

Results of CGILS, ASTEX, and Composite cases using JMA-GSM SCM

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Two Versions of JMA-GSM SCM

The operational JMA-GSM (Japan Meteorological Agency Global Spectral Model) includes a simple scheme to represent stratocumulus. Another simple treatment for stratocumulus is being tested as a trial to improve the vertical structure of Sc in current scheme. The results of SCM version of JMA-GSM were submitted to CGILS, ASTEX, and Composite cases using these two versions of simple stratocumulus schemes.

Version 1

This operational scheme (Kawai & Inoue, 2006) was developed for relatively coarse vertical resolution model to represent stratocumulus.

- Strong inversion layer just above the layer
- Not stable near the surface (\rightarrow existence of ML)
- Apply this scheme only below 940hPa

- Determine the cloud cover as a function of inversion strength
- In-cloud CWC is proportional to saturation specific humidity: $q_{cld} = \beta \cdot q_{sat}$

- Suppress mixing at the top of the cloud layer

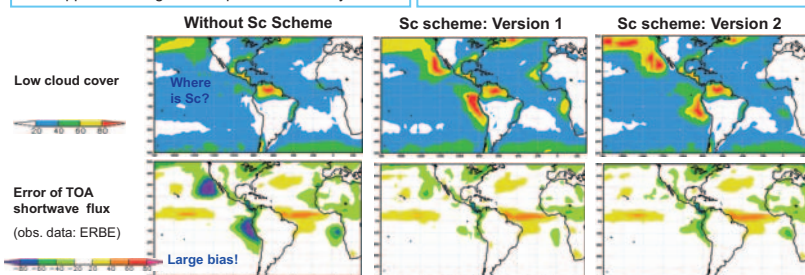
Version 2

Because of the recent increase of the vertical resolution, this simple version can also work reasonably well.

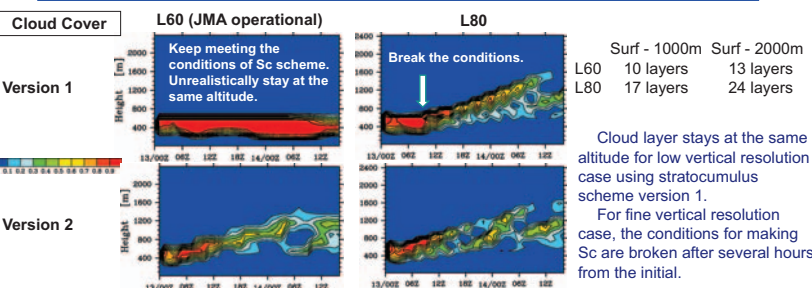
- $\theta_{700} - \theta_{surf} > 20[K]$ (Klein & Hartmann (1993))

- Not stable near the surface (\rightarrow existence of ML)

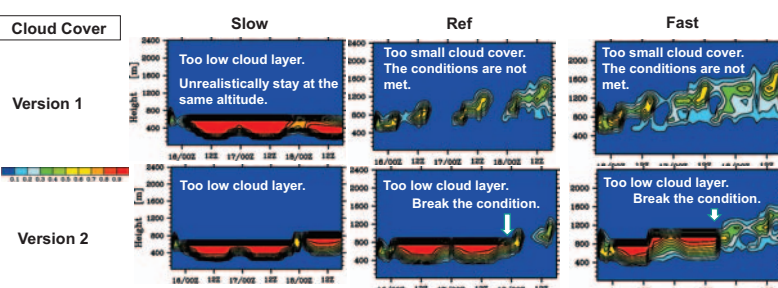
- Completely suppress mixing at the top of the cloud layer
- No additional mixing at the top of mixed layer
- Lower limit of vertical diffusivity ~ 0



ASTEX Case



Composite Case



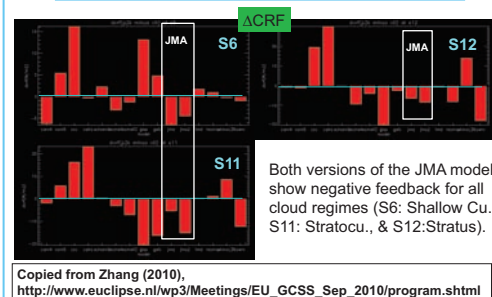
In reference case and fast case, cloud cover is too small using version 1 because the conditions of Sc scheme are not met. On the other hand, using version 2, the conditions are met for almost two days. When Sc is represented, the height of cloud layer is much lower than LES results.

Summary

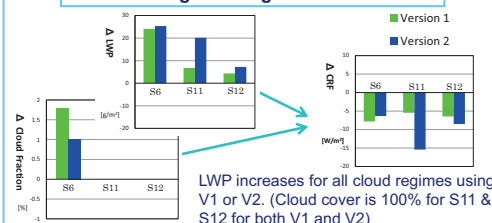
- The SCM version of JMA-GSM (Japan Meteorological Agency Global Spectral Model) joined CGILS (by Minghua Zhang), ASTEX (by Stephan de Roode), and Composite (by Irina Sandu) model intercomparison cases using two versions of the model.
- Two versions are briefly introduced and the basic results of ASTEX and Composite cases are shown.
- In order to understand the negative cloud feedback of the two versions of this model for all cloud regimes in CGILS case, simple numerical experiments were done and the mechanism are discussed.

CGILS Case

Cloud Radiative Feedback of the JMA model

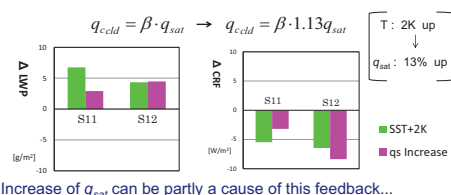


What brings the negative feedback?

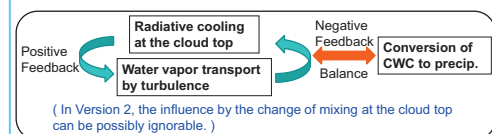


What increases the LWP? : Case of Version 1

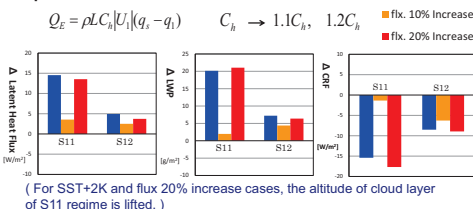
Exp. : Increase q_{sat} for giving in-cloud CWC in Sc scheme.



What increases the LWP? : Case of Version 2



Exp. : Increase latent heat flux.



Acknowledgements

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References

- Kawai, H., and T. Inoue, 2006: A simple parameterization scheme for subtropical marine stratocumulus. *SOLA*, **2**, 17-20.
- Klein, S.A., and D.L. Hartmann, 1993: The Seasonal Cycle of Low Stratiform Clouds. *J. Climate*, **6**, 1587-1606.