



Recent and New GNSS-RO missions: Quality Assessment and Comparative Data Assimilation

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NOAA New Platforms Evaluation



New platforms are **evaluated** for operations during a **Winter** and **Summer** season in two steps:

1. **O-B statistics** (Count, Bias, RMSE, rejection) are computed against NCEP **operational 3-9hr forecasts**.
2. **Assimilation impact**: the full operational suite is applied in cycling mode to **assimilate** the **new dataset** with current operational observations and compare to a **control** run

NOAA New Platforms Evaluation



Current platforms assimilated in operations are:
COSMIC-1, MetOp-A&B, TerraX & TandemX

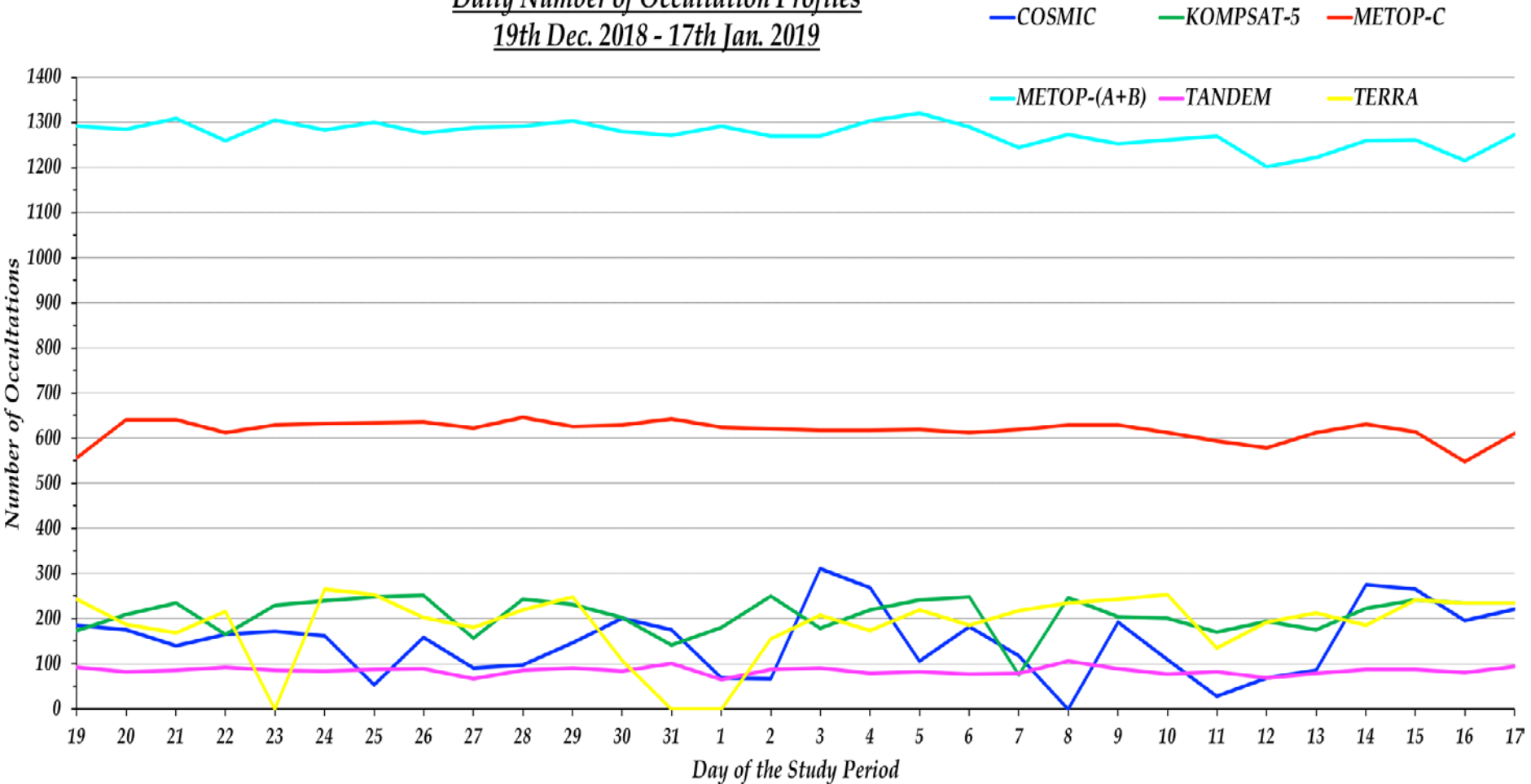
Recent JCSDA evaluations include:

- **Kompsat-5** Jun & Dec 2016
- **Megha-Tropiques** Jan & Jun 2018
- **PAZ** Jun 2018
- **MetOp-C** Jan 2019
- **COSMIC-2** Aug 2019 (first look)

MetOp-C data count



Daily Number of Occultation Profiles
19th Dec. 2018 - 17th Jan. 2019



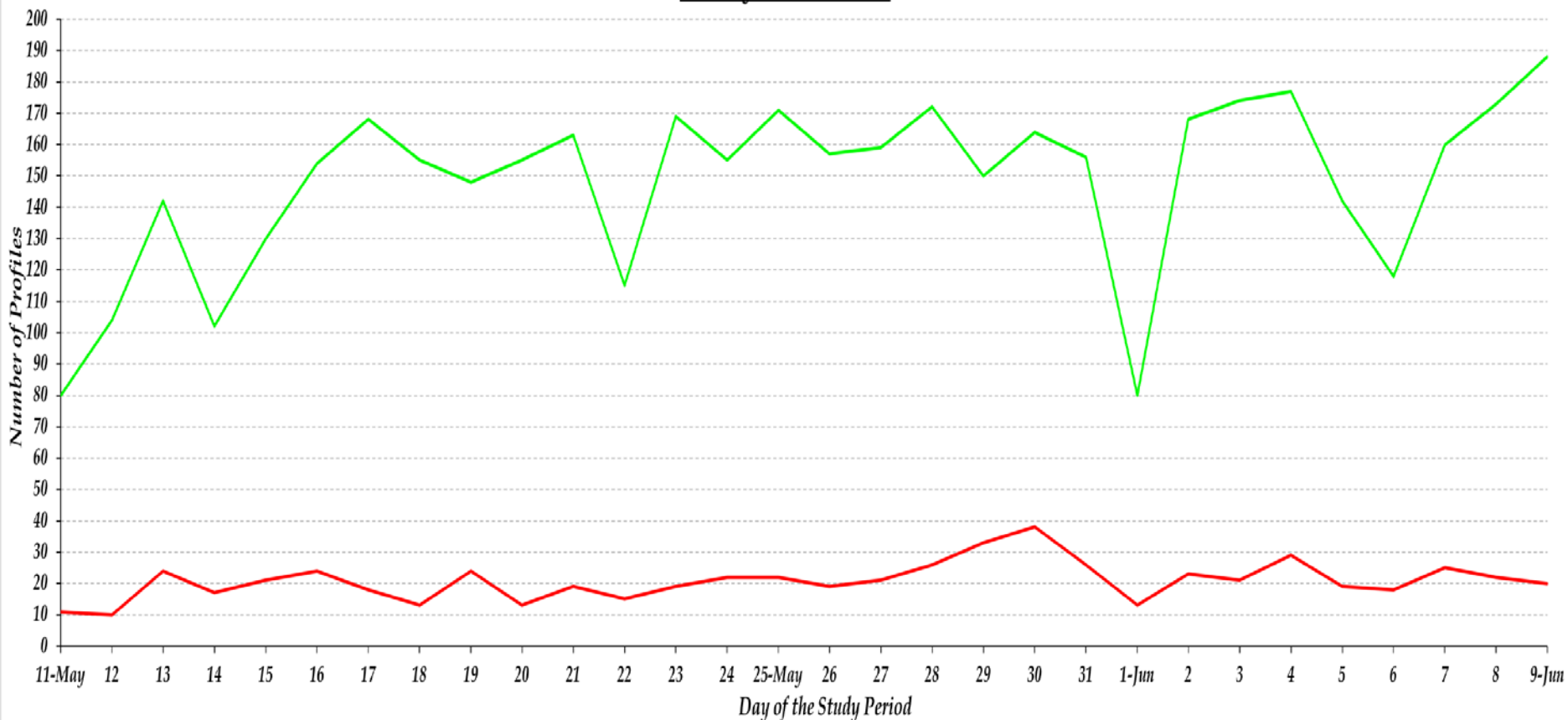
MetOp-C data count, 19 Dec 2018 – 17 Jan, 2019

