Inferring PSC Composition in the Arctic from UARS MLS HNO_3 and POAM II Aerosol Extinction Data

Michelle L. Santee

A. Tabazadeh
G.L. Manney
M.D. Fromm
R.M. Bevilacqua
E.J. Jensen

Overview of Arctic PSC Composition Studies

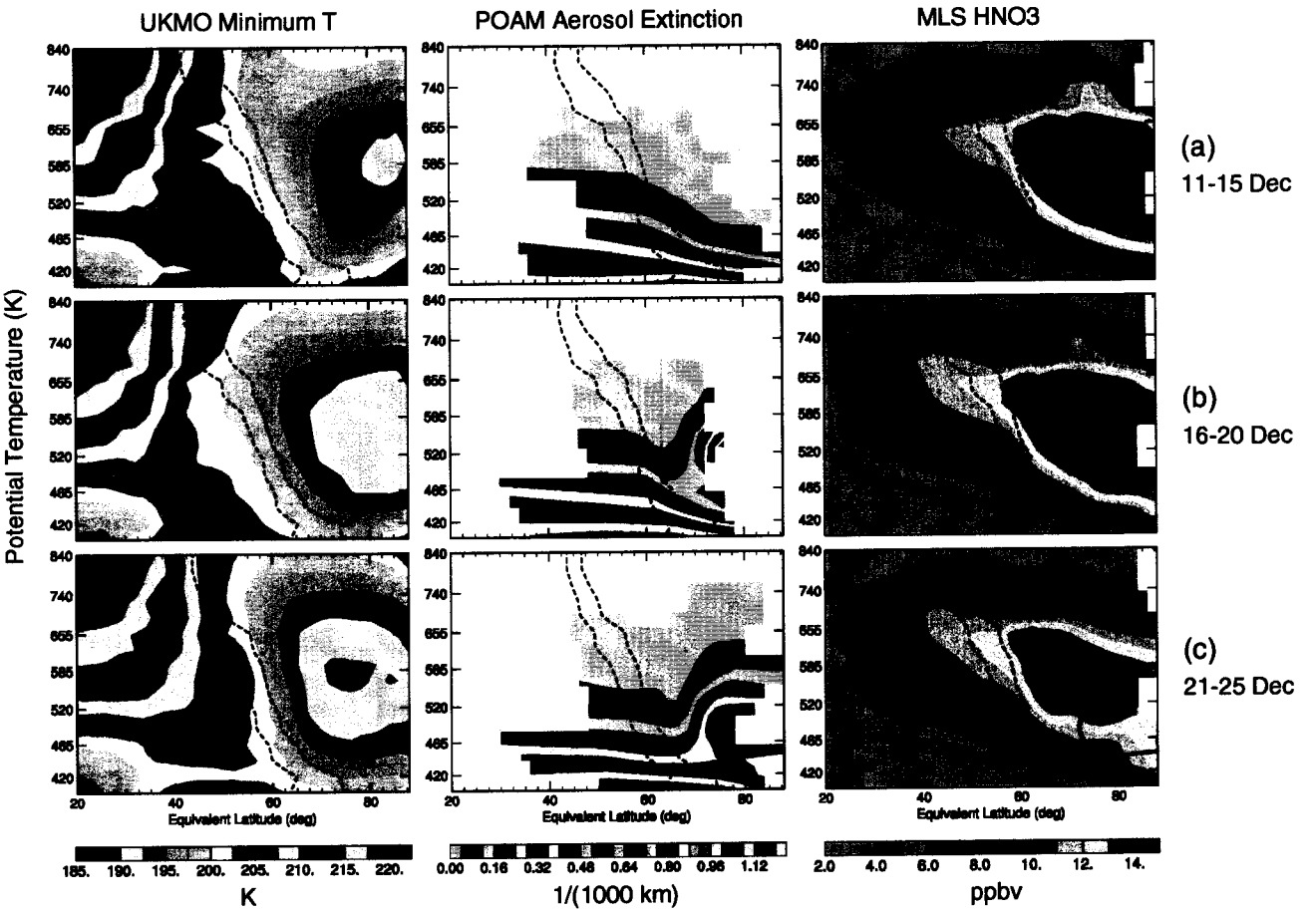
☆☆ Focus on 1995/1996 winter ☆☆

