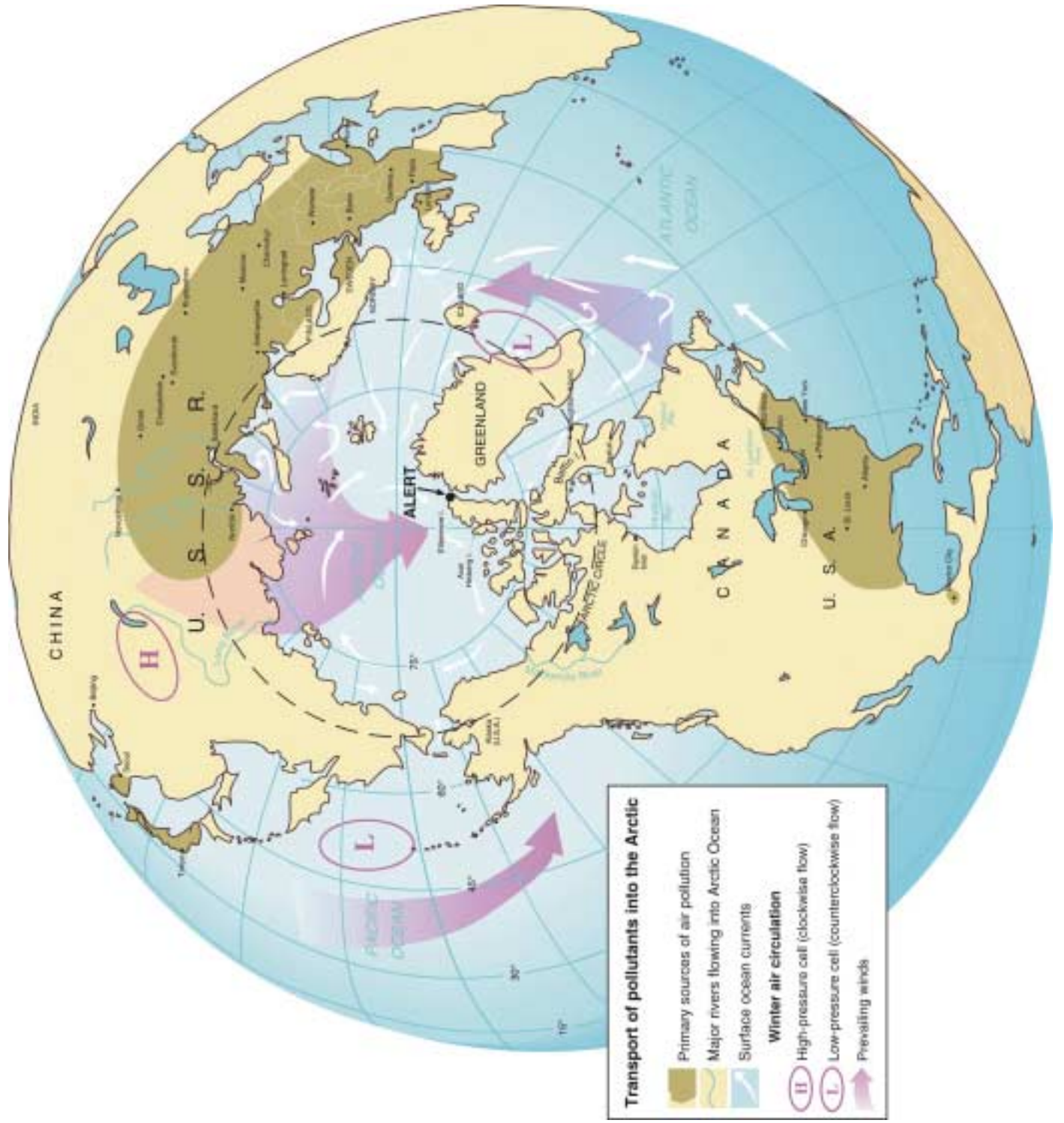


An Overview Of Arctic Haze And Surface Ozone Depletion At Polar Sunrise

Leonard A. Barrie
Pacific Northwest National Laboratory
Leonard.barrie@pnl.gov



HISTORY OF PRIORITY ISSUES RESEARCHED IN THE ARCTIC

ACID
RAIN

ARCTIC HAZE

OZONE
DEPLETION

TOXICS

CLIMATE
CHANGE

1970

75

80

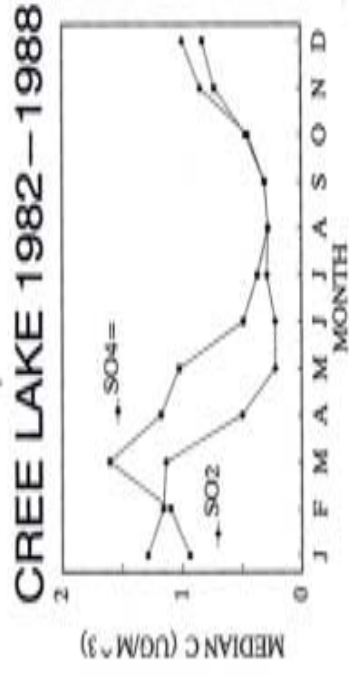
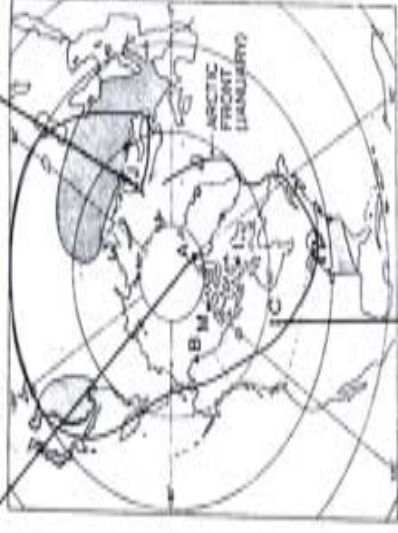
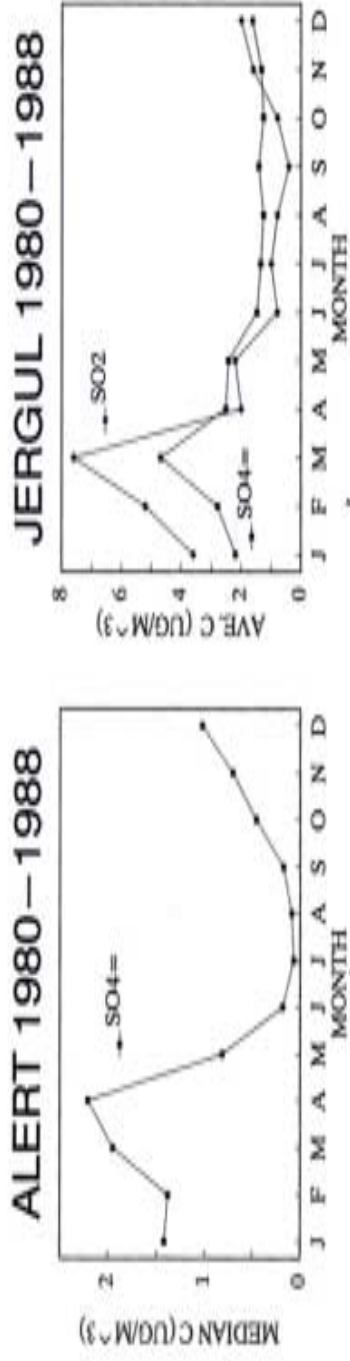
85

