



Winds development and use in the NCEP GFS data assimilation system

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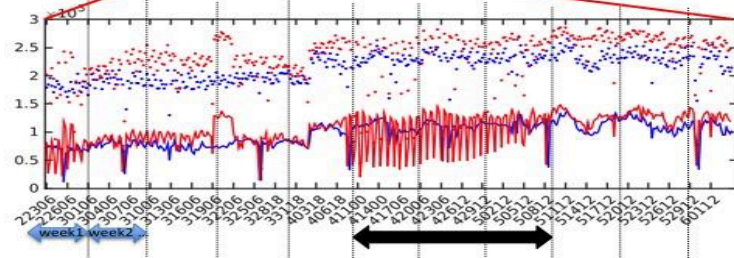
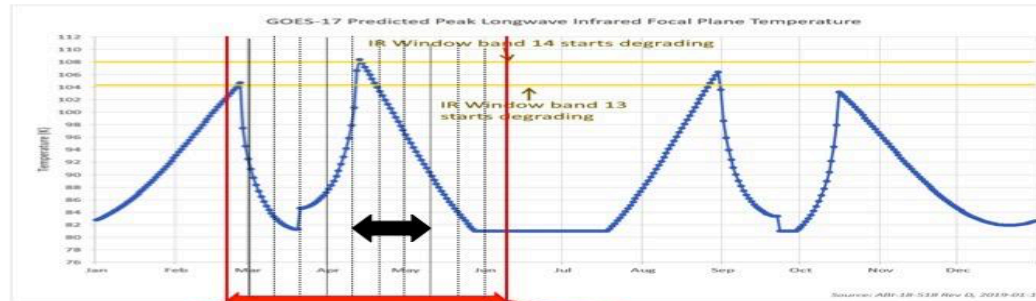
¹IMSG for NOAA/NCEP, ²NOAA/NCEP, ³NOAA/NESDIS, ⁴NOAA/AOML, ⁵CIMAS/
University of Miami, ⁶CIMSS/University of Wisconsin–Madison



Outline

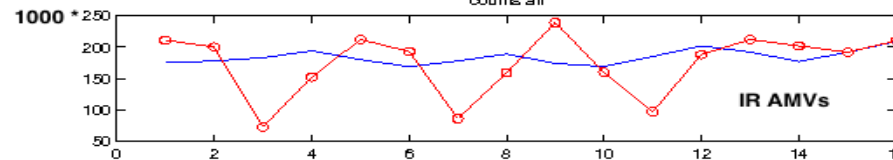
- Status of GOES-17 AMVs
- Status of NOAA-20 VIIRS AMVs
- Status of Leo-Geo AMVs
- Aeolus wind profiles - first results
- GOES-GOES Stereo winds – preliminary analysis
- Outlook

GOES-17 AMVs Loop Heat Pipe (LHP) anomaly impact on IR winds count

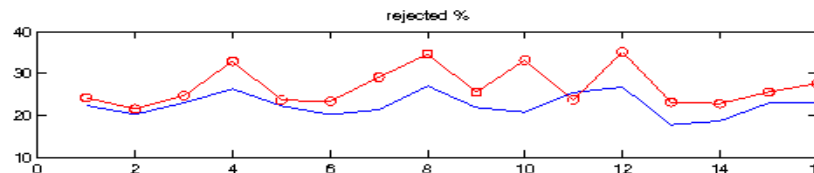


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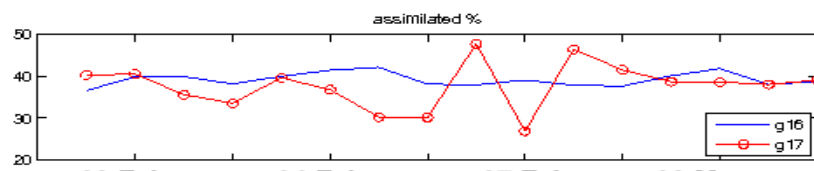
← ASSIMILATED



