

What determines earth system model performance? Physics or ...?

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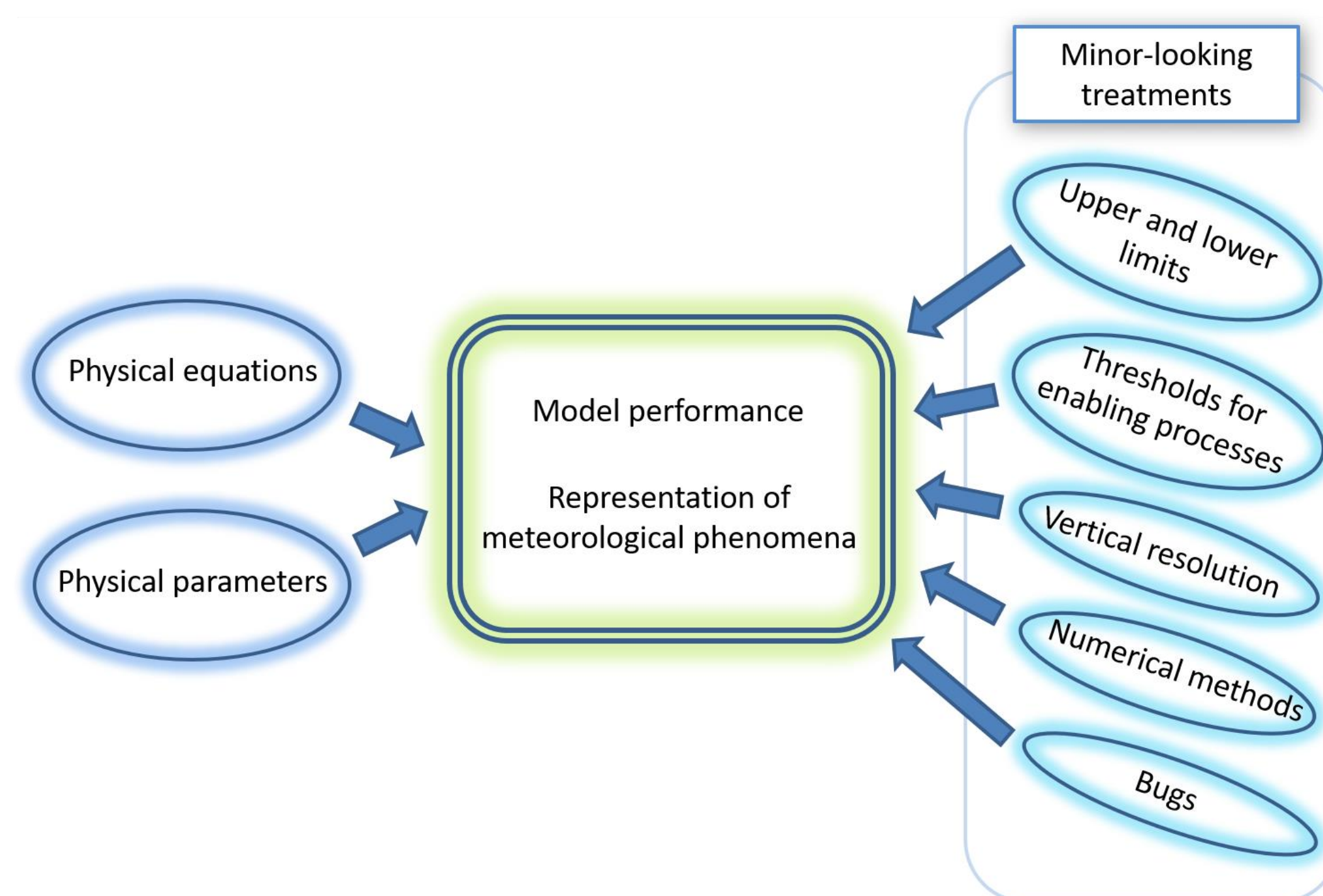
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Introduction

It is very well known that parameter tuning can have a major impact on the performance of Global Climate Models (GCMs). However, parameter tuning is not the only implementation detail that can drastically affect model performance and the representation of various phenomena in models.

