GOES-17 Saturation Prediction Reference Tools for 2022

Joseph Fiore, Matt Seybold, and Seth Iacangelo

Outline of Saturation Prediction Reference Tools

- Caveats & Assumptions
- Daily Maximum Temperatures
- Daily Maximum Temperatures with Band Thresholds
- Hour-by-Hour Band Saturation
- Interpretation of Marginal and Unusable Hours
- Example Images of “Marginal” and “Unusable” Hours
- Details on Cooling Timeline

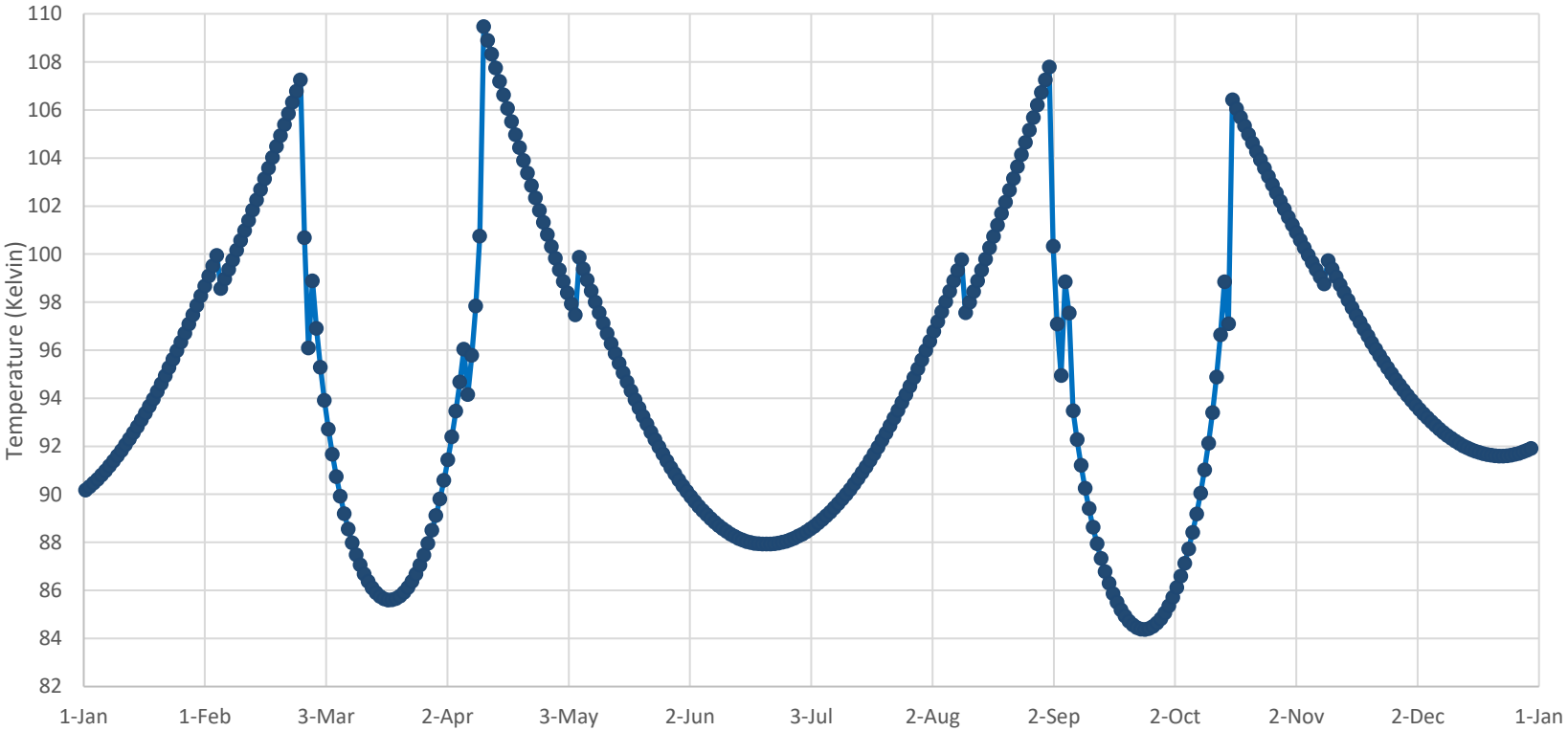
Important Caveat

- NOTE: All of the information in this slide deck is **predictive**
- The actual extent of saturation will differ from the predictions by both temperature magnitude and time of day
- Differences between actual and prediction may also have seasonal variations
- The data in this slide deck indicate “marginal” saturation when imagery is still useful, but some saturation artifacts are present (see example images toward the end of slide deck)
- In coming months, the predicted data will be revisited and in cases where the predictions may be improved, this slide deck will be updated and redistributed
- There is an additional planned mitigation that is not reflected in the predicted temperatures: During the four warm periods, the FPM set point will be changed to 87K which is expected to provide 2-3K cooling

Assumptions

- Inclusions reflect current (February 1, 2022) operational status
  - Thermal model uses Mode 6 with GOES-West mesoscale domain sector (MDS) default locations over Alaska and California
  - Semi-annual yaw flip to reduce solar load (~3 weeks after and before each equinox ~ April 6, 2022, and September 7, 2022)
  - Predictive Calibration is included in setting the “marginal” and “unusable” per-band imagery thresholds
  - Mode 3 Cooling Timeline: 15-minute Full Disk, 2 MDS Domains each at 2-minute refresh
    - See slides 17-21 for explanation of cooling timeline

