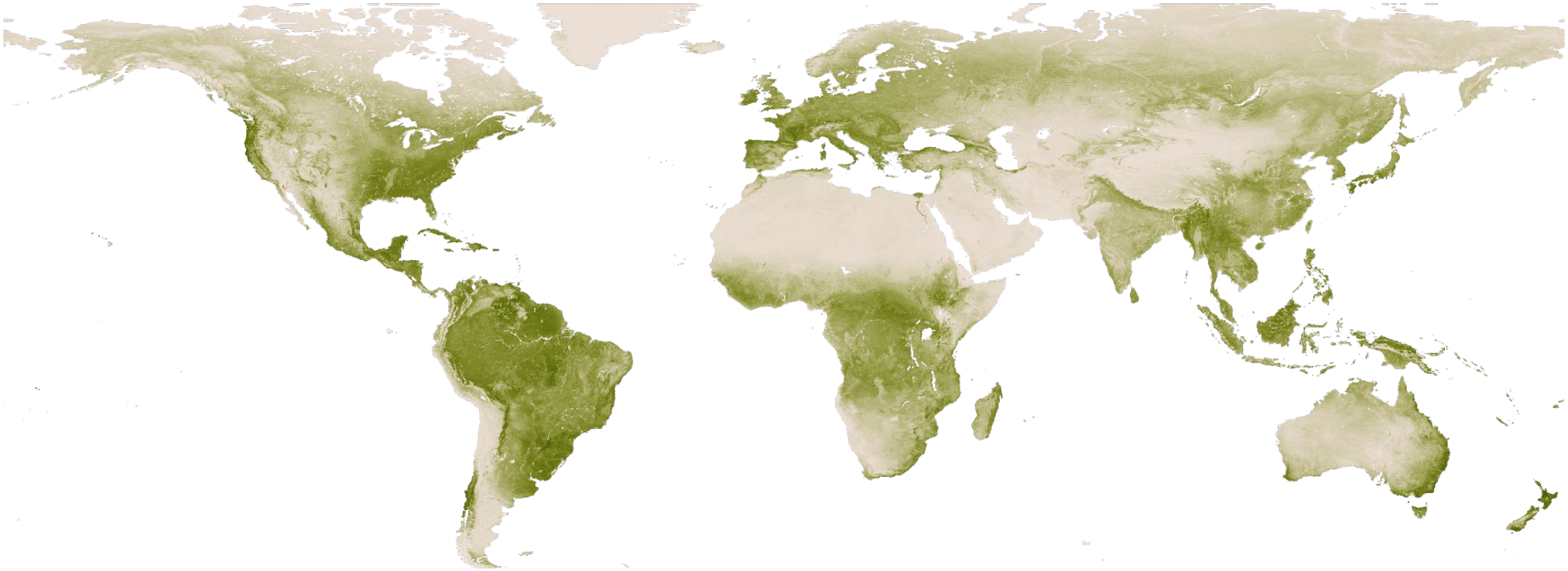
Meteorological Drought

- Meteorological variables impacting drought
  - Water availability
    - Soil moisture
      - Surface water: Reservoir, streamflow levels
      - Ground water
      - Precipitation: Rainfall/snowfall/runoff
  - Temperature
  - Evapotranspiration
- Satellite indices to monitor drought: Vegetation Indices, [e.g. Normalized Difference Vegetation Index (NDVI), Vegetation Health Index (VHI)] – proxy indices for crop health and state