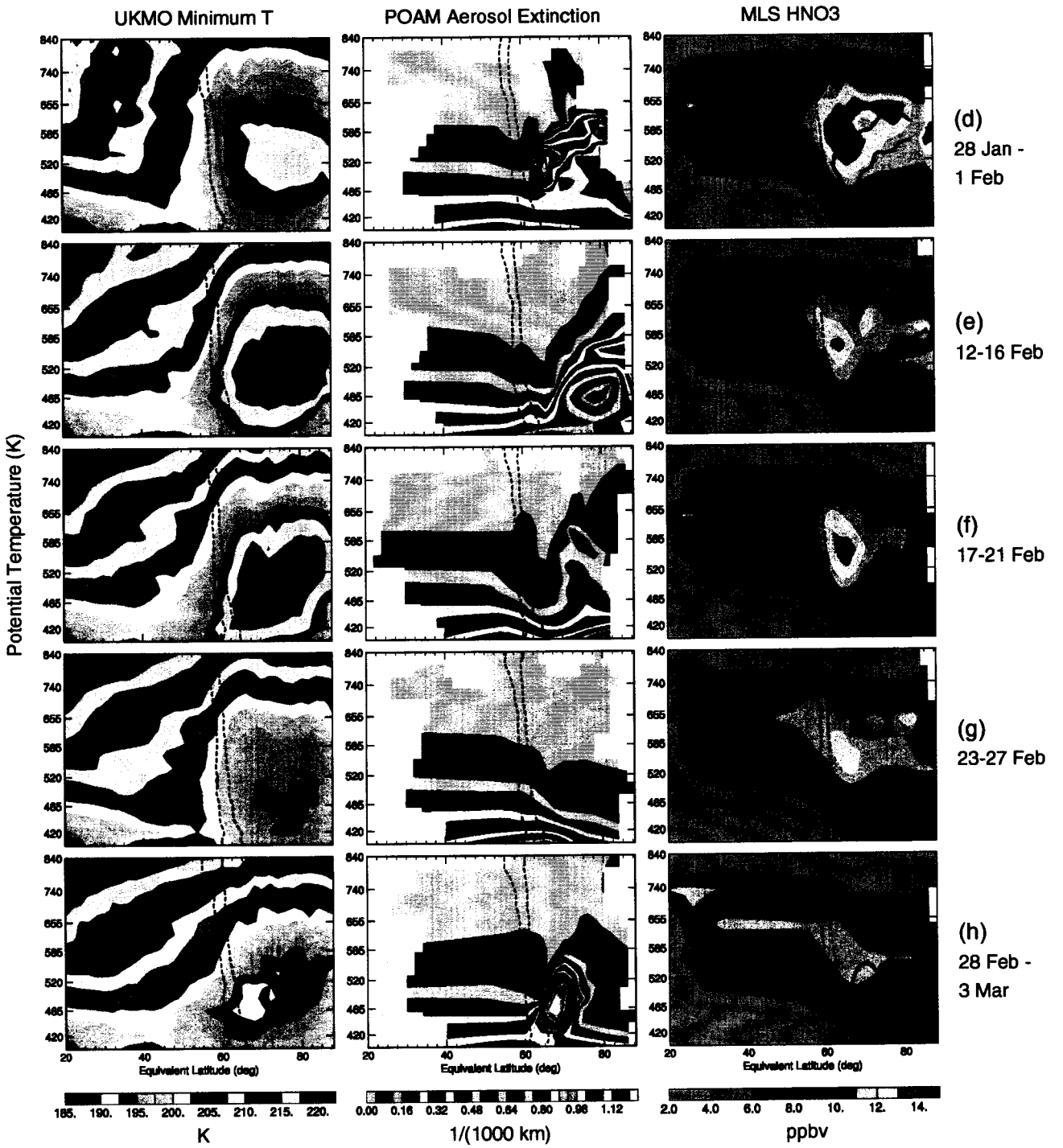
Data

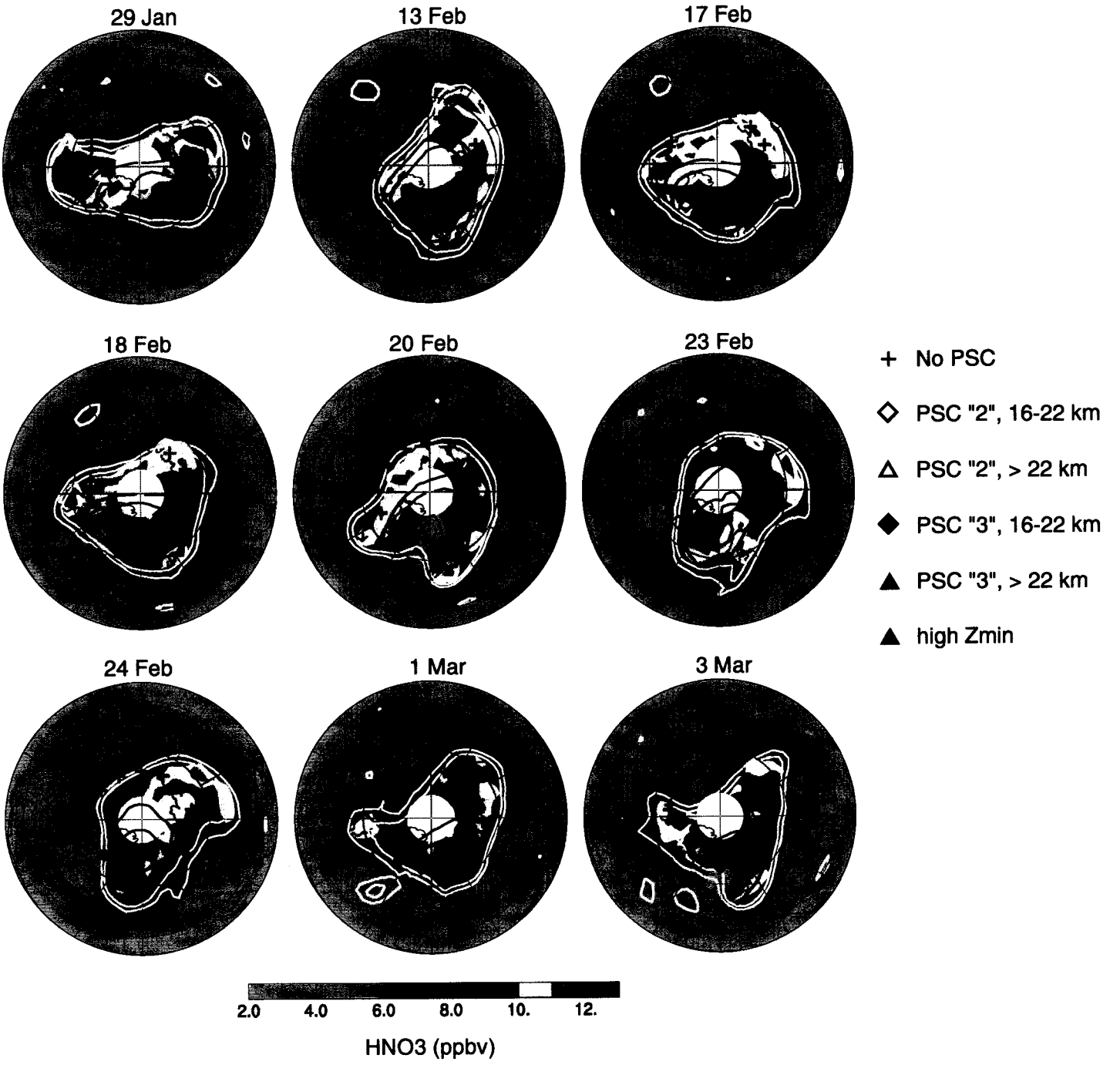
- ✦ Polar Ozone and Aerosol Measurement (POAM) II measurements of aerosol extinction at 1.06 μm
  - ✧ typically 12 solar occultations per day at ~65-68°N
  - ✧ PSCs observed almost daily between mid-December 1995 and early March 1996
- ✦ UARS Microwave Limb Sounder (MLS) measurements of gas-phase HNO_3
  - ✧ Full hemispheric coverage on 22 days during 16 November – 27 December, 1995
  - ✧ Full hemispheric coverage on 17 days during 29 January – 3 March, 1996

