Ocean acidification in the surface water of the Tsugaru Warm Current

*Masahide Wakita[1], Kenichi Sasaki[1], Hideki Yamamoto[1], Makoto Takada[1], Jun Yoshino[2], Takamitsu Ohmura[3], Shoko Tatamisashi[3], Yoshiaki Sato[2], Shuichi Watanabe[1]

1. Japan Agency for Marine-Earth Science and Technology, 2. Tohoku Environmental Sciences Services Corpration, 3. Marine Works Japan Ltd.

The Tsugaru Strait is a strait between Honshu and Hokkaido in northern Japan connecting the Sea of Japan with the North Pacific Ocean. The Tsugaru Warm Current (TWC) flows into the North Pacific from the Tsugaru Strait and is the branch of Tsushima warm current which is major warm current in the Sea of Japan. Mutsu Institute for Oceanography (MIO) is located in this Strait. The purpose of our research group is to investigate the coastal environmental change in the Tsugaru Strait by current and direction using HF radar, surface monitoring and hydrographic observation and to understand the pregression of ocean acidification in the coastal region. The coastal ocean acidification monitoring site at the Sekihama port (breakwater and floating pier) is registered as Global Ocean Acidification Observing Network (http://data.nanoos.org/files/goaon/inventory/assets-/FOTS_588.html). In the Sekinehama port (Breakwater (bottom depth 9m) and Floating pier (3m)), bucket Sampling and CTD profile have been carried out once a week since February 2014. In additoin, Ship-based hydrographic observations (water sampling and CTD profiles) have been carried out by T/S Ushio (Hokkaido Univ.) once a year since August 2012 in the 2 section lines (SE line and HO line) of eastern this strait. Measured properties are Bottle Salinity, Dissolved Inorganic Carbon (DIC) Total Alkalinity (TA), Nutrients, ^{18}O-H_2O, pCO_2/pH/$\Omega_{aragonite}$ (calculated from T, S, Nutrients, DIC and TA), Chlorophyll a, Total organic carbon (TOC) and Total dissolved nitrogen.
Station SE9 near the Cape Esan occupied Coastal Oyashio Water (COW) from winter to summer. The surface water in the other stations except SE9 is characteristic of the Tsugaru Warm Current (TWC) and agreed with those in the breakwater of the sekinehama port. The surface water in the breakwater are characteristic of TWC.
In 2014 winter, COW reached to the sekinehama port for the first time in 30 years. The COW approaching suddenly dropped Temp, pH and $\Omega_{aragonite}$. This suddenly drops in 2014 affected on anglerfish and scallop in the this strait. We remove these data in the deseasonalization method for calculation of annual mean values.
Deseasonalized annual means of pH and $\Omega_{aragonite}$ significantly decreased (pH: −0.0034 ±0.0009 /yr, $p<0.001$; $\Omega_{araginite}$: −0.048 ±0.006 /yr, $p<0.001$). These ocean acidification rates were faster than other time-series sites in open ocean (pH: −0.002 /yr, $\Omega_{araginite}$: −0.01 /yr; MIdorikawa et al., 2010, Dore et al., 2009, Wakita et al., 2017, Ishii et al., 2011). This might be caused by the oceanic uptake of anthropogenic CO_2 and DIC increase due to biological production change and the remineralization of organic matter from input form terrestrial, seashore or sea-bottom. The water in the floating pier is more scattered than the breakwater during summer-fall. Diurnal variation on the seashore might result in the faster coastal ocean acidification. We will deploy pH sensor in these port sites this winter to elucidate the impact of the faster coastal ocean acidification on diurnal variation on the seashore.

Keywords: Ocean acidification, Coastal region, Carbon cycle

