NOAA ESRL Global Monitoring Annual Conference, May 17-19, 2010

A Characterization of Arctic Aerosols as Derived from Airborne Observations and Their Influence on the Surface Radiation Budget

R. S. Stone, A. Herber, V. Vitale,
R. Schnell, E.G. Dutton, P. S. K. Liu, S-M Li

[*et al., JGR-Atmos. – 2010, in-press*]

CIRES

NOAA

AWI

ISAC

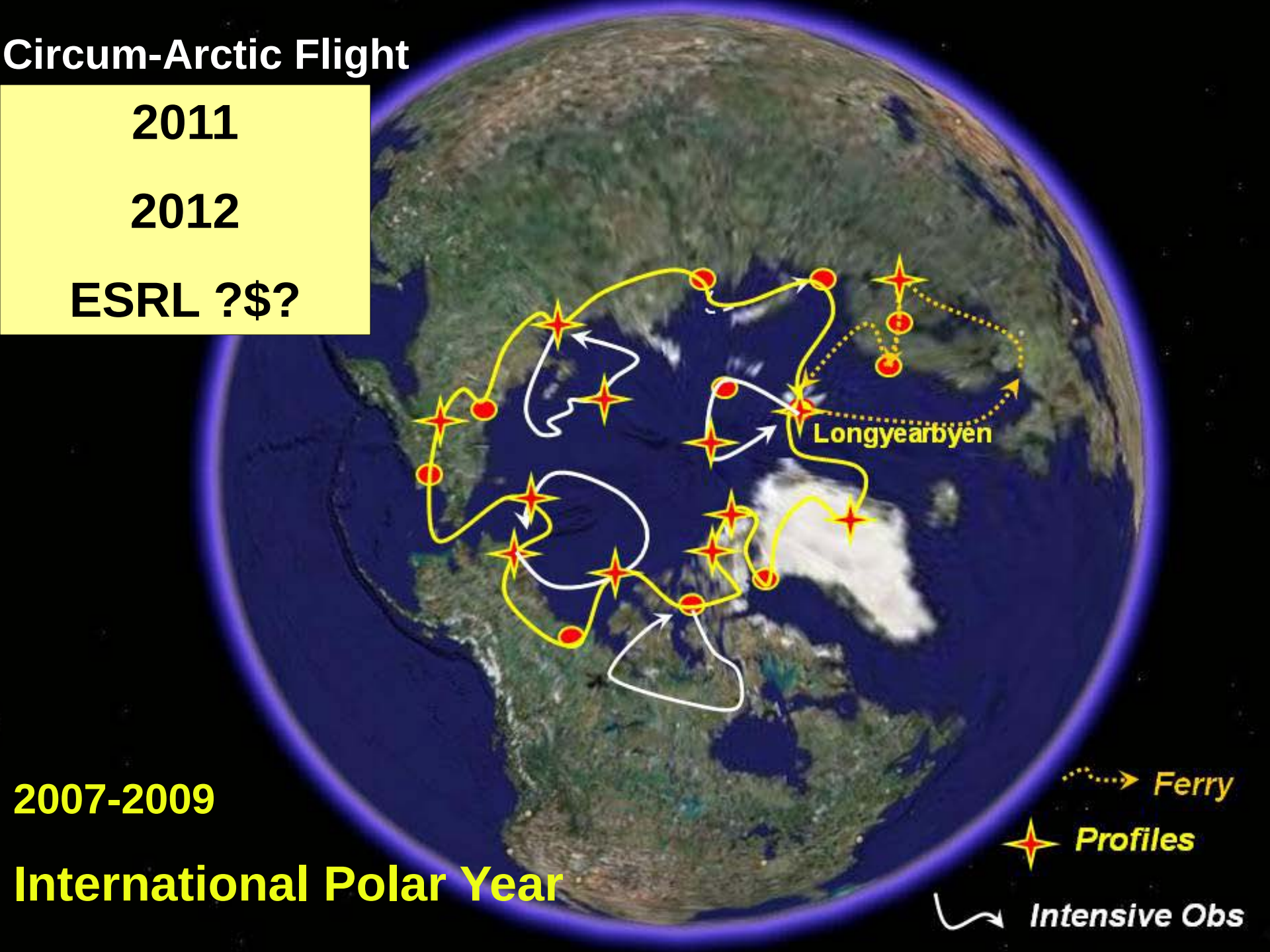
Environment Canada

Circum-Arctic Flight

2011

2012

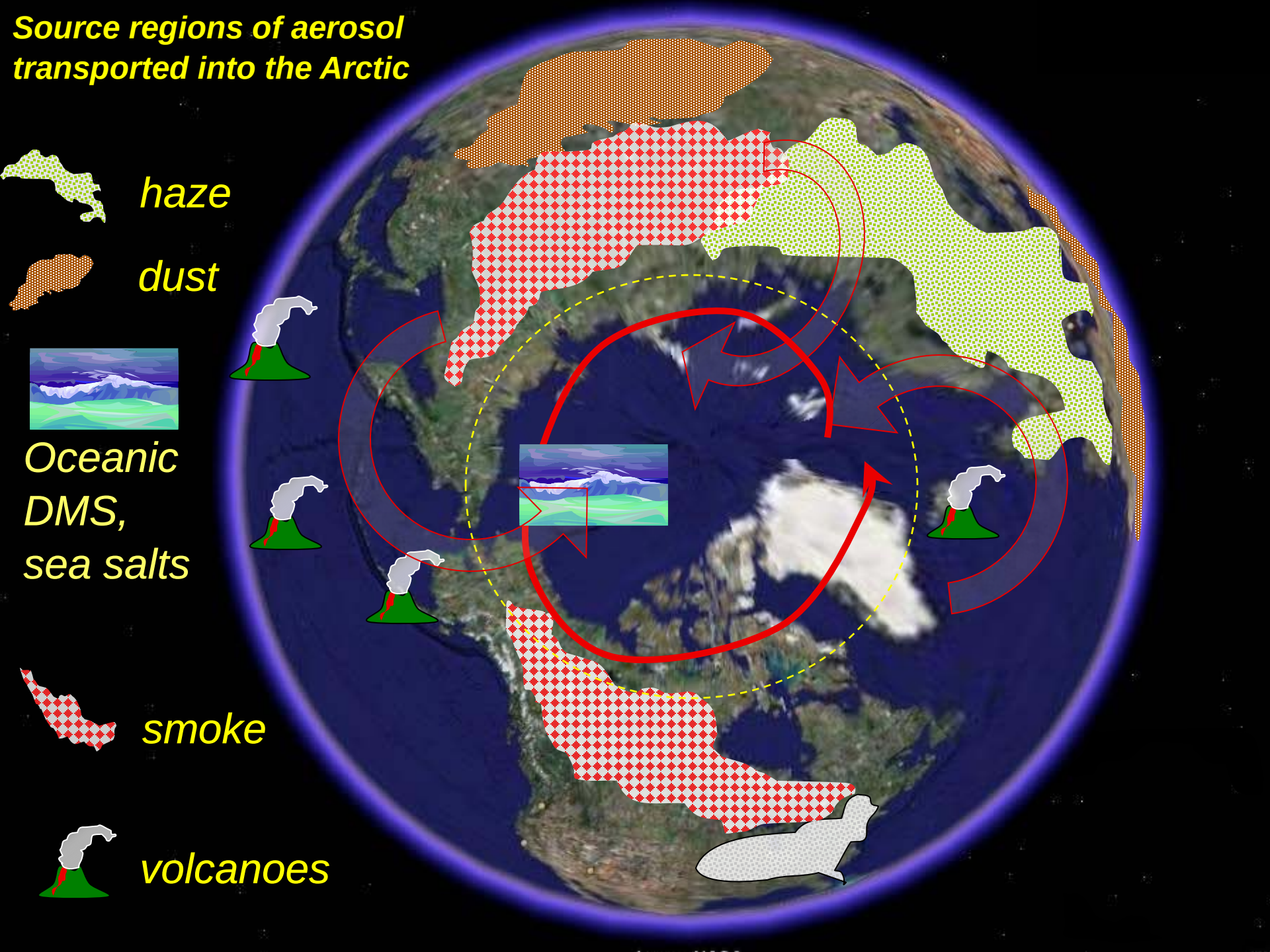
ESRL ?$?



