A layered model approach for simulating high river discharge events from land to the ocean

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Oceanic response to river outflows is investigated using a newly developed hydrological-ocean coupled model. Unlike conventional coupled models, this new model takes a layered model approach for simulating hydrological processes. By treating continental and oceanic water with separate layers but within a same model, dynamical interaction naturally occur between the two and enables more realistic simulation of river-ocean interaction in estuary zones during high water discharge events. The high frequency and vigorous hydrological events are often difficult to capture in ocean circulation models. When the model is forced with Radar-Rain gauge analyzed precipitation data around eastern Japan, we find the model to simulate the river discharge of Abukuma river basin that is analogous to observations. Realistic freshwater plumes also evolve and hug along the coastline. When mixing between continental and oceanic water is parameterized through a Richardson number criterion, we find the model to successfully capture the abrupt changes in the freshwater at upstream and downstream locations as well. The use of layered models, based on single dynamical core, appears to be a promising new approach for solving the water cycle from land to the ocean seamlessly.