Estimating Soil Carbon Sequestration Potential: Regional Differences and Remote Sensing

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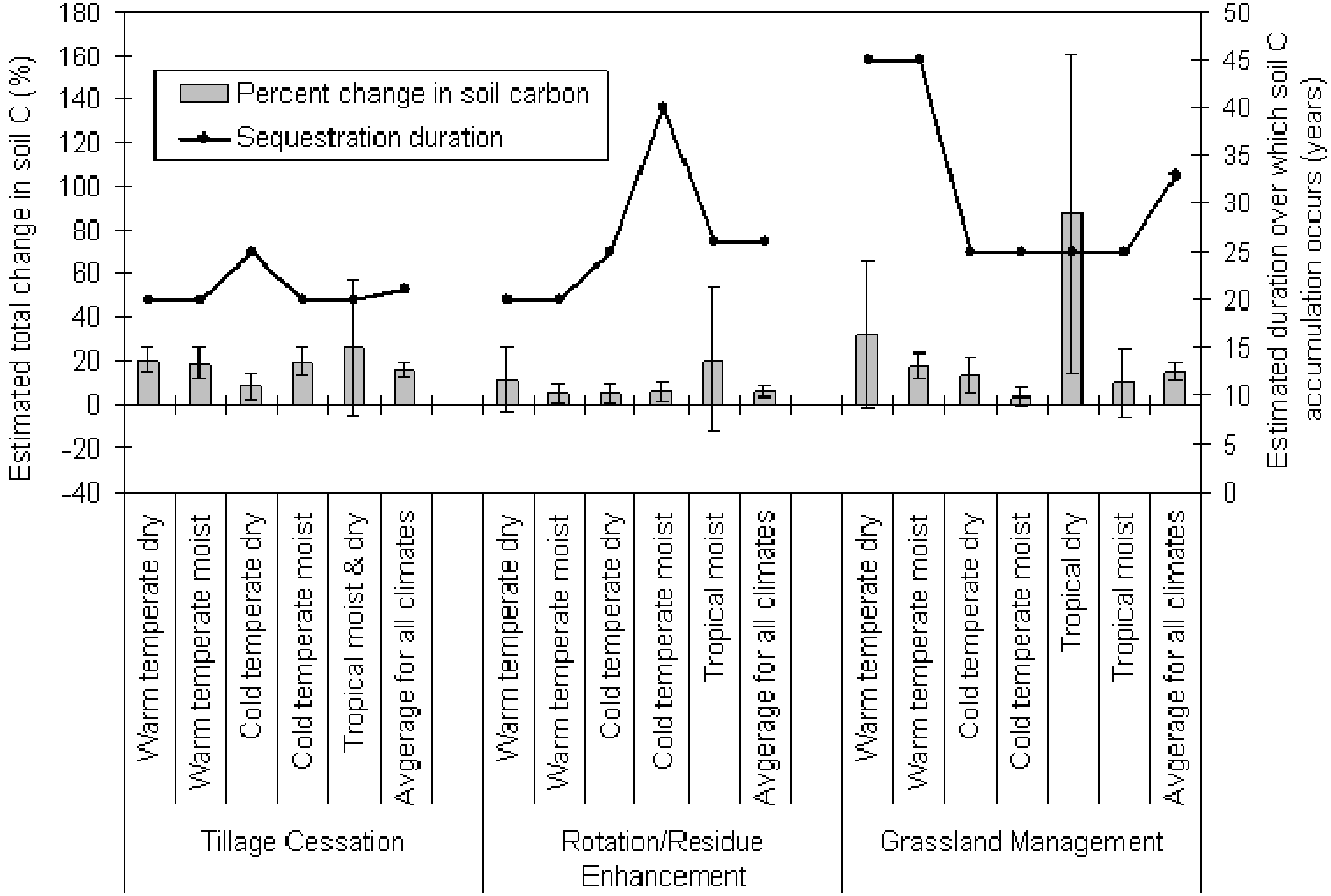
Regional Differences: Causes