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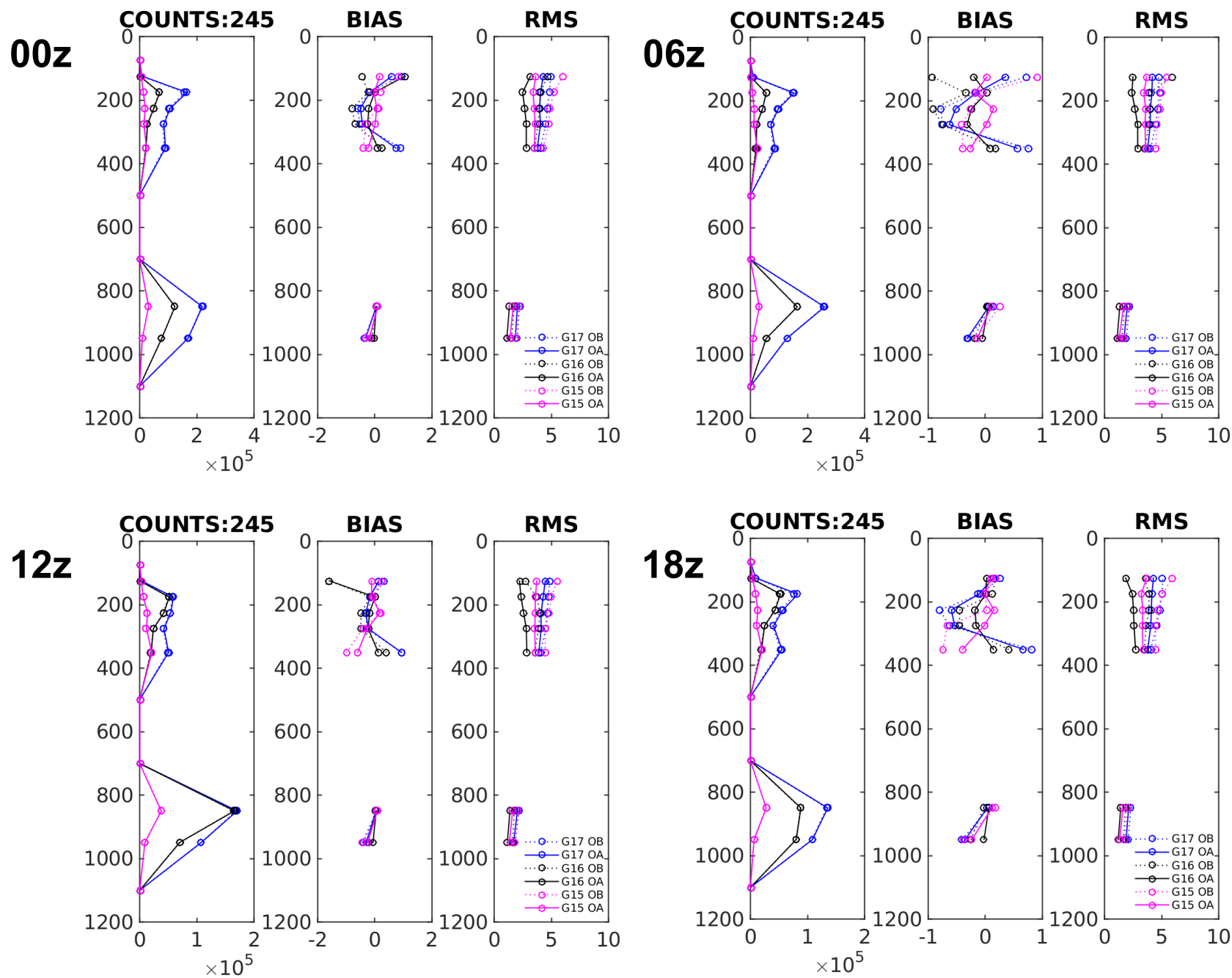
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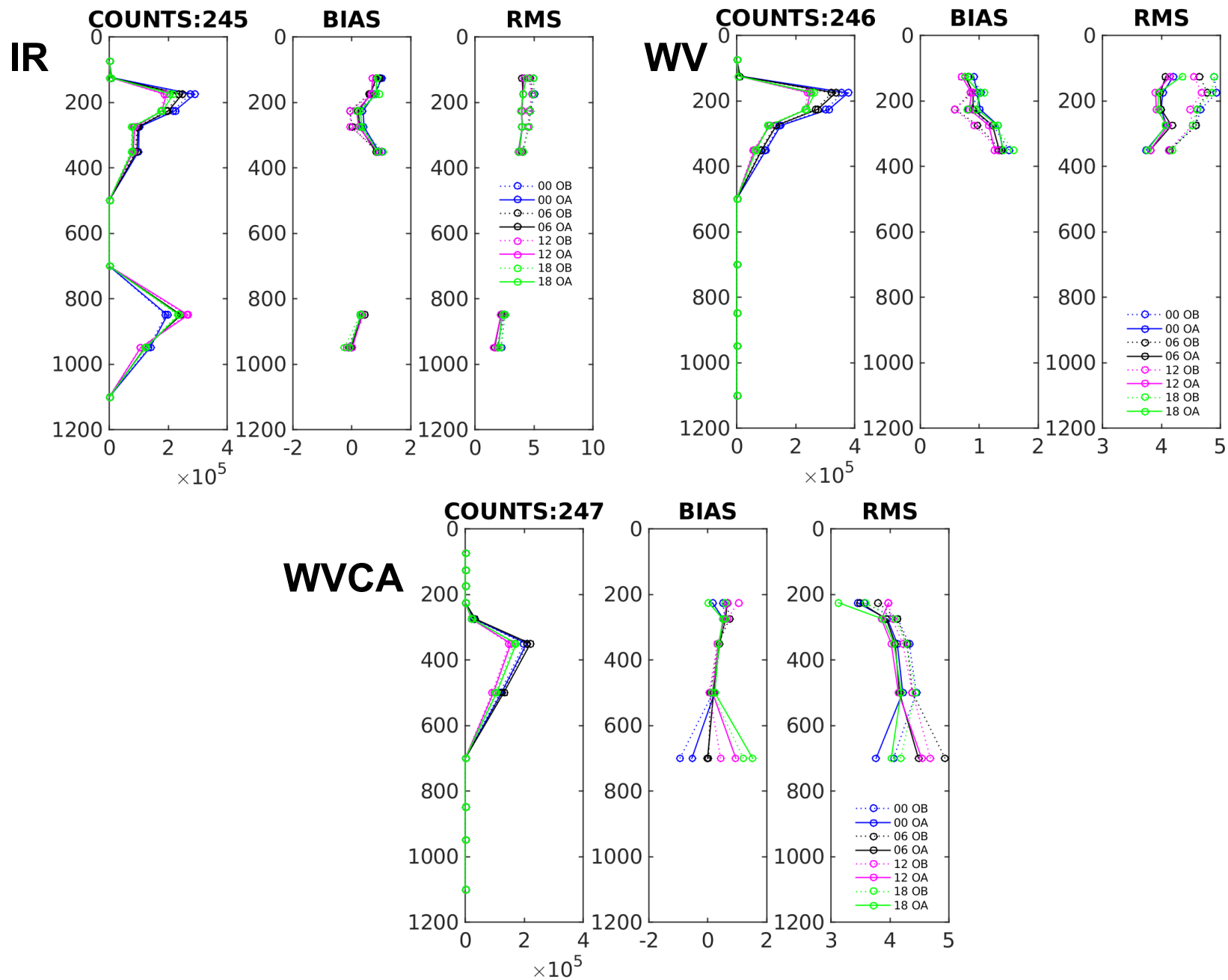
ASSIMILATED

