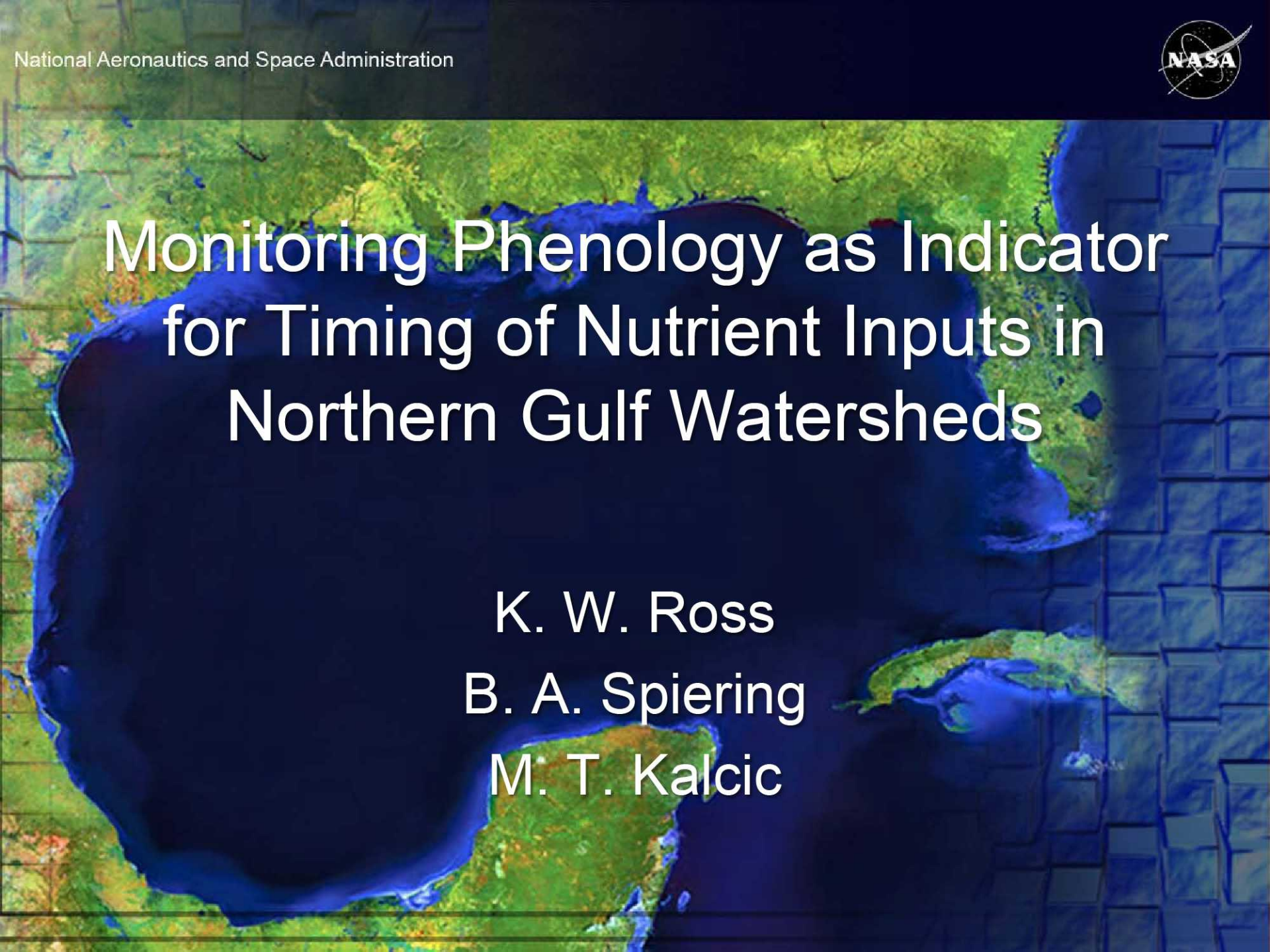
National Aeronautics and Space Administration



Monitoring Phenology as Indicator for Timing of Nutrient Inputs in Northern Gulf Watersheds

