Illustrated by yunqian 2015. 6. 25.

Comparing simulated PSC optical properties with CALIPSO observations in 2010 Antarctic Winter

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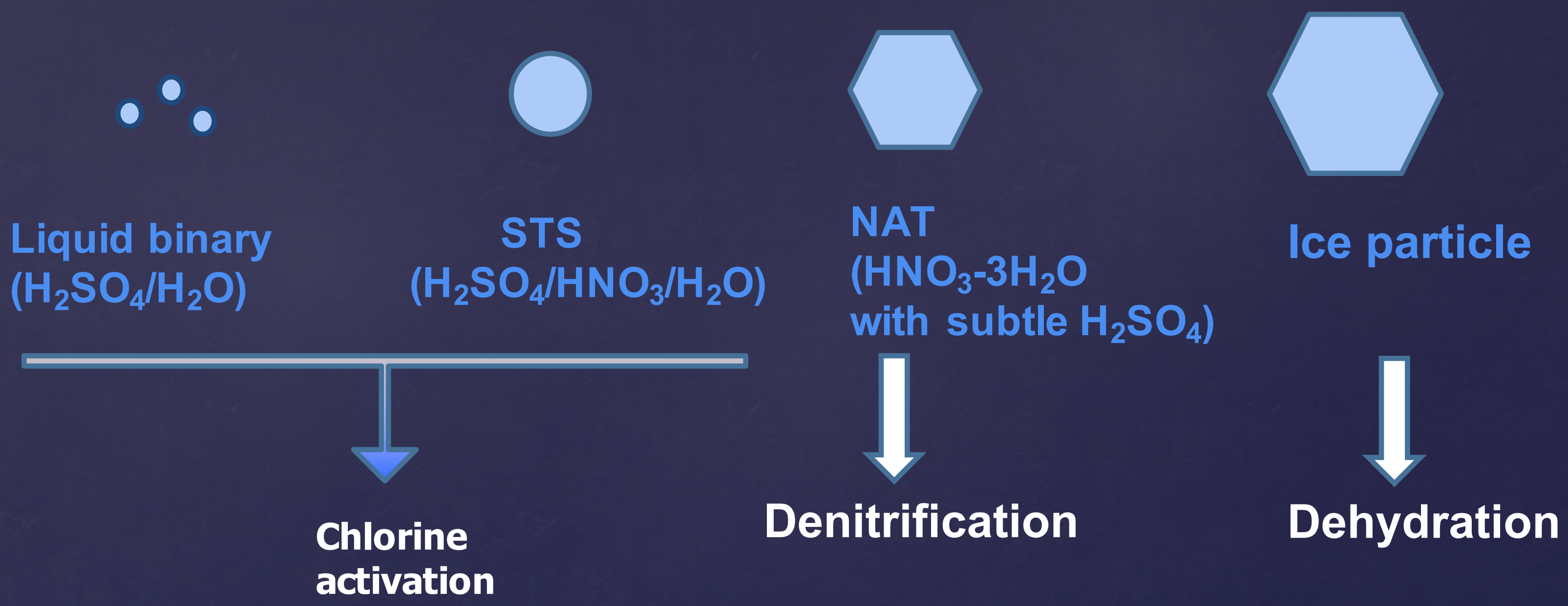
Yunqian Zhu[1,2], Owen B Toon[1,2], Michael C Pitts[3], Alyn Lambert[3], Charles Bardeen[4], Douglas E Kinnison[4]

1. University of Colorado, Boulder
2. Laboratory of Atmospheric and Space Physics
3. Jet Propulsion Laboratory, California Institute of Technology
4. National Center for Atmospherics Research

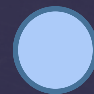
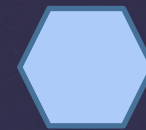
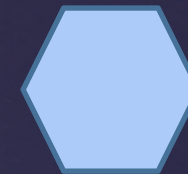
Department of Atmospheric and Oceanic Sciences
University of Colorado at Boulder

LASP
LABORATORY FOR ATMOSPHERIC AND SPACE PHYSICS
UNIVERSITY OF COLORADO AT BOULDER

What are PSCs and why are they important?

