Statistical analysis of solar events associated with SSC over one year of solar maximum during cycle 23: propagation and effects from the Sun to the Earth

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Taking the 32 sudden storm commencements (SSC) listed by the observatory de l'Ebre / ISGI over the year 2002 (maximal solar activity) as a starting point, we performed a statistical analysis of the related solar sources, solar wind signatures, and terrestrial responses.

For each event, we characterized and identified, as far as possible, (i) the sources on the Sun (Coronal Mass Ejections -CME-), with the help of a series of criteria (velocities, drag coefficient, radio waves, helicity), as well as (ii) the structure and properties in the interplanetary medium, at L1, of the event associated to the SSC: magnetic clouds -MC-, non-MC interplanetary coronal mass ejections -ICME-, co-rotating/stream interaction regions -SIR/CIR-, shocks only and unclear events that we call "miscellaneous" events.

The observed Sun-to-Earth travel times are compared to those estimated using existing simple models of propagation in the interplanetary medium. This comparison is used to statistically assess performances of various models.

The geoeffectiveness of the events, classified by category at L1, is analysed by their signatures in the Earth ionized (magnetosphere and ionosphere) and neutral (thermosphere) environments, using a broad set of in situ, remote and ground based instrumentation. The role of the presence of a unique or of a multiple source at the Sun, of its nature, halo or non halo CME, is also discussed. The set of observations is statistically analyzed so as to evaluate and compare the geoeffectiveness of the events. The results obtained for this set of geomagnetic storms started by SSCs is compared to the overall statistics of year 2002, relying on already published catalogues of events, allowing assessing the relevance of our approach (for instance the all 12 well identified Magnetic Clouds of 2002 give rise to SSCs).