Simulated atmosphere-ocean-biogeochemical interaction under the passage of tropical cyclone Trami (2018)

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In the subtropical ocean, tropical cyclones (TCs) play an important role on oceanic ecosystem because nutrients that limit the activity of phytoplanktons are sometimes mixed up to the ocean surface due to the strong wind forcing. However, it is also known that the accurate reproduction of a TC structure and intensity requires a high-resolution atmosphere-ocean coupled model. To aim at the accurate reproduction, a coupled atmosphere-ocean-biogeochemical model has been developed. The system consists of the JMA-NHM, MRI.COM mesh and a NPZD model as a high-resolution atmospheric, oceanic, and biogeochemical component, respectively. As a first trial of the coupled system, an observed enhancement of the primary production after the passage of TC Trami (2018) was simulated. The simulated results indicate that TC intensity is better reproduced in the coupled system. The NO3 rapidly increases to the passage of TC Trami in the mixed layer through the supply from the subsurface water. In contrast, the densities of phytoplankton and zooplankton firstly decreased just beneath the TC Trami (2018) presumably due to the shortage of the sunlight under TC-related clouds. However, their densities become about ten times in the next few days following the abundant NO3 and sufficient short wave radiation. The simulated increase of the density of phytoplankton is comparable to the satellite-based estimate of the phytoplankton at the ocean surface. The reasonable reproduction suggests the possibility of forecasting the enhancement of the ecosystem activity and may help the understanding of the relationship among atmosphere, ocean, and biogeochemical systems when a TC moves over the subtropical ocean.

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