

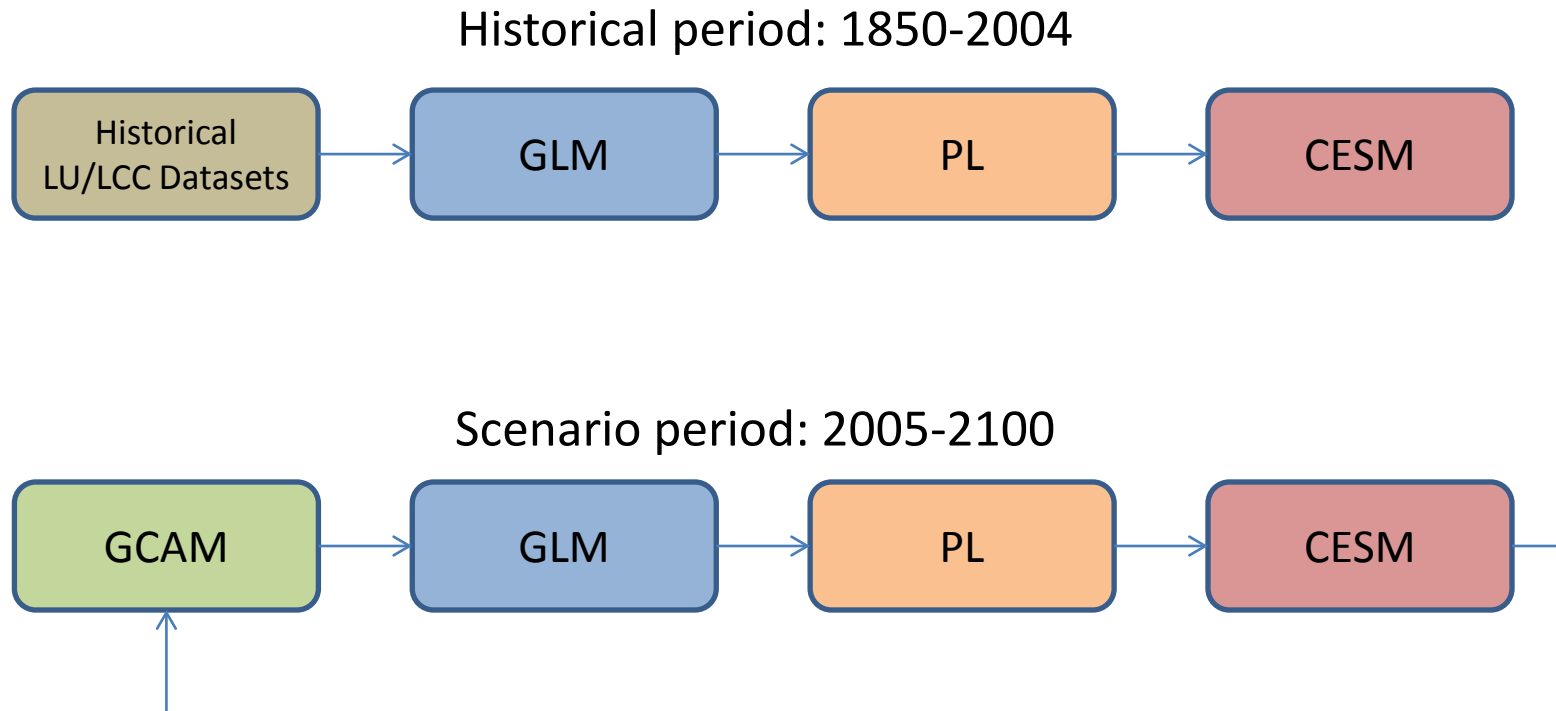
Influence of land use and land cover change on climate predictions over the period 1850-2004

