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Annual Report on "Studies of Marine Aerosols  
and Their Evolution in the Eastern North Atlantic,"  
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to Office of Naval Research

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## ONR-ASTEX Annual Report

### 1. Introduction

Activity during the 1992 calendar year centered around the ASTEX project in the Azores and what has been, essentially, a small follow-up experiment conducted off of the Washington-Oregon coast, at least partially in conjunction with a series of test flights by the newly outfitted NRL blimp. The main experiment, conducted during ASTEX, had several objectives: (1) evaluate data for the occurrence of significant relationships between DMS,  $\text{SO}_2$ ,  $\text{SO}_4^-$  and CCN concentrations, (2) evaluate the strength of the relationship between boundary layer CCN concentration and cloud drop concentration in capping stratocumulus decks, (3) investigate the evolution of the particle size distribution in the boundary layer and (4) assess the effect of ship-induced aerosol flux on cloud dynamics and chemistry. The west coast experiment concentrated on only the fourth objective of the ASTEX study. A review of data reliability has been undertaken, and some preliminary data analysis as well. We summarize the results below.

### 2. Data Base

#### 2.1 ASTEX

Fifteen research flights were flown during the course of the ASTEX field program. Of these, three appear to be reasonable candidates for analysis of objective (1), eight or nine for analysis of (2), four for (3) and one or two for (4). With respect to the first objective, all of the filter samples have now been analyzed for sulfate and  $\text{SO}_2$ , but air concentrations have not yet been calculated for all samples. We are still in the process of calculating CCN activation spectra from available measurements, a process that impacts the second as well as the first objective of the ASTEX study.

Concerning the evolution of the particle size distribution, we have already completed an analysis of some of the particle size measurements obtained during ASTEX and submitted it for publication. Although not directly relevant to our ONR objectives (and

supported by NSF rather than ONR), it has suggested several interesting approaches to the analysis of the evolution of the particle size distribution.

Finally, we are still in the course of analyzing our limited data relevant to ship tracks. We have one case in which there is a definite microphysical anomaly (low effective radius) plausibly associated with a ship plume and another case in which a ship plume was entering cloud without producing any observable anomaly. Hopefully, a comparison of these two cases will prove fruitful.

## 2.2 West Coast Study

Two research flights have been flown to date and a third is still pending for this study. Of the two flights, one examined the nature of the effluents from several ship plumes when clouds were not present and one acquired data in both the plume of a ship and the in-cloud ship track produced by that plume. The latter is, of course, the more interesting case and the one upon which most of our efforts have been expended to date. Preliminary analysis of cloud water samples taken in and outside of the ship-track show somewhat elevated  $\text{SO}_4^{2-}$  and  $\text{NO}_3^-$  in the track but no differences in  $\text{Cl}^-$ . This suggests that the particles which are presumably producing the track came from the combustion plume of the ship rather than her wake.

Another interesting facet of the measurements is an apparent relationship between the concentration of particles in the ship plume and the nature of the perturbation to the cloud microstructure which the plume induces. However, a more detailed data analysis is in order before any firm conclusions will be warranted. Certainly it is premature to even consider any sort of formal presentation or publication of our results.

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