

Spatiotemporal influence of vegetation on global surface-atmosphere exchange

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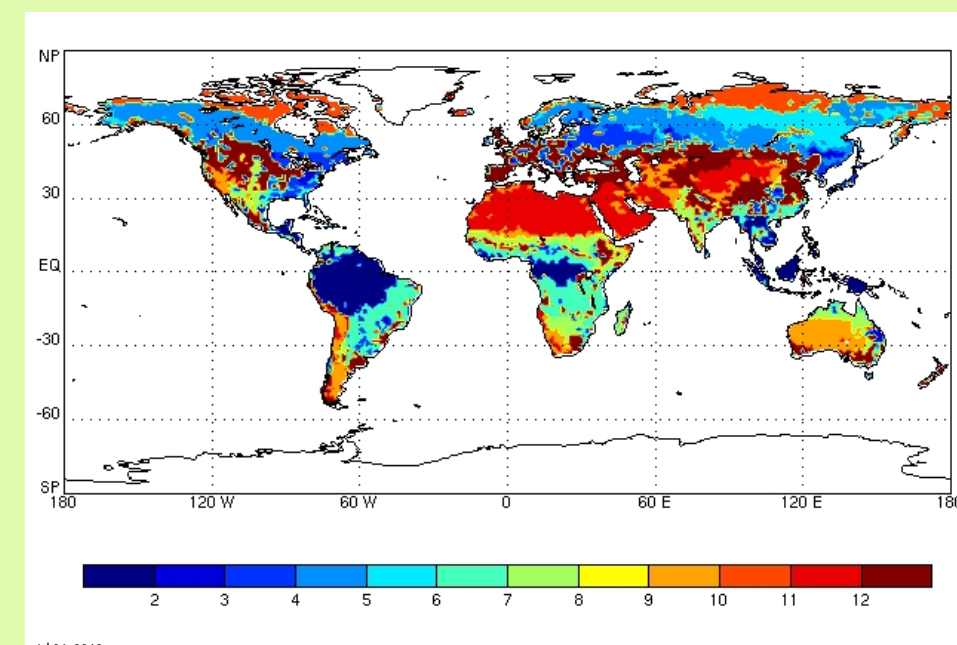
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Perspective

- We compare surface-atmosphere fluxes from three phenology treatments driven through the same land-surface model
 - NDVI: Normalized difference vegetation index, NOAA/NASA
 - MODIS: Moderate resolution imaging spectroradiometer, NASA
 - Prognostic: Developed by Reto Stöckli, computes LAI and fPAR using basic temperature, light, and humidity data
- Remote sensors (MODIS and NDVI) measure wavelength and intensity of light reflected into space by groundcover
- We focus on understanding the performance of the new prognostic phenology and its ground-up approach to quantifying vegetation cover

