

Multi-model analysis of terrestrial water and carbon cycle in Japan and Asia: Japan-MIP and Asia-MIP

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Terrestrial ecosystem models contain large uncertainties in simulating energy, water, carbon, and nutrient cycles. To evaluate these uncertainties, several model-intercomparison studies have been conducted in the past (e.g. NPP-MIP by W.Cramer et al.). However, most of them were based on the results of ecosystem models without sufficient model validation. We need to evaluate models using flux observations, and then conduct model intercomparison study. The study aims at (1) testing the inter-model uncertainties, (2) identifying uncertain processes, (3) discussing the role of ground observation data in terrestrial carbon/water cycle simulations, and (4) refining terrestrial carbon budget for Japan.

By running several ecosystem models (e.g. BEAMS, Biome-BGC, CASA, LPJ, Support Vector Machine, TOPS, and VISIT), we first evaluated how the models produce different simulation results at the flux sites (four flux sites in Japan) and at various spatial scales. Next, we improved each model using flux observations, then we evaluated how the model improvement process reduces uncertainties among different ecosystem model outputs.

At a point scale, model improvements based on flux tower observations significantly reduced uncertainties. For spatial analysis, although spatial differences among the model were also greatly reduced, still significant uncertainties remained between satellite-based and prognostic ecosystem models. Although this study significantly improved the understanding of current carbon and water budget estimations, further works is needed to find the remaining differences.