Integration of Process Models and Remote Sensing for Estimating Productivity, Soil Moisture and Energy Fluxes in a Tallgrass Prairie Ecosystem.

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Overview

1. Background: Seasonal burning in the Kansas Flint Hills
2. Modeling: VELMA
3. Remote Sensing: Triangle Methods
4. Early results and ongoing analysis

The Last Expanse of the Tall Grass Prairie

Flint Hills Seasonal Burning

- **Frequent Burning Maintains the Tallgrass Ecosystem**
- Late March\April
- Biannual in livestock producing areas

Flint Hills: Ecosystem Tradeoffs

- 200 Species of Birds
- 60 Species of Mammals

Flint Hills: Ecosystem Tradeoffs

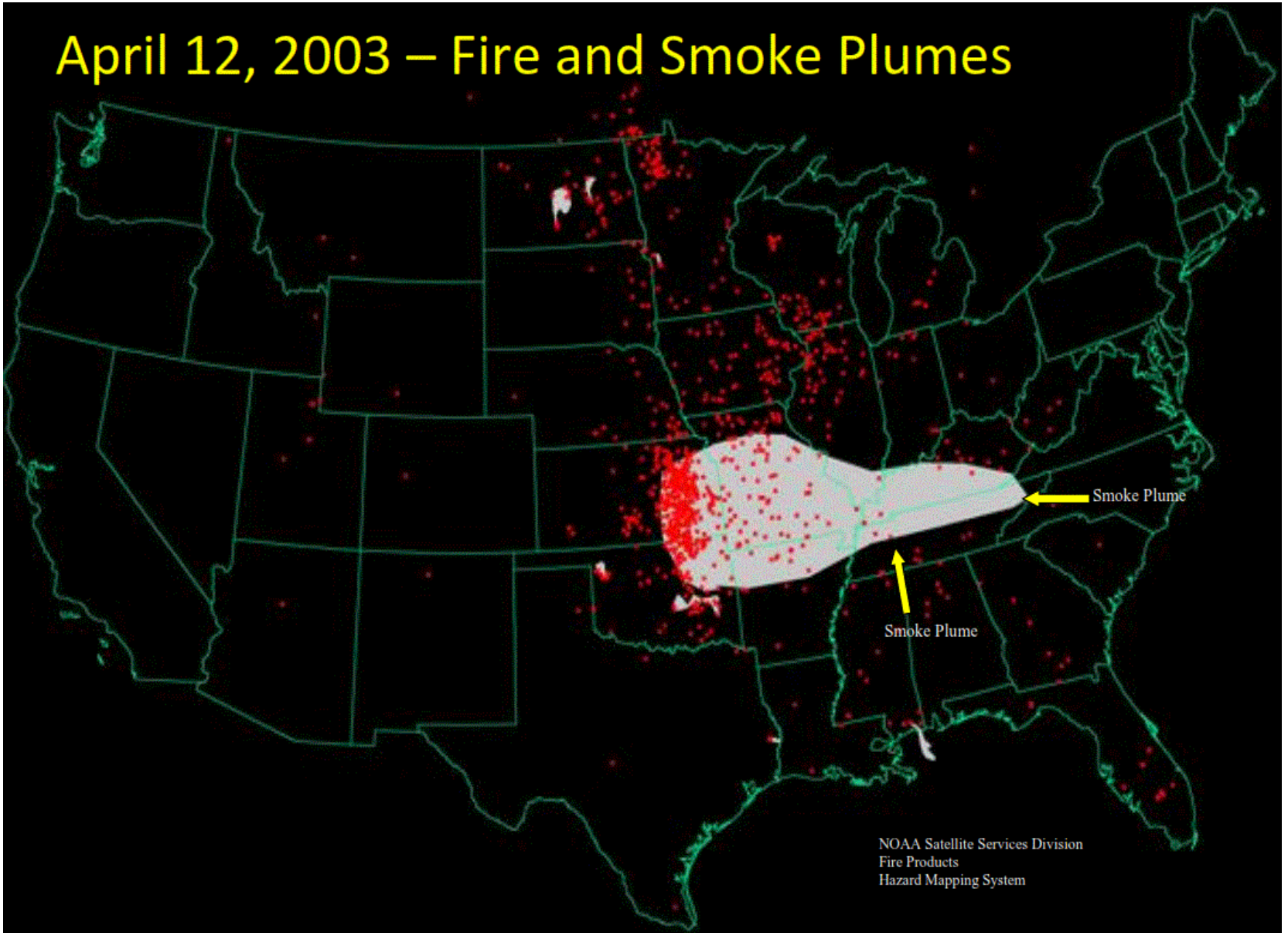
- Grassland resource
- Multi billion Dollar Grazing Economy

Flint Hills: Ecosystem Tradeoffs

Kansas City, Mo – April, 2011

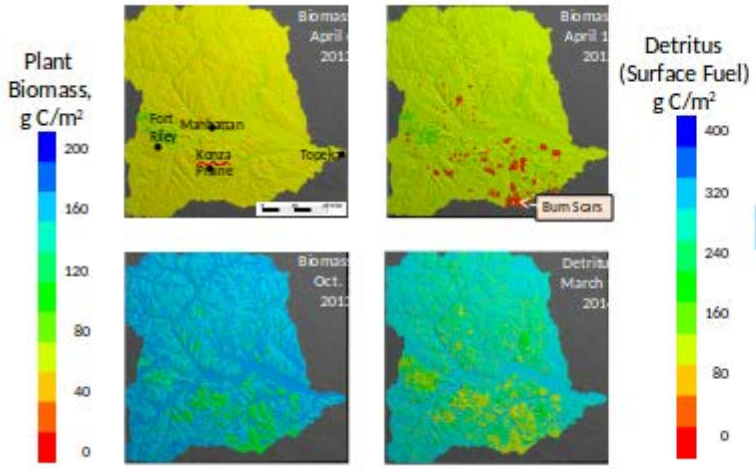
- Downwind smoke impacts from concentrated burning events
- Impacts in surrounding urban areas
- Associated with PM10, PM25 O_3 exceedance events

Flint Hills Burning: Regional Impacts

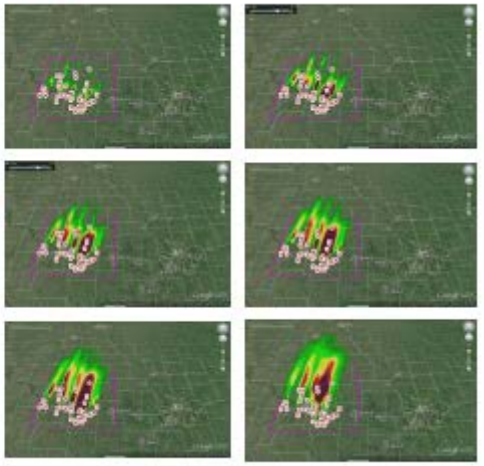


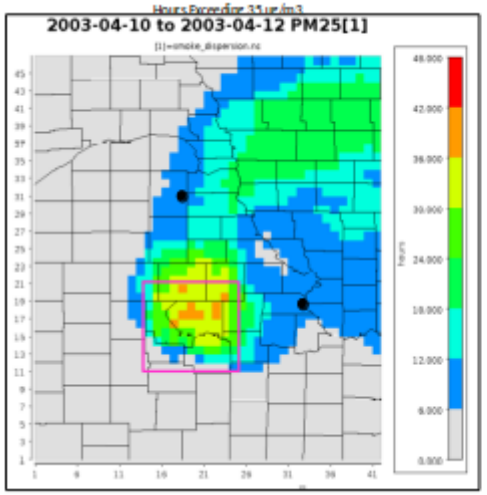
Management Model Suite

Ecohydrology Model (VELMA)

