Polar Mercury

Steve Brooks, Air Resources Laboratory, Atmospheric Turbulence and Diffusion Division, Oak Ridge, TN
steve.brooks@noaa.gov

Goals:

Assess current rates of atmospheric mercury oxidation and deposition, and fate in the Polar regions

Understand the role of mercury in polar atmospheric chemistry Accurately interpret mercury and halogen (Cl, Br, I) concentrations from historical ice core samples

Determine the impact of polar mercury dynamics on the overall global mercury dynamics

Develop techniques and methods for polar mercury measurements Predict polar mercury dynamics under potential climate change scenarios

Approaches:

Our Approach is to combine:
Atmospheric mercury speciation monitoring
Micro-met methods to measure mercury fluxes
Monitoring of mercury in the snow, firn and melt water
Atmospheric modeling

While other groups provide:
Other atmospheric constituents (ozone, BrO, PM, etc.)
Vertical profiles (balloons, DOAS, SODAR)
Horizontal extrapolation (aircraft, transects, satellite data)
Meteorological variables

Accomplishments:

1st to monitor full atmospheric mercury speciation in the Arctic and Antarctic

1st and only published estimates of current mercury dynamics and sequestration rates for the Antarctic and Greenland Ice Sheets

1st to apply micro-met techniques to determine mercury surface fluxes in the Arctic and Antarctic

Indicators of Success:

NSF grants and

Selected Publications:

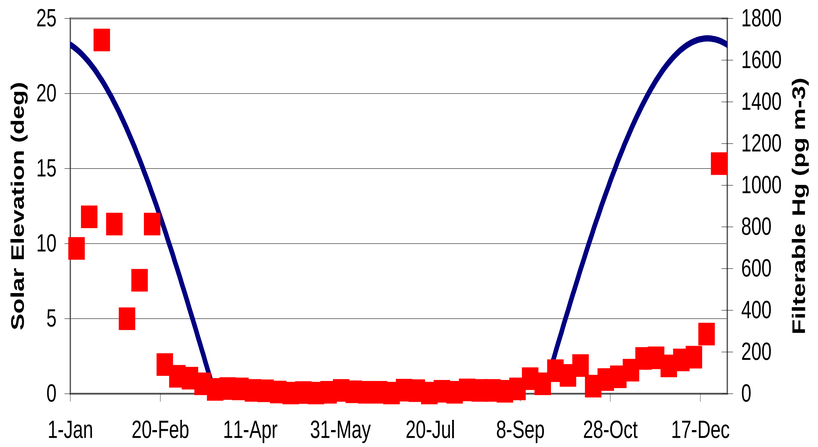
Brooks, S.B., C. Moore, D. Lew, B. Lefer, G. Huey, and D. Tanner (2010). Temperature and sunlight controls of mercury oxidation and deposition atop the Greenland Ice Sheet. *Atmospheric Chemistry and Physics Discussions*, acp-2010-1012.

Brooks, S., Arimoto, R., Lindberg, S., and Southworth, G., 2008. Antarctic polar plateau snow surface conversion of deposited oxidized mercury to gaseous elemental mercury with fractional long-term burial, *Atmospheric Environment vol. 42, no. 12,* 2877-2884.

Brooks, S., Lindberg, S., Southworth, G., and Arimoto, R., 2008. Springtime atmospheric mercury speciation in the McMurdo, Antarctica coastal region. *Atmospheric Environment vol. 42, no. 12,* 2885-2893.

Brooks, SB, Saiz-Lopez, A, Skov, H, Lindberg, SE.; Plane, JMC, and Goodsite, ME (2006) The mass balance of mercury in the springtime arctic environment, *Geophysical Research Letters*, Vol. 33, No. 13, 13 July 2006.

Brooks, S. B., S. E. Lindberg, J. Pacyna, J. Christensen, A. Gusev, K. Puckett, O. Travnikov, S. Wilson, V. Gordeev, R. Macdonald, and S. Marcy Chapter 3 - Transport Pathways and Processes Leading to Environmental Exposure. In AMAP, 2004. AMAP Assessment 2002: Pathways, Trends and Effects of Heavy Metals in the Arctic. Arctic Monitoring and Assessment Programme (AMAP), Oslo, Norway.



Weekly oxidized (filterable) atmospheric mercury at South Pole and solar elevation

Collaborators/Partners:

NSF Group - Antarctic Tropospheric Chemistry Investigation (ANTCI) ~ 25 Scientists from ~12 Institutes

NSF Group - Halogen Chemistry under Sunlit Snow at Summit, Greenland ~ 20 Scientists from 10 Institutes

Sandy Steffen and others from Environment Canada

Torunn Berg and others from Norway NILU

Henrik Skov and others from Denmark NERI

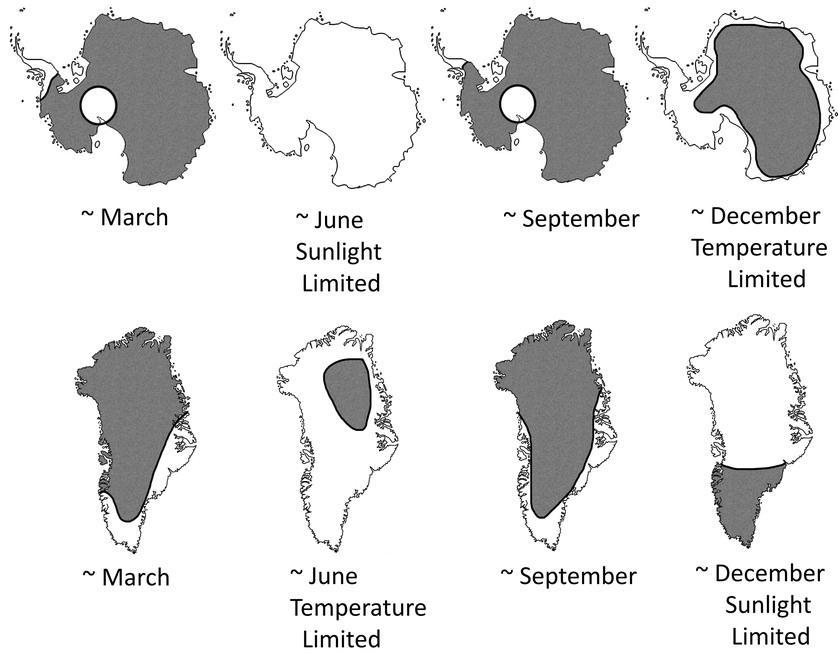
John Plane and other from the University of East Anglia

Future Directions:

Development of low cost passive samplers for atmospheric mercury

Determine polar mercury dynamics under predicted climate changes

Predict polar mercury dynamics under global emissions reductions



Shaded area shows extent of mercury oxidation and deposition