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# Typhoon-induced Phytoplankton Blooms and Primary Productivity Increase in the Western North Pacific Subtropical Ocean

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Using multiple satellite observations and series of numerical experiments, this work systematically studied phytoplankton blooms induced by tropical cyclones in the western North Pacific subtropical Ocean (WNPSO), because WNPSO is among the world oceans where most number of intense tropical cyclones are found. All eleven typhoon cases passing the study domain in 2003 were examined in detail. It was observed that only two typhoons (18%) were able to induce phytoplankton blooms (chlorophyll-a concentration increased from<=0.1 mg $m^{-3}$ to 0.4-0.8 mg $m^{-3}$) and strong sea surface temperature cooling of -2.5 to -6 degrees Centigrade. The other nine typhoons, including the most intense tropical cyclone on earth in 2003 (i.e., super-typhoon Maemi), were not able to induce phytoplankton blooms and the associated sea surface temperature cooling was weak (0 to -1.5 degrees Centigrade). Using series of numerical experiments, it was found that the presence of warm ocean eddy can effectively isolate the cold, nutrient-rich water to be entrained to the surface ocean. Under this situation, even category-5 typhoon Maemi at its peak intensity of 150kts could not induce phytoplankton bloom in the WNPSO. The weak responses of the other eight typhoons were due to insufficient wind intensity and transit time (caused by relatively small storm size and fast translation speed) in this deep nutricline/mixed layer ocean. As a result, the total annual primary production increase induced by typhoons in the WNPSO was estimated to be ~ 3.27x1012g C (0.00327 Pg), equivalent to 0.15% of the global annual anthropogenic $CO_2$ uptake. This suggests that though WNPSO has the highest number and intensity of tropical cyclones among the world oceans, tropical cyclones in the WNPSO have little contribution to enhance biological carbon fixation in the context of global carbon-climate system.

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