RECENT OBSERVATIONS OF GREENHOUSE GASES IN THE PACIFIC SECTOR OF THE SOUTHERN OCEAN ONBOARD R/V ARAON

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ABSTRACT

Korean ice-breaking research vessel Araon has been conducted scientific expedition at sea since 2010. Since then we have carried out measurements of diverse trace gases in both the marine boundary layer and the mixed layer of the sea to estimate their sink or source strengths of the oceans at high latitude. The greenhouse gases measured are CO_2, CH_4, N_2O, CO, and H_2, which are substantially important to the current global climate change. The ocean plays a wide range of role in the budget of these gases of the atmosphere: as a sink for CO_2 and a source for CH_4, N_2O, CO and H_2. High latitude of the Southern Ocean is particularly important as the current rapid change in the cryosphere can impact the ecological and physical settings that govern the content and flux of these dissolved gases in seawater. We have visited the Amundsen Sea threefold in the austral summer seasons of 2010/2011, 2012, and 2013/2014 and the Ross Sea in 2013. In addition to the expeditions in the Amundsen Sea, we had opportunity to survey the Pacific sector of the Southern Ocean in 2009 onboard R/V Polarstern. In the open ocean, CO_2 in the seawater was mostly undersaturated, CH_4 was slightly undersaturated, and N_2O and CO were supersaturated with respect to that in the marine boundary layer. These features were not observed in the sea-ice region; CO_2 in the seawater was slightly supersaturated in 2011, but not in 2012, and CH_4 in the seawater was undersaturated while dissolved N_2O and CO were supersaturated for both years. In the polynya of the Amundsen Sea, CO_2 and CH_4 were depleted in the seawater while N_2O and CO in the seawater were supersaturated with respect to those in the atmosphere. Based on these 3-year observations during austral summer season, high latitude of the southern ocean contributes as a sink for atmospheric CO_2 whilst as a source for N_2O and CO. In the case of CH_4, the open ocean was slightly undersaturated overall, which differs from the role of the ocean in the global scale.