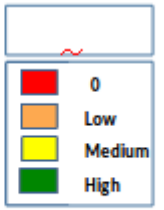


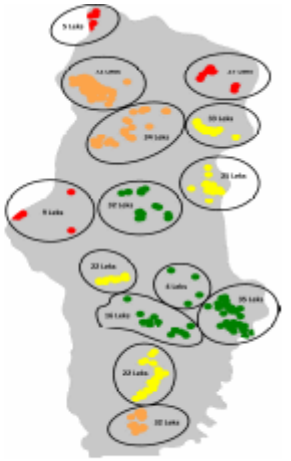
Air Quality Model





Human Health Model

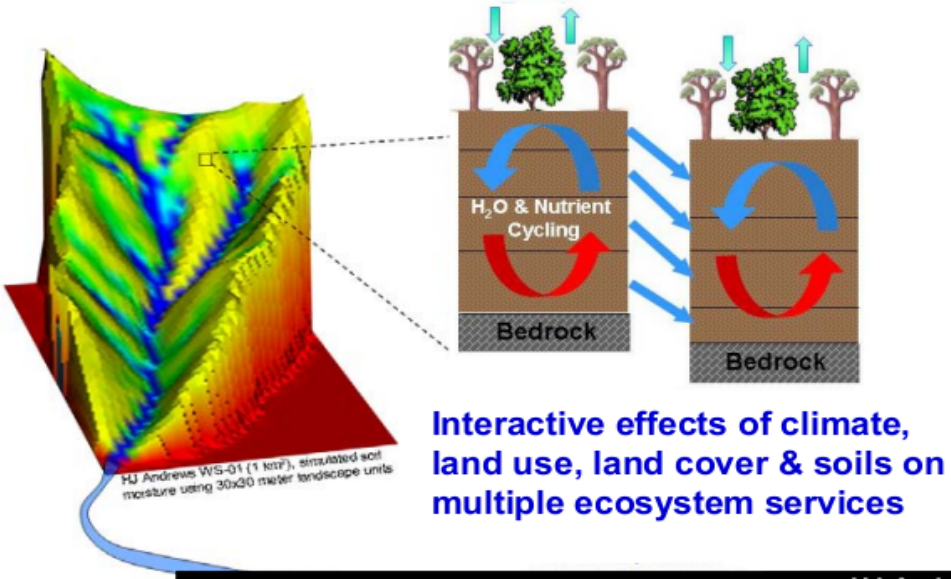




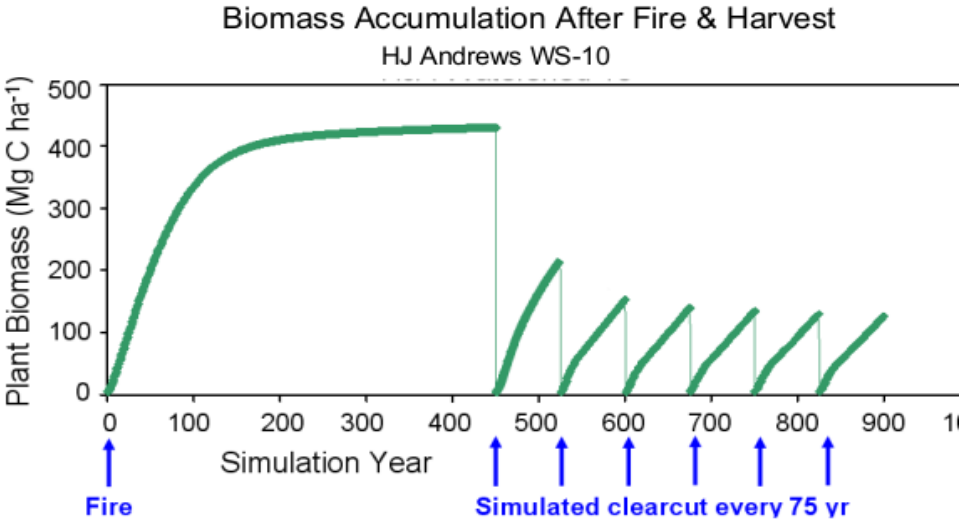
Wildlife Model

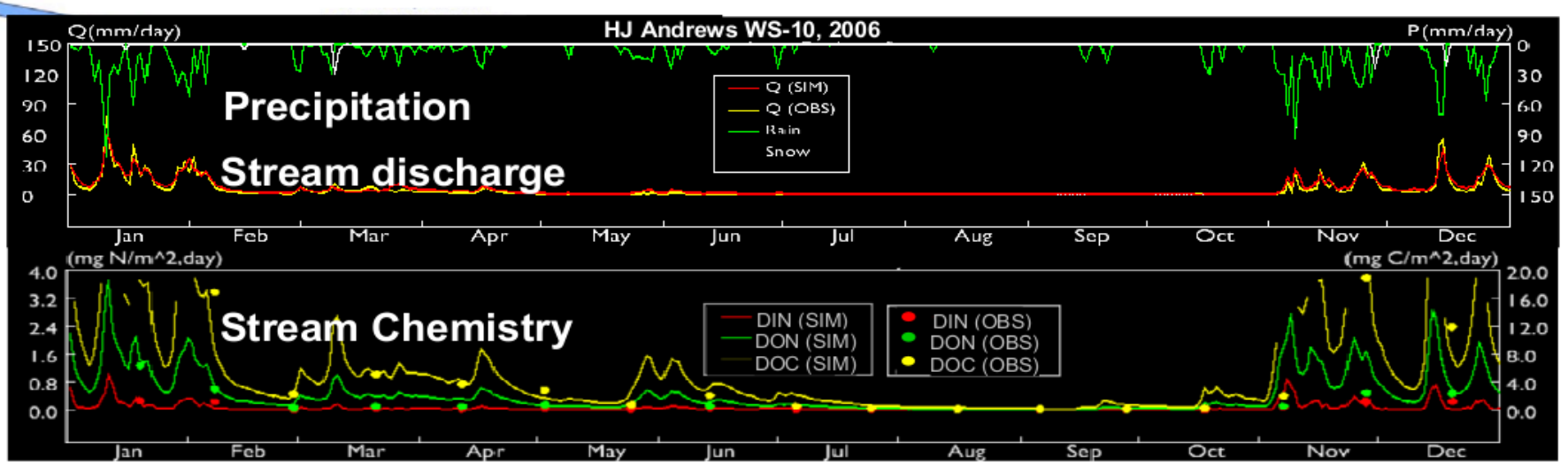
VELMA Ecohydrology Model

Linking Hydrological & Biogeochemical Processes in Watersheds



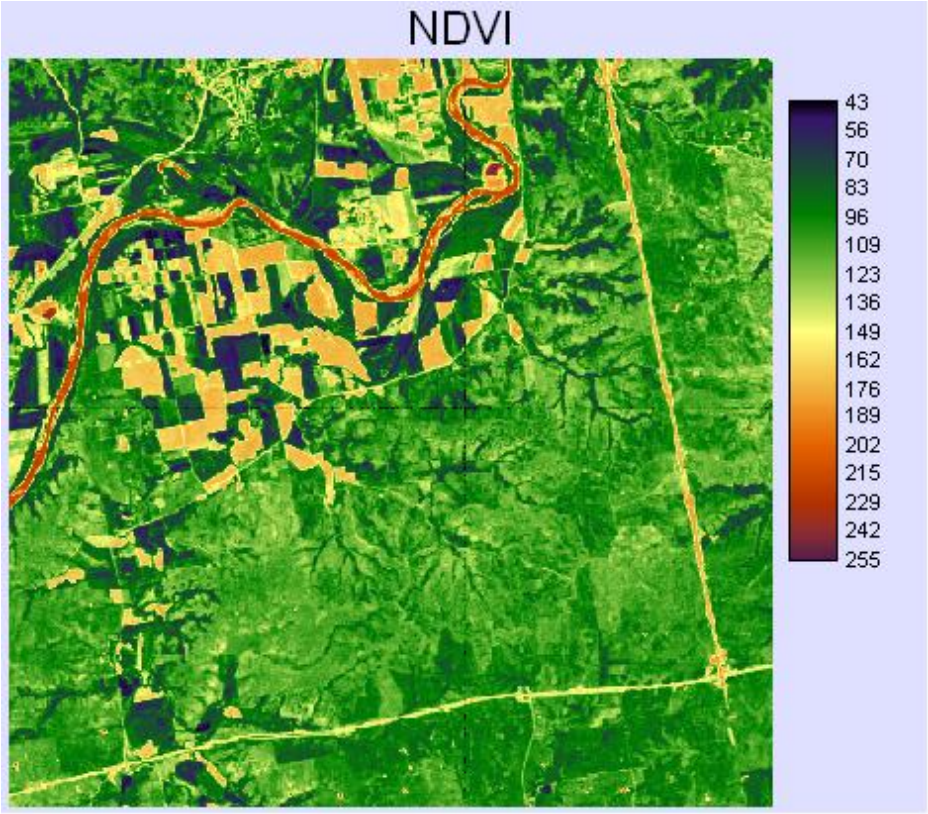
Interactive effects of climate, land use, land cover & soils on multiple ecosystem services