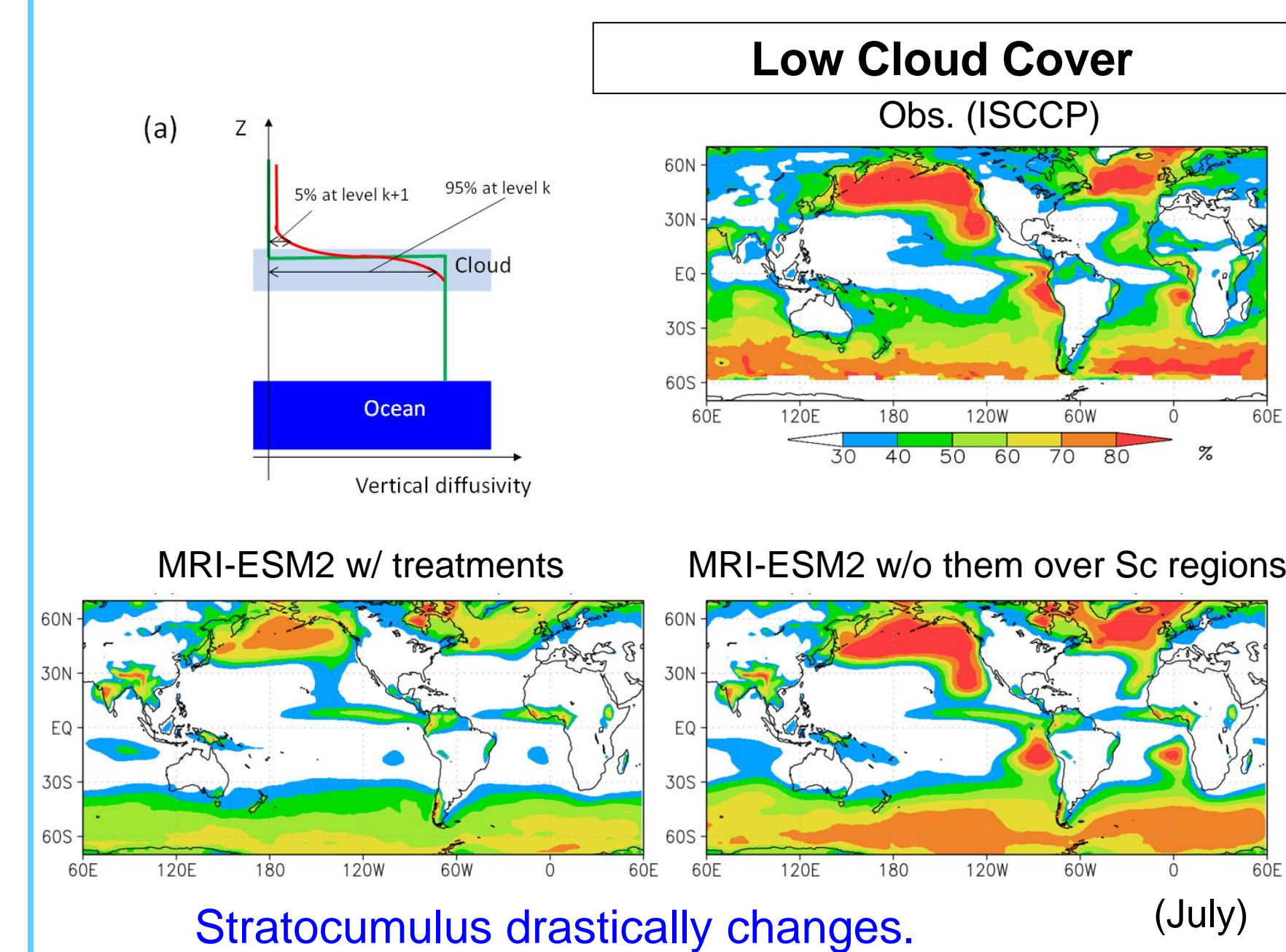
“Minor-looking treatments” often exert a critical control on model performance as experienced modelers know it well; they include lower and upper limits of parameters, thresholds of variables that control the enabling or disabling of a specific process, whether two schemes can work together or only one scheme works exclusively, and numerical methods including the order of calling various physics schemes.

