A Short Overview of NASA Data Resources Relevant to Space Weather Research

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Topics

- The Overall Data Policy

- Three categories of data

- Finding and accessing NASA Heliophysics data

NASA's Data Policy

- NASA and specifically the NASA Heliophysics program have and enforce an open data policy

    – All operating science missions are required to make research-usable data publicly available in a timely manner

- And NASA Heliophysics funds both its missions and multiple multi-mission data centers / data services / data archives to ensure such data availability

NASA Heliophysics Operating Missions

Mission	Solar Remote Sensing	In-Situ Solar Wind	Magnetosphere Remote Sensing	In-situ Magnetosphere	ITM	Deep-space (remote sensing)	Deep-space (In-Situ)
SDO	x						
SOHO (with ESA)	x	x (particles only)					
RHESSI	x	x (particles only)					
STEREO	x	x					
ACE		x					
Wind		x					
TWINS			x				
THEMIS/ ARTEMIS				x	x (ground-based program)		
MMS				x			
TIMED	x (solar irradiance)				x		
AIM					x		
IBEX						x	
Voyager							x

Missions Supported in SPDF

ACE	Geotail	NOAA 5-19
AE	GOES 6-15	OGO 1-6
Alouette 1/2	GPS	Pioneer 6-11
AMPTE	~170 Ground-Based Obs	Polar
Apollo	Hawkeye	ROCSAT
Arcad	Helios 1/2	S-Cubed
Ariel	IBEX	SAMPEX
ATS 1-6	IMAGE	San Marco
~40 BARREL Balloons	IMP 1-8	Skylab
Cassini	INJUN	SNOE
Cluster	Interball	STEREO
CNOFS	ISEE 1/2/3/ICE	THEMIS/ARTEMIS
CRRES	ISIS1/2	TIMED
Cubesats	LANL 1989-2002	TWINS
DE 1/2	MAGSAT	Ulysses
DMSP	Mariner 4-9	Van Allen Probes
DSCOVR	Messenger	(RBSP)
Explorer 4-35	MMS	Voyager 1/2
FAST	New Horizons	Wind
Genesis		

Coming missions include ICON, GOLD, PSP and part of SO

Three Categories of Data

- For purposes of this presentation, probably useful to distinguish data based on the time between data being taken on a spacecraft and the time data are available for use on the ground

- Long-term research data products
  - Primary science outputs of the spacecraft and instruments
  - Calibrated and converted to physical units; often reprocessed as better calibrations and data reduction algorithms are perfected
  - Days to months between taking data and producing products, sometimes with very long delays for spacecraft using on-board storage to capture most-interesting and highest-resolution data and then gradually download to the ground as telemetry allows

- Near real-time data
  - Data downloaded and available within minutes to hours of time taken on spacecraft
  - Sometimes secondary (lower time and parameter resolution) data stream
  - Sometimes captured at cooperating partner sites worldwide

- "Quicklook" data
  - Preliminary science data for browse and science planning purposes but not intended as the basis for published research
  - Approximate calibrations, often not full time and parameter resolution
  - Fraction of a day to a few days between taking data and producing products

Research Data

- Most active NASA missions operate their own mission and instrument specific websites, including use information and direct data access

- Almost all important NASA Heliophysics mission research data resources can be found using the Heliophysics Data Portal/HDP (https://heliophysicsdata.gsfc.nasa.gov)
  - HDP allows e.g. searches by observatory (mission) group and observatory, by instrument, by time span and by measurement type
  - Includes mission, instrument and data product descriptions
  - Returns direct links to data sources and can invoke external data services for plots/listings

- The best source to identify and retrieve current and past solar data is the Virtual Solar Observatory/VSO (https://www.virtualsolar.org)
  - VSO supports searches by time, physical observable, instrument/source/provider, and spectral range
  - VSO supports finding and retrieving data via browsers or directly in SolarSoft.

