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MEASUREMENTS OF ULTRAFINE PARTICLE FORMATION AND GROWTH DOWNWIND OF MACQUARIE ISLAND DURING ACE-1

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Ultrafine aerosol size distributions (~2.7 to 10 nm diameter) and gas phase sulfuric acid concentrations were measured from the NCAR C-130 aircraft as part of the Southern Hemisphere Marine Aerosol Characterization Experiment (ACE-1). This data can be used to estimate ultrafine particle formation rates and ultrafine particle growth rates. These observed rates, in turn, can be compared with the formation and growth rates of sulfuric acid droplets calculated from measured sulfuric acid concentrations. Our earlier work at remote marine and continental sites have shown that observed ultrafine particle formation and growth rates were much higher than those predicted for sulfuric acid droplets. We have speculated that the participation of ammonia may account for the enhanced particle formation rates and that condensation of additional species, like organics, could explain the higher growth rates.

During ACE-1, evidence of recent new particle formation was frequently observed in the out-flow regions of clouds. However, the highest concentrations of particles smaller than ~4 nm diameter and most dramatic evidence of recent new particle formation were recorded downwind of the southern tip of Macquarie Island, the site of a large penguin colony and a significant source of ammonia. Despite unusually high nucleation rates, sulfuric acid concentrations were typical of levels recorded in cloud out-flow regions, approximately 8×10^6 molecules cm^{-3}. Closest to the southern tip of the island, the ultrafine particle distribution appeared to peak below the ultrafine condensation particle counter lower detection limit of ~2.7 nm; further downwind from this point the ultrafine mode was observed at larger particle diameters suggesting that the particles were growing as they moved away from the island. In this paper, ultrafine particle formation and growth rates downwind of Macquarie Island will be discussed.

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