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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol formation over the Boreal forest in Hyytiälä, Finland: monthly frequency and annual cycles – the roles of air mass characteristics and synoptic scale meteorology" *by* E. D. Nilsson and M. Kulmala

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I have a comment regarding the "cyclone model" shown in your Figure 10 and the accompanying discussion, which in my opinion is not correct. Especially, the important 3-d nature of the airstreams in a cyclone is neglected here which is crucial when it comes to aerosol transport into the Arctic. I am writing this comment because conceptual figures are likely to have a large impact and, thus, should be correct by all means. This is not the case here. In fact, a new conceptual model is not needed, since a correct one already exists.

There exists a vast body of literature on how airstreams move in a cyclone, and I can only list a few of those studies, which I encourage the authors to consult.

Use of satellite imagery and isentropic analysis has established the pseudo-Lagrangian conveyor belt model (Carlson, 1980; Browning, 1990, 1999), which describes three characteristic airstreams in a coordinate system moving with a cyclone in the middle latitudes: the dry intrusion (DI), a descending airstream related to tropopause folding (Browning, 1997), the cold conveyor belt (CCB), an airflow ahead of a surface warm front, and the warm conveyor belt (WCB), the deepest of the three flows, which rises ahead of the surface cold front. Wernli and Davies (1997) show how these airstreams are related to the trajectories of air masses involved in the cyclone's circulation, and Stohl (2001) shows where these airstreams occur in the northern hemisphere and discusses the relationship with pollution tracer transport. Finally, Eckhardt et al. (2004) present a climatology of the WCB.

Now, the movement of warm polluted air into the Arctic lower troposphere ahead of the cold front (i.e., in the WCB) and through the cold front is not possible. The WCB is a strongly ascending air stream which produces plenty of clouds. Thus, the air mass would end up in the middle or upper troposphere, not in the lower troposphere over the Arctic (where Arctic Haze is most concentrated). Furthermore, the precipitation would remove most of the aerosols, thus cleansing the air.

Instead, the air masses producing the Arctic Haze have to be relatively cold from the beginning. They need to be transported over cold (often snow-covered) surfaces under relatively quiescent conditions closer to the Siberian High and cannot participate in the circulation within the cyclone itself. This is explained in a recent paper (Stohl, 2006).

ACPD

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