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Atmospheric Measurement Techniques Discussions

Interactive comment on "Simulating the effects of mid- to upper-tropospheric clouds on microwave emissions in EC-Earth using COSP" *by* M. S. Johnston et al.

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Reviewer's response to AC C5059 [Posted by the associate editor]

With regard to the second point, there is plenty of evidence from papers such as Heymsfield et al. (2004) [Andrew J. Heymsfield, Aaron Bansemer, Carl Schmitt, Cynthia Twohy, and Michael R. Poellot, 2004: Effective Ice Particle Densities Derived from Aircraft Data. J. Atmos. Sci., 61, 982-1003. doi: http://dx.doi.org/10.1175/1520-0469(2004)061<0982:EIPDDF>2.0.CO;2 who used observations from tropical cirrus to show the mass of aggregated ice varies as aDˆb, where b∼2.0 is their best fit, therefore, rho=cDˆd, where d∼-1.0 as opposed to d=-1.5 predicted by the sector snowflake

model of Liu (2008). At typical Dm sizes (i.e. maximum dimensions) found in the tropics, see Fig 4 left in Heymsfield et al. (2004) and Fig. 1 in Paul R. Field, J. Heymsfield, Aaron Bansemer, and Cynthia H. Twohy, 2008: Determination of the Combined Ventilation Factor and Capacitance for Ice Crystal Aggregates from Airborne Observations in a Tropical Anvil Cloud. J. Atmos. Sci., 65, 376-391. doi: http://dx.doi.org/10.1175/2007JAS2391.1, the Dˆ-1.5 relationship will predict very thin snowflakes which will have little interaction with radiation and these will essentially become what I call WILPS (Weakly Interacting Large Particles), thus leading to increased microwave transmission resulting in too warm brightness temperatures. Indeed, in Fig. 12 of Heymsfield et al. (2004) they do not consider b=-1.5 probably because it would have been close to an outlier in their data. You can see from Fig. 12, the value d=2.05 is the best-fit to their data. The basic microphysical model on which the authors microwave simulations are based is not supported by observations obtained generally in the tropics, and so one might expect the optical properties resulting from such a model not to fit observations in the tropics, which is what the authors find. Just because the model helps other simulations to get the right numbers does not mean it is a good physical model, but rather, there are probably compensating errors which help them to arrive at the right numbers. This is the point I was trying to make.

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 11753, 2015.