Wave clouds and PSCs above Scott's Discovery Hut at sunset, Sept. 26, 2004.
Photo by ***Alan Robock***

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The microphysical simulation of PSCs based on SD-WACCM/CARMA model over 2010-2011 winter

WAWG 2015. 02.

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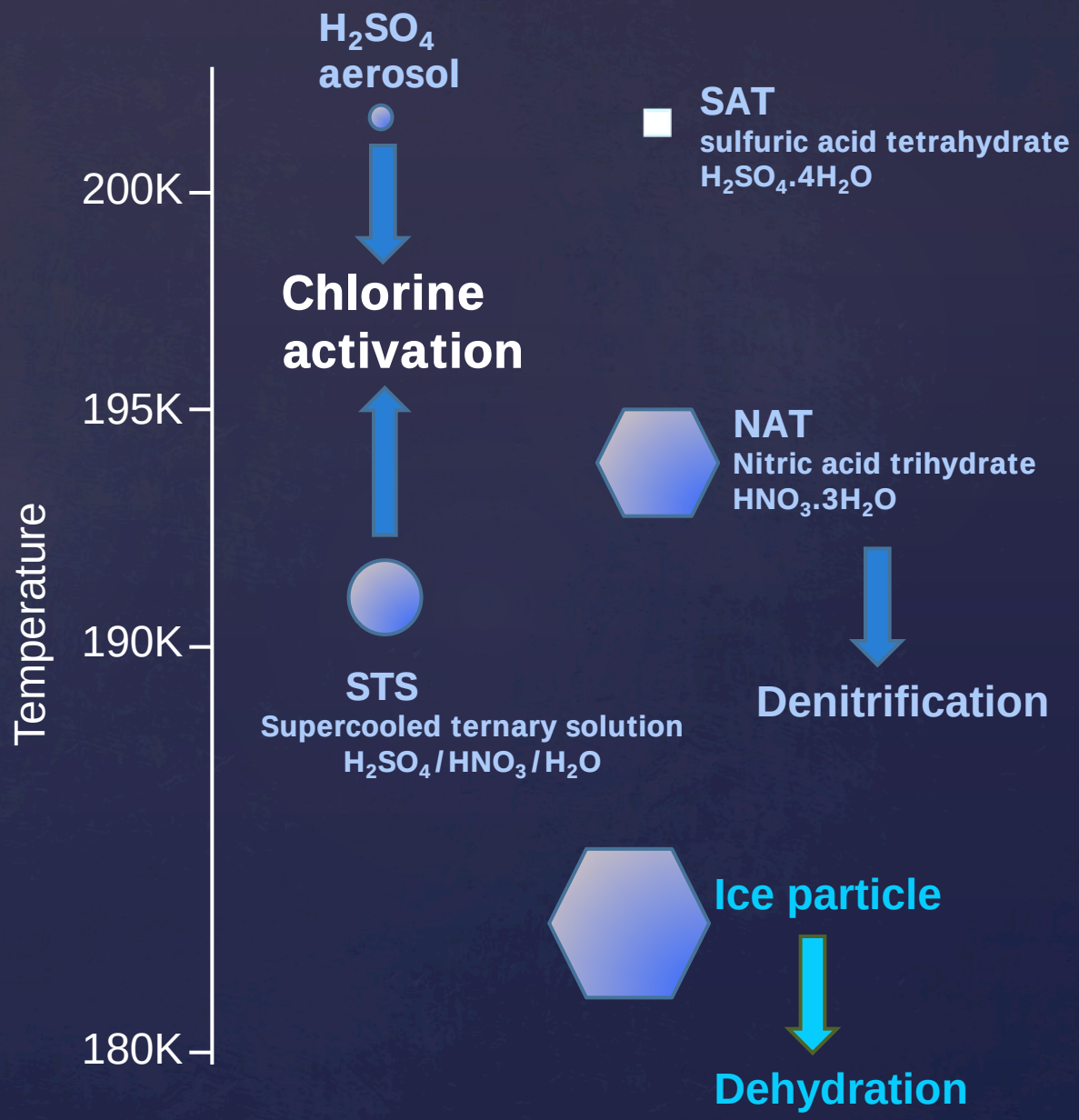
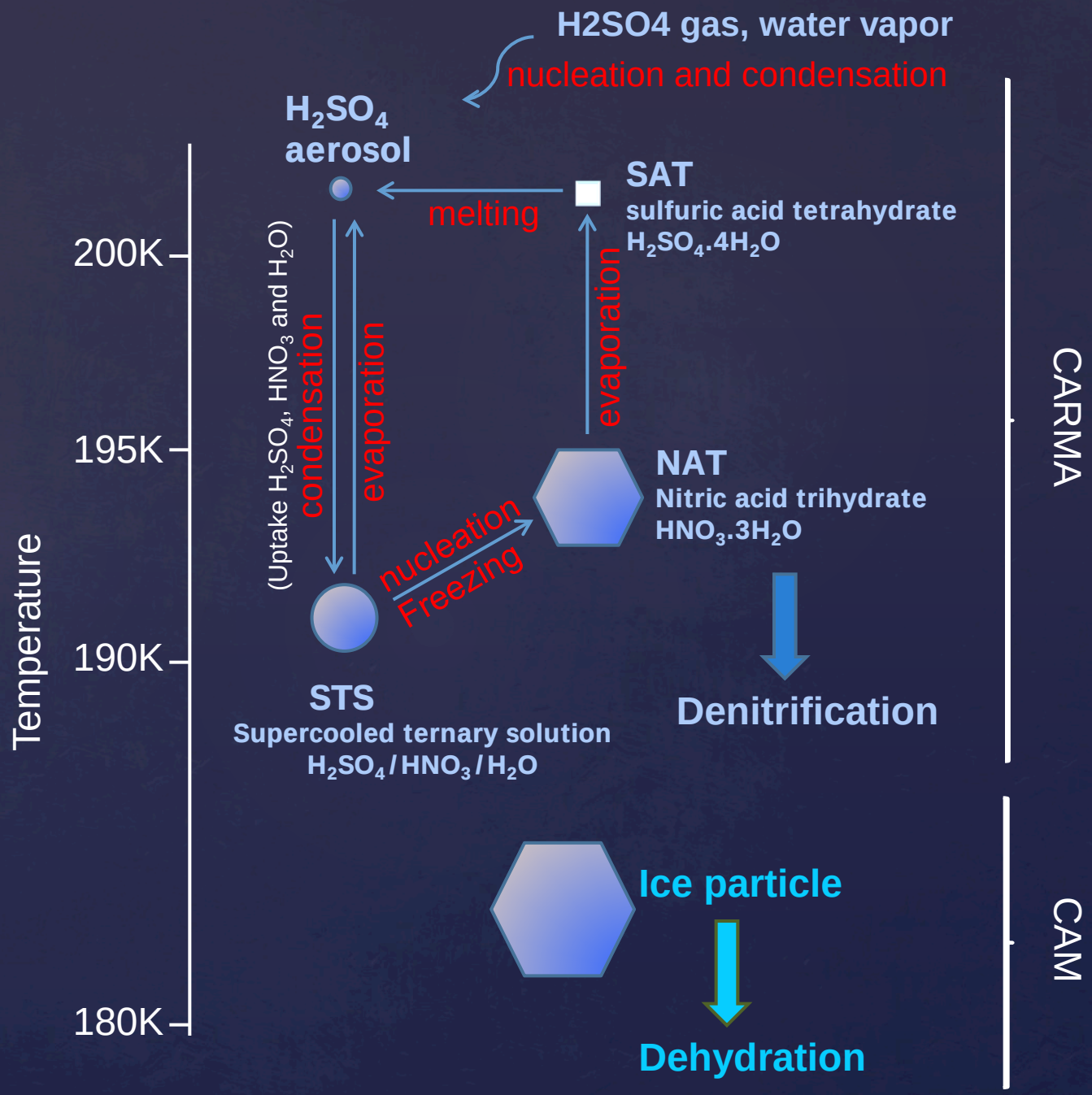
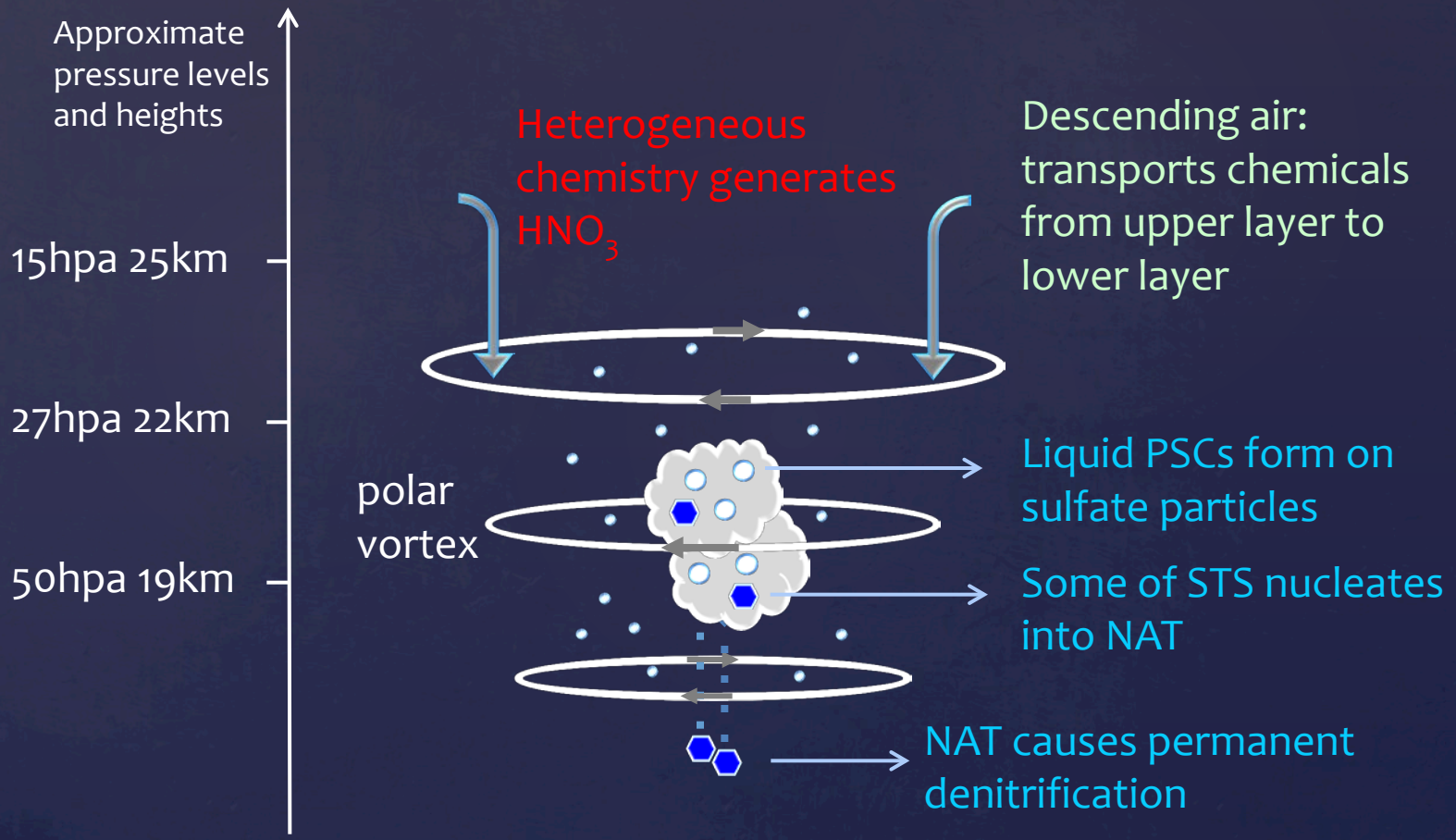
What are PSCs and what do they do?



