



# ***Studies of PSC Coverage and Composition Using CALIOP Data***

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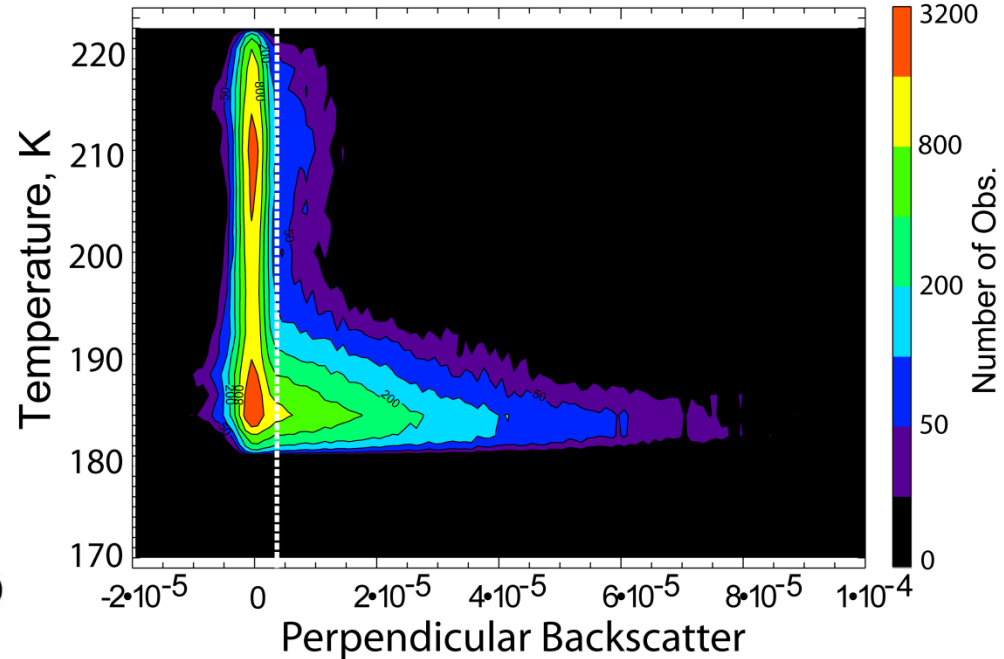
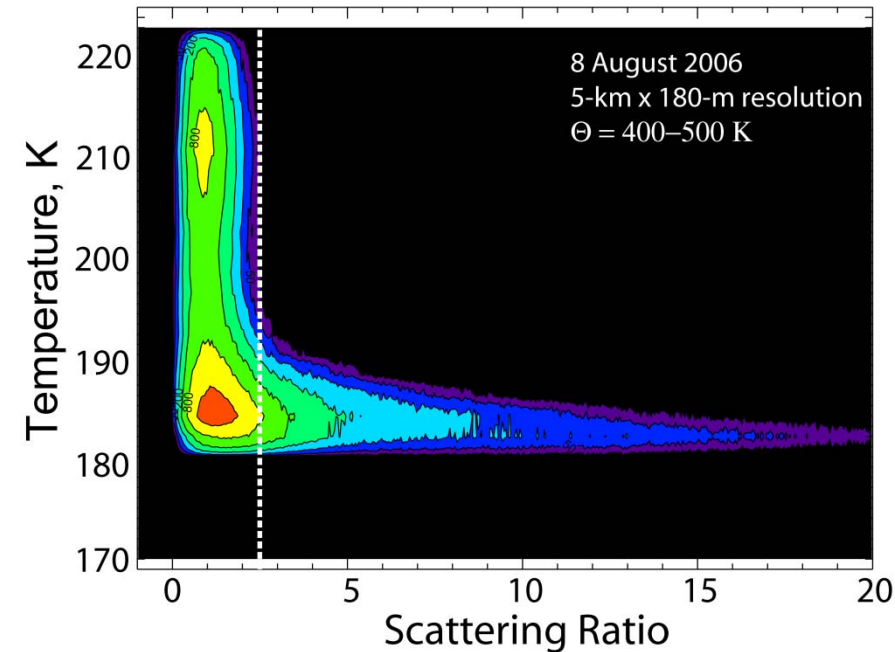
***CALIPSO/CloudSat Science Team Meeting, Madison, Wisconsin, 28-31 July 2009***



# *Outline*

- PSC detection and areal coverage
- PSC composition
  - Classification scheme
  - Comparison with MIPAS
  - Seasonal evolution
  - Thermodynamic verification using Aura MLS  $\text{HNO}_3$  &  $\text{H}_2\text{O}$  data
- Case study of NAT formation
- RECONCILE

