Impact of Air Pollutant Emissions from Shipping in Canada's Arctic

Presentation to PAME
September 16, 2014
Lynn Lyons and Richard Holt

Outline

- Objective:
  - Evaluate potential impact of air pollutant emissions from marine shipping in Canada's Arctic
- Key elements of work plan
  - Analyses to date
  - Presentation of preliminary results
- Next steps
  - Ongoing and future work
  - Continued outreach to other Arctic Nations and interested parties

Objective

- Canada is undertaking technical work and scientific analysis on air pollutant emissions from marine vessels in the Canadian Arctic

Current traffic and emissions

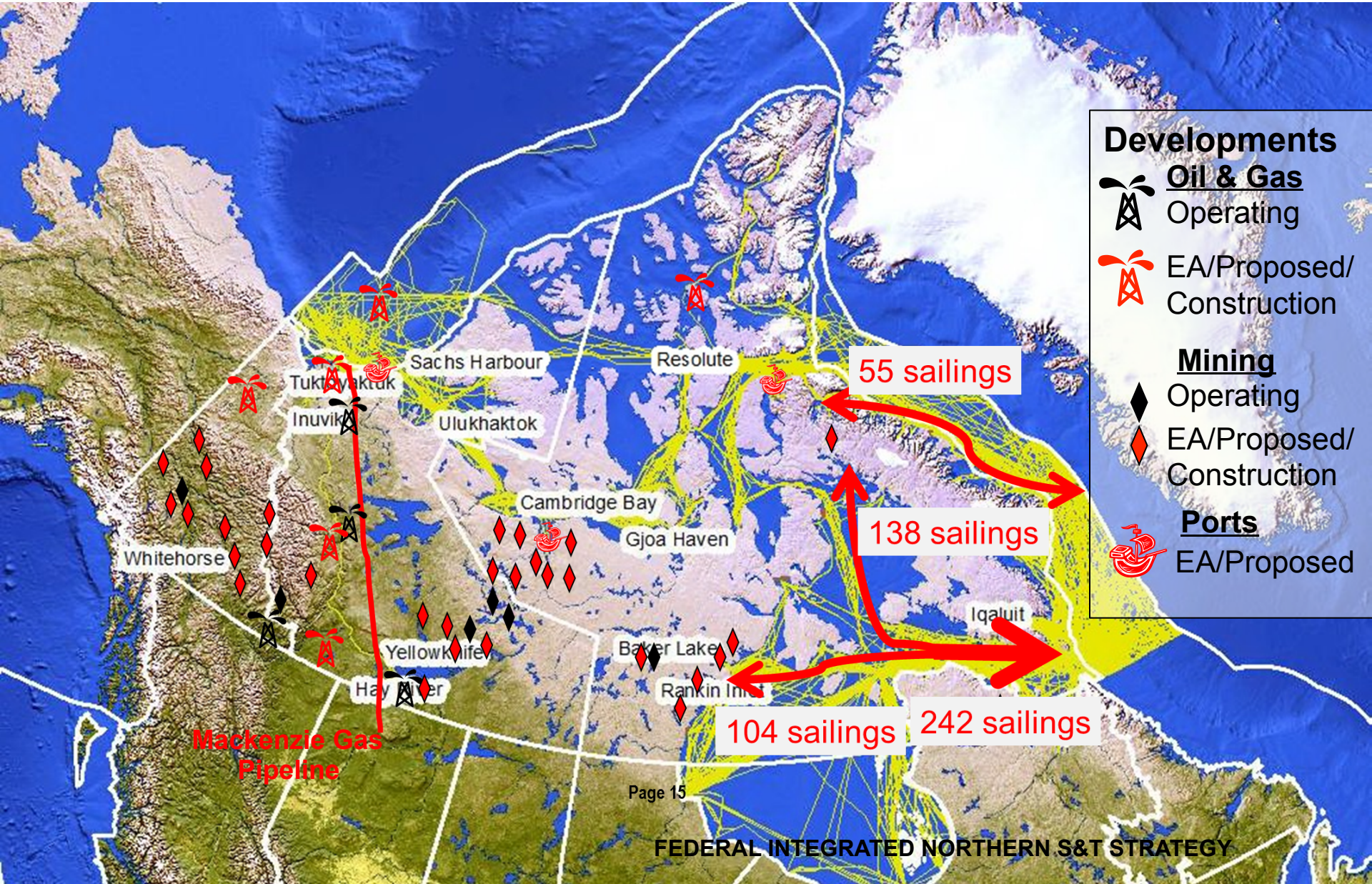
- Current levels of vessel traffic in the Canadian Arctic are well understood
- Environment Canada has estimated air pollutant emissions from ships for 2010

Baseline Marine Emissions

- Air pollutant emissions for marine vessels in the Arctic have been estimated for 2010

