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Mitigation of ionospheric scintillation effects in kinematic LEO precise orbit determination

Norbert Zehentner and Torsten Mayer-Gürr
TU Graz, Institute of Geodesy, Graz, Austria (zehentner@tugraz.at)

Kinematic orbit determination for Low Earth Orbiting satellites is one of the core elements in gravity field recovery from GNSS tracked satellites. The accuracy of the kinematic orbit positions directly determines the achievable accuracy in terms of gravity field results. We apply a precise point positioning approach based on raw GNSS observations, without using any linear combinations. This method requires to take every effect directly into account, as non of the effects is eliminated by forming differences or linear combinations. For example, the ionospheric influence is taken into account by estimating the slant TEC, including higher order terms and corrections for ionospheric bending. Our approach preserves the original high measurement accuracy of the phase observations. The remaining factors reducing the achieved accuracy are not or incorrectly modeled systematic effects.
The GOCE mission revealed one of these systematic effects: ionospheric scintillations. These are small and short term irregularities in the Earth's ionosphere which cause errors in GNSS observations. GOCE gravity field results showed a huge systematic effect along the geomagnetic equator. GOCE was flying in a sun-synchronous dusk-dawn orbit, which means that the satellite orbit is nearly stationary with respect to the Earth's ionosphere. As it is hardly possible to realistically model ionospheric irregularities they can not be corrected from the raw observations.
We introduce an observation weighting method based on the rate of TEC index to reduce the influence of observations affected by ionospheric scintillations. This weighting scheme in combination with variance component estimation greatly reduces the influence of ionospheric scintillation on the kinematic orbit and in turn also on the gravity field result. We will show that by using the introduced weighting scheme the error in GOCE kinematic orbits is almost removed, without removing observations.