

ELM-FATES Global Historical Runs

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With lots of help from lots of people, including (alphabetically):

Kjetil Aas, KC Cushman, Alan Di Vittorio, Rosie Fisher, Adrianna Foster, Jennifer Holm, Michael Keller, Ryan Knox, Jenny Kowalczyk, David Lawrence, Peter Lawrence, Greg Lemieux, Marcos Longo, Jessie Needham, Sam Rabin, Marit Sandstad, Shijie Shu, Anthony Walker



NGEE-TROPICS
NEXT-GENERATION ECOSYSTEM EXPERIMENTS

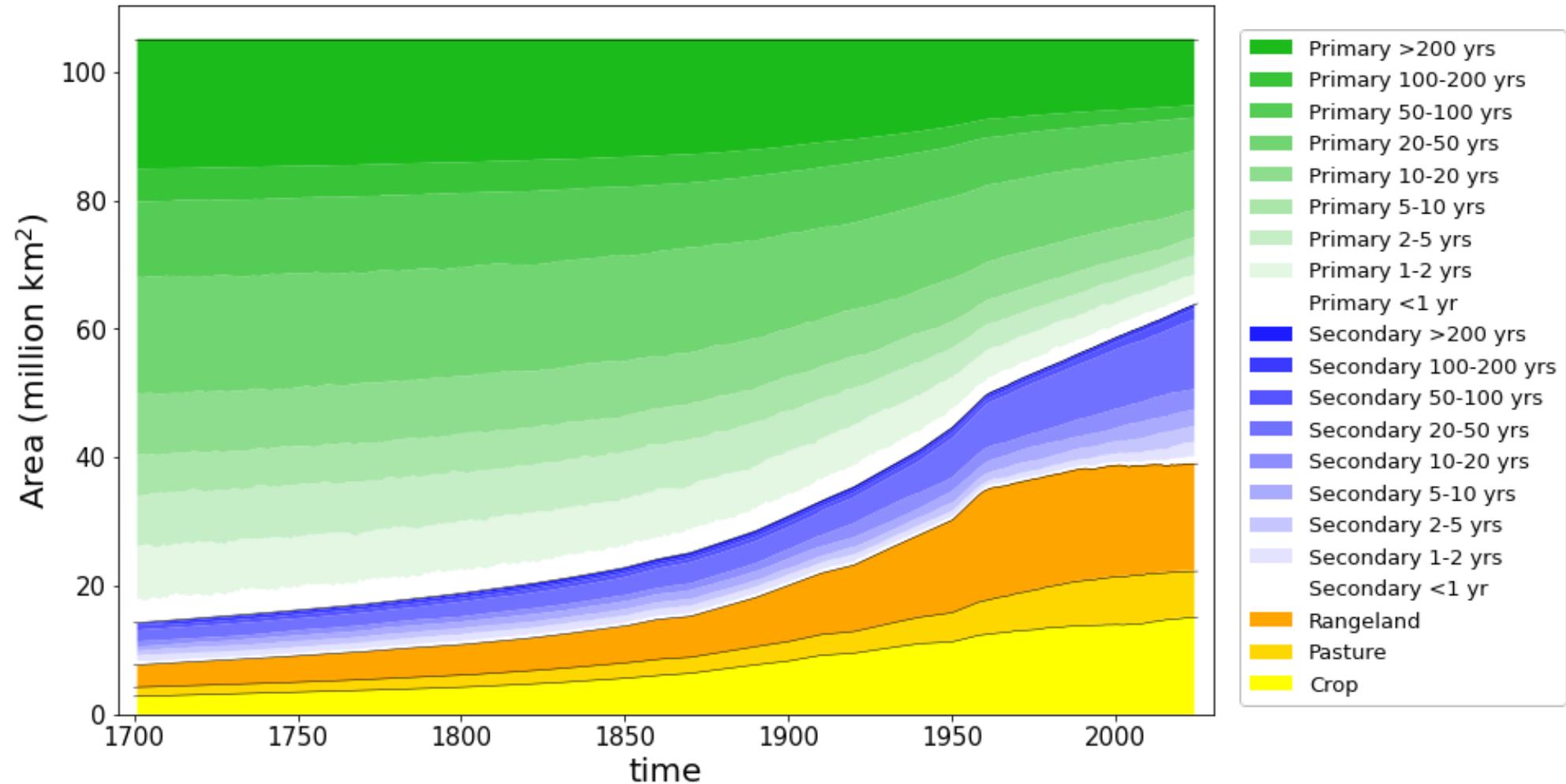


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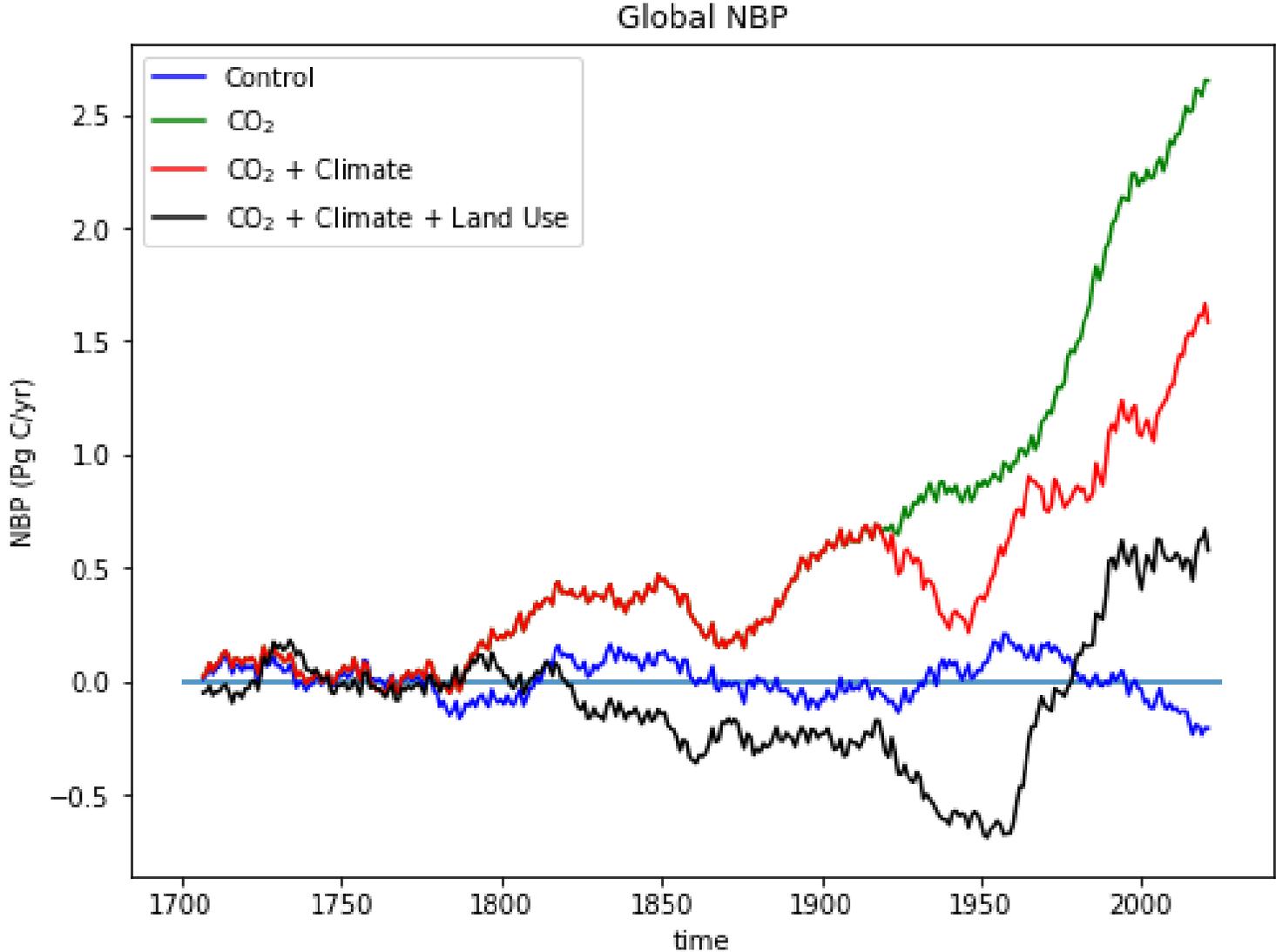
FATES new capability: land use change!

