STEREO Space Weather Update

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STEREO SWG-22
14 April 2011

STEREO Space Weather Group

- **Group leaders: Dave Webb & Doug Biesecker**

- **Website contains background on SWx, SWx-related meetings, PI SWx studies, tools/projects, references & links**

- **Member list with email addresses**
  - **Currently have ~130 members**
  - **Contact me to join: david.webb.ctr@hanscom.af.mil or david.webb@bc.edu**
  - **Can send your emails via: spaceweather@cronus.nrl.navy.mil (but please contact me first)**

- **We maintain:**
  - **list of URLs/links that all PI teams can use**
  - **STEREO CME/event catalog links**
  - **reference list of key SWx papers**
  - **Tools/Projects list**
  - **Feedback needed!**

SECCHI

Space Weather Pages
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Meetings & Working groups
Projects
Papers & Presentations
Announcement Lists
EVENTS
SUN-STEREO events
13-15 Dec 2006
19-22 May 2007
STEREO Data Links:
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COR1 CME Catalog
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HI Event List
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NOAA STEREO Beacon Plots
STEREO
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UCLA STEREO ICMEs, SIRs, Shocks
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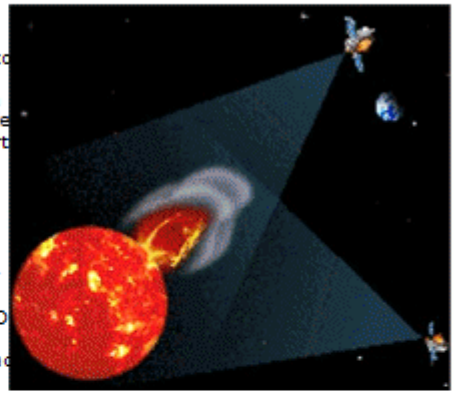
Data Products by year:
SWAVES and WIND/WAVES Type II/IV Lists
STEREO Modeling:
CCMC STEREO Support
CISM
Predsci MHDWEB
SECCHI 3D R&V
STEREO IMPACT Modeling
UCSD SWx Forecast
WSA Predictions: L1(ACE)
WSA Predictions: STEREO
Related Links
ACE
AF SWx Ctr of Excellence
ESA SWx Program
GOES SXI
Hinode
Intl. Heliophysical Year
LESIA Radio Monitor
LMSAL Latest Events
NASA Living With a Star
NOAA SWPC
NSF Natl. SWx Program

THE STEREO SPACE WEATHER GROUP



Welcome to the Home page of the STEREO Space Weather Group. The intent is that this be an open web site, where anyone from the scientific community can follow our efforts to prepare computer programs, modeling efforts and research studies in preparation to use the STEREO observations as a tool for Space Weather. We also invite scientists from outside the SECCHI or STEREO consortia to join in the group's effort. We describe below the procedure to join the Space Weather group.

There are now two coordinators of the STEREO Space Weather group: David Webb, the SECCHI Space Weather Coordinator and a Co-I on the SECCHI Heliospheric Imager experiment, and Doug Biesecker, of the NOAA Space Environment Center and NOAA's coordinator of the STEREO Beacon data. This site is intended to be the repository of all pertinent details and information related to the STEREO Space Weather efforts. Our activities are closely coordinated with the STEREO Science Center at GSFC where the Beacon data will reside. Our site will be updated as new information and revisions dictate. A general discussion of Space Weather, the role of coronal mass ejections, and the use of the STEREO instruments for space weather is HERE. We recently completed a chapter on STEREO Space Weather that will appear in the STEREO Instrument book. The current version is HERE

The overall purpose of the Space Weather Group is to help coordinate space weather efforts involving the STEREO mission and its instruments, including that of individual team members, and to help coordinate those efforts that lead to tools and products that can be tested and used before and after the STEREO launch. The STEREO real-time Beacon is a major STEREO effort having Space Weather implications. Other activities of the group include incorporating and interfacing STEREO data and space weather activities with: (1) Imaging and in-situ data from other existing space missions such as ACE, Wind, SOHO, Ulysses, GOES-12 SXI, the Transition Region and Coronal Explorer (TRACE) and Solar Mass Ejection Imager (SMEI), and ground-based observations such as interplanetary scintillation (IPS), optical line and broadband and radio emission, and future missions planned for the STEREO timeframe, such as Solar-B, GOES-13 SXI, and the Solar Dynamics Observatory (SDO); (2) The Geospace community to understand the coupling of and responses to CMEs and other transient disturbances by encouraging and participating in space weather campaigns; (3) The Community Coordinated Modeling Center (CCMC) and other simulation and modeling groups to use STEREO data as input to space weather models; (4) The SECCHI 3D Reconstruction and Visualization Team to develop models that have a space weather context; (5) The various virtual observatories that are being developed; (6) The International Heliophysical Year (IHY) program in 2007-08; (7) Meetings and workshops involving space weather; and (8) NASA's PAO EP/O and other outreach activities.

