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Chemical mass closure and assessment of the origin of the submicron aerosol in the marine boundary layer and the free troposphere at Tenerife during ACE-2

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ABSTRACT

The organic, inorganic, mineral content and mass concentration of the submicron aerosol were measured in June–July 1997 on Tenerife in the marine boundary layer (MBL) and the free troposphere (FT). Aerosol size distributions were measured simultaneously at the same sites. The submicron aerosol mass concentrations derived from the chemical composition and calculated from the number size distributions agreed within the experimental uncertainties both in the MBL (±47%) and the FT (±75%). However, the analytical uncertainties in the concentration of organic compounds (OC) for the average sample collected in the MBL (-97, +77%) and the FT (±74%) were high. The average contribution of aerosol various components to the submicron aerosol mass were calculated for different air masses. The absolute uncertainties in these contributions were calculated by adding random uncertainties quadratically and possibly systematic errors in a conservative way. In the unperturbed MBL, the aerosol average composition (±the absolute uncertainty in the contribution) was 37 (-3,+9)% for non-sea-salt SO_4^{2-} + NH_4^+, 21 (-2,+10)% for sea-salt, and 20 (-7, +11)% OC (N=19). In the unperturbed FT, OC and SO_4^{2-} accounted for 43 (±20)% and 32 (-5, +3)% of the submicron aerosol mass, respectively (N=15). Considering these aerosol compositions, we suggest that the source for the FT aerosol could be the transport of continental aerosol through precipitating convective clouds. A simple budget calculation shows, that in background conditions, the MBL and FT aerosol compositions are consistent with the hypothesis that the MBL aerosol is formed by the dilution of continental aerosol by FT air, modified by deposition and condensation of species of oceanic origin. Dramatic continental aerosol outbreaks were observed in both the MBL and the FT. The aerosol outbreaks in the MBL were due to transport of polluted air masses from Europe. They were characterized mainly by increases in SO_4^{2-} + NH_4^+, making up 75 (-5,+19)% of the submicron aerosol mass. The aerosol outbreaks in the FT were due to advection of desert dust, probably mixed with pollution aerosol.

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