

Improving the WBF process in CAM5 and impacts on cloud phase partitioning

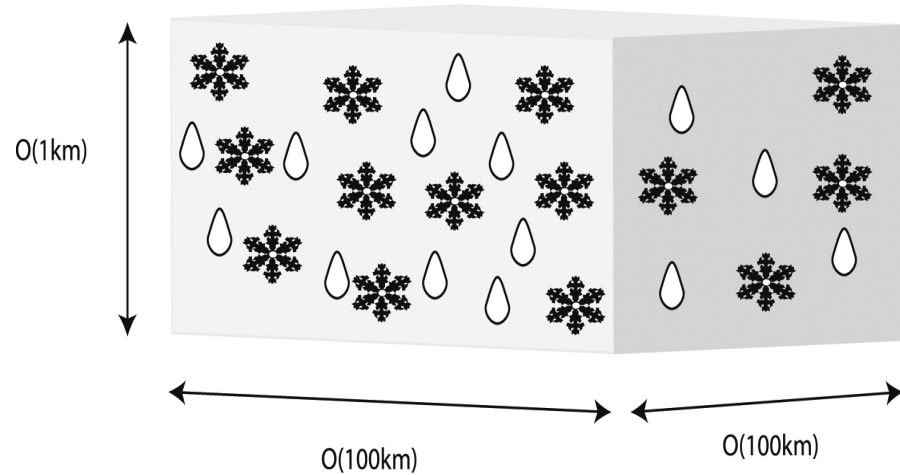
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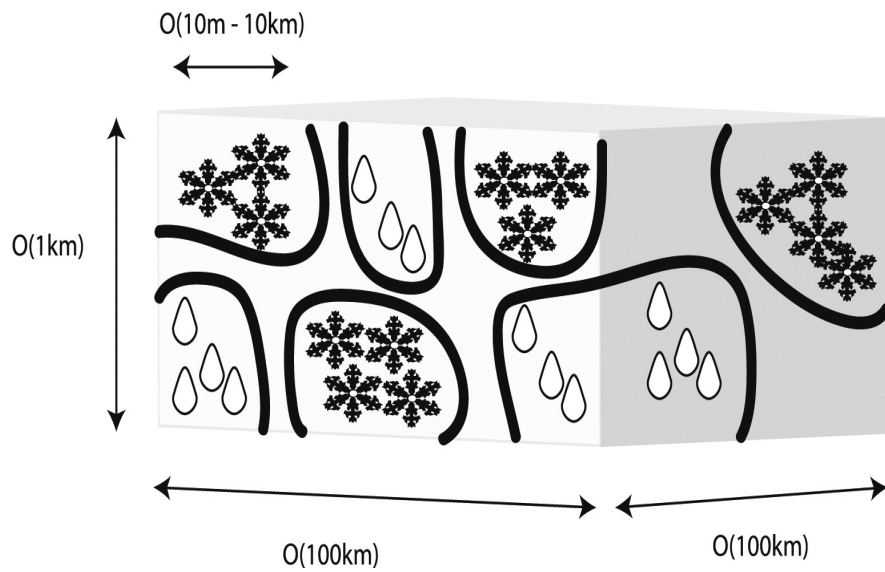
Wegener-Bergeron-Findeisen

(a)

Tan et al. 2016



(b)



Homogeneous mixing:

- Mixing zone volume: $(100) \text{ km} (100) \text{ km} (1) \text{ km} = (10^{13}) \text{ m}^3$ in the typical GCM grid box.

Heterogeneous mixing (pocket structure) (Korolev et al. 2003):

- Pockets extend to $(10^2) \text{ m}$ in extreme case.
- $(1^0) \text{ m}$ as the mixing zone.
- Mixing zone volume: $(10^3) \text{ m} (10^3) \text{ m} (10) \text{ m} = (10^7) \text{ m}^3$.

Wegener-Bergeron-Findeisen

- The supersaturation relaxation time scale for ice deposition is given by $\tau_i = (\text{epsi})^{-1}$ for ice.
- τ_i determine the local in-cloud deposition rate of water vapor onto cloud ice through