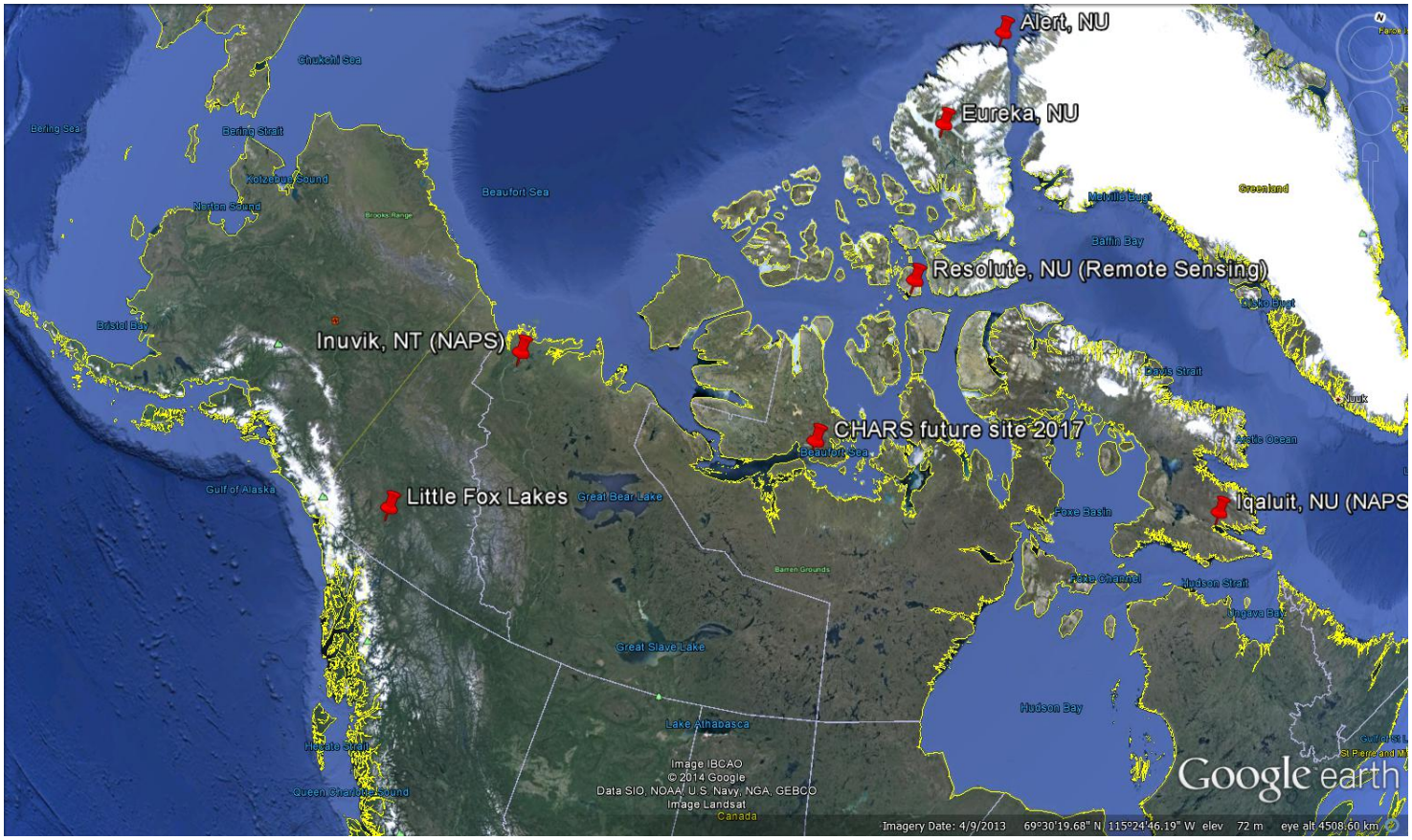
	NOx (t)	SO2 (t)	PM2.5 (t)
Coast Guard	613	10	13
Fishing	231	4	5
Merchant Bulk	431	206	28
Merchant Container	0	0	0
Merchant Other	815	568	74
Merchant Passenger	308	127	18
Special Purpose	38	1	1
Tanker	575	305	42
Tug Boat	506	7	9
TOTAL	3517	1228	190
Marine as a percentage of total emissions:	9.1%	66%	1.2%