90

95

2000

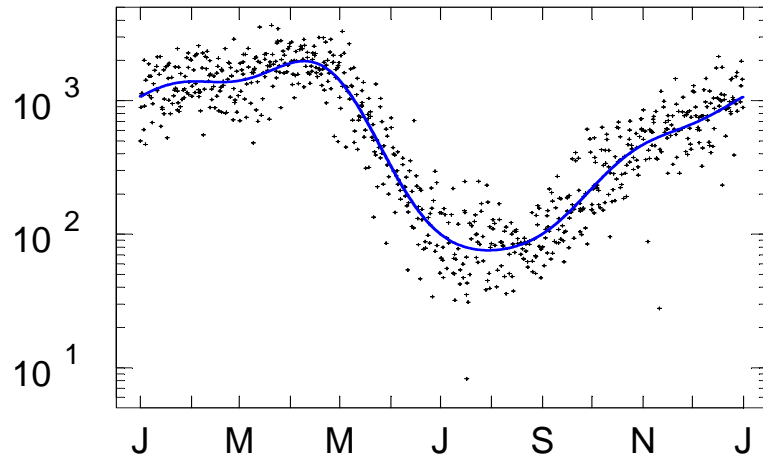
Arctic Sulphur Pollution is Widespread: Eurasia is Connected to North America



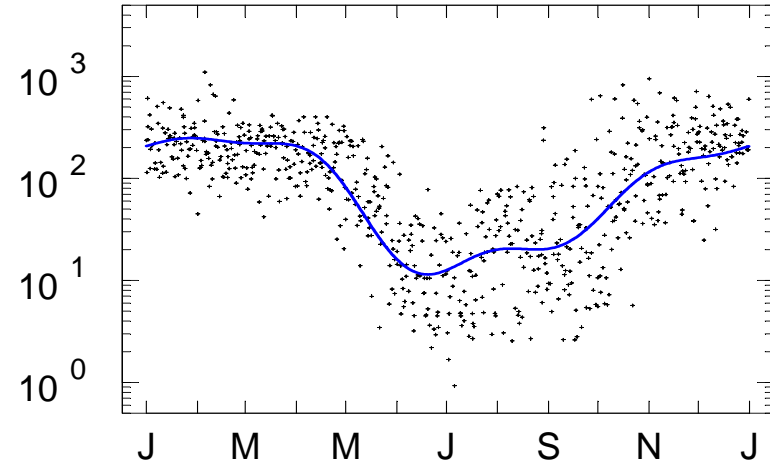
Seasonality of Major Aerosol Components At Alert:1980-1995

From Sirois, A. and L.A. Barrie, 1999, J. G. R., 104D, 11599-11618.

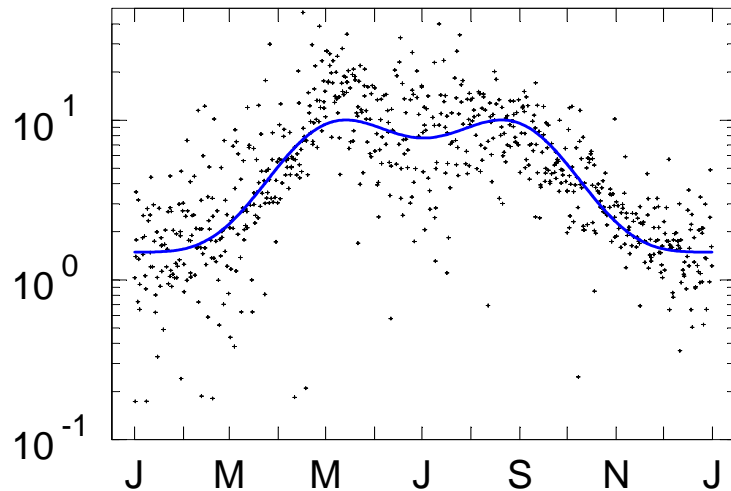
sulphate



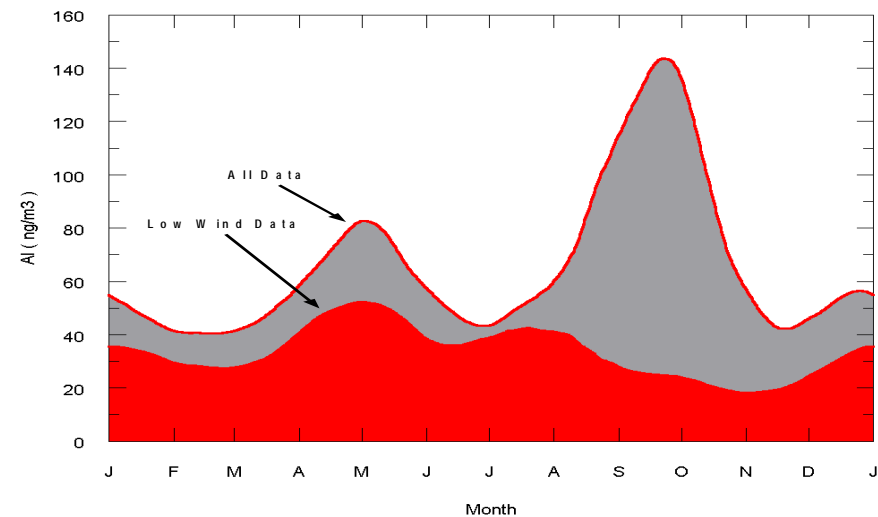
sodium



methylsulphonate



aluminum



Apportionment Of Aerosol Mass At Ny Alesund in Spring of 1996.

(Staebler et al, J. G. R.,1999, 103D, 5515-5529)