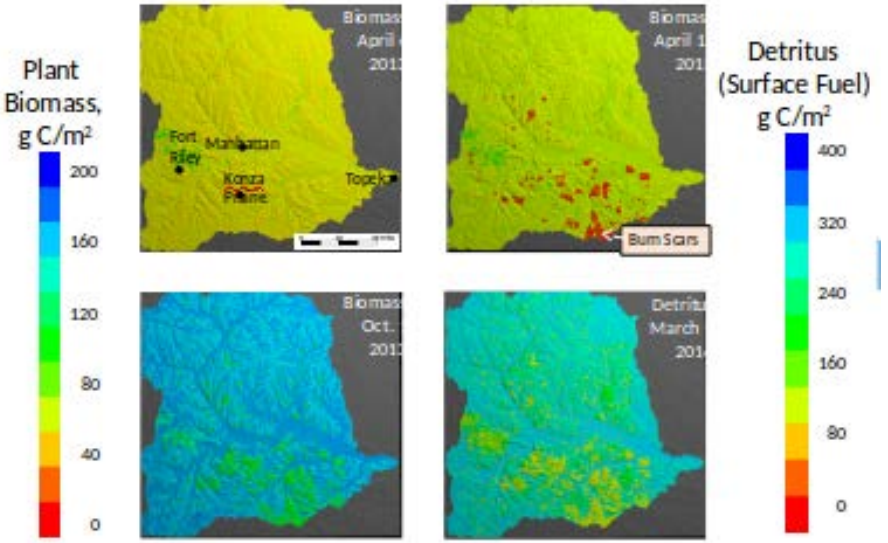
Modeling Challenges

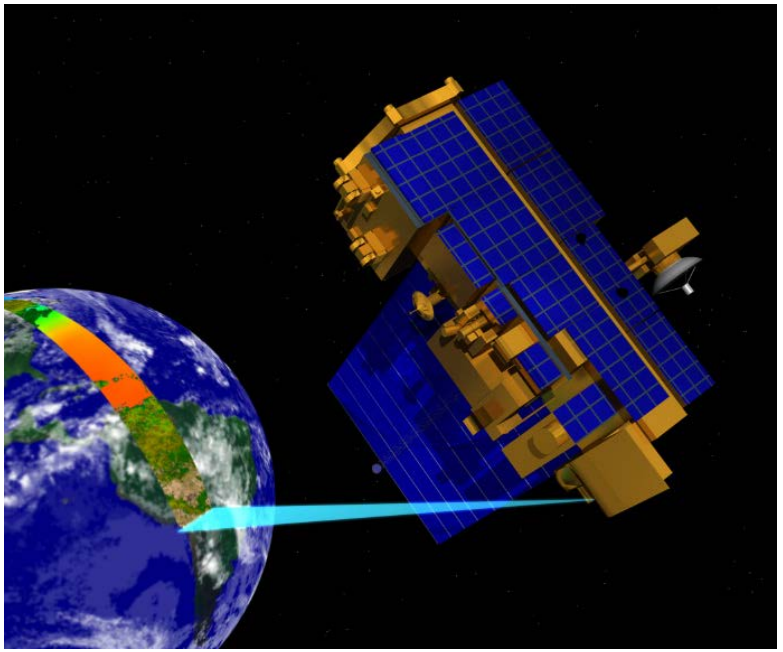
- Parameterization
- Validation
- Spatial Agreement
- Extrapolation



Calibration\Validation Site:
Konza Prairie Biological Station

Modeling + Remote Sensing



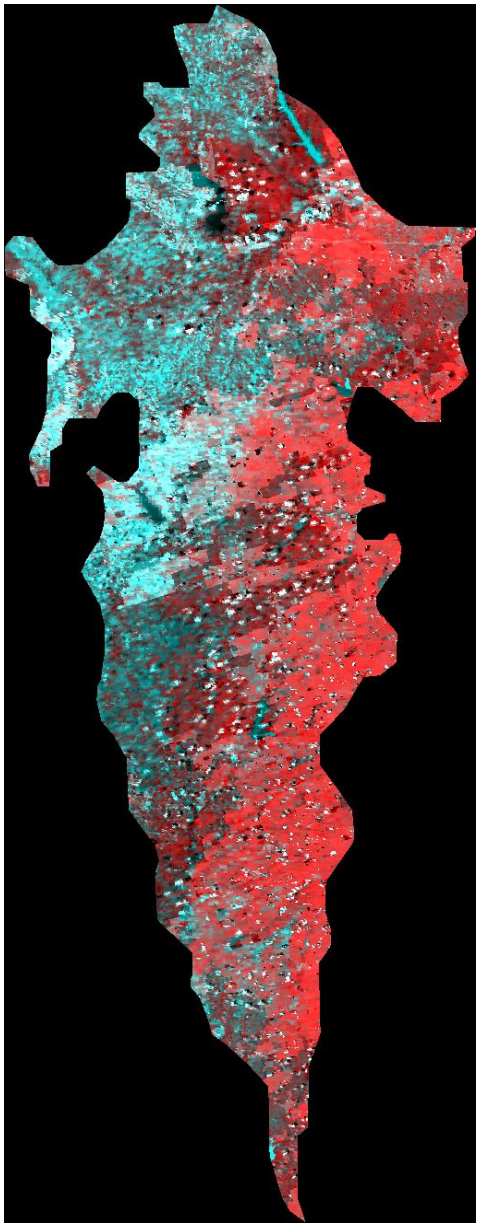


Do the resulting spatial patterns match?