Example of Vegetation Indices Data Sources

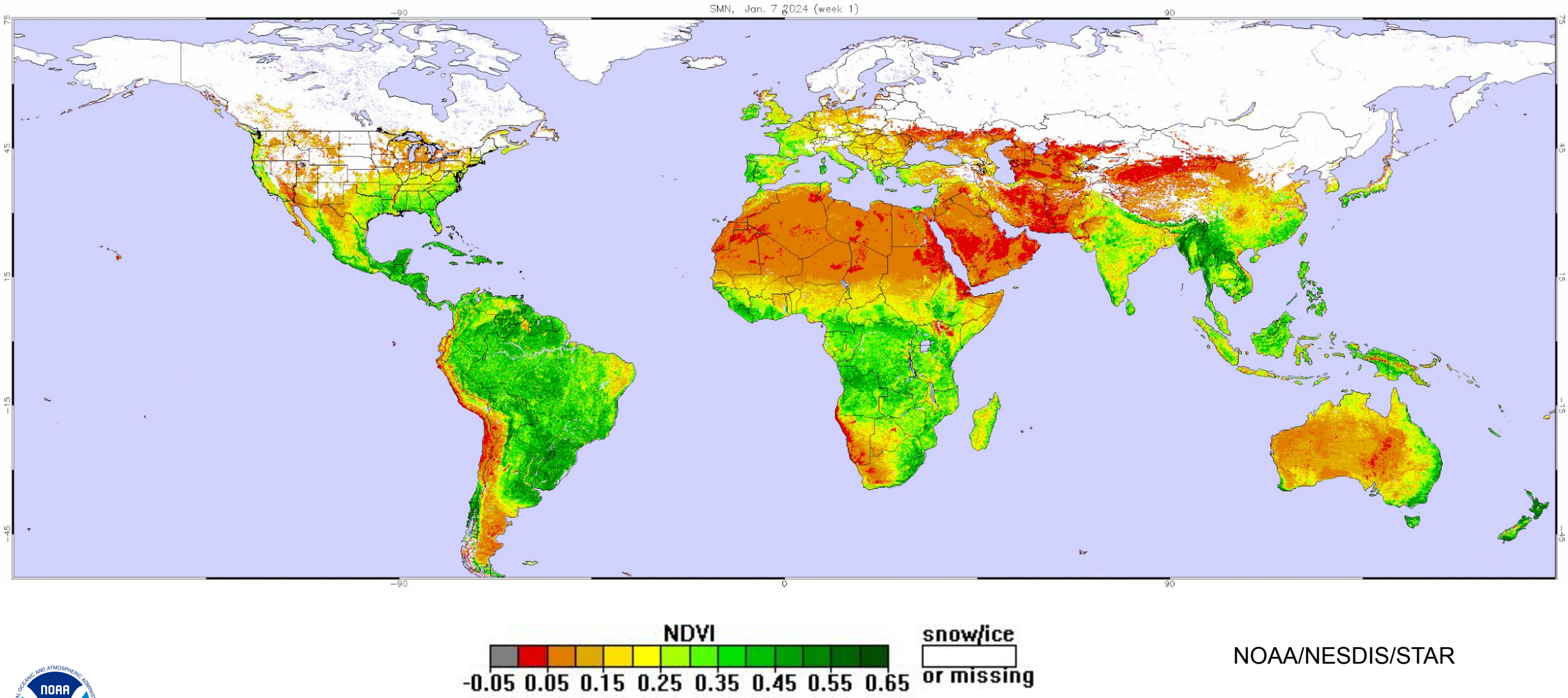
- NOAA/NESDIS/STAR
  - https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/index.php
- NASA GIMSS Global Agricultural Monitoring
  - https://glam1.gsfc.nasa.gov
- International-FEWS NET
  - https://earlywarning.usgs.gov/fews/

