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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Characteristics, sources, and transport of aerosols measured in spring 2008 during the aerosol, radiation, and cloud processes affecting Arctic climate (ARCPAC) project" *by* C. A. Brock et al.

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The discussion paper by Brock et al. gives an excellent overview over the results of the Aerosol, Radiation, and Cloud Processes affecting Arctic Climate project (ARCPAC). Extensive and data-rich results are reported on the physico-chemical and optical properties of aerosol particles of various origin which were measured in Spring of 2008 in the troposphere of Alaskan Arctic. Included measurement platforms were several research aircraft and the monitoring station Barrows.

The paper separates aerosol types according to their origin: free tropospheric background haze, aerosol of the sea-ice boundary layer, plumes containing anthropogenic pollution, and biomass burning plumes. All aerosol types are characterised in terms of key gas phase components, size distribution, optical properties, chemical composition, CCN activity and hygroscopic growth behaviour. Furthermore, for all aerosol types, the resulting radiative forcing per unit optical depth is calculated.

The discussion paper is of outstanding scientific quality with only few minor remarks to be made.

1/ The characteristic properties of biomass burning plume particles are extensively discussed. However, further insight in the properties of this aerosol type can be gained, if the ARCPAC observations are compared to observations from two other biomass burning aerosol studies dealing with particles emitted from boreal fires. Müller et al. (2007) reported results on particle transformation of forest-fire smoke during long-range transport in the free troposphere obtained from Raman lidar measurements. This publication presents particle effective radii and Ångström exponents of aged free-tropospheric forest-fire smoke. The particle plumes were observed with different multi-wavelength Raman lidars downwind of the fires that burned in boreal areas of the northern hemisphere. The authors found an increase of particle size with transport time which was more than two weeks in some of the investigated cases. Mean effective radii were as large as 0.4 μm. From this data set they could show that particle growth levels off after approximately ten days of transport time.

Results from in situ measurements pointing in the same direction are reported by Petzold et al. (2007) for Canadian fire plumes transported to Western Europe. In this paper the relationship from Dentener et al. (2006) of the count median diameter to the geometric standard deviation of the particle number size distribution is further confirmed by observational data. Comparing the ARCPAC results as listed in Table 3 to the data given by Petzold et al. (2007), excellent agreement is found. The data suggest that the average age of the ARCPAC plume was approx. 5-8 days. Plume ages given

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in Figure 11 of the discussion paper seem to confirm this estimate. For plumes of this age, the Raman lidar data suggest an effective radius of 0.275 – 0.3 μm (Müller et al., 2007). It might be of interest to compare the ARCPAC data to the Raman lidar data as well. The authors may consider including this discussion in the revised version of the paper.

2/ References Intrieri et al. (2002), Lehrer et al., (2004), and Pierce et al. (2009) were not found in the paper.

3/ In Table 1, reference King (1978) should read King et al. (1978).

4/ The authors should ensure that Figures 2, 6, and 12 are printed in sufficient size in the final version so that axis lables and legends can be read.

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