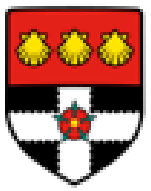
Researching Solar Storms with Citizen Scientists

Engaging with Four Thousand Volunteer Research Assistants

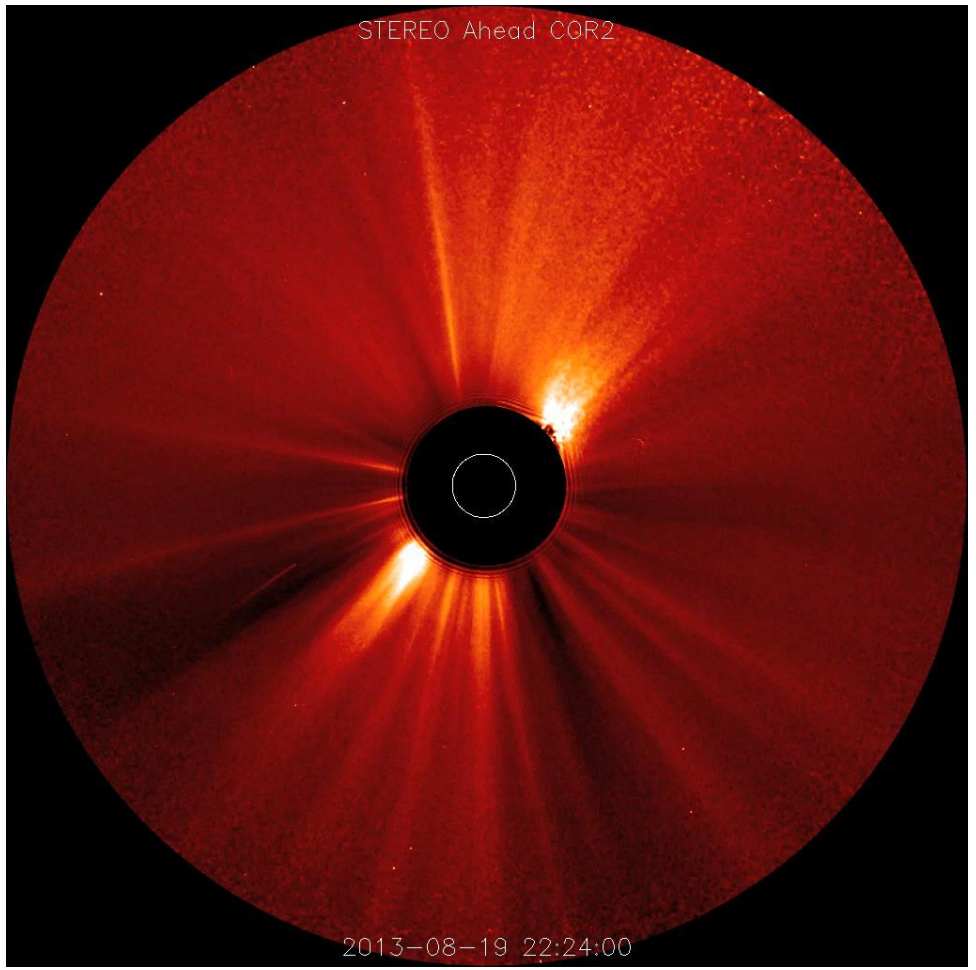
C. Scott, S. Jones & L. Barnard



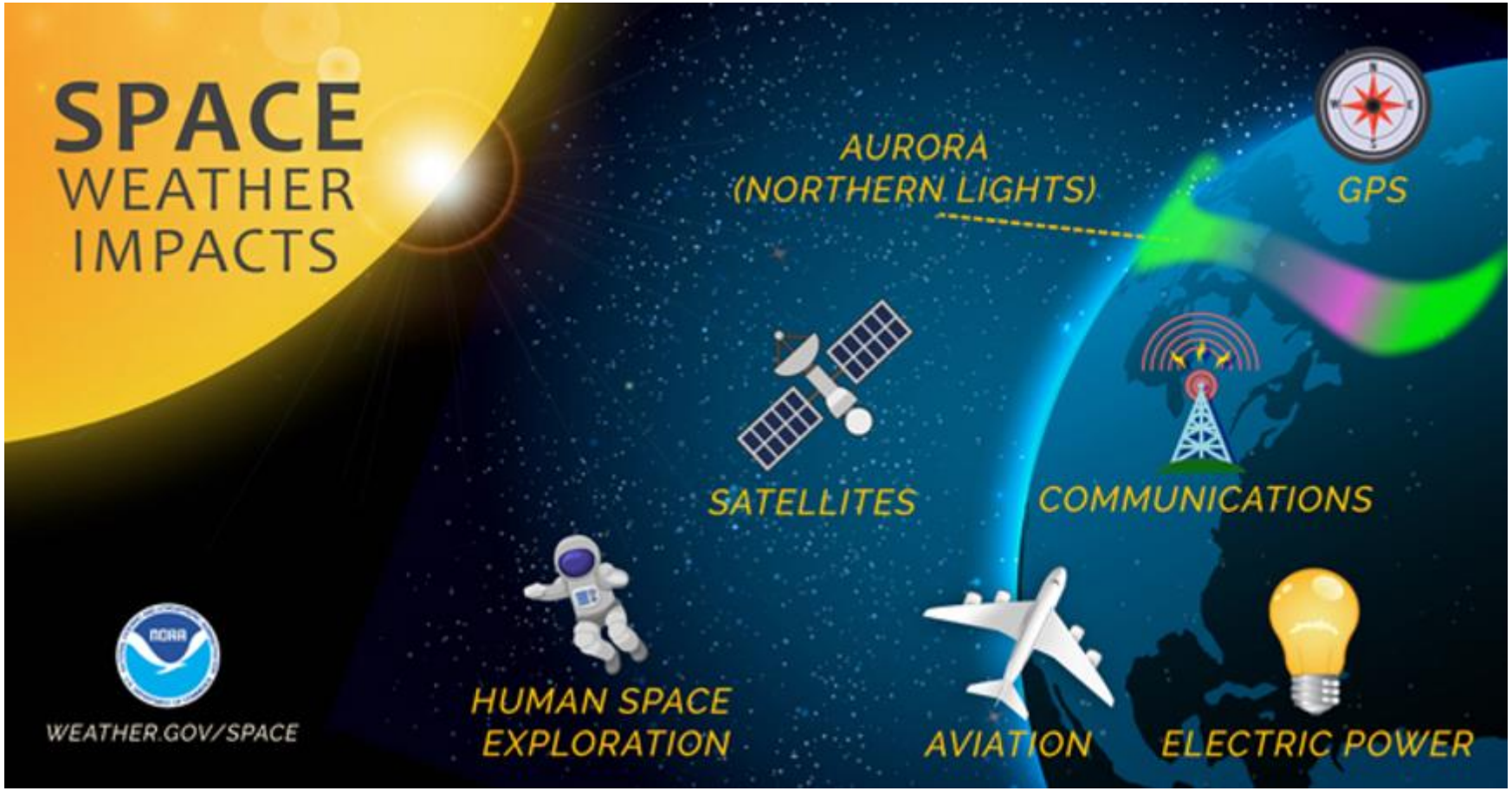
University of Reading

Introduction

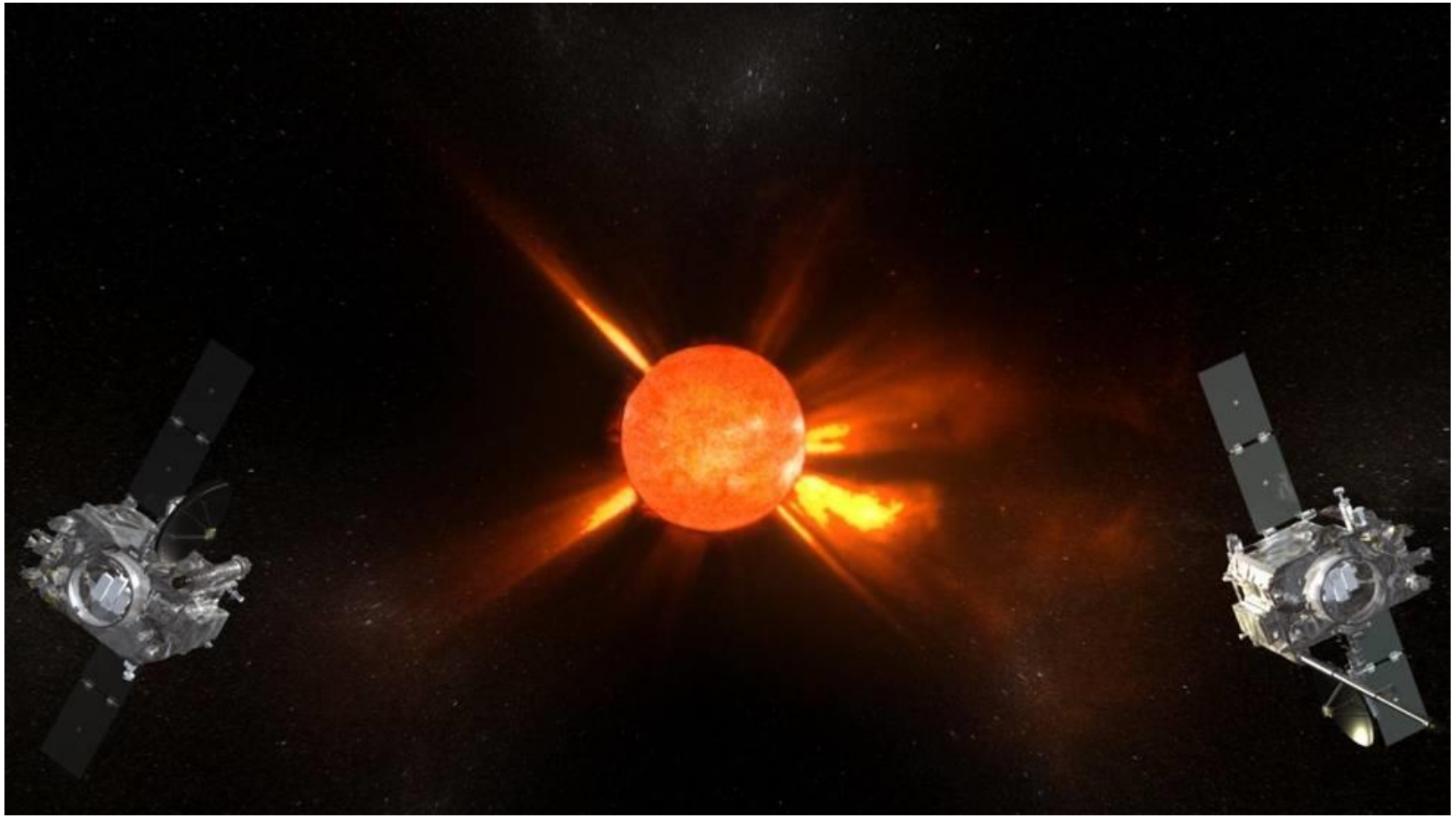
Solar Storms, or Coronal Mass Ejections



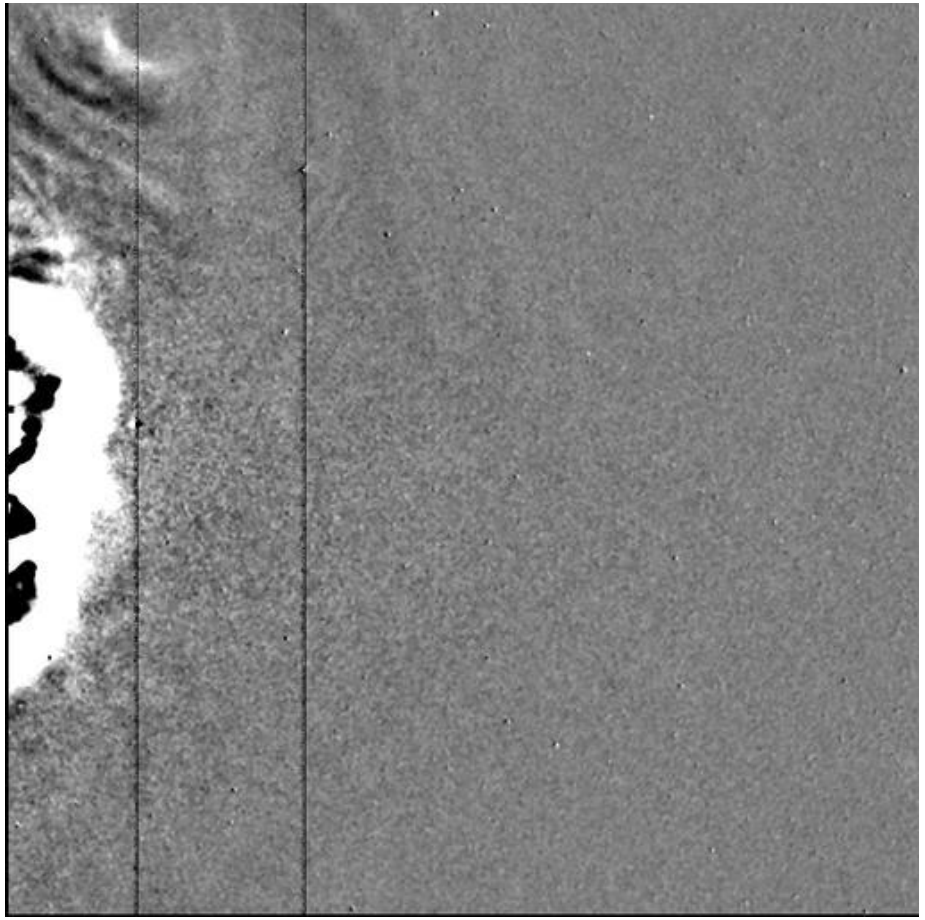
Impacts of Solar Storms



The twin STEREO spacecraft



A lot of data!



Each spacecraft:

- One image every 40 minutes
- 36 images per day
- 13,140 images per year

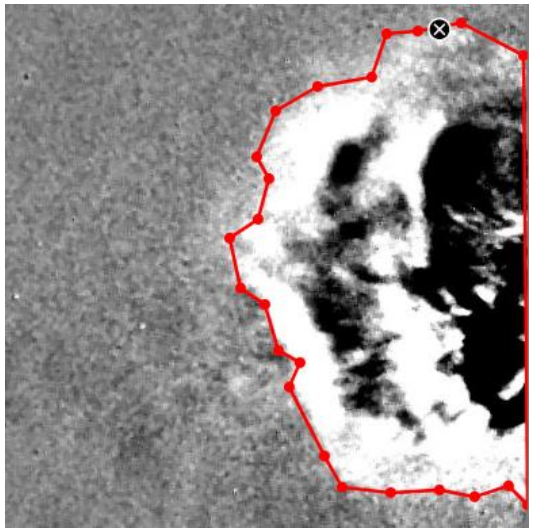
Altogether, since launch:

- 184,000 images to look through and Identify Solar Storms

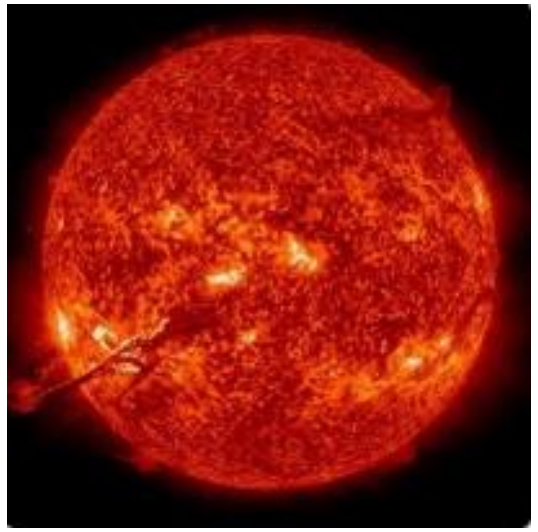
Complex features of Solar Storms difficult to identify automatically

Citizen Science Projects

The Solar Stormwatch Project



Solar Stormwatch II



Protect our Planet from Solar Storms

Seven Publications So Far

- The distribution of interplanetary dust between 0.96 and 1.04 au as inferred from impacts on the STEREO spacecraft observed by the heliospheric imagers, Davis+ 2012.
- The Solar Stormwatch CME catalogue: Results from the first space weather citizen science project, Barnard+ 2014.
- Validation of a priori CME arrival predictions made using real-time heliospheric imager observations, Tucker-Hood+ 2015.
- Observational Tracking of the 2D Structure of Coronal Mass Ejections Between the Sun and 1 AU, Savani+ 2015.
- Differences between the CME fronts tracked by an expert, an automated algorithm, and the Solar Stormwatch project, Barnard+ 2015.
- Testing the current paradigm for space weather prediction with heliospheric imagers, Barnard+ 2017.
- Tracking CMEs using data from the Solar Stormwatch project; observing deflections and other properties, Jones+ 2017

