Global vTEC and PTEC maps based on combined GNSS and TOPEX/Jason measurements

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Instruments like the ionosondes, sounder and incoherent scatter radars (ISR) are extremely useful to monitor and register the state and evolution of the free electrons vertical distribution. This measuring capability is mainly limited by the reduced geographic coverage that they provided and the height raging that they covered (excluding the ISR). In opposition, the GNSS measurements form satellites orbiting at 20,200 Km, can be used to monitor the terrestrial ionosphere on a global scale, with total electron content (TEC) measurements from the ground to the satellite height. Also, altimetry satellites provide accurate measurements of the vertical TEC over the ocean region (complementing GNSS data) and from the ground to an altitude of 1,300 Km in the latitude range ±66°. Combining GNSS and altimetry data provides a unique opportunity to improve the representation of the electronic content and, at the same time, to try to separate ionospheric componet (ITEC) from the plasmaspheric (PTEC). In this notation, GNSS measurements are the sum of both components (ITEC+PTEC). To accomplish this purpose we use an updated version of La Plata Ionospheric Model (LPIM), which can assimilate and combine long GNSS and TOPEX data series. For the ionosphere component (ITEC) the model assumes the usual infinitesimal spherical shell at 450 km of height, with a Spherical Harmonic (SH) expansion in the modip-local time system for the global geographic distribution. The plasmasphere component (PTEC) enters into the equation through a term with the values given by Gallagher model scaled by a constant factor. The equations also contains terms for the GNSS satellite and receivers biases. Finally, an additional term is added to consider any possible systematic difference between GNSS and altimetry data series. Applying a mean square algorithm the model can estimate the SH coefficients, the satellite and receivers bias, the plasmaspheric scale factor and the possible systematic bias between GNSS and altimetry data. For this study, we have analyzed the equinoxes and solstices for 2002 (high solar activity) and 2006 (low solar activity). The main goal of this work is to analyze and asses the improvements obtained by taking advantage of the complementary potentialities of both, GNSS and altimetric information sources. Combining them in a common model allows GNSS observations provide high temporal resolution of the TEC variability, while TOPEX observations enhance TEC interpolation in open ocean regions and helps to disaggregate the PEC contribution.