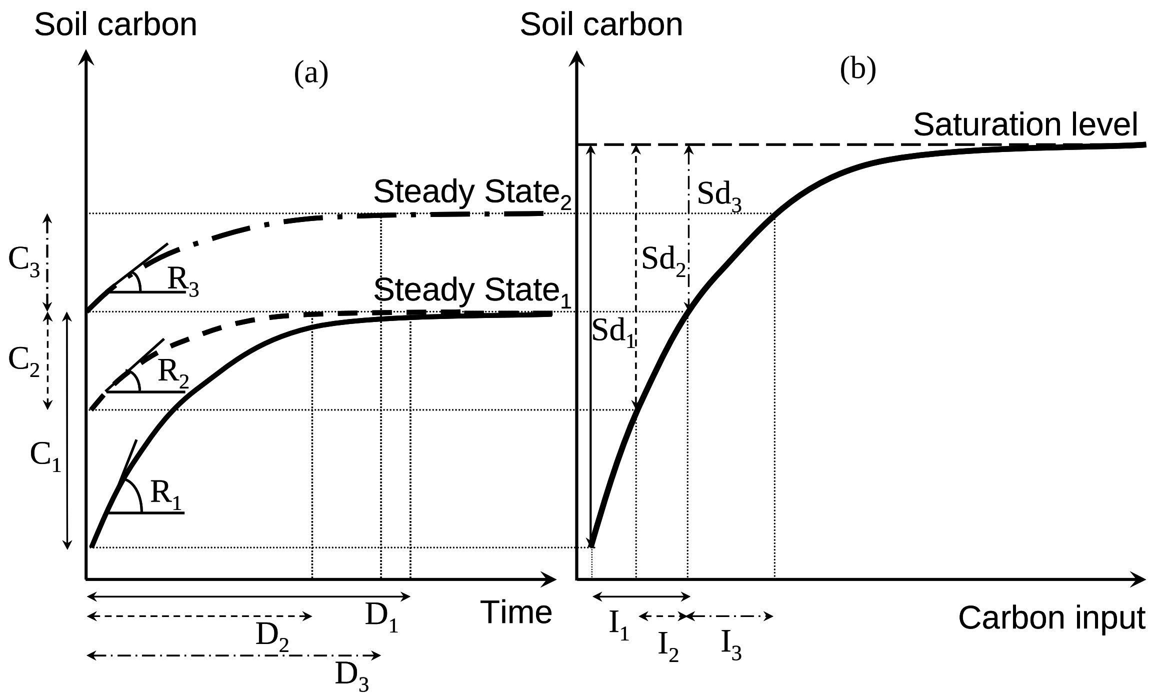
- Climate
- Annual weather
- Soils (texture and water holding capacity)
- Management (crop rotation; tillage & residue management; manure & grazing management)
  - Management can be manipulated, and is currently done through conservation programs and education

Regional Differences: Some Results



West and Six. 2007. Climatic Change 80: 25-41.

Regional Differences: Sequestration Dynamics



West and Six. 2007. Climatic Change 80: 25-41.

Sequestration potential can be defined as:

(1) Sequestration rate (soil carbon accumulation per unit area and per soil depth) X

(2) Potential land area available for carbon sequestration activities =

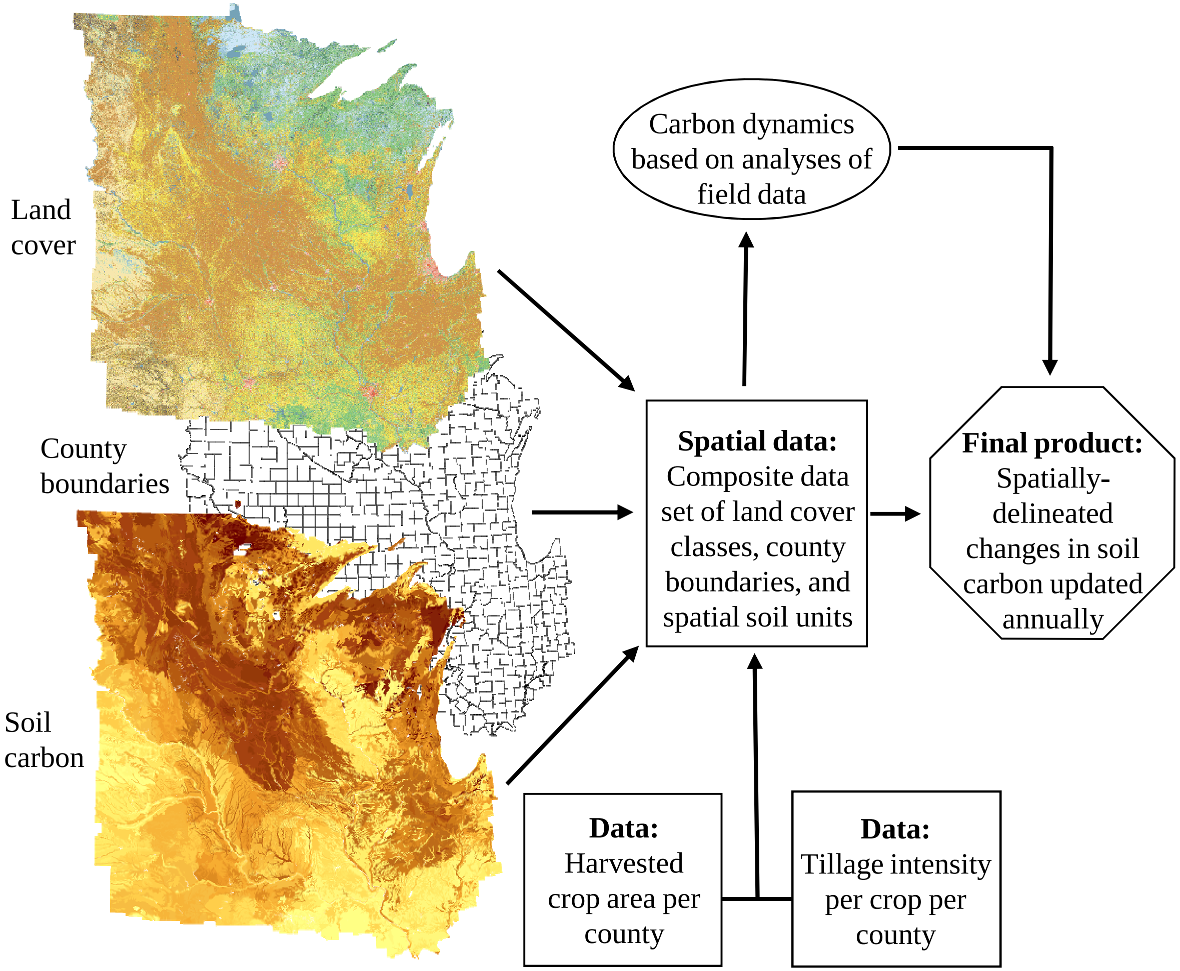
(3) Total carbon sequestration potential