Open, online Solar Storm Catalogue

AGU PUBLICATIONS

Space Weather

RESEARCH ARTICLE

10.1002/2014SW001119

Key Points:

- Solar Stormwatch has produced a unique CME catalogue, using STEREO/HI images
- The CMEs are tracked over multiple position angles and out to large elongations
- The full data set is publicly available online

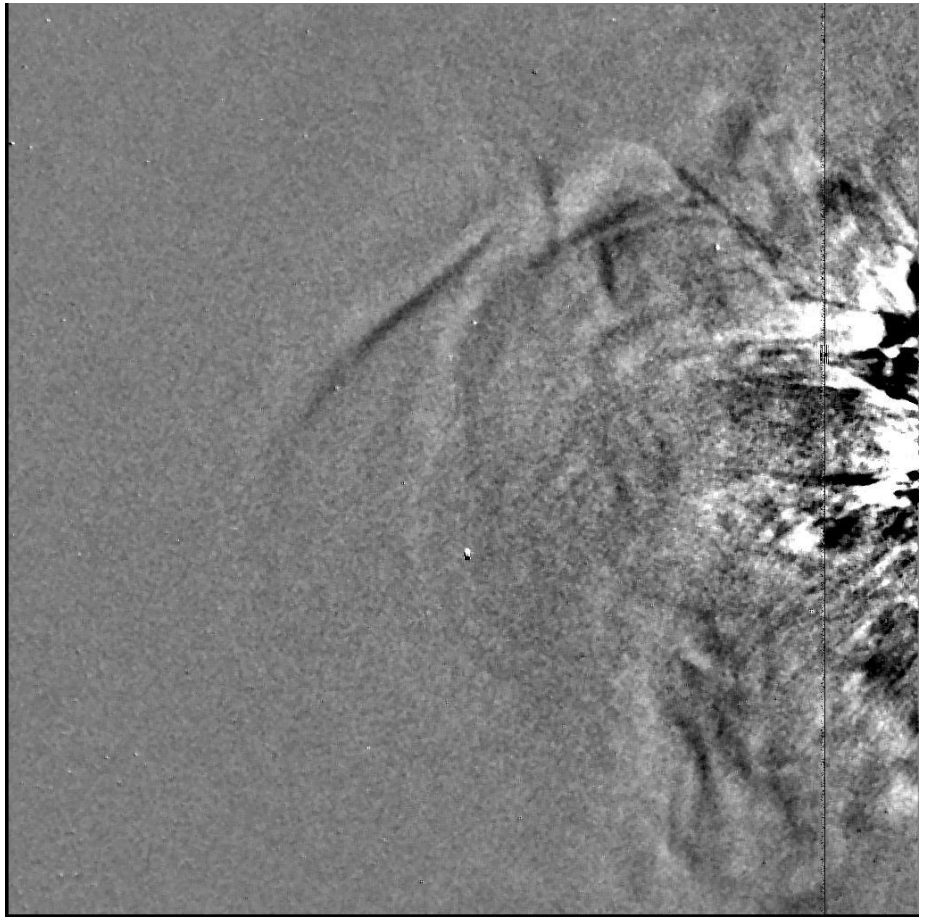
The Solar Stormwatch CME catalogue: Results from the first space weather citizen science project

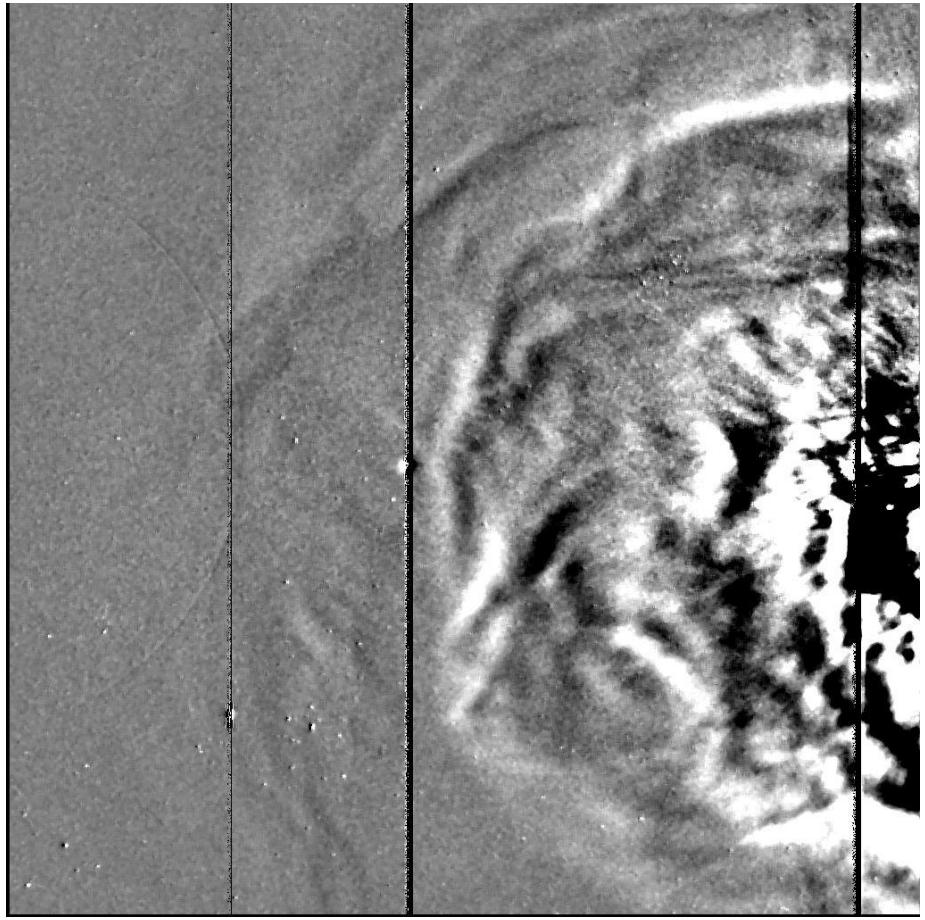
L. Barnard[1], C. Scott[1], M. Owens[1], M. Lockwood[1], K. Tucker-Hood[1], S. Thomas[1], S. Crothers[2], J. A. Davies[2], R. Harrison[2], C. Lintott[3], R. Simpson[3], J. O'Donnell[3], A. M. Smith[4], N. Waterson[5], S. Bamford[6], F. Romeo[7], M. Kukula[7], B. Owens[7], N. Savani[8], J. Wilkinson[9], E. Baeten[9], L. Poeffel[9], and B. Harder[9]

[1]Department of Meteorology, University of Reading, Reading, UK, [2]RAL Space, Rutherford Appleton Laboratory, Chilton, UK, [3]Astrophysics Department, University of Oxford, Oxford, UK, [4]GitHub Inc, San Francisco, California, USA, [5]National Maritime Museum, Greenwich, UK, [6]Centre for Astronomy and Particle Theory, University of Nottingham, Nottinghamshire,

Anyone can get involved!

Which is more complicated?





