Automated Flux Recognition with SDO-EVE-SAM Images

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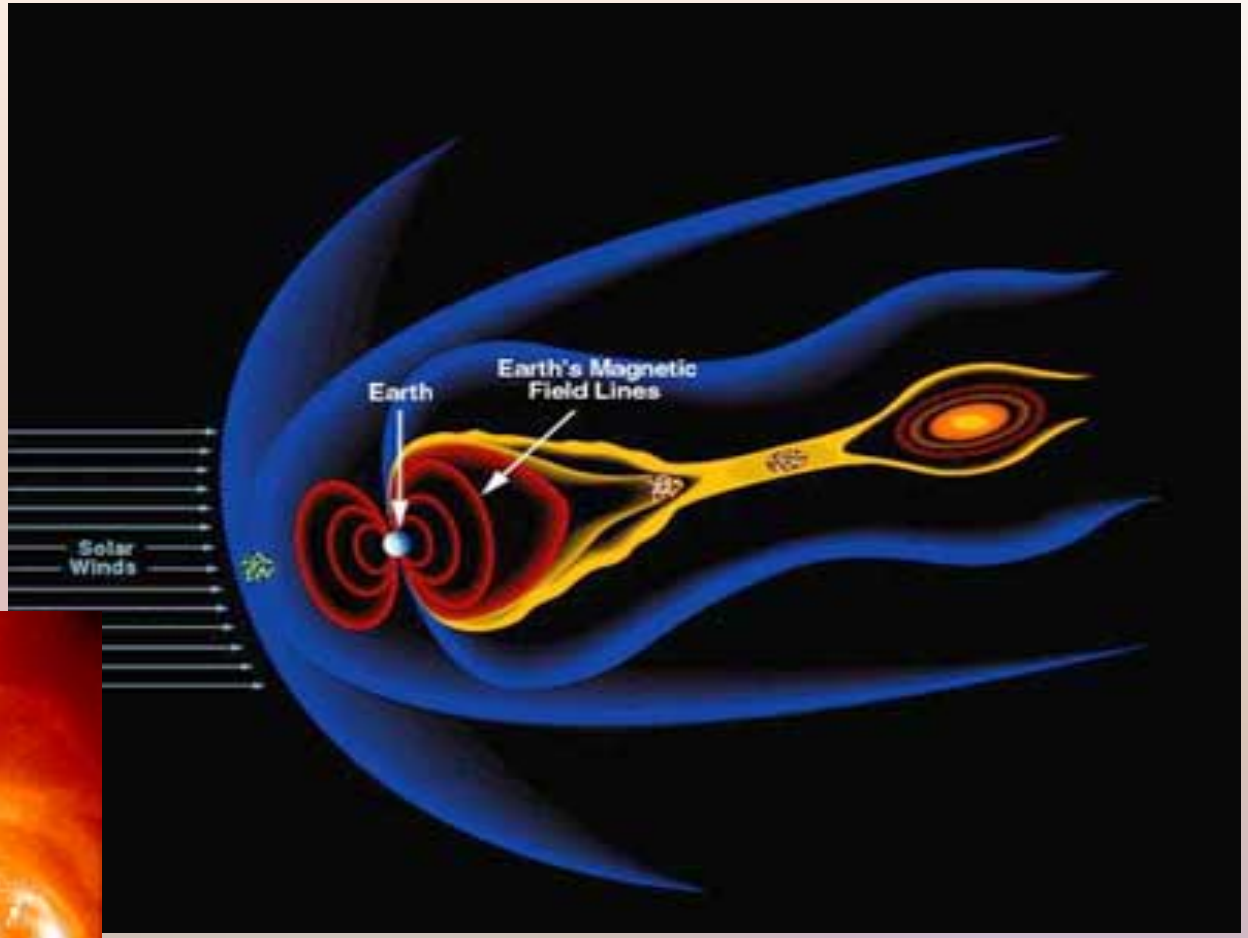
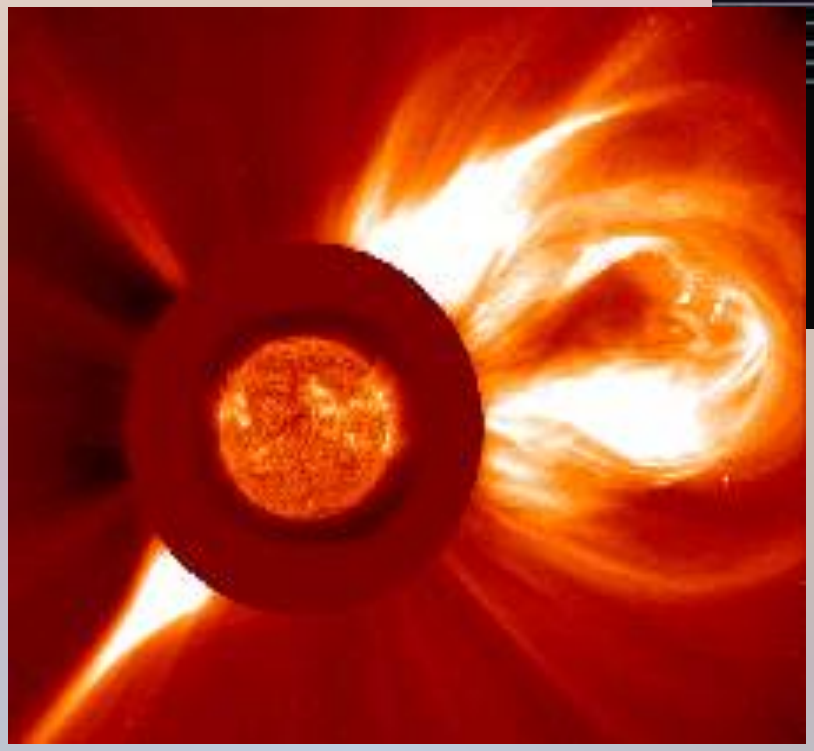
Space Weather



Earth's Magnetosphere



Coronal Mass Ejection

These particles can…

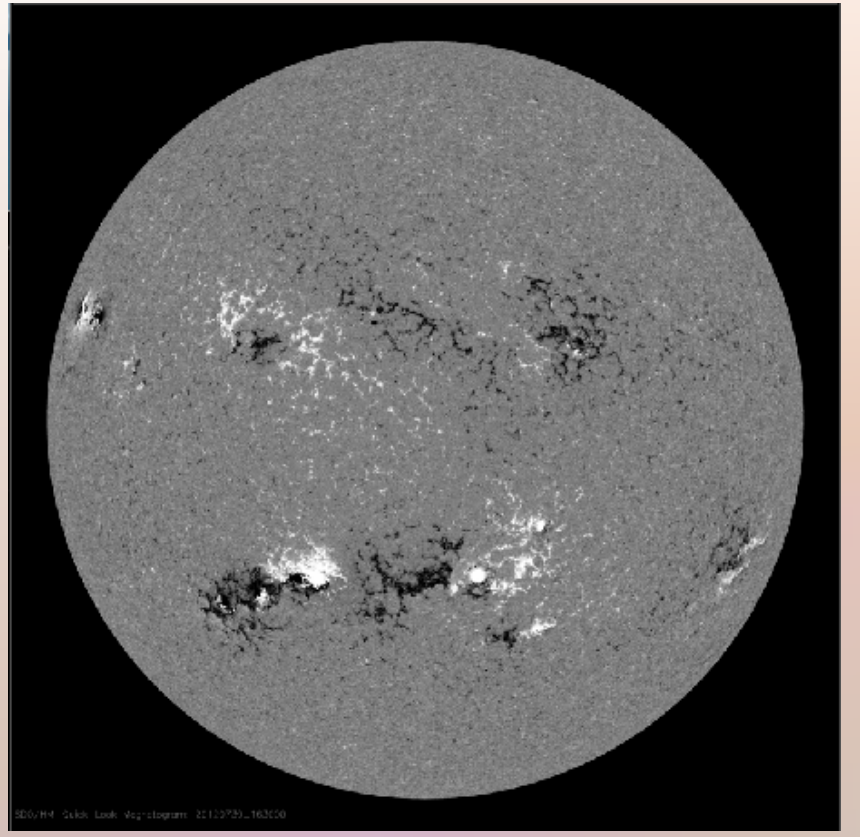
-- Cause satellite computer and memory upsets and failures

