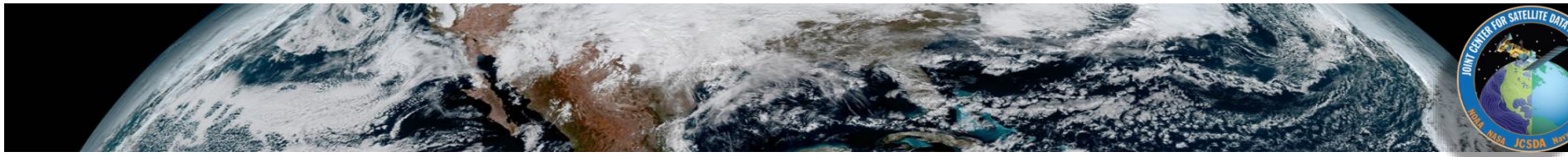


Commercial Weather Data Products Evaluation preliminary results

Joint Center for Satellite Data Assimilation

UCAR/CDAAC

NOAA/NESDIS/STAR

NOAA/ NESDIS/OPPA

September 22, 2019

Introduction

Evaluation of a new satellite data set is typically conducted on a **Winter** and a **Summer** period, however vendor 2 did not provide data for Winter.

	Nov 2018-May 2019	June	July
Vendor 1	~900 occs/day	~900 occs/day	~900 occs/day
Vendor 2		~600 occs/day	1200 occs/day

Evaluation time periods and daily data counts

Data Evaluation Methodology

1. **Data book keeping** (daily count, constellations, etc.) and **various statistics** (Bias, RMSE, rejection, etc.). **Statistics** are computed against NOAA operational **3-9hr forecasts**.

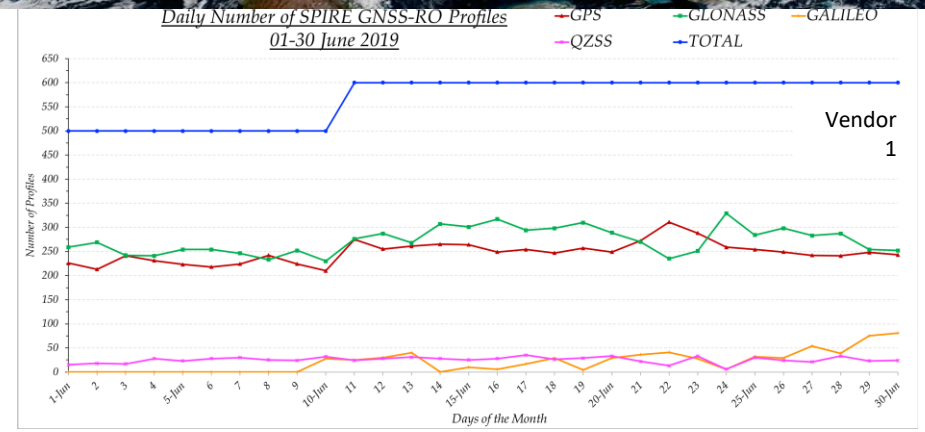
2. **Month long Assimilation & forecast impact**: the full NOAA **operational forecasting suite** is applied in **cycling mode 4 times a day** to **assimilate** the **new dataset**, in addition to the current **operational** observations. Daily **Forecast** (day 1-6) **scores** are produced by comparison to a **control** run (NOAA Verification System Data Base, GFSv14+GSI)

Status

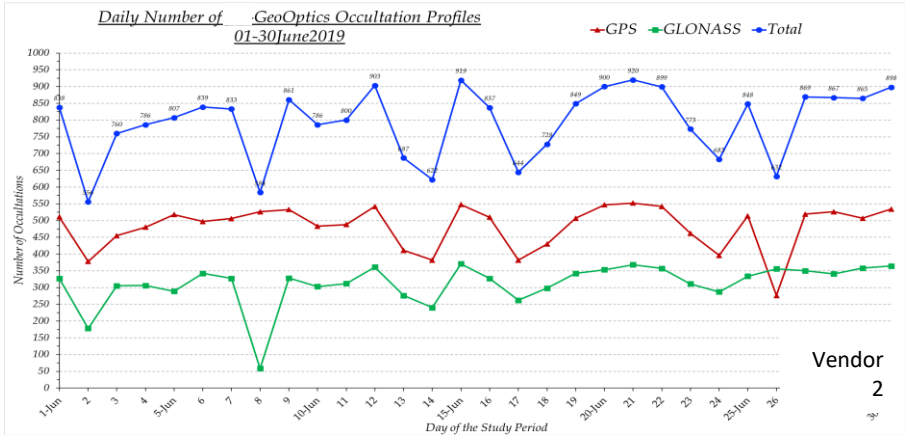
Vendor/ Processing center	winter stats Jan. 2019	winter score card Jan. 2019	summer stats June 2019	summer score card June 2019	summer stats July 2019	summer score card July 2019
GeoOptics/CDAAC	completed	completed	completed	in progress	CDAAC processing	CDAAC processing
GeoOptics/JPL	JPL reprocessed 4 Sept. 2019	JPL reprocessed 4 Sept. 2019	JPL reprocessed 4 Sept. 2019	JPL reprocessed 4 Sept. 2019	JPL reprocessed 4 Sept. 2019	JPL reprocessed 4 Sept. 2019
Spire/CDAAC	NA	NA	in processing at CDAAC	in processing at CDAAC	in processing at CDAAC	In processing at CDACC
Spire/Spire	NA	NA	completed	in progress	completed	in progress
Spire + GeoOptics	NA	NA	JPL reprocessed	JPL reprocessed	JPL reprocessed	JPL reprocessed

Geo-Optics initial delivery had some issues. Geo-Optics offered to re-process the data.