2007-2009

International Polar Year

Longyearbyen, Svalbard - 1 April 2009


Source regions of aerosol transported into the Arctic
haze
dust
Oceanic DMS, sea salts
smoke
volcanoes

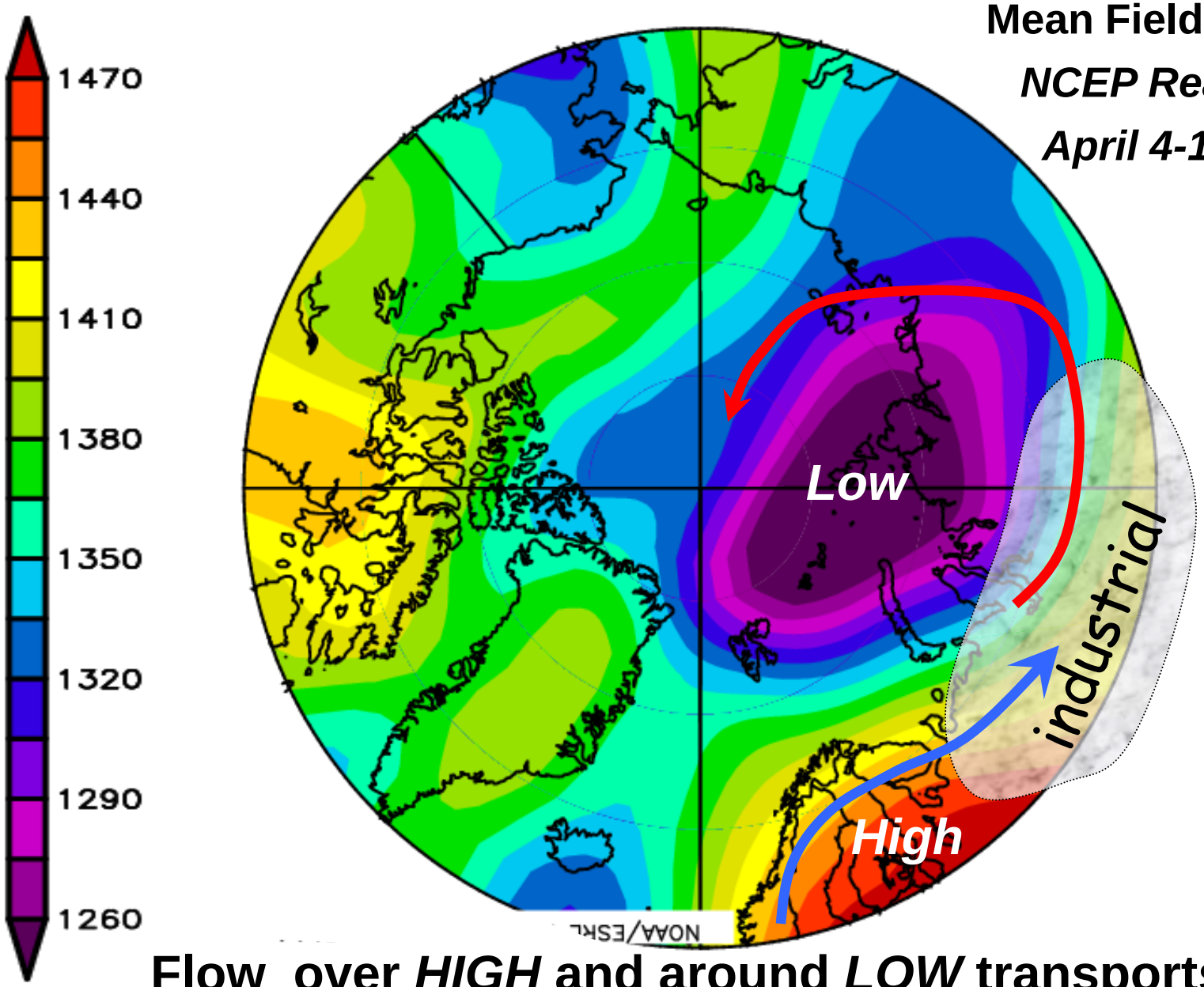
NOAA/ISAC photometer mated to a Schulz solar tracker; Polar-5