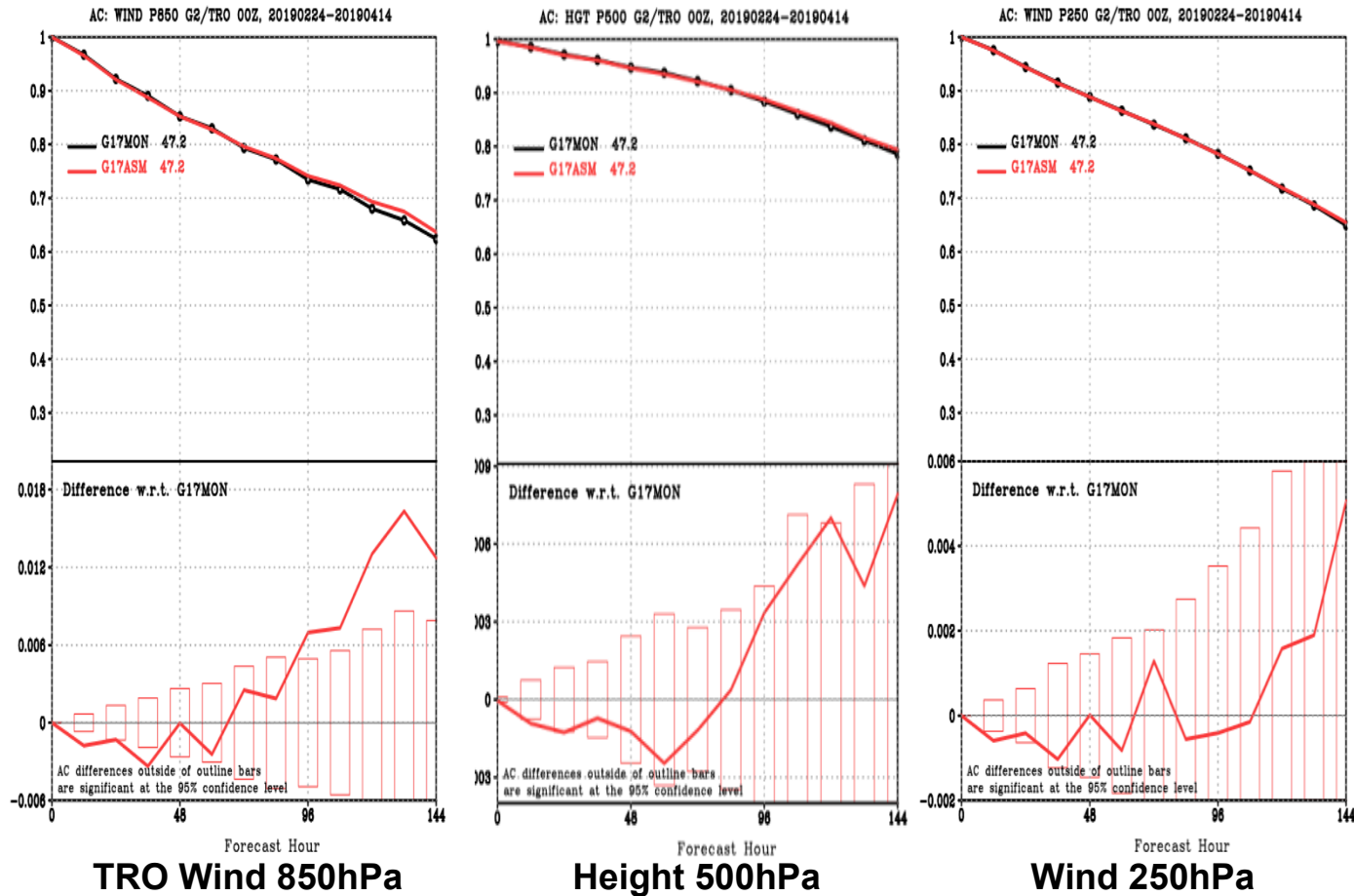
BLUE: GOES-16 RED: GOES-17

Comparison of GOES-15, GOES-16 and GOES-17 IR AMVs by AN hour



Comparison of GOES-17 IR AMVs split by Spectral type and AN hour

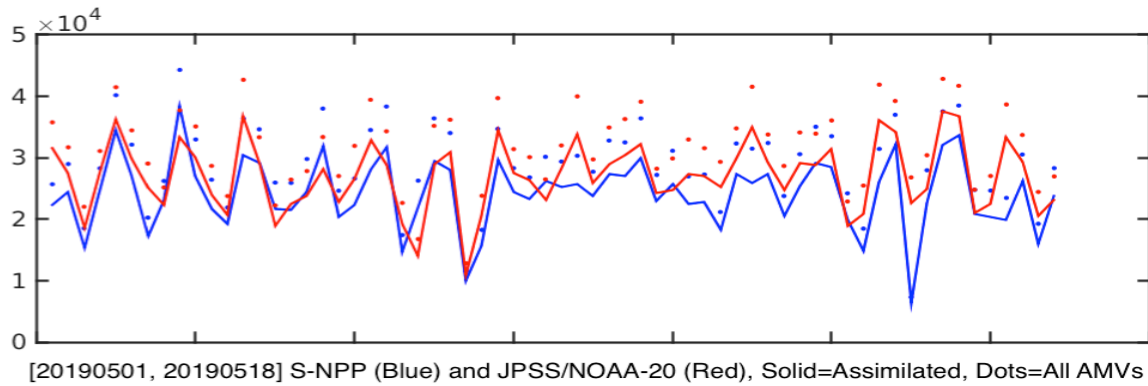




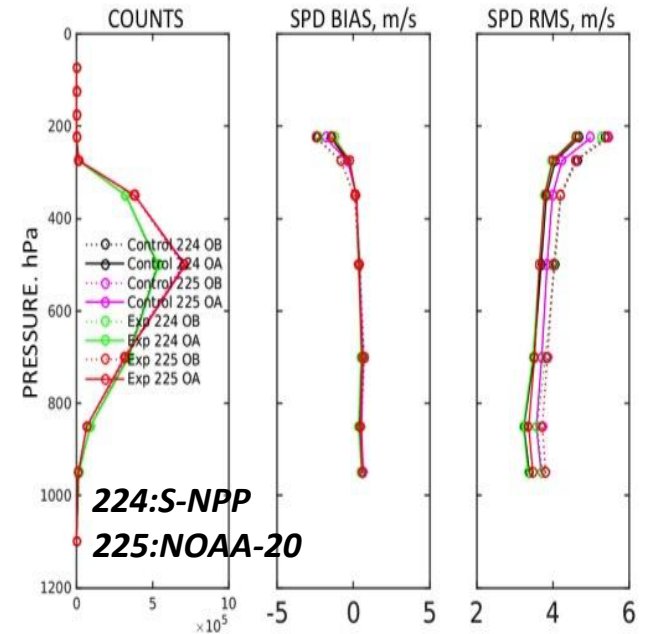
Due to the LHP issue less GOES-17 winds are assimilated at 12z and 18z. However the background departures and AN increments are consistent across all analysis hours, and comparable to these from GOES-15 and GOES-16. The forecast impact is mostly neutral aside from a slight improvement in the 120-144h FC in the tropics at 850hPa.

Operational assimilation of GOES-17 AMVs began November 2019

JPSS/NOAA-20 VIIRS AMVs