Data Counts for June 2019



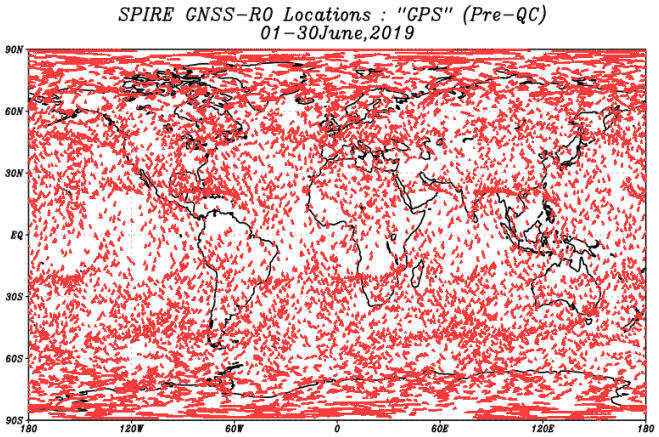
Vendor 1



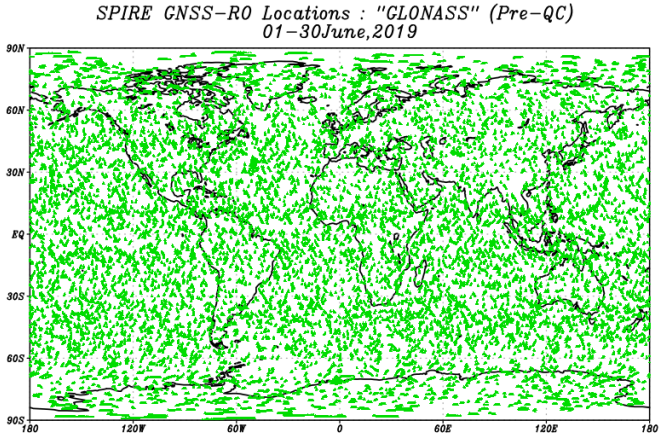
Vendor 2

SPIRE data coverage June 2019

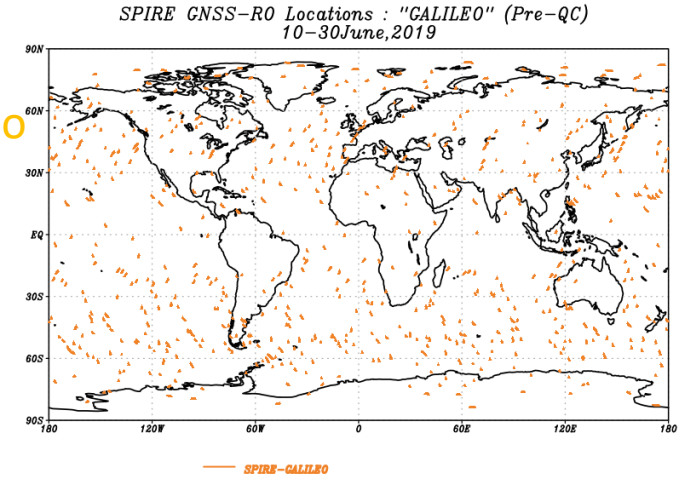
GPS



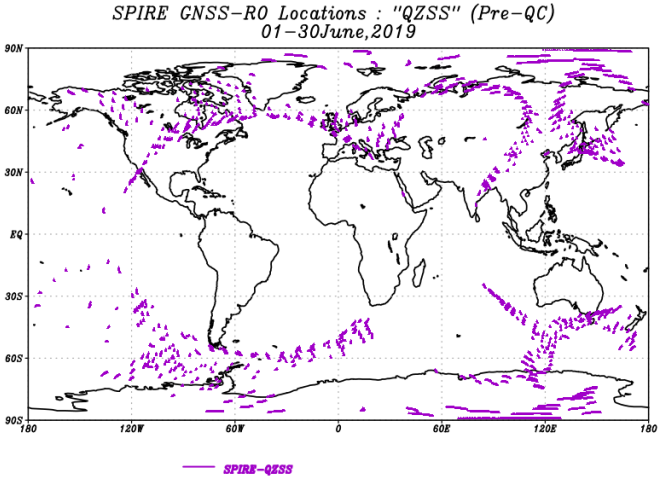
GLONASS



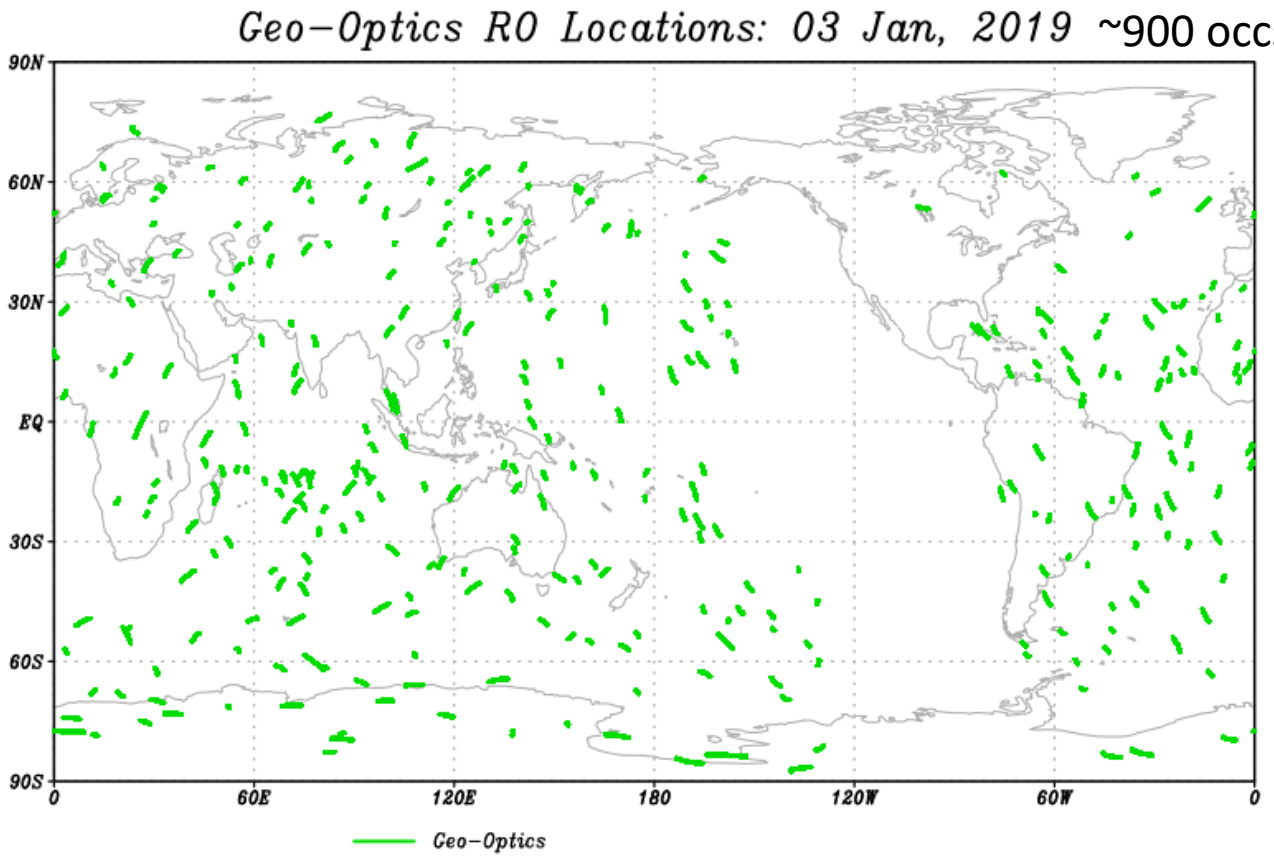
Galileo



QZSS



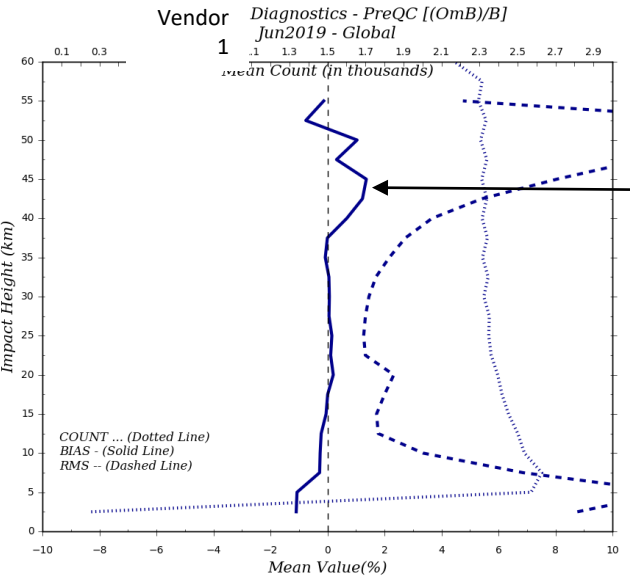
Geo-Optics data coverage



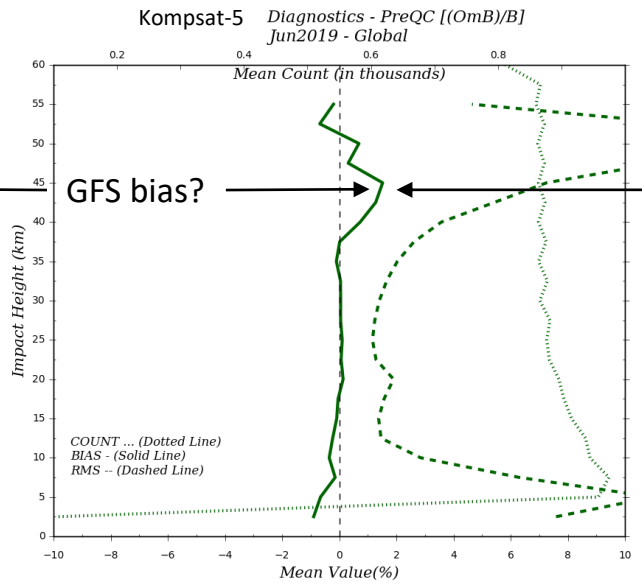
~900 occs

Bias for June 2019

Vendor 1

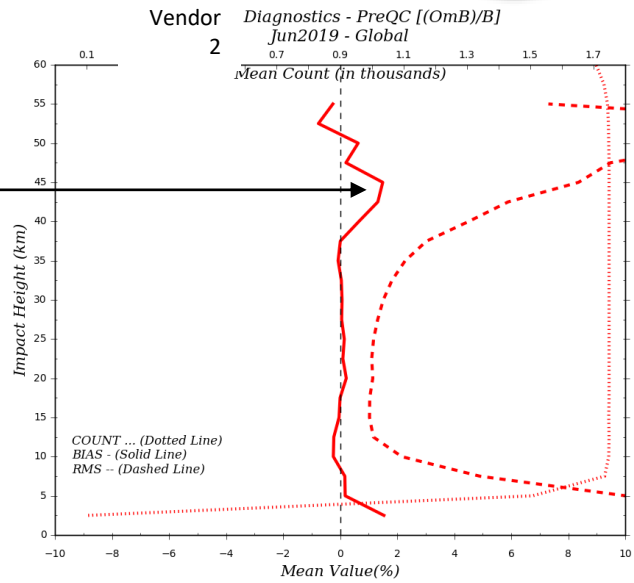


Kompsat-5



GFS bias?

Vendor 2



