Cold water formation in response to typhoon passages in and around Seto Inland Sea, Japan

Yusuke UCHIYAMA[1#+], Tatsuya NISHII[1]

[1]*Kobe University, Japan*

[#]*Corresponding author: uchiyama@harbor.kobe-u.ac.jp* [+]*Presenter*

Impacts of typhoon passages are investigated with a detailed ocean modeling on extensive upper-ocean cooling in and around Seto Inland Sea, the largest semi-enclosed estuary in Japan. We develop a synoptic, double nested downscaling ROMS model (Shchepetkin and McWilliams, 2005; 2008) by implementing a bulk formula developed for COAMPS forced by the assimilative JCOPE2 (Miyazawa *et al*., 2009) and JMA GPV-MSM reanalysis datasets. The horizontal grid refinement occurs from 1/12 degree (JCOPE2) to 2 km (ROMS-L1) and to 600 m (ROMS-L2), where the L2 model runs for about two years, 2012-2013.

In the fall 2012, SST is found to decrease about two degrees for a two-week period during three consecutive typhoons passing nearby. The first EOF mode of SST corresponds to the seasonal cooling along with mixed-layer deepening, whereas the effects of the typhoons appear in higher modes. Topographically-generated cold-core cyclonic eddies are extracted in the second mode, followed by intermittent eastward transport by Kuroshio. The third and forth modes jointly represent cold water formation associated with storm-driven coastal upwelling that propagates with the eastward estuarine circulation.

The heat budget analysis exhibits that the net heat flux at surface becomes negative to induce prominent surface cooling and cold-water formation in the upper ocean. Whereas divergence of the horizontal advective heat flux is crucial in the daily-averaged heat budget, the surface net heat flux is essential to long-term temperature variation. Latent heat flux is found to play a primary role in the negative net surface flux as well as decrease of downward shortwave (solar) radiation. Unstable lowest atmospheric planetary boundary layer leads to pronounced changes in the latent heat flux in response to surface wind and abrupt decrease of the near-surface humidity after the typhoon passages.

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