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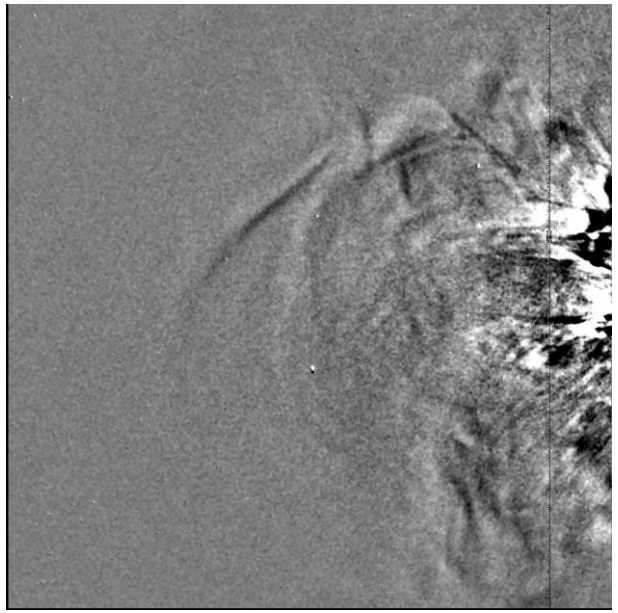

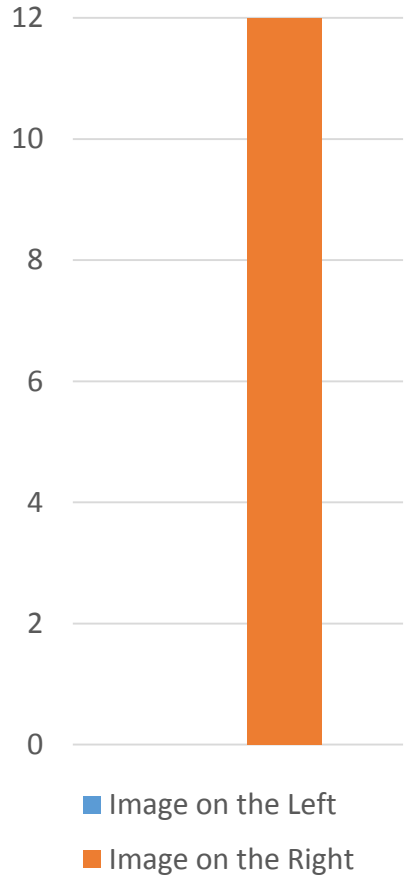

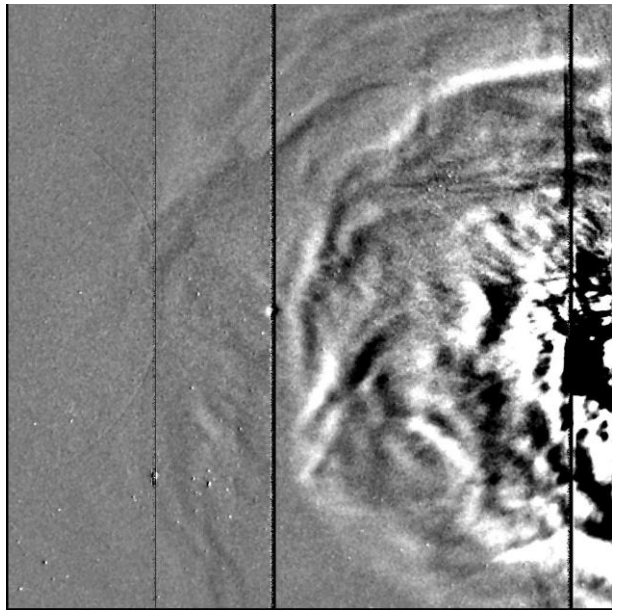

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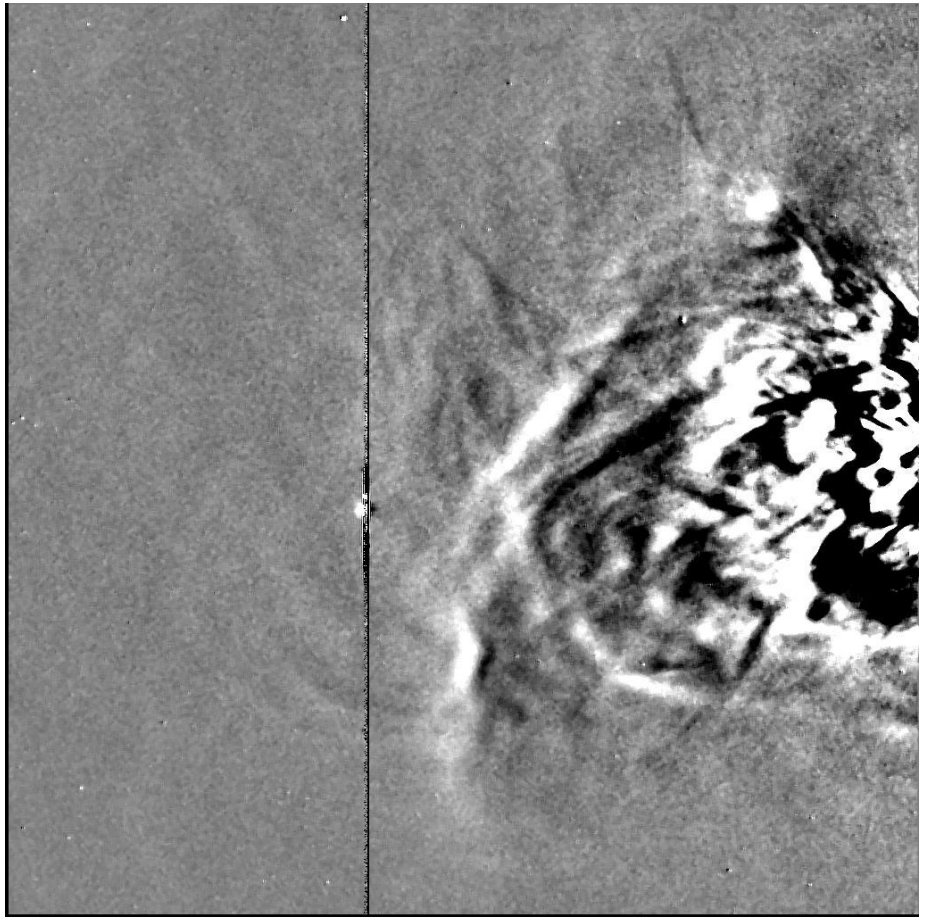