2024 VIIRS NDVI



https://www.nnvl.noaa.gov/view/globaldata.html#NDVI

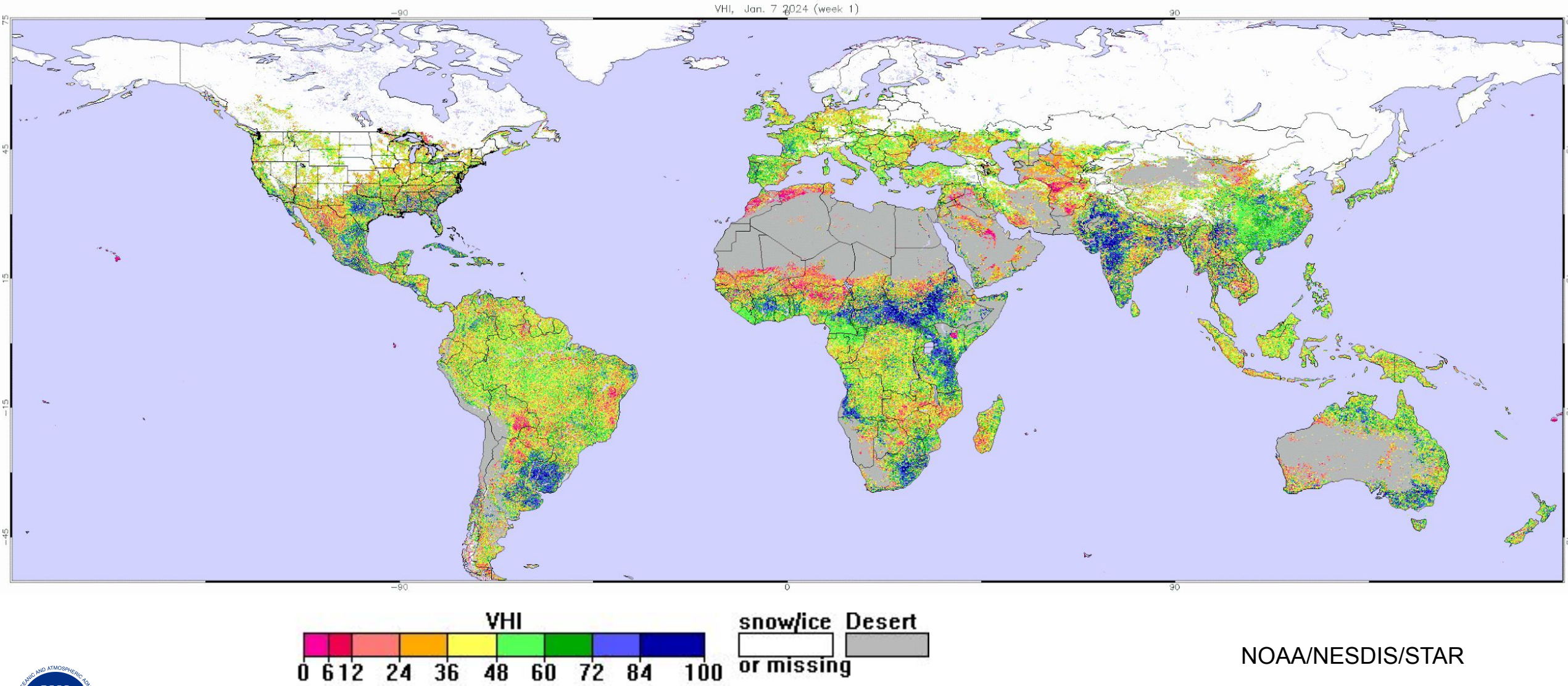
2024 NDVI



NOAA/NESDIS/STAR

https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/index.php

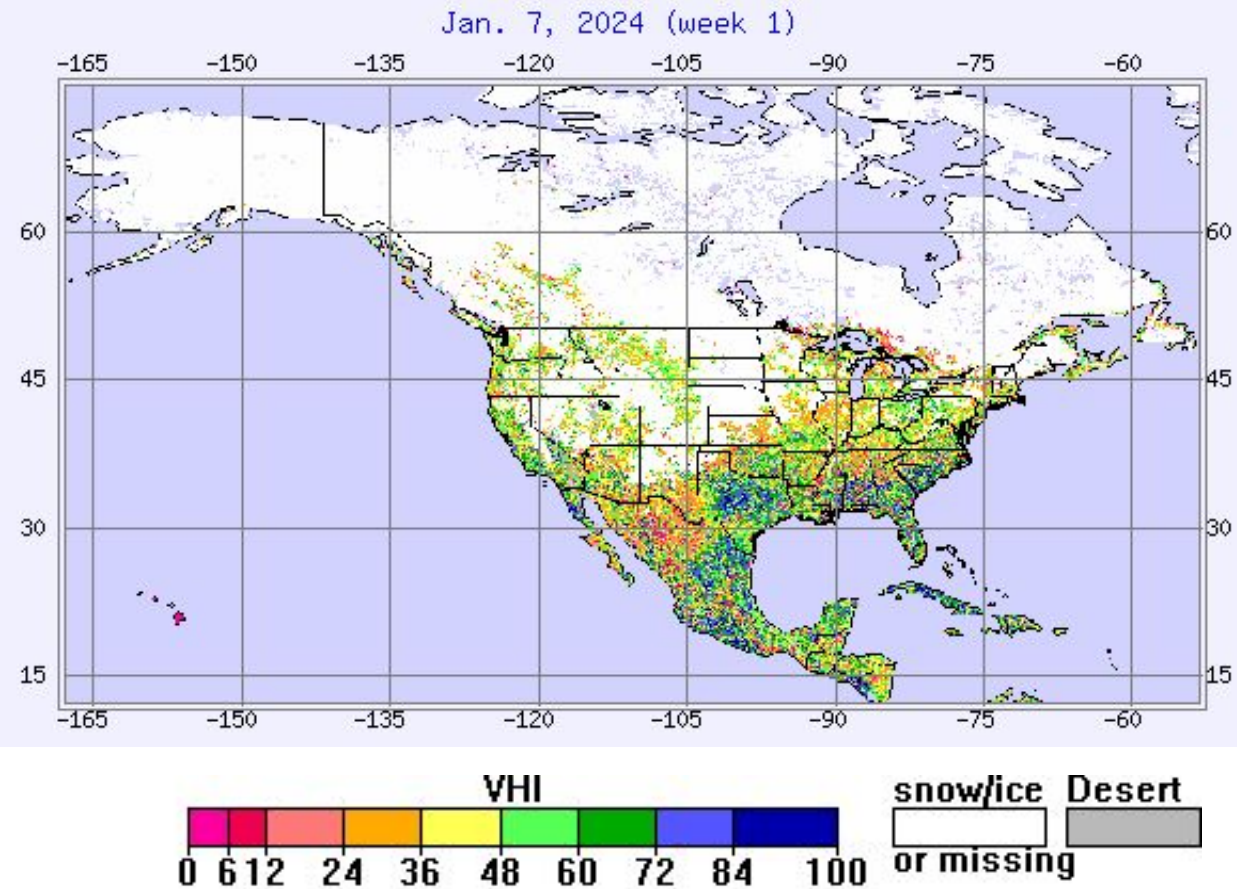
2024 Vegetation Health Index (VHI)