PAZ data count



Daily PAZ RO Profiles
11 May-09 Jun, 2018

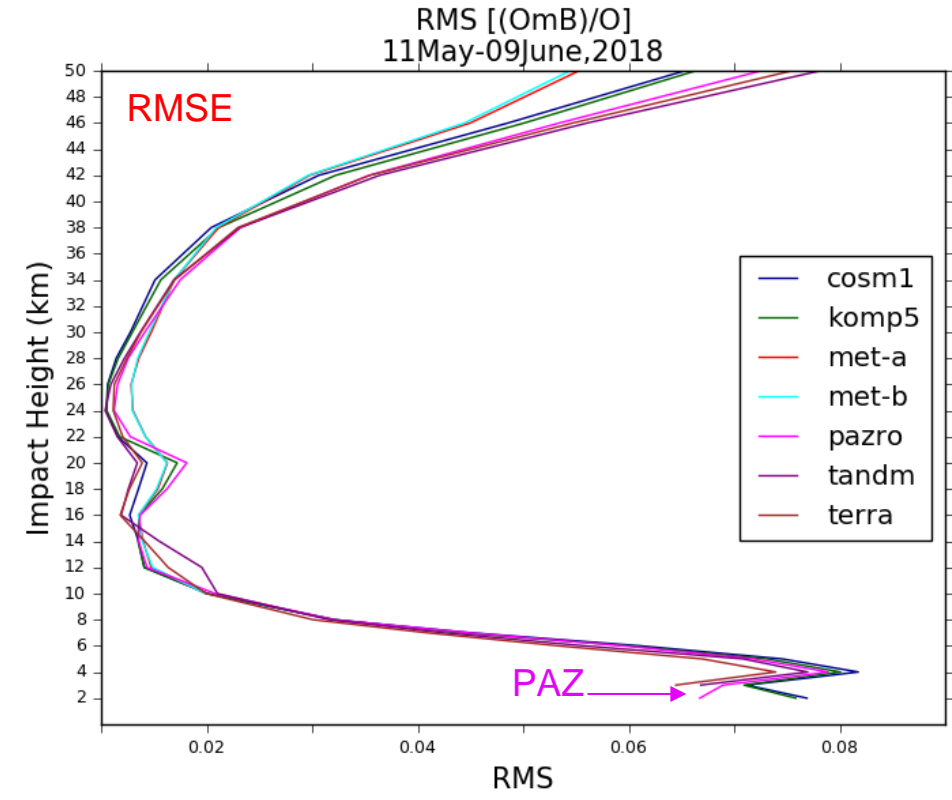
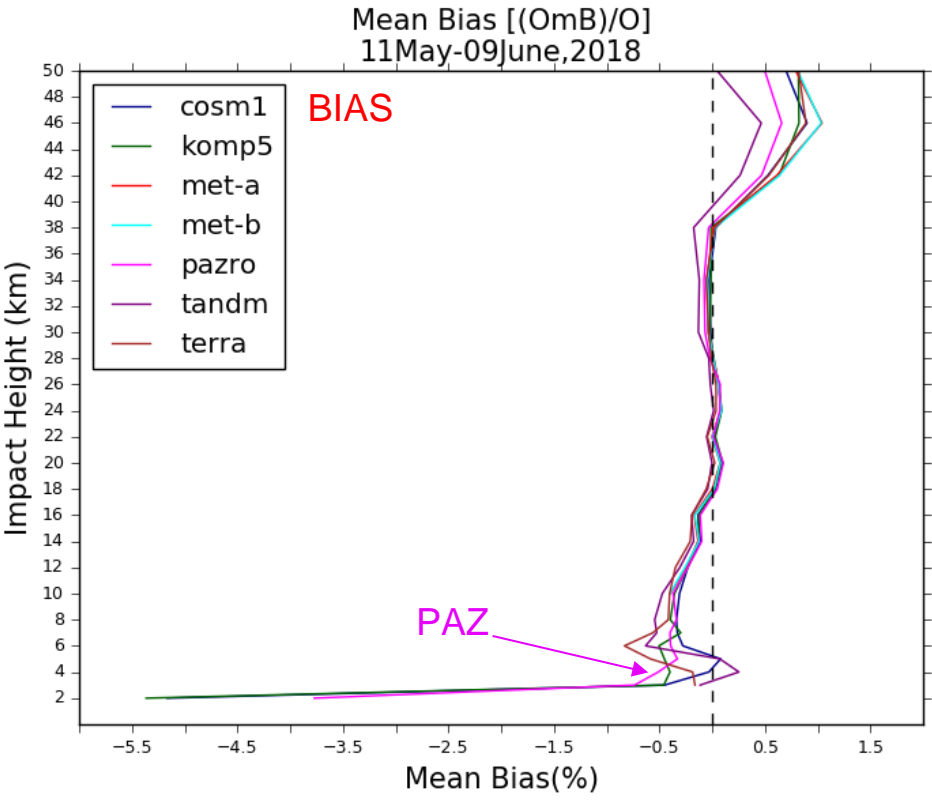
—Nominal —Non-Nominal



PAZ data count, 11 May – 09 June, 2018



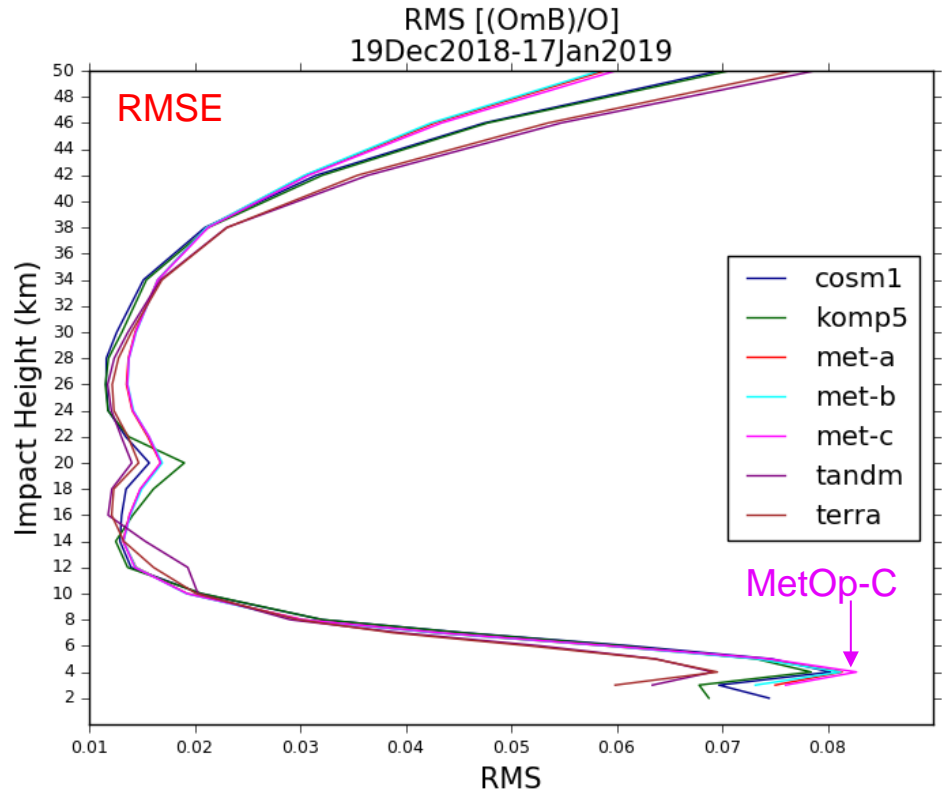
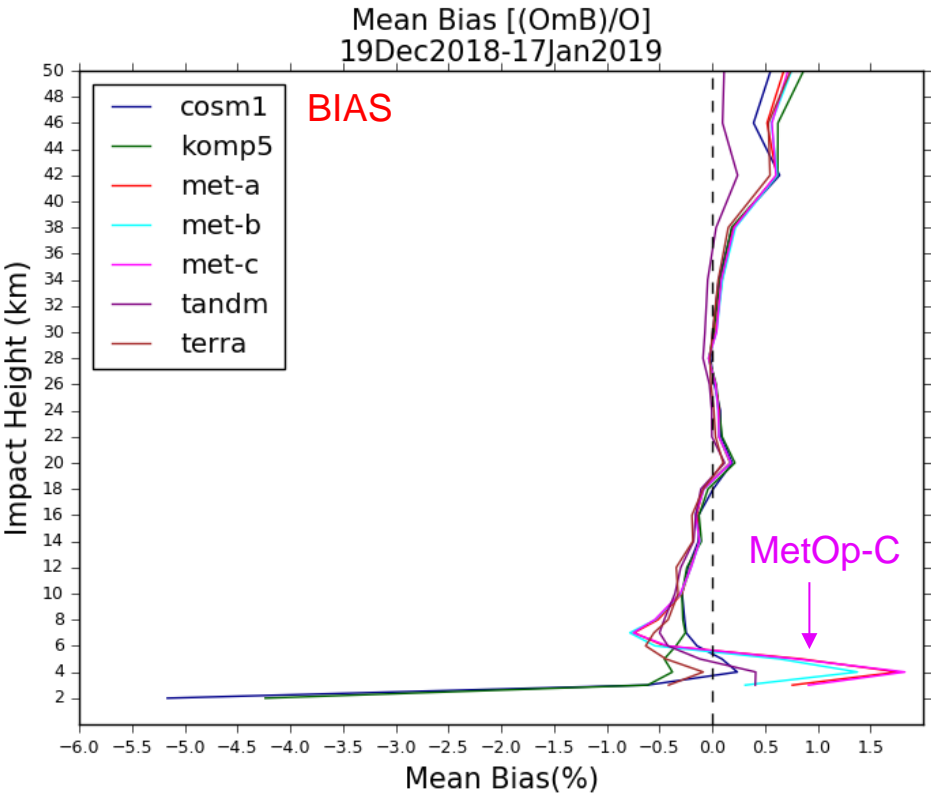
PAZ Statistics (after GSI QC)