-- Scintillate satellite signal

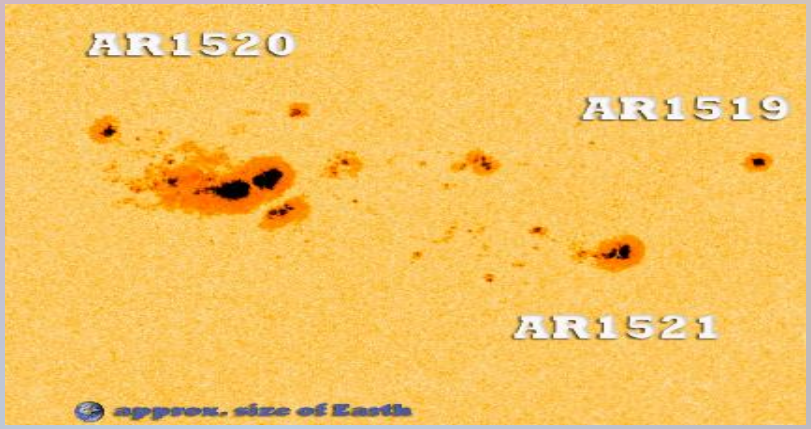
-- Interfere in high frequency communication (3-30 MHz)

-- Disrupt navigation systems

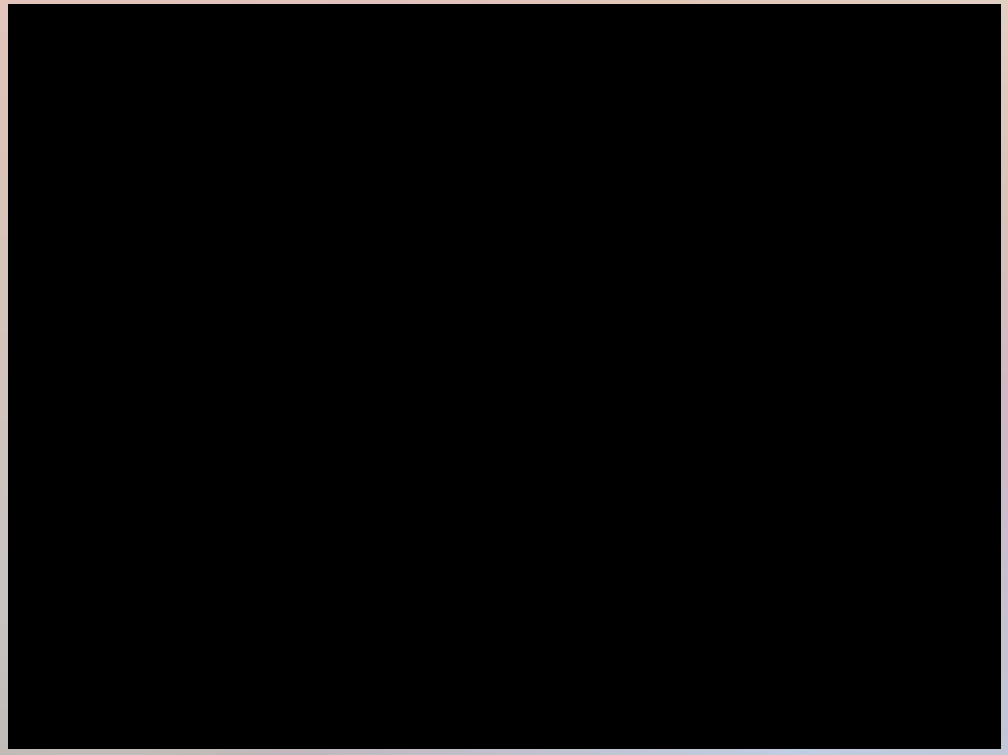
Emergent X-Ray Flux



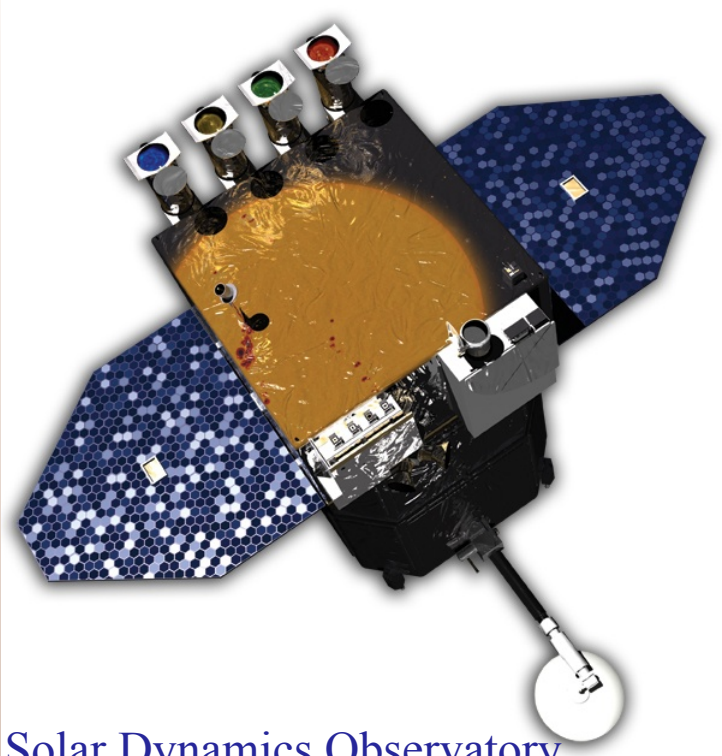
SDO – Helioseismic and Magnetic Imager



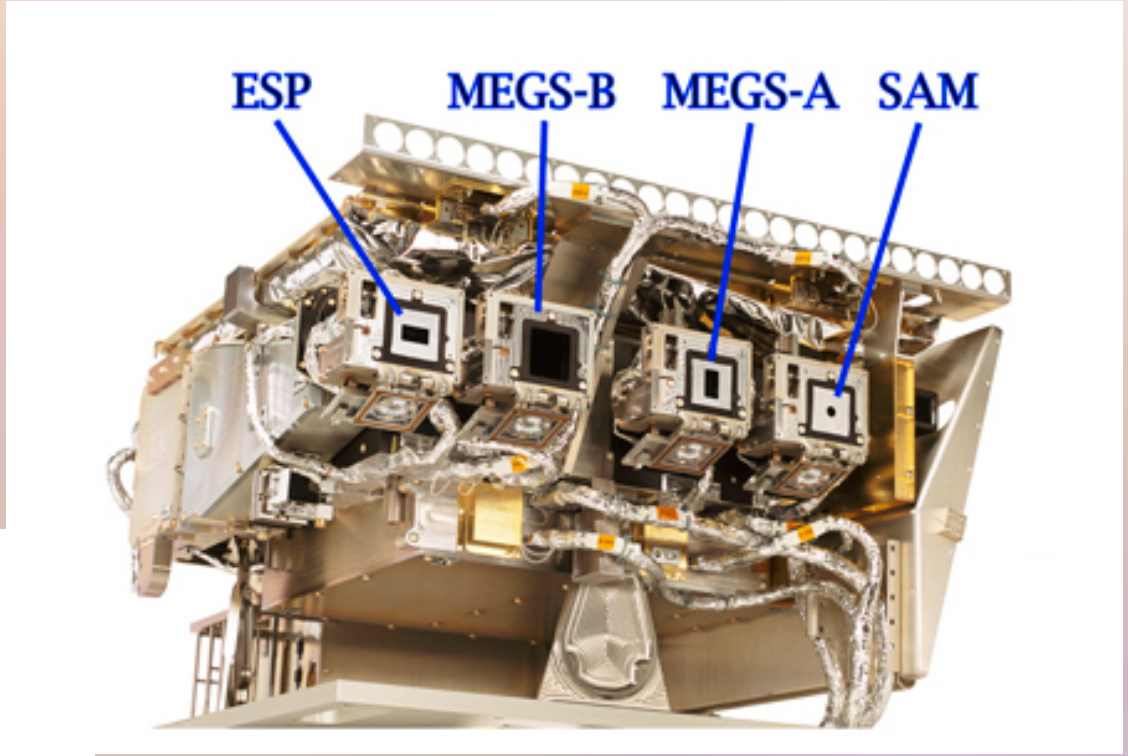
SDO: X-Ray and Visible Wavelength Composite



