Current State of Satellite-Derived Wind Assimilation in NCEP GSI

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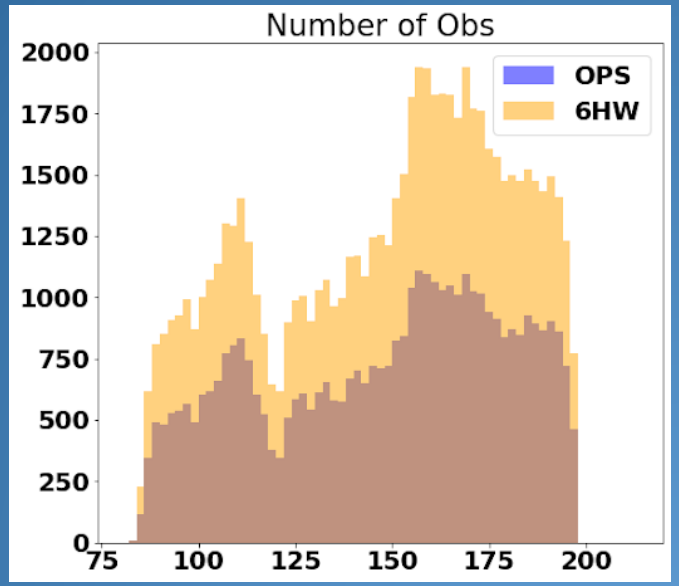
Geostationary Satellite Changes

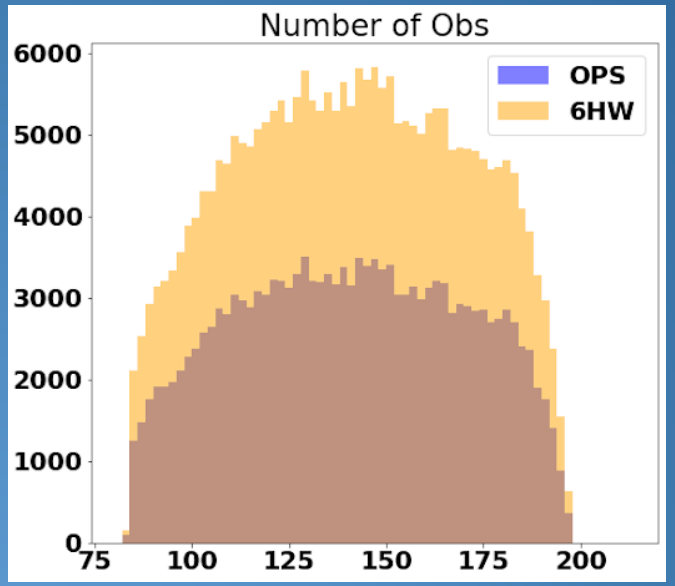
- Himawari-8 AMVs were replaced with Himawari-9
- Meteosat-8 AMVs were replaced with Meteosat-9
- Meteosat-10 and Meteosat-11 performed a switch of both task and orbit, replacing M11 AMVs with M10
- GOES-17 AMVs were replaced with GOES-18

Many of these changes occurred without incident, although a few of them raised issues for EMC

