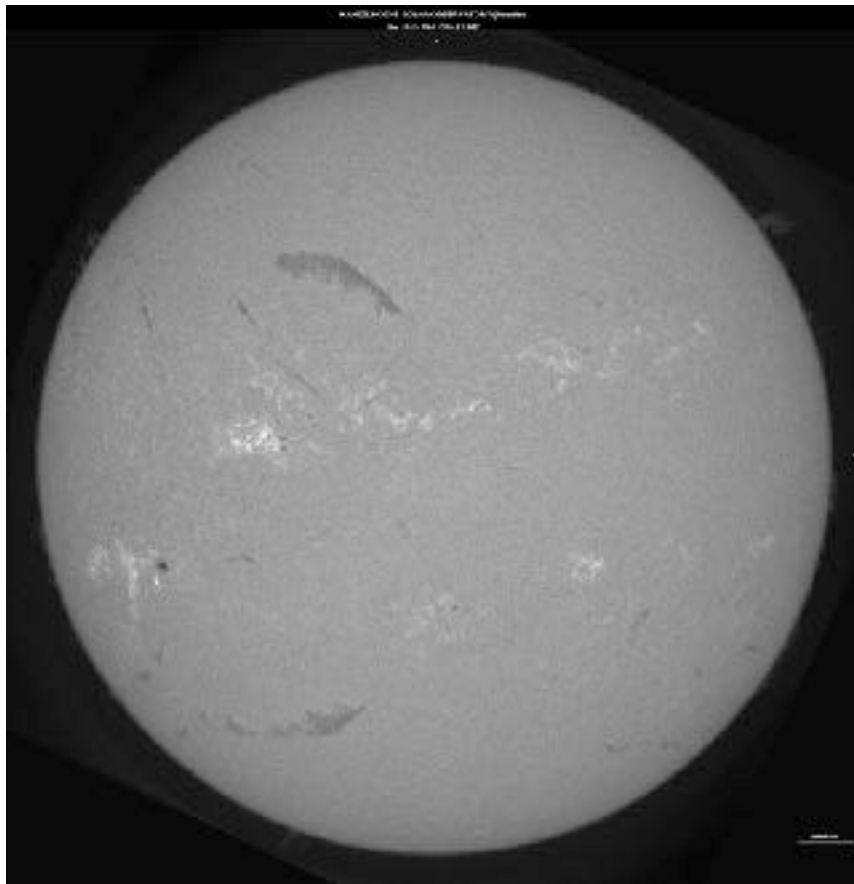


Solar (Data) Explosion: Challenges in Using Large Astrophysical Imaging Data Sets

