**Evaluation of the Carbon Cycle in the CMIP5 Earth System Model ESM2G**

M. Leonard[1,2]

[1]Science and Technology Corporation, Boulder, CO 80305; 303-497-6823, E-mail: mark.leonard@noaa.gov
[2]NOAA Earth System Research Laboratory, Global Monitoring Division (GMD), Boulder, CO 80305

Understanding potential carbon cycle climate feedbacks is essential, however future simulations are extremely uncertain. Coupled climate-carbon cycle models project an additional rise in carbon dioxide ($CO_2$) by year 2100 of between 20 to 200 parts per million (ppm) due to carbon cycle feedbacks. The higher end of this range could have significant additional impacts on global climate. This paper demonstrates methods to improve coupled climate-carbon cycle models by evaluating the models based on NOAA's indispensible and multi-decadal data record. We will focus on the coupled climate-carbon model GFDL ESM2G that is a possible prior flux model for the future NOAA Earth System Analyzer (ESA). The NOAA ESA will be a diagnostic carbon cycle model that will quantify the carbon budget over recent decades covered by the NOAA observational record. Such a model will help improve coupled climate-carbon models by improving their ability to simulate the recent past. This paper investigates global to regional scaled comparisons of the coupled climate-carbon model GFDL ESM2G using two types of data-constrained models: CarbonTracker and SiBCASA-GFED. The former is constrained by atmospheric observations, while the later is constrained by space-based estimates of photosynthesis unlike the GFDL ESM2G, which is purely predictive. We will discuss in detail the following: an early growth seasons in the northern boreal regions, an inverse annual cycle around the Indian and Southern Ocean, and an overestimation of Gross Primary Production in regions near the Inter Tropical Convergence Zone. We present ideas for improving future versions of GFDL ESM2G applicable for other coupled climate-carbon models.

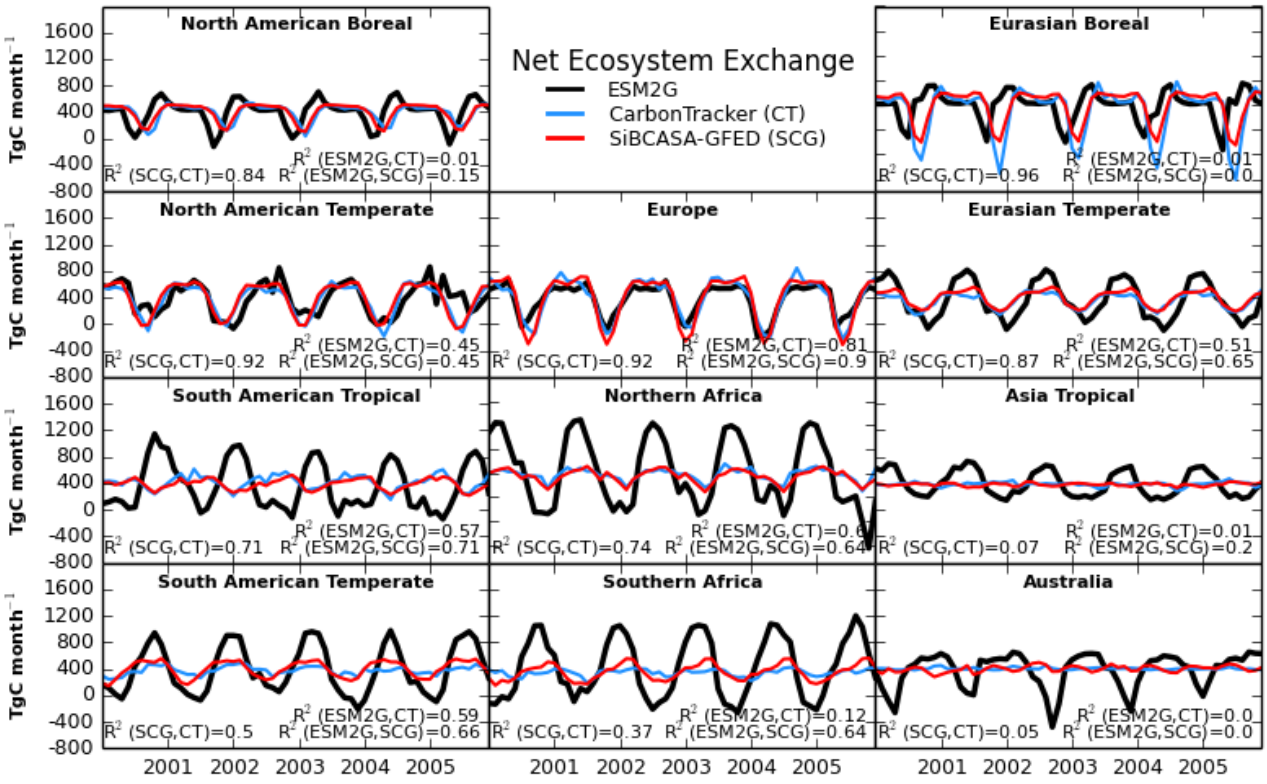


**Figure 1.** Regional monthly means of net ecosystem exchange of carbon from land fluxes to the atmosphere from years 2001-2005.