Himawari 8 → 9



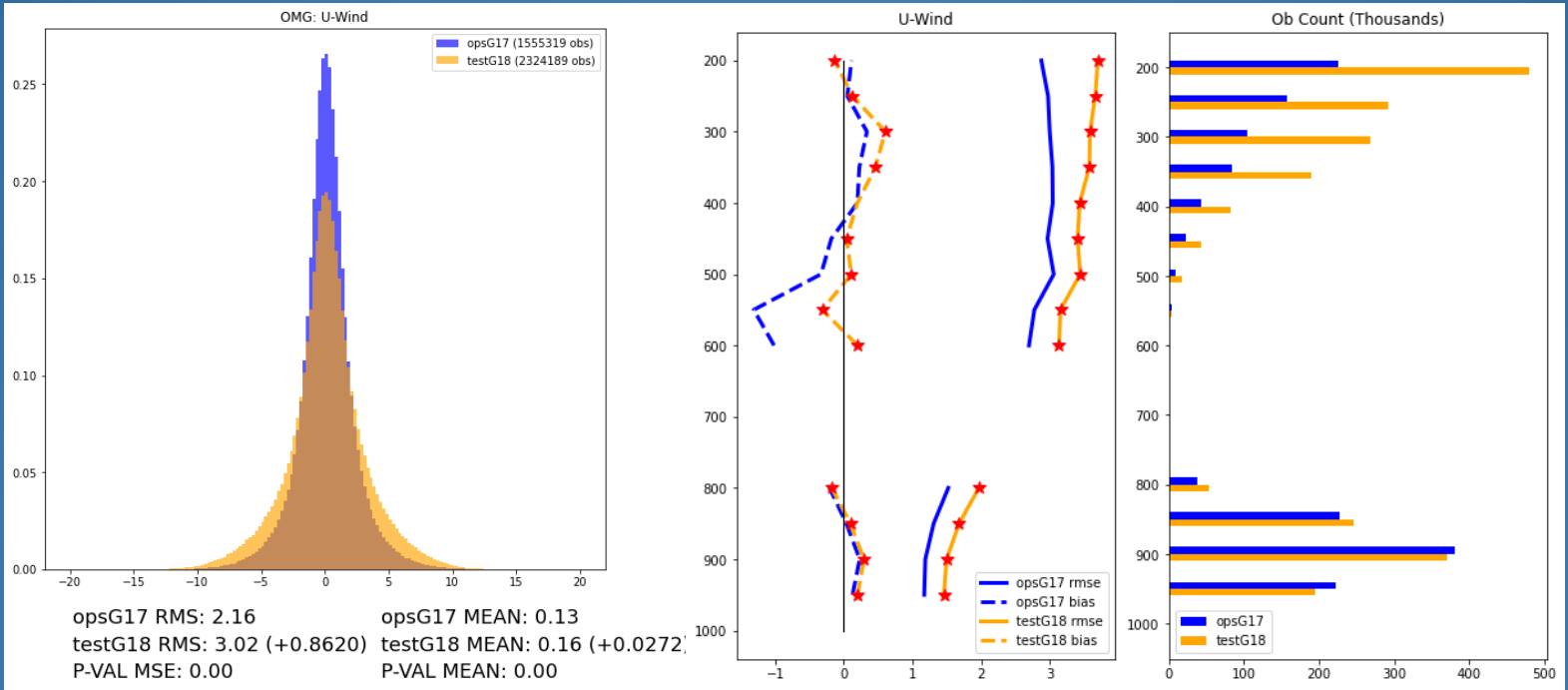
Lower Troposphere



Upper Troposphere

The AMV **quality did not change** between **H8 → H9**, but it was discovered that operations is currently only assimilating Himawari AMVs within a **restricted 3-hr window** around the analysis time. This appears to be **accidental**.

GOES-17 → GOES-18



Initial tests of GOES-18 AMVs, monitoring OmB statistics **without assimilation**, showed a **significant RMS increase** relative to operational GOES-17 AMVs. These departures were **not** present during cycled assimilation tests performed later.

GOES-17 → GOES-18

Cycled experiment Oct 01 – Nov 20 2022 dealt with **multiple irregularities in AMV counts**

Oct 01

Nov 20

GOES-17 → GOES-18

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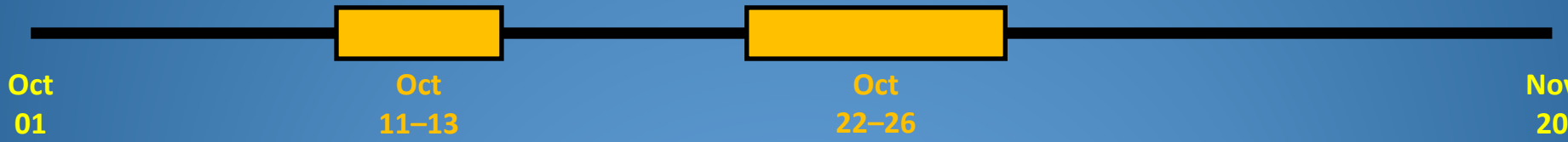

