Foundation of the Austrian Space Weather Office

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The Austrian Space Weather Office (ASWO) was founded at the end of 2022, and is now a competence unit within the general geophysics department at the GeoSphere Austria. Its purpose is to conduct both basic heliophysics research and to develop and apply real-time models to improve space weather forecasts. The ASWO is now the main research institution in Austria to alert the public and stakeholders of space weather events, as well as providing research and solar wind predictions that are relevant on a global level. Solar wind forecasts are further connected to the geomagnetic variations observed at the Conrad Observatory and currents in the Austrian power grid.

The main goal of the ASWO is to improve the prediction of the solar wind, which is a key space technology but remains a largely unsolved problem. If we could know how the solar wind magnetic field and speed near Earth behave half a day to a day in advance, the accuracy of models for the upper atmosphere, aurora, radiation at flight altitudes, or geomagnetically induced currents (GICs) could be much improved. ESA is strongly increasing the budget of its Space Safety programme over the next few years, with the Vigil spacecraft mission as pinnacle. This mission will provide key real-time observations to feed models for solar wind forecasts from the Sun-Earth Lagrange 5 point, at 60° heliospheric longitude away from Earth after 2030.

To this end, we are pursuing basic research in the field of heliophysics, concerning the ambient solar wind and solar storms, by combining hyperfast physical models with spacecraft data. The low computational needs of these models allow us to directly implement them in operational settings. We also use artificial intelligence methods to solve problems such as the automatic detection of events, or mapping solar wind parameters to GICs. In collaboration with the NASA Community Coordinated Modeling Center (CCMC), we validate the models.

Figure 1: The ASWO is located on the top floor of a recently refurbished historical building in the Reininghaus area in Graz.

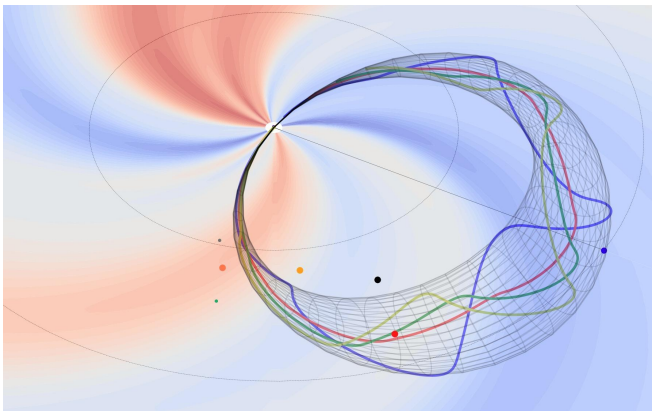

Figure 2: A visualization of the ambient solar wind THUX model and the 3DCORE simulation, which describes the magnetic fields inside solar storms as a bent tube.

On our portal https://helioforecast.space we provide the largest catalog of solar storms observed in situ for the research community, a solar cycle tracker and a prototype for a solar wind forecast, called PREDSTORM, among other services. This forecast drives a prototype aurora model, which we plan to improve and connect to real-time weather maps for the public. Forecasts for GICs are also envisaged, with the data provided by the Conrad Observatory representing a key data source.

Within the HELIO4CAST project, funded with 2 million Euros by the European Research Council from 2022-2027, we aim to significantly improve the understanding of the magnetic fields in solar storms. Strong geomagnetic storms only occur when solar storms that impact Earth have strong southward pointing magnetic fields. The coherence of these flux rope fields should allow forecasts of geomagnetic activity up to a day when our 3DCORE model is applied. The current fleet of spacecraft including Solar Orbiter, Parker Solar Probe, DSCOVR, Wind and STEREO provides multipoint in situ observations to improve the realism of the model, and will allow many other novel research opportunities in the future.

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