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Motivation

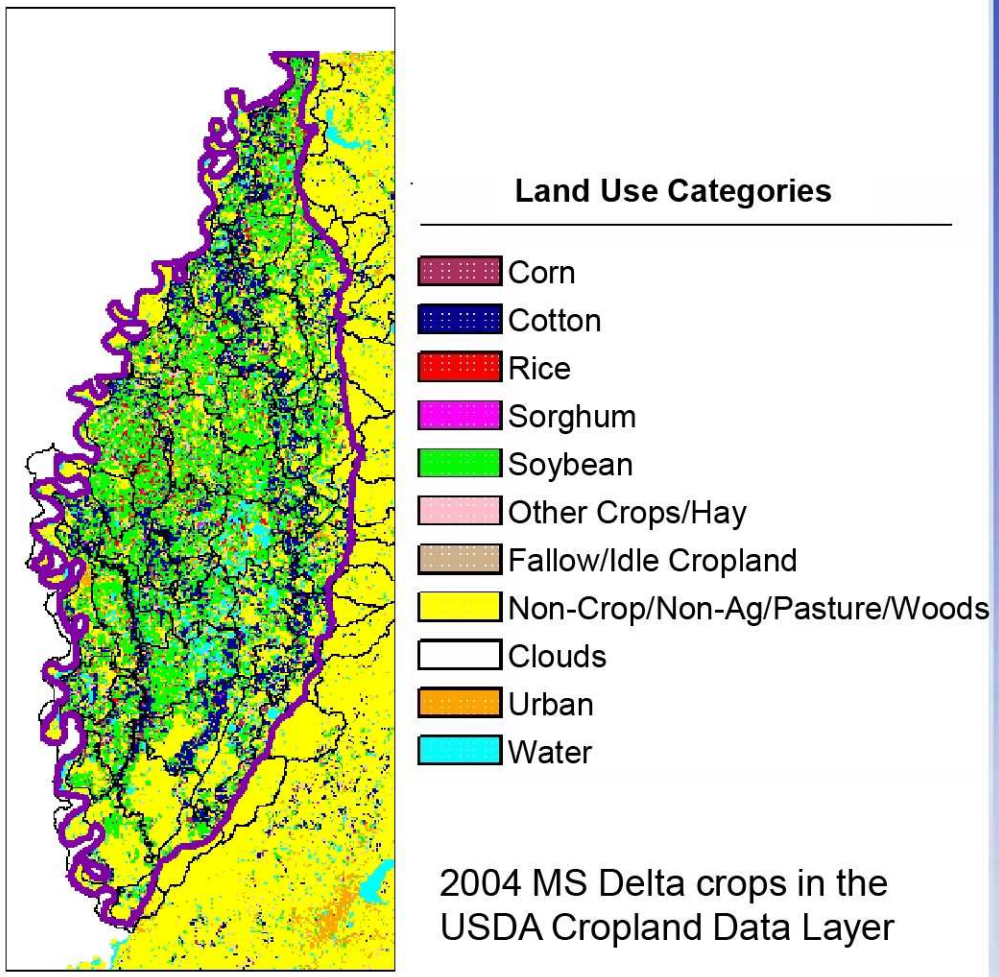
Need to understand when non-point source nutrients are applied to the landscape

If you will use more than 100 pounds nitrogen per acre, you should split the rate because of the danger of salt damage. A split of one-half preplant and one-half sidedress, or two-thirds preplant and one-third sidedress, can be used.

Excerpt from “Cotton Fertility,” Publication 1622 of the Extension Service of the Mississippi State University by William H. McCarty

Challenge

Develop phenologies for crop cover types on watershed-by-watershed basis



2004 MS Delta crops in the USDA Cropland Data Layer

Solution

Develop tool to summarize crop and other land cover phenologies to provide indicators of timing of fertilizer applications

Definitions

Phenology

The study of recurring plant and animal life cycle stages

NDVI *(normalized difference vegetation index)*

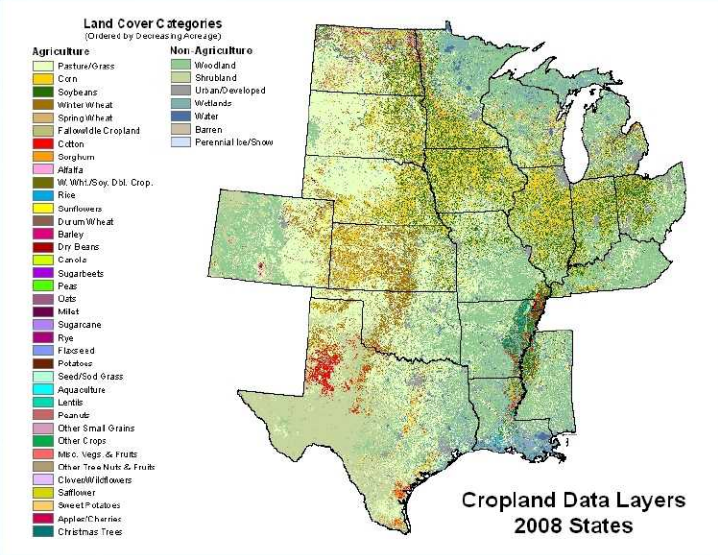
Difference of red and NIR reflectance divided by the sum of red and NIR reflectance