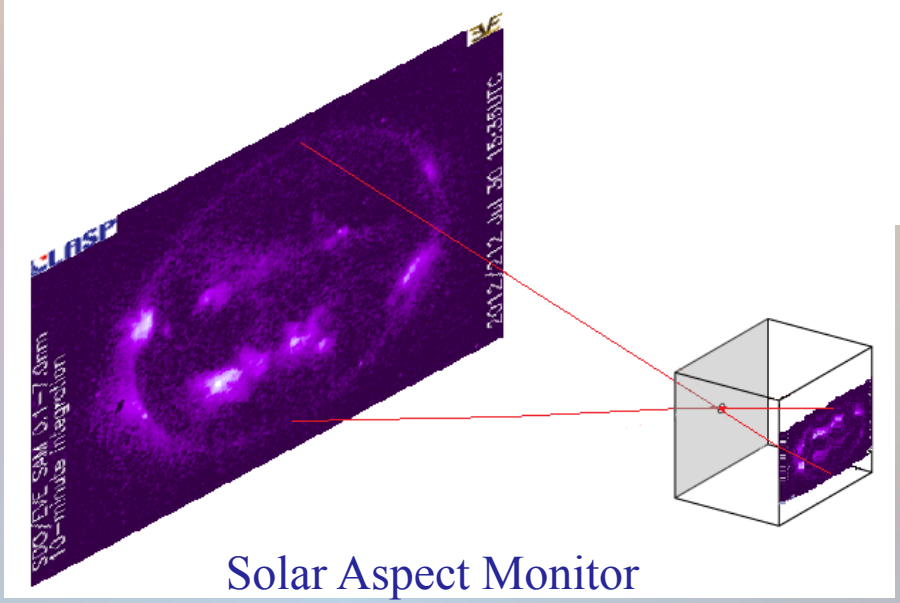
SDO-EVE-SAM



Solar Dynamics Observatory



EUV Variability Experiment



Solar Aspect Monitor

Firefox | Laboratory for Atmospheric and Spac... | Extreme ultraviolet Variability Experim...

lasp.colorado.edu/home/eve/data/eve-spaceweather-data/

University of Colorado Boulder
Laboratory for Atmospheric and Space Physics

Extreme ultraviolet Variability Experiment

Home | Science | Data | Education | News | Reference

Search site: Search

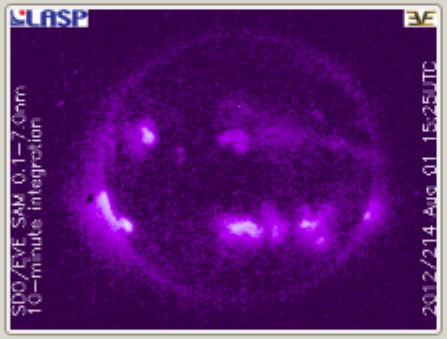
Data

- Data Access
- EVE Spaceweather Data
- Ground Calibration Results

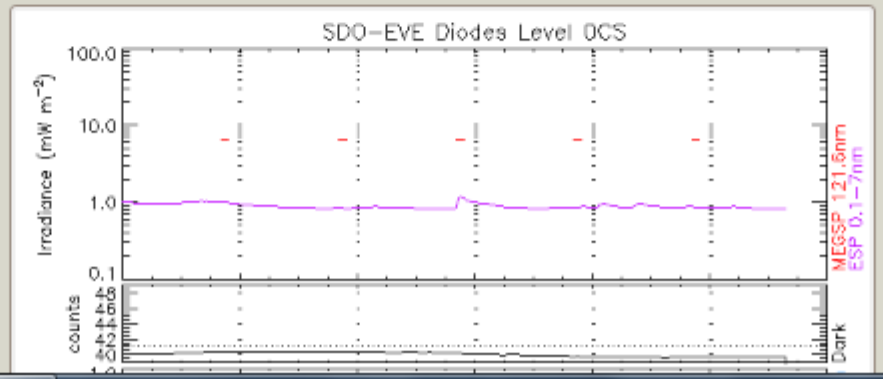
EVE Spaceweather Data

SDO/GOES X-Ray Flare Watch

Latest soft X-ray image from the EVE SAM pinhole camera
(10-minute updates)



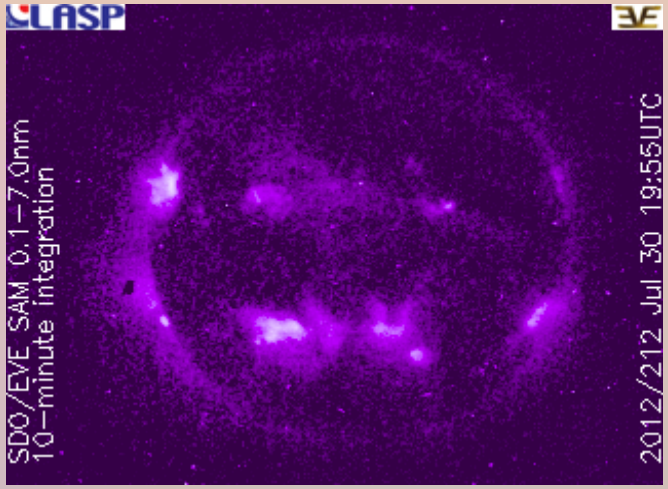
- Latest SAM Rotation movie (mp4)- the last full Carrington rotation plus the current partial rotation
- Latest SAM daily movie (mp4)- all of yesterday through the last 10 minutes
- Historical SAM Images and Movies
- Dark spot explanation



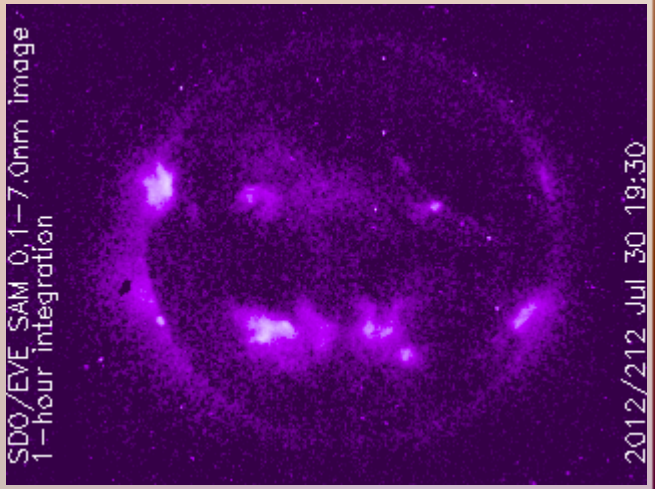
9:41 AM
8/1/2012

SAM Data Product

1 Minute Integration



10 Minute Integration



1 Hour Integration

Overview

-- Purpose: Utilize SDO-EVE-SAM near real-time imaging capabilities to detect emergent flux in the solar corona, and use these data products for space weather applications

