ELM-Crop in coupled model framework

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Background

- Agriculture accounts for ~20% US land use
- Crop management has strong feedbacks to atmosphere:
  - surface energy
  - heat exchange
  - water fluxes, and
  - biogeochemical cycles

- But, crops have only been tested offline, not in a coupled framework with the atmosphere

Goal*

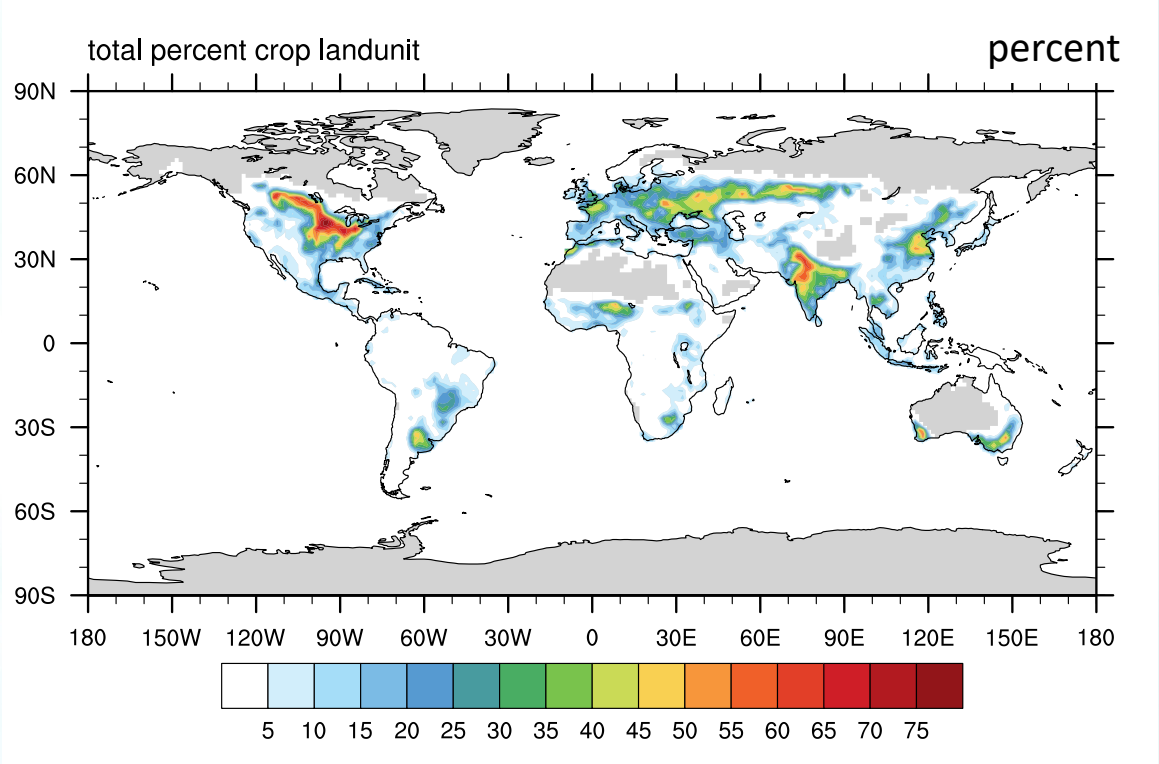
- Test the coupled configuration with crops active for:
  - 1) Atmosphere-Land (17-year simulation with spinup)
    - Compset: FC5L45BGC (modified)

    1850_CAM5%CMIP6_CLM45%BGC_CICE%PRES_DOCN%DOM_SROF_SGLC_SWAV_SIAC_SESP
    - Resolution: ne30_ne30 (global crops)
  - 2) Atmosphere-Land-Ocean (10-year simulation with spinup)
    - Compset: BGCEXP_BCRC_CNPRDCTC_1850

    1850_CAM5%CMIP6_CLM45%CNPRDCTCBC_MPASSI%BGC_MPASO%OIECOOIDMS_MOSART_SGLC_SWAV_SIAC_SESP_BGC%BCRC
    - Resolution: ne30_oECv3 (temperate crops only)

*Disclaimer: All simulations presented here are preliminary. The initial experimental setup was designed to catch bugs and test robustness when crops are active in different coupled modes. As such, the simulations are not long enough for a full analysis, but an extended test will be performed in the future.