Future ship traffic is expected to increase



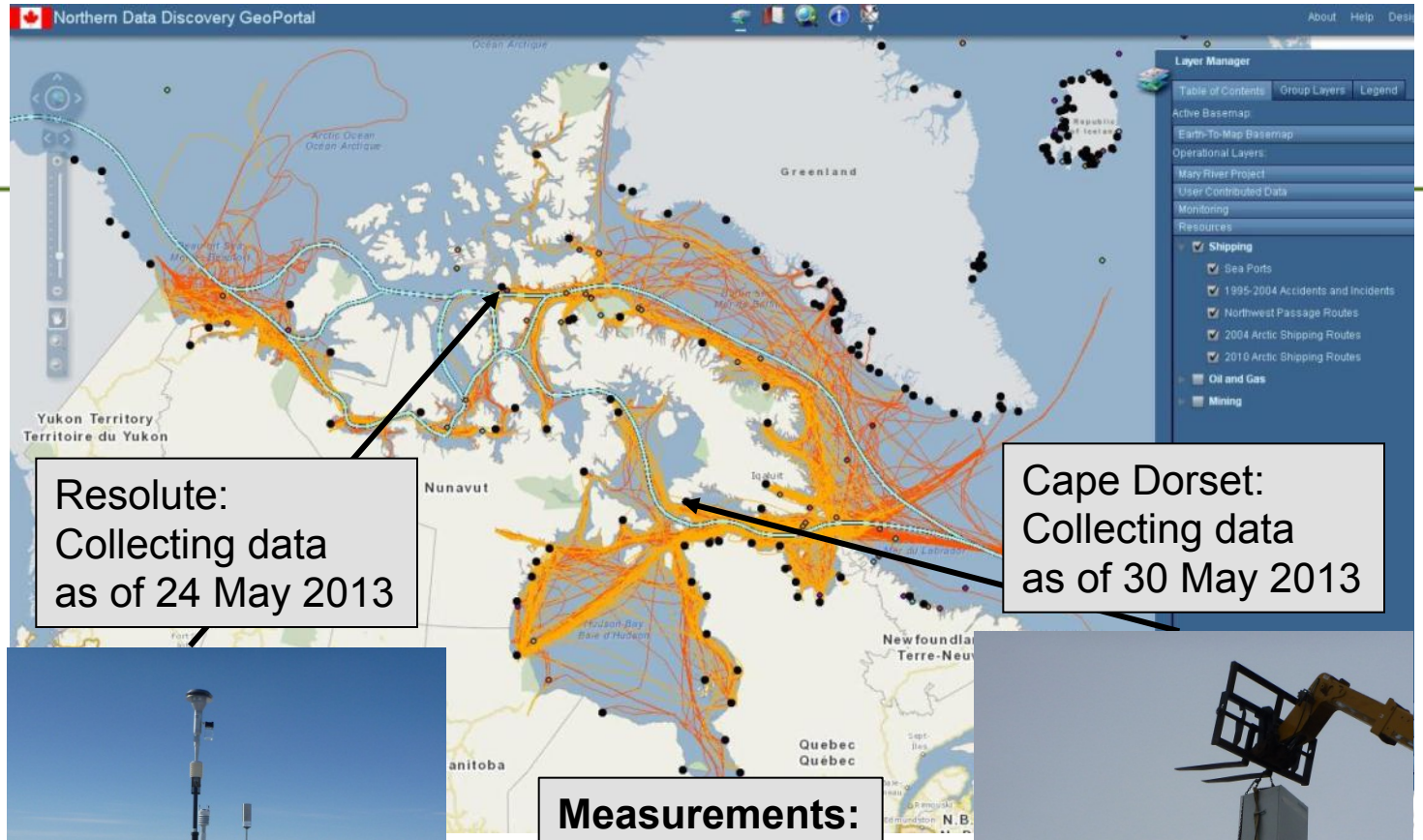
Ambient Air Monitoring

- Existing ambient air monitoring is sparse in the Canadian Arctic.



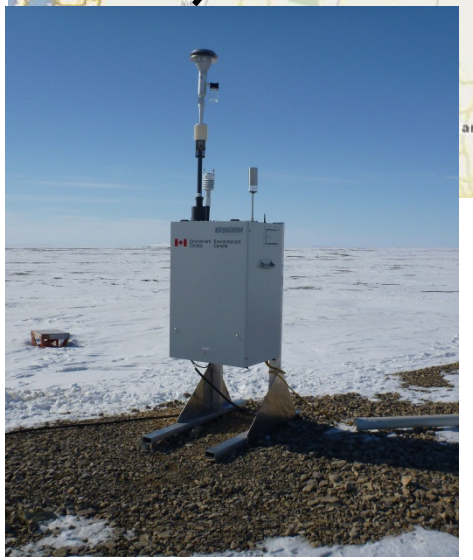
Canada

Work Underway - New Ground-based Measurements



Resolute:
Collecting data
as of 24 May 2013

Cape Dorset:
Collecting data
as of 30 May 2013



Measurements:

- $PM_{2.5}$
- NO, NO_x
- SO_2
- O_3
- Meteorology

Resolute only:

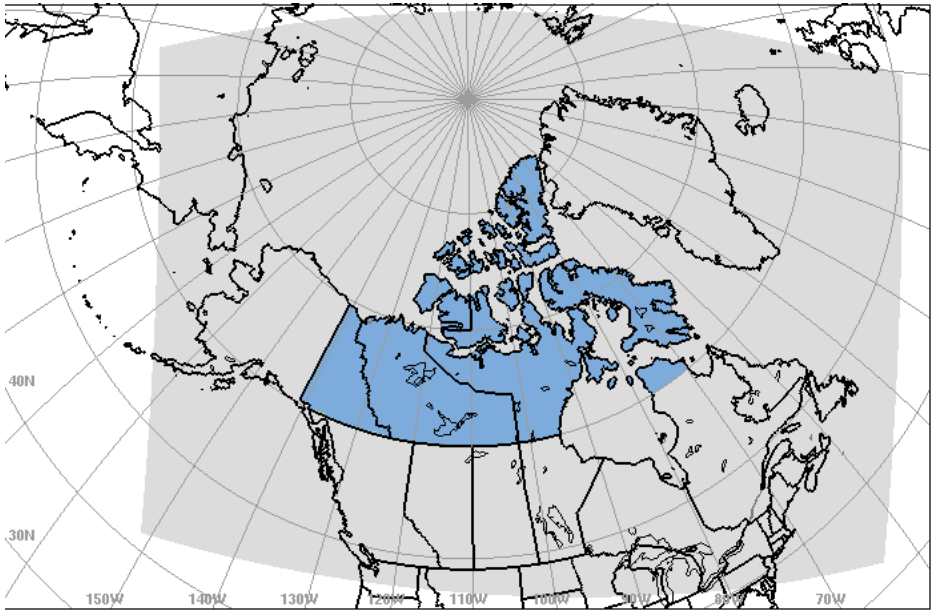
- Aerosols
- Black Carbon

Ambient Air Monitoring – Preliminary Results

- During the 2013 shipping season, ships contributed to approximately at Resolute and Cape Dorset, respectively:
  - 7% and 25% of PM2.5
  - 4% and 17% of ozone
- Additional measurements in Resolute suggested that percent ship contribution to black carbon was between 4.3 and 9.8% and that
  - black carbon constituted 1.3-9.7% of total PM2.5 mass in ship plumes.
- Calculations of high resolution Air Quality Health Index shows that ships affect air quality at each location

Air Quality Modelling of Emissions in the Canadian Arctic

- Development of air quality modelling capacity to simulate the contribution of ships and other activities to Arctic air quality
- Ambient air quality monitoring used as a basis for evaluating air quality predictions
- Modelling of a number of emissions scenarios at various spatial and temporal resolutions
- Focus will be on air quality impacts, black carbon will also be assessed
- Work is to be completed in 2014-2015

