JGR-Atmospheres - (in press)

A Three-dimensional characterization of arctic aerosols from airborne sun photometer observations;

PAM-ARCMIP – April 2009

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NOAA

CIRES

AWI

ISAC

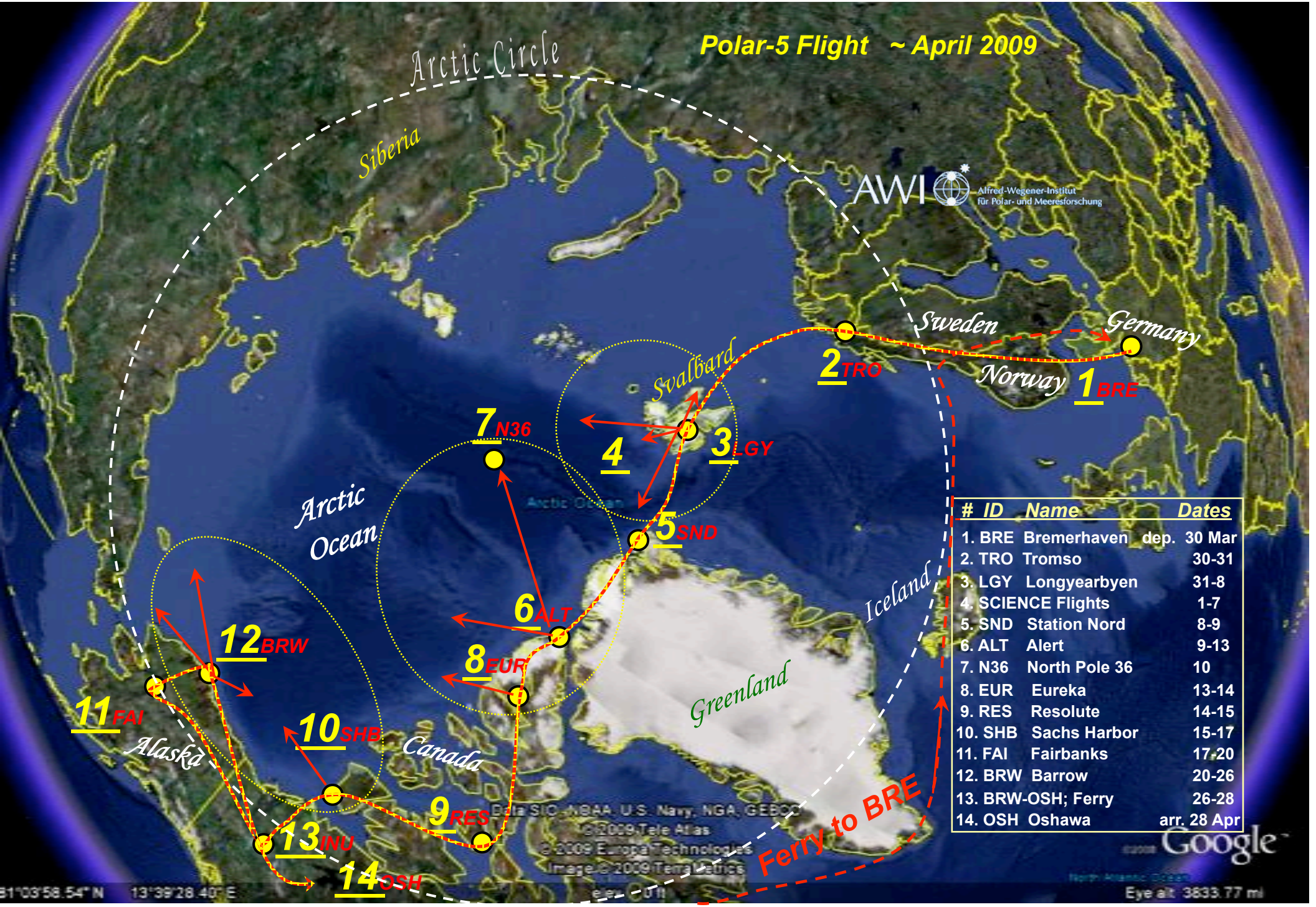
Environment Canada

POLAR 5

Instrument racks onboard Polar-5; P. Liu (front), C. Haas (rear).