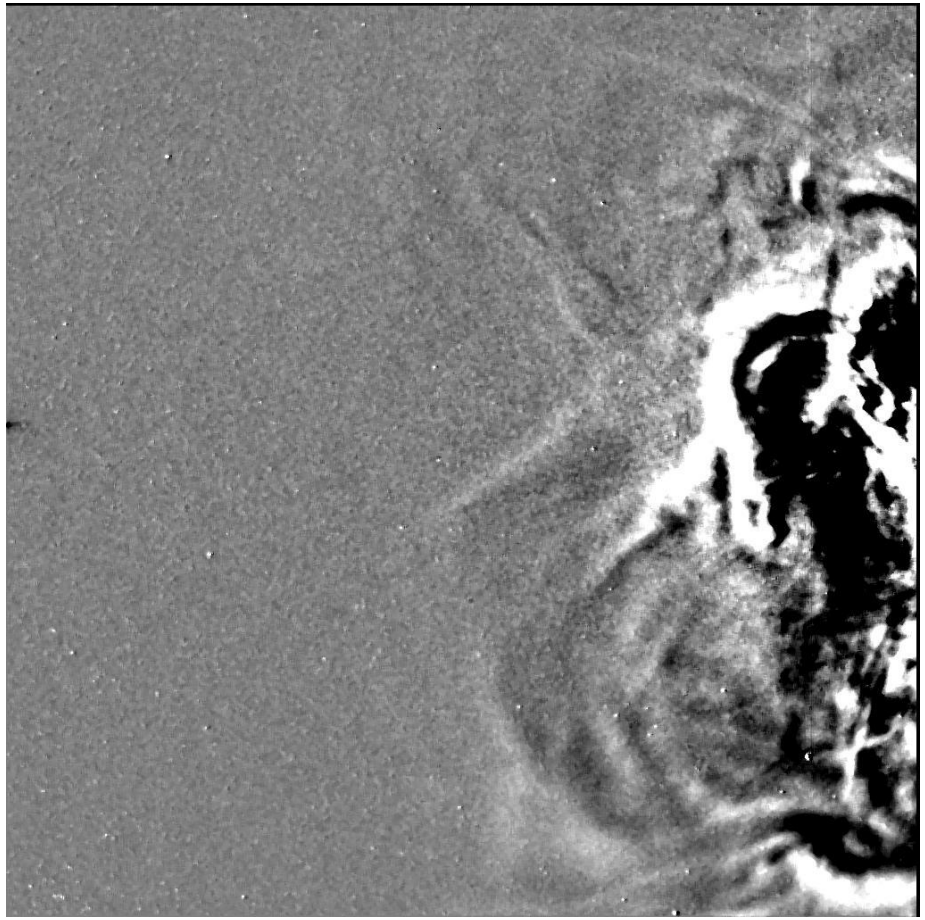

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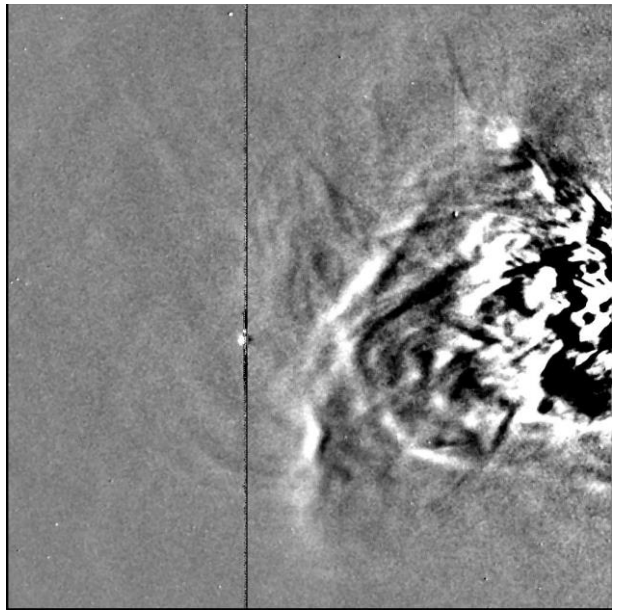
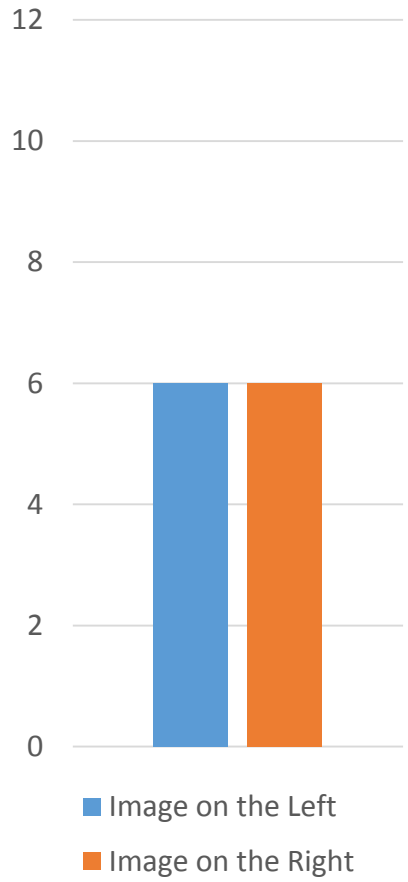
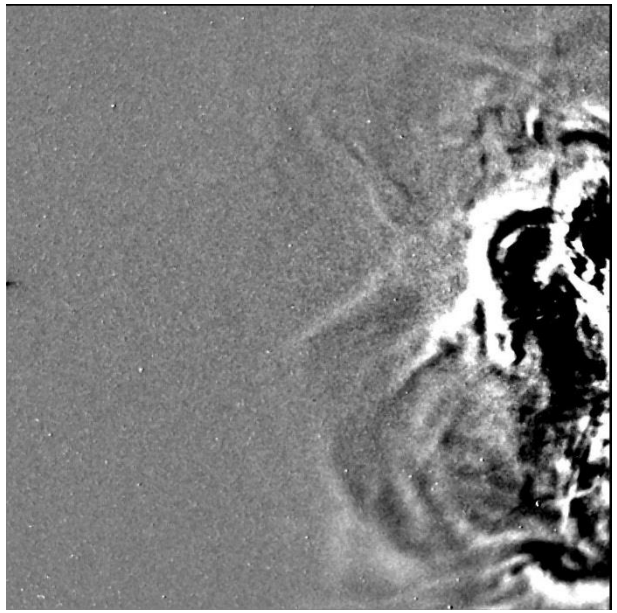
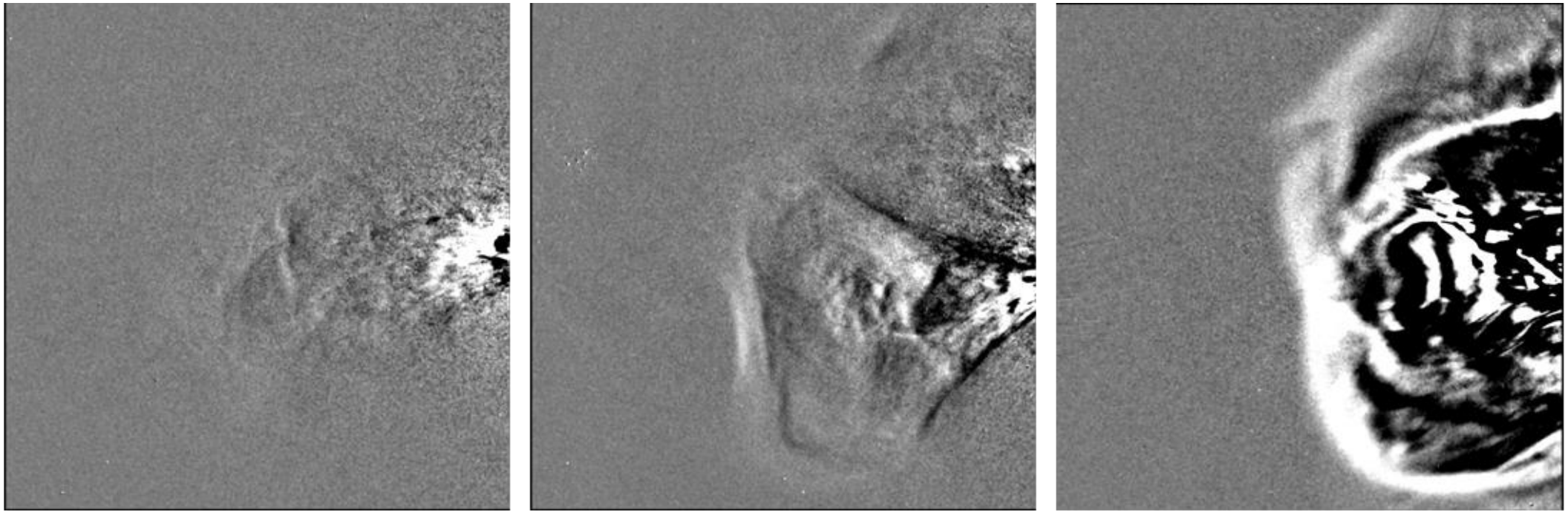


