Modeling the Upper-Tropospheric Ice Water Content in TWP-ICE

Xiping Zeng, Wei-Kuo Tao, Minghua Zhang, and Shaochen Xie

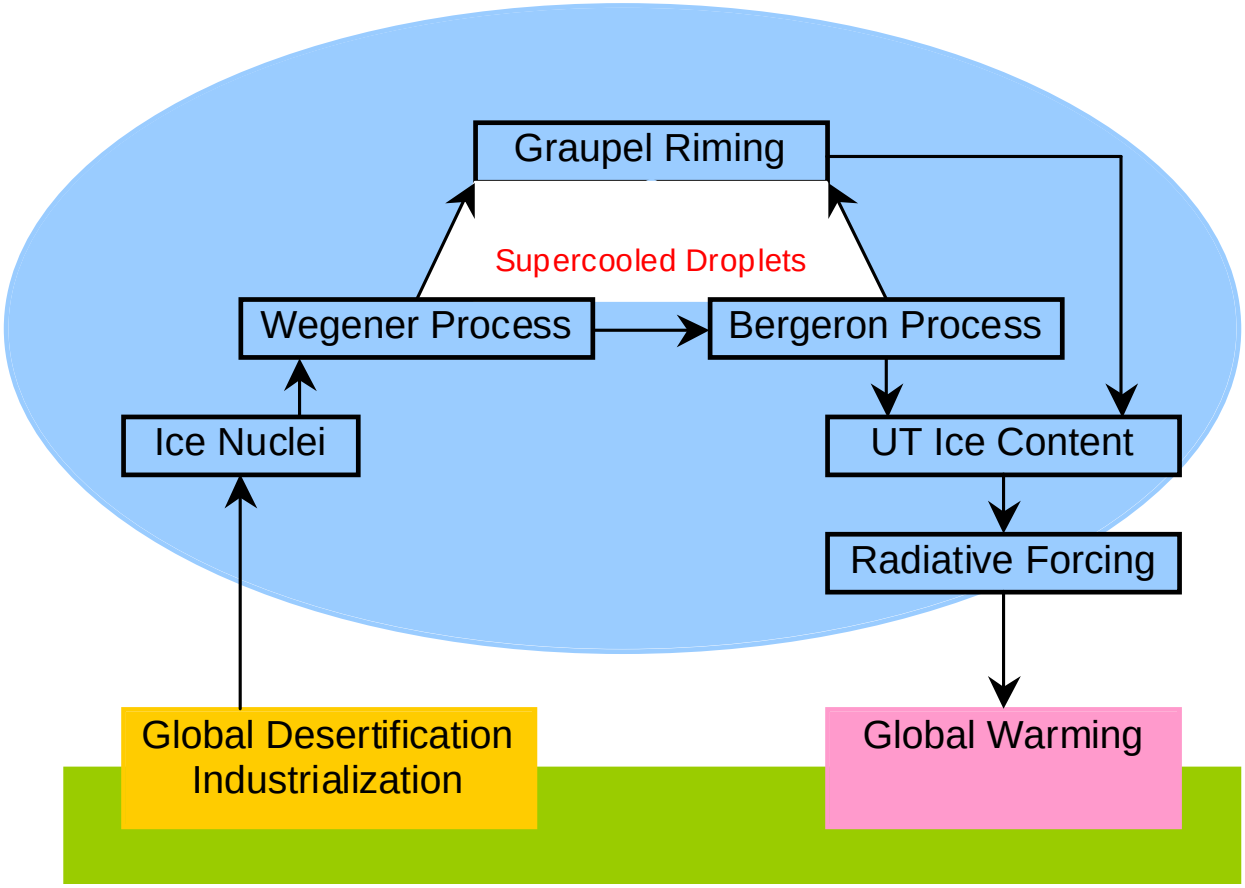
March 31, 2009

Papers Published Recently

- Zeng, X., W.-K. Tao, M. Zhang, A. Y. Hou, S. Xie, S. Lang, X. Li, D. Starr, X. Li, and J. Simpson, 2009: An indirect effect of ice nuclei on atmospheric radiation. *J. Atmos. Sci*., **66**, 41-61.

- Zeng, X., W.-K. Tao, M. Zhang, A. Y. Hou, S. Xie, S. Lang, X. Li, D. Starr, and X. Li, 2009: A contribution by ice nuclei to global warming. *Quart. J. Roy. Meteor. Soc., (accepted)*.

