



Improved Resolution of SCATSAT for Weather Forecasting

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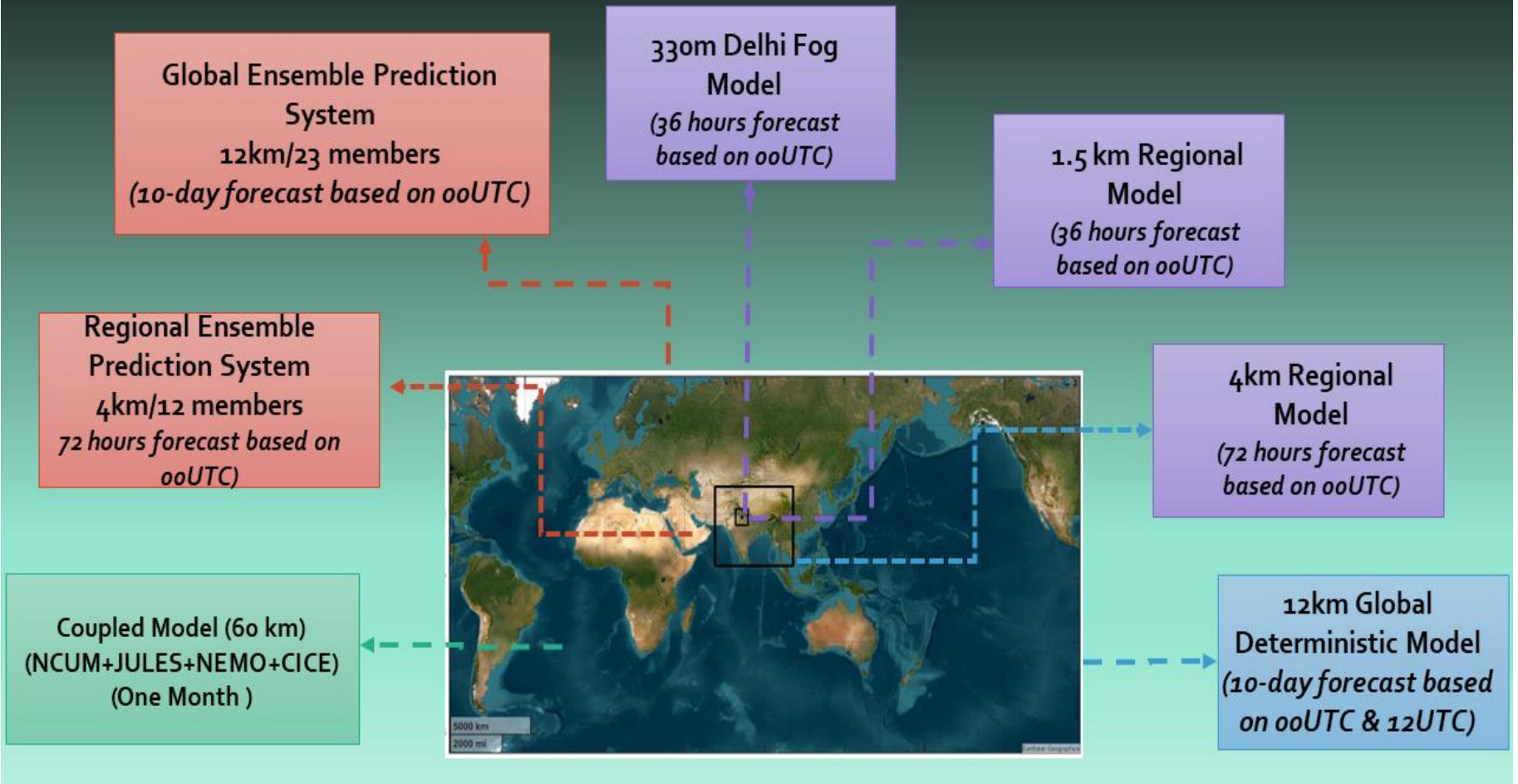
National Centre for Medium Range Weather Forecasting

