Title: Quantifying error structures of a global terrestrial carbon cycle model with FLUXNET data

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Outline:

Large uncertainties exist in the current generation of terrestrial carbon cycle models. Such uncertainties translated into 100-300ppm differences in projected CO2 in future coupled carbon-climate models. FLUXNET data provide a critically needed set of observations that can be used to validate our models. This proposal aims to compare such a model VEGAS with FLUXNET data, in doing so, quantify the parameter errors in the model VEGAS.

The VEGAS model is part of the University of Maryland Earth system model, and it ***has been used in the Coupled-Carbon-Cycle-Climate Model Intercomparison Project (C4MIP) for future climate-carbon projection***. In the NACP interim synthesis, initial analysis of multiple NACP models showed that site-level comparison with flux data is generally not satisfactory. VEGAS also has been participating in the NACP MsTMIP and the international TRENDY multi-model comparison project, and it appears to be robust in comparison with atmospheric CO_2 inversion on both seasonal and interannual timescales. ***A particular strength of the VEGAS is its new module on land use and land cover change (LULCC) that allows us to tease apart the contributions of LCC.*** Here we aim at a comprehensive comparison of VEGAS with FLUXNET data. Multiple ensemble simulations with VEGAS will be conducted using a Monte Carlo Perturbed Parameter Experiment (PPE) and GPP, Re and NEE will be compared to those from FLUNET. The resulting constraint will give rise to a probabilistic distribution of parameters. The best set of parameters will come out to be the set that optimizes fluxes globally. Agreement or disagreement with FLUXNET data will be analyzed via ecosystem types. Special attention will be paid to the impact of land use and land management, leveraging on a subgrid-scale parameterization of VEGAS on age structure change due to such as cropland abandonment and disturbances.

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FLUXNET Sites for Proposed Analysis

We intend to use the LaThuile dataset, and we seek to include as many sites as possible in the analysis to represent spatial variability among biomes and bioclimatic types, and the temporal variability associated with inter-annual variability in temperature, rainfall and associated seasonal timing and magnitude. We anticipate that most sites with data in the FLUXNET Synthesis database will have the parameters needed for the analysis. We need mostly carbon flux, but other ancillary data (e.g., field measured temperature, humidity, rainfall, and soil moisture, biometric data, etc.) would be useful for interpretation and diagnosis of forcing conditions.

Proposed Guidelines for Co-Authorship

We will adhere to the FLUXNET Synthesis protocols for co-authorship and err on the side of inclusivity rather than risk any error or appearance of exclusivity. This will include early notification of PIs of any and all sites that we would like to include in the analysis; invitation to site personnel to participate in the analysis, interpretation and written presentation of the results; and appropriate inclusion of co-authors based on contributions to the analysis or participation in the conceptual, numerical and written development of the paper or papers arising.