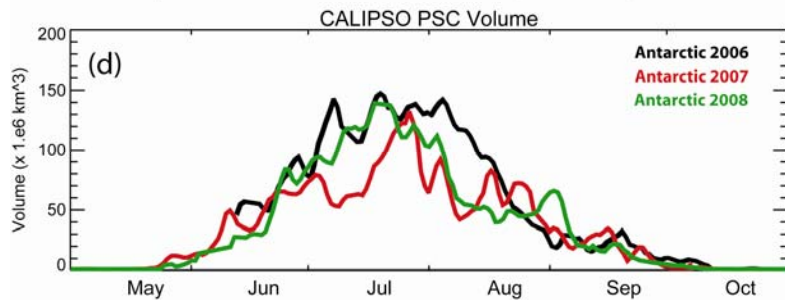
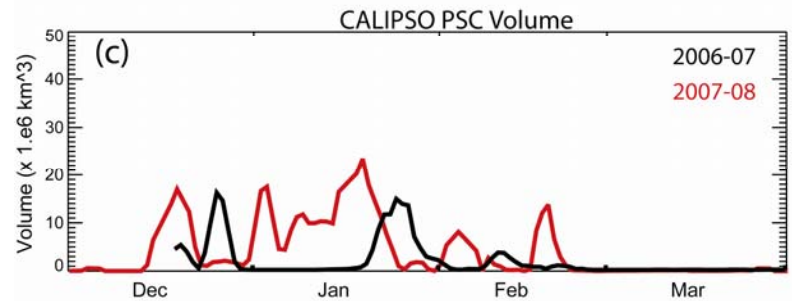
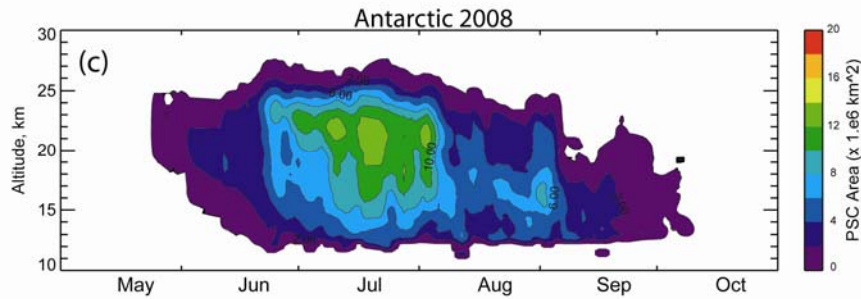
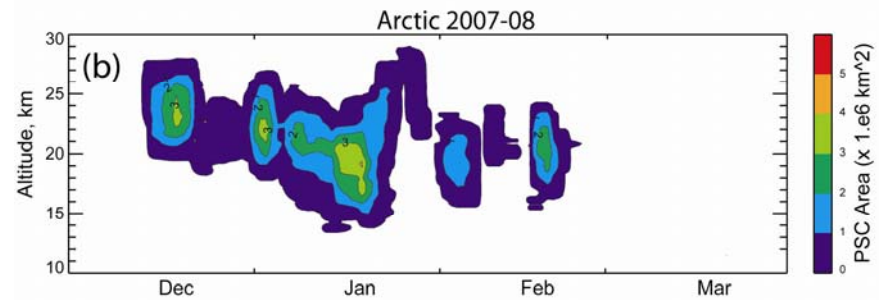
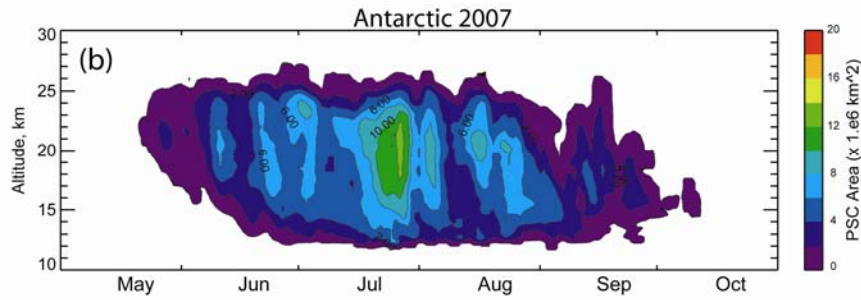
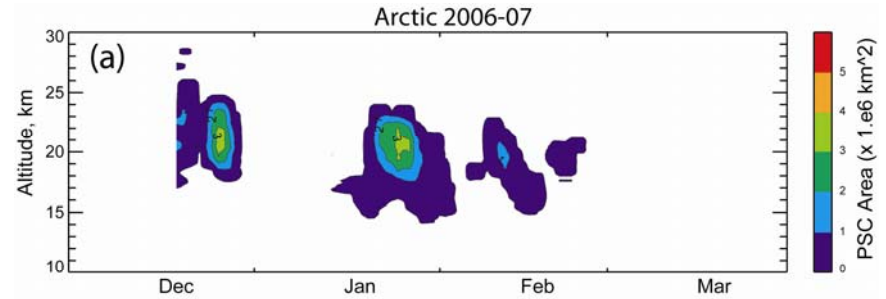
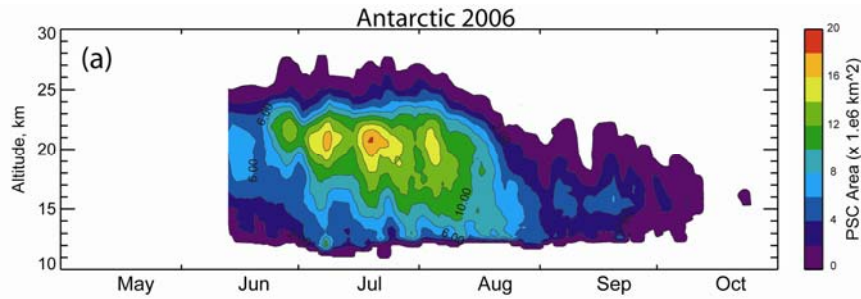
# CALIPSO PSC Detection Algorithm (Second Generation)

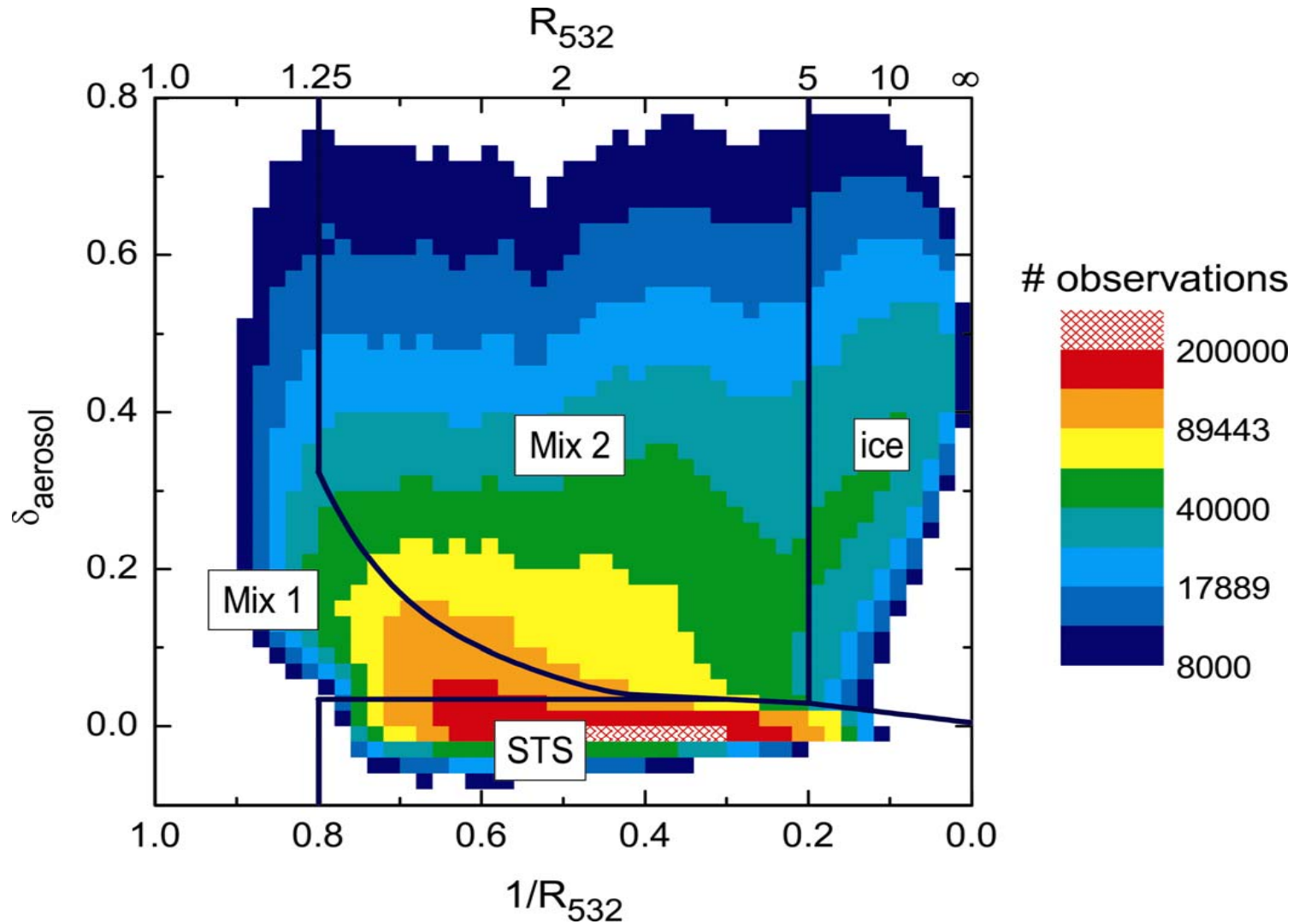


- PSCs are detected as statistical outliers in scattering ratio (total/molecular backscatter) or  $\beta_{\perp}$  at 532 nm.
- Successive horizontal averaging (5, 15, 45, & 135 km)
- Pitts et al., 2009, *Atmos. Chem. Phys. Discuss.*, 9, 8121-8157.