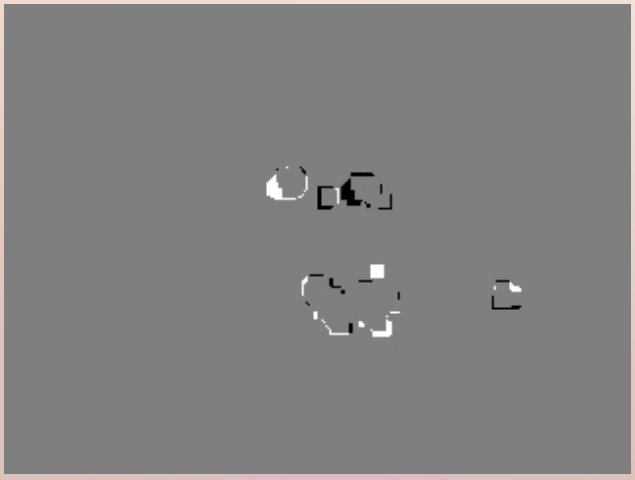
-- Challenges:

- -- Noise Reduction
- -- Technique Application and Comparison
- -- Flux Markers on SAM Images

Processing Techniques

- Difference Imaging

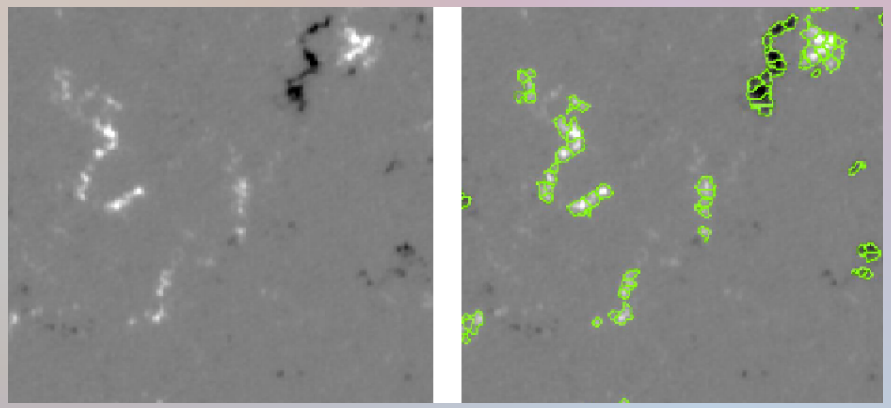
  -- Subtraction Method



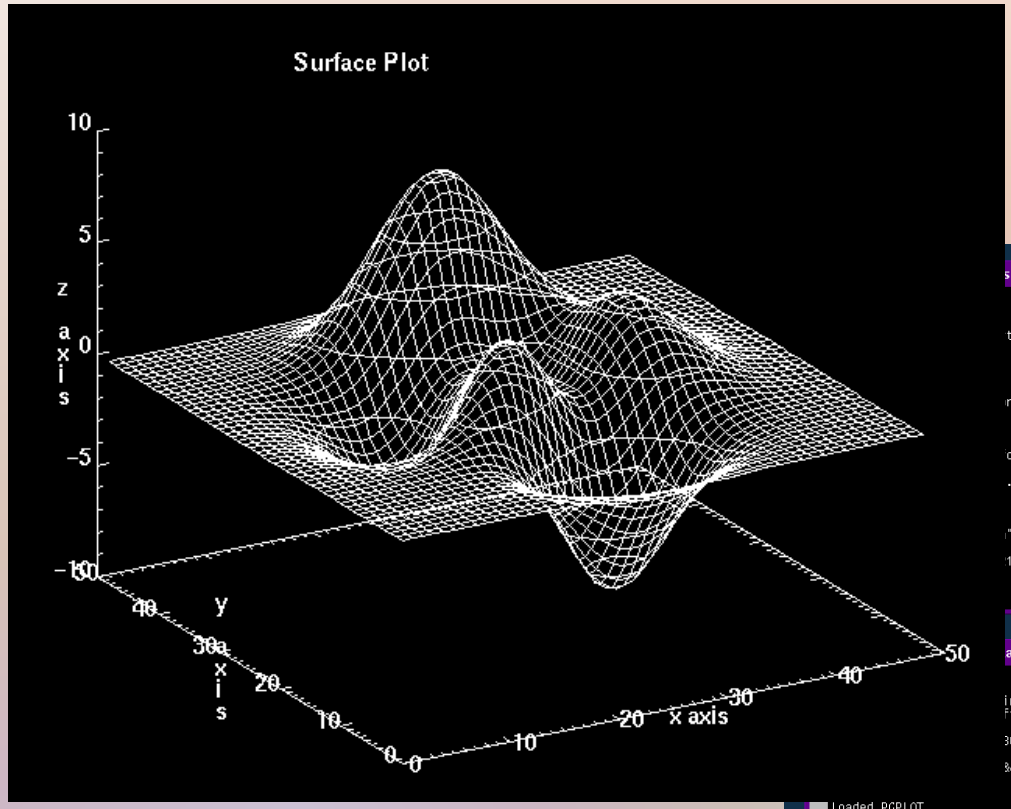
- Feature Tracking (SWAMIS)