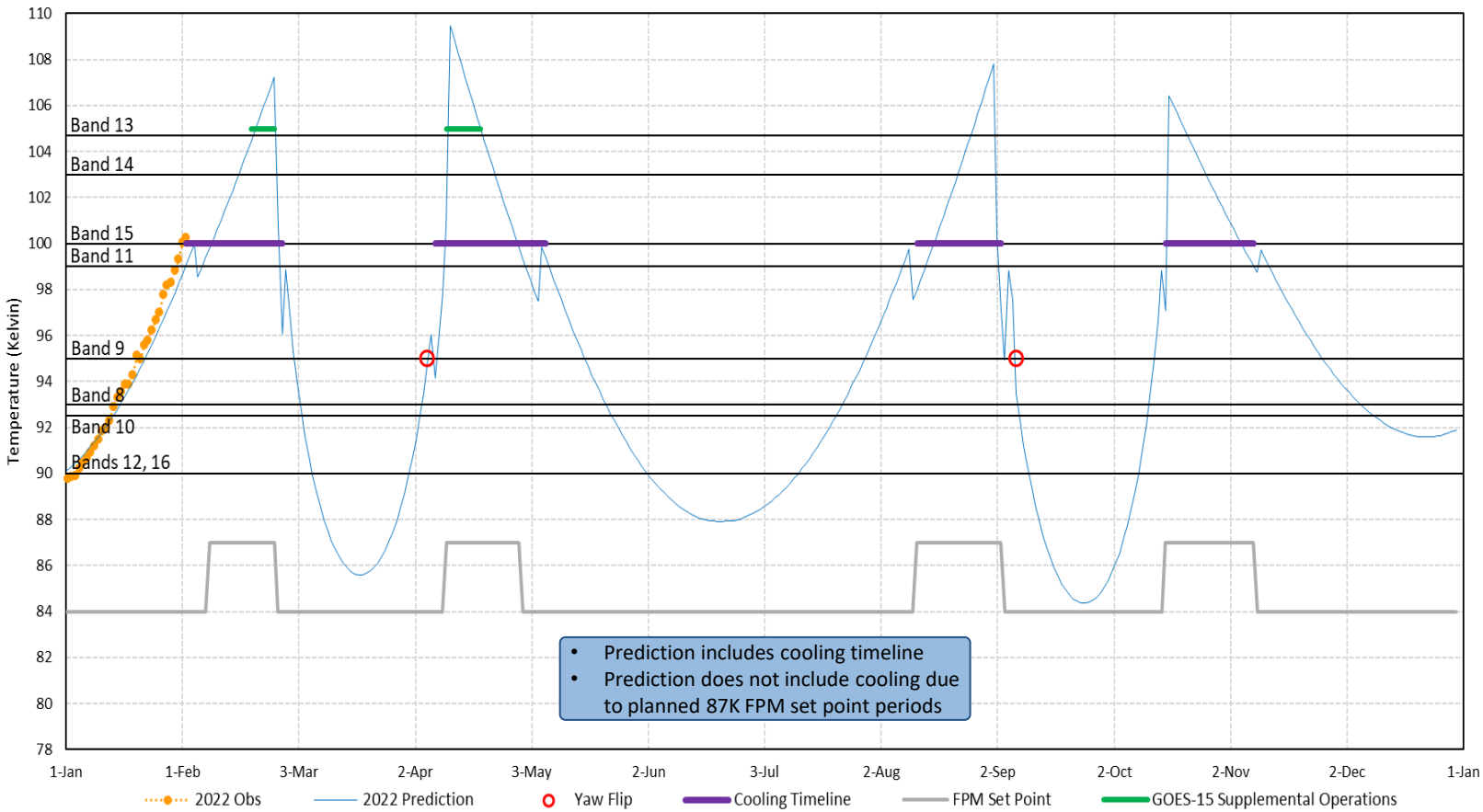
2022 GOES-17 Predicted Daily Maximum Temperatures of Focal Plane Module (FPM)



This plot shows daily maximum temperature of the ABI focal plane module. These maximums occur at night. The higher the temperature, the more saturated imagery becomes.

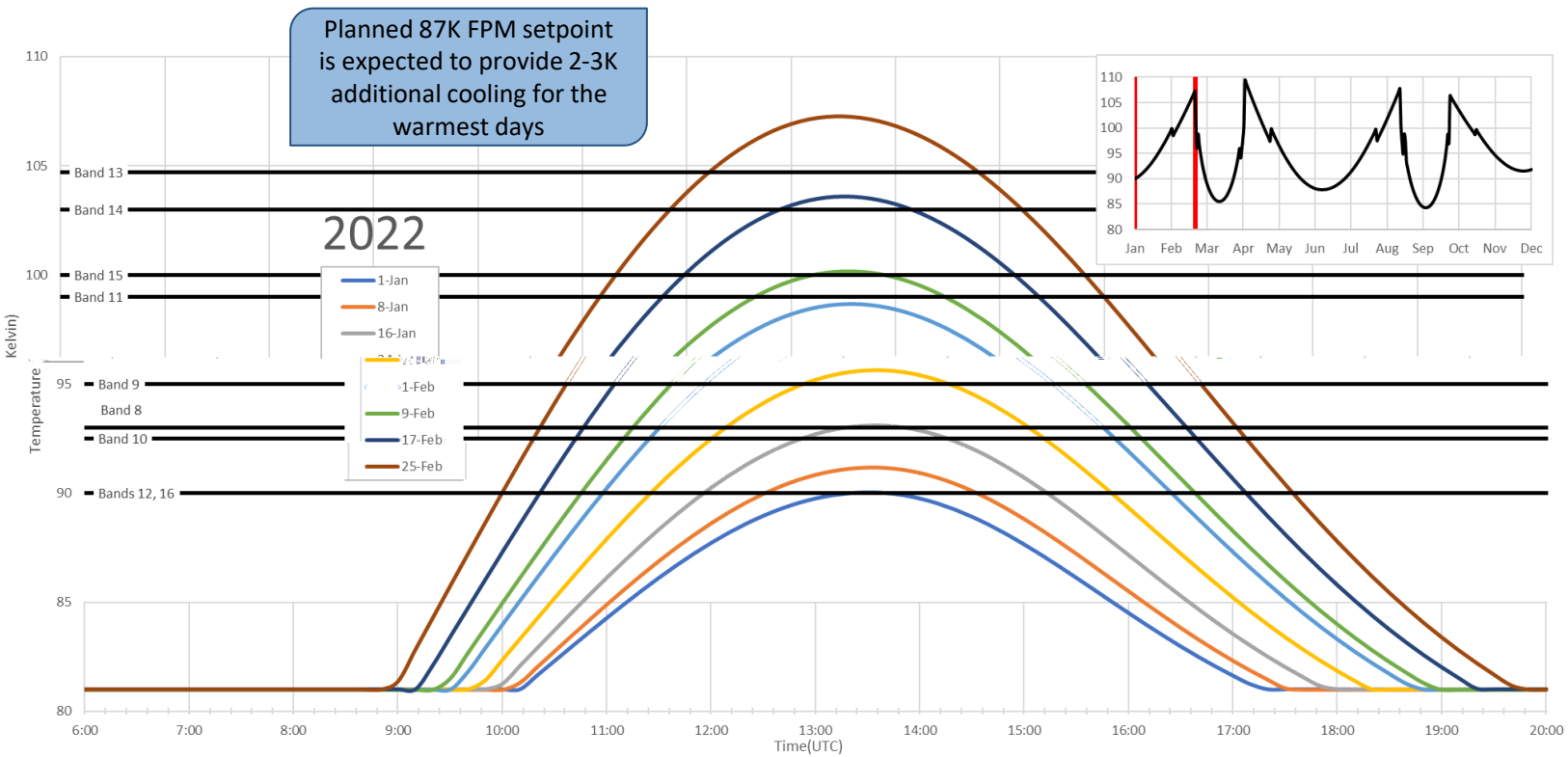
2022 GOES-17 Predicted Daily Maximum Temperatures of Focal Plane Module (FPM)

Including Marginal Saturation Thresholds for Each Band and Various Mitigations



This plot shows daily maximum temperature of the ABI focal plane module. These maximums occur at night. The higher the temperature, the more saturated imagery becomes. Where the temperature rises to approach a black line for each band, marginal saturation may be observed in imagery. Where the temperature curve exceeds a black line for each band, the imagery may begin to saturate so much that it becomes unusable. The plot also shows the cooling timelines (purple line), and yaw flips (red circles) for 2022.

Predicted Marginally Saturated Hours by Band



This plot shows hourly maximum temperature of the ABI focal plane module. The higher the temperature, the more saturated imagery becomes. Where the temperature rises to approach a black line for each band, marginal saturation may be observed in imagery. Where the temperature curve exceeds a black line for each band, the imagery may begin to saturate so much that it becomes unusable. The hour of peak temperature varies from day to day.