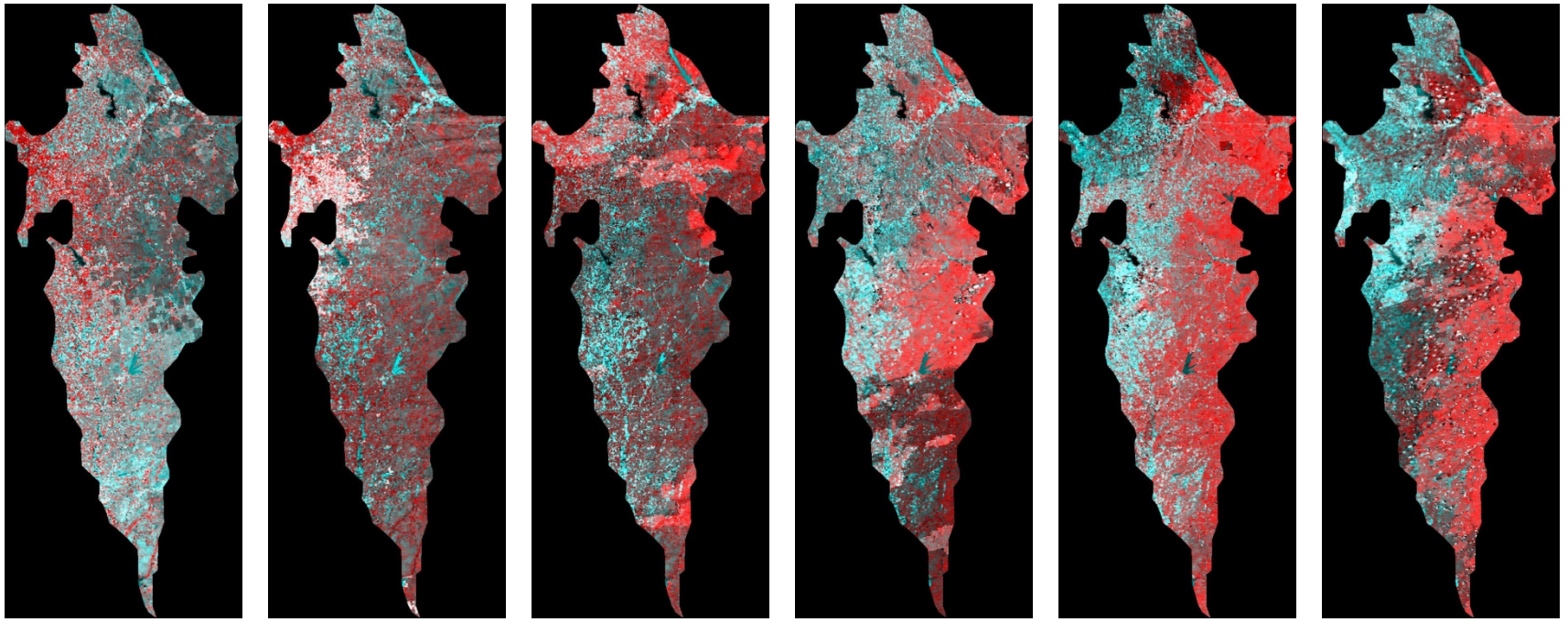
Do simulated values match remote sensing estimates?

Normalized Difference (NDVI)

- Sensitive to productivity, but restricted to growing season?
- Spatial correspondance to VELMA outputs

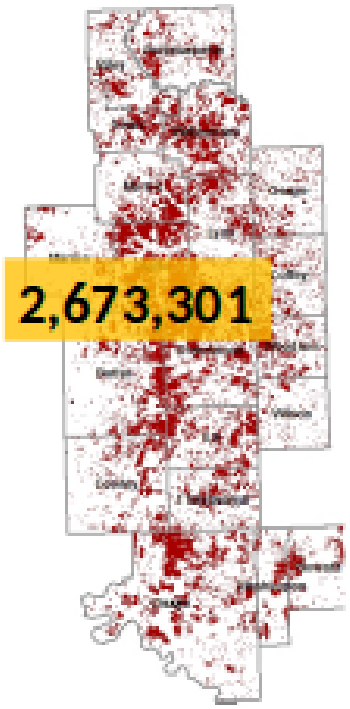


Remote Sensing



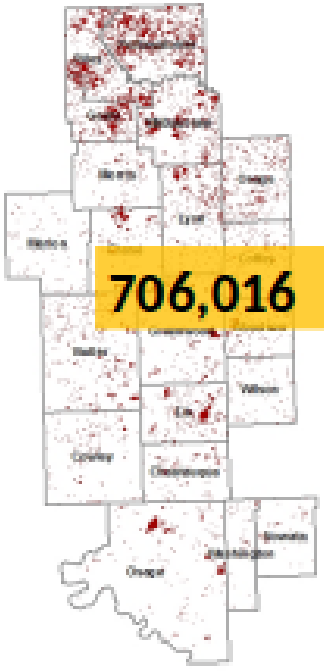
Burn Frequency and Location Analysis
From MODIS Times Series