PAZ Bias and RMSE, 11 May – 09 June, 2018

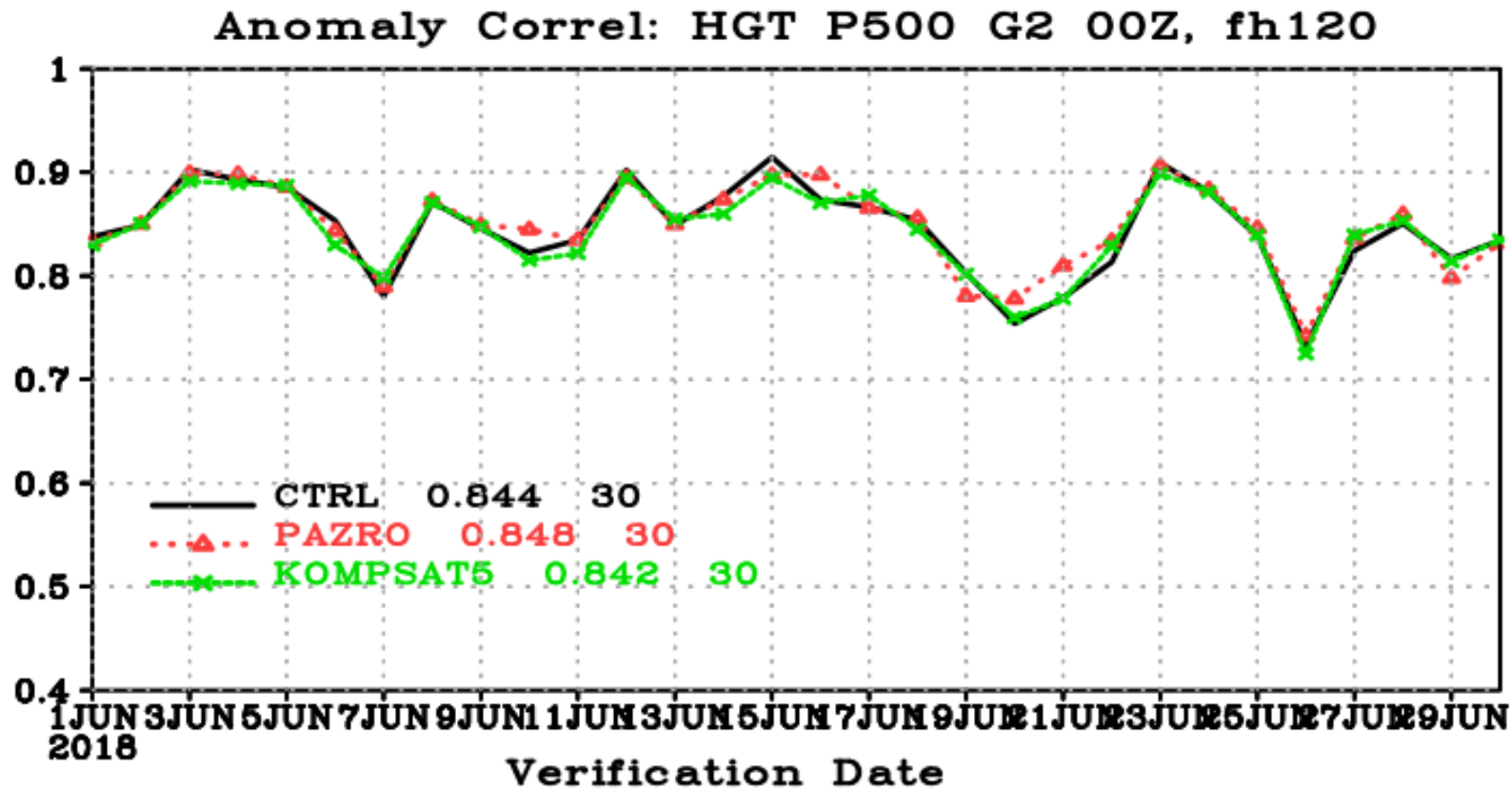


MetOp-C Statistics (after GSI QC)



