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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Ice nuclei properties within a Saharan Dust Event at the Jungfraujoch" *by* C. Chou et al.

Anonymous Referee #2

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This paper describes a new ice nucleation chamber (PINC) and shows results obtained over extended time periods at the Jungfraujoch research station. The ice nuclei concentration active in deposition mode increases from a typical background of 10 per litre up to a few hundreds per litre when Saharan dust was observed. These observations are good and contribute towards the understanding of ice nucleation and the paper should therefore be published subject to minor revisions.

I have three main issues, but none major: Firstly, there is a lot of detail on the instrument that is not directly relevant to the observations discussed. Although, since this is first paper using the PINC, a more detailed instrument section might be justified. Secondly, the background counts in the PINC are significant especially during non Saharan dust events and therefore should be better described. Thirdly, the Saharan dust event

should be determined by back trajectories rather than a scattering parameter given the limited aerosol instrumentation.

abstract: This paper does not determine the relative contribution of deposition nucleation to mixed phase clouds.

page 23708, subsection 2.1.1: A table which summarises both ZINC and PINC (activation/growth and droplet evaporation chamber dimensions, gap-width, residence time, operating temperature and humidity range, time taken to flood the chamber with water, etc) would be useful to show differences between the two instruments.

page 23709, line 13: Why can't the PINC measure immersion mode ice nucleation? by removing the inlet sample drying system.

page 23709, line 21: The refrigeration systems could be identical, its just that to reach colder temperatures more easily you have added a compressor in series. The actual cooling system layout is not really relevant to the IN measurements discussed here and could be better summarised or removed completely.

page 23710, line 1: Aircraft usually operate in balanced flight so significant tilting of instruments should not be an issue.

page 23710, line 4: So is -51C the coldest you can achieve on the cold-wall?

page 23710, line 8: What range of temperature inhomogeneities do you see (both with and without the heating pads) and what is it caused by? Can you say what the error on sample humidity is given this level of inhomogeneity.

page 23710, line 15: Given that this paper only discusses IN activating in deposition mode, the droplet evaporation section is not really doing anything, and figure 2 showing maximum RHW before droplet breakout is not relevant.

page 23710, line 19: Again, details of Compact-RIO architecture not really relevant.

page 23710, line 30: Is this 3 micron optical size threshold for latex spheres or similar?

Or have you corrected for refractive index etc.

page 23711, line 8: The impactor used has a relatively low cut size of 0.9 microns. Why did you not use one with an larger cut size? Rogers CFDC has similar residence time but used a 2.0 micron cut (although not very sharp). Especially as large aerosol are expected to be better IN. Can you operate the droplet evaporation section not as an isothermal chamber at ice saturation, but as two independent walls extending the main activation/growth chamber and therefore increasing ice crystal residence time. This would allow for a higher OPC threshold and a larger impactor cut size.

page 23713, line 5: The background signal seems to be comparable to your observations when there is no Saharan dust and should be better described. How does the background compare to that from ZINC? For each 15 minute measurement cycle, how long do you measure the aerosol free background signal? Do these wall-grown crystals occur randomly throughout the sampling? Do the error bars represent the combined error from sample and background count statistics? The time-series of IN concentration might be better plotted with both the uncorrected and background values.

page 23714, line 1: The Grimm OPC sizes that are shown in later figures, are these corrected for refractive index/particle shape or just valid for latex spheres?

page 23714, line 8: Would it not be simpler to just use the dust model forecast and back-trajectories to forecast Saharan dust events, rather than the scattering parameter? The Atlantic source for the trajectories shown in figure 7 mean that the scattering parameter criterion sometimes gets it wrong.

page 23715, line 6: What is the typical ambient temperature and humidity upwind of the instrument station? Since biological material might initiate ice nucleation at warmer temperatures than mineral dust, might they already be activated?

page 23716, line 5: The time series figure 8 would be improved if you mark clearly the intervals that the Saharan dust events occur, defined by both back-trajectory and

scattering coefficient.

page 23716, line 25: So the 16 June dust event has a Atlantic source region? It should not be called a Saharan dust event at the start of this section then.

page 23718, line 12: Is the 0.8 micron size the optical or aerodynamic size? This conversion is valid for spheres,

what is the error on this size caused by non-spherical nature of dust?

page 23718, line 16: Both plots in figure 11 really look similar in terms of correlation and the argument for an increased IN number when there are larger particles looks weak.

page 23719, line 1: Can you re-plot figure using only the back-trajectory criterion to define a Saharan dust event?

page 23719, line 17: -31 C and 91% RHW operating conditions are stated in the abstract.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 23705, 2010.