Total Annual Acreage Burned



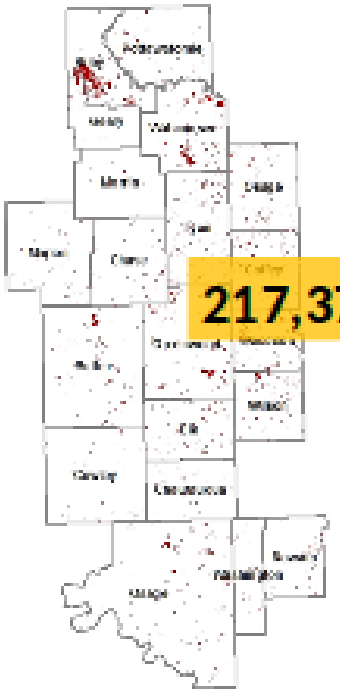
2,673,301

2011



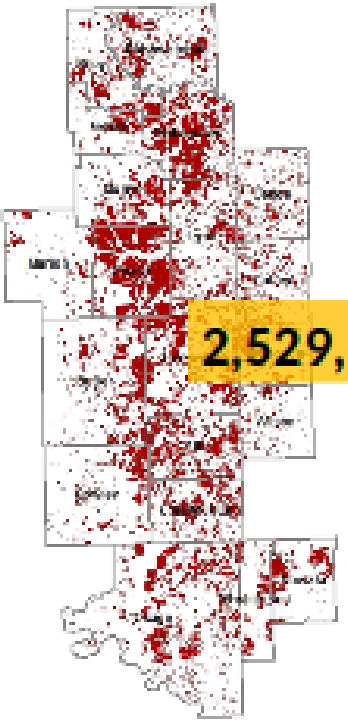
706,016

2012



217,377

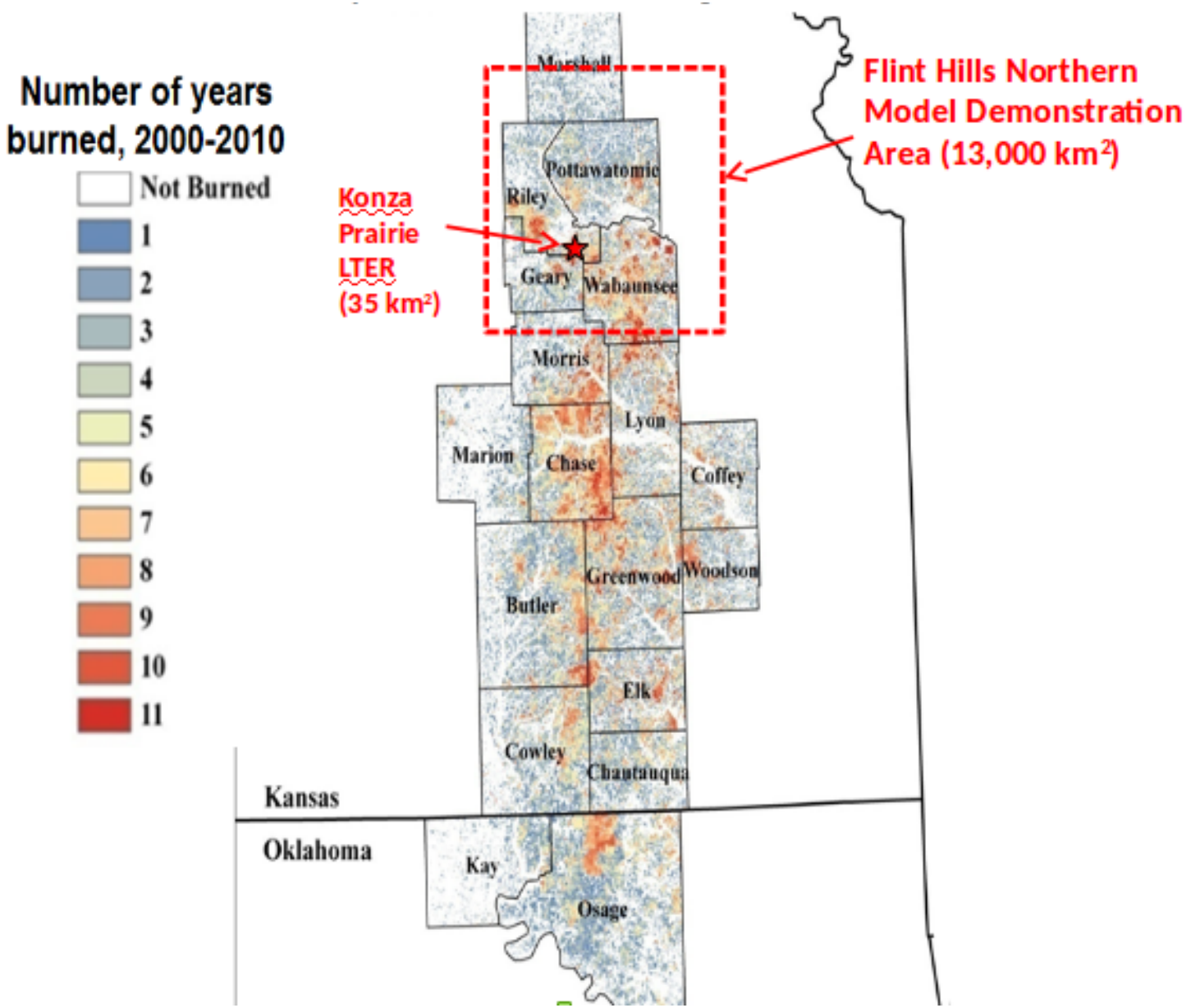
2013



2,529,468

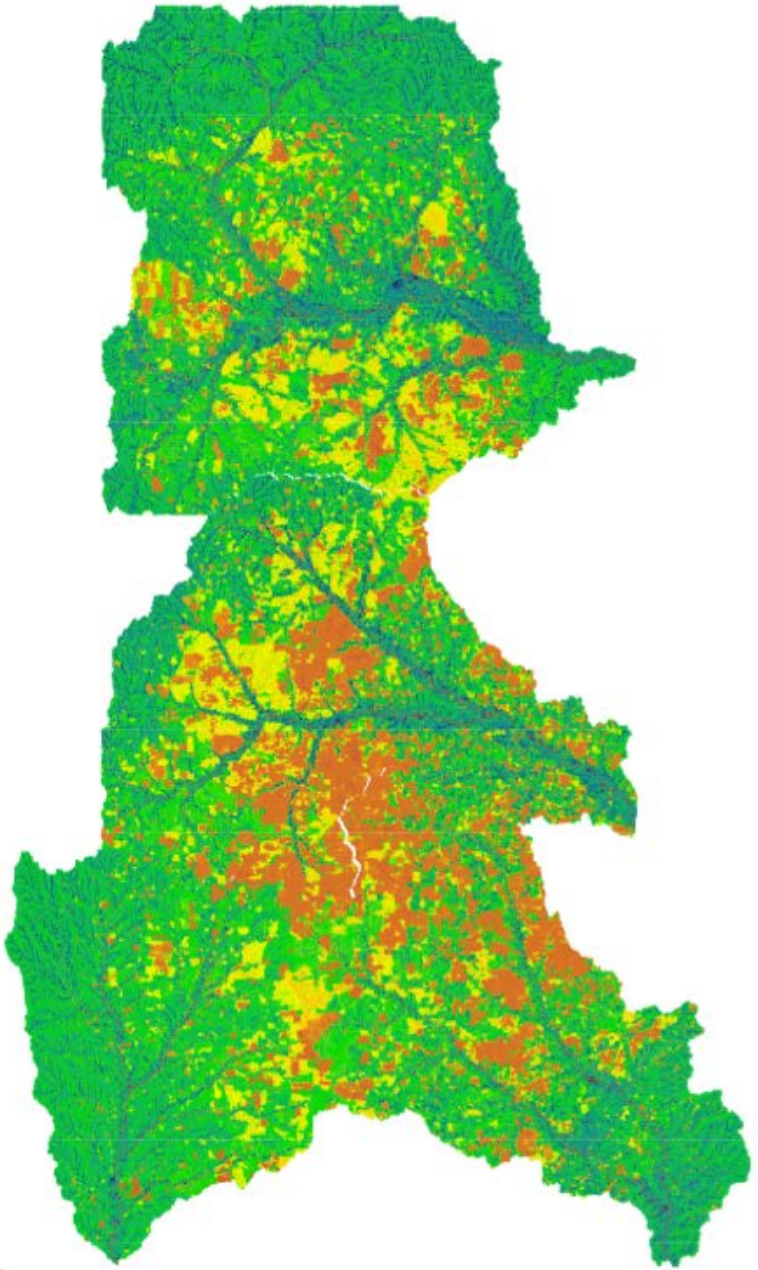
2014

Flint Hills Burn Mapping



