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To: Nunavut Research Institute
Box 1720, Iqaluit, NU, X0A 0H0
Attn: Mosha Cote

From: Sangeeta Sharma, Yuan You, Daniel Veber, and Ralf Staebler
Environment Canada
4905 Dufferin St., Toronto, ON, M3H 5T4

**Re: Progress Report 2018 / License # 02 039 18R-M
Arctic Aerosol and Gas Measurements Pond Inlet**

Background

The Canadian Aerosol Baseline Measurement program under the Climate Chemistry Research Measurement Section in collaboration with the Air Quality Processes Section in the Air Quality Research Branch proposed to measure changes in atmospheric pollution levels in the Arctic. These changes are expected due to increasing economic activities in the Arctic region and increasing accessibility due to diminishing sea ice, which lead to increased ship traffic. Black carbon is released in the atmosphere from incomplete combustion of fossil fuels, from biomass burning and biofuels. Black carbon is climatically important in the Arctic atmosphere and is recognized as one of the “Short Lived Climate Forcers” that can warm up the atmosphere. In addition, it may be responsible for faster melting upon deposition on the ice-pack. Also measured are sulfur dioxide (SO₂), nitrogen oxides (NO_x) and ozone (O₃). SO₂ and NO_x are also emitted during fossil fuel combustion, while O₃ is a product of transformation processes of pollutants due to atmospheric chemistry. All three are important pollutants with detrimental effects on human health and the biosphere.

Our measurements further help verify regional models that will predict the impact of increases in pollutants on the climate and air quality in the Arctic. These measurements were implemented in Resolute Bay and Cape Dorset, as these sites are close to the potential pathway for additional shipping through the Northwest Passage. The pertaining measurements program at these sites was conducted from June 2013 to June 2017 to monitor the baseline conditions before an increase in ship traffic occurs in this region. All instruments from Resolute Bay were moved to Pond Inlet in 2018; measurements began July 20.

Activities

The climate and air quality related instruments (Figure 1) were installed the Wildlife Building at Pond Inlet operated by Environment and Climate Change Canada. The climate measurements included total amount of particle light extinction which is the sum of light absorption and light scattering by the particles. Particle size distributions are also measured.

The air quality package measures sulphur dioxide (SO₂), nitrogen oxides (NO_x), PM_{2.5} and ozone (O₃) as well as meteorology.

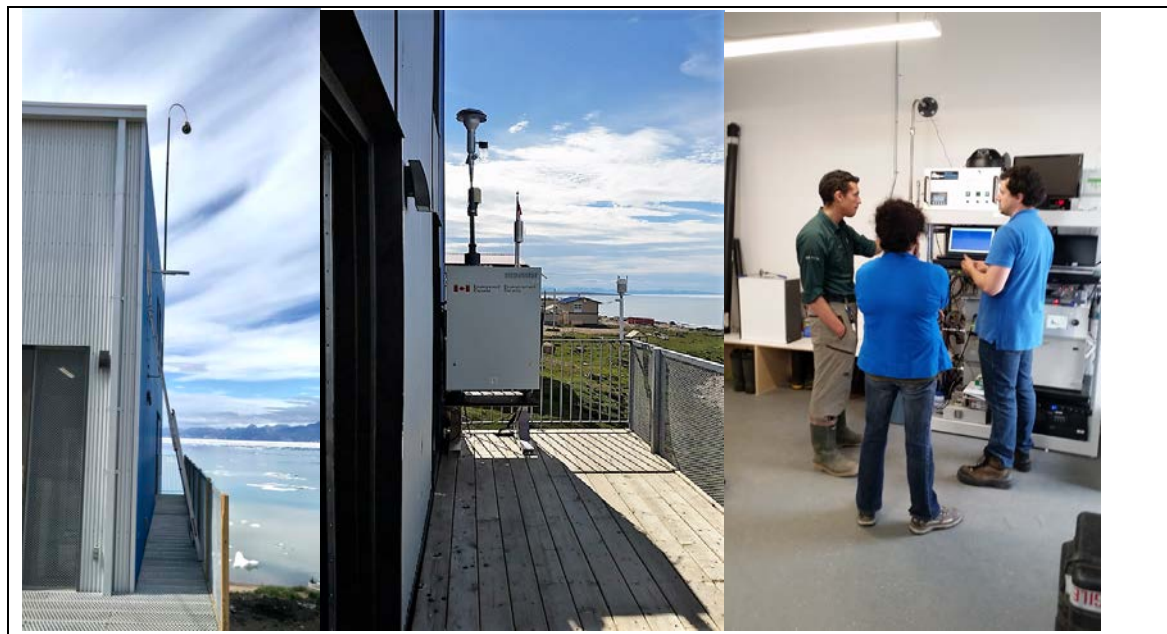


Figure 1: Air Quality Airpointer and Climate Monitoring Station in Wild Life building, Pond Inlet

Initial Findings

Using the Canadian Coast Guard Database, we have tracked the shipping traffic patterns in the Canadian Arctic in the summer of 2013 to 2017 at the three locations. Ship traffic data were taken from Canadian Coast Guard daily records in the Northern Canada Vessel Traffic Services Zone (NORDREG).

Table 1 gives vessel types and numbers for all three sites from 2013-2017. Numbers of vessels within a 205 km radius of Pond Inlet site have doubled in 2017 relative to 2015, primarily due to operations at the Baffinland mine. Ship traffic has been roughly constant at the other two locations. On the basis of plain statistics alone, it will be very interesting to measure ship traffic influence on atmospheric pollution at Pond Inlet. We recently obtained satellite-based ship location data for 2018 and will be investigating the effect of ship traffic in the vicinity of Pond Inlet.

Plans for 2018

All instruments were moved to Wildlife Research Station established by Environment and Climate Change Canada in Pond Inlet in July 2018 to continue to assess the effect of ship traffic on local pollution levels. We know already from measurements at Resolute Bay and Cape Dorset sites that the Arctic environment experiences high seasonal variations, due to both human activities (e.g. local traffic, power plant emissions, home heating, ship traffic, and long range trans-continental transport of pollution from Siberia/Europe or East Asia) as well as natural meteorological conditions. Data collected at Pond Inlet has been remotely

sent to Toronto ECCC's facility. We are in the process of quality controlling and assuring all data.

Table 1: Vessel types and the number of voyages within 205 km of three communities over the shipping seasons 2013-2017.

	Vessel Type	Bulk Carriers	Fishing Vessels	General Cargo	Government Vessels and Icebreakers	Passenger Ships	Pleasure Crafts	Tanker Ships	Tug/Barge	oil/gas exploration/Exploitation	Voyages total
Cape Dorset	2013	15	0	12	4	1	1	11	5	0	49
	2014	12	0	13	4	2	0	13	2	0	46
	2015	7	0	13	7	2	1	12	3	0	45
	2016	0	0	16	7	3	2	11	2	0	41
	2017	0	0	15	6	2	0	10	2	0	35
Resolute	2013	1	0	3	7	7	10	1	0	0	29
	2014	0	0	2	7	6	11	1	1	0	28
	2015	0	1	2	3	11	13	2	0	0	32
	2016	0	0	2	5	12	12	3	0	0	34
	2017	0	1	2	7	10	9	1	0	1	31
Pond Inlet	2013	2	1	14	6	8	12	8	0	1	52
	2014	1	2	13	10	7	19	5	1	0	58
	2015	13	1	8	7	14	9	6	2	0	60
	2016	38	2	8	7	11	15	5	2	0	88
	2017	56	3	19	13	12	17	5	4	3	132