GOES-18 AMV outages: Revert to GOES-17 AMVs in assimilation, forecasts not evaluated

GOES-17 → GOES-18

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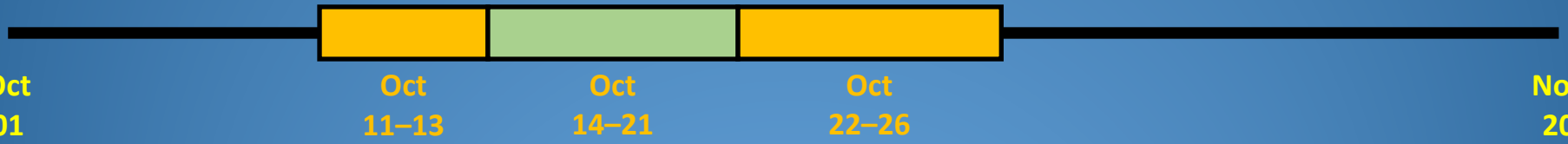

GOES-18 AMV outages: Revert to GOES-17 AMVs in assimilation, forecasts not evaluated
GOES-17 FPM overheating: Cloud-top WV AMV ob-counts drastically reduced

GOES-17 → GOES-18

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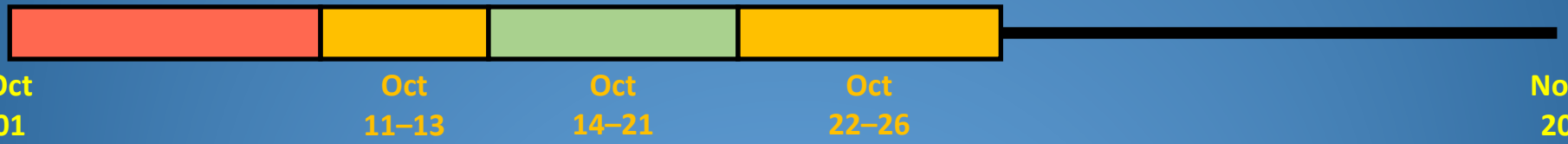

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GOES-18 AMV low counts: Overall low ob-counts compared to GOES-17

