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Systematic differences of ionospheric parameters from various space geodetic techniques

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Most space geodetic observation techniques are affected by the free electrons in the Earth's ionosphere. Some of them have been used to monitor ionospheric parameters for many years, e.g. dual-frequency GNSS observations. Unfortunately, terrestrial GNSS stations are seldom available in ocean regions and their measurements are not equally distributed around the globe. Moreover, they could only be used to monitor the horizontal electron distribution. Almost no information about the vertical distribution is included. Measurements from other techniques such as dual-frequency altimetry data, DORIS measurements, GPS data from low earth orbiters (LEOs), or VLBI observations can densify the data base and improve the measurement geometry. Besides, each of these measurement techniques shows a different sensitivity to the free electrons because of their different frequencies and frequency separations.

However, it had turned out that there are some offsets between ionospheric observations of all these techniques mainly caused by calibration uncertainties or model errors, e.g. within the single layer model used for terrestrial GNSS data interpretation. Direct comparisons of the information from different data types are difficult because of the different measurement epochs and locations. In the present approach all measurements are combined in one ionosphere VTEC model. A variance component estimation is performed to take into account the different accuracy levels of the observations. In order to consider systematic offsets, for each of the observation groups a constant bias term is allowed with respect to the used reference model. The estimated variance components as well as the biases include information about the offsets and sensitivity of the different data types. For a time interval of about two weeks in August 2008 (within the CONT08 VLBI measurement campaign) and in a region around the Hawaiian islands the variance components as well as the biases of different space geodetic ionosphere measurements are analyzed and presented.