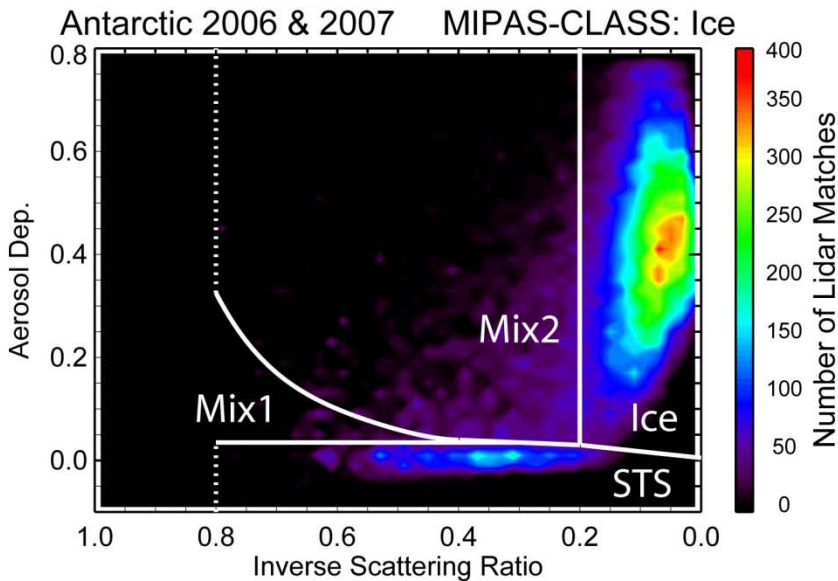
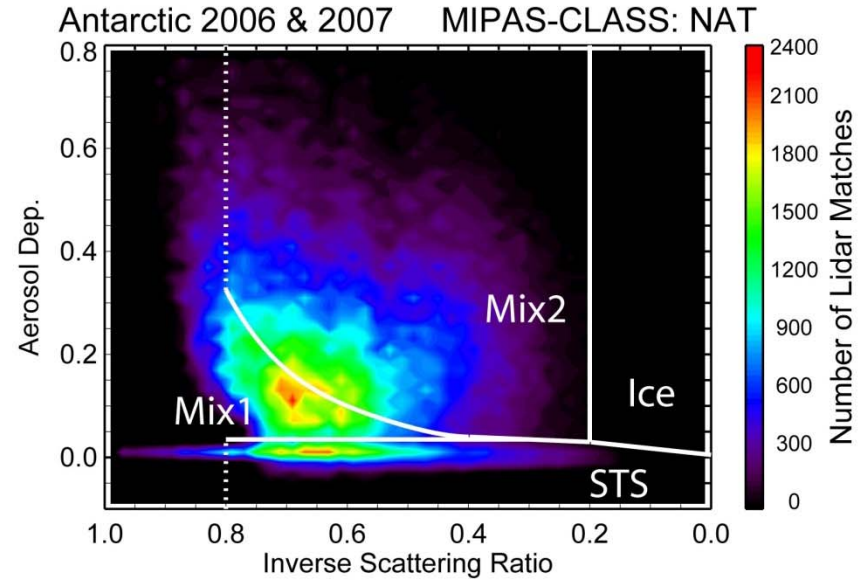
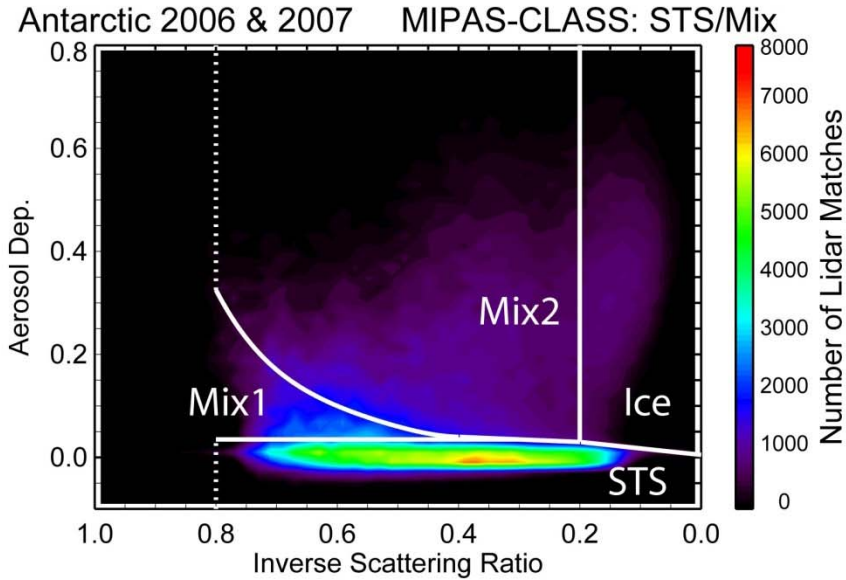
# CALIPOP PSC Areal Coverage