Ministry of Earth Sciences



Seamless Modelling System

Unified Model at NCMRWF Same Model for Global/Regional/Mesoscale/City/ Coupled





Operational NWP models at NCMRWF



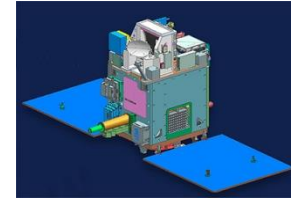
	Urban Model (DM-Chem)	Meso-scale Model (1.5 km)	Regional UM (NCUM-R) (4km)	Global UM (NCUM-G) (12km)	Global EPS (NEPS) (12km)	Coupled UM (CNCUM) (60km)
Domain						
Horizontal resolution	330m	1.5km	4.4 km	12km	12km	Atmosphere: approx. 60 km Ocean: approx. 25 km
Fcst length (IC)	48 hours	48 hours	75 hours(00UTC & 12UTC)	10 days (00,12 UTC)	10 days (00,12 UTC)	1 month (ERP) 3 /4 months (Seasonal)
Ensemble size	1	1	1	1	23	ERP:16 Seasonal: 55 (Only atmosphere)
Initial conditions	Downscaled IC	Downscaled IC	Regional DA (4-D Var)	Global DA (Hybrid 4-D Var)	Global DA Pert: ETKF+SKEB+SP	Atmosphere: Global DA Pert: SKEB Ocean: NEMOVAR
SST Conditions	Downscaled	Downscaled	OSTIA SST Analysis (EKF)	OSTIA SST Analysis (EKF)	OSTIA SST Analysis (EKF)	Predicted SST in the fully coupled model



Indian Satellite Data added to the NCMRWF NWP system: Timeline



Microsat-2B (2023 expt)



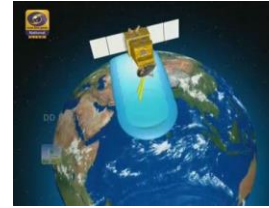
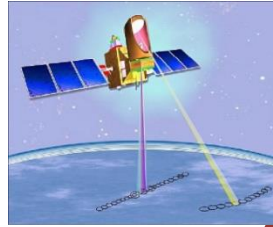
INSAT-3DR AMVs (2017)



Oceansat-3 (2023)

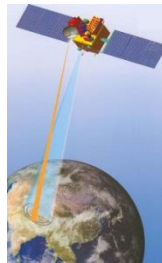


Megha-Tropiques (2014)

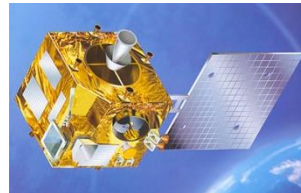


Scatsat-1 (2017)

Oceansat-2 (2012)