How do we form the PSCs in the model?

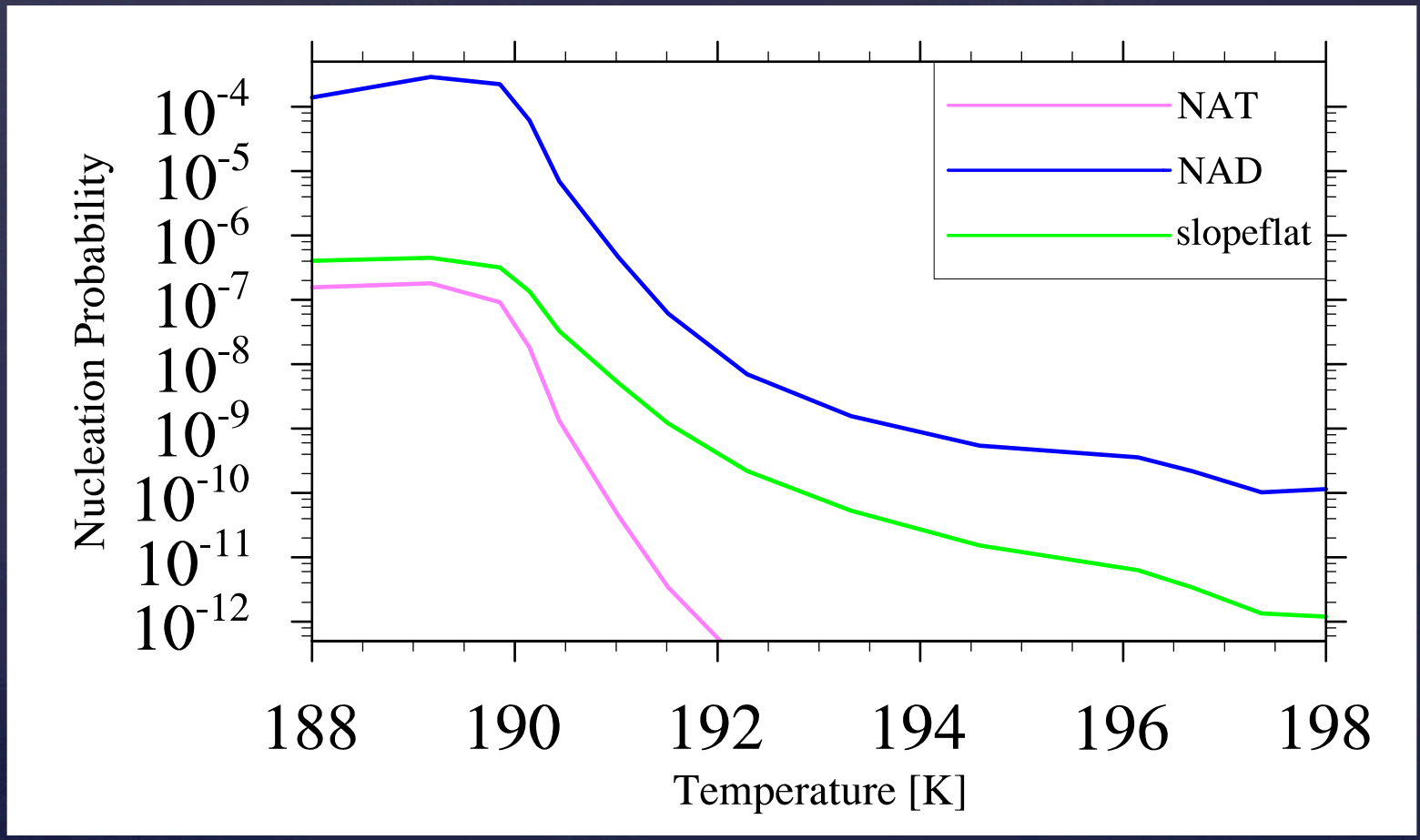


HNO_3 abundance is affected by variety of sources and sinks. We are interested in the denitrification.