last updated 03/09/2009

http://secchi.nrl.navy.mil/spwx/

STEREO Space Weather Event Pages

- **Contain an event summary, online data, modeling & links to other data**

- **Continue to update "Sun-STEREO" Events**
  - **Most recent: April 8-12, 2010 events**
  - **There are now 14 events;**
    Need to add August 2010 and February 2011 events - probably should be more

- **Need your feedback on these Event pages!**

  - **Incorporate or link to other STEREO data:**
    Beacon (NRT quicklook)
    SECCHI & SWAVES imagery
    PLASTIC & IMPACT in-situ data
    Modeling/simulation results
  - **Need to add more on CIR SWx effects**
  - **Need more geo inputs!**
  - **Try to incorporate new events/pages soon after events occurrence**
  - **Any missing events, new data links, revisions/corrections?**

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CCMC STEREO Support
CISM
Predsci MHDWEB

Sun-STEREO Events

INTRODUCTION

STEREO began science operations in early 2007 and has operated during an unprecedented extended period of minimal solar activity. Despite this, there have been a number of events in which a CME observed at the Sun by one or both STEREO spacecraft passes over one of them (or the Earth) as detected from in-situ data. These form a special class of space weather-type events that can provide information on the characteristics of the geometry, propagation and internal structure of ICMEs. Important to this study are the remote imaging observations from the SECCHI Heliospheric Imagers (HIs) and, occasionally, also from the Solar Mass Ejection Imager (SMEI) in Earth orbit.

We call these Sun-STEREO (Earth) Connection Events. Below is the current list of such events with some notes about them and references to analysis results. The earliest two events are well known and have their own pages on this site. Other events will have separate pages as merited. The list will be updated periodically. We have added detail pages for the recent events in 2010, including discussions and predictions for each one by members of the STEREO SWx Group. We emphasize that these are only a subset of all the events that have been identified in other STEREO CME lists (e.g., see STEREO Data Links in lefthand column); we chose these events because of their special potential for detailed Sun-to-STEREO/Earth studies to understand space weather. Please send additions/corrections/comments on these events to David.Webb@hanscom.af.mil.

Sun-STEREO (Earth) Connection Events

2010 April 8-12
A B3.7 long duration flare in AR 1060 at N25E16 (Earth) on April 8, 02:30, with EF, wave, and double dimmings. See LMSAL: http://www.lmsal.com/solarsoft/gev_20100408_0230/gev_20100408_0230.html. A bright CME to NE is observed in LASCO as well as the following halo. Are these different events? SOHO Halo Alert: SOHO/LASCO observed a full halo CME on April 8, 2010. Onset in C2 at 04:30 as a faint ragged loop front centered at PA 246 degrees. The event quickly developed to material at all positions or 360 deg. Also seen in C3 starting at 06:18. Speed 286 km/s at PA 240 deg. See EIT and LASCO data at: http://umbra.nascom.nasa.gov/lasco/observations/halo/100408/. A shock was detected at SOHO and ACE on Apr. 11, ~12:00 followed by an ICME and possible Magnetic Cloud, starting early on Apr. 12. Southward field during and before this time resulted in small geostorm with Kp reaching 6 early on Apr. 12.

2010 April 3-5
A classic B7.4, long duration event in AR1059, S23W11 (Earth), with an EF, double dimmings, wave and possibly full halo CME on April 3, ~10:00. The CME was brightest in the southern hemisphere. Event observed at SE and SW limbs at ST-A and ST-B, resp. See LMSAL: http://www.lmsal.com/solarsoft/gev_20100403_0904/. SOHO Halo Alert: SOHO/LASCO observed a partial Halo CME onset in C2 at 10:33; wide symmetric loop front over the South Pole with width 243 deg. By 11:06 a second wave begins over the south with a slow multiloop front. Speed 512 km/s at PA 192 deg. See EIT and LASCO data at: http://umbra.nascom.nasa.gov/lasco/observations/halo/100403/ . A shock was detected at SOHO and ACE on Apr. 5, 08:00 followed by a possible ICME/Magnetic Cloud. If associated, it is a fast event with the wind speed ~800 km/s. Geostorm with Kp reaching 7.