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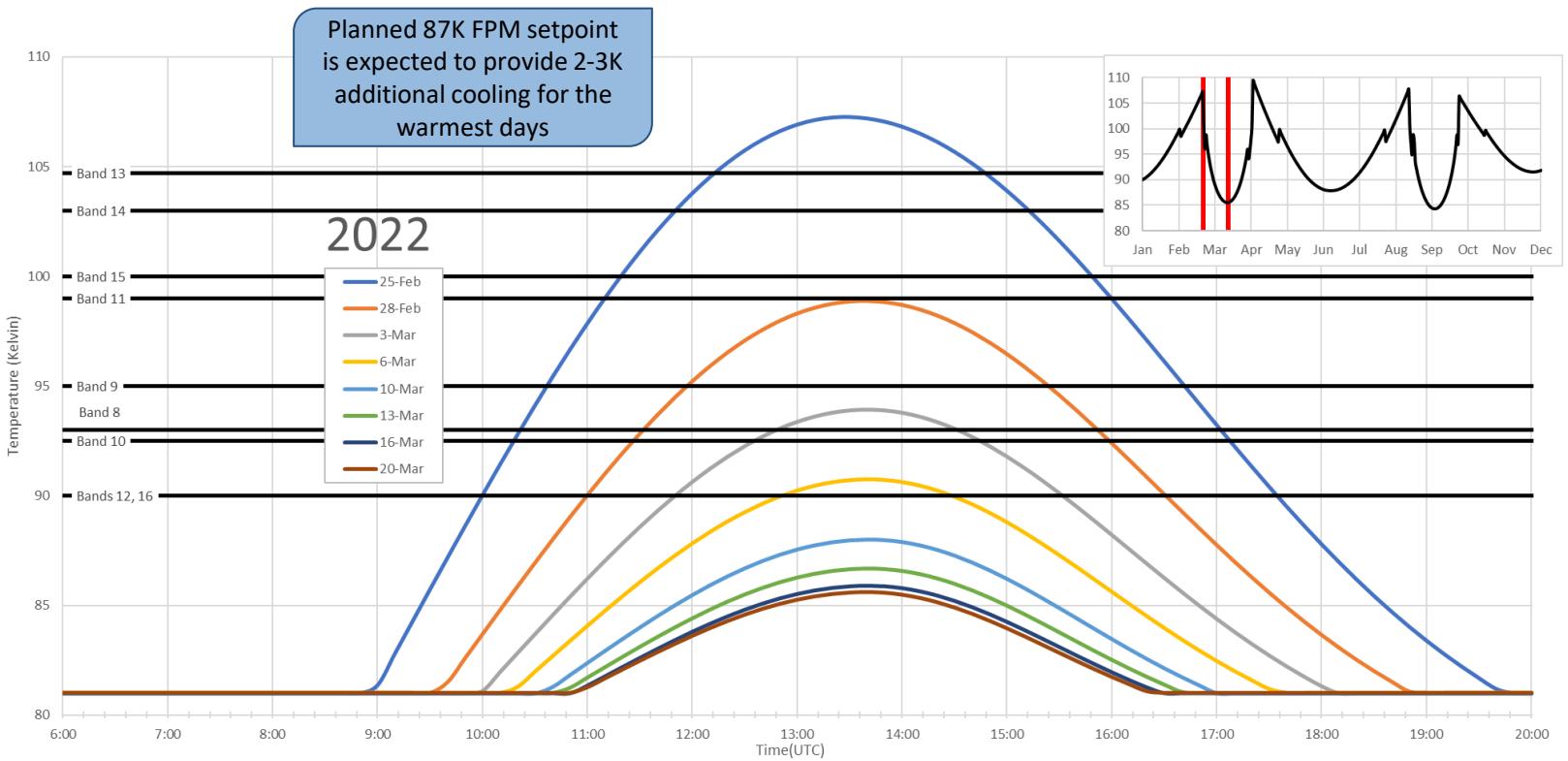

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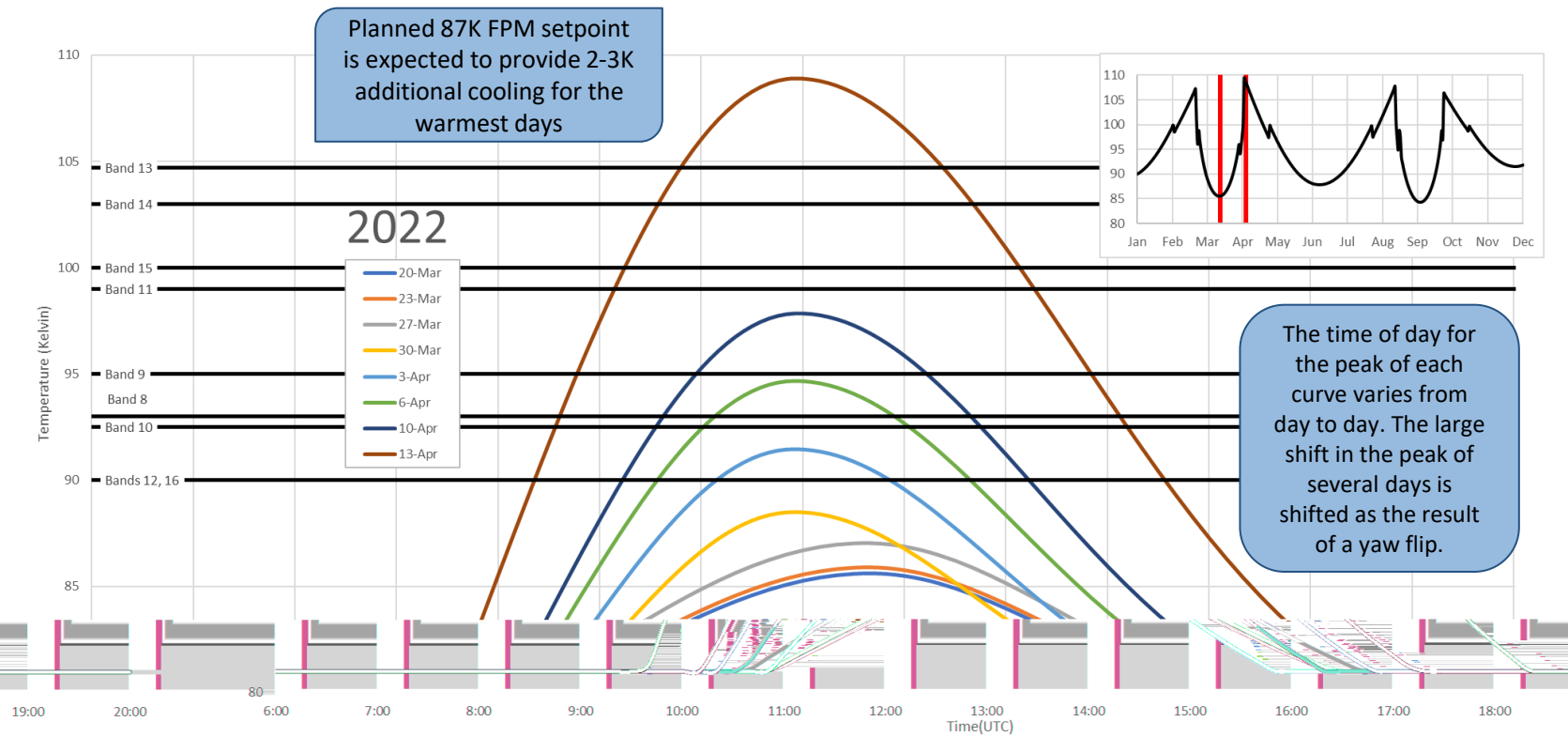