Premise

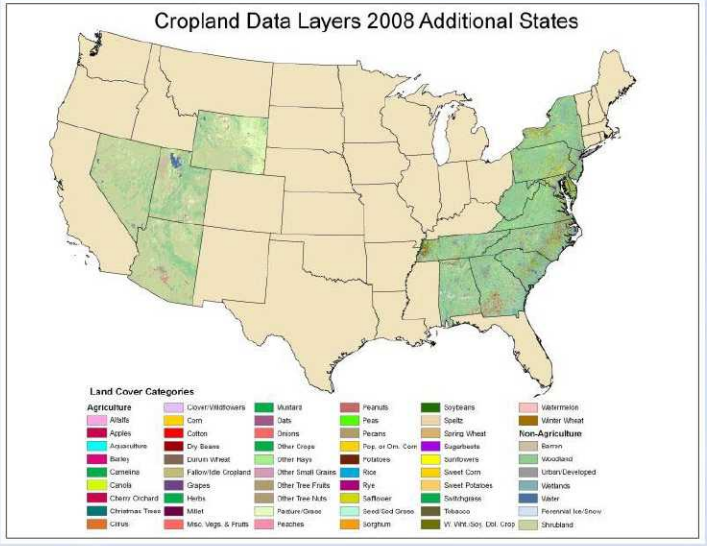
- For areas in which certain crops require large-scale addition of nutrients in the early season, a pulse of nutrients may be available for run-off in watersheds
- By observing phenology of particular crops, we might obtain remotely sensed indicators of the timing of this pulse

USDA Cropland Data Layer

Continuing Outputs



New Outputs

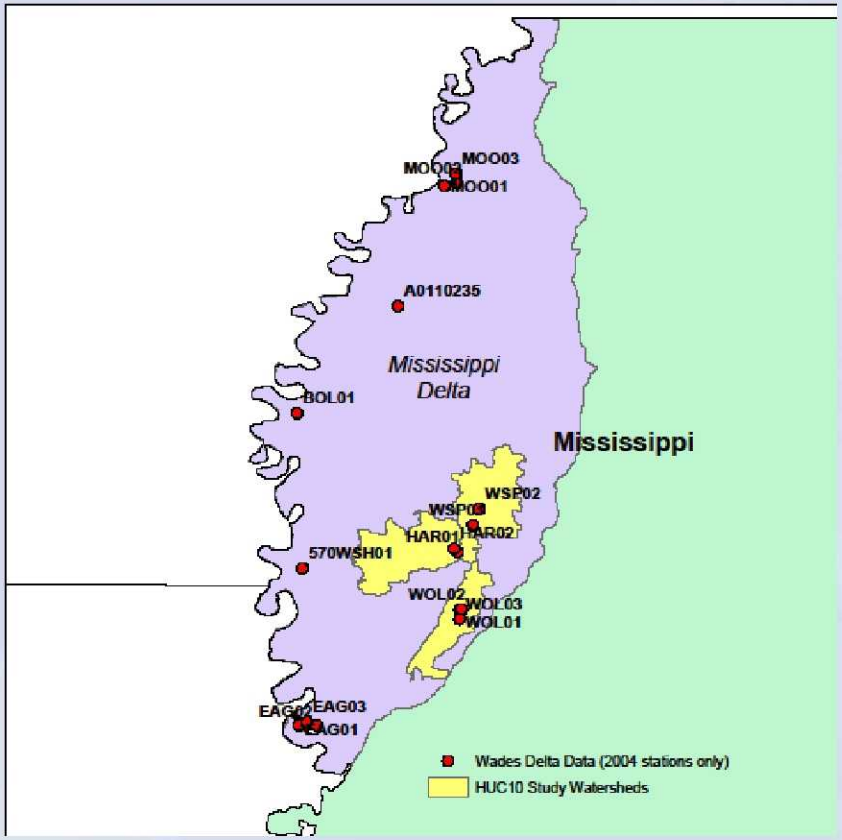


The Cropland Data Layer (CDL) is a raster crop cover classification originally derived from Landsat (30 m) and currently based on the Indian government's ResourceSat-1 AWiFS sensor (60 m)