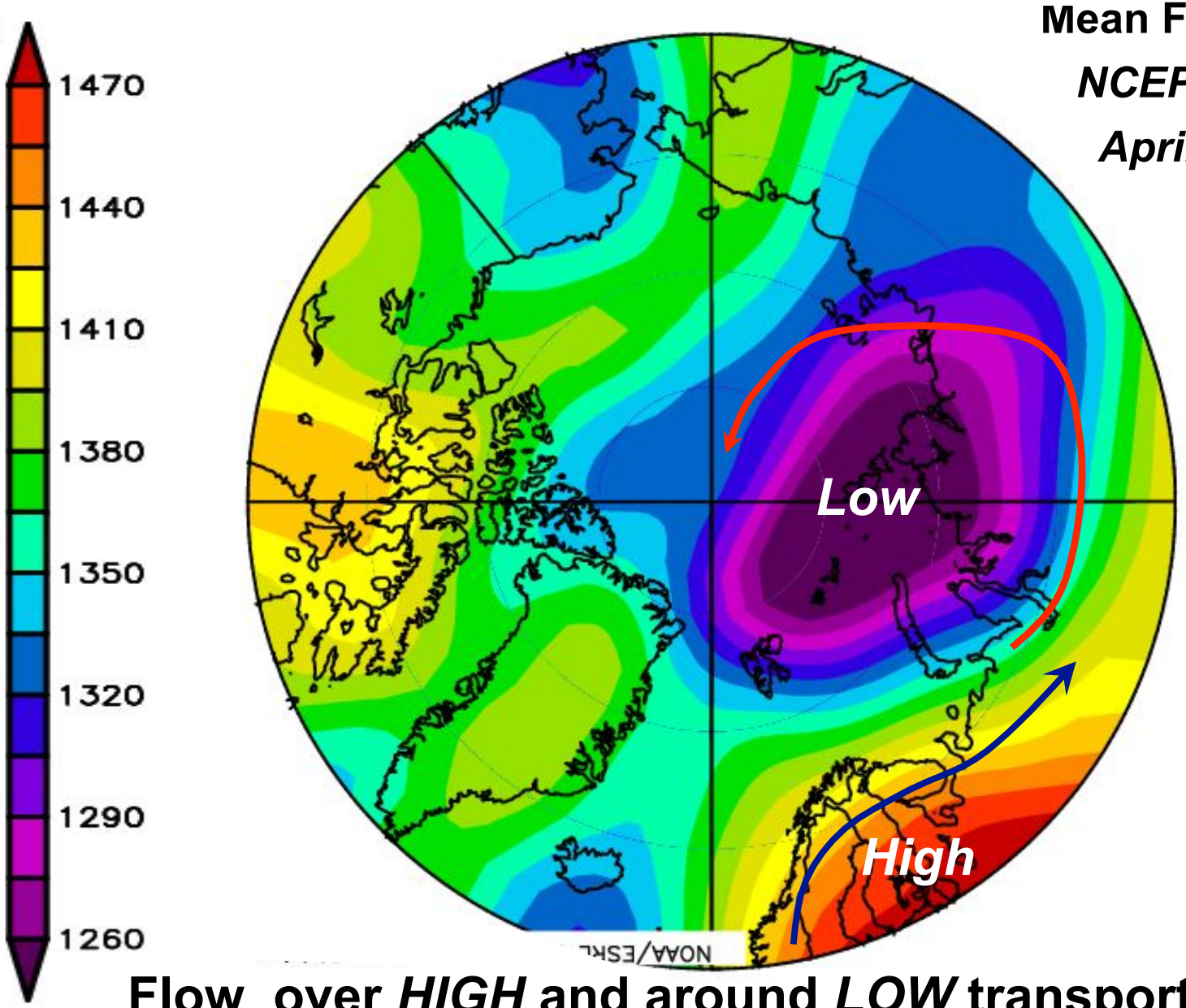
NOAA/ISAC System and
Solar tracker on Polar-5

K-H Schulz



#	ID	Name	Dates
1.	BRE	Bremerhaven	dep. 30 Mar
2.	TRO	Tromso	30-31
3.	LGY	Longyearbyen	31-8
4.	SCIENCE	Flights	1-7
5.	SND	Station Nord	8-9
6.	ALT	Alert	9-13
7.	N36	North Pole 36	10
8.	EUR	Eureka	13-14
9.	RES	Resolute	14-15
10.	SHB	Sachs Harbor	15-17
11.	FAI	Fairbanks	17-20
12.	BRW	Barrow	20-26
13.	BRW-OSH; Ferry		26-28
14.	OSH	Oshawa	arr. 28 Apr

On 10 April, 2009 Polar-5 landed on an ice runway at 88˚ N,
prepared by the crew of the Russian ice station, NP-36.

