Department of Meteorology M.S. Defense Announcement

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Detection of the Inversion Layer over the Central Pacific Ocean using GPS Radio Occultation

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Abstract:

Spatial variation of the inversion over the central North Pacific Ocean is a subject that has previously been limited both spatially and temporally by the absence of available data. Since the launch of the first Constellation Observing System for Meteorology, Ionosphere, and Climate (COSMIC) in 2006, the Global Positioning System radio occultation (GPS RO) data allows for high-resolution atmospheric profiling with a vertical grid ~ 100 m to be extended over the open oceans where conventional data are sparse. In this study, the GPS RO data during 2006-2012 will be used to study the spatial variations of the inversion throughout the annual cycle over the region (5°N-45°N and 120°W-180°W). In addition, the impacts of El Nino and the diurnal heating cycle on the spatial variations of the inversion base height will also be examined.

Previous studies have shown that the base height of the inversion can be measured using vertical profiles of refractivity obtained by the GPS RO technique. This identification method is based on the measured refractivity and calculated vertical refractivity gradient. The refractivity value is a function of temperature, pressure and moisture; with moisture as the dominant factor of the three. Accordingly, the base of the inversion is identified as the location of the minimum gradient of refractivity which corresponds to the sharp decrease in water vapor that is encountered upon entering the inversion layer. The strength of the inversion is estimated using the relative minimum gradient (rmg) or "sharpness parameter" which is calculated by dividing minimum gradient of refractivity by the root mean square of the measurements within the lowest 3,500 m.

The first objective is to identify the horizontal distribution characteristics of the inversion over the domain. This is achieved by combining seasonal data for the years 2006-2012 over the entire domain into 5° x 5° grids. The resulting horizontal distribution highlights the effect the Hawaiian Islands have on the otherwise uniform flow within the marine boundary layer (MBL). Additionally, the seasonal variation can be shown with regard to the horizontal distribution of both height and strength of the inversion layer. The end goal is to provide an analysis of the TWI over each season, a comparison of ENSO vs. non-ENSO seasons, and the diurnal variation during the summer months.