3.129 Marine organic carbon: simulating impacts on aerosol, clouds, and climate.

Presenting Author:
Matt Woodhouse, CSIRO Climate Science Centre, Aspendale, Australia, matthew.woodhouse@csiro.au

Co-Authors:
Ashok Luhar, CSIRO Climate Science Centre, Aspendale, Australia
Sarah Lawson, CSIRO Climate Science Centre, Aspendale, Australia
Melita Keywood, CSIRO Climate Science Centre, Aspendale, Australia
Mike Harvey, NIWA, Wellington, NZ

Abstract:

The marine aerosol burden is often thought of as being dominated by sulfate from phytoplankton-derived dimethyl-sulfide and sea salt. In the last decade, observations and laboratory studies have highlighted a significant contribution to the marine aerosol burden from emission of organic carbon. However, even the latest generation of aerosol schemes included in climate models often neglect these organic carbon emissions, introducing potential biases to the simulated clouds, precipitation, and radiative budget. Marine organic carbon emissions can be primary (direct release of organic carbon in particles) or secondary (organic carbon emitted in the gas-phase). The lifetime and fate of aerosol from the two distinct marine organic carbon source mechanisms are quite different, and require individual representation in an aerosol scheme to quantify their role in the climate system.

We have used the ACCESS-UKCA global composition-climate model (which includes the GLOMAP-mode aerosol microphysics scheme) to simulate the emission and fate of both primary and secondary organic carbon. We compare the model against detailed observations made during the Surface Ocean Aerosol Production (SOAP) ship campaign in the biologically productive seas east of New Zealand, and also against long-term observations from fixed stations (e.g. Cape Grim). We quantify the contribution marine organic carbon makes to aerosol mass and number, and the subsequent impacts on cloud optical properties and radiation, finding significant contributions from both primary and secondary sources of marine organic aerosol. In order to properly represent the critically important marine boundary layer in climate simulations, marine organic carbon emissions should be included, and may help to address long-standing climate model biases.