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The role of wave motions in polar stratospheric cloud formation and spatial distribution

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While the role of Polar Stratospheric Clouds (PSCs) in the depletion of ozone over the poles is well known, critical issues still remain, such as the nucleation mechanism for the nitric acid hydrate, concerning the chemistry and microphysics of these clouds. Considerable uncertainty also exists regarding the interaction of these clouds with the dynamics of the stratosphere. In the Arctic and Antarctic gravity waves have been found to have an influence on the formation of PSCs. However, some authors have concluded that large-scale planetary waves are the drivers of the temperature fluctuations that cause these clouds with gravity waves simply modulating their fine-scale structure.

This study uses a combination of POAM III aerosol extinction measurements and CHAMP GPS/RO temperature measurements to examine the role of atmospheric waves in defining the spatial distribution of Polar Stratospheric Clouds (PSCs) in the polar regions. POAM III aerosol extinction observations are used to identify Type I Polar Stratospheric Clouds using an unsupervised k-means clustering algorithm which is detailed. Observations of the gravity wave field are made using Radio Occultation from the Challenging Minisatellite Payload/Global Positioning System (CHAMP/GPS) experiment. Examination of the spatial distribution of PSC occurrence as a function of time of year, and latitude (which also varies as a function time of year) and longitude are examined. The spatial distribution is examined to determine whether there is potentially a bias towards region of high gravity wave activity early and late in the Arctic and Antarctic PSCs season. This study also examines the differences between the Antarctic and the Arctic climatological gravity wave field and makes inferences about the relative importance of these waves on PSC formation in

the two regions.

Detailed observations from super-pressure balloon flights made during the French Space Agencies Vorcore/Strateole mission are also examined for cases where super-pressure balloon measurements occur close in both space and time to PSCs identified in the POAM III aerosol extinction data. The temperature evolution of these cloud air parcels are examined by examining the temperatures along the trajectory of the super-pressure balloon observations and the potential impact of these temperature series on PSC formation probability is discussed.