A STUDY ON THE RELATIONSHIP BETWEEN IONOSPHERIC CORRECTION AND DATA CONTROL FOR GPS RADIO OCCULTATION IN AUSTRALIA

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ABSTRACT

Global Navigation Satellite Systems (GNSS) meteorology refers to the science and technology that makes use of GNSS for active remote sensing of the Earth's atmosphere. The space-based technique has attracted much attention since the feasibility study of the pioneering GPS/MET project in late 1990s when GPS radio occultation (RO) technique was tested as a new means of atmospheric probing.

Recent developments of GNSS, such as GPS, have offered exciting potential for meteorological research. GPS RO, using low Earth orbit (LEO) satellites such as CHAMP [1][2][3], GRACE and COSMIC, is an emerging technique for profiling the atmosphere. Vertical gradients of the atmospheric refractivity are retrieved from precise measurements of radio propagation path between a LEO GPS receiver and an occulting GPS satellite transmitter pair [4].

The CHAMP RO derived atmospheric profiles were compared with radiosonde observations and NCEP model values separately at ten strategically selected locations across the entire Australian continent [5][6].. The comparisons have demonstrated a good agreement between temperature and water vapor derived from GPS RO events (ROEs) and radiosonde measurements respectively. The problems associated with the GPS RO technique in the lower troposphere, have been identified.

Both temperature and water vapour profiles at two radiosonde stations in Western Australia were compared and its results are shown on Figure 1. The top two plots in Figure 1 show that above 12 km, radiosonde measurements are in general cooler than the co-located GPS RO measurements. Between about 5 km and 12 km, both temperature profiles (GPS and radiosonde) align closely. The small differences are attributed to possible multi-path and tracking problems of the GPS system and the Abel inversion process. For water vapour profiles, there is a general agreement between the GPS and radiosonde profiles below 4 km and above 7.5 km (bottom two graphs in Figure 1). It is also found that there is a peak difference of approximately 0.4 hPa at an altitude of 7 km; this difference decreases to below 0.1 hPa between altitudes of 8 km and 10 km.

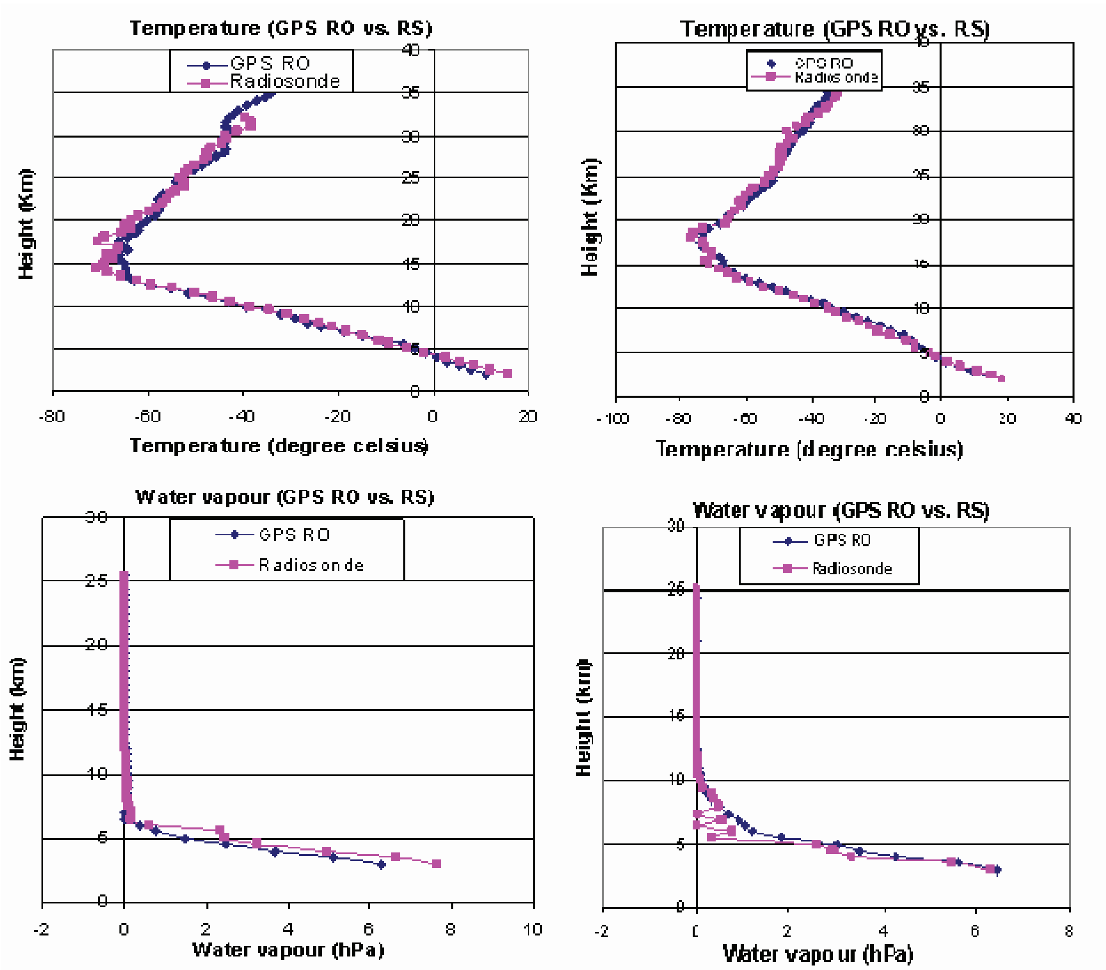

Figure 1. A comparison of both temperature (top two graphs) and water vapour (bottom graphs) profiles at two radiosonde stations in Western Australia (spatial collocation - 300 km radius and temporal collocation - 3 hours)

Because the profiles of temperature and humidity are not suit for the data assimilation in Numeric Weather Prediction (NWP), direct data assimilation of the refractivity profiles are suggested to be one of the better options [7]. According to these results, quality control of the RO data is important for the RO retrieval process especially for ionospheric correction in the algorithm and Abel inversion processing. The simplest method to reduce the effects of the ionosphere is by adopting linear combination of bending angles at a common impact parameter [8]. The resulting bending angle profiles at altitudes above about 50 km are very noisy. This is due to the fact that residual errors of the ionospheric correction originate from small scale ionospheric turbulence and receiver noise [9].

In order to remove the ionospheric contribution to RO events, different ionospheric models (MSISE and IRI) will be used. Atmospheric refractivity profiles will be derived from RO events using COSMIC data over the

Australian region. The atmospheric refractivity profiles will be compared with those from other organizations and the precision of the refractivity will be analyzed. The improved refractivity profiles also will be introduced into the assimilation approach in the study for enhancing the weather forecasting performance and establishing high-accuracy climate monitoring in Australian region.

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