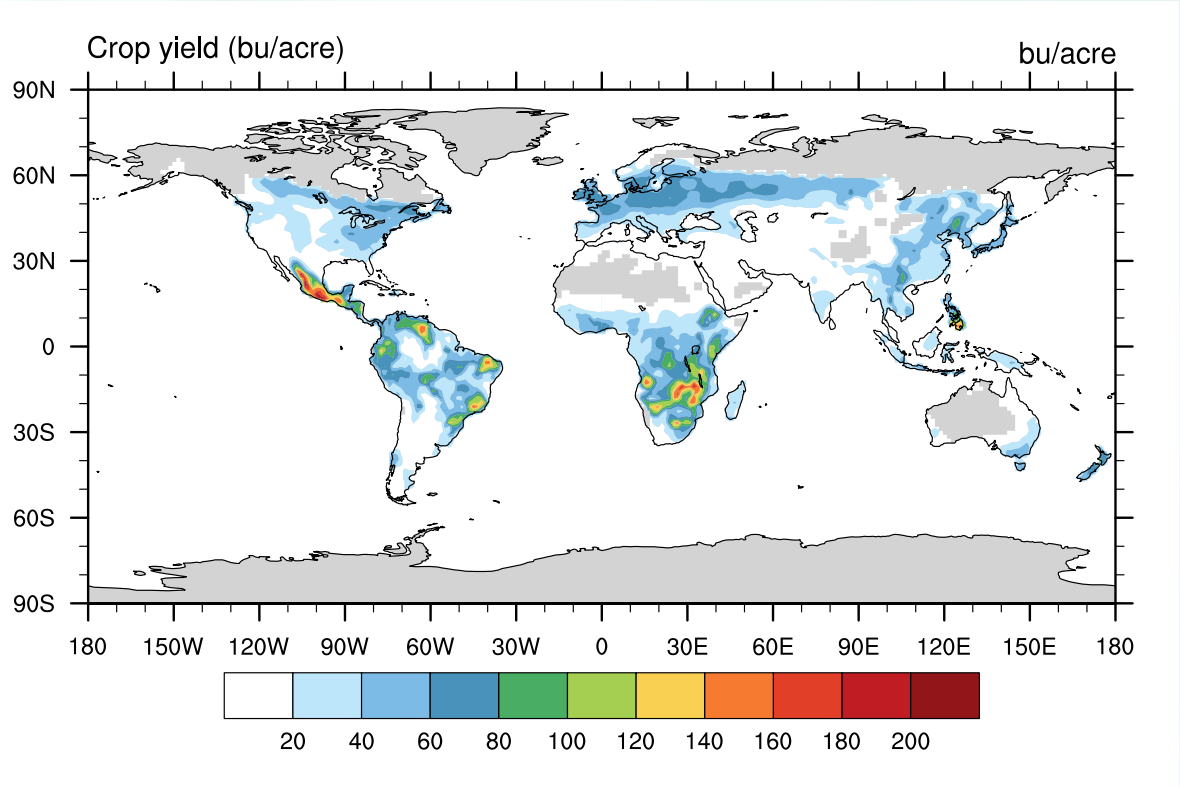
Global crop distribution

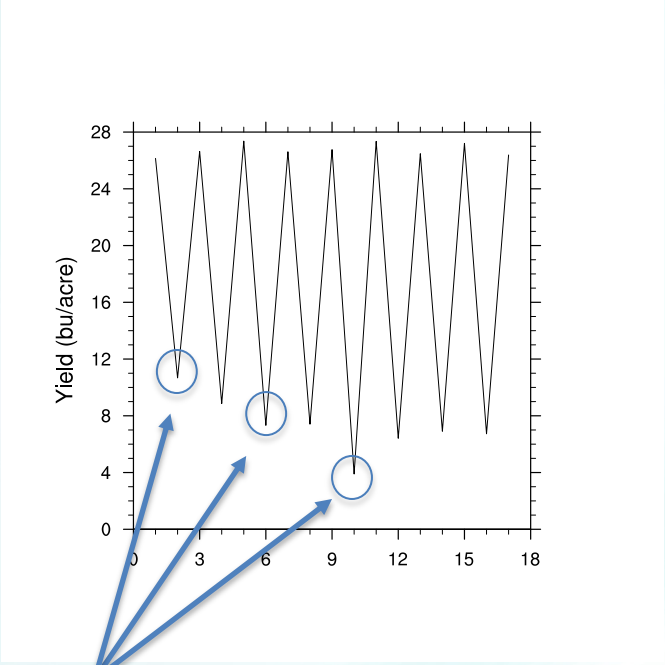


- The number of crop types in ELM has been expanded to 36 total, although most are placeholders.
- Crop types include (rainfed and irrigated): 1 generic crop, 10 food crops, 2 non-food crops, and 5 bioenergy crops.
- Map shows the distribution (percent) of all crops, except generic crop types. Currently, all crops other than maize and soybean are modeled as spring wheat using the mergetocft parameter.

Yield

Compset: FC5L45BGC (modified)
Resolution: ne30_ne30 (global crops)