a tribute to

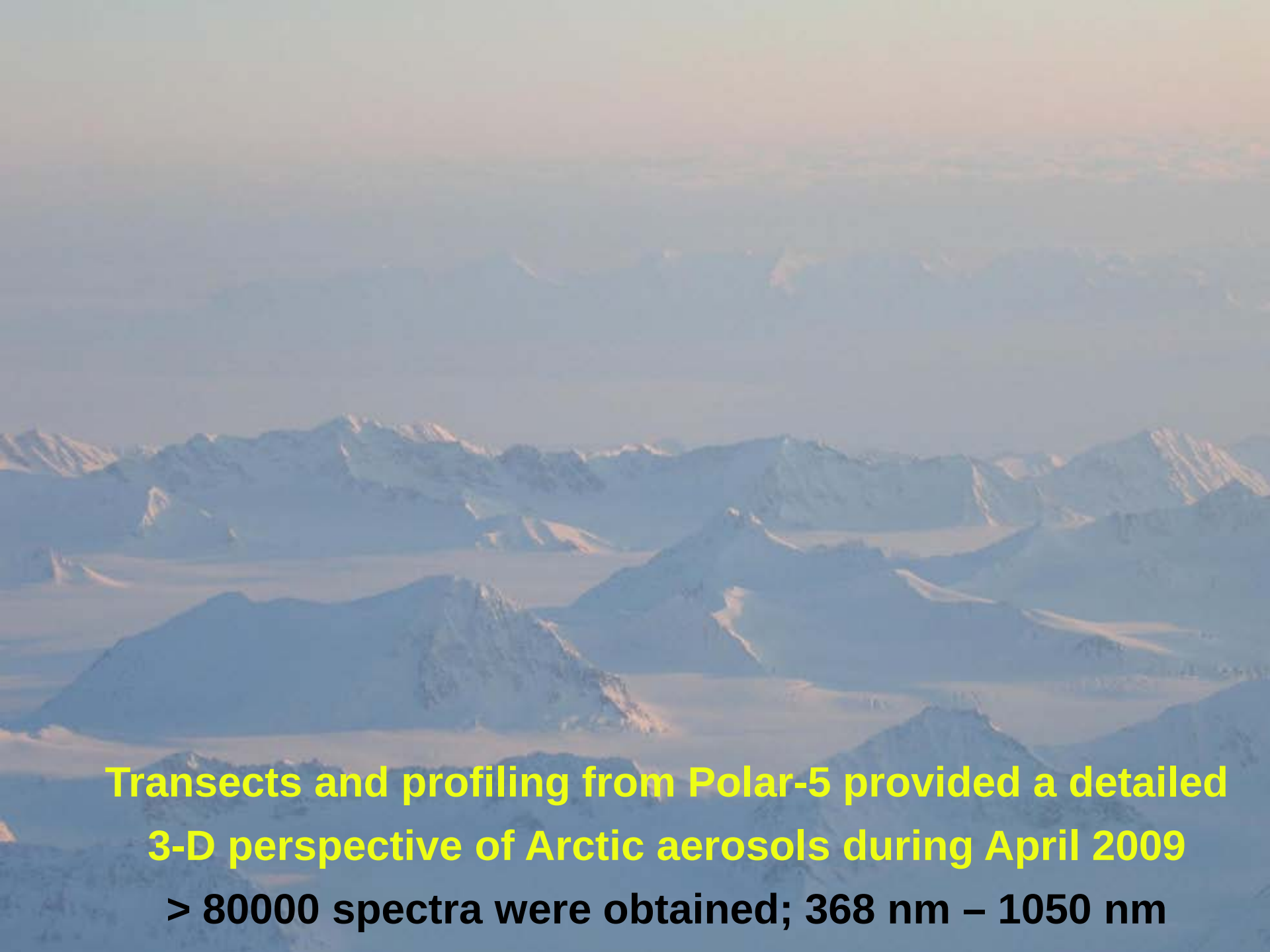
Dave Hofmann

1937 - 2009

On 1 April, 2009 the atmosphere was clean over eastern Svalbard.

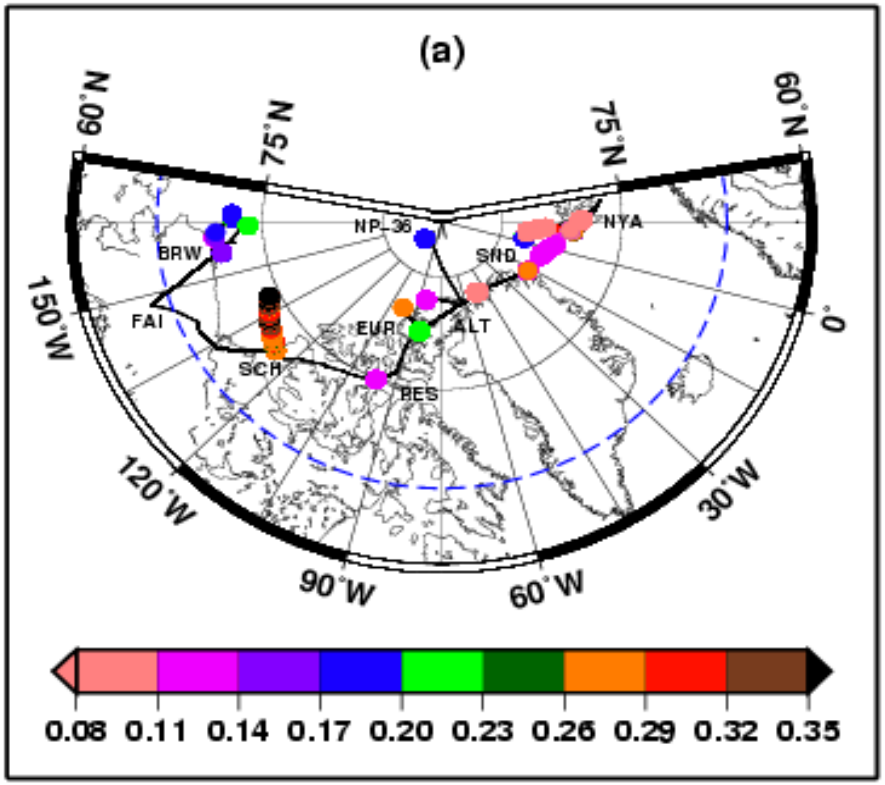


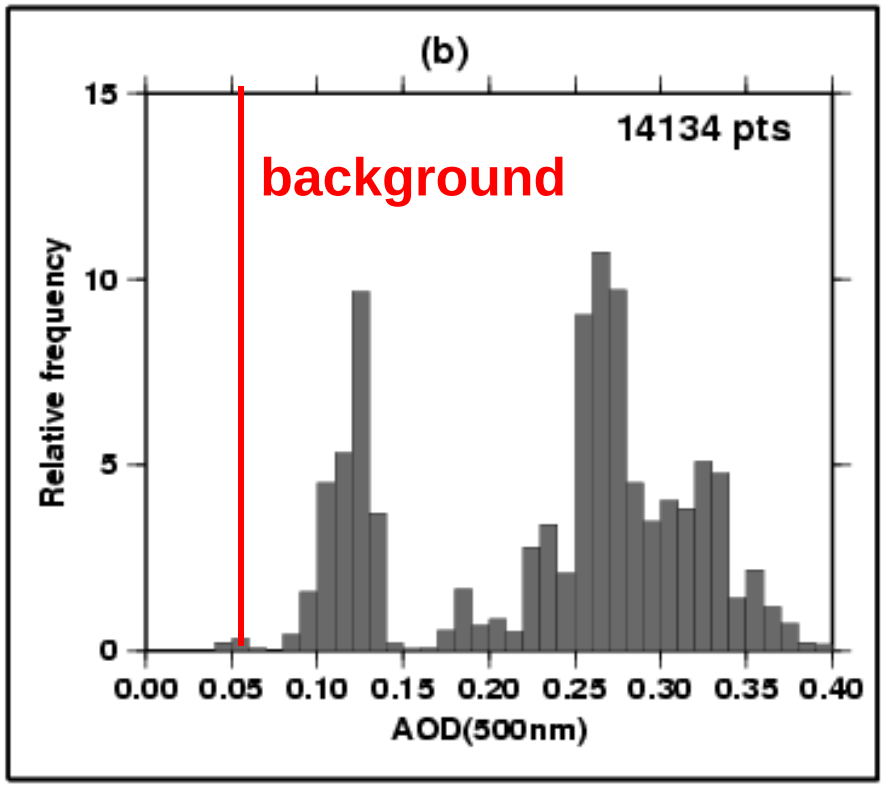
Flow over *HIGH* and around *LOW* transports Eurasian pollutants into the central Arctic



