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# Development and Evaluation of the IAP Dynamic Global Vegetation Model

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The IAP Dynamic Global Vegetation Model (IAP-DGVM) is a component of the developing Earth System Model of Chinese Academy of Science (CAS-ESM). It simulates ecosystem processes in two levels: at the individual level, it calculates the carbon balance between photosynthesis, respiration, and turnover, as well as the carbon allocation among leaves, roots, and stems; at the population level, it considers the dynamics of population density of establishment (seed production and germination) and mortality (caused by light competition, stress, mortality and fire). Besides, it also includes a process-based fire parameterization of intermediate complexity to simulate the fire burned area, the fire impacts on vegetation, as well as the fire carbon, trace gas and aerosol emissions.

The model simulates total of 12 plant functional types (PFTs), including 7 tree, 2 shrub, and 3 grass types, plus bare soil. To evaluate the model performance, a global offline simulation is run at T-62 spatial resolution (192x94 grid cells) for 600 years, forced with the cycling of observed-based atmospheric data during 1950-1999, and only the results from the last 50 years of simulation are used for analysis.

Results show that the model can roughly reproduce the regimes of forest, shrubland, grassland, and desert, and correctly capture the zonal distributions of different vegetation types. The model demonstrates that ecosystems changes from desert to shrubland to grassland and finally to forest as mean annual precipitation increases, and from cold desert to boreal shrubland to coexistence of grassland/forest and finally to hot desert as mean annual temperature increases. A climate index is derived from mean annual precipitation and temperature, and can separate clearly the dominant regions for trees, grasses, shrubs, and bare soil, in good agreement with the observational data. The global performance of the fire parameterization is also assessed. The simulated global totals and spatial patterns of burned area and fire carbon emissions are in close agreement with the Global Fire Emission Database (GFED3), and the average relative error of simulated trace gas and aerosol emissions due to biomass burning is 7%.