Interactive Multi-Instrument Database of Solar Flares

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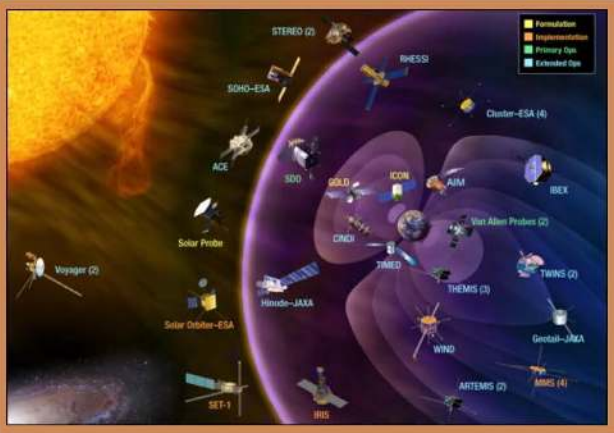
Solar Flare Observatories

Many ground-based and space-based instruments detect and observe solar flares in an attempt to understand underlying physical mechanisms (Illustration: NASA).



Project Description

The fundamental motivation of the project is that the scientific output of solar research can be greatly enhanced by better exploitation of the existing solar/heliosphere space-data products jointly with ground-based observations.

Our primary focus is on developing a specific innovative methodology based on recent advances in "big data" intelligent databases applied to the growing amount of high-spatial and multi-wavelength resolution, high-cadence data from NASA's missions and supporting ground-based observatories.

Our flare database is not simply a manually searchable time-based catalog of events or list of web links pointing to data. It is a preprocessed metadata repository enabling fast search and automatic identification of all recorded flares sharing a specifiable set of characteristics, features, and parameters.

The result is a new and unique database of solar flares and data search and classification tools for the Heliophysics community, enabling multi-instrument/multi-wavelength investigations of flare physics and supporting further development of flare-prediction methodologies.

Launch Solar Flare Query Page

Query Page
Retrieve solar flare events using a variety of event-based and instrument-based filters

Data Sources
A description of sources for background and event data

Data Products
A description of some of the special data products used in this site's source catalog

Acknowledgements
Contributing instruments and observatories, and researcher contact information

Curator: Ryan Spaulding
NASA Official: Nagi Mansour

Query Page

Please visit the **help page** for tips and a video on how to use this query tool.

Upload Previous Query: Browse... No file selected. Upload

Time Interval (available Jan 01, 2002 to present):

From: Year 2002 Month 01 Day 01 Hours 00 Minutes 00 Seconds 00

To: Year 2018 Month 01 Day 24 Hours 00 Minutes 00 Seconds 00

List of Active Filters:

- [x] **Position Box Filter**
  - X coord: from -1100 arcsec to 1100 arcsec
  - Y coord: from -1100 arcsec to 1100 arcsec
- [x] **Limb Flare Filter**
  - Threshold distance from the Solar limb: 200 arcsec
  - *(Note: currently Solar radius is assumed to be 975 arcsec without annual variations.)*
- [x] **Center Flare Filter**
  - Distance from the Solar center: 400 arcsec
  - *Note: currently Solar radius is assumed to be 975 arcsec without annual variations.)*
- [x] **Active Region Filter**
  - From: 0 to: 15000
- [ ] **Display Instrument-Based Filters**

Submit

Background Data Sources

1) GOES X-ray Flux

http://satdat.ngdc.noaa.gov/sem/goes/data/new_full/
https://umbra.nascom.nasa.gov/goes/fits/

Available for: January, 2002 - current

- The 2s cadence X-ray flux received by GOES/XRS is used as the background data in the project. The fluxes in two channels (1-8 A and 0.5-4 A) are displayed.
- Currently the events are displayed in front of this data, which helps to find reflection of different events in soft X-ray activity of the sun.
- Additionally, it is possible to display Temperature and Emission measure graphs calculated from GOES data in the single-temperature approximation.

2) SDO/EVE ESP Data

http://lasp.colorado.edu/eve/data_access/evewebdata/products/level1/esp/

Available for: February, 2010 - current

- For better presentation of the data, there is a 10-second averaging applied to the ESP/EVE curves.
- The curves are available for the whole instrument operational period and are updated daily.

3) Nobeyama Polarimeter Light Curves

ftp://solar-pub.nao.ac.jp/pub/nsro/norp/xdr/
Available for: January, 2010 - current

- The Nobeyama polarimeter data, as well as ESP/EVE data, are averaged every 10 seconds.
- The curves are available starting from January 01 2010 and are updated daily.