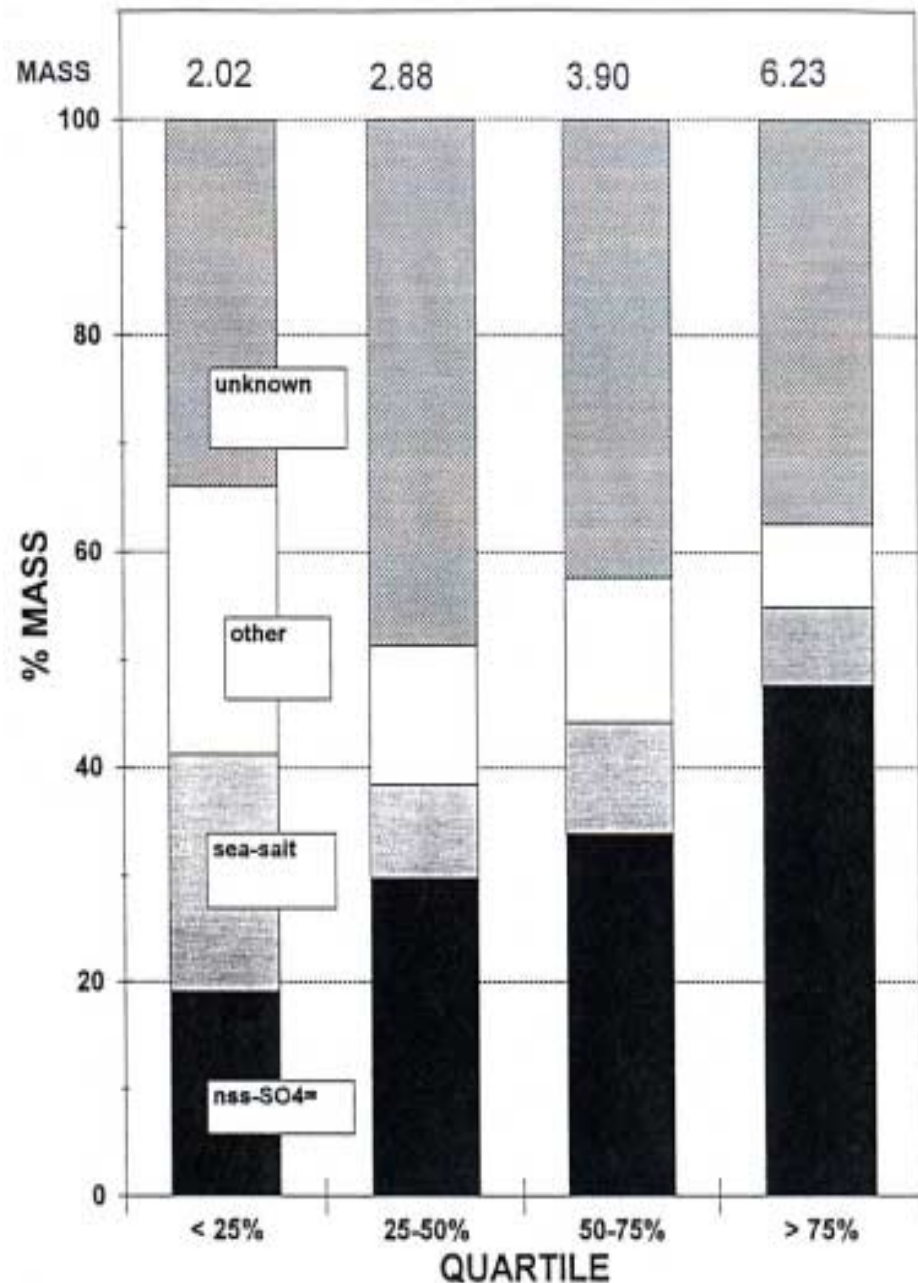
▪The average estimated mass concentration in $\mu\text{g m}^{-3}$ is given at the top of each bar.

▪An average apportionment is shown for each quartile of daily mean accumulation mode aerosol volume.

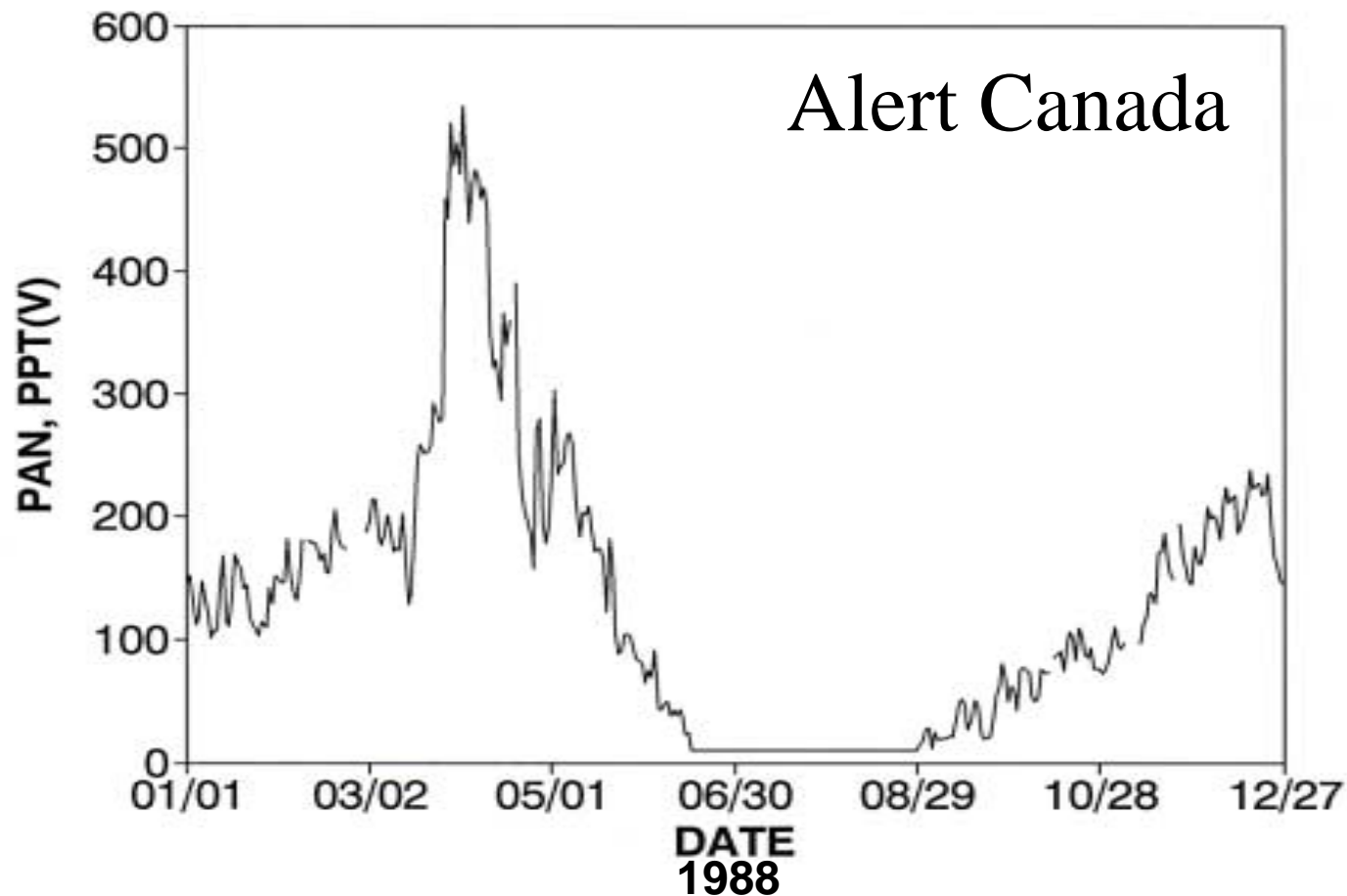
▪The top quartile is most polluted from Europe and Russia while the lowest quartile is off the North Atlantic and Greenland.