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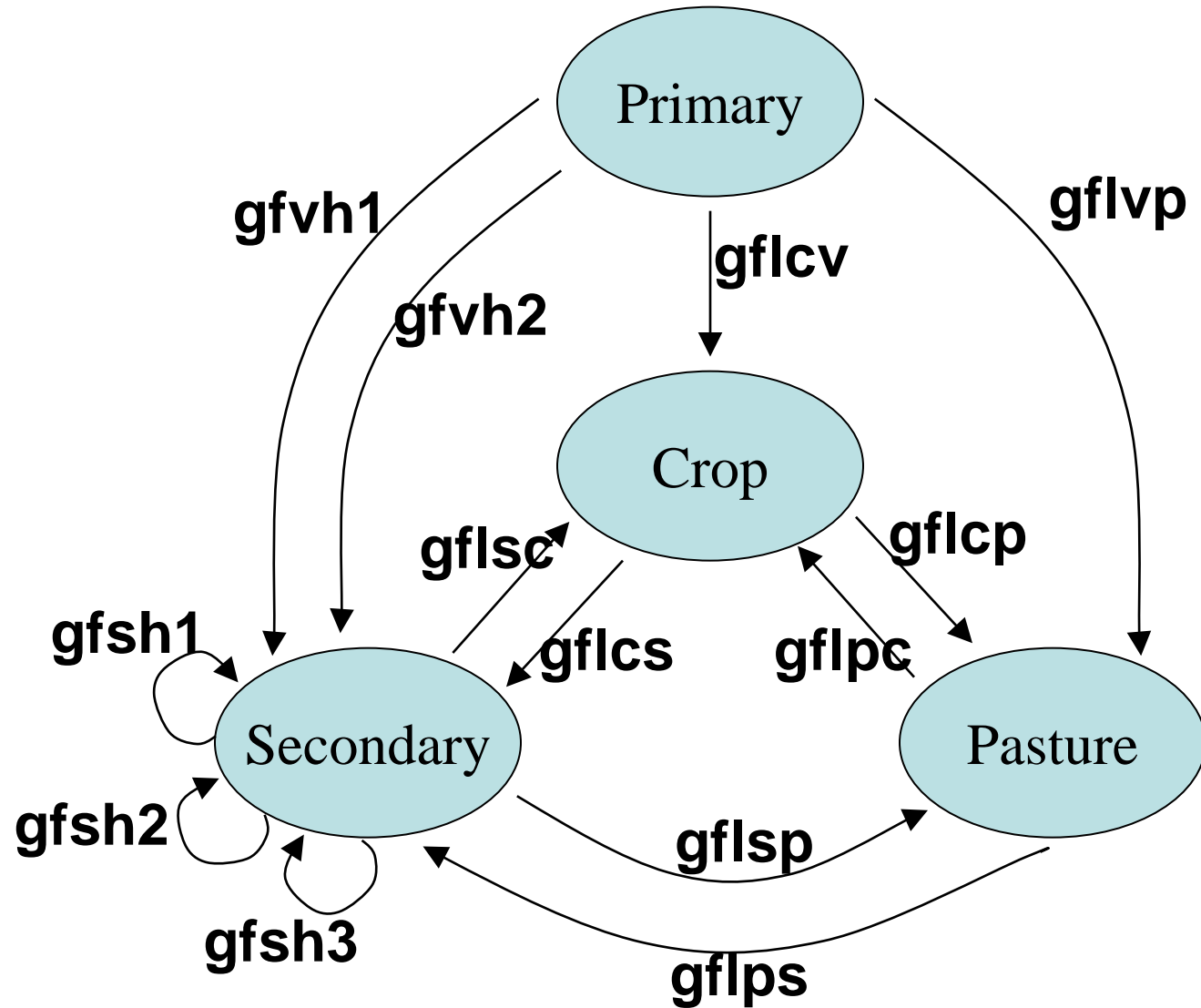
(¹PNNL, ²LBNL, ³ORNL, ⁴U Md, ⁵NCAR)