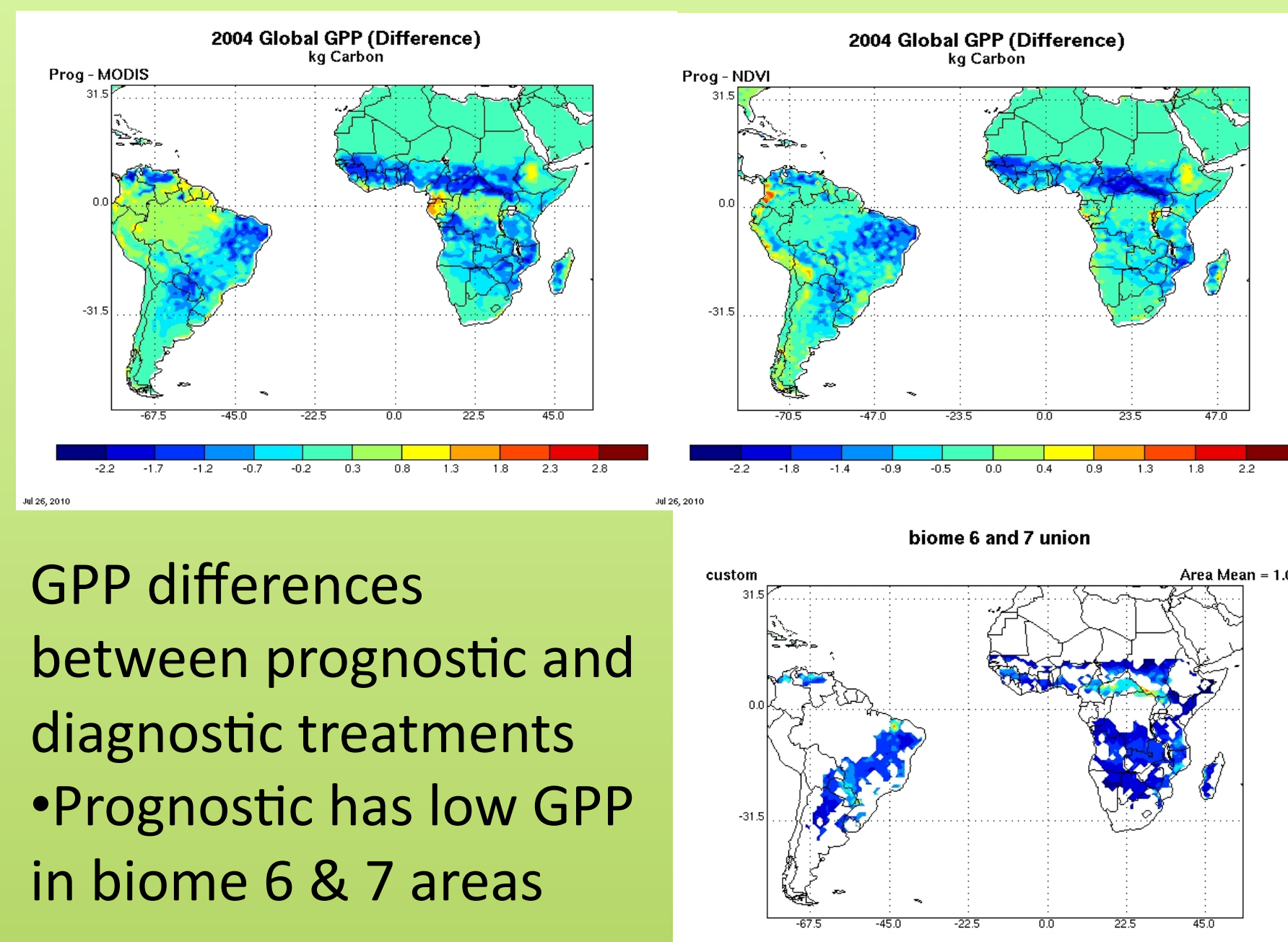