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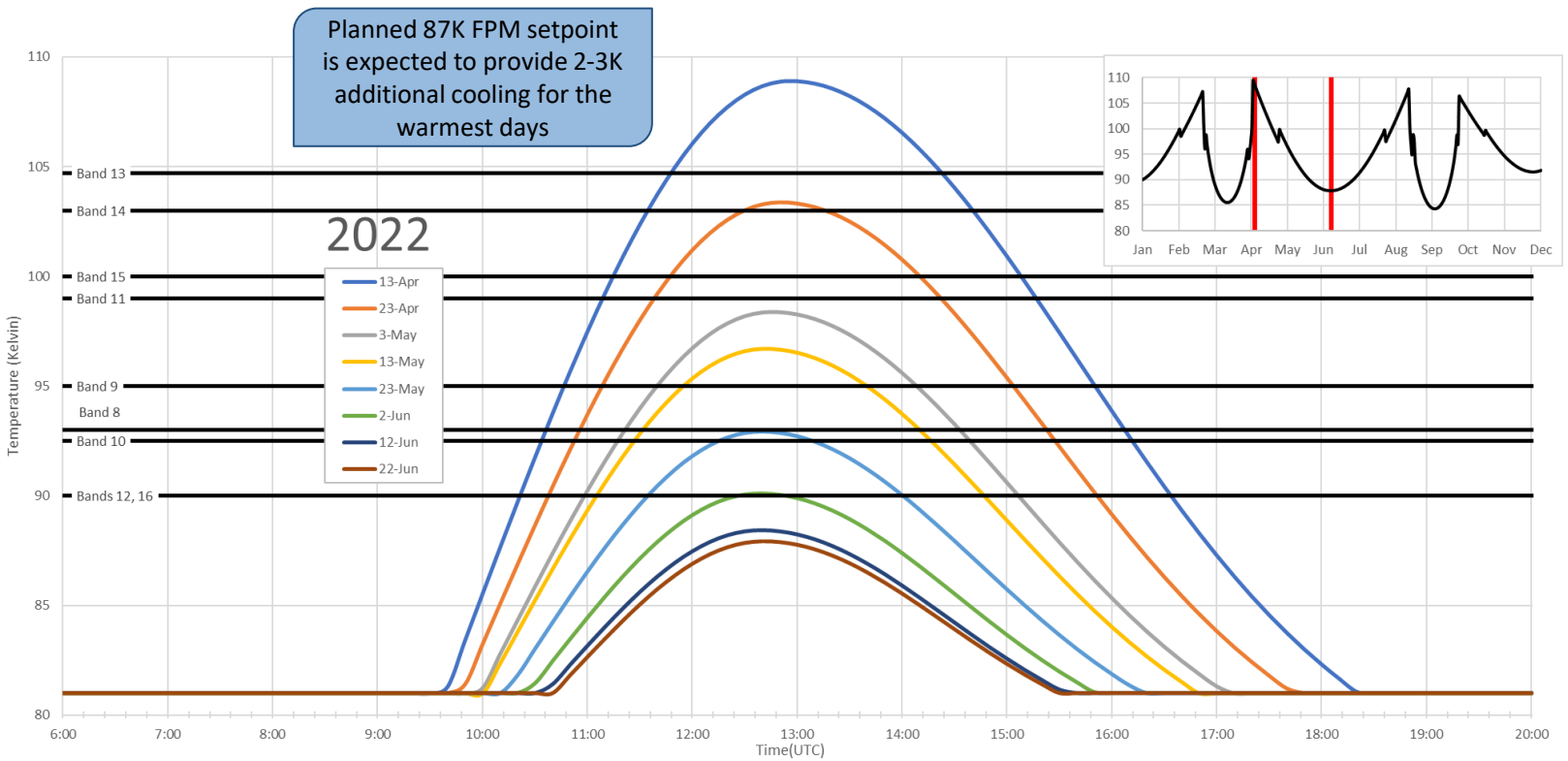

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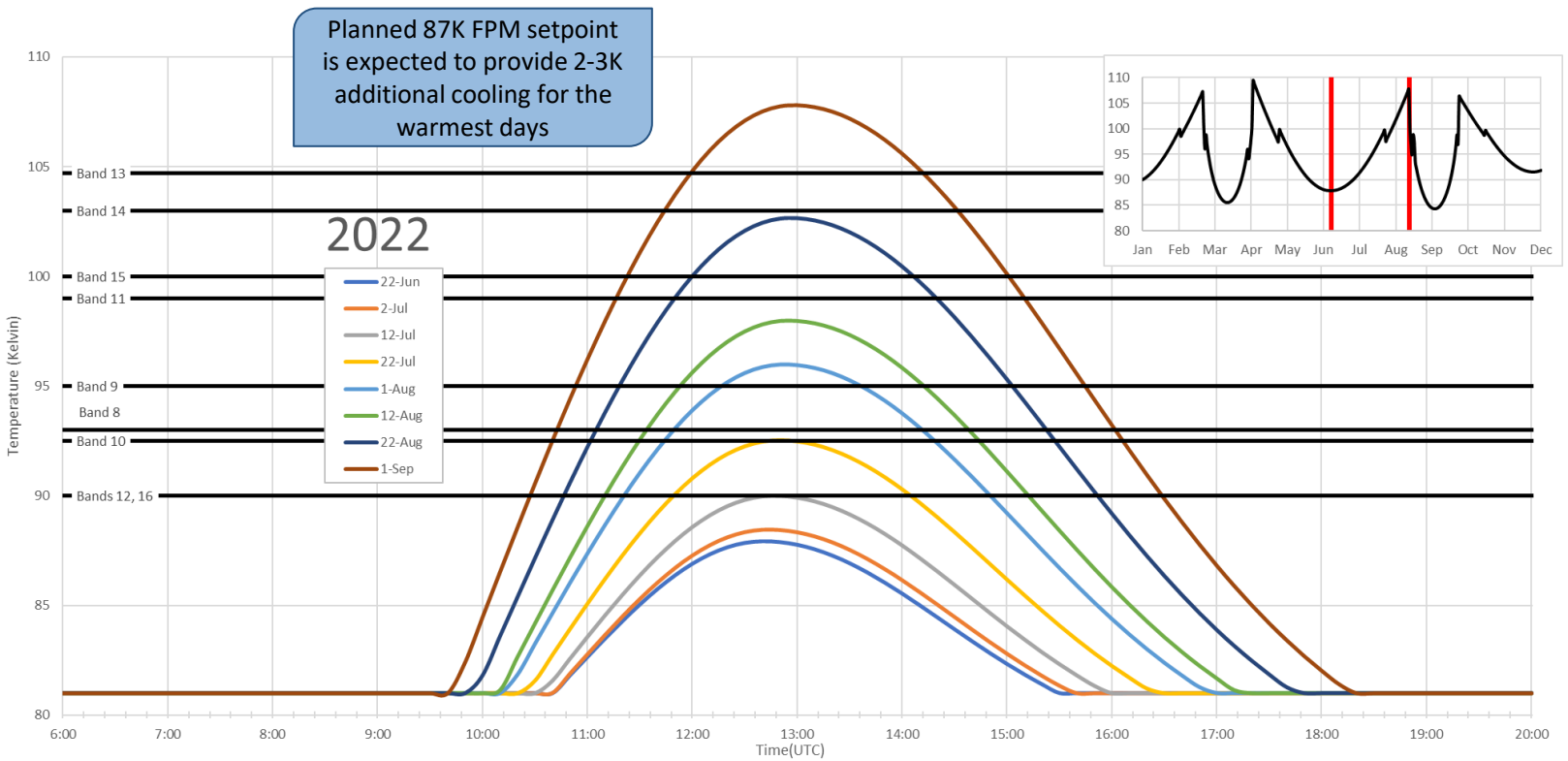