iESM: integrated Earth System Model

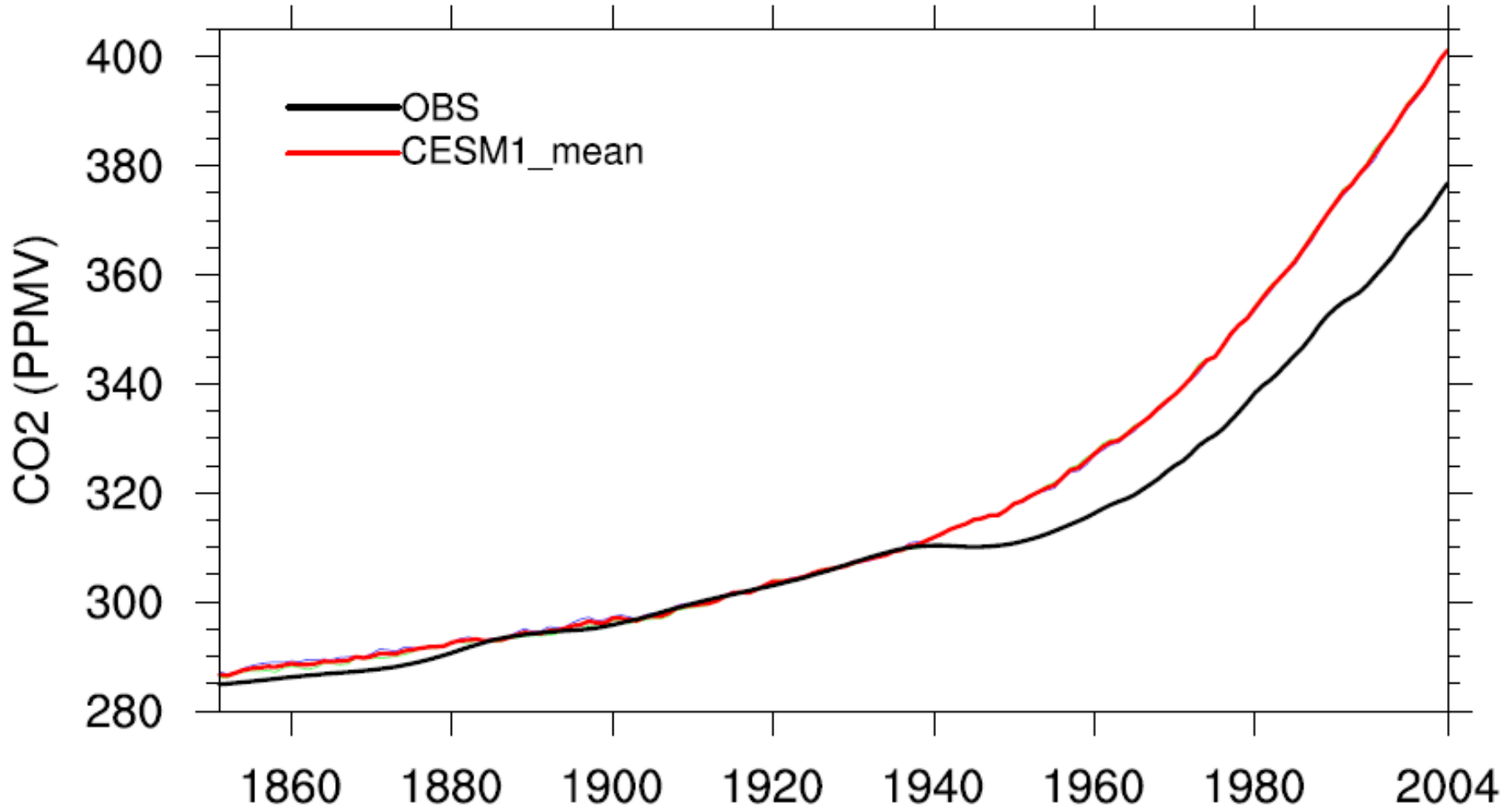
iESM: LU/LCC coupling



Land use states and transitions represented by GLM (Hurtt et al., 2011)