- The Space Physics Data Facility/SPDF (https://spdf.gsfc.nasa.gov) holds and serves a wide range of non-solar NASA Heliophysics data
  - Including very recent research data, with online plot/listings/super-subset services
  - Includes s/c position database and Java-based 4D Orbit Viewer

Finding Heliophysics Data

Heliophysics Data Portal / HDP

Virtual Solar Observatory / VSO

Select NASA Near Real-Time Solar and Solar Wind Data

- SDO (reduced resolution solar images)
  - AIA solar images: Fe XVIII 94Å, Fe XX 131Å, Fe IX/X 171Å, FeXII 193Å, Fe XIV 211Å, He II 304Å, Fe XVI 335Å, Continuum+C IV 1600Å, Cont'm 1700Å, Cont'm 4500Å
  - EVE: Solar irradiances
  - HMI: Magnetogram and Intensitygram

- SOHO (coronagraph images)
 - LASCO C2: Coronagraph white light images

- ACE (solar wind at L1)
  - In-situ solar wind density, speed, temperature and vector magnetic field

- STEREO (Ahead) Beacon Data
  - SECCHI EUVI solar images in: 195A, 304A
  - SECCHI COR1 (inner) and COR2 (outer) coronagraphs
  - IMPACT: Solar wind plasma, magnetic field and energetic particles
  - WAVES: Solar radio waves and bursts

- Wind (solar wind at L1/backup source)
 - Depends on Wind tracking; ground processing presently under repair

Other NASA Near Real-Time and Quicklook Data

- Van Allen Probes
  - Wide range of field and radiation belt sample measurements
  - Electric and magnetic fields, waves, plasma and energetic particles
  - Few hours delays but not continuous; depends on partner groups for data capture

- MMS
  - Wide range of displays showing in turn a wide range of field and particle measurements
  - "Quicklook" in nature; typical time lag from real-time of 1-2 days

- THEMIS
  - Displays showing a wide range of field and particle measurements
  - "Quicklook" in nature; typical time lag from real-time of 1-2 days

- AIM, RHESSI, TIMED, TWINS and VOYAGER
  - Preliminary and definitive data are made public as they become available but time from data collection to first public data is typically at least weeks

