The Radiative Effect on Cloud Microphysics and its Parameterization

Xiping Zeng

GESTAR/GSFC/NASA

ASR Meeting on Nov 5, 2013

Uncertainty of a Climate Model Parameter

- Clouds in climate models form when

  f (relative humidity) $> f_{ic}$ (a parameter)

- Textbooks say: $f_{ic} = 100\%$

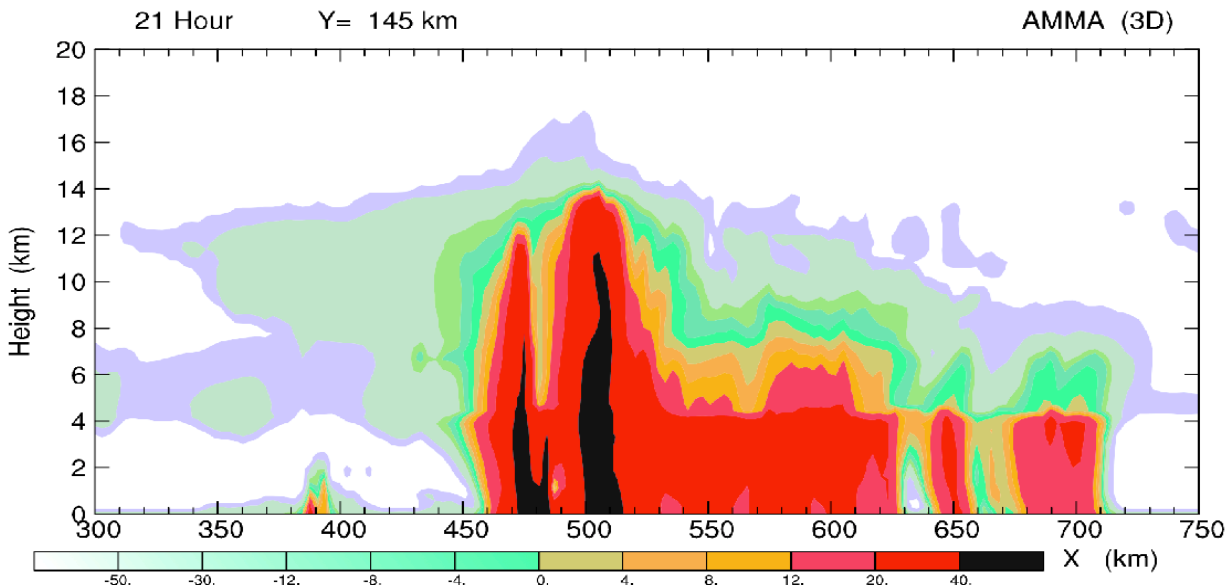
- Experienced Modelers: $f_{ic} < 100\%$

  Sensitive to f_{ic}

- Motive: why $f_{ic} < 100\%$?

  what determine f_{ic} ?

Modeling Anvil of MCSs



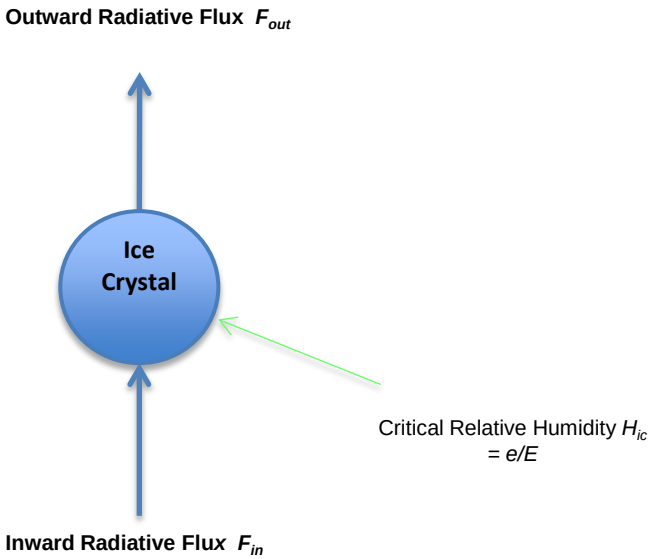
Comparison with W-band radar data: CRM-modeled anvil is too thick

See Powell et al. (2012, JAS), Zeng et al. (2013, JAS) for details

Observations of Drops/Crystals Formation in Unsaturated Environments

Dew drops form on a summer night of Maryland with f <100%

Radiative Effect on Drops/Crystals Growth



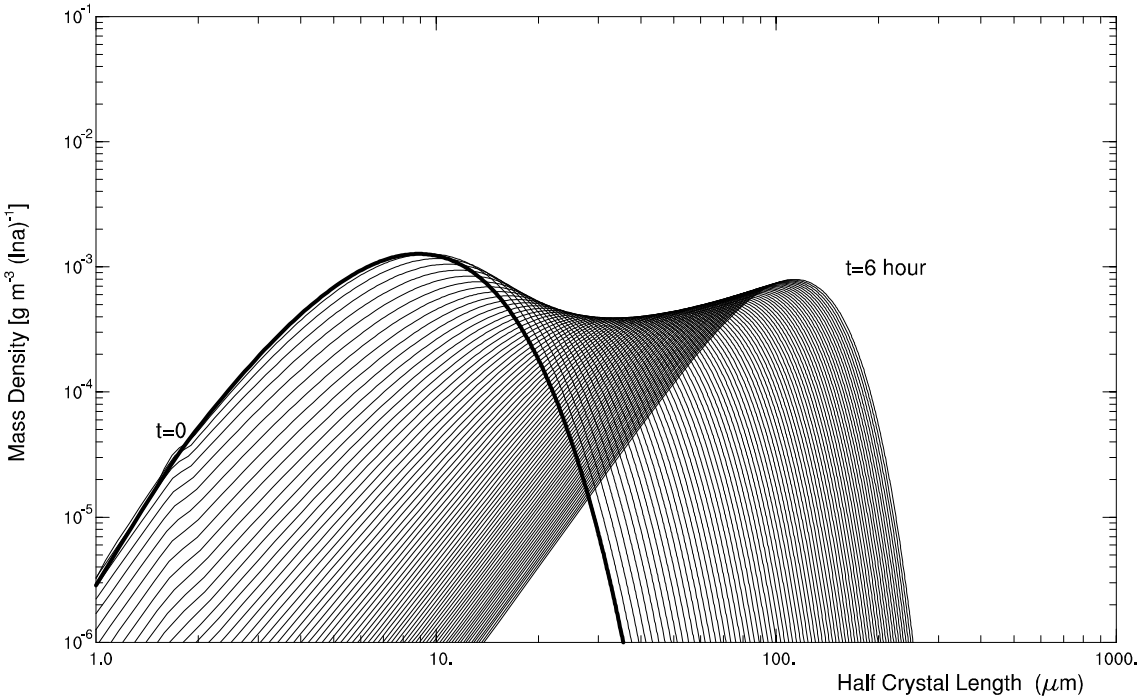
➔ $\eta \approx 1$ for a black or gray atmosphere

➔ *$\eta > 1$ or $\eta < 1$ for the atmosphere with atmospheric windows*

$$\eta \approx F_{in} / F_{out}$$

Ratio of Inward to Outward Radiative Fluxes

Bin Model Simulations of the Radiative Effect



η = 0.5 and *p =250 hPa*

See Zeng (2008, QJ)

Future Work

- Develop a parameterization on the radiative effect,
- Evaluate the parameterization via comparing CRM results to ARM data,
- Provide two versions of the parameterization for CRM and climate models, respectively.