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Aerosol optical properties relevant to regional remote sensing of CCN activity and links to their organic mass fraction: airborne observations over Central Mexico and the US West Coast during MILAGRO/INTEX-B

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Abstract. Remote sensing of cloud condensation nuclei (CCN) would help evaluate the indirect effects of tropospheric aerosols on clouds and climate. To assess its feasibility, we examined relationships of submicron aerosol composition to CCN activity and optical properties observed during the MILAGRO/INTEX-B aircraft campaigns. An indicator of CCN activity, κ, was calculated from hygroscopicity measured under saturation. κ for dry 100 nm particles decreased with increasing organic fraction of non-refractory mass of submicron particles (OMF) as 0.34–0.20×OMF over Central Mexico and 0.47–0.43×OMF over the US West Coast. These fits represent the critical dry diameter, centered near 100 nm for 0.2% supersaturation but varied as $\kappa^{(-1/3)}$, within measurement uncertainty (~20%). The decreasing trends of CCN activity with the organic content, evident also in our direct CCN counts, were consistent with previous ground and laboratory observations of highly organic particles. The wider range of OMF, 0–0.8, for our research areas means that aerosol composition will be more critical for estimation of CCN concentration than at the fixed sites previously studied. Furthermore, the wavelength dependence of extinction was anti-correlated with OMF as −0.70×OMF+2.0 for Central Mexico's urban and industrial pollution air masses, for unclear reasons. The Angstrom exponent of absorption increased with OMF, more rapidly under higher single scattering albedo, as expected for the interplay between soot and colored weak absorbers (some organic species and dust). Because remote sensing products currently use the wavelength dependence of extinction albeit in the column integral form and may

potentially include that of absorption, these regional spectral dependencies are expected to facilitate retrievals of aerosol bulk chemical composition and CCN activity over Central Mexico.

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