

Daily Monitoring of Rangeland and Pasture using 30m Vegetation Index for USDA LTAR Sites

Feng Gao¹, Rowan Gaffney², David Augustine², Lauren Porensky²

1. Hydrology and Remote Sensing Laboratory, USDA-ARS, Beltsville, MD 20705, USA

2. Rangeland Resources and Systems Research Unit, USDA-ARS, Fort Collins, CO 80526, USA



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Long-Term Agro-ecosystem Research (LTAR) network

Sustaining US Agricultural Production and Ecosystem Services through 2050

How can US agriculture be intensified in a sustainable fashion?

- 1) What factors drive agricultural productivity and its environmental impacts?
- 2) What are the tradeoffs between production and ecosystem services?
- 3) What are the barriers to sustainable intensification?
- 4) How do we better target our use of resources?
- 5) What management strategies are needed for agriculture to be resilient to extreme events?
- 6) What scientific measurements are needed for decision making?

Partner Networks including:
LTER, NEON
Climate Hubs
GRACEnet, REAP,
CZO, AmeriFlux
NUOnet

LTAR investigates sustainable intensification of agriculture by comparing outcomes under Business as Usual and Aspirational management of Croplands, Rangelands, and Pasturelands

PRODUCTION
Provisioning Services

ENVIRONMENT
Regulating & Supporting Services

SOCIETY
Cultural Services

LTAR's research is based on

Field Experimentation and Monitoring, Modeling, Database systems and Remote Sensing

**Above-ground
Measurements**

NPP, erosion, runoff, energy, water,
carbon fluxes,
biological diversity

**Below-ground
Measurements**

Soils, soils biology, GHGs, water,
nutrient cycles, and balances

**Spatial and Temporal
Scaling**

Site-specific to continental scale,
biophysical, socio-economic

USDA-ARS LTAR Network Overview



- Total 18 sites
- Data Records: 12 (Pullman, WA) to 100 years (Las Cruces, NM and Mandan, ND)
- Area Covered (km²): 0.57 (Pullman, WA) to 6,200 (Ames, IA)
- NEON Domains: 11 out of 17 (in lower 48 states)
- Major Drainage Basins: 12 out of 18 (in lower 48 states)
- Farm Resource Regions: 8 Out of 9 (in lower 48 states)

LTAR Sites in Farm Regions

Long-Term Agro-ecosystem Research Sites and Farm Resource Regions



LTAR Web Site: <https://ltar.nal.usda.gov/>

The screenshot shows the LTAR Web Site interface. At the top, the USDA logo and "United States Department of Agriculture Agricultural Research Service" are displayed on the left, and "Long-Term Agroecosystem Research" is on the right. A navigation bar below contains links for "Data Home", "About LTAR", "Real-Time Meteorology", "Real-Time Cameras", "Published Data and Articles", and "Beta Version".

Long-Term Agroecosystem Research Data Overview

The USDA Agricultural Research Service (ARS) Long-Term Agroecosystem Research network consists of 16 Federal and university agricultural research sites with an average of over 50 years of history. The goal of this research network is to ensure sustained crop and livestock production and ecosystem services from agroecosystems, and to forecast and verify the effects of environmental trends, public policies, and emerging technologies.

Display Options

- LTAR
 - LTAR sites
 - Soil Climate Data
 - Atmospheric Gas Data
 - Camera Images
 - Aerial Imagery
- Other Research Network
- Boundaries
- Ecological Context
 - Watersheds
 - Weekly Drought Out
 - Seasonal Drought Ou
 - Ecosystems
 - Bioclimates
 - Land Surface Forms
 - Surface Lithology
 - Topographic Position
- Base Maps

Central Plains Experimental Range

- LTAR sites
- Soil Climate Data
- Camera Images
- Aerial Imagery
- LTAR Weather

Central Plains Experimental Range

Nunn, CO

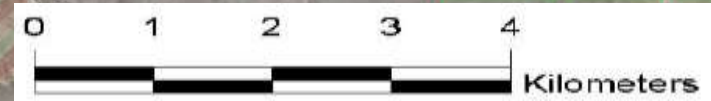
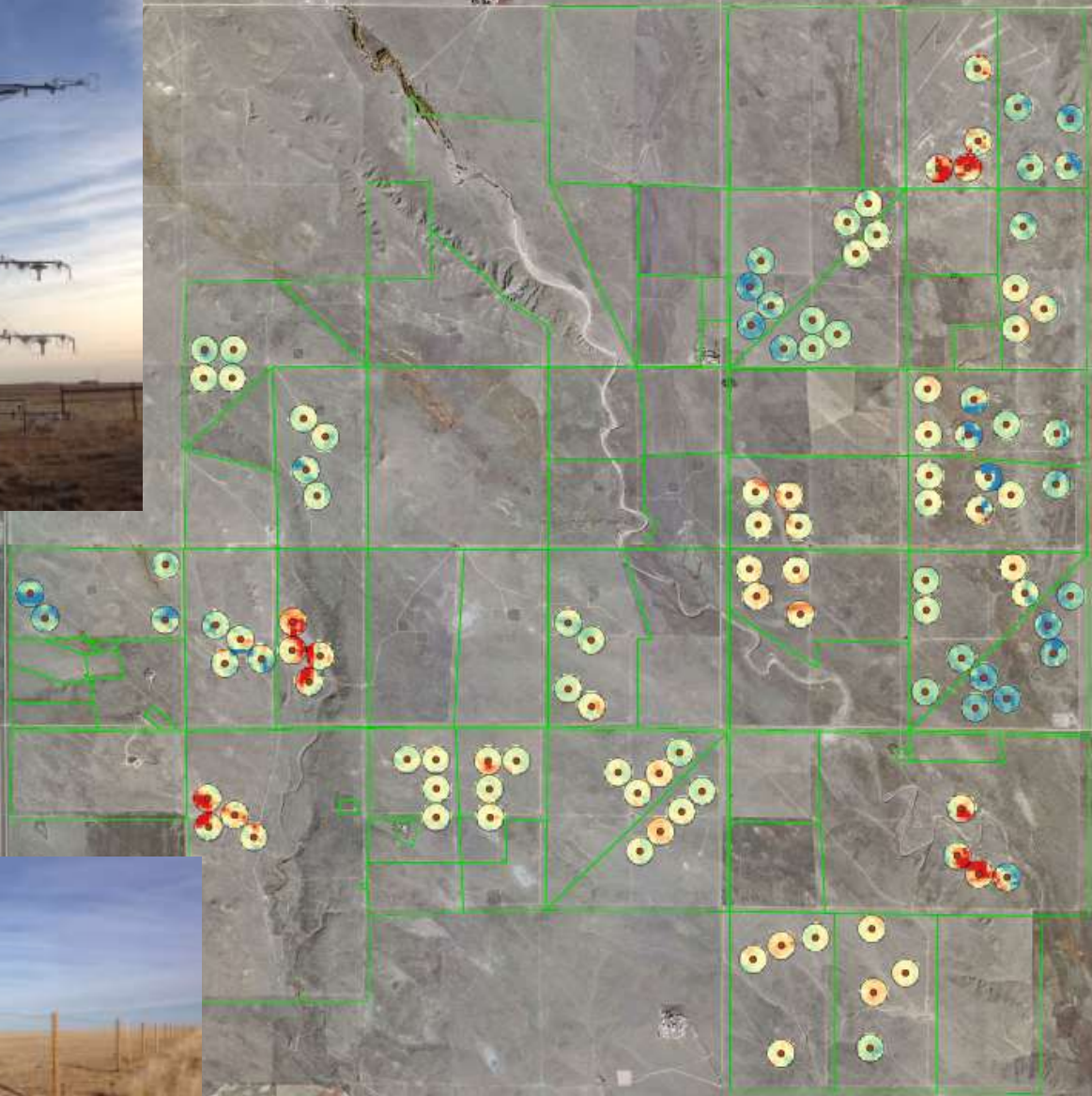
Established: 1939