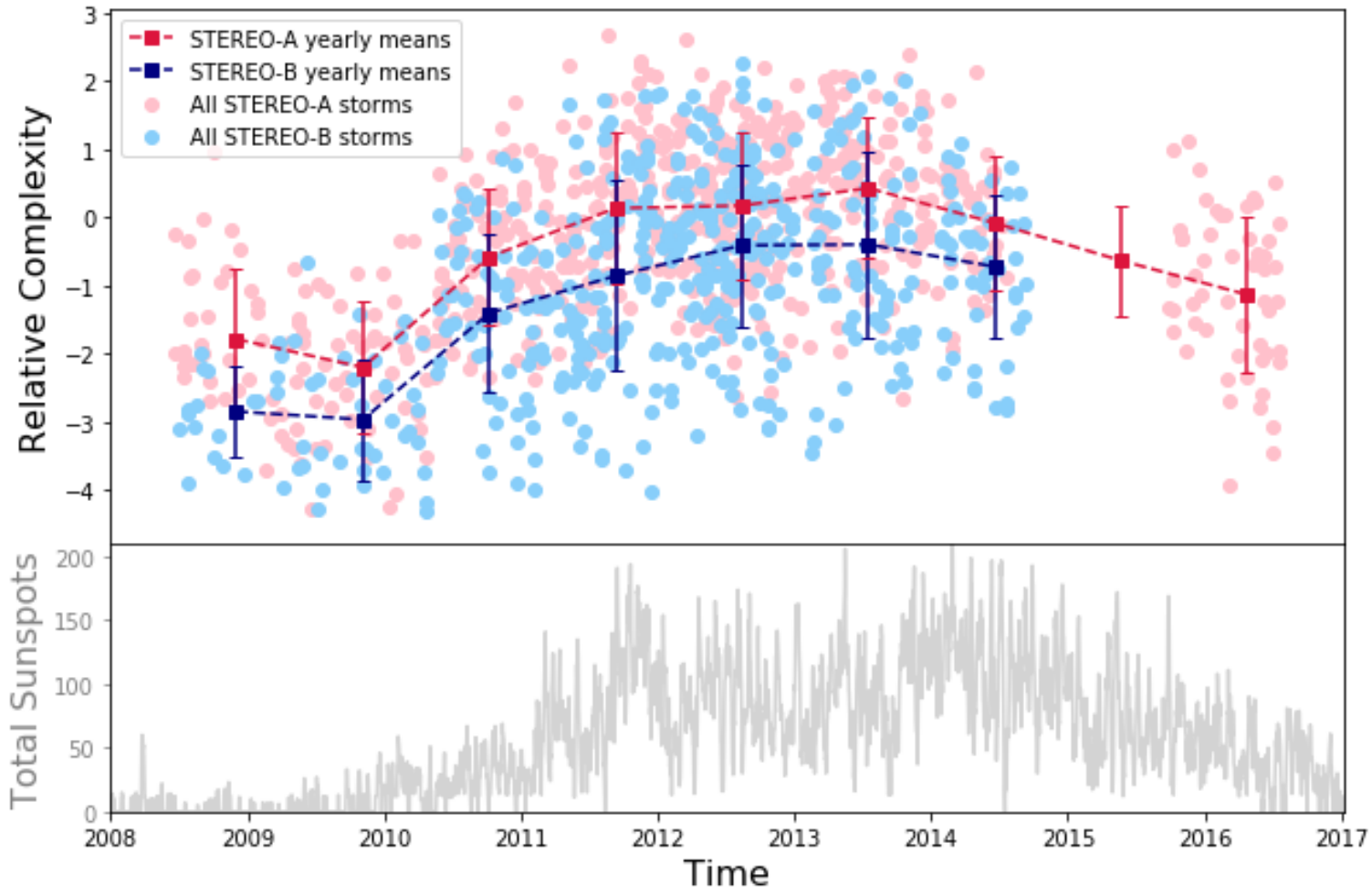




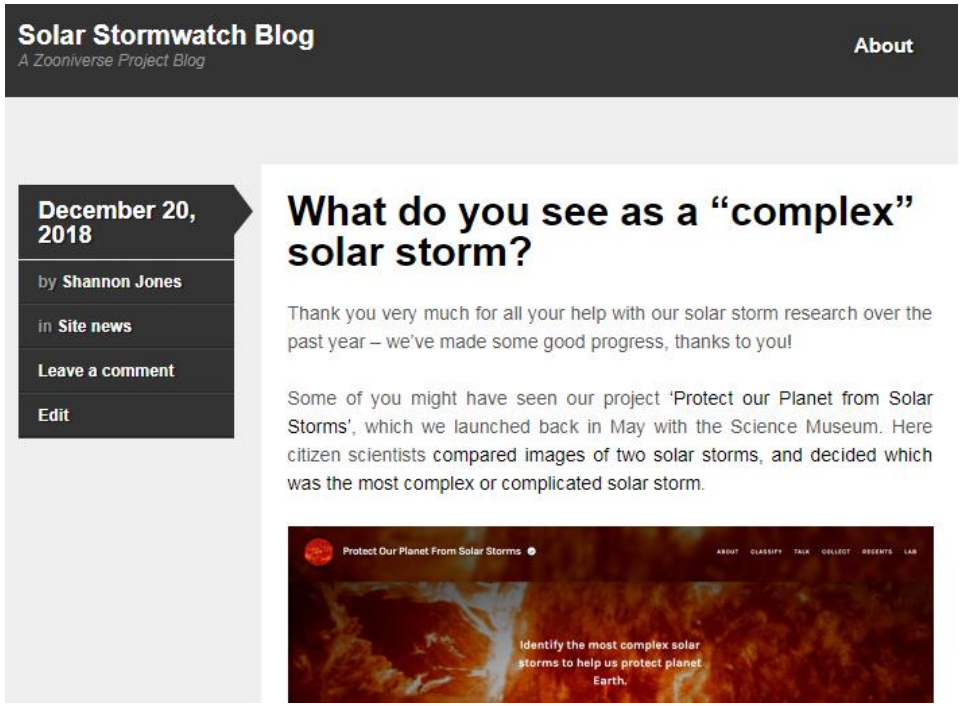
Ranking

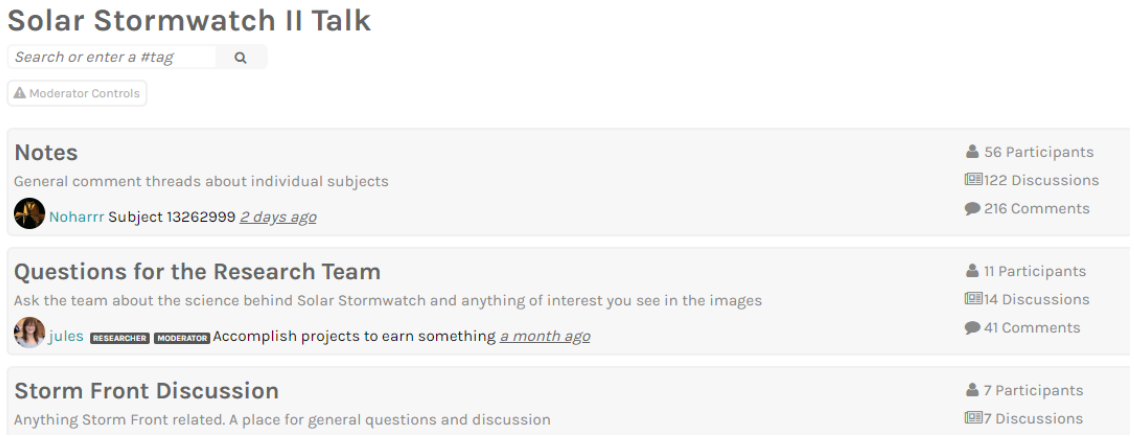


Result


STEREO-A yearly means
STEREO-B yearly means
All STEREO-A storms
All STEREO-B storms
Relative Complexity
Total Sunspots
Time
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017

