Far-infrared measurements benefit nighttime ice cloud property retrievals

Masanori Saito* **and Ping Yang**

Department of Atmospheric Sciences, Texas A&M University, 3150 TAMU, College Station, TX 77843, USA

**Presenting author (masa.saito@tamu.edu)*

Ice clouds are ubiquitous and play a pivotal role in the earth–atmosphere system. Satellite measurements have provided the global distribution of ice cloud properties based on passive remote sensing techniques. In particular, the bispectral method based on a pair of visible and near-infrared channels [1] and the split-window method based on the brightness temperature differences between a pair of thermal infrared (TIR) channels (so-called window channels) [2] are the two major retrieval techniques. However, the former approach is not applicable during nighttime, and the latter approach is only sensitive to optically thin clouds with small ice crystals. Therefore, the current understanding of ice cloud properties is quite limited. Recently, a couple of projects focusing on spaceborne far-infrared (FIR) measurements are planned to understand outgoing FIR radiation from Earth. Although these projects do not mainly focus on ice clouds, previous studies demonstrate large sensitivities of FIR measurements to ice cloud properties [3]. This may overcome the shortcomings of the passive cloud remote sensing over nighttime. Therefore, there is a pressing need for quantitative evaluations of the feasibility and capability of the FIR measurements to ice cloud retrievals.

In this presentation, we quantitatively illustrate how much the FIR measurements, in addition to TIR, improve the ice cloud retrievals. Potential inherent error sources of ice cloud retrievals such as temperature-dependent indices of ice refraction and subpixel cloud coverage will be discussed.

References

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[3] Yang, P., M. G. Mlynczak, H. Wei, D. P. Kratz, B. A. Baum, Y. X. Hu, W. J. Wiscombe, A. Heidinger, and M. I. Mishchenko, 2003: Spectral signature of ice clouds in the far-infrared region: Single-scattering calculations and radiative sensitivity study, *J. Geophys. Res.* **108**, 4569.

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