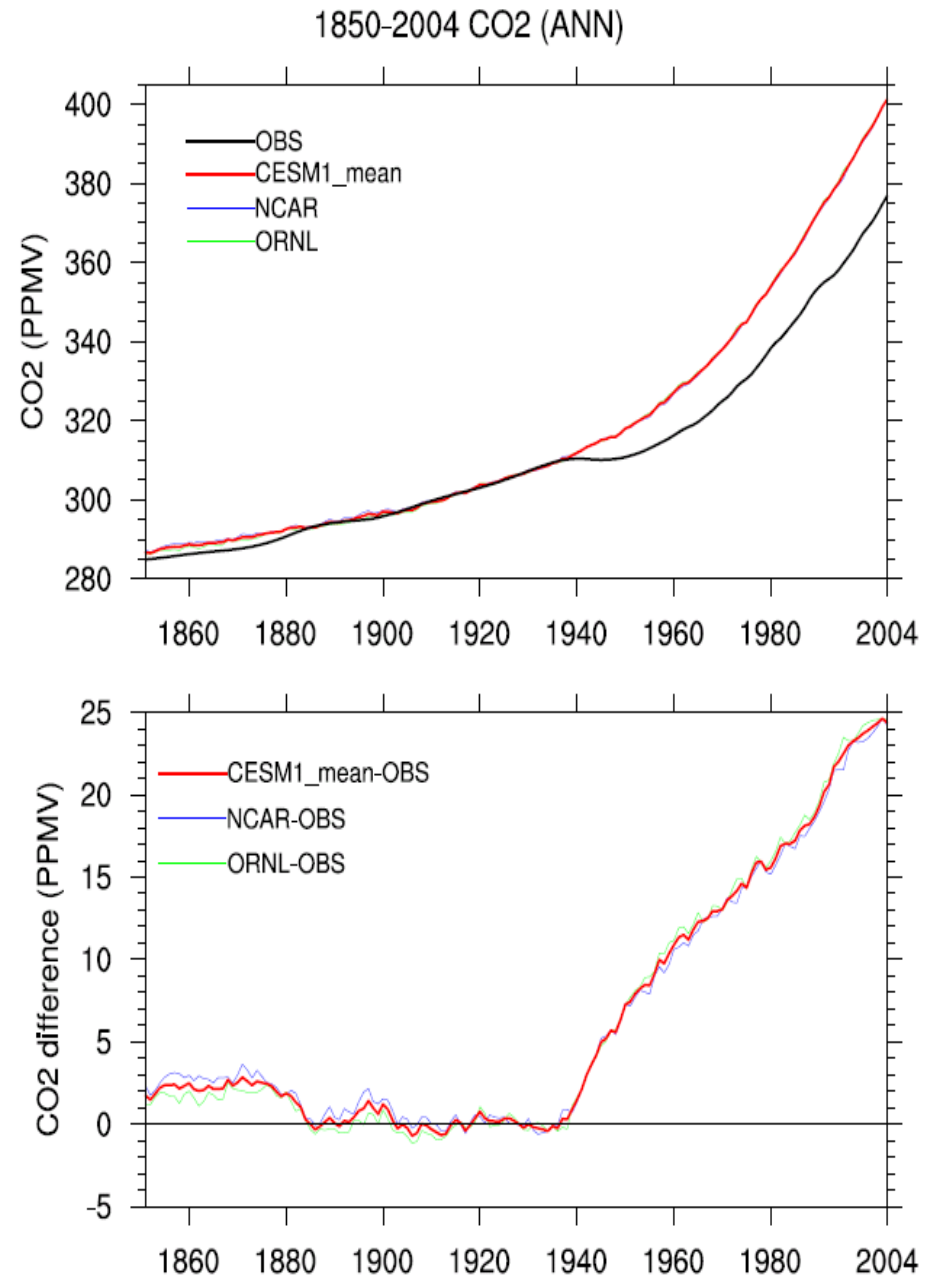


Assessment of bias in global mean CO₂ concentration

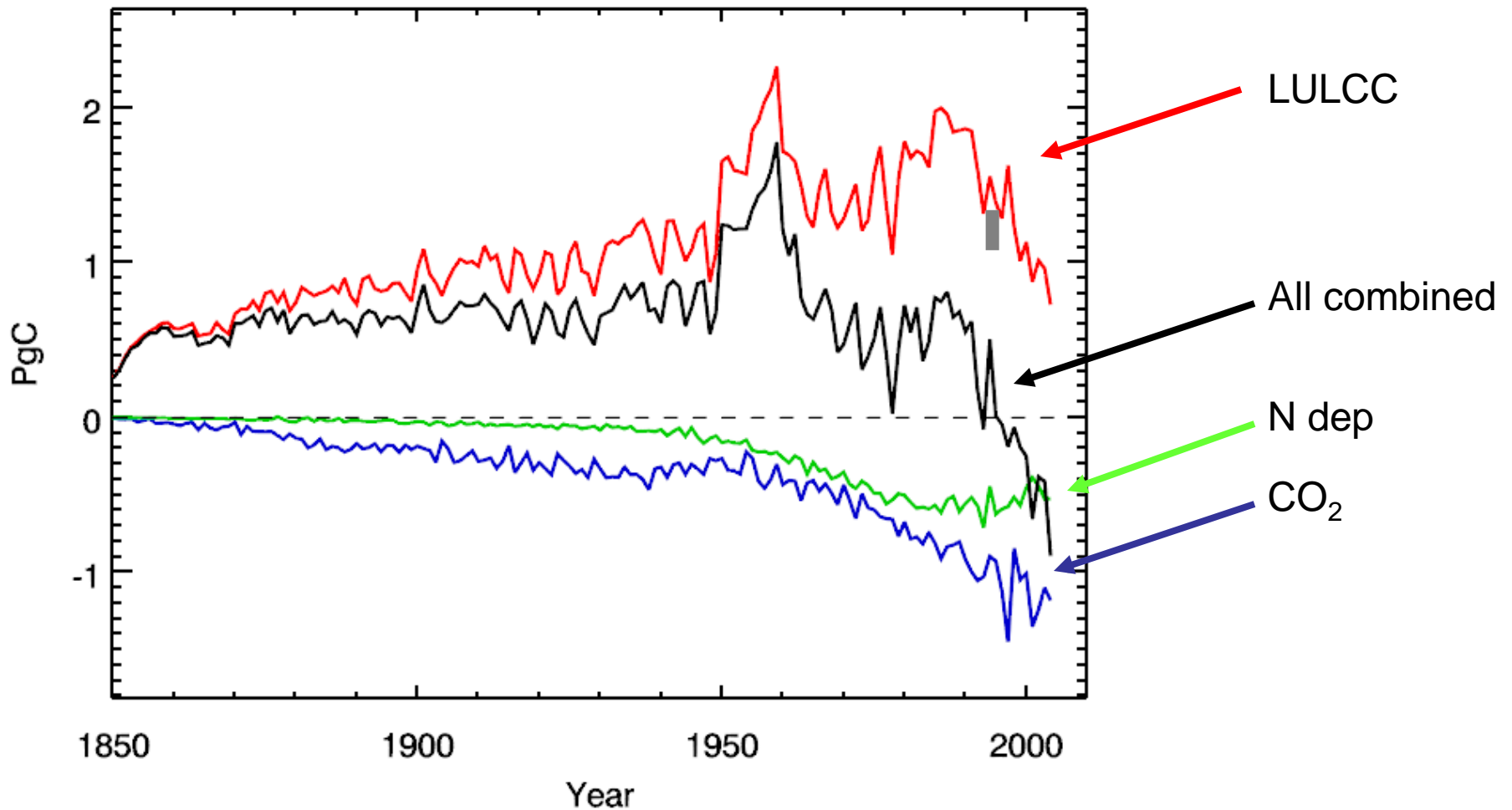


What's wrong with this picture?

- Observed CO₂ concentration is biased
 - Ice core / instrument transition?
- Fossil fuel emissions are biased
 - Emissions forcing too high during WWII?
- Land use / land cover change data are biased.
 - Forest harvest too high? Regrowth too small?
- Model is biased
 - Internal climate variability?
 - Low land and/or ocean sensitivity to rising CO₂?
 - Response to harvest too strong?
 - Regrowth response too weak?

