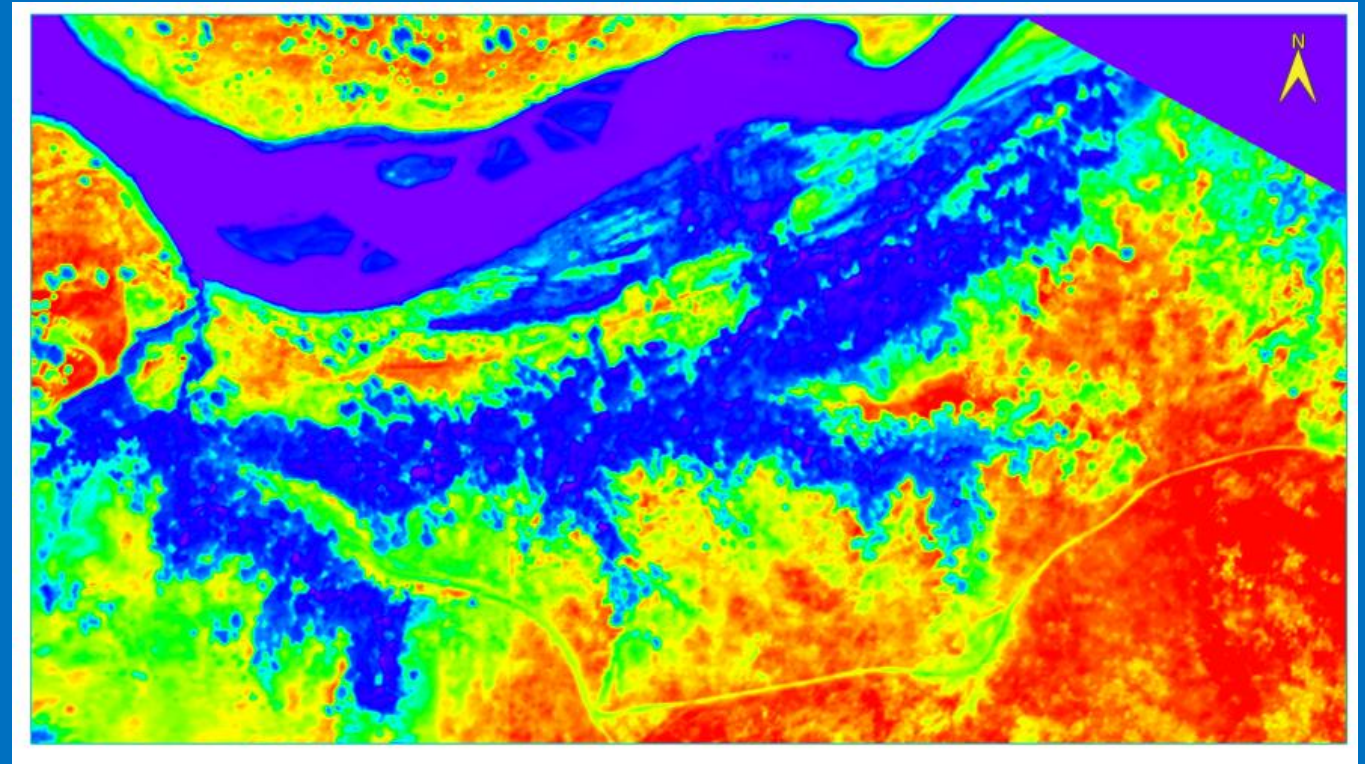
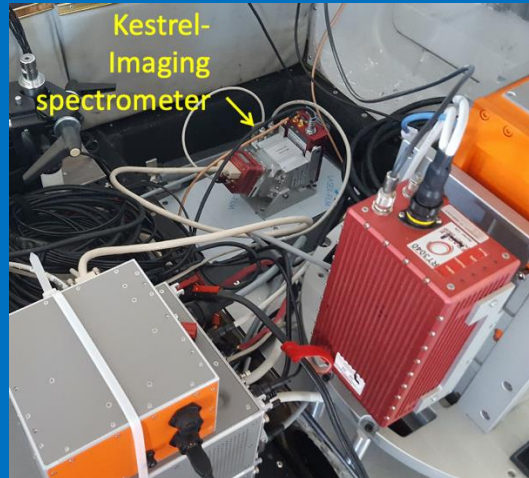


# Nebraska Earth Observatory (NEO)

*Revealing dynamic states and processes through airborne imaging spectroscopy*



Thermal image of Niobrara Smithsonian ForestGEO plot (established by Sabrina Russo. Image Tithira Lakkana)