- Had been last key missing piece before transient global historical and future scenario simulations could be performed
- Allows patch disturbance approach to reflect both natural and anthropogenic land use history
- Differs from classic CLM/ELM in the relationship between land use and land cover:
 - Classic approach: preprocessing translates land use to land cover before full model is run
 - Current FATES (nocomp) approach: ingest land use timeseries, as well as static dataset for land cover conditional on land use

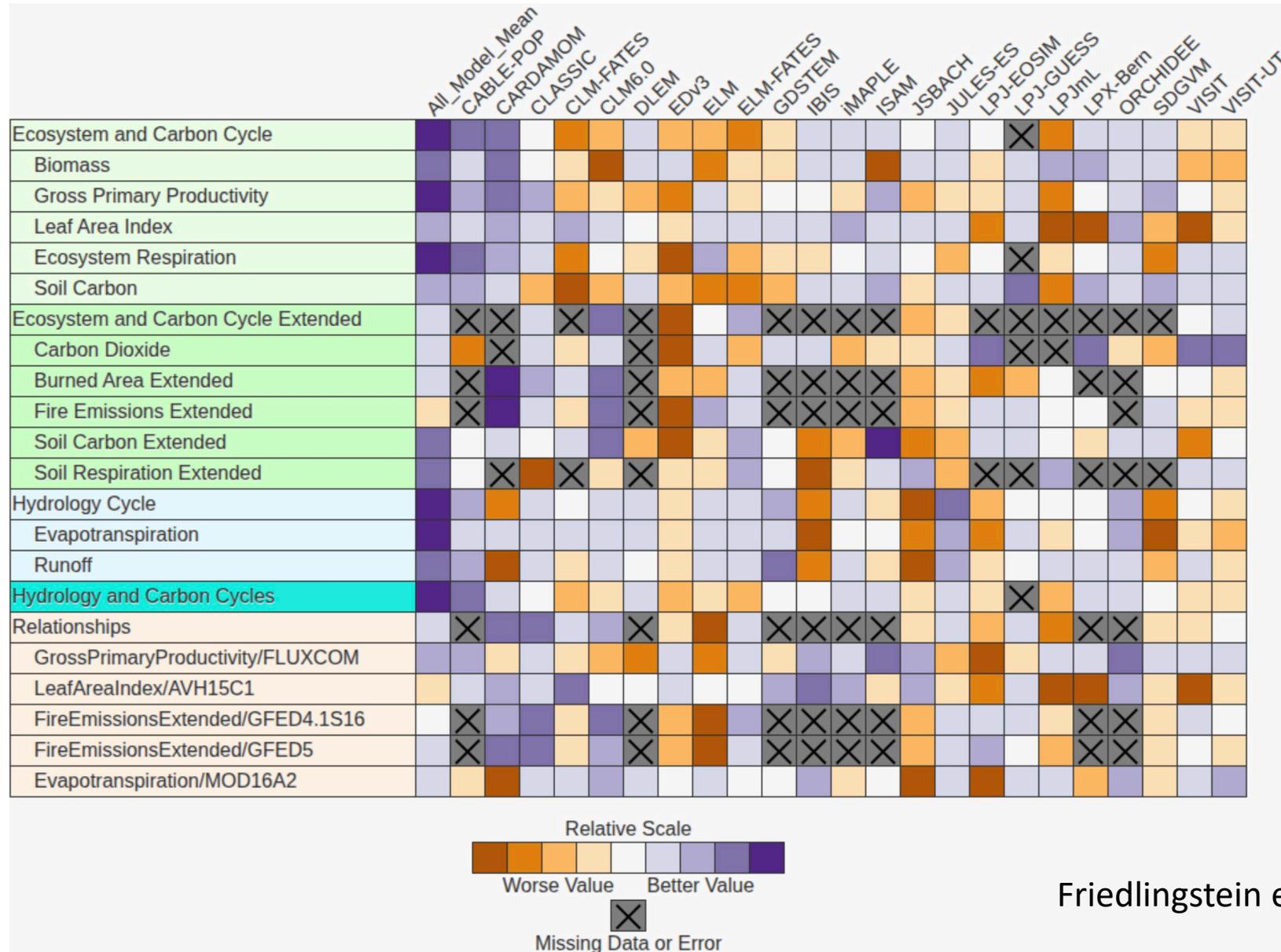
Transient changes to global patch land use types and age distributions