Agricultural land use: Wheat-fallow, rangeland, beef cattle

Watershed: HUC 10 Missouri River

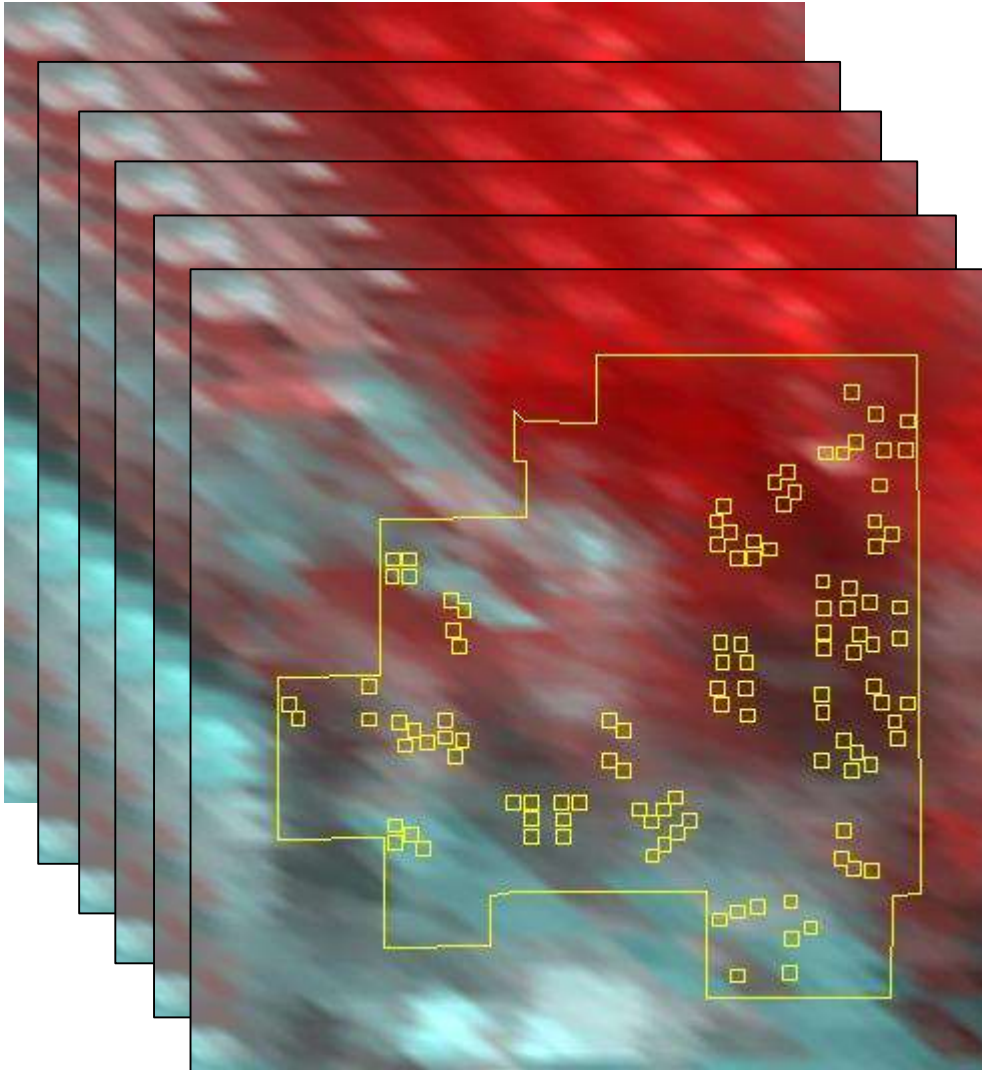
NEON Domain: Central Plains

Central Plains Experimental Range (CPER) LTAR Site