We comprehensively summarize examples of various minor-looking treatments (Kawai et al. 2022).

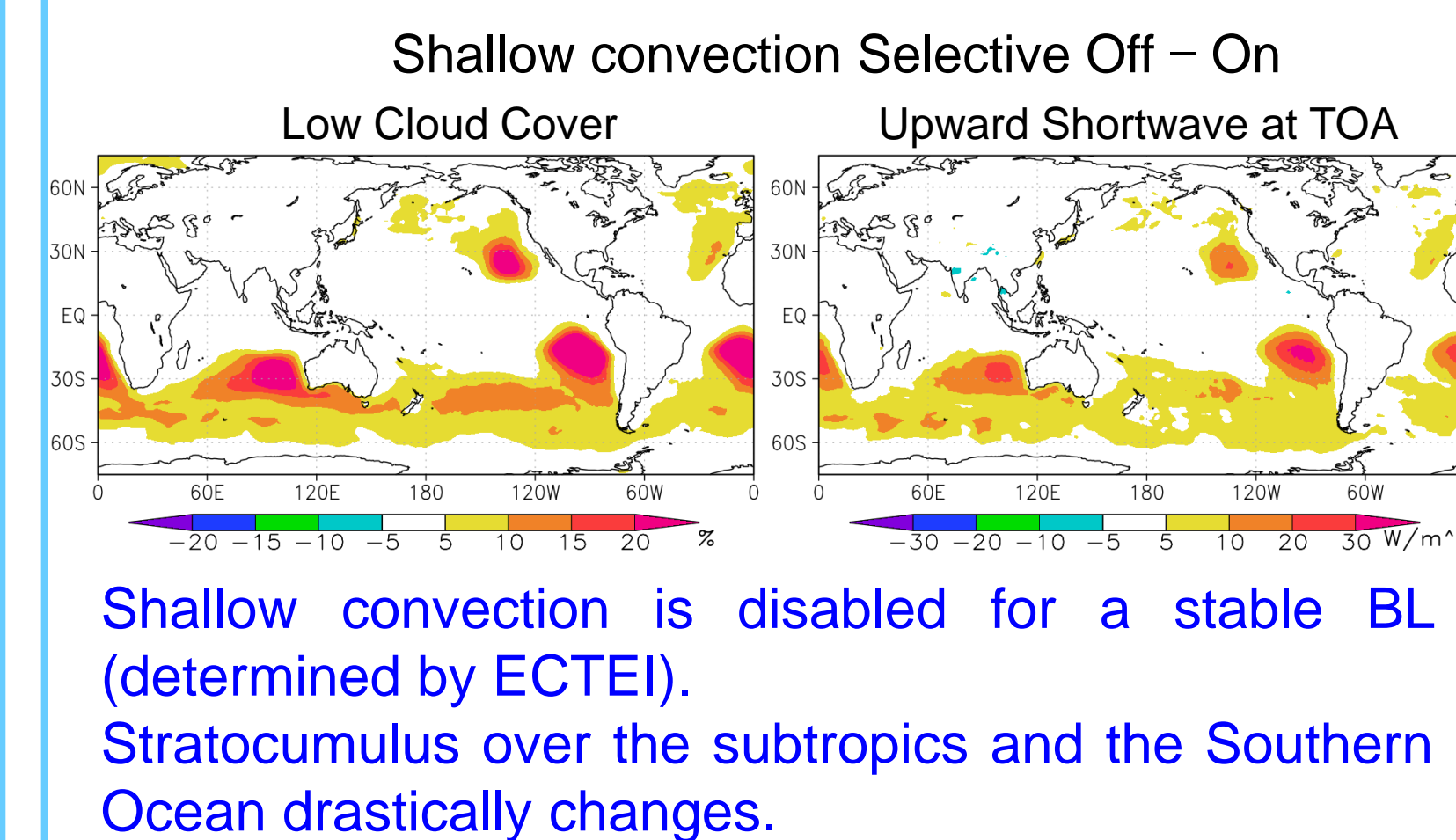


