Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2019-345-SC1, 2019


Atmospheric Chemistry and Physics Discussions

# *Interactive comment on* "Small Ice Particles at Slightly Supercooled Temperatures in Tropical Maritime Convection" *by* Gary Lloyd et al.

**Benjamin Murray**

b.j.murray@leeds.ac.uk

Received and published: 5 October 2019

This is an interesting paper on an important topic and I have some suggestions for enhancing the paper. There are some published studies which should be discussed and provide some constraints on variables at the core of this paper:

1. At the core of this paper is a study of the first ice formation at relatively high supercooled temperatures. On p 7 it is stated that "the measurements show concentrations of small ice particles that are higher than would be expected through primary ice nucleation alone when viewed in the context of only slightly supercooled temperatures (e.g. DeMott et al., 2010)." At this point a discussion of the INP measurements made from this aircraft during this campaign would be appropriate (Price et al., 2018). These



measurements were made from close to the surface up to several kilometres in air with a range of dust loadings and INP concentrations from the same flight (b926) were reported. While the technique only yielded results at lower temperature, the technique does define an upper limit at warmer temperatures of around 0.1 L-1. In addition, Price et al. also report estimates of marine organic INP and desert dust INP over the full temperature range from a global aerosol model.

Surface level INP measurements in Cape Verde have been reported in the literature (Welti et al., 2017). These measurements are probably representative of the marine boundary layer, hence are relevant for these convective systems. Welti never measured more than $\sim$ 1 m-3 at -5oC, again providing a constraint on primary ice production.

The fact that INP have not been observed at these warm temperatures in sufficient concentrations to produce the reported 6-30 ice crystals per litre suggests that some other factor is at play (as the authors go on to say, i.e. secondary production). The available measurements are not consistent with a population of bacterial INP as suggested on P8, ln 20.

2. The size distribution of dust is also extremely important for this paper. The authors suggest rough semi-spherical particles of 10s microns observed by HALOHolo are ice particles. This is partly justified on the basis that Price et al. "found a mode particle diameter of $\sim$ 10 $\mu$m, which is smaller than the ice particles observed by the HALOHolo". This can be improved. Ryder et al. (2018) present a study of the full size distributions measured from the FAAM aircraft, on the same deployment (ICE-D and AER-D were conducted at the same time). They report a substantial population of dust particles in the 10-100 $\mu$m size range. Are the concentrations of these rough spherical particles observed by HALOHolo really inconsistent with dust concentrations?

Technical comment

P3 ln 10. Koop 2013 is not in the reference list. If the authors are referring to the News and Views article, this probably isn't an appropriate citation.

References

Price, H. C., Baustian, K. J., McQuaid, J. B., Blyth, A., Bower, K. N., Choularton, T., Cotton, R. J., Cui, Z., Field, P. R., Gallagher, M., Hawker, R., Merrington, A., Miltenberger, A., III, R. R. N., Parker, S. T., Rosenberg, P. D., Taylor, J. W., Trembath, J., VergaraâĂŘTemprado, J., Whale, T. F., Wilson, T. W., Young, G., and Murray, B. J.: Atmospheric IceâĂŘNucleating Particles in the Dusty Tropical Atlantic, J. Geophys. Res., 123, 2175-2193, doi:10.1002/2017JD027560, 2018.

Ryder, C. L., Marenco, F., Brooke, J. K., Estelles, V., Cotton, R., Formenti, P., McQuaid, J. B., Price, H. C., Liu, D., Ausset, P., Rosenberg, P. D., Taylor, J. W., Choularton, T., Bower, K., Coe, H., Gallagher, M., Crosier, J., Lloyd, G., Highwood, E. J., and Murray, B. J.: Coarse-mode mineral dust size distributions, composition and optical properties from AER-D aircraft measurements over the tropical eastern Atlantic, Atmos. Chem. Phys., 18, 17225-17257, 10.5194/acp-18-17225-2018, 2018.

Welti, A., Müller, K., Fleming, Z. L., and Stratmann, F.: Concentration and variability of ice nuclei in the subtropic, maritime boundary layer, Atmos. Chem. Phys. Discuss., 2017, 1-18, 10.5194/acp-2017-783, 2017.

---

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2019-345, 2019.