# The many dimensions of NEO data

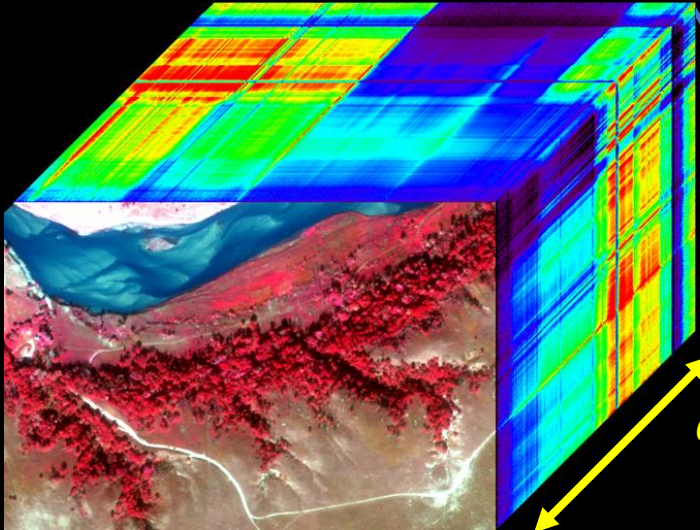
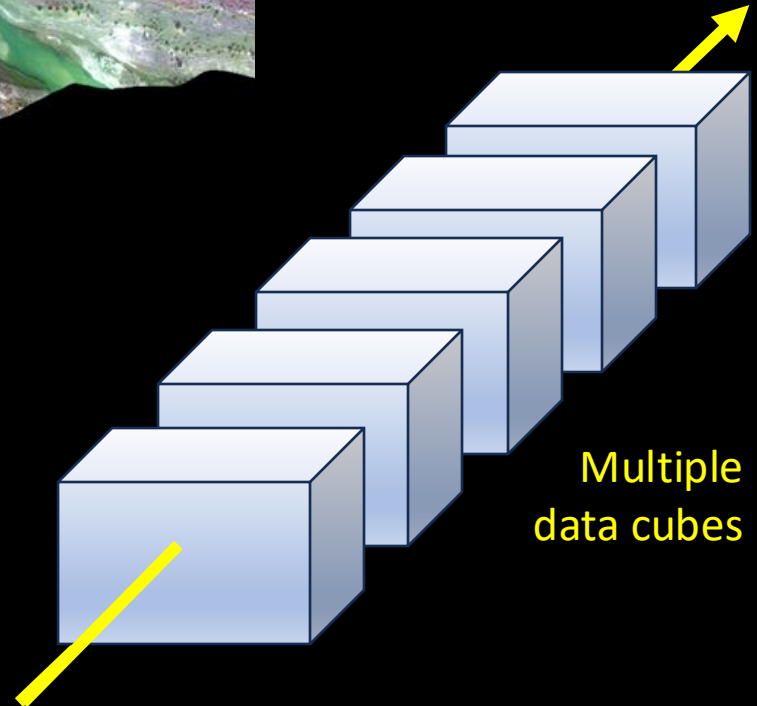


Image (data) cube

Spectral dimension



Temporal dimension



Multiple data cubes

Nebraska Earth Observatory (NEO) flight line  
(Niobrara ForestGEO plot, established by S. Russo)

# Field calibration/validation



# THRIVING ON OUR CHANGING PLANET

A Decadal Strategy for Earth Observation from Space



## ***Decadal Survey (2018) – Focus Areas:***

*Global Hydrological Cycles and Water Resources*

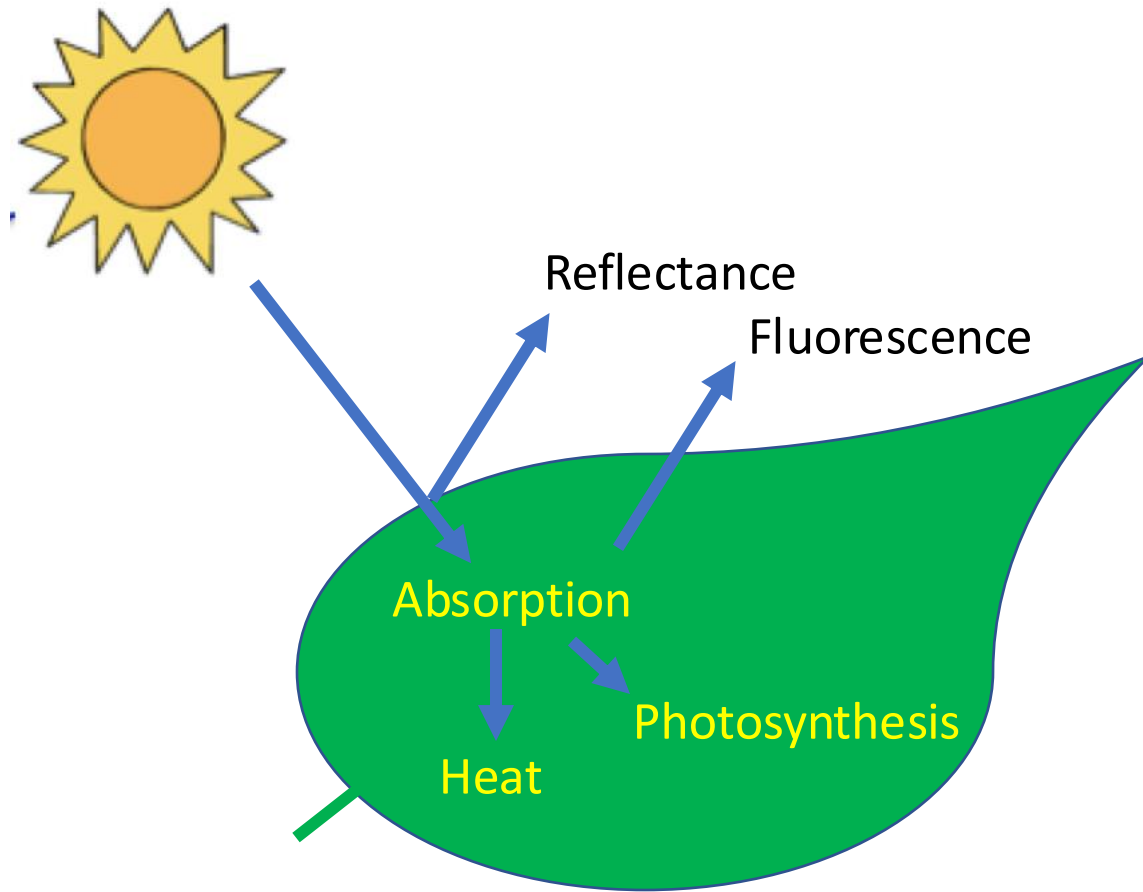
*Terrestrial Ecosystems and Natural Resource Management*

*Climate Variability and Change: Seasonal to Centennial*

## **NEO aligns with NASA programs & missions:**

- Carbon Cycle & Ecosystems
- ECOSTRESS sensor (Space Station)
- Surface Biology & Geology (SBG, planned)