2010 January 17-21
Energetic CME from AR 1041, dimmings and global coronal wave. During launch CME had unusual circular profile viewed from

Interactive Forecasting Using STEREO Beacon Data

• **At Dublin SWG, March 2010, we discussed if and how we could use STEREO Beacon data for near realtime forecasting purposes.**

• **Since then several members have used various heuristic/formal models for forecasting Earth arrival for 3 event periods.**

• **First was the April 2010 events**

- Paper published in SWx Journal discussing use of 6 techniques:
Davis, C.J., C. A. de Koning, J. A. Davies, D. Biesecker, G. Millward, M. Dryer, C. Deehr, D. F. Webb, K. Schenk, S. L. Freeland, C. Möstl, C. J. Farrugia and D. Odstrcil; A comparison of space weather analysis techniques used to predict the arrival of the Earth-directed CME and its shockwave launched on 8 April 2010; SPACE WEATHER, 9, S01005, doi:10.1029/2010SW000620, 2011.

- Techniques used:
COR2 (geometric localization & polarization STEREO-A & B)
HI "J-plots"
Biesecker
Enlil WSA model (SOHO/LASCO & STEREO/COR2)
STOA shock model

- **August 2010 event series**

  - Paper by Schrijver and Title, JGR, in press, 2011 on solar conditions of complex series of flares/filament eruptions/CMEs.
  - 2011 Workshops in UK and Graz on other papers
  - Added Tappin- Howard model to above techniques & SMEI data

- **February 2011 event series, including first X flare in 4+ years**

  - Used similar prediction techniques as for the Aug. 2010 events
  - About 10 models in total
  - HI, T-H and HAFv2 models did best; Arrival time & Lead time.

NOAA SWPC Beacon Data (D. Biesecker)

- http://www.swpc.noaa.gov/stereo/STEREO_data.html

  - NRT 6 and 24-hour and 3, 7 and 30-day plots of data from in-situ instruments, PLASTIC & IMPACT: Measurements of solar wind plasma, particles, magnetic field & SEPs. Each plot has estimate of the corotation time a structure at ST-B will take to arrive at L1 (ACE - or L1 to STEREO-A).

  - NOAA: MAG + PLASTIC data plotted only for last 24 hr. but not archived.

  - PLASTIC data is available as 1, 3, 7 and 30 day plots.

- STEREO imagery used for input to ENLIL and for monitoring far side activity.

  - ENLIL run whenever the forecasters see an event of interest. STEREO used in conjunction with LASCO to derive best possible inputs. It also gives good general situational awareness. STEREO IMPACT/MAG and PLASTIC are part of the daily briefing the forecasters give. Generally for looking at corotating structures and giving them more info on when recurrent structures will hit Earth and with what sort of intensity. Also, situational awareness whenever there is a CME observed.

  - STEREO IMPACT/HET is being used more now for SEP events. Given the dearth of data for these high impact events, any additional data is welcome. The STEREO's can be well connected to a source location while Earth is less well connected, and this can help with both forecasting and with general situational awareness.

- Of general importance to us:
  - Rise of solar activity → more SWx events
  - Decrease in DSN downlinks
  - The lack of ground-based 24 hr. Beacon coverage continues to be a problem

STEREO-B as a SWx Monitor

- **STEREO-B is now at 95° from Sun-Earth line. When it was near the L5 point (60°), ST-B data was assessed as a pathfinder for a possible SWx monitor mission.**

  - At L5 can view & study CMEs aimed Earthward, e.g., with near-Sun & heliospheric imaging like with COR2 and HIs. Ideal to compare L5 HI views with those from a HI near Earth.

  - An L5 monitor can also view beyond Earth-facing east limb, monitoring activity-producing regions for forecasting.