MetOp-C Bias and RMSE, 19 Dec – 17 Jan, 2019

PAZ Forecast Impact



5-day forecast 500hPa Height Anomaly Correlation

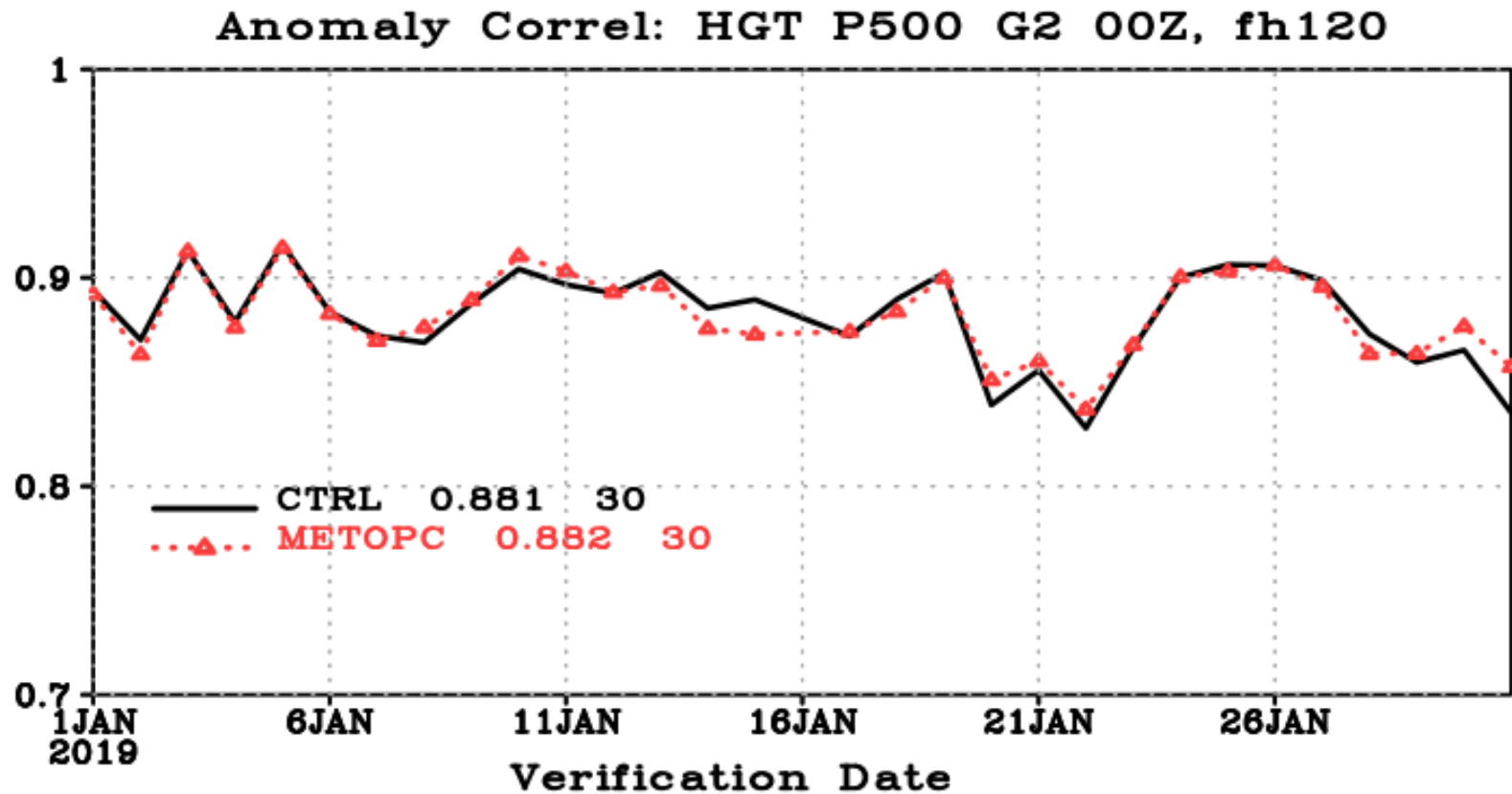
CTRL: operational configuration

PAZRO: CTRL + PAZ assimilation

KOMPSAT5: CTRL+KOMPSAT5 assimilation

June 01-30, 2018

METOP-C Forecast Impact



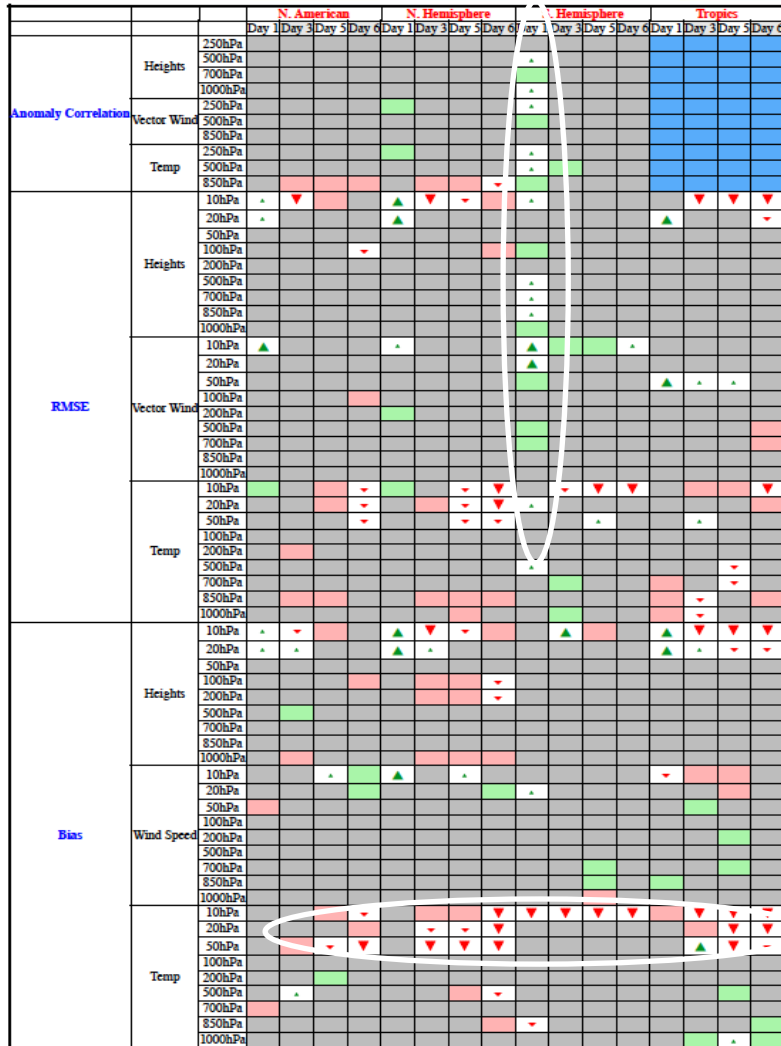
5-day forecast 500hPa Height Anomaly Correlation

CTRL: operational configuration

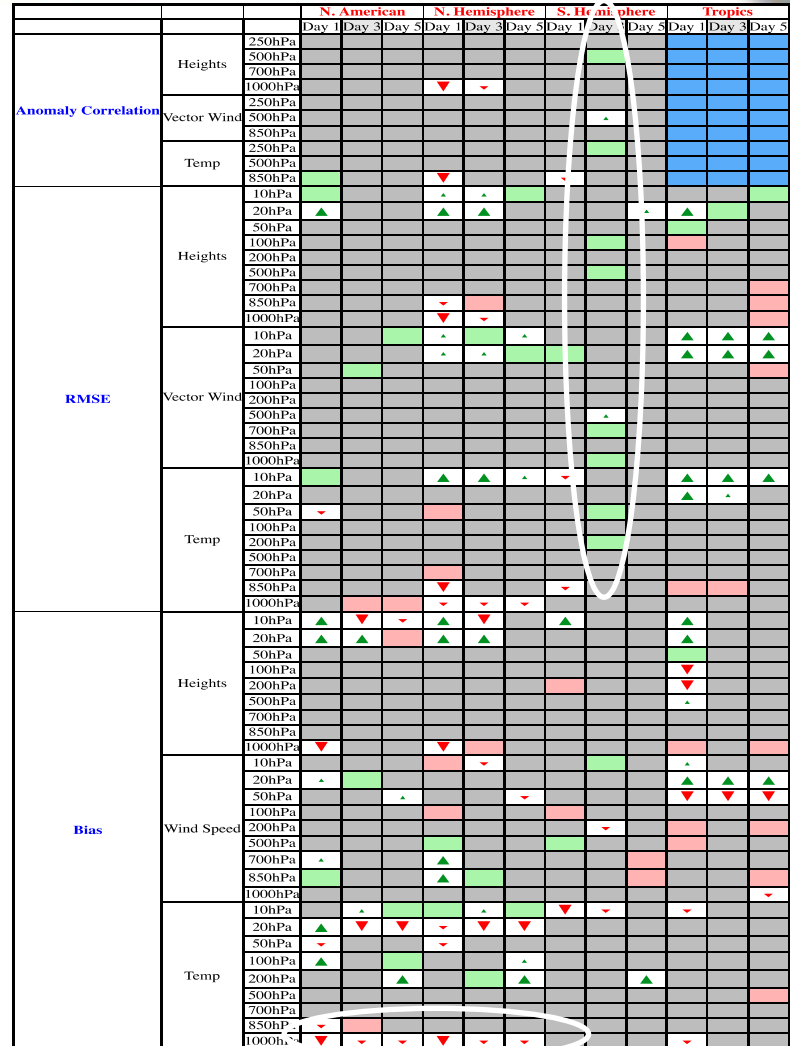
METOPC: CTRL + METOP-C assimilation

January 01-31, 2019

PAZ/MetOp-C Forecast Impact



PAZ June 1-30, 2018



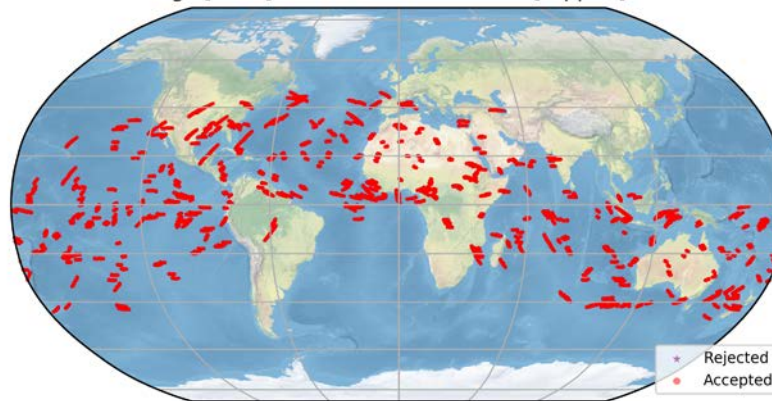
MetOp-C Jan 1-30, 2018

First Look at COSMIC 2



13 days between July 26-August 15, 2019

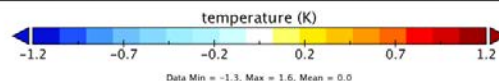
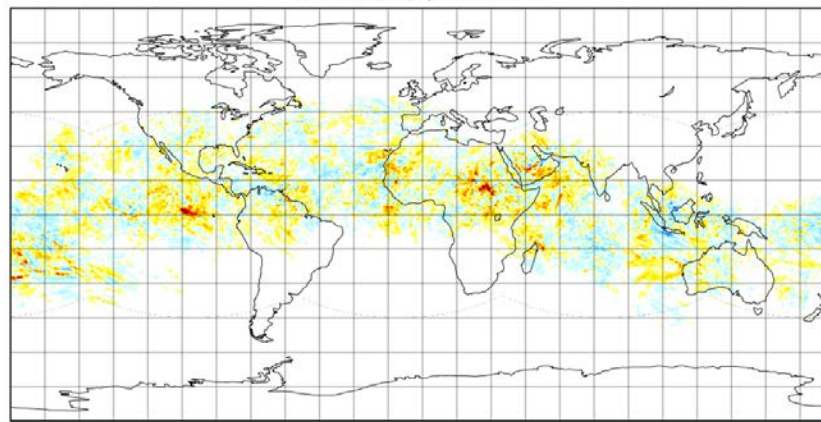
Observation locations
gfs[c768] 20190727.12Z cosmic2[ropp2d]