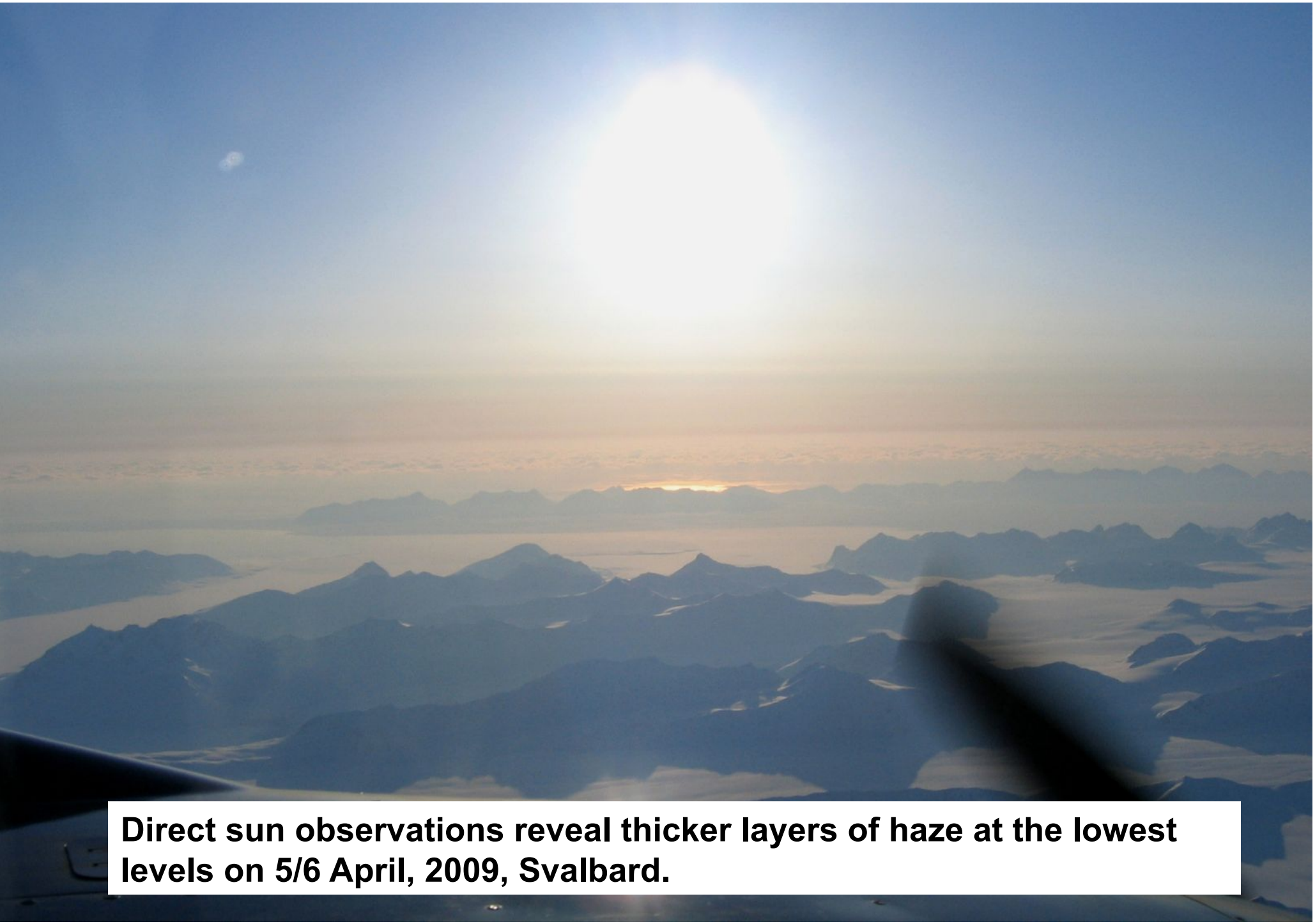


Mean Field - *850 mb*

NCEP Reanalysis

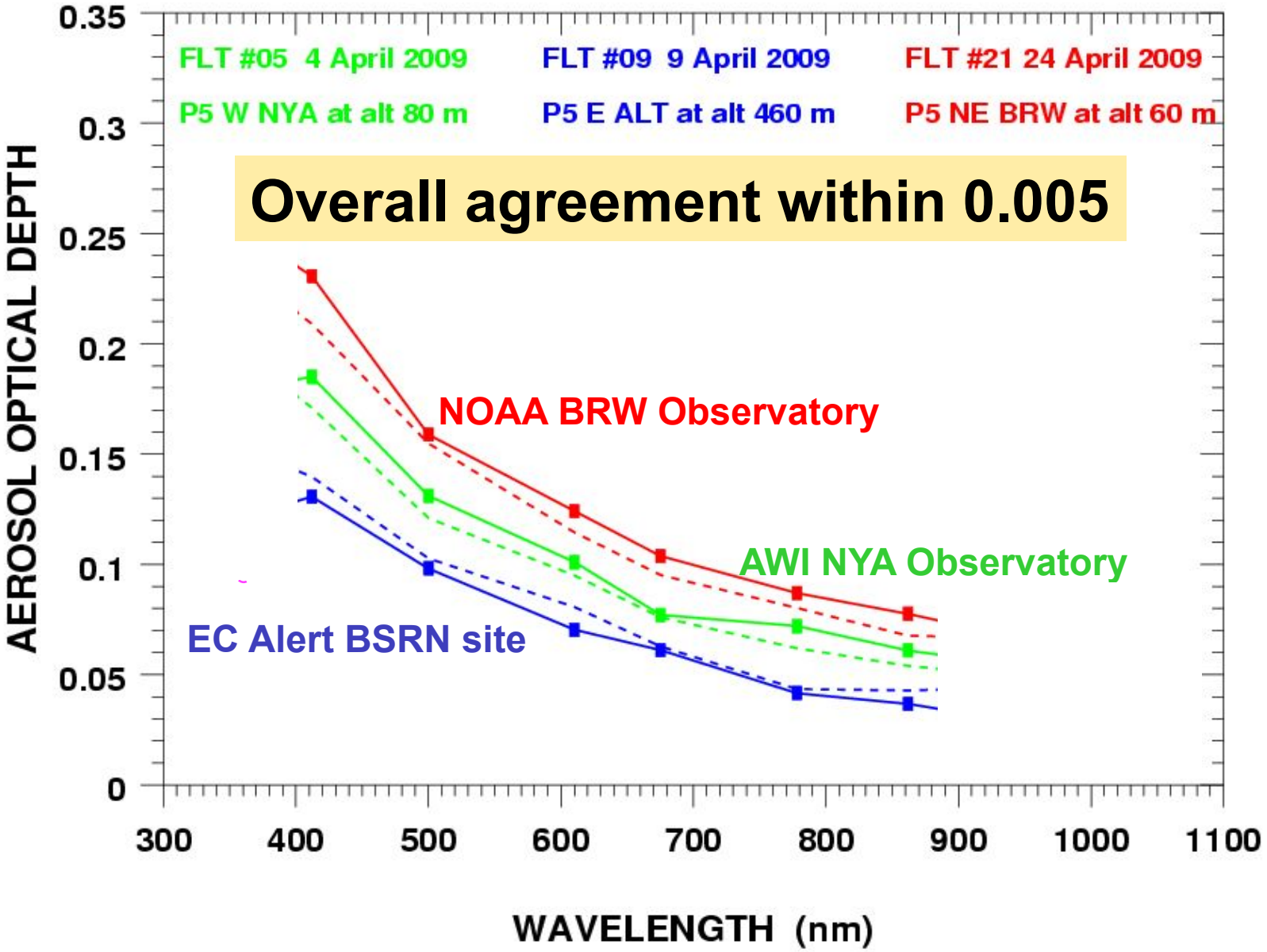
April 4-15, 2009

