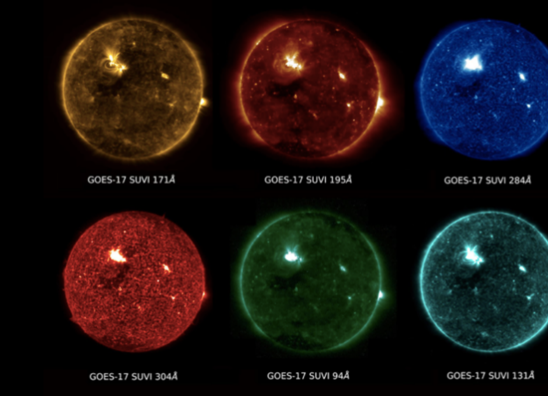
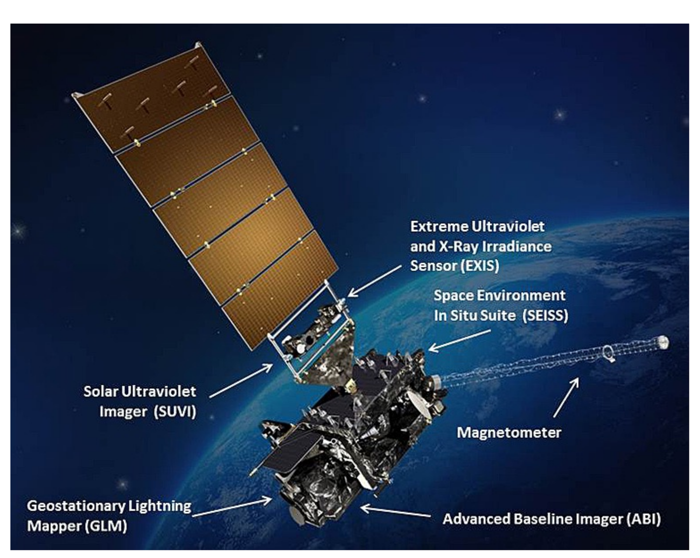


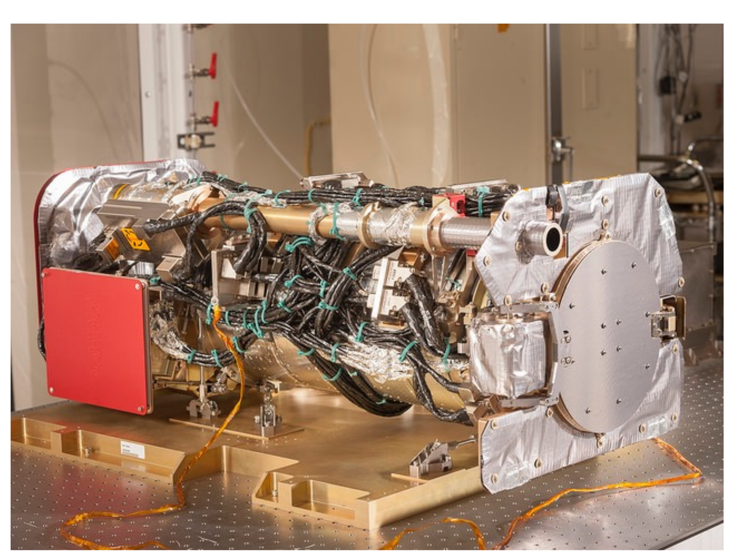
# Solar Ultraviolet Imager (SUVI) Intercalibration between Geostationary Operational Environmental Satellites (GOES) -16 and -17

Taylor Miller| Jamese Sims, Ph.D., Matthew Seybold, Daniel B. Seaton, Ph.D. | Spelman College | National Oceanic and Atmospheric Administration

