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Assessment of GNSS and Satellite Altimetry Combined Global Ionospheric Maps Using Precise Point Positioning

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The high free-electron density in the ionosphere affects both the group and phase velocity of the signals of all space geodetic techniques, operating in the microwave band. In first approximation this delay is proportional to the so-called Slant Total Electron Content (STEC) along the ray path and can be almost eliminated if the measurements are carried out at two distinct frequencies. In contrast, this effect allows gaining information about the parameters of the ionosphere in terms of Total Electron Content (TEC) values. The classical input data for the development of Global Ionosphere Maps (GIM) of the total electron content is obtained from dual-frequency Global Navigation Satellite System (GPS and GLONASS) observations. However, the GNSS stations are inhomogeneously distributed, with large gaps particularly over the sea surface, which lowers the precision of the GIM over these areas. On the other hand, dual-frequency satellite altimetry missions such as Jason-1 provide information about the ionosphere precisely above the sea surface. In this study we create two-hourly GIM from GNSS data and additionally introduce satellite altimetry observations, which help to compensate for the insufficient GNSS coverage of the oceans. The obtained combined ionosphere models, referred to as IGG (Institute of Geodesy and Geophysics) GIM, are evaluated through GPS precise point positioning, applying different positioning strategies for several IGS stations worldwide. The point positioning methods are the double frequency ionospheric-free combination, and the single frequency positioning applying different ionospheric correction models. These models are the models de-

rived from the official IGS (International GNSS Service) GIM, from the IGG GNSS only GIM, and finally from the IGG combined GIMs. The coordinates computed by these different methods are also compared with the ITRF coordinates of the stations.