➤ Pitts et al., 2009, *Atmos. Chem. Phys. Discuss.*, 9, 8121-8157

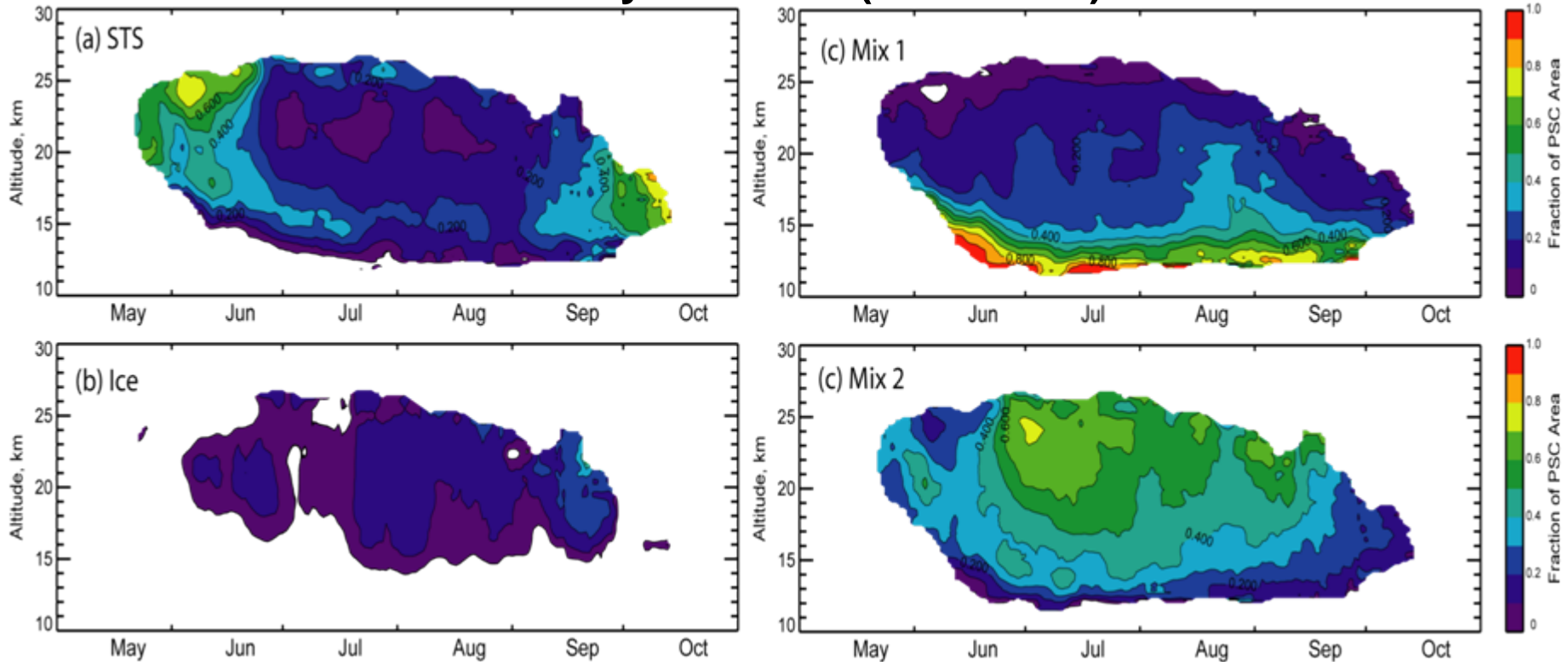
# CALIPSO vs MIPAS PSC Composition



- Different approaches: lidar vs. IR limb emission/scattering (12-13  $\mu\text{m}$ )
- Approximately 3000 coincident (<6hr, <200km) PSC observations in Antarctic in 2006-2007
- Good agreement overall, especially between MIPAS NAT and CALIPSO Mix1/Mix2 (90%)
- Höpfner et al., 2009, *JGR* (accepted)

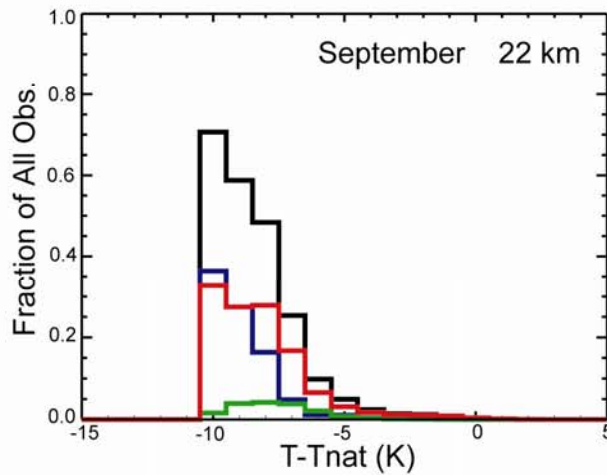
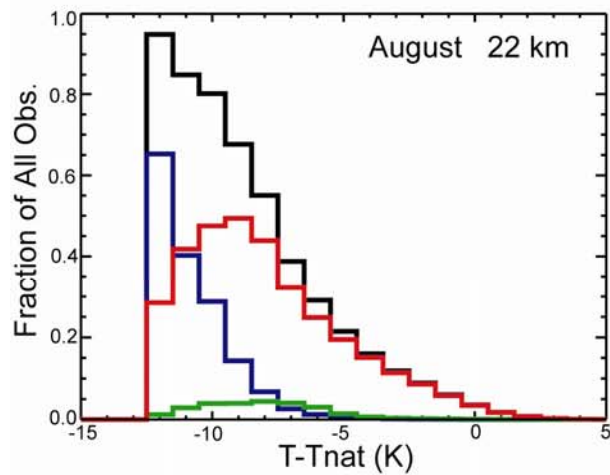
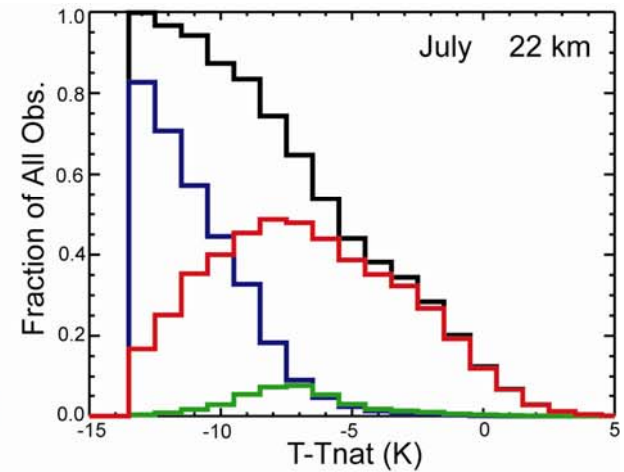
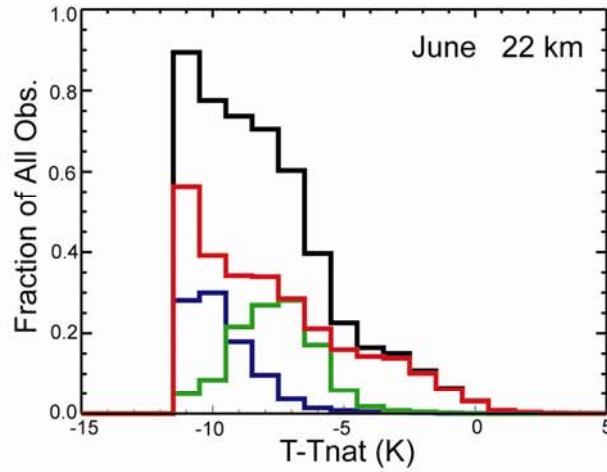
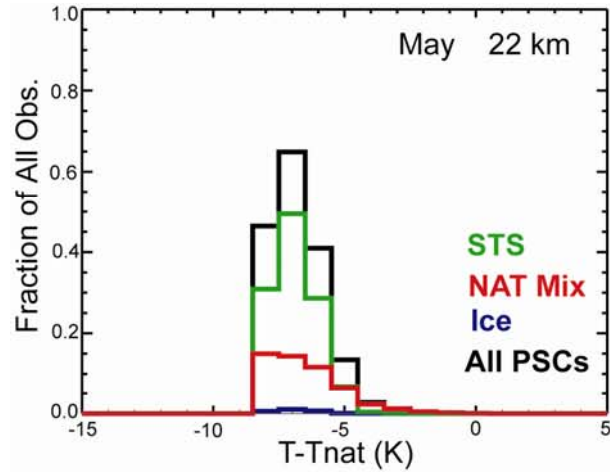
# Seasonal Evolution of Antarctic PSCs by Composition Class