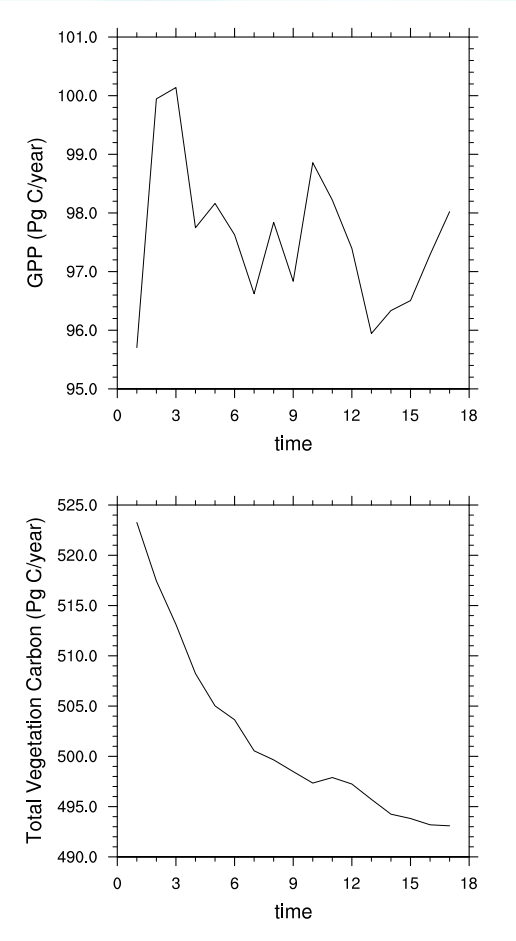


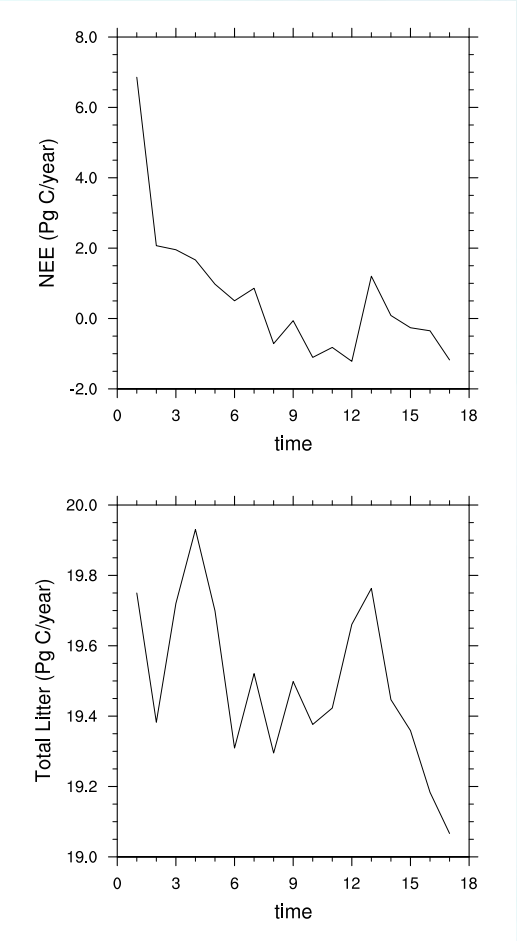


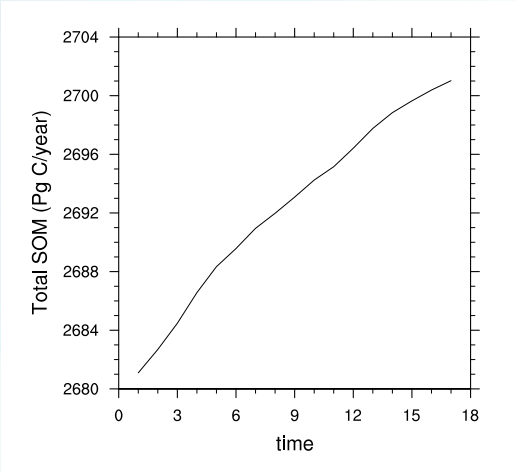
The low yield every other year is from large swaths of missing data during those years. Likely a bug with the compset.

Other Variables

Compset: FC5L45BGC (modified)
Resolution: ne30_ne30 (global crops)