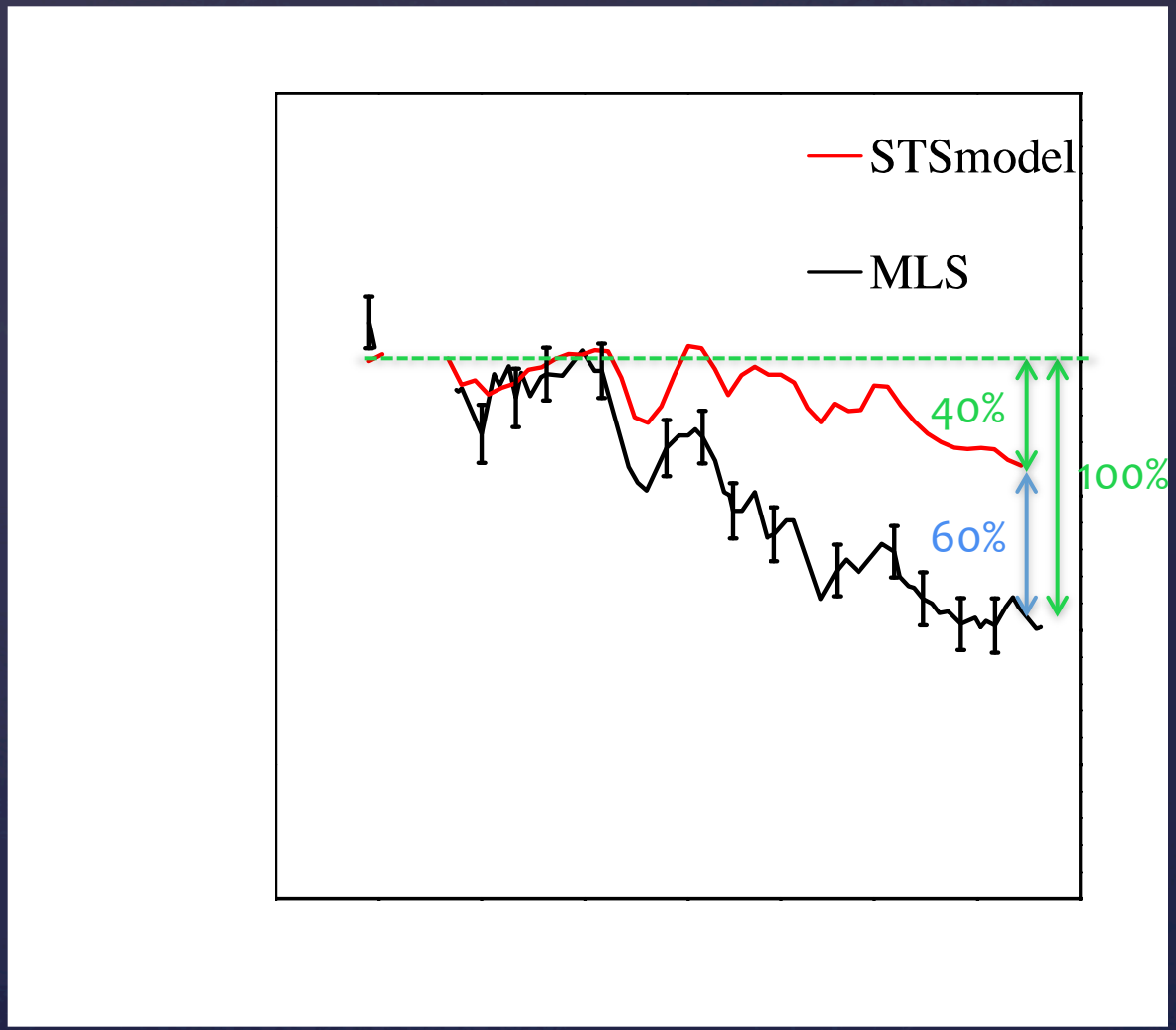


The NAT nucleation rate is not known, we test 3 homogeneous schemes.

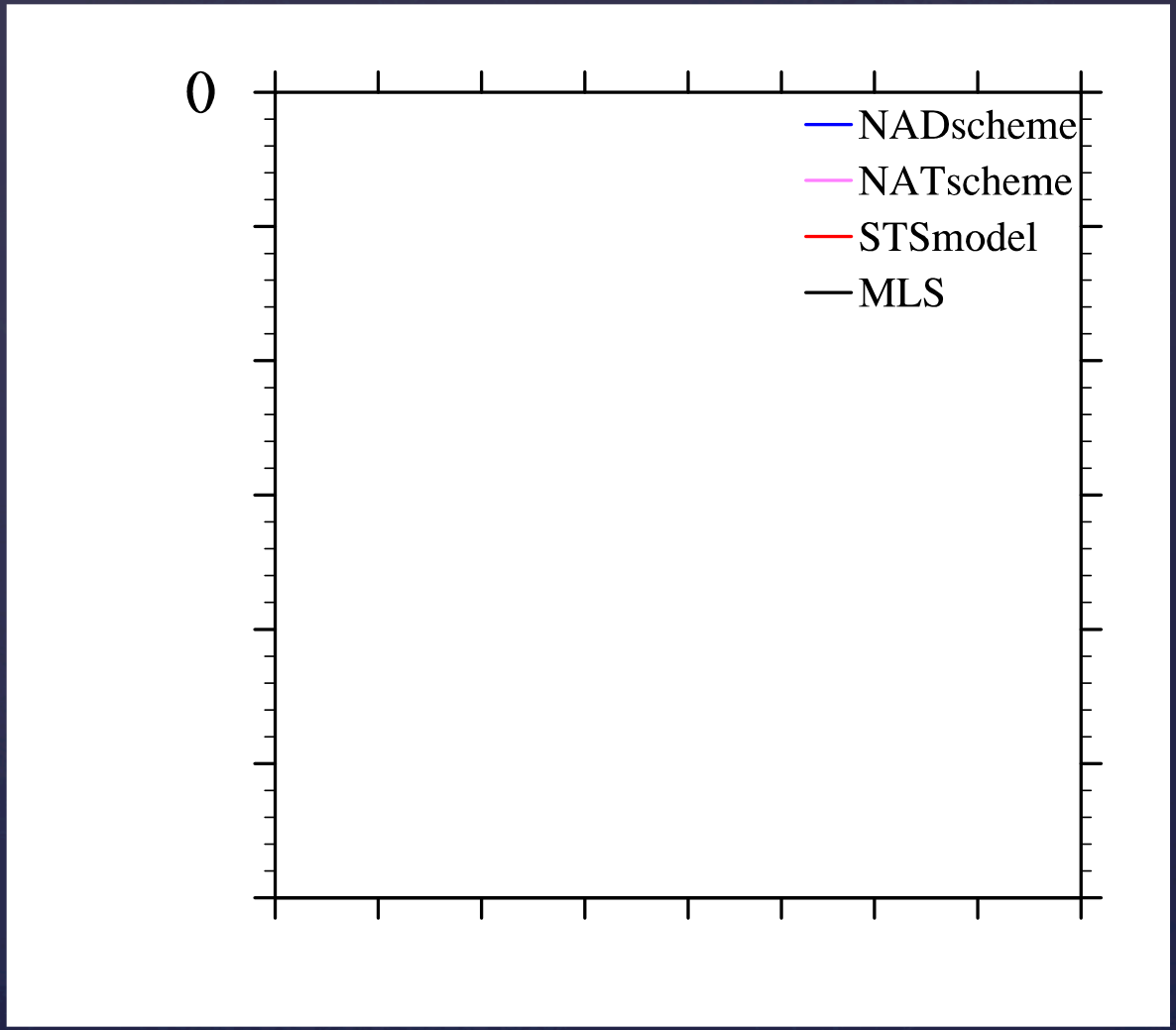
The nucleation probability is as a function of temperature and HNO_3 mole fraction of the STS particles [Tabazadeh et al., 2002].



