Solar wind properties and coronal rotation during the activity cycle

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Abstract

The properties of the solar wind flow are strongly affected by the time-varying strength and geometry of the global background magnetic field.
The wind velocity and mass flux depend directly on the size and position of the wind sources at the surface.
The angular momentum (torque) balance depends on how the differential surface rotation is transmitted upwards across the highly stratified chromospheric layers, and up to the corona along the magnetic field.
We address these problems by performing numerical simulations coupling a kinematic dynamo code (STELEM) evolve in a 2.5D axisymmetric coronal MHD code (DIP) covering an 11 yr activity cycle.
We defined and tested a simple approximation allowing the study of coronal phenomena while taking into account a parametrised effective chromospheric reflectivity (which accounts for the effects of the chromospheric stratification on rotation).
We found that the global Sun's mass loss rate, angular momentum flux and magnetic braking torque vary considerably throughout the cycle.
Also, a high (yet partial) effective reflectivity is required for sustaining the coronal rotation against the solar wind magnetic breaking torque, while still allowing for the necessary amount of footpoint leakage (coronal stress release).
Finally, we point out directions to assess the effects of more transient phenomena on the global properties of the wind.

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