Transects and profiling from Polar-5 provided a detailed 3-D perspective of Arctic aerosols during April 2009

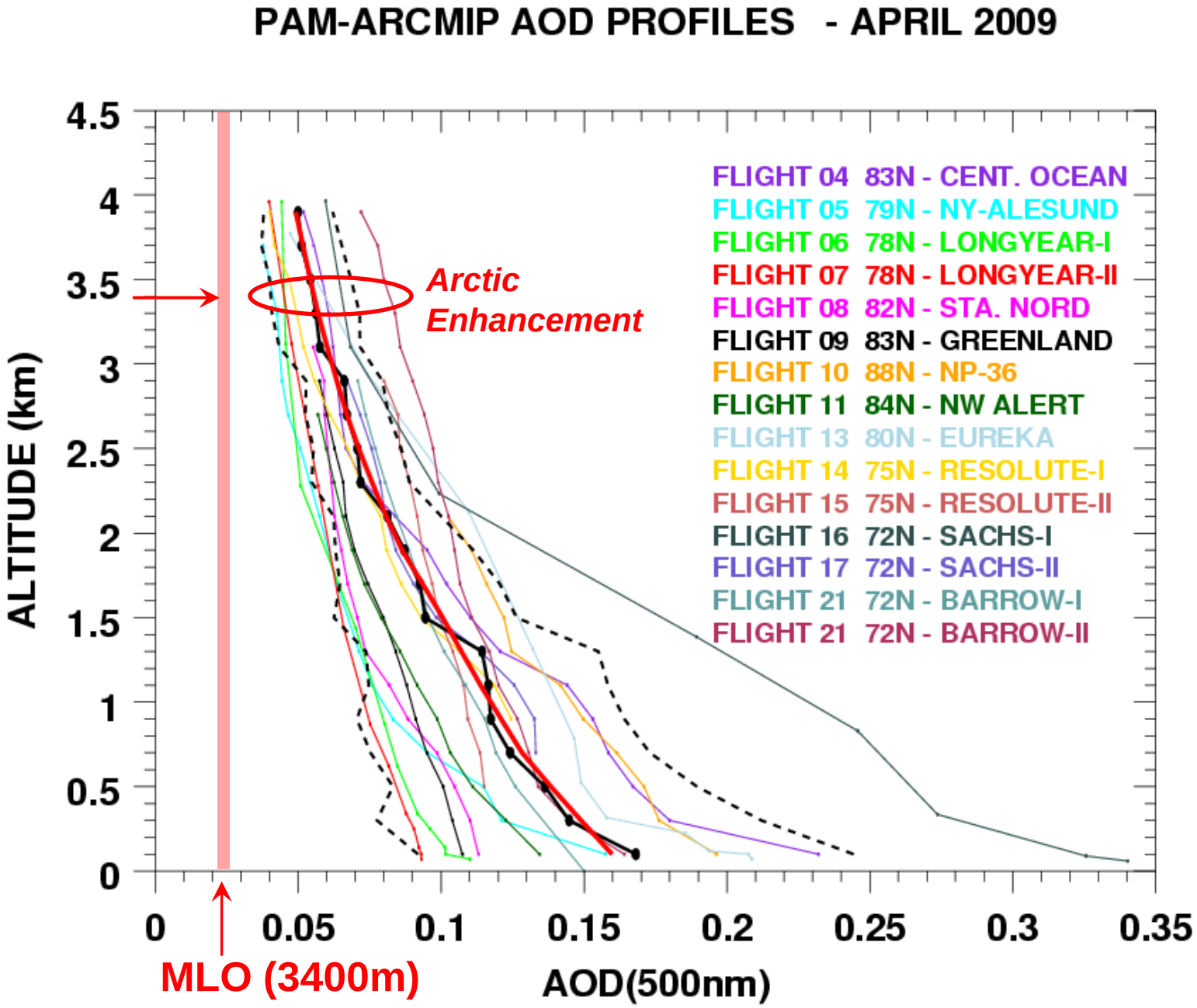
> 80000 spectra were obtained; 368 nm – 1050 nm

