



## **New ionospheric sounding techniques and opportunities with single-frequency GNSS receivers**

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The huge number of single-frequency GNSS receivers, when considering in particular the mass-market chipsets, is a scientific and technical opportunity to increase, in particular, the capability of ionospheric sounding. In this context we will summarize new techniques and opportunities of ionospheric sounding with single-frequency GNSS receivers. It will be exploited in particular: (1) the repeatability period of the transmitter-receiver geometry for permanent receivers in different GNSS; (2) the non-conventional ways of calibrating single-frequency carrier phase ambiguities and delay code bias; (3) different potential frequencies available; and (4) efficient single-frequency cycle-slip detection for single-frequency chipsets.

These approaches have been analyzed and assessed in two different scenarios: (A) At mid and low latitude, in North America, during the recent total solar eclipse of August 2017, from several permanent dual-frequency receivers processing the L1 carrier phase and pseudorange observations only. And scenario (B) at high latitude (Akureyri, North of Iceland) in an urban canyon with frequent loss of lock, from a cheap single-frequency receiver.

The results obtained analyzing such single-frequency measurements strongly suggest the good capabilities of the single-frequency GNSS receivers to monitor the ionospheric electron content with high temporal resolution and precision which can be comparable to the precision of dual-frequency GNSS receivers.