# NEO aligns with the European Space Agency's FLEX\* Mission



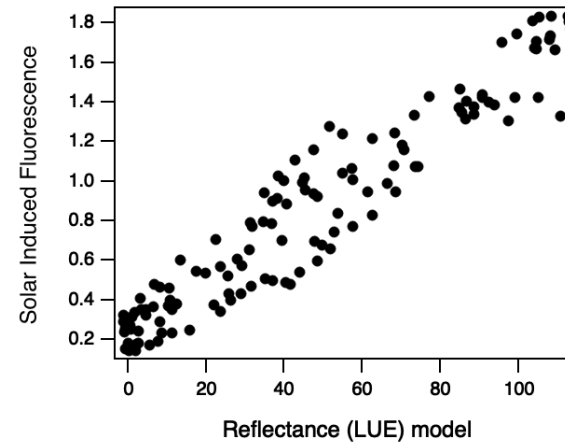
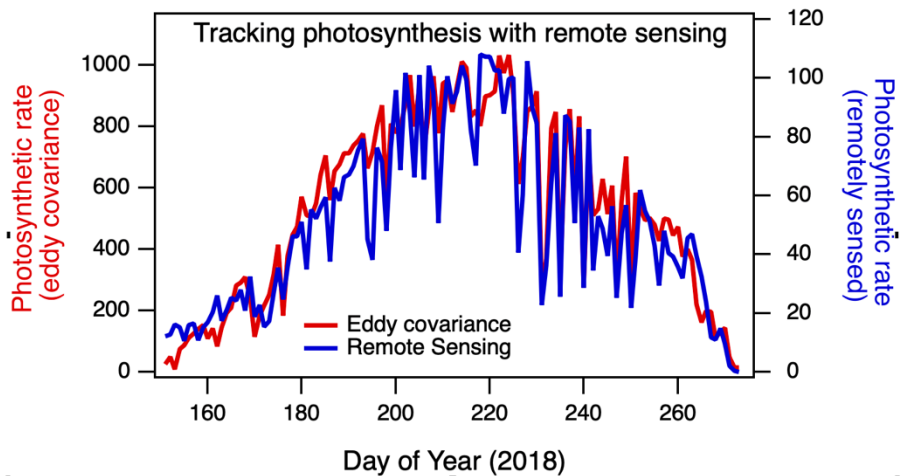
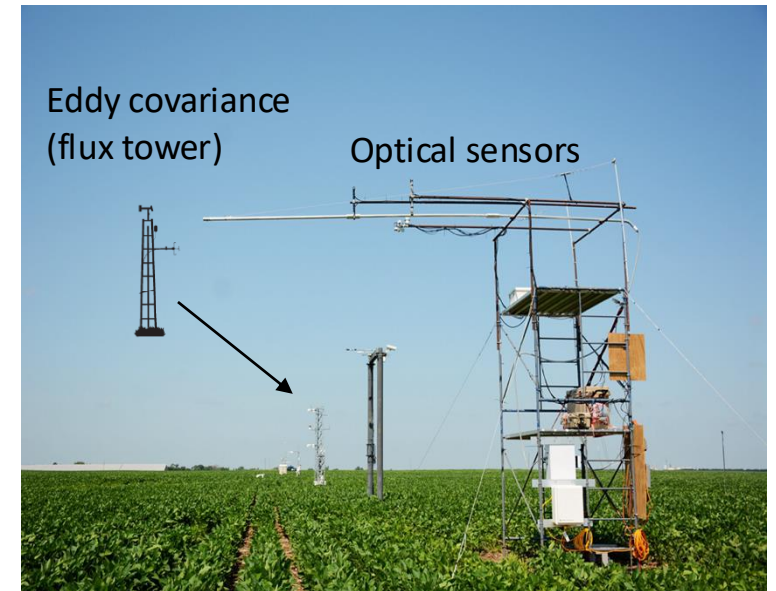
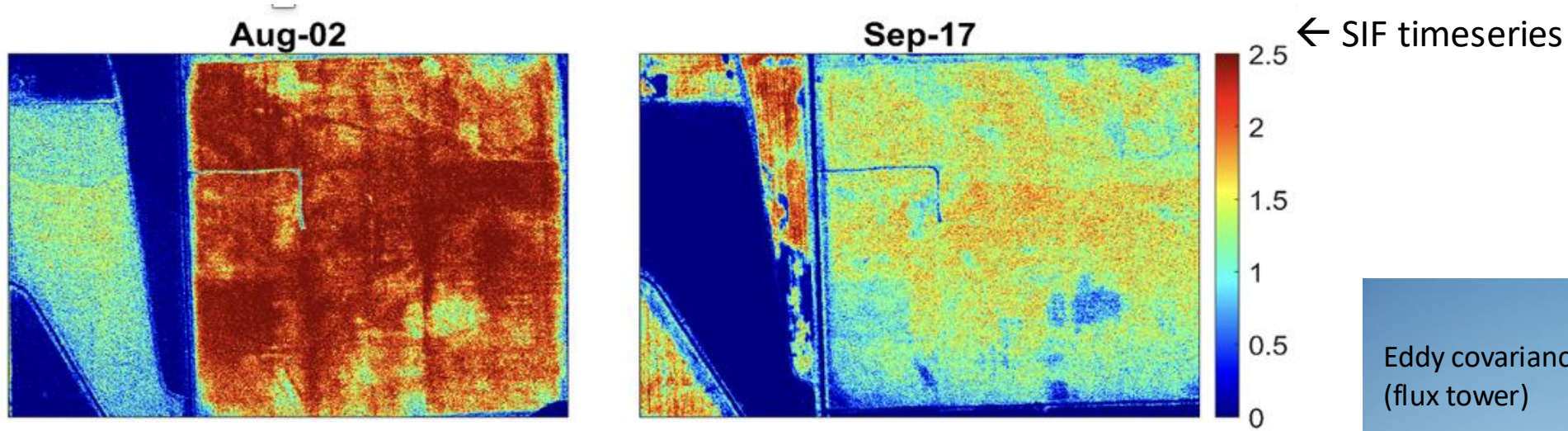
## \*Fluorescence Explorer:

A global mission to combine imaging spectrometry and fluorometry for assessing plant photosynthesis and carbon cycle

## NEO sensors:

- Reflectance
- Fluorescence
- Surface temperature

# Spatial and temporal variation in crop photosynthesis (GPP) revealed with chlorophyll fluorescence & spectral reflectance



