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Tropospheric jet stream as a source of traveling ionospheric disturbances observed by GPS

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The integrity and the reliability of real-time precise positioning applications with Global Positioning System (GPS) are affected by the ionospheric variability with time and space. As a consequence, scientific community aims at describing, explaining and forecasting the occurrence and the amplitude of ionospheric irregularities observed by GPS. The use of the geometric-free combination of GPS dual frequency signals allows to retrieve the Total Electron Content (TEC) along the satellite-to-receiver path, which is the basic trans-ionospheric observable.
Based on L1/L2 GPS phase measurements collected at a given station, the TEC high-frequency variability is isolated. A climatological study performed over 10 years in Western Europe shows that TEC irregularities are mostly observed daytime during quiet geomagnetic background in autumn and winter and correspond to classical Medium-Scale Traveling Ionospheric Disturbances (MSTIDs). The latter are generally understood as the ionospheric signature of Atmospheric Gravity Waves (AGWs), either generated in situ (solar terminator) or in the lower atmosphere and propagating upward. Because of its associated strong wind shears, the tropospheric jetstream, occurring mainly during autumn and winter months, constitutes an ideal candidate for AGW generation. This paper analyzes the spatial correlation between the presence of both MSTIDs and strong jetstream over Western Europe. This correlation is positive when the ionospheric pierce point of the satellite is located above regions of interest where wind shears are very large. In practice, we have selected regions for which wind speed is larger than 50 m/s. In addition, the propagation of AGWs up to the ionospheric layer is taken into account by assuming horizontal and vertical velocities of 200 and 50 m/s respectively. It comes that the region of interest of the correlation study is computed using an isotropic slant propagation of the AGW, which is supposed to be generated at a tropospheric level.
Based on 30s GPS data collected over several stations in Belgium and on European Centre for Medium-Range Weather Forecasts (ECMWF) wind velocity maps, the correlation study covers a period ranging from January 2002 to December 2011. Preliminary results based on a limited number of cases show that large amplitude MSTIDs are generally observed during periods of strong wind speeds at an altitude corresponding to a pressure level of 250hPa (about 10 km).