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# Improved monitoring and tracking hurricanes using GPS atmospheric water vapor

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Hurricanes produce devastating economic, social and environmental impacts in the areas they strike. The 2017 Atlantic hurricane season was one of the most active on record, witnessing the third highest number of major hurricanes in a single year of the past century, surpassed only by the 1961 and 2005 seasons. Accurately predicting their path and intensity is therefore extremely valuable. The Global Positioning System (GPS) captures water vapour distributions in the atmosphere within a few millimeters of accuracy under all weather conditions and in real time. We used an integrated water vapour (IWV) retrieved with GPS receiver to track and explore the complex properties of storm events in their spatial and temporal distribution, using a network of ground-based GPS receivers. Our results show that a surge in GPS-retrieved IWV occurred several hours prior to the manifestation of the three major hurricanes to hit the USA's east coast in 2017 and 2018, namely Florence, Harvey and Irma. For our ensemble forecasts, we used the GPS-retrieved IWV data as input to spaghetti lines empirical weather models, enabling us to predict the paths of hurricanes Harvey and Irma. Hence, a directly estimable parameter derived from GPS can provide an additional resource for improving the monitoring of hurricane paths, hitherto not reported. The GPS-retrieved IWV and satellite rainfall products Global Precipitation Measurement Integrated MultisatellitE Retrievals and Tropical Rainfall Measuring Mission (GPM IMERG and TRMM) exhibit a strong coupling associated with the footprint of the hurricanes. A correlation of 65 % between the two parameters was found.