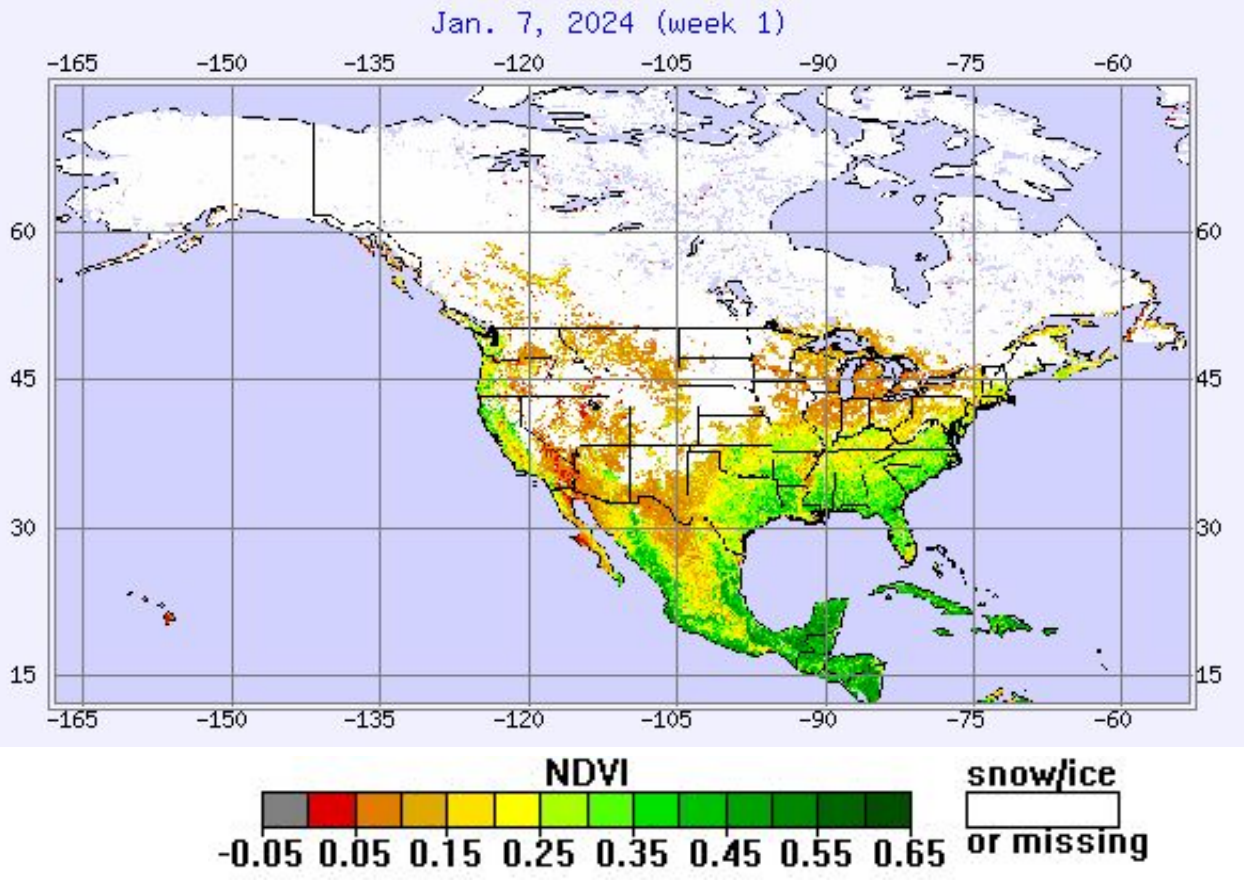


NOAA/NESDIS/STAR

https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/index.php