S-NPP and NOAA-20 VIIRS AMVs comparison

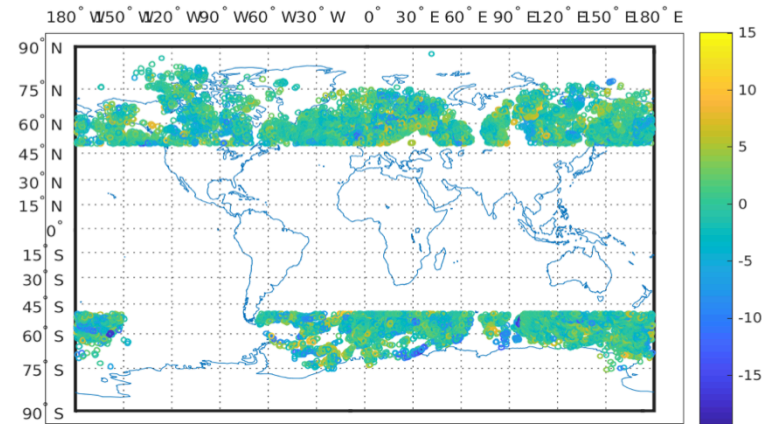


NCEP began assimilating S-NPP VIIRS winds in 2016. NOAA-20 nearly doubled the VIIRS winds while quality remained good. Operational assimilation started Sep 2019 with neutral to positive forecast impact. The VIIRS winds BUFR table was updated Dec 2019. A code bug set the winds temporarily to monitoring mode but assimilation will resume in 2021.

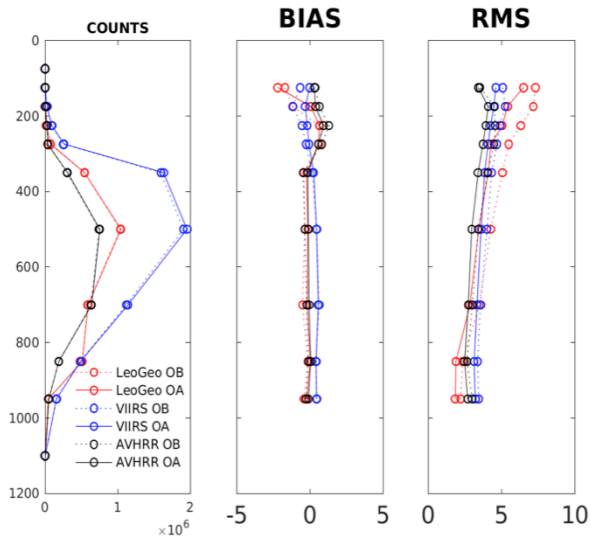
LEO-GEO AMVs

Leo-Geo winds cover the observation sparse zones between geo- and polar winds. They show steady positive forecast impact across the SH and hold strong potential as the next wind product being assimilated.