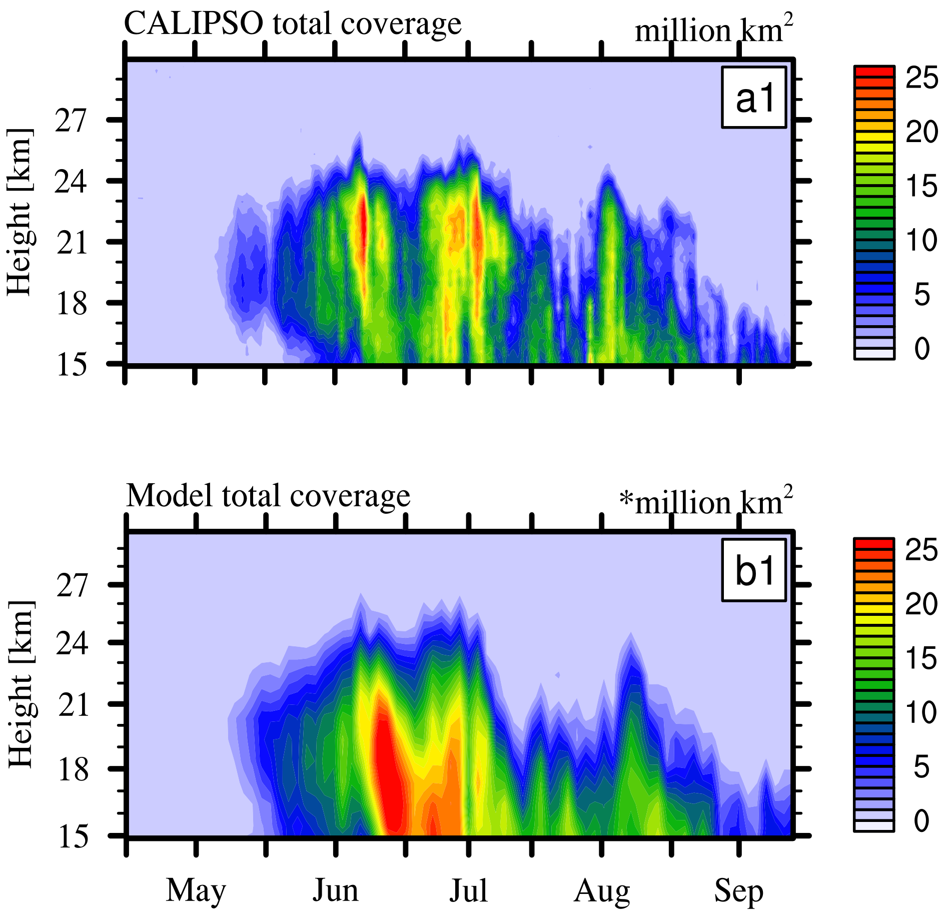


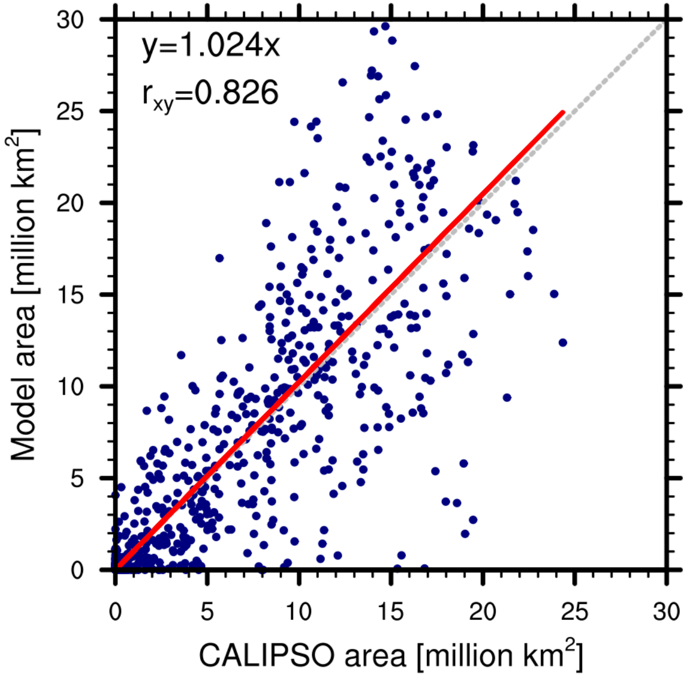
How do we form PSCs in the model?

	 Liquid binary (H_2SO_4/H_2O)	 STS ($H_2SO_4/HNO_3/H_2O$)	 NAT (HNO_3-$3H_2O$ with subtle H_2SO_4)	 Ice particle
WACCM/ MOZART [Wegner et al., 2012]	**SAGE observation to provide the SAD**	**Equilibrium