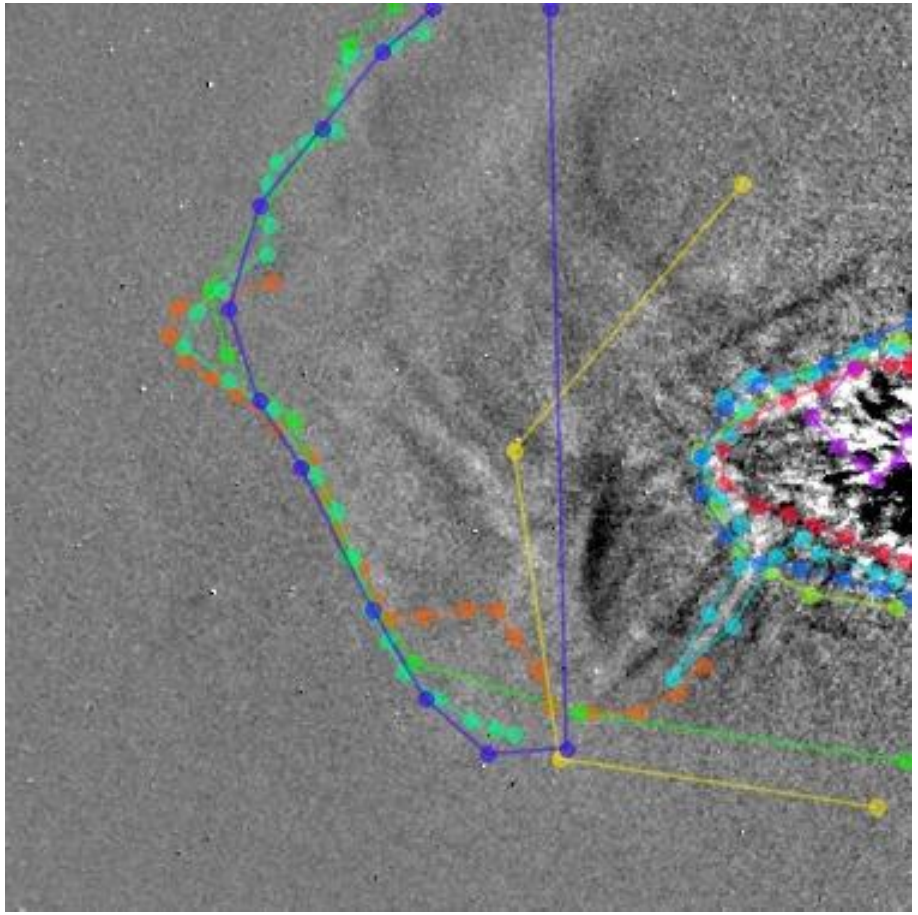
The Solar Stormwatch Blog and Forum





Problems & Benefits

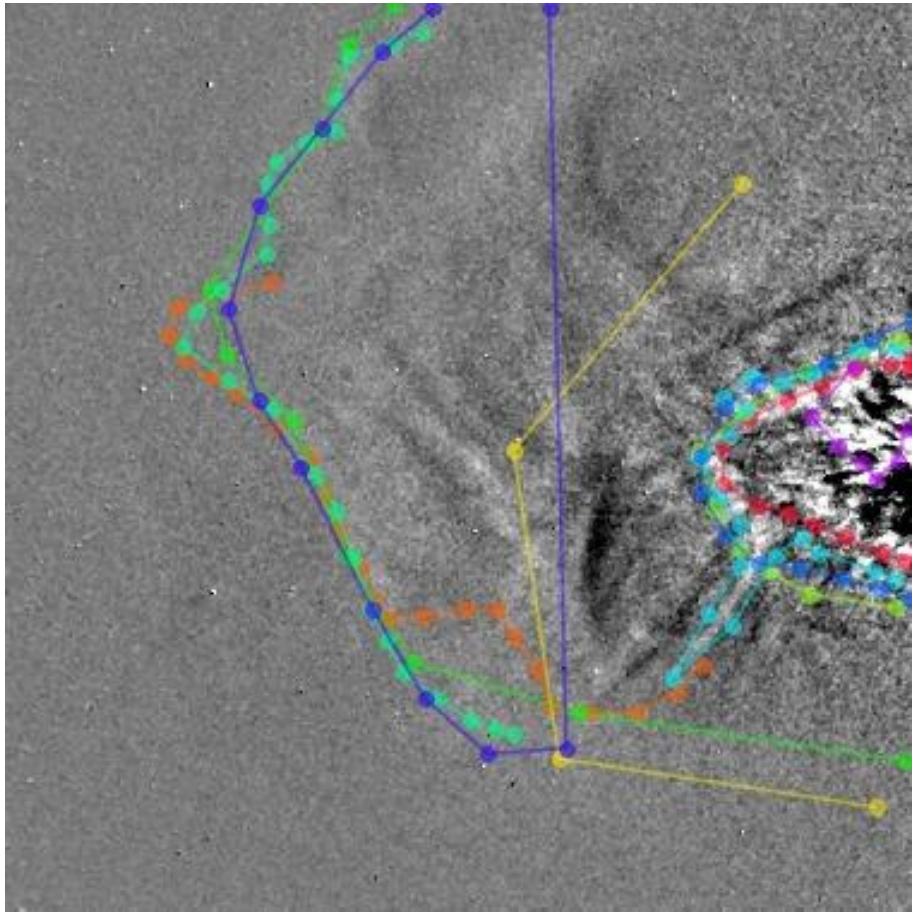
Getting participants to do the right thing

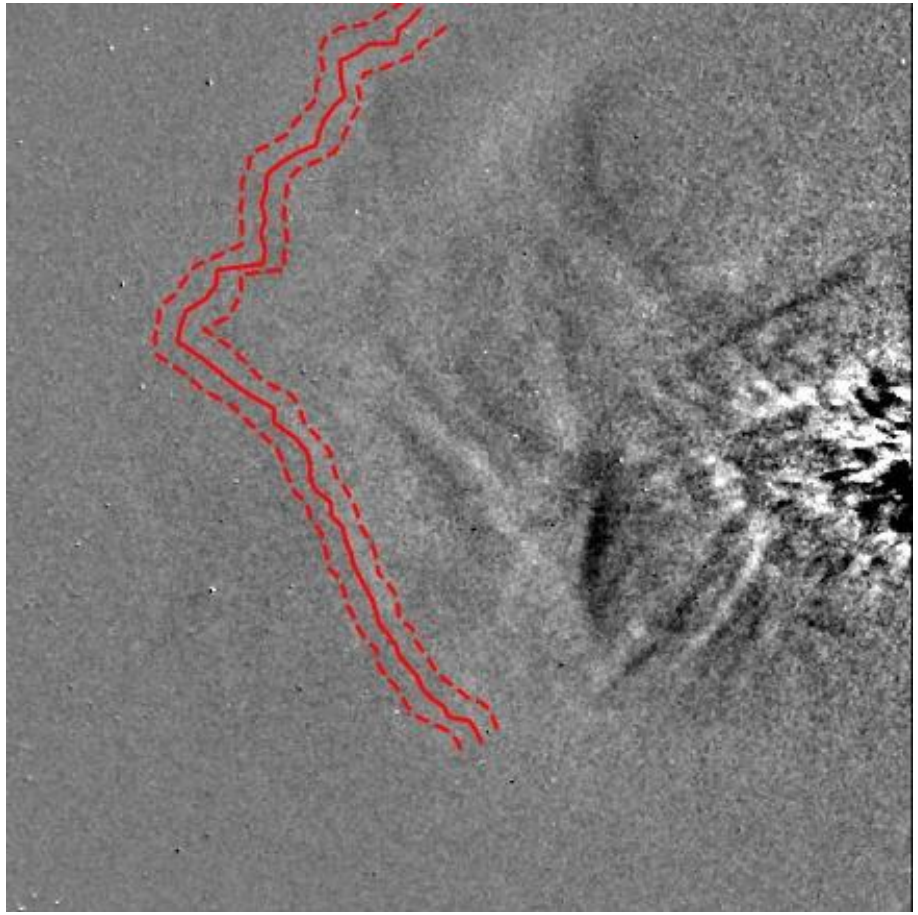


Draw around the outermost storm front.

Draw around the **brightest** and **outermost** storm fronts.