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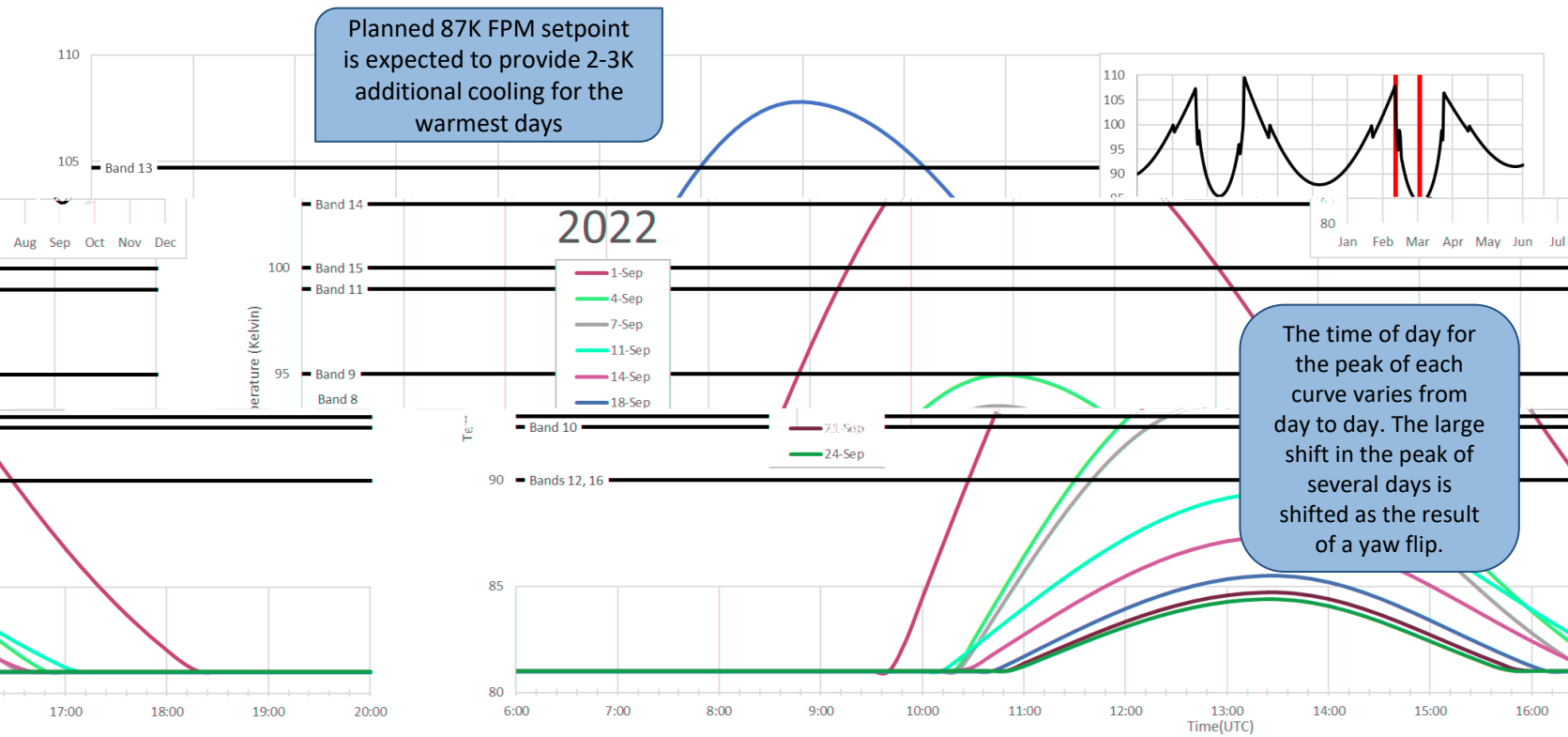

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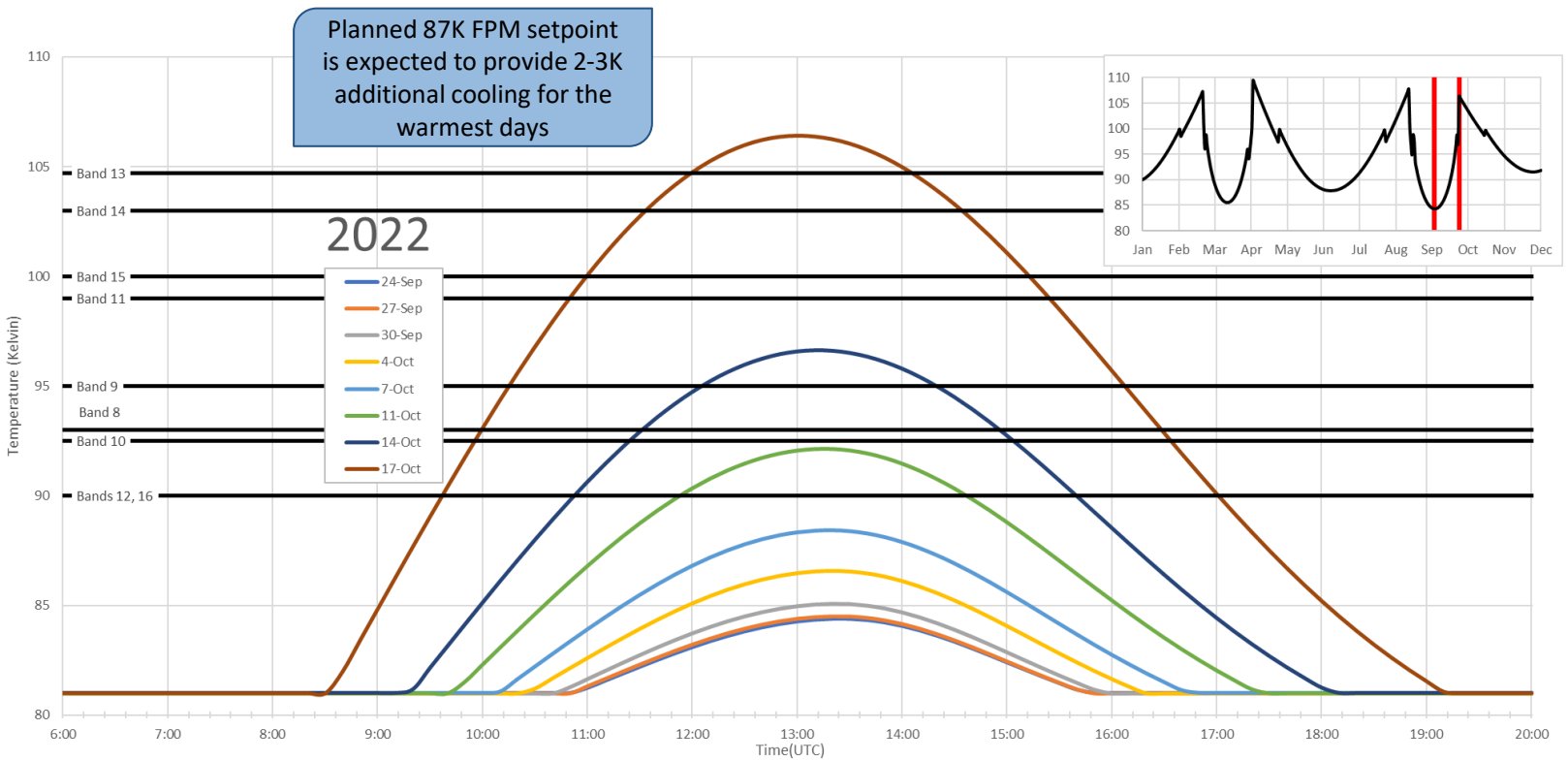