GOES-17 → GOES-18

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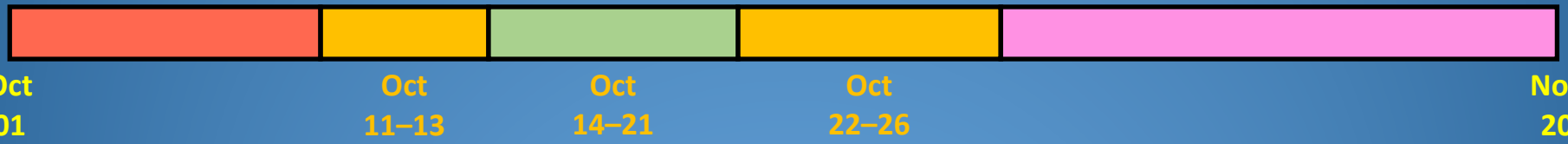
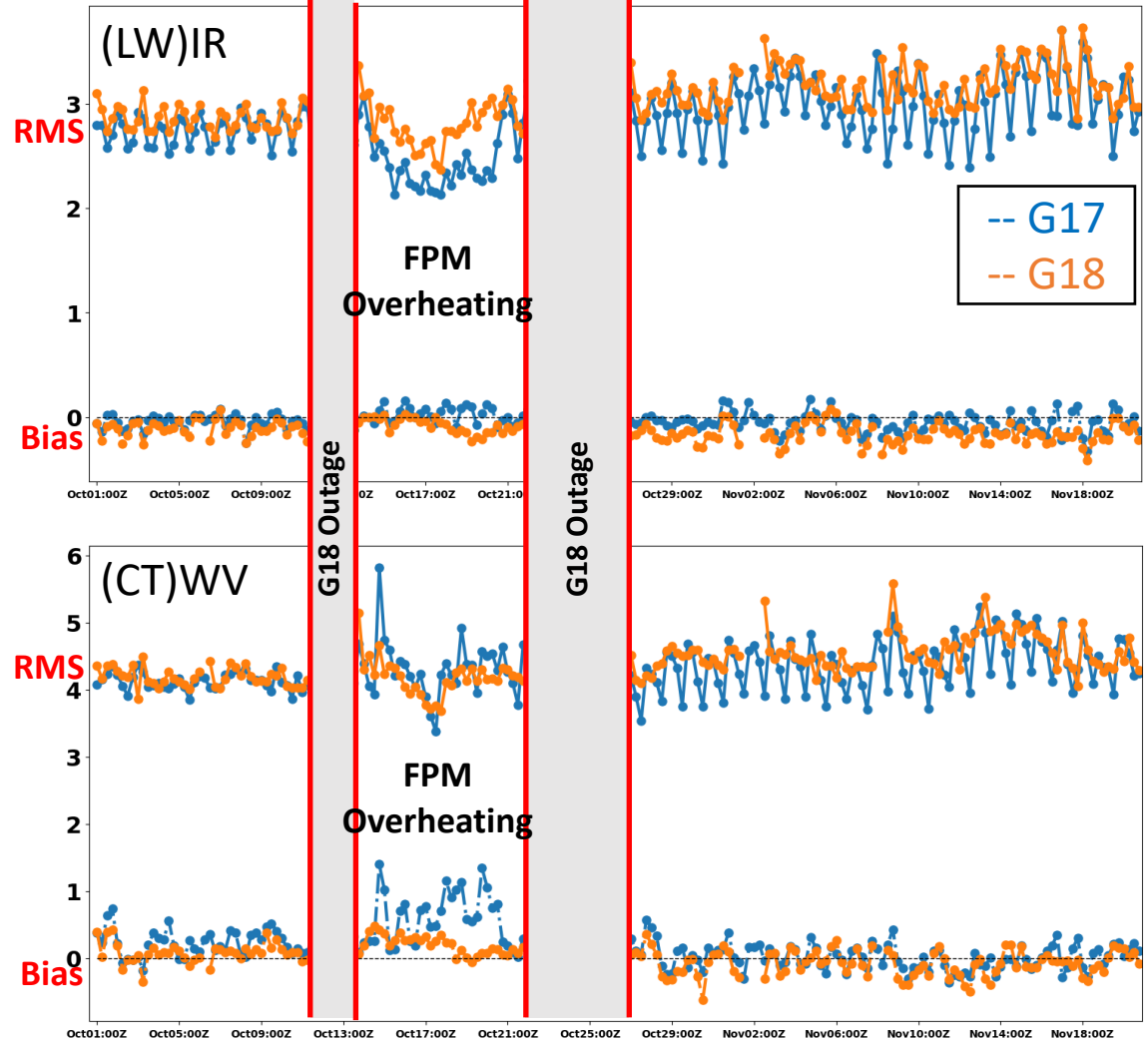


