Evaluation of Cooling Operation

GOES-R Calibration Working Group (CWG)
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• GOES-17 ABI LHP anomaly imposes a daily period of lost imagery when the FPM is too hot.
• Cooling operation shortens that period by using the ABI less for earth viewing and more for cooling to slow down the FPM heating.
• It uses the timeline to the right when the heating is intense:
  – 0600 – 1200 UTC.
  – 4/9 – 5/1; 8/12 – 9/1; 10/14 – 31; …
• Evaluation: Has the operation:
  – Reduced the FPM temperature?
  – Shortened the period of lost imagery?

Modified from https://www.ospo.noaa.gov/Operations/GOES/west/Mode3G_Cooling_Timeline_G17.html
Cooling Operations for GOES-17

FD: 3 to 2
CONUS: 6 to 0
MESO: 60 to 30

Replaces three nominal Mode 6 Timelines with two Cooling Timelines.
IMPACT ON FPM TEMPERATURE
LWIR

Why 1K warmer?
• A quarter day difference on the same DOY in terms of $\beta$ angle.
• MESO location etc.
• Cooling capacity.


1K warmer than 2019 when or if no cooling (green vs. red).
• Reduced the daily peak temperature by ~4K (green vs. blue).
• Slightly larger reduction on warmer days.
• All as expected.
• Similar as LWIR FPM.
• No 2020 Prediction (without cooling).

Data gap in 2019.
IMPACT ON IMAGERY
On the same day, good image ended by 10:40 in 2019 but continued after 10:45 in 2020, ...
... and resumed by 16:10 in 2020 but not in 2019 ...
Until 16:40. Cooling gained 1 more FD image before saturation and 3 more FD images after saturation.
Evaluation by Algorithm

- Inspect all images of all channels everyday.
- “Coefficient of Variation” (CV) detects sudden change of image quality.

\[
CV = \frac{\text{standard}\_\text{deviation(radiance)}}{\text{mean(radiance)}}
\]

CV on a day **without** and **with** Cooling timeline.

The value of CV is less relevant than its change.

- Period of lost imagery without cooling.
- Reduced period of lost imagery with cooling.
Results – More Time

- 30 – 90 minutes (half to one and one half hour) for most channels on most days.
  * A lot more when it did not saturate with cooling but would without.
  * More benefits after saturation.
  * FPM Temperature changes faster during heating than cooling.

Incomplete MESO images disseminated at PDA on 04/18/2019, 04/23/2019 and 04/26/2019
Results – More MESO

- 50 – 150 more MESOs for most channels on most days.
  - A lot more when it did not saturate with cooling but would without.
- More benefits after saturation.
  - FPM Temperature changes faster during heating than cooling.
  - One MESO per minute before saturation and four after.
Results – More FD

- 2 – 6 more FDs for most channels on most days.
  - A lot more when it did not saturate with cooling but would without.
- More benefits after saturation.
  - FPM Temperature changes faster during heating than cooling.
  - Four FDs per hour before saturation and six after.
Results – More CONUS

• 2 – 8 more CONUS for most channels on most days.
  • A lot more when it did not saturate with cooling but would without.
  • All CONUS are gained after saturation.
Results – Impact of Shorter Cooling

- On April 25, the cooling was shortened by 30 minutes (Mode 6 started at 1130 UTC instead of 1200 UTC) to resolve an operation conflict.
- LWIR FPM temperature is ~0.2K warmer than ending at 1200 UTC (estimate).
- Period of lost imagery for B15 increased by ~25 minutes than ending at 1200 UTC (estimate).
- Negligible impact for B08 and B09. No impact for B10, B12, and B16. Cannot assess for the other four bands.
Summary

• NOAA implemented a “Cooling Timeline” for GOES-17 ABI during the
eclipse season to shorten the period of lost imagery by slowing down the FPM
heating.
• It was tested in Feb and used in operation in April.
• We found that the Cooling Operation:
  – Reduced the daily peak FPM temperature by ~4K.
    o Slightly larger reduction on warmer days.
  – Had no impact on B07 and B14.
  – Shortened the period of lost imagery by 30–90 minutes. For most channels and on most
days, that means 50 – 150 MESO images, 2 – 8 CONUS images, and 2 – 6 FD images.
    o A lot more when a channel would saturate without cooling but did not with cooling.
    o More benefits during the period of daily cooling than heating.
  – The FPM temperature was ~0.2K warmer on April 25 when the cooling was shortened by
  30 minutes. The impact was minor for one channel, negligible for two channels, non-
detectable for three channels, and cannot be assessed for four channels.
• We found no surprise nor unresolved issues.