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Simulating the detection of traveling ionospheric disturbances with the ICON mission

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Traveling Ionospheric Disturbances (TIDs) are of the utmost importance in energy and momentum transfer from the lower atmosphere to the ionosphere. The upcoming NASA's ICON mission will address these topics by performing remote sensing of ion and electron density, velocity and temperature from the bottom of the ionosphere up to the altitude of the spacecraft. More precisely, the ICON Far UltraViolet (FUV) instrument will image the ionospheric limb in two wavelength channels: the first one is dedicated to atomic oxygen and detects its emission at 135.6 nm. The second one studies the N2 Lyman-Birge-Hopfield (LBH) band around 155 nm. With an inclination of 27° and a circular orbit at an altitude of 550 km, the ICON mission will focus on low-latitudes only.

Using ICON/FUV data, TID detection can be performed following two different approaches. The first possibility makes use of raw measurements (level-1) of the limb, corresponding to the line-of-sight integrated values of the O+ ion density. The second option consists in analyzing vertical profiles of the O+ density (level-2 product) derived from the inverse Abel transform of level-1 data. In this study, we simulate integrated O+ emission based on a background ionosphere provided by IRI-2016 on which we superimpose a TID of known characteristics: wavelength, period and velocity. This work investigates the retrieval of TID characteristics with algorithms using either level-1 or level-2 data. Given that the assumed spherical symmetry used in inverse Abel transform is rarely met in low-latitude regions, TID detection using ICON/FUV could prove to be more reliable using line-of-sight integrated values directly provided by the imager rather than using the inverted O+ profiles. We investigate the advantages and drawbacks of both above-mentioned methods in detecting TIDs and untangle possible ambiguities that may arise from the spherical symmetry hypothesis.