## Abstract

Space weather affects Earth's atmosphere and magnetic field, both of which shield human life from many potentially disastrous impacts. Fluctuations in space weather can lead to negative impacts with electricity and power grids, aviation systems, and satellites, to name a few. The Solar Ultraviolet Imager (SUVI) provides information on solar flares and eruptions that influence space weather. SUVI's intercalibration data will be collected from the two Geostationary Operational Environmental Satellite-16 and -17 (GOES-16/GOES-17) for comparison using SAO Image and Python. The objective is to verify the consistency of the GOES-16 and GOES-17 processed satellite data. The tested hypothesis is that the SUVI L1b data from the two launched GOES-R series satellites will produce similar outputs. Differences in the SUVI products between the two satellites could suggest a discrepancy in the data processing algorithms or a space weather issue emergence. Therefore, research on the data products are critical to the lifespan, maintenance of the instrument and preserving the utility of the forecast products. In conclusion, the results support the hypothesis as the SUVI instrument on GOES-16 and GOES-17 is intercalibrated.



Left: Geostationary Operational Environmental Satellites -16 and -17 model with all of its products. (Photo Credit: NASA) Right: The Solar Ultraviolet Imager close-up.(Photo Credit: NOAA)

## Problem / Question

Is the Solar Ultraviolet Imager (SUVI) on Geostationary Operational Environmental Satellites (GOES)-17 intercalibrated with Geostationary Operational Environmental Satellites (GOES)-16?

## Background

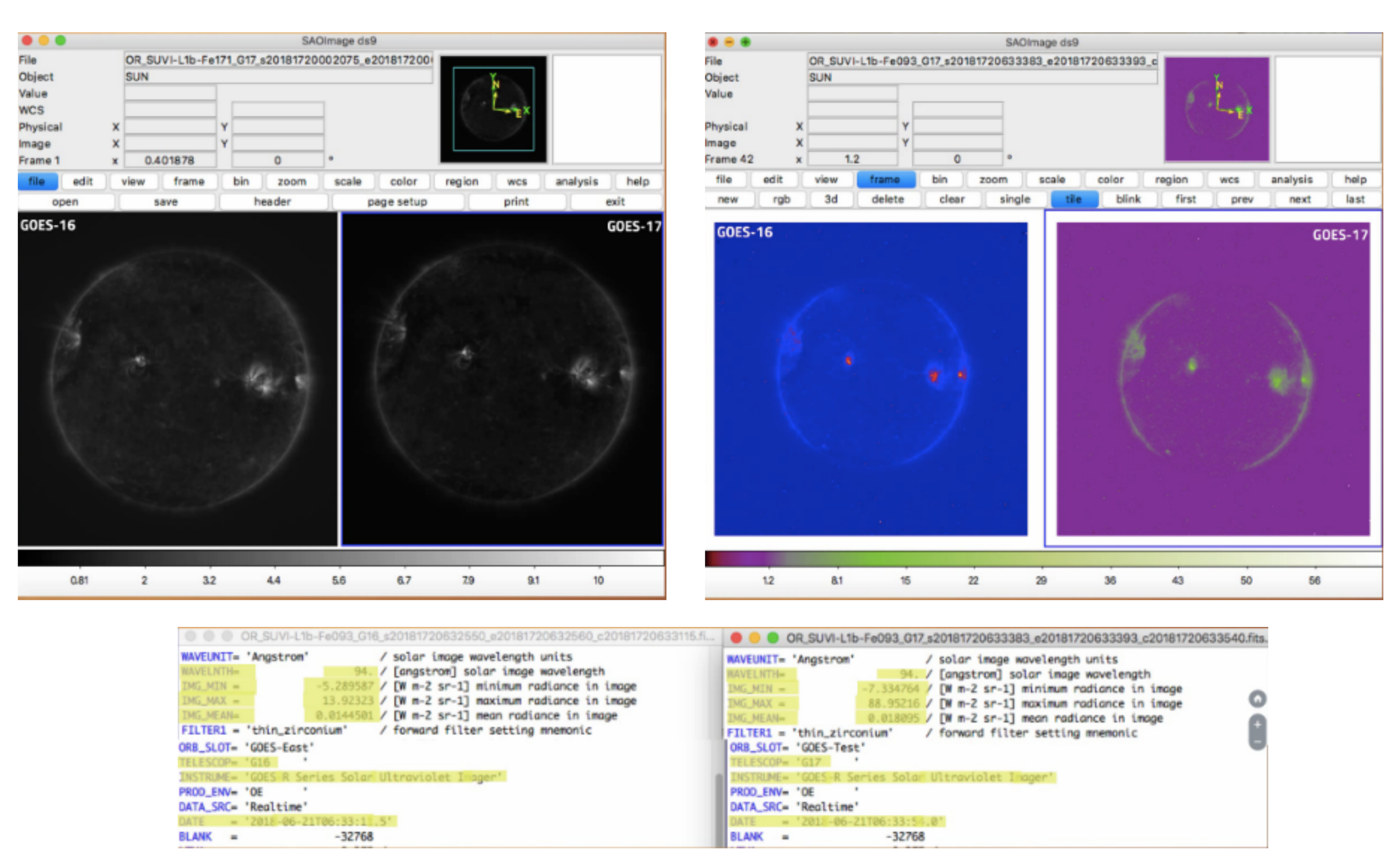
SUVI is a Cassegrain telescope that observes occurrences of the sun and instead of an eyepiece, SUVI has a camera. SUVI has six wavelength channels that it captures ranging from 94 A to 304A. Each wavelength is crucial in detecting various solar phenomenons.

