



<http://solardemon.oma.be/>

# Solar Demon

Real-time automatic

Dimming, Flare, and EUV wave Monitor

on SDO/AIA data

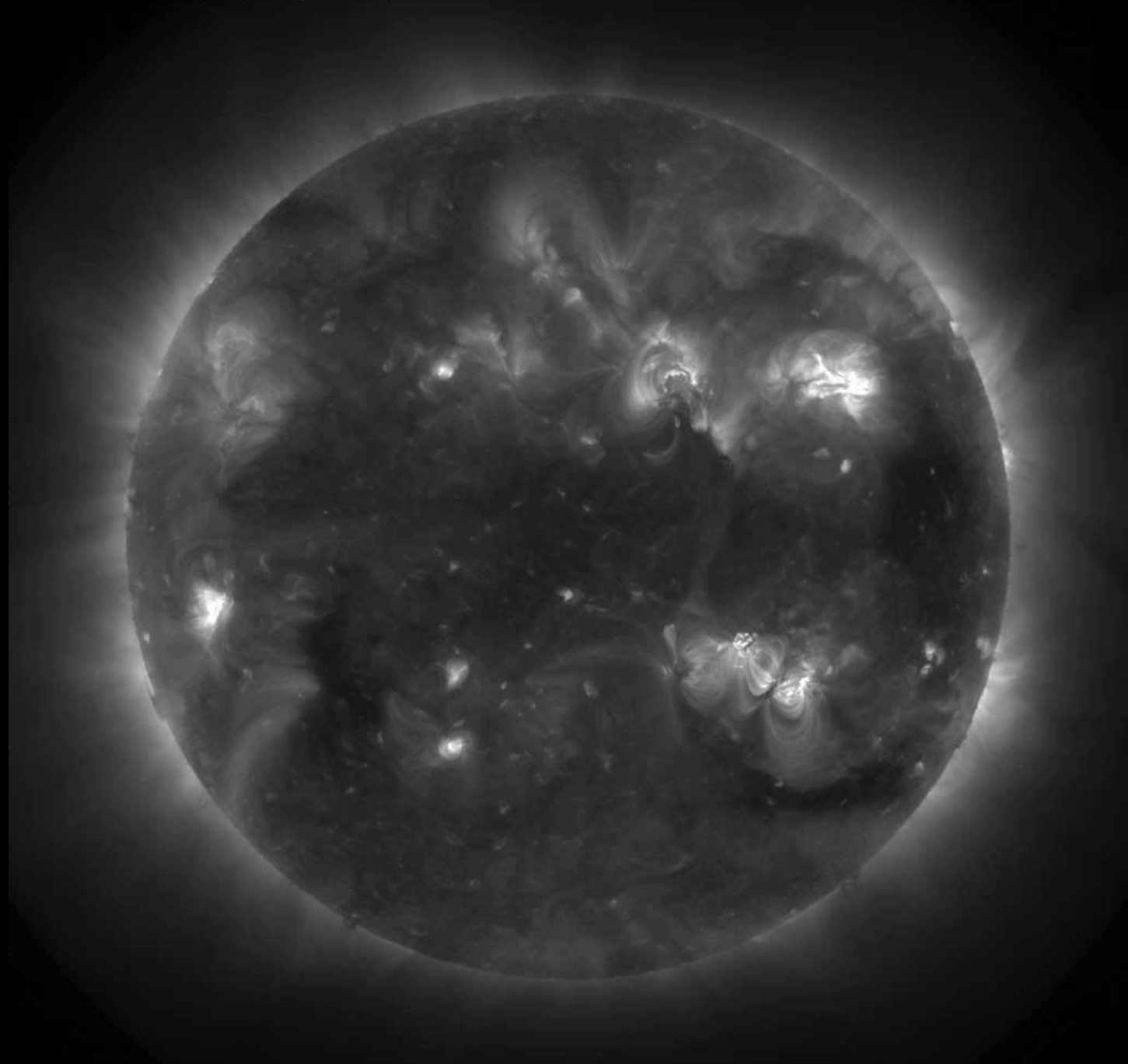


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<sup>1</sup>Royal Observatory of Belgium

2012-03-17 20:30:02 (#3907)