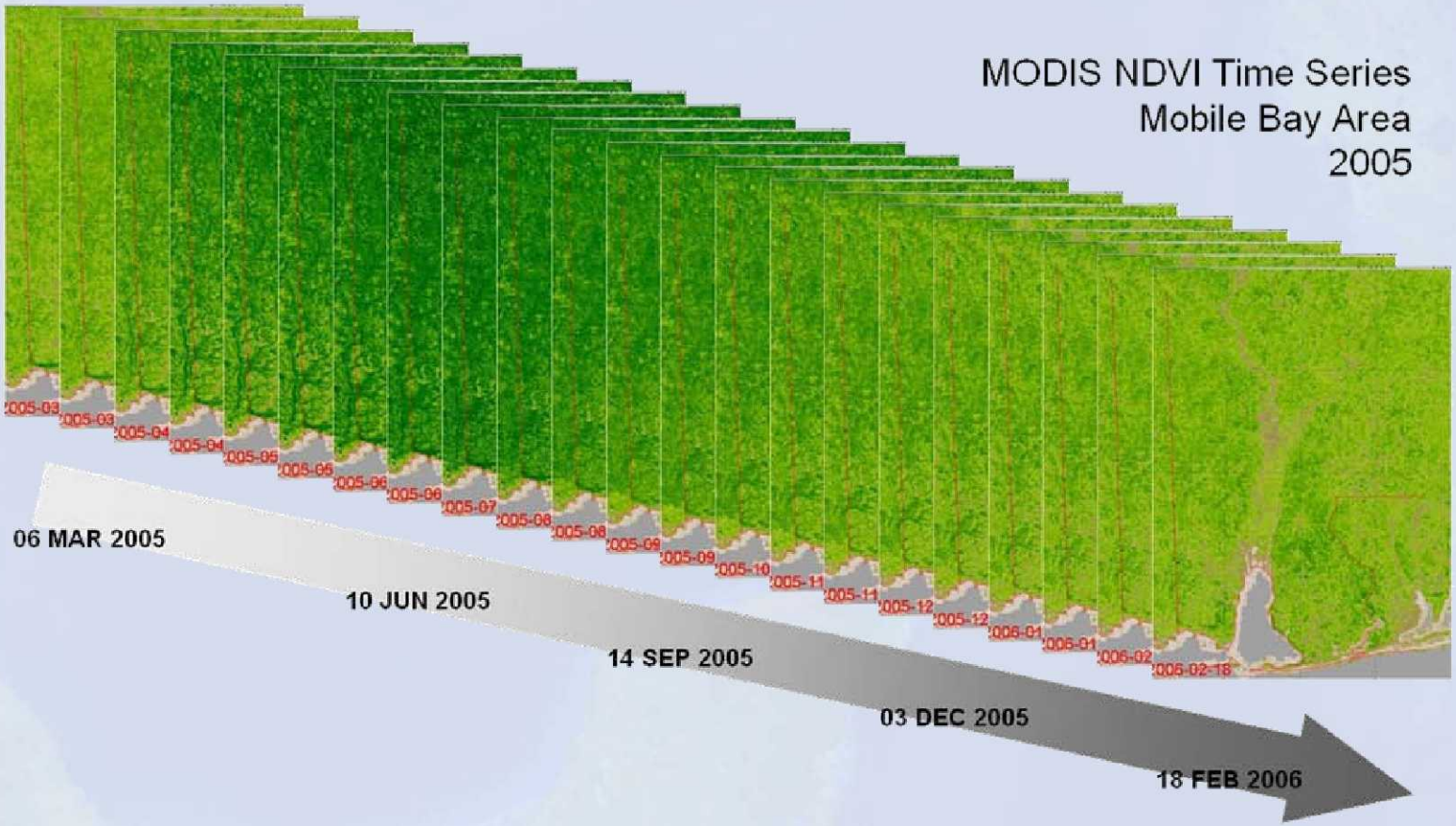
http://www.nass.usda.gov/research/Cropland/SARS1a.htm