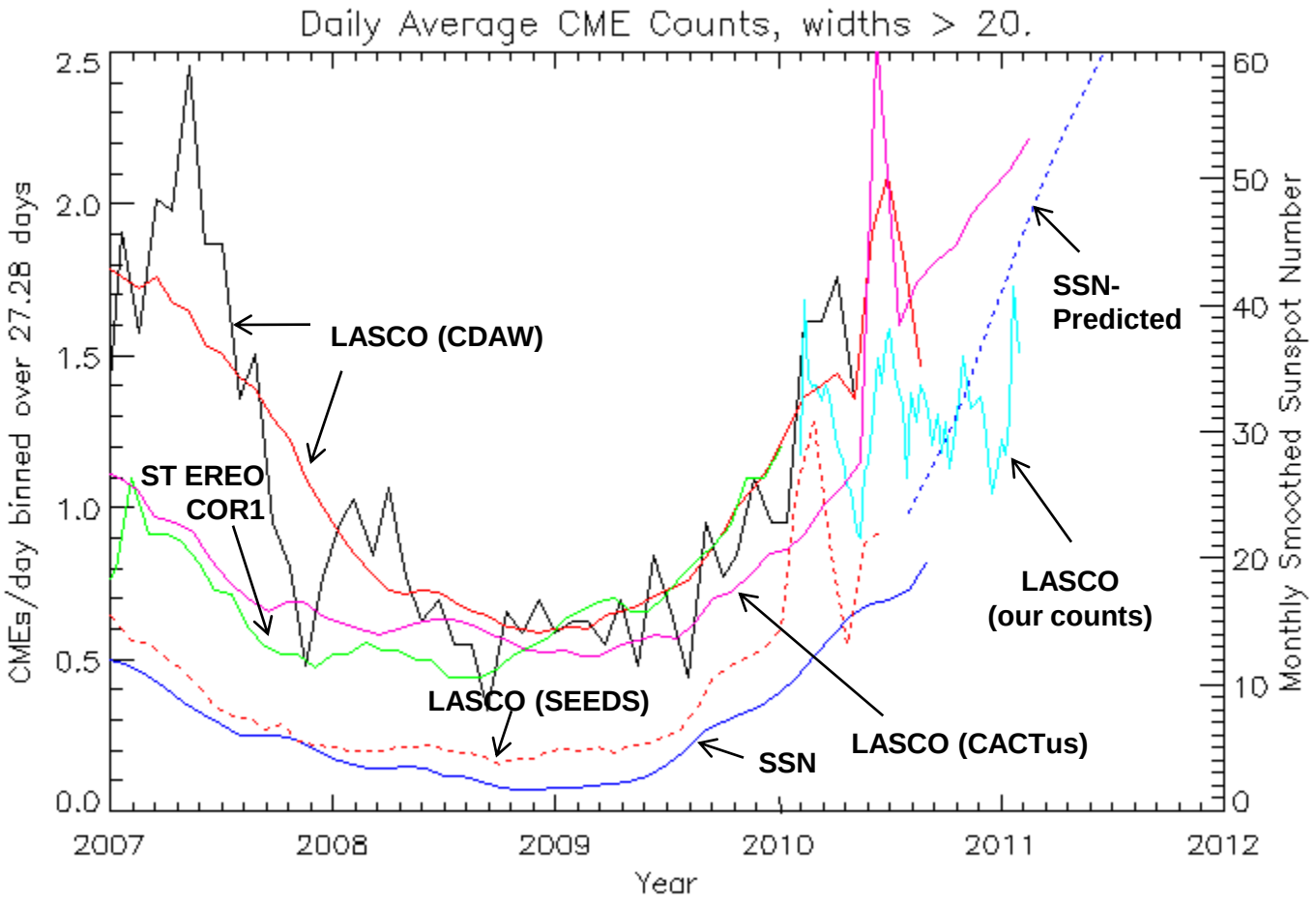
- **Papers on L5 missions published:**

  - Webb et al., "Using STEREO-B as an L5 Space Weather Pathfinder Mission", Space Research Today, 178, 10-16 (2010)

  - Gopalswamy, N. et al., "Earth-Affecting Solar Causes Observatory (EASCO): A New View from Sun-Earth L5", JASTP, in press (2011)

  - Two white papers submitted to the National Academies Heliophysics Decadal Survey

CME & Sunspot Rates through Solar Minimum



Daily CME rate for 2010-11 in the context of the rate through recent solar minimum. CME data sources: LASCO = manual online CDAW catalog (NRL, CUA) & our counts since Jan. 2010; SEEDS = automatic catalog courtesy J. Zhang & J. Bannick (GMU); CACTus = automatic catalog courtesy E. Robbrecht & B. Bourgoignie (SIDC); STEREO COR1 = manual catalog courtesy C. St. Cyr (NASA) & H. Xie (CUA); Sunspot number (SSN) from NOAA SWPC. CDAW & SEEDS rates are for CME widths > 20. CDAW, SEEDS & SSN plots are 13-month, COR1 6-month, & 2010 LASCO counts 6-week running averages.