Examples of Minor-looking treatments

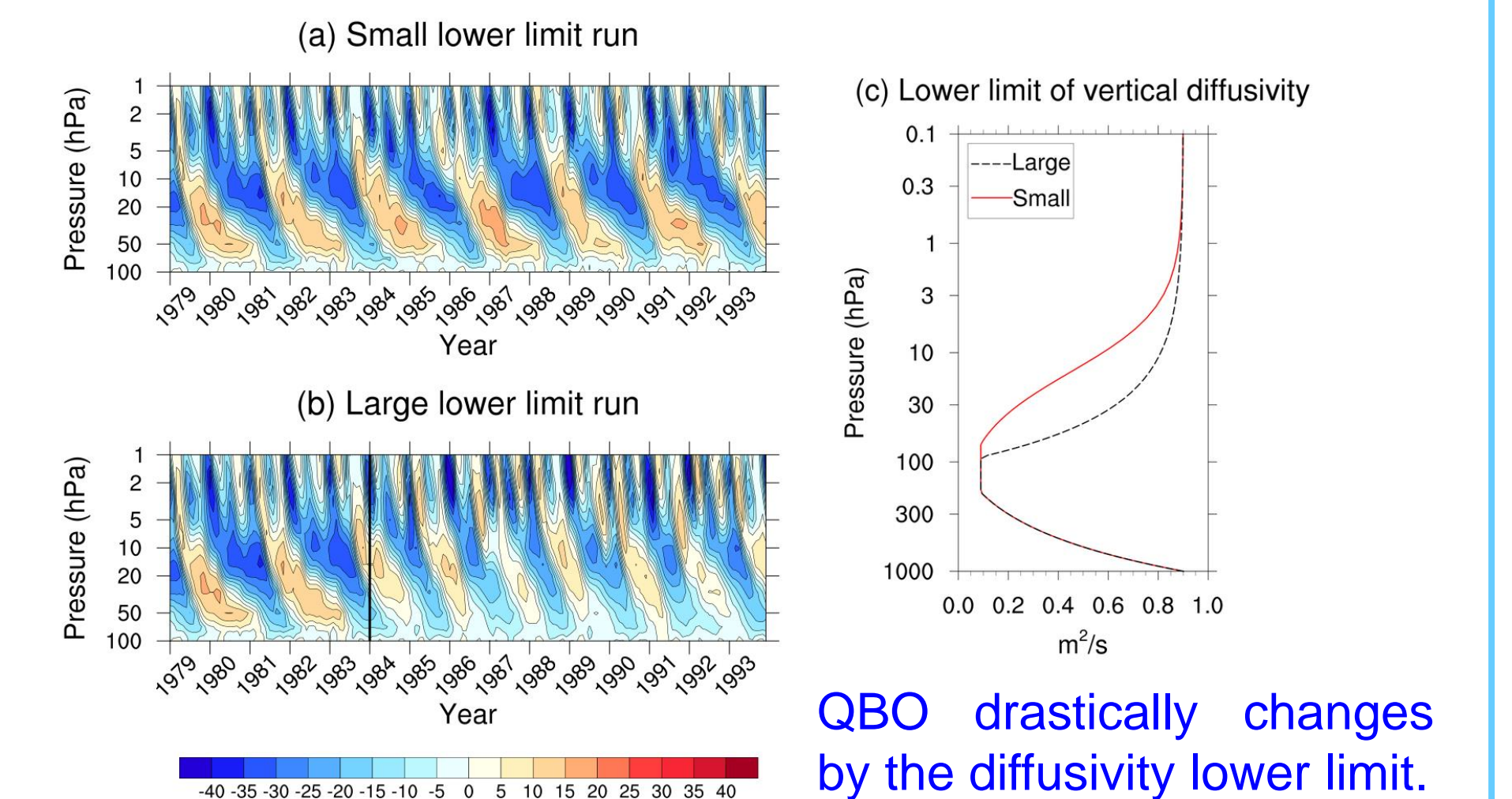
Lower limit & smoothing of vertical diffusivity



