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Foretelling Flares and Solar Energetic Particle Events: the FORSPEF tool

Anastasios Anastasiadis (1), Athanasios Papaioannou (1), Ingmar Sandberg (1), Manolis K. Georgoulis (2), Kostas Tziotziou (1), and Piers Jiggens (3)

(1) National Observatory of Athens, IAASARS, Athens, Greece (atpapaio@astro.noa.gr), (2) RCAAM, Academy of Athens, Athens, Greece, (3) ESTEC, ESA, The Netherlands

A novel integrated prediction system, for both solar flares (SFs) and solar energetic particle (SEP) events is being presented. The Forecasting Solar Particle Events and Flares (FORSPEF) provides forecasting of solar eruptive events, such as SFs with a projection to coronal mass ejections (CMEs) (occurrence and velocity) and the likelihood of occurrence of a SEP event. In addition, FORSPEF, also provides nowcasting of SEP events based on actual SF and CME near real-time data, as well as the complete SEP profile (peak flux, fluence, rise time, duration) per parent solar event. The prediction of SFs relies on a morphological method: the effective connected magnetic field strength (Beff); it is based on an assessment of potentially flaring active-region (AR) magnetic configurations and it utilizes sophisticated analysis of a large number of AR magnetograms. For the prediction of SEP events new methods have been developed for both the likelihood of SEP occurrence and the expected SEP characteristics. In particular, using the location of the flare (longitude) and the flare size (maximum soft X-ray intensity), a reductive statistical method has been implemented. Moreover, employing CME parameters (velocity and width), proper functions per width (i.e. halo, partial halo, non-halo) and integral energy (E>30, 60, 100 MeV) have been identified. In our technique warnings are issued for all > C1.0 soft X-ray flares. The prediction time in the forecasting scheme extends to 24 hours with a refresh rate of 3 hours while the respective prediction time for the nowcasting scheme depends on the availability of the near real-time data and falls between 15-20 minutes for solar flares and 6 hours for CMEs. We present the modules of the FORSPEF system, their interconnection and the operational set up. The dual approach in the development of FORPSEF (i.e. forecasting and nowcasting scheme) permits the refinement of predictions upon the availability of new data that characterize changes on the Sun and the interplanetary space, while the combined usage of SF and SEP forecasting methods upgrades FORSPEF to an integrated forecasting solution. Finally, we demonstrate the validation of the modules of the FORSPEF tool using categorical scores constructed on archived data and we further discuss independent case studies.

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