

Using ARM Data to Constrain Cirrus Cloud Parameterizations in Climate Models

Xiaohong Liu, X. Shi
(Pacific Northwest National Laboratory)

Cloud Microphysics in NCAR CAM5

- ▶ Two-moment for cloud liquid and cloud ice
 - Predicts water/ice mixing ratio & number concentrations
 - Gamma functions, simplified ($\gamma=0$) for cloud ice
- ▶ Diagnostic 2-moment precipitation (rain and snow)
- ▶ Liquid and Ice indirect effects represented
- ▶ Consistent treatment of sub-grid cloud water
 - for all relevant microphysics processes
- ▶ Ice supersaturation

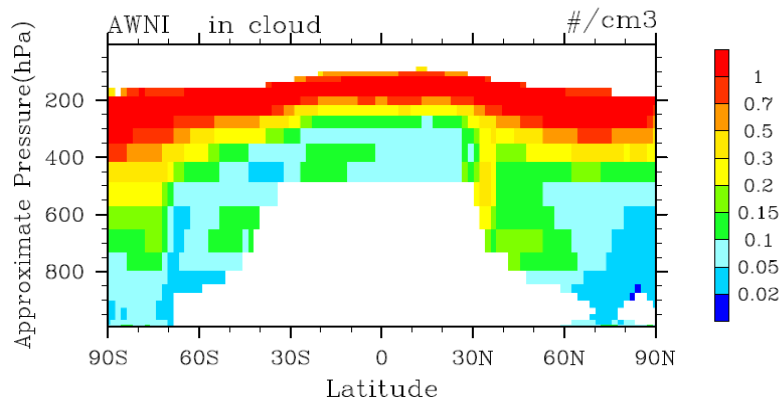
Ice Nucleation Parameterizations

- ▶ Liu and Penne (2005) developed a physically based ice nucleation parameterization that considers the transition from the heterogeneous to homogeneous dominated nucleation and the competition between homogeneous and heterogeneous nucleation in transition regime (hereafter **LP**).
- ▶ Barahona and Nenes (2008a,b; 2009) developed a framework that can use different ice nuclei (IN) nucleation spectra (CNT, CFDC measured IN) and consider the competition of homogeneous and heterogeneous nucleation (hereafter **BN**)

