Geophysical Research Abstracts
Vol. 19, EGU2017-14869, 2017
EGU General Assembly 2017

Global GNSS processing based on the raw observation approach

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Many global navigation satellite system (GNSS) applications, e.g. Precise Point Positioning (PPP), require high-quality GNSS products, such as precise GNSS satellite orbits and clocks. These products are routinely determined by analysis centers of the International GNSS Service (IGS). The current processing methods of the analysis centers make use of the ionosphere-free linear combination to reduce the ionospheric influence. Some of the analysis centers also form observation differences, in general double-differences, to eliminate several additional error sources. The raw observation approach is a new GNSS processing approach that was developed at Graz University of Technology for kinematic orbit determination of low Earth orbit (LEO) satellites and subsequently adapted to global GNSS processing in general. This new approach offers some benefits compared to well-established approaches, such as a straightforward incorporation of new observables due to the avoidance of observation differences and linear combinations. This becomes especially important in view of the changing GNSS landscape with two new systems, the European system Galileo and the Chinese system BeiDou, currently in deployment.

GNSS products generated at Graz University of Technology using the raw observation approach currently comprise precise GNSS satellite orbits and clocks, station positions and clocks, code and phase biases, and Earth rotation parameters. To evaluate the new approach, products generated using the Global Positioning System (GPS) constellation and observations from the global IGS station network are compared to those of the IGS analysis centers. The comparisons show that the products generated at Graz University of Technology are on a similar level of quality to the products determined by the IGS analysis centers. This confirms that the raw observation approach is applicable to global GNSS processing. Some areas requiring further work have been identified, enabling future improvements of the method.