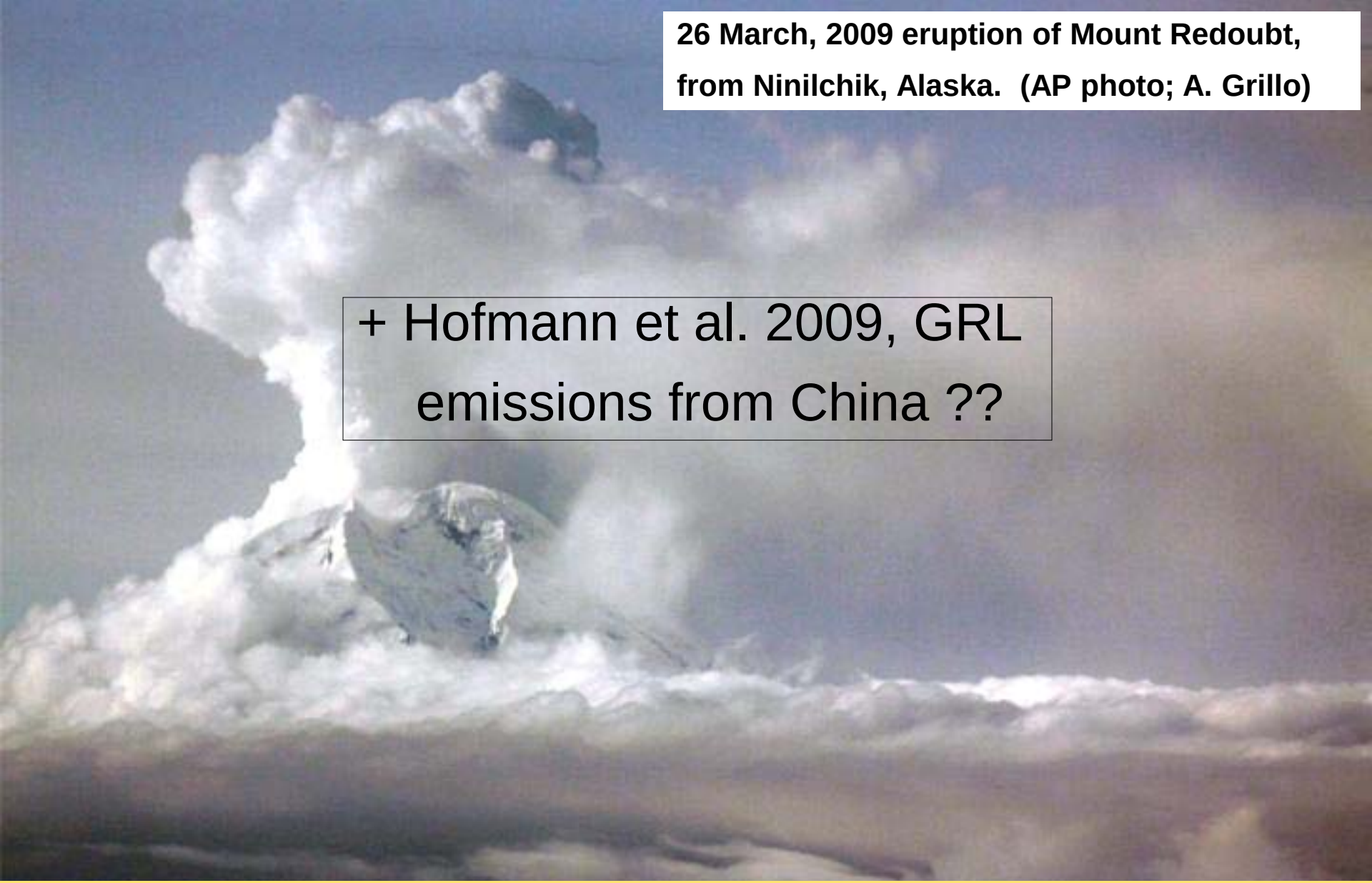




a) locations where *AOD* was measured during low-level flight (alt < 160 m)

b) corresponding histogram of relative frequency of *AOD(500)* values relative to background


PAM-ARCMIP AOD PROFILES - APRIL 2009
ALTITUDE (km)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
AOD(500nm)
Arctic
Enhancement
MLO (3400m)
FLIGHT 04 83N - CENT. OCEAN
FLIGHT 05 79N - NY-ALESUND
FLIGHT 06 78N - LONGYEAR-I
FLIGHT 07 78N - LONGYEAR-II
FLIGHT 08 82N - STA. NORD
FLIGHT 09 83N - GREENLAND
FLIGHT 10 88N - NP-36
FLIGHT 11 84N - NW ALERT
FLIGHT 13 80N - EUREKA
FLIGHT 14 75N - RESOLUTE-I
FLIGHT 15 75N - RESOLUTE-II
FLIGHT 16 72N - SACHS-I
FLIGHT 17 72N - SACHS-II
FLIGHT 21 72N - BARROW-I
FLIGHT 21 72N - BARROW-II

