**Poster #9-7**

**Variation in the Representation of Photosynthesis in CMIP5 Terrestrial Biosphere Models**

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BER Program: TES
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Estimates of gross primary productivity by terrestrial biosphere models (TBMs) rely on accurate model representation of leaf level photosynthesis. We have used a modular modelling code to enable a process-level systems analysis of the representation of leaf level photosynthesis for an evergreen broadleaved tropical plant functional type. At the heart of many TBMs is the Farquhar, von Caemmerer and Berry (FvCB) model of C3 photosynthesis. We coded the TBM specific structure and parameterization used to represent the different flavors of the FvCB formulation in eight of the TBMs that were included in the fifth coupled climate carbon cycle model intercomparison project (CMIP5). Using the multi-assumption architecture and testbed (MAAT) we simulated the response of $CO_2$ assimilation to irradiance, temperature, vapor pressure deficit and carbon dioxide concentration for the various stock TBM configurations. The resulting plots of these simulations revealed dramatic model divergence. We then conducted a stepwise unification of model structural and parametric assumptions which demonstrated the influence of key PFT specific parameters such as the maximum carboxylation rate, maximum electron transport rate and maximum triose phosphate utilization rate. Even with identical PFT specific parameterization there was still marked model divergence that was dominated by model assumptions associated with identification of the biochemical process limiting $CO_2$ assimilation, transport of $CO_2$ to the site of carboxylation, kinetic constants associated with $CO_2$ fixation and model representation of electron transport. These results highlight the importance of understanding the effect of model configuration on leaf level carbon assimilation and identify possible explanations for model diversity associated with highly integrative model outputs such as net ecosystem exchange and carbon storage.