

**Meeting Report : COST-735-100510-06724 : Primary Marine Aerosol Flux Workshop
National University of Ireland, Galway, May 10-11, 2010**

Co-organisers/Chairs : Dr Ian M. Brooks (University of Leeds) and Prof. Colin O'Dowd (NUI Galway)

Primary marine aerosols generated from sea spray constitute the largest fraction of atmospheric aerosol loading over the open oceans. They have a controlling influence on cloud microphysics, and are an important sink for trace gases. In recent years it has also become apparent that they contribute a significant source of organic material. Quantifying and parameterizing the flux of sea spray to the atmosphere has historically relied upon indirect methods and assumptions that are difficult to verify. Only recently has the technology to make direct flux estimates become available; however, early measurements have emphasized the significant challenges involved. Chemically resolved fluxes present even greater challenges, and significant differences exist between the results from different studies.

This workshop was convened to discuss current issues relating to primary marine aerosol fluxes, their measurement, and the extension of source functions determined from in-situ process-based measurement campaigns and laboratory studies to a global scale via satellite retrievals. A conscious decision was made to avoid extended presentations of completed studies and to focus on areas where the participants believed significant problems or gaps in our understanding exist, with an aim to draw up recommendations for future research priorities. Short presentations (~15 minutes) were invited, with equal time being allocated to open discussion of the issues raised. The workshop was split into three sessions:

1. The application of micrometeorological techniques (eddy covariance, flux-profile relationships, etc) to the measurement of sea-spray fluxes
2. The organic enrichment of marine aerosols and problems in chemically partitioning flux estimates
3. The use of satellite retrievals to derive global-scale source functions and marine aerosol products

A total of 22 participants registered for the workshop but travel problems resulting from the ongoing volcanic eruption on Iceland caused 4 people to miss the meeting.

The opening session considered measurement of sea-spray aerosol fluxes by micrometeorological techniques. Dongliang Zhao presented details of a new offshore tower for air-sea interaction studies in China. Sarah Norris presented statistics of eddy covariance flux estimates from both ship and spar-buoy based studies, noting significant differences, the uncertainties associated with interpreting the results, and the potential for conditions under which such measurements may not provide a useful means for deriving source functions. Monica Mårtensson presented preliminary results of eddy covariance measurements from mast installed on the coast of Svalbard. Ed Andreas presented some theoretical considerations of possible measures of the transfer velocity for sea-spray aerosol. Jacek Piskozub compared results from three different techniques: eddy covariance, flux-gradient relationships, and inertial dissipation estimates. Finally Darius Ceburnis presented flux estimates from concentration gradients at the Mace Head site, including some estimates of chemically partitioned fluxes. Discussion focused on the assumptions underlying the various micrometeorological techniques, and the current lack of verification of the validity of these assumptions for aerosol processes.

The second session focused on attempts to chemically partition aerosol fluxes. Matteo Rinaldi presented results from the MAP cruise on the RV Celtic Explorer – laboratory studies of the chemical composition of particulates generated by bursting bubbles in circulating sea water were conducted

throughout the cruise alongside measurements of ambient aerosol. Elena Fuentes presented the results of laboratory studies with sea water prepared with different concentrations of natural organic matter from algal exudates. Jurgita Ovadnevaite discussed observations of high concentrations of organic matter in marine aerosols. Finally Monique Albert linked this session and the following session by considering uncertainties in the organic fraction of aerosol estimated from a combination of satellite products and current source functions. The discussion following this session focused on areas of particular uncertainty, notably the very different results that came out of laboratory studies using different setups; a pressing need was identified for understanding which parameters in the setup were controlling factors and how they impacted on results so as to allow better comparison and synthesis of results from different groups.

The final session reviewed progress and problems in extending results from in-situ or laboratory studies to the global scale through use of satellite retrievals. Maggie Anguelova presented details of whitecap fraction retrievals from satellite microwave emissivity measurements and the influence of forcing conditions other than wind speed. Wave state, wind fetch/duration, and boundary layer stability were all identified as having a significant impact. Kaylan Randolph presented some results of bubble size distributions from in-situ measurements and discussed the impact these had on satellite retrievals of other quantities such as ocean colour – which is used to estimate bioproductivity and organic enrichment of sea spray. Lonneke Goddijn-Murphy discussed the combination of in-situ measurements with model and satellite data and the discrepancies that arose between different methodologies for parameterizing the whitecap fraction and aerosol flux. Jacques Piazzola presented modelling results of sea spray production on a regional scale, emphasising the importance of wind fetch and local wave conditions on the predicted flux. Finally Colin O'Dowd considered recent work on the development of a combined organic-inorganic sea spray source function using a combination of in-situ measurements and satellite retrievals. Open discussion raised issues of what products are required from satellites, the need for in-situ validation of satellite retrievals, the problem of how to handle temporal/spatial gaps in satellite fields, and the problems associated with the use of NWP model data in sea-spray parameterizations.

A goal of the meeting was to produce some recommendations for future research based on areas of uncertainty or gaps in current knowledge. In order to disseminate these recommendations a published meeting report was considered highly desirable. To this end a proposal for a short meeting report for publication in the Bulletin of the American Meteorological Society is in preparation for submission to the editor.

AGENDA

Session 1

- Dongliang Zhao : Eddy covariance measurements of sea-spray aerosol fluxes
- Sarah Norris : Statistics of eddy covariance estimates of sea-spray aerosol fluxes
- Monica Mårtensson : Measurements of sea spray aerosol emissions with the eddy covariance method at Svalbard (78.9° N)
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- Edgar Andreas : The Production Velocity of Sea Spray Droplets
- Jacek Piskozub : The gradient method of flux measurements, and comparison with eddy correlation and inertial dissipation methods for sea-spray aerosol
- Darius Ceburnis : Gradient flux measurements at Mace Head

Session 2

- Matteo Rinaldi : Characterization of sea spray organic matter from natural sea water and selected algal cultures
- Elena Fuentes: Impacts of phytoplankton-derived organic matter on the primary sea spray production: a laboratory study
- Jurgita Ovadnevaite: High concentrations of primary organic matter in marine air
- Monique Albert: Uncertainties in the determination of the organic fraction of global sea-spray emissions

Session 3

- Magdalena Anguelova : Whitecap fraction database for studies of whitecaps variability and its influence on sea-spray source function
- Kaylan Randolph : Measurements of bubble populations resulting from large-scale wave breaking
- Lonneke Goddijn-Murphy: Combining field data with model and satellite data, in whitecap parameterizations using wind speed and sea state parameters
- Jacques Piazzola : Sea Spray Fluxes over a Mediterranean Coastal Zone
- Colin O'Dowd: A combined organic-inorganic sea spray source function