Use of Remote sensing data and products for modeling agricultural systems and soil carbon sequestration

- Identify crops and fields [EVI, NDVI]
- Identify underlying soil attributes
- Estimate management practices [CAI]
- Estimate NPP [LAI]

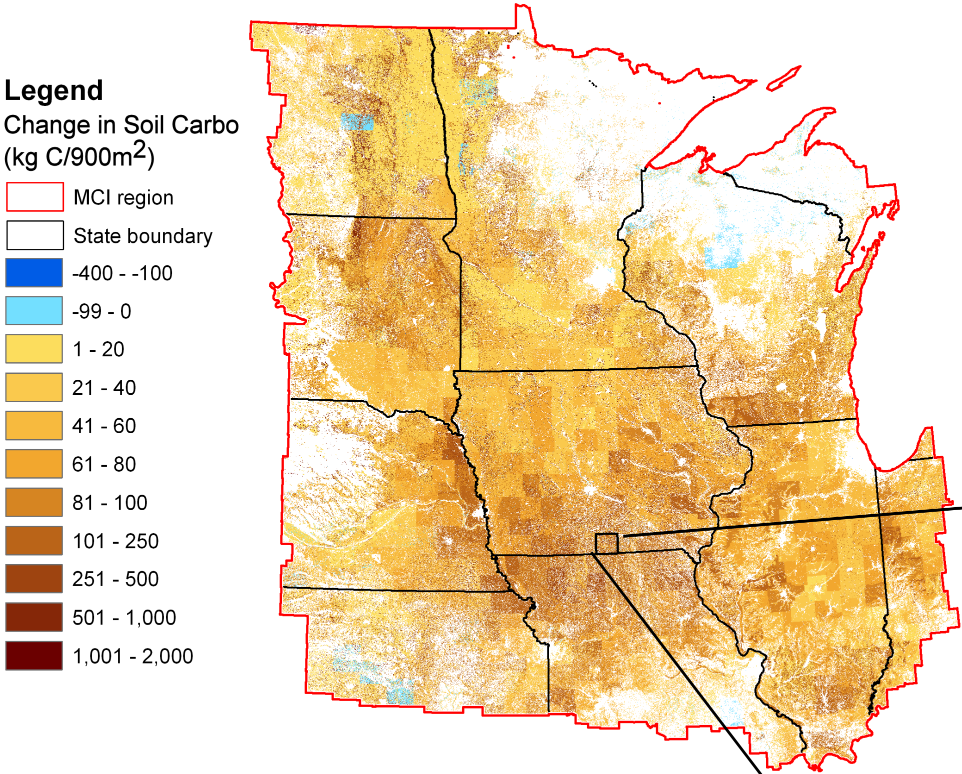
All of the above can be developed in conjunction with existing inventory data.