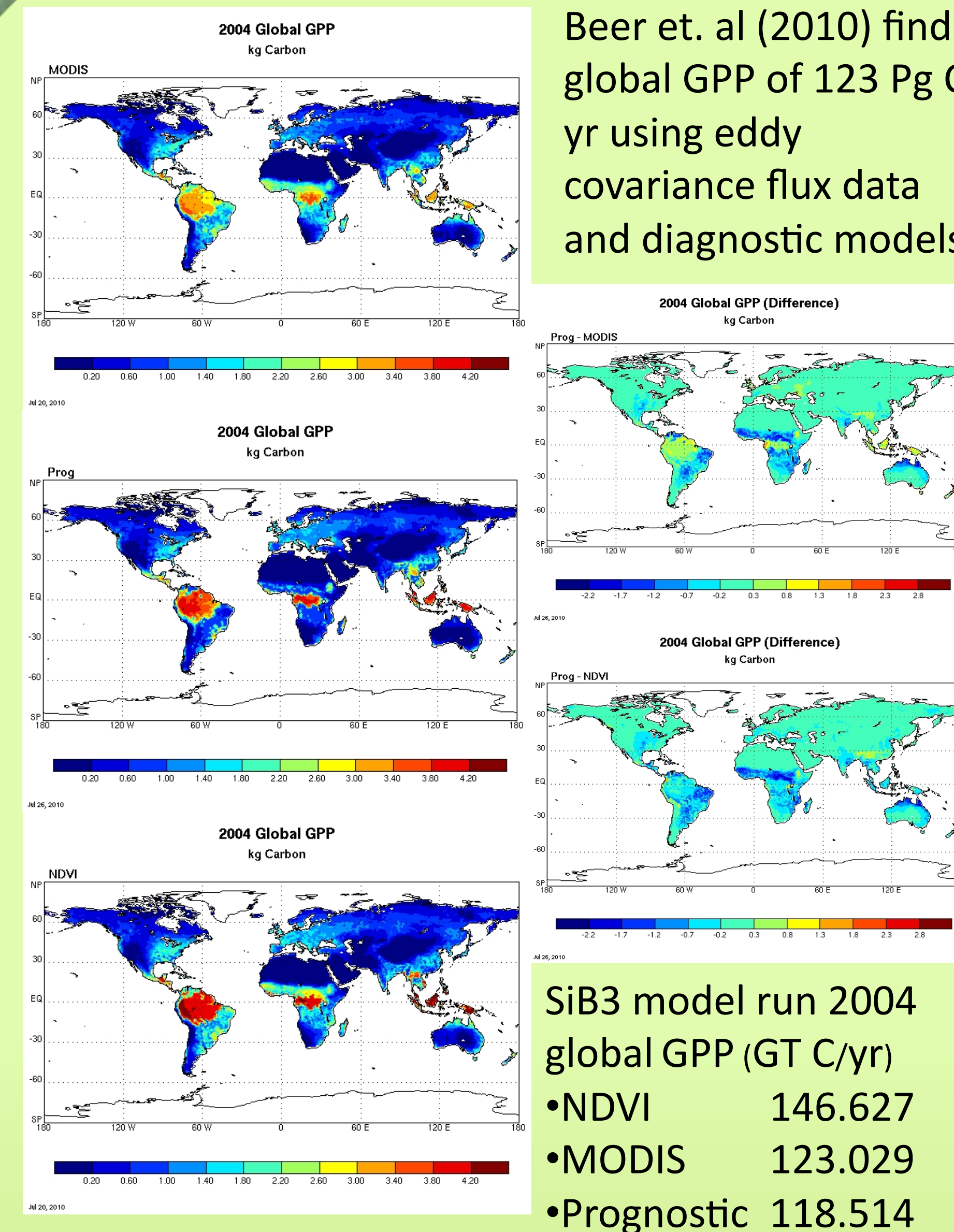
Model