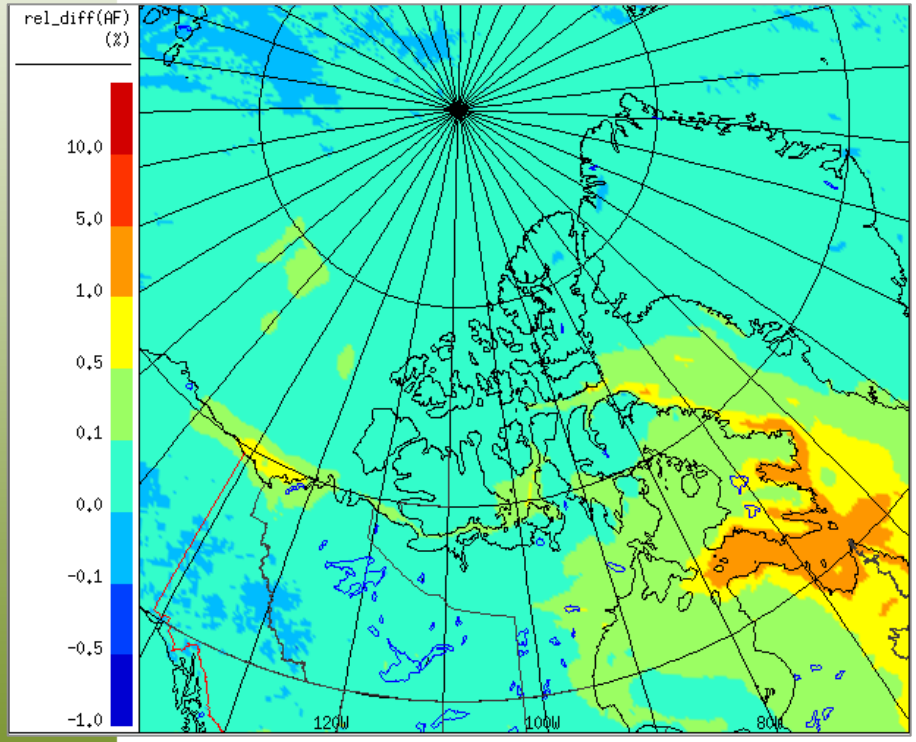


Environment Canada

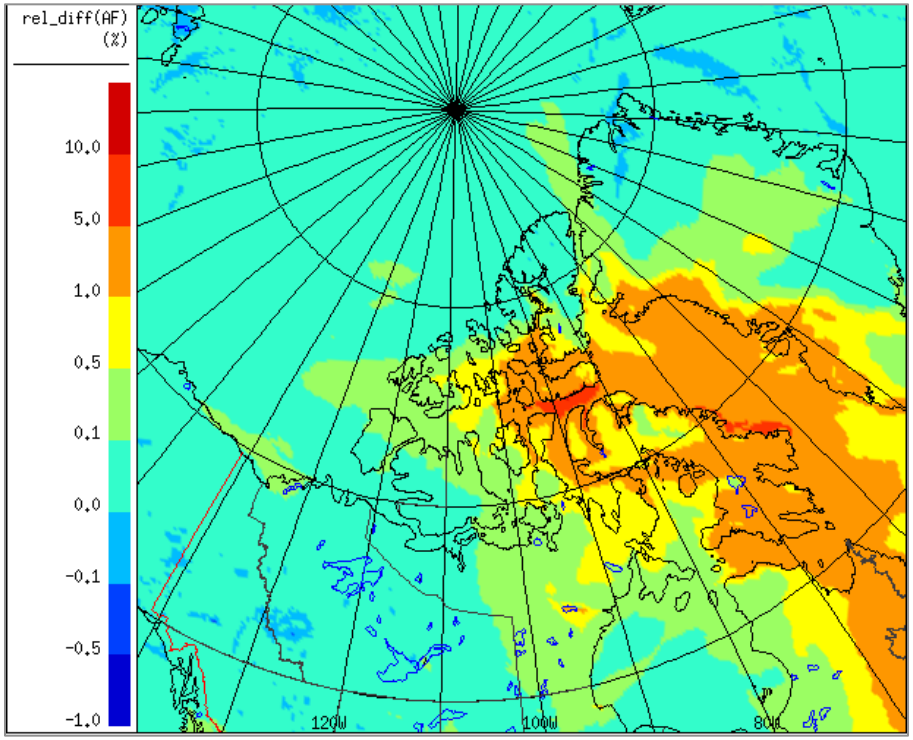
Modelling outputs will be developed for areas shown in blue

Preliminary Results:
Impact of shipping emissions on ambient $PM_{2.5}$ concentration (relative differences in monthly mean, %)