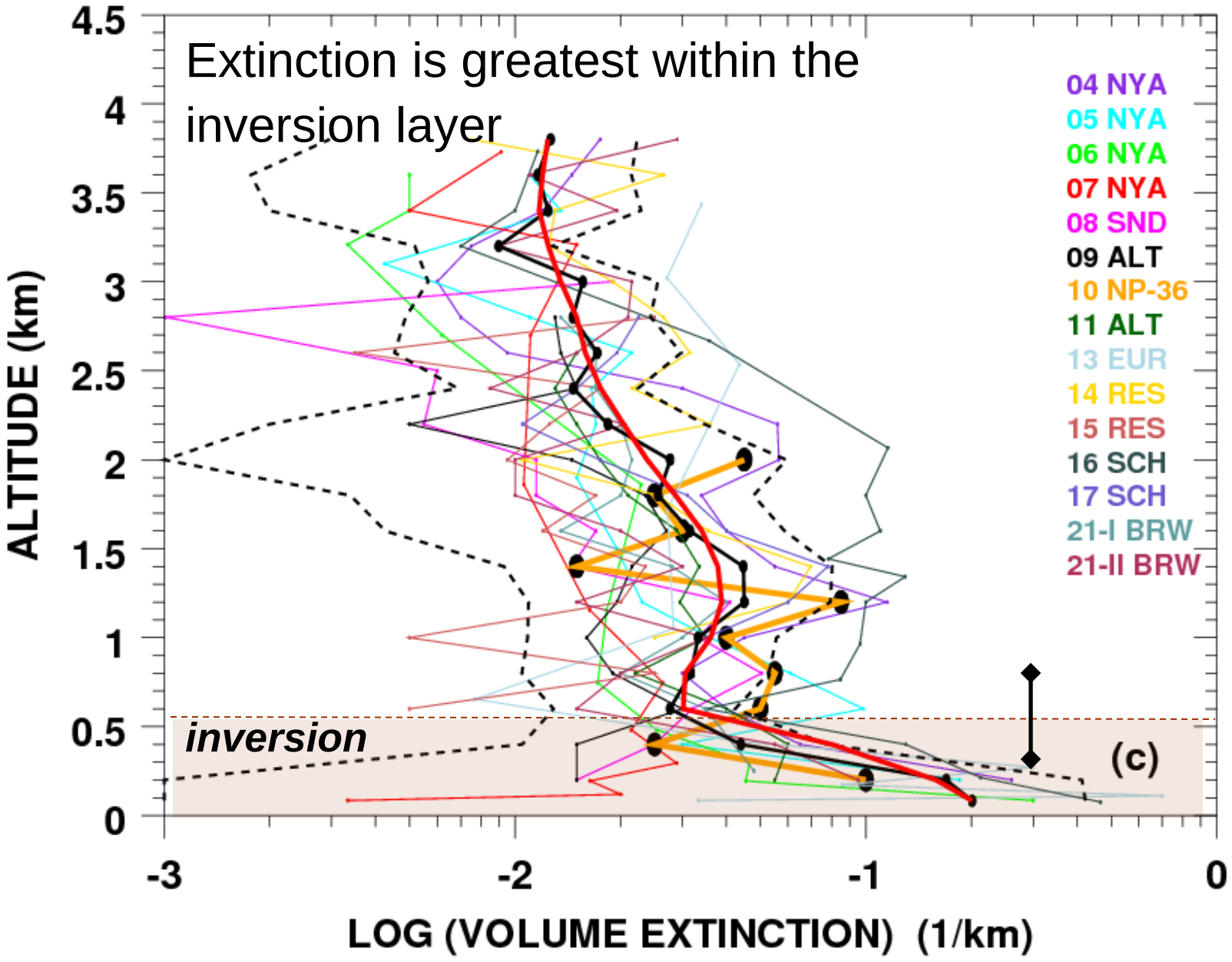


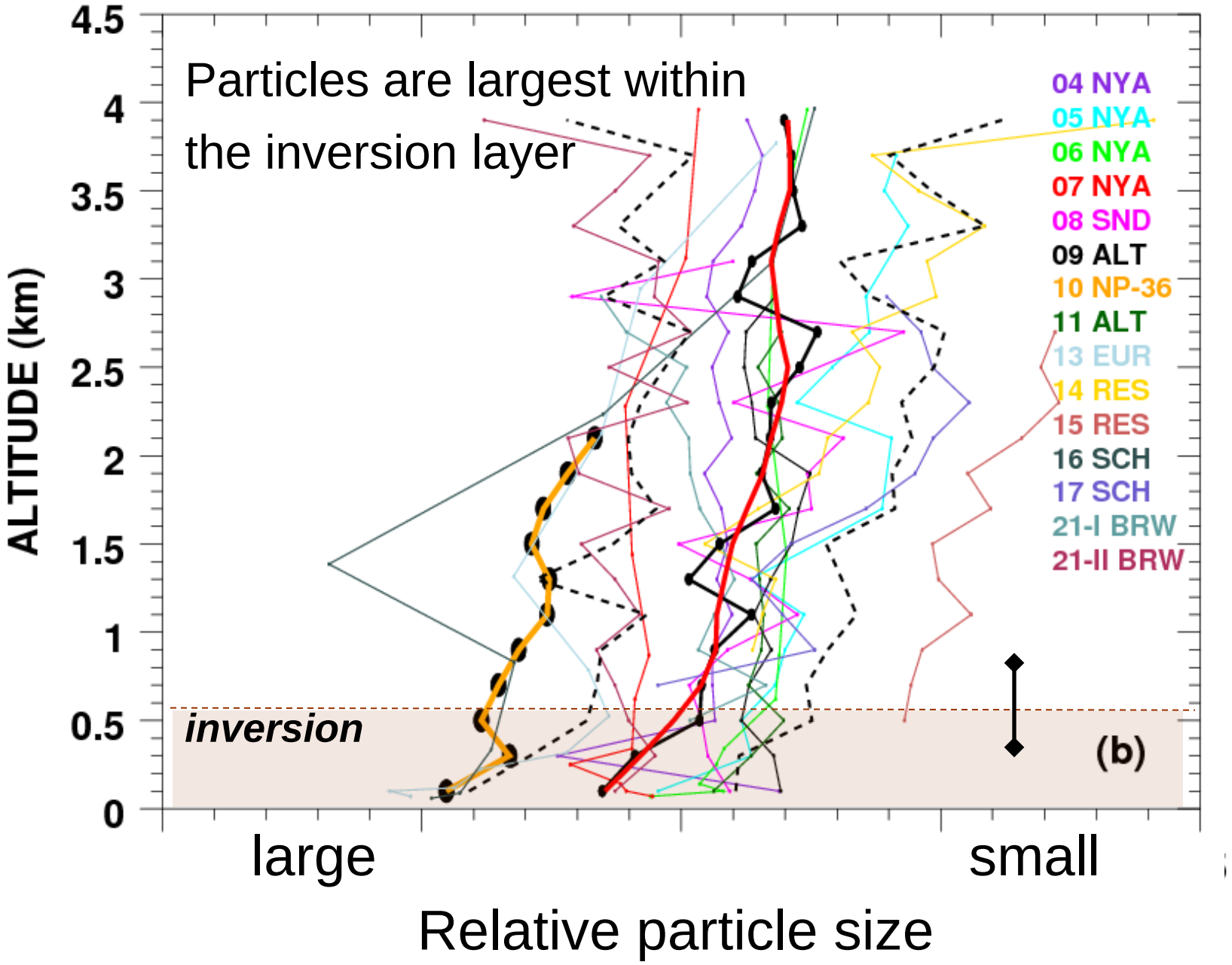
26 March, 2009 eruption of Mount Redoubt, from Ninilchik, Alaska. (AP photo; A. Grillo)

+ Hofmann et al. 2009, GRL

emissions from China ??

Volcanic aerosols were lofted at times to over 60000 ft and carried east and northward into the Arctic


Extinction is greatest within the inversion layer
04 NYA
05 NYA
06 NYA
07 NYA
08 SND
09 ALT
10 NP-36
11 ALT
13 EUR
14 RES
15 RES
16 SCH
17 SCH
21-I BRW
21-II BRW
inversion
(c)
ALTITUDE (km)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-3
-2
-1
0
LOG (VOLUME EXTINCTION) (1/km)