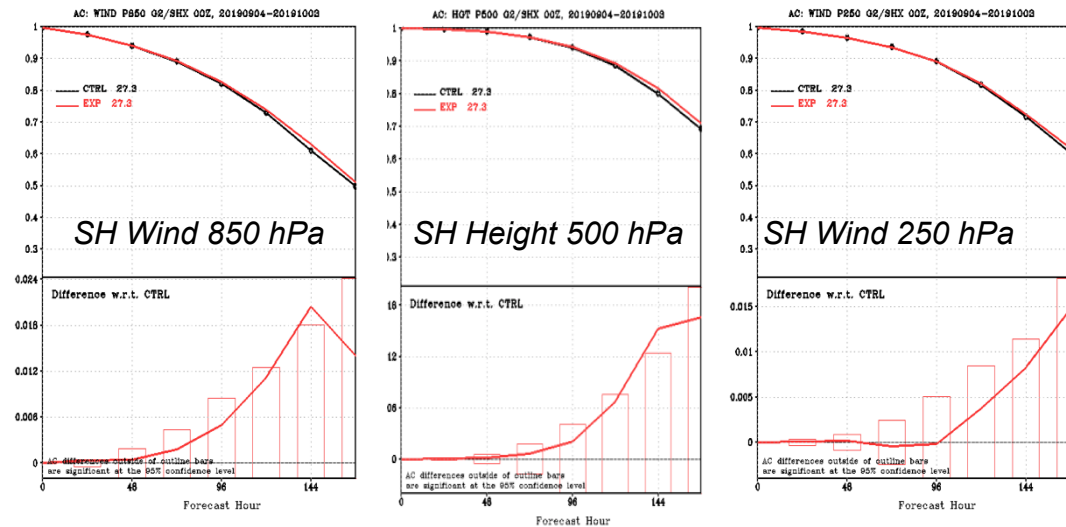
Leo-Geo AMVs spatial distribution



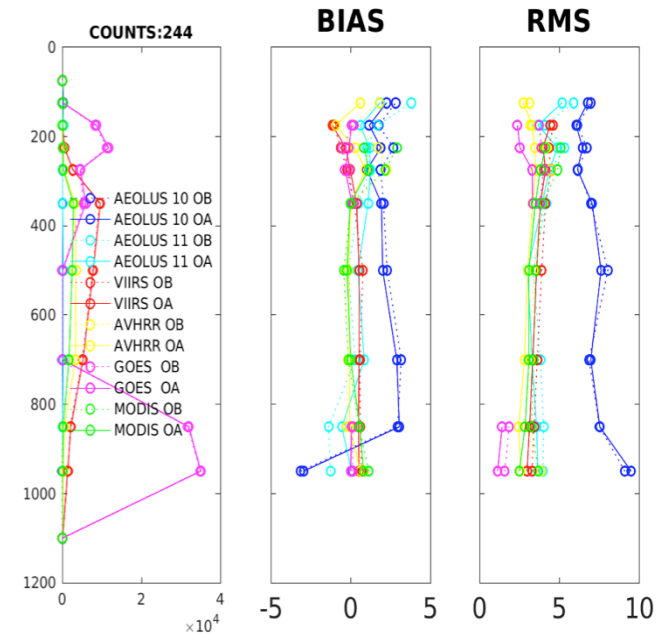
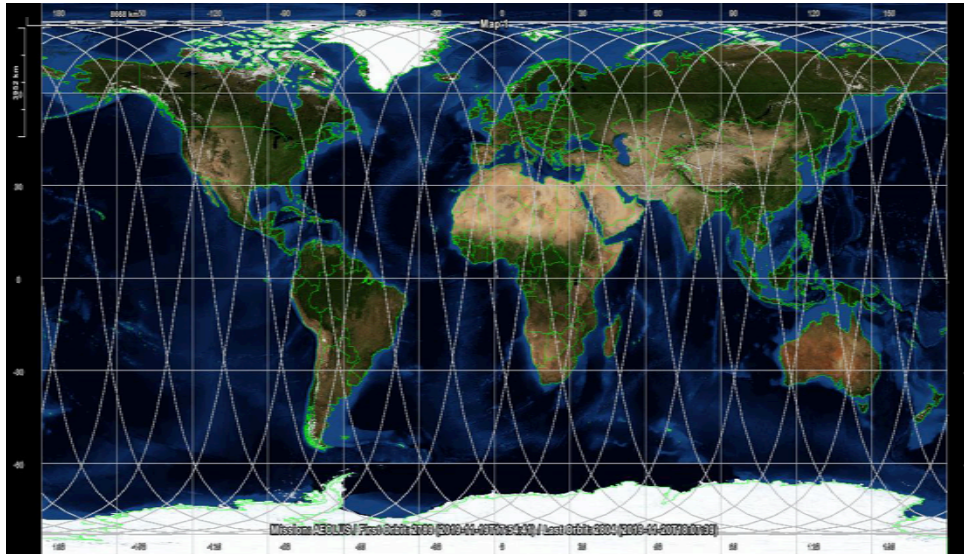
Leo-Geo and polar AMVs comparison



Anomaly Correlation



AEOLUS Wind Profiles



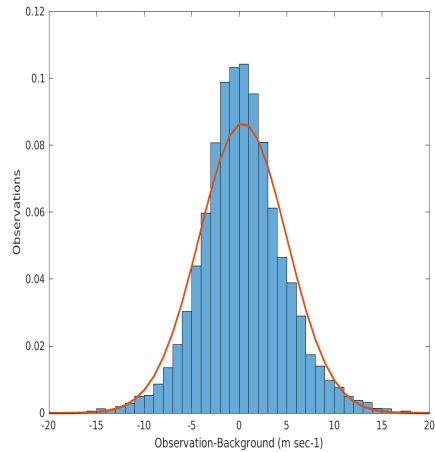
Early Aeolus Mie Clear (10) and Mie Cloudy (11) winds O-B vs VIIRS, AVHRR, MODIS and GOES O-B/O-A (first ECMWF QC)

Aeolus provides global high accuracy DWL wind profiles in two channels, Mie and Rayleigh. Initial experiments show the Mie Cloudy and Rayleigh Clear winds first guess departures are lower or comparable to these from AMVs. We have developed bias correction, observation error regression and variational quality control (VarQC) schemes for Aeolus data and DA experiments are ongoing.