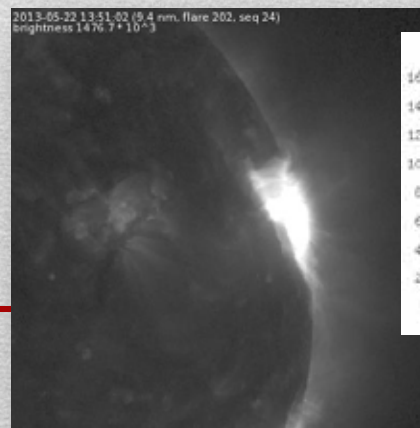
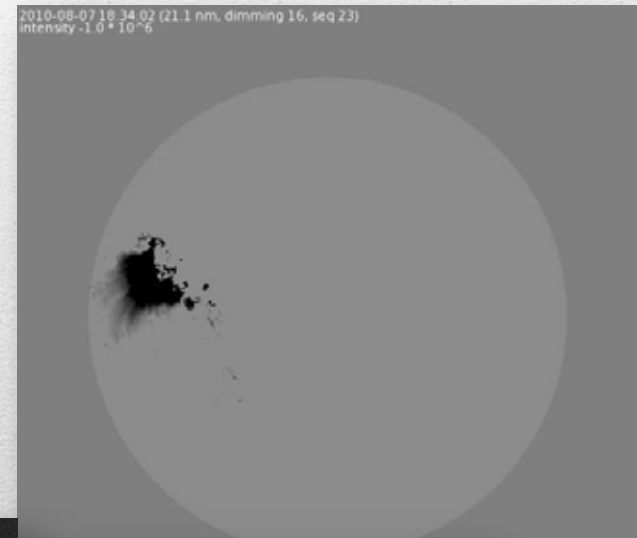
2012-03-17 20:30:02



## *Dimmings, flares and EUV waves are closely related to CMEs*

- Provide early warning system for earth-directed CMEs
  - front sided events
- Characterize dimming and EUV wave events for research purposes
  - 21.1nm SDO/AIA
  - Location, intensity, size
- Detect and characterize flares
  - 9.4 nm SDO/AIA
  - Flare location, category
- Quick-look data
  - Fast: events usually detected within 20 minutes!
  - Provide Flare Alerts for COMESEP system
  - Allow space weather forecasters to find out the location of flares and dimmings in near real-time
- ..and Synoptic
  - Science data, 7 day delay

# Objectives







# solar DEMONstration

# Solar Demon - Flare Detection

running in real time on SDO/AIA 94 QKL data  
3 minute cadence, typical delay 15 minutes  
([view all Solar Demon detection tools](#))

## Last processed image:

0 hours and 28 minutes ago (2013-11-21 14:57:00 UTC)

## Last detected flare:

2 hours and 48 minutes ago (2013-11-21 12:36:02 UTC)

## Filters (category)

[All classes](#)

-- [Only C class flares and above](#)

[Only M class flares and above](#)

[Only X class flares and above](#)

## Filters (time)

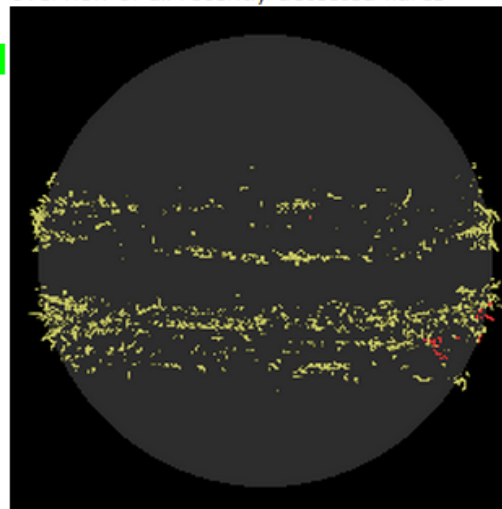
-- [Show all](#)

[Last week](#)

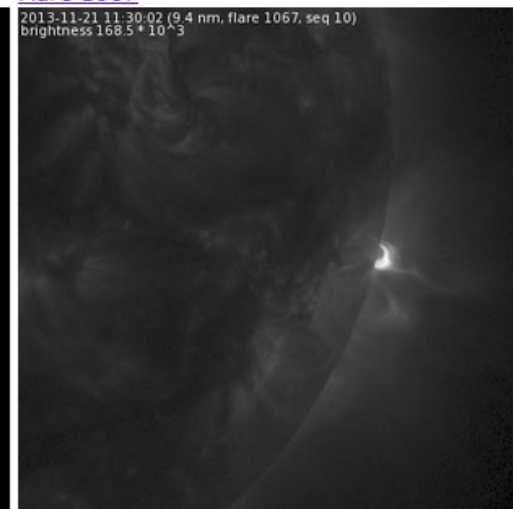
[Last 30 days](#)