formation** [Tabazadeh et al., 1994]	**30% of HNO3 are allowed to be taken to form ~ 3K below equilibrium temperature** [Hanson and Mauersberger, 1988]	**CAM4 parameter**
WACCM/ CARMA [zhu et al., 2015]	**Homogeneous nucleation and growth**	**Condensational growth and evaporation** [Luo et al., 1995]	**Homogeneous nucleation from STS and growth** [Tabazadeh et al., 2002] [Hanson and Mauersberger, 1988]	**CAM4 parameter**

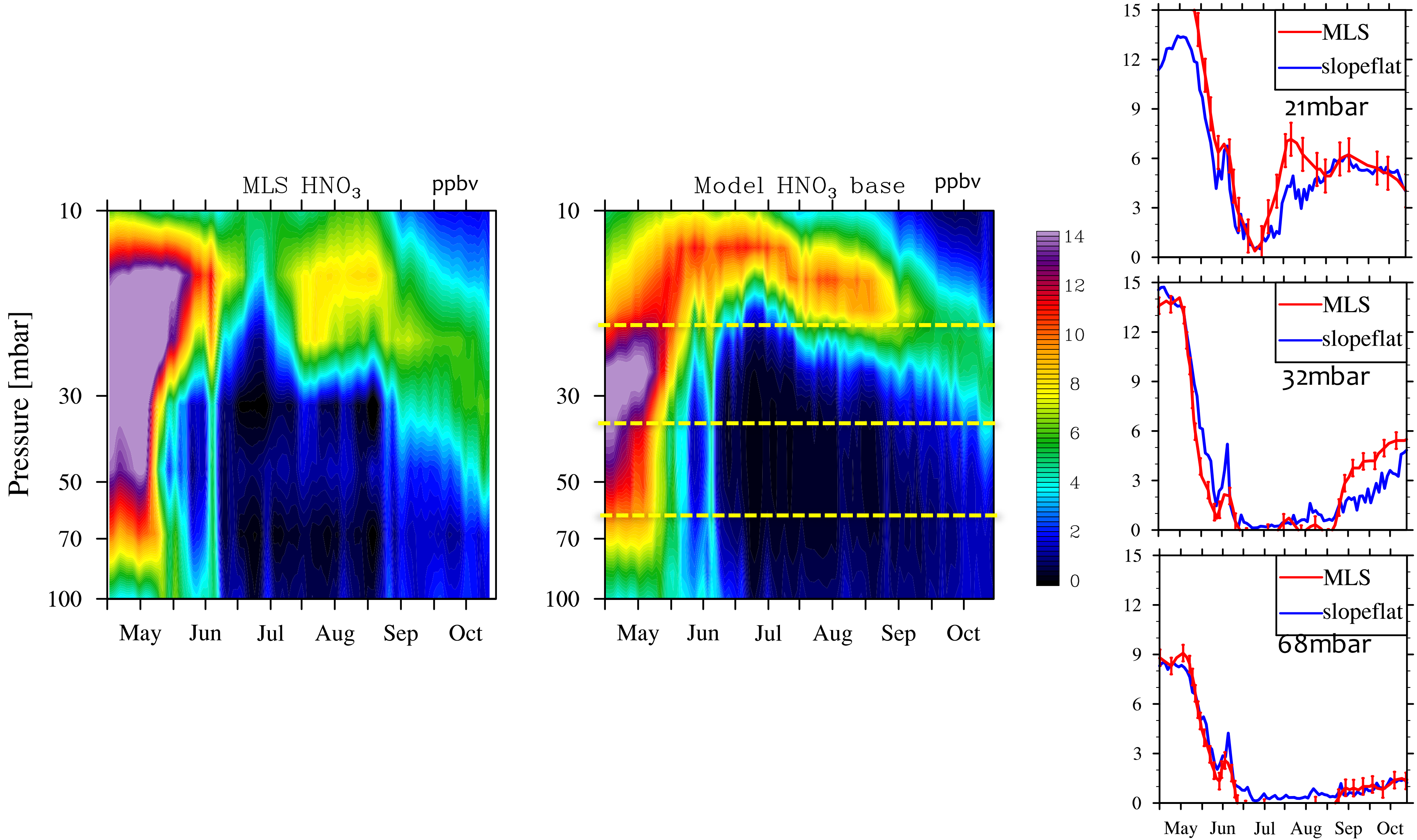
A detailed Microphysics model give us the flexibility to calculate PSC optical properties (such as particle backscatter, cloud coverage) to compare with satellite data.