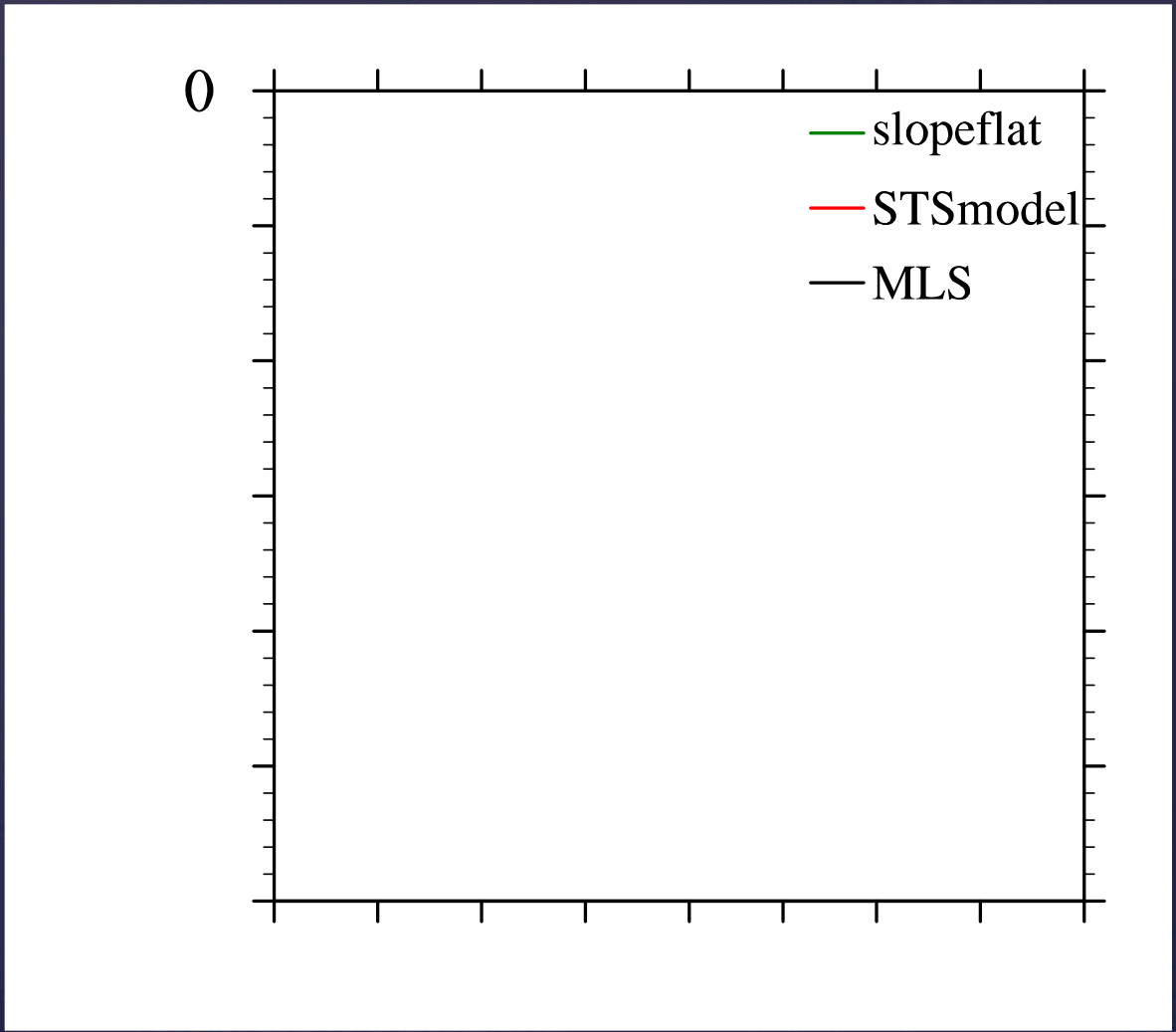
First, we test the model without NAT formation. We find 60% of HNO_3 change is caused by NAT denitrifying and 40% is caused by dynamics.



Then we test NATscheme and NADscheme.



We test the slopeflat case and find it fits the MLS observations the best.

