Quantifying the sources of uncertainty in a global aerosol model

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I will present a new approach to understanding the uncertainty in a global aerosol microphysics model (GLOMAP) using a statistical emulator. Based on a relatively small number of model runs, emulation allows a full Monte Carlo-type variance-based uncertainty analysis to be undertaken. The full pdf and standard deviation of any model quantity can be quantified in all grid boxes, including the fractional contributions to the uncertainty from all model parameters. I will show results for present-day global CCN and black carbon in terms of 28 uncertain process and emission parameters in the model. I will also show a similar analysis for the first indirect forcing, which reveals that the parameters of most importance to present-day aerosol are not the same ones that are important for forcing. The maps of uncertainty contribution provide a detailed picture of how uncertainty varies and how different parameters affect it. The ranked uncertainties also provide a strong steer on what processes modellers need to focus on in future, with some “popular” processes having only a small effect on uncertainty. I will also discuss how such global sensitivity analyses could be combined with observations to constrain model predictions through calibration, and what we can learn by comparing these parametric uncertainty results with multi-model diversity.