Three-year mean (2006-2008)



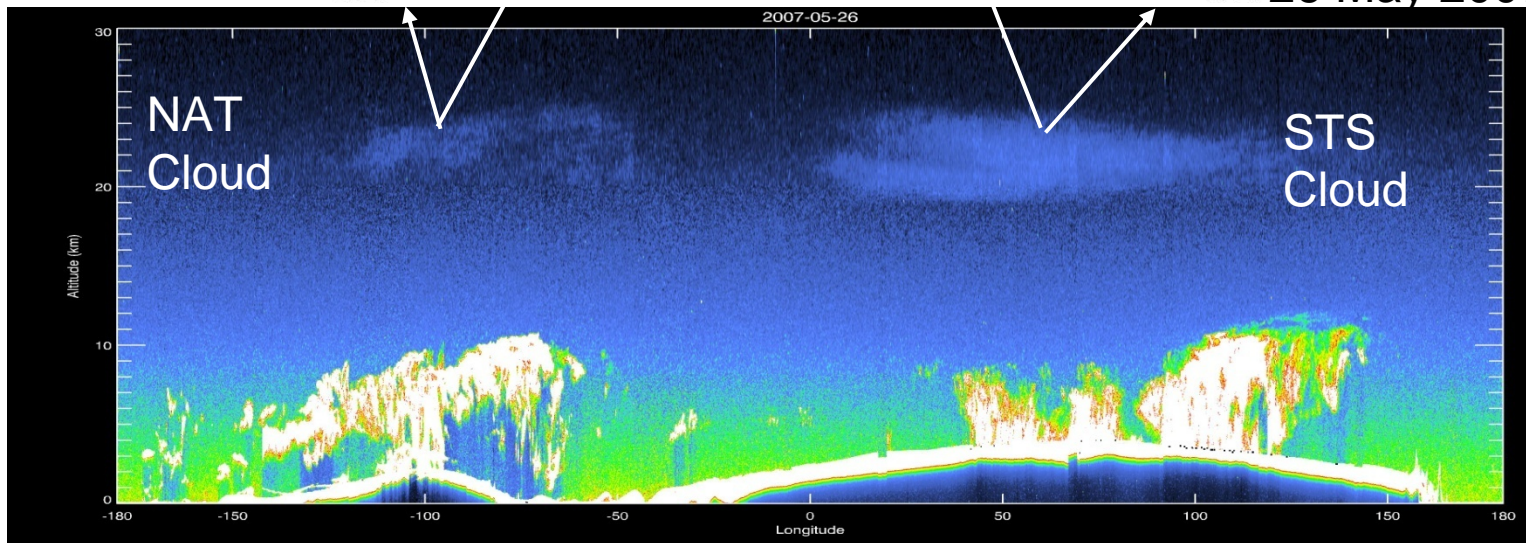
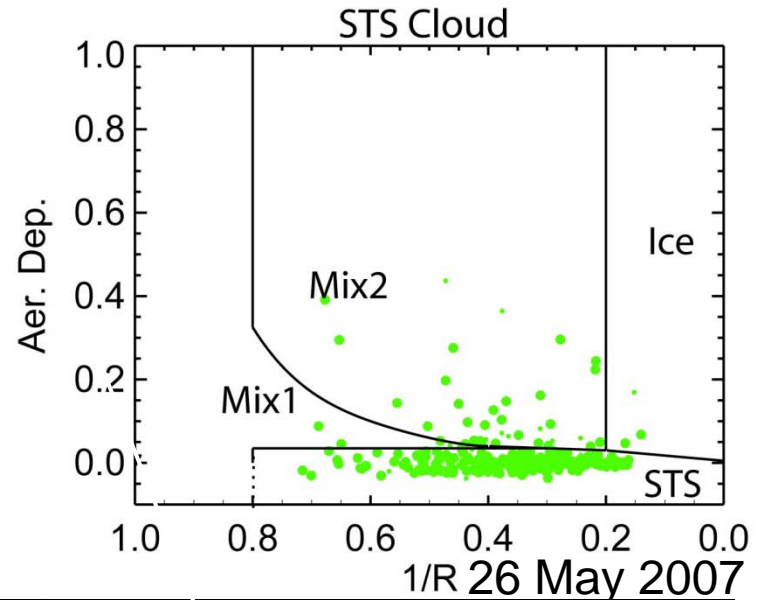
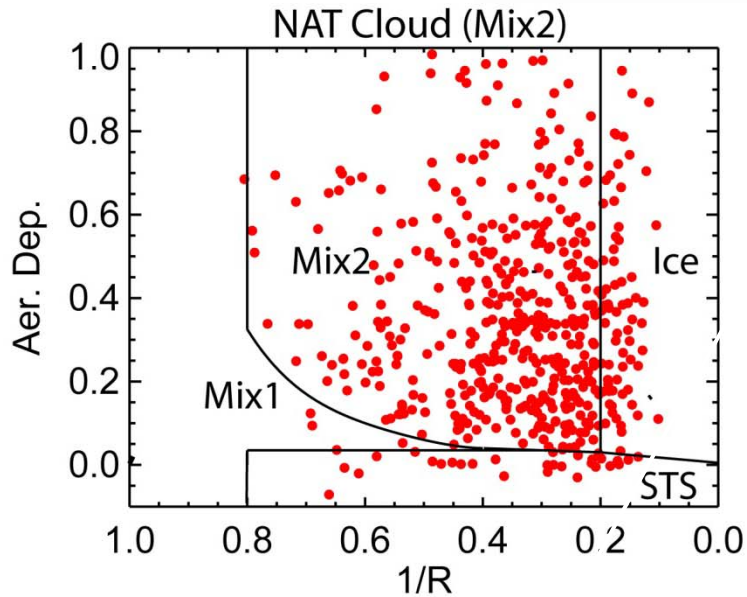
The values have been normalized by the total PSC area to show the relative coverage of each composition class as indicated by the color bars.