The simulated cloud coverage agrees with the CALIPSO cloud coverage within a few percent on average, and with a correlation coefficient of 0.83.

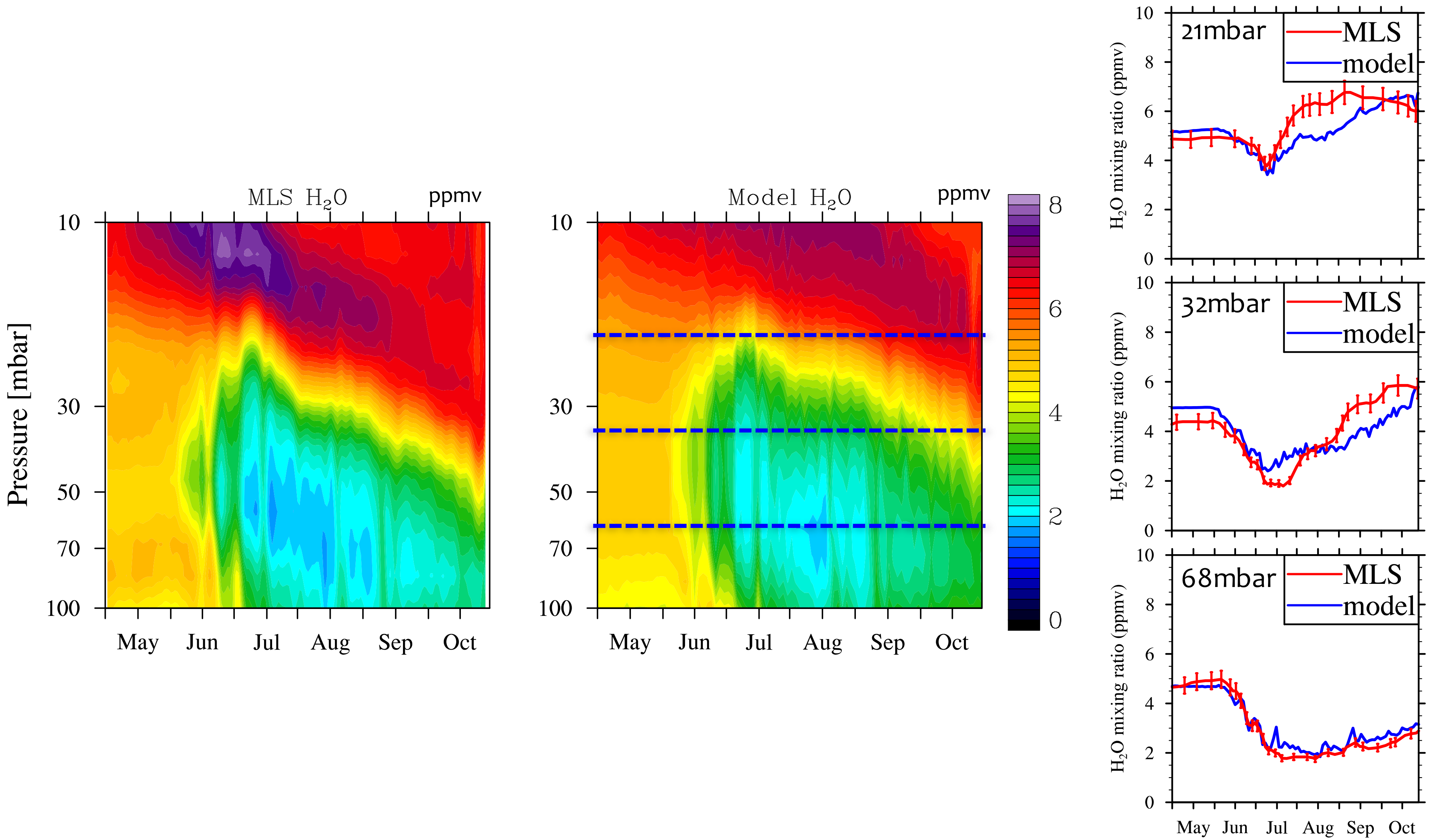




The model simulates denitrification reasonably well.



The H_2O parameterization in the model reproduces the dehydration seen in MLS data.



Two major NAT formation mechanisms are suggested in Antarctic.

