National Aeronautics and Space Administration
Jet Propulsion Laboratory
California Institute of Technology

Oceanic Response to Typhoons in the Northwest Pacific using Aquarius and SMAP Data

Kyung-Ae Park, Jae-Jin Park, Wenqing Tang. Front. Mar. Sci., 2023

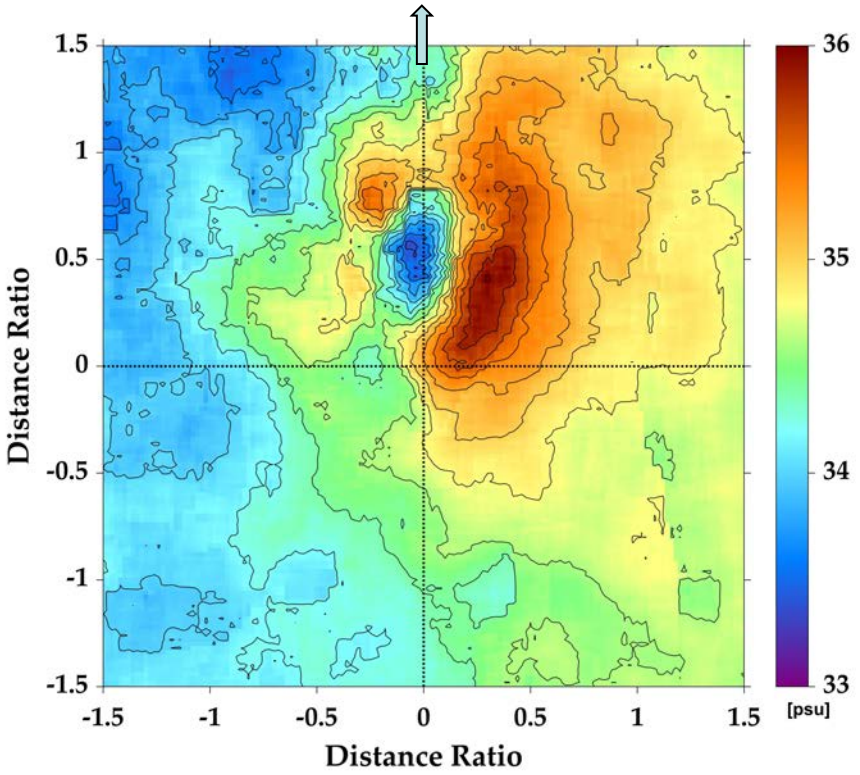

Figure 1. SMAP sea surface salinity field composed around the typhoon centers in rotated coordinates in the moving direction of typhoons (indicated by the upward arrow) as a function of distance ratio (distance from the typhoon center divided by the radius of the typhoon's maximum wind gust) in the Northwest Pacific.

Reference: Kyung-Ae Park, Jae-Jin Park, Wenqing Tang (2023). Oceanic Response to Typhoons in the Northwest Pacific using Aquarius and SMAP Data (2011–2020). Frontiers in Marine Science. DOI: 10.3389/fmars.2022.1037029.

Science or Technology Question: Sea surface salinity (SSS) changes induced by typhoon passage have major effects on oceanic circulation through its control on seawater density along with water temperature, thereby affecting the local marine ecosystem. We investigate whether satellite observed SSS can explain oceanic responses to typhoons in the Northwest Pacific.

Results: We first characterized the error structure of SMAP and Aquarius SSS under typhoons by comparing with in situ data collected by Argo floats collocated with twenty representative typhoons in the past decade. We found a characteristic latitude-dependence of satellite SSS error, which was reduced in subtropical regions at low latitudes under high sea surface temperature conditions in summer. Using SMAP SSS for storms occurred in area with relatively low SSS error, we derived the 2-D synoptic SSS structure around typhoon center (Fig.1). The surface freshening on the left side of typhoon path coincided with observed higher precipitation rate on the same side at approximately -0.04 psu per mm h^{-1}. On the right side of storm path, the relatively high salinity was caused by a vigorous evaporation process due to increased wind speed. Changes in the vertical profiles of the Argo data supported this partial freshening of salinity as well as the characteristic surface cooling and deepening of the mixed layer after the passage of the typhoon.

Significance: Our results provide observational evidence of oceanic responses to typhoons in the Northwest Pacific and contribute to the understanding of atmospheric and oceanic processes related to the evolvement of tropical storms.