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SWiFT-FORECAST: A fully physics-based solar wind simulation pipeline

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We present a new real-time solar wind forecasting pipeline named SWiFT (Solar Wind Flux-Tube)-FORECAST developed at IRAP. SWiFT couples together a series of modules derived from mature research models: determination of the background coronal magnetic field, calculation of the properties of many individual solar wind streams from ∼1 to 30 solar radii, propagation across the heliosphere and formation of CIRs, estimation of synthetic diagnostics (white-light COR/HI and EUV imaging, in-situ time-series) and comparison to observations and spacecraft measurements.
The multiple flux-tube approach allows for very significant gains in computation time in respect to the full 3D MHD problem and allows for a better description of the plasma density and temperature than classical MHD models, and for a systematic evalution of the wind ram pressure phase speeds all across the solar atmosphere. SWiFT currently uses a combination of existing surface magnetograms and PFSS extrapolations but the interface is ready to include different combinations of magnotograms sources (WSO, SOLIS, GONG), flux-transport and data assimilation techniques (ADAPT), coronal field reconstruction methods (NLFFF, Solar Models), wind models (MULTI-VP), and heliospheric propagation models (CDPP/AMDA 1D MHD, ENLIL, EUHFORIA).
We discuss the substantial benefits of multi-point observations and in-situ measurements for the predictive capabilities of the model and present a real-time space-weather application tailored to take advantage of multiple spacecraft (e.g, both at L5 and L1). This new modeling strategy aims at estimating the state of the Earthward background solar wind (up to 7-10 days in advance). The method uses early-on east-limb coronography and several intermediate control points (observations and in-situ data) to refine the solar wind solutions.
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