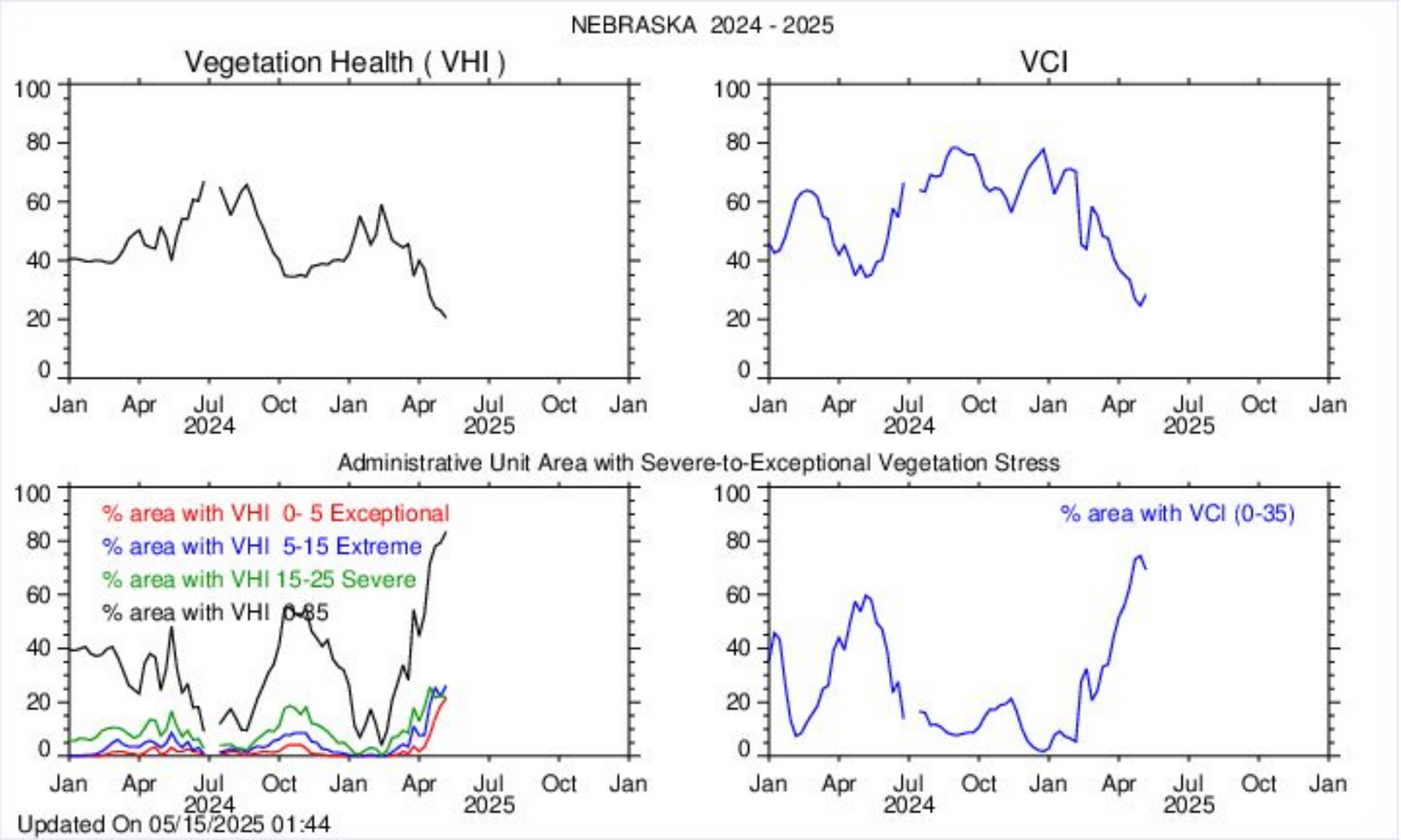
2024 North America – Vegetation Indices



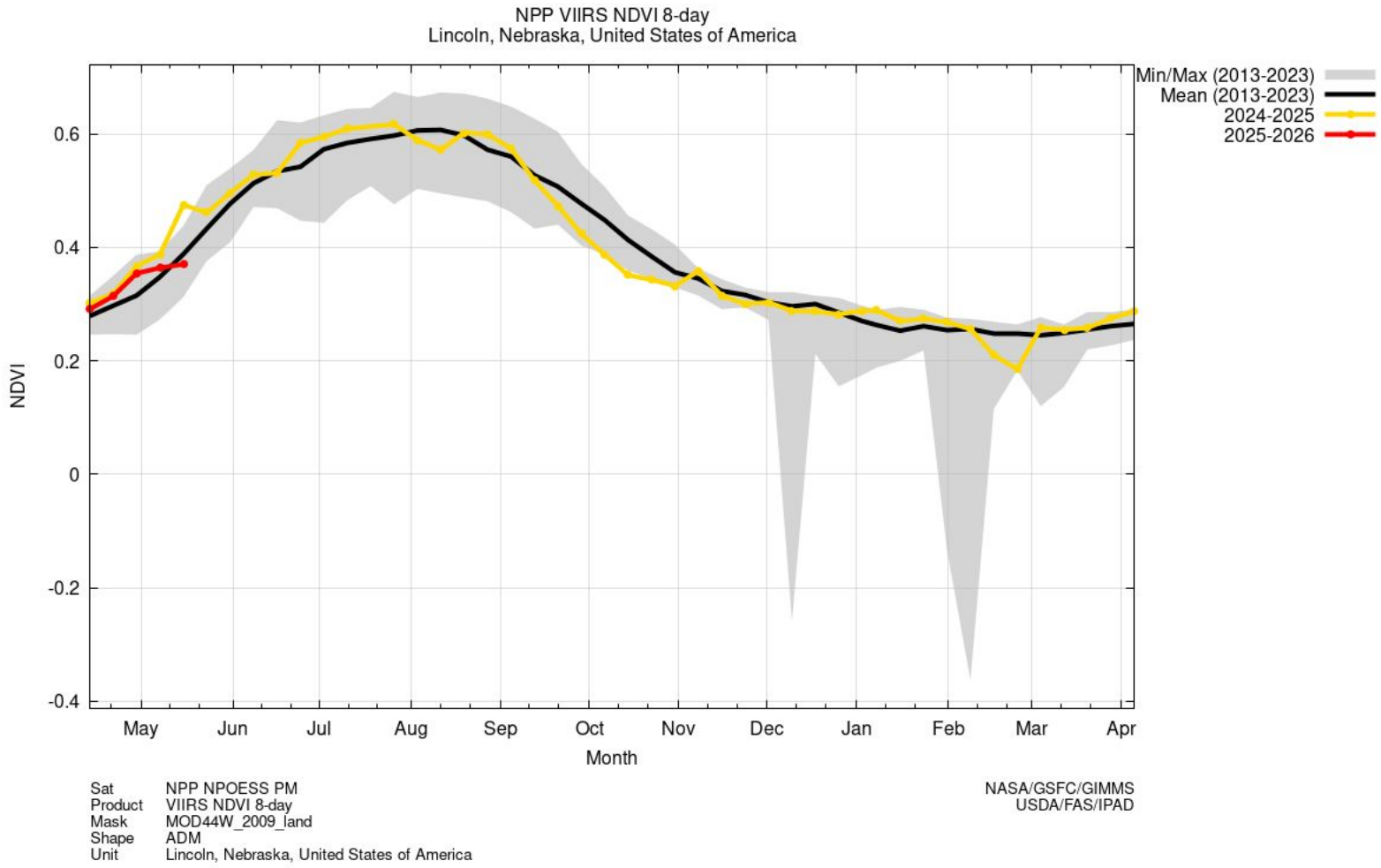


