Quantitative Analysis of Biofuel Sustainability, Including Land Use Change GHG Emissions

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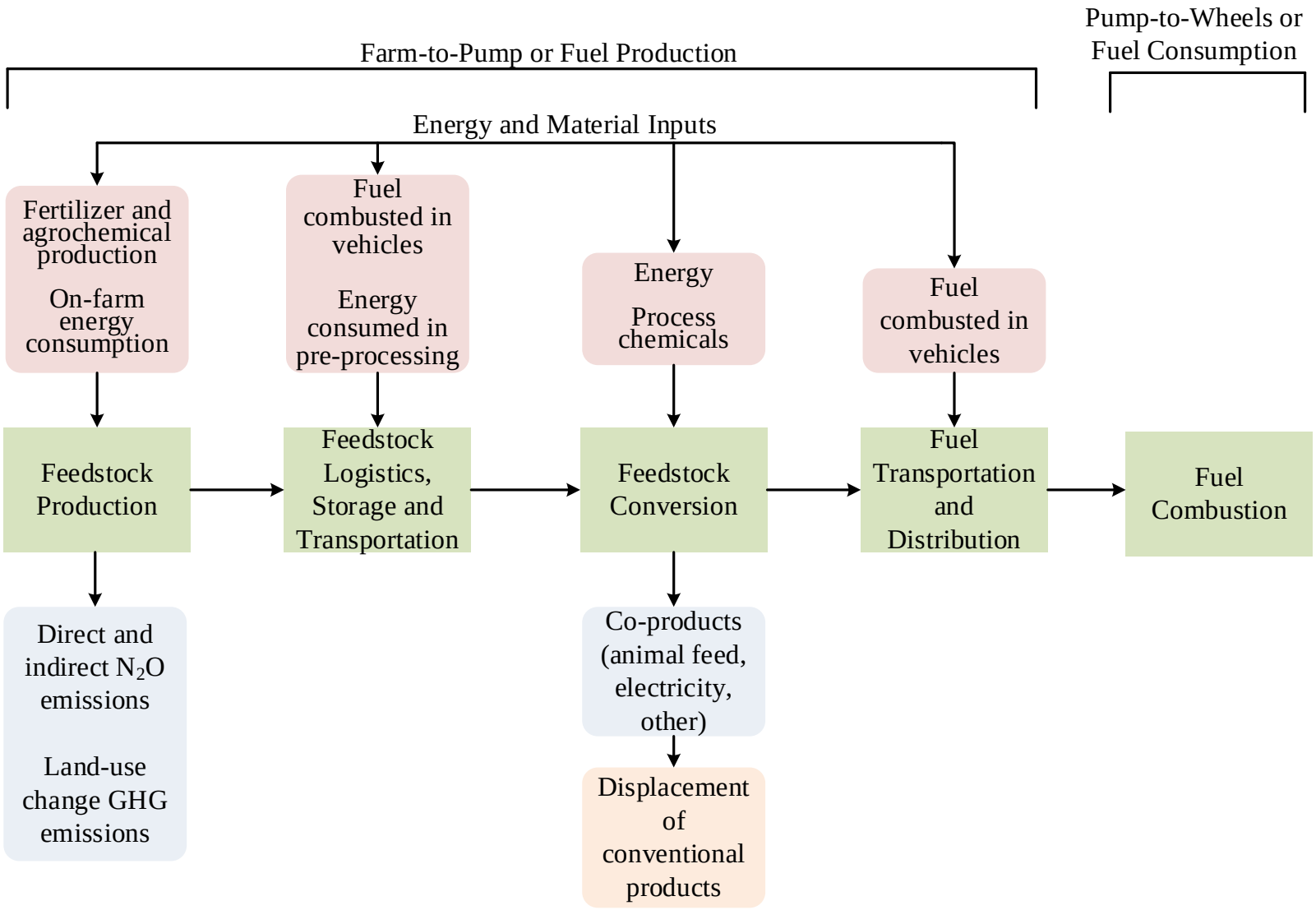
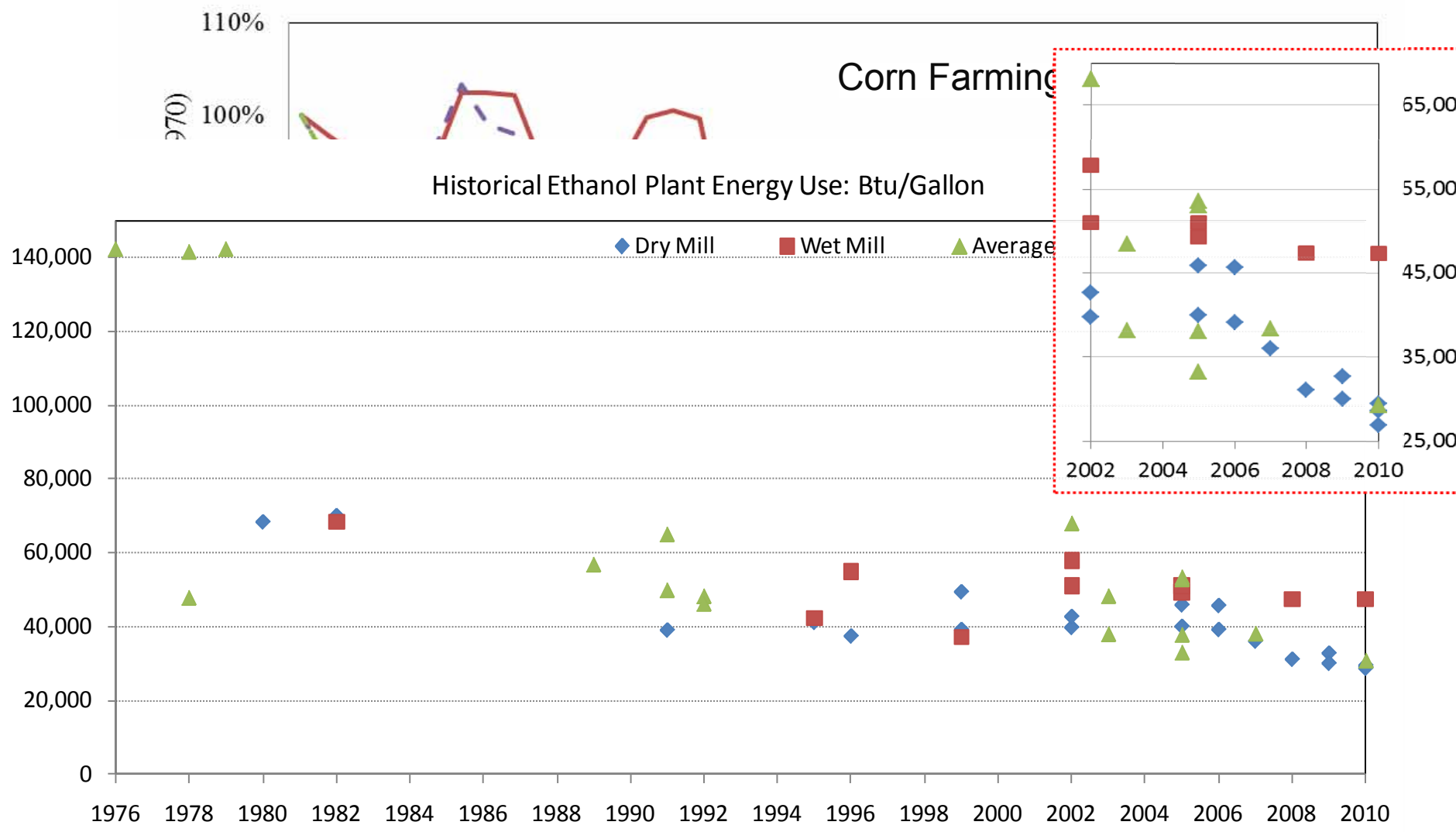