Vendor 1 (~900 occ/day)
CDAAC processed

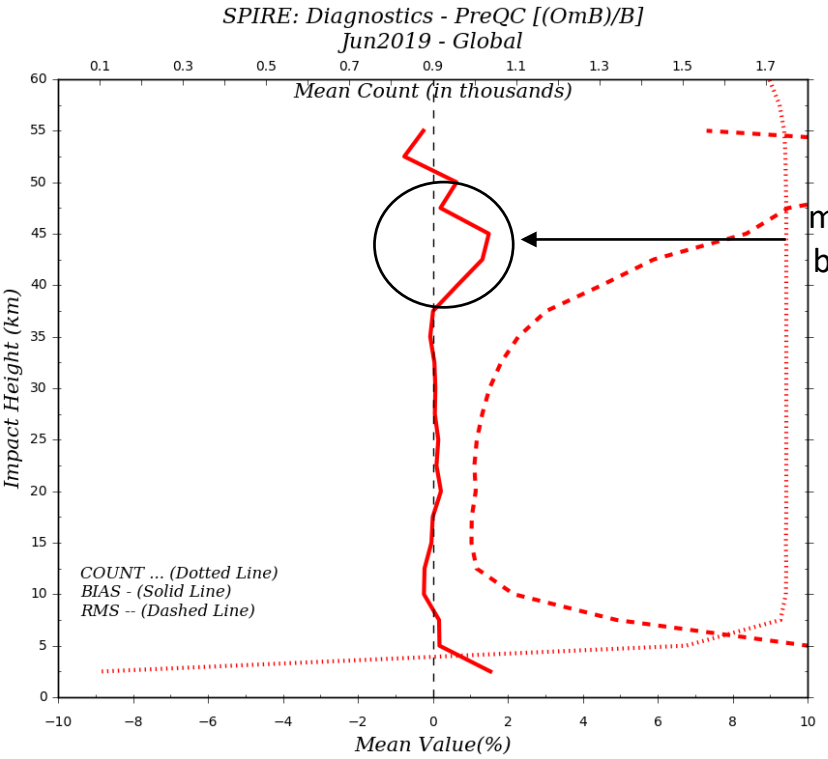
Kompsat-5 (~250 occ/day)
CDAAC processed

Vendor 2 (~600 occ/day)
Vendor 2 processed

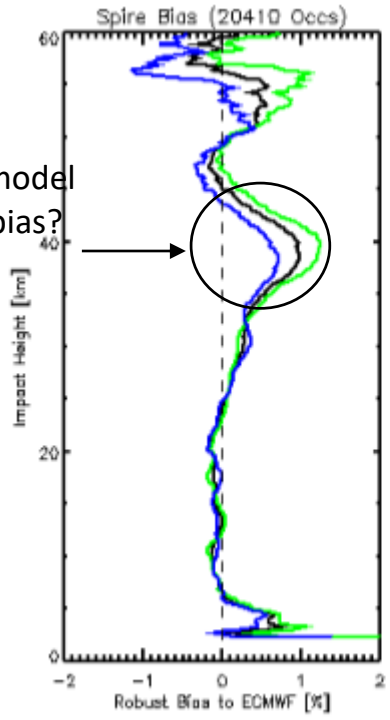
Global Bias, Root Mean Square Errors and Daily Data Count for vendor 1 (left), vendor 2 (right) and Kompsat-5 (middle) as function of height (profile) for the month of January 2019

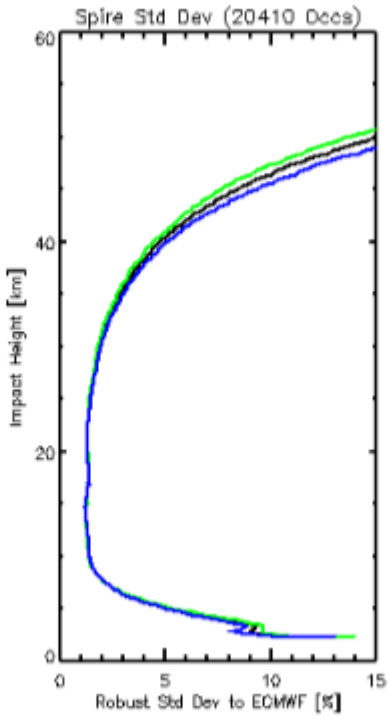
The Kompsat-5 Korean mission is currently operational and used as comparison

SPIRE Data Statistics June 2019



model bias?





