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Ministry of Earth Sciences
Government of India

Assessment of ADM-Aeolus HLOS Winds using NCMRWF Global Forecast System

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3rd Aeolus NWP impact and L2B product quality working meeting

Presentation Outline:

1. Introduction

2. Science & Objective

3. Experiment & Results

4. Conclusion

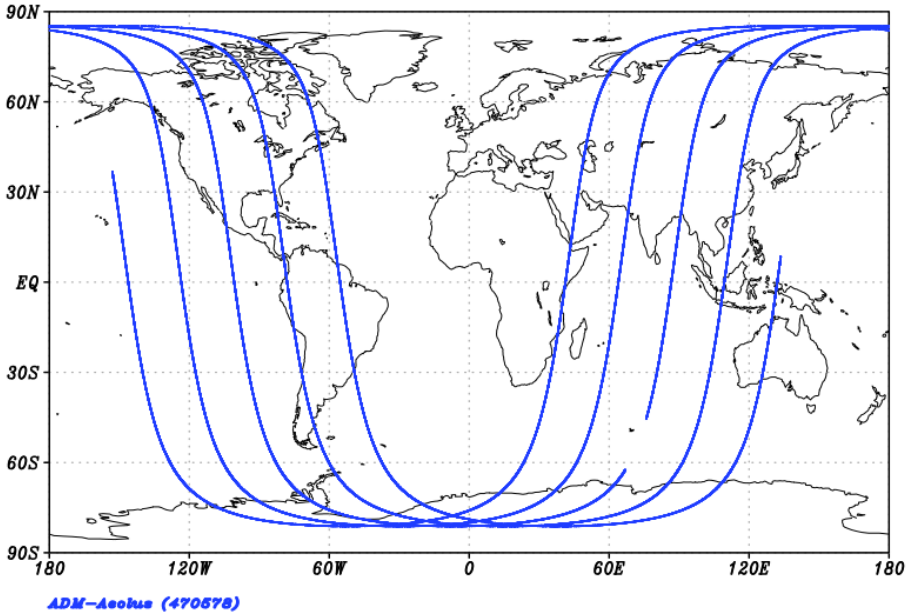
Introduction

- Aeolus is the first space-based ***Doppler Wind Lidar*** mission by European Space Agency.

- ***Horizontal Line-of-Sight*** (HLOS) wind is the observed parameter used for Data Assimilation in NWP System.

- The instrument on board the Aeolus mission used for measuring HLOS wind is ***Atmospheric LAser Doppler Instrument (ALADIN)***.

ADM-Aeolus Global Coverage (Received at NCMRWF)
2020081100



ADM-Aeolus Global Coverage (Received at NCMRWF)
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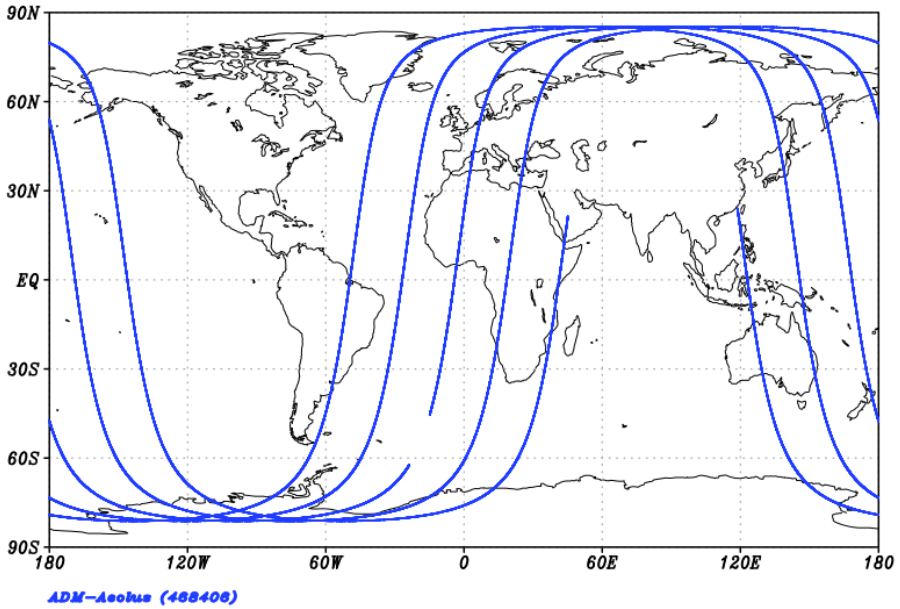

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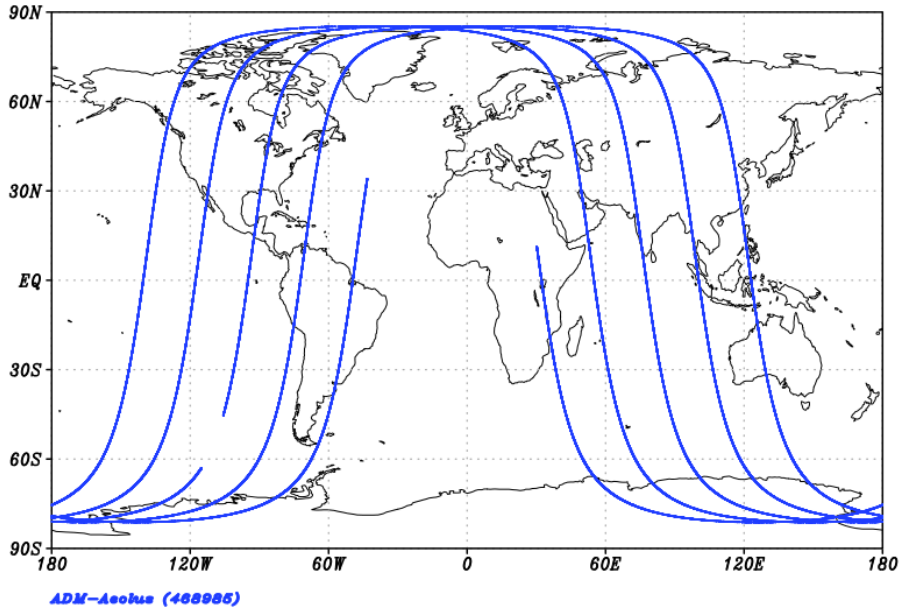