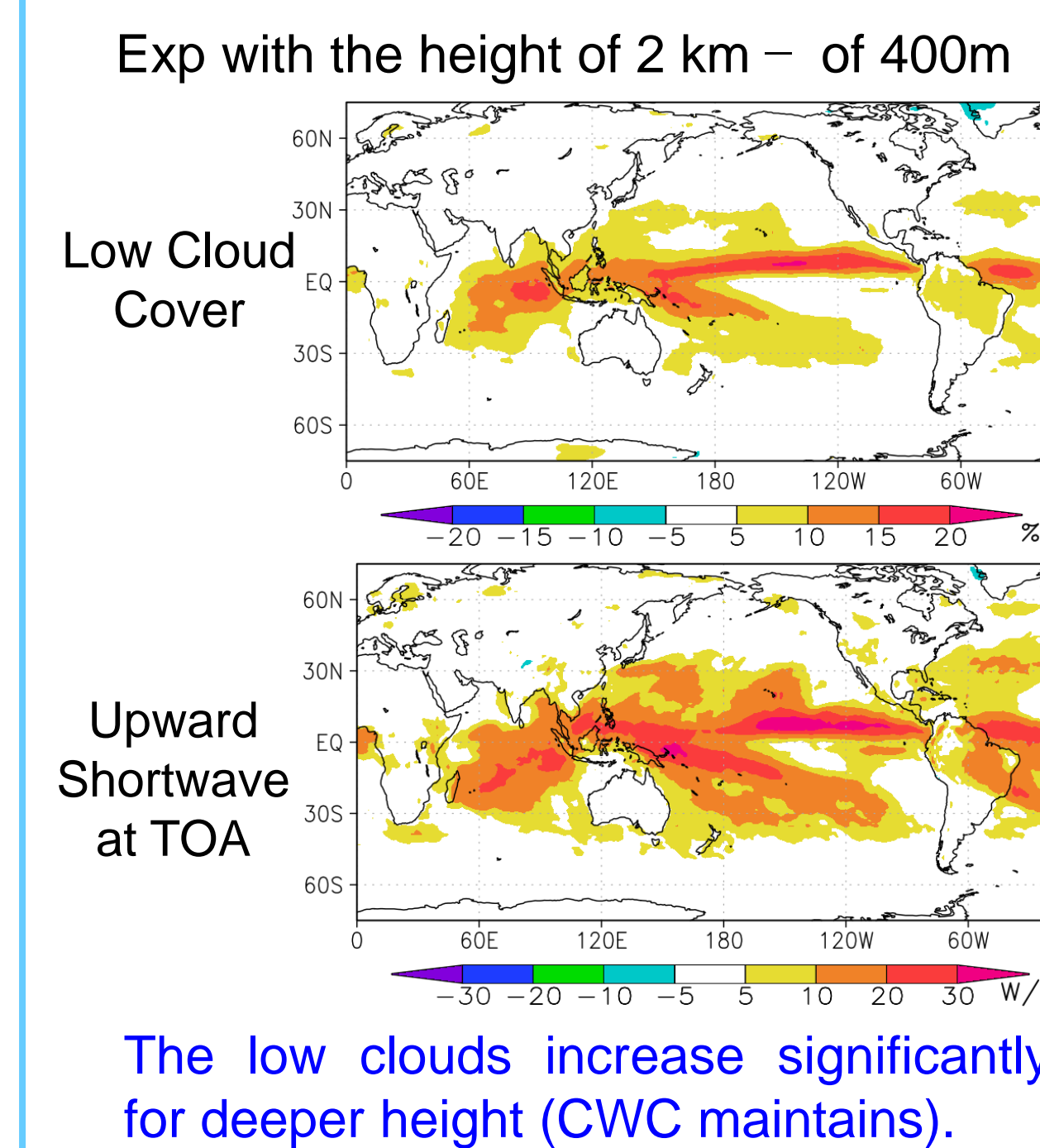
Conditionally disabling shallow convection