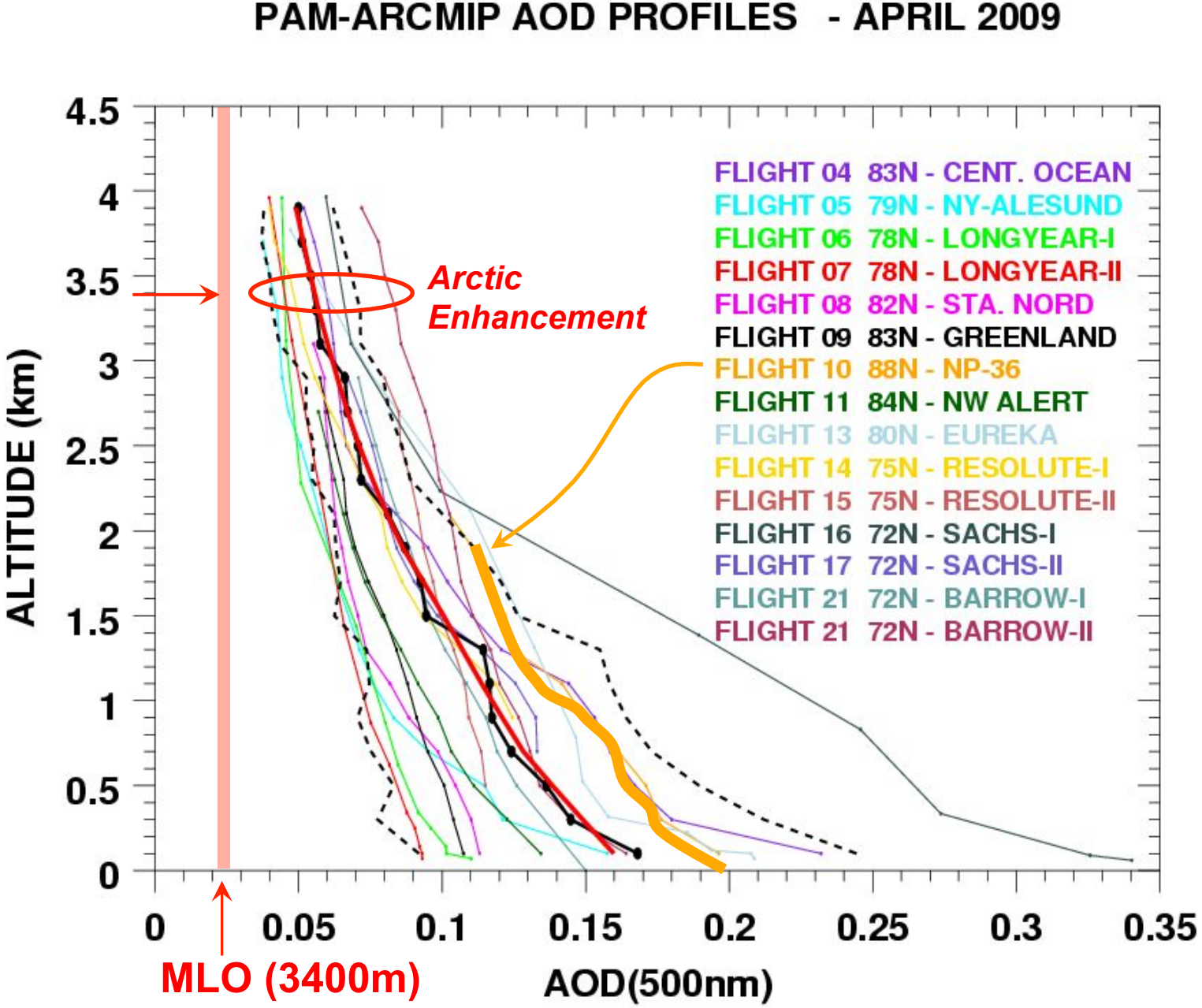
Flow over *HIGH* and around *LOW* transports Eurasian pollutants into the central Arctic