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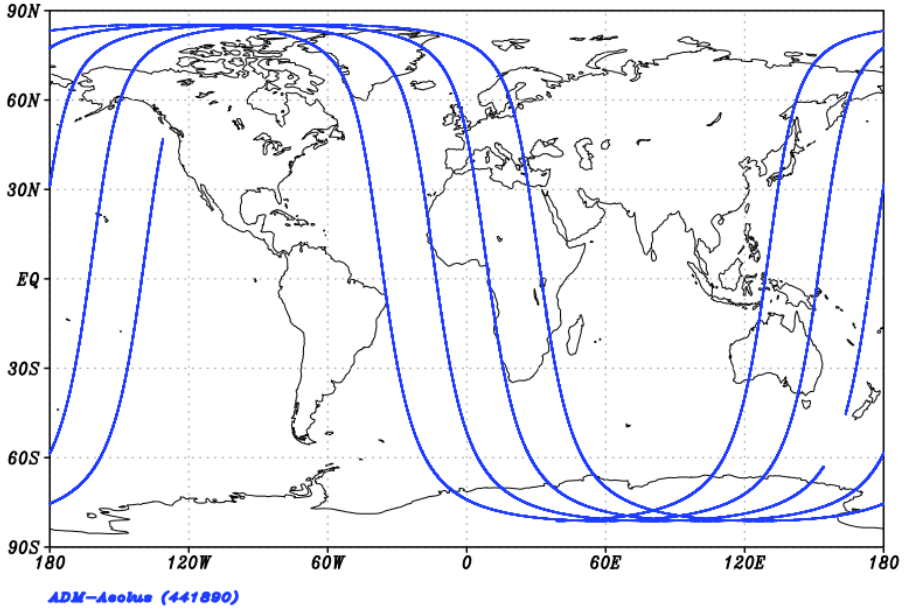
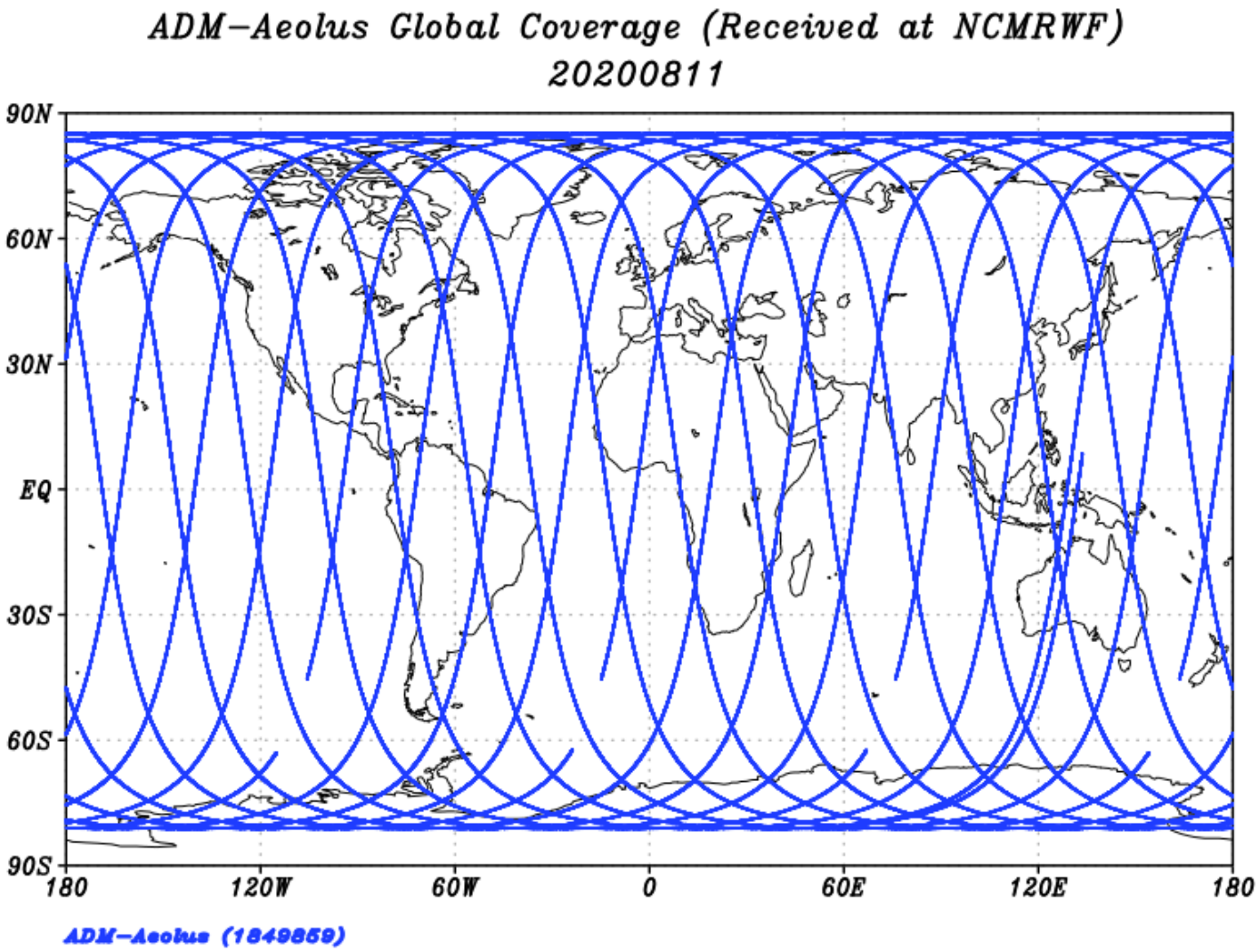



ADM-Aeolus Global Coverage (Received at NCMRWF)
20200811
90N
60N
30N
EQ
30S
60S
90S
180
120W
60W
0
60E
120E
180
ADM-Aeolus (1849659)

Science & Objective

- The HLOS wind measurements are assimilated using the observation operator:

$$v_{HLOS} = -u \sin\theta - v \cos\theta$$

where: v_{HLOS} **=> HLOS Wind derived by NWP Model**

u => NWP Model Zonal Wind

v => NWP Model Meridional Wind

θ **=> Azimuth Angle as observed/measured at the observation location.**

- NWP model zonal & meridional wind component is interpolated at the observation geolocation and HLOS wind values are derived using the said operator.

- This model derived HLOS wind measurements are than adjusted against the observed values as obtained from Aeolus, for assimilation into the NWP system.

- The main objective is the evaluation of HLOS Wind observation and its implementation in Global Data Assimilation System (GDAS) for acceptance into the operational system.

Experiment & Results

- ***Global Data Assimilation & Forecast System*** (GDAS-v14 & GFS) is used for assimilation of HLOS wind data and subsequent forecast.

- HLOS wind is assimilated in GDAS using ***GSI*** assimilation scheme in 3D-Var mode.

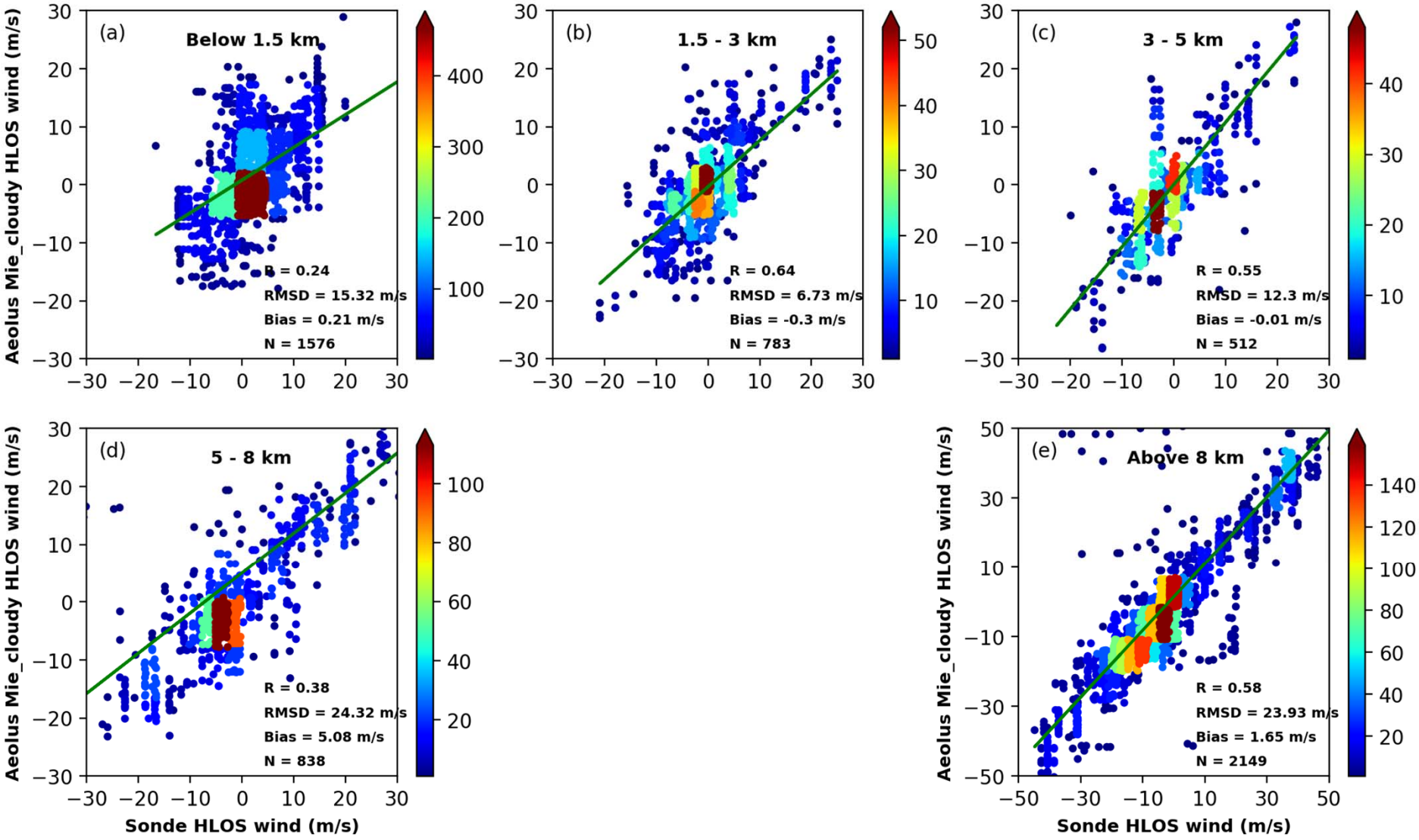
- HLOS wind assimilation capability is implemented in GSI (Gridpoint Statistical Interpolation) code.

