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New stratagies for modelling and forecasting the background solar wind

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The large-scale solar wind speed distribution varies in time in response to the cyclic variations of the strength and geometry of the magnetic field of the corona. Semi-empirical predictive laws (such as in the widely-used WSA law) parametrise the asymptotic solar wind speed via simple parameters describing the geometry of the coronal magnetic field. In practice, such scaling laws require ad-hoc corrections and empirical fits to in-situ spacecraft data, and a predictive law based solely on physical principles is still missing. I will discuss improvements to this kind of laws based on the analysis of very large samples of wind acceleration profiles in open flux-tubes (both from MHD simulations and potential-field extrapolations), and show that flux-tube expansion effectively control the locations of the slow and fast wind flows (as in WSA), but that the actual asymptotic wind speeds attained - specially those of the slow wind - are also dependent on field-line inclination.

I will furthermore present a new solar wind model - MULTI-VP - which takes a coronal magnetic field map as input (past data or forecast), and computes a collection of solar wind profiles (1 to 30 Rsun) spanning a region of interest of the solar atmosphere (up to a full synoptic map) at any instant desired in quasi-real time, while keeping a good description the plasma heating and cooling mechanisms. MULTI-VP provides full sets of inner boundary conditions for heliospheric propagation models (such as ENLIL; see https://stormsweb.irap.omp.eu/doku.php?id=windmaptable), bypassing the need to rely on semi-empirical approaches. I will fully discuss the predictive capabilities of the model (synthetic imagery and in-situ time series) and its suitability to real-time space-weather applications.

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