1. Broadleaf evergreen (tropical forest)
2. Broadleaf deciduous
3. Mixed forest
4. Needleleaf
5. Needleleaf deciduous
6. Broadleaf with ground cover (c4)
7. Ground cover maize optical (c4)
8. Not used
9. Shrubs with ground cover
10. Tundra
11. Low-latitude desert
12. Crops (broadleaf deciduous over wheat)

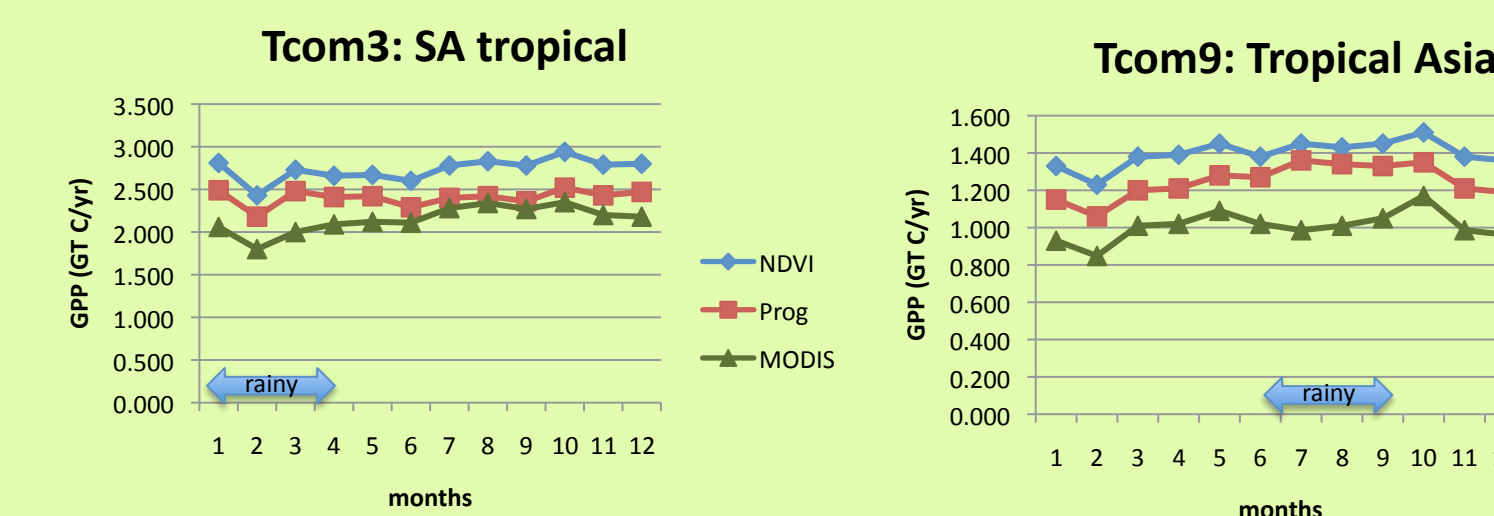
- SiB3 - Simple biosphere three, land-surface interaction model
- SiB originated in 1986 by Piers Sellers as a lower boundary for Atmospheric General Circulation Models (AGCMs), yet with a level of ecophysiological detail to make the model useful for ecologists
- Updated in 1996 to include remotely-sensed specification of vegetation phenology
- Prognostic Canopy Air Space developed in 2003, incorporated Community Land Model (CLM) snow and hydrology submodels in 2008
- Vegetation classified into 12 biomes