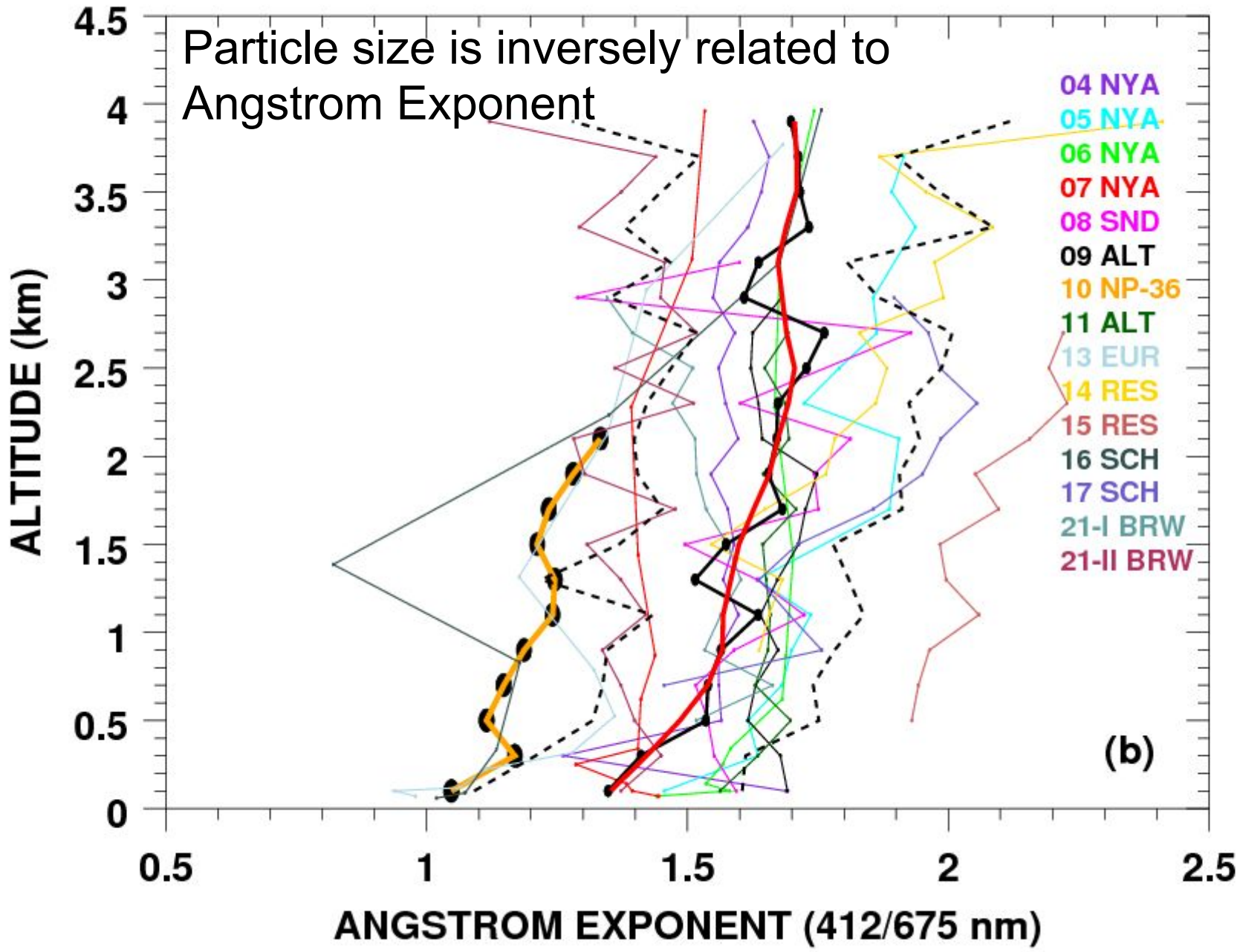


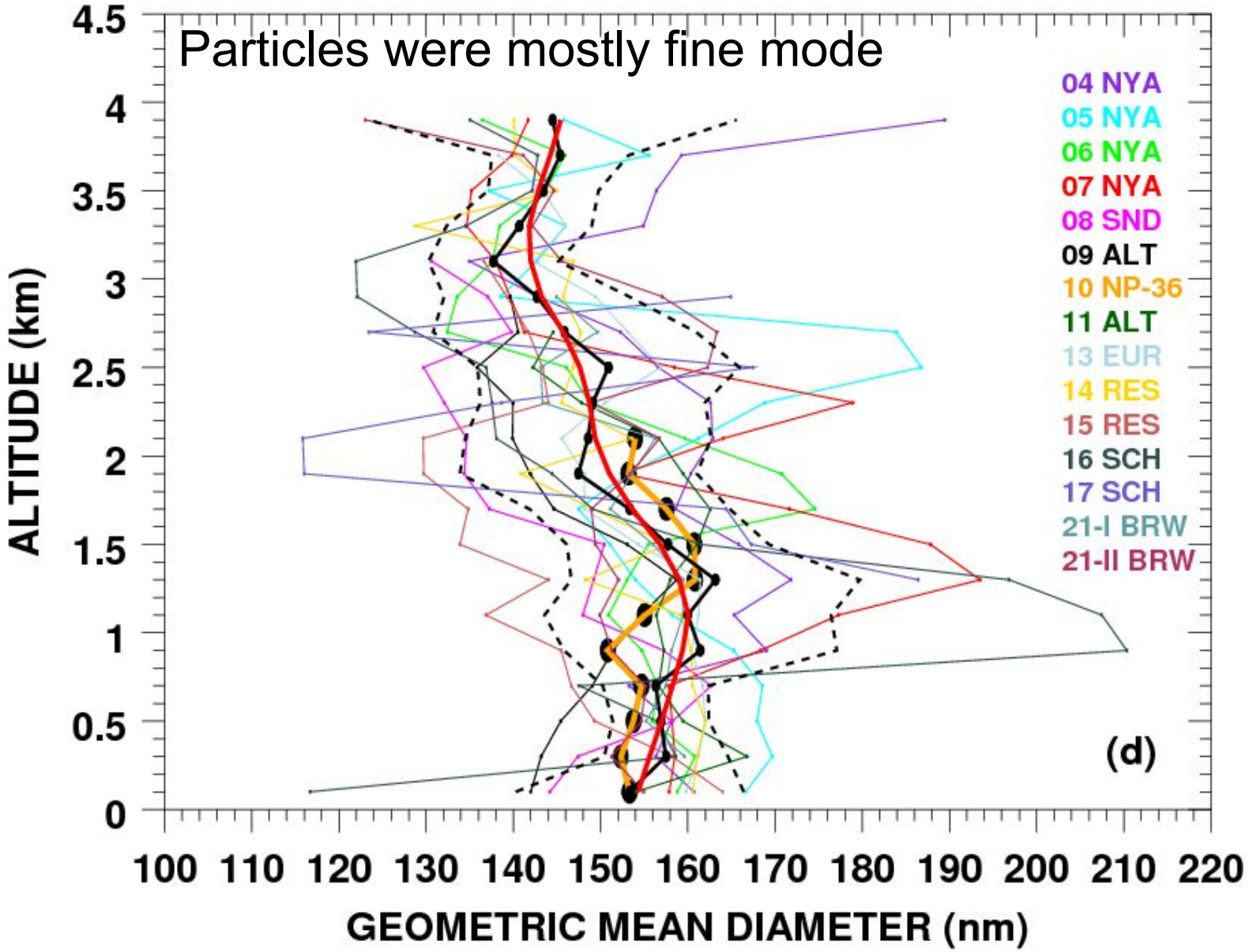
Direct sun observations reveal thicker layers of haze at the lowest levels on 5/6 April, 2009, Svalbard.