Example NASA
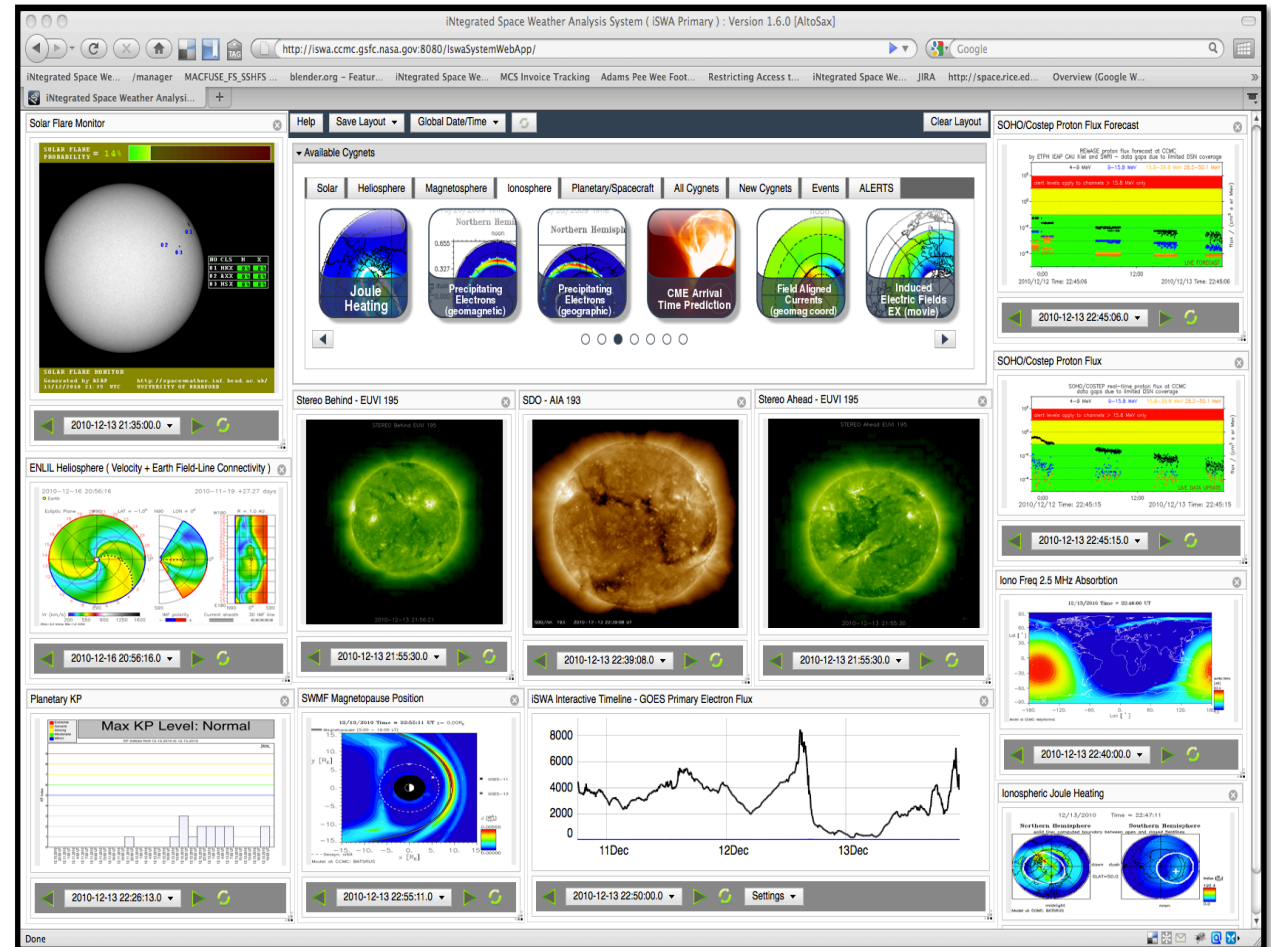# Near Real-Time Data
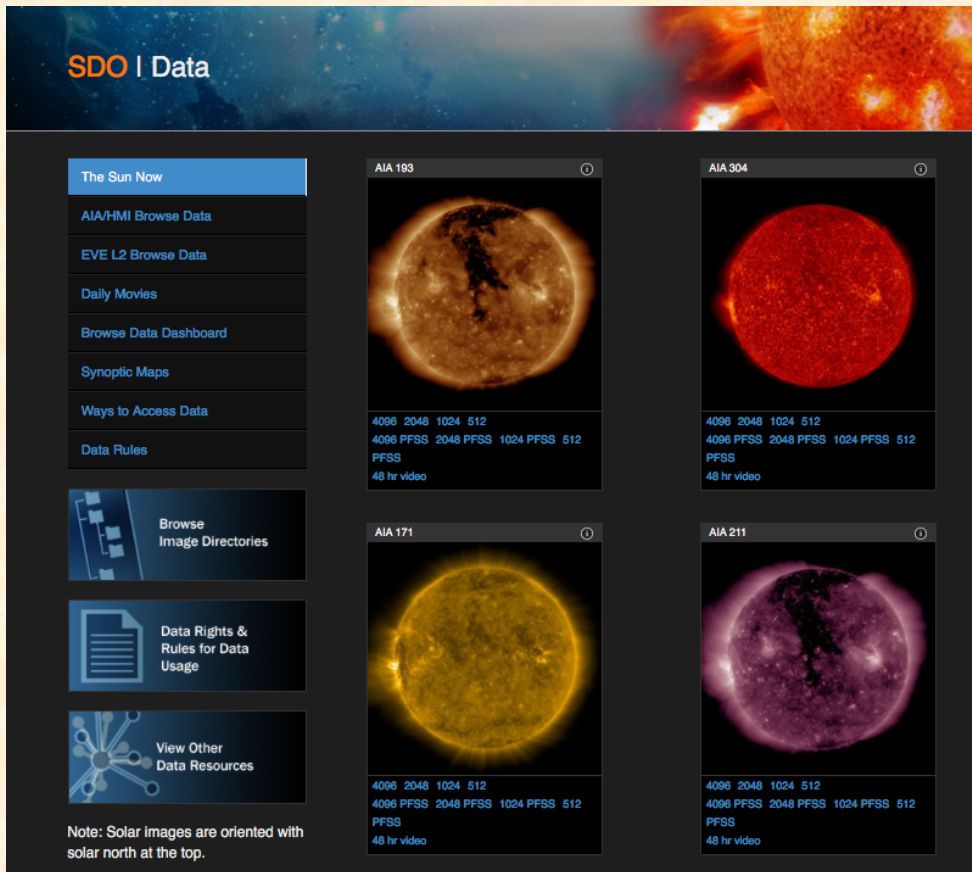
Solar Dynamic
Observatory / SDO)
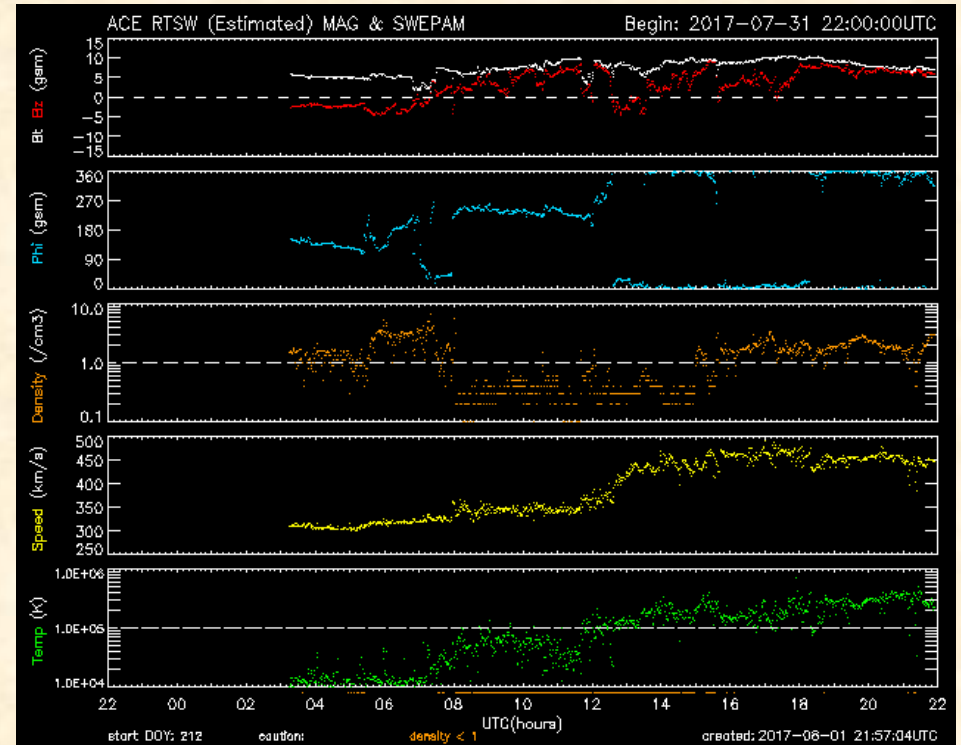
Advanced Composition
Explorer / ACE
(Also DSCOVR from
NOAA)