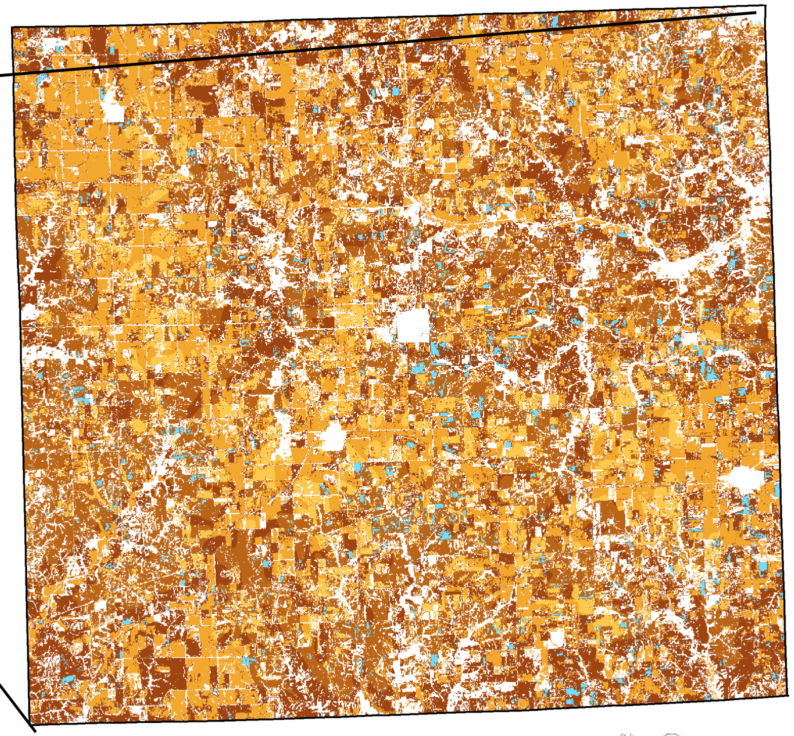
Integration of field data, inventory data, and remote sensing for soil carbon accounting



West et al. 2008. Soil Science Society of America Journal 72: 285-294.

Soil carbon change, 1990-2000



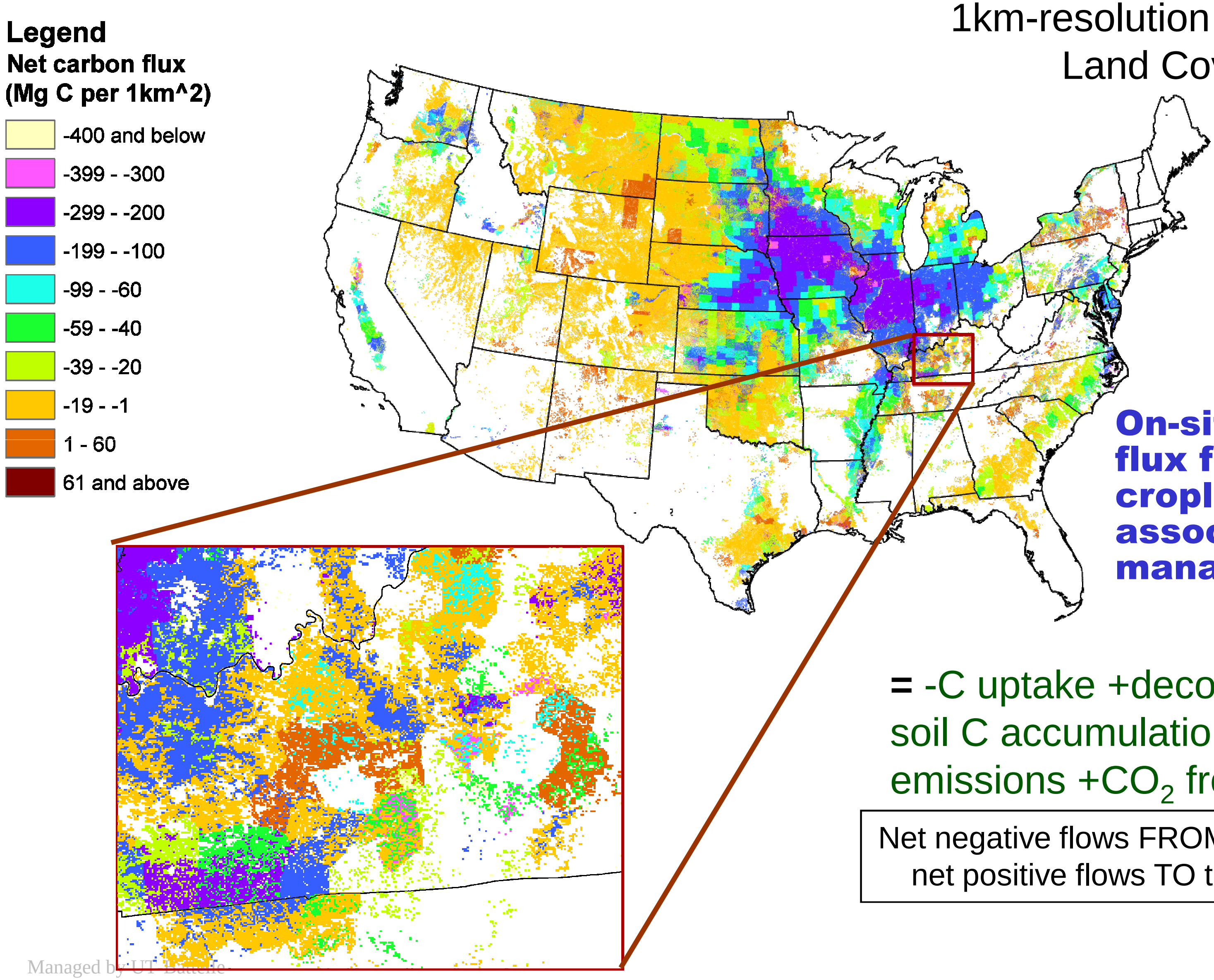


Results commensurate with
30m-resolution **Landsat**-based
Land Cover Data

West et al. 2008. Soil Science Society of America Journal 72: 285-294.