[Last 365 days](#)

overview of all recently detected flares



[Flare 1067](#)



## Overview of flares

	est. class	start	peak	end	#	lat	lon	dist. R <sub>☉</sub>	est. flux	GOES flux	GOES peak time	COMESAP	# det.	
<b>November, 2013</b>														
21	C6	11:03	11:18	12:36	<a href="#">1067</a>			1.03	66.4	<b>123.0</b>	11:11	-7	98310	32
20	C1	18:21	18:30	18:39	<a href="#">1063</a>			1.01	15.9	<b>24.3</b>	18:22	-8	0	7
20	C2	17:03	17:24	18:06	<a href="#">1062</a>	-19	54	0.87	29.3	<b>64.0</b>	17:22	-2	0	20
20	C2	11:27	11:30	12:09	<a href="#">1059</a>	-19	50	0.82	23.4	<b>46.5</b>	11:29	-1	0	14
19	C1	18:00	18:06	18:24	<a href="#">1054</a>	-14	73	0.97	11.1	<b>21.2</b>	18:01	-5	0	8
19	X1	10:12	10:30	11:42	<a href="#">1052</a>	-13	69	0.96	1,295.0	<b>1,040.0</b>	10:26	-4	98309	31
18	C1	15:57	16:03	16:12	<a href="#">1051</a>	-21	20	0.51	14.6	<b>26.7</b>	15:59	-4	0	6
18	C3	14:03	14:27	15:21	<a href="#">1050</a>	-14	60	0.89	39.1	<b>70.8</b>	14:15	-12	98307	27
18	C1	00:42	00:48	00:57	<a href="#">1044</a>	-12	55	0.84	10.6	<b>16.5</b>	00:46	-2	0	6
17	C1	20:21	20:21	20:42	<a href="#">1042</a>	-15	20	0.44	14.4	<b>34.2</b>	20:21	-0	0	8

# Solar Demon - Dimming Detection

running in real time on SDO/AIA 211 QKL data  
3 minute cadence, typical delay 15 minutes  
([view all Solar Demon detection tools](#))

## Last processed image:

0 hours and 23 minutes ago (2013-11-21 15:06:00 UTC)

## Last detected dimming:

3 hours and 29 minutes ago (2013-11-21 12:00:01 UTC)

## Filters (location)

-- [All locations](#)

[On-disc](#)

[Off-disc](#)

## Filters (intensity)

[All intensities](#)

-- [At least -66K](#)

[At least -200K](#)

[At least -600K](#)

## Filters (time)

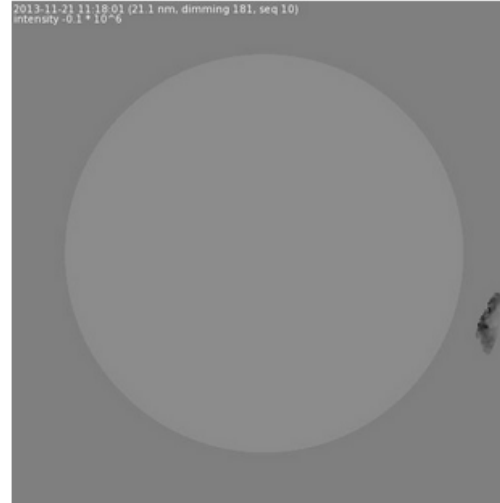
-- [Show all](#)

[Last week](#)

[Last 30 days](#)

[Last 365 days](#)