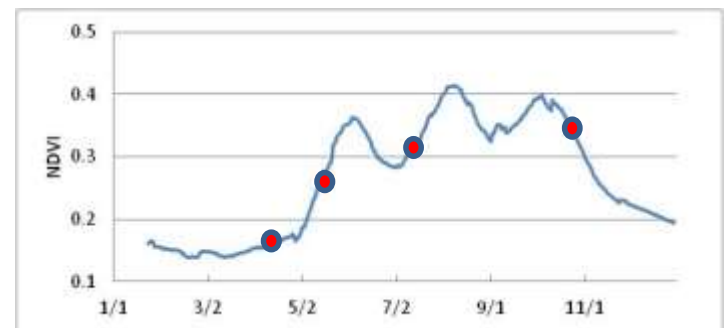
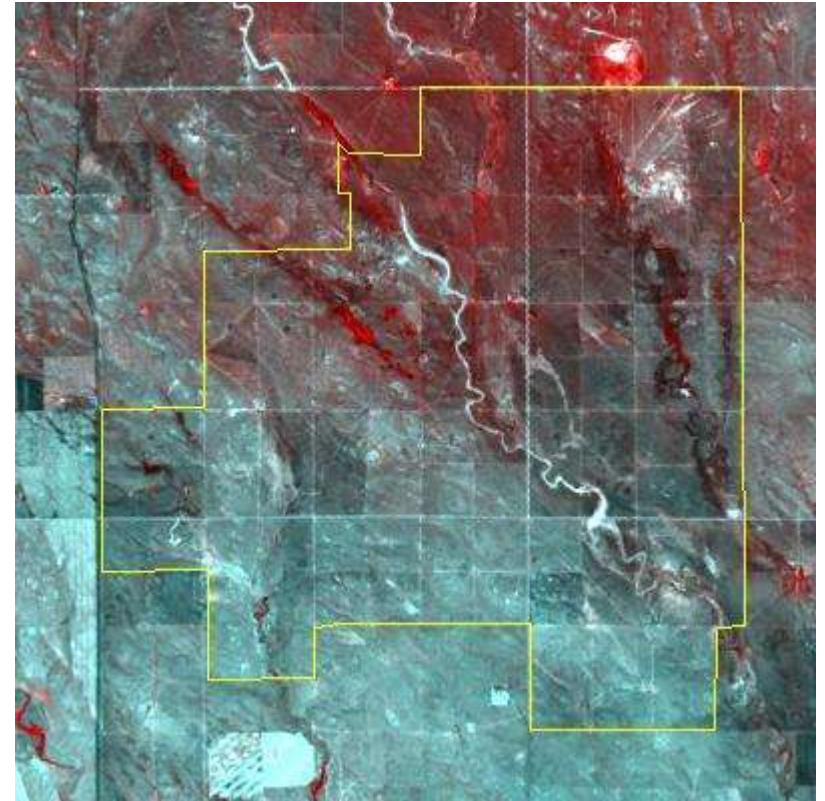


Spatial and Temporal Requirement

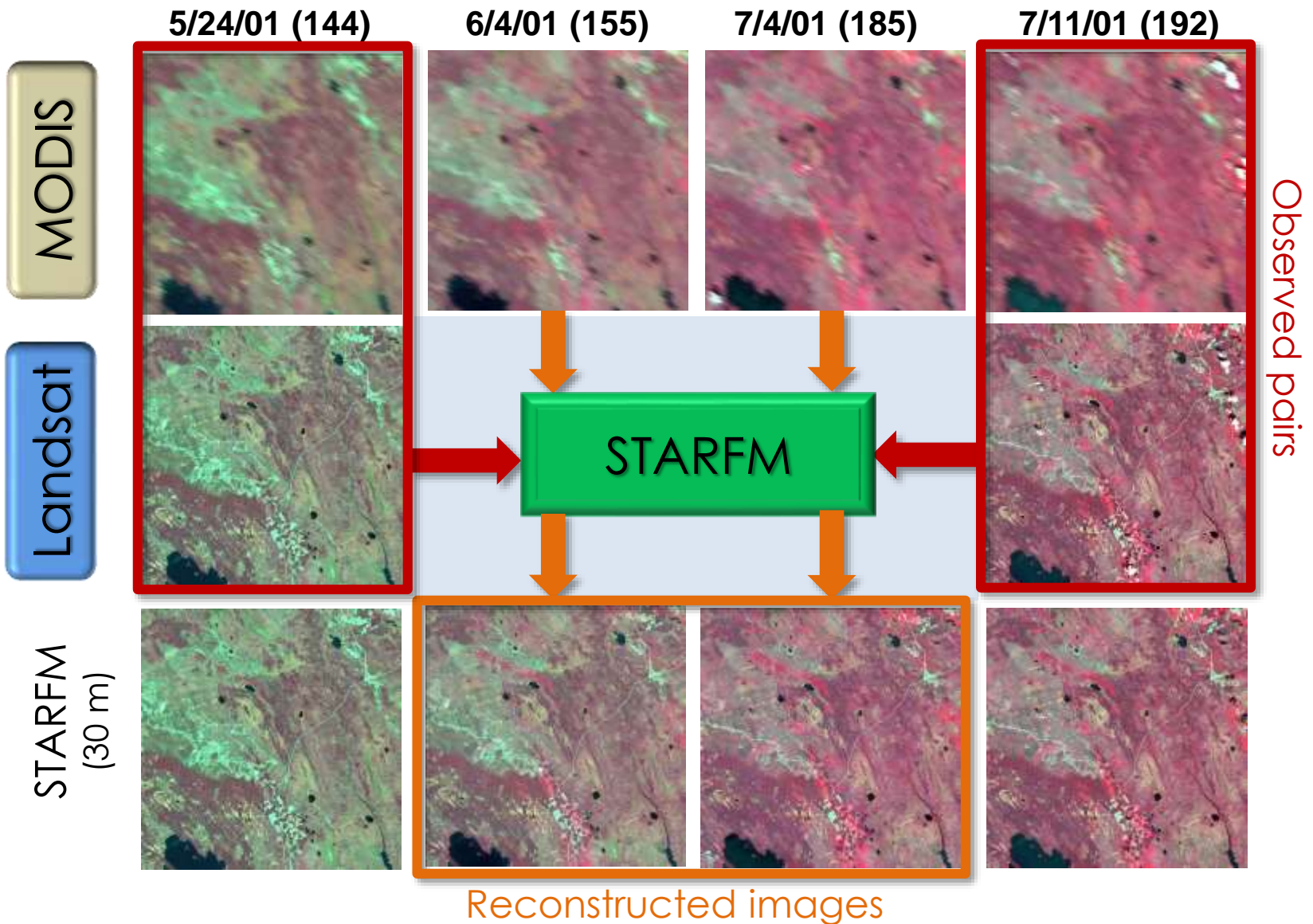
Terra MODIS 250m (8/9/13)