Kathy Reeves, Harvard-Smithsonian Center for
Astrophysics

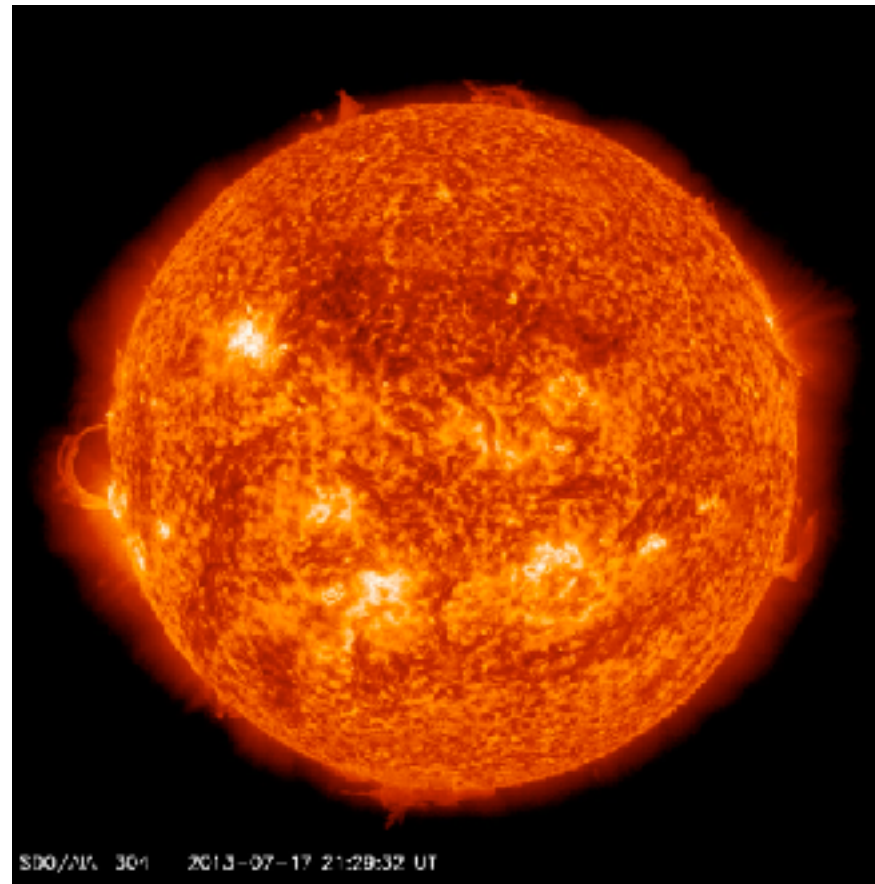
Data sources



H-alpha data

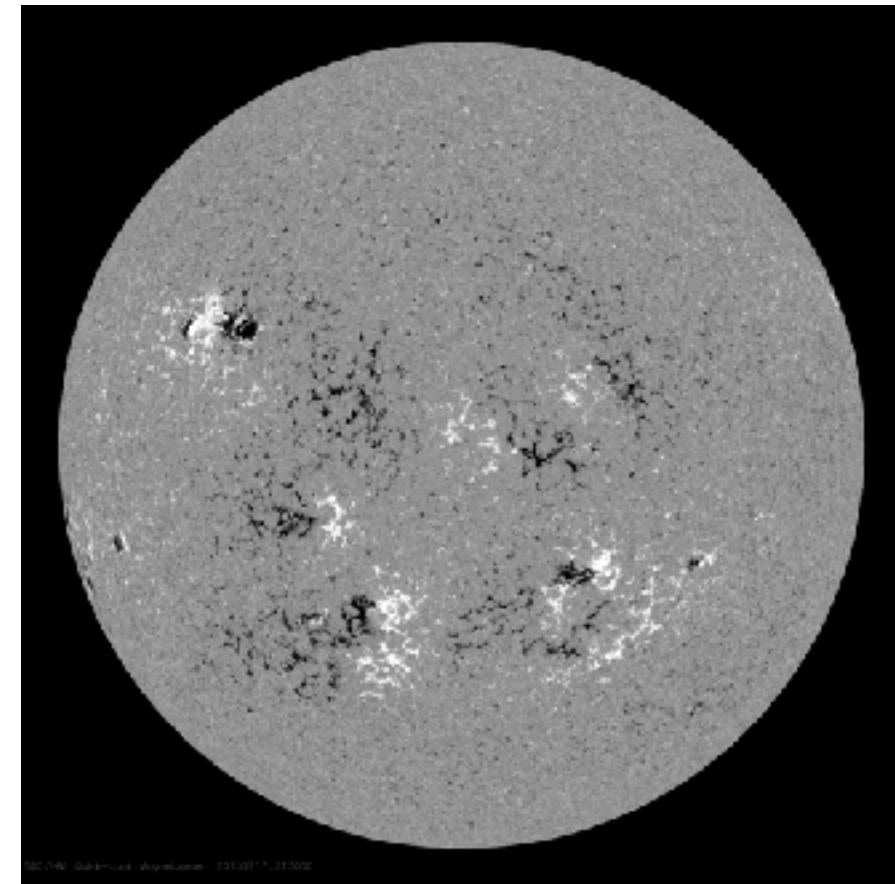
- Big Bear Solar Observatory
- Kanzelhöhe Solar Observatory

Global H-alpha
Network



Extreme ultraviolet data

- Atmospheric Imaging Assembly (AIA)