Comparison between LP and BN scheme

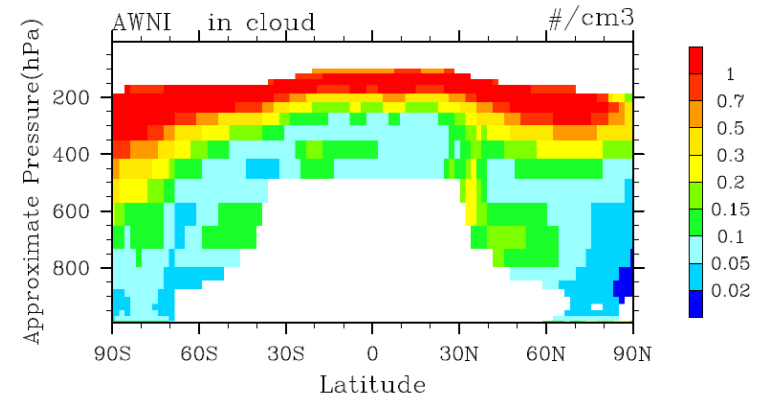
LP

LP hom allso4

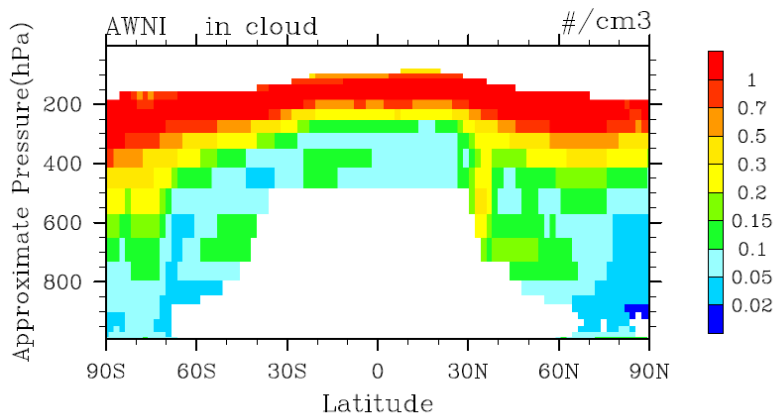


BN