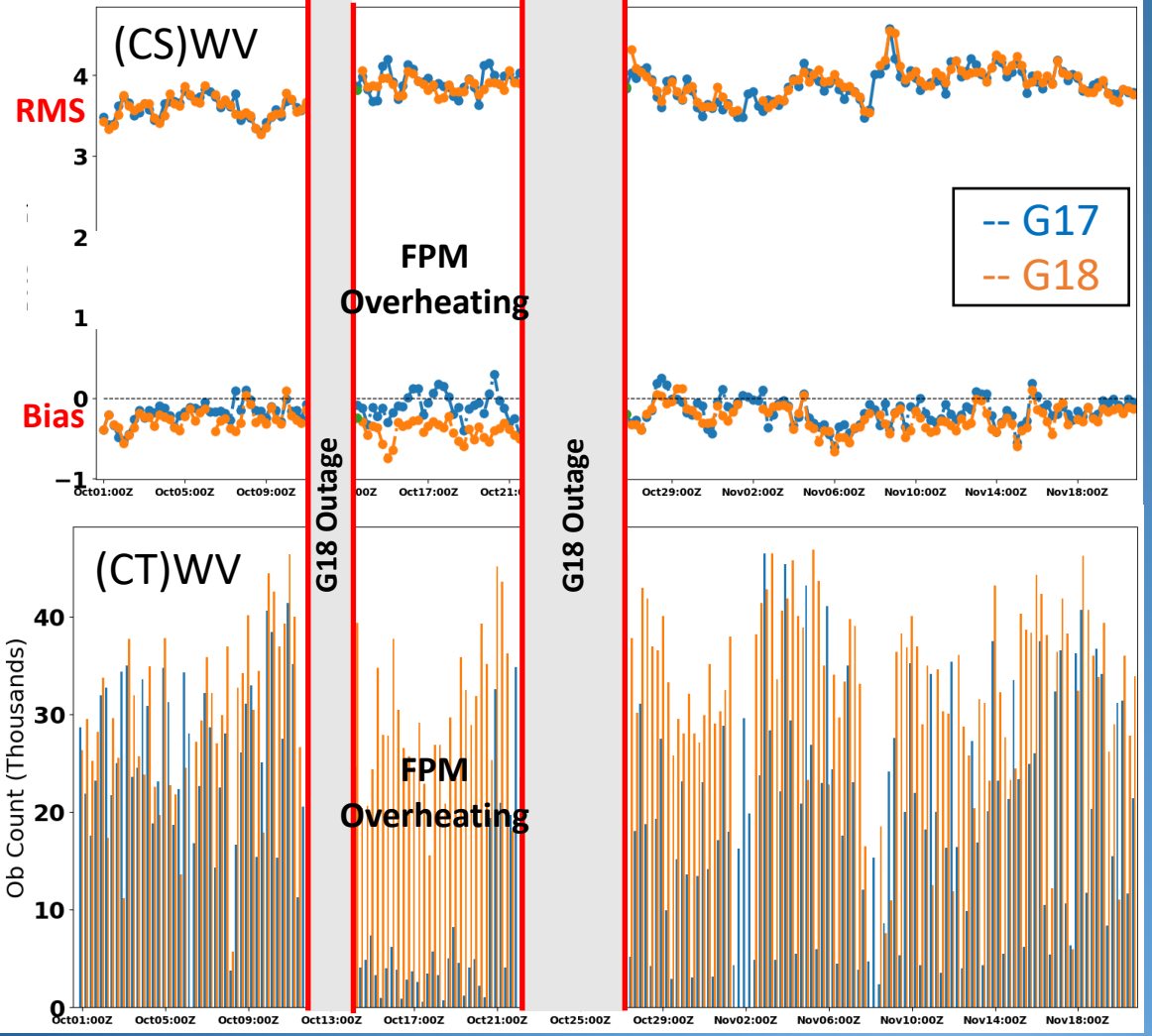
GOES-18 AMV outages: Revert to GOES-17 AMVs in assimilation, forecasts not evaluated
GOES-17 FPM overheating: Cloud-top WV AMV ob-counts drastically reduced
GOES-18 AMV low counts: Overall low ob-counts compared to GOES-17
GOES-17 AMV diurnal variation: Likely continued, diurnal FPM heating problems



(LW)IR AMVs from GOES-17 express **exaggerated saw-toothing** of RMS in late Oct through Nov, **probably diurnal FPM overheating**