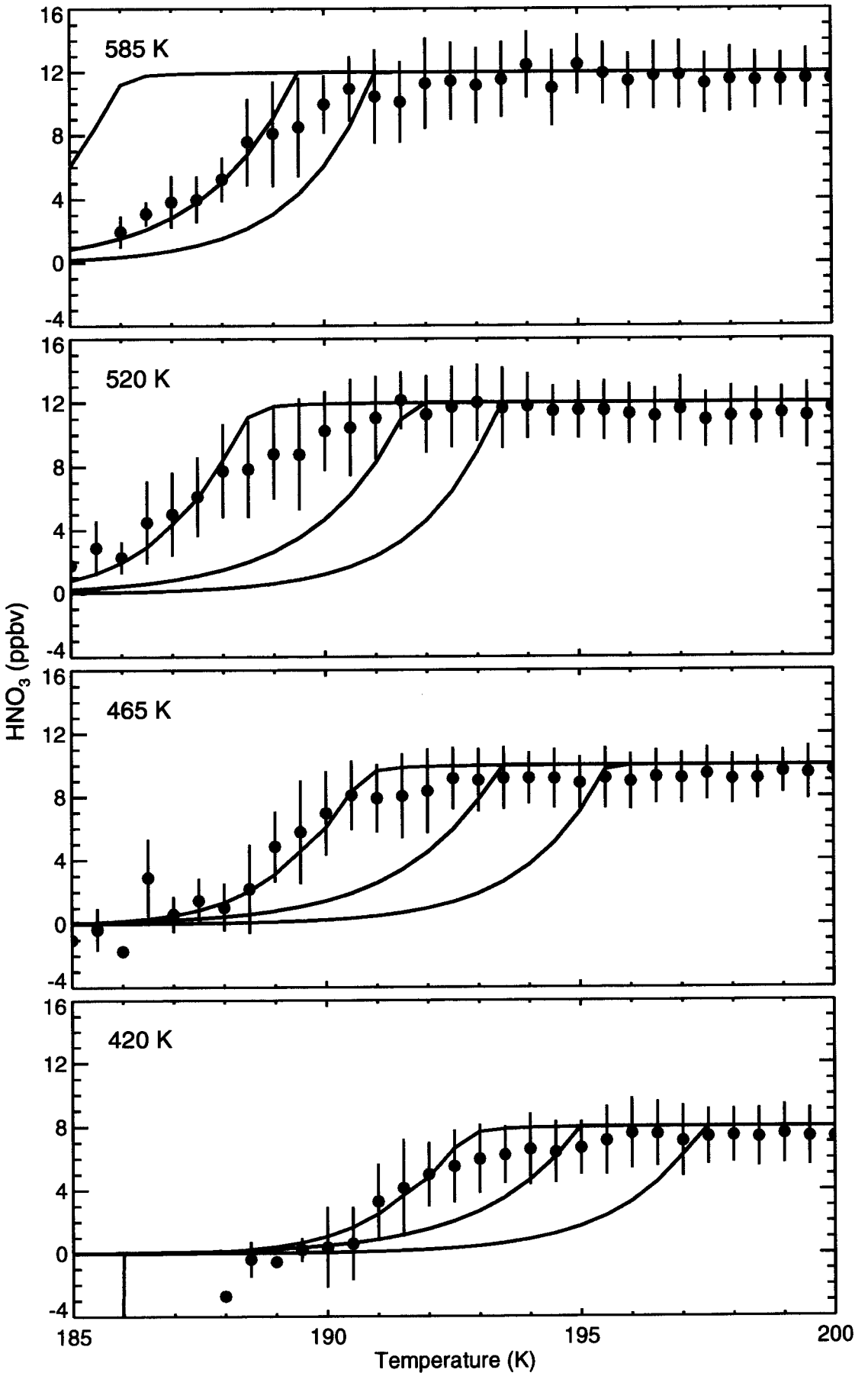
Approach

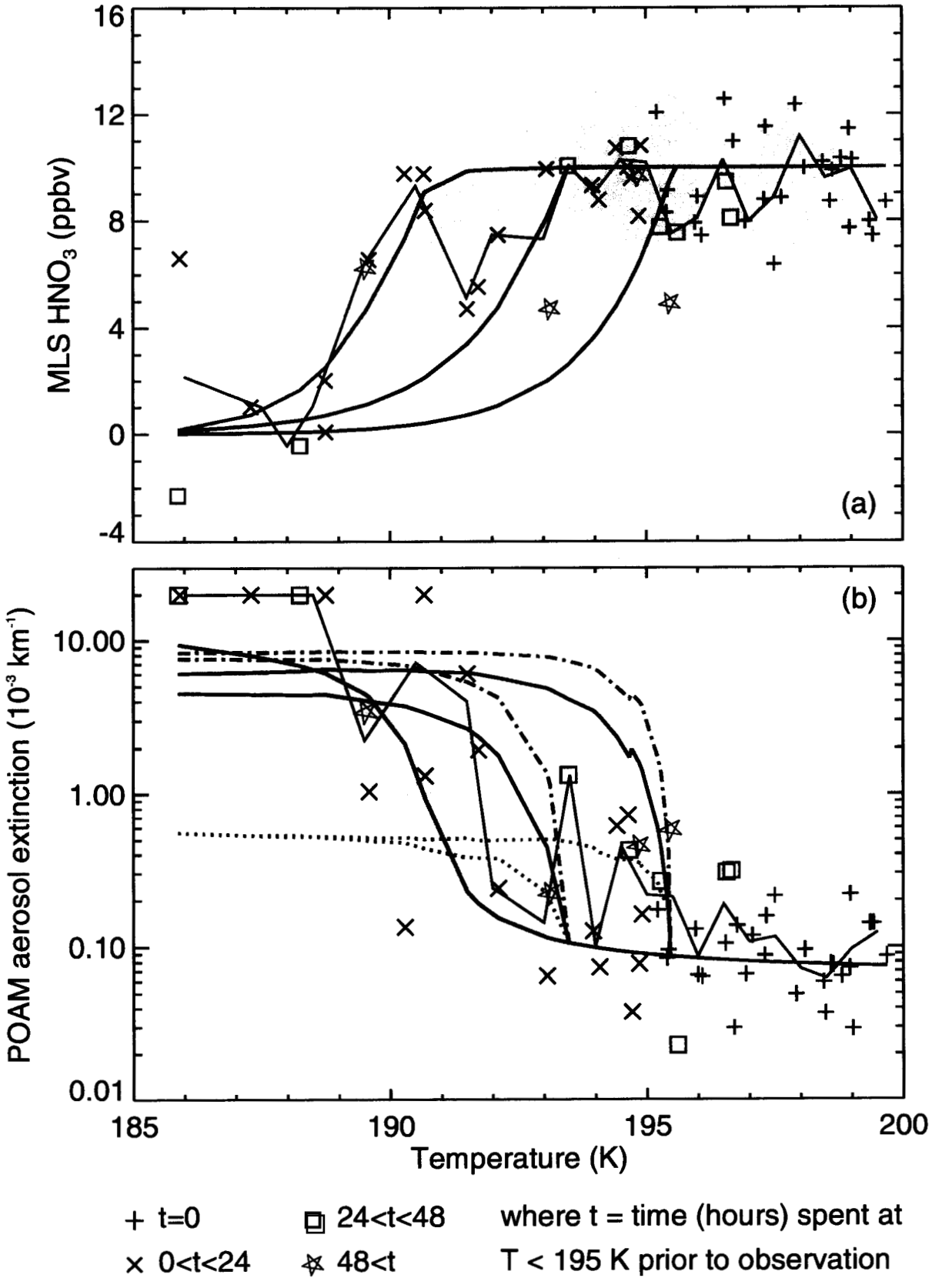
- ✦ The observed evolution of the gas-phase HNO_3 is compared against the observed aerosol extinction and the behavior predicted by various models of PSC composition:
  - ✧ NAT: [Hanson and Mauersberger, 1988]
  - ✧ NAD: [Worsnop et al., 1993]
  - ✧ STS: [Tabazadeh et al., 1994]


UKMO Minimum T
POAM Aerosol Extinction
MLS HNO3
Potential Temperature (K)
840
740
655
585
520
465
420
20
40
60
80
Equivalent Latitude (deg)
(a)
11-15 Dec
(b)
16-20 Dec
(c)
21-25 Dec
185. 190. 195. 200. 205. 210. 215. 220.
K
0.00 0.16 0.32 0.48 0.64 0.80 0.96 1.12
1/(1000 km)
2.0 4.0 6.0 8.0 10. 12. 14.
ppbv