Main Study Area & Time

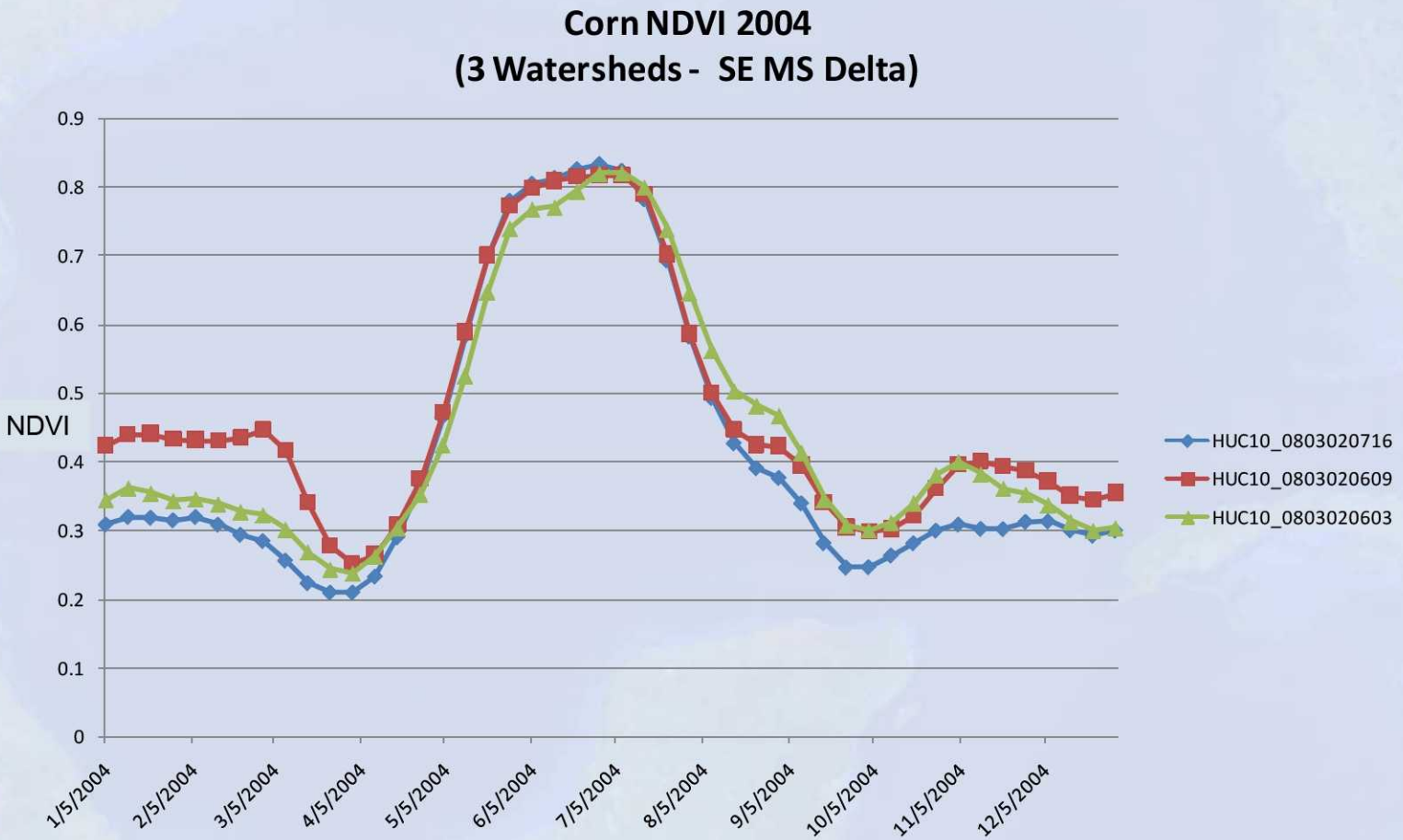
- 3 HUC 10 watersheds in the southwest portion of Mississippi Delta region
- Watersheds chosen based on available in-situ nutrient monitoring data
- Desirable to find watersheds that would be somewhat isolated
- Selected time frame was 2004