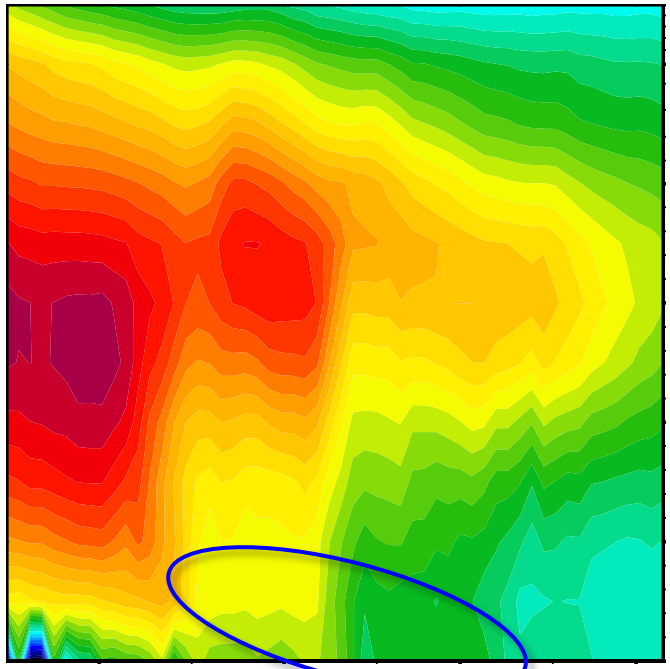


The simulations agree with MLS observations except near 400K where the model has a cold bias of 0.5K to 1K relative to MLS.

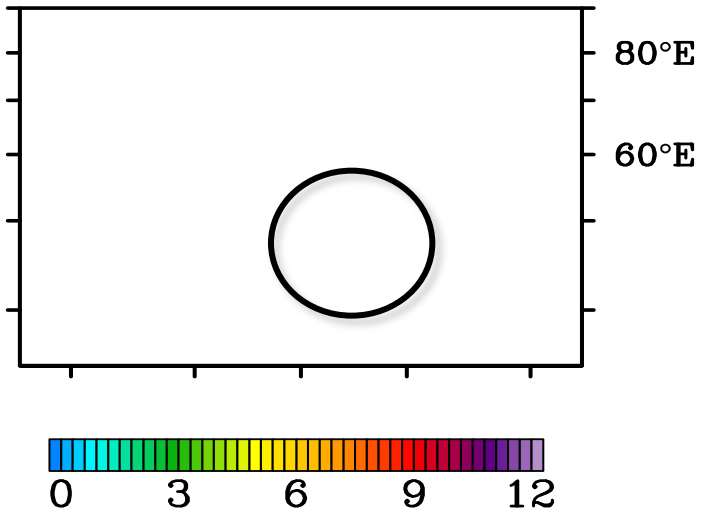
MLS HNO3

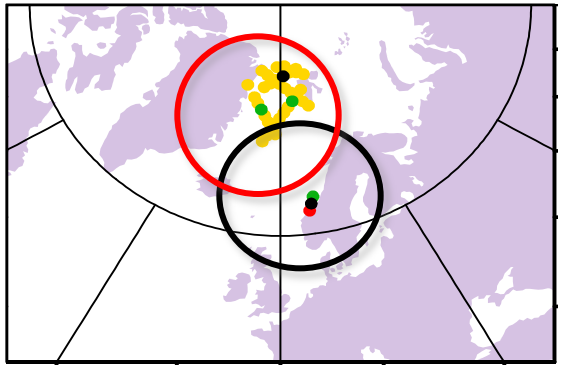
Model HNO3

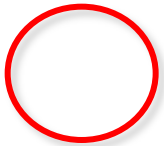
Theta [K]



The model captures the locations of STS and NAT.