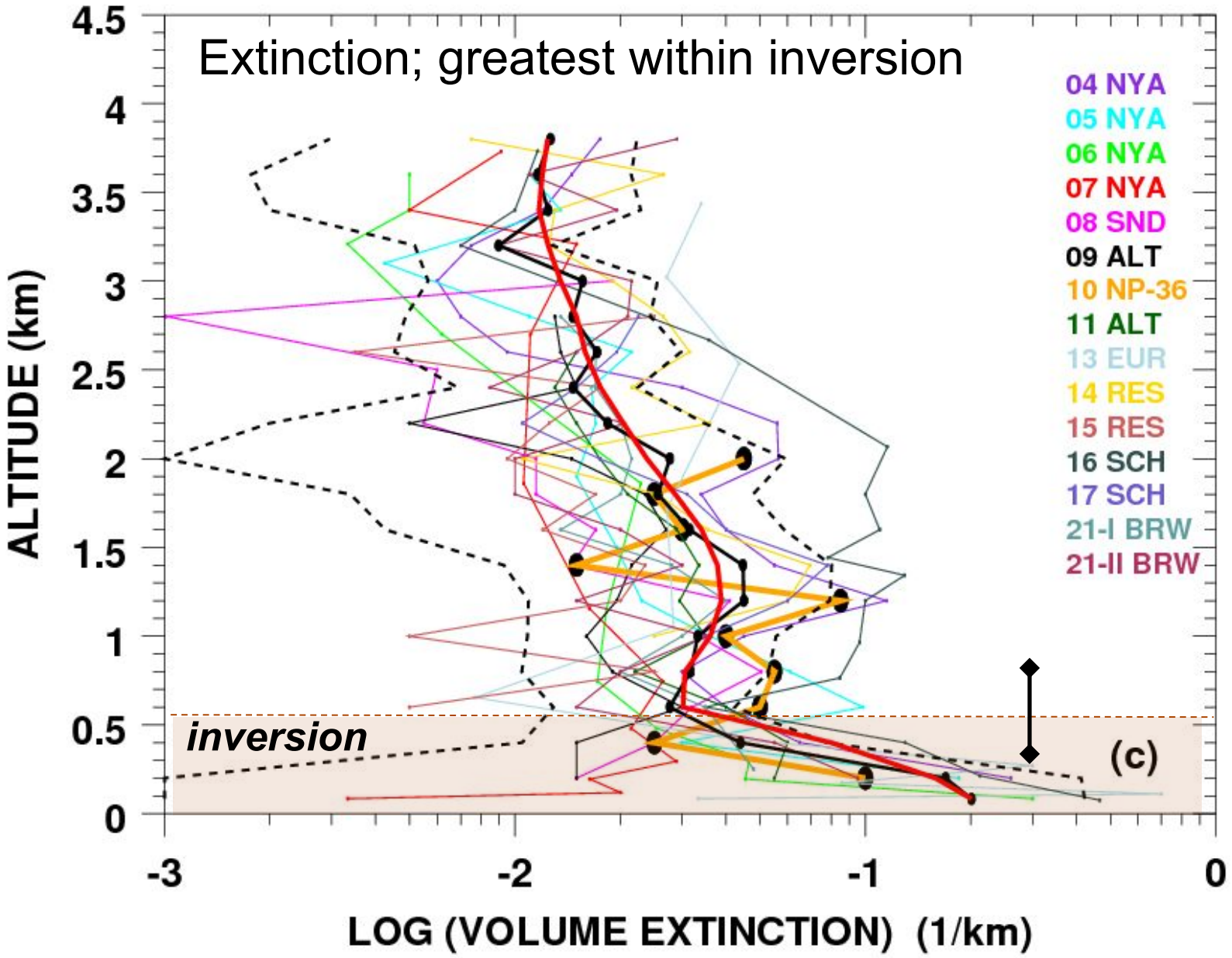
PAM-ARCMIP VALIDATIONS APRIL 2009



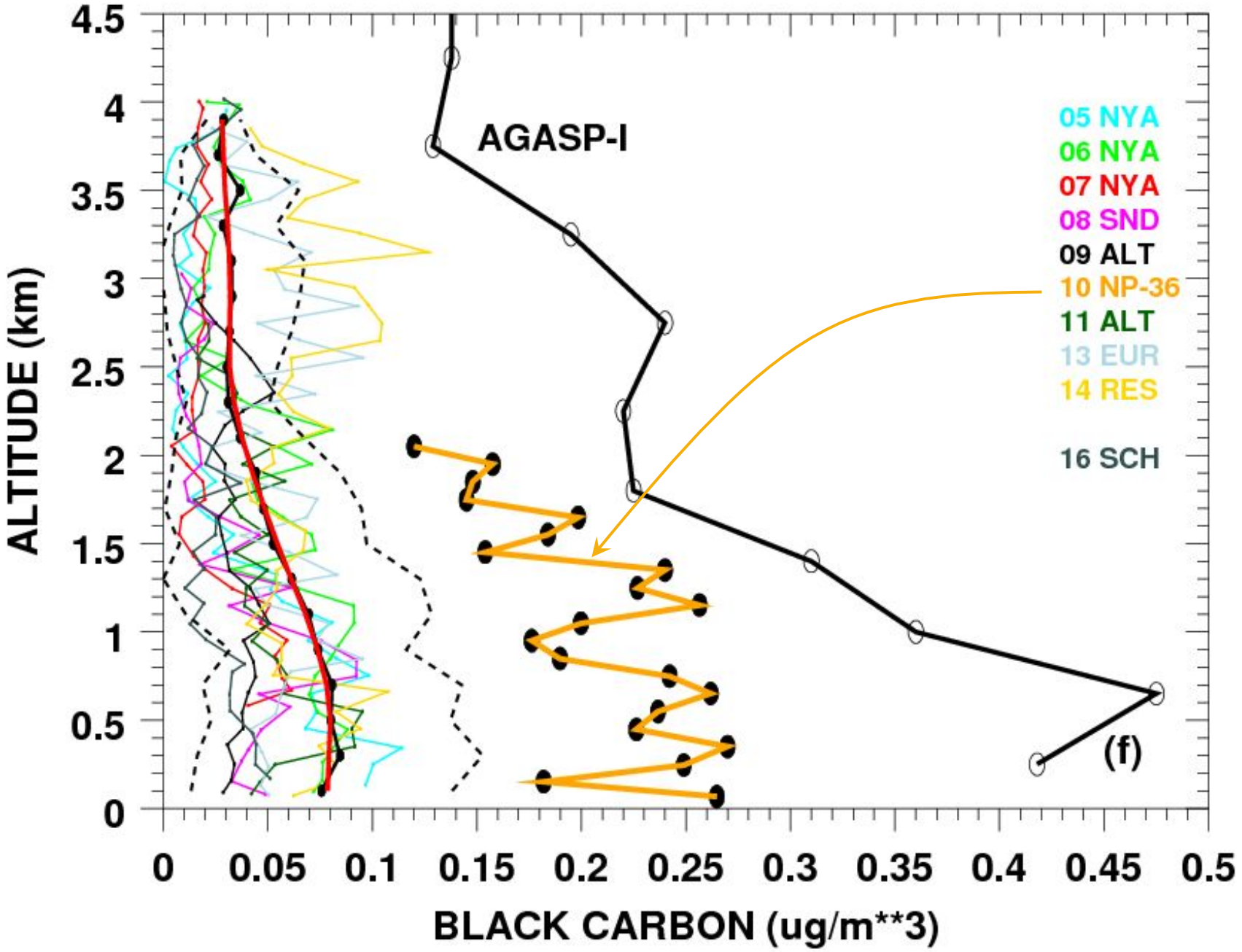

PAM-ARCMIP AOD PROFILES - APRIL 2009
ALTITUDE (km)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
AOD(500nm)
MLO (3400m)
Arctic Enhancement
FLIGHT 04 83N - CENT. OCEAN
FLIGHT 05 79N - NY-ALESUND
FLIGHT 06 78N - LONGYEAR-I
FLIGHT 07 78N - LONGYEAR-II
FLIGHT 08 82N - STA. NORD
FLIGHT 09 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


Particle size is inversely related to Angstrom Exponent
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
(b)
ALTITUDE (km)
ANGSTROM EXPONENT (412/675 nm)
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5


Particles were mostly fine mode
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
(d)
ALTITUDE (km)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
100 110 120 130 140 150 160 170 180 190 200 210 220
GEOMETRIC MEAN DIAMETER (nm)

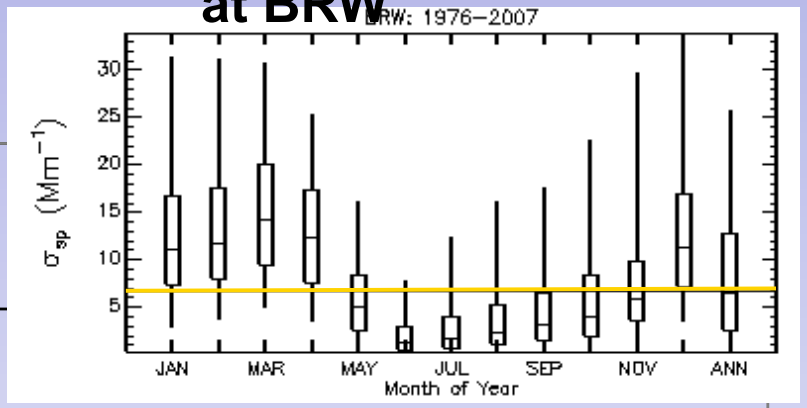

Extinction; greatest within inversion
04 NYA
05 NYA
06 NYA
07 NYA
08 SND
09 ALT
10 NP-36
11 ALT
13 EUR
14 RES
15 RES
16 SCH
17 SCH
21-I BRW
21-II BRW
inversion
(c)
ALTITUDE (km)
LOG (VOLUME EXTINCTION) (1/km)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
-3
-2
-1
0

[BC] during PAM-ARCMIP was relatively low



Monthly averaged scattering for March and April at BRW

Annual light scattering statistics at BRW



Light Scattering (Mm^{-1})

25
20
15
10
5
0

1977
1982
1987
1992
1997
2002
2007

Year

Annual median scattering

Preliminary findings

- **The western Arctic during April 2009 was generally hazy; *AOD(500 nm)* in range ~ 0.12 to > 0.38**

- **Extinction within the inversion layer was ~ order of magnitude greater than above**

- **Particles were small , tend to diminish with altitude**

- **North Pole was especially hazy, even at upper-levels**

- **Significant aerosol loading above 4 Km attributed, in part, to Redoubt (volcanic) aerosols**

- **Radiative surface cooling due to haze (+ volcanic?) aerosol (over ice) is estimated to be ≈ 2-5 W/m^{-2}**

Thank You