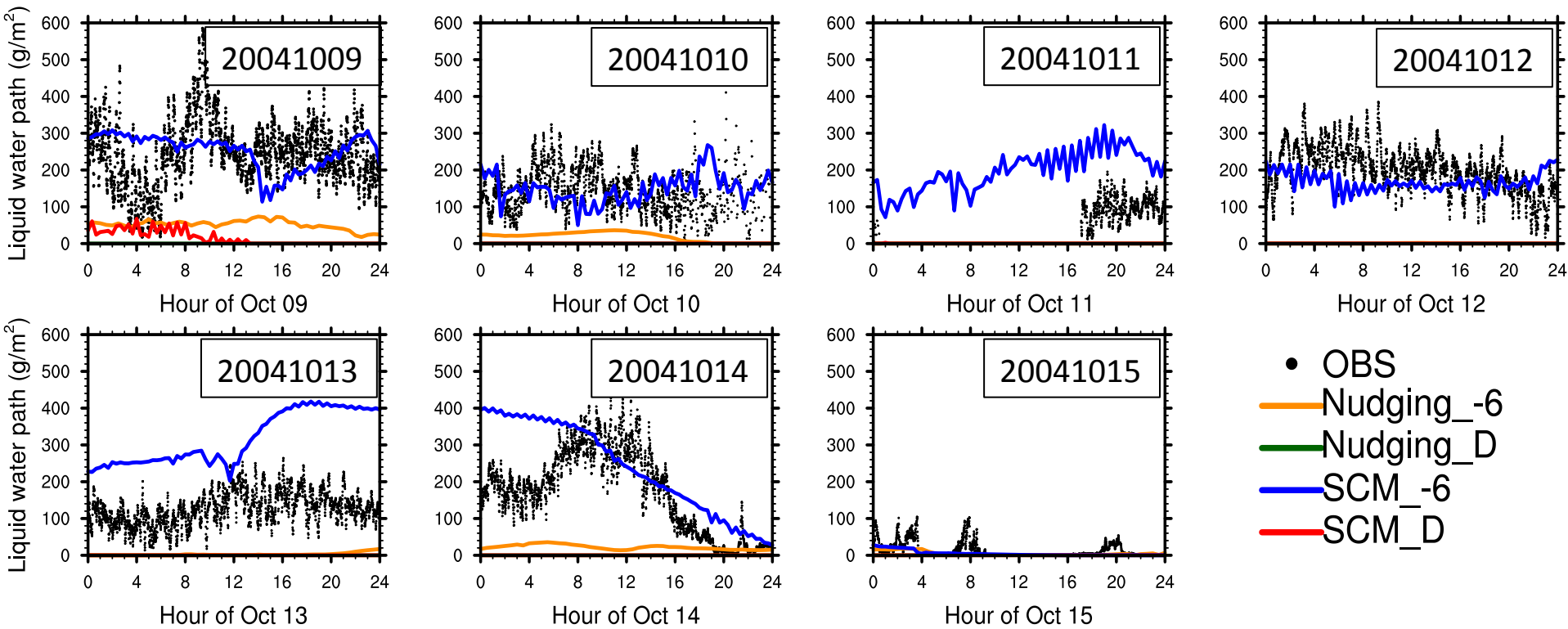
$$A = \frac{q_v^* - q_{vi}^*}{\Gamma_p \tau_i}$$

where q_v^* is the in-cloud water vapor mixing ratio, q_{vi}^* is the in-cloud water vapor mixing ratio at ice saturation and Γ_p is the psychrometric correction to account for the release of latent heat.

- Apply a random number to simulate randomly distributed sub-grid pocket structures of pure liquid and pure ice.

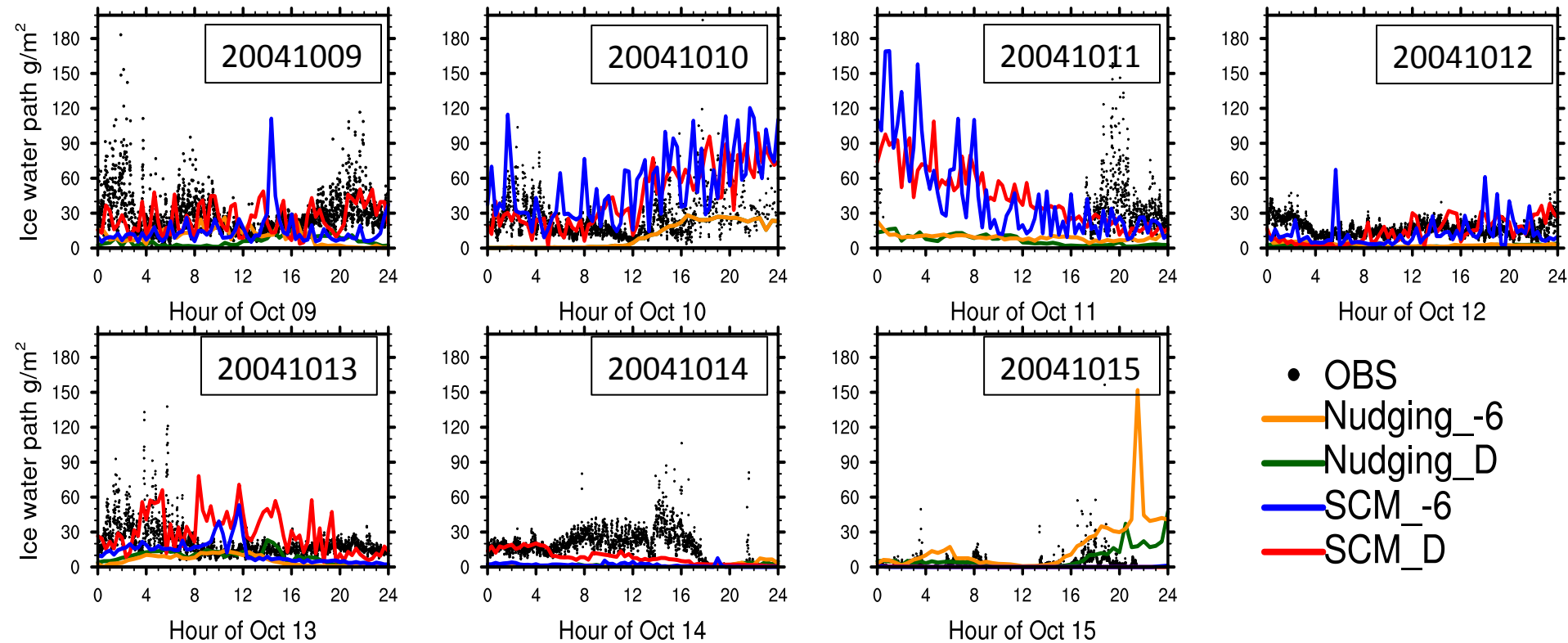
The ARM NSA Mixed-Phase Arctic Cloud Experiment (M-PACE) October 9 to October 15, 2004

LWC in Boundary Layer Mixed-phase Clouds



The ARM NSA Mixed-Phase Arctic Cloud Experiment (M-PACE) October 9 to October 15, 2004

IWC in Boundary Layer Mixed-phase Clouds



Boundary Layer Mixed-Phase clouds

Model vs. Aircraft Data (Oct. 9-12)