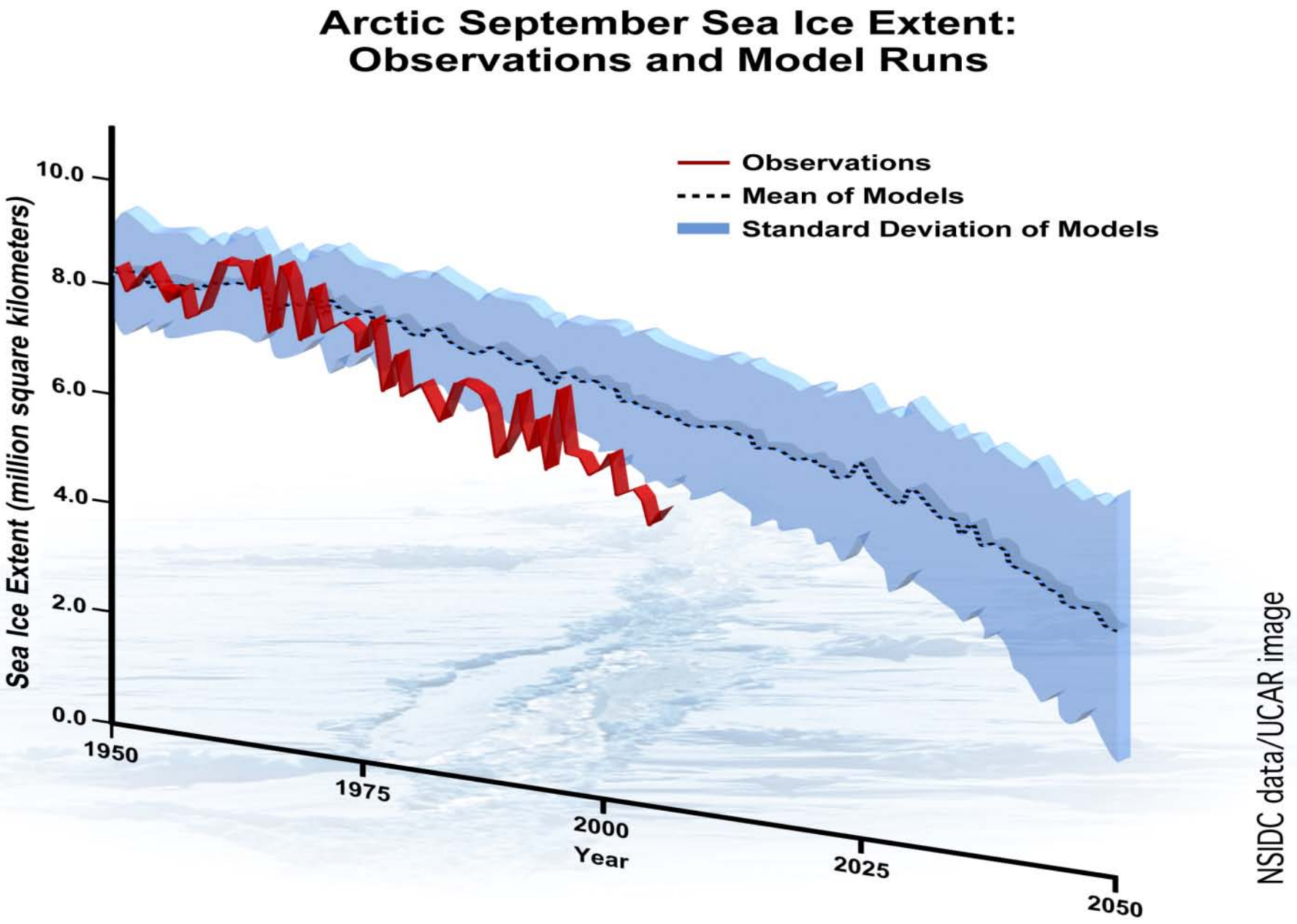

Particles are largest within the inversion layer
04 NYA
05 NYA
06 NYA
07 NYA
08 SND
09 ALT
10 NP-36
11 ALT
13 EUR
14 RES
15 RES
16 SCH
17 SCH
21-I BRW
21-II BRW
inversion
(b)
ALTITUDE (km)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
large
small
Relative particle size

The role of black carbon

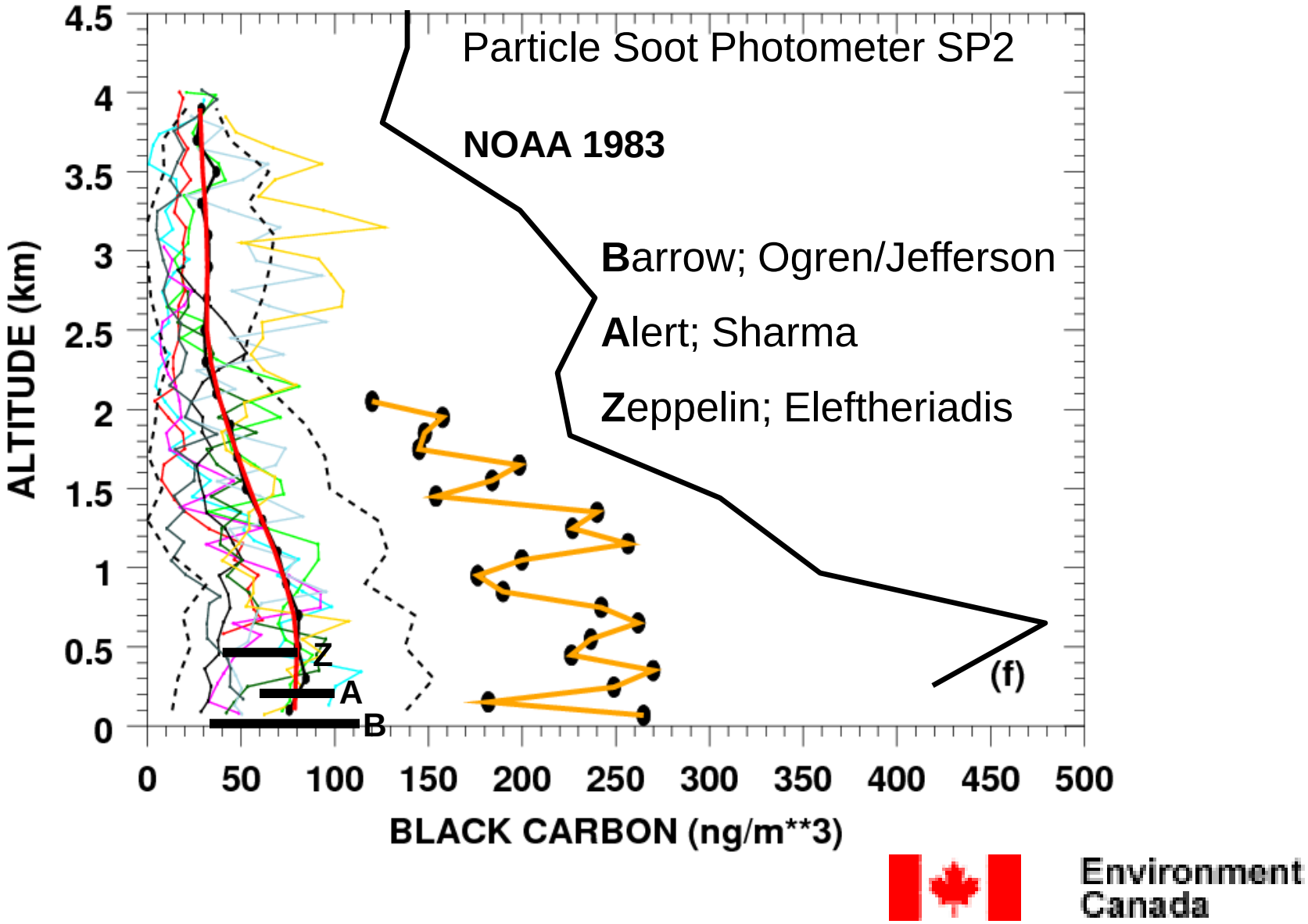
"…soot may be contributing to changes happening near the North Pole, …pollution is raising atmospheric temperatures and speeding up the melting of snow.."