▪“Other” are remaining measured anions and cations

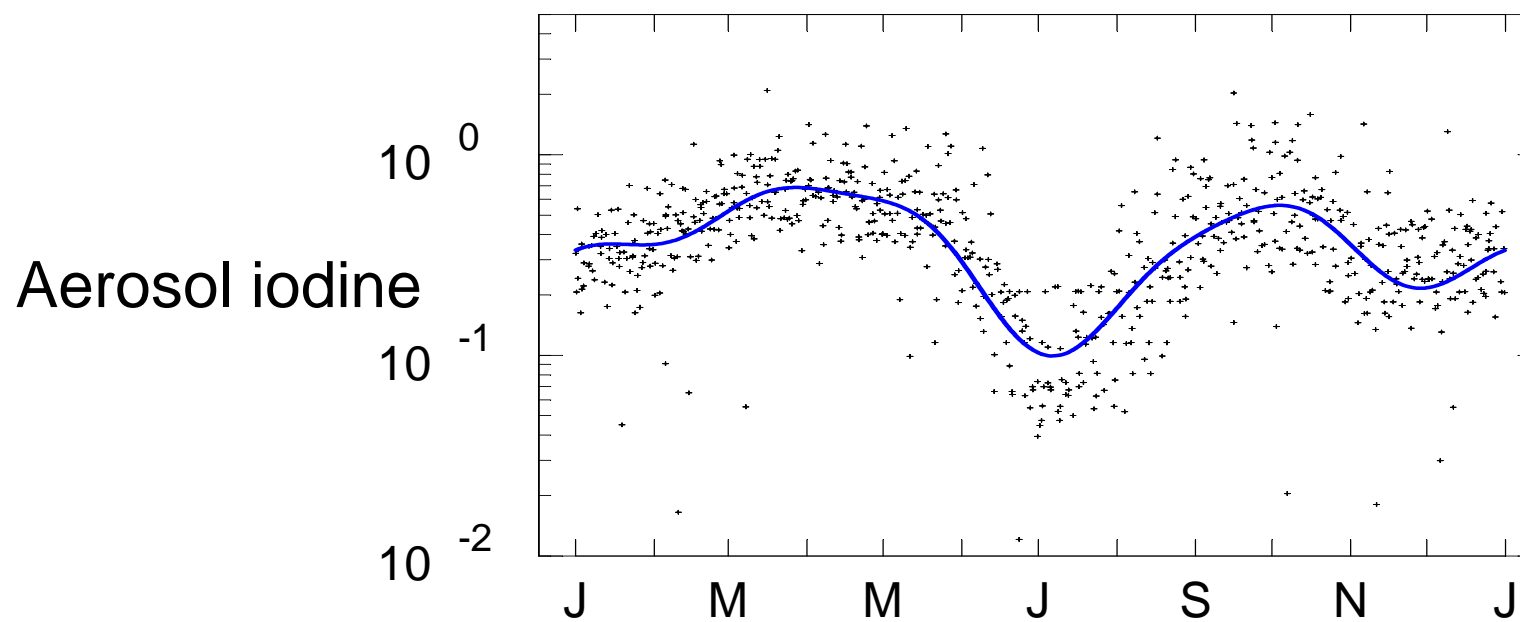
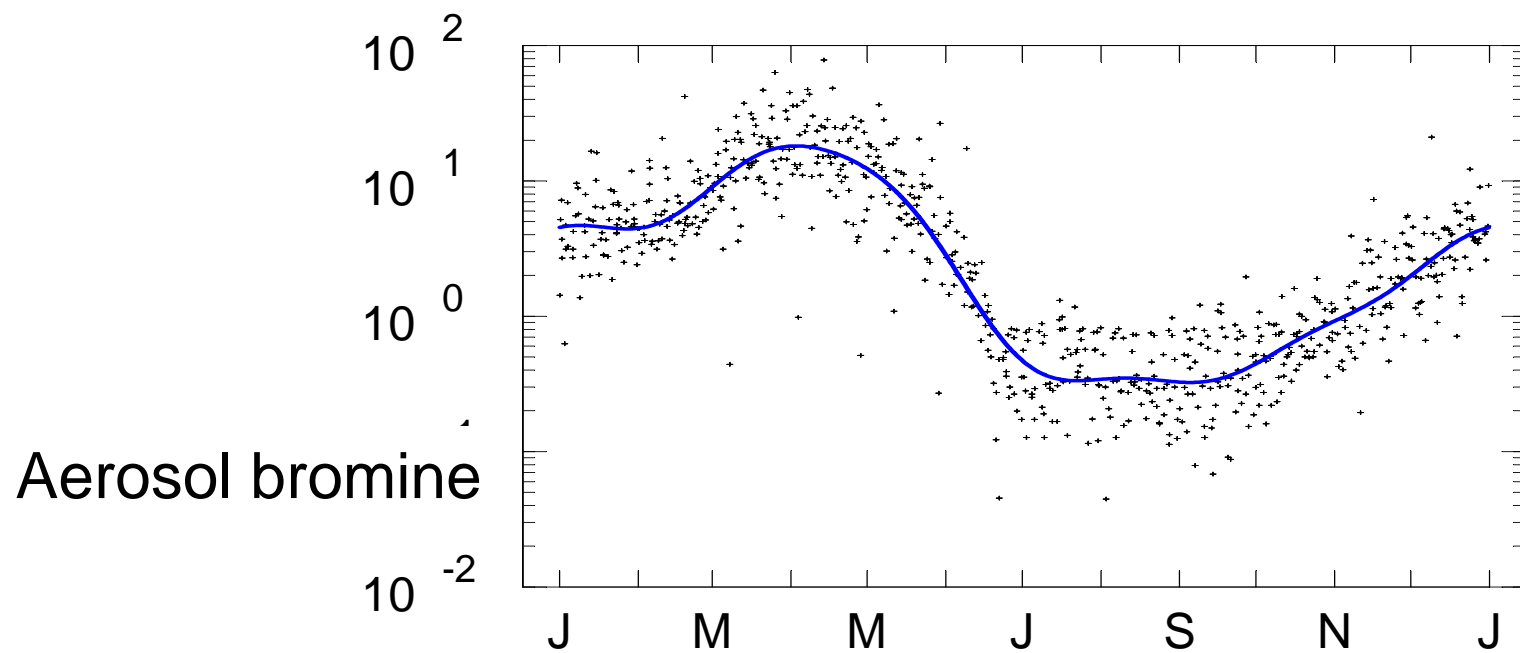
▪“Unknown” is most probably the organic fraction.