Validating remotesensed models against carbon flux (eddy covariance) at CSP3

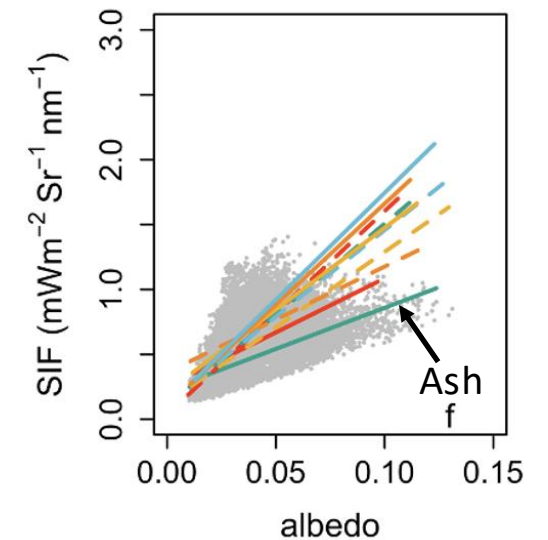
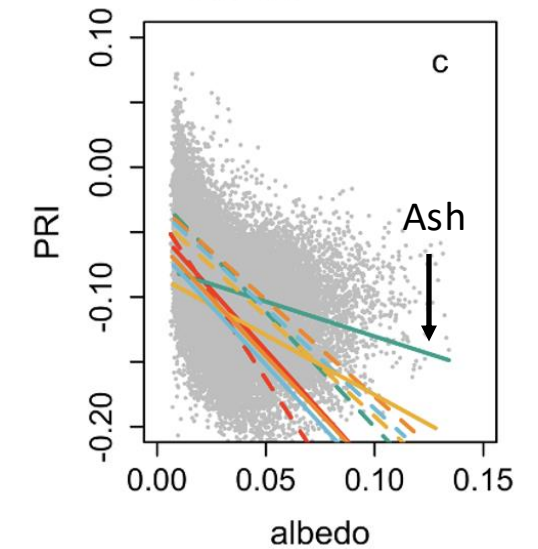
# East Campus – functional diversity (photosynthesis and early stress detection)



- *C. canadensis*   ● *Q. bicolor*   ● *Q. rubra*   ● *P. nigra*   ● *P. pungens*  
● *F. pennsylvanica*   ● *Q. macrocarpa*   ● *P. abies*   ● *P. ponderosa*   ● *P. sylvestris*

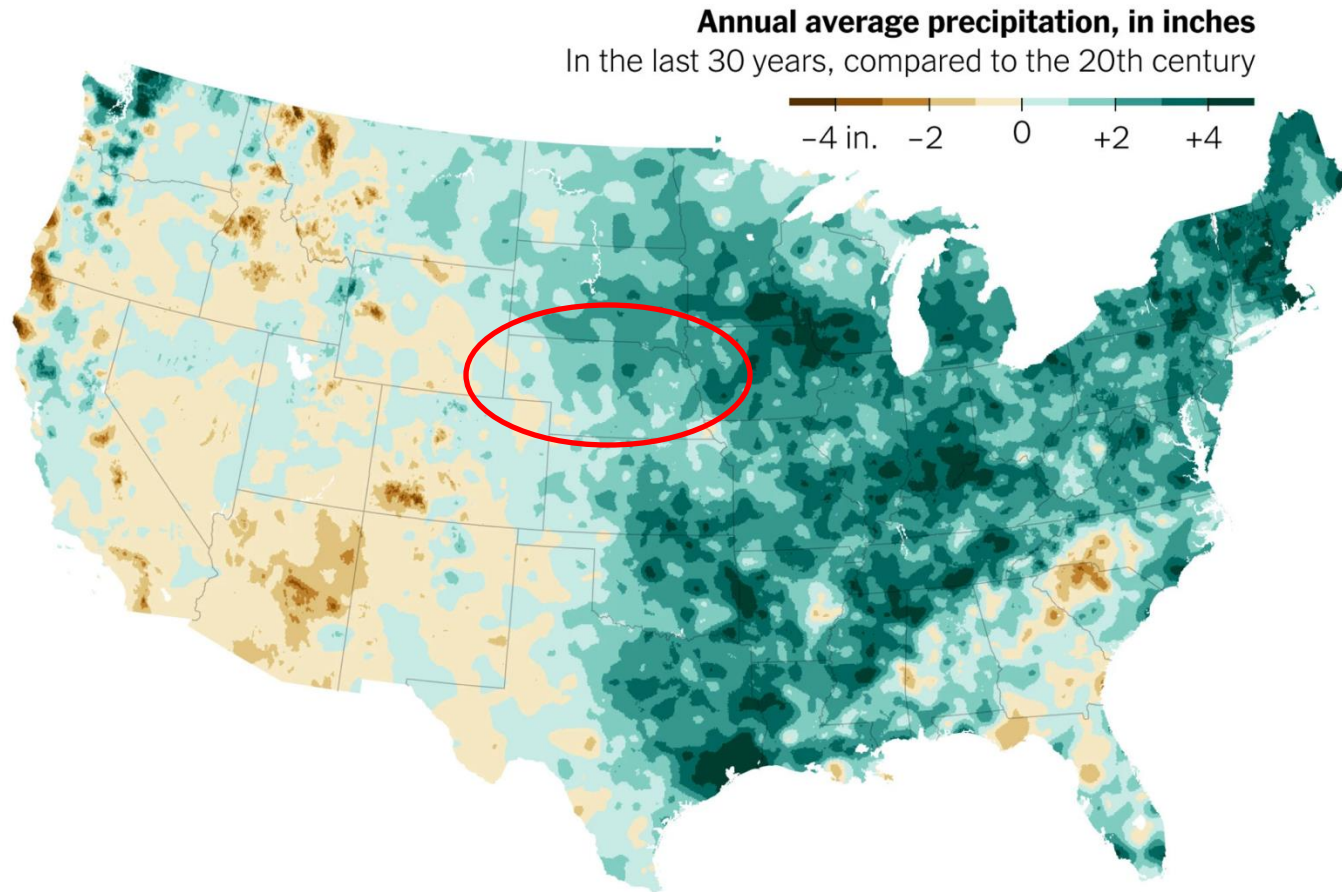
Wang et al.  
(in review)

True color composite image of the University of Nebraska-Lincoln East Campus area. Reflectance at 640 nm, 550 nm, and 460 nm were used for the R, G, and B channels, respectively. Tree species data (colored dots) were provided by the University of Nebraska-Lincoln Landscape Services.



