Quantifying Climate-Smart Agriculture Management Impacts on Soil Carbon Storage at Multiple Scales

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Acknowledgements:
Ren Lab members
Collaborators
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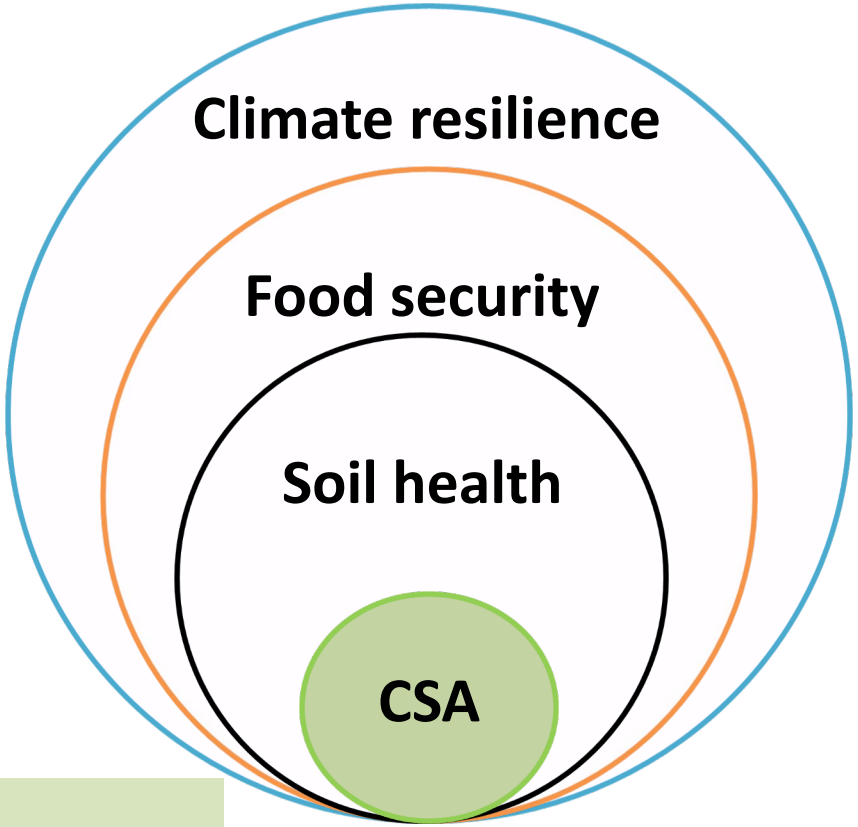
Climate Smart Agriculture (FAO, 2010)

Climate Smart Agriculture (CSA)

- ✓ An integrated approach
- ✓ Diverse practices, technologies, etc.
- ✓ Objectives: soil, food, climate



<u>CSA practices such as:</u>

- Reduced/No tillage
- Cover crops
- Biochar
- Diverse varieties/breeds
- Improved water and nitrogen fertilizer use

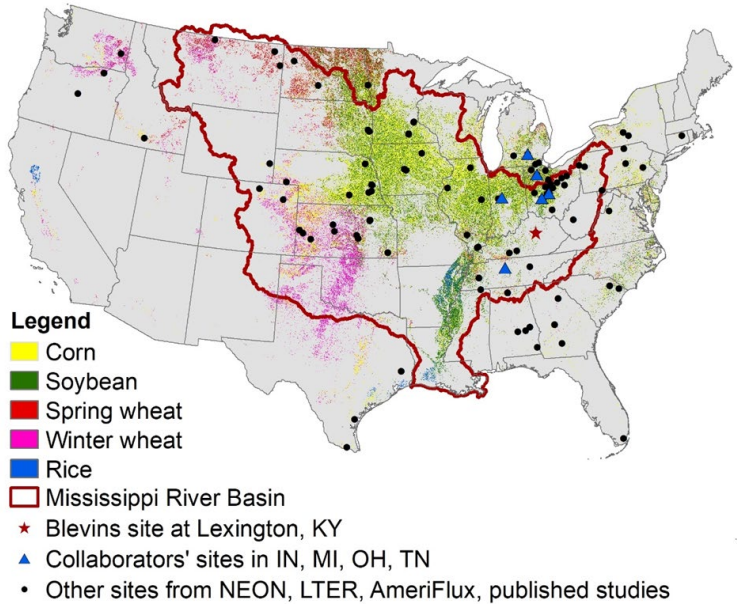
Challenges of CSA assessment at multiple scales

Multiple goals: food security, carbon sequestration, climate mitigation, etc.