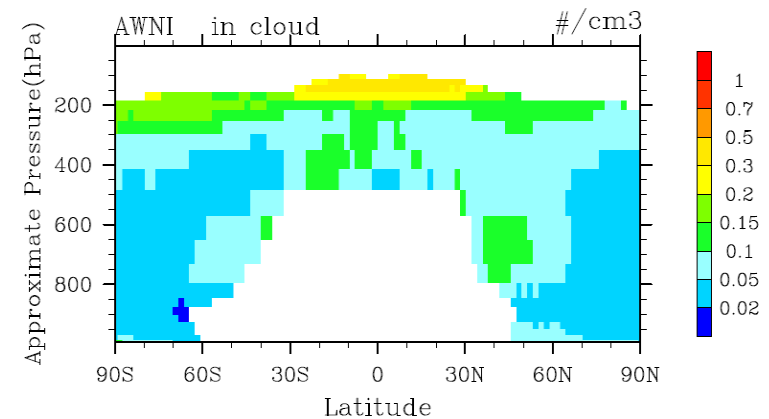
BN hom allso4



LP allso4



BN allso4

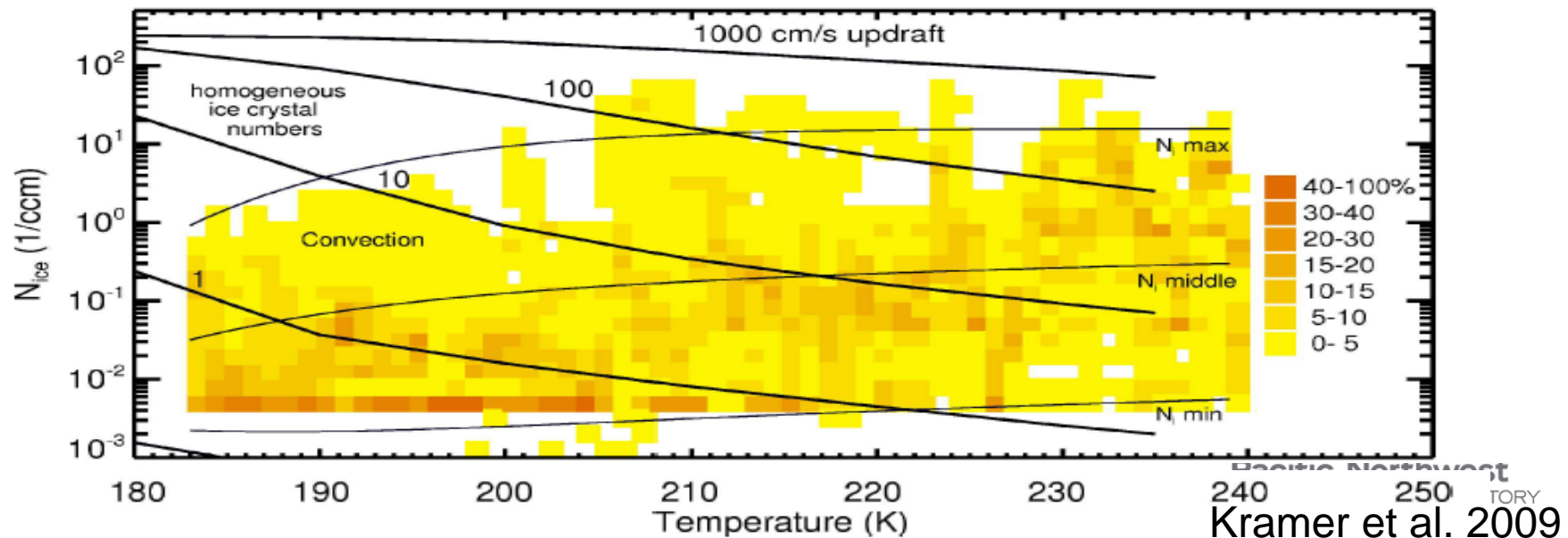
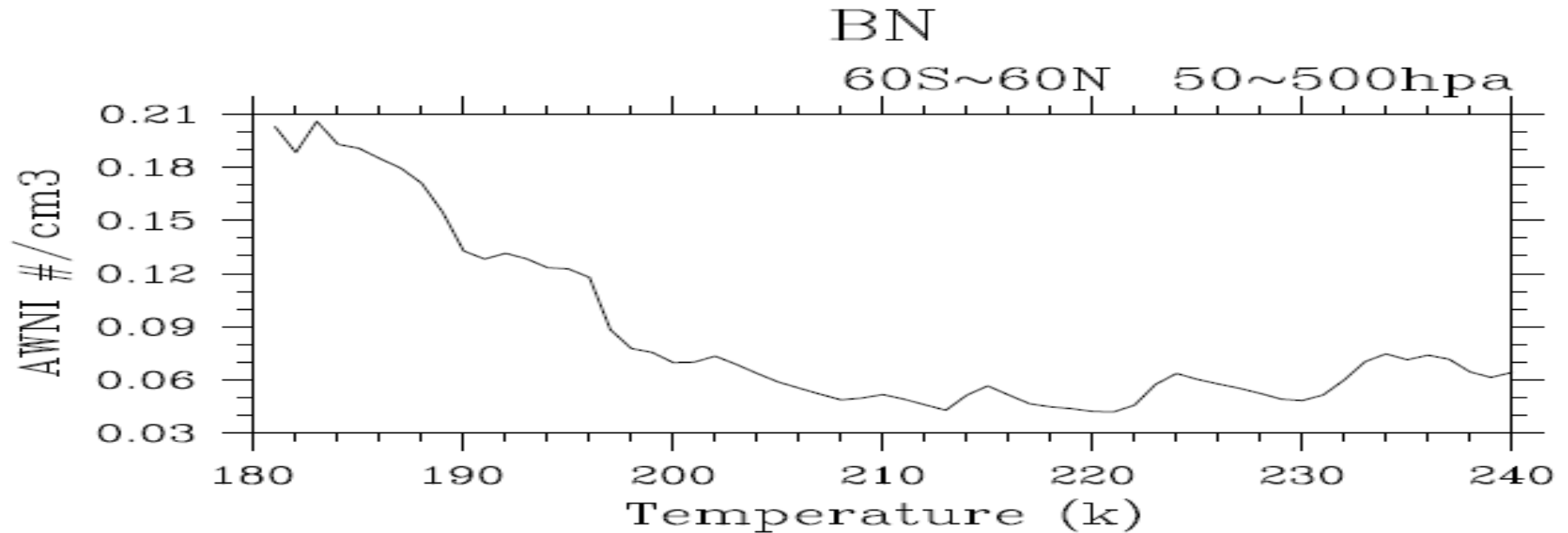