- The QC criteria are applied for quality check prior to assimilation of the wind product.

- The acceptance and rejection criteria are considered following the "***ECMWF Technical Memo 864".***

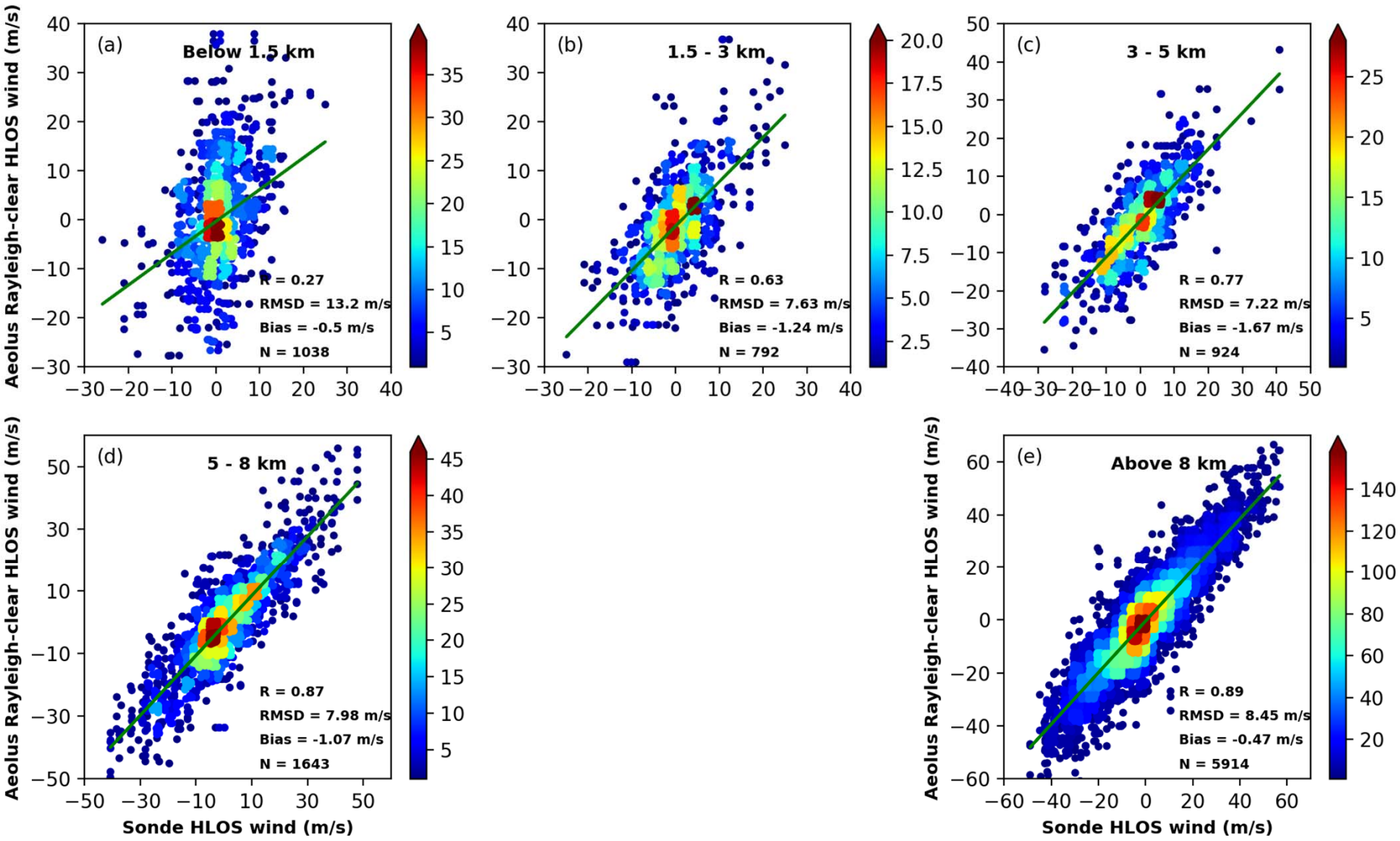
HLOS Validation against Observation:

01-31 Nov 2020 (Mie-cloudy)