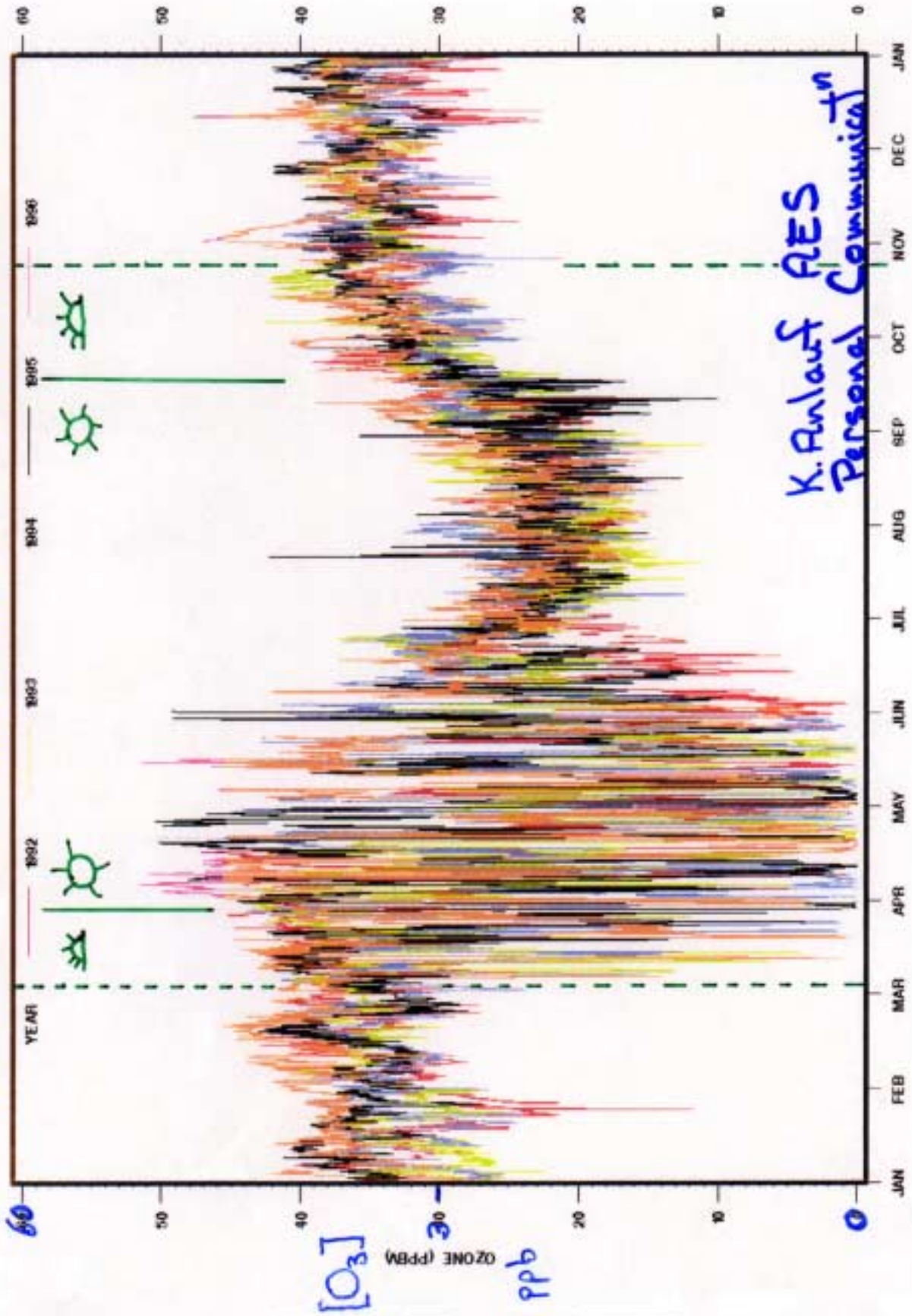
The Primary Nitrogen Oxide In Arctic Haze Pollution is PAN