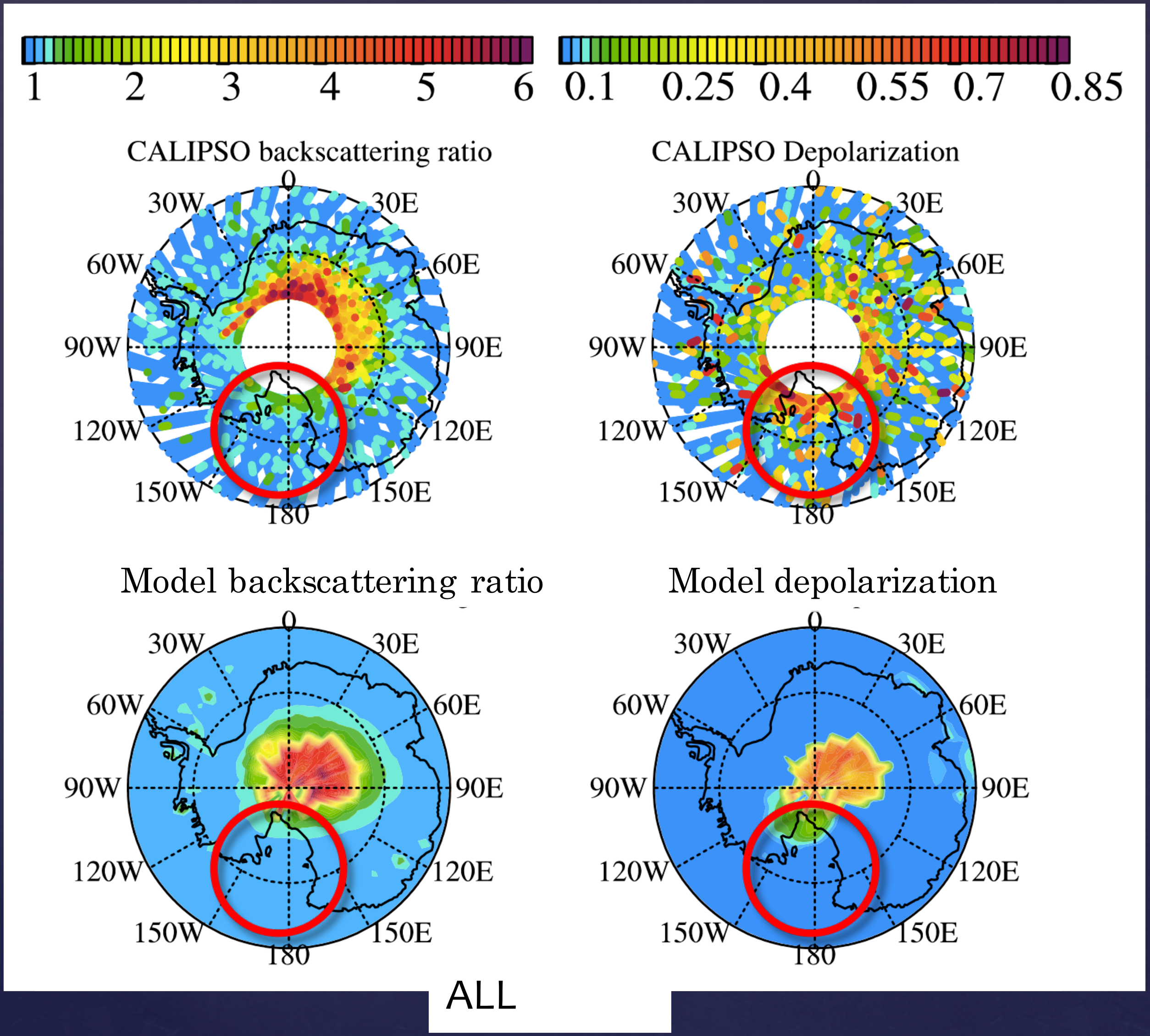
Large NAT

- Large effective radius (> 5-7 μm) .
- Low number densities (< 10^{-3} cm^{-3}); low backscattering ratio.
- Contribute to denitrification.
- Nucleate from STS.

Small NAT

- Small effective radius (< 3 μm) .
- Large number densities (> 1 cm^{-3}); high backscattering ratio.
- Contribute to surface area; may contribute to denitrification if they grow.
- Nucleate from STS in gravity wave; nucleate from numerous ice particles.