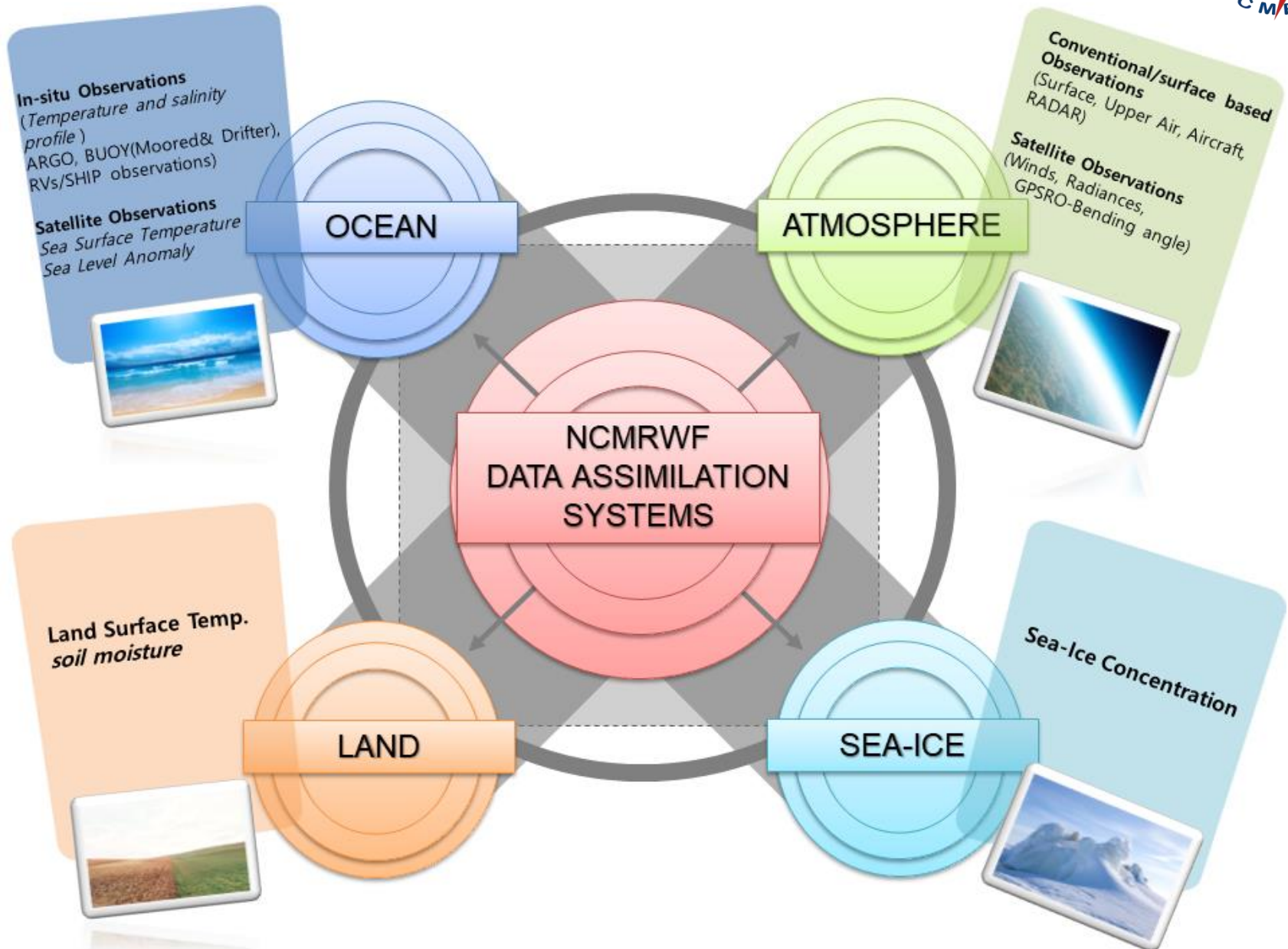
INSAT-3D radiances (Imager & Sounder) and AMVs (2013-2014)



Kalpana AMVs (2009-2010)