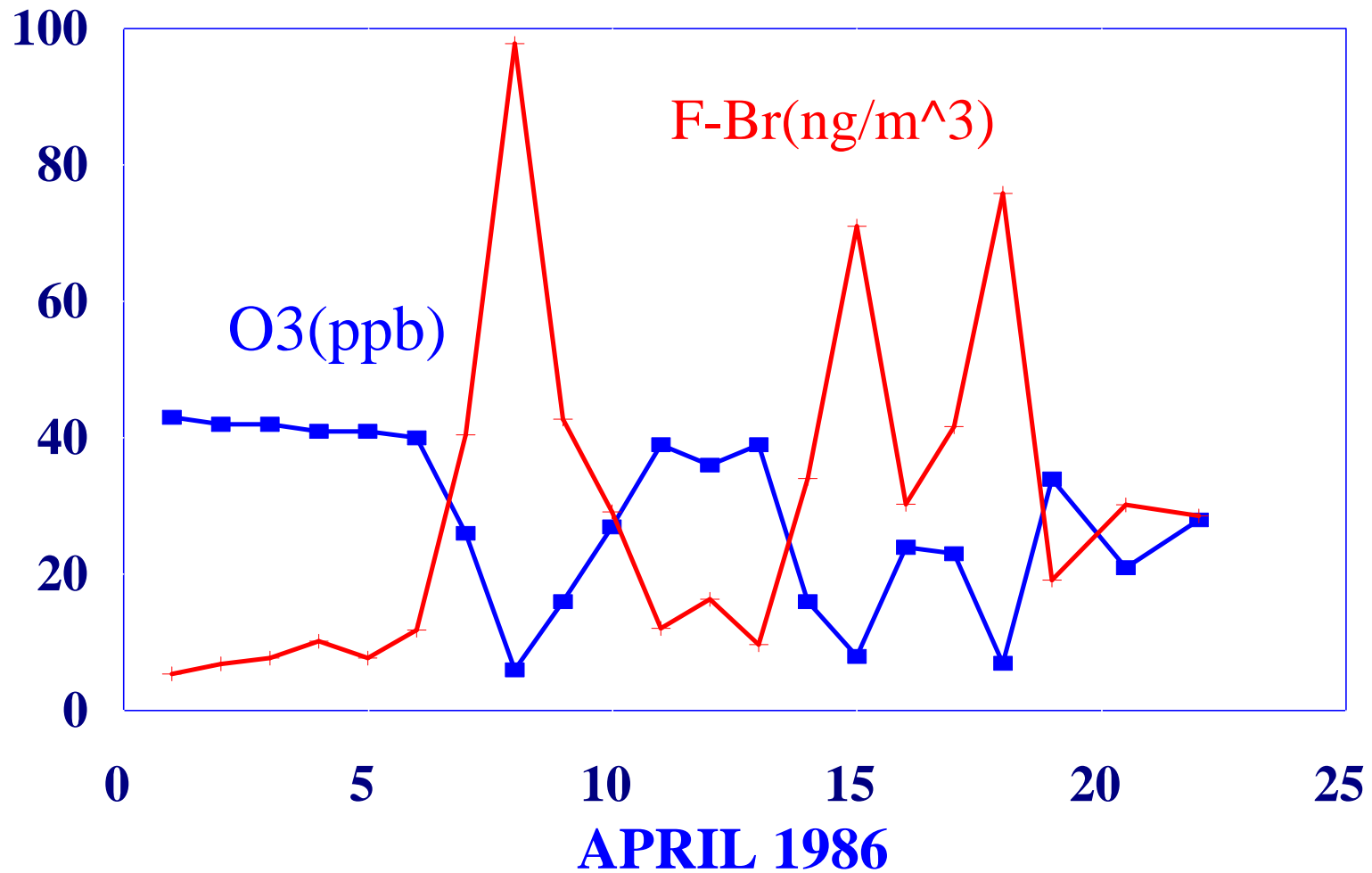
Courtesy of Dr. J. Bottenheim



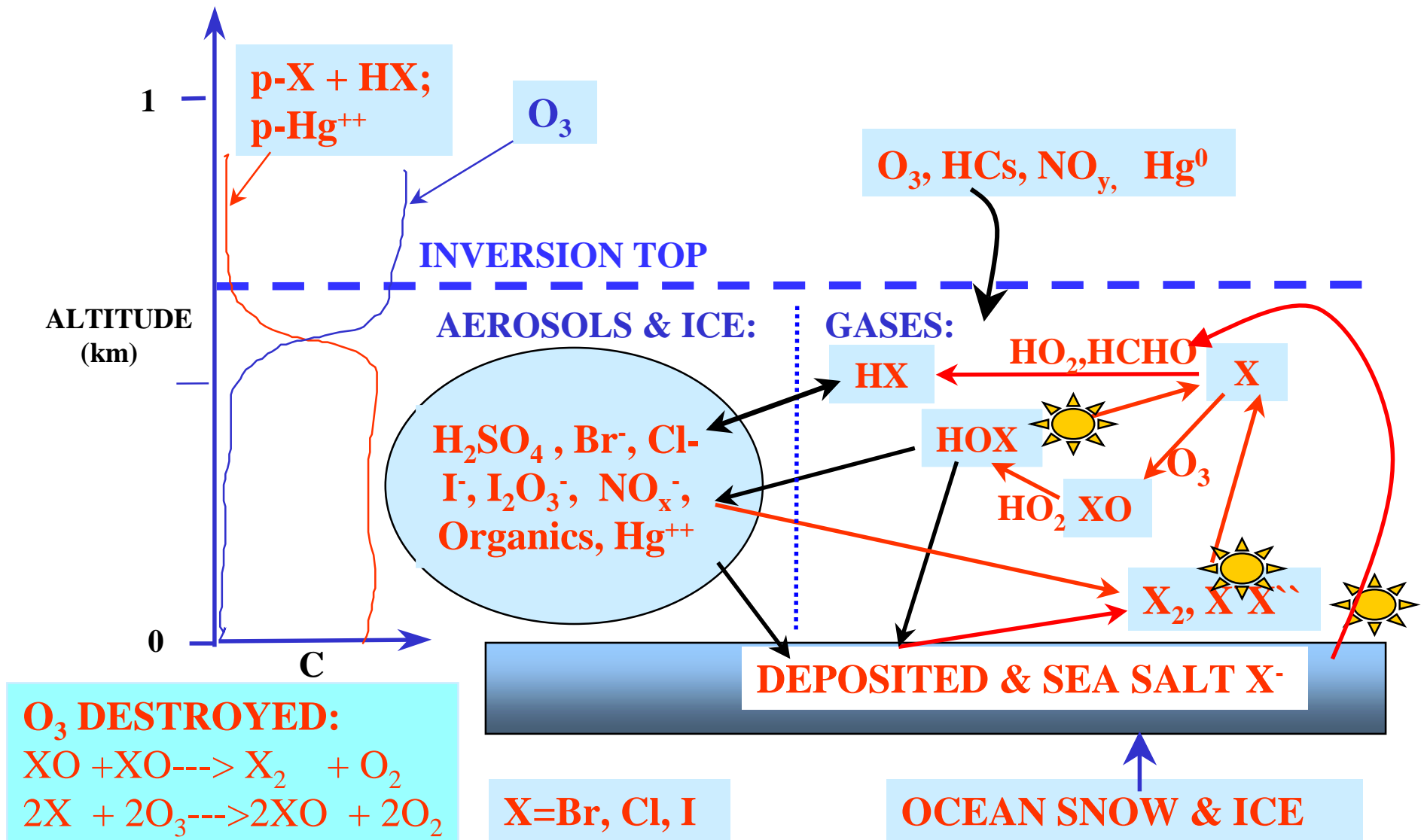
Hourly Surface Ozone Mixing Ratios at ALERT, N.W.T., CANADA



Barrie, L.A., J.W. Bottenheim, R.C. Schnell, P.J. Crutzen and R.A. Rasmussen, Ozone destruction and photochemical reactions at polar in the lower Arctic atmosphere, *Nature*, 334, 138-141. (1988).