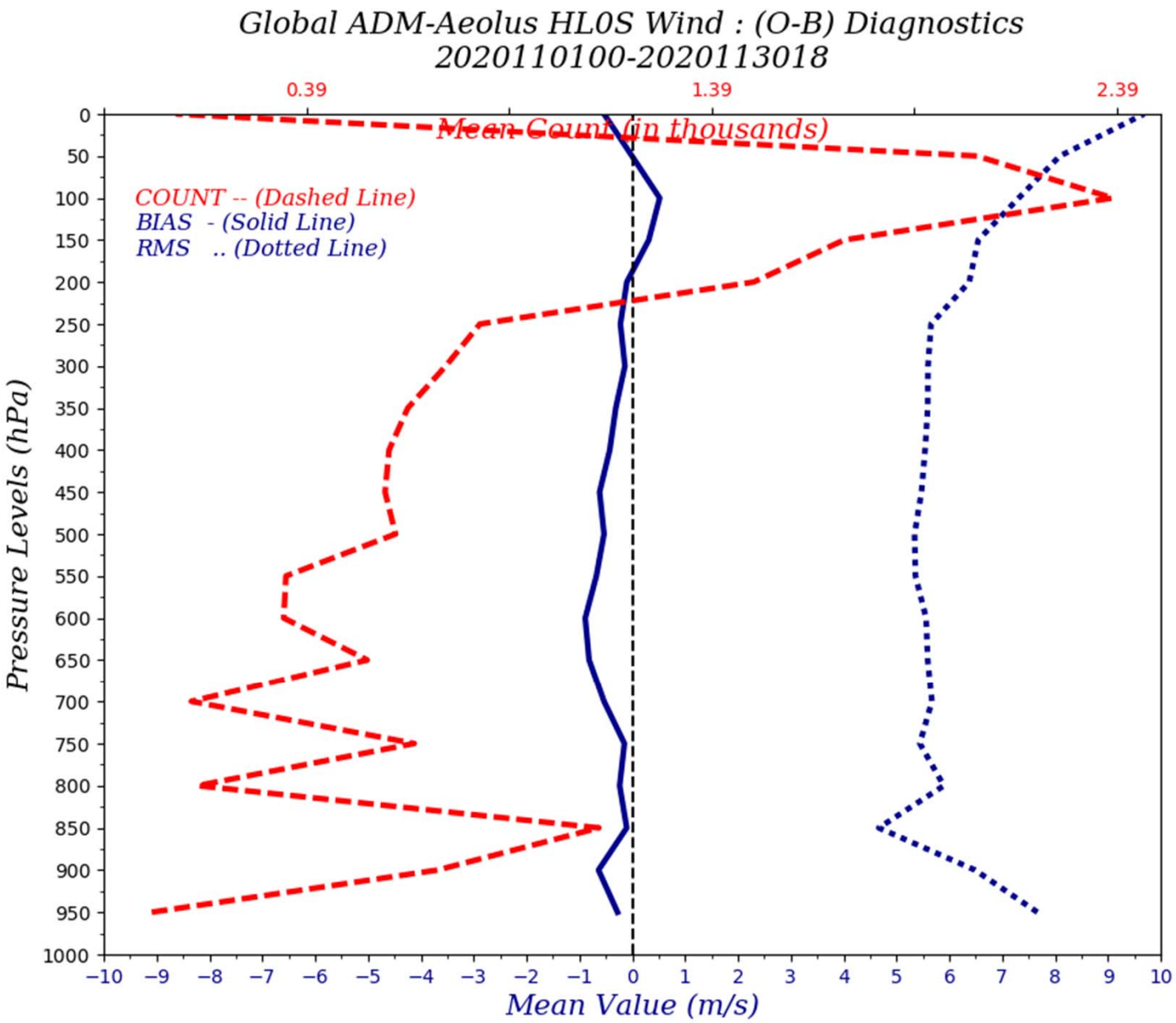


HLOS Validation against Observation:

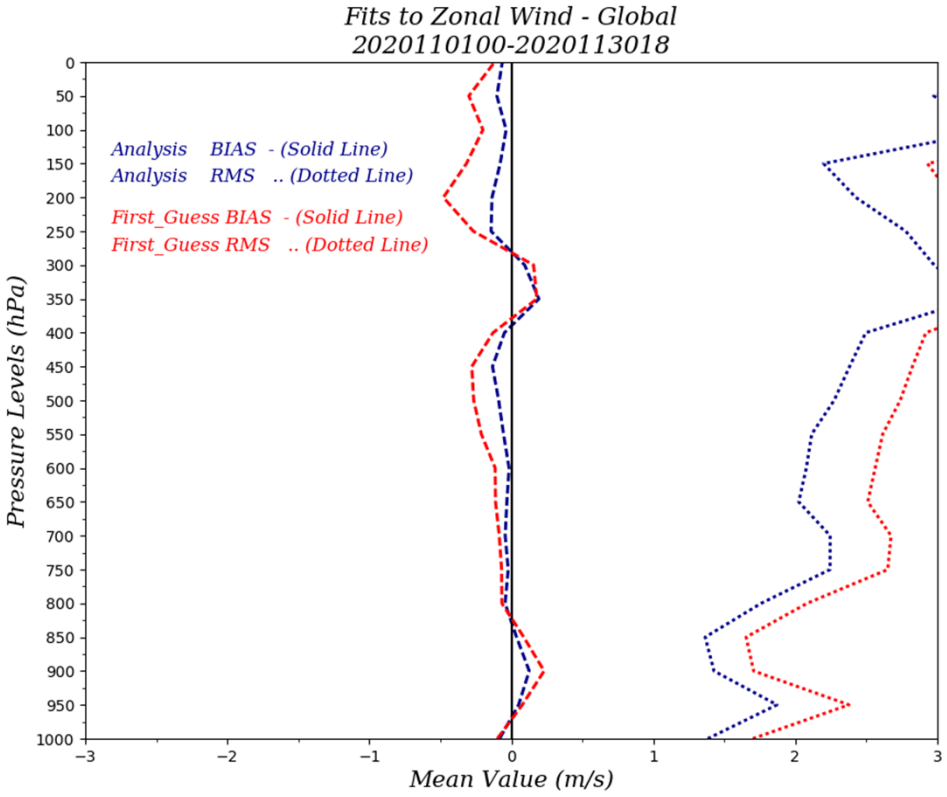
01-31 Nov 2020 (Rayleigh-clear)

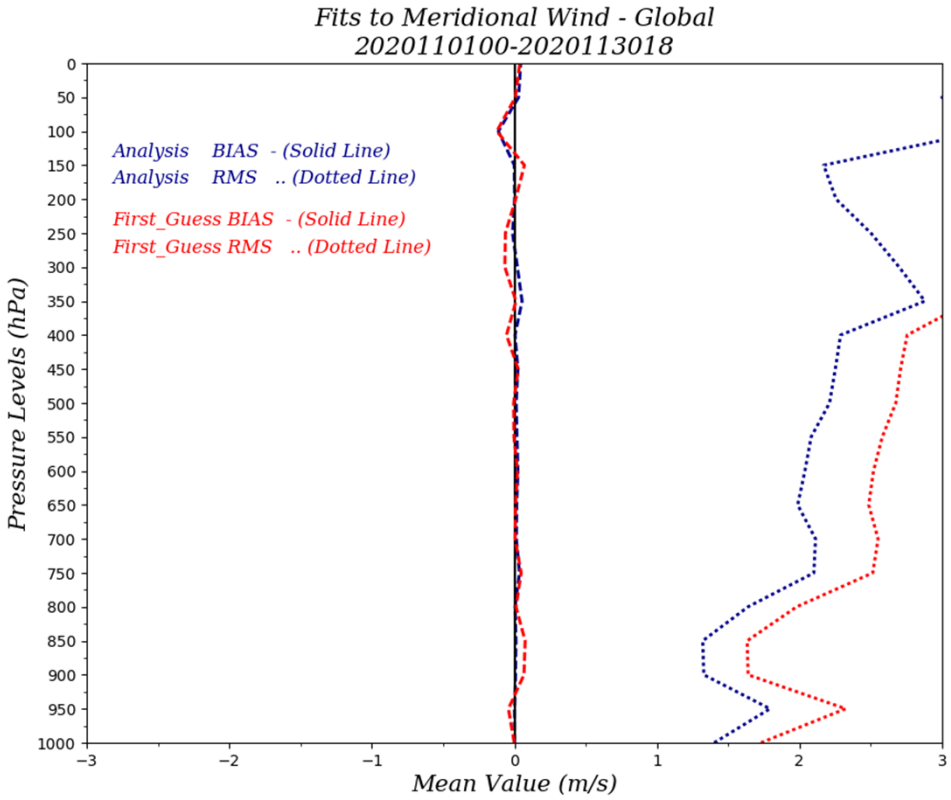


Assimilation Diagnostics:

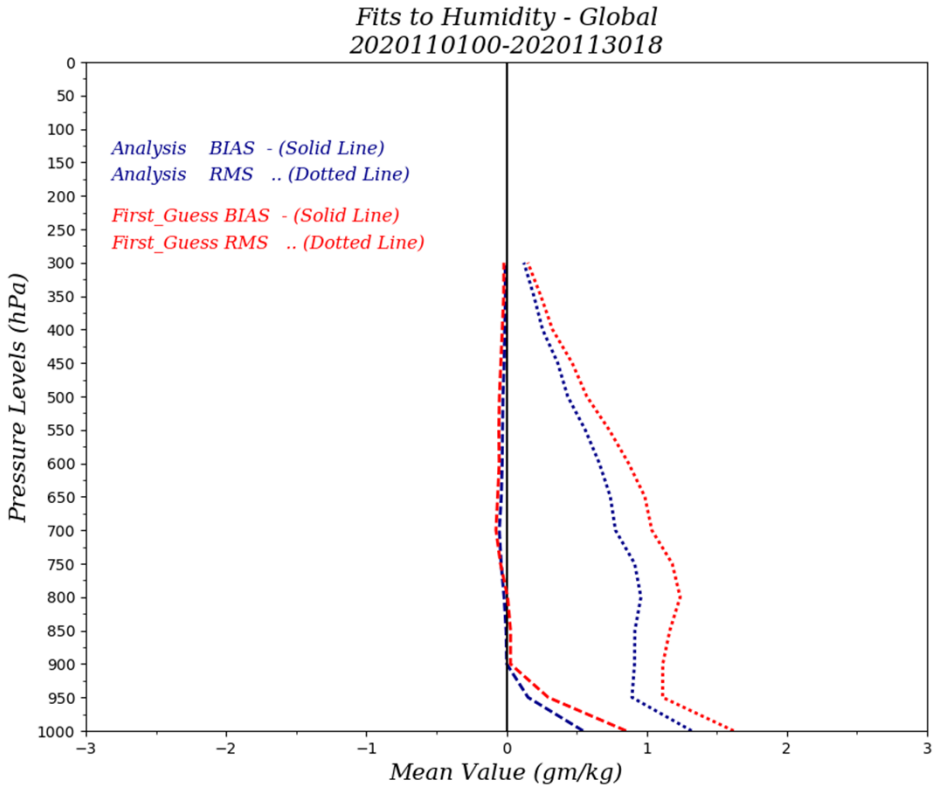


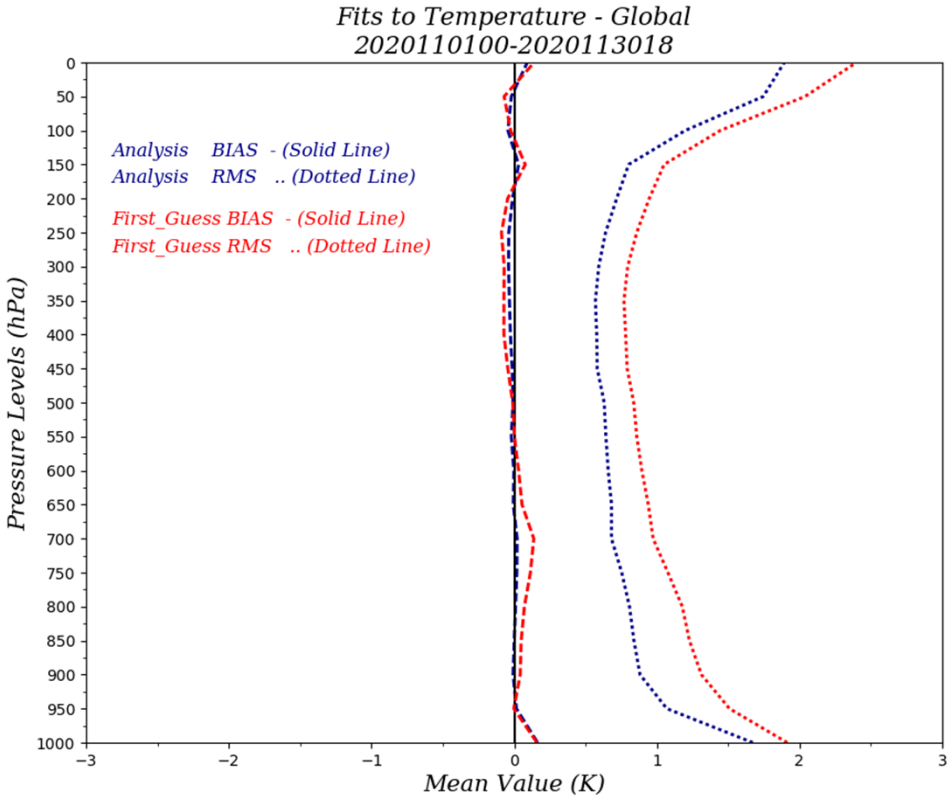
Fit-to-Obs:


Fits to Zonal Wind - Global
2020110100-2020113018
Analysis BIAS - (Solid Line)
Analysis RMS .. (Dotted Line)
First_Guess BIAS - (Solid Line)
First_Guess RMS .. (Dotted Line)
Pressure Levels (hPa)
Mean Value (m/s)