Data Assimilation at NCMRWF



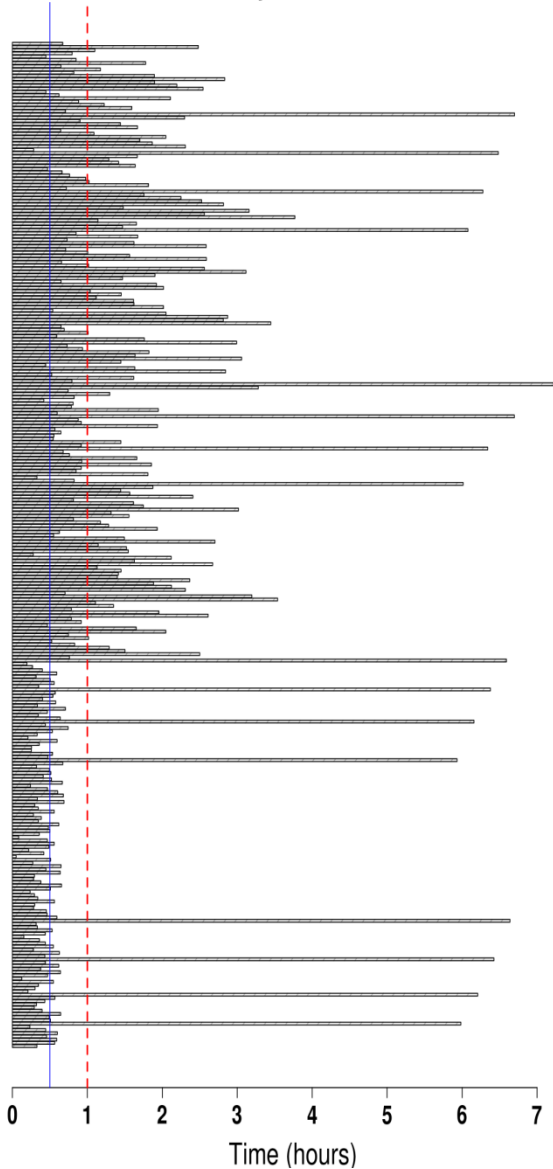


Indian DBNet Data Processing at NCMRWF

Data Provider	Satellites	Sounders
INCOIS	NOAA-18/19	AMSU-A, MHS, HIRS
	Metop-B	AMSU-A, MHS, HIRS, IASI
NRSC	SNPP, NOAA-20	ATMS, CrIS
	NOAA-19	AMSU-A, MHS, HIRS
	Metop-B	AMSU-A, MHS, HIRS, IASI



HRPT Data Delay at NCMRWF : 202306



Data Availability



NRSC JPSS-1 and NPP data

NCMRWF receives the DBNet data from NRSC with in 30 minutes of observation time.

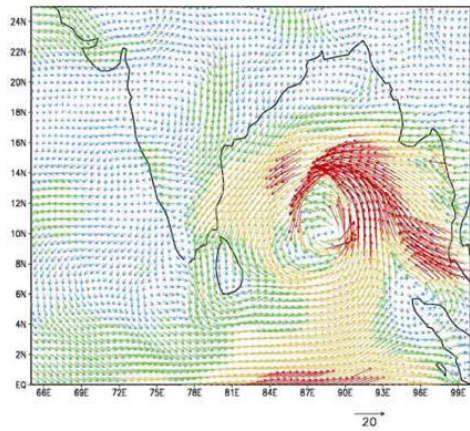
NCMRWF will be transmitting the DBNet data of ATOVS, ATMS, CrIS, IASI with global community



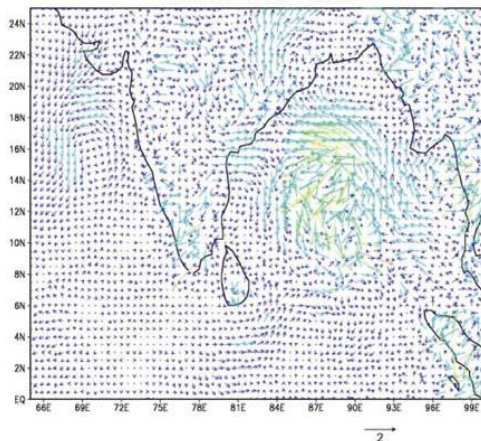
Validation and Assimilation of scatterometer winds at NCMRWF