CCMC iNTEGRATED SPACE WEATHER ANALYSIS (iSWA) SYSTEM

- A number of these NRT data streams are available as iSWA "Cygnets"

  – iSWA combines forecasts based on space weather models with concurrent space environment information (https://ccmc.gsfc.nasa.gov/iswa/)

  – Both direct web and mobile app interfaces

http://iSWA.ccmc.gsfc.nasa.gov

NRT and Quicklook Data URLs

SDO	https://sdo.gsfc.nasa.gov/data/
SOHO	https://soho.nascom.nasa.gov/data/realtime-images.html
ACE	http://www.swpc.noaa.gov/products/ace-real-time-solar-wind
STEREO	https://stereo.gsfc.nasa.gov/spaceweather/spaceweather.shtml
Wind	https://pwg.gsfc.nasa.gov/windnrt
Van Allen Probes	http://rbspgway.jhuapl.edu/rPlotTime?sw
MMS	https://lasp.colorado.edu/mms/sdc/public/quicklook/
THEMIS	http://themis.ssl.berkeley.edu/summary.php?
CCMC/ISWA	https://ccmc.gsfc.nasa.gov/iswa/
SWPC (NOAA)	http://www.swpc.noaa.gov
SolarSoft	http://www.lmsal.com/solarsoft/last_events/
Solar Monitor (ESA)	https://solarmonitor.org
Helioviewer	https://www.helioviewer.org

LANCE (NRT Earth Data)

https://earthdata.nasa.gov/earth-observation-data/near-real-time/download-nrt-data