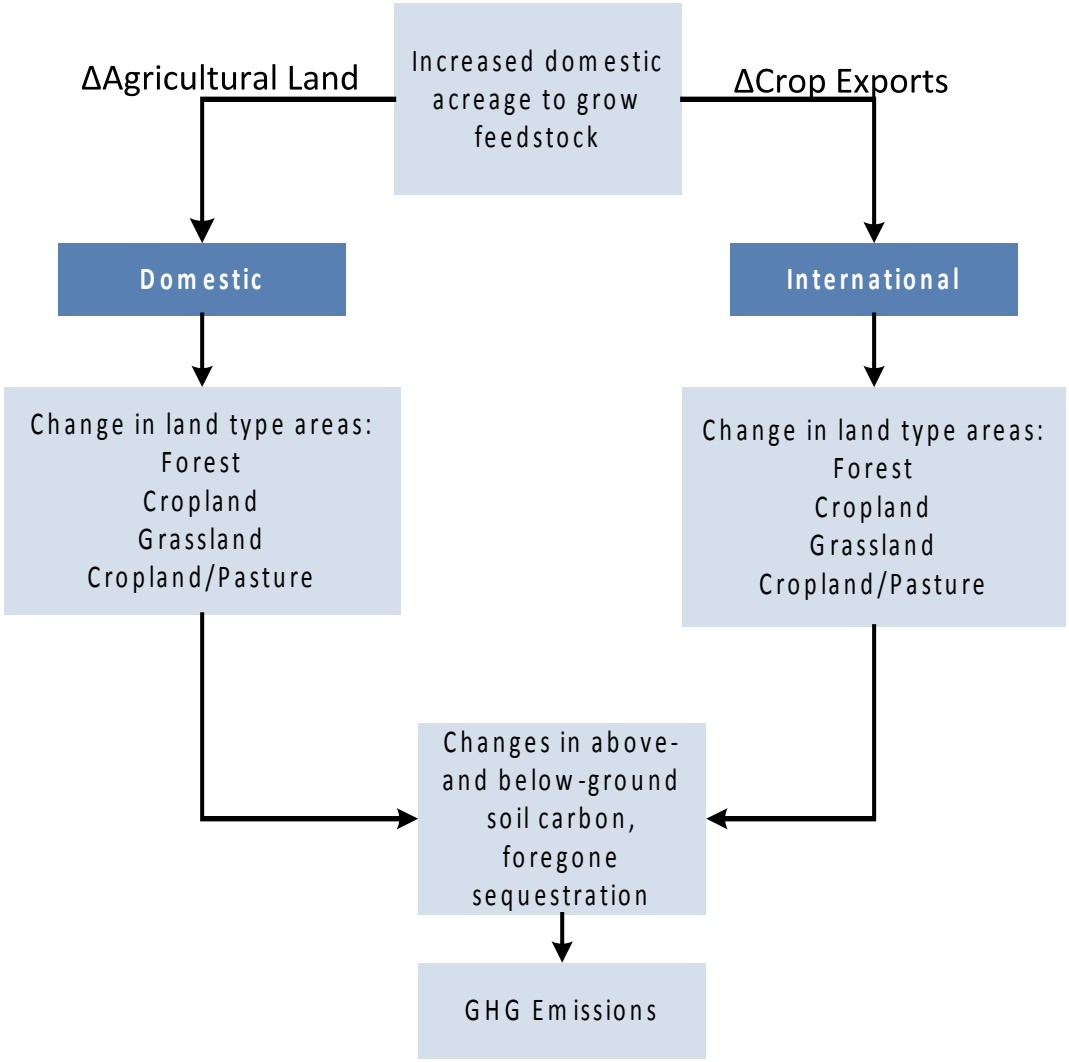
Data that underpin life cycle analysis of biofuels continue to improve