  -- Helioseismic and Magnetic Imager (HMI) Magnetograms

  -- Tracking Algorithm

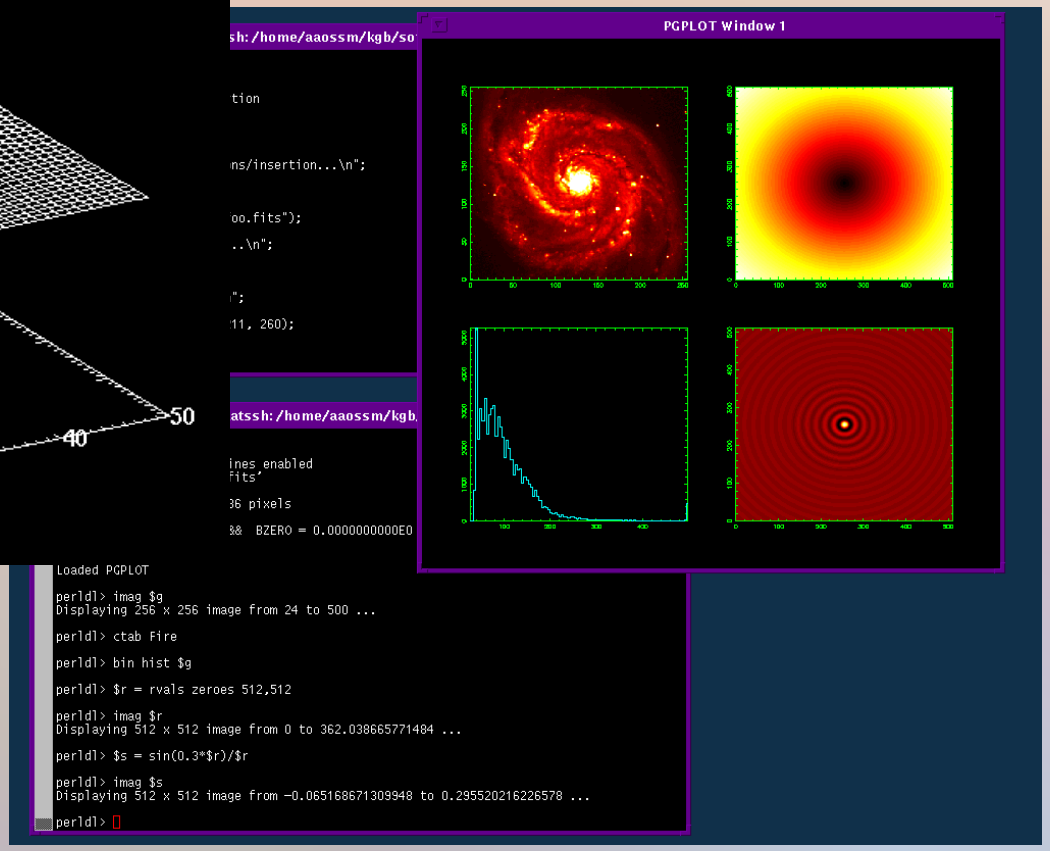


IDL and PDL



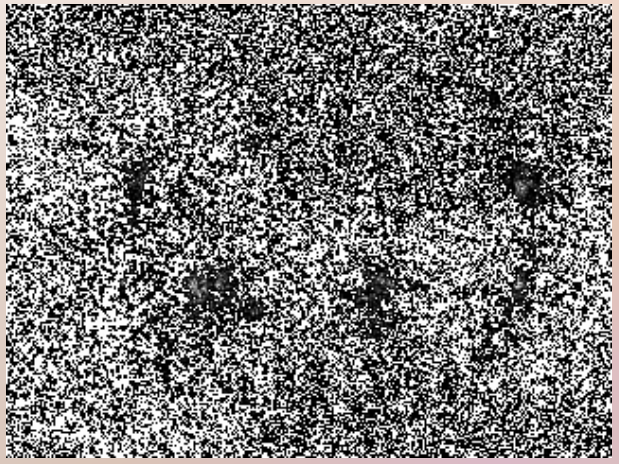
Plotting with IDL

PDL with PGPLOT

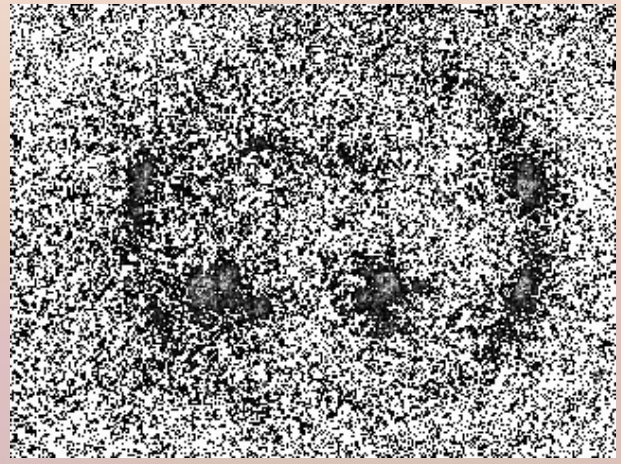


Difference Imaging

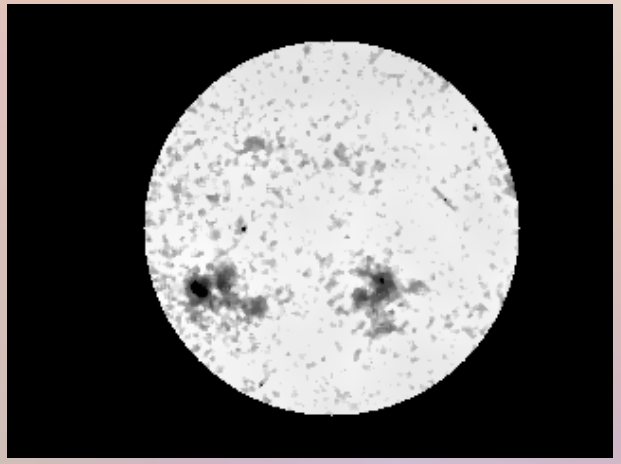
Data from May 1, 2012



I. Raw Data (1 min integration)

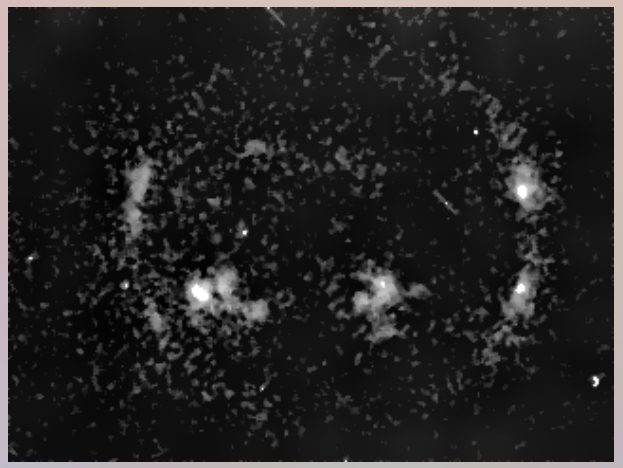


II. 3 Minute Integration



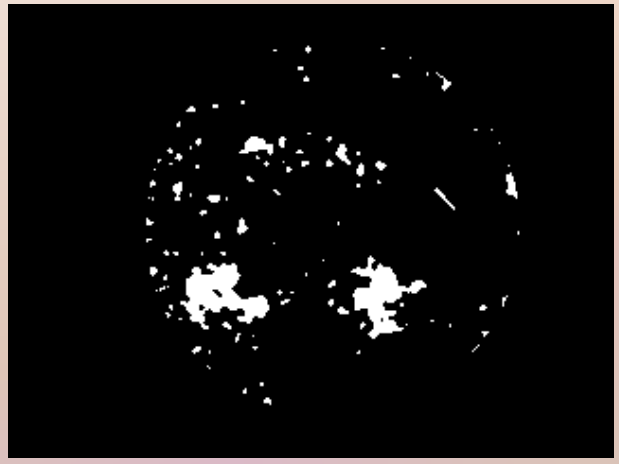
V. Mask Outside Solar Disk

III. Adaptive Equalization

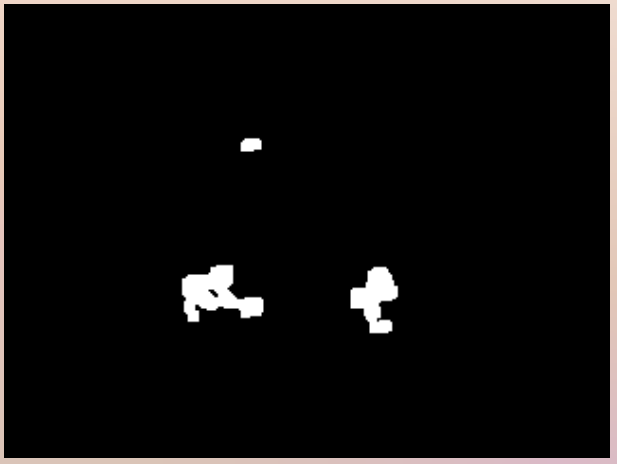


IV. Reduce Noise/Smoothing

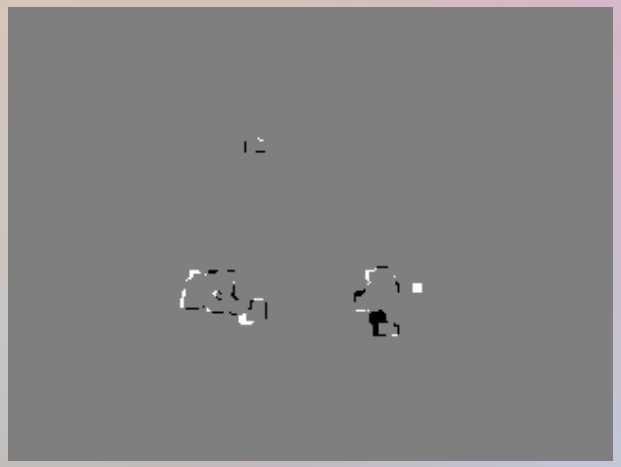
Difference Imaging



VI. Threshold/Binary Mask



VII. Sieve



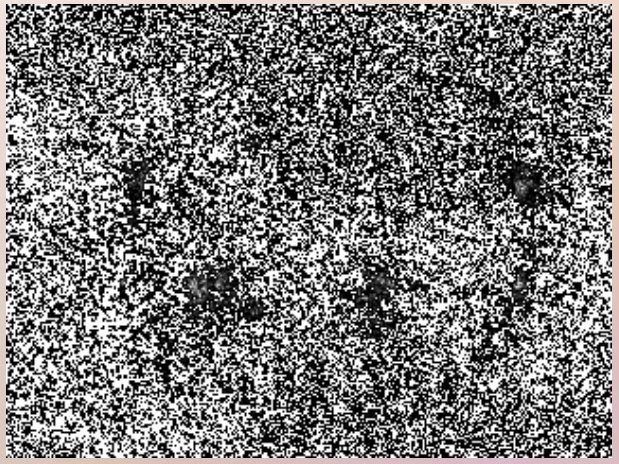
VIII. Differencing

Differencing Result

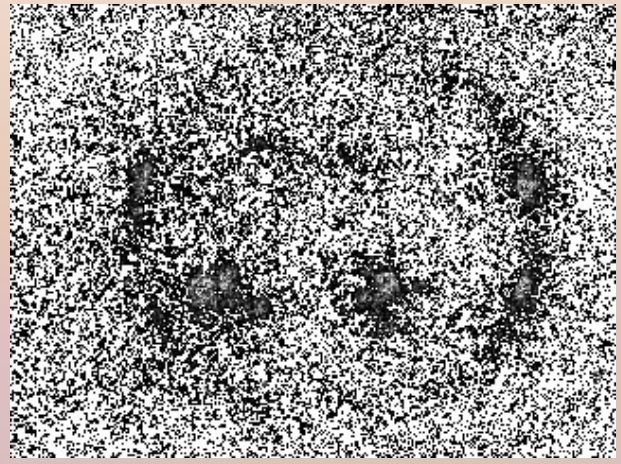
Difference imaging applied to a time series

SWAMIS

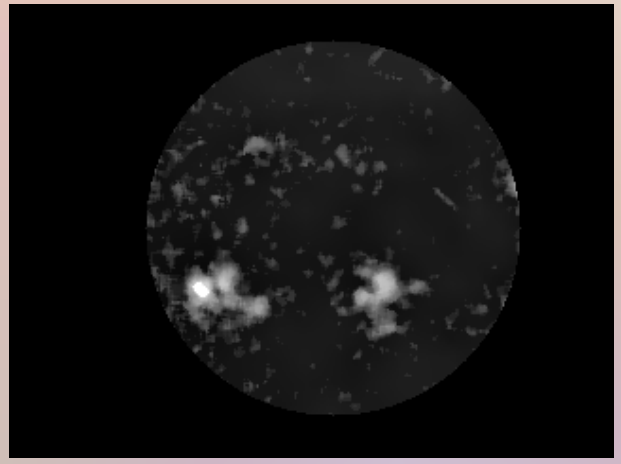
Well, if it works on magnetograms...