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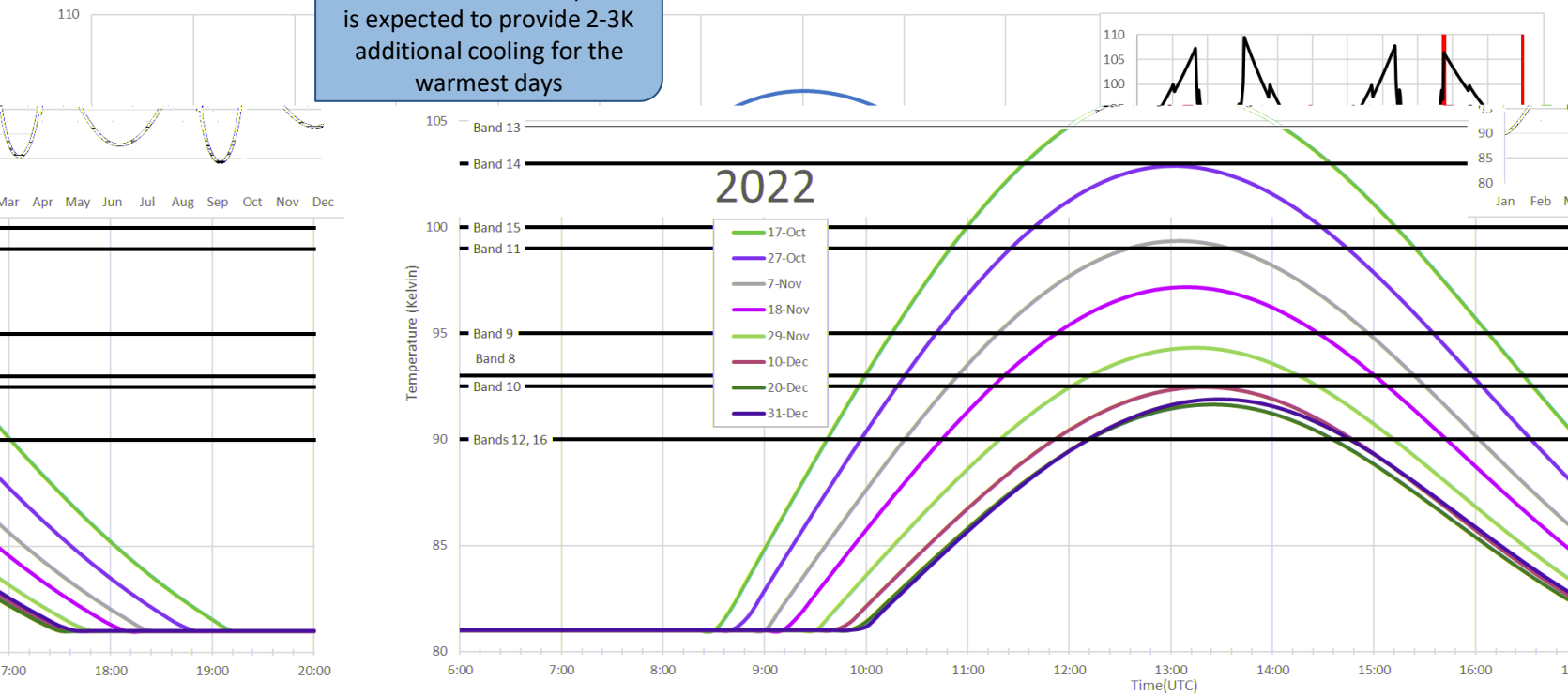
Predicted Marginally Saturated Hours by Band

Planned 87K FPM setpoint is expected to provide 2-3K additional cooling for the warmest days



