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Validation of ionospheric density retrievals using Abel transform improvement with COSMIC/FORMOSAT-3

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Information about the vertical distribution of electron density in the ionosphere can be retrieved from GPS radio signals tracked by GPS receivers on board a Low Earth Orbit (LEO) satellite. A wide used radio occultation inversion technique is the Abel transform which, in the ionospheric context, allows to retrieve electron densities as a function of height from STEC (Slant Total Electron Content) measurements. The classical approach of the Abel inversion assumes spherical symmetry of the electron density field in the vicinity of an occultation. However, in practice, the footprint of an occultation generally covers wide regions that may suffer from ionospheric variability and this hypothesis can not be guaranteed. Indeed, inhomogeneous electron density in the horizontal direction for a given occultation is believed to be the main source of error when using the Abel inversion. In order to correct the error due to the spherical symmetry assumption, the separability concept developed by Hernandez-Pajares et al. (2000) overcomes this limitation considering that the electron density can be expressed by a combination of VTEC (Vertical Total Electron Content) data assuming the horizontal dependency and a shape function which assumes the height dependency that is common to all the occultation observations. This technique was successfully applied obtaining an improvement close to 38% in rms when comparing with ionosonde data in front of the classical Abel inversion. In this mentioned paper, the main observable to apply inversion was the LI observable (the geometric free combination). The advantage of this observable is its simple computation but it presents two main drawbacks: different signal path between L1 and L2 and its only aplicability to ionosphere. An alternative to invert the profile, which overcomes these two disadvantages, is to use as main observable the so-called bending angle of the

signal calculated from the observational excess phase. The implementation of separability when using the bending angle is not immediate. In this work, the separability approach has been applied to measured L1 bending angles instead of the LI observable as reported in previous works, such as the above mentioned paper. Actually, this work is focused on showing the improvement this separability approach can provide to inversions when inverting the bending angle observable. For this reason, recently available COSMIC/FORMOSAT-3 data have been processed. The retrieved occultations, both with the classical Abel inversion and the separability approach, have been evaluated versus collocated ionosonde data.