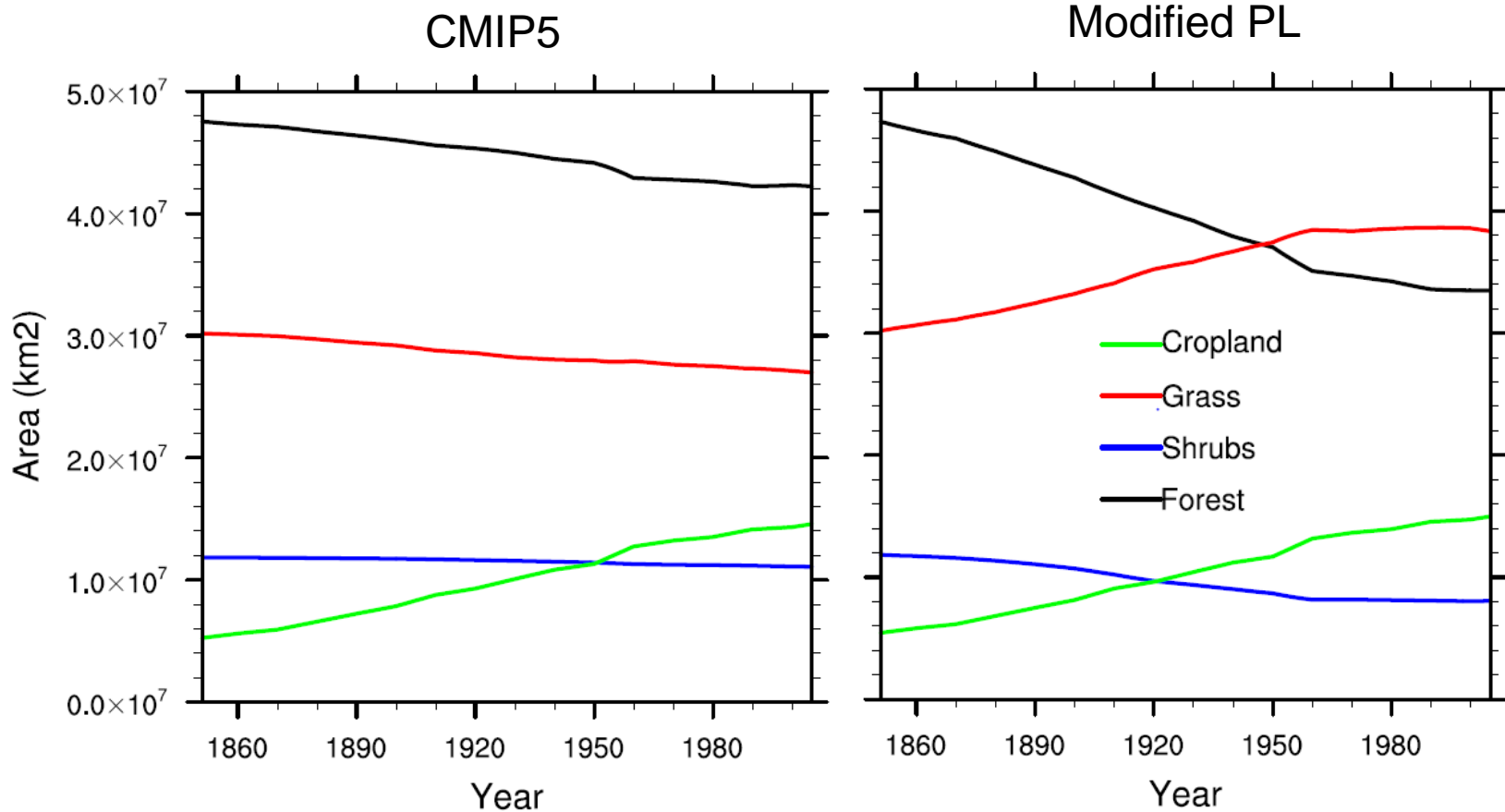


Single and combined effects on NEE



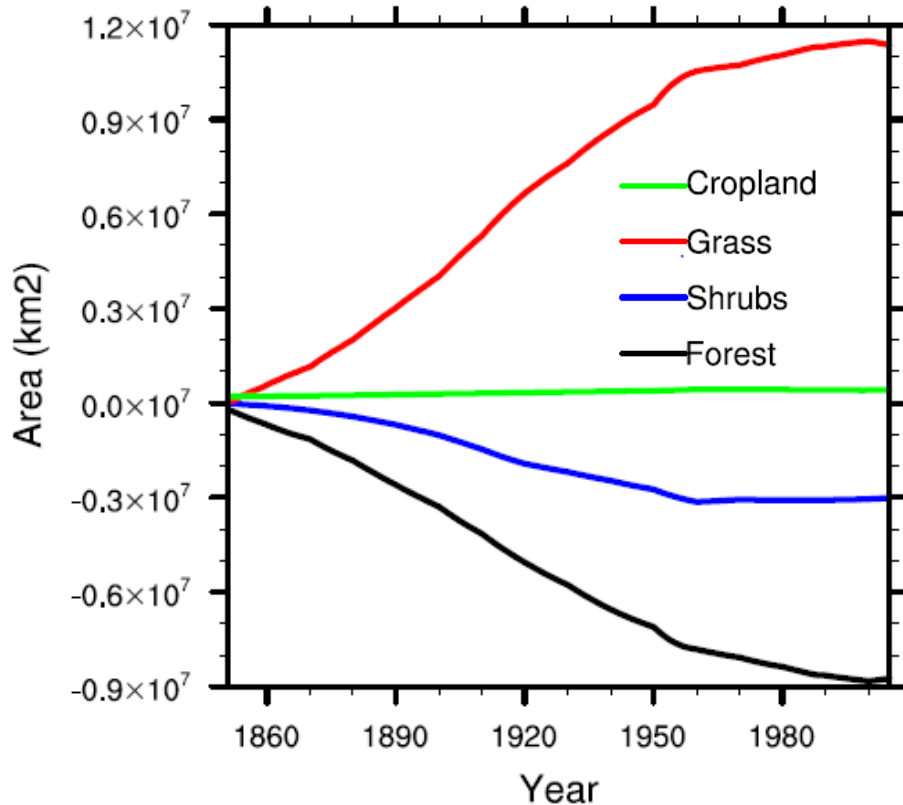
Shevliakova 2009 (LM3V model result)