NOAA/NESDIS/STAR

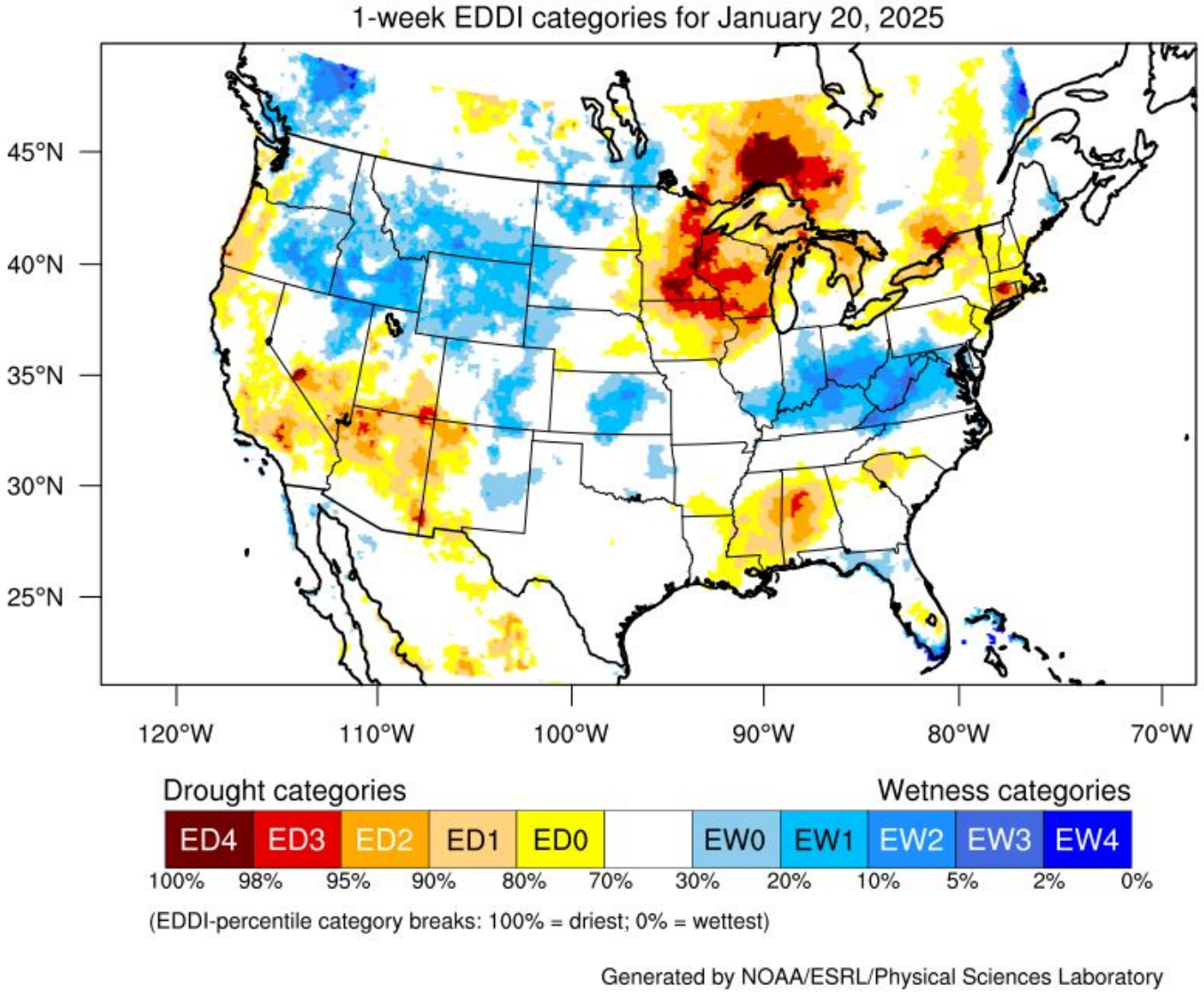
Time Series From NOAA/STAR



VIIRS NDVI Time Series of NASA GIMSS



