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Uncertainties in Precipitation and Their Impacts on Simulation of Global CO2 Budget

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Information on the global terrestrial net CO_2 exchange rate is necessary for evaluation and validation of the Greenhouse Gases Observing Satellite (GOSAT) products. For simulating the terrestrial biosphere CO_2 fluxes at daily time step with 1^o x 1^o and 0.5^o x 0.5^o resolutions, a plant ecophysiology-based model, called Vegetation Integrative SImulator for Trace gases (VISIT), is being developed and tested with the NIES transport model. Operating the VISIT requires a comprehensive set of near-surface atmospheric forcing, vegetation, soil, and topography data at consistent scales. Among these datasets, precipitation is one of the most critical environmental forces to accurately simulate the global terrestrial carbon cycle, since water is the essential medium for plant growth and development, and the biochemical processes of photosynthesis. This study uses the Japan Meteorological Agency (JMA) Climate Data Assimilation System (JCDAS) reanalysis as input atmospheric variables. The JCDAS provides 6-hourly global atmospheric variables required by the VISIT with T106 Gaussian grid after 1979. Precipitation datasets from reanalysis products often show systematic errors and differences among the products due to the models used in the reanalysis assimilation system. To assess the uncertainties in the JCDAS precipitation and their impacts on simulation of global CO_2 budget, the precipitation products from the JCDAS and the National Centers for Environmental Prediction-Department of Energy (NCEP-DOE) Atmospheric Model Intercomparison Project (AMIP-II) Reanalysis (NCEP-2) were compared here with the Climate Research Unit (CRU). The JCDAS and CRU were very similar in 24-year mean annual precipitation over the land area; in contrast, NCEP-2 was higher over 100 mm y^{-1} compared to other two products. However, the JCDAS showed systematic underestimate in precipitation around the equator, especially in the Amazon area. This underestimate significantly affected the growth of plants in the model, and substantially reduced the net primary productivity in these regions, and consequently increases uncertainties in the simulation of global carbon budget. Accordingly, this study used a merged precipitation dataset derived from the JCDAS and NCEP-2 to minimize precipitation bias. Results suggest the needs of a bias reduction strategy and accurate precipitation reanalysis products.