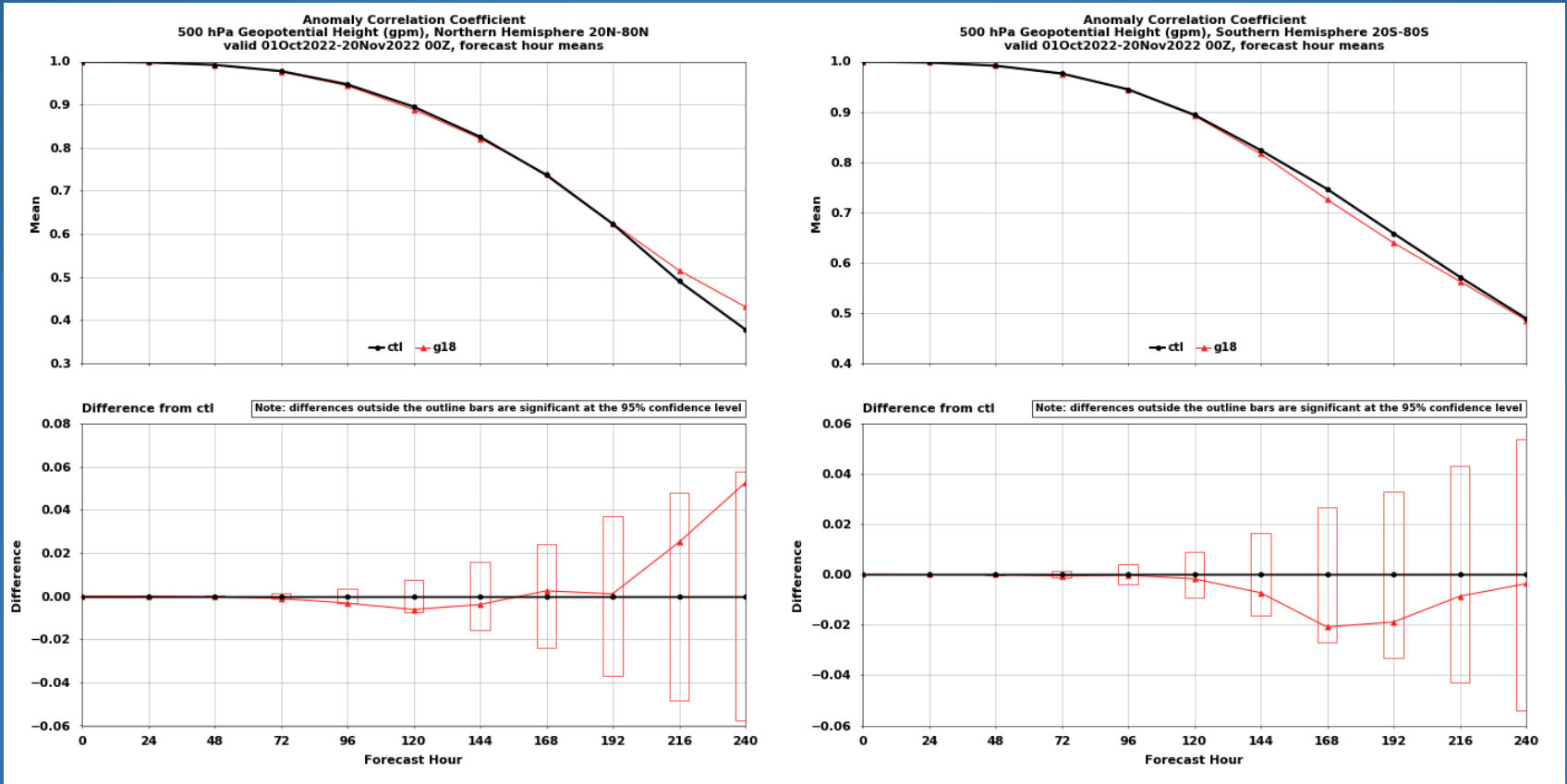
(CT)WV AMVs from GOES-17 also express this diurnal variation, and **biases are large when ob-counts are small during peak overheating**.

GOES-18 AMVs show less variation.