I. Raw Data (1 min integration)

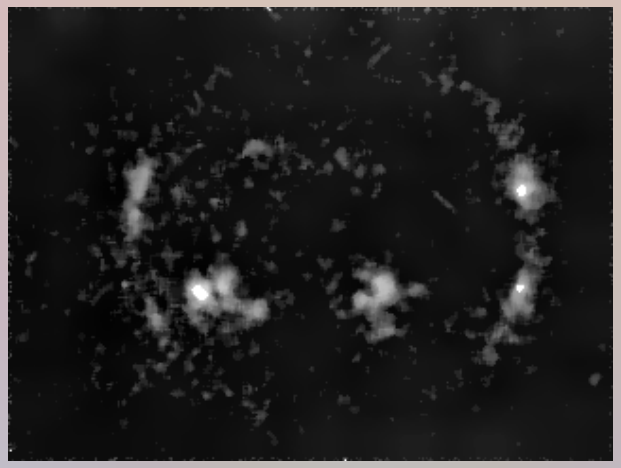


II. 3 Minute Integration



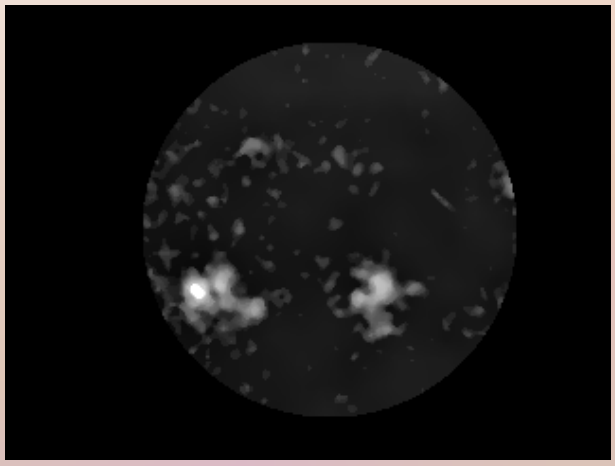
V. Mask Outside Solar Disk

III. Adaptive Equalization

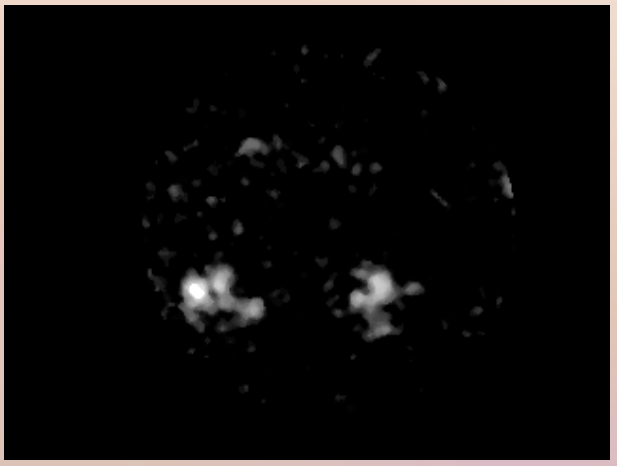


IV. Reduce Noise/Smoothing

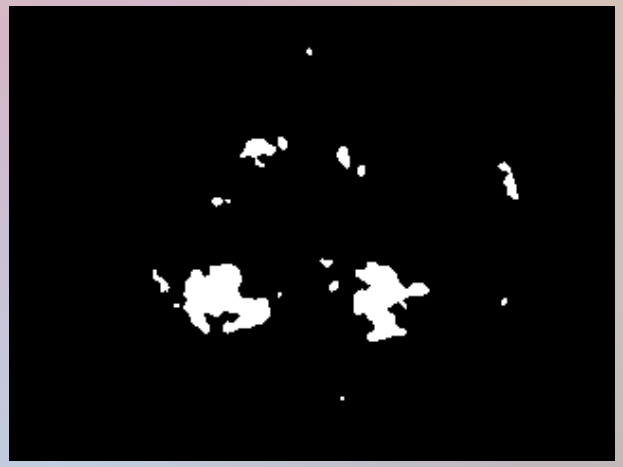
SWAMIS

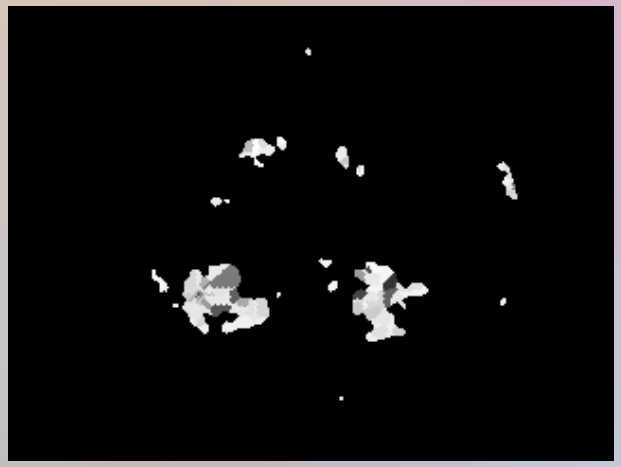


VI. Another Smoothing



VII. Isolate Pixel Values





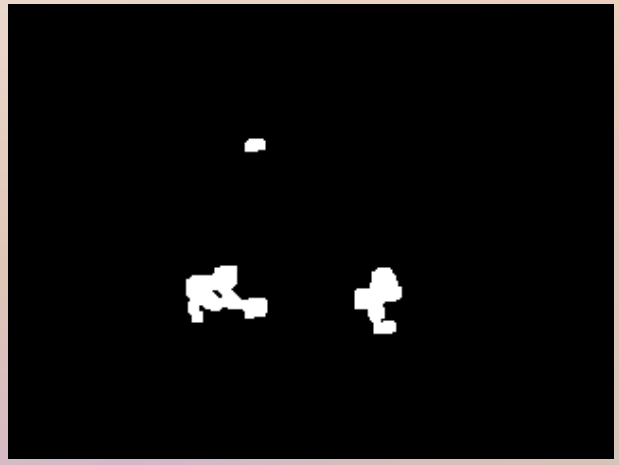
VIII. SWAMIS Results