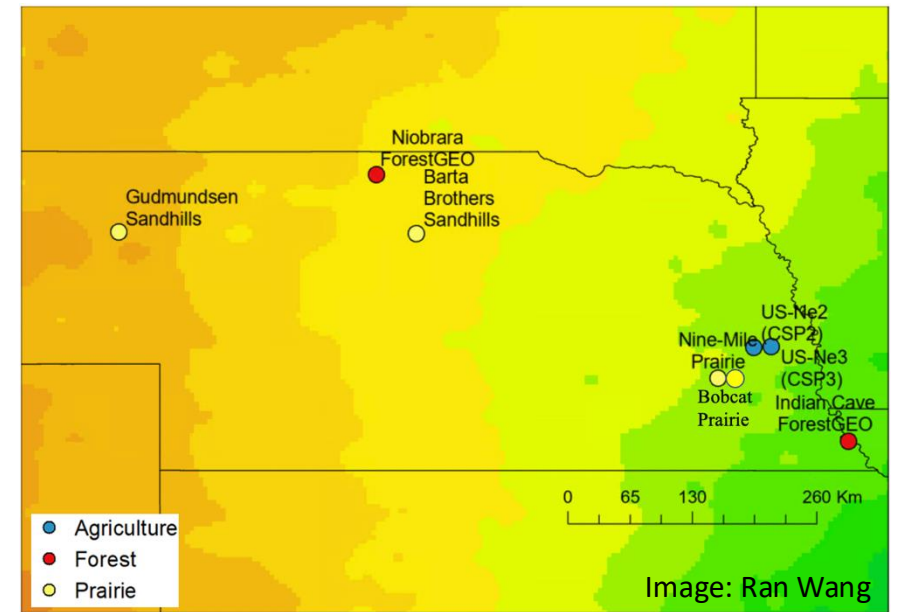
Ash trees appear as outliers  
(possibly indicating decline  
due to emerald ash borer)

# Changing hydrological and thermal regimes

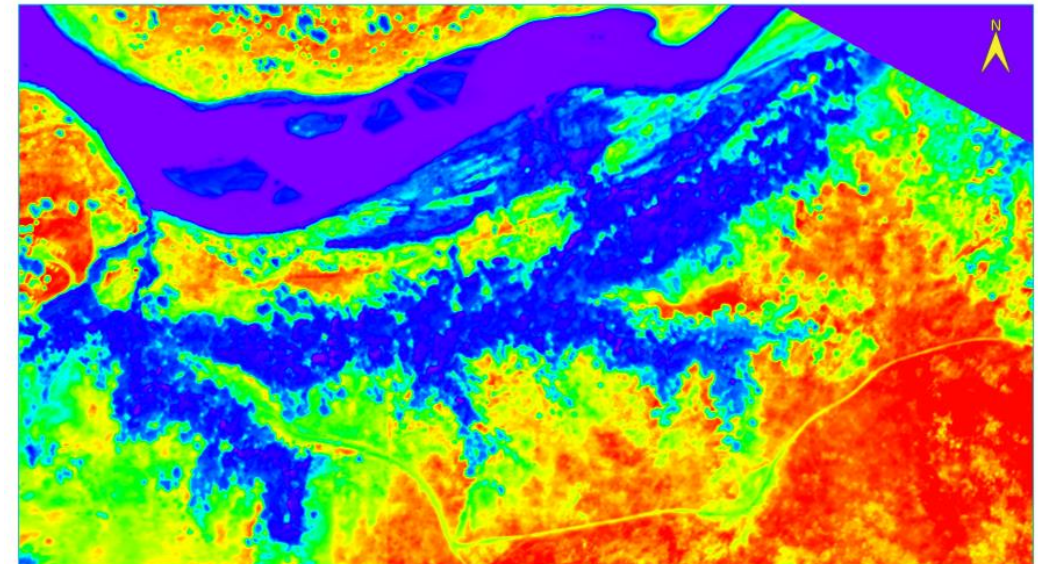


Rainfall Trends (past 30 years)

Source: NOAA National Centers for Environmental Information  
(as reported in the New York Times, Aug 24, 2021)



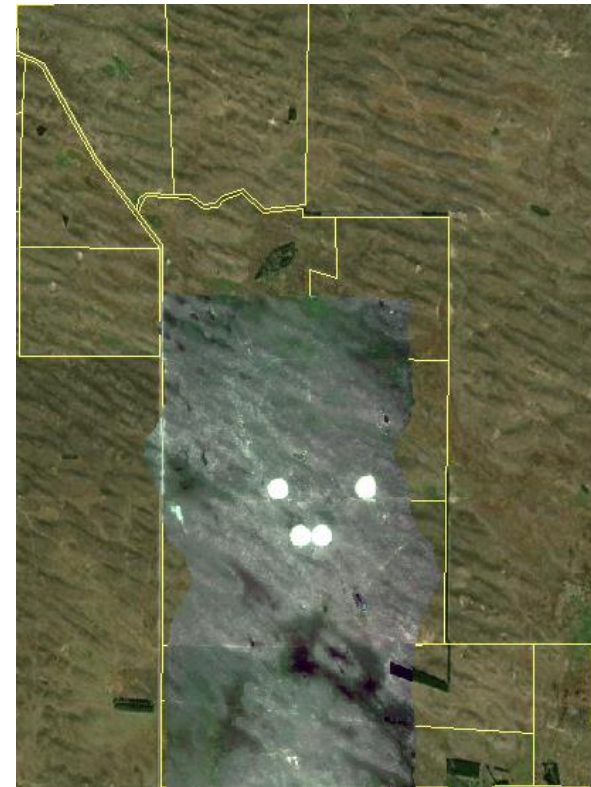
NEO flights span hydrological and thermal gradients