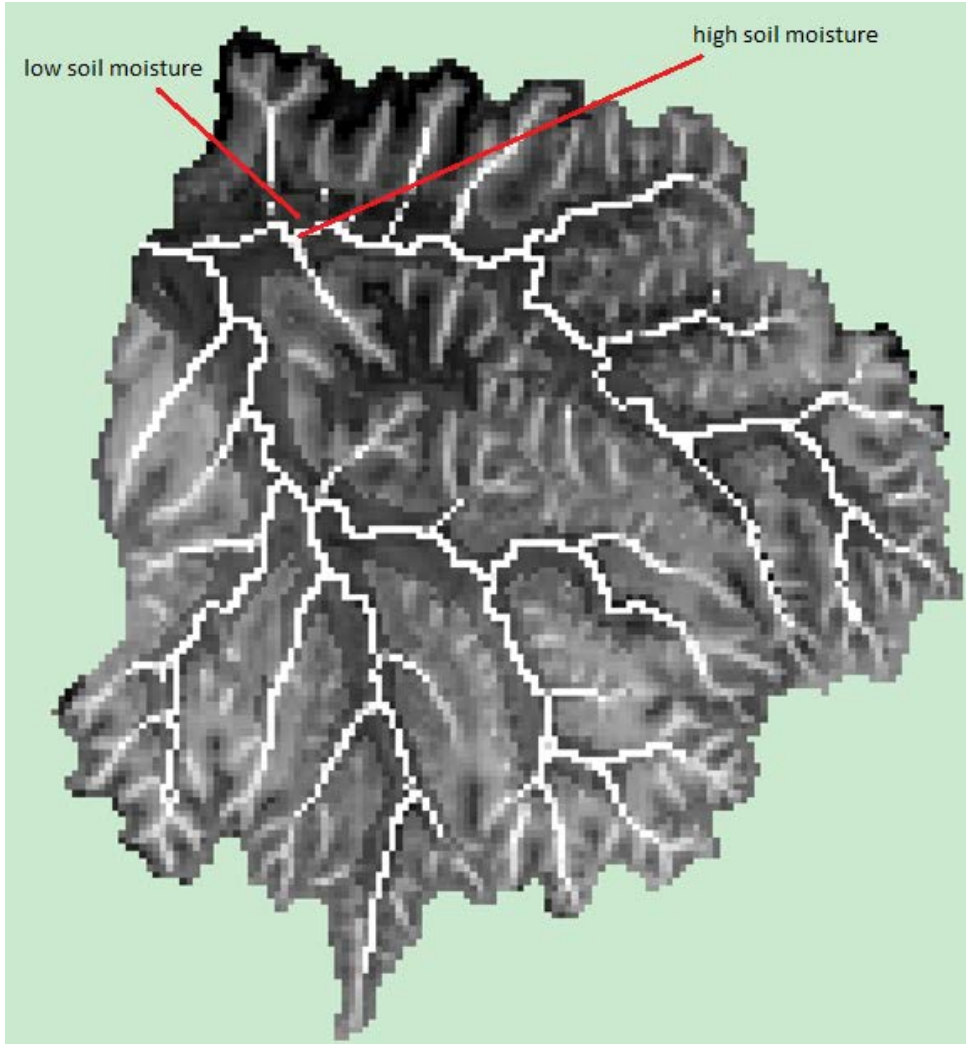
Flint Hills KS VELMA Output

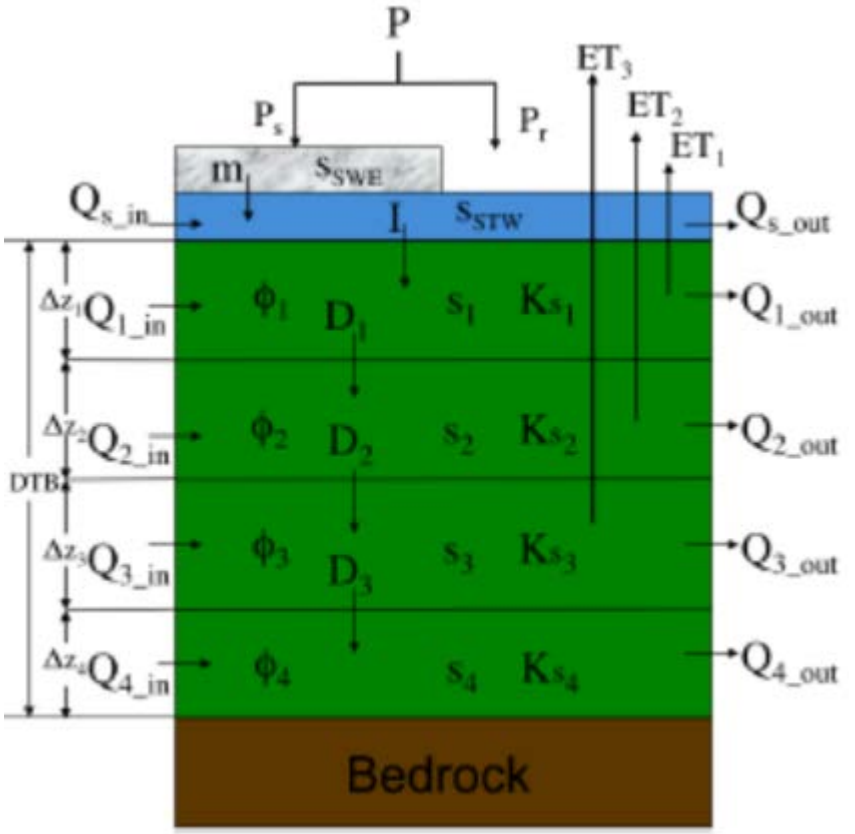
Simulated Fuel Load for March 1, 2016



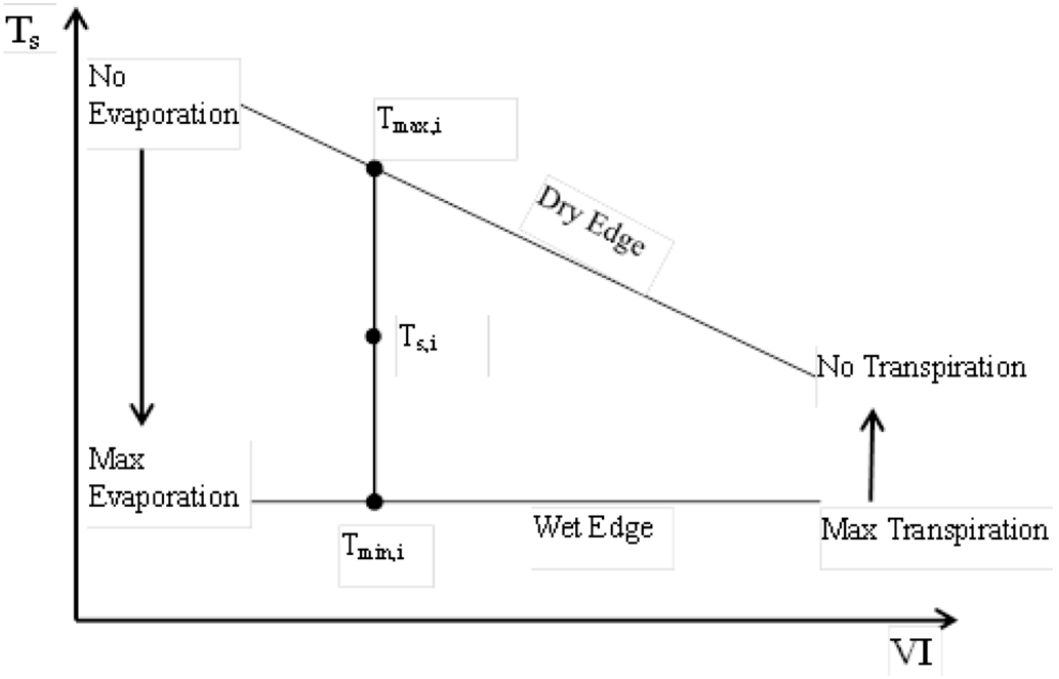
Author: EPA WED
Date: 25 Mar 2016
Datum: NAD 83
Projection: UTM Zone 14N