Sensitivity to assumptions about LU/LCC

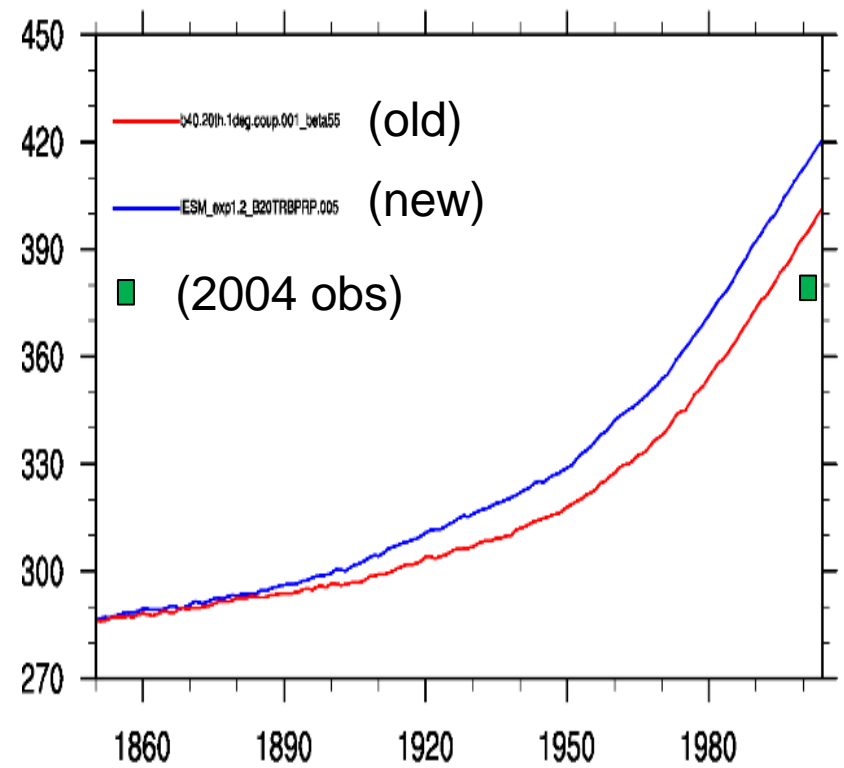


Impact on historical prognostic CO₂

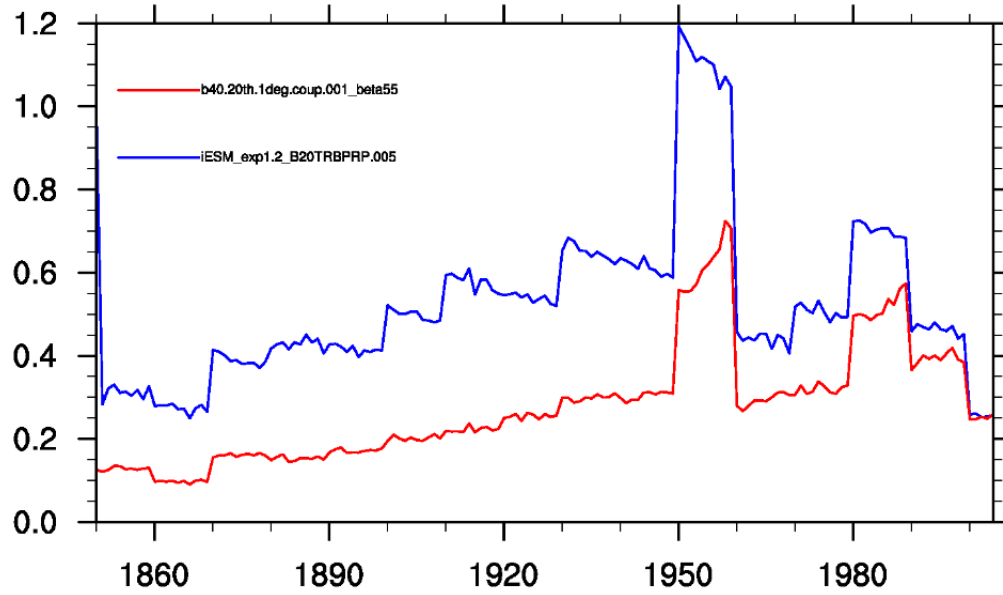
Landcover summary: new - old