Landsat 8 OLI 30m (8/9/13)



Spatial and Temporal Adaptive Reflectance Fusion Model

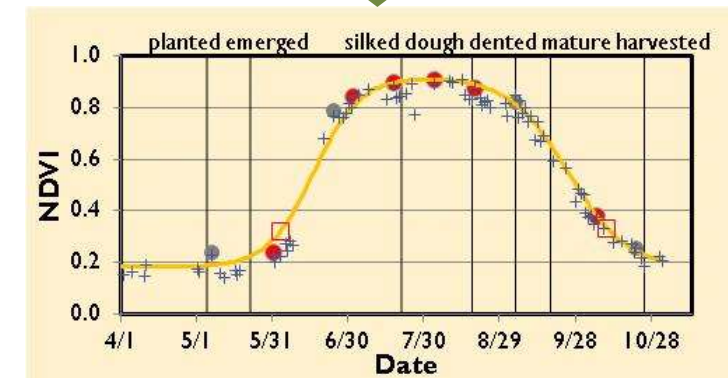
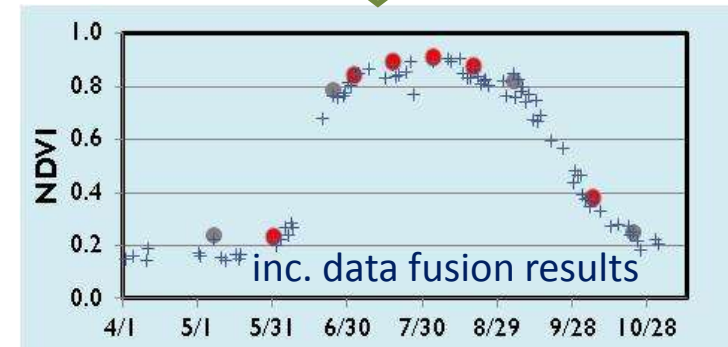
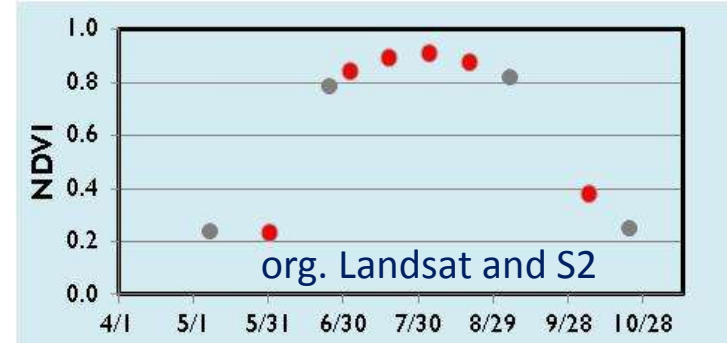




Proposed Daily 30m Vegetation Index Data Cubes for the USDA LTAR Sites



- **Product Description:**
Provides the daily NDVI and EVI/EVI2 at 30 m over the selected USDA-ARS LTAR sites
- **Retrieval Strategy:**
 - Landsat/Sentinel-2 and MODIS/VIIIRS surface reflectance are fused to bridge gaps between Landsat observations
 - Vegetation indices (NDVI, EVI2, NDWI and NDTI) are computed from the Landsat/S2 observations and the fused Landsat-MODIS surface reflectance
 - The smoothed and gap-filled NDVI and EVI2 are generated from the observed and the fused data at 30m
 - Green-up and dormancy dates are extracted using the MODIS phenology curvature approach
- **Product Layers:**
 - Original Landsat and S2 NDVI, EVI2, NDWI and NDTI
 - Fused Landsat-MODIS NDVI, EVI2, NDWI and NDTI
 - Smoothed and gap-filled NDVI and EVI2
 - Crop green-up and dormancy dates
 - Quality control layer
- **Contacts:**
 - Feng Gao (USDA-ARS HRSL)



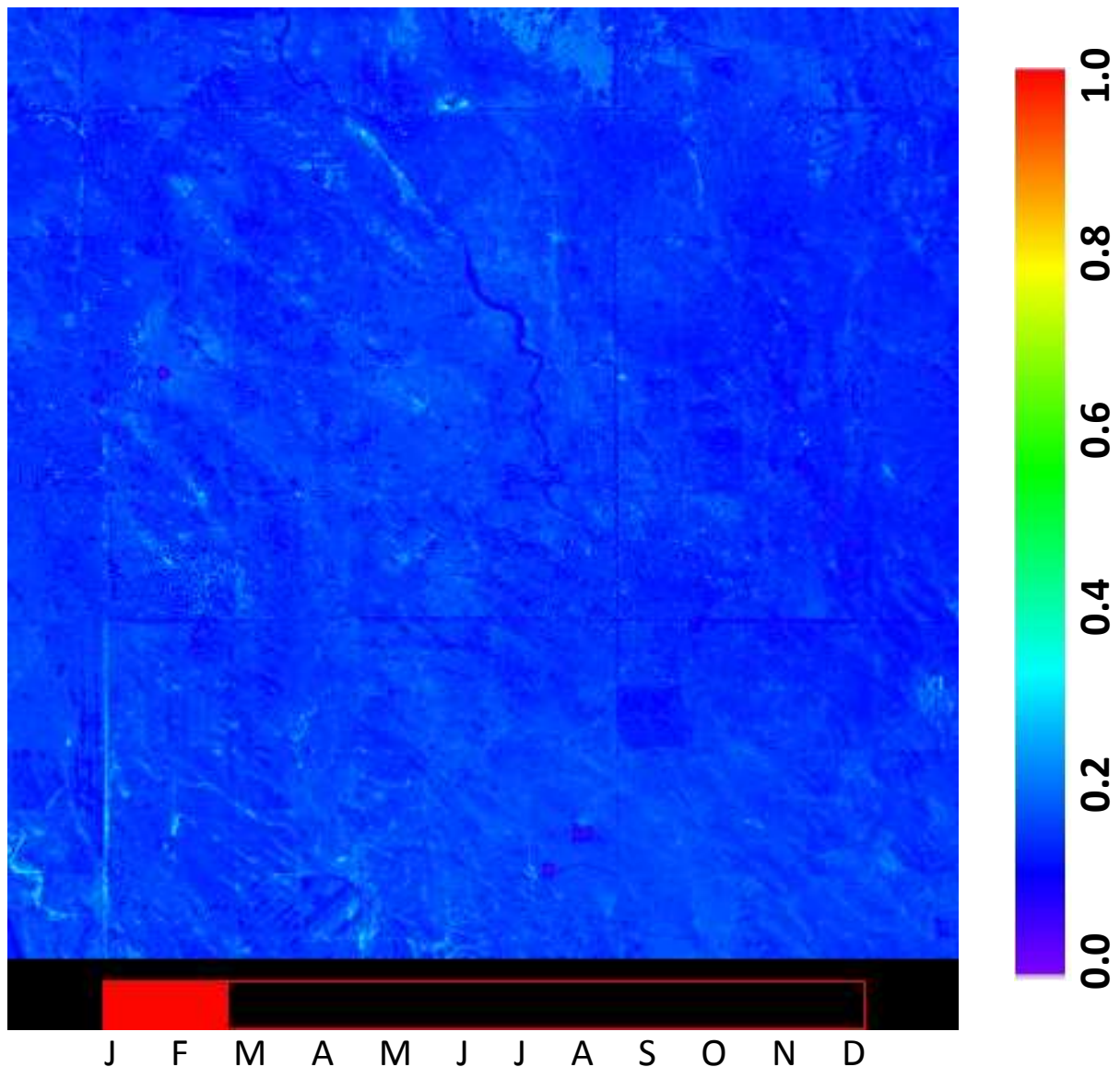
Data Sources:

Landsat -8
125, 157, 173,
221, 237, 269,
365

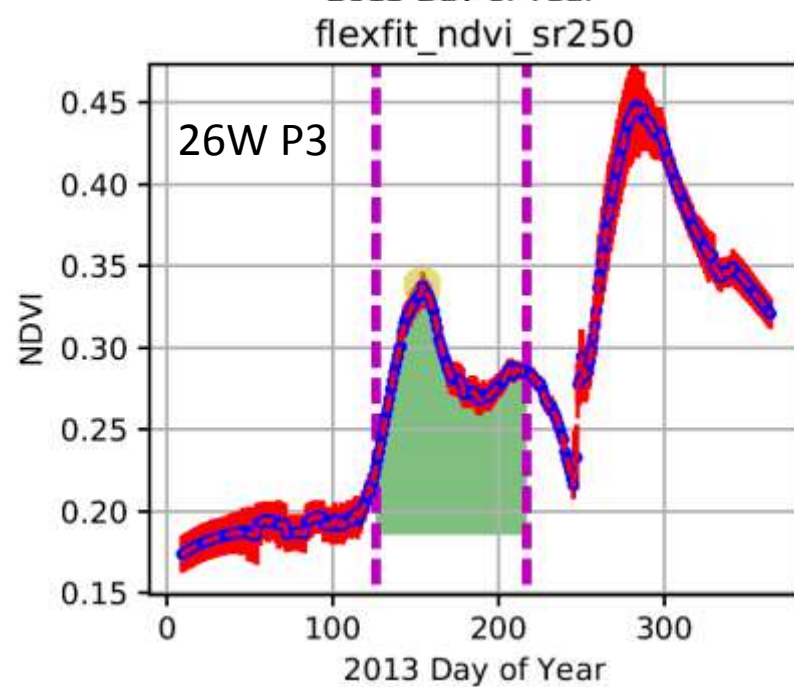
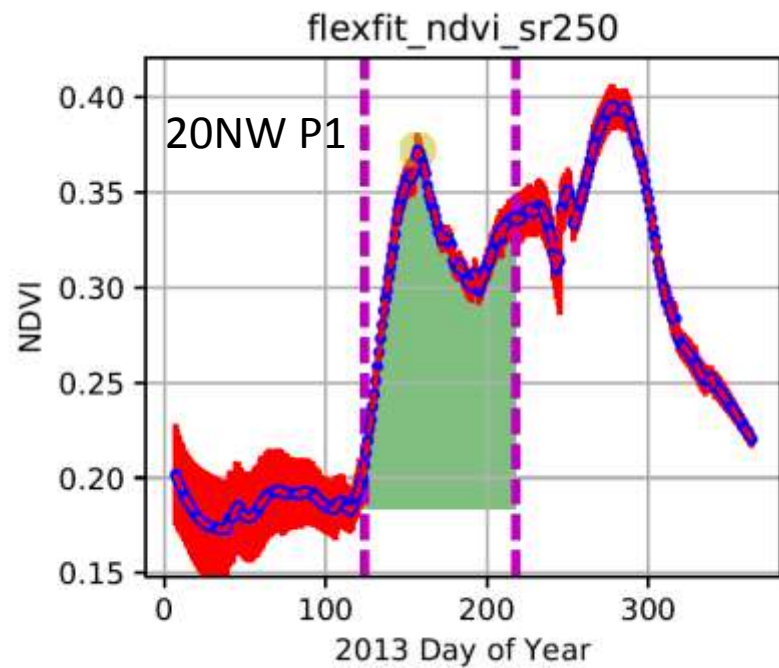
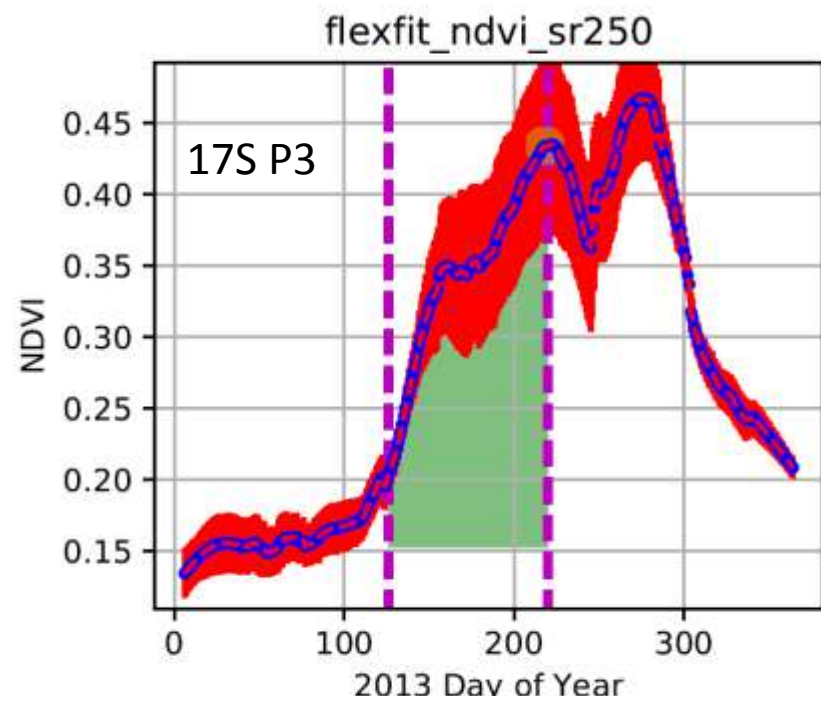
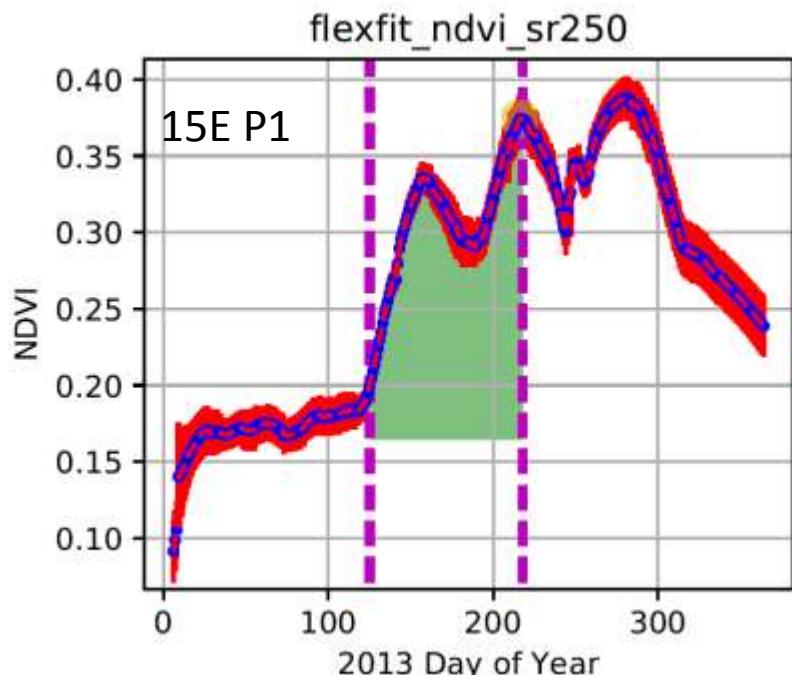
MODIS
Daily (250m)
16-day BRDF