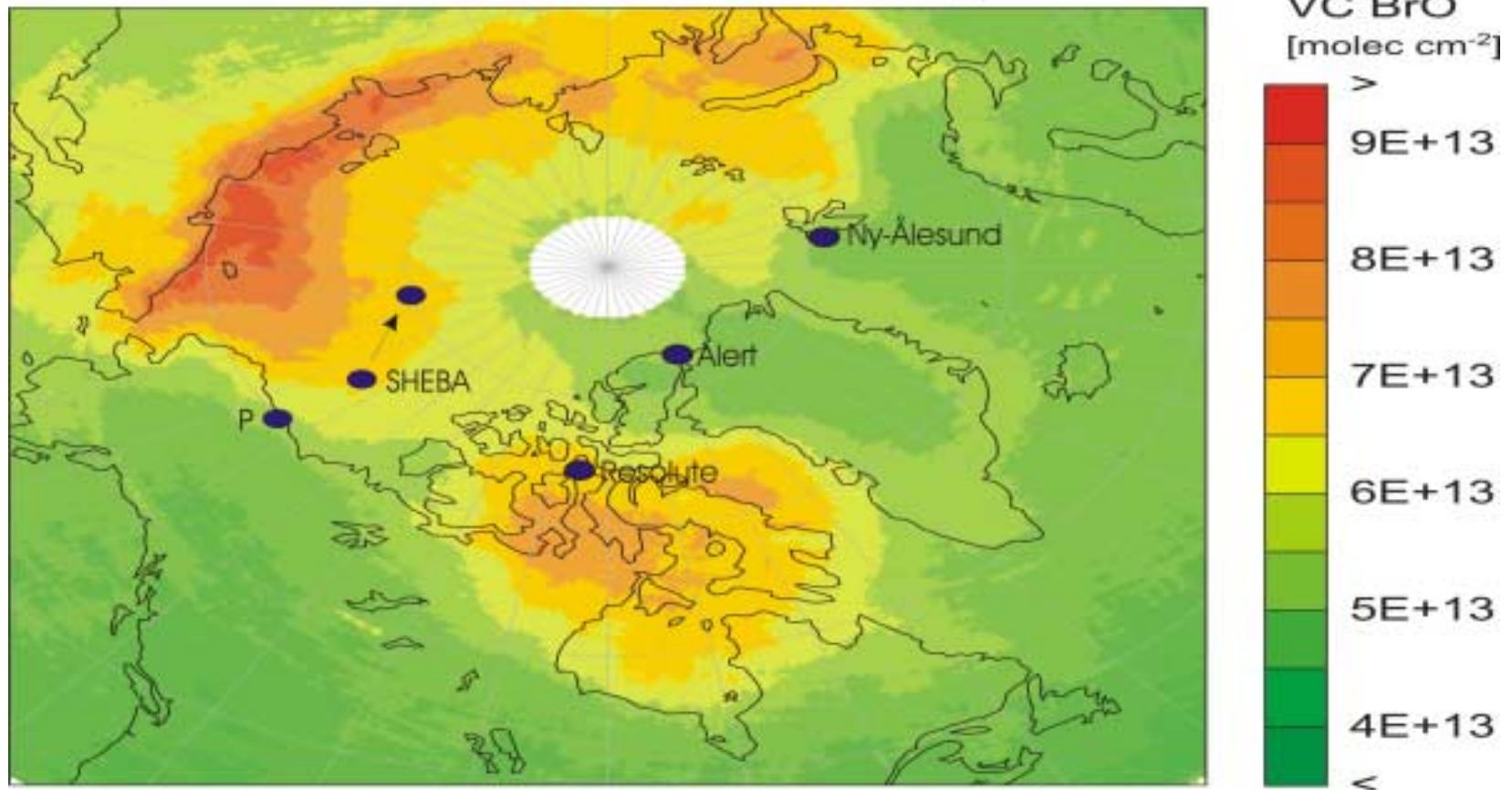


OZONE AND MERCURY DEPLETION OVER THE ARCTIC OCEAN



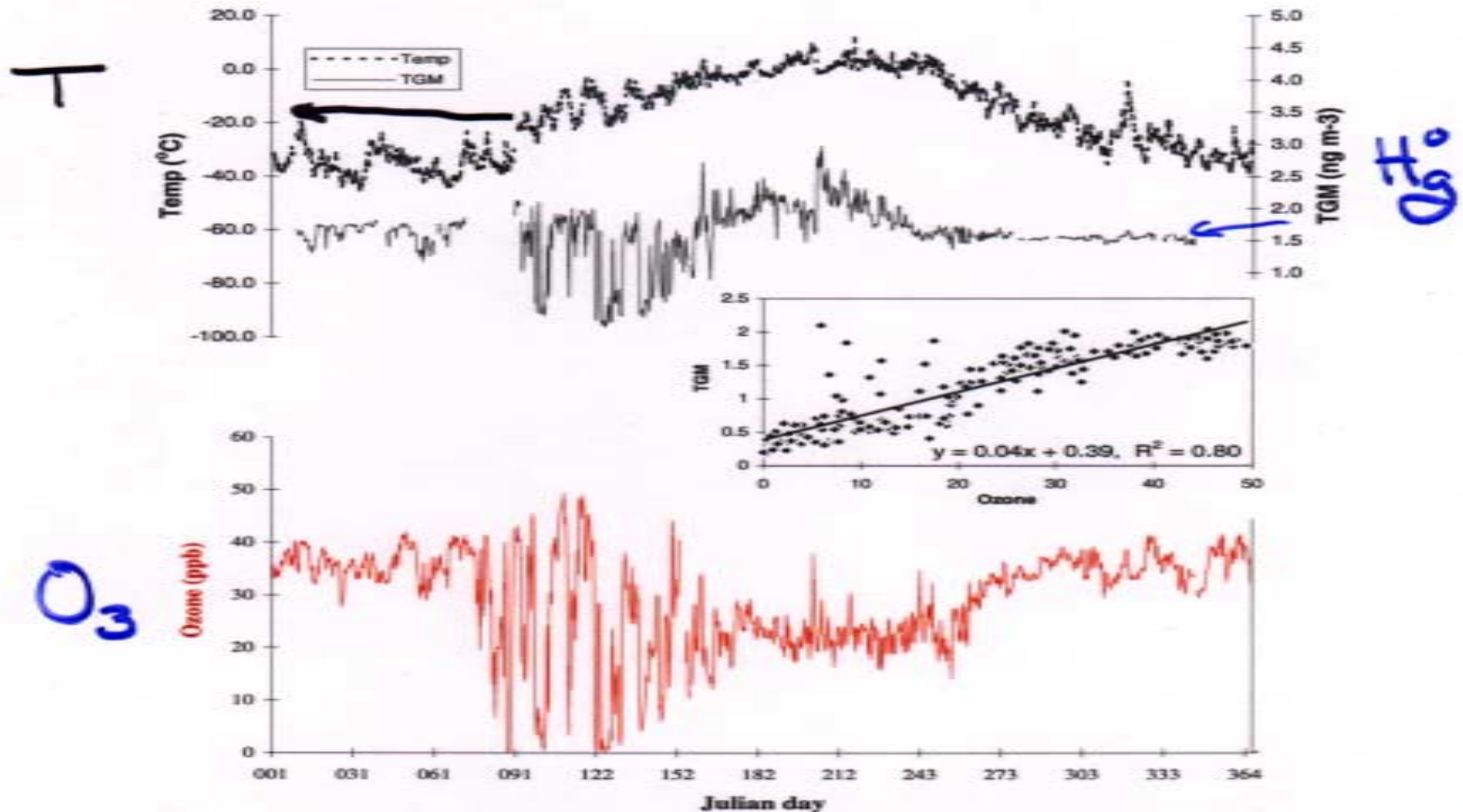
Spatial Distribution of Tropospheric BrO In The Arctic from GOME Satellite Observations

GOME BrO 1 March - 31 May 1998



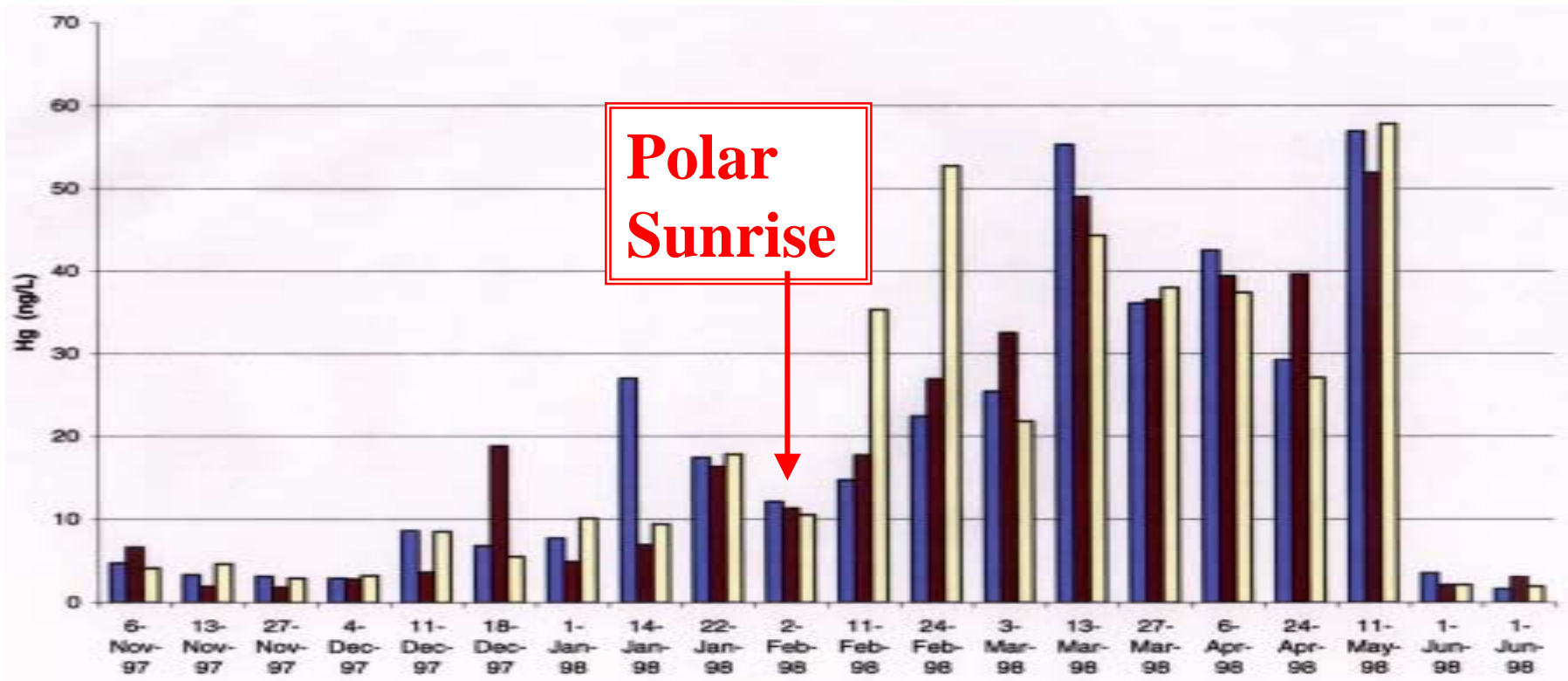
Lu, J.Y. , W. H. Schroeder, L. A. Barrie et al, 2001, Magnification of atmospheric mercury deposition to polar regions in springtime: the link to tropospheric ozone depletion chemistry, *Geophys. Res. Letters*, in press

