B05-O14

RAPID REDUCTION OF ARCTIC SEA ICE AND ITS IMPACTS ON BROMINE, OZONE, AND MERCURY PROCESSES

Son V Nghiem *(NASA Jet Propulsion Laboratory, California Institute of Technology, United States)*

Son.V.Nghiem@jpl.nasa.gov

Arctic sea ice has been reduced drastically and may profoundly alter the Arctic environment. Here we present National Aeronautics and Space Administration (NASA) and Japan Aerospace Exploration Agency (JAXA) satellite observations of the rapid reduction of Arctic perennial sea ice in springtime and its impacts on Arctic chemical processes, which lend support to the Minamata Convention, a global treaty to curb mercury pollution signed in Minamata, Japan, in 2013.

Arctic sea ice consists of two major classes: the thinner and saltier seasonal sea ice that forms and melts away seasonally, and the thicker and less saline perennial sea ice that survives year round. These sea ice classes can be identified with satellite radars such as the Phased Array type L-band Synthetic Aperture Radar (PALSAR) on the Advanced Land Observing Satellite (ALOS) launched by JAXA in 2006, and the SeaWinds Ku-band Scatterometer aboard the QuikSCAT Satellite (QS) launched by NASA in 1999. We have developed sea ice classification algorithms using PALSAR and QS data. High-resolution (100 m) results of seasonal and perennial sea ice from PALSAR are used to cross-verify low-resolution (25 km) results from QS with a daily coverage across the Arctic Ocean over the decade of the 2000s. We will present an animation of satellite observations to show the perennial sea loss over the Arctic Ocean. In March, which is the polar sunrise period important to photochemical processes, satellite observations show a rapid loss rate of 1.5 million square kilometers per decade of perennial sea ice extent in the 2000s, which tripled the decreasing rate in the previous three decades estimated from Arctic buoy measurements. Perennial sea ice extent has remained low after the 2000s as observed with the Oceansat-2 Ku-band Scatterometer launched by the Indian Space Research Organisation (ISRO) in 1999 and operated until 2014.

To investigate impacts of the rapid loss of Arctic perennial sea ice in springtime, we conducted the NASA InterDisciplinary Science (IDS) BRomine, Ozone, and Mercury EXperiment (BROMEX) field campaign in the sea ice, land, and atmosphere environment around Barrow, Alaska, in March-April 2012. As perennial sea ice diminished drastically, the Arctic has undergone a regime shift to a new state of sea ice cover dominated by seasonal sea ice with more salt sources and more open leads and polynyas that sustain halogen photochemical processes in the Arctic troposphere, enhancing bromine explosions leading to the depletion of ozone and mercury from the atmosphere. We will present a time-lapsed high-definition movie of convective vapor plumes from open leads in the Chukchi Sea observed during BROMEX. The gaseous mercury depleted from the atmosphere then precipitates on land and ocean, and subsequently becomes toxic and harmful to wildlife and people in the Arctic. The Minamata Convention, which has been signed by 128 countries but ratified by only 8 countries so far, specifically calls out the mercury problem in the Arctic, where discoveries from BROMEX can contribute to the science basis supporting the global mercury convention.