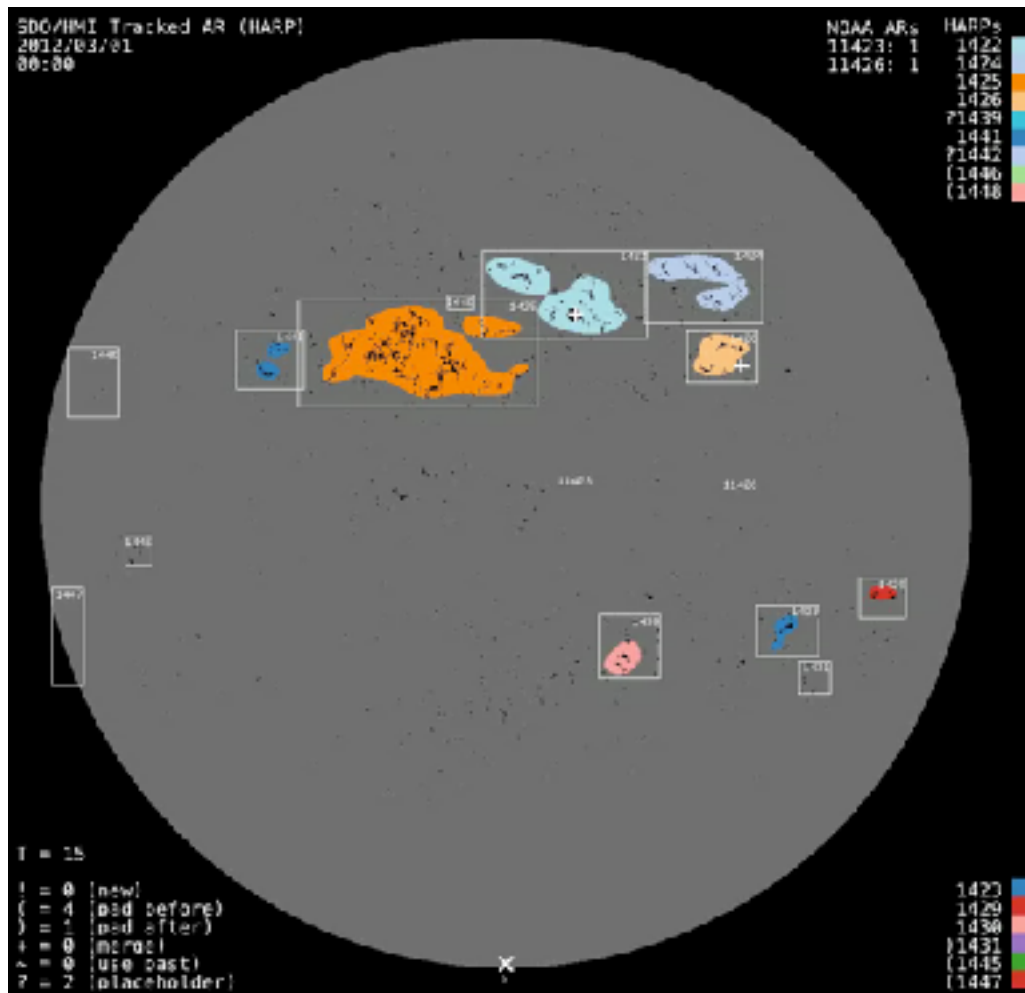


Magnetic field data

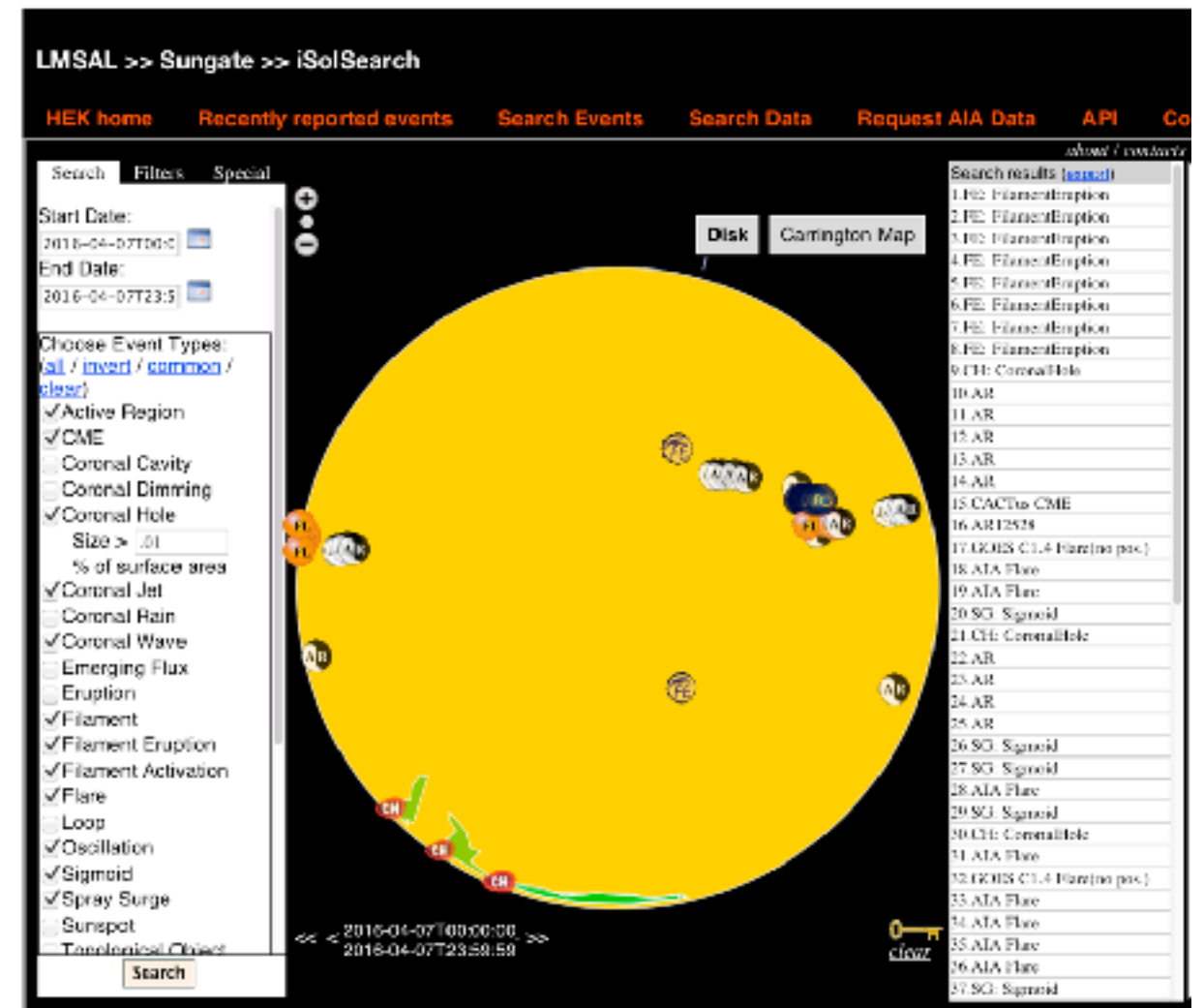
- Helioseismic and Magnetic Imager (HMI)

Solar Dynamics
Observatory (SDO)

Meta-data sources



Spaceweather HMI Active
Region Patch (SHARP)
[http://jsoc.stanford.edu/doc/
data/hmi/sharp/sharp.htm](http://jsoc.stanford.edu/doc/data/hmi/sharp/sharp.htm)



Heliophysics Event Knowledgebase
<https://www.lmsal.com/isolsearch>

Meta-data sources



SPACE WEATHER PREDICTION CENTER
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Thursday, May 14, 2020 17:45:01 UTC