July 2010

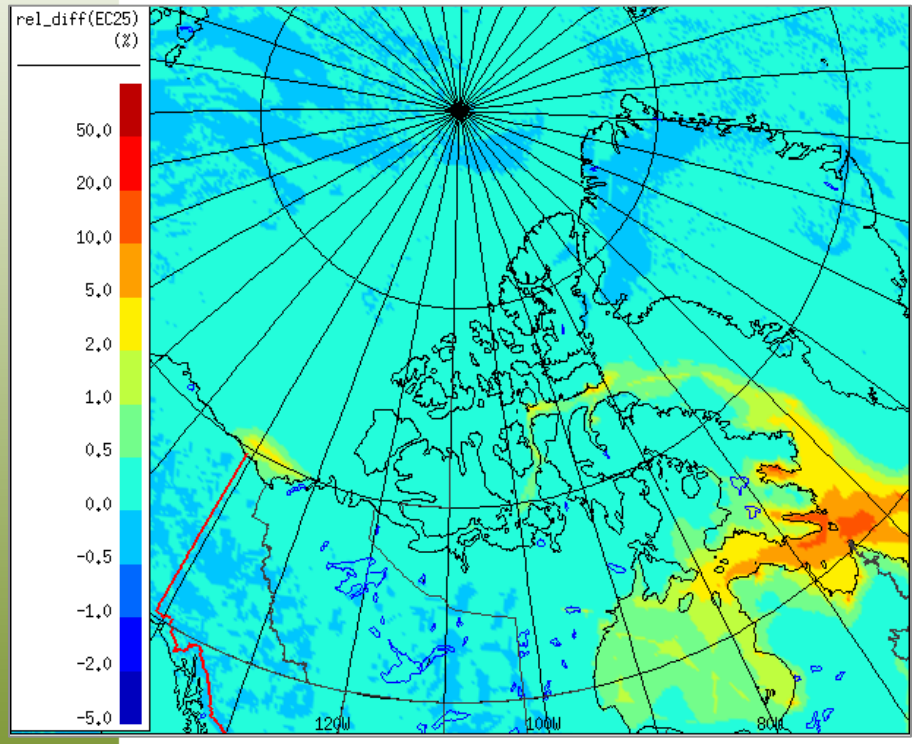


August 2010

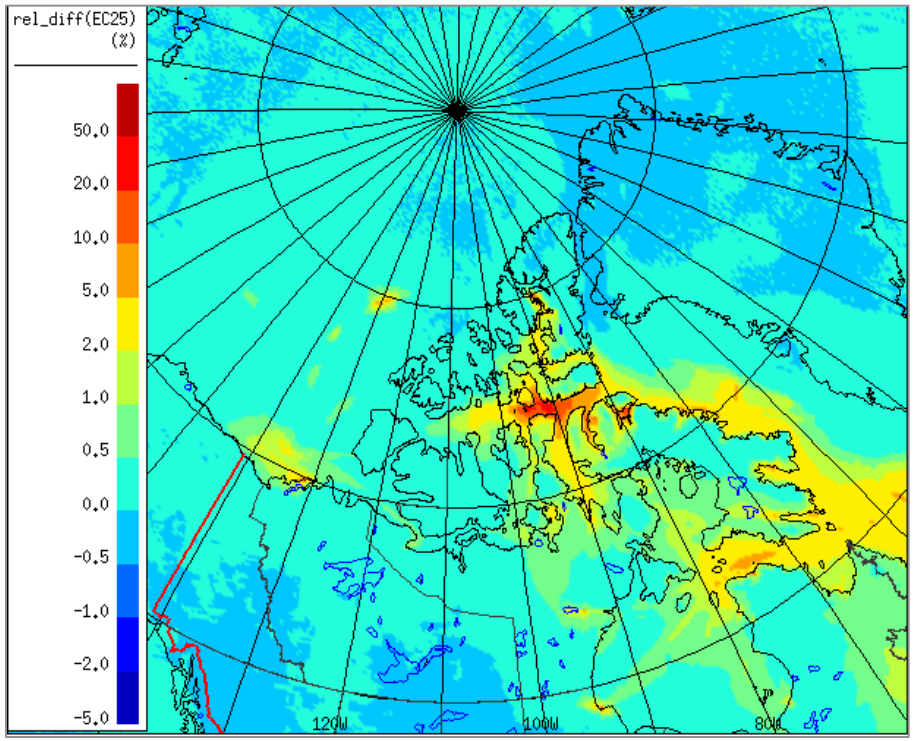


Preliminary Results:
Impact of shipping emissions on ambient $BC_{2.5}$ concentration (relative differences in monthly mean, %)

July 2010

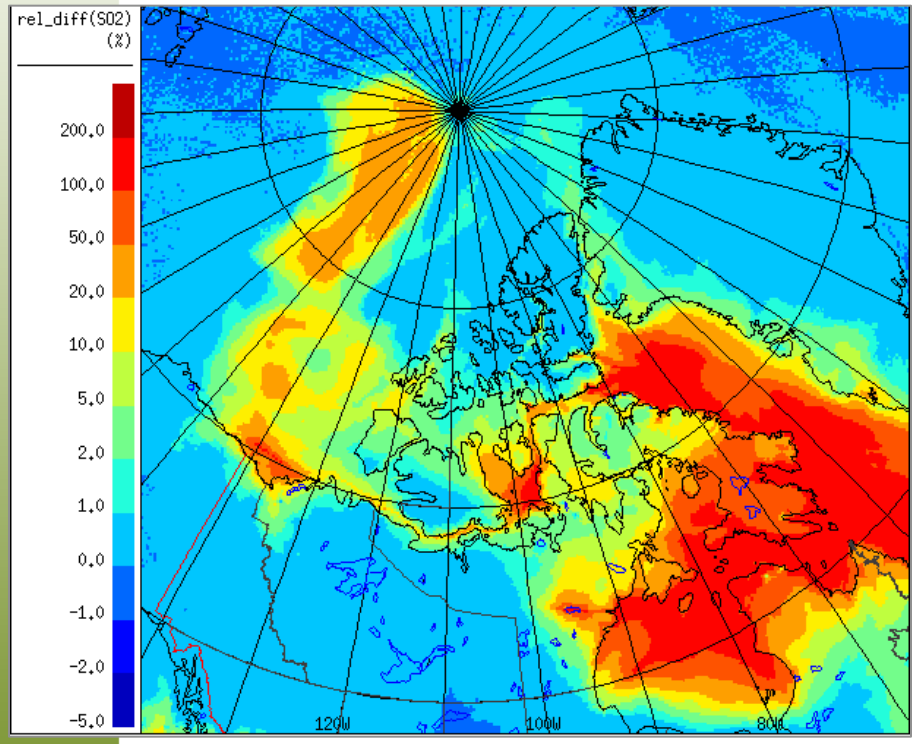


August 2010



Preliminary Results:
Impact of shipping emissions on ambient SO_2 concentration
(relative differences in monthly mean, %)

