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Developing a global mixed-canopy, height-variable vegetation structure dataset for estimating global vegetation albedo by a clumped canopy radiative transfer scheme in the NASA Ent Terrestrial Biosphere Model and GISS GCM

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Processes determining biosphere-atmosphere coupling are strongly influenced by vegetation structure. Thus, ecosystem carbon sequestration and evapotranspiration affecting global carbon and water balances will depend upon the spatial extent of vegetation, its vertical structure, and its physiological variability. To represent this globally, Dynamic Global Vegetation Models (DGVMs) coupled to General Circulation Models (GCMs) make use of satellite and/or model-based vegetation classifications often composed by homogeneous communities. This work aims at developing a new Global Vegetation Structure Dataset (GVSD) by incorporating varying vegetation heights for mixed plant communities to be used as boundary conditions to the Analytical Clumped Two-Stream (ACTS) canopy radiative transfer scheme (Ni-Meister et al., 2010) incorporated into the NASA Ent Terrestrial Biosphere Model (TBM), the DGVM coupled to the NASA Goddard Institute for Space Studies (GISS) GCM. Information sources about land surface and vegetation characteristics obtained from a number of earth observation platforms and algorithms include the Moderate Resolution Imaging Spectroradiometer (MODIS) land cover and plant functional types (PFTs) (Friedl et al., 2010), soil albedo derived from MODIS (Carrer et al., 2014), along with vegetation height from the Geoscience Laser Altimeter System (GLAS) on board ICESat (Ice, Cloud, and land Elevation Satellite) (Simard et al., 2011; Tang et al., 2014). Three widely used Leaf Area Index (LAI) products are compared as input to the GVSD and ACTS forcing in terms of vegetation albedo: Global Data Sets of Vegetation (LAI)3g (Zhu et al. 2013), Beijing Normal University LAI (Yuan et al., 2011), and MODIS MOD15A2H product (Yang et al., 2006). Further PFT partitioning is performed according to a climate classification utilizing the Climate Research Unit (CRU; Harris et al., 2013) and the NOAA Global Precipitation Climatology Centre (GPCC; Scheider et al., 2014) data. Final products are a GVSD consisting of mixed plant communities (e.g. mixed forests, savannas, mixed PFTs) following the Ecosystem Demography model (Moorcroft et al., 2001) approach represented by multi-cohort community patches at the sub-grid level of the GCM, which are ensembles of identical individuals whose differences are represented by PFTs, canopy height, density and vegetation structure sensitivity to allometric parameters. The performance of the Ent TBM in estimating VIS-NIR vegetation albedo by the new GVSD and ACTS is assessed first by comparison against the previous GISS GCM vegetation classification and prescribed Lambertian albedoes of Matthews (1984), and secondly, against MODIS global estimations and FLUXNET site-scale observations. Ultimately, this GVSD will serve as a template for community data sets, and be used as boundary conditions to the Ent TBM for prediction of biomass, carbon balances and GISS GCM climate.