| Wavelength<br>Log (Te) | 94 Å 6.8 | 131 Å 7.0,7.2 | 171 Å 5.8 | 195 Å 6.1,7.3 | 284 Å 6.3 | 304 Å 4.7 |
|---|---|---|---|---|---|---|
| Filaments | | | | | | |
| Coronal Holes | | | | | | |
| Active Region Complexity | | | | | | |
| CMEs (e.g. dimming) | | | | | | |
| Flare Location and Morphology | | | | | | |
| Quiet Regions | | | | | | |

Each wavelength detects an important trait of the sun that influences space weather. (Photo Credit: NOAA)

## Methods

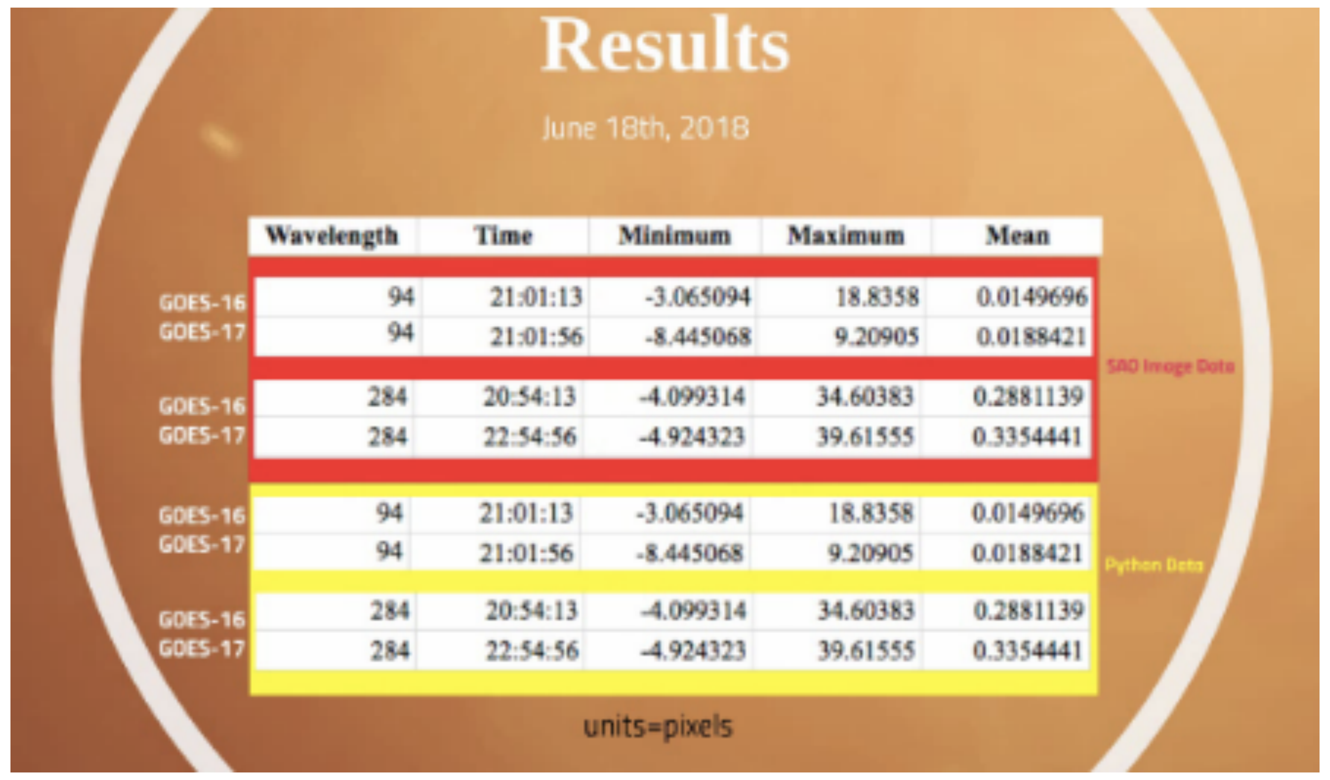
SUVI fits files were the primary resource to track the intercalibration of the device on the two satellites. SAO Image and Python were used to analyze the variables of SUVI's images. To determine the images minimum, maximum and mean from SUVI on GOES-16 and -17, SUVI data was used to observe the pixel differences. Sometimes the differences weren't always noticeable so changing the color scheme was useful qualitative data to emphasize key traits of the images. Therefore, Python was used to verify the variables of the same images input into SAO image. For each image, the following highlighted variables are the quantitative data I compared SUVI on GOES-16 to SUVI on GOES-17 images.