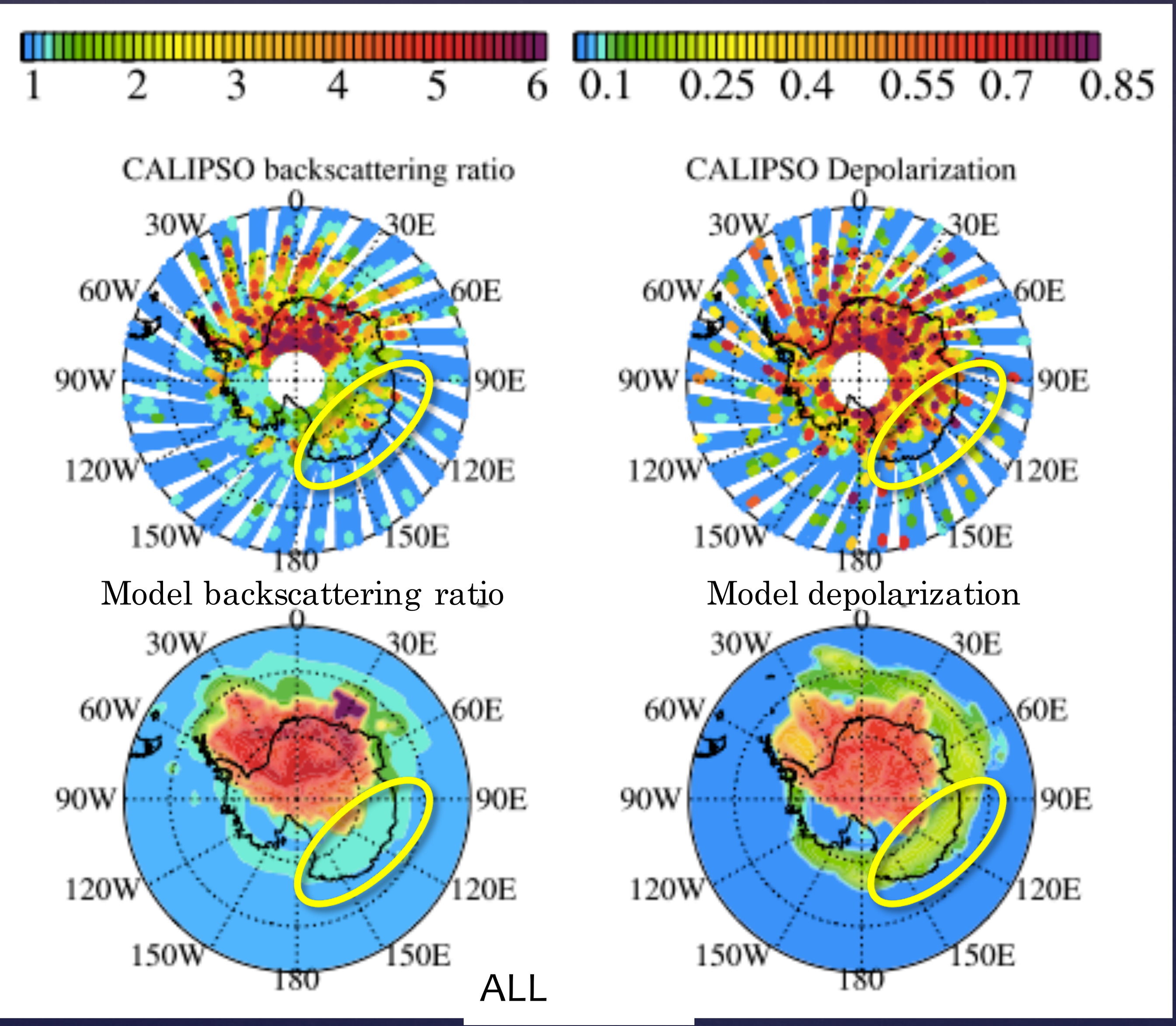
From May 24-28, the model reproduces the NAT as observed by CALIPSO.



CALIPSO observes low backscattering ratio with high depolarization.

Modeled NAT with large size and small number captures the characteristics.