Upper : pure hom

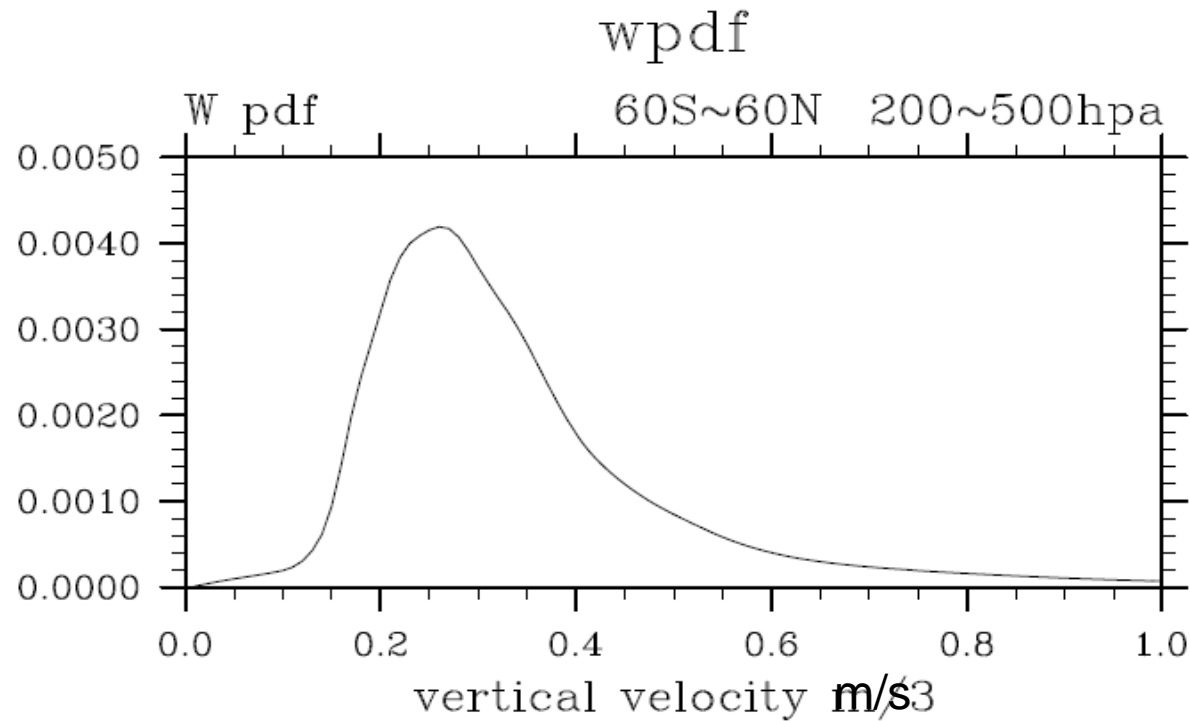
Lower : competition between hom and het

allso4--using all sulfate

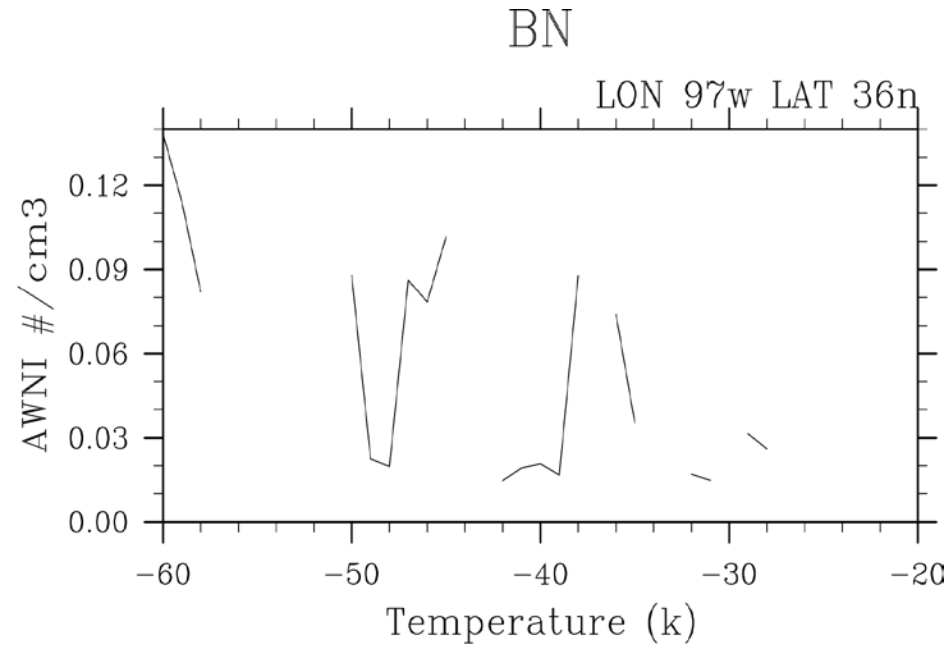
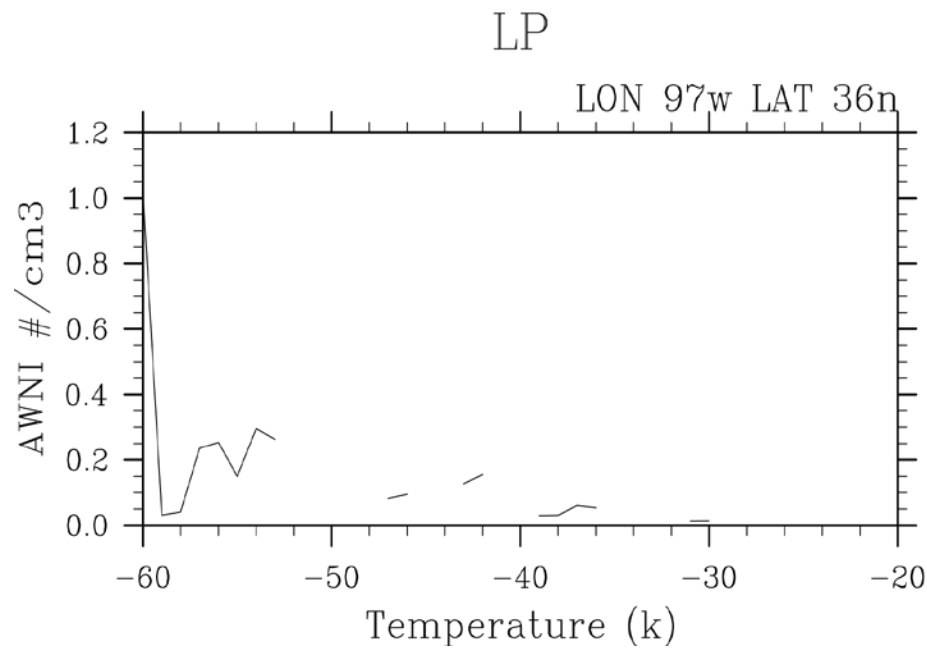
Ice crystal number vs. T



