Low sensitivity of cloud condensation nuclei to changes in the sea-air flux of dimethyl-sulphide

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The emission of dimethyl-sulphide (DMS) gas by phytoplankton and the subsequent formation of aerosol has long been suggested as a n important climate regulation mechanism. The key aerosol quantity is the number concentration of cloud condensation nuclei (CCN), but un til recently global models did not include the necessary aerosol physics to quantify CCN. Here we use a global aerosol microphysics model t o calculate the sensitivity of CCN to changes in DMS emission using multiple present-day and future sea-surface DMS climatologies. Calcula ted annual fluxes of DMS to the atmosphere for the five model-derived and one observations based present day climatologies are in the rang e 15.1 to 32.3 Tg a−1 sulphur. The impact of DMS climatology on surface level CCN concentrations was calculated in terms of summer an d winter hemispheric mean values of ΔCCN/ΔFluxDMS, which varied between −43 and +166 cm−3/(mg m−2 day−1 sulphur), with a mea n of 63 cm−3/(mg m−2 day−1 sulphur). The range is due to CCN production in the atmosphere being strongly dependent on the spatial distri bution of the emitted DMS. The relative sensitivity of CCN to DMS (i.e. fractional change in CCN divided by fractional change in DMS flu x) depends on the abundance of non-DMS derived aerosol in each hemisphere. The relative sensitivity averaged over the five present day DM S climatologies is estimated to be 0.02 in the northern hemisphere (i.e. a 0.02% change in CCN for a 1% change in DMS) and 0.07 in the so uthern hemisphere where aerosol abundance is lower. In a globally warmed scenario in which the DMS flux increases by ~1% relative to pre sent day we estimate a ~0.1% increase in global mean CCN at the surface. The largest CCN response occurs in the Southern Ocean, contrib uting to a Southern Hemisphere mean annual increase of less than 0.2%. We show that the changes in DMS flux and CCN concentration bet ween the present day and global warming scenario are similar to interannual differences due to variability in windspeed. In summary, althoug h DMS makes a significant contribution to global marine CCN concentrations, the sensitivity of CCN to potential future changes in DMS flu x is very low. This finding, together with the predicted small changes in future seawater DMS concentrations, suggests that the role of DM S in climate regulation is very weak.

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