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GNSS Analysis in a Multi-GNSS and Multi-Signal Environment

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GPS and GLONASS are being modernized, whilst at the same BeiDou, Galileo, and QZSS are emerging. The modernization of the existing and the deployment of new Global Navigation Satellite Systems (GNSS) will introduce new frequencies and also a whole range of new signals to the GNSS end user community for new applications. The achievable improvements resulting from the new GNSS signals and systems will strongly depend on the combined use of the GNSS and also on the understanding and handling of the biases that will inevitably exist between the various systems. Thus, the new and enhanced GNSS systems raise the question: "How to optimally process multi-constellation, multi-frequency GNSS signals?"

At ESA/ESOC, a fundamentally new GNSS analysis approach for the future multi-GNSS and multi-signal environment has been developed. The key difference of this approach compared to the current practice is that it avoids the formation of any form of signal differences as well as any form of linear combinations. In the ESOC approach, which is internally called the “raw” approach, all available observations from all available GNSS systems as observed by all the receivers in a network are incorporated in one single parameter estimation process. The advantages of this approach are multifold. It avoids loss of information due to differencing, avoids increase of noise due forming linear combinations, give direct access to the clocks, biases and residuals of all the signals from all systems, and it ensures an optimal use of all available information. Last but not least the ESOC raw method is also ideally suited for integer ambiguity resolution. The presentation will show selected results from our on-going research in which we process the data of GPS, GLONASS, Galileo, and BeiDou. In addition, this presentation will focus on the unique features and results of our raw processing method.