Global Desertification & Warming



Cloud Microphysics

The Rutledge-Hobbs Scheme

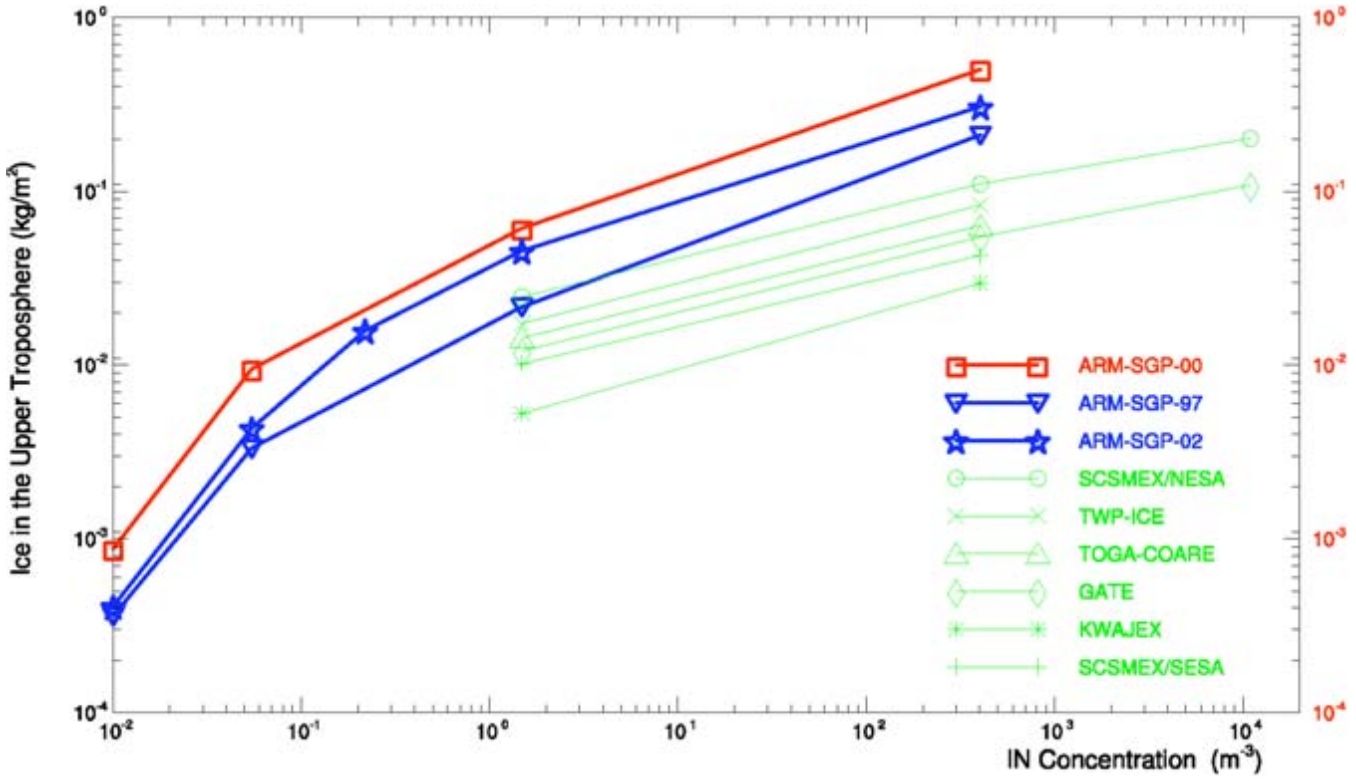
\+ Ice Crystal Concentration or

(or μN_i)