Databases of Events

1) GOES flare list

ftp://ftp.swpc.noaa.gov/pub/warehouse/
https://umbra.nascom.nasa.gov/goes/fits/
Available for: January, 2002 - current

- The GOES daily flare lists represent the events registered by GOES satellite. Currently only X-Ray activity events are considered.
- It is possible to search for GOES events based on their physical characteristics, as Temperature and Emission Measure in single-temperature approximation, and their class.

2) HEK register flare list

https://www.lmsal.com/isolsearch
Available for: February, 2010 - current

- The HEK register was developed to help with browsing the SDO/AIA telescope data. The catalog contains reports about the activities in different segments of the solar disk.
- Users can search based on peak flux and the AIA channel of the observed events.

Data Products

1) List of Cold Flare Candidates

The following list cannot be created using the query engine, but is generated from GOES and RHESSI flare lists stored in our database.

Selection Procedure:

1. The RHESSI flare list is searched for all events having the highest energy band with observable flare signal equal to 100-300 keV. The considered time period is Feb. 11, 2010 – Feb. 22, 2016.
2. The GOES flare lists are searched to find the corresponding GOES event.

3. If the GOES flare occurs with some delay (GOES event start time is later than the RHESSI event start time), the event becomes selected as a Cold Flare Candidate. If not, the event is removed from the list.

Here is the final list of the Cold Flare Candidates.

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2) List of the T-EM complemented GOES flares

Creation procedure:

1. Instead of the standard GOES flare descriptors, the file provides the Temperature and Emission Measure calculated in one-temperature approximation (Thomas et al., 1985, Solar Physics, 95, 323).
The values, as well as their error bounds, are computed from GOES X-ray fluxes using TEBBS (Temperature and Emission measure-Based Background Subtraction algorithm; Ryan et al, 2012, ApJS, 202, 11).

The GOES temperature response functions for different satellites may be found in the Appendix of (White et al., 2005, Solar Physics, 227, 231, GOES 1-12 only) and in the SSWIDL GOES software routines (updated by White, S.)

2. Please find the corresponding daily updated TEBBS output file.

3. The TEBBS code GitHub repository is available at https://github.com/vsadykov/TEBBS.git .

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We also thank the teams managing the currently used catalogs (GOES, RHESSI, Hinode, Fermi GBM, Konus-WIND, OVSA flare catalogs, Filament eruption catalog, CACTus CME catalog and Heliophysics Event Knowledgebase) for the possibility to work with their data.

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Key Contacts

Viacheslav Sadykov

Ph.D Student in Physics, New Jersey Institute of Technology

email: vsadykov@njit.edu

Rishabh Gupta

Master's Student in Computer Science, New Jersey Institute of Technology

email: rg388@njit.edu

Dr. Gelu Nita

Research Professor, Center for Solar-Terrestrial Research, New Jersey Institute of Technology

email: gnita@njit.edu

Dr. Alexander Kosovichev

Professor, Department of Physics, New Jersey Institute of Technology
Research Scientist, NASA Ames Research Center

email: sasha@bbso.njit.edu

Dr. Vincent Oria

Professor, Computer Science Dept., New Jersey Institute of Technology

email: vincent.oria@njit.edu

Help Notes

How to Make the First Query

1. Select the time interval, coordinate range and active regions-of-interest. By default, the entire time period from January 01, 2002 to the present date is set, and all possible coordinates and active regions are included.
2. Click "Display Instrument-Based Filters". The list of available catalogs and filters will appear.
3. Select the instrument-based filters. Click the checkbox next to the intrument/catalog name to activate the filters for that instrument/catalog. Then set up the filters of interest. The active filters appear in the "List of Active Filters" field on top of the query form.
4. Click "Submit" button. The table of events satisfying the selected filters appears. One can scroll the table, sort it based on a particular column, or save the query results to the file.
5. Select the event of interest from the table, and click the "Plot Data" button. The new page with the event details appears. You can look at the light curve graphs, verify the observational coverage of the selected event, and find similar events.

How to Upload the Saved Query Result

1. Click the "Choose file" button in the "Upload Previous Query" field.
2. Click the "Upload" button to push the selected file to the server.
3. Click "Submit" button. Now you can work with the received table.

For more help, please view this video.

Questions and Answers

How to select the events from one catalog having no counterparts in other catalog?

This cannot be done directly in the current implementation of the database. However, this search can be done in several steps by 1) querying all the events mentioned in the first catalog; 2) querying all the events mentioned in the first and second catalogs simultaneously; 3) subtracting the results of the second query from the results of the first query.

Is it possible to query the CMEs not associated with the flares?

Sorry, we do not currently provide such an option.

What expansion of the IRIS field of view is suggested to use?

Based on personal experience, we suggest that users expand the IRIS FOV by 100 arcsecs. Positions of the GOES flares are often determined based on the active regions, and use of a smaller expansion may result in loss of some events of interest during the query.