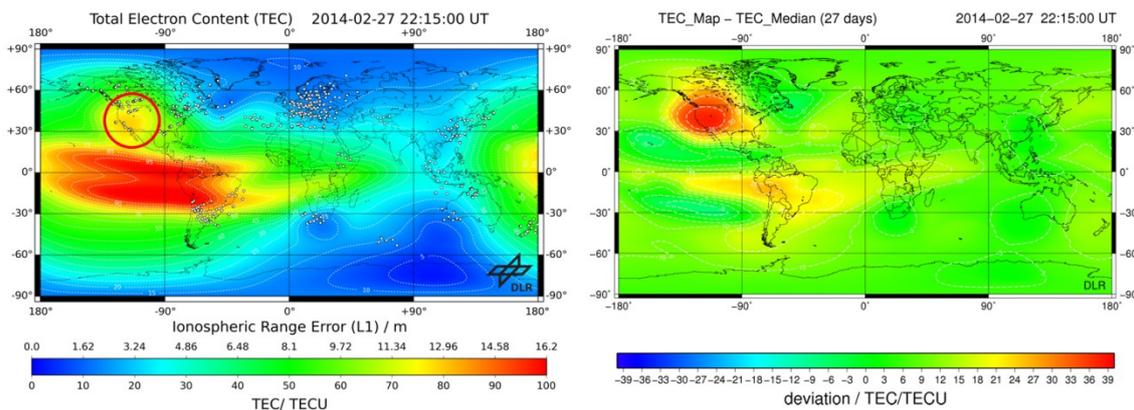


## Space Weather influence on navigation

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Space weather has a significant impact on the performance and reliability of space-based and ground-based technological systems and can also indirectly endanger human life. Especially time-varying conditions on the sun and in the solar wind as well as their effect on the coupled ionosphere-thermosphere-magnetosphere (ITM) system can have strong effects on the performance of radio systems used in space-based communication, navigation and remote sensing. Moreover, ionospheric disturbances caused by space weather effects may degrade the accuracy, reliability and availability of Global Navigation Satellite Systems (GNSS) [1, 2], such as GPS and the future civilian European system Galileo. We present the impact of space weather induced changes in the ionosphere on navigation and the positioning accuracy achievable by GNSS users. The results are based on GNSS data measured during several space weather events within the last two solar cycles (see Figure 1 as example).



**Figure 1.** Shown are solar storm related ionospheric disturbances over North America on February 27<sup>th</sup>, 2014. In the left panel DLR's global TEC map is shown with the most affected area encircled. The white dots represent the ionospheric piercing point where TEC values from real time GNSS data are assimilated into the ionospheric background model NTCM (Neustrelitz TEC Model). The plot on the right-hand side shows the difference of the global real time TEC map from the TEC median (27 days) map, where the affected area is further pronounced by suppression of climatological effects. The shown example caused an outage of several hours in the Space Based Augmentation System WAAS (Wide Area Augmentation System), which is an air navigation aid.

In addition, we present an overview of the existing space weather activities at the DLR Institute for Solar-Terrestrial Physics and their integration into international space weather activities, like the ESA SSA Space Weather Expert Center for Ionospheric Weather or the PECASUS consortium supporting the aviation community.

## References

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