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Ocean isoprene emissions: The new mechanism for the effect of phytoplankton on climate

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The effect of ocean biological productivity on marine clouds is explored over the large phytoplankton bloom in the Southern Ocean using remotely sensed data. Compared to the background, cloud droplet number concentration over the bloom was doubled and cloud effective radius was reduced by 30%. The resulting change in the short-wave radiative flux at the top-of-the-atmosphere was -15W m^{-2}, comparable to the aerosol indirect effect over highly polluted regions. This observed impact of phytoplankton on clouds is attributed to changes in the size-distribution and chemical-composition of cloud condensation nuclei (CCN). We propose that secondary organic aerosol (SOA) formed from the oxidation of phytoplankton-produced isoprene, may affect chemical-composition of marine CCN and impact cloud droplet number. Model simulations presented support this hypothesis, making ocean isoprene emissions a viable mechanism by which marine biota may affect warm clouds. This "unaccounted" isoprene SOA may partly reconcile the large organic aerosol source "missing" from current global models.

Marine boundary layer isoprene concentration measurements over different productivity regions near Galapagos Islands and the lab measurements of isoprene emission rates for different phytoplankton species under variable environmental conditions will also be presented. The data is employed to create global 1x1 degree marine isoprene emission maps to be used in global Chemical Transport Models (CTMs) or regional climate models (RCMs).