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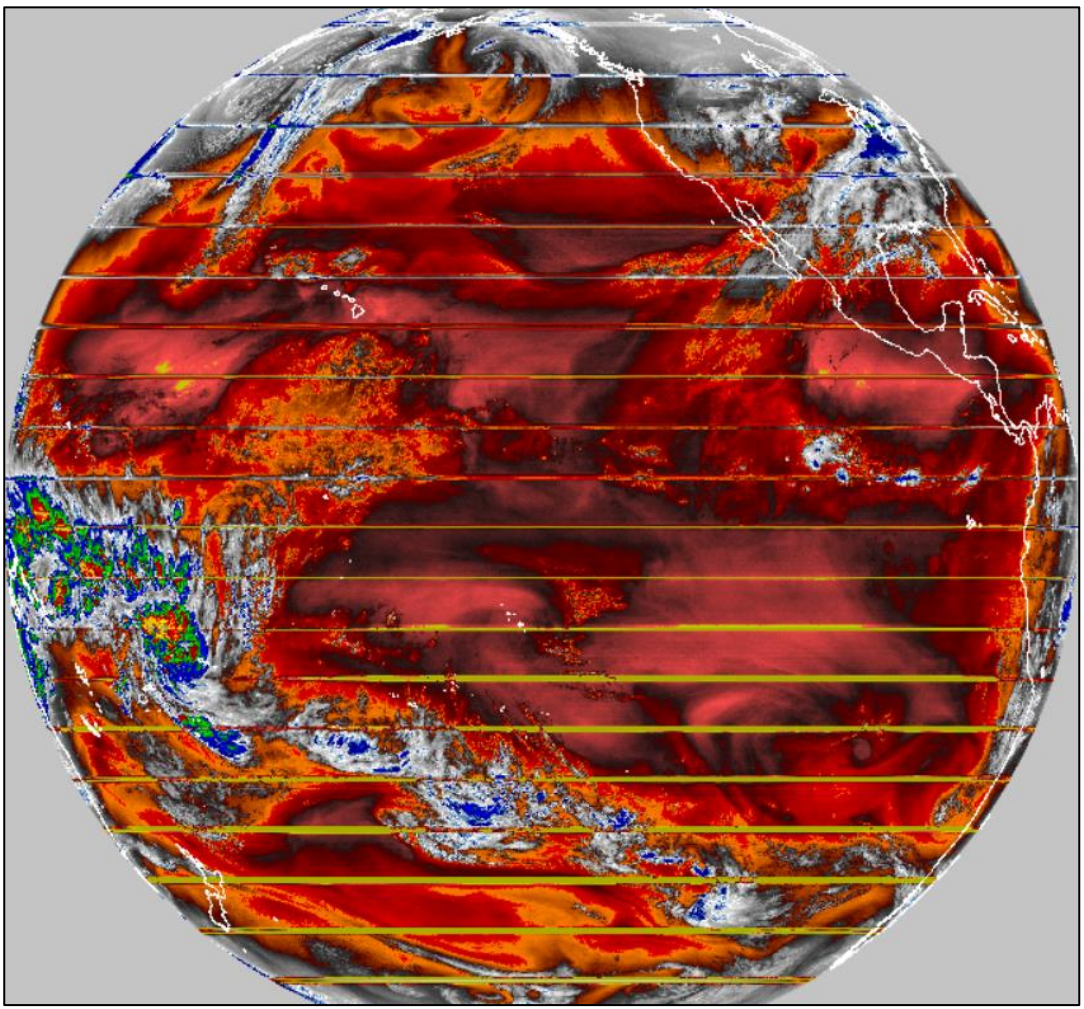
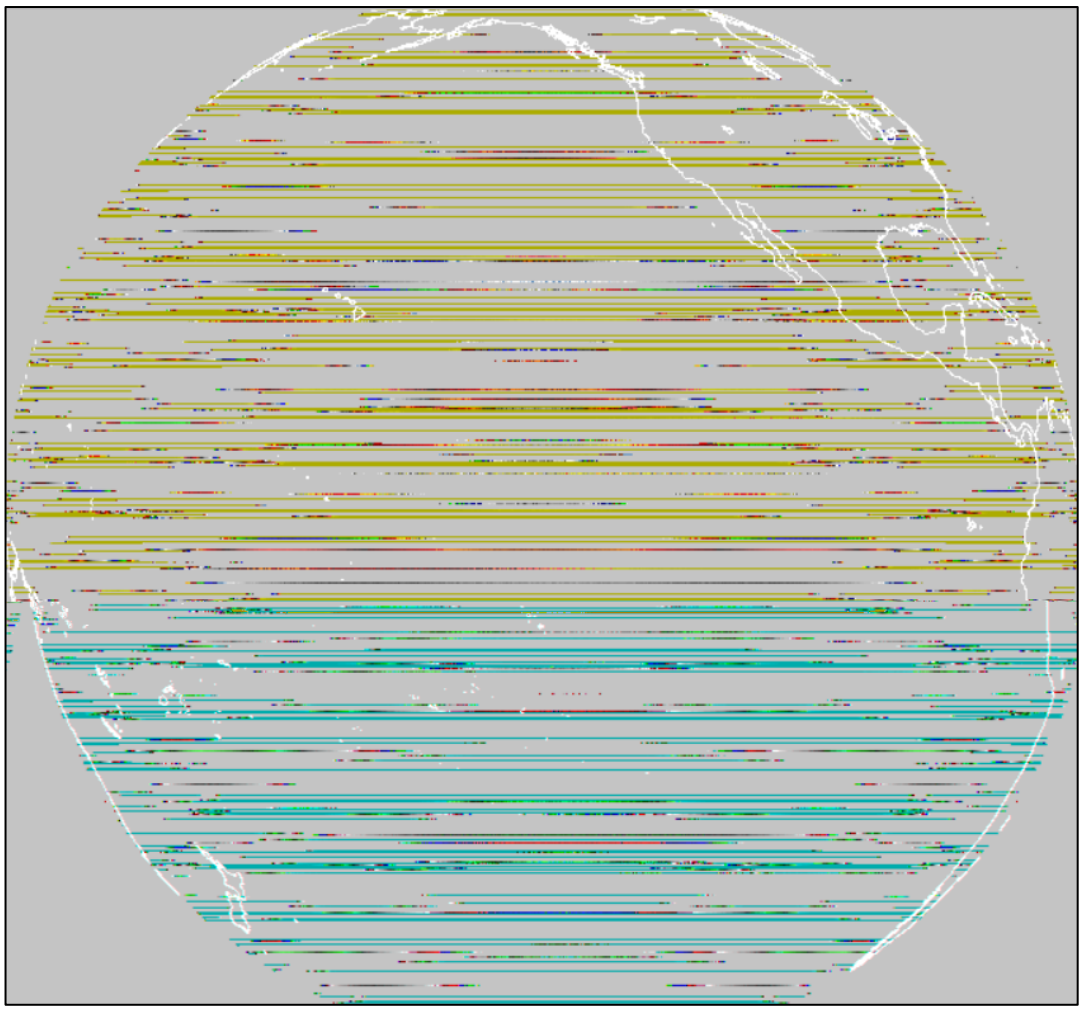
Characterization of Marginal and Unusable Hours

2022 Predictions	Characterization of Daily Maximum Values	Characterization of Diurnal Values
All Periods	For impacted days, channel saturation begins each day with impacts to bands in this chronological order: 12, 16, 10, 8, 9, 11, 15, 14, 13	Peak saturation occurs at approximately 1300-1330 UTC.
Jan 1-Feb 25	Channel impacts begin as marginal and end as unusable from the beginning to the end of time period with a slight cooling correction when the cooling timeline is turned on.	Saturation may occur between approximately 1000-1730 UTC. Peak saturation occurs at the end of the time period.
25 Feb – 20 Mar	Channel impacts begin as unusable and end as marginal from the beginning to the end of the time period with a slight warming correction when the cooling timeline is turned off.	Saturation may occur between approximately 1000-1730 UTC. Peak saturation occurs at the beginning of the time period.
20 Mar	Spring Equinox	
20 Mar –13 Apr	Channel impacts begin as marginal and end as unusable from the beginning to the end of time period with a slight cooling correction when the cooling timeline is turned on.	Saturation may occur between approximately 1030-1630 UTC. Peak saturation occurs at the end of the time period.
13 Apr-Jun 22	Channel impacts begin as unusable and end as marginal from the beginning to the end of the time period with a slight warming correction when the cooling timeline is turned off.	Saturation may occur between approximately 1030-1630 UTC. Peak saturation occurs at the beginning of the time period.
21 Jun	Summer Solstice	
Jun 22-Sep 1	Channel impacts begin as marginal and end as unusable from the beginning to the end of time period with a slight cooling correction when the cooling timeline is turned on.	Saturation may occur between approximately 1030-1630 UTC. Peak saturation occurs at the end of the time period.
1 Sep – 24 Sep	Channel impacts begin as unusable and end as marginal from the beginning to the end of the time period with a slight warming correction when the cooling timeline is turned off.	Saturation can occur between approximately 1030-1630 UTC. Peak saturation occurs at the beginning of the time period.
22 Sep	Fall Equinox	
24 Sep-17 Oct	Channel impacts begin as marginal and end as unusable from the beginning to the end of time period with a slight cooling correction when the cooling timeline is turned on.	Saturation can occur between approximately 0930 1700 UTC. Peak saturation occurs at the end of the time period.
17 Oct – 31 Dec	Channel impacts begin as unusable and end as marginal from the beginning to the end of the time period with a slight warming correction when the cooling timeline is turned off.	Saturation can occur between 0930-1700 UTC. Peak saturation occurs at the beginning of the time period.