Evaporative Drought Index



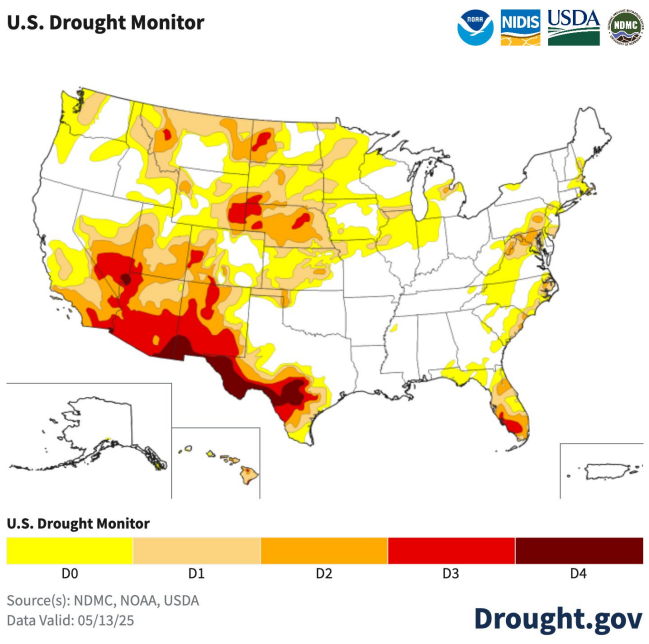
evaporative demand (E_0): also known as "the thirst of the atmosphere"

