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# Predicting the critical frequency *fo*F2 over Europe through the assimilation of vTEC measurements from EUREF and RING networks

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The vertical electron density profile of the ionosphere is characterized by an absolute maximum related to the ordinary critical frequency (*fo*F2), a parameter routinely recorded by ground-based ionosondes, which is the most important parameter for radio-communication purposes.
In Europe, about fifteen ionosondes are present, operating with a sounding repetition rate of 15 minutes. Their spatial distribution and sounding repetition rate are usually enough to predict the distribution of the ionospheric electron density during quiet periods. Differently, under severe Space Weather events (like geomagnetic storms), the ionosphere exhibits variations at smaller spatial and temporal scale that are difficult to be represented.
In this work, a procedure for updating the International Reference Ionosphere (IRI) model by assimilating vertical total electron content (vTEC) measurements from the EUREF and RING (Rete INteGrata nazionale) permanent GNSS receivers networks has been developed. According to this, a mathematical procedure to obtain *fo*F2 values from vTEC measurements using co-located ionosonde and GNSS stations is proposed. Through this procedure, assimilated vTEC values are employed to calculate the $IG_{12eff}$ index for each GNSS assimilated station. Maps of $IG_{12eff}$ are then produced through the Kriging method and ingested by IRI to produce updated *fo*F2 values over the European region.
The goodness of the method, named IRI UPdate (IRI UP), has been tested for several quiet and disturbed days, by resulting in a very promising complement to the IRI model for Space Weather events prediction purposes.