Automated Flux Recognition with SDO-EVE-SAM Images

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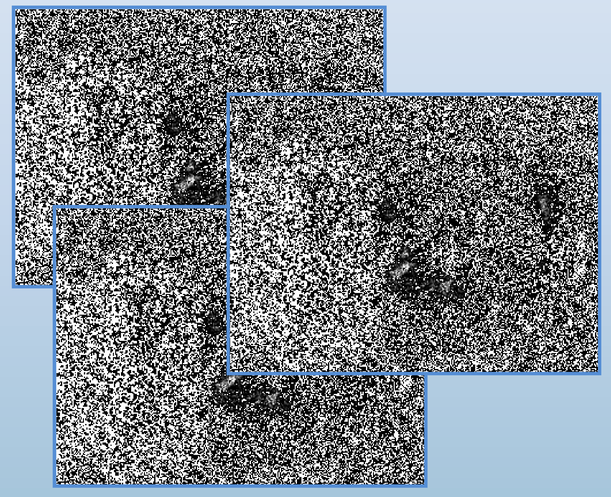
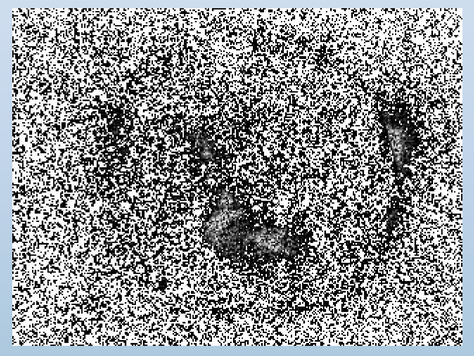
Abstract

The Solar Aspect Monitor (SAM), part of the EUV Variability Experiment (EVE) instrument suite aboard NASA's Solar Dynamics Observatory (SDO), captures soft X-Ray (0.1-7 nm) images of the Sun. SAM's ten second cadence allows for near real-time solar imaging, which is beneficial when monitoring and predicting space weather. Solar X-Rays originate from hot plasma confined by the Sun's magnetic field. This field containing the plasma emerging from below the solar surface can evolve into active regions and sunspots. Emergent flux observed in the solar corona and located in current active or "quiet" regions could provide early indication of the possible development of flaring regions. The Southwest Research Institute's Southwest Automatic Magnetic Identification Suite (SWAMIS) program has demonstrated the automatic detection of emerging magnetic flux in magnetogram images. SDO-EVE-SAM images provide a simple, near real-time monitor of emergent flux by looking at the resultant heated plasma in the soft X-Ray wavelengths. SAM images, though lower resolution than SDO-Helioseismic Magnetic Imager (HMI) images, will provide a back-up if the HMI images are unavailable, and a local monitor of emergent flux at LASP. The challenge was to reduce the large amount of noise found in the SAM images. Through image processing with IDL, we achieved significantly lower noise levels, allowing us to then apply a difference imaging technique to the time series as well as feed the reduced-noise images into the SWAMIS program. The difference images accentuate the brightening, dimming, and motion of EUV irradiance shown in SAM images, while SWAMIS divides each area of flux into smaller segments, tracking the individual parts through the time series. While the difference imaging allows us to focus on the change in magnetic activity, SWAMIS provides a more detailed picture including regions which are magnetically active, but relatively stable. Further work in noise reduction and flux emphasis could produce higher quality results with both techniques. Ultimately, the work performed during this project will be integrated into the EVE data analysis pipeline to provide near real-time tracking of magnetic features for space weather forecasts.