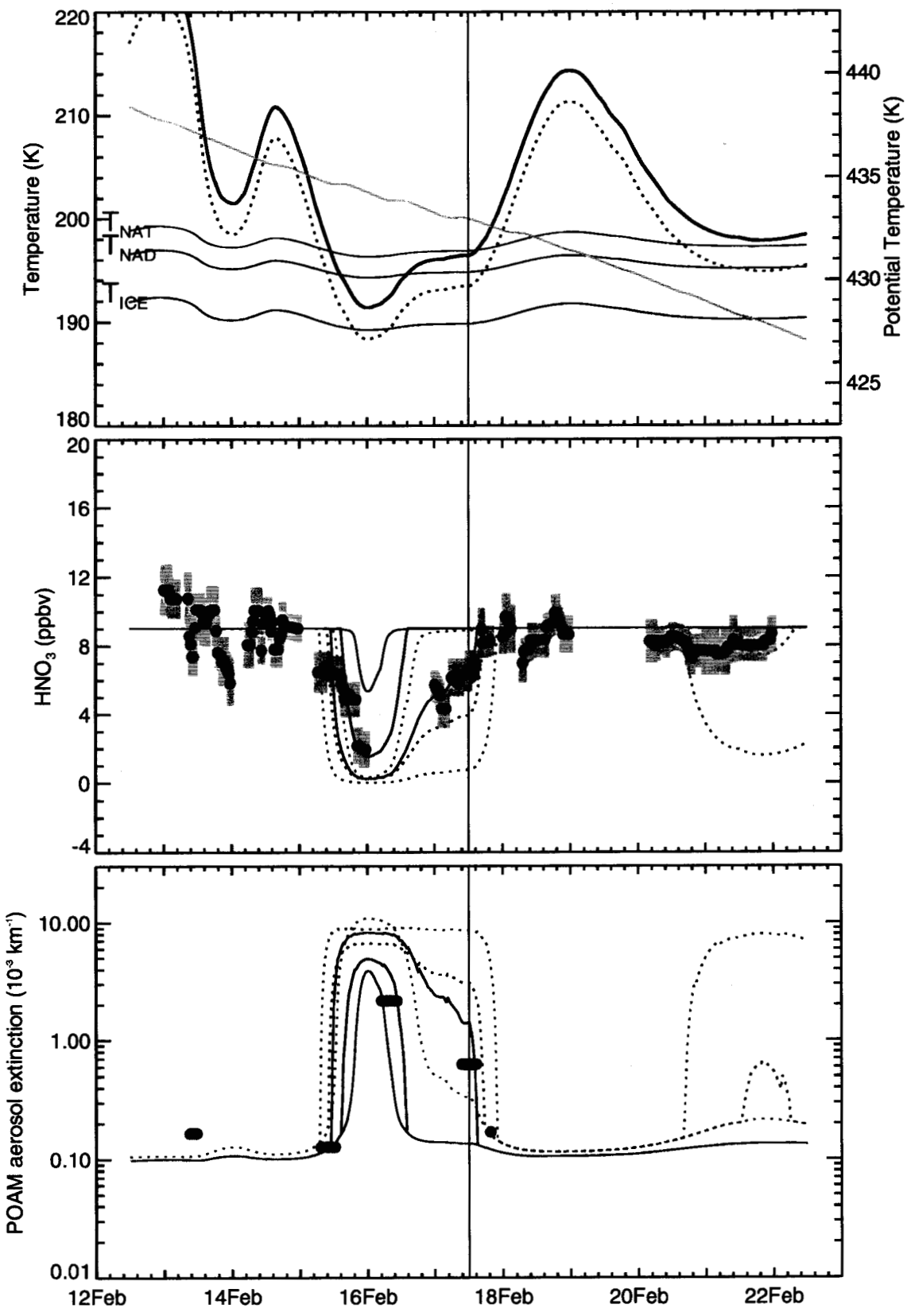

UKMO Minimum T
POAM Aerosol Extinction
MLS HNO3
Potential Temperature (K)
840
740
655
585
520
465
420
20
40
60
80
Equivalent Latitude (deg)
185. 190. 195. 200. 205. 210. 215. 220.
K
0.00 0.16 0.32 0.48 0.64 0.80 0.96 1.12
1/(1000 km)
2.0 4.0 6.0 8.0 10. 12. 14.
ppbv
(d)
28 Jan -
1 Feb
(e)
12-16 Feb
(f)
17-21 Feb
(g)
23-27 Feb
(h)
28 Feb -
3 Mar


29 Jan
13 Feb
17 Feb
18 Feb
20 Feb
23 Feb
24 Feb
1 Mar
3 Mar
+ No PSC
◇ PSC "2", 16-22 km
△ PSC "2", > 22 km
◆ PSC "3", 16-22 km
▲ PSC "3", > 22 km
▲ high Zmin
2.0
4.0
6.0
8.0
10.
12.
HNO3 (ppbv)