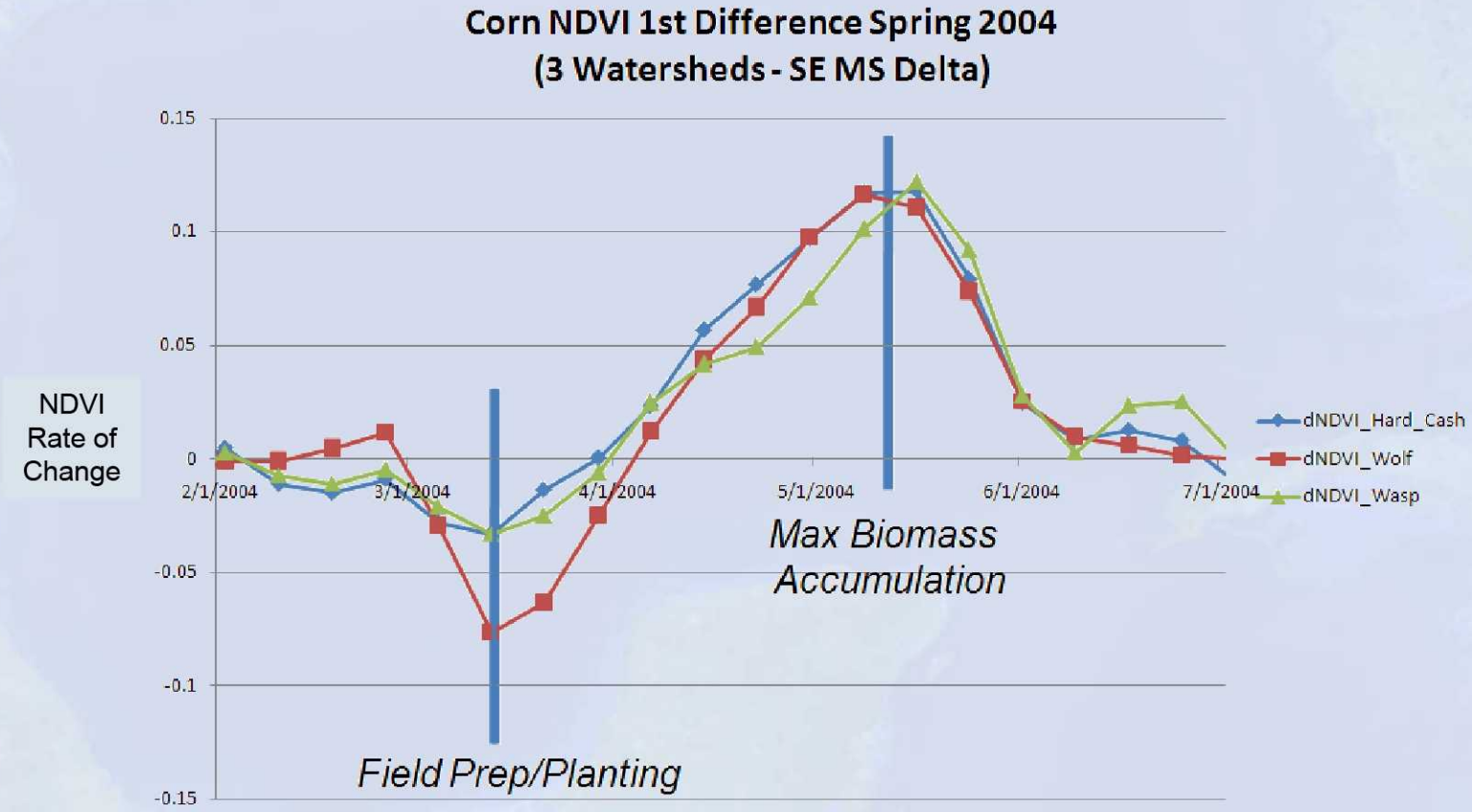
Observable: MODIS NDVI



Observable: MODIS NDVI



Non-Point Source Critical Dates Derived from MODIS

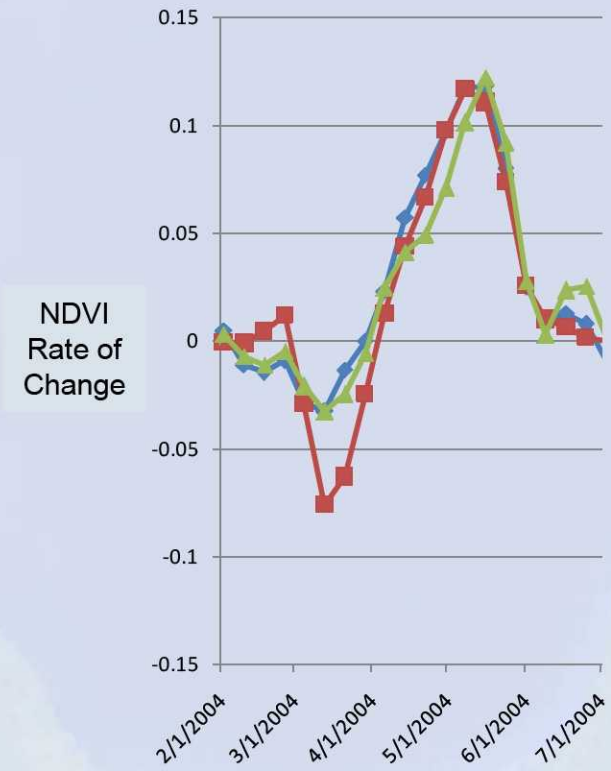


Significance of Critical Dates

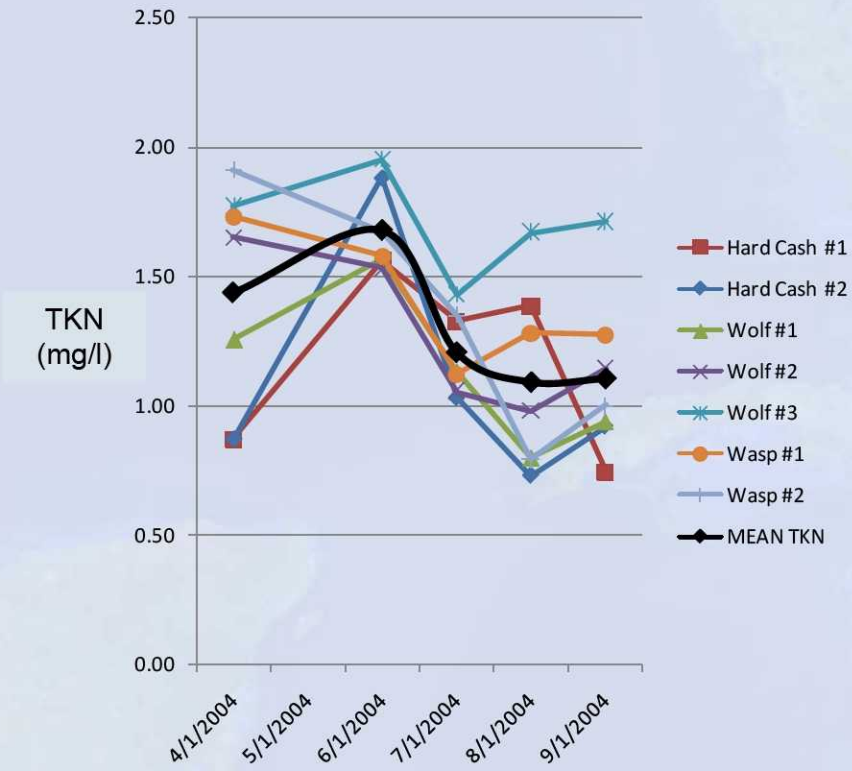
- Field Prep/Planting date represents time of most likely pre-plant and planting fertilizer application – also time of maximum erodibility
