Profiling the Antarctic Atmosphere Using the GPS Radio Occultation Technique from Stratospheric Balloons – Perspectives for a future addition to the LAOF

J.S. Haase, J. Maldonado Vargas, F. Rabier, P. Cocquerez, V. Guidard, P. Wyss, A. Johnson, B. Murphy

GPS radio occultation measurements were made during the Antarctic Concordiasi campaign, which was carried out in the austral spring of 2010 to study ozone and polar stratospheric clouds, gravity waves over the Antarctic peninsula, and data assimilation in numerical weather prediction models using observations made from stratospheric superpressure balloons. Dropsondes were also deployed for assessing the quality of satellite data assimilation over the Antarctic. Neither the driftsondes nor the GPS radio occultation instruments are currently part of the Lower Atmospheric Observing Facilities, though both systems were supported by the National Science Foundation. The proof-of-concept experiment was successful in showing that refractivity profiles could be retrieved that are comparable in quality to those derived from dropsondes. We also compare the GPS Radio occultation measurements near the Antarctic Peninsula with refractivity derived from the Météofrance ARPEGE model. The GPS radio occultation profiles are measured with respect to precise geometric height, so there is some uncertainty when mapping the dropsonde measurements of temperature and relative humidity to refractivity as a function of pressure to geometric height. Given the refractivity profiles from dropsondes and the model, raytracing was used to simulate the GPS signal excess phase, excess Doppler shift and bending angle due to the refractive bending in the atmosphere, for comparison with the observations. The first profiles show a close agreement between model simulations and observations of Doppler shift, down to the lowest level of 2.2km above the ellipsoid. The two balloons equipped with GPS radio occultation systems flew a combined total of 107 days within the Antarctic polar vortex, and recorded more than 700 occultations, a comparable number of profiles to the 647 dropsondes released by the 13 balloons equipped with driftsonde systems during the campaign. The observation system could provide complementary measurements to driftsondes because it could continue to provide measurements after the dropsonde payload has been expended. Given that the GPS radio occultation technique has the potential to provide sufficiently high quality estimates of Antarctic atmosphere profiles of temperature to be helpful with model validation, it could be an interesting addition to the LAOF effort for advancing Climate System Science. We will discuss the technological readiness of the system and potential for collaboration with the balloon driftsonde effort.