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Studying new particle formation from chemical emissions from sea surface using ship-borne air-sea-interaction tanks

Maija Peltola[1], Manon Rocco[1], Neill Barr[2], Erin Dunne[3], James Harnwell[3], Karl Safi[2], Alexia Saint-Macary[2], Andrew Marriner[2], Stacy Deppeler[2], Aurélie Colomb[1], Clémence Rose[1], Mike Harvey[2], Cliff Law[2], and Karine Sellegri[1]

[1]Université Clermont Auvergne, CNRS, Laboratoire de Météorologie Physique (LaMP), Clermont-Ferrand, France
[2]National Institute of Water and Atmospheric Research (NIWA), Wellington, New Zealand
[3]CSIRO, Oceans and Atmosphere, Climate Science Centre, Aspendale, Australia

Even though oceans cover over 70% of the Earth's surface, the ways in which oceans interact with climate are not fully known. Marine micro-organisms such as phytoplankton can play an important role in regulating climate by releasing different chemical species into air. In air these chemical species can react and form new aerosol particles. If grown to large enough sizes, aerosols can influence climate by acting as cloud condensation nuclei which influence the formation and properties of clouds. Even though a connection of marine biology and climate through aerosol formation was first proposed already over 30 years ago, the processes related to this connection are still uncertain.

To unravel how seawater properties affect aerosol formation and to identify which chemical species are responsible for aerosol formation, we built two Air-Sea-Interaction Tanks (ASIT) that isolate 1000 l of seawater and 1000 l of air directly above the water. The used seawater was collected from different locations during a ship campaign on board the R/V Tangaroa in the South West Pacific Ocean, close to Chatham Rise, east of New Zealand. Seawater from one location was kept in the tanks for 2-3 days and then changed. By using seawater collected from different locations, we could obtain water with different biological populations. To monitor the seawater, we took daily samples to determine its chemical and biological properties.

The air in the tanks was continuously flushed with particle filtered air. This way the air had on average 40 min to interact with the seawater surface before being sampled. Our air sampling was continuous and consisted of aerosol and air chemistry measurements. The instrumentation included measurements of aerosol number concentration from 1 to 500 nm and chemical species ranging from ozone and sulphur dioxide to volatile organic compounds and chemical composition of molecular clusters.

Joining the seawater and atmospheric data together can give us an idea of what chemical species are emitted from the water into the atmosphere and whether these species can form new aerosol particles. Our preliminary results show a small number of particles in the freshly nucleated size range of 1-3 nm in the ASIT headspaces, indicating that new aerosol particles can form in the ASIT

headspaces. In this presentation, we will also explore which chemical species could be responsible for aerosol formation and which plankton groups could be related to the emissions of these species. Combining these results with ambient data and modelling work can shed light on how important new particle formation from marine sources is for climate.

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