## Dimming 181



## Overview of dimmings

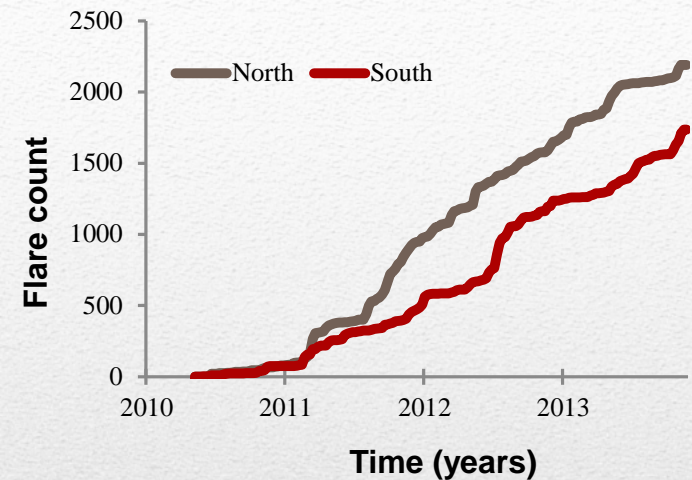
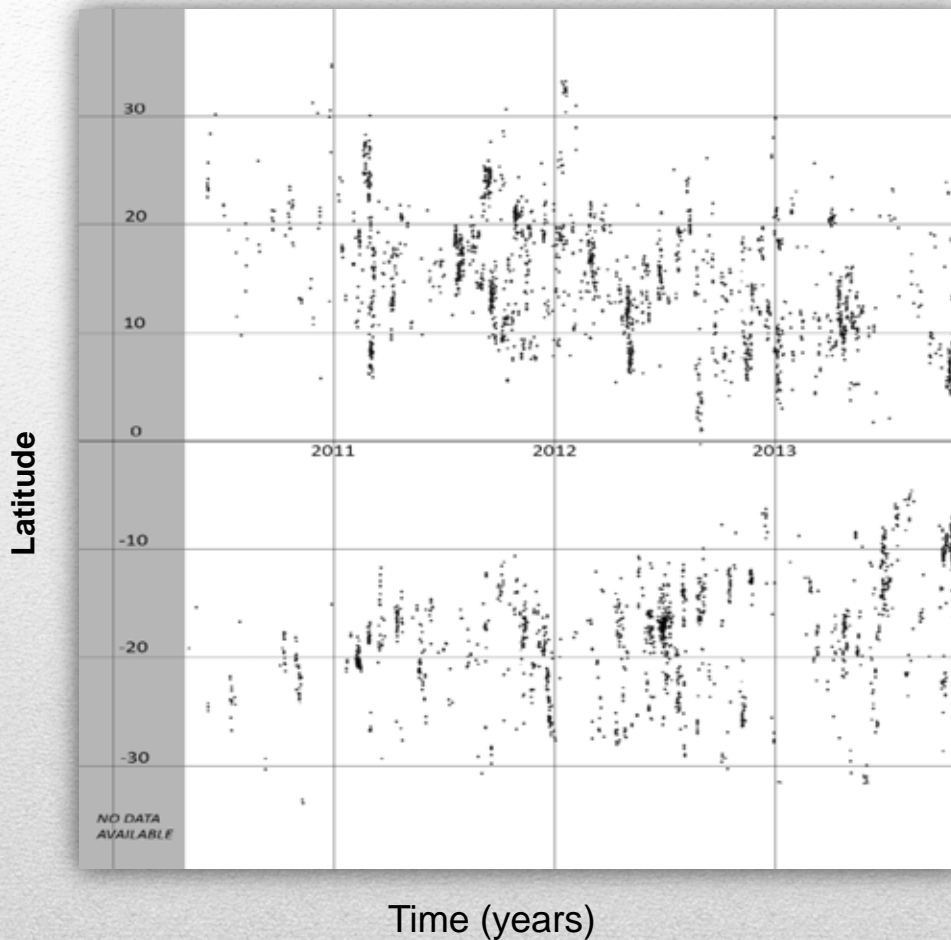
	intensity	start	peak	end	#	max detection	lat	lon	dist. R <sub>⊙</sub>	count	EUV wave
November, 2013											
21	-88	11:06	11:09	12:00	<a href="#">181</a>	6			1.16	24	
19	-366	10:27	10:36	11:42	<a href="#">173</a>	318			1.10	30	
17	-145	16:45	16:51	17:33	<a href="#">168</a>	8	17	-27	0.51	22	?
17	-146	12:57	14:00	14:15	<a href="#">167</a>	8	-7	38	0.64	32	?
17	-155	07:00	08:15	09:06	<a href="#">165</a>	28	-22	47	0.80	48	?
16	-289	08:00	09:06	09:33	<a href="#">158</a>	11	-11	1	0.24	33	?
11	-145	21:06	21:24	22:03	<a href="#">150</a>	6			1.06	25	
10	-686	05:15	05:24	06:27	<a href="#">147</a>	307	-24	15	0.51	30	?