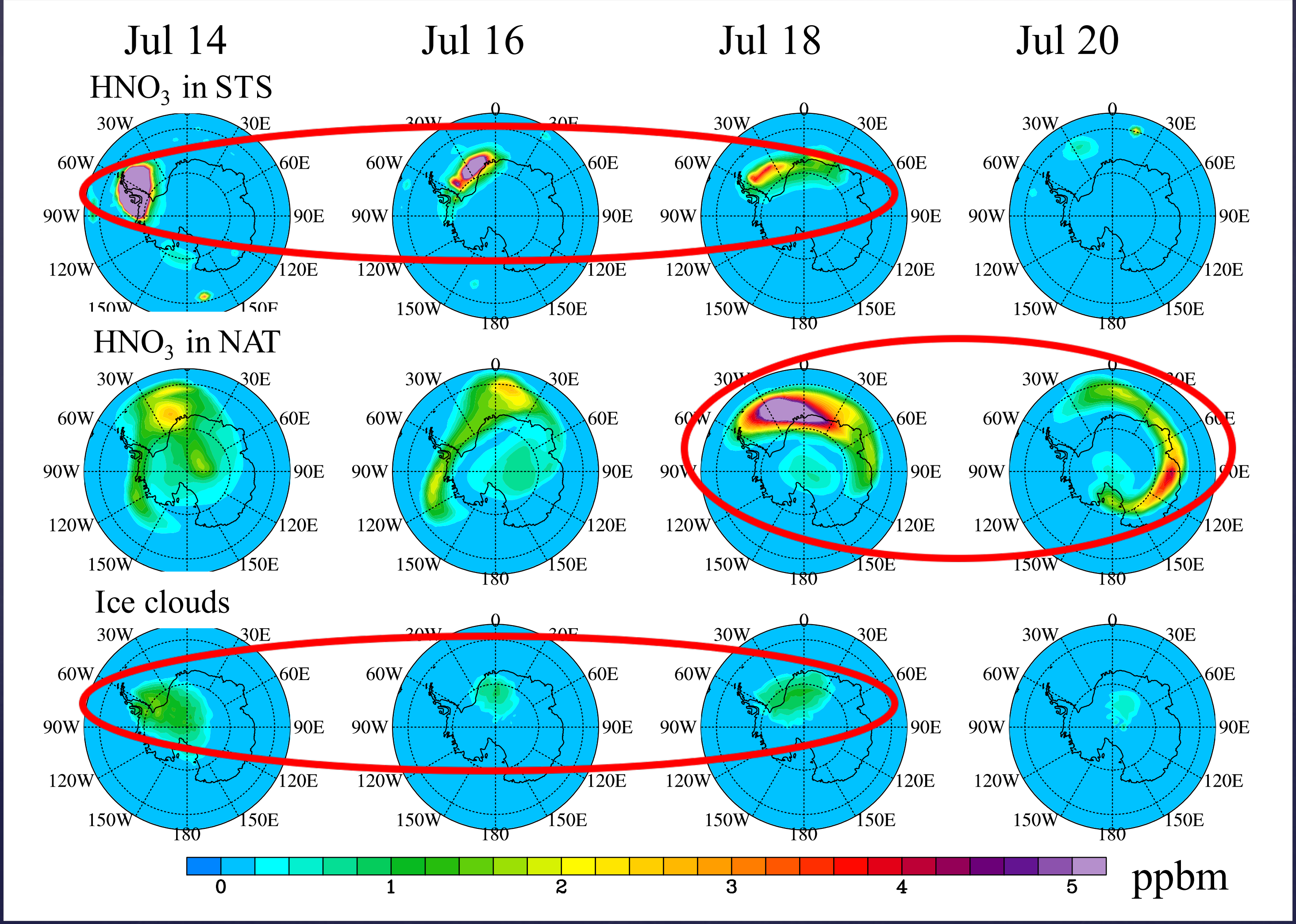
From Jul 18-22, the model cannot reproduce the NAT as observed by CALIPSO.



CALIPSO observes high backscattering ratio with high depolarization.

Modeled NAT captures the location but not the backscattering ratio.

The belt shape of NAT is likely to be triggered by nucleation from STS in wave or left behind by evaporated ice.



Gravity waves need to be resolved or NAT produced by ice needs to be modeled.

Conclusions:

- The simulated cloud coverage agrees with the CALIPSO cloud coverage within a few percent on average, and with a correlation coefficient of 0.83.
- The homogeneous NAT nucleation scheme creates the right size and concentration of NAT to explain the observed denitrification.
- In May, the model produces NAT with low backscatter and high depolarization as seen by CALIPSO.
- In July, NAT often forms in a belt around Antarctica with high depolarization and high backscatter. This NAT is likely produced for evaporating ice, or nucleated from STS in gravity waves. Model improvement is needed. Ice now is being modeled with CARMA.


Thank you!
CALIPSO
by yunqian 2015. 6. 23.