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SOLAR AND GEOPHYSICAL EVENT REPORTS

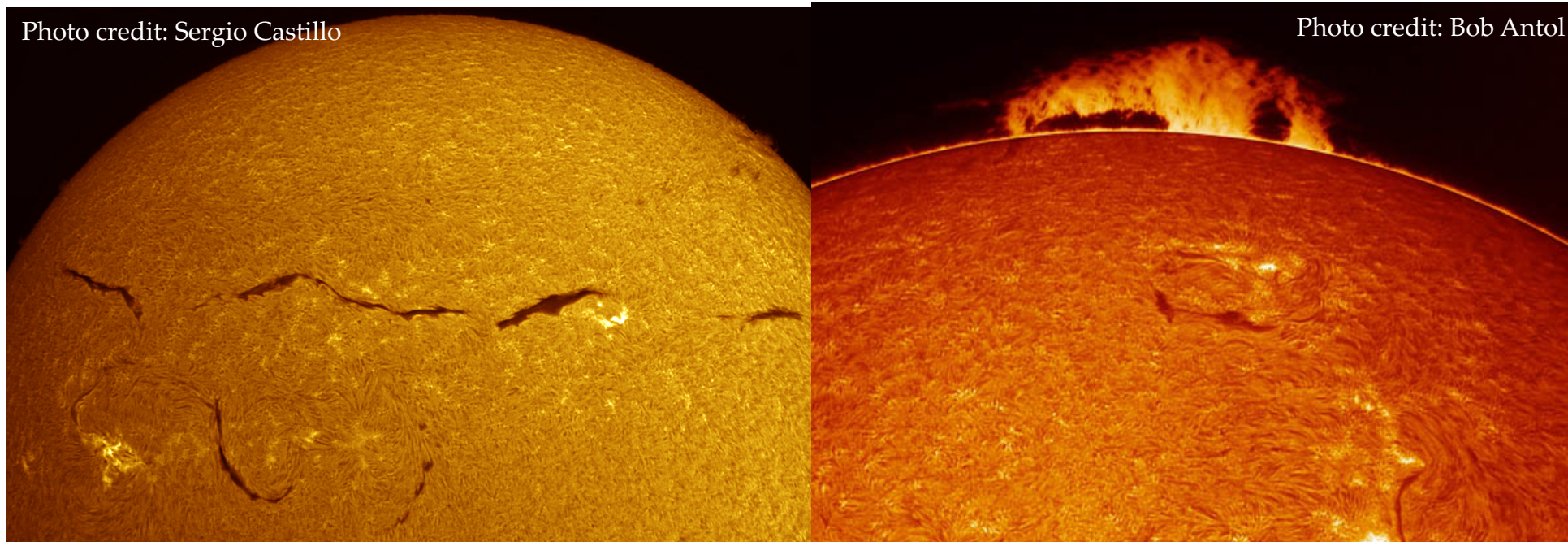
```
:Product: 20140107events.txt
:Created: 2014 Jan 10 0332 UT
:Date: 2014 01 07
# Prepared by the U.S. Dept. of Commerce, NOAA, Space Weather Prediction Center
# Please send comments and suggestions to SWPC.Webmaster@noaa.gov
#
# Missing data: ////
# Updated every 30 minutes.
#
# Edited Events for 2014 Jan 07
#
#Event   Begin   Max     End  Obs  Q  Type  Loc/Frq  Particulars  Reg#
#-----
```