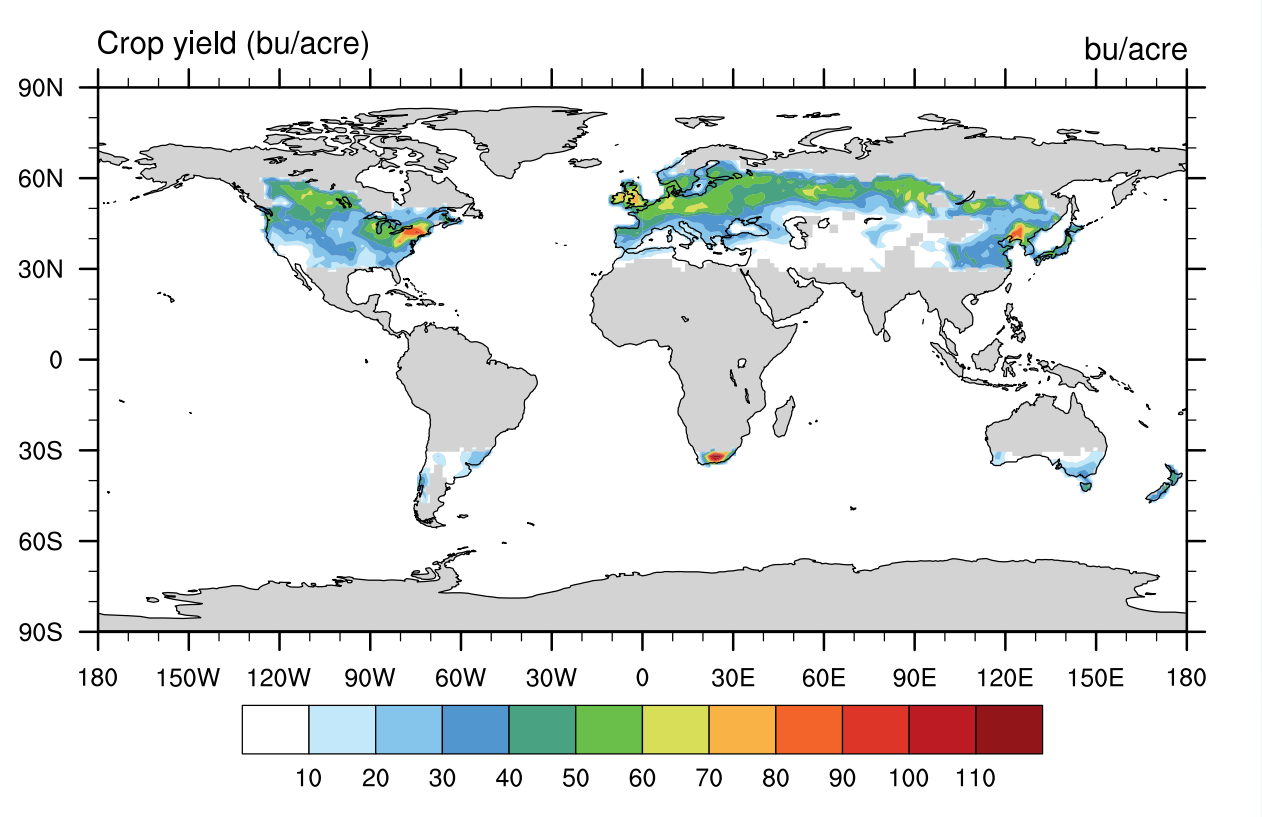


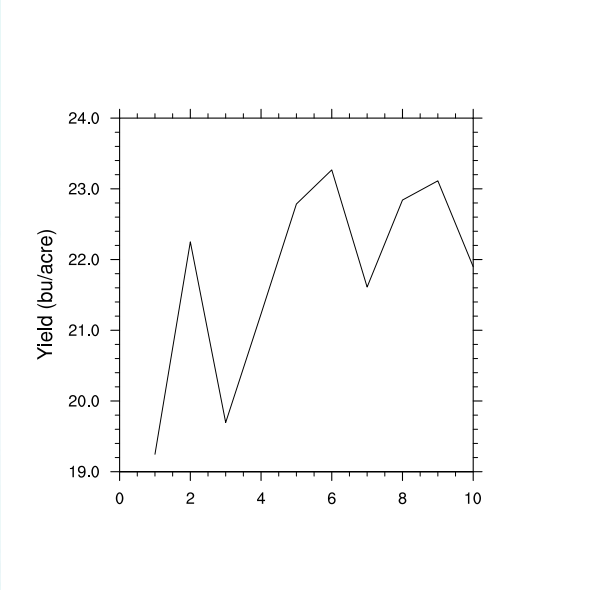


Model does not appear to be in equilibrium yet, but GPP is comparable to other simulations. Litter is too low.

Yield

Compset: BGCEXP_BCRC_CNPRDCTC_1850
Resolution: ne30_oECv3 (temperate crops only)