CO₂_PPMV(Pa) for model year 1850-2004



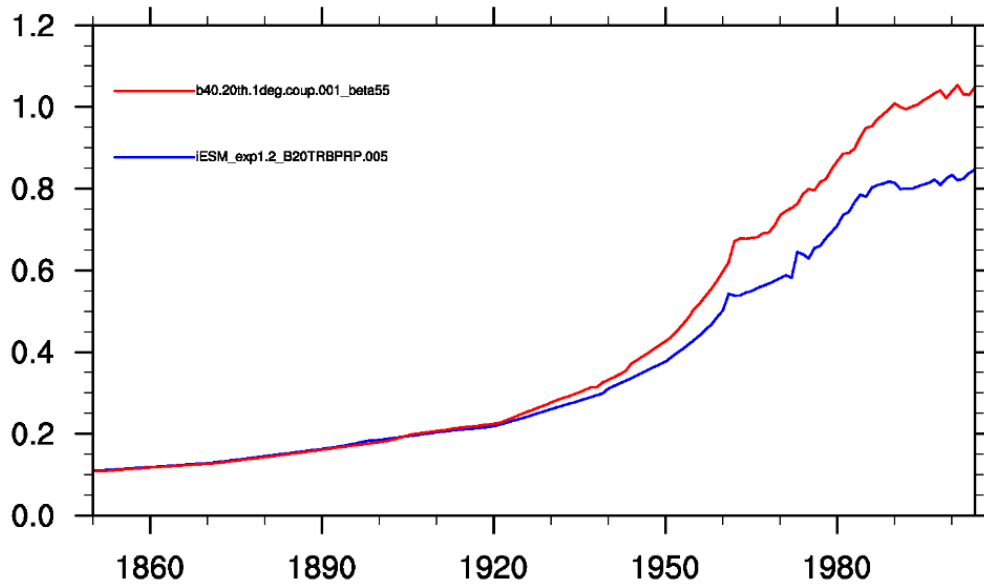
DWT_CLOSS(PgC/y) for model year 1850-2004



Carbon source due to land cover conversion

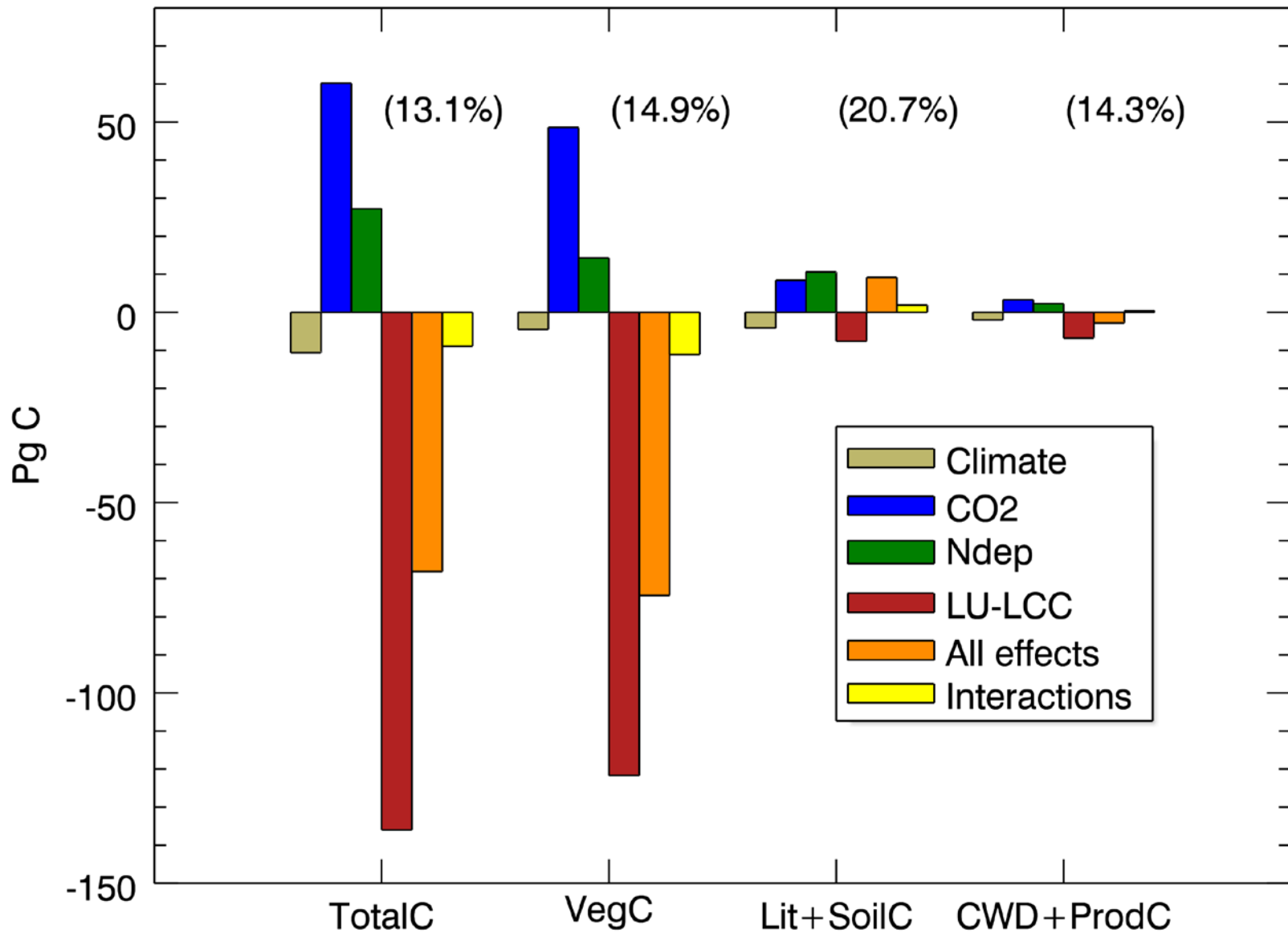
— (old)
— (new)