GFS v14

Num accepted obs: 166967 Num rejected obs: 19293

COSMIC2 Temperature Analysis Increment at 500hPa
JEDI 3D-EnVar - July 27, 2019 at 12z

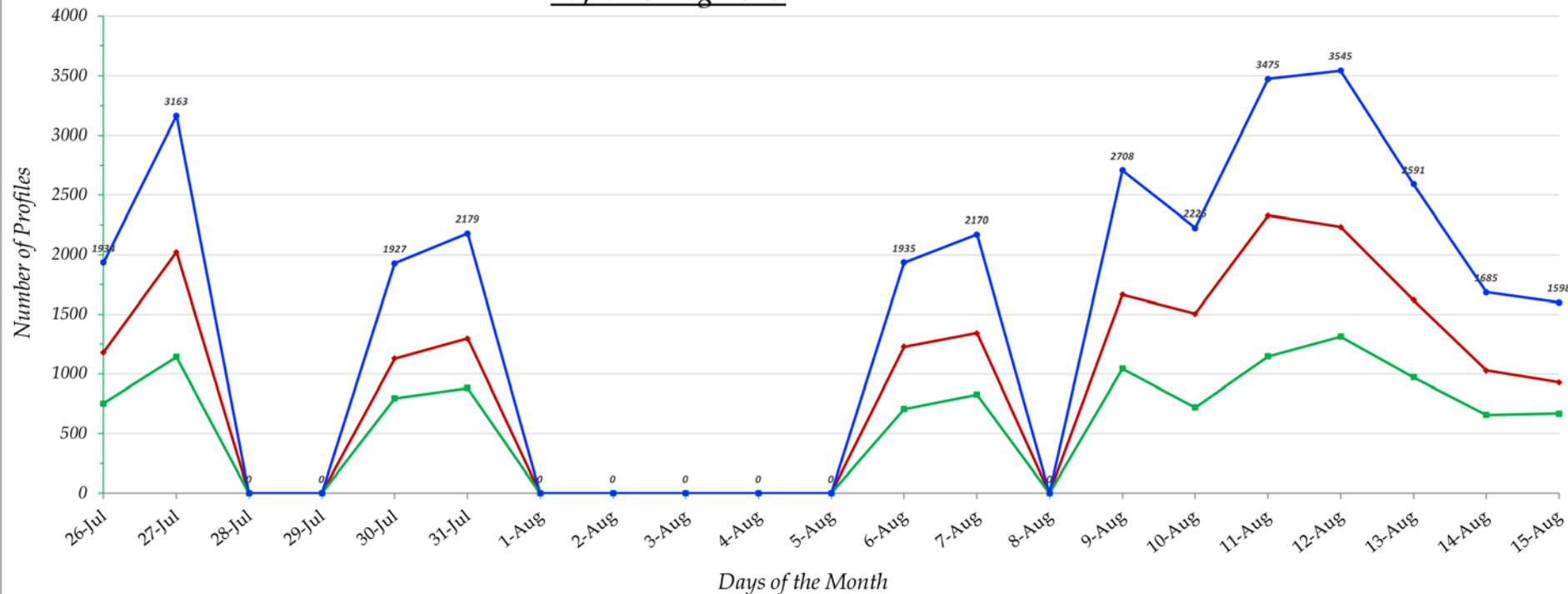


COSMIC2 Data Counts



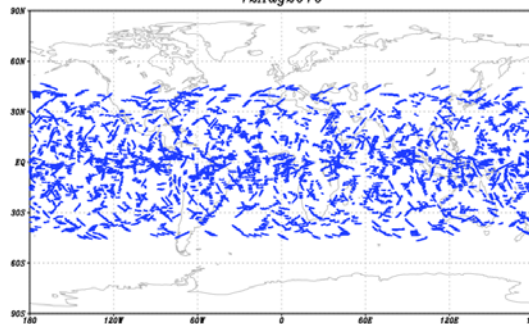
Daily Number of COSMIC-2 GNSS-RO Profiles
26Jul-15Aug 2019

GPS GLONASS TOTAL



Days of the Month

COSMIC-2 GNSS-RO Locations
12Aug2019

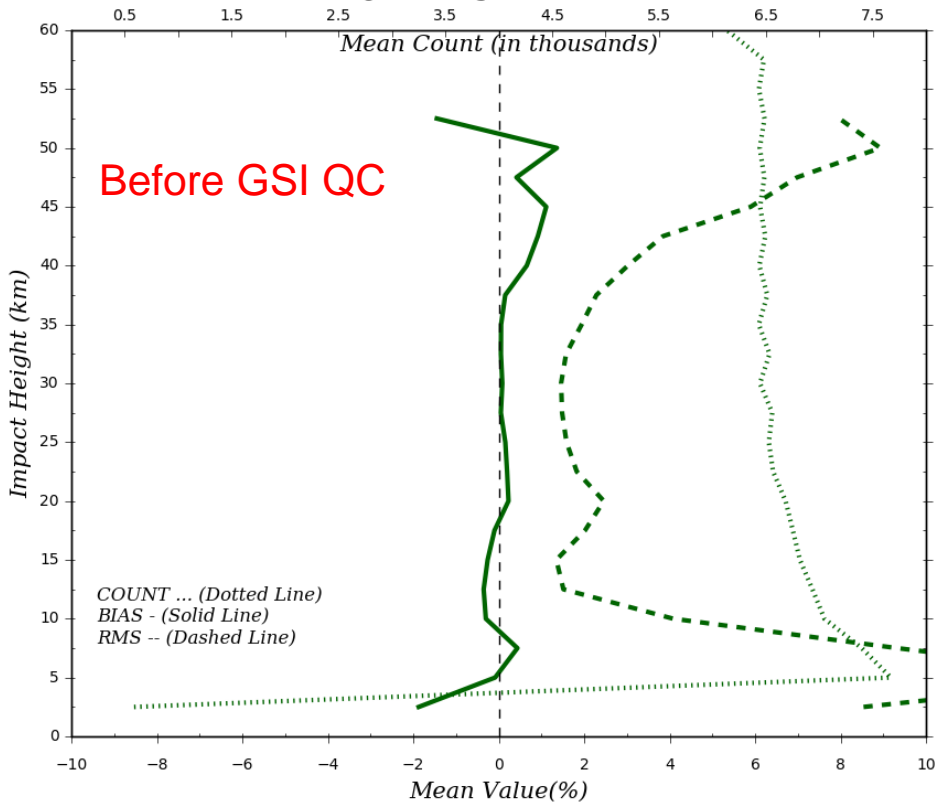


~2300 occs/day

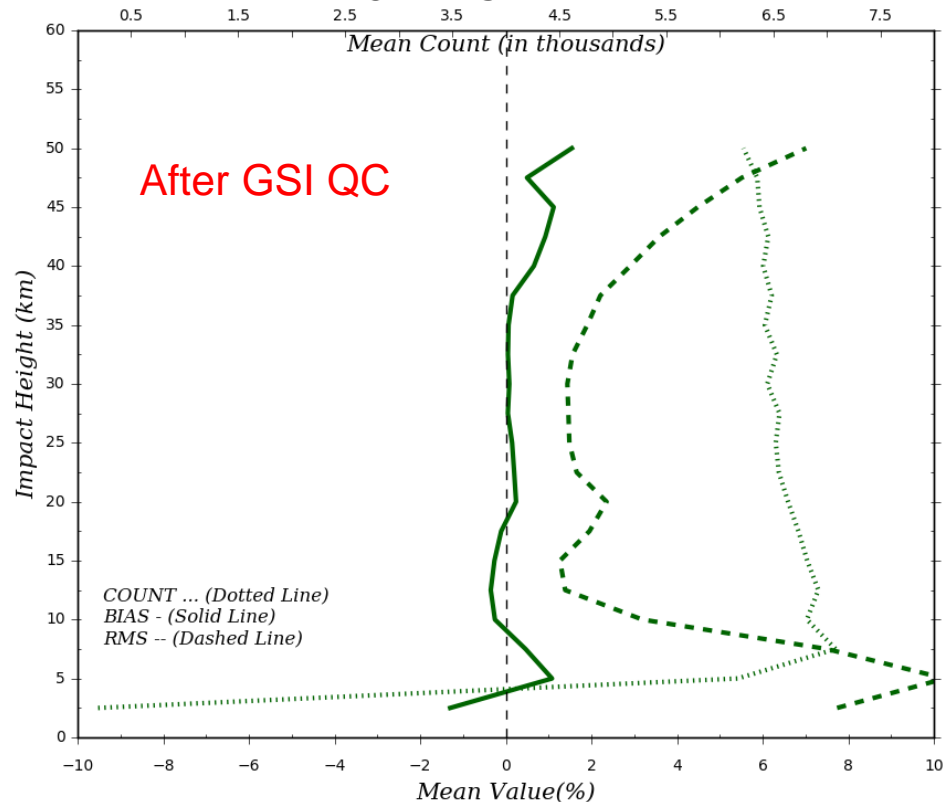
COSMIC-2 Statistics (13 days)