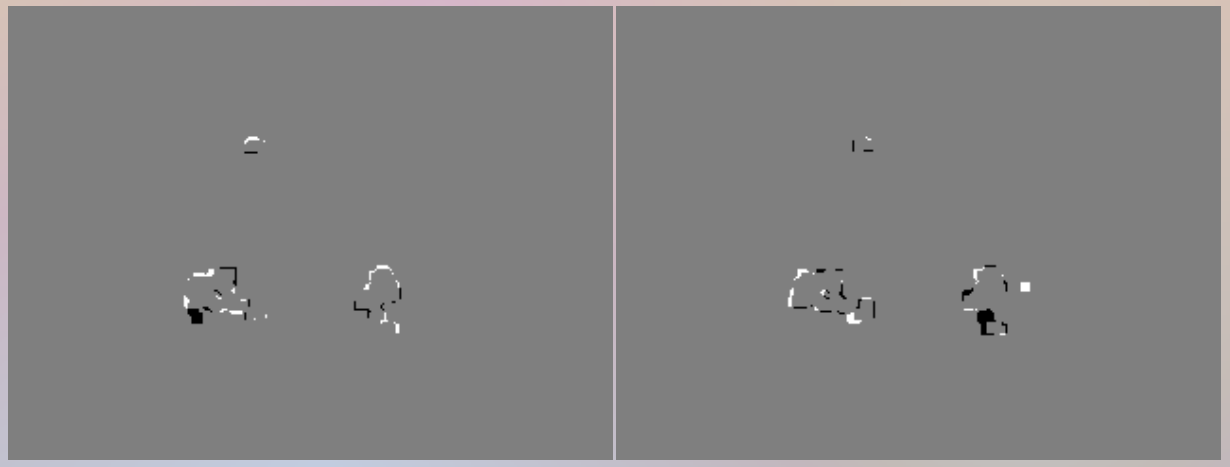
SWAMIS Result

SWAMIS applied to a time series

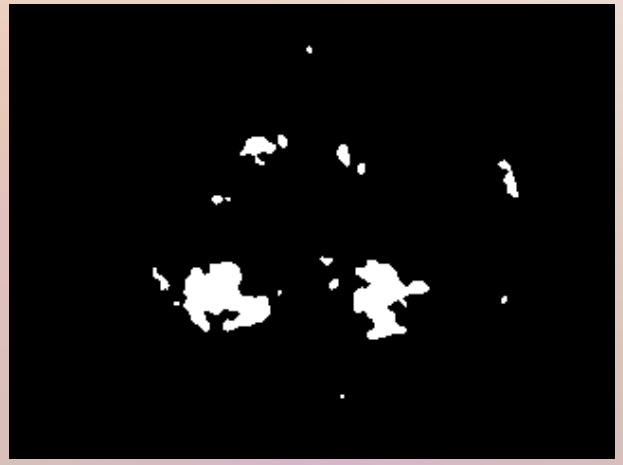
Technique Comparison

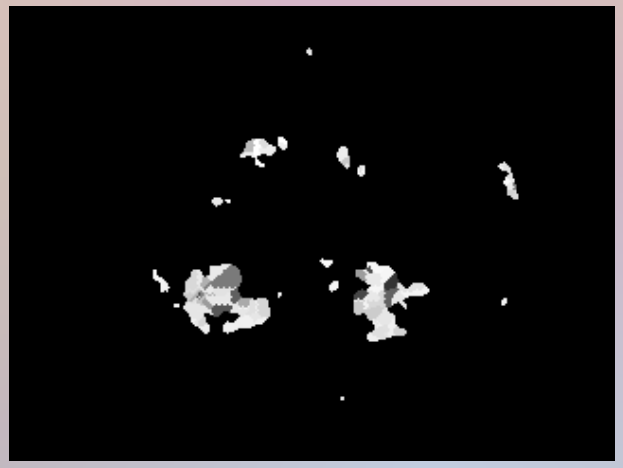
Difference Imaging





SWAMIS





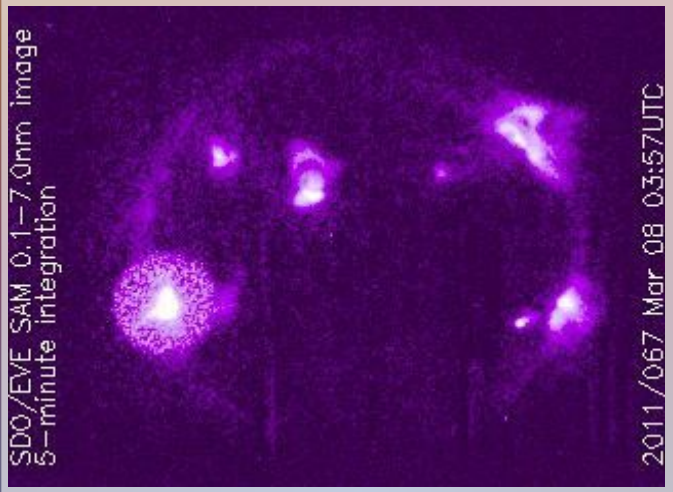
Future Study

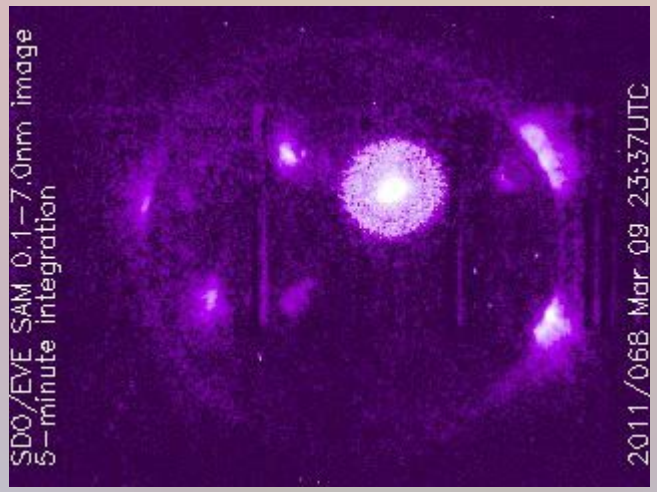
-- 'Pipeline' usage

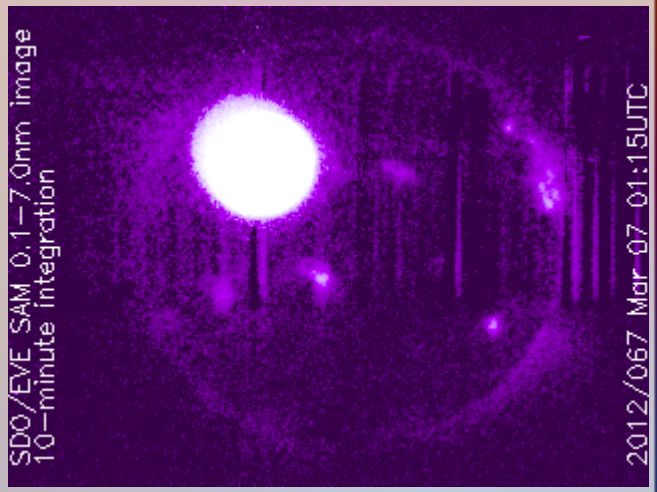
-- Further comparison and improvement of techniques

  -- More detail achievable in difference imaging?