## Antarctic 2006-2008



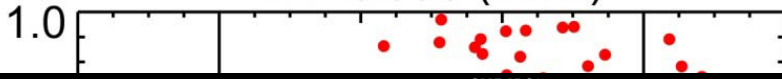


# Onset of PSCs in May 2007

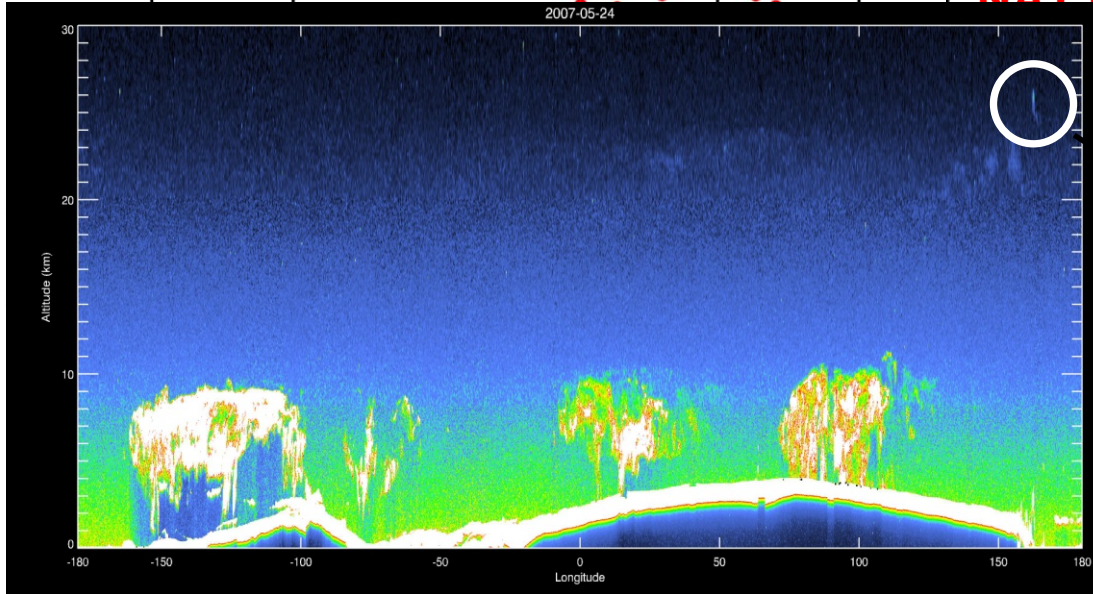
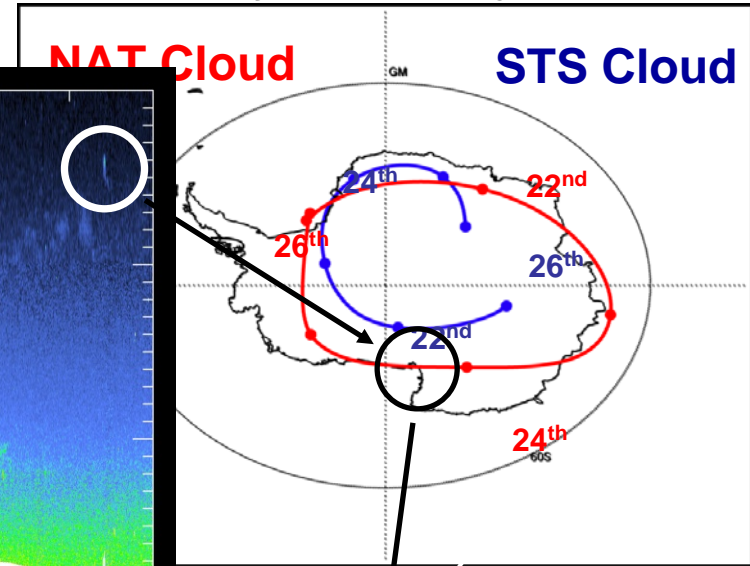


# Onset of PSCs in May 2007

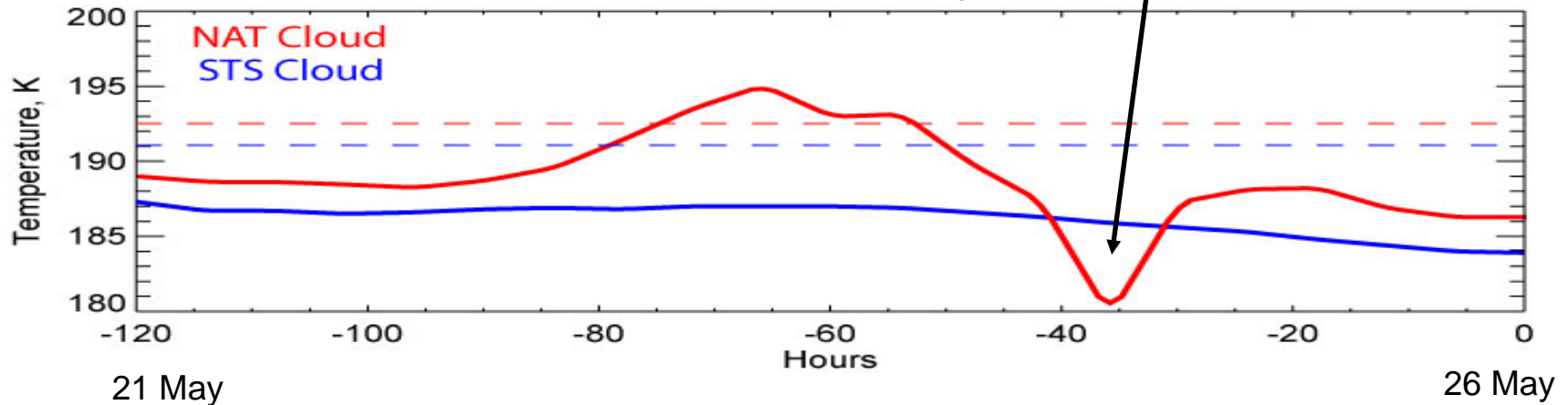
### NAT Cloud (Mix2)



### 5-day Back Trajectories



### Temperature History





# ***RECONCILE***



- Four-year (2009-2013) EU project: “Reconciliation of essential process parameters for an enhanced predictability of Arctic stratospheric ozone loss and its climate interactions”
- We are an invited Associated Partner (Work Package 2: PSC Microphysics and Heterogeneous Chemistry, led by Prof. Thomas Peter, ETH-Zurich)
  - Intensive field campaign in Kiruna, Sweden, January-March 2010 (two separate deployments, 30 days apart)
  - M55-Geophysica high-altitude aircraft with full instrument suite, many flights targeting in-situ measurements in PSCs
  - Match campaign with balloon-borne  $O_3$ ,  $H_2O$ , and backscatter measurements



# ***CALIPSO and RECONCILE***

- CALIOP expedited browse images used to identify PSC regions for flight planning purposes
- Possible direct aircraft underflights of CALIPSO, as well as coordination of Match balloon launches with CALIPSO overpasses
- Quick-look comparison of CALIOP PSC data products with aircraft and balloon-borne data during field mission, more comprehensive comparisons during extended post-campaign data analysis phase
- Monitoring of PSC activity between two separate phases of field campaign
- Use multi-year Antarctic and Arctic CALIOP PSC database to expand studies beyond limited scope of field campaign



