Geoeffective interactions between structures at the beginning of solar cycle 24

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Abstract

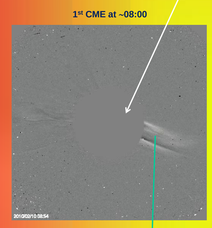
In this work we present a study of geoeffective events that took place during the rising phase of solar cycle 24. We track the events backwards in time from Earth to Sun characterizing common features for the interaction between structures that could trigger their geoeffectiveness. Data from ACE and WIND for the interplanetary medium properties are used as well as data from STEREO, SOHO, PROBA2 and SDO for the sources of the events.

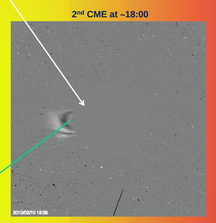
Geoeffective events of 2010 as measured by Dst index

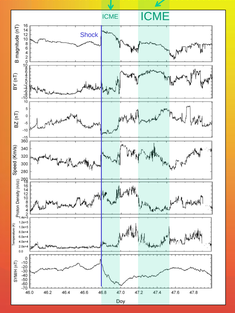
Peak Date	16 February	6 April	12 April	2 May	29 May	4 August	11 October
Peak Value	-58	-73	-56	-67	-85	-65	-79
Geoeffectivity Source	CME + CME	CH + CME	CME	CH	CME + CH	CME + CME	CME

A selection of events with Dst index ≤ 50 nT during 2010 has been made in order to study their geoeffectivity source.

CME + CME



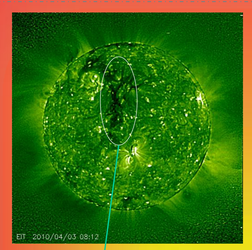


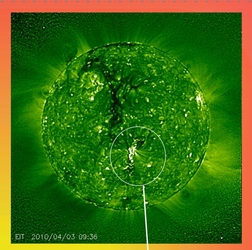


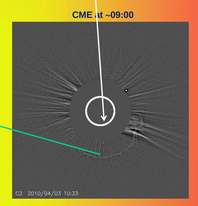
-IP data shows two ICME's for the disturbance of SYM-H the 15th and 16th.
-The shock arrives the 15th around 19:00, driven by an ICME with ~320 Km/s, meaning 5.5 days before for the source of the event.
-LASCO images show a CME around 8:00. EIT show the active region on NW as the source.
-A second ICME shows up in the data around four hours later. LASCO and EIT show a CME at 18:00 from the active region at NE.

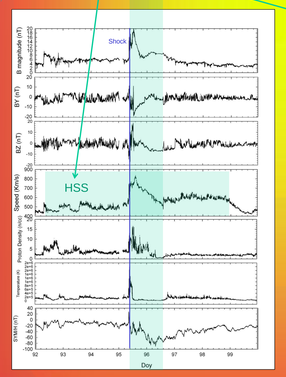
15th - 16th February

CH + CME







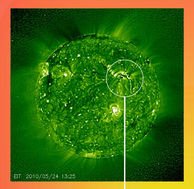


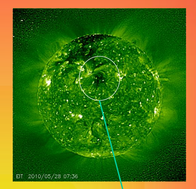
3rd April

-IP data shows a HSS (High Speed Stream) of 500km/s-600km/s lasting 7 days.
-The 5th of April, at mid day, an ICME arrived at L1 point at more than 700km/s. This high speed means that the CME started just 2.5 days before.
-Looking at LASCO images we see a CME as expected at the beginning of the 3rd of April. EIT images show the active region causing the event from South-Central Meridian.

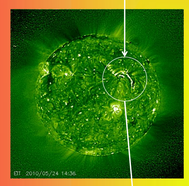
2nd - 3rd April

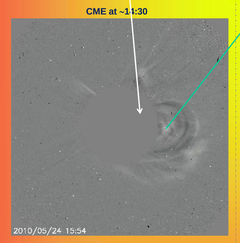
CME + CH



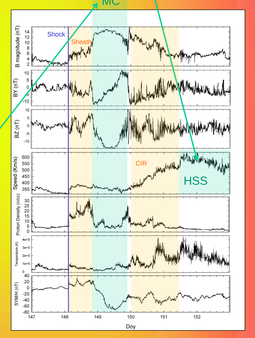


28th May





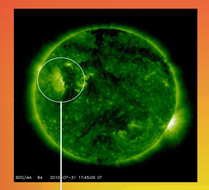
24th May

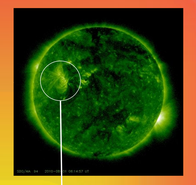


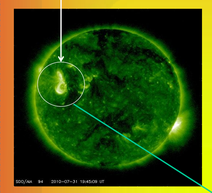
27th May - 1st June

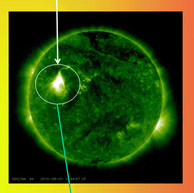
-A shock the 28th of May, followed by a sheath and a MC. The low speed of less than 400km/s gives a source 4 days before (around the 24th of May.
-Just behind the MC, a CIR followed by a HSS show up in the data at 600 km/s expenting a CH the 28th of May.

CME + CME



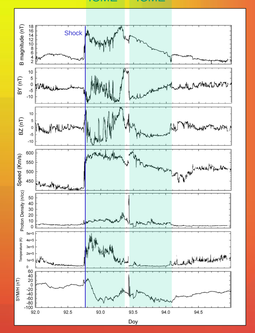






31st July

1st August



-A shock arrives at almost 600 km/s the 3rd of August followed by an ICME.
-Another shock-like precede the second ICME, with clear discontinuity signatures.
-Images from 31st July and 1st August support the interplanetary features.

3rd - 5th August

Conclusion:

In 2010, seven events had a Dst index under -50 nT. None of them was an intense storm (Dst ≤ -100 nT).
Four out of the seven events show an increase in their geoeffectiveness caused by the interaction of structures.
The other three were single events caused either by a Coronal Mass Ejection or by a Coronal Hole.
Out of the four events were interaction between structures have been found, the more geoeffective are the mixed ones (CME + CH) with peak values of the Dst index of -73 nT and -85 nT. The other two had a CME + CME interaction giving Dst index peaks of -58 nT and -65 nT.

Acknowledgements: *We would like to thank to NASA, Goddard Space Flight Center to make available ACE , WIND and SYM-H data via OMNIWeb and SDO (Solar Dynamics Observatory) data, as well as Naval Research Laboratory for the EIT and LASCO images from SOHO.*
We would like to thank to P2SC (PROBA2 Science Center) at Royal Observatory of Belgium for SWAP and STEREO Science Center for the availability of data used for this work, even though, they do not appear on this poster.
This work has been supported by grant AYA2009-08662 from the "Ministerio de Ciencia e Innovación" of SPAIN and grant PPII10-0183-7802 from "Junta de Comunidades de Castilla-La Mancha".

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