Geospatial estimates of net carbon flux from croplands

Results commensurate with 1km-resolution **MODIS**-based Land Cover Data



On-site net carbon flux from US croplands in 2004 associated with land management

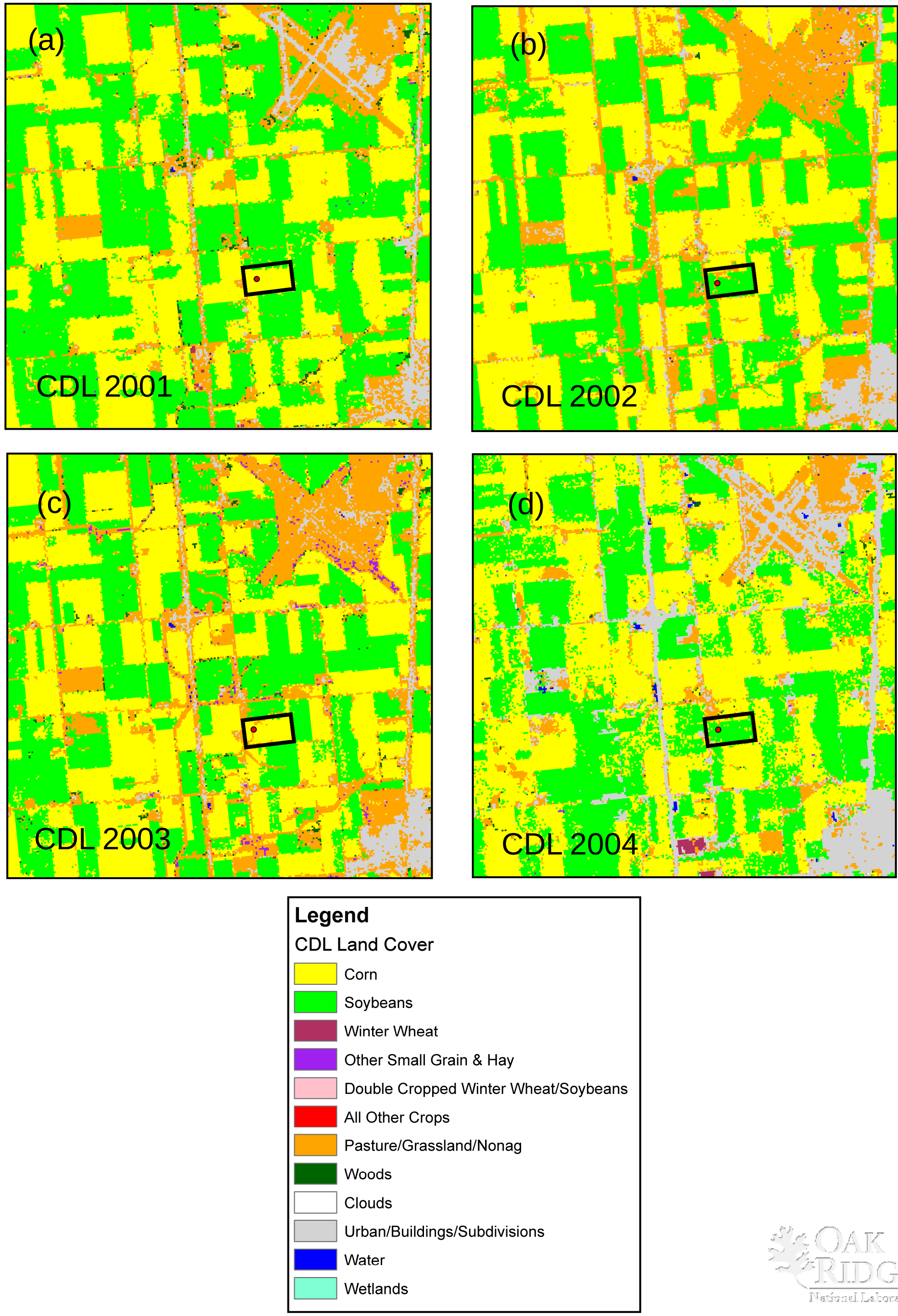
= -C uptake +decomposition - soil C accumulation +fossil CO_2 emissions +CO_2 from aglime.

Net negative flows FROM the atmosphere, net positive flows TO the atmosphere.