- Biogeochemical footprints
- Multiple factors
- Scaling issues

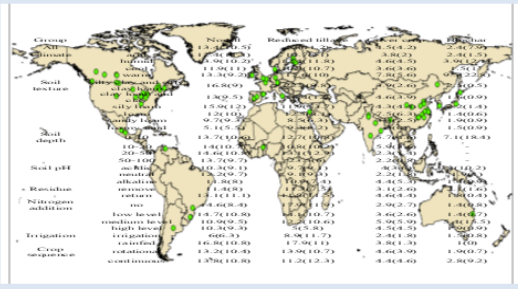
Opportunities

- Field experiments
- Sensors
- Remote sensing
- Numerical models
- Meta-analysis and other data analytics tools



Meta-analysis review: CSA impacts on Soil Carbon Storage

Meta-data



Climate-smart agriculture management practices

- ❑ Biochar applications represent the most effective approach for increasing SOC content (39%), followed by cover crops (6%) and conservation tillage (5%).
- ❑ The effects of CSA management practices are more pronounced in regions with relatively warmer climates or lower soil nitrogen fertility.
- ❑ Most existing studies were conducted over small spatial scales and short periods and showed varied responses of carbon footprints.

Publications: 59

Data sets: >3700 paired measurements

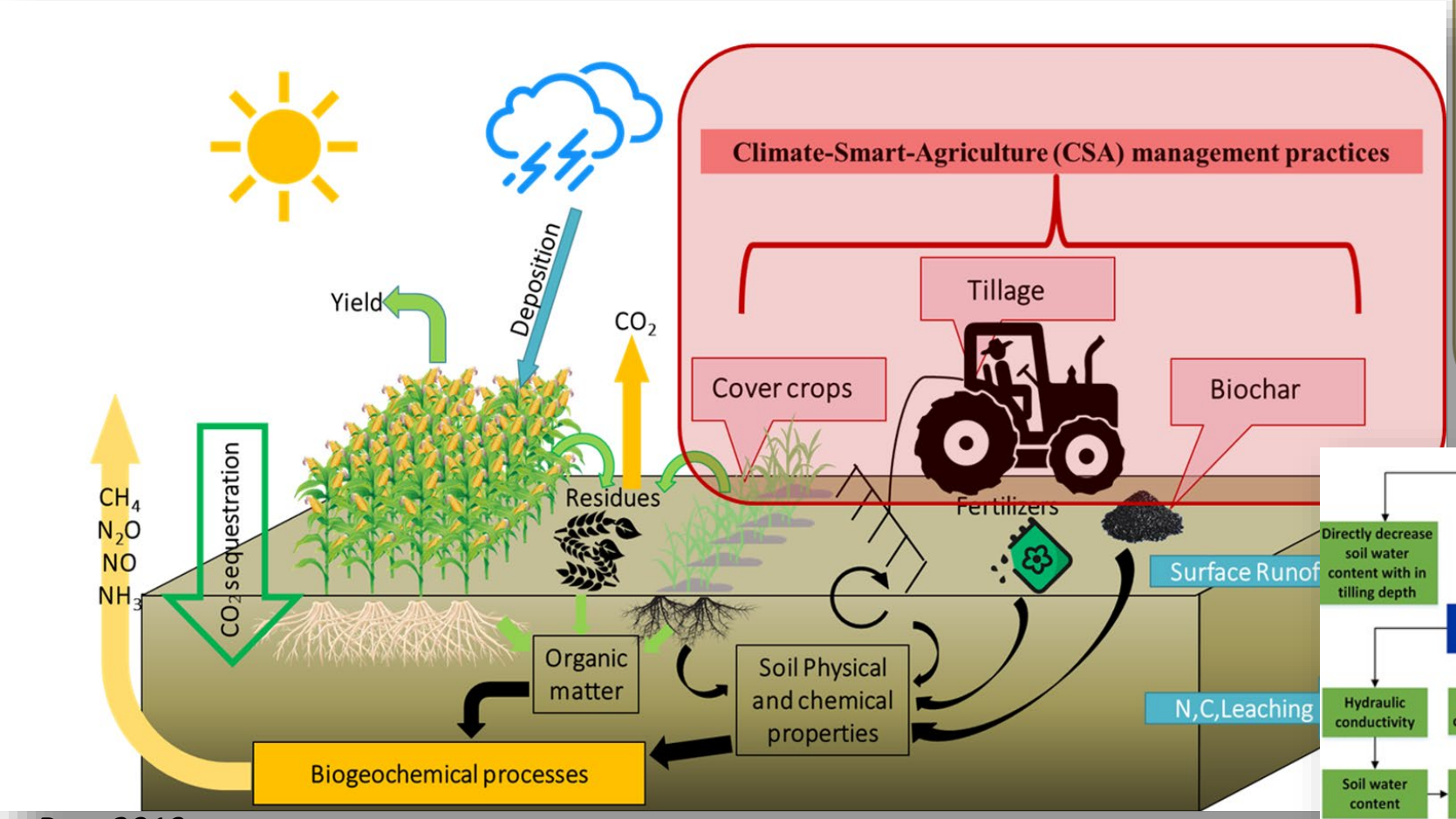
CSA practices: no-till, cover crop, biochar