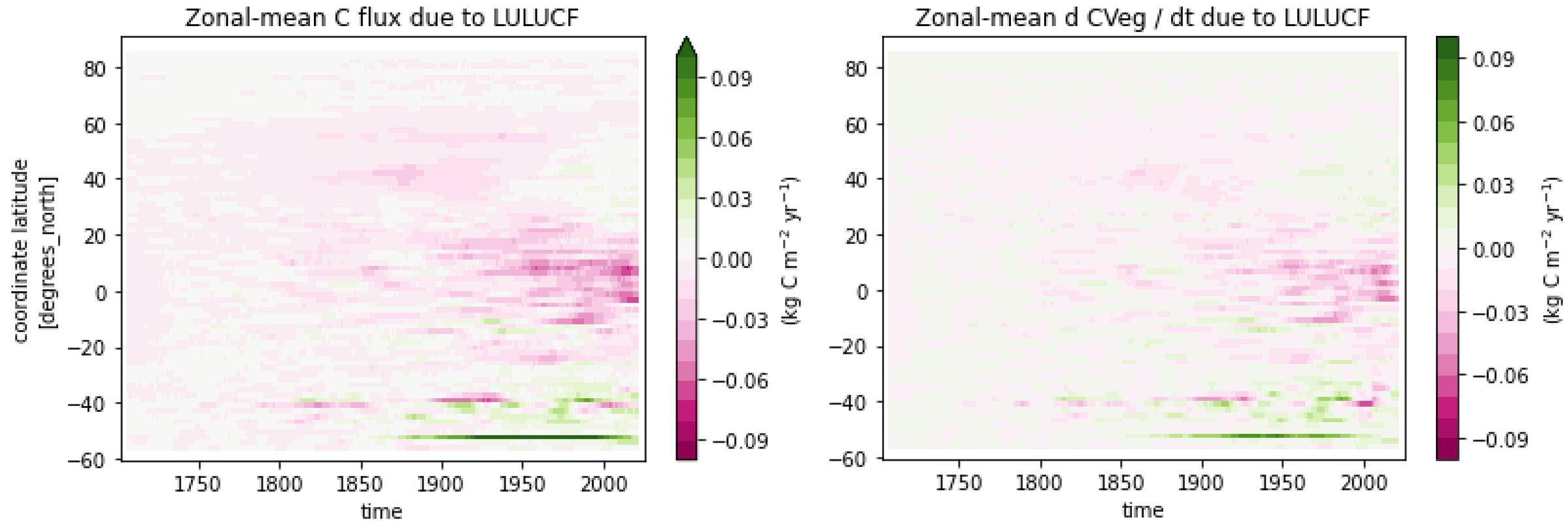
Global FATES NBP integrals following TRENDY experimental protocol