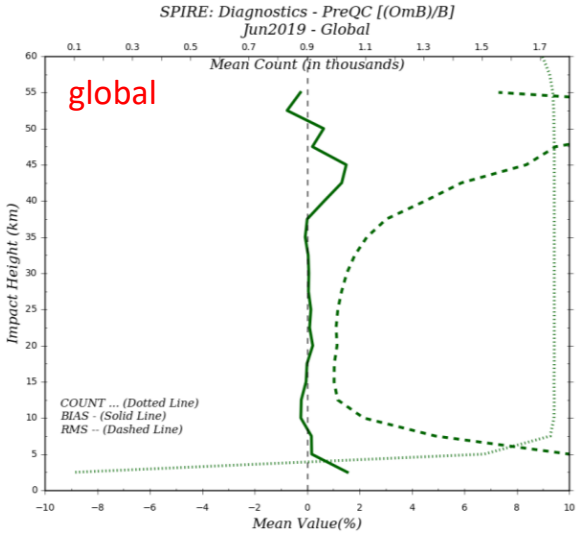
Start: 201905220000
End: 201907012122
Occ/day: 499
Fail: 0.0%
Wghs: 93.7%

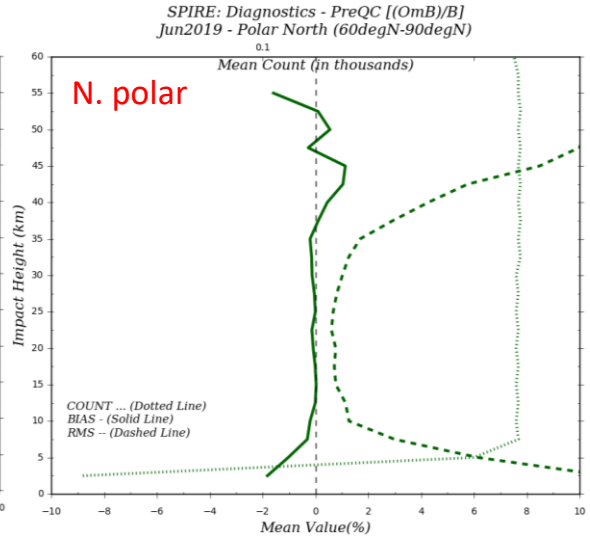
All (20410)
Setting (10795)
Rising (9615)

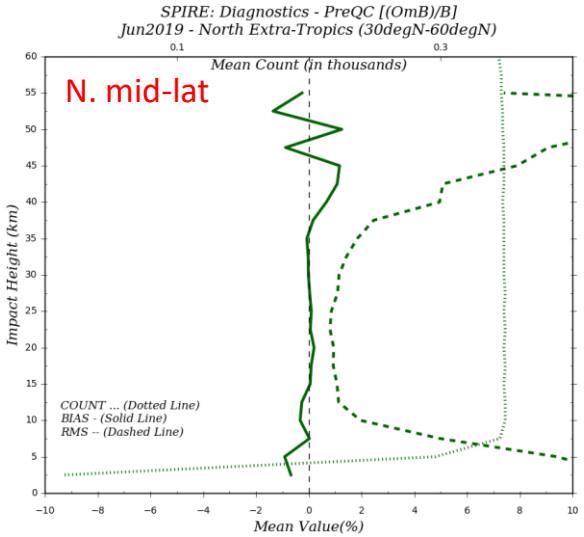
SPIRE vs GFS 3-9hr fct

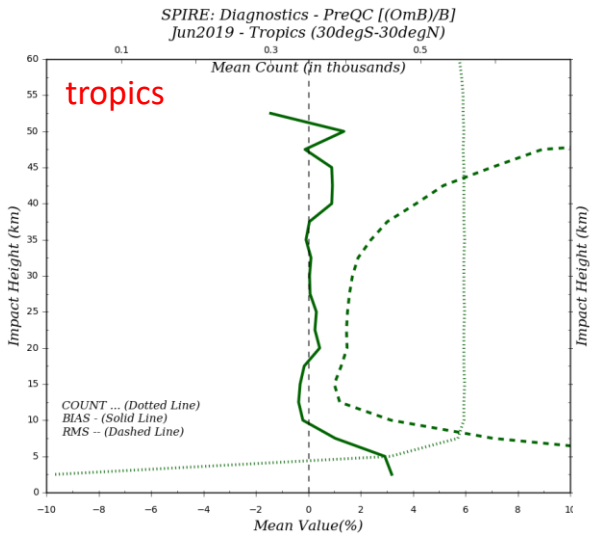
SPIRE vs ERA-5

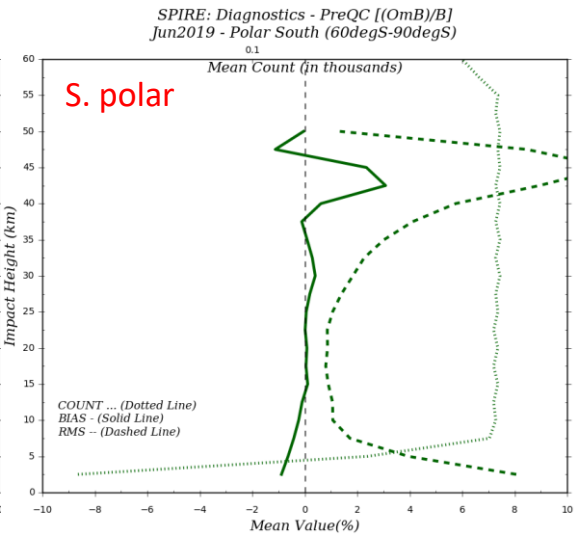
From Eumetsat presentation July 10, 2019

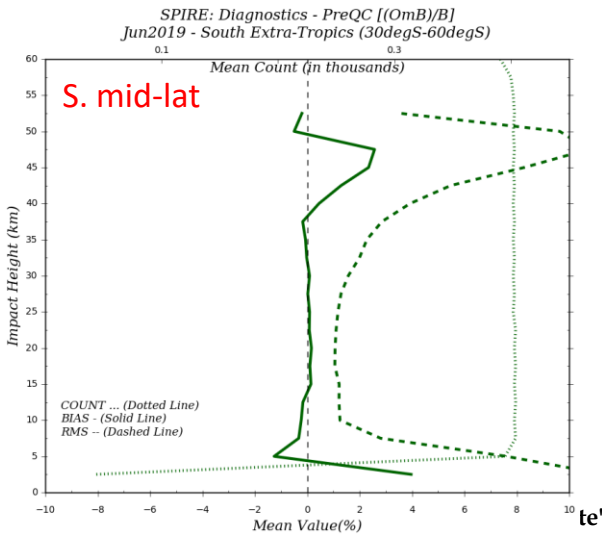

SPIRE: Diagnostics - PreQC [(OmB)/B]
Jun2019 - Global
global
Mean Count (in thousands)
Impact Height (km)
Mean Value(%)
COUNT ... (Dotted Line)
BIAS - (Solid Line)
RMS -- (Dashed Line)


SPIRE: Diagnostics - PreQC [(OmB)/B]
Jun2019 - Polar North (60degN-90degN)
N. polar
Mean Count (in thousands)
Impact Height (km)
Mean Value(%)
COUNT ... (Dotted Line)
BIAS - (Solid Line)
RMS -- (Dashed Line)

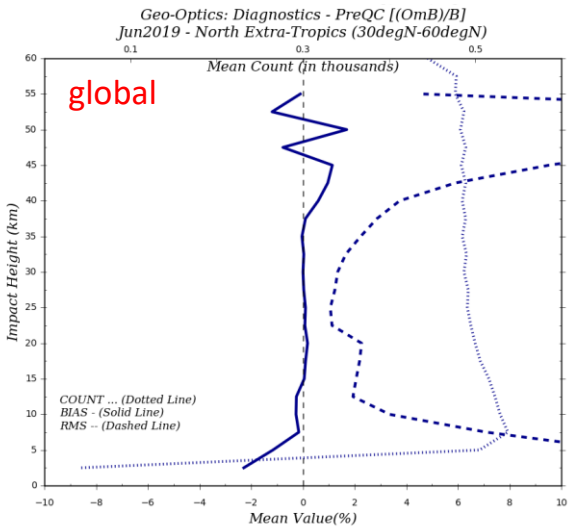

SPIRE: Diagnostics - PreQC [(OmB)/B]
Jun2019 - North Extra-Tropics (30degN-60degN)
N. mid-lat
Mean Count (in thousands)
Impact Height (km)
Mean Value(%)
COUNT ... (Dotted Line)
BIAS - (Solid Line)
RMS -- (Dashed Line)