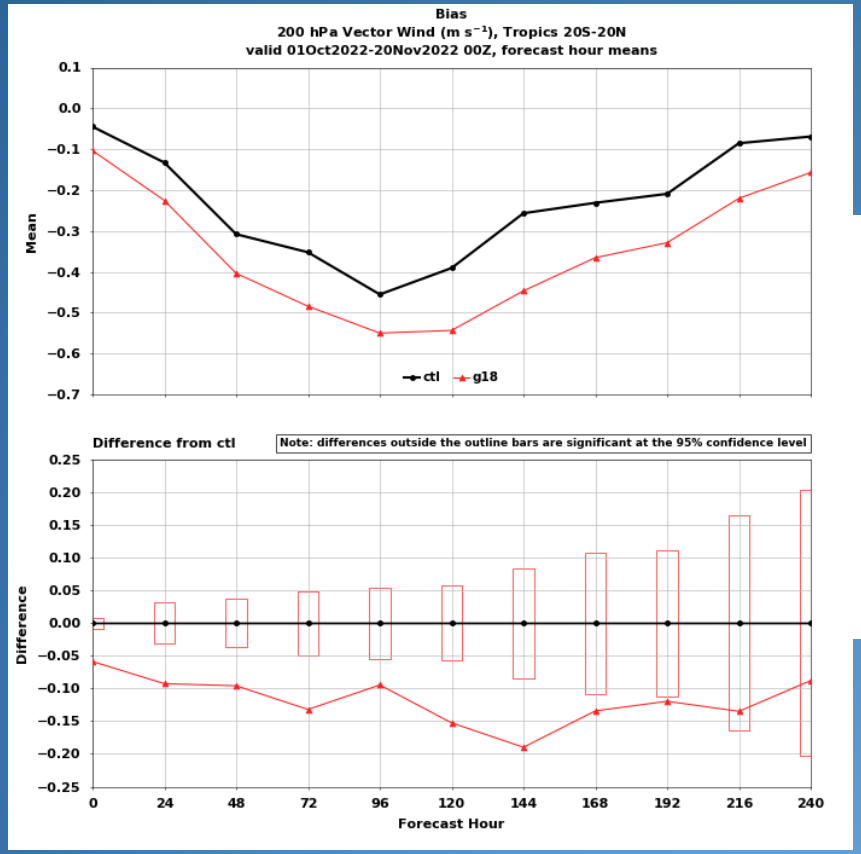


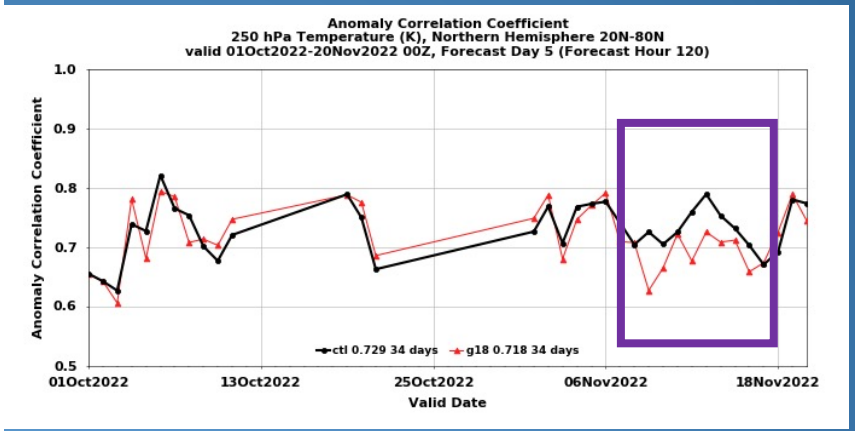
By comparison, (CS)WV AMVs show **very little difference** between GOES-17 and GOES-18, and **no exaggerated diurnal variation**.

GOES-18 (CT)WV AMV counts during FPM overheating period are **not dramatically reduced**, as expected.



500 hPa geopotential height ACC scores are **neutral** in both hemispheres





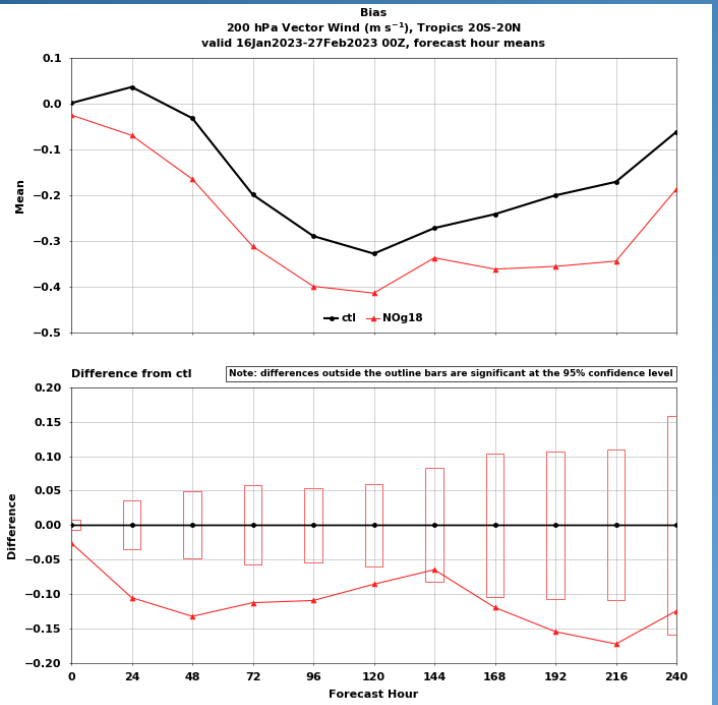
500 hPa geopotential height ACC scores are **neutral** in both hemispheres

