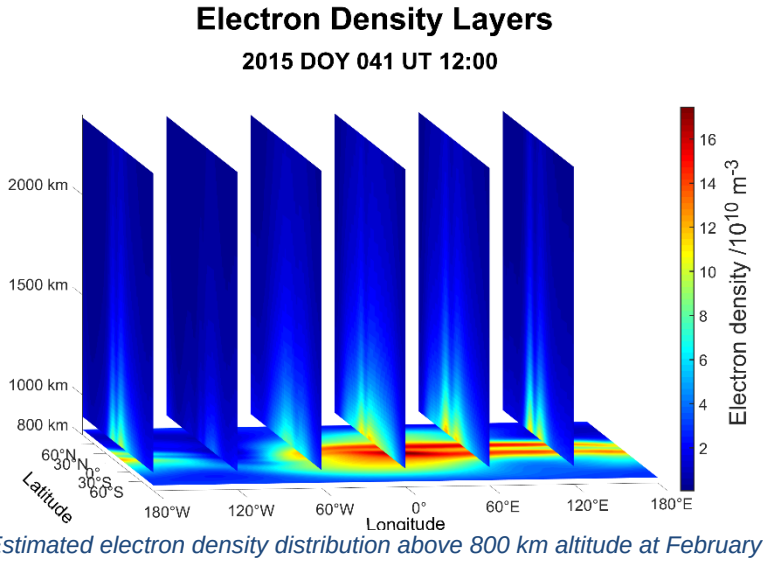
Current topic for a Master's Thesis

Operational method of the 3D ionosphere reconstruction

The ionosphere and plasmasphere have a significant influence on applications dealing with trans-ionospheric radio waves, like GNSS navigation, GNSS related augmentation systems (e.g. EGNOS) and remote sensing. Thus, the modelling and reconstruction of ionospheric key parameter is very important. At DGFI-TUM, methods for modelling ionospheric parameters by the utilisation of direct and indirect ionospheric measurements has been developed and validated for years. Within the DFG funded project 'Multi-Satellite ionosphere-plasmasphere Electron density reconstruction' (MuSE) different methods were developed and tested for the reconstruction of the electron density content of the ionosphere and plasmasphere by the assimilation of Low Earth Orbit (LEO) satellite Slant Total Electron Content (STEC) measurements; cf. Gerzen et al., (2016, 2020). The methods have been implemented in Matlab.

Within this master thesis, the existing code should be automated such that the reconstruction methods can be run in an operational mode. One important task thereby is the automation of the data acquisition used for assimilation. Afterwards, the operational code should be verified, tested and validated by the reconstruction of the electron density content over a longer time period. Finally, the findings shall be put into the context of modelling ionospheric key parameters.



Estimated electron density distribution above 800 km altitude at February 10, 2015 at 14:00 UT, visualized by one horizontal layer at an altitude of 800 km and six vertical layers at different fixed longitudes

Main tasks:

- Automatization of the ionospheric data acquisition.
- Automatization of the ionosphere reconstruction methods already available at DGFI-TUM.
- Validation of the developed operation code over a longer time period and especially for ionospheric perturbed conditions.

References:

Gerzen, T., D. Minkwitz, M. Schmidt, E. Erdogan: Analyses of different propagation models for the estimation of the topside ionosphere and plasmasphere with an Ensemble Kalman Filter, Ann. Geophys. Discuss., https://doi.org/10.5194/angeo-2020-39, 2020.

Gerzen, T and D. Minkwitz, Simultaneous multiplicative column normalized method (SMART) for the 3D ionosphere tomography in comparison with other algebraic methods. Ann. Geophys., 34, 97-115, doi: 10.5194/angeo-34-97-2016, 2016.

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