WOOD_HARVESTC(PgC/y) for model year 1850-2004

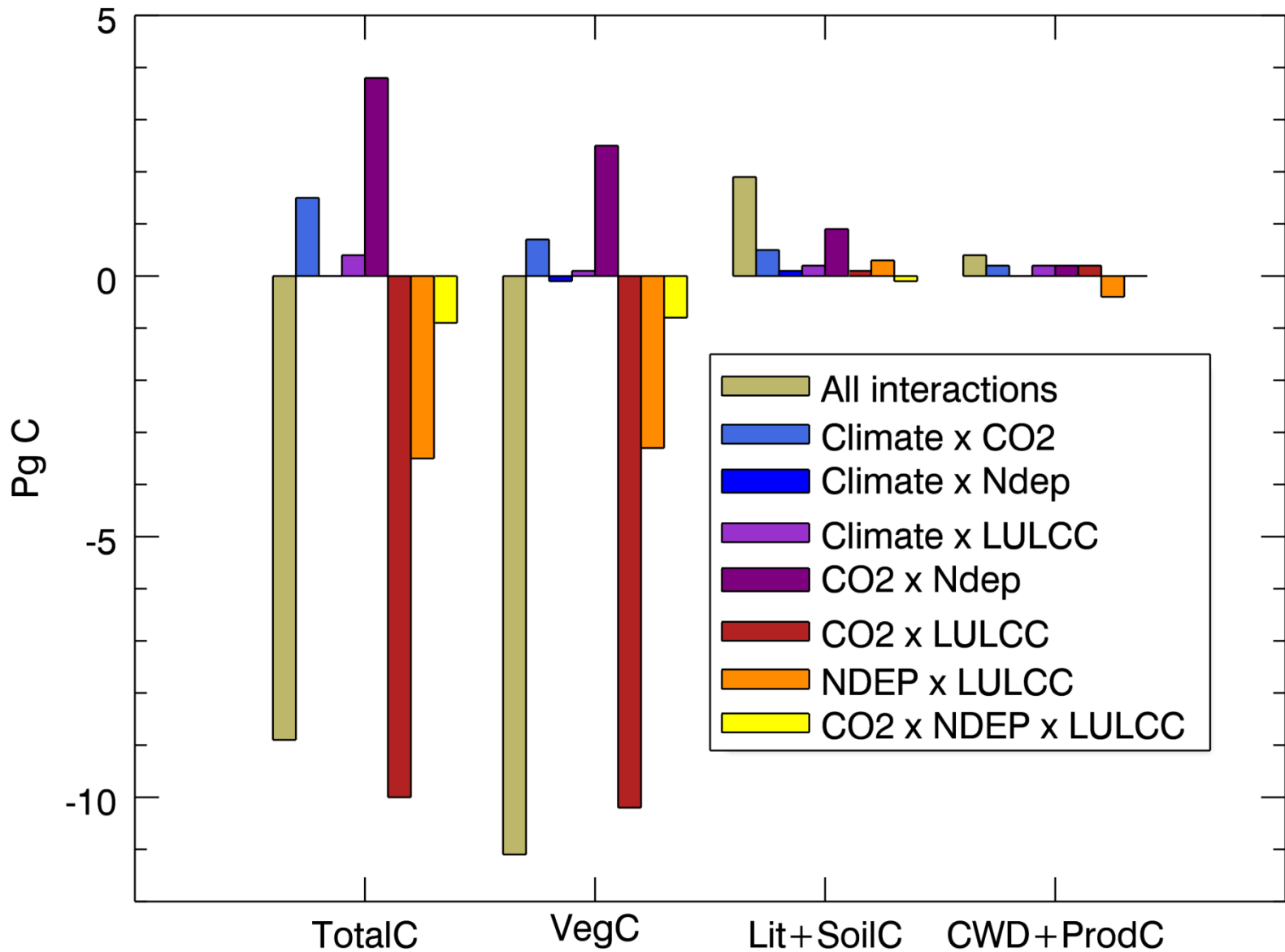


Carbon removed from forests due to harvest

SFF: Impacts on total land carbon stock, 1850-2009



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Conclusions

- Model-data inconsistency starting ~1940 remains unexplained
 - Revisiting pasture data
- LU/LCC uncertainty can drive significant variation in historical atmospheric CO₂
- Interactions among LU/LCC, rising CO₂, and N deposition need to be considered
- LU/LCC modeling requires a consistent treatment of carbon pools and fluxes