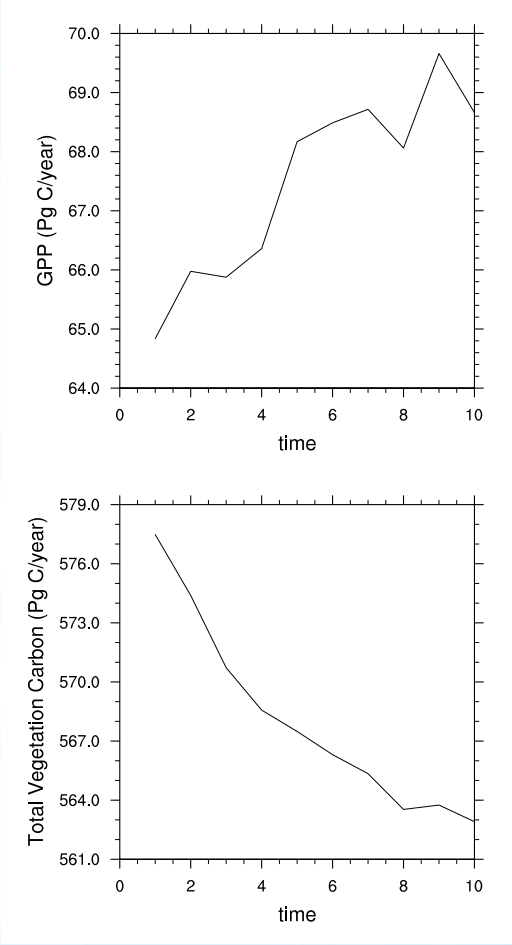


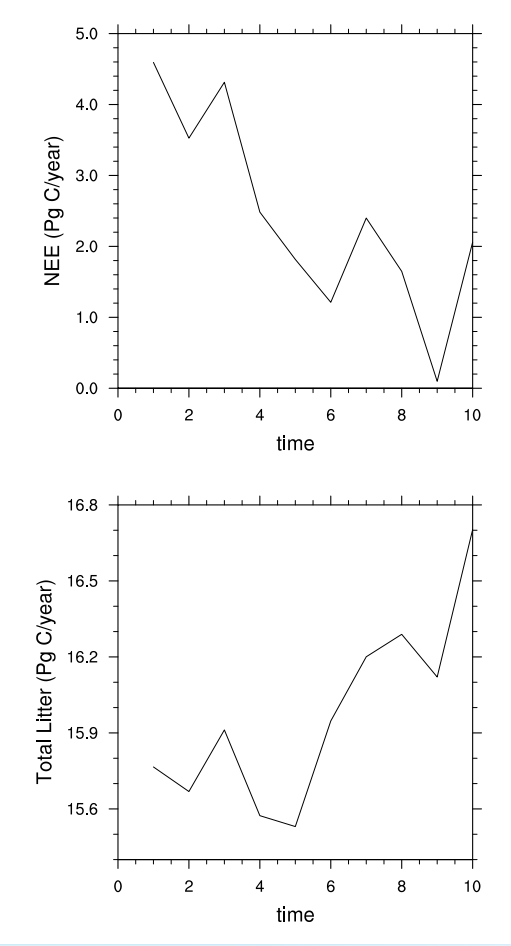


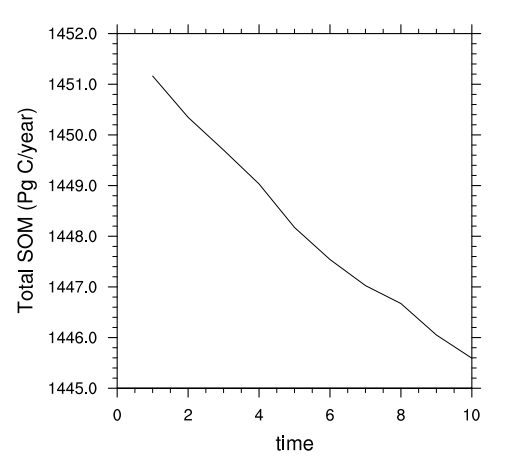
No missing years of yield data or productivity loss. Yields are comparable with F-case (note scale is different).

Other Variables

Compset: BGCEXP_BCRC_CNPRDCTC_1850
Resolution: ne30_oECv3 (temperate crops only)