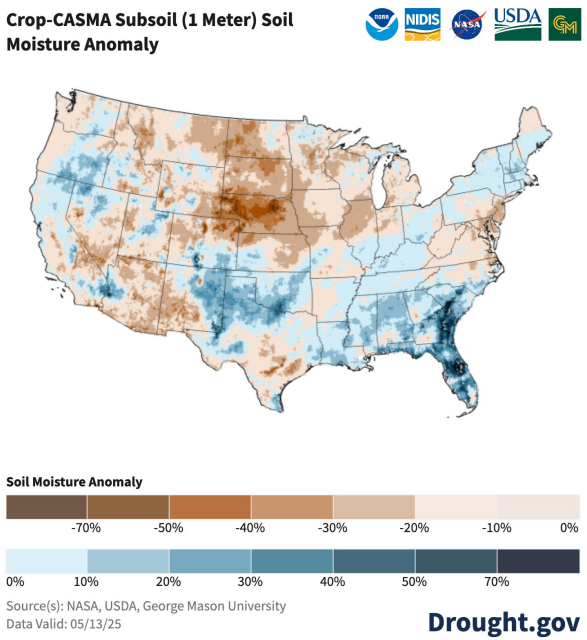
https://psl.noaa.gov/eddi/#current_conditions

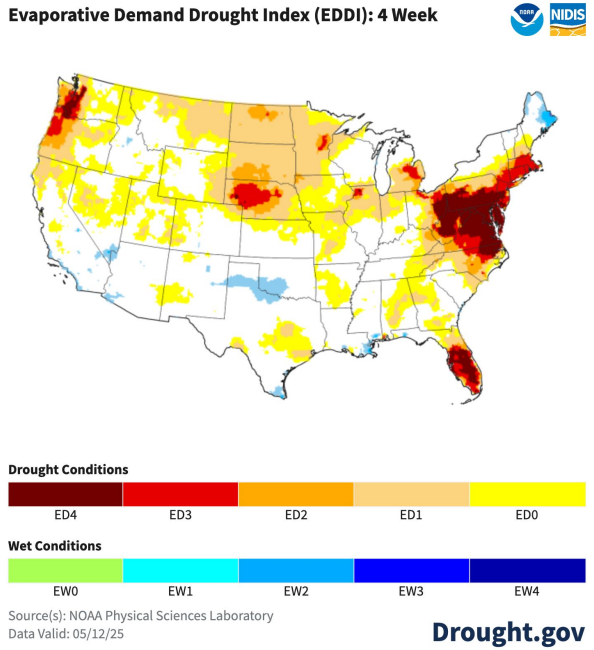
Somes Examples of LEO Data For Drought Monitoring

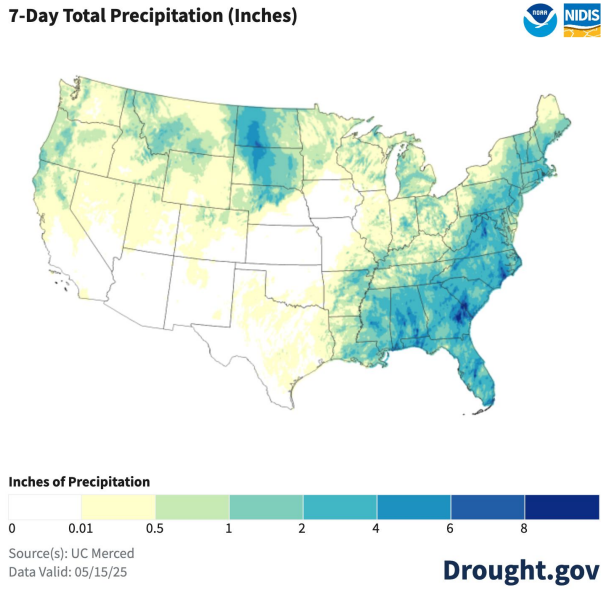
- The US Drought Monitor
  - https://www.drought.gov/
- Famine and Early Warning System
  - https://earlywarning.usgs.gov/fews/

The National Integrated Drought Information System (NIDIS)
The US Drought Monitor









https://www.drought.gov/

Questions to the Audience

- What are your information needs for agricultural applications?
- What type of satellite data do you need?
- Are you aware of satellite data that NOAA provides?