FATES ILAMB benchmarks aren't totally crazy



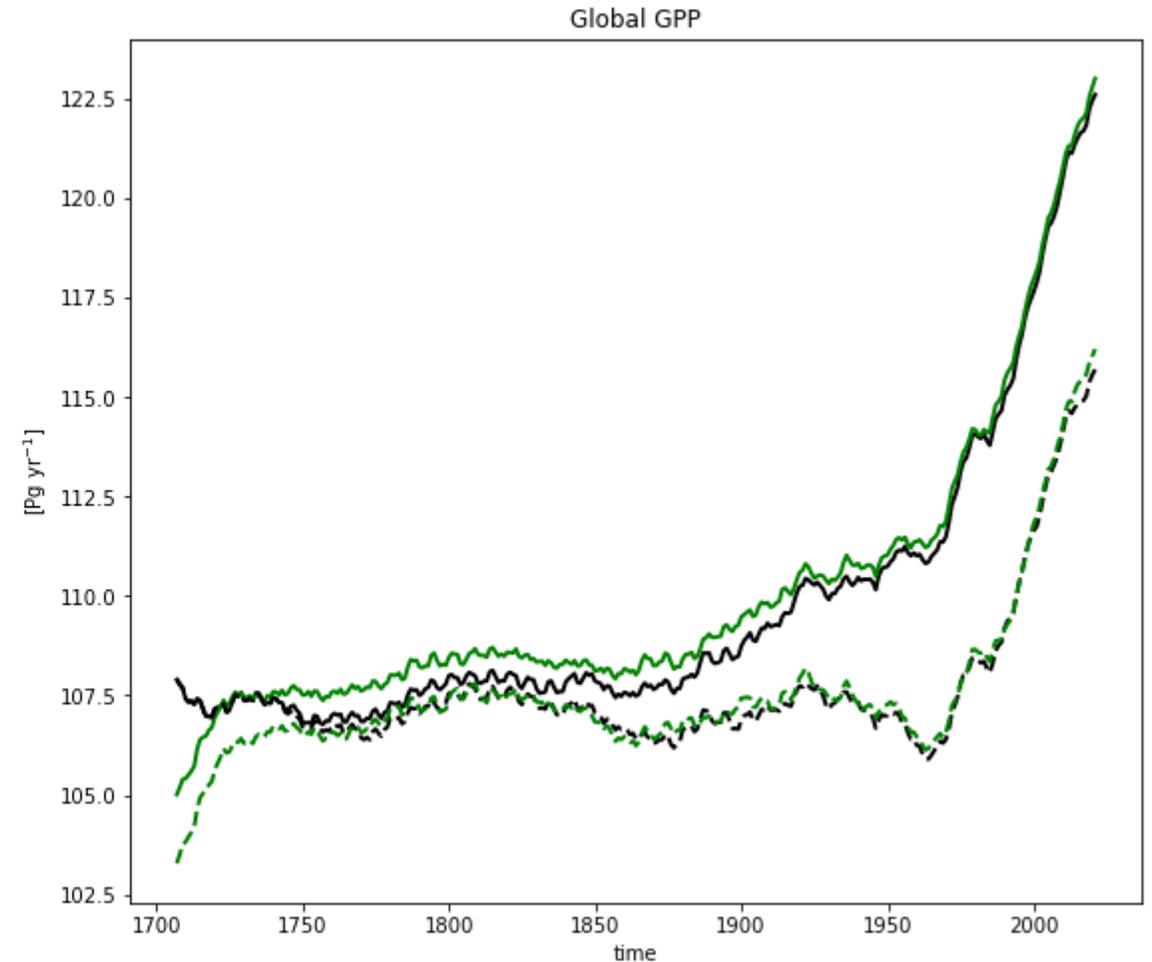
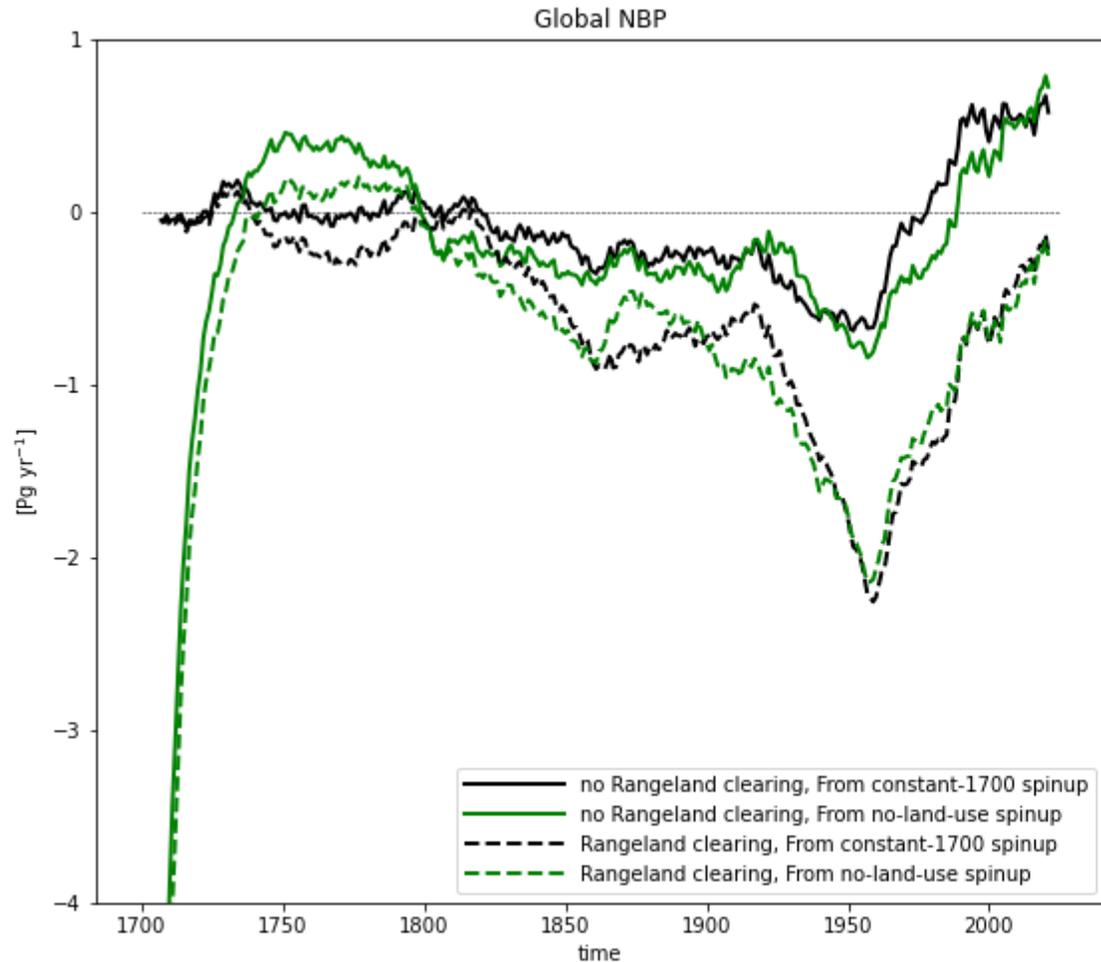
Global Land-Use driven C flux distributions: source in tropics, regrowth-driven sink in mid latitudes