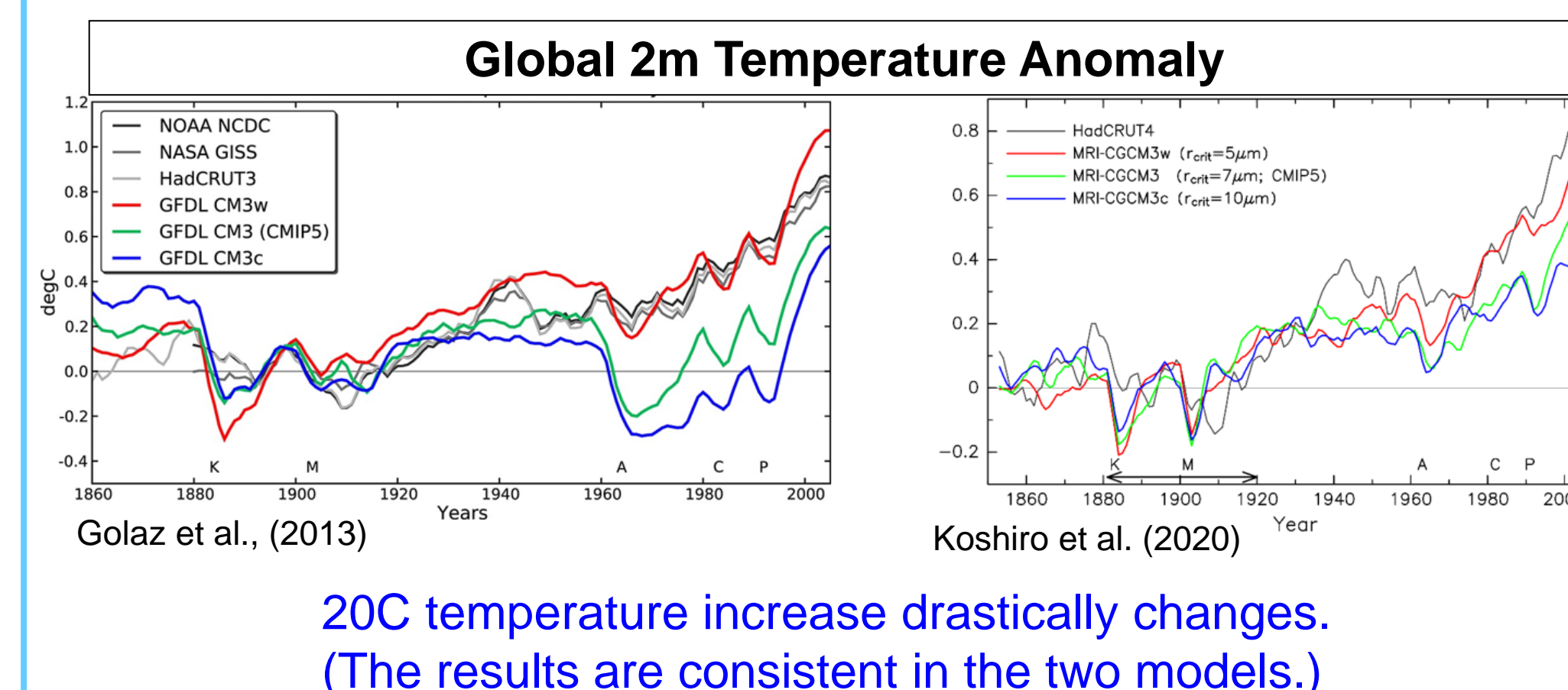
lower limit of vertical diffusivity in stratosphere