8590	0000	0040	0323	LEA	G	RNS	245	150		
8670	0000	////	1054	LEA	C	RSP	025-180	IV/2		
8670	0006	////	1054	LEA	C	RSP	025-180	VI/1		
8560	0229	0234	0239	G15	5	XRA	1-8A	C2.6	1.1E-03	1944
8560	0232	0232	0244	LEA	3	FLA	S14E18	SF	ERU	1944
8570	0349	0353	0356	G15	5	XRA	1-8A	M1.0	2.7E-03	1946
8570	0350	0351	0404	LEA	3	FLA	N07E08	1N	ERU	1946
8570	0351	0351	0351	LEA	G	RBR	4995	100		1946
8570	0351	0351	0351	LEA	G	RBR	8800	110		1946
8580	0408	0411	0416	G15	5	XRA	1-8A	C2.7	8.9E-04	1944
8580	0409	0410	0421	LEA	3	FLA	S10E13	SF	ERU	1944
8600	0440	0453	0520	G15	5	XRA	1-8A	C2.4	4.8E-03	1944
8600	0442	0448	A0453	LEA	3	FLA	S09E13	SF	ERU	1944

- Curated by an observer
- Can be updated at a later date

Challenges: Classification

- **Same or similar phenomena can sometime have different names**
 - **Classic example: filaments vs. prominences**
 - **See also: jets, surges, microflares**



Challenges: Database cleaning

- **Meta databases use different algorithms to identify different features**
 - **Sometimes algorithms can fail in opposite directions**
 - **Example: HEK undercounts filaments (especially in active regions) but overcounts sigmoids**
- **Meta databases often record instances of the same object over and over as it rotates across the solar disk**
 - **Tracking is not straightforward, since objects can evolve, split, appear and disappear**
 - **Kempton & Angryk tracking work for solar features**
- **Meta databases sometimes record multiple instances of the same event from different data sources**
 - **Example: flares HEK records instances from AIA, GOES, IRIS**
- **Propagation of mistakes from original sources**
 - **Example: SWPC Solar Event Report is a common source for flares, but it is human-maintained and sometimes errors enter in to the report. They are often corrected, but may not propagate to other meta databases.**

Challenges: Completeness and Consistency

- **Solar conditions or ground-based weather can limit detection of some events during some time periods**
 - **Example: During active times, background flux in GOES limits the detection of smaller events**
- **Some meta databases use human observers**
 - **Different observers will record non-standard inputs to meta database**
 - **Example: HEK filament eruptions bounding boxes**
 - **Human observers may not record all events**

Challenges: Calibration & Instrumentation

- **Some events are recorded using different instruments with different characteristics**
 - **Example: Filaments in HEK come from Big Bear and Kanzelhöhe Solar Observatories, which have different spatial resolutions, causing the algorithm to calculate different lengths for the same filament**