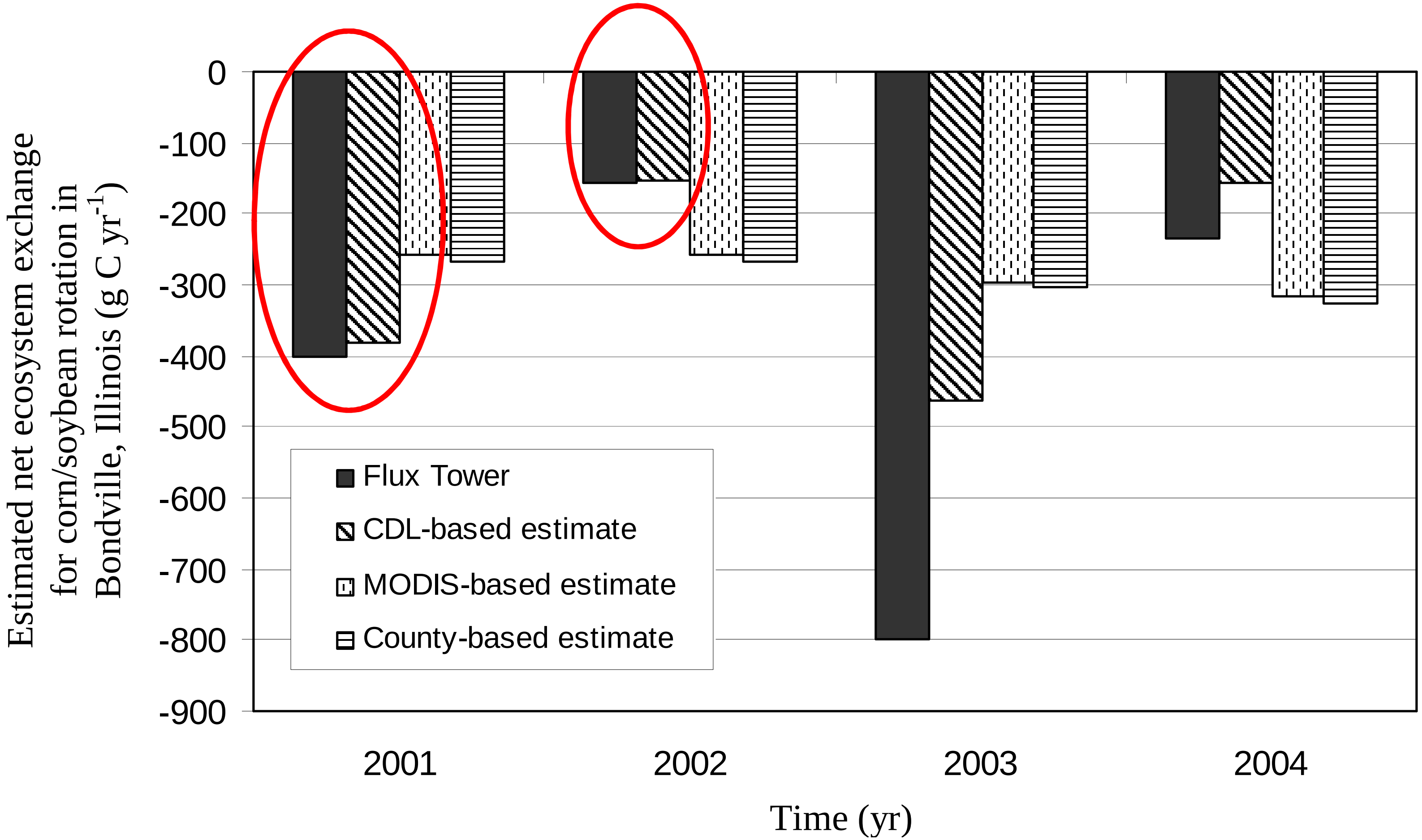
Method and more recent results in West et al. Ecological Applications (in press)

Moving from MODIS to Cropland Data Layer, including use of flux tower measurements