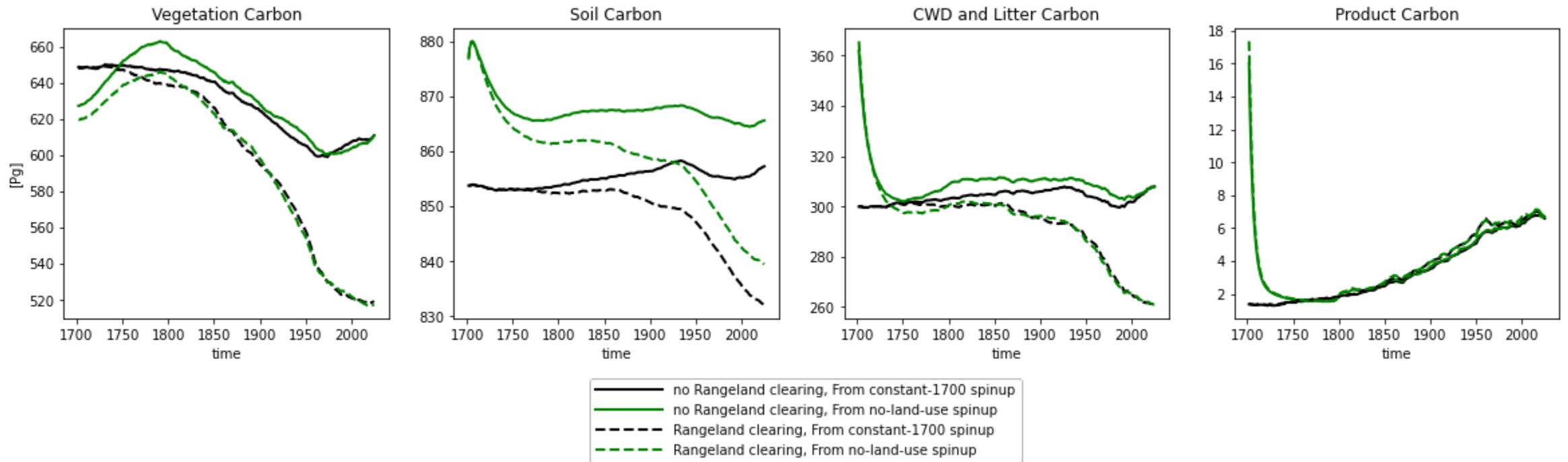
A few initial structural sensitivities to investigate:

- Initial conditions
 - Two possible ways of spinning up FATES:
 - Late-preindustrial steady-state spinup, using a set of constant harvest rates that give secondary land age distributions that approximate transient millennial run
 - No-land-use spinup, followed by initial land use conversation to give land use types at start of transient run
- How aggressively to clear land during transitions to rangeland

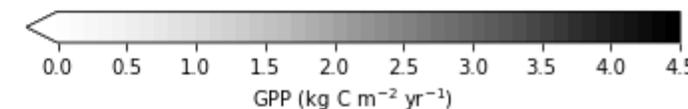
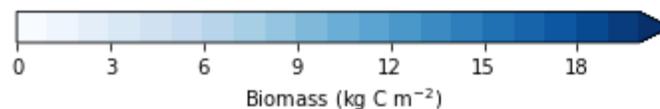
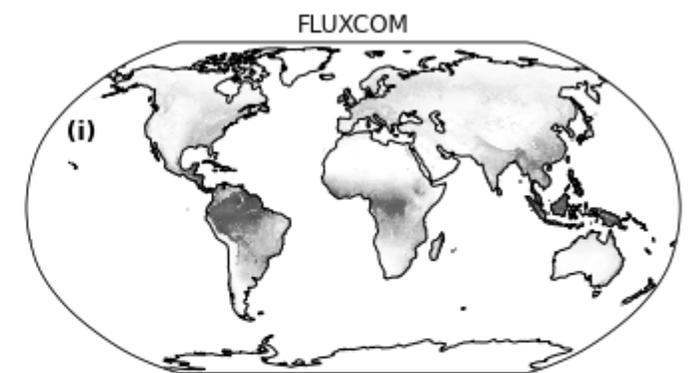
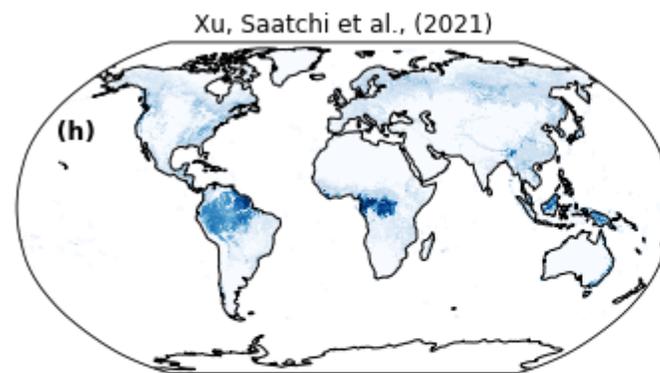
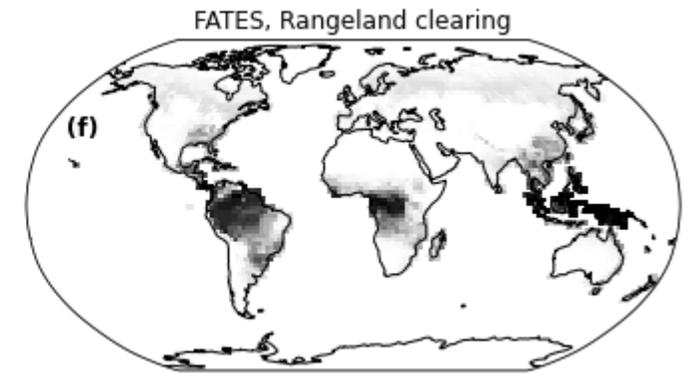
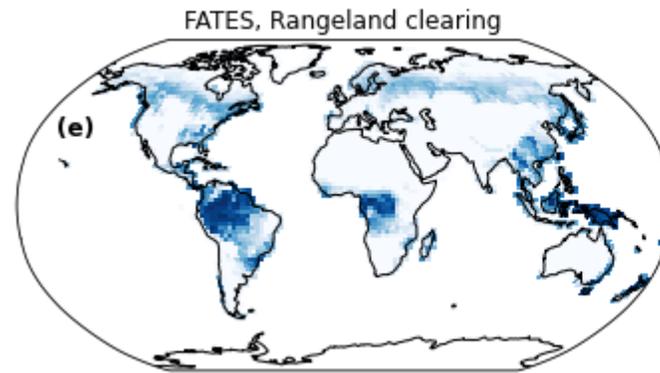
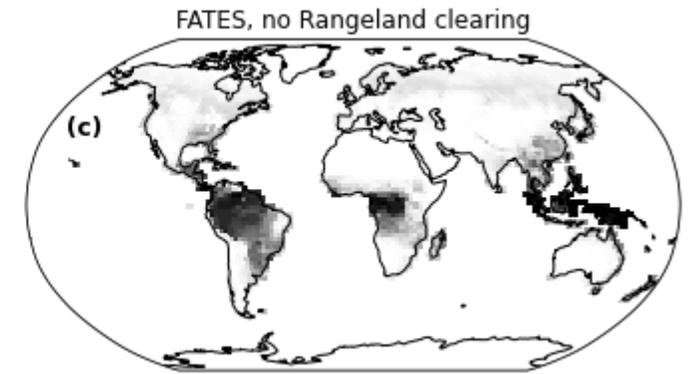
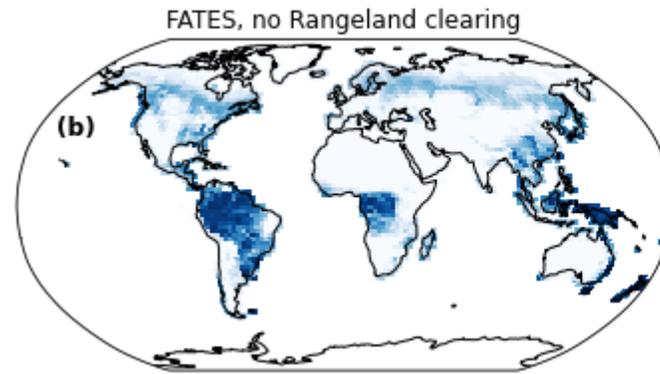
Spinup effects have long legacies and interact with rangeland clearing rules. Rangeland clearing substantially weakens C sink and changes sign of recent C fluxes to source.



Rangeland clearing rules dominate C stock differences, with the exception of soil C that shows multi-century persistence of spinup protocol effects



Simulation with more aggressive clearing during rangeland conversion shows better agreement with remote sensing observations.



Summary

- First set of FATES global historical transient experiments.
- Spinup protocol leaves a long legacy
 - Recommendation to use the constant land-use method for spinup, which is more analogous to spinup protocol of classic CLM/ELM, because it avoids long transients associated with no-land-use spinup
- High uncertainty related to how handle some of the details of land use conversion, particularly for rangeland
 - Complete clearing during rangeland conversion leads to better agreement with bottom-up remote sensing benchmarks
 - But also degrades top-down benchmark of recent global land sink (model predicts it is a source instead)
- Much work to do still...