Gross Primary Productivity

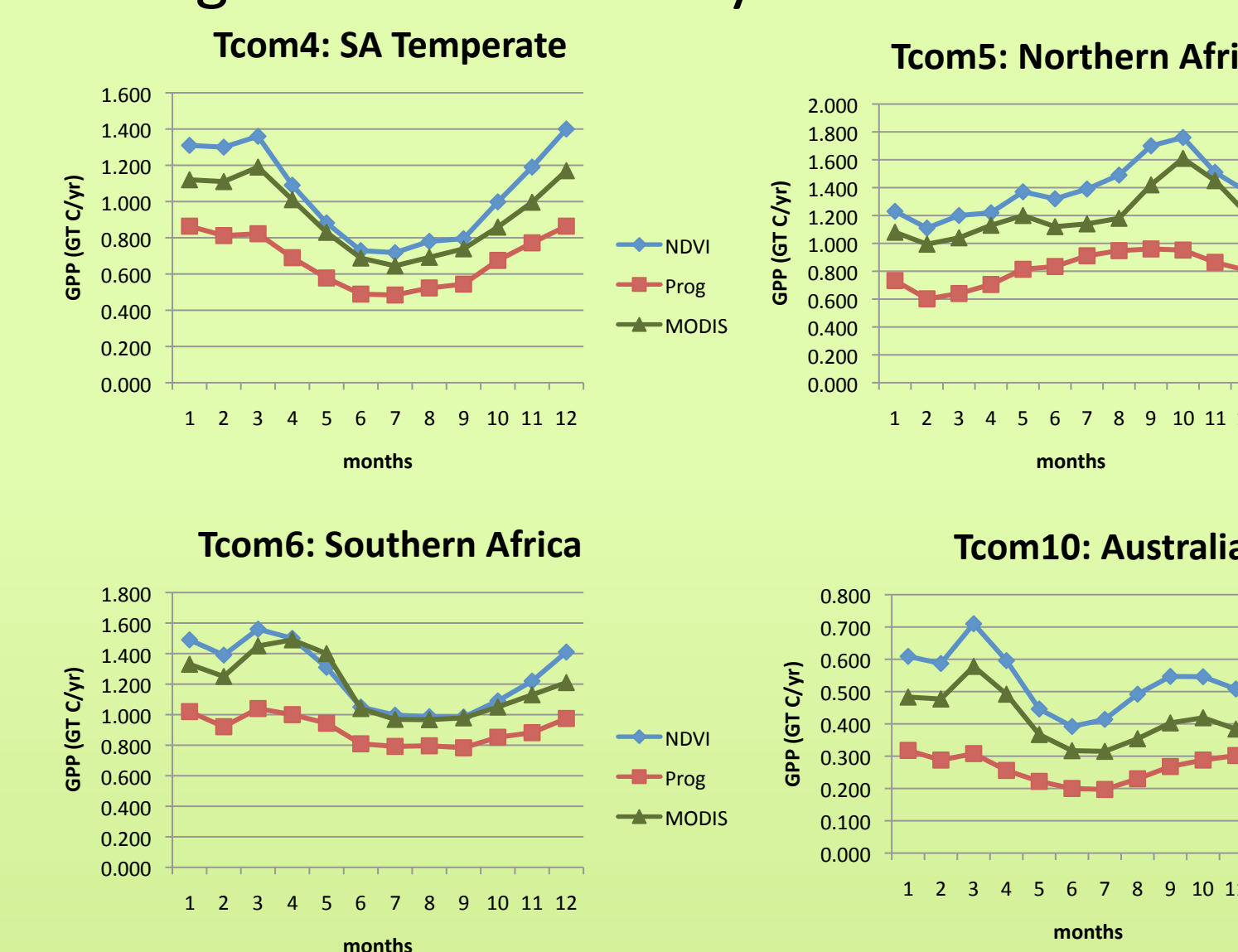


Results

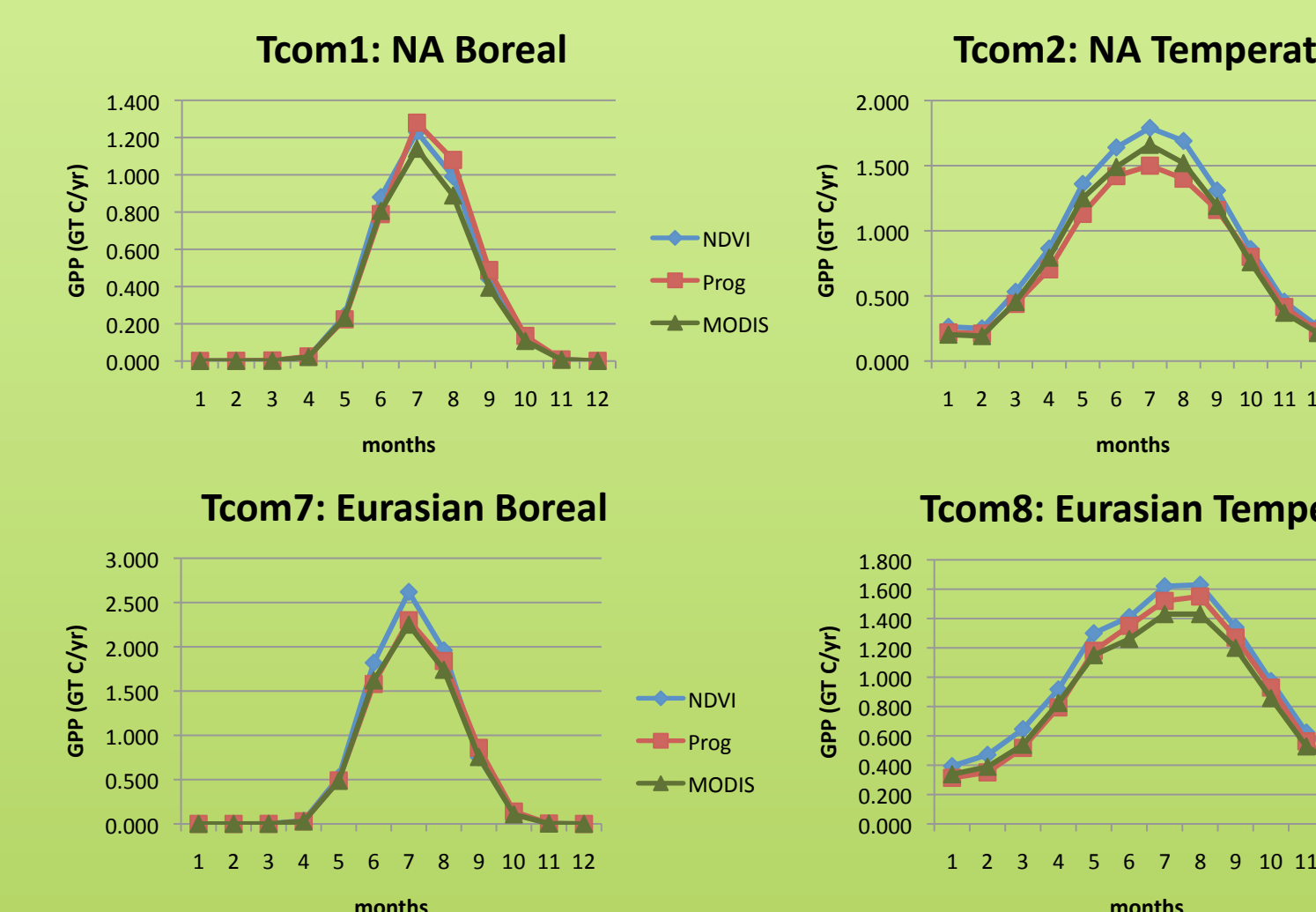
- Transcom regions with primarily tropical biomes
 - NDVI higher due to constant LAI assignment across every month
 - MODIS low due to rainy season cloud masking



