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Weak response of CCN to changes in DMS flux: implications for the CLAW feedback in current climate assessments

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The CLAW hypothesis (Charlson et al., 1987) relates the production of dimethyl-sulphide (DMS) by phytoplankton in the surface ocean to the optical properties of clouds via the first and second aerosol indirect effects, thereby proposing a climate feedback. The CLAW feedback has been the subject of much investigation over the last two decades, but only recently have aerosol models with detailed aerosol microphysics become available.

Presented here are simulations in the UK Met Office HadGAM atmospheric general circulation model where the flux of DMS to the atmosphere from the oceans is perturbed. The impact of these DMS flux perturbations on aerosol when simulated by two different aerosol schemes is investigated. One aerosol scheme carries only mass in several aerosol types, each with a prescribed size distribution, and is typical of most aerosol schemes used in recent global climate assessments (e.g. IPCC AR4). The second aerosol scheme (UKCA-mode, Mann et al., 2010) uses a two-moment approach transporting number and mass in several size modes, allowing particle number to be conserved and growth to be simulated.

The more detailed two-moment aerosol scheme predicts a very weak CCN response to changes in DMS flux. This suggests that the role of the CLAW feedback is either very weak, or negligible. The simpler mass-only aerosol scheme predicts a larger response of CCN to DMS changes. The greater response in the mass-only aerosol scheme is believed to be incorrect, due to the very limited representation of aerosol microphysics within the scheme. These results have significance for the representation and quantification of the CLAW feedback in current climate assessments, suggesting that the strength of the feedback may be over-estimated by simple aerosol schemes.