

NOAA's QuickPUNCH Project

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NOAA Organization



National Weather Service



Space Weather
Prediction Center

National Environmental
Satellite, Data, and
Information Service

National Centers for
Environmental Information

Office of Projects,
Partnerships, and Analysis
(Space Weather Office)

Office of System
Architecture and Advanced
Planning

NOAA Organization



- Develop and maintain data pipelines
- Calibration and trending

National Centers for
Environmental Information

Office of Projects,
Partnerships, and Analysis
(Space Weather Office)

- Forward looking analysis on NOAA capabilities and assets

- Produces space weather forecasts
- Develop forecasting tools

Space Weather
Prediction Center

NOAA needs a Coronagraph

- Currently, SPWC is solely reliant on SOHO/LASCO/C3 data for CME identification and tracking
- Given the critical nature of coronagraph data in the forecasting system, NOAA has been active in preparing for post-SOHO era (current estimate is LASCO will turn off Dec 2025)
- Since 2018, NOAA has been preparing to commission their own coronagraphs
 - Two instruments, built by NRL, on GOES-U (geostationary) and SWFO-L1 (Sun-Earth Lagrange Pt 1)

Gap Mitigation Strategy

- Internal NOAA study in 2019 identified critical gaps in space environment observations
- How else can we detect CMEs?:
 - Using NOAA assets: off-point one of the Solar UltraViolet Imagers (GOES-R series)
 - Using NASA assets: STEREO-A and **PUNCH**
 - Looking ahead: Aditya or ESA Vigil

What is QuickPUNCH?

- Study to produce “proof of concept” deliverables: can SWRI deliver data to SWPC that meet operational requirements?
 - Processing Latency
 - Data reliability
 - Calibration quality
 - Compatibility with SWPC tools
- Contingency: The bottleneck is the downlink schedule. If SWPC needed to rely on PUNCH data, is there a way to reduce the total data latency and meet reliability requirements?

QuickPUNCH Data Specification

- **NFI**

- 5.4-32 Rs FOV, 1024x1024 px, 4 minute cadence, total brightness

- **WFI mosaic**

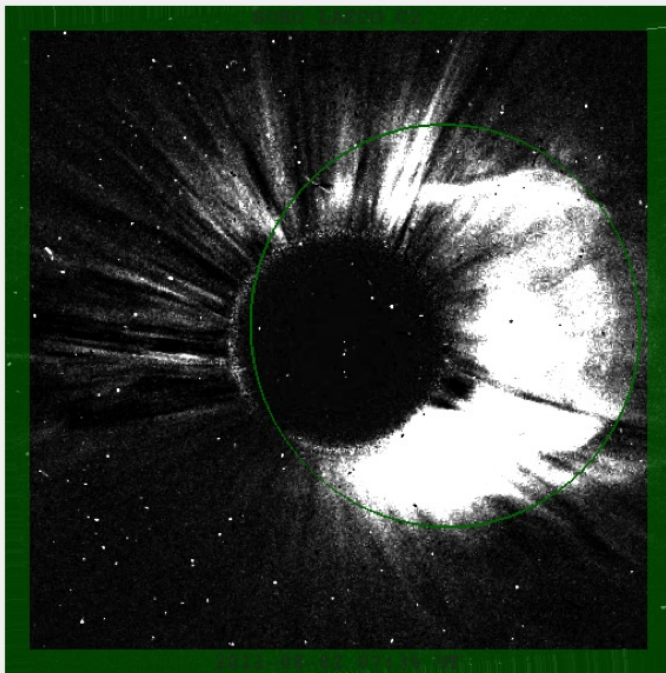
- 5.4-80 Rs FOV, 1024x1024 px, 8 minute cadence, total brightness

- Data are produced by the PUNCH Data Center

- Latency to not exceed 2 hour from data arriving at ground station
- Data are not proprietary to NOAA

How is coronagraph data used at SWPC?

- Stack of images converted to fixed difference movie in CAT tool
- The CME shape in each image is fit to a cone
- A linear fit is calculated for the radial expansion of the cone
- Output: eruption start time, lat./lon. of CME base, expansion angle, velocity
- CME parameters are feed into a heliosphere model (WSA-Enlil) to propagate CME to Earth: impact or no-impact?
- Heliosphere models are updated every two hours and propagate ten days into the future



START / END TIMES

Start [Y M D H M]
 2011 8 1 12

End [Y M D H M] [+12h] [+24h]
 2011 8 2 12 0

Load Images

ANIMATION CONTROLS

L C R

Play

Speed Altern8

IMAGE ADJUST

L C R

Stretch Bottom

Stretch Top

Gamma Correction

image saturation value

Reset

<- Copy to L Copy to R ->

CME CONTROLS

Latitude

Longitude

Angular Width (2 omega)

Radial Distance (delta)

Transparency

CME Parameters

θ : 8.5

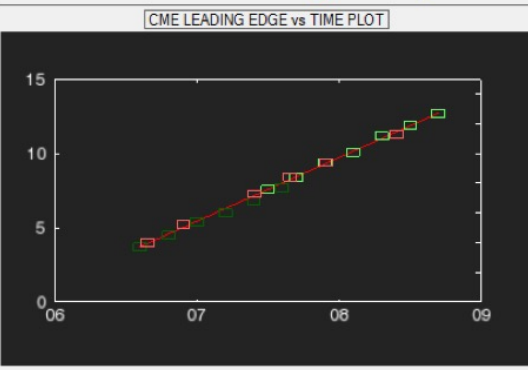
ϕ : 26.2

2ω : 108.0

δ : 3.7

Transparency

Bernoulli



ENLIL PARAMETERS

T 2011-08-02 10:44

Lat 9

Lon 26

Cone 54

Vel 827

Calculate Velocity

Export Analysis

Reset Analysis

Where do we go from here?

- Can WFI data be a high-impact tool for forecasting?
- Can polarization information be exploited for forecasting?
(Matt West)
- Observations are leading the models. What is the next detail of CME (or solar wind) structure that is important to incorporate into forecasting models?

WSA-Enlil Pipeline

➤ Runs on WCOSS every 2 hours

- Forecasters get results 2 hours after run initiated

➤ Starts with the most recent photospheric magnetogram

- Currently GONG zero-point corrected
- Soon to be replaced by 12-member ADAPT/GONG ensemble

➤ WSA model for ambient wind

- PFSS/SCS B
- semi-empirical expressions for v , density, T , P
- 1 - 21.5 R_{sun}
- IC for Enlil as Lower BC, then relaxed for 10 days

➤ CMEs superposed on ambient wind

- Spherical pressure pulses at 21.5 R_{sun} based on CAT Cone fits
- Propagated with Enlil to 1AU