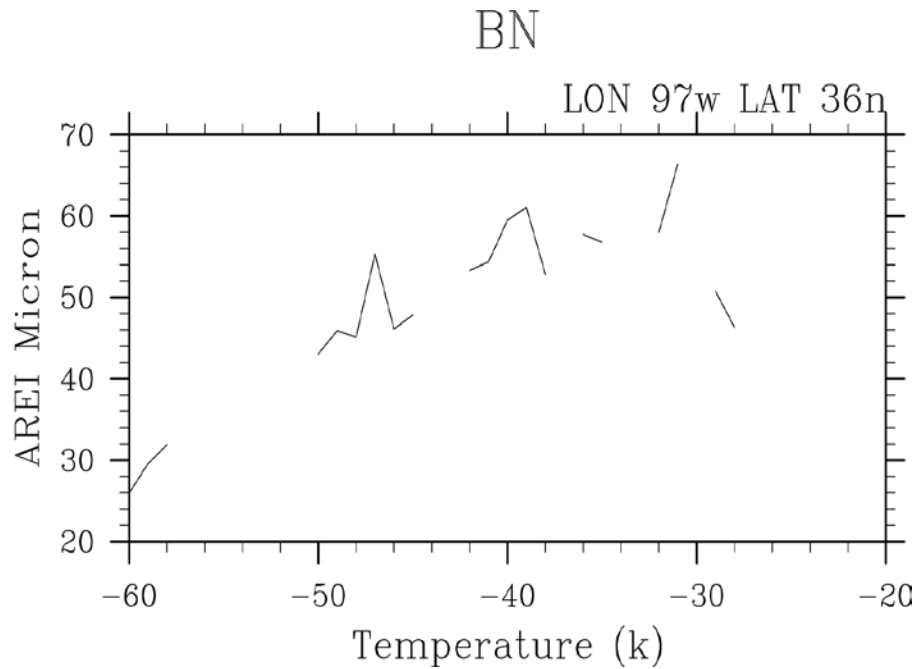
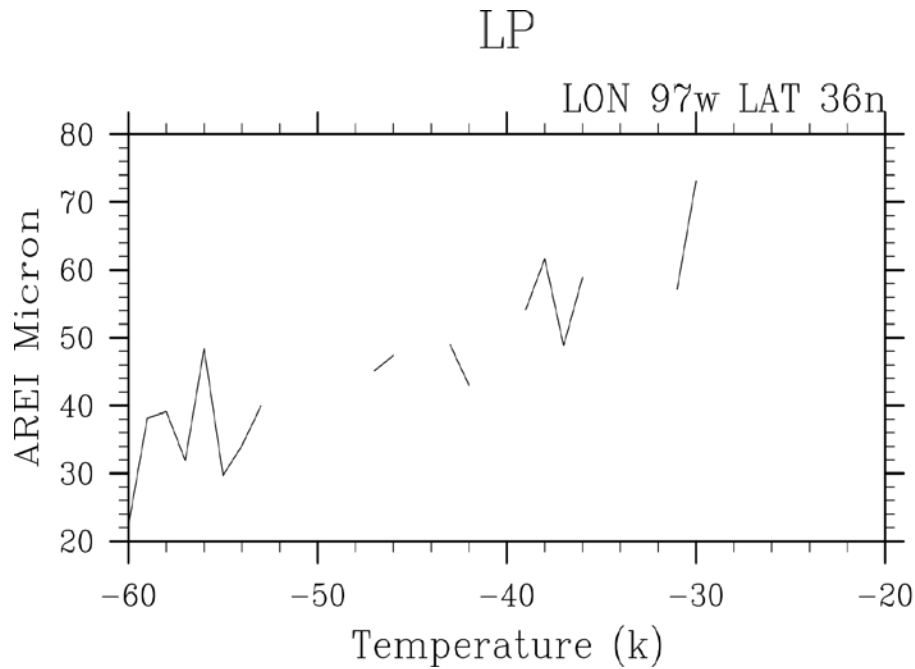
Air Dynamics



Ice crystal number vs. T (SGP in January)



Ice effective radius vs. T (SGP in January)



Summary

- ▶ Sparticus is providing the first, long-term, reliable climatological data set on ice crystal properties to constrain the GCM cloud parameterizations on ice formation. It will provide guidance for developing cloud parameterizations on ice microphysics.
- ▶ A close collaboration between modelers and observers.