GNSS Radio Occultation Technique and Detailed Evaluation Study Using COSMIC Data for Australia

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In late January and early February 2009, south-eastern Australia experienced unprecedented heatwaves with disastrous consequence of bushfires and loss of over 200 lives. A number of record-breaking climate extremes have been recorded. These extreme weather events tend to be global around the world (e.g. snow storms in UK and USA, flooding in Indonesia and drought in China occurred almost concurrently) and are not limited to regional individual phenomena. These extremes due to the changing climate have disastrous impacts on environment, society and economy worldwide. However, monitoring and prediction of meteorological conditions have been challenging tasks due to the high-uncertainty and high-dynamics nature of the climate and weather. This is particularly true for countries in the southern hemisphere such as Australia, where a significantly small number of meteorological stations are established to conduct observations in comparison with the northern hemisphere.

A novel atmospheric observation technique, Global Navigation Satellite System (GNSS) radio occultation (RO) meteorology, has been recently introduced for the successful acquisition of numerous and comprehensive Earth's atmospheric profiles. Many research results have demonstrated the great potential of the new technique to most of meteorological studies, such as global climate change, numerical weather forecasting and cyclone warning. This space-based atmosphere observation method has opened new avenues for measuring the Earth's atmospheric parameters with a high accuracy, high resolution, and global coverage. Long term and near real-time observations using this technology will significantly advance our knowledge of both Earth's atmospheric structure and processes. With the newly launched six COSMIC LEO satellites in 2006, thousands of high quality globally distributed daily vertical profiles of refractivity, temperature and water vapour have been obtained. In the near further, the new generation GNSS such as European Galileo and Chinese Campass can be integrated into this monitoring system with doubled, tripled and/or multi-fold measurements. Near real-time applications (2-hour latency currently) have become a reality with the continuing improvement of data processing techniques that transfers the GNSS measurements to atmospheric profiles. Therefore, it is anticipated that GNSS RO technique will play more important role in meteorological studies because of the significantly increased amount of observations and improved data processing method.

There is increasing evidence that the climate is changing on a global scale and consequently it will be important to monitor the changes in both regional and global scale of the patterns in atmospheric characteristics, in particular temperature and moisture vertical profiles. The most destructive climatological hazards such as tropical cyclones, thunderstorms and lightning are temperature-sensitive weather phenomena and there is a possibility of increase in their activity in warmer climate. COSMIC RO observations will provide a large number of atmospheric temperature and humidity vertical profiles in or in the vicinity of the storms and therefore will provide more specific information on the interaction with their environment. Results of evaluation of accuracy of GPS RO measurements over the Australian region are presented.

Keywords: GNSS, COSMIC, Radio Occultation, Australia, meteorology