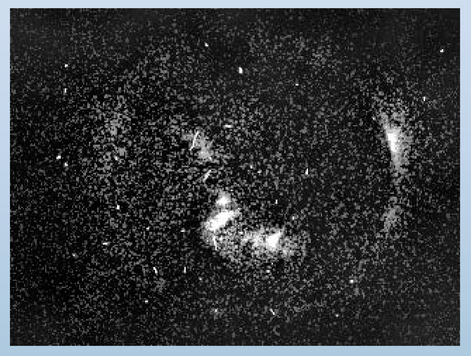
Preliminary Processing



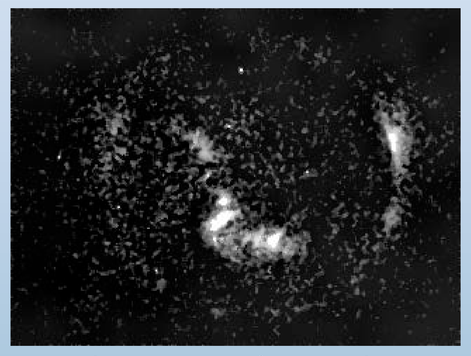
Raw Data:
10 Second Integration



3 Minute Integration

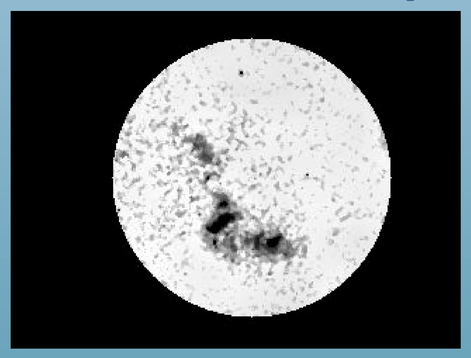


Adaptive Equalization

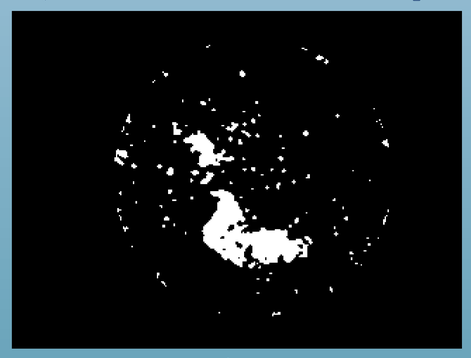


Reduce Noise/Smoothing

Difference Imaging



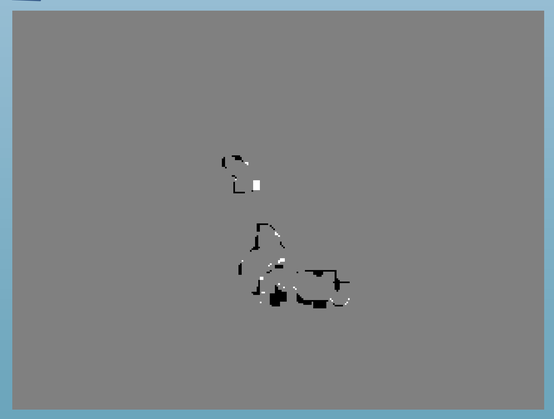
Mask Outside Solar Disk

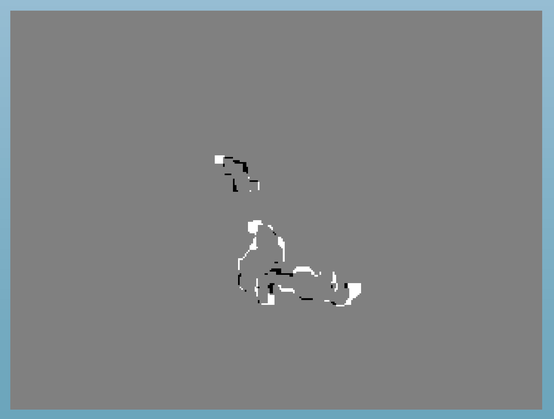


Threshold/Binary Mask

Sieve

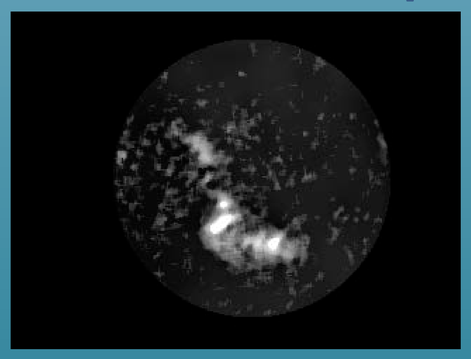
Results



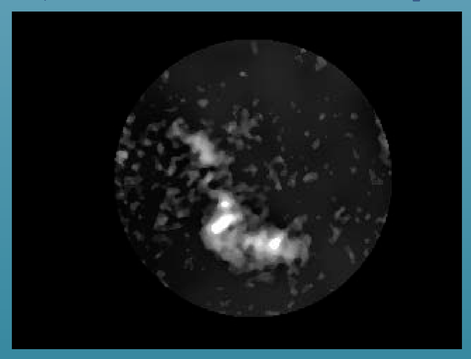


Differencing Result

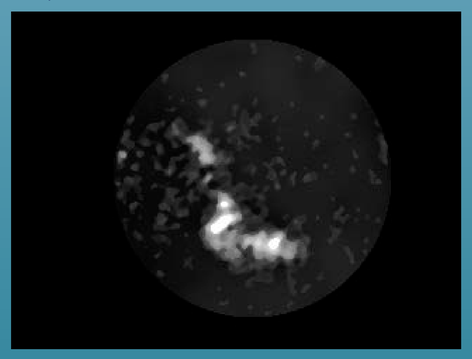
SWAMIS



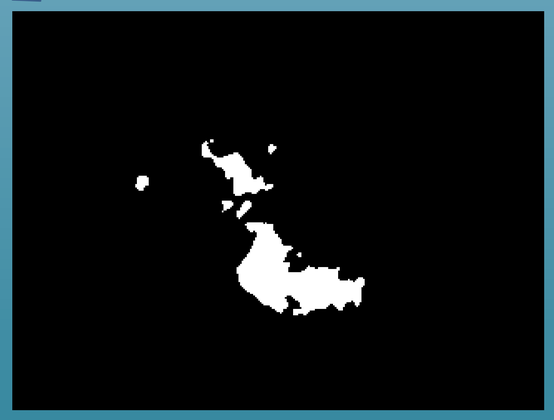
Mask Outside Solar Disk

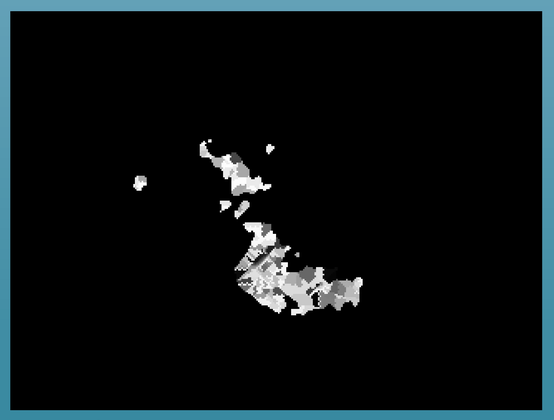


Extra Smoothing



Pixel Isolation





SWAMIS Result