# Monitoring Cycle 24

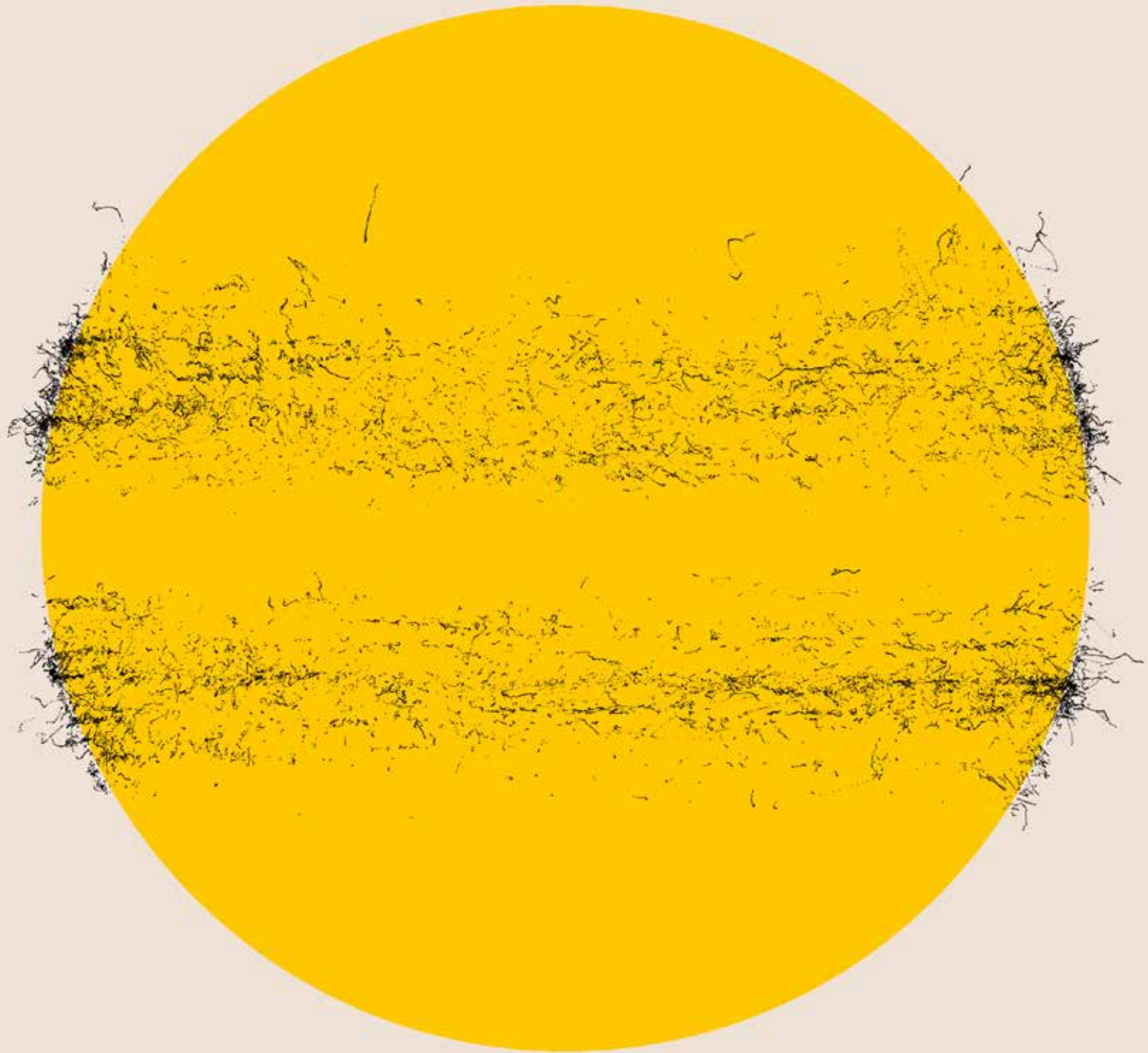
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Cumulative count of flares for the northern and southern hemisphere (May 2010 up to and including October 2013)

“Butterfly” diagram displaying the Stonyhurst latitude of all detected flares since May 2010.