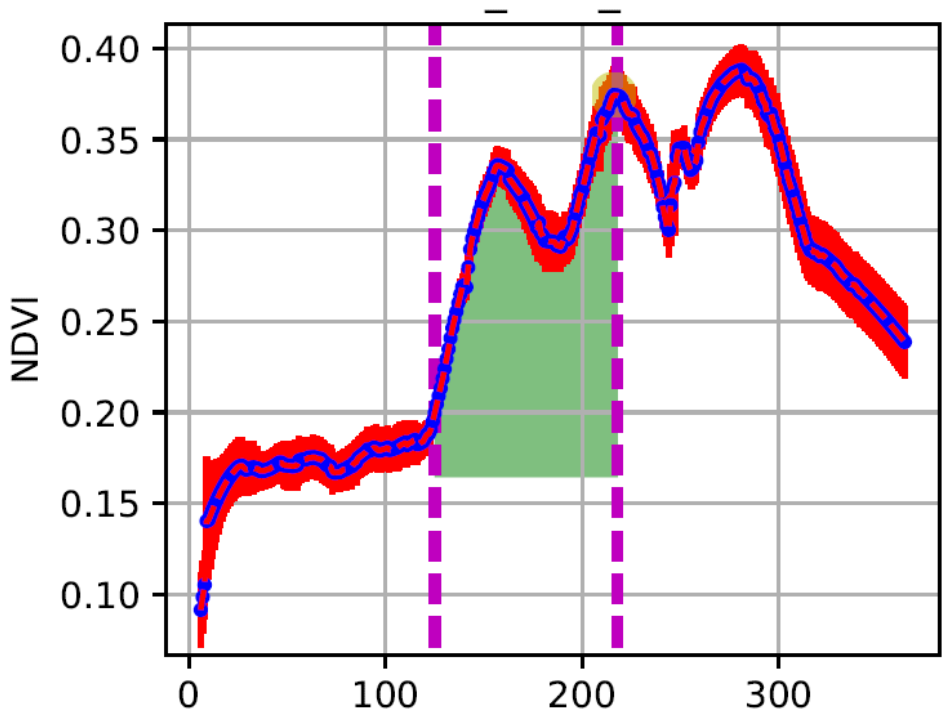
Approach:

