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EUHFORIA 2.0

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The EU Horizon2020 project EUHFORIA 2.0 aims at developing an advanced space weather forecasting tool, combining the MHD solar wind and CME evolution model EUHFORIA [1] with the Solar Energetic Particle (SEP) transport and acceleration model PARADISE [2]. We will first introduce EUHFORIA and PARADISE and then elaborate on the plans of the EUHFORIA 2.0 project which will address the geo-effectiveness of impacts and mitigation to avoid (part of the) damage, including that of extreme events, related to solar eruptions, solar wind streams, and SEPs, with particular emphasis on its application to forecast Geomagnetically Induced Currents (GICs) and radiation on geospace.

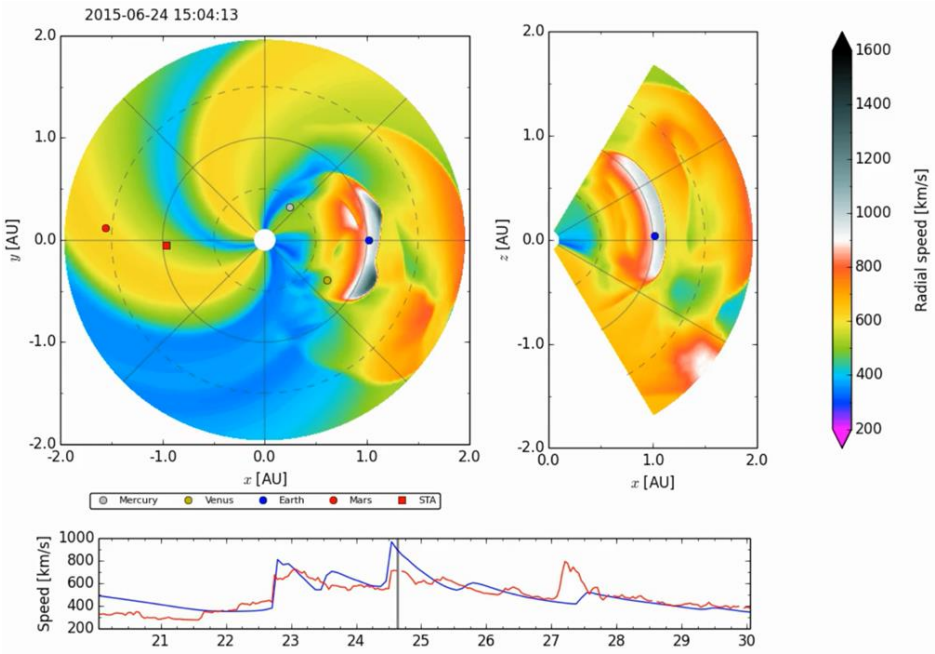

***Fig. 1**: Snapshot of a forecast simulation with EUHFORIA, showing the radial velocity in the equatorial plane (top left, viewed from above) and in the meridional plane through the position of Earth (top right, side view). Bottom: comparison of simulated (in blue) and measured (ACE, in red) radial velocity at L1 [from Pomoell & Poedts 2018 [1]].*

Applying innovative methods and state-of-the-art numerical techniques we extend the recent heliospheric solar wind and CME propagation model EUHFORIA with two integrated key facilities that are crucial for improving its predictive power and reliability, namely 1) data-driven flux-rope CME models, and 2) physics-based, self-consistent SEP models for the acceleration and transport of particles along the magnetic field lines. This involves the novel coupling of advanced space weather models: after validating the upgraded EUHFORIA/SEP model, it will be coupled to existing models for geomagnetically induced currents (GICs) and atmospheric radiation transport models. This will result in a reliable prediction tool for radiation hazards from SEP events, affecting astronauts, passengers and crew in high-flying aircraft, and the impact of space weather events on power grid infrastructure, telecommunication, and navigation satellites.

The EUHFORIA 2.0 project started on 1 December 2019, and yielded some interesting results. These concern alternative coronal models, the application of radial grid stretching and solution adaptive mesh refinement (AMR) techniques in the heliospheric part of EUHFORIA, alternative flux-rope CME models (Fri3D, torus), evaluation of data-assimilation based on Karman filtering for the solar wind modelling, and a feasibility study of the integration of SEP models. The novel tool will be accessible by the whole space weather community via the ESA Space Weather Service Network as it will be integrated in the Virtual Space Weather Modelling Centre (VSWMC) [3], which is part of that network and available on the Heliospheric-ESR (Expert Service Centre) webpage.

References

[1] J. Pomoell and S. Poedts, *J. of Space Weather and Space Climate*, **8**, A35 (2018)
[2] N. Wijsen, PhD thesis in Mathematics (KU Leuven) and Physics (Universitat de Barcelona). April 2020.
[3] S. Poedts *et al.*, *J. of Space Weather and Space Climate*, **10**, Art. 14 (2020).