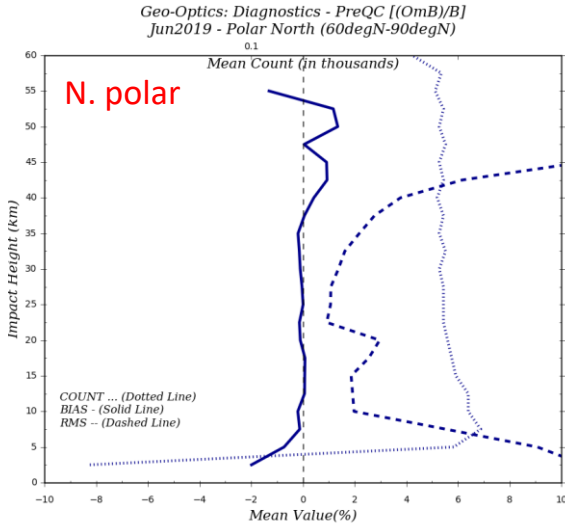

SPIRE: Diagnostics - PreQC [(OmB)/B]
Jun2019 - Tropics (30degS-30degN)
tropics
Mean Count (in thousands)
Impact Height (km)
Mean Value(%)
COUNT ... (Dotted Line)
BIAS - (Solid Line)
RMS -- (Dashed Line)

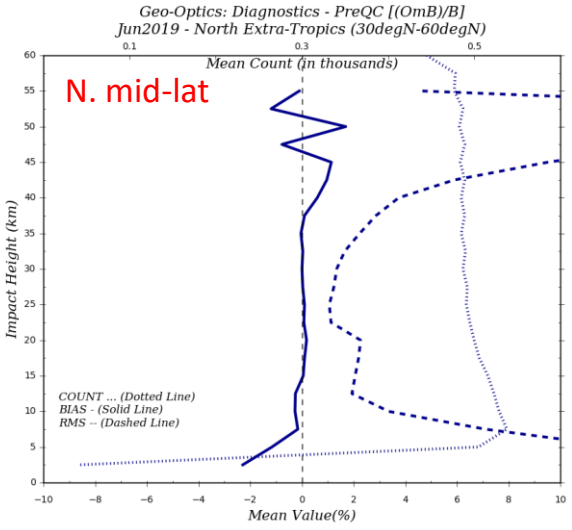

SPIRE: Diagnostics - PreQC [(OmB)/B]
Jun2019 - Polar South (60degS-90degS)
S. polar
Mean Count (in thousands)
Impact Height (km)
Mean Value(%)
COUNT ... (Dotted Line)
BIAS - (Solid Line)
RMS -- (Dashed Line)

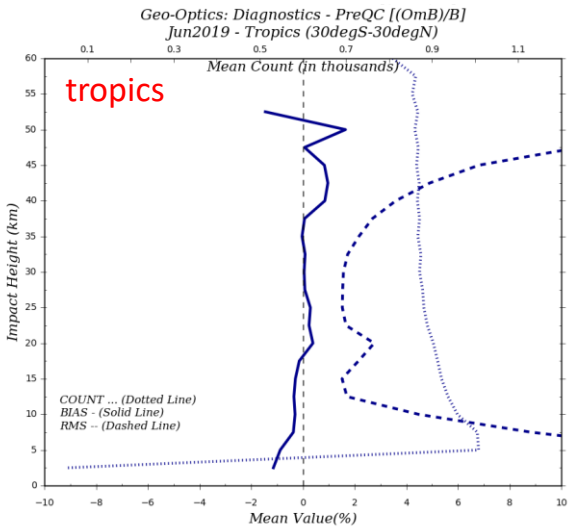

SPIRE: Diagnostics - PreQC [(OmB)/B]
Jun2019 - South Extra-Tropics (30degS-60degS)
S. mid-lat
Mean Count (in thousands)
Impact Height (km)
Mean Value(%)
COUNT ... (Dotted Line)
BIAS - (Solid Line)
RMS -- (Dashed Line)

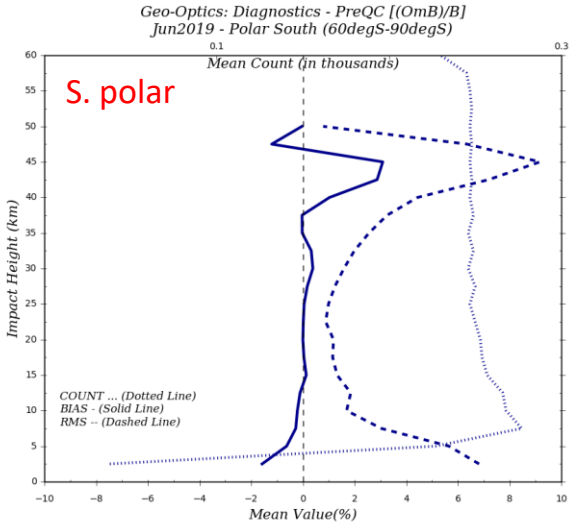
te"

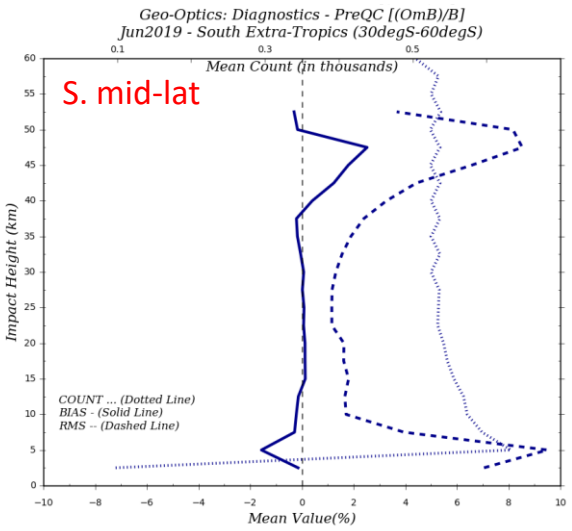

Geo-Optics: Diagnostics - PreQC [(OmB)/B]
Jun2019 - North Extra-Tropics (30degN-60degN)
global
Mean Count (in thousands)
Impact Height (km)
Mean Value(%)
COUNT ... (Dotted Line)
BIAS - (Solid Line)
RMS -- (Dashed Line)

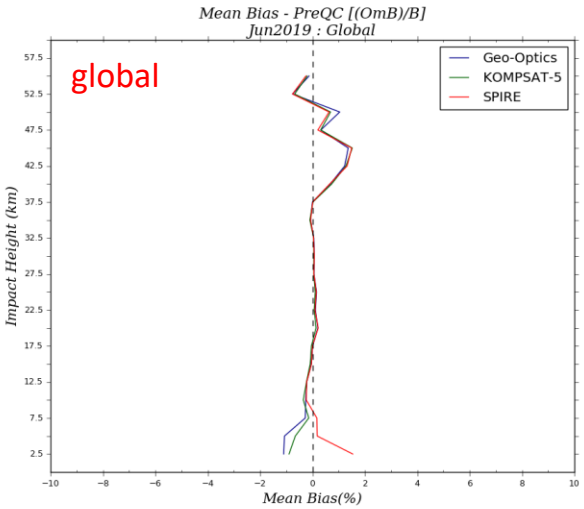

Geo-Optics: Diagnostics - PreQC [(OmB)/B]
Jun2019 - Polar North (60degN-90degN)
N. polar
Mean Count (in thousands)
Impact Height (km)
Mean Value(%)
COUNT ... (Dotted Line)
BIAS - (Solid Line)
RMS -- (Dashed Line)