N_i : ice nuclei concentration

μ : ice crystal enhancement factor

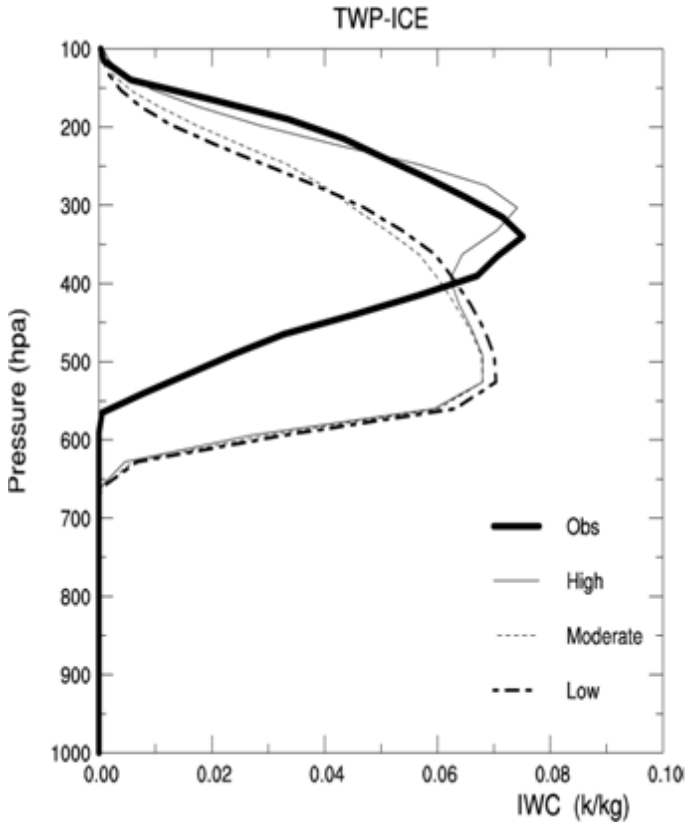
UT Ice Water Content vs μN_i



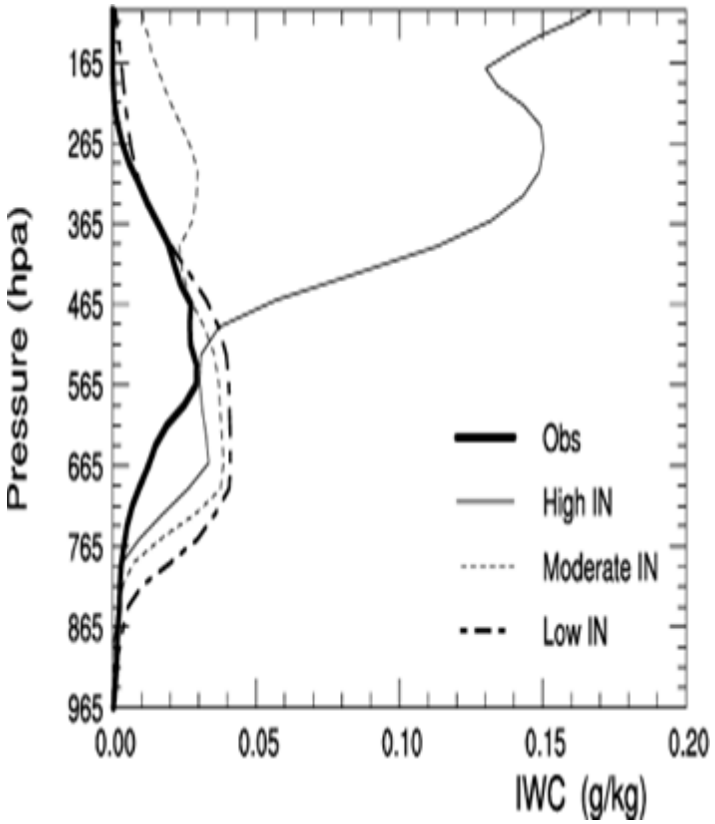
TWP-ICE Simulations

- Model Gridpoints: 256x256x41
- Horizontal Resolution: 1 km
- Period: 2100 UTC 6 to 12 February 2006

Modeled IWC vs Retrieved IWC



TWP-ICE

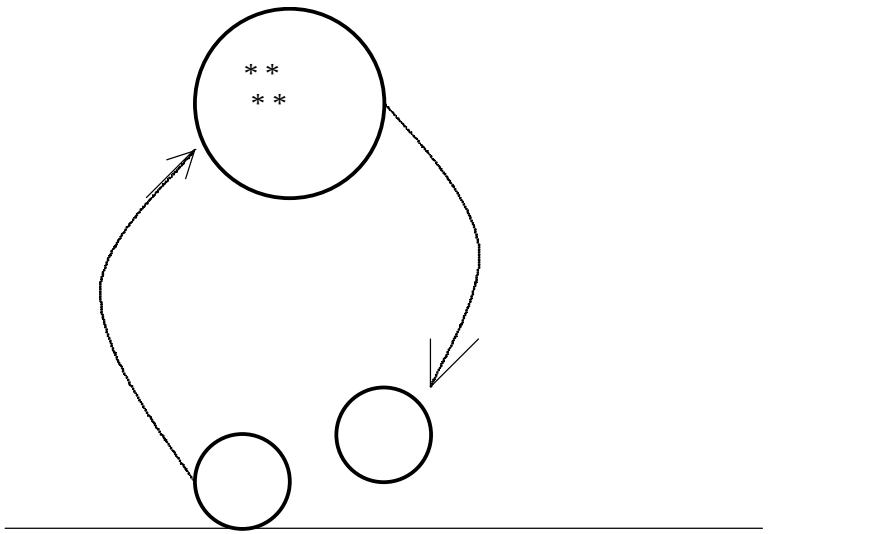


ARM-SGP-00

Difference in Ice Crystal Enhancement Factor between Tropical and Mid-latitudinal Clouds

μN_i	>>	μN_i
TWP-ICE		ARM-SGP 97,
KWAJEX		2000,
GATE		2002

An Irreversible Process for Ice Crystal Enhancement



Papers on Downdraft Observations

•Wei, D., A. M. Blyth, and D. J. Raymond, 1998: Buoyancy of convective clouds in TOGA COARE. *J. Atmos. Sci.*, **55**, 3381-3391.

• Igau, R. C., M. A. LeMone, and D. Wei, 1999: Updraft and downdraft cores in TOGA COARE: Why so many buoyant downdraft cores? *J. Atmos. Sci.*, **56**, 2232-2245.

• Zipser, E. J., 2003: Some view on “hot towers” after 50 years of tropical field programs and two years of TRMM data. Cloud systems, hurricanes, and the Tropical Rainfall Measuring Mission (TRMM). *Meteor. Monogr.*, **29**, 49-58.

Conclusions

- UT ice water content is sensitive to IN concentration and ice crystal enhancement factor.
- The ice crystal enhancement factor is much larger in tropical clouds than in mid-latitudinal ones.
- Two-momentum microphysics schemes should take account of the effect of subgrid motions on ice crystal concentration.