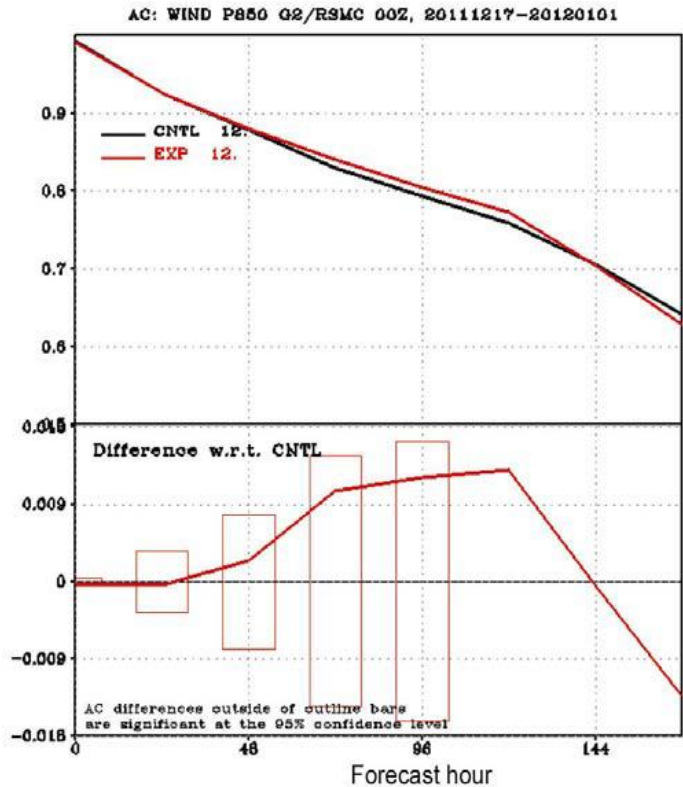
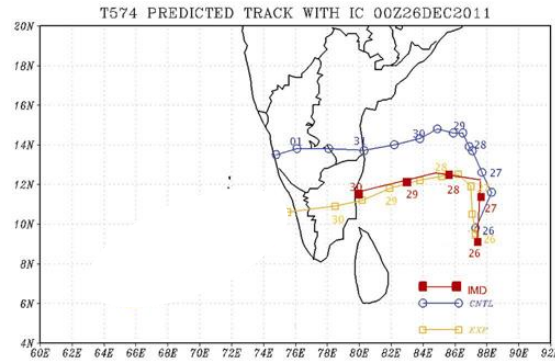
Impact of OScat surface wind data on T574L64 assimilation and forecasting system (Prasad et al. 2013)