Variables: Crop yield, GHGs (CO_2,CH_4,N_2O)

Soil organic carbon

Huang et al.,2018; Bai et al.,2019

Modeling CSA management at multiple scales



Ren, 2019

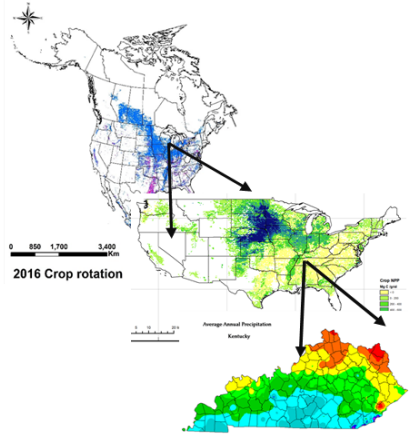
Field observations

Locations: KY, TN, OH

Experiments: Long-term no-tillage and cover crop

Observations: crop yield, GHGs, SOC, soil moisture, soil C and N etc.

Regional data

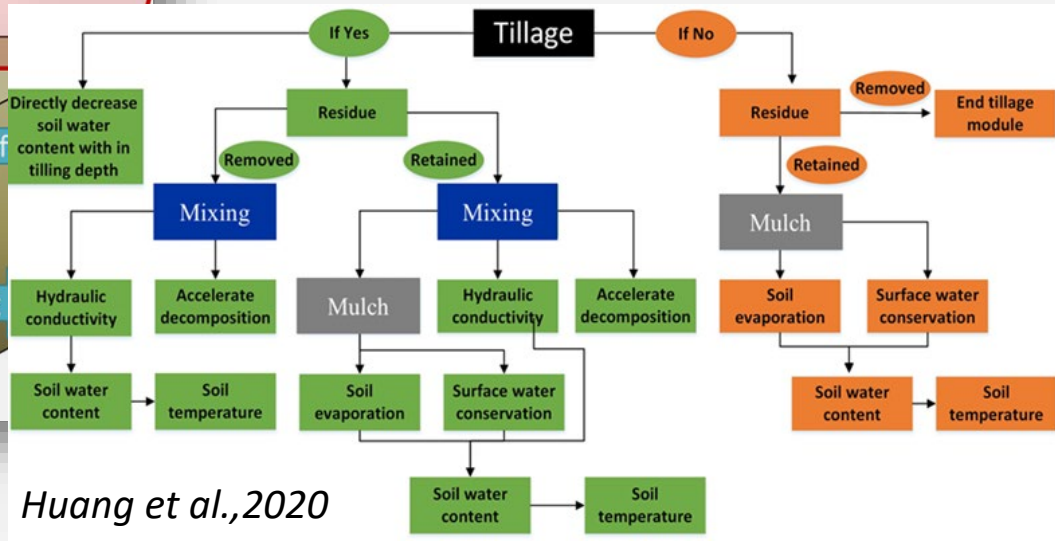


Kentucky: 1 km

US: 4 km

NA: 8 km

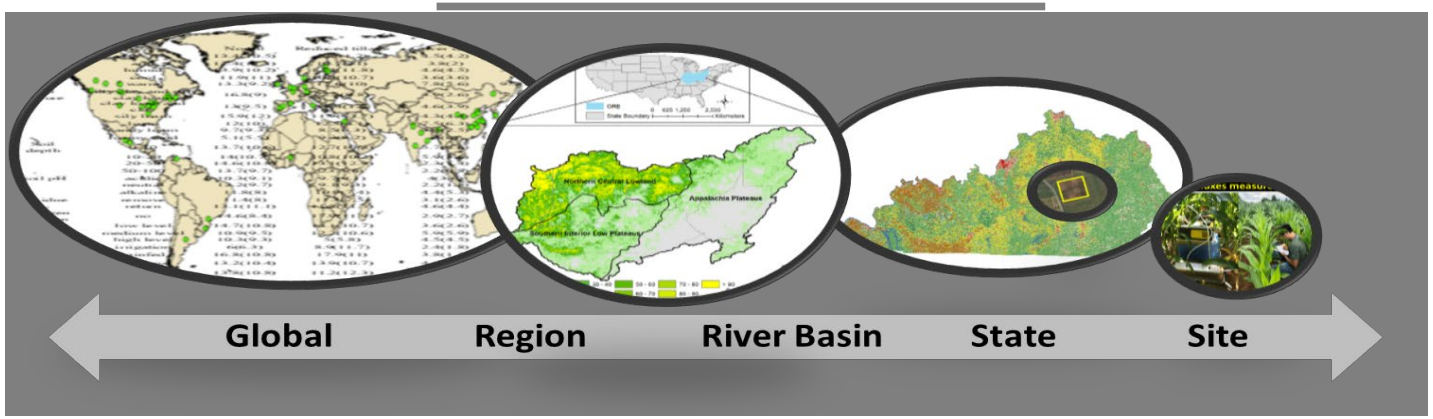
Climate, Land use and management



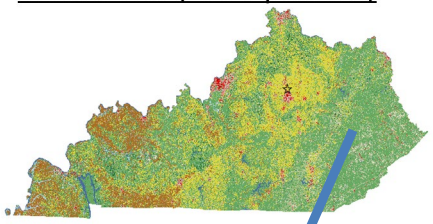
Huang et al.,2020

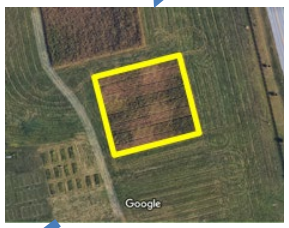
Case Studies

Bai et al.,2019;