Example of Marginally Saturated Image



Example of Unusable Saturated Image

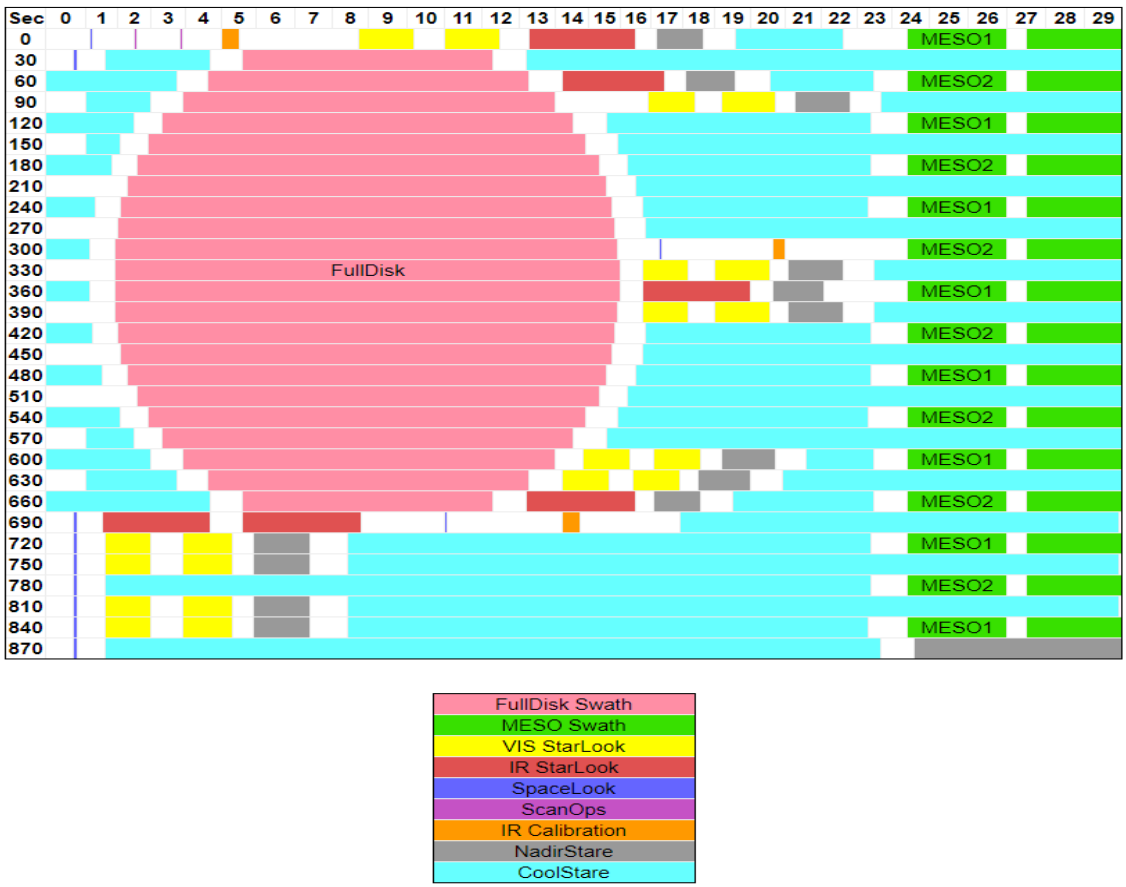


Introduction to Cooling Timeline

- Objective: Lower focal plane temperatures and decrease hours of degraded and saturated imagery
- Approach: Alter ABI timeline to spend additional time looking at cool space-looks (vs. comparably hot Earth-looks)
- Timeline runs from 0600 UTC to 1200 UTC on days when cooling timeline is active
- Past Activations
  - Feb 4, 2021 – Mar 4, 2021
  - April 2, 2021 – May 3, 2021
  - Aug 3, 2021 – Sep 3, 2021
  - Oct 9, 2021- Nov 5, 2021
- Upcoming Activations
  - Feb 3, 2022 – Feb 27, 2022
  - ~April 3, 2022 – May 3, 2022
  - ~Aug 5, 2022 – Sep 3, 2022
  - ~Oct 14, 2022- Nov 5, 2022

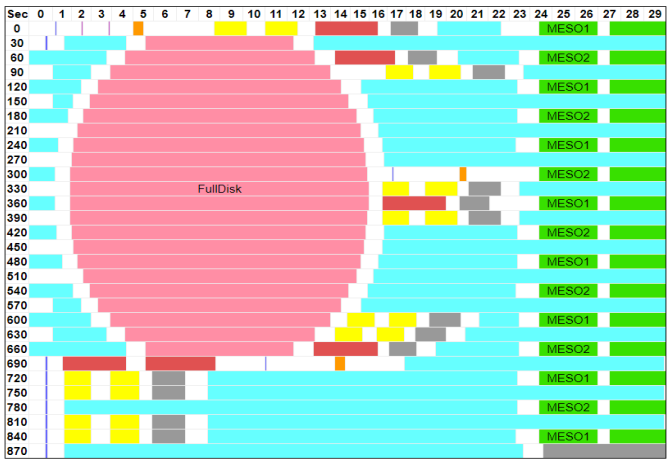
Introduction to Cooling Timeline

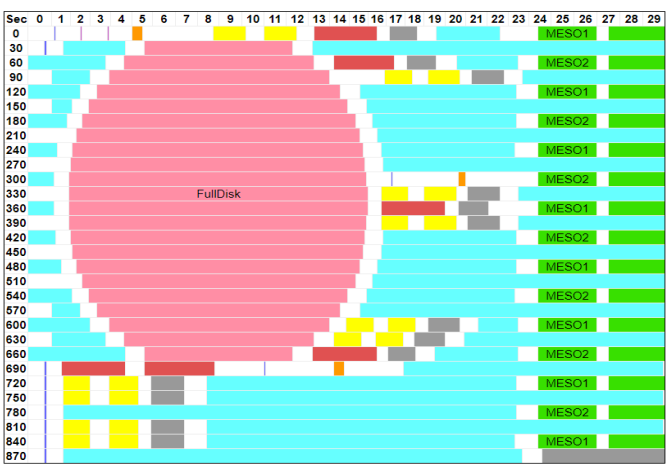
- Classified as Mode 3:
  - 15 min Full Disk
  - No CONUS
  - Alternating MESO 1/minute
- Compare to Nominal Mode 6:
  - 10 min Full Disk
  - 5 min CONUS
  - MESO 2x1 min / 1x30 sec



Modified from https://www.ospo.noaa.gov/Operations/GOES/west/Mode3G_Cooling_Timeline_G17.html

Introduction to Cooling Timeline





Over the same time period, Mode 3, replaces three nominal Mode 6 Timelines with two Cooling Timelines:

Full Disk: 6 to 4
CONUS: 6 to 0
MESO: 60 to 30

FullDisk Swath
MESO Swath
VIS StarLook
IR StarLook
SpaceLook
ScanOps
IR Calibration
NadirStare
CoolStare

Modified from https://www.ospo.noaa.gov/Operations/GOES/west/Mode3G_Cooling_Timeline_G17.html

Observed Cooling Timeline Benefit

Metric	April 9 – May 1, 2020	August 12 – September 1, 2020	Note
Reduction of Peak FPM Temperature	~3-5 K	~4-5 K	Greater benefit on warmest days
Minutes of Additional Unsaturated Images	30-130 minutes	30-120 minutes	
# of Additional Unsaturated Images	2-6 Full Disk	1-5 Full Disk	More extra images during the daily falling FPM temperature side (after peak temperatures) than during the rising side (before peak temperatures)
	2-10 CONUS	2-8 CONUS	
	50-150 MDS	30-100 MDS	

Source: Fred Wu