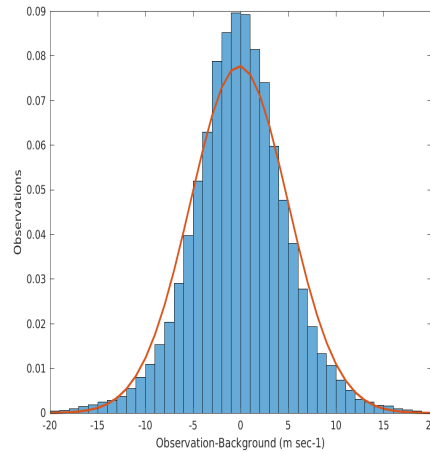
- Developed an accurate probability model for Aeolus observations from (O-B) statistics
- Observed departures from the pure Gaussian form

Innovation Statistics: valid: 2019082018

Mie cloudy

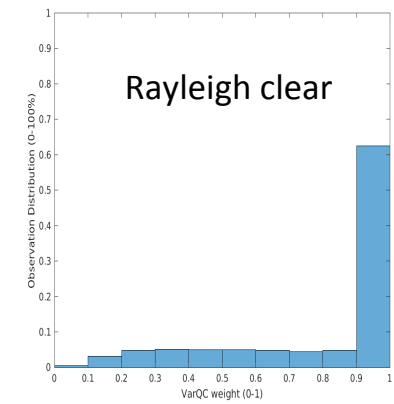
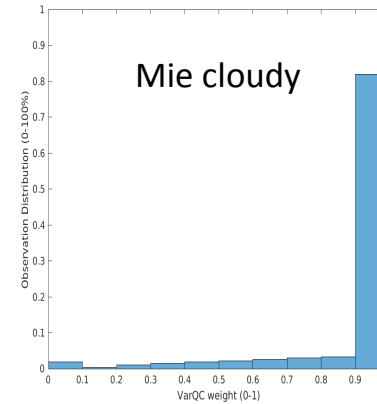


Rayleigh clear



- VarQC deals with rejection limits outside of the Gaussian
- Not discarding observations that lead to large departures, but assigning less weight during the final

Adaptive weight distribution valid: 2019082018



- Adopted a new VarQC scheme implemented in the 2021 operational NCEP/GFS (Purser et al., 2019) to improve the assimilation of Aeolus
- VarQC assigns adaptive weights as a function of observation increment and the probability of gross error

$$W_i(z_i) = \begin{cases} 1 & : z_i = 0 \\ \frac{-1}{z_i} \frac{dg_i(\alpha_i \beta_i \kappa_i z_i)}{dz_i} & : z_i \neq 0 \end{cases}$$

VarQC adaptive weights 0 to 1 range

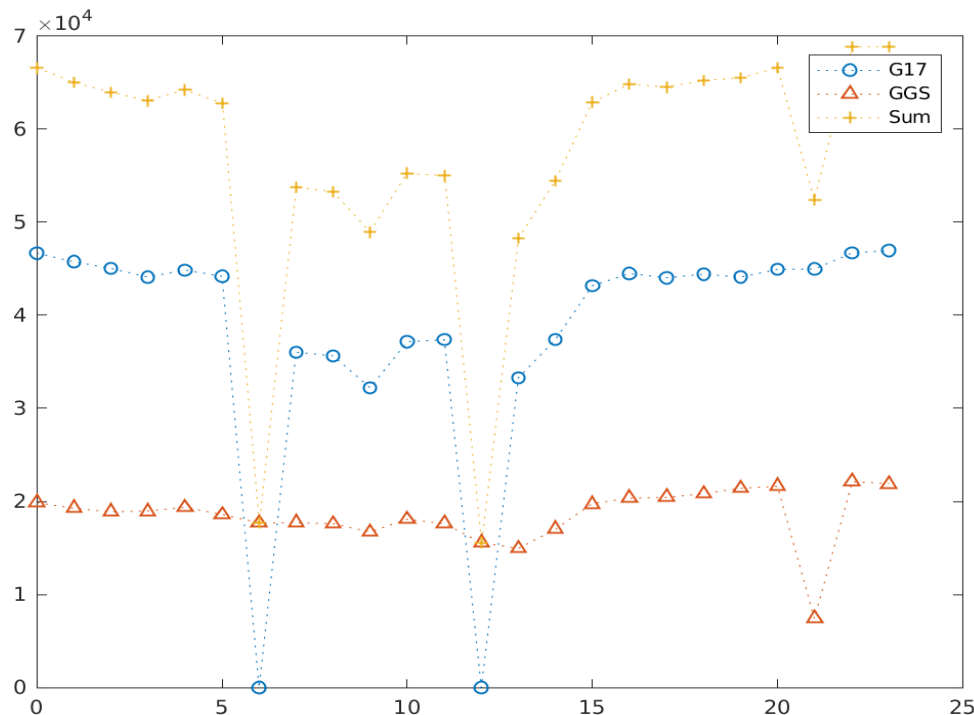
- 0 least impact to the analysis
- 1 most impact to the analysis

For more detail, see:

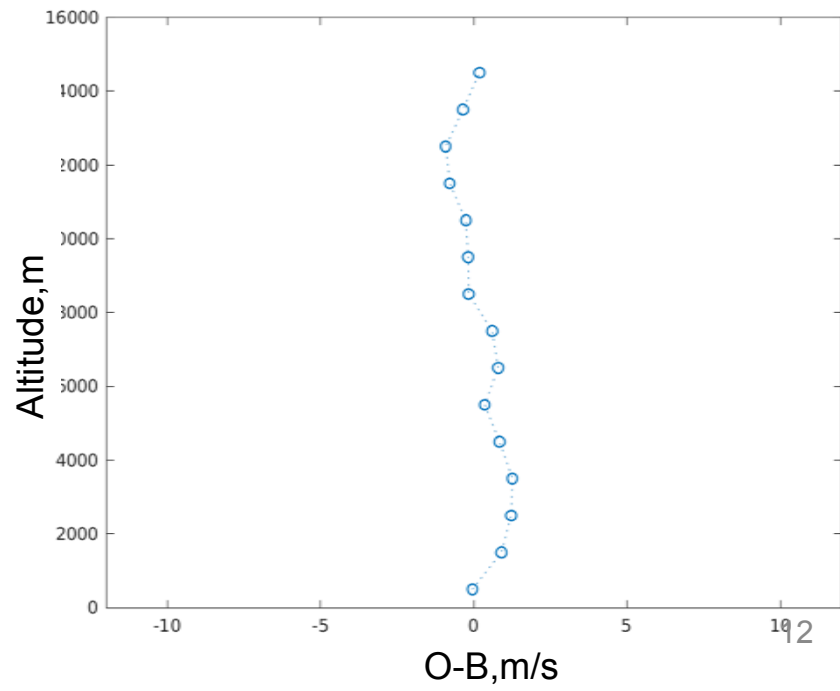
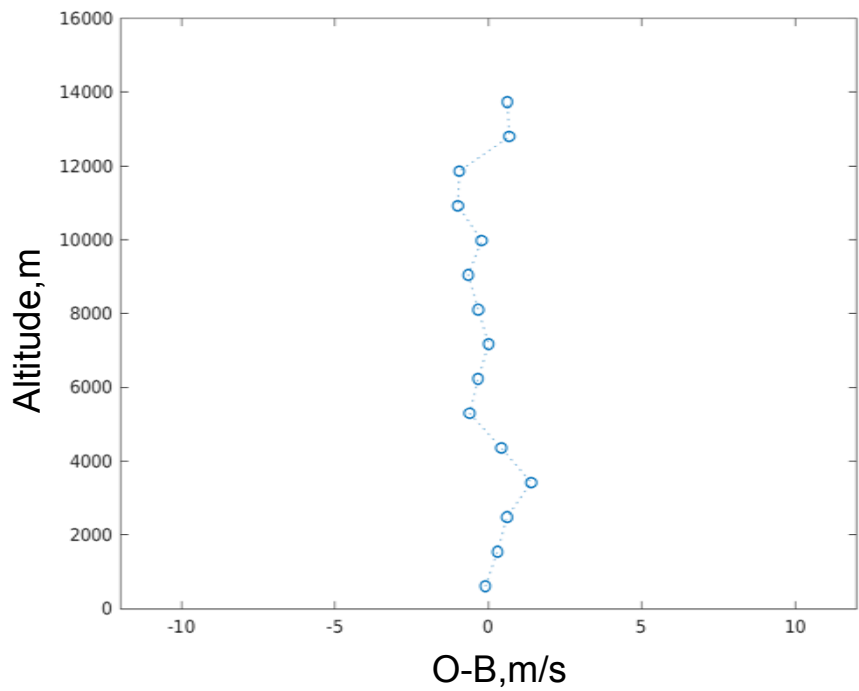
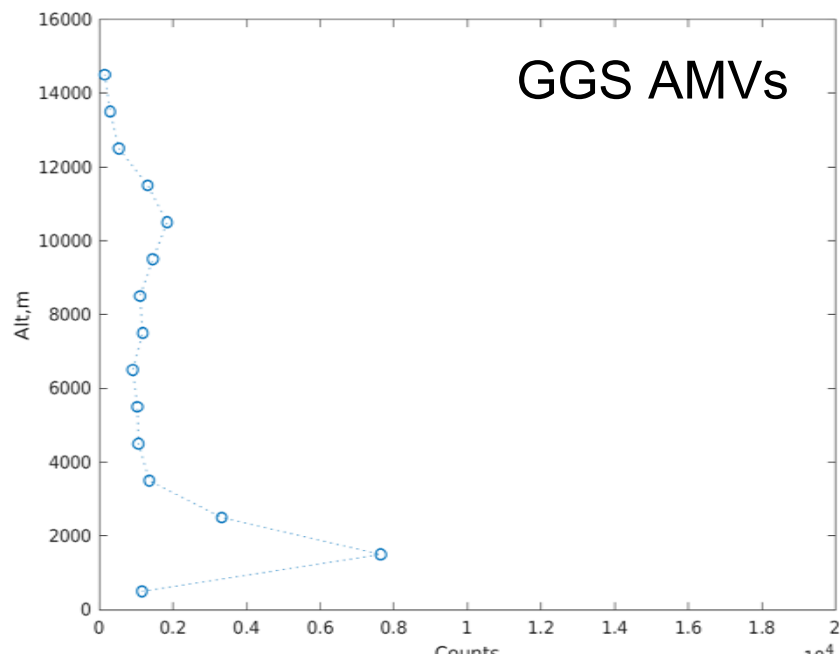
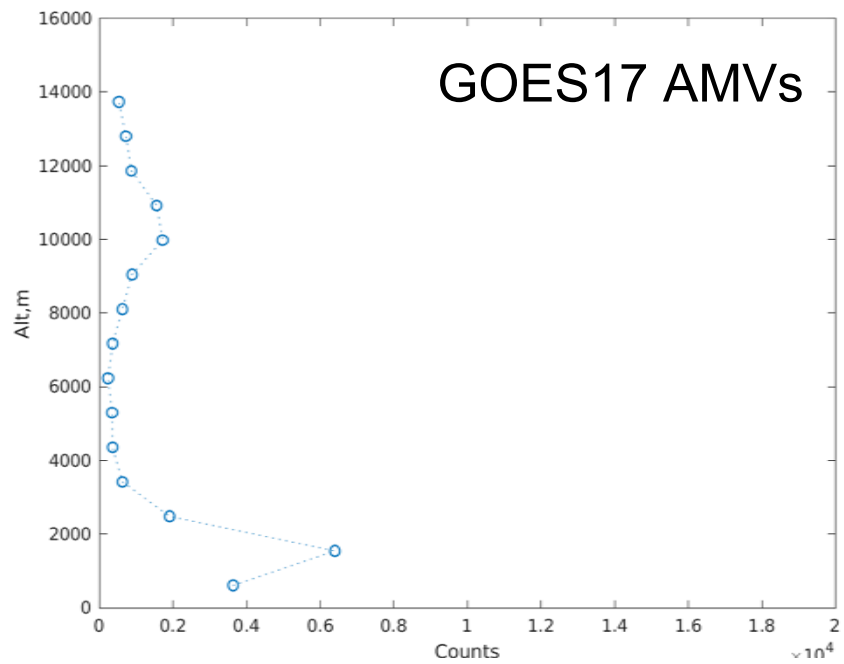
Karina Apodaca
“Refining the Assimilation of Aeolus DWL Observations by adopting VarQC”