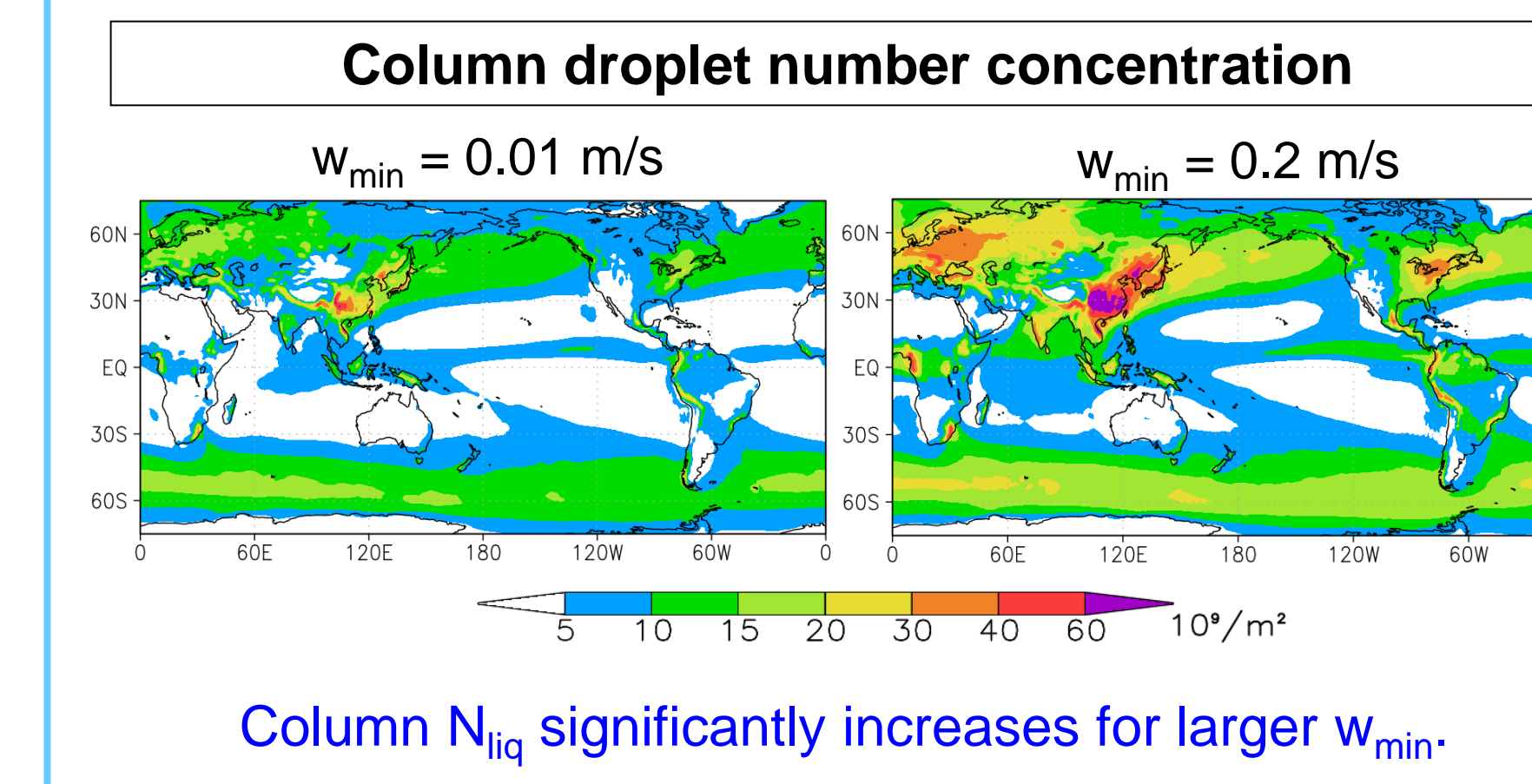
Minimum height of permitting convective precipitation



