

TEC Forecast during Coronal Mass Ejections with an Empirical Storm Model

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The prediction of space weather events and their impact on Earth's ionosphere is a major research field of the Institute for Solar-Terrestrial Physics (SO) of the German Aerospace Center (DLR). Improved monitoring and forecasting space weather events allows to provide critical information required to ensure the operation of our modern infrastructure and technologies [1]. The information about the current state of the ionosphere can be given by Total Electron Content (TEC) maps and rate of change of TEC index (ROTI) maps and a forecast of such maps will give users regional and timed warnings.

Strong impacts on the ionosphere are expected during coronal mass ejections (CME), where various TEC changes can occur. In this study we aim to forecast these changes with an empirical approach using several large data sets: DLR TEC maps and solar wind parameter measured the satellite missions Advanced Composition Explorer (ACE) and Deep Space Climate Observatory (DSCOVR). Based on these data sets different CMEs were categorized according to the observed solar flux and solar wind parameter as well as geomagnetic activity and the geometry between Sun and Earth. The respective TEC response was extracted from the available maps. An example of such an event with its observed solar wind parameter B_z and the respective TEC map at one selected time step is shown in Figure 1.

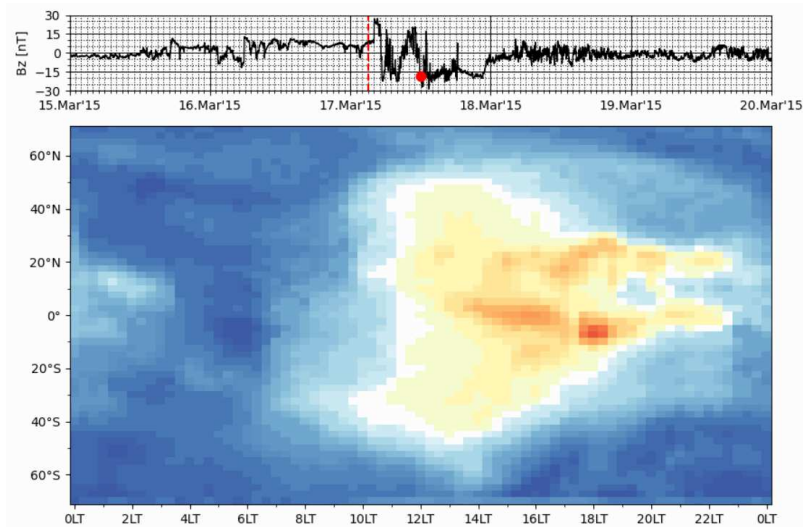


Figure 1 B_z component of the solar wind and Total Electron content (TEC) map during a CME in March 2015. The starting point of the event (dashed red line) and the shown time step (red dot) are given in the top plot.

The analyzed data are combined in a lookup table approach which derives the fitting TEC response for a set of solar wind input parameter and the current ionospheric conditions. In the future the forecast model might provide sufficient information to predict the ionospheric response to CME.

References

- [1] J. Berdermann, M. Kriegel, D. Banyś, F. Heymann, M. M. Hoque, V. Wilken, C. Borries, A. Heßelbarth und N. Jakowski, „Ionospheric Response to the X9.3 Flare on 6 September 2017 and Its Implication for Navigation Services Over Europe,“ *Space Weather*, Bd. 16, pp. 1604-1615, 2018.