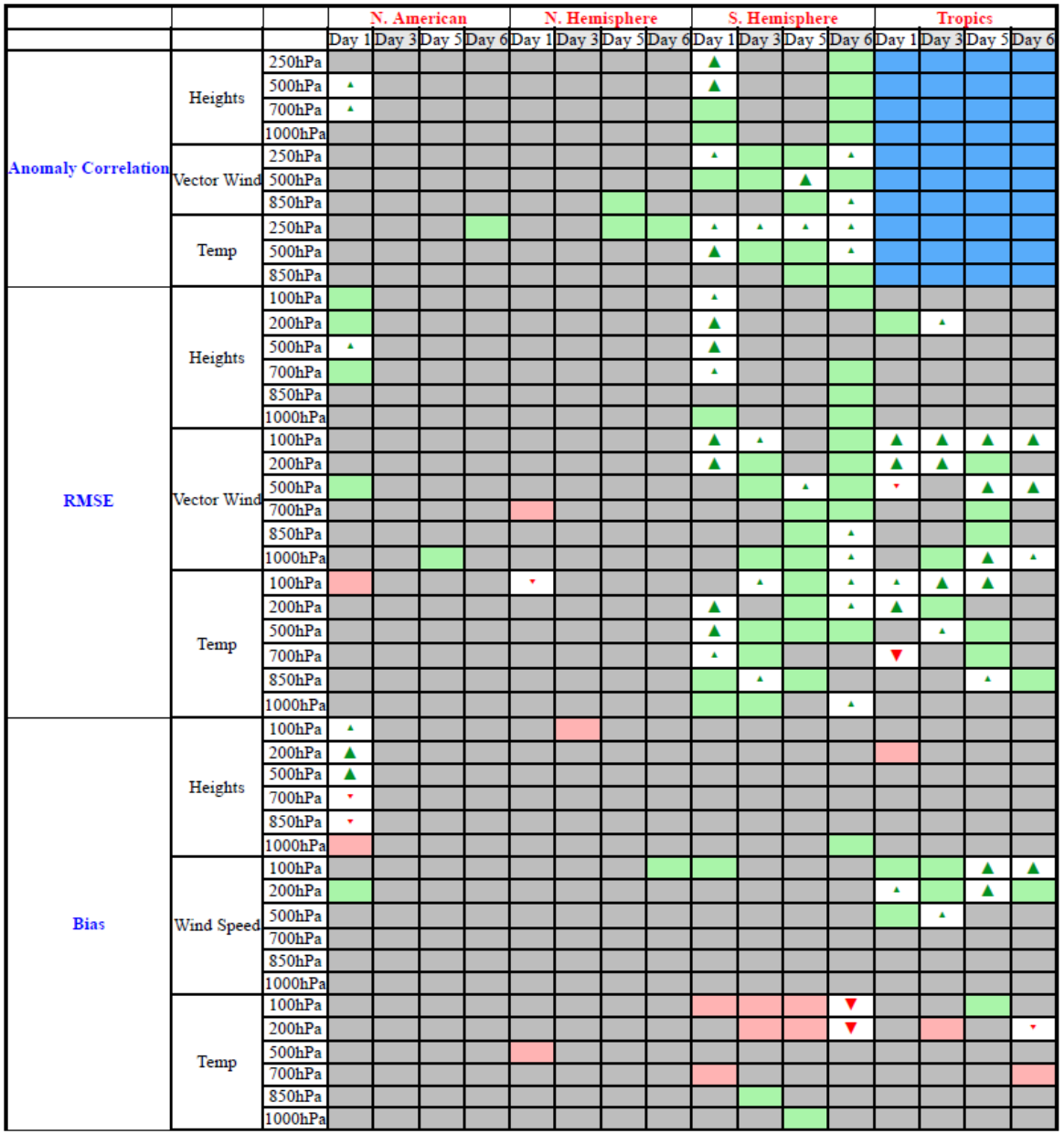

Fits to Meridional Wind - Global
2020110100-2020113018
Analysis BIAS - (Solid Line)
Analysis RMS .. (Dotted Line)
First_Guess BIAS - (Solid Line)
First_Guess RMS .. (Dotted Line)
Pressure Levels (hPa)
Mean Value (m/s)

Fit-to-Obs:

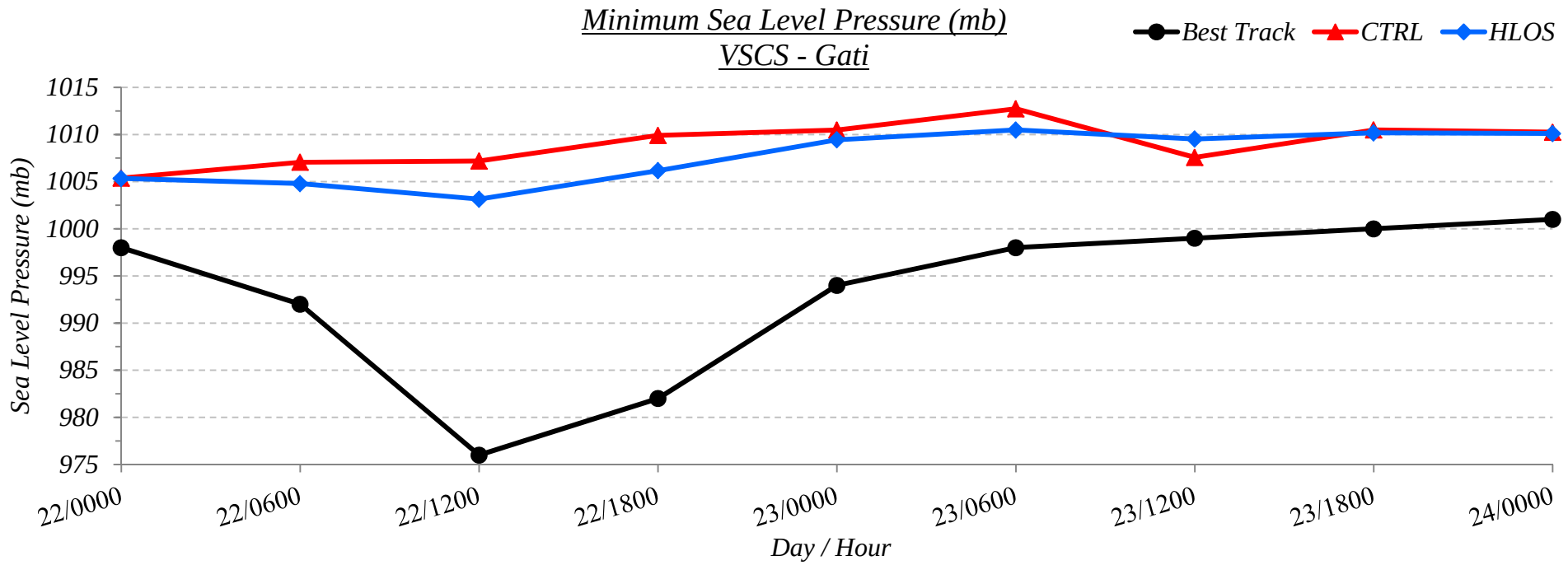

Fits to Humidity - Global
2020110100-2020113018
Analysis BIAS - (Solid Line)
Analysis RMS .. (Dotted Line)
First_Guess BIAS - (Solid Line)
First_Guess RMS .. (Dotted Line)
Pressure Levels (hPa)
Mean Value (gm/kg)

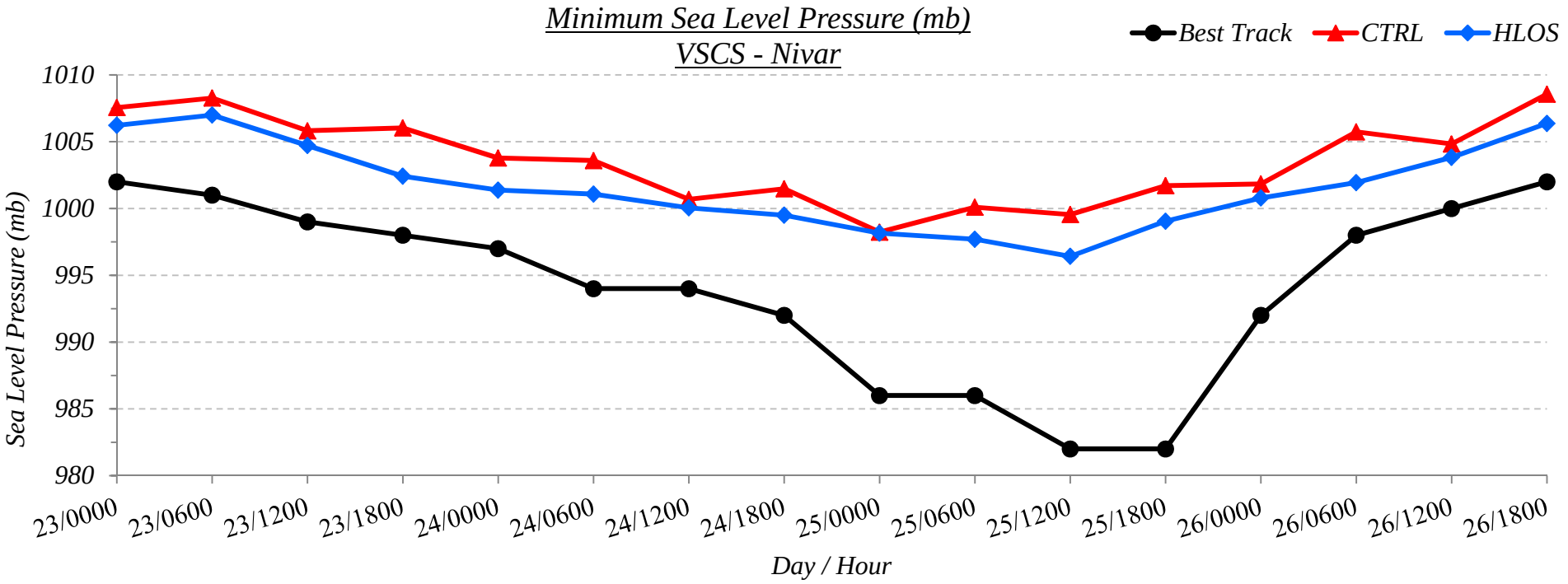

Fits to Temperature - Global
2020110100-2020113018
Analysis BIAS - (Solid Line)
Analysis RMS .. (Dotted Line)
First_Guess BIAS - (Solid Line)
First_Guess RMS .. (Dotted Line)
Pressure Levels (hPa)
Mean Value (K)