Soil\Canopy Moisture Results



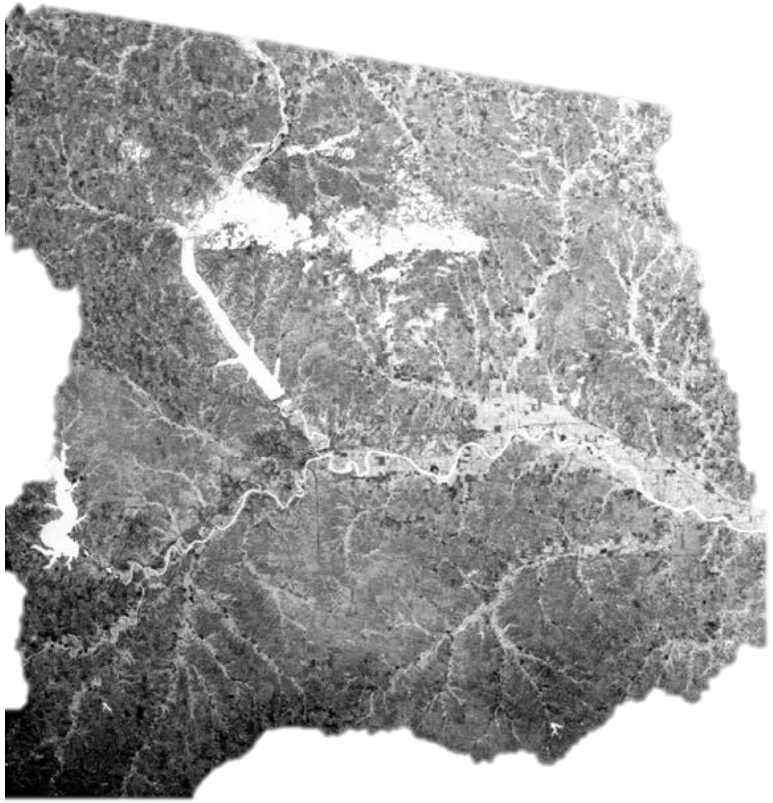


“Triangle” Indices

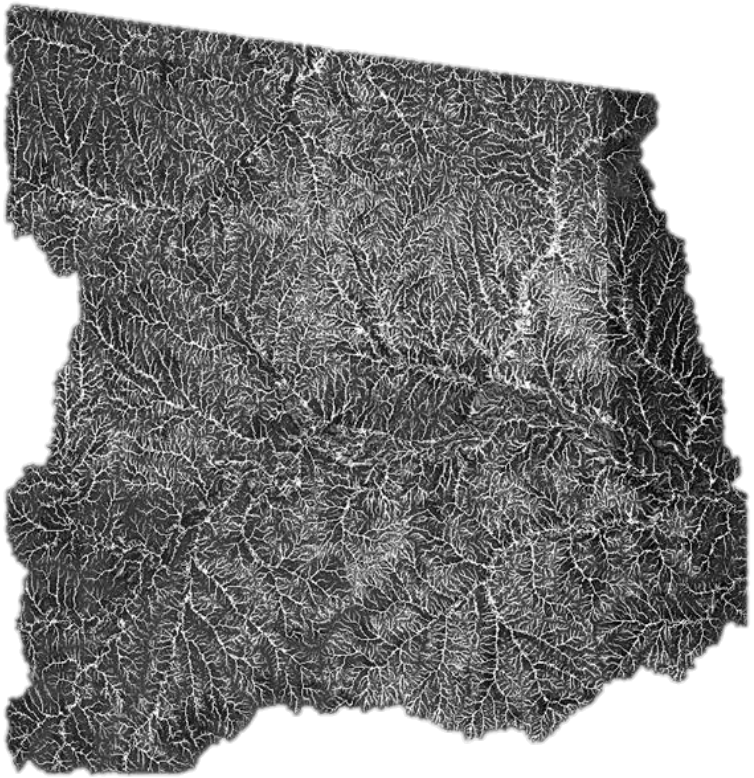


- Based on relationship between NDVI and Surface Temperature
- Theoretically linked to soil moisture and ET