COSMIC-2: Diagnostics - PreQC [(OmB)/B]
26Jul-15Aug2019 - Global



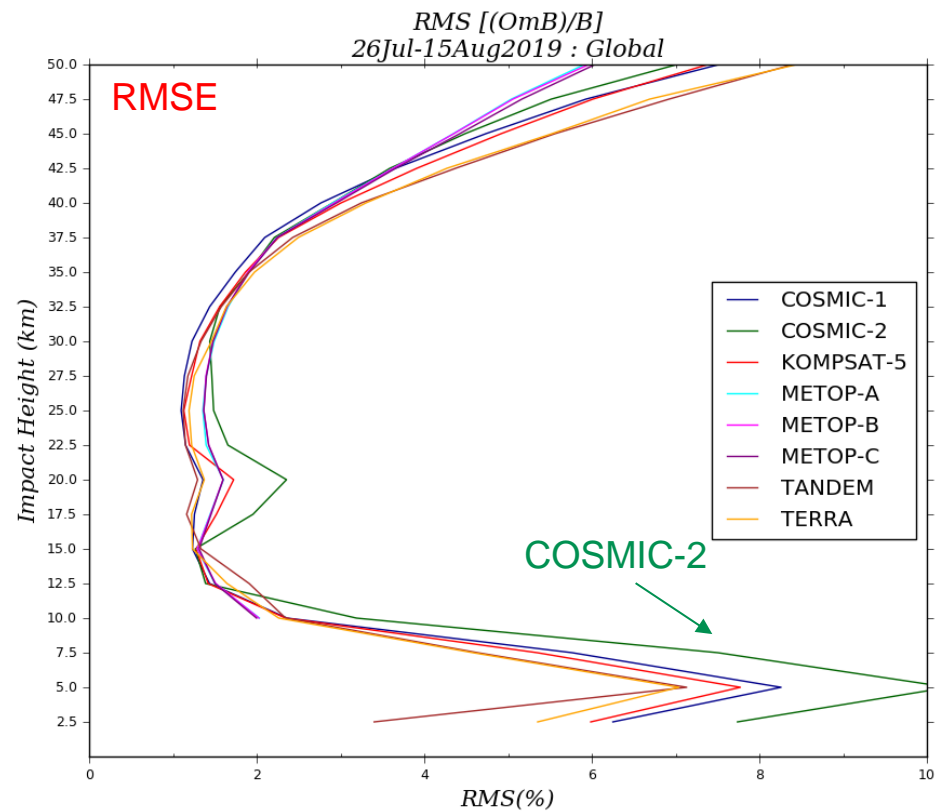
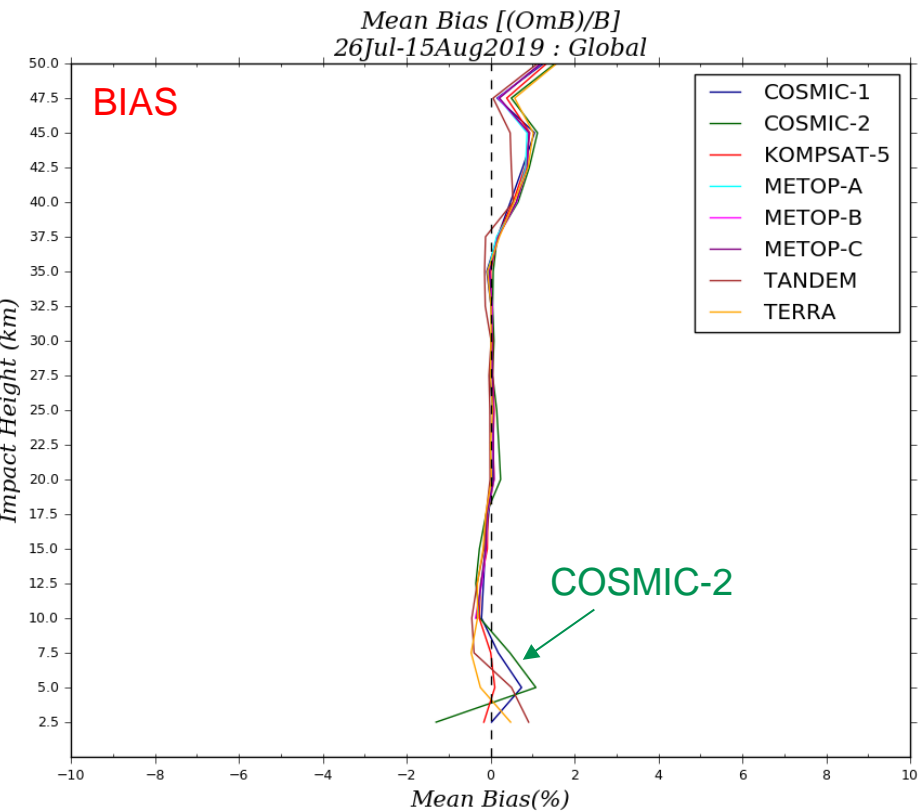
COSMIC-2: Diagnostics - PostQC [(OmB)/B]
26Jul-15Aug2019 - Global



COSMIC-2 Bias, RMSE and data count, 26Jul – 15 Aug 2019

GFS v14

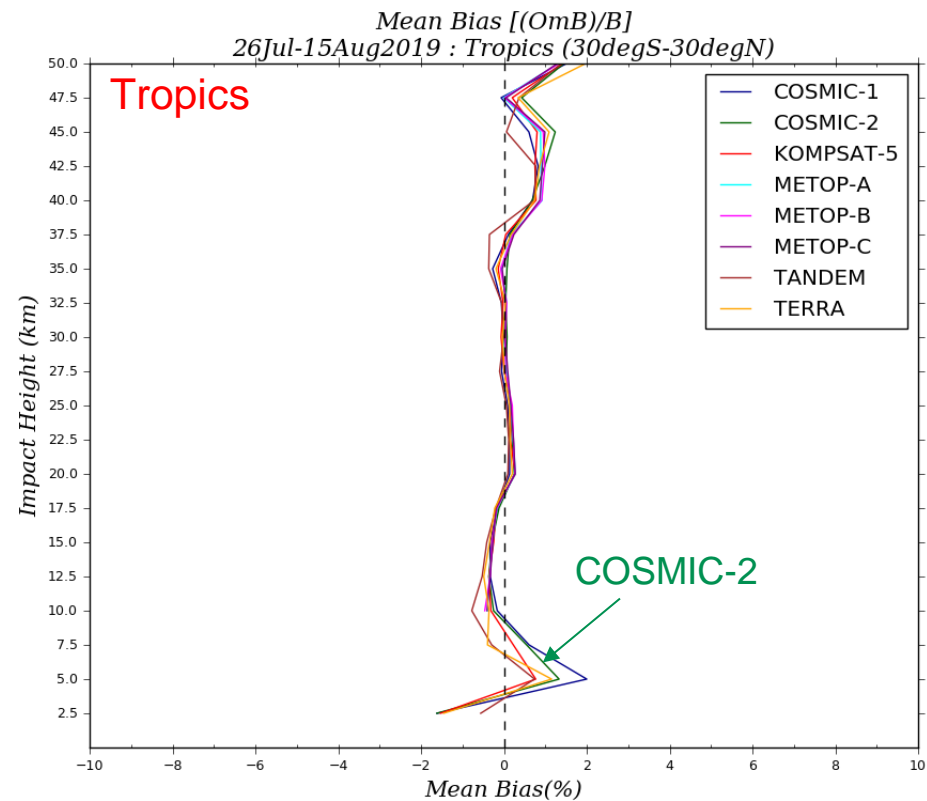
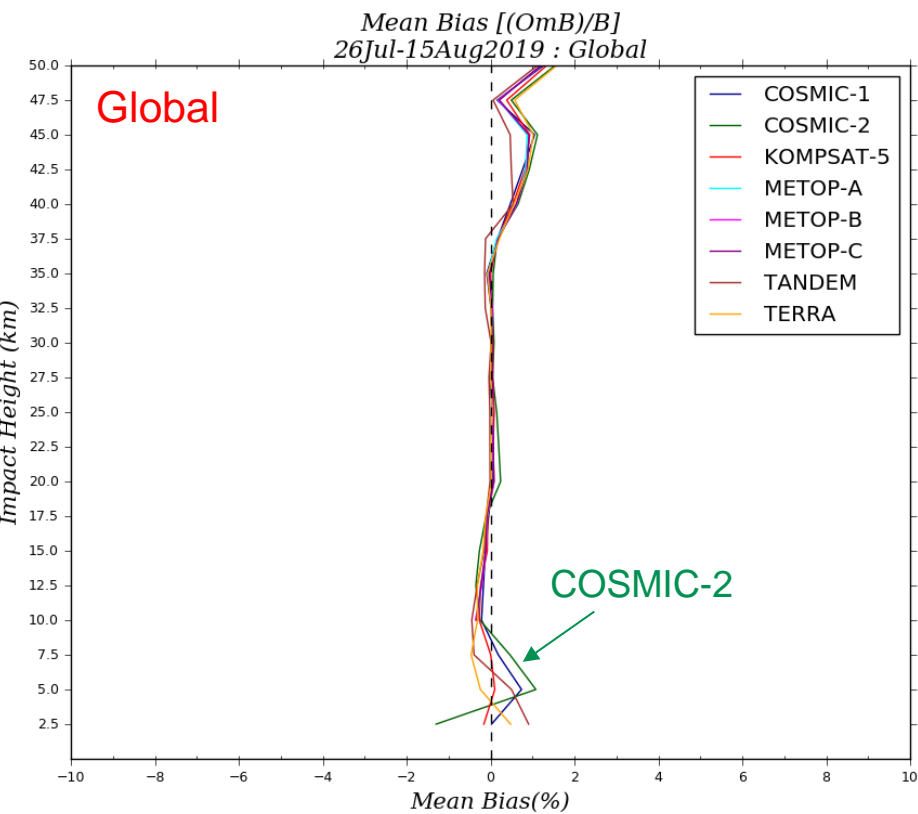
COSMIC-2 Statistics (13 days)



