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Rigorous bounds on aerosol optical properties from measurement and/or model constraints

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Sparse-particle aerosol models are an attractive alternative to sectional and modal methods for representation of complex, generally mixed particle populations. In the quadrature method of moments (QMOM) a small set of abscissas and weights, determined from distributional moments, provides the sparse set. Linear programming (LP) yields a generalization of the QMOM that is especially convenient for sparse particle selection. In this paper we use LP to obtain rigorous, nested upper and lower bounds to aerosol optical properties in terms of a prescribed Bayesian-like sequence of model or simulated measurement constraints. Examples of such constraints include remotely-sensed light extinction at different wavelengths, modeled particulate mass, etc. Successive reduction in bound separation with each added constraint provides a quantitative measure of its contextual information content. The present study is focused on univariate populations as a first step towards development of new simulation algorithms for tracking the physical and optical properties of multivariate particle populations.