- Maximum Biomass Accumulation date represents the physiological target for nutrient availability for the crop – time of side-dress fertilizer application

NDVI Surge Corresponds to Elevated N

Corn NDVI 1st Difference



In-Situ Nitrogen

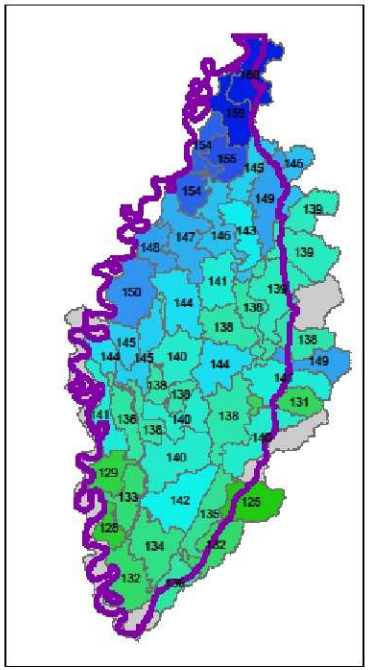


Critical Dates Can Be Mapped

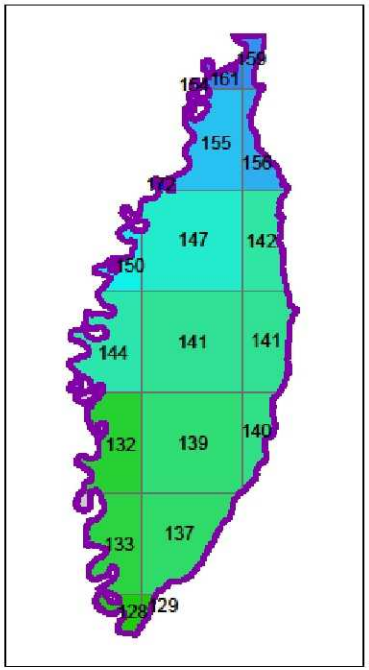
Unit of analysis may be arbitrarily complex