On the farm and at the biorefinery, corn ethanol production has seen efficiency gains



Land-Use Change (LUC) is one potential indirect effect of using land to produce biofuel feedstocks

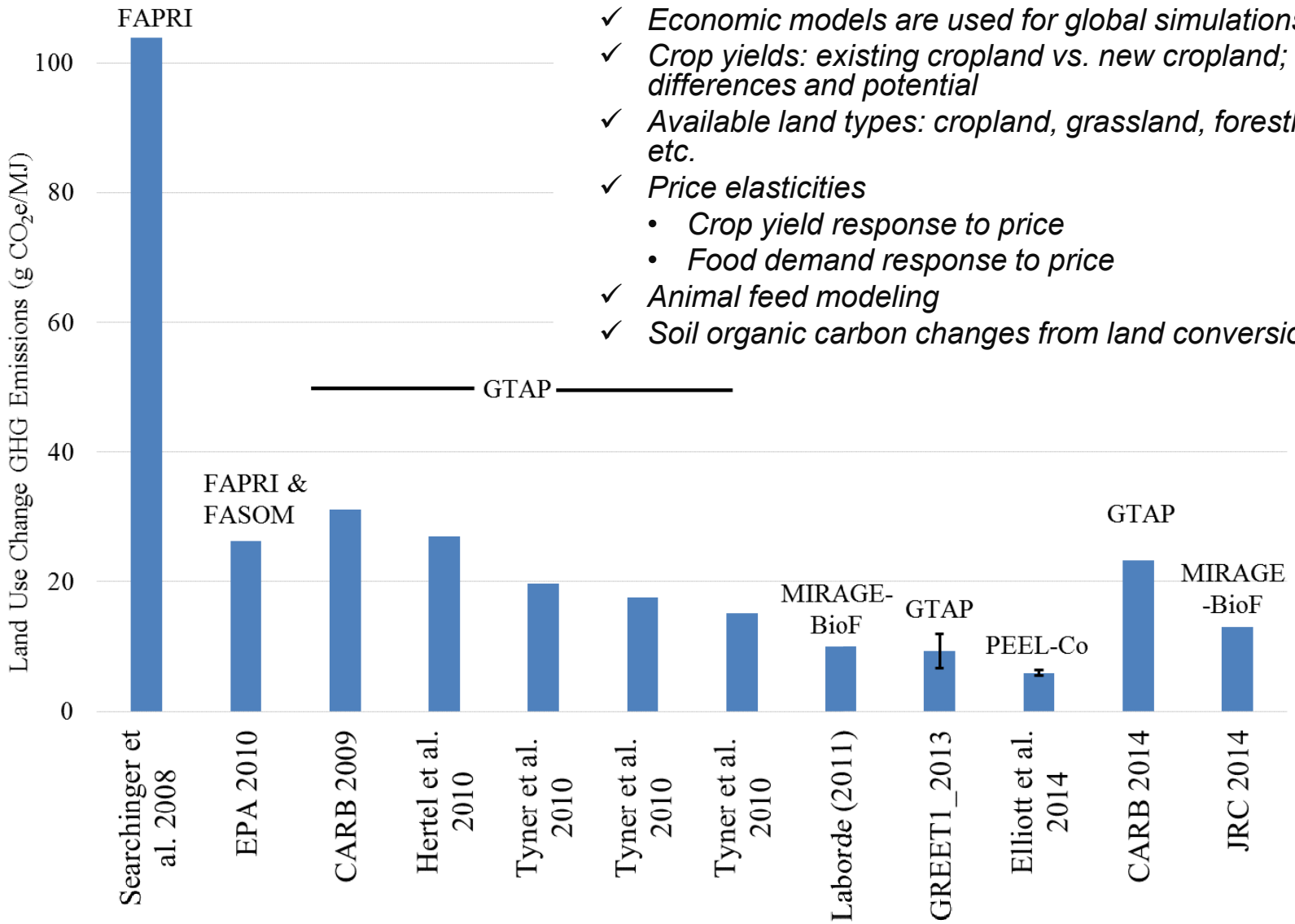


LUC GHG emissions are estimated through a combination of economic model output and carbon stock estimates.

