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Geo-effectiveness prediction of CMEs with EUHFORIA coupled to OpenGGCM

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The European Heliospheric FORecasting Information Asset (EUHFORIA, Pomoell and Poedts, 2018) is a physics-based heliospheric and CME propagation model designed for space weather forecasting and other scientific studies. Although EUHFORIA can predict the solar wind plasma and magnetic field parameters at Earth, it is not designed to evaluate geomagnetic indices like Disturbance-storm-time (Dst) or Auroral Electrojet (AE) that quantify the impact of the magnetized plasma encounters on Earth's magnetosphere. Therefore, we coupled EUHFORIA with the Open Geospace General Circulation Model (OpenGGCM, Raeder et al, 1996), a magnetohydrodynamic model of Earth's magnetosphere. In this coupling, OpenGGCM is driven with the synthetic solar wind and interplanetary magnetic field obtained from EUHFORIA simulations as input to produce the magnetospheric and ionospheric parameters of Earth. This coupling is validated with observed geo-effective CME events modelled with flux-rope CME models like Spheromak and FRi3D. We compare these simulation results with the indices obtained from OpenGGCM simulations driven by the measured solar wind data from spacecraft like WIND. We further discuss how the choice of CME model and observationally constrained parameters influence the input parameters, and hence the geomagnetic disturbance indices estimated by OpenGGCM. We also discuss some limitations of the coupling and suggest improvements for future work.

Primary author: Ms MAHARANA, Anwsha (Centre for mathematical Plasma Astrophysics, KU Leuven, Belgium)

Co-authors: Dr SCOLINI, Camilla (UNH, USA); Prof. RAEDER, Joachim (University of New Hampshire, USA); Dr CRAMER, W. Douglas (University of New Hampshire, USA); POEDTS, Stefaan (Center for Mathematical Plasma Astrophysics, Department of Mathematics, KU Leuven, Celestijnenlaan 200B, 3001Leuven, Belgium; Institute of Physics, University of Maria Curie-Skłodowska, Pl. Marii Curie-Skłodowskiej 5, 20-031 Lublin, Poland)

Presenter: Ms MAHARANA, Anwsha (Centre for mathematical Plasma Astrophysics, KU Leuven, Belgium)

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