T574L64 Analysis wind at 850mb difference



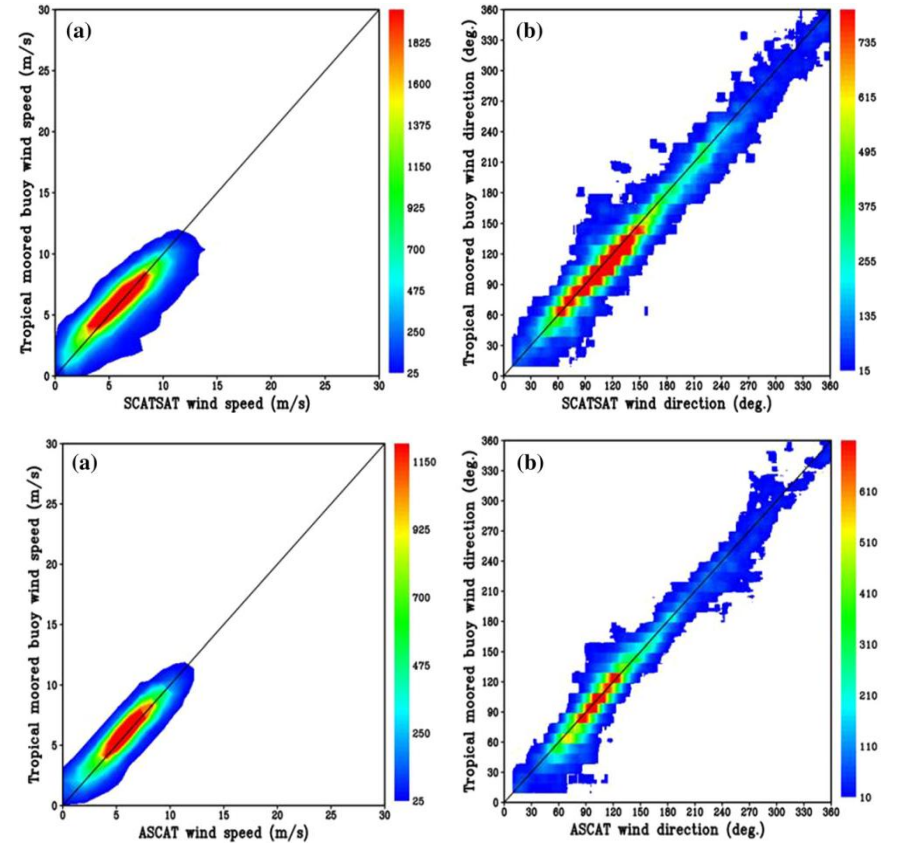
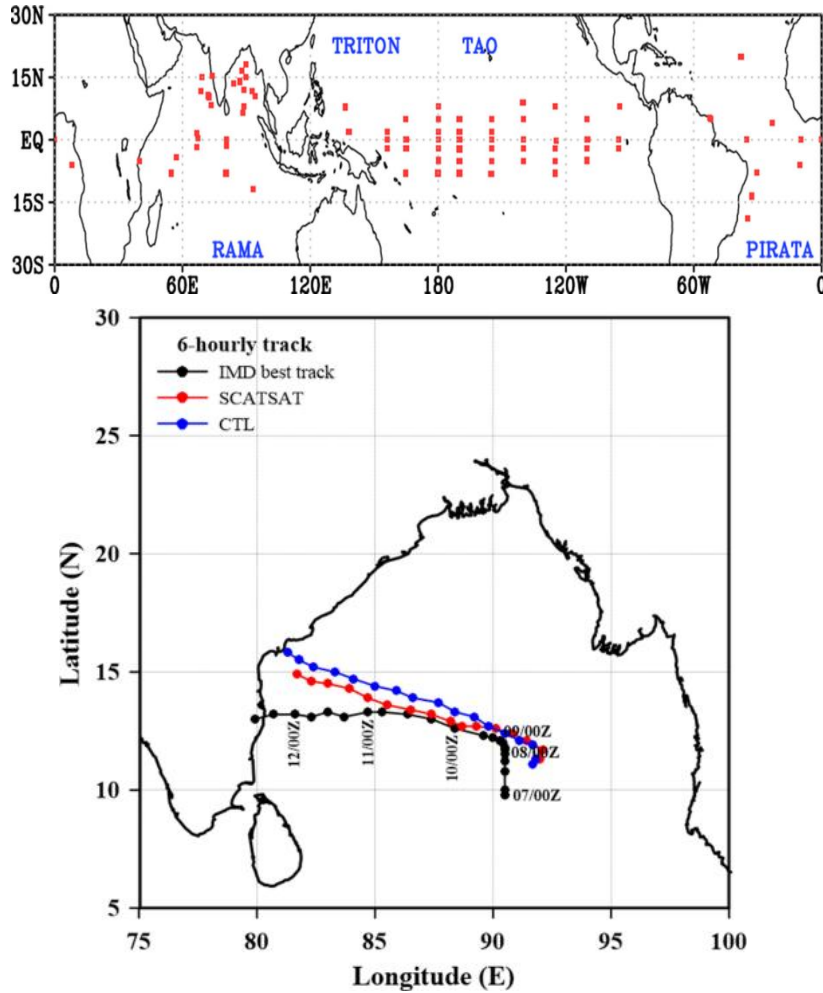
06Z261211 EXP-CNTL