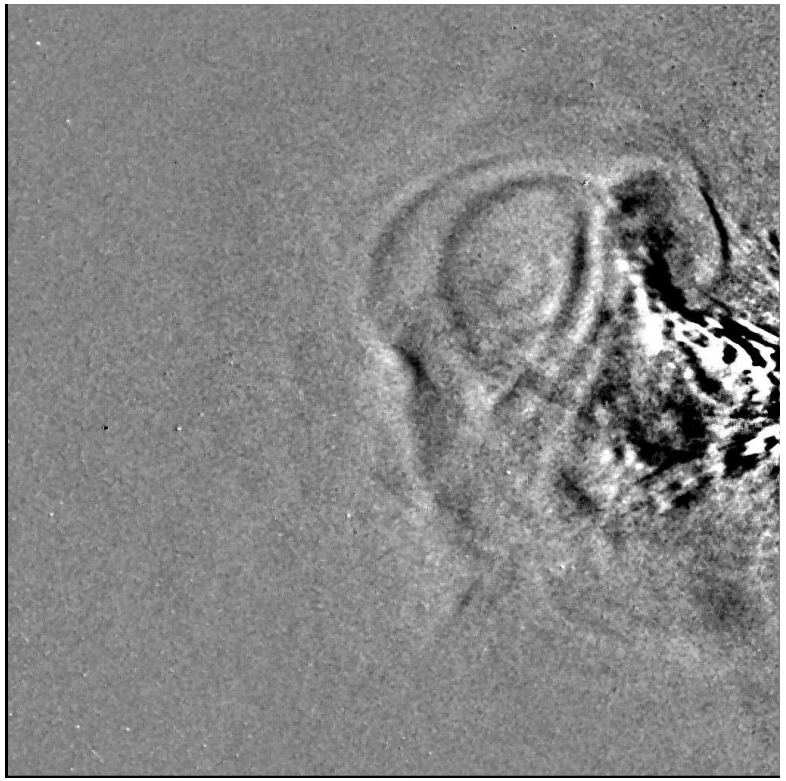
Reduced Subjectivity



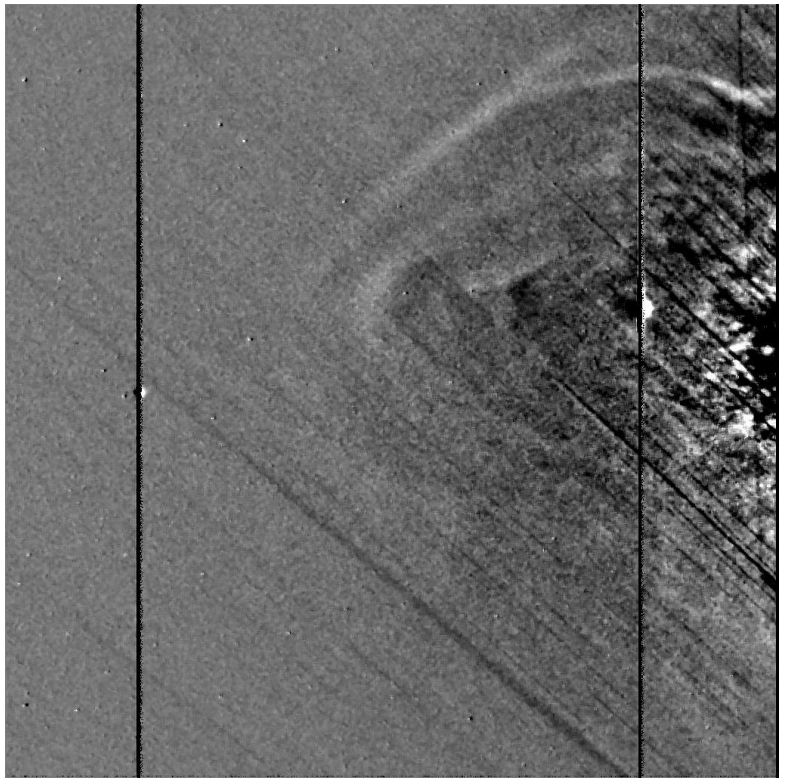


Unusual Events

#ghost



#dust



Education

ciderboyafc
Newbie
Posts: 2

Re: Migraines and Coronal Mass Ejections
« **Reply #3 on:** April 07, 2010, 11:16:25 pm »

Ive been using galaxyzoo for a while now, just found solar stormwatch. having a nose around and come across this forum. i have suffered migraines and disturbed sleep patterns all my life and find it interesting you can match them up with solar flare activity. i would like to see if mine do too. where would i find details of flare activity? it would be great to see if my occasional "sleep-walking" activities matched too! thanks...

Logged

Quialiss
Global Moderator
Sr. Member
Posts: 494

Re: Migraines and Coronal Mass Ejections
« **Reply #4 on:** April 08, 2010, 07:06:42 am »

If any of you are interested in pursuing this further, I suggest you make a note of days when you suffer from migraines and have strange dreams for a month, and then compare that to the solar weather that occurred. Try to *avoid* looking at any real time solar forecasts while you're recording data to reduce the chances of biasing the results in any way.

I'd be happy to help analyzing trends, but you have to have some numbers to work with first.

Logged

ciderboyafc
Newbie
Posts: 2

Re: Migraines and Coronal Mass Ejections
« **Reply #5 on:** April 08, 2010, 08:50:08 pm »

Thanks for that. Will follow suggestion and get back at a later date. best wishes, ciderboyafc.

Logged

T.Roc
Newbie
Posts: 18

Re: Migraines and Coronal Mass Ejections
« **Reply #6 on:** April 19, 2010, 01:47:42 am »

ciderboyafc,

If you really want to give it a fair shake, as was suggested by Quialiss, and in the spirit of this citizen-scientist program, you should post your results online here.

I would not think that there is any need to 'prove' anything here, it's been studied by the correct specialists for many decades. One good summary paper is here:

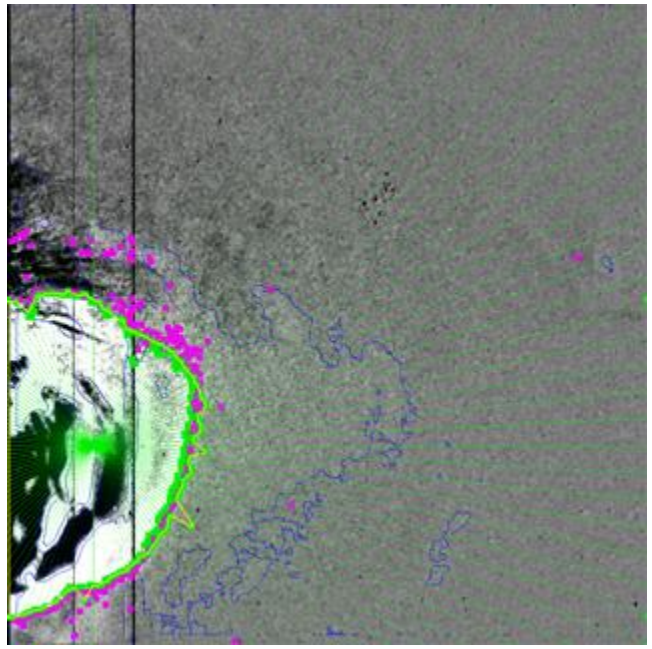
Geomagnetic Fields, their Fluctuations and Health Effects

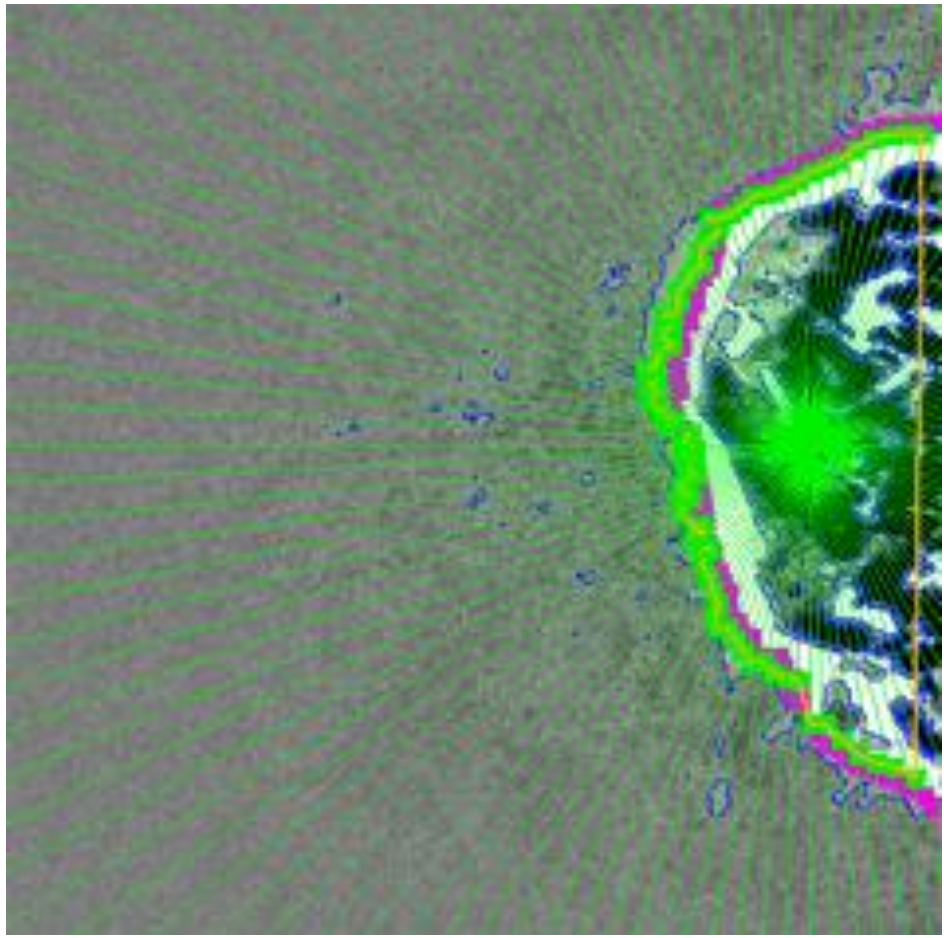
regards,

T.Roc

Inspiration

High school student from USA wrote algorithm to identify storm fronts





And finally…

Open-access, peer-reviewed publications

Code online on GitHub

https://github.com/S-hannon/solar-stormwatch-track-it-back

Data online on figshare

doi: 10.6084/m9.figshare.5224936.v1

Thank you!