COSMIC-2 Bias and RMSE, 26Jul – 15 Aug 2019

GFS v14

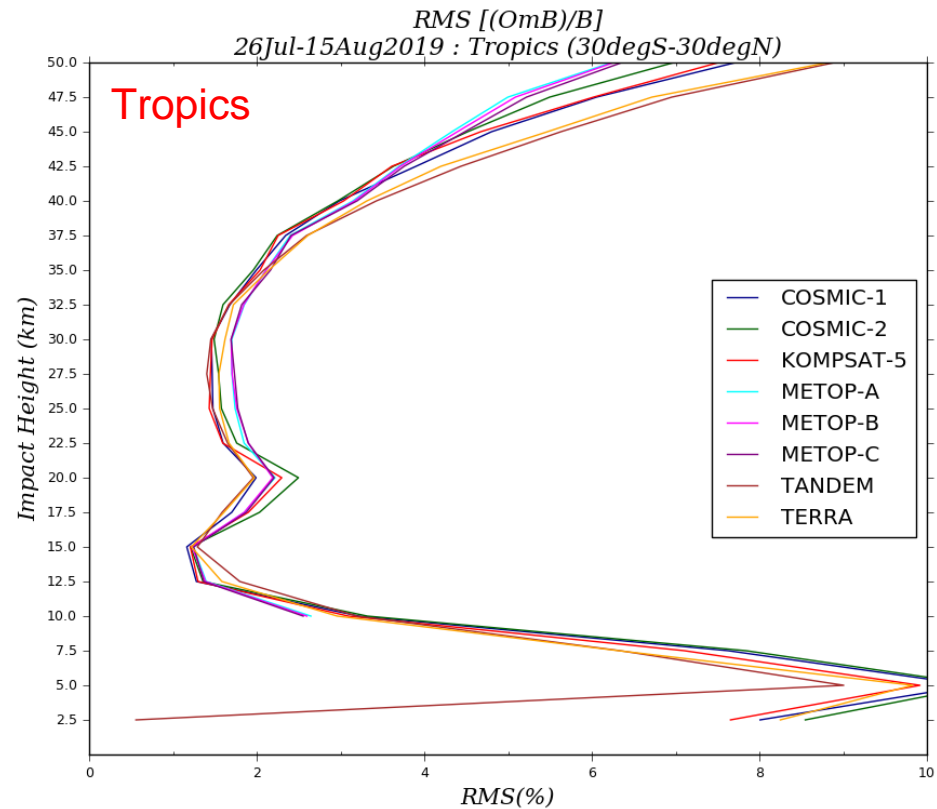
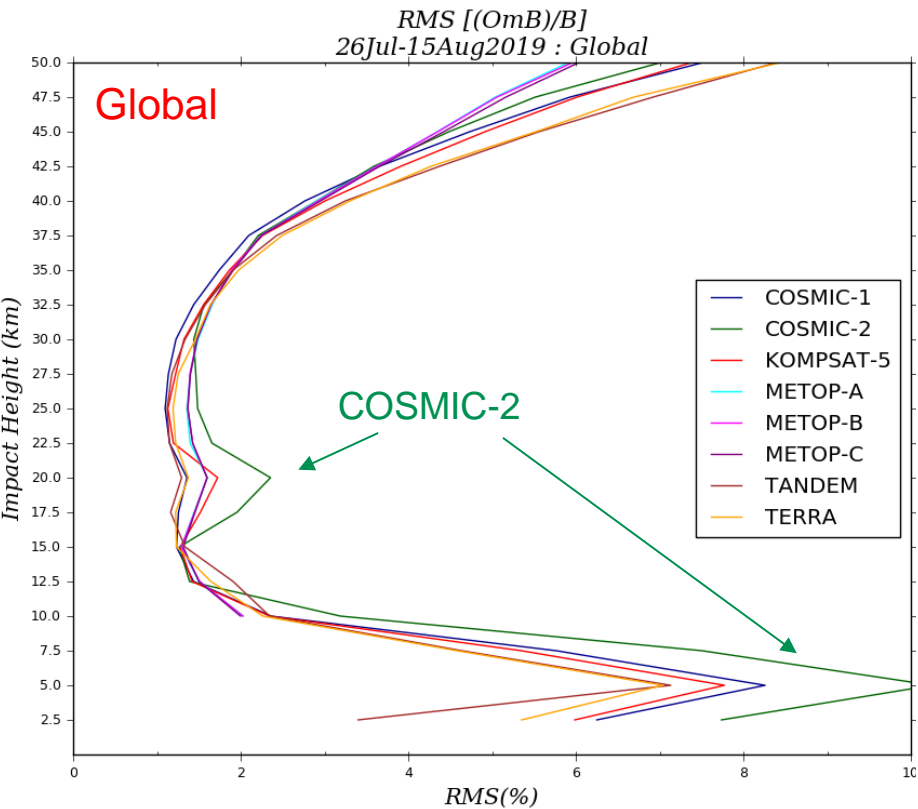
COSMIC-2 Bias (13 days)



COSMIC-2 Bias Global vs Tropics, 26Jul – 15 Aug 2019

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COSMIC-2 RMSE (13 days)



