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Single carbonaceous aerosol particles from the continental atmosphere

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Knowledge of the chemical and physical properties of single atmospheric aerosol particles is of great importance for understanding their formation histories and climatic effects. We collected aerosol samples at a rural continental site in Hungary in all four seasons under variable meteorological conditions, from 1999 to 2004. Using transmission electron microscopy (TEM), particles were classified into groups on the basis of their morphologies, sizes, compositions and mixing states. Our aims were to understand the annual, seasonal and daily changes in the various types of fine particles, and to determine their possible origins. The hygroscopic properties of individual particles were studied using atomic force microscopy (AFM) under controlled relative humidities.

Based on composition, the majority of particles can be sorted into two broad categories, sulfate/organic and carbonaceous particles. Sulfates are internally mixed with carbon-bearing species in every sample, under both polluted and clean conditions. In the mixed particles the relative amount of carbonaceous material varies widely. Carbonaceous particles without a visible sulfate component include soot, tar ball, and "other" particles. In accordance with their combustion origins, soot and tar ball particles are abundant in autumn and winter. The other types of organic particles have variable morphologies, and different morphologies are related to distinct compositions, presumably reflecting variations in the origins of their constituent organic compounds. On the basis of airmass back-trajectories and relative concentrations of various particle types, carbonaceous particles having foil-like morphologies are likely secondary particles, the precursors of which may originate from natural sources. Such particles are abundant in the summer and likely contain water-soluble compounds.