Thermal image of Niobrara ForestGEO plot (S. Russo)  
(Image courtesy Tithira Lakkana)



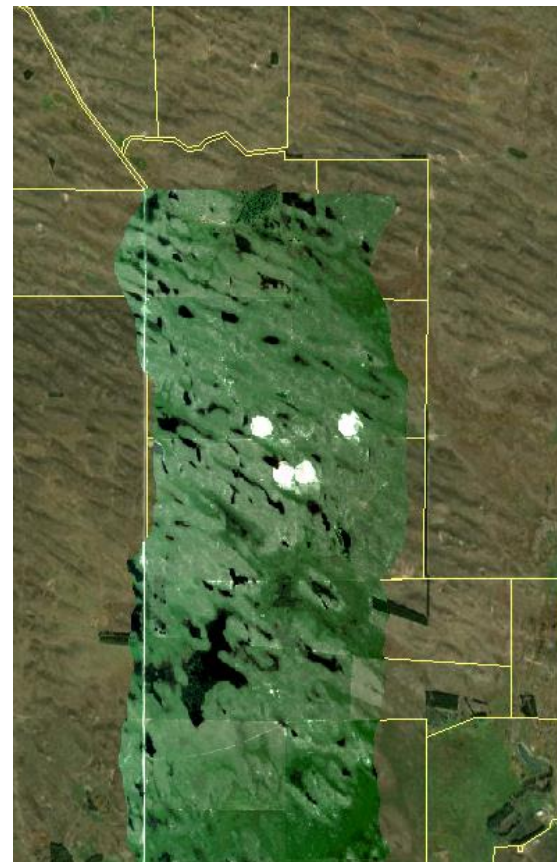
# NEO Time Series, Barta Brothers Ranch



2007 Jun 25

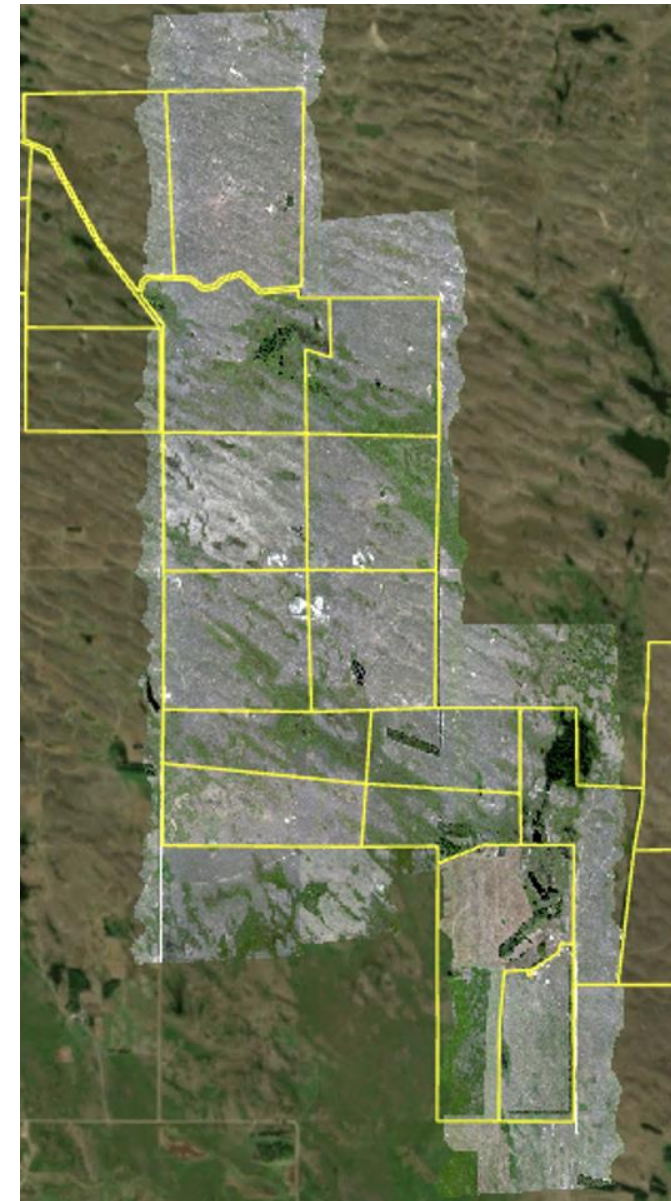


2009 Jun 29



2010 Jun 30

...



2022 July 13

...

