

Assessment of GNSS-PWV and Comparison with Radiosonde and MODIS During Extreme Precipitation Event

Thainara Munhoz Alexandre de Lima

The Global Navigation Satellite Systems (GNSS) have revolutionized activities involving geodetic positioning and is used to determine the position of an object on the surface. GNSS measurements have been successfully used in ionosphere and neutral atmosphere studies, being one of the very few tools that can provide continuous, unbiased, precise and robust atmosphere condition information. One of these measurements is the neutral atmosphere delay that is estimated from GNSS observations. These estimates, in addition to being used to evaluate models that deal with the effects of the neutral atmosphere, can be converted into estimates of precipitable water vapor (PWV). Atmospheric water vapor is highly variable in both space and time across the Earth, and knowledge of the distribution of PWV is essential to understanding weather and global climate as well as the studies of extreme events. In Brazil, the most frequent extreme climatic events are intense rains, which affect various parts of the country annually. In this study, the GNSS derived from PWV (GNSS-PWV) were examined during a precipitation extreme event in Sao Paulo city, where the accumulated precipitation reached a maximum of 146 mm on July 16, 2019. In order to assess the performance of different instruments, GNSS-PWV is compared against water vapor from radiosonde and MODIS sensor (Water Vapor Product). This experiment focuses on the relationship between the variations of PWV values from different sources and associated rainfall during this severe weather event. The results show a good correlation between the PWV of the three sources, mainly between GNSS and radiosonde ($R = 0.98$). Regarding MODIS-PWV, the results showed that low PWV is overestimated by MODIS, decreasing as PWV increases. Despite this, a good correlation between GNSS and MODIS is observed ($R = 0.82$). The high frequency of GNSS-PWV (5 minutes) allowed the observation of a sharp increase in PWV before the most intense rain peak, called in the literature as GNSS-PWV Jump. The findings suggest that the GNSS data can be proposed further as a tool to help to nowcast the occurrence of intense precipitation activity.