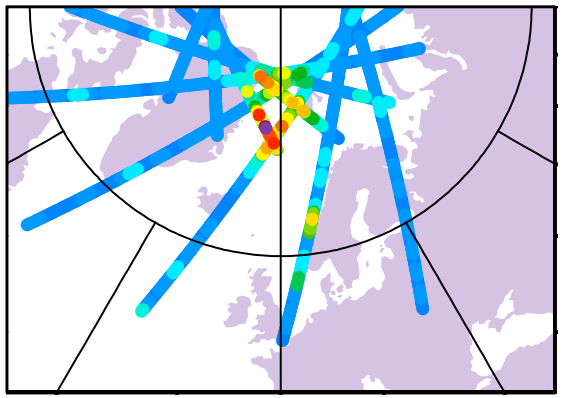


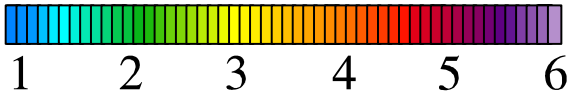




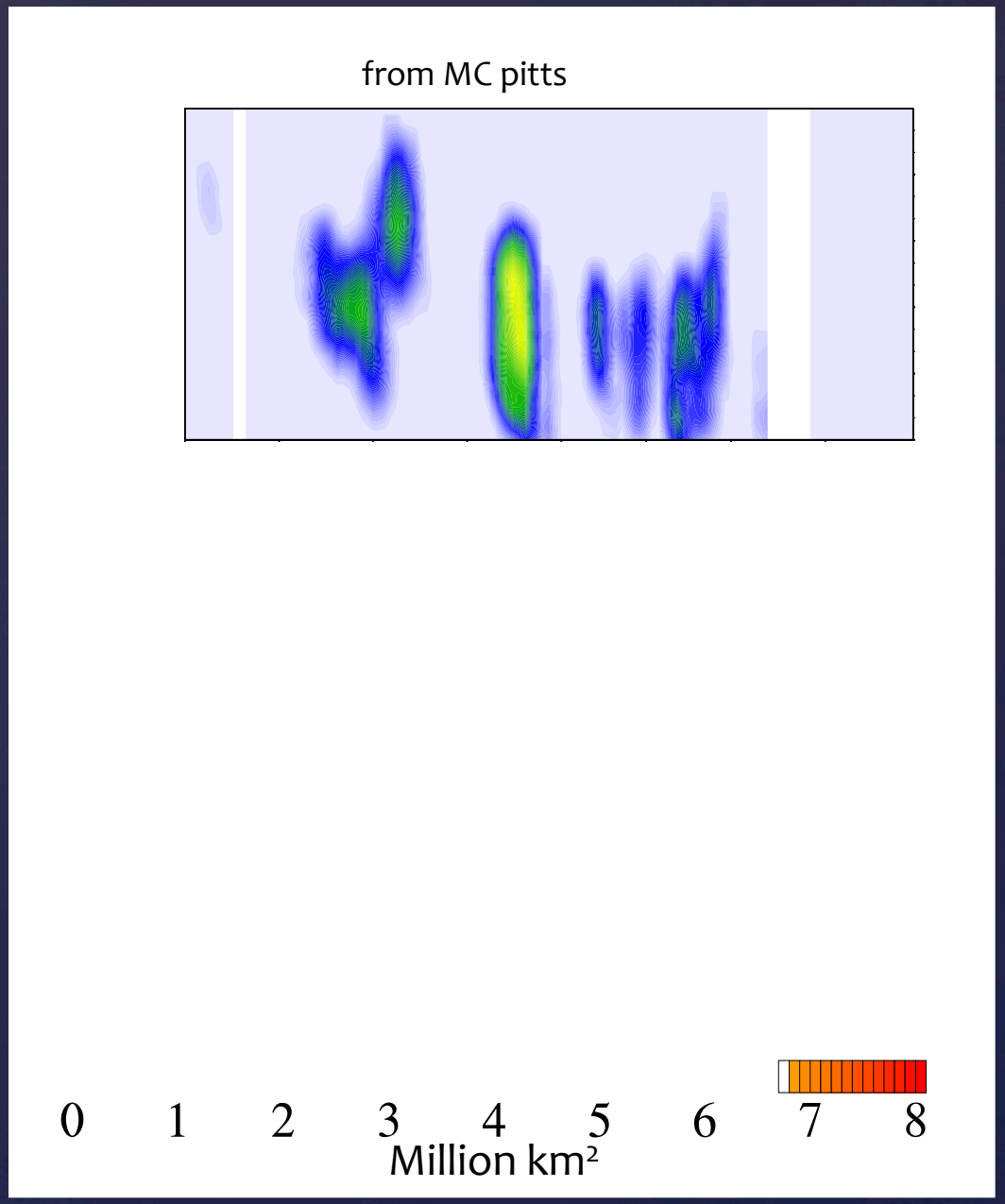
STS+NAT3
STS+NAT2
STS+NAT1
STS

The modeled backscattering ratio is very close to the CALIPSO observation.

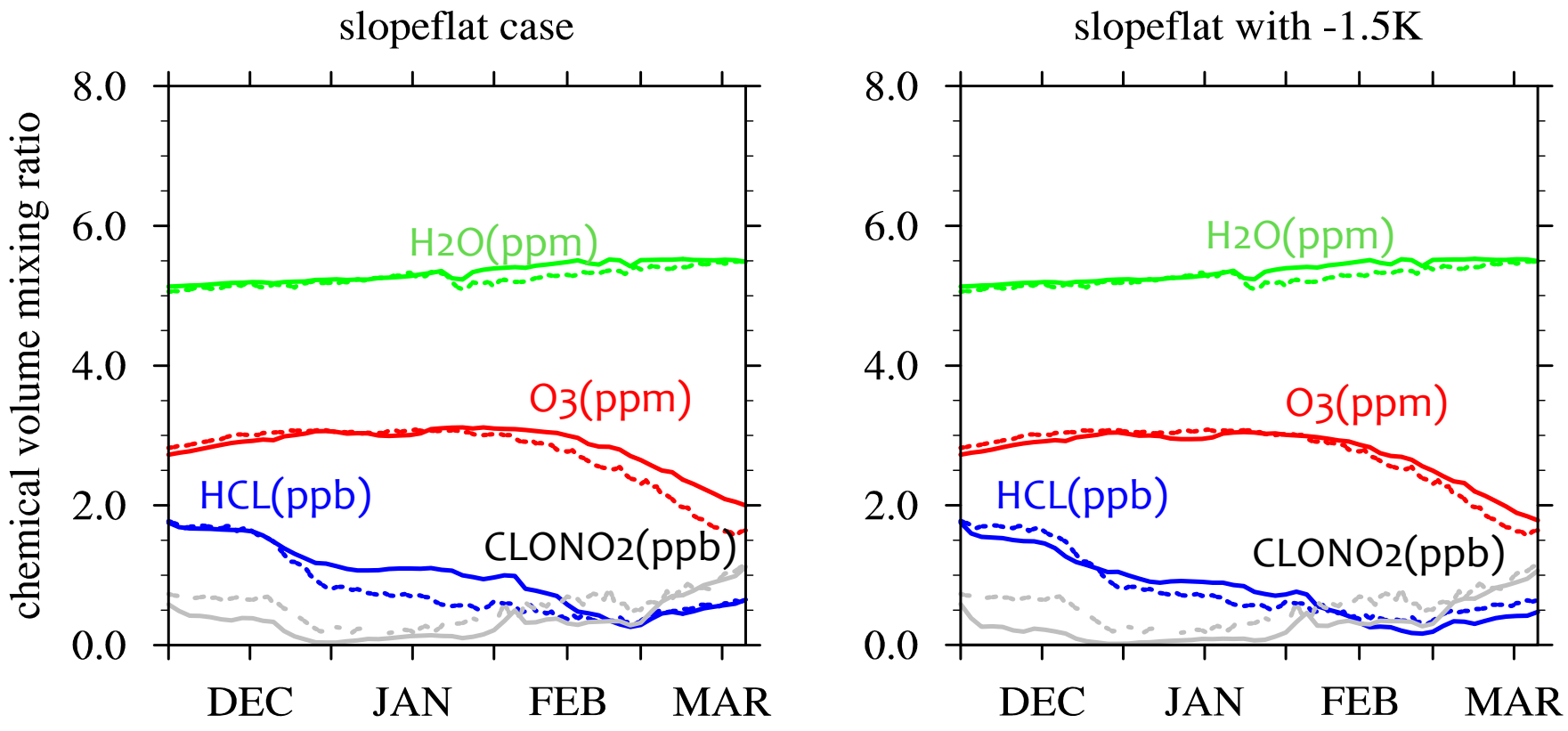




The PSCs coverage is overestimated in late January.