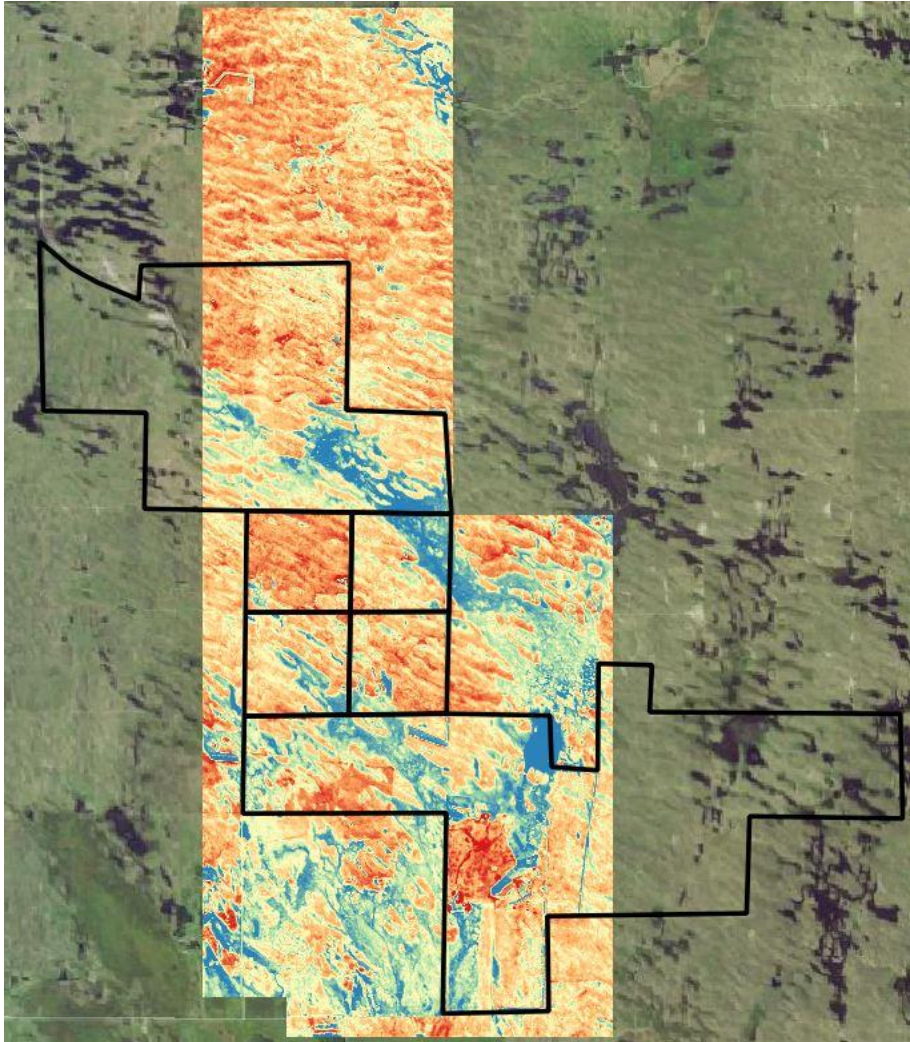
**Kestrel (356 bands)**

**AISA Eagle (63 bands)**

NEO flight lines overlaid on Google Earth Imagery

(Fig. R. Wang, J. Gamon)

# Barta Brothers Ranch (Sandhills)



Flight lines overlaid on Google Earth Imagery  
Thermal Quicklook – July 2022  
(Aaron Schepers)

## Spectroscopy reveals affects of Burning & Grazing



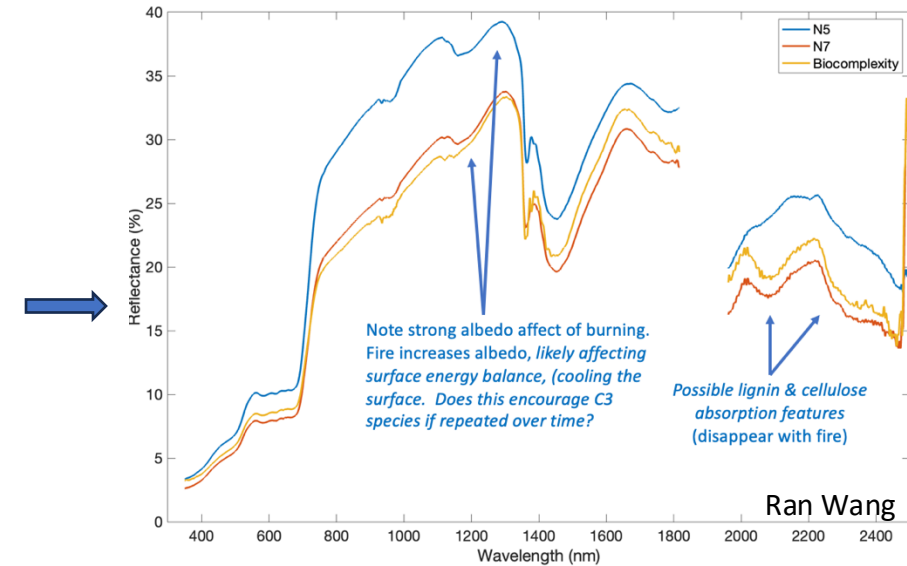
Field N5 (burned)



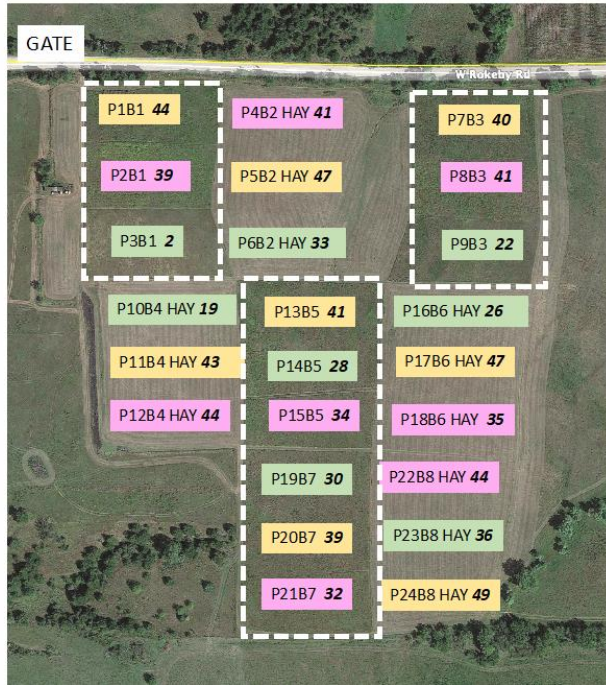
Field transect spectra



Field N7 (unburned)