Top Left: GOES-16 and -17 SUVI fits files in SAO Image taken on the same day at the same time. (Photo Credit: NOAA). Top Right:SUVI fits files from the two satellites with different color schemes in SAO Image. (Photo Credit: NOAA). Bottom: Quantitative data used for comparison from SAO Image. (Photo Credit: NOAA)

## Results

After many hours of research on SUVI, the sun, and crunching data, I came upon my results of the two satellites intercalibration records for SUVI. I picked two sets of data from the 94 and 284 wavelengths. As we can see, the image values in SAO imager and Python were precise. In addition, we can see that the minimum, maximum, and mean were similar for a SUVI image of the same wavelength on both satellites. We do take into account standard deviation as each wavelength is meant to detect specific solar traits, but will pick up on every detail from the sun's activities.




| | Wavelength | Time | Minimum | Maximum | Mean |
|---|---|---|---|---|---|
| GOES-16 | 94 | 21:01:13 | -3.065094 | 18.8358 | 0.0149696 |
| GOES-17 | 94 | 21:01:56 | -8.445068 | 9.20905 | 0.0188421 |
| GOES-16 | 284 | 20:54:13 | -4.099314 | 34.60383 | 0.2881139 |
| GOES-17 | 284 | 22:54:56 | -4.924323 | 39.61555 | 0.3354441 |
| GOES-16 | 94 | 21:01:13 | -3.065094 | 18.8358 | 0.0149696 |
| GOES-17 | 94 | 21:01:56 | -8.445068 | 9.20905 | 0.0188421 |
| GOES-16 | 284 | 20:54:13 | -4.099314 | 34.60383 | 0.2881139 |
| GOES-17 | 284 | 22:54:56 | -4.924323 | 39.61555 | 0.3354441 |

Data comparison of an image from SUVI taken at the same time at different wavelengths on GOES-16 and -17. (Photo Credit: Taylor Miller)

## Conclusion

In conclusion, the SUVI instrument is intercalibrated on GOES-16 and GOES-17, proving the hypothesis to be accurate. Moreover, the images captured by SUVI on both satellites are similar in their output. As we can see from an image taken by SUVI on GOES-16 and -17, the photo looks almost the same with minor pixel deviations on -17. The next steps for SUVI are to improve the image errors for GOES-17 as it is still in the testing phase. After improving SUVI's imagery, the next phase would be placing GOES-17 in a location where it monitors the western region of Earth.

## Acknowledgements

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