- Transcom regions with significant biome 6 and 7: c4 savannah grasses
 - Prognostic consistently low

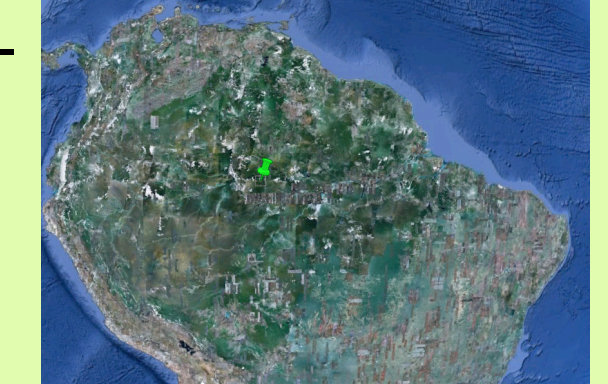


- Transcom regions in mid to high latitudes
 - General agreement between treatments

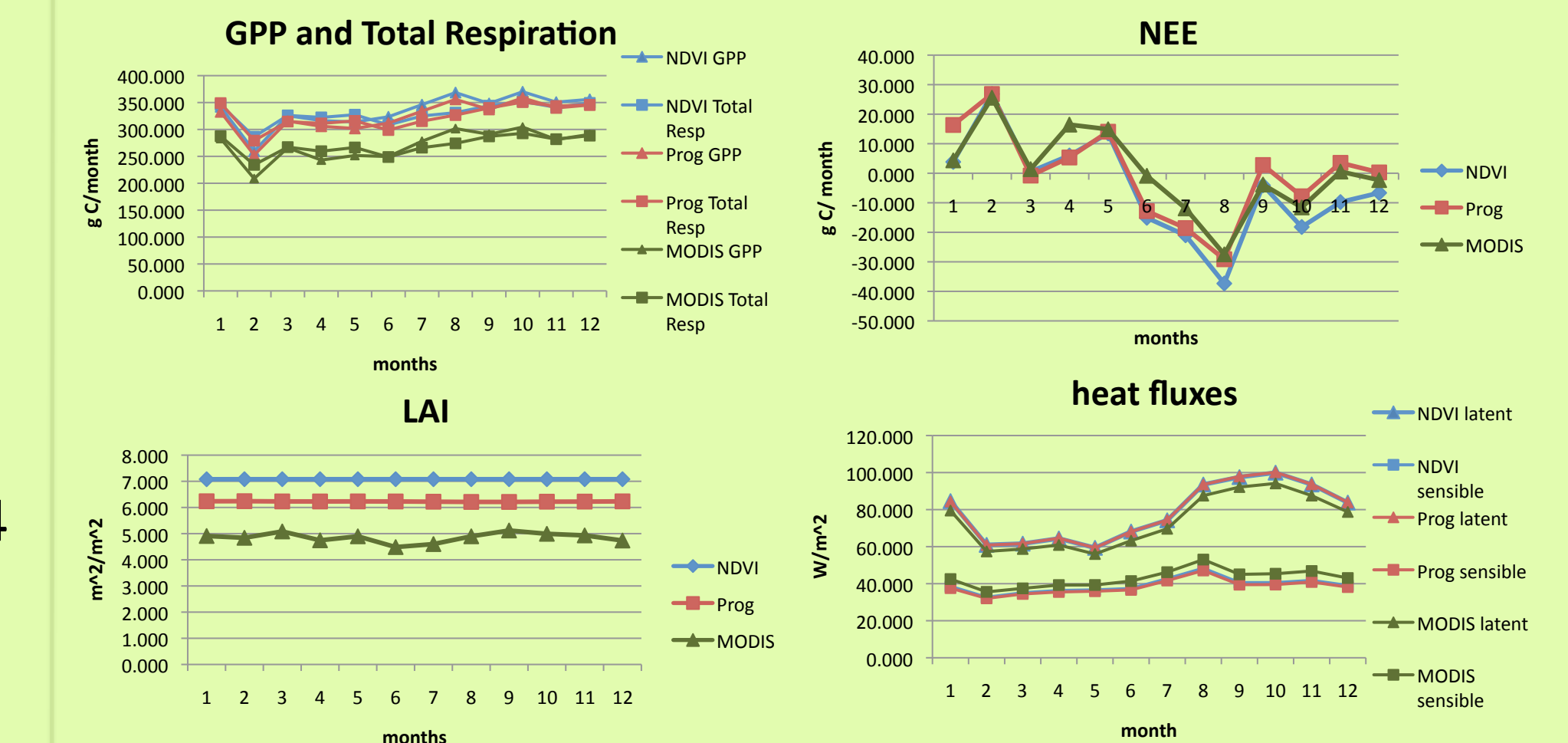


Point Behavior

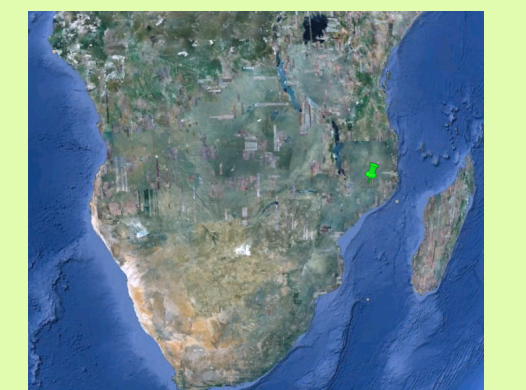
Amazon Rainforest
lat: -2.2, lon: -63.2
Biome 1