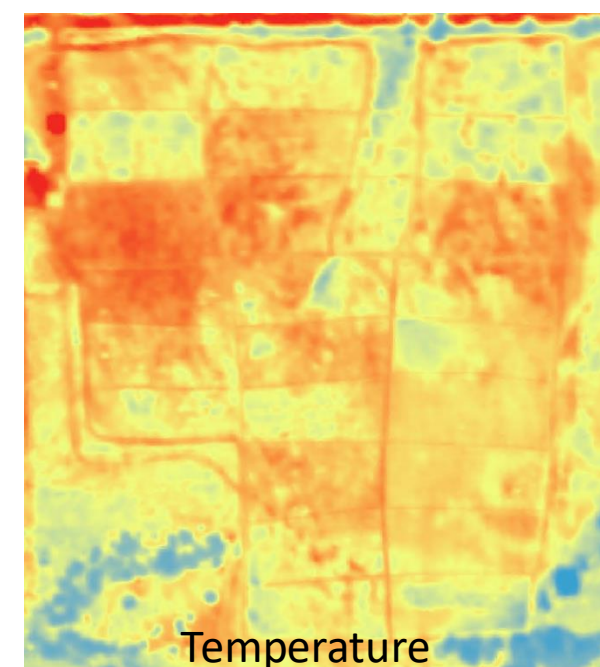
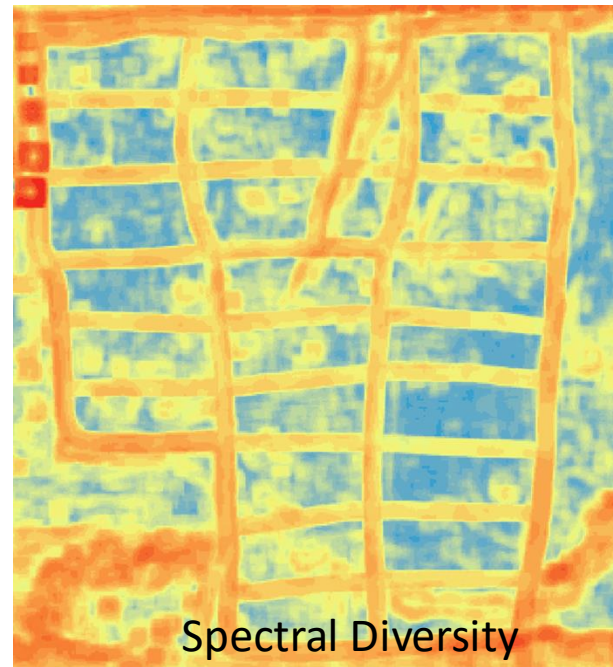
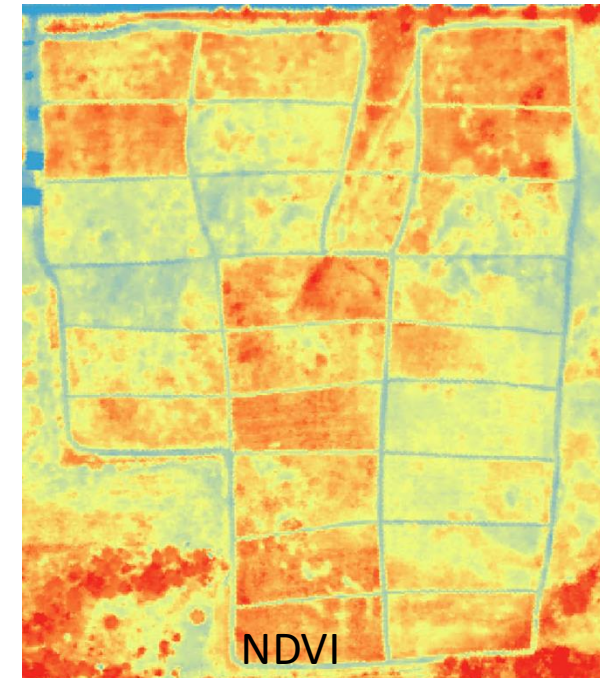
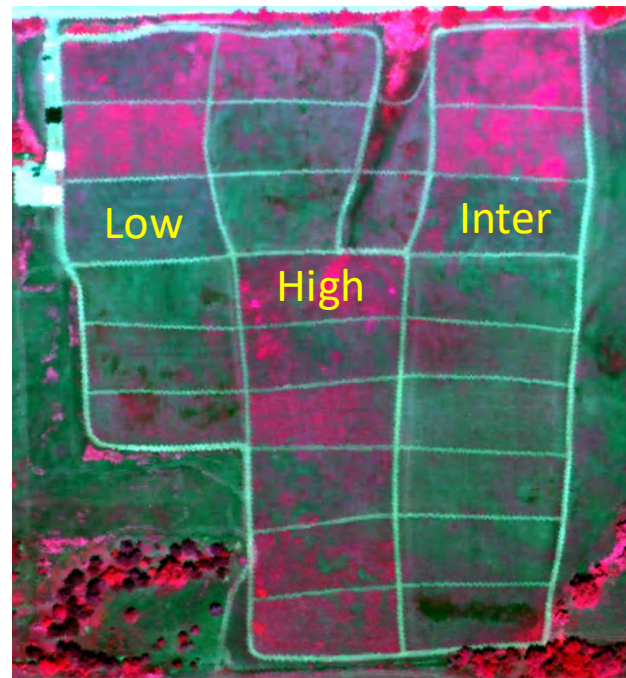
Bobcat Prairie (near Lincoln NE)  
 study of biodiversity & productivity under  
 contrasting management treatments.  
 (collaboration with D. Wedin, K. Hogan)



150 species seed mix

40 species seed mix

Control



Revealing  
 treatment  
 effects on  
 productivity,  
 diversity and  
 surface  
 temperature

False Color IR, NDVI, spectral diversity, surface temperature, July 20, 2022 – Figure: Ran Wang

# *Advancing NEO for maximal impact ---*



- Interdisciplinary research advancing knowledge
  - Advancing interdisciplinary science at the intersection of climate, hydrology, physiology and ecology.
- Collaboration
  - Working across disciplines
  - Enhanced university and industry partnerships
- Outreach
  - Enhancing community engagement across the Heartland.
- Training for capacity building
  - Expanding capabilities in spatial sciences (GIS & remote sensing).
- Informatics – open data access
  - Advancing Open Science approaches.

→ *Help us advance NEO's mission for open, accessible airborne science across the Heartland!*

# For discussion:

- Regional consortium of airborne remote sensing?
- Tackling informatics & cyberinfrastructure (archiving)
- Tuning the dial → operational products → actionable results