# Solar flare effect of 6 September 2017. An analysis using Spherical Elementary Current Systems.

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**For the first time, we analysed the temporal evolution of a Solar Flare Effect (Sfe) event, that of 6 September 2017, by using the technique of Spherical Elementary Current Systems (SECS). Thus we were able to follow the temporal evolution of the current system during the Sfe lifetime. At the beginning, a sharp increase in current intensities occurred driven by the hard X rays which at that moment were dominant. Then, a slow decay followed the advent of soft X and EUV rays. Sfe modelled current systems appeared abnormally displaced in longitude with respect to the subsolar point. During the whole event, both vortices remained static and no significant shift was detected. A clear prevalence of the northern hemisphere was observed although the event occurred during the equinox.**

The Sun emitted two big solar flares on the morning of 6 Sept. 2017. The first one, classified as an X2.2 flare, peaked at 9:10 UT, while the second one was classified as X9.3 and peaked at 11:58 UT. This day, Ebre observatory and most European and American magnetic observatories detected two Sfe events due to their favourable location respect to the Sun (Figure 1).

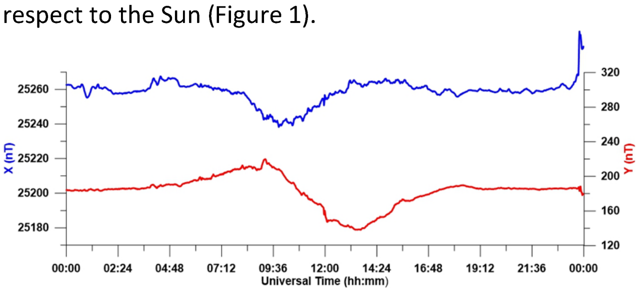


Figure 1: Magnetogram corresponding to Ebre magnetic station (41.0º N, 0.3º E) for 6 September 2017 showing X (true north component; blue line) and Y (east component; red line). In the Y component, an initial increase (eastward deflection) around 9:00 UT is followed by a subsequent decrease (westward deflection) around 12:00 UT.

The amplitude of the Sfe was found at each of these stations after removing the Sq field. This was obtained by linearly interpolating between the initial and the final Sfe time and was used as input for the SECS computation. SECS is an equivalent source method aimed at explaining the observed ground magnetic variations in terms of its current sources in the ionosphere and in the subsurface. The technique was developed by Amm and Viljanen (1999), modelling a current system from the superposition of elementary currents originating from a network of poles. Marsal et al. (2017) used this technique to map the polar current systems associated with a geomagnetic sudden commencement. In this work we applied this technique for the first time to analyse the temporal evolution of the Sfe event that happened at noon time. As a result, a sequence of snapshots covering the whole duration of the event was obtained. Figure 2 presents the snapshot corresponding to the moment of maximum.

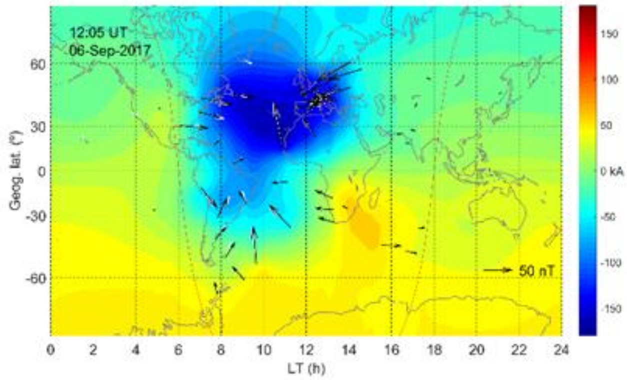


Figure 2: SECS-derived equivalent current system flowing at ionospheric heights at the moment of the maximum. Black arrows represent the measured Sfe field, while white arrows show the modelled Sfe field using the SECS technique. The dotted red line represents the terminator.

The most outstanding features revealed by this study were: a) Unlike other cases, the analysed current system was very static in time, the shape of the current vortices remained stable and their position did not shift substantially; b) The Sfe current system was found away from the subsolar point meridian, with a faint Southern focus noticeably shifted towards East; c) The Northern vortex was clearly dominant; it was slightly shifted towards west, and its area presented a certain eccentricity in the zonal direction.

**References:**

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