The model (solid lines) overestimates O_3 in Mid-March compared with MLS.
The sensitivity test with -1.5K improves the prediction.



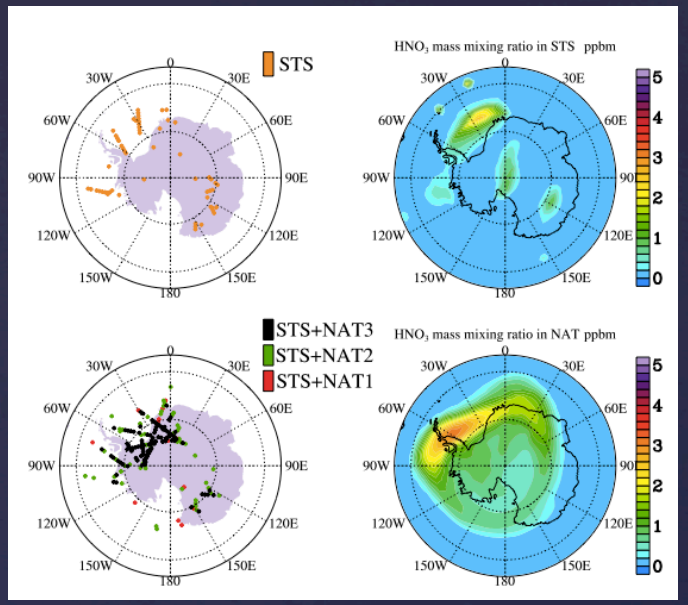
Conclusions

- Tuning the free energy in the nucleation rate improves HNO_3 prediction compared with NATscheme and NADscheme.

- The locations and backscattering ratio of PSCs are similar with CALIPSO observations.

- The area of the vortex containing PSCs is too high in late January because of the different threshold of NAT definition.

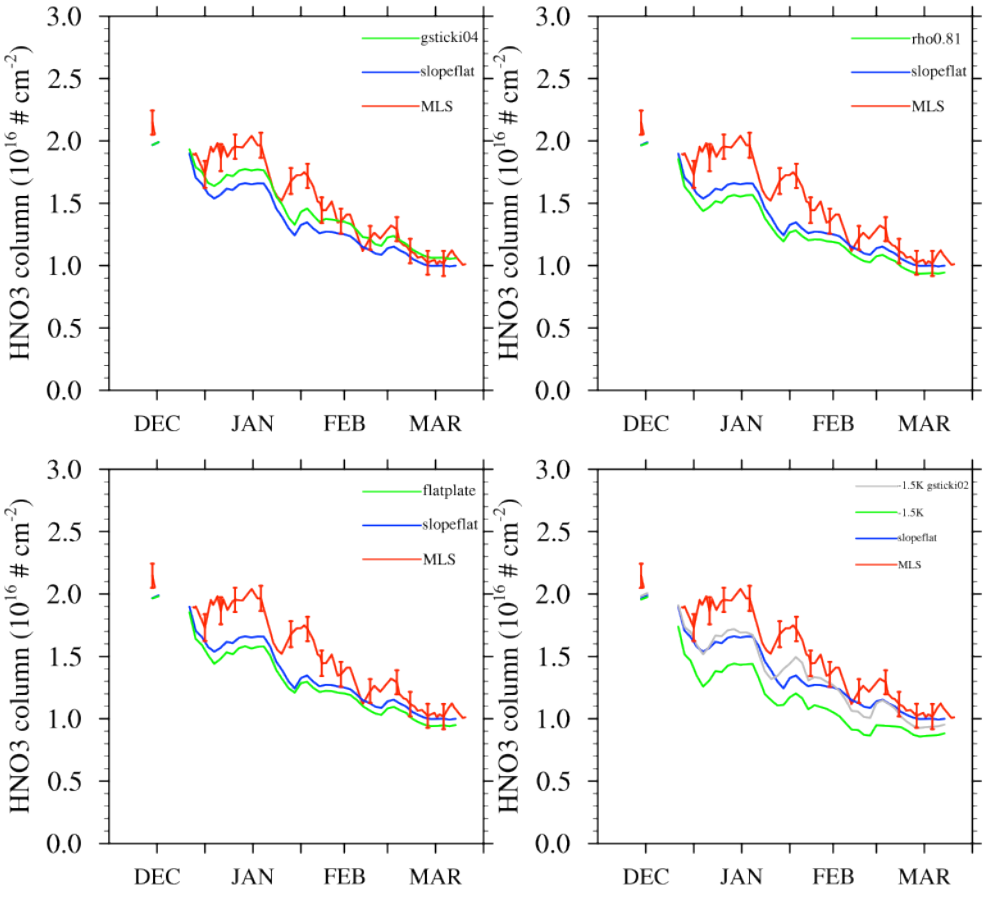
Future work



- We will simulate the Antarctic PSCs.

- We will add ice particle formation in our microphysical model.


Thank you!
SHOON 2013. MAY


HNO3 column (10^{16} # cm^{-2})
3.0
2.5
2.0
1.5
1.0
0.5
0.0
DEC
JAN
FEB
MAR
gsticki04
slopeflat
MLS
rho0.81
slopeflat
MLS
flatplate
slopeflat
MLS
1.5K gsticki02
1.5K
slopeflat
MLS