Geophysical Research Abstracts
Vol. 20, EGU2018-8223, 2018
EGU General Assembly 2018

Enhancing the Modular Earth System Model (MESSy) with biosphere processes from LPJ-GUESS

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The Modular Earth System Model (MESSy) framework includes advanced representations of chemical and physical processes in the atmosphere and oceans and so is a sophisticated tool for examining atmosphere-ocean interactions and feedbacks. However, land surface processes of a comparable level of complexity are conspicuously absent from the current framework. To rectify this, the LPJ-GUESS dynamic global vegetation model is being coupled into the MESSy framework. The LPJ-GUESS framework includes a forest-gap model of vegetation dynamics, a crop and managed-land scheme, a nitrogen cycle and a choice of fire models; and hence the integration of LPJ-GUESS into MESSy includes representations of key biosphere processes mediated by vegetation, humans and fire. When complete, this development will elevate the EMAC (ECHAM MESSy Atmospheric Chemistry) model to a full earth system model (ESM) including dynamic representations of all key earth system components (when coupled to an ocean GCM) with a broad range of potential applications. The combination of the state-of-art atmospheric chemistry representations in EMAC and a wide variety of prognostic trace gas emissions from the land surface as produced by LPJ-GUESS will give EMAC particular strength in the area of land-atmosphere chemical interactions and related processes. Here we report on the successful integration of LPJ-GUESS into the MESSy framework and benchmark the simulated vegetation of the coupled EMAC/LPJ-GUESS system against a suit of remotely-observed datasets.