July 2010



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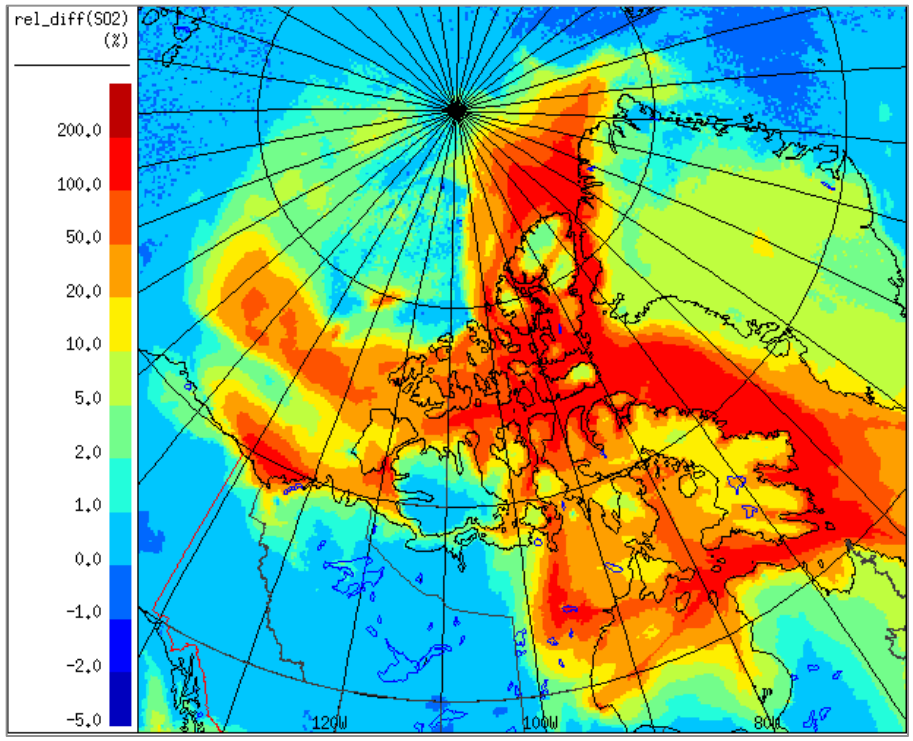
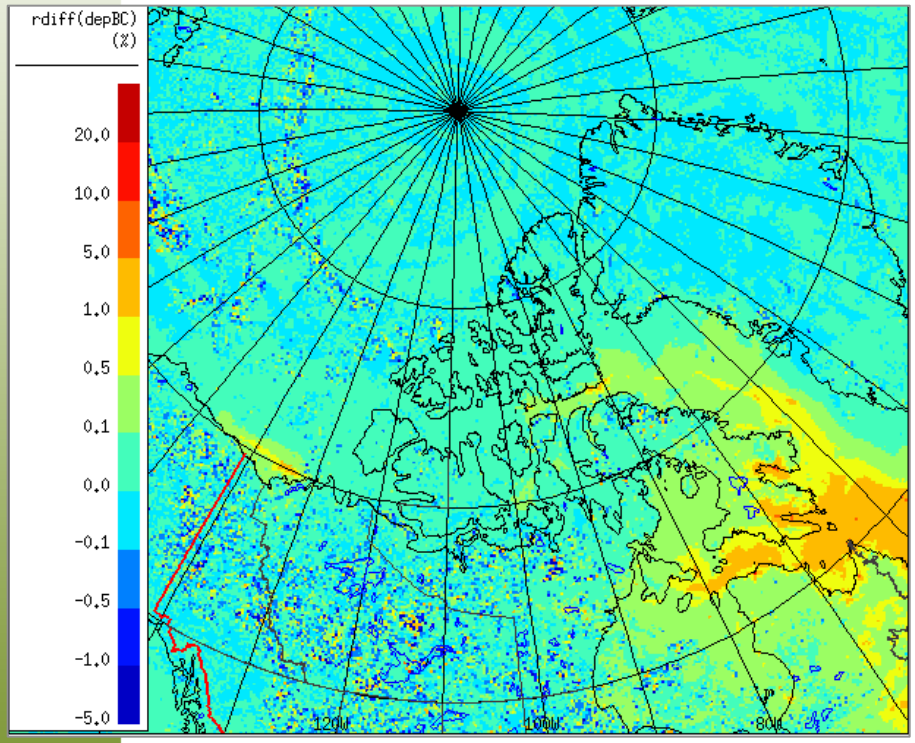


Preliminary Results:
Impact of shipping emissions on total BC deposition
(relative differences in monthly accumulated fluxes, %)

