On forecasting solar eruptive events, alas Space Weather - A leap forward

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Abstract

Space Weather forecast is one of the key priorities of a number of national and international funding agencies given the potential danger Space Weather phenomena may cause to our sophisticated, high-tech based technology-driven civilisation. The question is not anymore whether but when will Space Weather strike. The stakes are really rather high: protecting our facilities, e.g. GPS systems, telecommunication facilities, pipe- and power lines, … the list is very long, from the bursty energetic stream of particles and radiation originating from the Sun, that is far from a trivial issue.

After a shot historic introduction and outlining the underlying physics, we present new insights into pre-flare and Coronal Mass Ejection behaviour and the evolution of the magnetically most dynamics regions, also referred to as Active Regions (ARs), of the Sun. We demonstrate how analysing joint satellite and ground-based data (e.g. SOHO/MDI-Debrecen Data (SDD) and the SDO/HMI - Debrecen Data (HMIDD) sunspot catalogues) may bring us further in resolving a more accurate Space Weather forecast. We embark on our novel method that has the potential to make a leap forward as it is employed to flare and CME prediction.

Our new approach is based on the weighted horizontal gradient of magnetic field (WG_M) defined between opposite polarity spot-groups at the polarity inversion line of ARs. This parameter gives, as we will demonstrate, important diagnostic information not only (i) towards a more accurate prediction of eruption onset time, and (ii) on the flare intensity but also provides new insight (iii) into CME risk assessment from C class to the X class flares. We discuss our findings and highlight some potential future directions that may really help us towards a better and more reliable pre-flare and CME monitoring and further analysis.