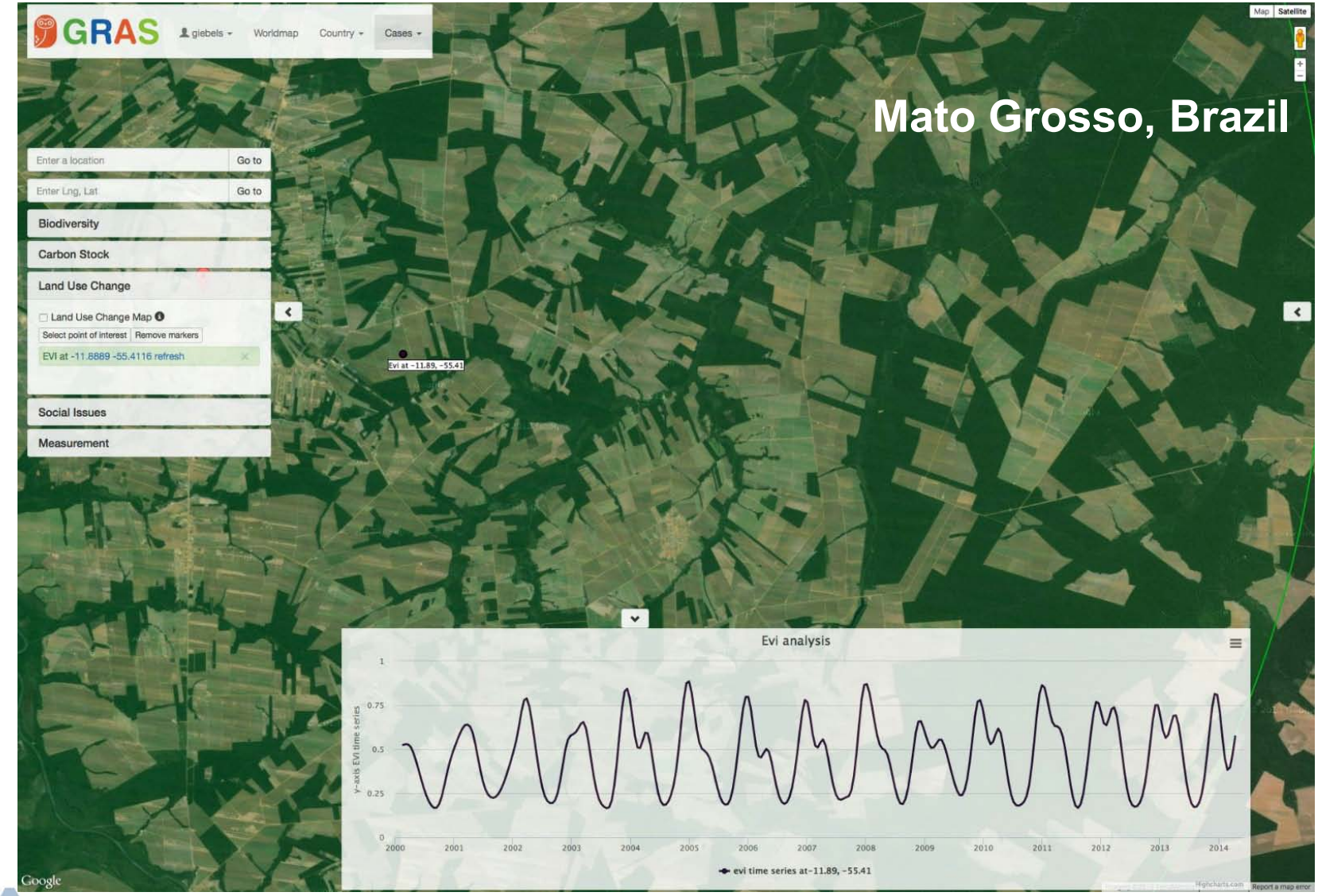
Estimates of LUC GHG emissions for the corn ethanol pathway are well below early estimates

Critical factors for LUC GHG emissions:

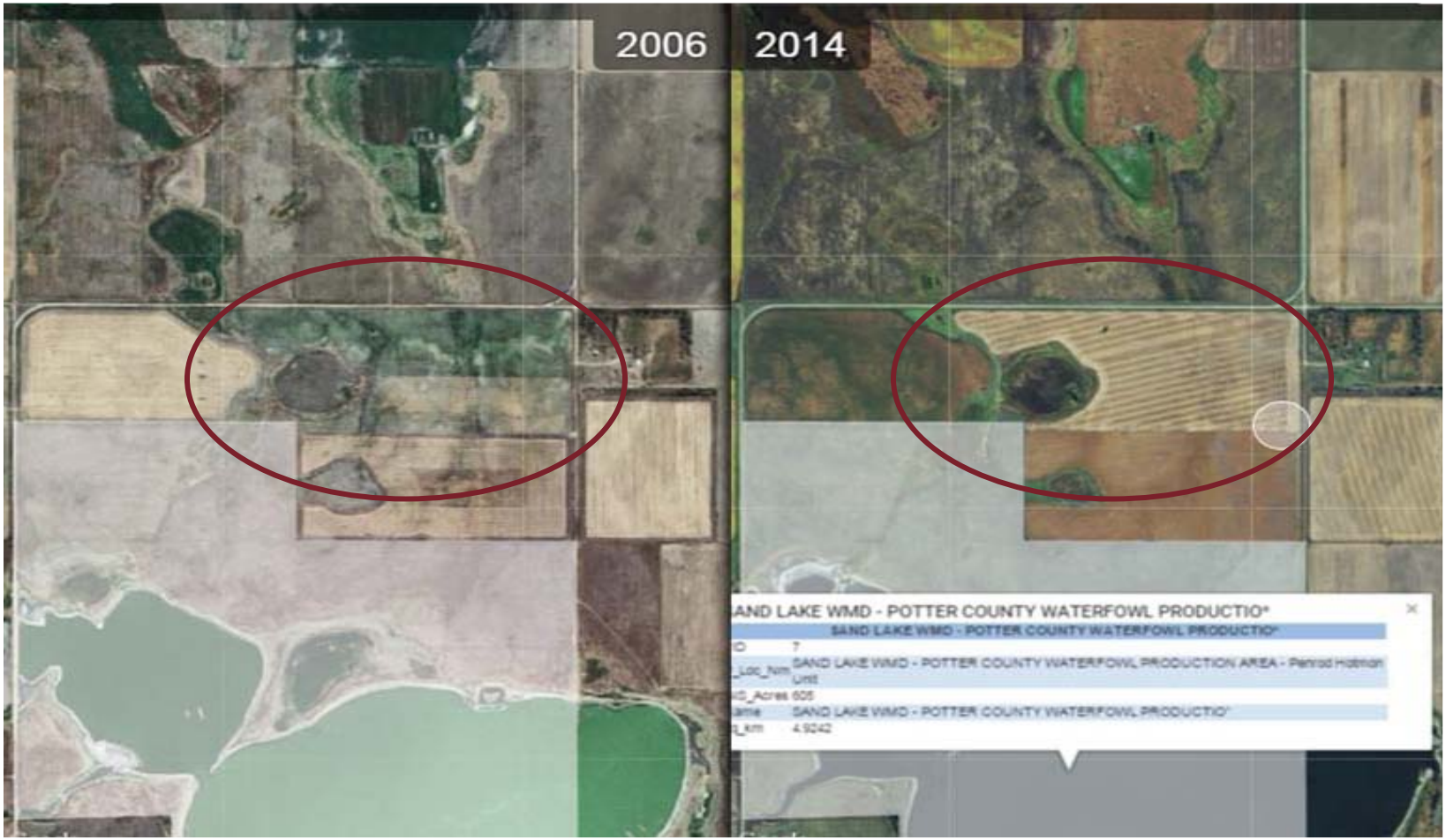
- ✓ *Economic models are used for global simulations*
- ✓ *Crop yields: existing cropland vs. new cropland; global yield differences and potential*
- ✓ *Available land types: cropland, grassland, forestland, wetland, etc.*
- ✓ *Price elasticities*
  - *Crop yield response to price*
  - *Food demand response to price*
- ✓ *Animal feed modeling*
- ✓ *Soil organic carbon changes from land conversions*



