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The prevalence of MSP-core sulphuric particles in the stratospheric Junge layer

Graham Mann (1,2), James Brooke (3), John Plane (3), Sandip Dhomse (1,4), Wuhu Feng (1,2), Ryan Neely (1,2), Chuck Bardeen (5), Nicolas Bellouin (6), Mohit Dalvi (7), Colin Johnson (7), and Luke Abraham (8)

(1) School of Earth and Environment, University of Leeds, LEEDS, United Kingdom, (2) National Centre for Atmospheric Science, University of Leeds, LEEDS, United Kingdom, (3) School of Chemistry, University of Leeds, LEEDS, United Kingdom, (4) National Centre for Earth Observation, University of Leeds, LEEDS, United Kingdom, (5) National Center for Atmospheric Research, Boulder, Colorado, United States of America, (6) University of Reading, Reading, United Kingdom, (7) U. K. Met Office, Exeter, United Kingdom, (8) University of Cambridge, Cambridge, United Kingdom

The widespread presence of meteoric smoke particles (MSPs) within a distinct class of stratospheric aerosol particles has become clear from in-situ measurements in the Arctic (Weigel et al., 2014; Curtius et al., 2005), Antarctic (Campbell and Deshler, 2014) and mid-latitudes (Murphy et al. 2013; Murphy et al., 1998). The key role such MSP inclusions play in enabling stratospheric aerosol particles to nucleate into polar stratospheric clouds (PSCs) has been established from microphysical PSC simulations (Hoyle et al., 2013; Engel et al., 2013) and space-borne lidar measurements (Pitts et al., 2011).

In this study, we apply the UM-UKCA stratosphere-troposphere composition-climate model with interactive modal aerosol microphysics (Dhomse et al., 2014) to assess the global distribution of these MSP-core sulphuric particles in the stratosphere. In our 80km top UM-UKCA model, we impose a monthly-varying MSP number and mass distribution based on separate simulations with the NCAR 120km top WACCM-CARMA model, which has sectional aerosol microphysics (e.g. Bardeen et al., 2008). In UM-UKCA, the MSP-core particles are tracked in a separate mode from the homogeneously nucleated particles, and the two different types of sulphuric particles both take up and evaporate off sulphuric acid vapour according to ambient conditions.

By comparing simulations particle concentrations to balloon-borne stratospheric aerosol measurements, we observationally constrain the MSP input into the upper atmosphere, and identify the treatment of H2SO4 photolysis as an important sensitivity in model predictions. We illustrate how the MSP-core sulphuric are not restricted to polar regions, but are prevalent at all latitudes, particularly in the upper part of the Junge layer. We show there is a steep vertical profile in particle morphology, the layer transitioning from being mostly homogeneously nucleated particles in the lower stratosphere to being mostly heterogeneously nucleated particles at the top.

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