



Studying the Causes of the California Wildfires with GOES-17 Imagery

Eric Sun, Sean Jiang
Gilman Middle School, Baltimore, Maryland, USA



ABSTRACT

This project aims to study whether the GOES-17 data from ABI-1, ABI-2, ABI-3, ABI-13, FDC, AOD, and GLM can be used to detect smoke and possible wildfire hazards such as lightning and dryness.

We chose to examine the August 2020 California Wildfires. The August 2020 California Wildfires contributed to the August Complex Fire, the largest wildfire ever recorded in California^[1]. These fires were possibly caused by lightning and low humidity.

First, we use True Color (ABI-1, -2, -3), AOD, and FDC to visualize smoke and fire areas. ABI-1 is good at detecting smoke; ABI-2 and ABI-3 bands can help us visualize surface types and atmospheric features; AOD (Aerosol Optical Depth) highlights smoking areas; FDC (fire detection and characterization) reveals fires and their characteristics. We found that the smoke is visible from True Color images and that AOD and FDC images highlight the smoke and fire areas. Second, to explore the humidity level in the fire area, we used Band ABI-13, which is good at detecting ground level humidity. Indeed, ABI-13 data shows a low humidity level before the fire for more than two months, consistent with the precipitation data of California ground stations. Third, we explored the possibility of these fires being ignited by lightning with the GLM band, which is specialized in recognizing lightning's presence. We detected intense lightning events before the massive fire started.

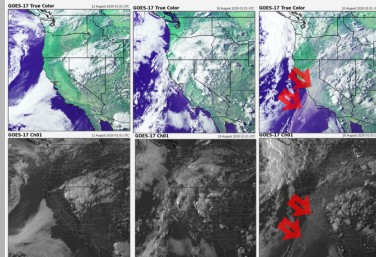


Fire rages at the LNU Lightning Complex. A wildfire sparked and ignited by lightning strikes^[2].
Noah Berger/AP

Research Question

Can Goes-17 imagery of bands 1, 2, 3, 13, FDC, AOD, and GLM help detect potential weather factors such as lightning and low humidity that caused the California Lightning Wildfires in August of 2020?

RESEARCH with Satellite Images & ABI Bands

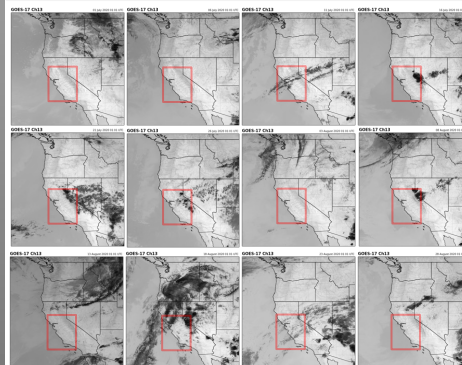
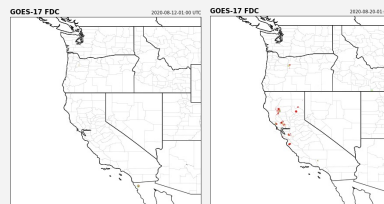


- Top row: True Color RGB composition (Red, ABI-1; Green, ABI-3; Blue, ABI-2). Bottom row: ABI-1 band alone (visible "Blue Band").
- ABI-1 Band is good at detecting aerosols, such as smoke, haze, and dust. ABI-2 and ABI-3 bands can help us visualize surface types and atmospheric features.
- Left and middle (both rows), one week and one day before the fire; right, one day after the fire.
- ABI-1 reveals obvious smoke after the fire started on Aug 19, 2020. The smoke is also obvious in the True Color image (red arrows).

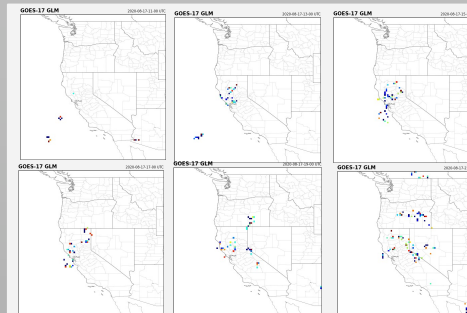


- Aerosol Optical Depth (AOD) quantifies the amount of aerosol in the atmosphere.
- Left and middle, one week and one day before the fire; right, one day after the fire.
- AOD can be used to highlight the smoke from the August 2020 California Wildfires.

- Fire Detection and Characterization (FDC) detects fire using mainly the ABI-7 band (3.9-micron channel).
- It screens out usable surfaces and clouds.
- The two images on the right show one week before (left) and one day after the fire (right).
- FDC successfully detected the August 2020 California Wildfires.



- ABI-13 band shows humidity and water vapor from July 6 to August 26 (5-day interval).
- Choose this band to evaluate the dryness level before and after the fire.
- ABI-13 data suggests low precipitation and a dry environment in California before and after the fire.
- A long period of dryness is a possible reason for the August 2020 California Wildfires.



- GLM (Geostationary Lightning Mapper) measures total lightning activity.
- Data shows intensive lightning events in California on Aug 17, 2020, from 11:00 to 21:00 UTC (2-hour interval).
- These intensive lightning events could be the ignitor of the August 2020 California Wildfires.

RESULTS and CONCLUSIONS

- ABI-1, ABI-2, ABI-3, ABI-13, FDC, AOD, and GLM can be used to monitor and predict wildfires.
- Combination of multiple bands (True Color, FDC, AOD) provides clear visualization of smokes and fires.
- Historical archives of GOES images are useful in studying the causes and consequences of natural disasters.
- A long period of dryness and intense lightning events are possible contributors to the August 2020 California Wildfires.
- Dry lightning might be the ignitor of the August 2020 California Wildfires.

References

1. "August 2020 California lightning wildfires" [Wikipedia](#) ([link](#))
2. Vanessa Romo, Aug 19, 2020 "1 Dead In Vanessa Romo, Aug 19, 2020, California Fire, As Lightning-Strike Fires Push Resources To Limit", [NPR](#). ([link](#))
3. All data in this study are extracted by a python code modified from an Unidata Training example written by Brian Blaylock ([link](#))