July 2010



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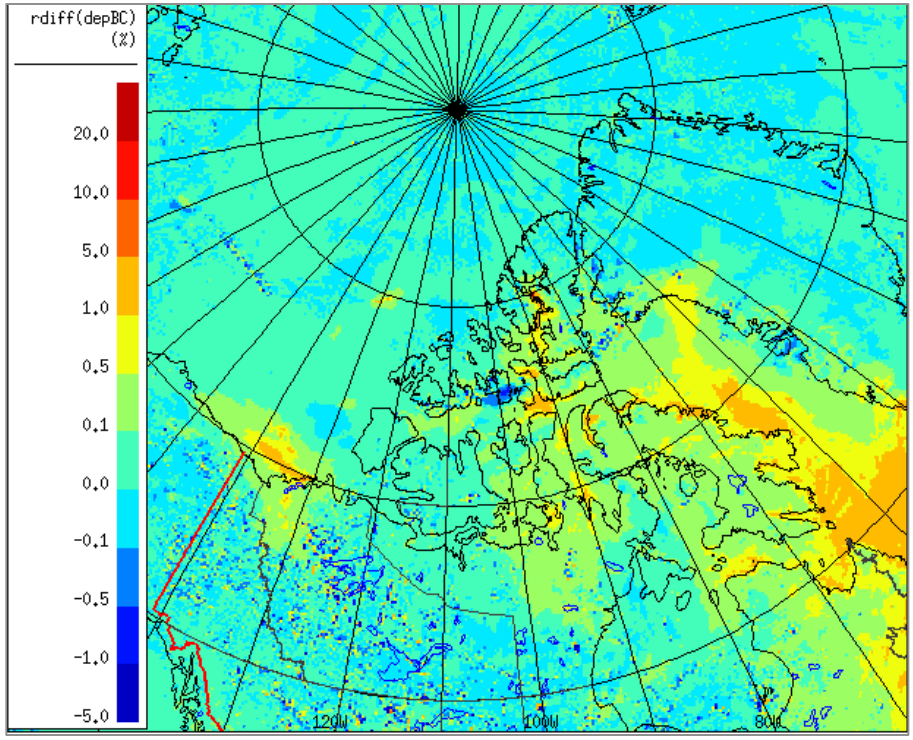
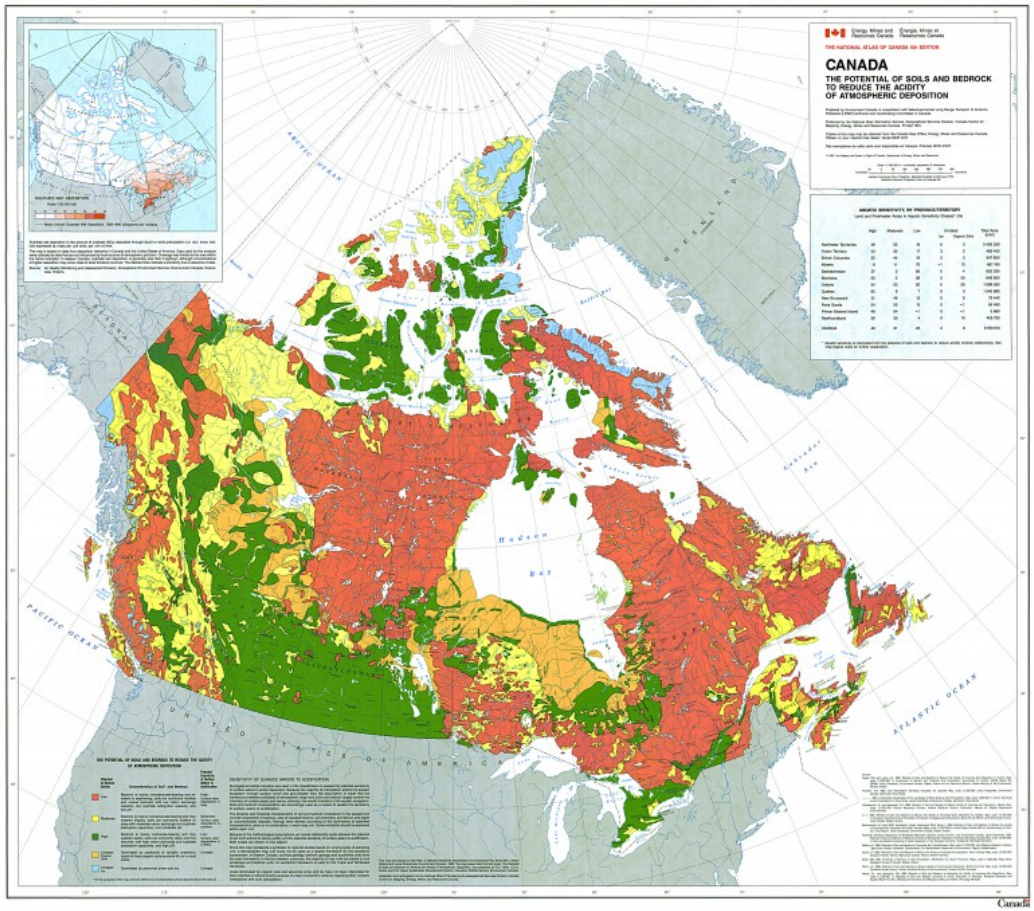


Ecosystem Impacts: Acid deposition and evaluation of critical loads

- Large areas of the Canadian Arctic have acid sensitive terrain
- Critical loads have been established for only a few aquatic ecosystems in the Canadian Arctic
- Environment Canada is considering options for sampling to establish critical loads in the Canadian Arctic where elevated emissions and acid sensitive terrain coincide
- Acid deposition results from the air quality modelling will assist in areas of focus



Natural Resources Canada

Next steps for project

- Complete air emissions projections
- Air quality measurements (continuing)
- Undertake air quality model runs
  - Air quality model development work in progress; final model scenario runs for baseline and forecast years will be completed in fall-winter of 2014-15
  - Evaluation of local impacts with finer temporal resolution (i.e. hourly impacts)
- Ecosystem (critical loads) analyses and health effects modelling are planned
- On-going consultations and sharing of results with interested parties

Questions

Richard Holt
Energy and Transportation Directorate
Environment Canada
Richard.Holt@ec.gc.ca
+1 (604) 666-6552

Lynn Lyons
Energy and Transportation Directorate
Environment Canada
Lynn.Lyons@ec.gc.ca
+1 (819) 420-4213