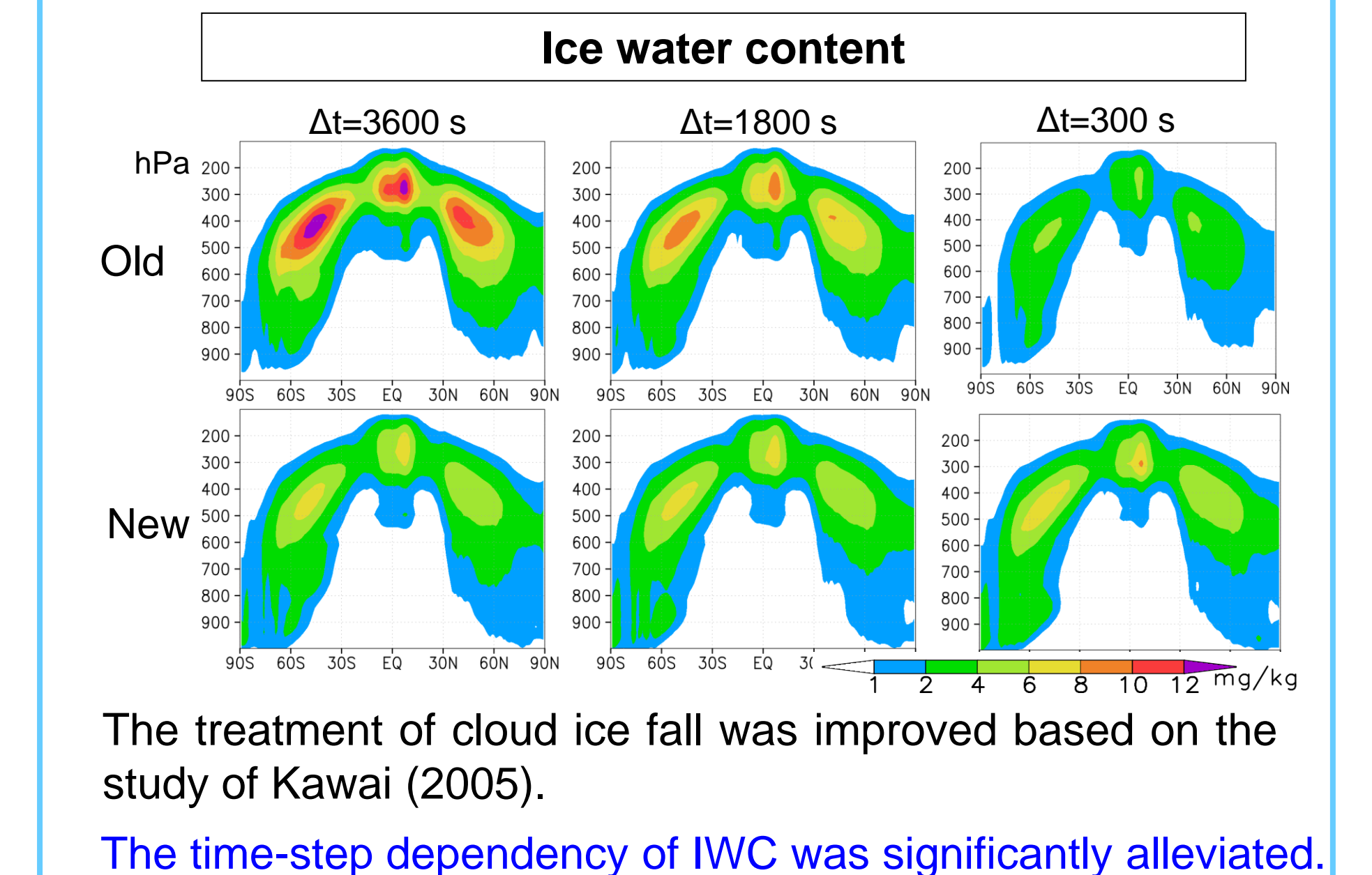
Droplet radius threshold for autoconversion



Lower limit of turbulence updraft speed for aerosol activation calculation



Calculation method of cloud ice fall



Acknowledgements

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References

Kawai, H., K. Yoshida, T. Koshiro, and S. Yukimoto, 2022: Importance of Minor-Looking Treatments in Global Climate Models. *J. Adv. Model. Earth Syst.*, **14**, e2022MS003128, <https://doi.org/10.1029/2022MS003128>.

Summary

- The impacts of such minor-looking treatments are sometimes comparable to or even larger than those obtained by introducing advanced parameterizations based on theory and observation.
- Minor-looking treatments should be discussed more, and the details as well as the tuning process should be described and shared in the climate modeling community in as much detail as possible.

See Kawai et al. (2022) for more examples.