Cotton Start-of-Season (DOY20L)

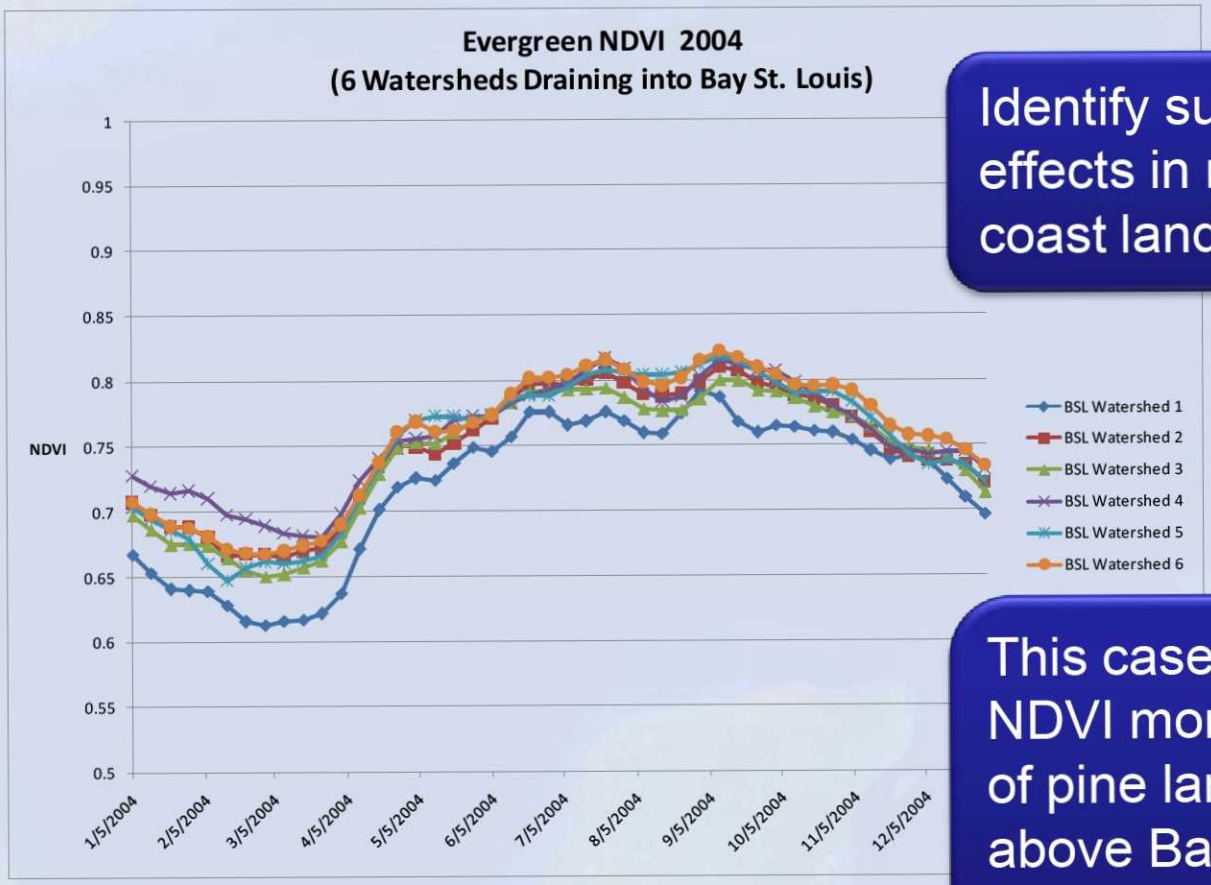
by Watershed (HUC 10)



by Arbitrary Grid



Future Work



Identify subtler effects in near-coast land cover

This case shows NDVI monitoring of pine lands above Bay St. Louis

Discussion

- Results showing correspondence of cropland-specific NDVI rate of change to in-situ N
- Products are fully quantifiable temporally and spatially, so they can be useful for model input
- Approach based on standardized NASA and USDA data with minimal user interaction necessary
- Further study necessary to demonstrate reliability of MODIS proxy data in varied circumstances
- To serve as a useful model input, product would require new generation of nutrient model that would be both spatially and temporally explicit