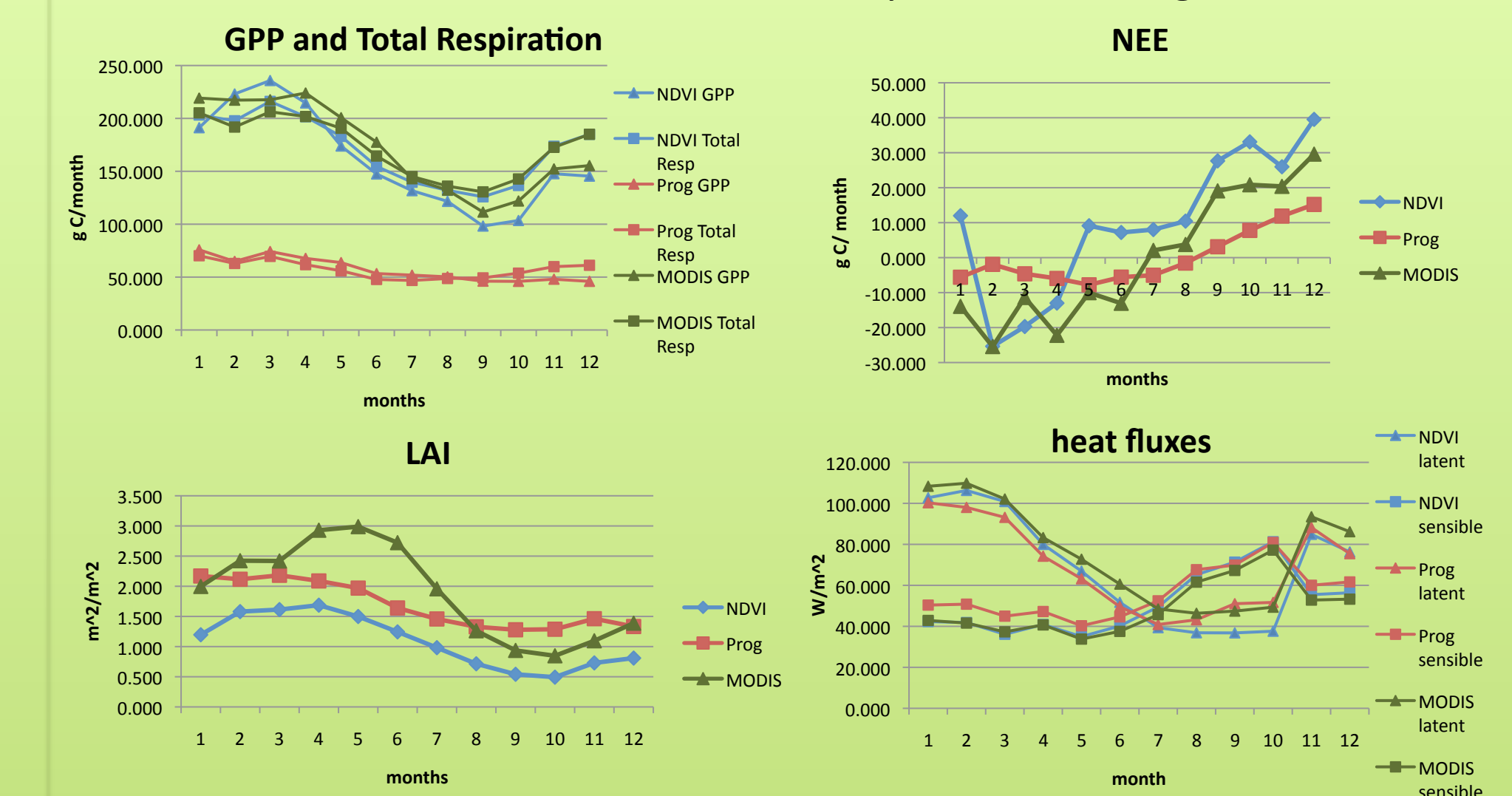
Typical biome 1: Prognostic intermediate GPP is explained by intermediate level of leaf area index. Generally agreeable NEE.



South Savannah Africa
lat: -15.0, lon: 37.6
Biome 6



Typical biome 6: Prognostic's very low GPP and total respiration are not totally explained by LAI. Generally higher sensible heat flux and lower latent heat flux. NEE has similar seasonality but lower magnitude.



Conclusions

- Mid to high latitude boreal and temperate forests agree well between treatments
- Tropical biomes show prognostic GPP as intermediary between high NDVI due to maximum LAI assigned to every month and low MODIS due to cloud masking
- Prognostic global GPP is less than MODIS and NDVI primarily due to low GPP values in savannah C4 grasslands (biomes 6 and 7)

Future Work

- Run treatments over multiple years to analyze interannual variability
- Run treatments through PCTM, parameterized chemical transport model, to obtain CO₂ concentrations
- Assess these PCTM CO₂ concentrations from the three treatments against observational flask data

Literature/Acknowledgements

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- Background image from <http://andybeardsley.net/Pictures/BrisbanetoCairns/RainForestCanopy.jpg>
- Satellite images from google earth
- Contact: kyle.hemes@coloradocollege.edu for more information

Transcom regions from Gurney et. al 2008