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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The ARCTAS aircraft mission: design and execution" *by* D. J. Jacob et al.

Anonymous Referee #1

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1. Does the paper address relevant scientific questions within the scope of ACP? The manuscript provides a description of the scientific rationale and the experimental design and execution of a major multiplatform field program. By accepting this manuscript for publication in ACPD, the editors have evidently decided that this manuscript meets the scientific content requirement for publication. However, there is very little new science or new fundamental technique involved, although it may be argued that the coordinated mission itself is a method.

2. Does the paper present novel concepts, ideas, tools, or data? The manuscript describes in detail the unique capabilities of the aircraft, satellite, and modeling capabilities. It presents background information, and details the instruments and techniques, and the location and times of the measurements. It will serve as a valuable technical

reference for subsequent papers.

3. Are substantial conclusions reached? There are no substantive scientific findings. The only real scientific presentation and discussion regards the early and large biomass burning events that occurred in Russia in April 2008 (Figs 2 and 3). However, the statement that this event is climatologically anomalous, while likely correct, is not supported by the data that are presented, since the figures do not place the temporal or spatial occurrence of the fires in a climatological context. The claim is supported rather by reference to a more comprehensive manuscript (Fisher et al., submitted, 2009). Since Figs. 2 and 3 are not discussed further, they are probably not necessary to this paper and indeed stand out a bit oddly as the only data presented despite the many other interesting and important findings from this field program.

4. Are the scientific methods and assumptions valid and clearly outlined? A link to the TabMep web site (http://www-air.larc.nasa.gov/cgi-bin/ic2008r) that provides aircraft comparisons, and a brief description of this program, is warranted. This substantial comparison effort is critical to assessing whether measurements from various platforms can be evaluated as a single, unified dataset with quantified uncertainties and biases.

5. Are the results sufficient to support the interpretations and conclusions? Not applicable. Exception: the results presented regarding fire climatology (see 3 above) are not sufficient to independently support the findings..

6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? Yes.

7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? No. Although this is not a comprehensive review article, it should serve as a resource and solid starting point for current investigators (many of them new to the study of Arctic atmospheric chemistry) to explore past findings. There is a rich literature of earlier research that is barely touched upon. Referencing only more recent work, such as the Quinn et al. climatology, is not sufficient; older, relevant

literature should be directly cited. Two of the co-authors (G. Shaw and A. Clarke) were involved in the early stages of Arctic atmospheric chemistry research and should be able to provide references to key citations leading into this older, but important, literature. Some suggestions for inclusion would be:

Barrie, L. A., Hoff, R. M. and Daggupaty, S. M. 1981. The influence of mid-latitudinal pollution sources on haze in the Canadian Arctic. Atmos. Environ. 15, 1407–1419.

Barrie, L.A., J.W. Bottenheim, R.C. Schnell, P.J. Crutzen and R.A. Rasmussen, Ozone destruction and photochemical reactions at polar in the lower Arctic atmosphere, Nature, 334, 138-141. (1988).

Bodhaine, B. A., Barrow surface aerosol: 1976-1986, Atmos. Environ., 23, 2357-2369, 1989.

Bodhaine, B. A., E. G. Dutton, J. J. DeLuisi, G. A. Herbert, G. E. Shaw, and A. D. A. Hansen, Surface aerosol measurements at Barrow during AGASP II, J. Atmos. Chem., 9, 213-224, 1989.

Brock, C. A., Radke, L. F., Lyons, J. H. and Hobbs, P. V. 1989. Arctic hazes in summer over Greenland and the North American Arctic, I, Incidence and origins. J. Atmos. Chem. 9, 129–148.

Clarke, A. D. 1989. In-situ measurements of the aerosol size distributions, physico-chemistry, and light absorption properties of Arctic haze. J. Atmos. Chem. 9, 255–267.

Heintzenberg, J, Particle size distribution and optical properties of Arctic Haze., Tellus, 32, 251-260, 1980.

Leaitch, W. R., Hoff, R. M., Melnichuk, S. and Hogan, A. 1984. Some physical and chemical properties of the Arctic winter aerosol in northeastern Canada. J. Clim. Appl. Met. 23, 916–928.

Radke, F. S., Lyons, J. H., Hegg, D. A., Hobbs, P. V. and Bailey, I. H. 1984. Airborne

observations of Arctic aerosols, I, Characteristics of Arctic haze. Geophys. Res. Lett. 11, 393–396.

Rahn, K. A., R. D. Borys and G. Shaw 1977. The Asian source of Arctic haze bands, Nature 268, 713 - 715, doi:10.1038/268713a0.

Schnell, R. C. 1984, Arctic haze and the Arctic Gas and Aerosol Sampling Program (AGASP), Geophys. Res. Lett., 11(5), 361–364.

Shaw, G.E., The vertical distribution of atmospheric aerosols at Barrow, Alaska, Tellus, 27, 39-50, 1975.

8. Does the title clearly reflect the contents of the paper? Yes

9. Does the abstract provide a concise and complete summary? Yes

10. Is the overall presentation well structured and clear? Yes

11. Is the language fluent and precise? Yes. The paper is well written, concise, and clear.

12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? Yes, except Table 2 provides units of airspeed in knots rather than m/s.

13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? Figs. 2 and 3 are not needed (c.f. (3))

14. Are the number and quality of references appropriate? No (cf. 7).

15. Is the amount and quality of supplementary material appropriate? Yes.

Minor suggestions:

p. 17078, line 15, change "a 'polar dome' that shields . . . " with "a 'polar dome' of cold, generally stable air that shields. . . ."

p. 17078, lines 24-25. A critical determinant of summer/winter contrast in the Arctic is

loss mechanisms (photochemistry and precipitation scavenging). These are probably at least as important as the transport/dilution differences discussed here.

p. 17079. Other important reasons to make a springtime mission is to compare with earlier missions to study Arctic atmospheric chemistry, and because springtime is the critical time period of snowmelt and radiative forcing.

p. 17080. The references regarding boreal fire emissions are, like the arctic haze references, heavily skewed toward recent field programs. There is a rich literature going back to the 1980s in which many of the fundamental processes (particle emission characteristics, evolution of gas-phase and particulate composition) were first elucidated (e.g. Radke et al., Effects of Aging on the Smoke from a Large Forest Fire, Atmos. Res., 38, 315-332, 1995.

P. 17087, and elsewhere in the manuscript. Acronyms such as ARCPAC, ISDAC, ARM, DLR, NSF, CNRS etc. need to be expanded.

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 17073, 2009.