Double cropping increases biomass production on existing agricultural land



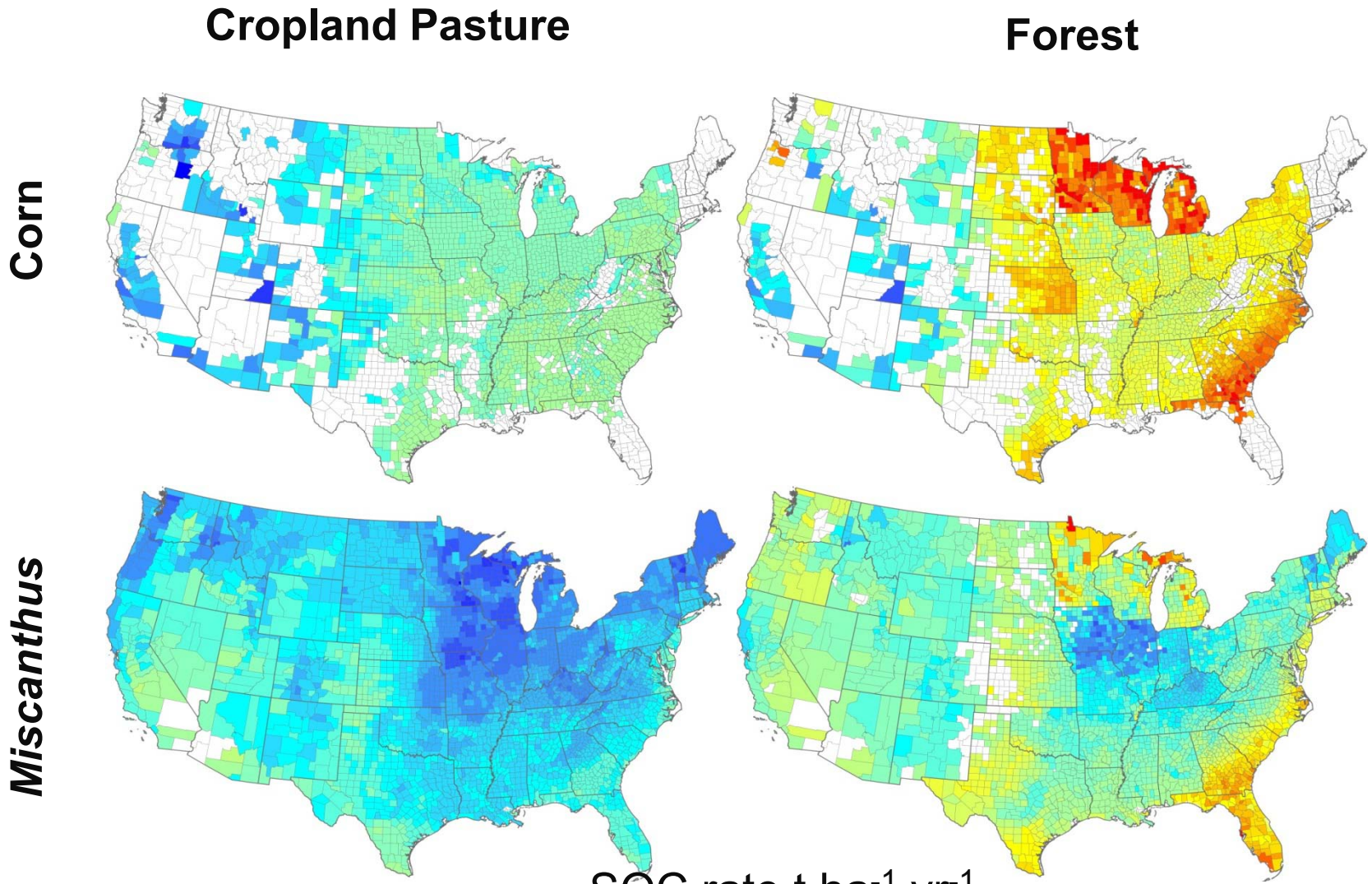
National Agricultural Imagery Program (NAIP) data allows visual validation of LUC (or no LUC)



Potter County, South Dakota (Prairie Pothole Region)

Genscape

Soil organic carbon changes upon land transition are highly spatially- and feedstock-dependent



Qin et al., *GCB Bioenergy*, 2015, submitted

Conclusions

- Biofuel life cycle analysis benefits from data that reflect the evolution and maturing of feedstock production and conversion technologies
- Data are available that can inform our discussion and understanding of historical land use change and help us improve models that estimate it
- An understanding of historical land use change based on data can inform development of strategies to mitigate undesirable land use change
- Carbon stock changes upon land transitions are spatially- and feedstock-dependent

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