Bondville, Illinois
flux site as represented by the Cropland Data Layer

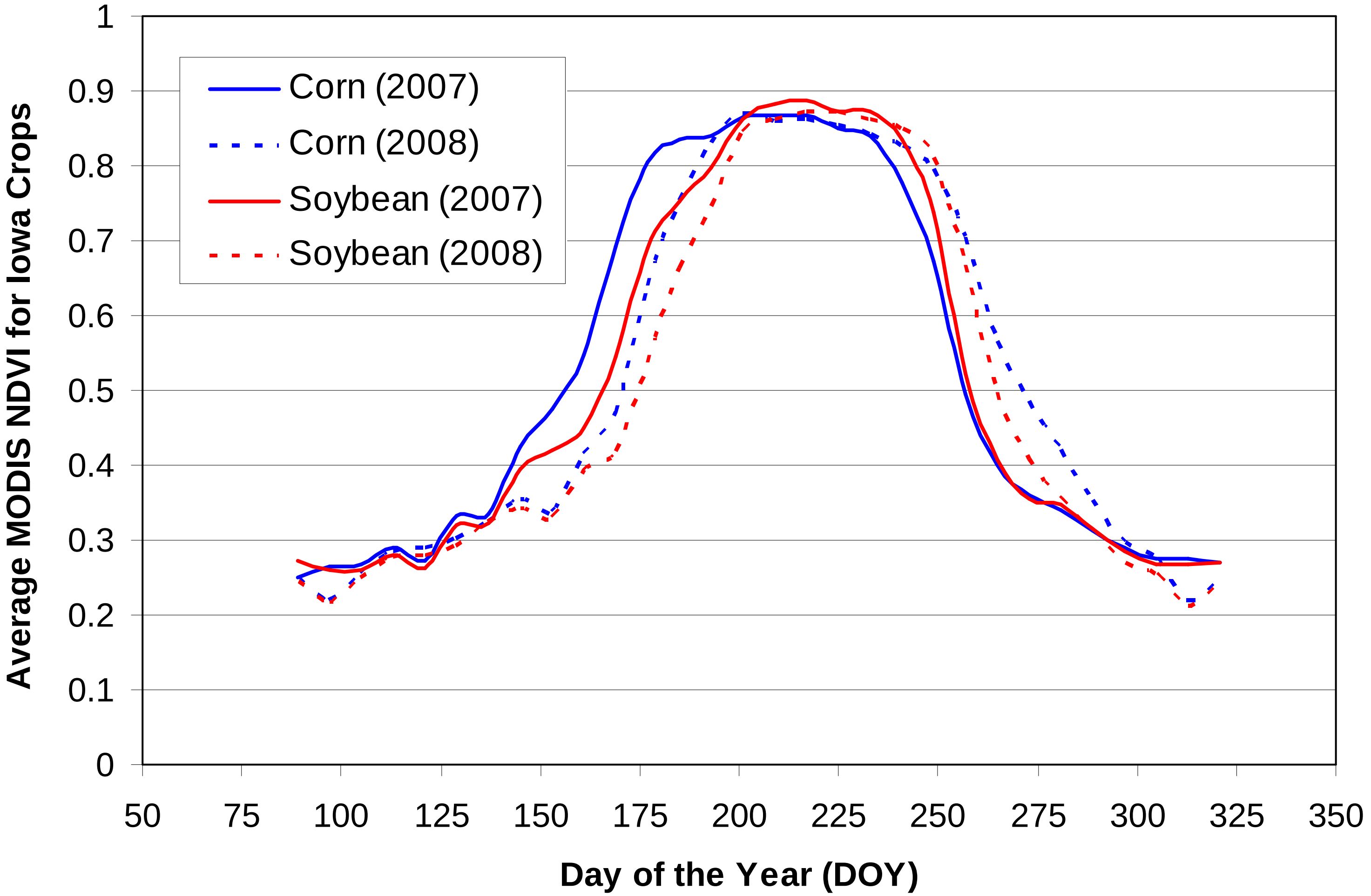


Annually aggregated NEE from Bondville flux tower compared to our C accounting approach, using different land cover data sets



NEE = estimated -NPP + harvested carbon + decomposed biomass + soil carbon change + CO2 from lime application + on-farm fossil fuel emissions

Shift in crop phenology does not always change annual yield, but does change temporal signature of carbon uptake and release



NDVI processed by Prasad Bandaru, ORNL

Ideal sensor for agricultural monitoring

Important bands:

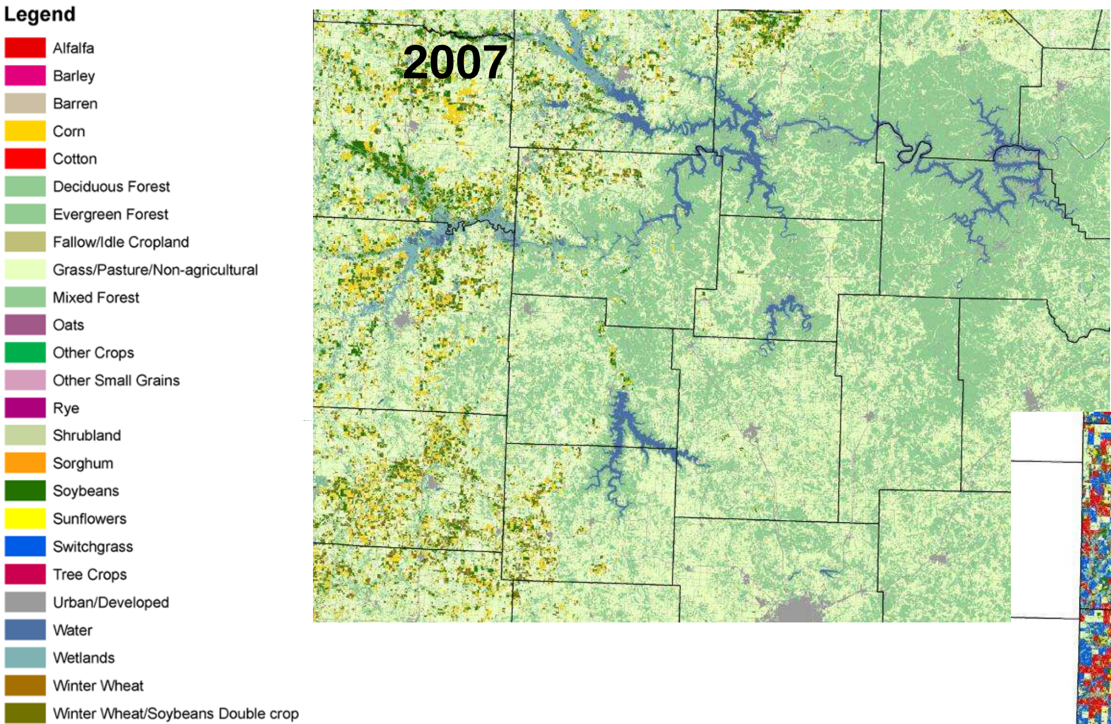
• 480 nm (blue)	aerosols
• 550 nm (green)	chlorophyll
• 670 nm (red)	vegetation cover
• 710 nm (red-edge)	chlorophyll
• 850 nm (NIR)	vegetation cover
• 1650 nm (SWIR)	vegetation water content
• 2030 nm (SWIR)	cellulose
• 2100 nm (SWIR)	cellulose
• 2210 nm (SWIR)	cellulose
• 11 & 12 μm (Thermal IR)	vegetation stress, ET

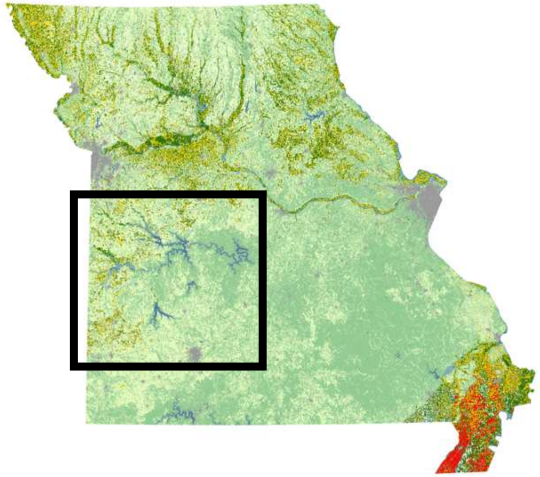
Compiled by Guy Serbin (USDA Foreign Agriculture Service)

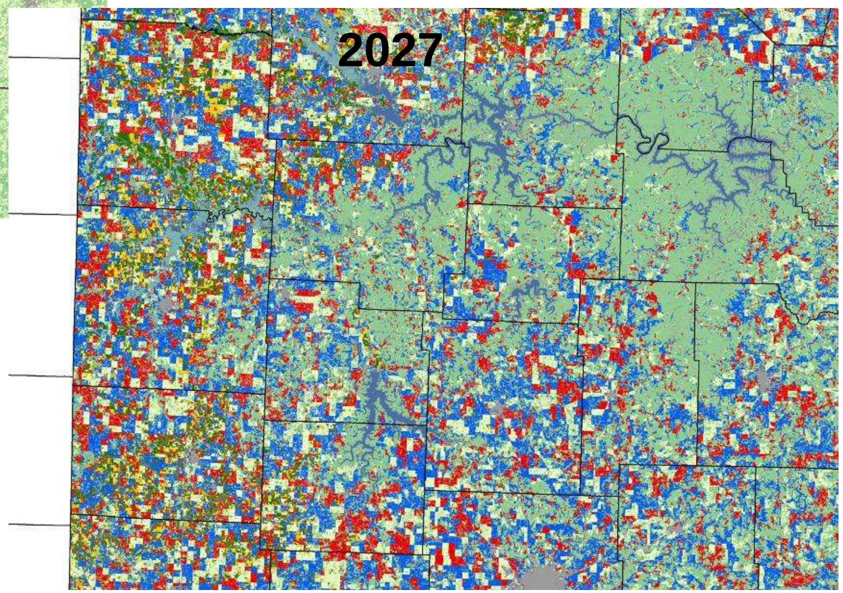
Conclusions

- Integration of ACTUAL cropland cover, annually, nationally – can be done now, further development of standardized approach could be considered
- Integration of crop phenology (inter-annual carbon uptake and residue contribution) per crop species can be done in near future (1-3 years).
- Crop residue management needs long-term effort (5+ years).
- National database on soils and on land management, with focus on soil carbon change, could be better coordinated and possibly revised (i.e., SSURGO, NRI, USDA NASS, USDA ERS)

Estimating Future Land Management and Carbon Budgets – Predicting land-use change







- Improved estimates of available land for bioenergy crops