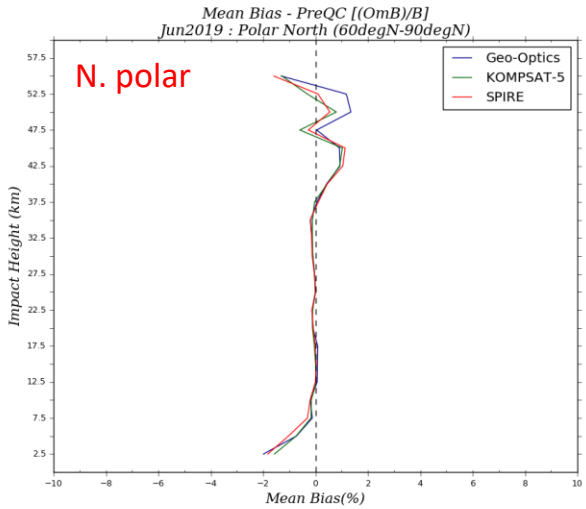

Geo-Optics: Diagnostics - PreQC [(OmB)/B]
Jun2019 - North Extra-Tropics (30degN-60degN)
N. mid-lat
Mean Count (in thousands)
Impact Height (km)
Mean Value(%)
COUNT ... (Dotted Line)
BIAS - (Solid Line)
RMS -- (Dashed Line)

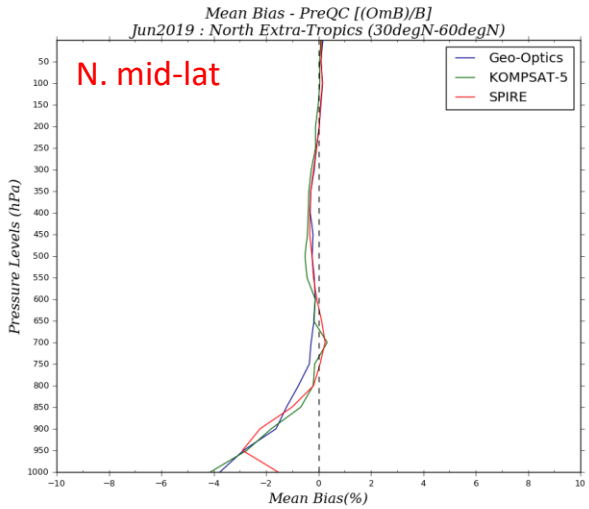

Geo-Optics: Diagnostics - PreQC [(OmB)/B]
Jun2019 - Tropics (30degS-30degN)
tropics
Mean Count (in thousands)
Impact Height (km)
Mean Value(%)
COUNT ... (Dotted Line)
BIAS - (Solid Line)
RMS -- (Dashed Line)

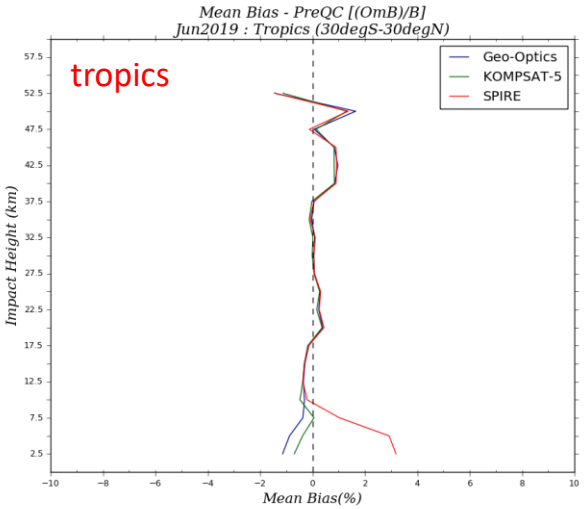

Geo-Optics: Diagnostics - PreQC [(OmB)/B]
Jun2019 - Polar South (60degS-90degS)
S. polar
Mean Count (in thousands)
Impact Height (km)
Mean Value(%)
COUNT ... (Dotted Line)
BIAS - (Solid Line)
RMS -- (Dashed Line)

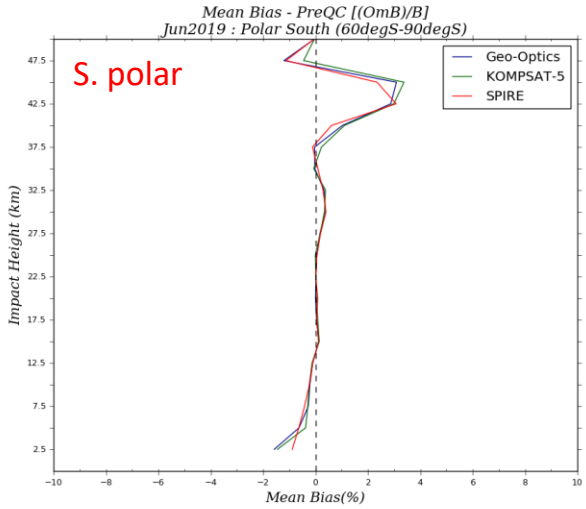

Geo-Optics: Diagnostics - PreQC [(OmB)/B]
Jun2019 - South Extra-Tropics (30degS-60degS)
S. mid-lat
Mean Count (in thousands)
Impact Height (km)
Mean Value(%)
COUNT ... (Dotted Line)
BIAS - (Solid Line)
RMS -- (Dashed Line)

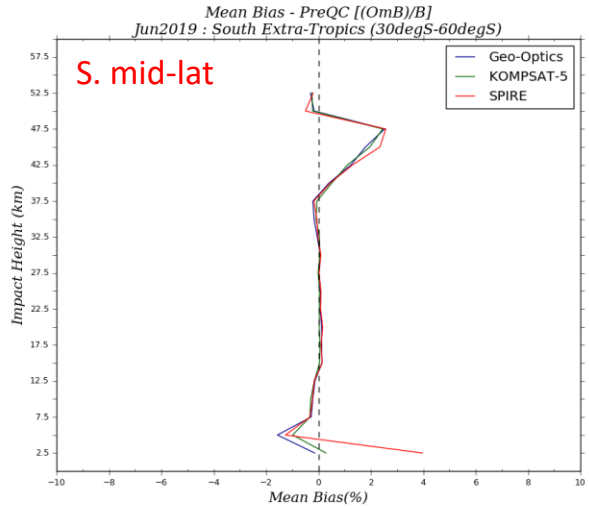

Mean Bias - PreQC [(OmB)/B]
Jun2019 : Global
global
Geo-Optics
KOMPSAT-5
SPIRE
Impact Height (km)
Mean Bias(%)


Mean Bias - PreQC [(OmB)/B]
Jun2019 : Polar North (60degN-90degN)
N. polar
Geo-Optics
KOMPSAT-5
SPIRE
Impact Height (km)
Mean Bias(%)