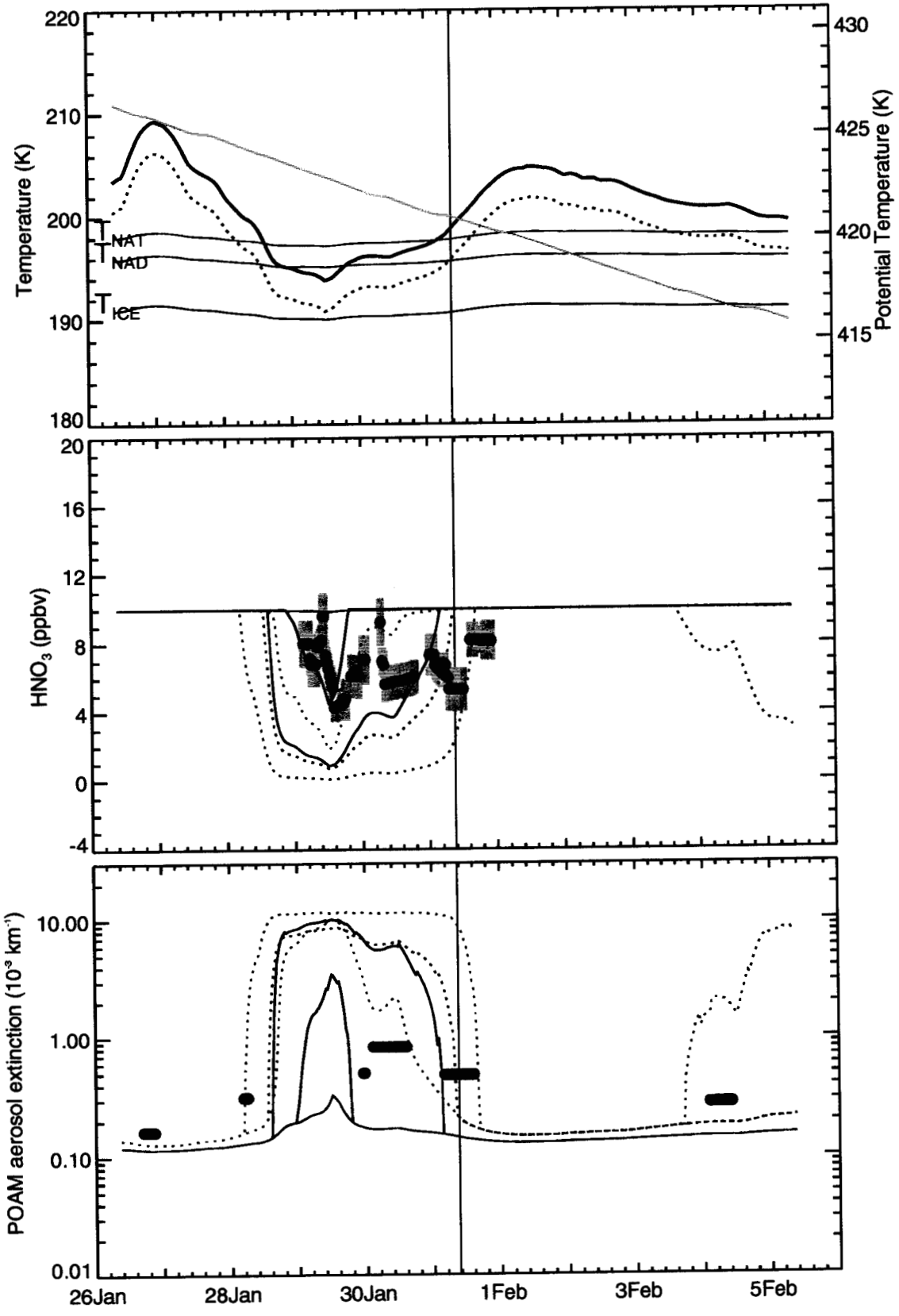
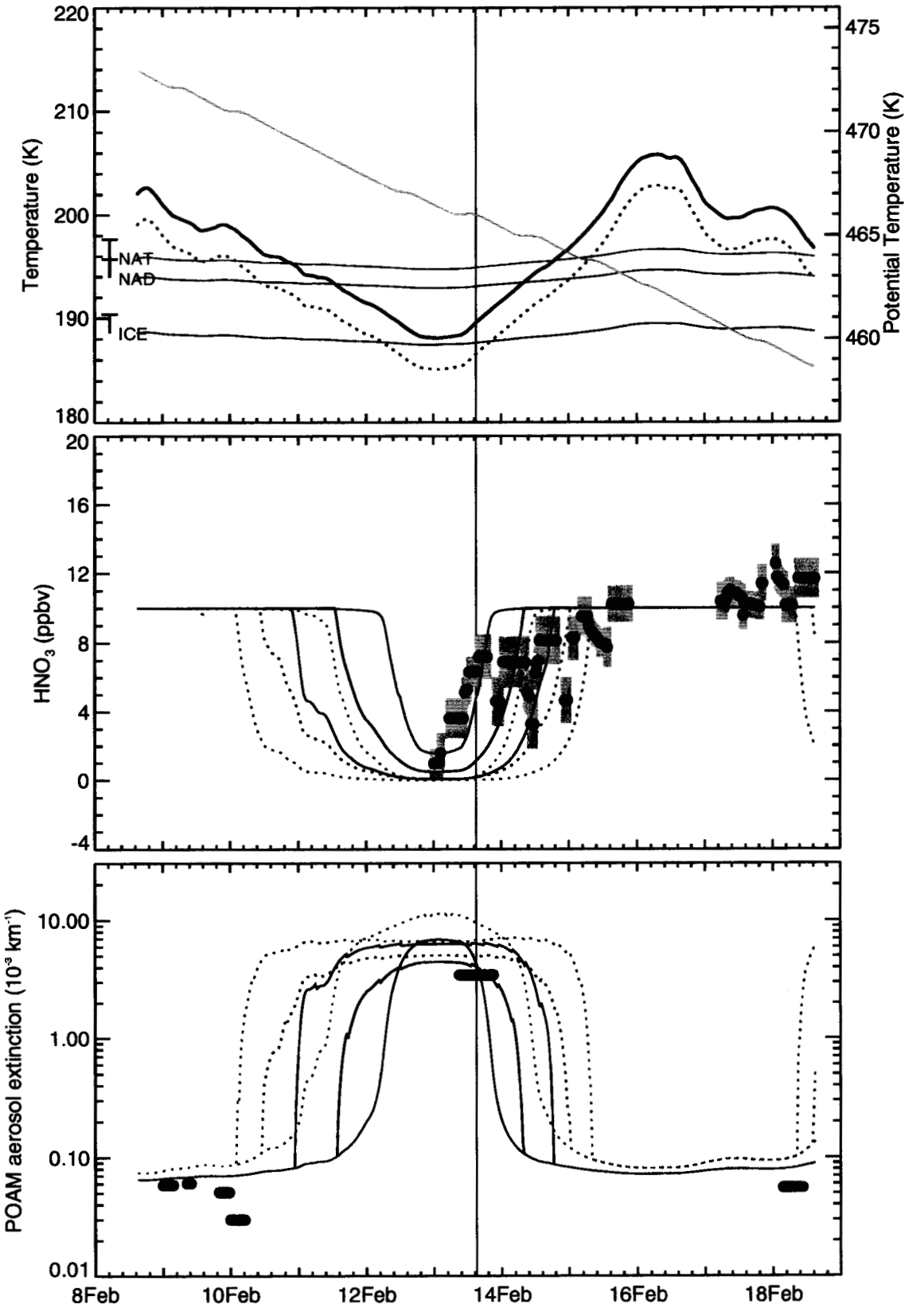

585 K
520 K
465 K
420 K
16
12
8
4
0
-4
185
190
195
200
Temperature (K)
HNO_3 (ppbv)


16
12
8
4
0
-4
MLS HNO_3 (ppbv)
(a)
(b)
10.00
1.00
0.10
0.01
POAM aerosol extinction (10^{-3} km^{-1})
185
190
195
200
Temperature (K)
+ t=0
× 0<t<24
24<t<48
48<t
where t = time (hours) spent at
T < 195 K prior to observation

17 Feb 1996: POAM rev #12411
POAM PSC Category 3 at 18 km, 433 K, 67.4N, 64.0E



31 Jan 1996: POAM rev #12168
POAM PSC Category 3 at 17 km, 421 K, 66.1N, 92.9E



13 Feb 1996: POAM rev #12356
POAM PSC Category 3 at 20 km, 465 K, 67.2N, 15.5E