-STARFM
-Modified SG
filtering

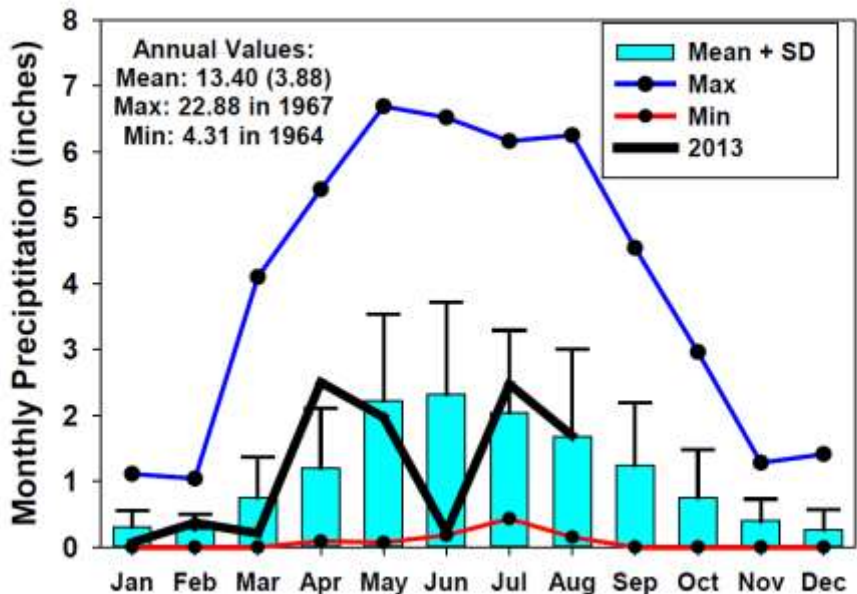
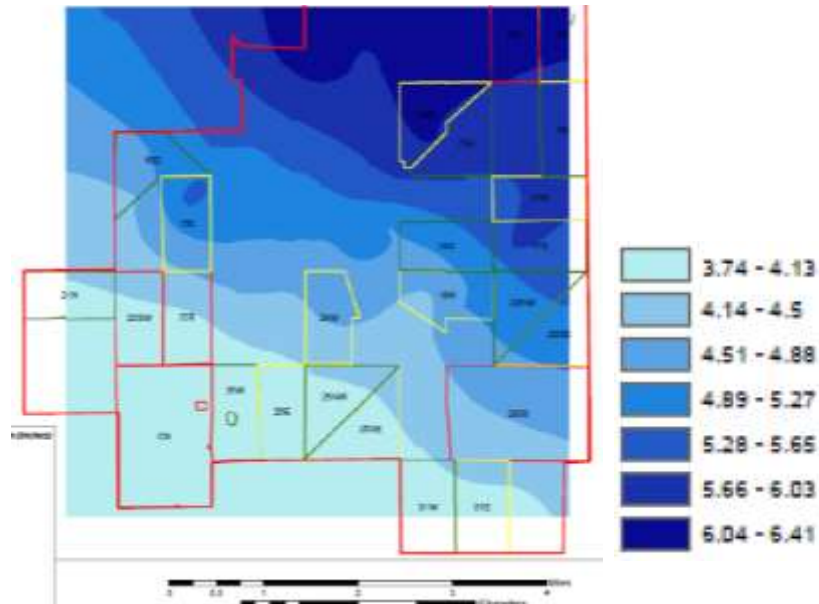


Gap-filled and smoothed daily NDVI(30m) using original Landsat and the fused Landsat-MODIS data
Central Plains Experimental Range (CPER) LTAR site, 2013

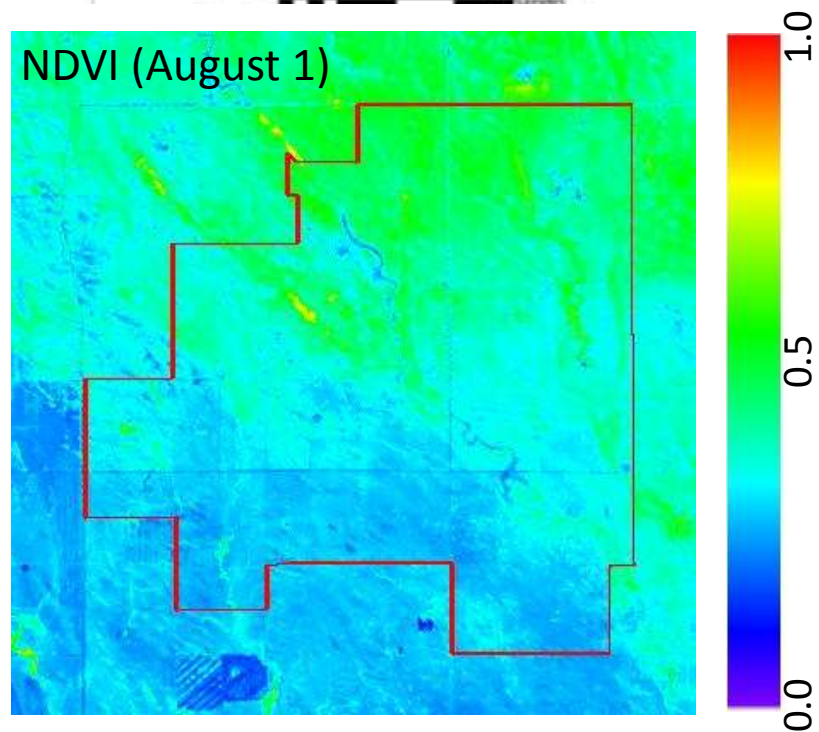




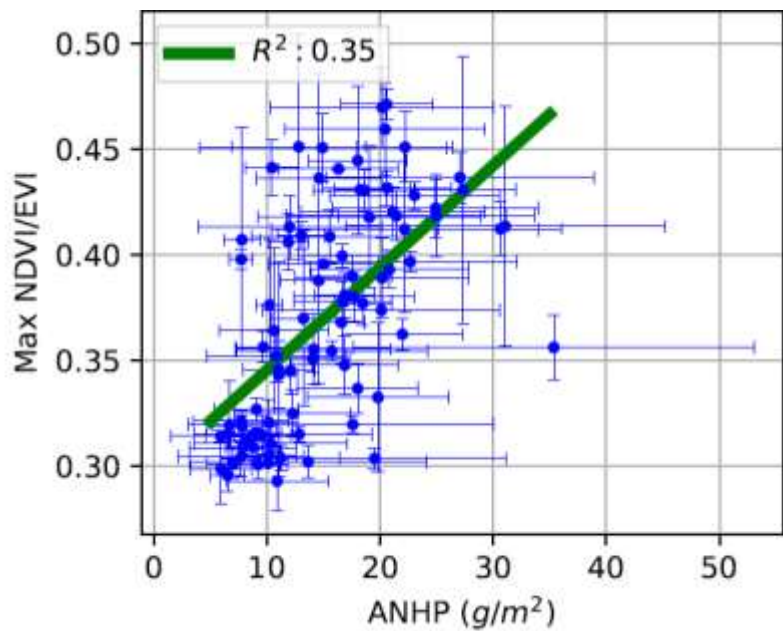
Precipitation (May 15-Oct 1)