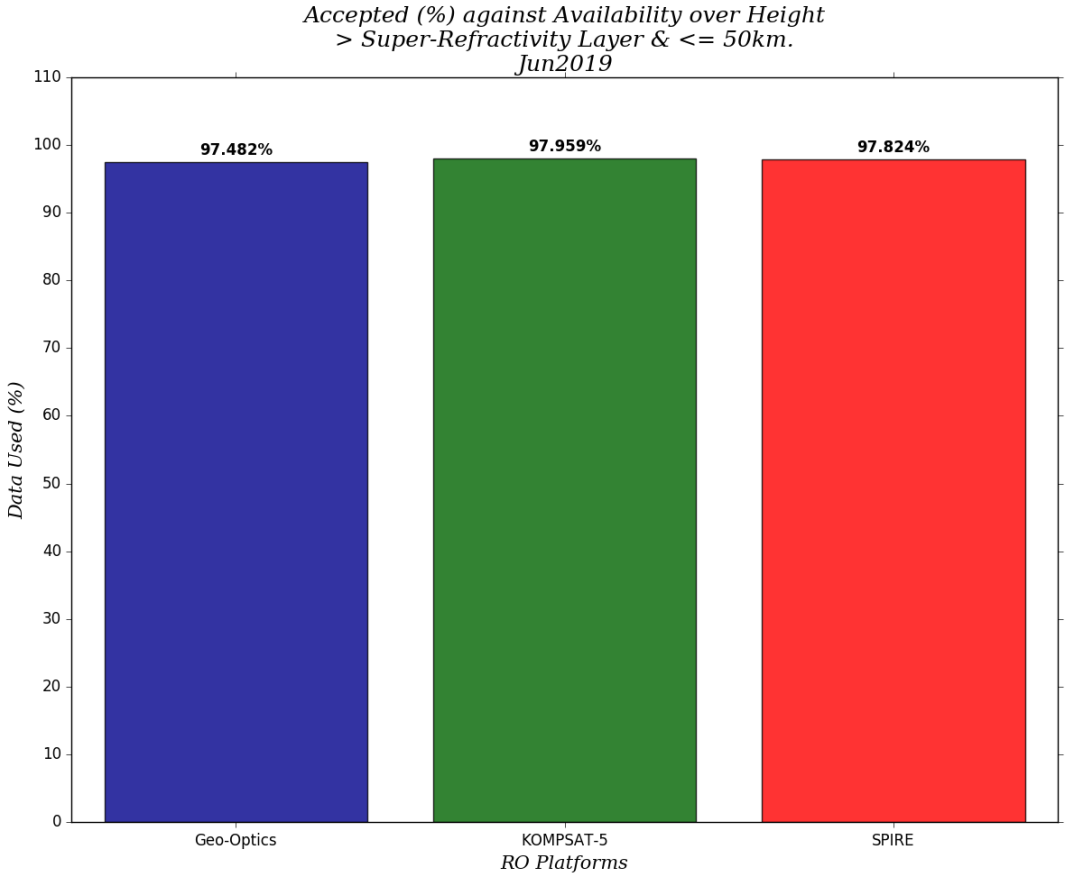

Mean Bias - PreQC [(OmB)/B]
Jun2019 : North Extra-Tropics (30degN-60degN)
N. mid-lat
Geo-Optics
KOMPSAT-5
SPIRE
Pressure Levels (hPa)
Mean Bias(%)


Mean Bias - PreQC [(OmB)/B]
Jun2019 : Tropics (30degS-30degN)
tropics
Geo-Optics
KOMPSAT-5
SPIRE
Impact Height (km)
Mean Bias(%)

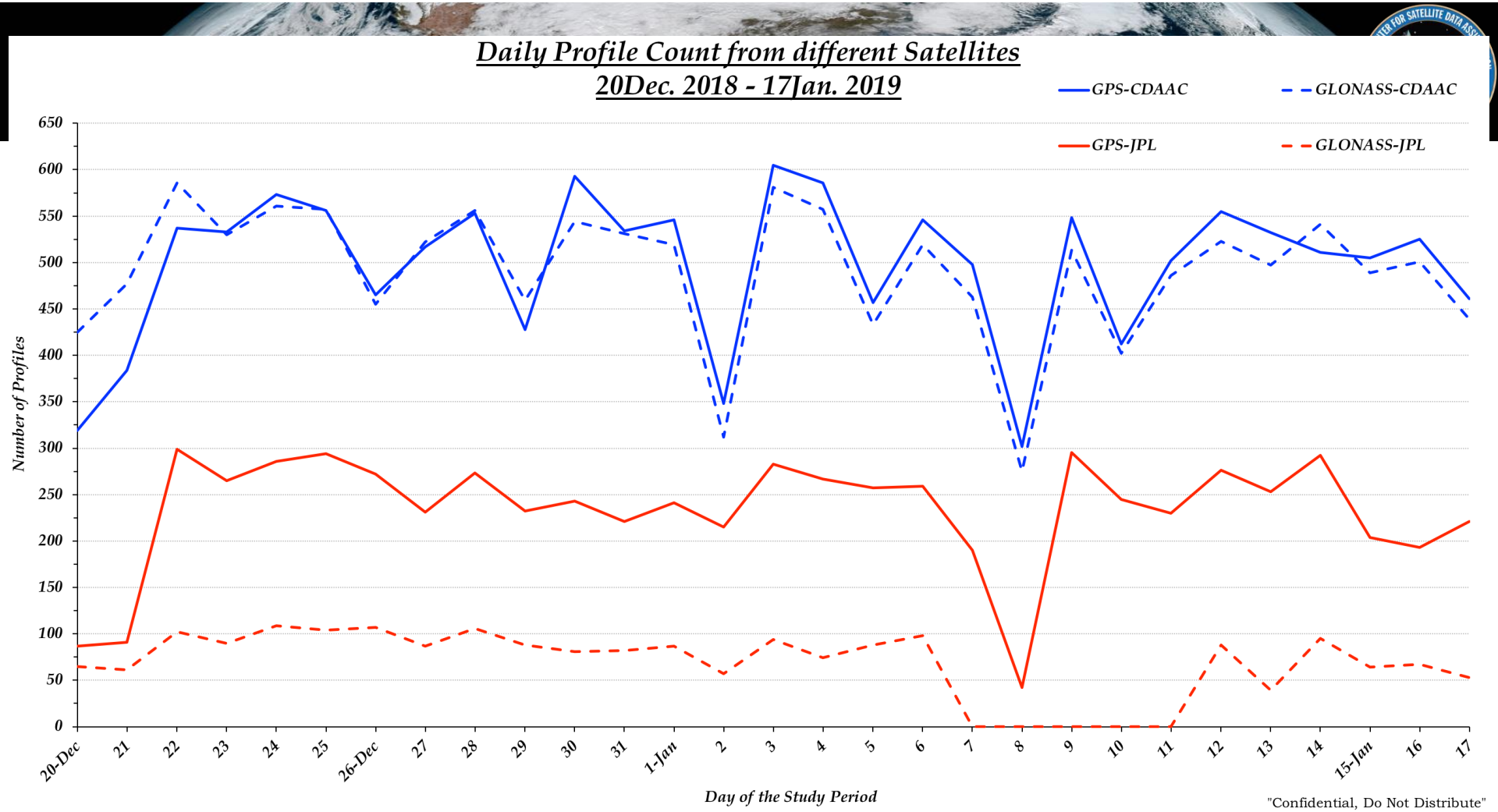

Mean Bias - PreQC [(OmB)/B]
Jun2019 : Polar South (60degS-90degS)
S. polar
Geo-Optics
KOMPSAT-5
SPIRE
Impact Height (km)
Mean Bias(%)


