



Monitoring of ionospheric irregularities with multi-GNSS observations: a new ionosphere activity index and product services

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The ionospheric irregularities have a strong impact on many applications of Global Navigation Satellite Systems (GNSS) and other space-based radio systems. The rate of ionospheric total electron content (TEC) change index (ROTI, TECu/min), defined as the standard deviation of rate of TEC change (ROT) within a short time (e.g. 5 minutes), has been developed to describe the ionospheric irregularities and associated scintillations. However, ROT parameter may still contain the trend term of ionospheric TEC in spite of small-scale fluctuations. On the basis of single-differenced ROT (dROT) values, we develop a new ionosphere activity index, rate of ROT change index (RROT, TECu/min), to characterize the irregularity degree of the ionosphere. To illustrate the use of the index, we investigated the consistency between ROTI and RROT indexes, through the analysis of GPS data and S4 observations collected at two high-latitude stations of the northern hemisphere. It is confirmed that the correlation coefficients between RROT and S4 are higher than those between ROTI and S4 for the test period, meaning that the proposed RROT index is applicable to monitor the ionospheric irregularities and associated scintillations.

RROT index can be easily calculated from dual-frequency GNSS signals (like GPS L1 and L2 carrier phase measurements). On the basis of GPS and GLONASS data provided by the IGS, ARGN, EPN and USCORS tracking networks (more than 1500 stations per day), absolute ROT (AROT), gradient of TEC index (GOTI), ROTI and RROT maps are generated to reflect the ionospheric irregularity activities. These maps are provided in an IONEX-like format on a global scale with a temporal resolution of 15 minutes and a spatial resolution of 5 and 2.5 degrees in longitude and latitude, respectively, and the maps with high spatial resolution (2x2 degrees) are also generated for European, Australia and North American regions. The product files are produced on a daily basis with a latency of 3 days. Users now can access these products from the ftp archive of the Chinese Academy of Sciences (CAS, <ftp://ftp.gipp.org.cn/product/>).

These maps can be used for ionospheric weather services, ionospheric irregularity modeling and forecasting, as well as other GNSS applications. Although they are provided in a post-processing mode at present, it is expected that the near real-time services will be available since the availability of real-time data streams from the IGS.