Modeled Versus Remotely Sensed Results

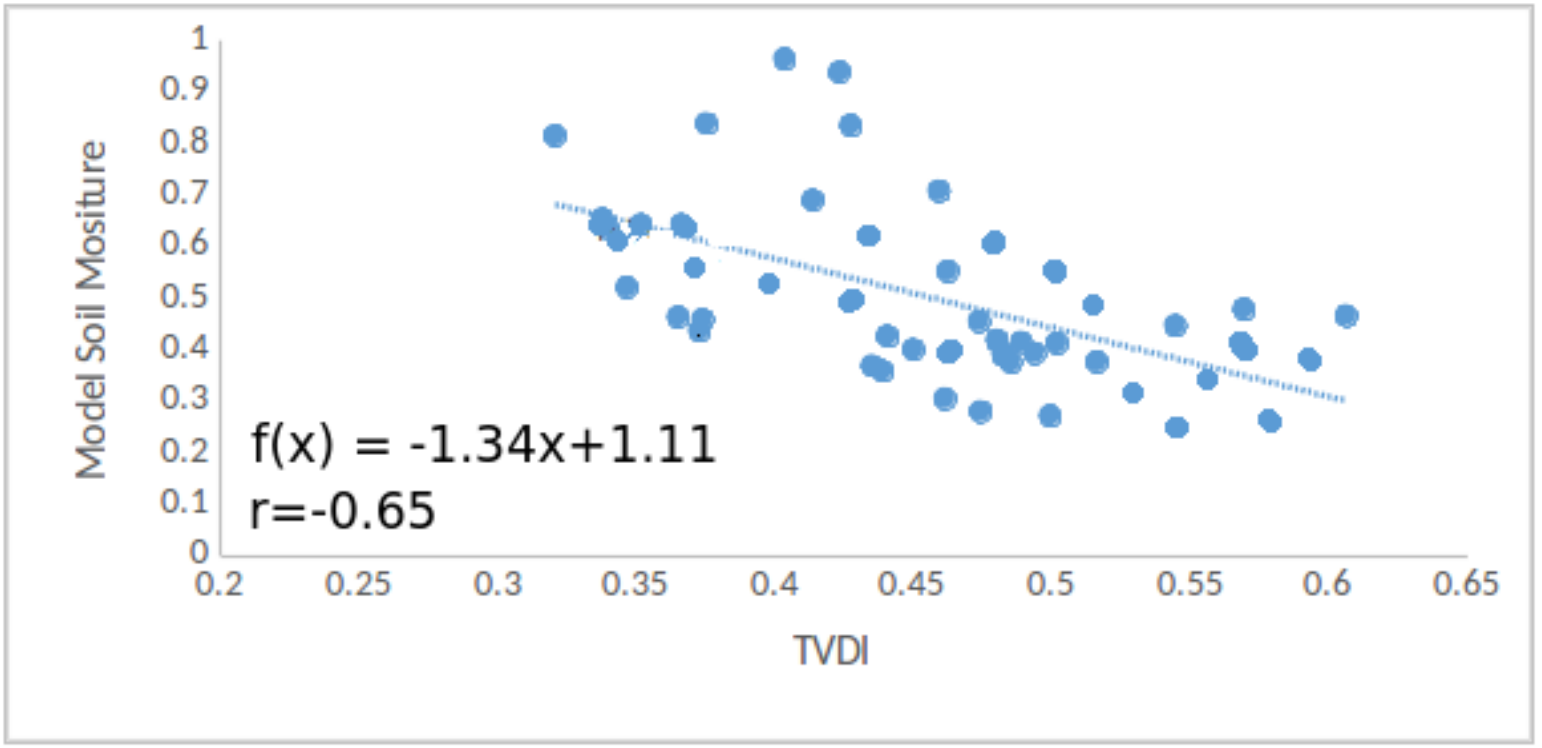


RWC – Triangle Index



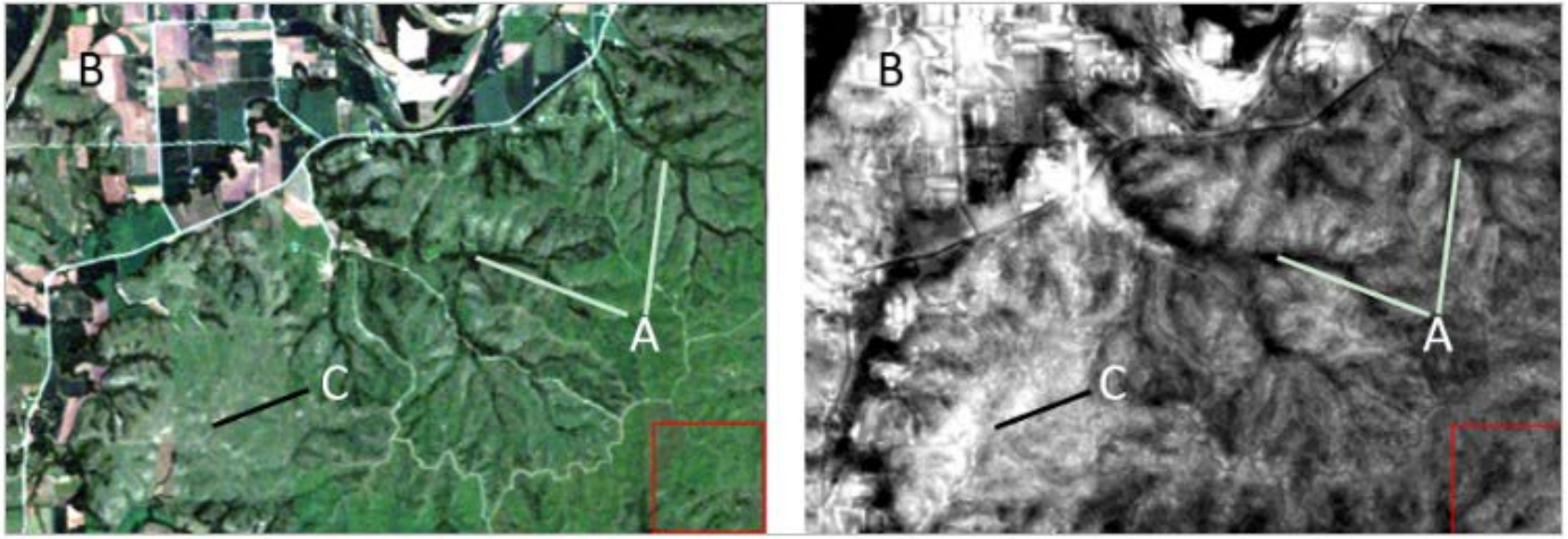
Velma Output

Remotely Sensed v. Modeled Results

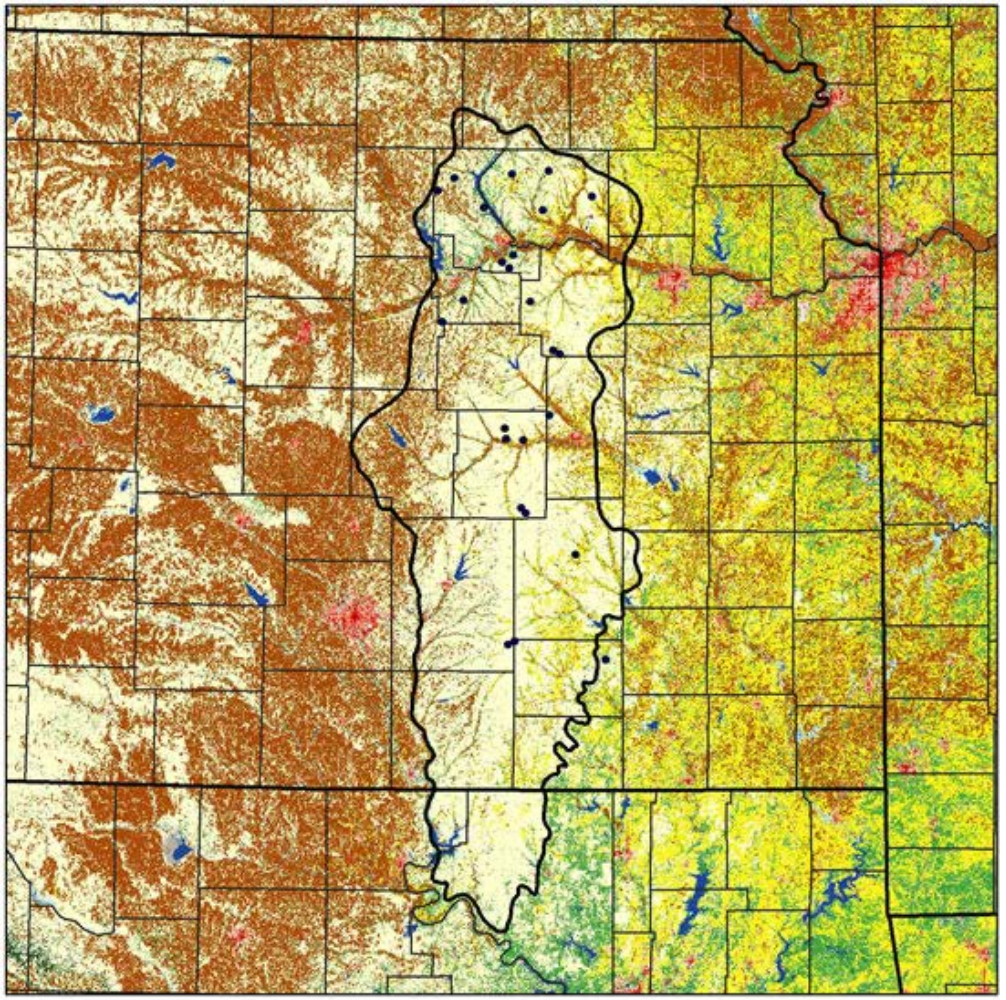


Soil Moisture Anomalies

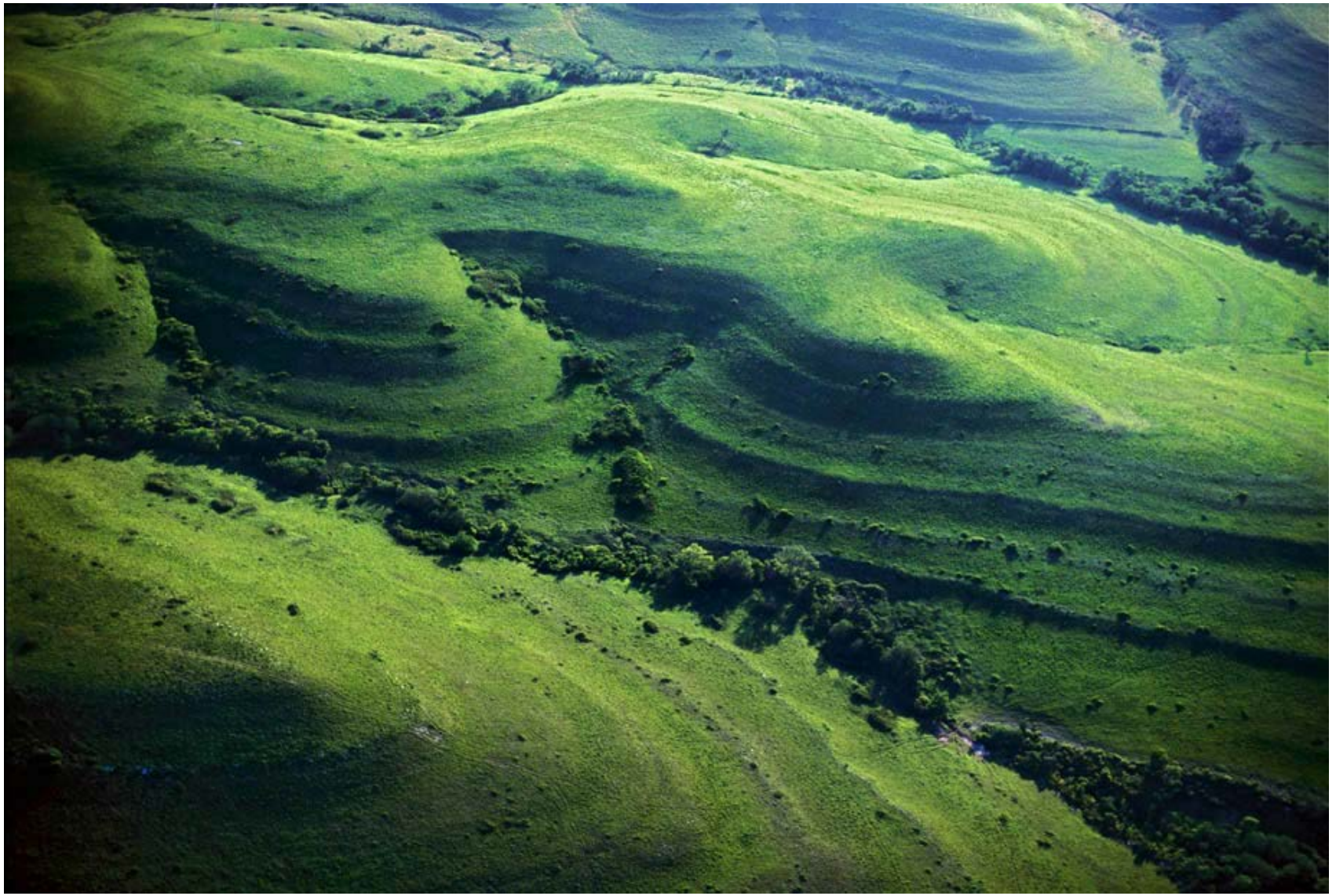
Taking image 2008221 as an example, the valley (illustrated as A) in the Konza tend to have low TVDI value, and it usually is most vegetated and has lowest TVDI. Places around the valley in Konza are covered by grass, and they have high TVDI value. Agricultural lands (B) in the north of Konza have high TVDI value because it is bare soil and not covered by crops. The west of Konza has higher TVDI value than the east because it is less vegetated.



Next Step
Integration of Land Cover



Terrain and Model Resolution



Conclusions and Next Steps