Mean Bias - PreQC [(OmB)/B]
Jun2019 : South Extra-Tropics (30degS-60degS)
S. mid-lat
Geo-Optics
KOMPSAT-5
SPIRE
Impact Height (km)
Mean Bias(%)

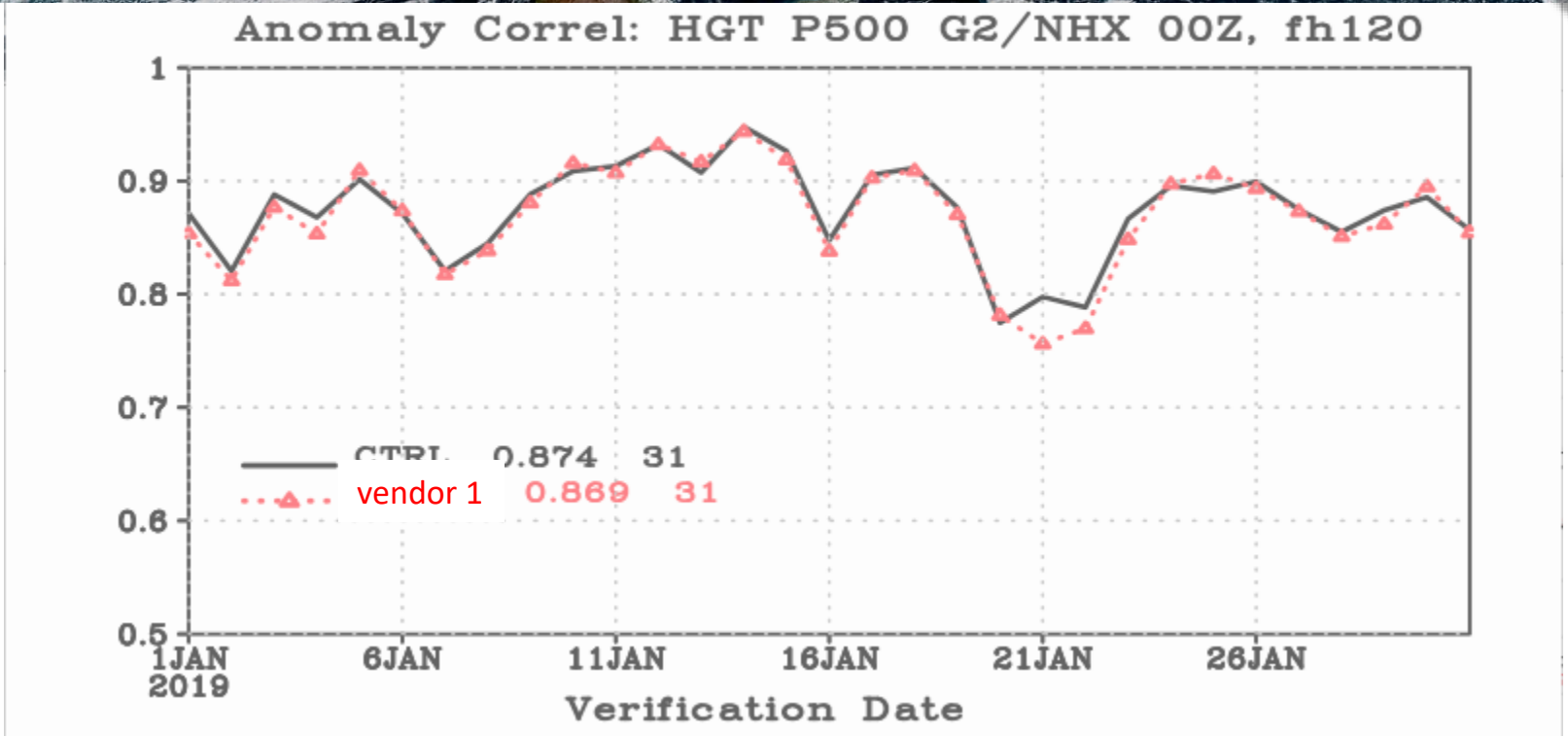
Data Passing GSI QC



Kompsat-5: GPS setting occ. only



Forecast Impact for January 2019

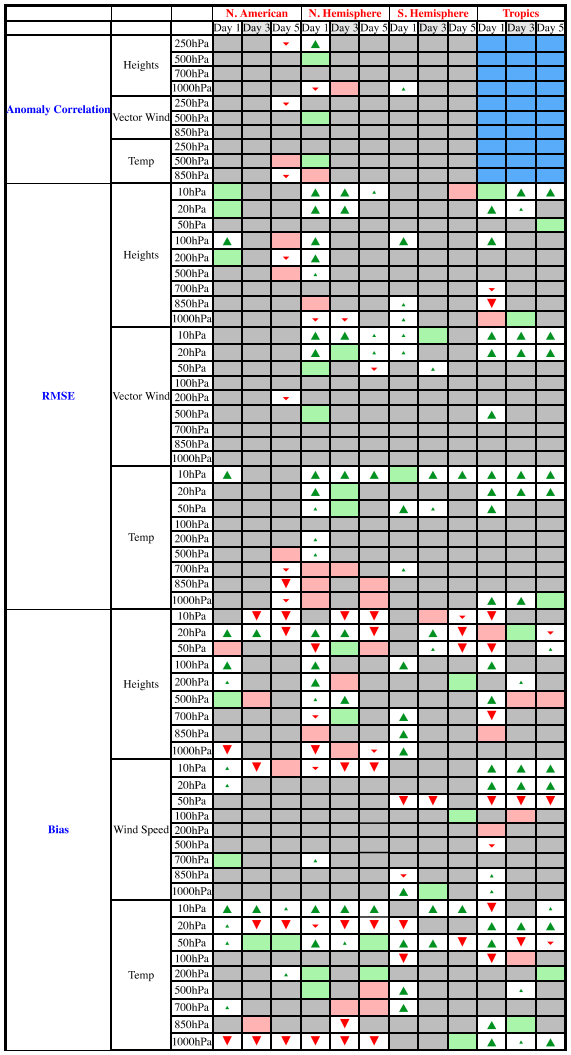


Day-5 forecast height anomaly correlation at 500mb for the month of January 2019

Black: assimilation of currently operational data (control run)

Red: assimilation of currently operational data and vendor 1 data

all plots



EMC Verification Scorecard	
Symbol Legend	
▲	GEOPT is better than CTRL at the 99.9% significance level
▵	GEOPT is better than CTRL at the 99% significance level
	GEOPT is better than CTRL at the 95% significance level
	No statistically significant difference between GEOPT and CTRL
	GEOPT is worse than CTRL at the 95% significance level
▿	GEOPT is worse than CTRL at the 99% significance level
▼	GEOPT is worse than CTRL at the 99.9% significance level
	Not statistically relevant
Start Date: 20190101	
End Date: 20190131	

Findings

- **CWDP** vendors make use of signals from **GPS, GLONASS, GALILEO & QZSS** navigation satellite constellations. Current **operational** missions **before COSMIC-2** only used **GPS**.
- Daily data **count** (600~1200 profiles/day) is significantly **larger** than Kompsat-5, Cosmic-1, TerraX & TandemX (200~500/day) and **comparable** to the European MetOp-A, B or C mission.
- Less than **3%** of the delivered **nominal** data were deemed **bad quality**, this is **consistent** with **operational** platforms.