# BACKUP SLIDES

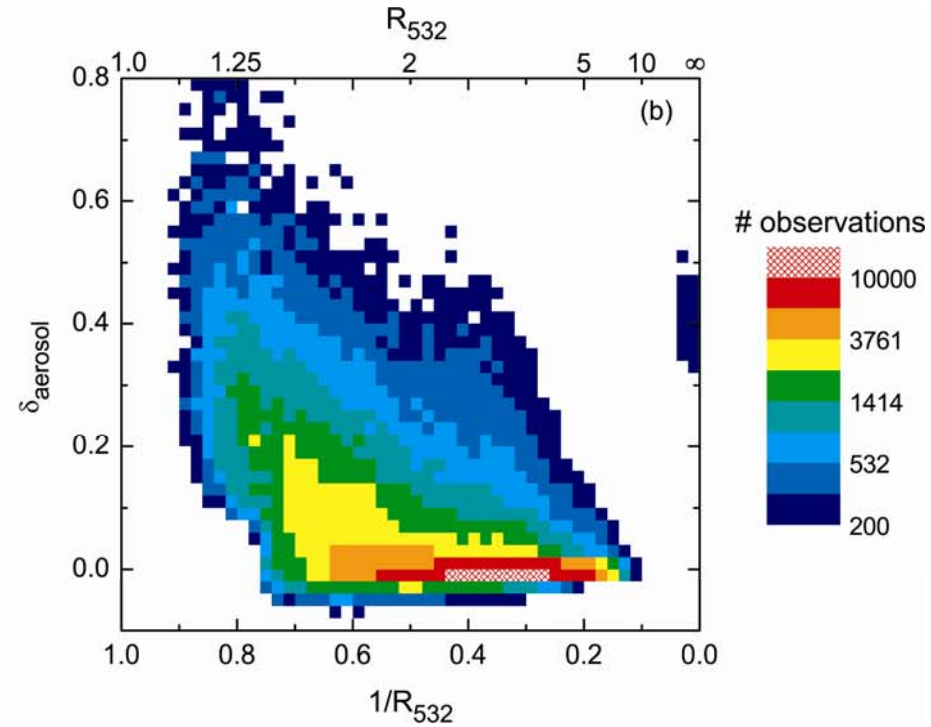
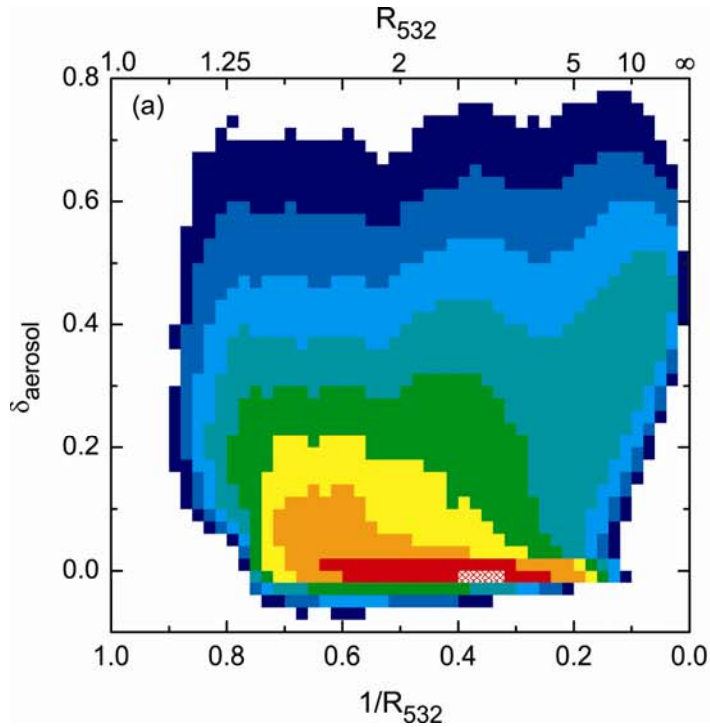


# CALIPOP PSC Composition Inter-hemispheric Differences

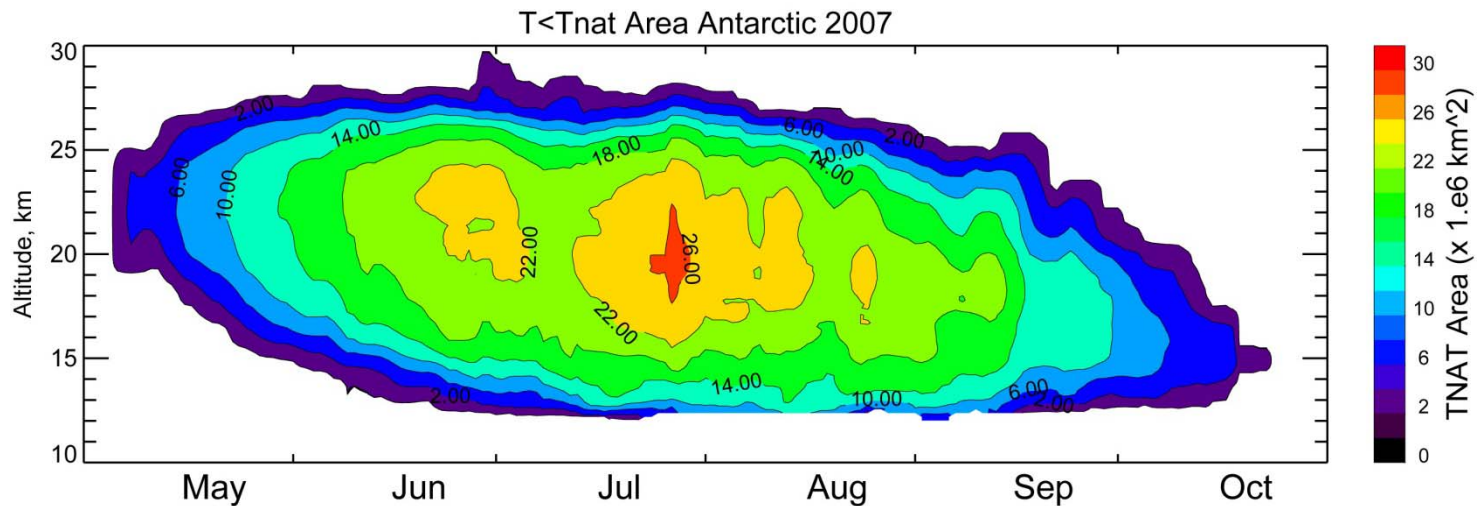
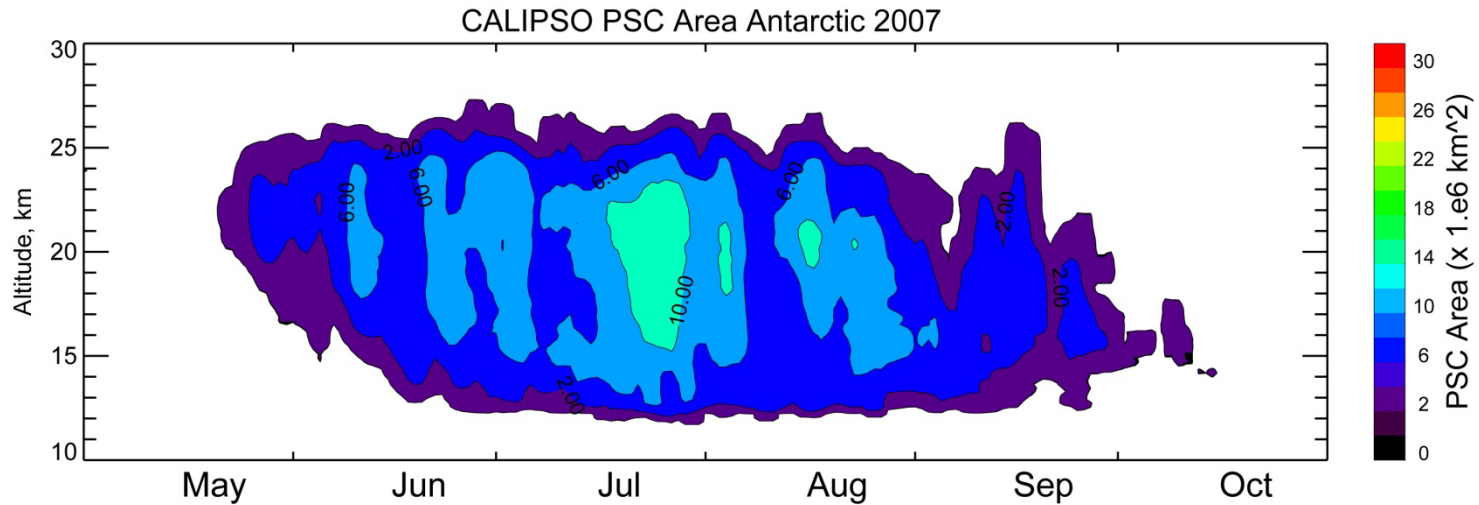