200 hPa mean vector wind expresses a **significant negative bias in the tropics**

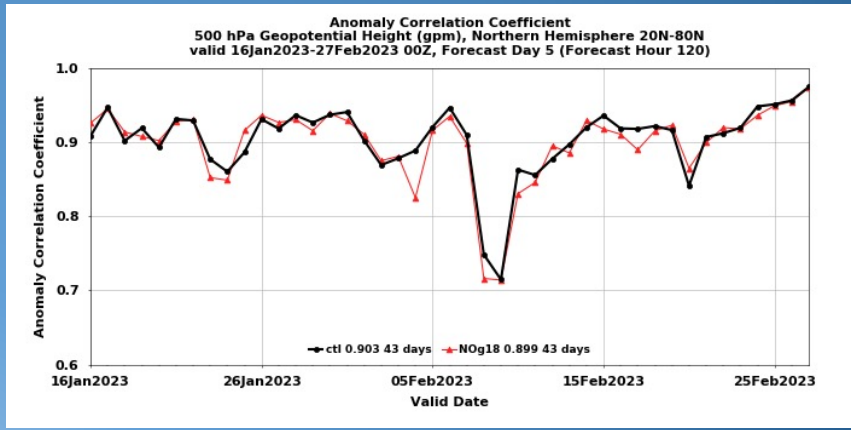
A **forecast dropout period** appears in November without a known cause

GOES-17 → GOES-18

- As a **sanity check**, a **denial** experiment was carried out over Jan–Feb 2023 to determine if GOES-18 AMVs were detrimental. This period also included a **forecast bust** initialized in early Feb.



Removing GOES-18 AMVs contributes to **degraded wind bias over the tropical upper troposphere**, and **no impact** is observed on the control's forecast bust, **validating** the AMVs as **non-detrimental**.



Low Earth Orbiting Satellite Changes

- MetOp-B AMVs underwent an algorithm change
- MetOp-C AMVs, scatterometer winds replaced MetOp-A
- UW-Madison/CIMSS LeoGeo winds introduced

A series of **impact tests** were carried out Mar–Apr 2022 to evaluate the **new MetOp-B AMVs** and the inclusion of **MetOp-C AMVs**, showing **higher ob-counts** for new AMVs and **statistically insignificant impact** on forecasts (not shown).

Upcoming Changes

- GOES AMVs will be generated by the **Enterprise Algorithm**: Early testing in 2022 showed the potential for an improved forecast, but a **GOES-18/EA impact test is TBD**
- Adding **NOAA-21 VIIRS** AMVs
- **LEO Retirements**: MODIS Terra/Aqua Dec 2023, NOAA-15/18/19 AVHRR Mar 2024 will be **lost**

Potential Future Changes

- LEO retirements may require **mitigation**
  - UW/CIMSS **LeoGeo AMVs not expected to be strongly impacted**, which provides a significant source of AMVs in LEO territory
  - Most immediate new resource may be **MetOp tandem-wind AMVs**, will consider a test following an impact test on LEO retirements w/o mitigation
- Current processing of AMVs in GSI is done with a **single, omnibus AMV BUFR file**, which holds back operational implementation of new AMVs
  - Testing strategies to **split the BUFR file** and process in-parallel to increase speed
  - **Super-obs** could be considered as another scaling-strategy as AMVs increase in number and the suite of AMV types continues expanding