New Particle Formation Enhancing CCN Concentrations Over Antarctic Peninsula

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Abstract

New particle formation has been recognised and studied all over the world, however, studies over the remote parts of the globe have been rare. Even fewer studies have investigated the impact of new particle formation (NPF) on cloud condensation nuclei (CCN) in remote Antarctica, and none has elucidated the relationship between NPF and CCN production. A full year observations of NPF events on the Western Antarctic peninsula revealed 97 events with clear annual and seasonal pattern: high concentration and frequency of nucleation-mode particles in summer (December–February: 53 NPF cases) and undetected nucleation-mode particles in winter (June–August: no NPF cases). A novel methodological approach allowed the estimation of the spatial scale of NPF by multiplying the time during which a distinct nucleation mode can be observed at the sampling site by the locally measured wind speed. The estimated median spatial scale of NPF around the Western Antarctic Peninsula was found to be approximately 155 km, indicating the large scale of NPF events. Air back trajectory analysis revealed that 80 cases of NPF events were associated with air masses originating over the open ocean, followed by sea-ice (12 cases), multiple origin (3 cases), and land (2 cases) regions. Satellite estimates for sea-surface dimethylsulfoniopropionate (DMSP; a precursor of gaseous dimethyl sulfide) data showed that the production of oceanic biogenic precursors could be a key component in marine NPF events, whereas halogen compounds released from ice-covered areas could contribute to sea-ice NPF events. Out of 97 observed NPF events, 83 cases were characterized by the simultaneous increase in the CCN concentration by 2 %–270% (median 44 %) in the following 1 to 36 hours (median 8 h) after NPF events. Overall, Antarctic NPF events were found to substantially contribute to cloud condensation nuclei supporting previously identified activation pathways based on nuclei chemical make-up.

Early Career Scientist

NO, I am not an early career scientist.

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