Mercury Correlation With Ozone



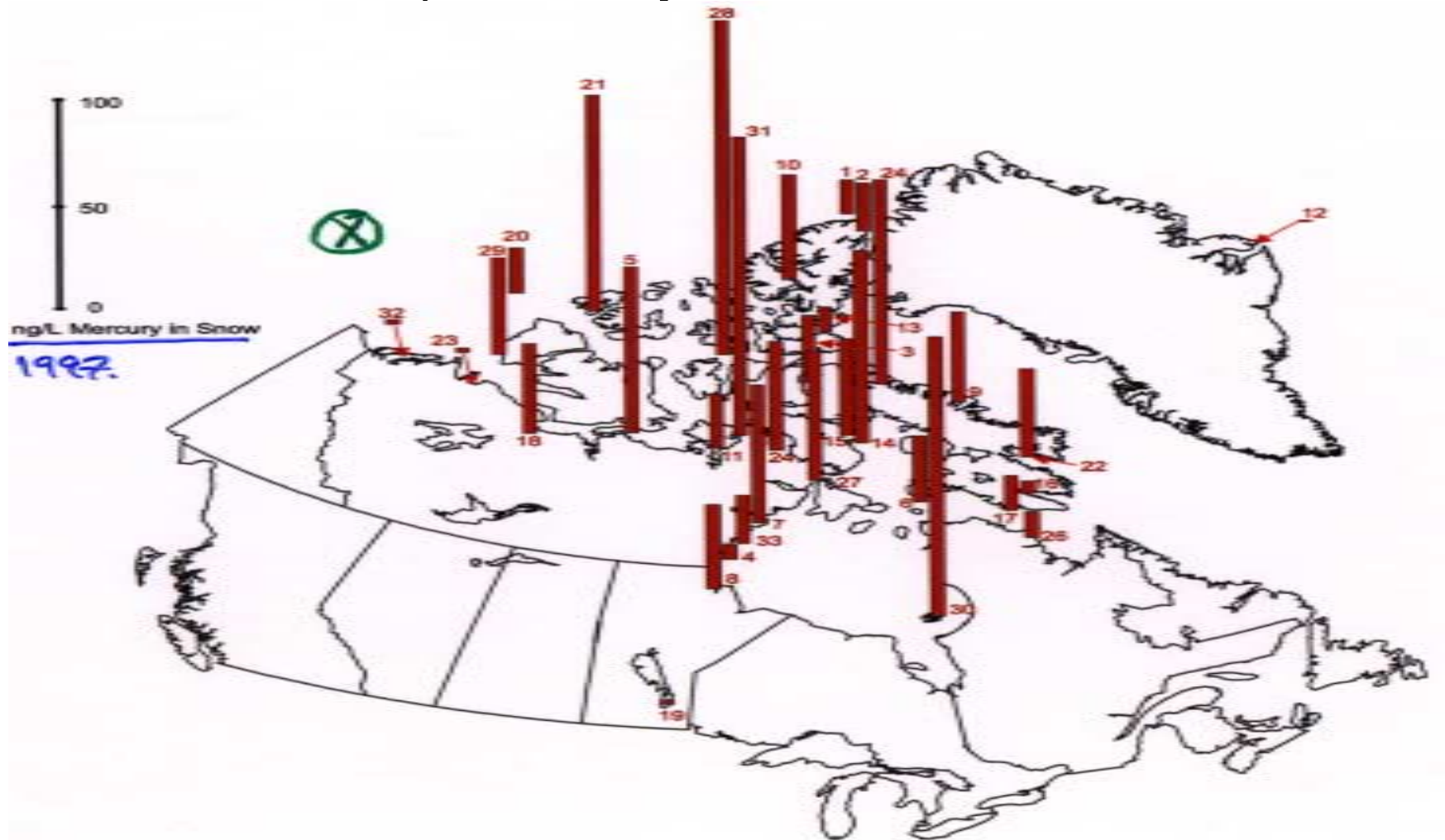
Schroeder, W.H., K.G. Anlauf, L.A. Barrie, J.Y. Lu, A. Steffen, D.R. Schneeberger and T. Berg, 1998, Mercury vapour depletion in Arctic air during springtime, *Nature*, 394, 331.

Mercury In Snow At Sheba Site North Of Alaska For One Year:



Lu, J.Y. , W. H. Schroeder, L. A. Barrie et al, 2001, Magnification of atmospheric mercury deposition to polar regions in springtime: the link to tropospheric ozone depletion chemistry, *Geophys. Res. Letters*, in press

Mercury In April Surface Snow



Lu, J.Y. , W. H. Schroeder, L. A. Barrie et al, 2001, Magnification of atmospheric mercury deposition to polar regions in springtime: the link to tropospheric ozone depletion chemistry, *Geophys. Res. Letters*, in press

SUMMARY

- From November to May, the Arctic air mass is *a highway* for Eurasian pollution to North America
- The high latitude lower troposphere is *decoupled* from the middle to upper troposphere. North American and SE Asian sources play a relatively more important role with increasing height.
- Re tropospheric ozone: polar region snowpack chemistry is an *important sink* in the frozen marine boundary layer and an *important source* of ozone precursors for mid latitudes in spring
- Surface ozone depletion at polar sunrise leads to greatly enhanced mercury deposition near frozen marine surfaces of the Arctic and Hudson Bay.