COSMIC-2 RMSE Global vs Tropics, 26Jul – 15 Aug 2019

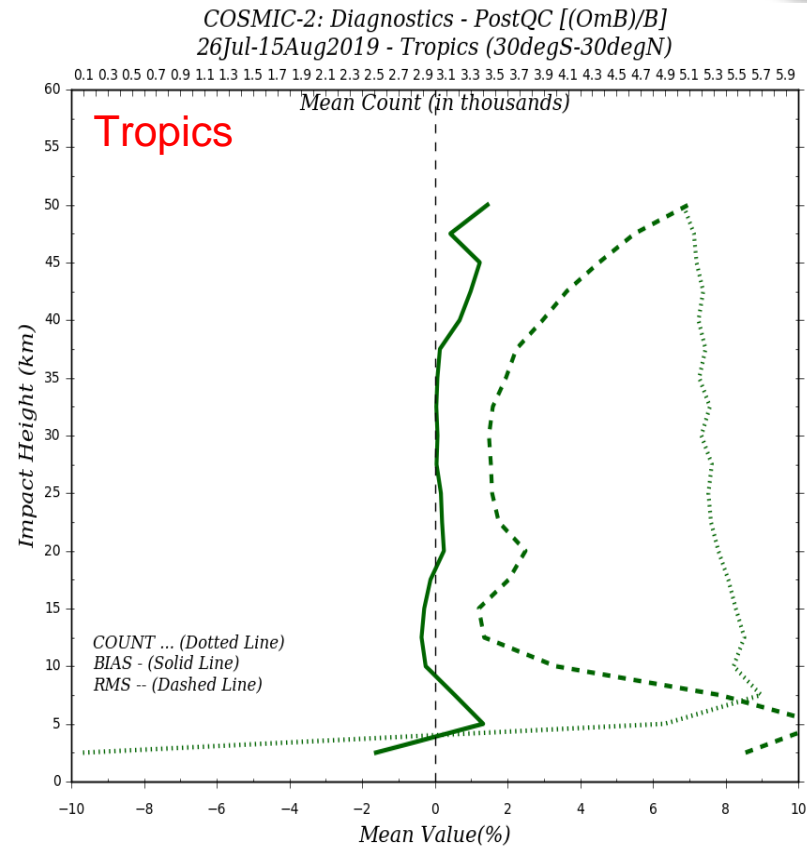
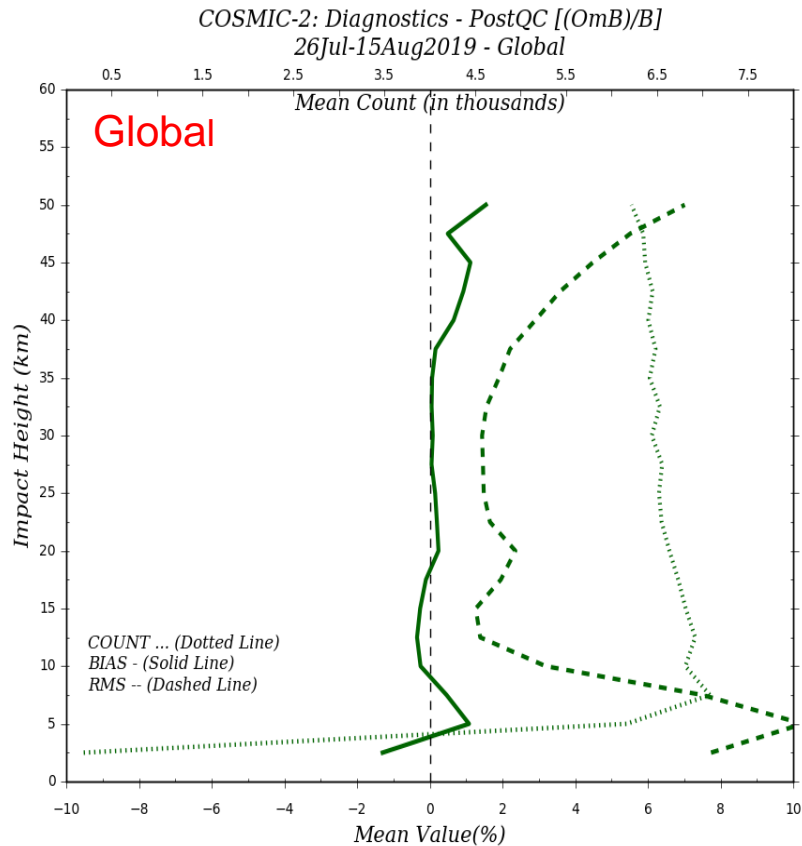
GFS v14

Summary



1. PAZ (Summer) and MetOp-C (Winter) found to have a neutral/positive impact on forecast.
2. COSMIC-2 initial data look promising.
3. Fair comparisons to COSMIC-2 can only be made in the tropics.
4. GSI not tuned for COSMIC-2.

COSMIC-2 Statistics (13 days)



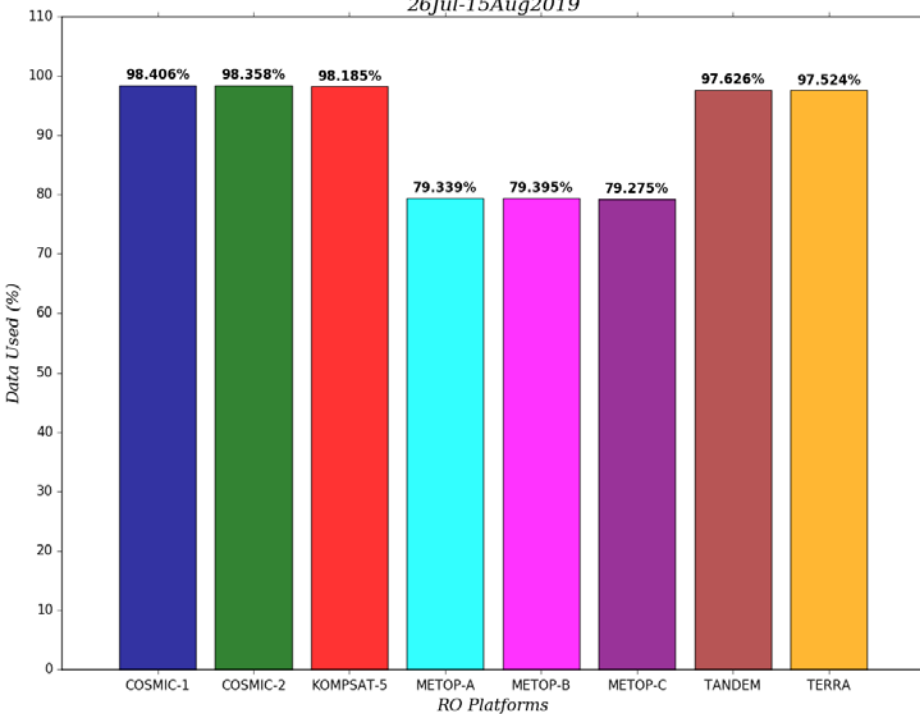
COSMIC-2 Bias, RMSE and data count, 26Jul – 15 Aug 2019

GFS v14

COSMIC-2 Statistics (13 days)

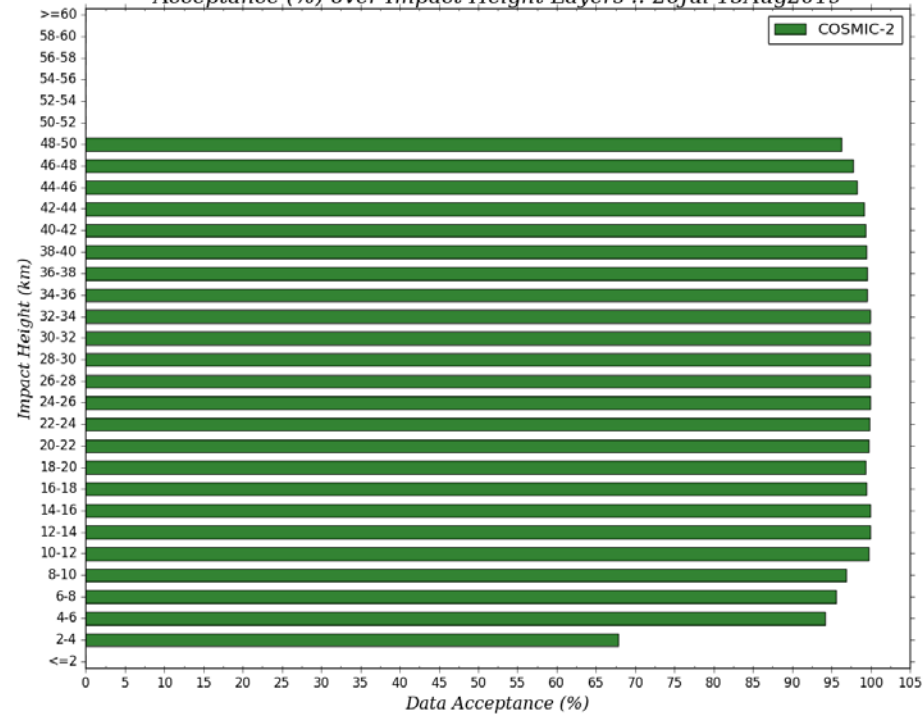


Accepted (%) against Availability over Height
> Super-Refractivity Layer & ≤ 50km.
26Jul-15Aug2019



% of data passing GSI QC
and assimilated

Vertical Distribution of "COSMIC-2" Bending Angle
Acceptance (%) over Impact Height Layers :: 26Jul-15Aug2019



% of COSMIC-2 data
assimilated per vertical layer

Forecast Impact Metric



EMC Verification Scorecard	
Symbol Legend	
▲	PAZRO is better than CTRL at the 99.9% significance level
▲	PAZRO is better than CTRL at the 99% significance level
■	PAZRO is better than CTRL at the 95% significance level
■	No statistically significant difference between PAZRO and CTRL
■	PAZRO is worse than CTRL at the 95% significance level
▼	PAZRO is worse than CTRL at the 99% significance level
▼	PAZRO is worse than CTRL at the 99.9% significance level
■	Not statistically relevant
Start Date: 20180601	
End Date: 20180630	