Antarctic 2006-2008

Arctic 2006/07-2007/08



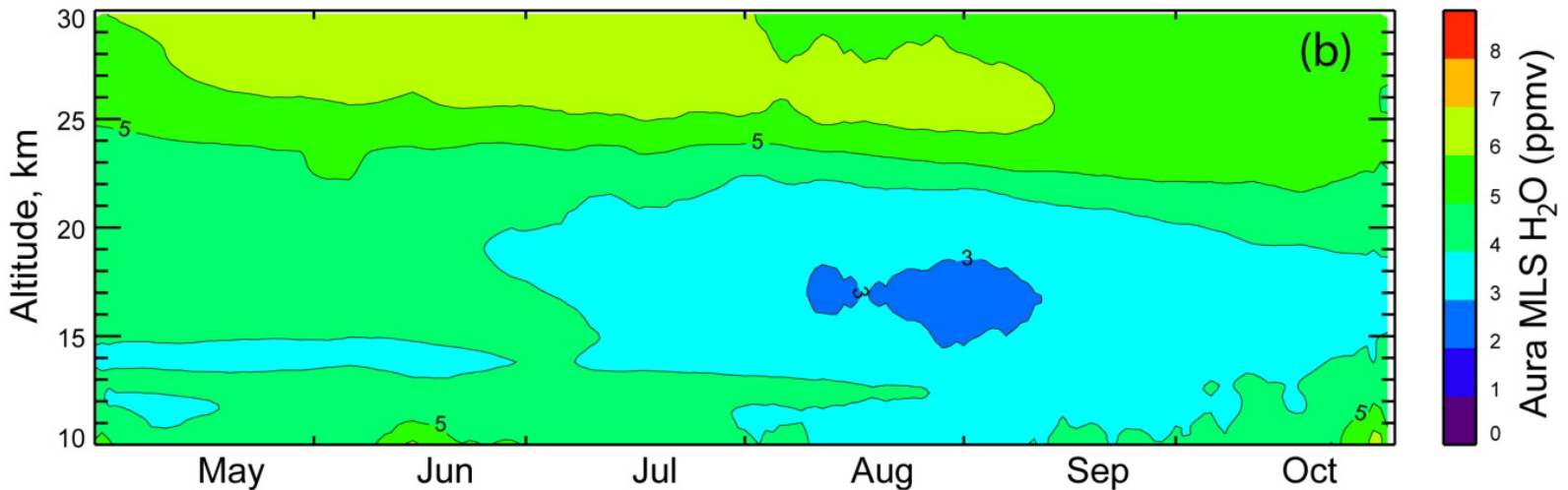
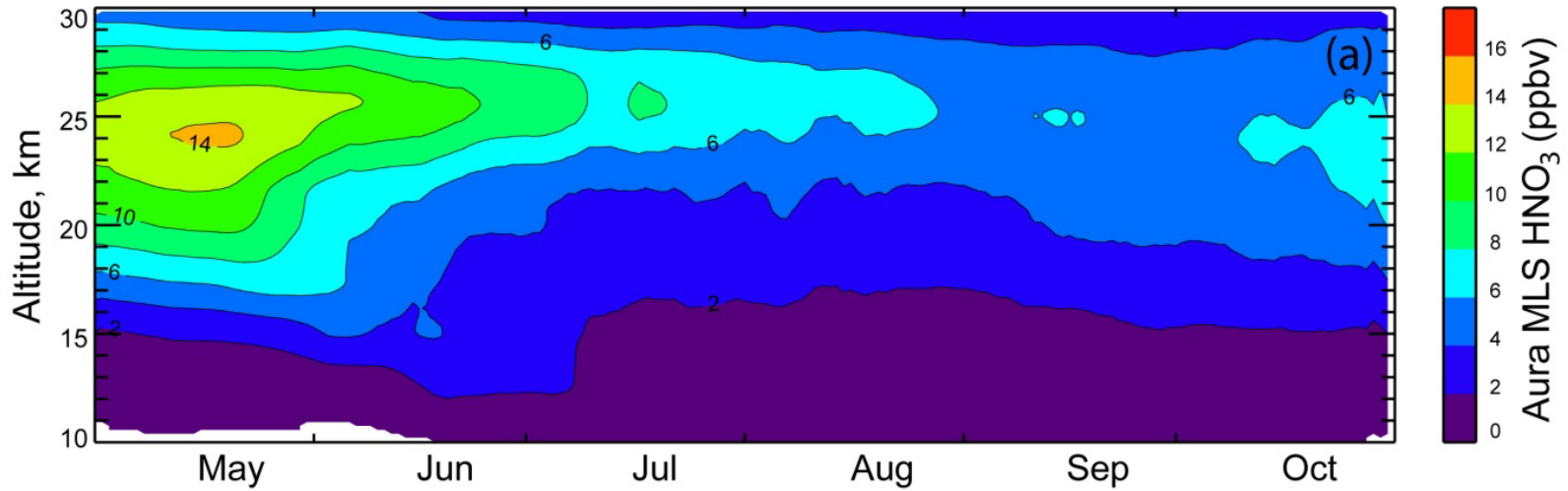
# PSC Area versus $T < T_{NAT}$ Area



Equilibrium  $T_{NAT}$  values calculated using Hanson and Mauersberger (1988) relationship with cloud-filtered Aura MLS  $\text{HNO}_3$  and  $\text{H}_2\text{O}$  mixing ratio measurements

# Seasonal Evolution of Aura MLS $\text{HNO}_3$ and $\text{H}_2\text{O}$ Mixing Ratio

Three-year mean (2006-2008) Cloud-Filtered





## Antarctic 2006-2008