  -- Further noise reduction







References

-- Solar Magnetic Tracking (C. E. DeForest, et al.)

I. Software Comparison and Recommended Practices

II. The Apparent Unipolar Origin of Quiet-Sun Flux

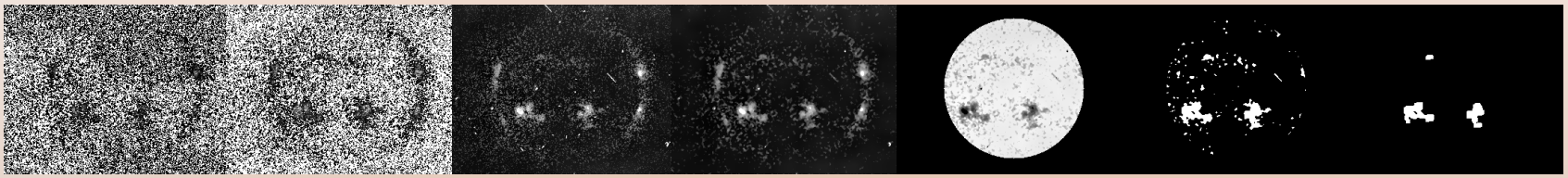
III. Apparent Unipolar Flux Emergence in High-Resolution Observations

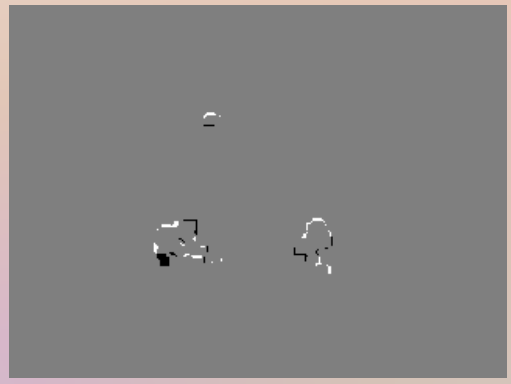
-- Extreme Ultraviolet Variability Experiment (EVE) on the Solar Dynamics Observatory (SDO): Overview of Science Objectives, Instrument Design, Data Products, and Model Developments (T. N. Woods, et al.)

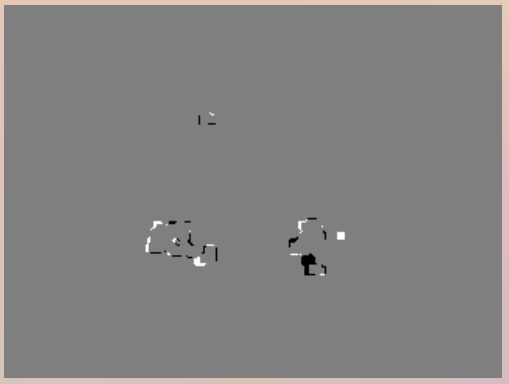
-- IDL and PDL Guidebooks and Online Help

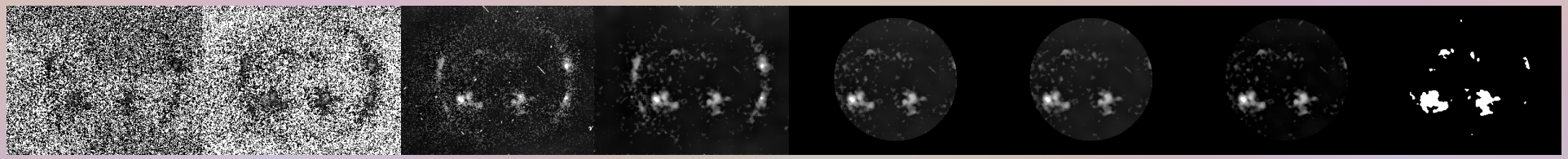
-- Images courtesy of LASP, NASA, and NOAA

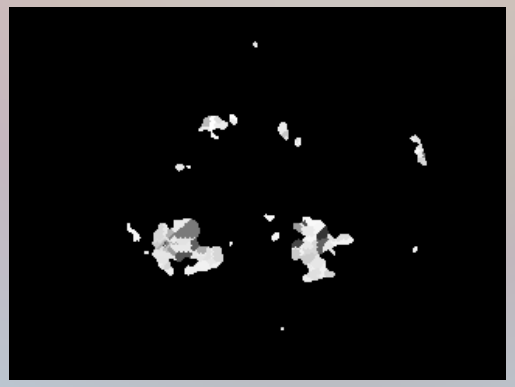
Questions?





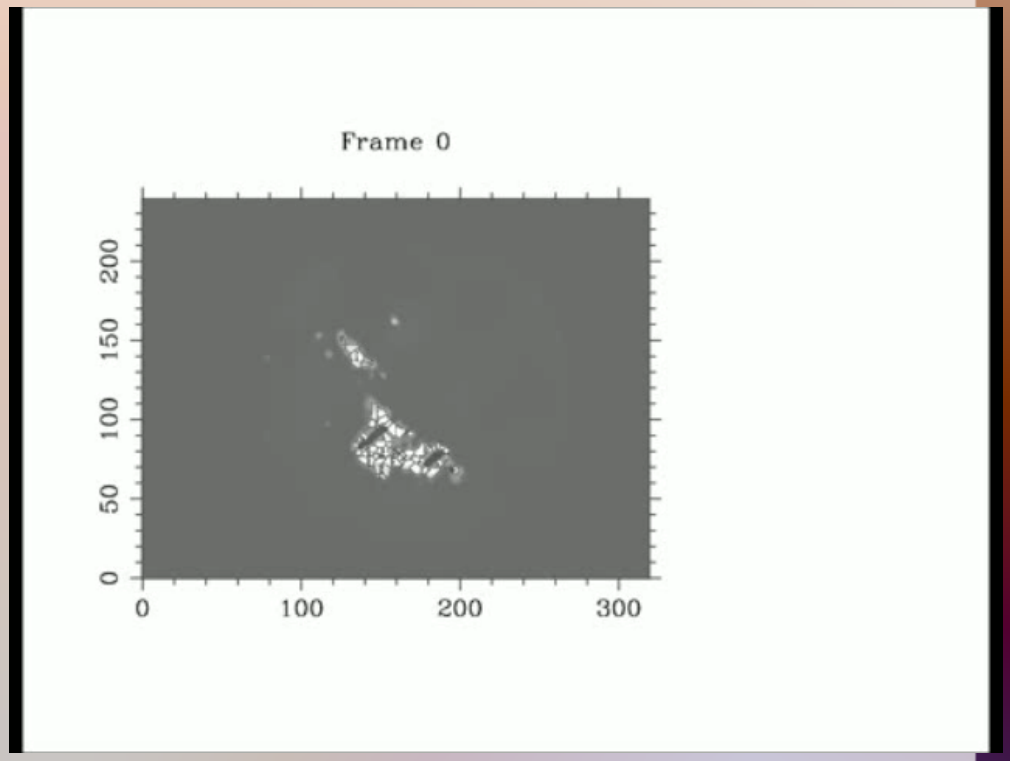






Handling a Flare?

Difference Imaging



SWAMIS