Questions?

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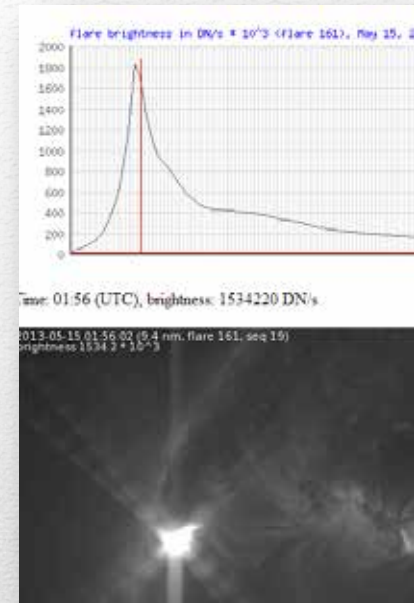




Backup slides

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- SDO/AIA 9.4 nm images, detect bright changes
  - Running differences and thresholded original images
- Can detect multiple flares occurring at the same time in separate locations
- No macro-pixels, *very accurate* location
- If a flare peaks ‘again’, the event is split
- GOES flux/flare class is estimated using the brightness of the flare
  - Also the original GOES 0.1-0.8nm flux is shown on the website (extracted from the STAFF database)

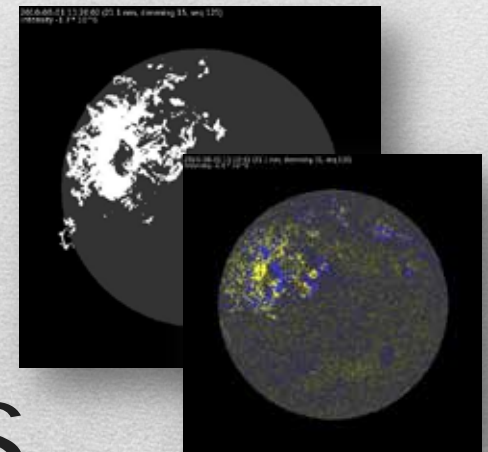
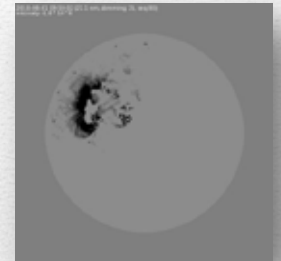


June, 2013										
21	M4	02:36	03:27	04:30	202	-14	-73	0.97	406.2	292.0
7	M5	22:39	22:54	01:09	247			1.03	563.1	597.0
5	M1	08:24	09:12	10:27	242	+31	59	0.87	118.9	131.0
3	M1	07:12	07:33	08:24	239	+32	25	0.63	102.3	95.0
May, 2013										
31	M1	19:57	20:03	20:30	235	12	-43	0.71	188.5	105.0
22	M5	12:42	13:45	16:42	202			1.01	500.9	N/A
20	M1	15:04	15:06	15:16	191	13	9	0.30	114.1	97.0
20	M2	05:00	06:02	07:02	186			1.03	214.3	not
17	M3	08:46	09:02	13:16	166	12	-36	0.64	330.5	321.0
16	M1	21:40	22:02	22:58	166	11	-41	0.69	123.2	131.0
15	X2	01:20	01:32	06:38	161	12	-71	0.95	2,368.2	1,290.
14	X3	00:04	01:14	05:38	155			1.01	3,066.1	3,230.
13	X1	14:02	16:14	21:58	149	11	-83	1.02	1,782.9	2,860.
13	X1	02:00	02:24	06:56	141			1.04	1,319.7	1,750.

# Detecting Flares



- Event detection on running difference images
  - Detect intensity changes on a 6-minute timescale
- Event characterization using base difference image from before the event was detected
  - Track intensity changes during event
  - differential derotation
    - limb brightness correction
- Only one event is active at a time
  - If multiple dimming events occur close by in time or space, it is considered to be the same event
  - Dimming mask will include this new dimming!
- Dimming masks become noisy over time
  - Difficult to track events accurately for a long amount of time



# Detecting Dimmings