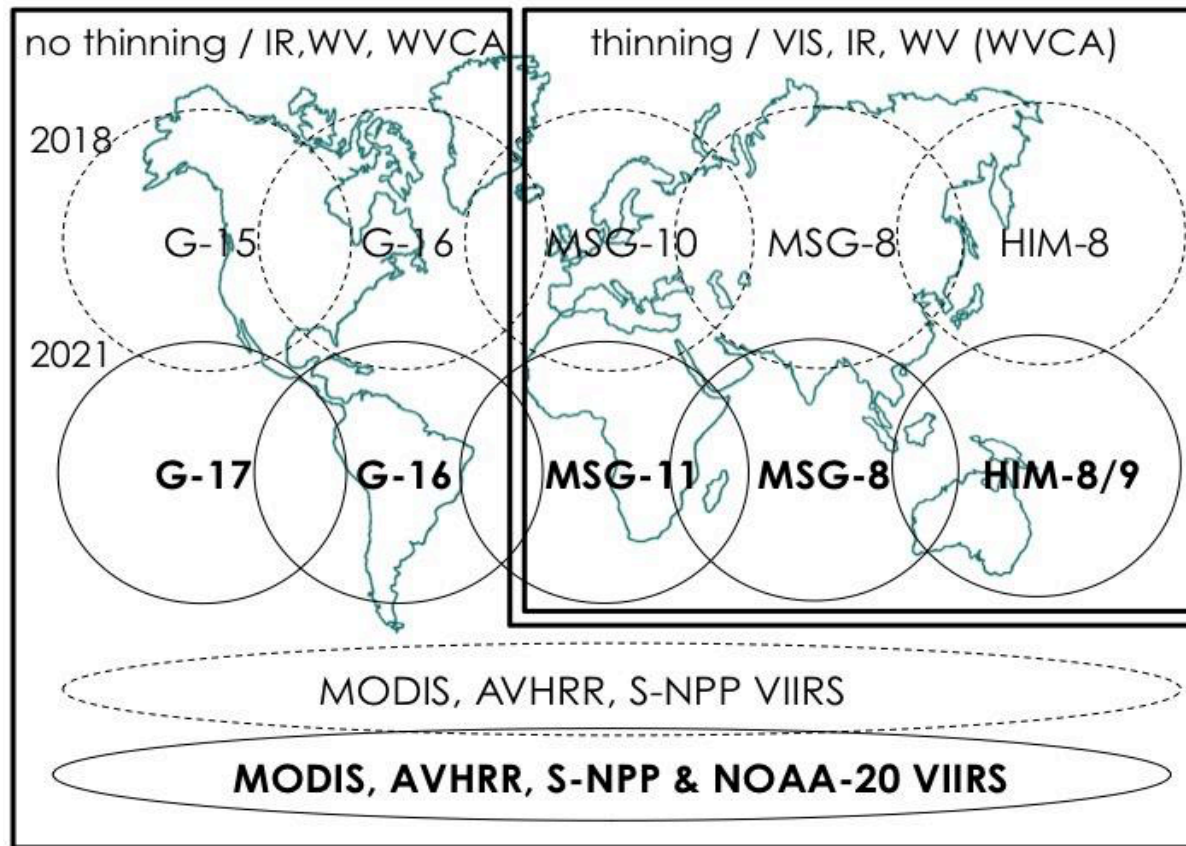
GOES-GOES Stereo winds (GGS) – preliminary analysis

- GOES-16-GOES-17 Stereo winds and GOES-17 AMVs were domain-collocated for 2020-04-01, 12UTC
- Same targets, different height assignments methods
- Height cut off for GGS is 15,000 meters
- Caveat: O-B is using AMV retrieval's background (12h FC)



- Drop in G17 AMV counts between 6 and 12 UTC is due to switch from Mode 6 to Mode 3
- Drop in G17 AMV counts @ 6 and 12z is associated with the switching between ABI Mode-6 (10-min FD) and ABI Mode-3 Cooling Timeline (15-min FD) (processing bug)
- Drop in GGS at 21 UTS is due to a calibration update impacting one of the 3 images in the triplet





Outlook

- Evaluate GOES-17 mitigated AMVs
- Transition from Metop A/B to Metop B/C AVHRR AMVs
- Evaluate older AVHRR & Modis phasing out
- Look into Metop Dual and Global AMVs from EUMETSAT
- Speeding up the analysis time