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Detection of severe weather events using new remote sensing methods

S. Choy (1), C. Wang (1), K. Zhang (1), Y. Kuleshov (2,1)

(1) School of Mathematical and Geospatial Sciences, RMIT University, Melbourne, Australia, (2) National Climate Centre, Bureau of Meteorology, Melbourne, Australia

The potential of using ground- and space-based Global Positioning System (GPS) observations for studying severe weather events is presented using the March 2010 Melbourne storm as a case study. This event generated record rainfall and flash flooding across the state of Victoria, Australia. The Victorian GPSnet is the only state-wide and densest ground-based GPS infrastructure in Australia. This provides a unique opportunity to study the spatial and temporal variations in precipitable water vapour (PWV) as the storm passed over the network. The results show strong spatial and temporal correlation between variations of the ground-based GPS-PWV estimates and the thunderstorm passage. This finding demonstrates that the ground-based GPS techniques can supplement conventional meteorological observations in studying, monitoring, and potentially predicting severe weather events. The advantage of using ground-based GPS technique is that it is capable of providing continuous observation of the storm passage with high temporal resolution; while the spatial resolution of the distribution of water vapour is dependent on the geographical location and density of the GPS stations. The results from the space-based GPS radio occultation (RO) technique, on the other hand, are not as robust. Although GPS RO can capture the dynamics of the atmosphere with high vertical resolution, its limited geographical coverage in a local region and its temporal resolution over a short period of time raise an important question about its potential for monitoring severe weather events, particularly local thunderstorms which have a relatively short life-span. GPS RO technique will be more suitable for long-term climatology studies over a large area. It is anticipated that the findings from this study will encourage further research into using GPS meteorology technique for monitoring and forecasting severe weather events in the Australian region.