Masters thesis on the effect of changing climate on sea spray aerosol emissions

Along with mineral dust, the largest natural source of aerosol particles on Earth is sea spray, an important source of cloud condensation nuclei for marine clouds. These particles form when breaking waves entrain air into the ocean surface water, which subsequently breaks up into bubbles. As these bubbles burst at the sea surface, they emit small droplets into the air, which consist of water, sea salt, bacteria, viruses, and organic surfactants and particulates.

At ACES, we have studied sea spray aerosol for more than a decade using a combination of laboratory and field measurements and modelling studies (e.g. Salter et al., 2014). In some of our more recent work we have refined our understanding of how much sea spray aerosol is emitted under different wind speed and seawater temperatures using a sea spray simulation tank (Salter et al., 2015). With this new understanding we were able to improve our representation of sea spray aerosol in an earth system model (NorESM) that is often used to investigate future changes in climate. Under future greenhouse gas scenarios, climate models consistently predict an increase in sea surface temperature in most regions of the world. Additionally, the models predict larger surface wind speeds in mid- and high-latitude oceanic regions, especially in the Southern Ocean.

We would like to probe how future changes in the Earth system may impact the emission of sea spray aerosols which will in turn feedback on climate via direct and indirect aerosol effects. Within this project there is a lot of scope for a dedicated masters thesis and a number of areas to explore immediately spring to mind:

1) How might global and regional sea spray aerosols change as future climate changes?
2) What is/are the main driver/s of sea spray aerosol emissions in warmer climates?
3) Can we identify any sea spray aerosol-climate feedbacks in the system?
4) Can we quantify potential impacts on marine stratocumulus cloud microphysical and radiative properties due to changing sea spray aerosol emissions?

The supervisors for the project will be Matt Salter (matthew.salter@aces.su.se), an expert in sea spray aerosol and Juan Acosta, an expert in earth system modelling (Juan-Camilo.Acosta@aces.su.se).

Salter et al., 2014. J. Geophys. Res., 119, 9052–9072.
Salter et al., 2015. Atmos. Chem. Phys. 15, 13783-13826.