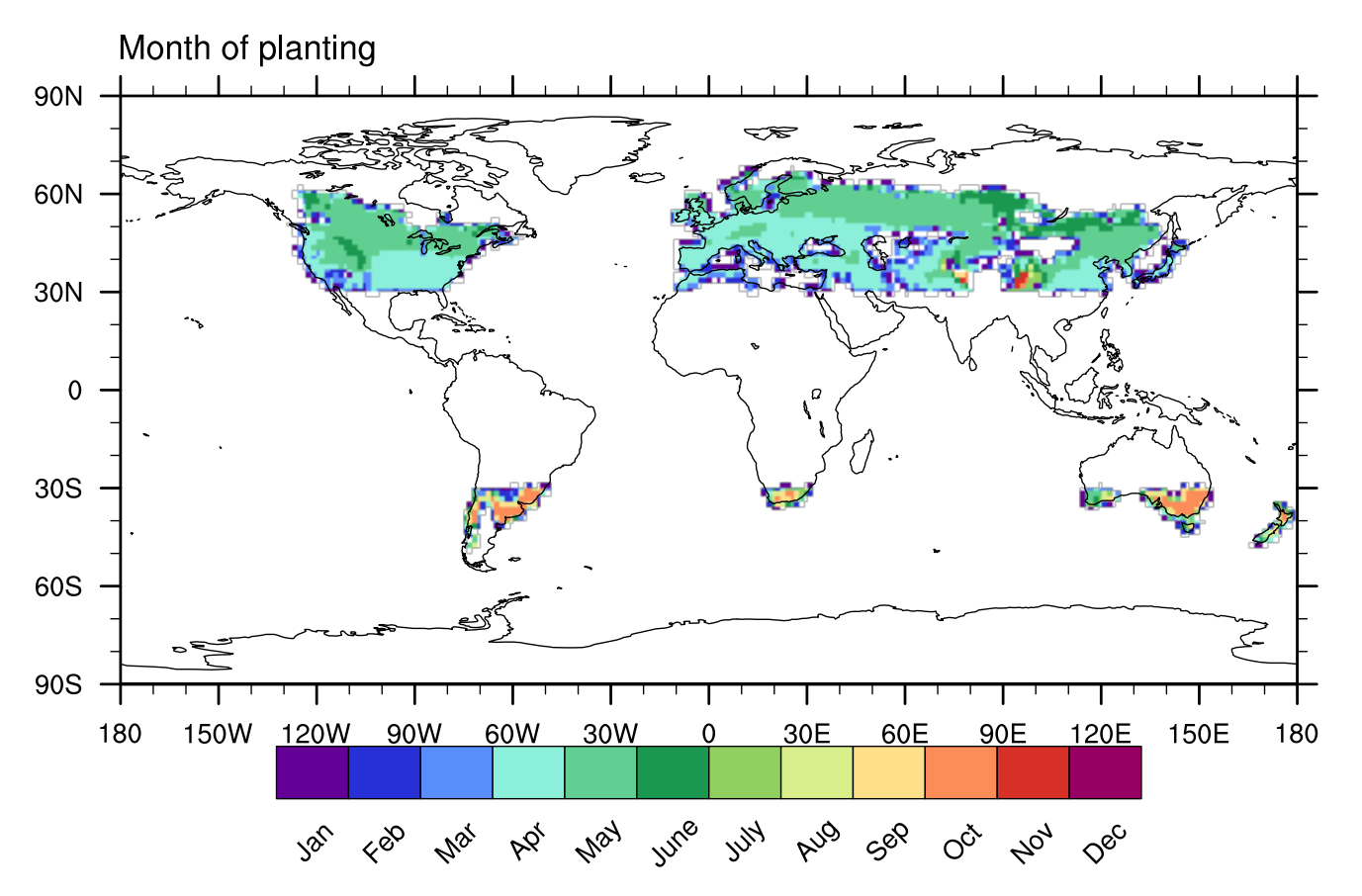




Need more years for a meaningful analysis. GPP is lower than F-case simulation. Litter is still too low. SOM is lower in this case too.

Plant Date

Compset: BGCEXP_BCRC_CNPRDCTC_1850
Resolution: ne30_oECv3 (temperate crops only)



Average planting date for temperate crops shows planting may be too early in some regions, particularly in areas that rely on precipitation to determine the growing season.

Future Work

- Investigate the missing years of crop productivity in F-case
  - Extend the spinup
  - Fix some of the namelist settings
  - Increase output frequency and add other variables to history
- Extend the production run
- Analyze individual crop types
- Evaluate changes in crop planting date and the length of the growing season with coupled model