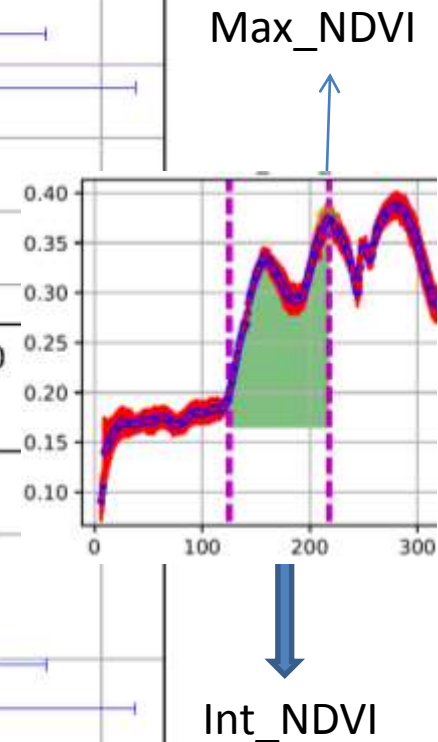
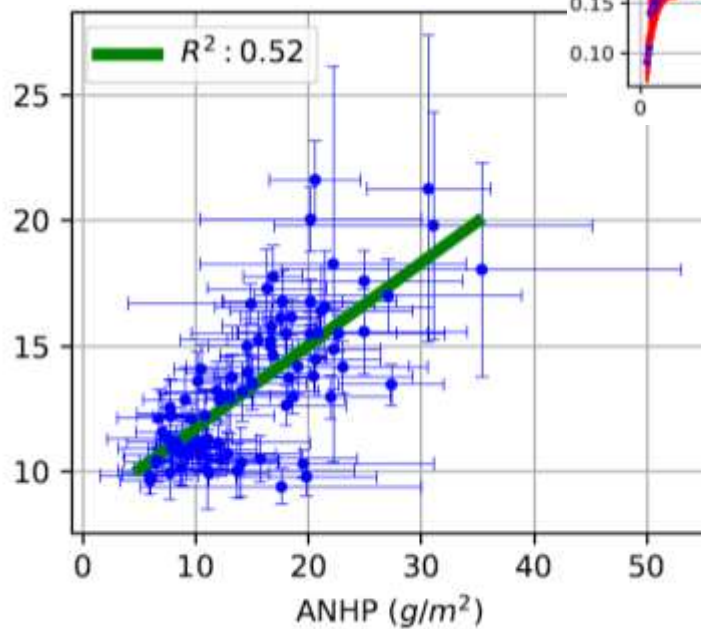
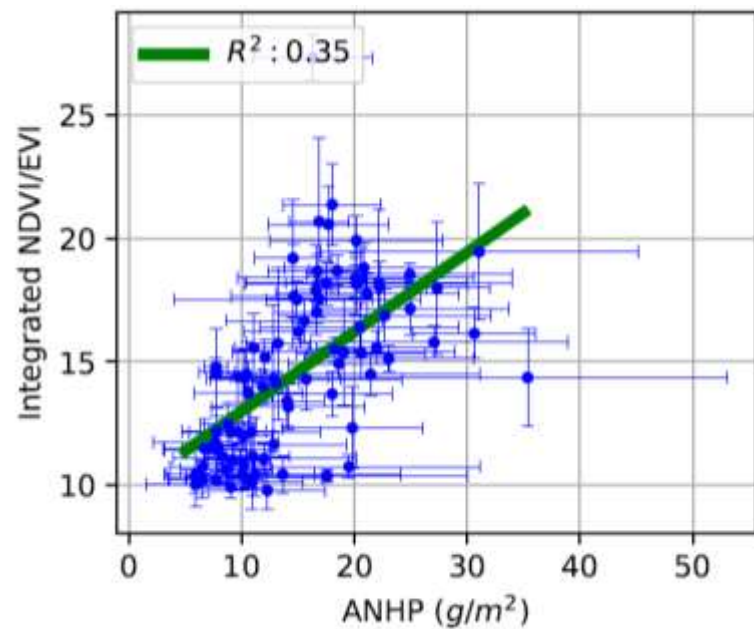
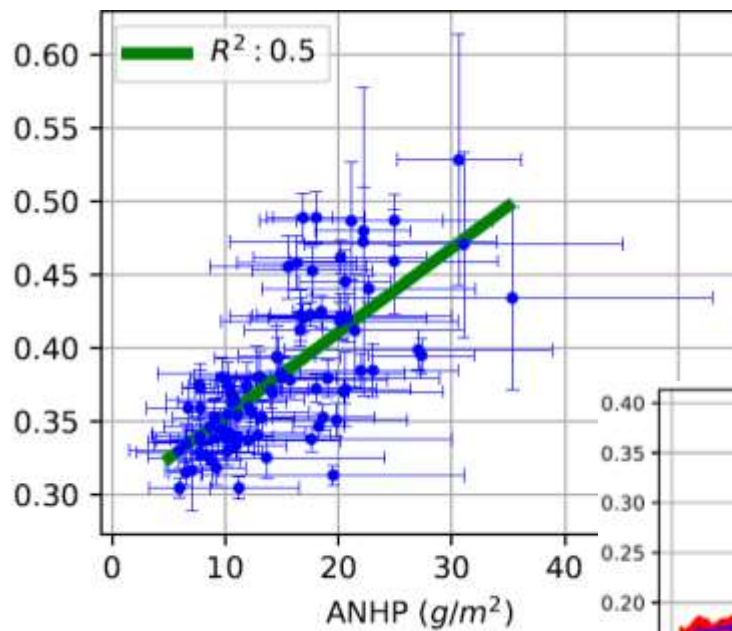
NDVI (August 1)



MODIS



Landsat-MODIS



Challenges: field measurement and standing dead ANHP: Aboveground Net Herbaceous Production

Summary

- LTAR provide a platform to study outcomes under different management of croplands, rangelands and pasturelands
- High spatial and temporal resolution data improve grass biomass estimation but standing dead grass is a challenge
- Sentinel-2 (5-days revisit) can definitely bring additional values for rangeland and pasture monitoring at field scale