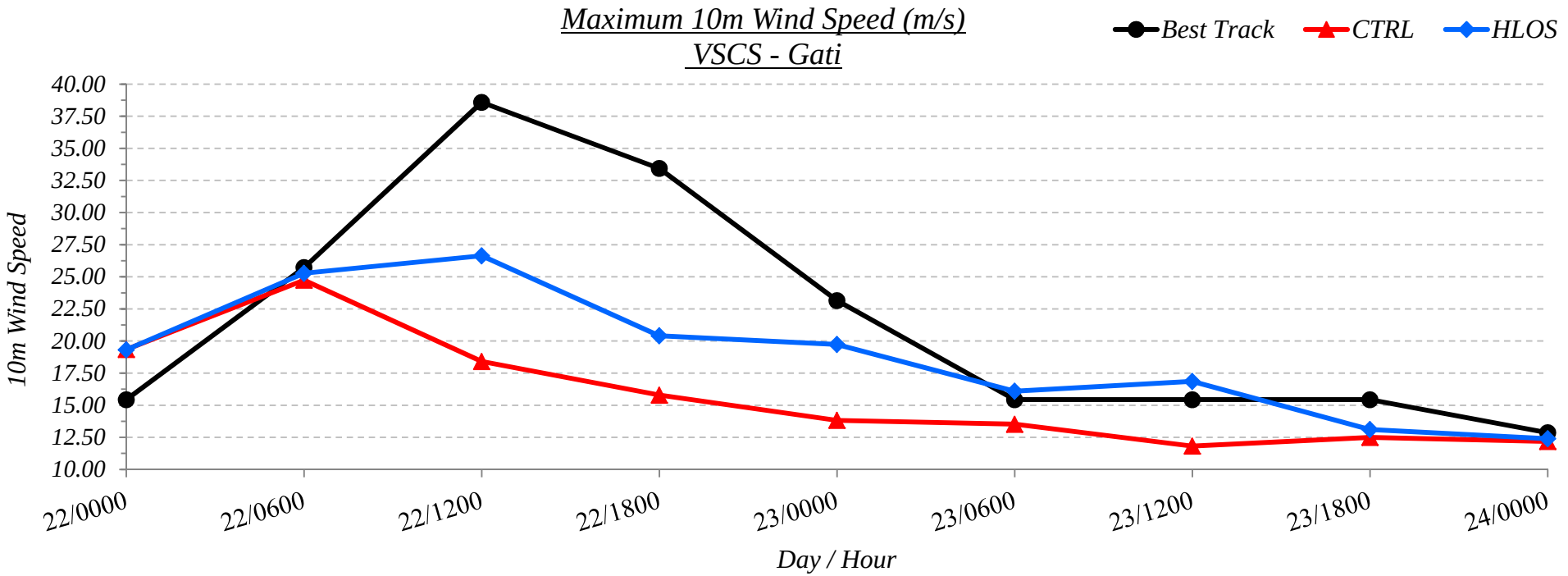
Forecast Diagnostics:

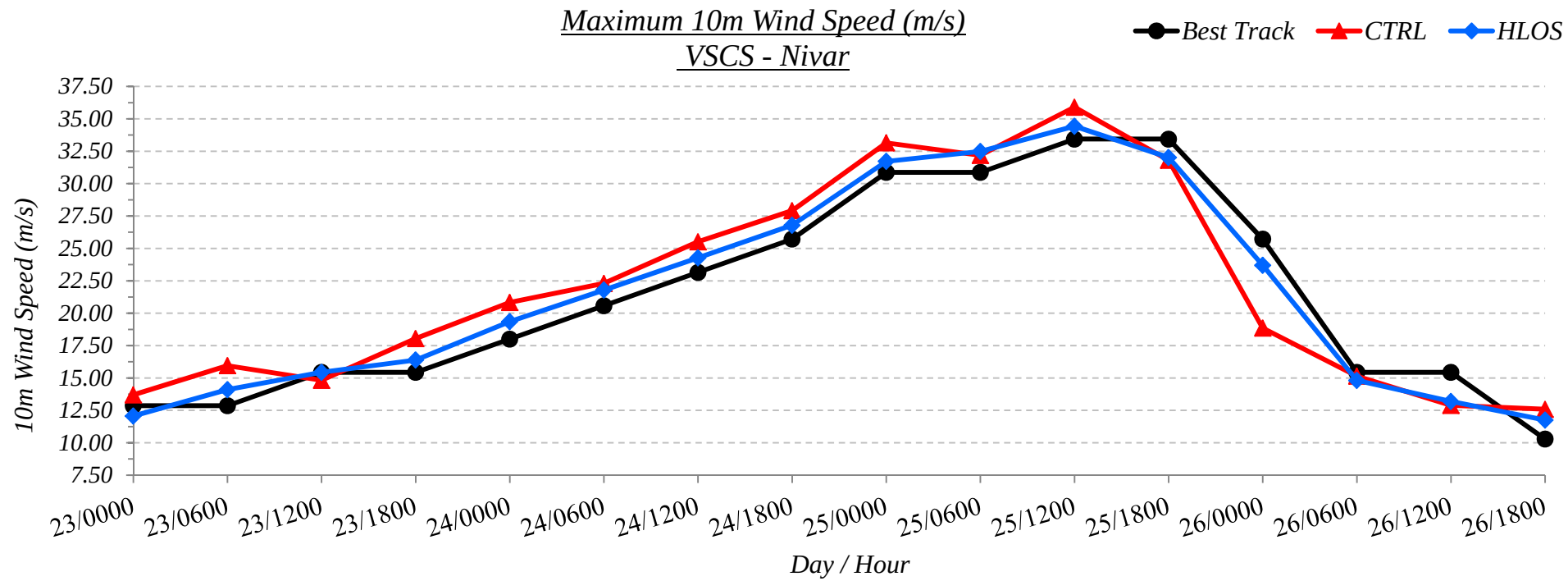


FCST Verification Scorecard Symbol Legend	
▲	HLOS is better than CTRL at the 99.9% significance level
▲	HLOS is better than CTRL at the 99% significance level
	HLOS is better than CTRL at the 95% significance level
	No statistically significant difference between HLOS and CTRL
	HLOS is worse than CTRL at the 95% significance level
▼	HLOS is worse than CTRL at the 99% significance level
▼	HLOS is worse than CTRL at the 99.9% significance level
	Not statistically relevant
Start Date: 20201101	
End Date: 20201130	


Minimum Sea Level Pressure (mb)
VSCS - Gati
Best Track
CTRL
HLOS
Sea Level Pressure (mb)
1015
1010
1005
1000
995
990
985
980
975
22/0000
22/0600
22/1200
22/1800
23/0000
23/0600
23/1200
23/1800
24/0000
Day / Hour