NASA March 2005

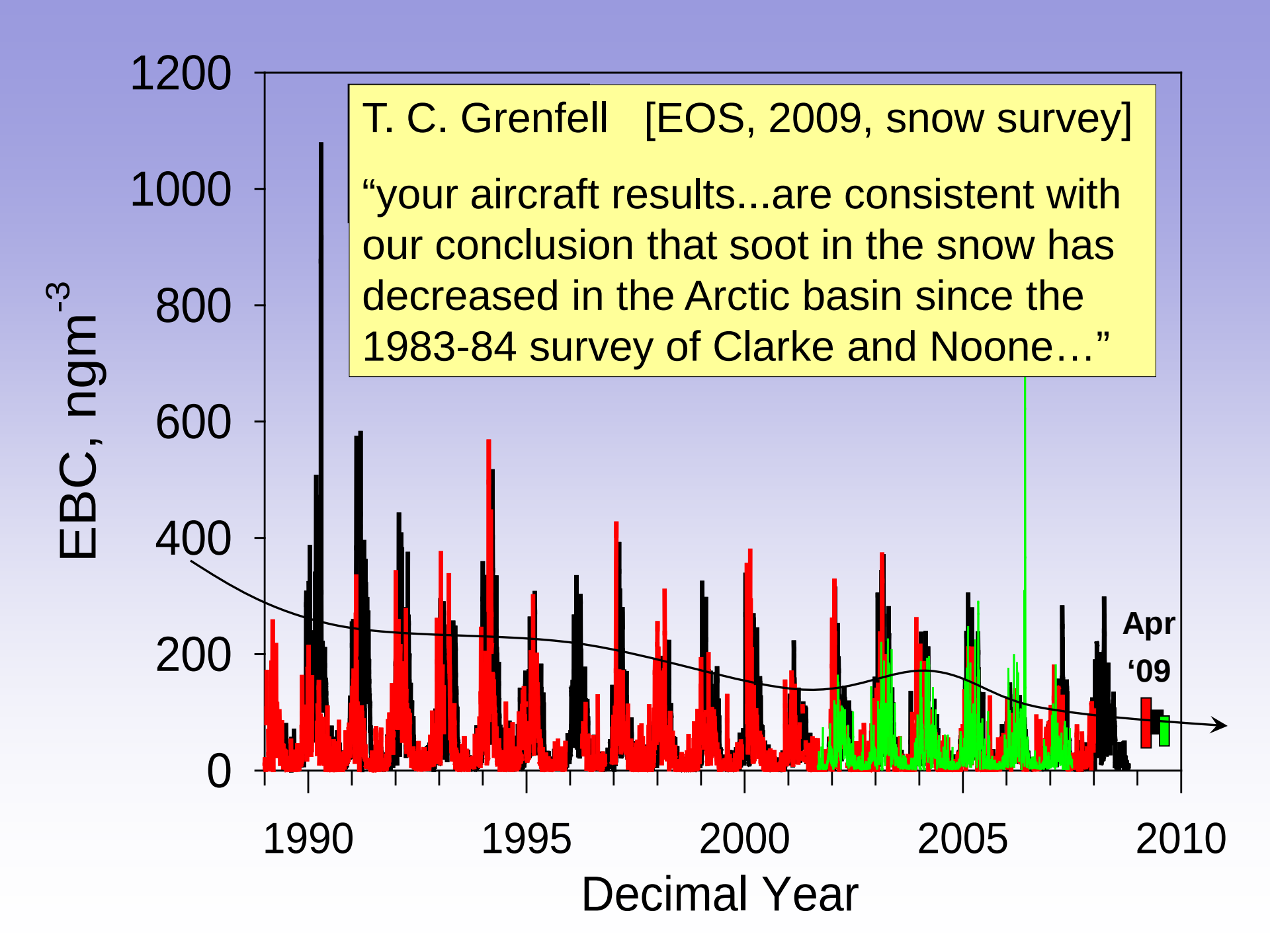
What are the radiative impacts of ~~aerosols in the Arctic~~?



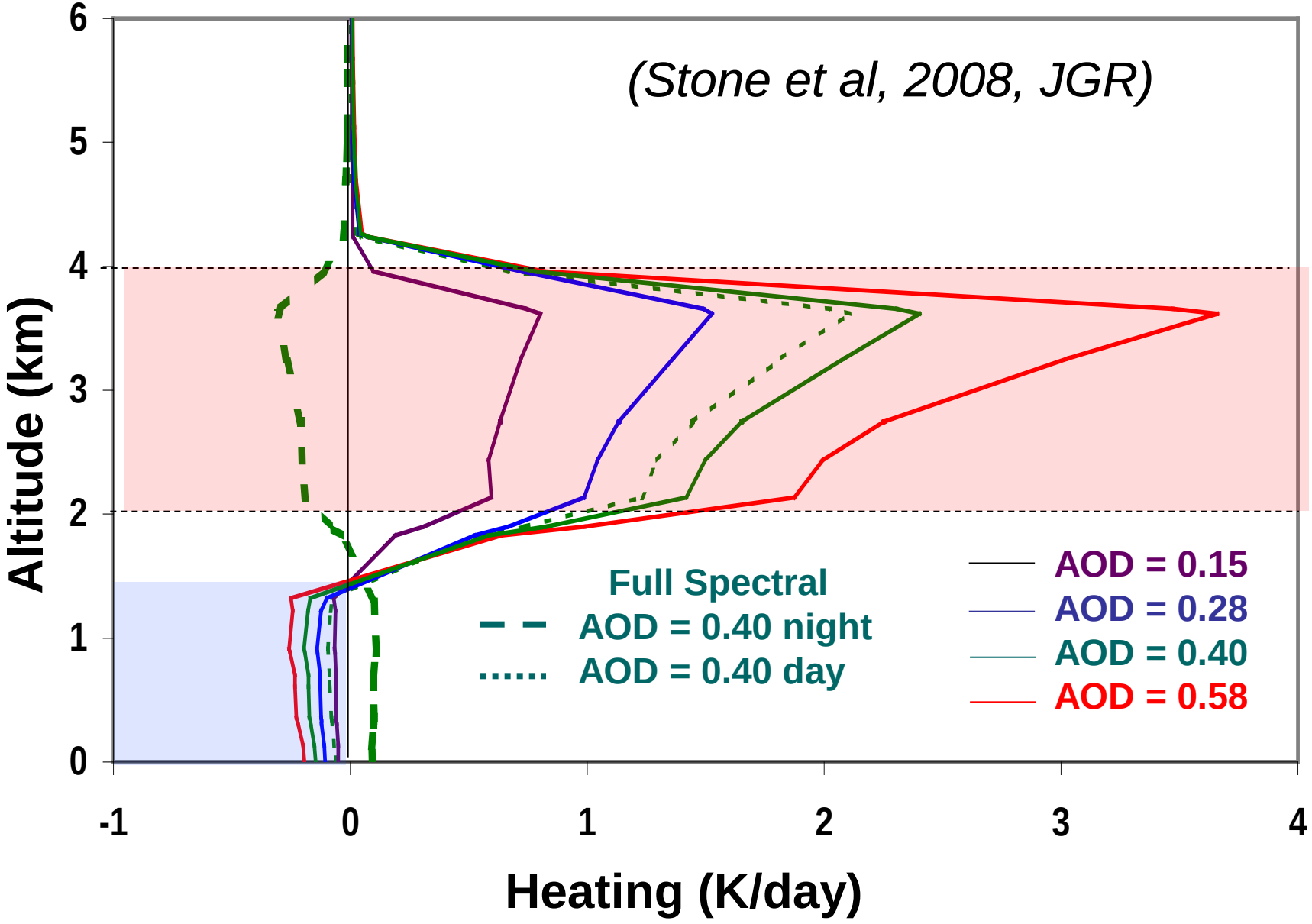
"Arctic Sea Ice Decline: Faster Than Forecast?"



Environment Canada


T. C. Grenfell [EOS, 2009, snow survey]
"your aircraft results...are consistent with our conclusion that soot in the snow has decreased in the Arctic basin since the 1983-84 survey of Clarke and Noone…"
EBC, ngm-3
1200
1000
800
600
400
200
0
1990
1995
2000
2005
2010
Decimal Year
Apr '09

aerosols warm layers within, while cooling the surface




Thank You