Huang et al.,2018, 2020,2021;
Ren et al.,2019;

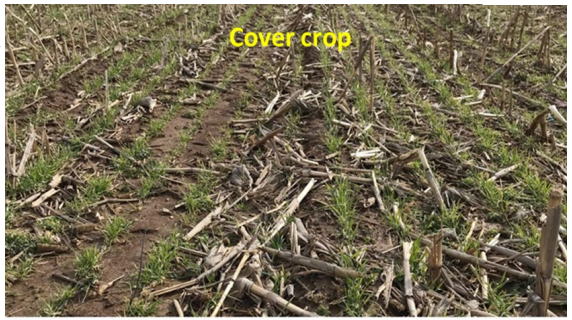


Blevins site (1970-present)

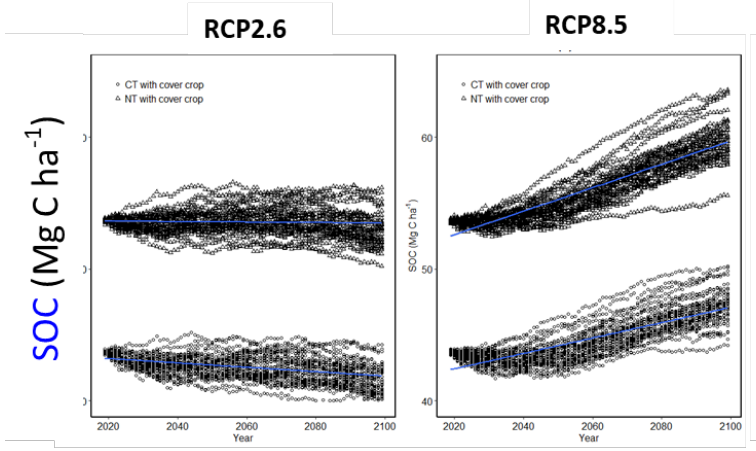




Contributions of Cover Crops

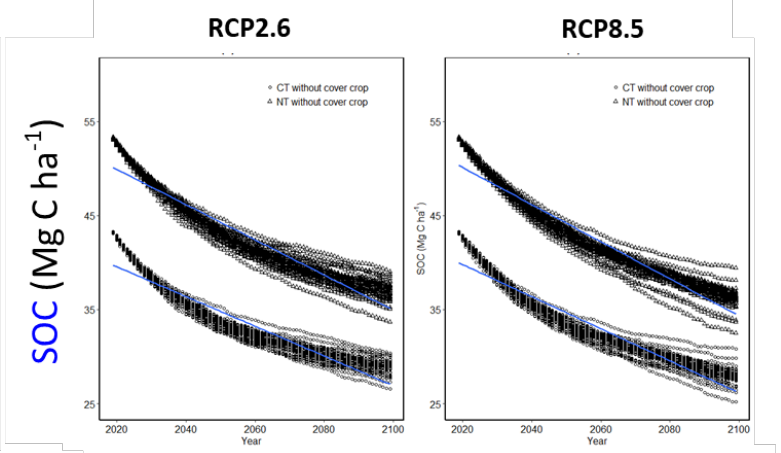


NT/CT **with** cover crop



SOC changes during 2019-2099 at the 0-30 cm depth

NT/CT **without** cover crop



SOC changes during 2019-2099 at the 0-30 cm depth

CSA opportunities for making bioenergy crops more environmentally friendly


https://phys.org/news/2014-10-bioenergy-crops-carbon-soil.html

- Climate-smart agricultural practices in bioenergy cropping systems
- Byproducts of bioenergy crops for CSA management such as biochar