Minimum Sea Level Pressure (mb)
VSCS - Nivar
Best Track
CTRL
HLOS
Sea Level Pressure (mb)
1010
1005
1000
995
990
985
980
23/0000
23/0600
23/1200
23/1800
24/0000
24/0600
24/1200
24/1800
25/0000
25/0600
25/1200
25/1800
26/0000
26/0600
26/1200
26/1800
Day / Hour


Maximum 10m Wind Speed (m/s)
VSCS - Gati
Best Track
CTRL
HLOS
10m Wind Speed
40.00
37.50
35.00
32.50
30.00
27.50
25.00
22.50
20.00
17.50
15.00
12.50
10.00
22/0000
22/0600
22/1200
22/1800
23/0000
23/0600
23/1200
23/1800
24/0000
Day / Hour


Maximum 10m Wind Speed (m/s)
VSCS - Nivar
Best Track
CTRL
HLOS
10m Wind Speed (m/s)
37.50
35.00
32.50
30.00
27.50
25.00
22.50
20.00
17.50
15.00
12.50
10.00
7.50
23/0000
23/0600
23/1200
23/1800
24/0000
24/0600
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25/0000
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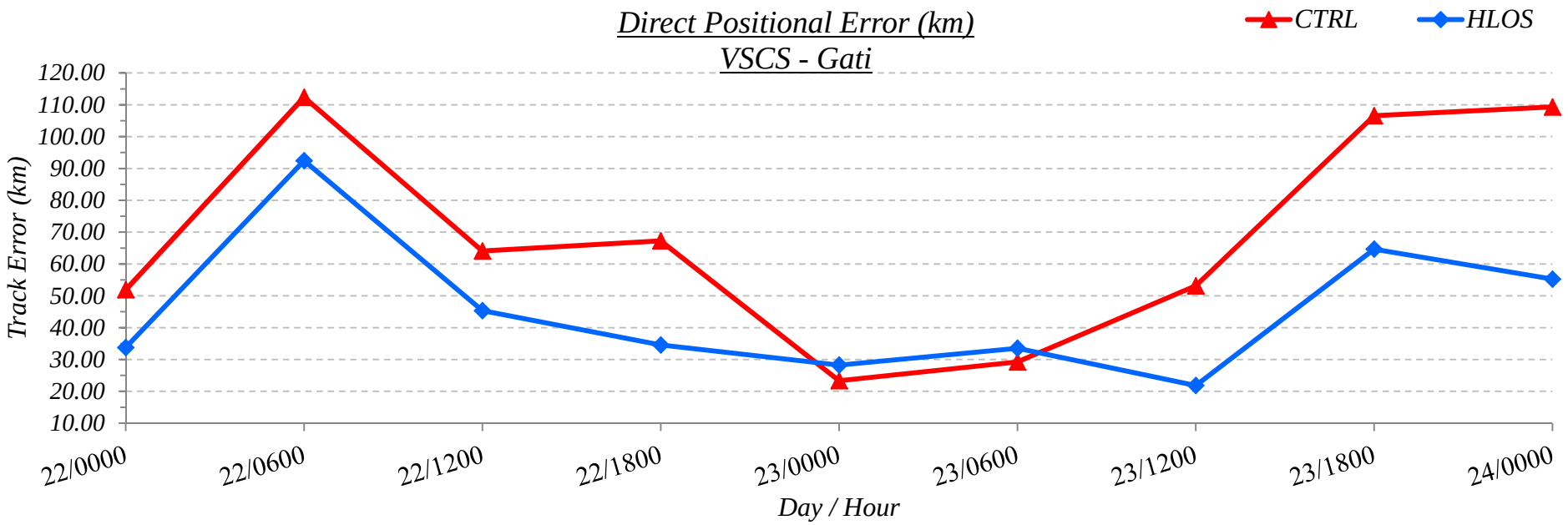
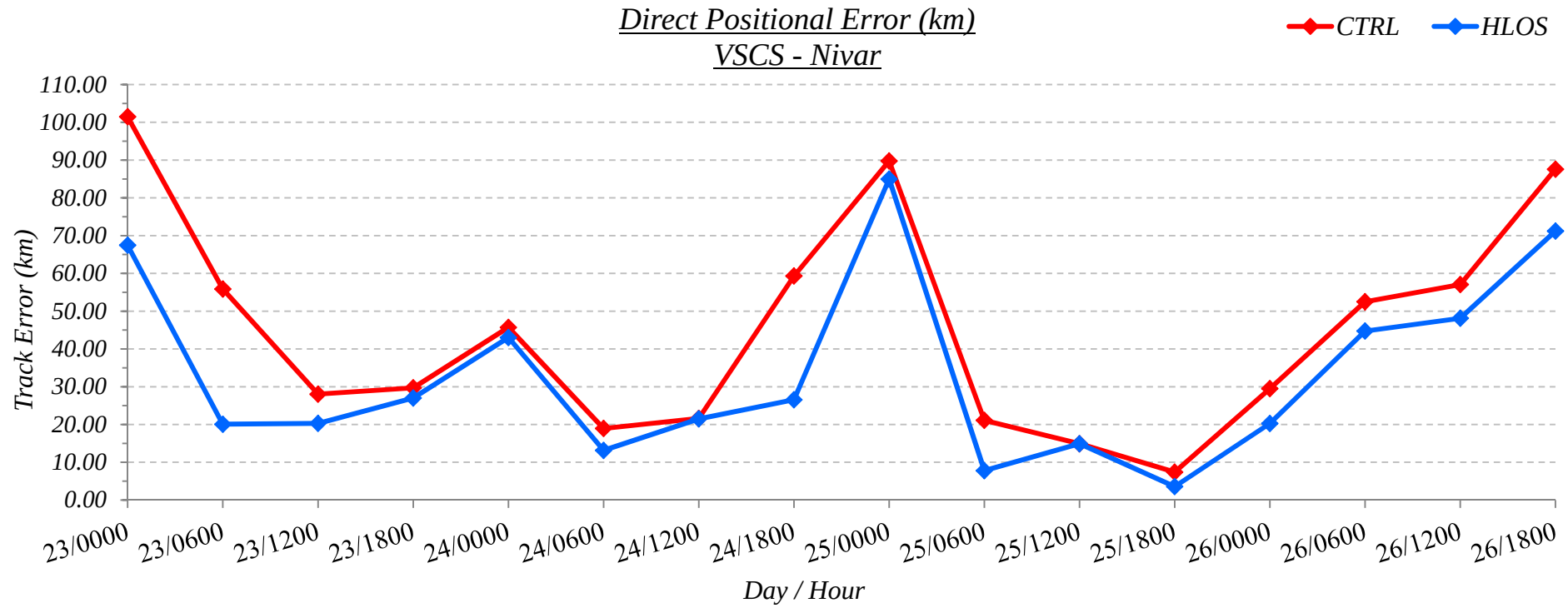
25/1800
26/0000
26/0600
26/1200
26/1800
Day / Hour


Direct Positional Error (km)
VSCS - Gati
CTRL
HLOS
Track Error (km)
120.00
110.00
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
22/0000
22/0600
22/1200
22/1800
23/0000
23/0600
23/1200
23/1800
24/0000
Day / Hour


Direct Positional Error (km)
VSCS - Nivar
CTRL
HLOS
Track Error (km)
110.00
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
23/0000
23/0600
23/1200
23/1800
24/0000
24/0600
24/1200
24/1800
25/0000
25/0600
25/1200
25/1800
26/0000
26/0600
26/1200
26/1800
Day / Hour

Conclusion

✓ Based on the assessment results, ADM-Aeolus HLOS data is implemented operationally in NCMRWF Global Data Assimilation and Forecast System.

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Thank You