Assimilation of OSCAT winds improved cyclone track



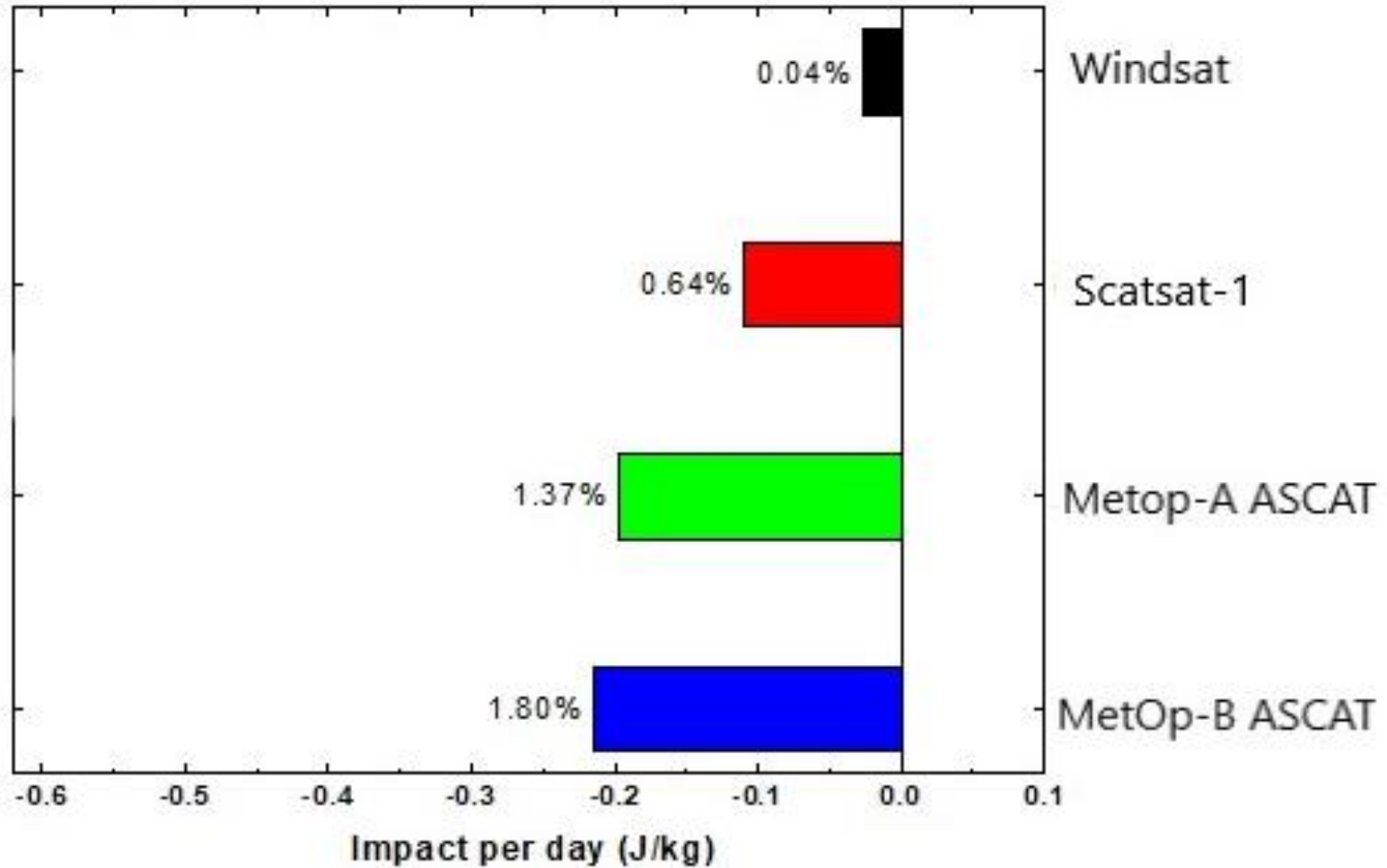
Validation and Impact of SCATSAT-1 Scatterometer Winds (Johny et al. 2019)



- Good agreement between scatsat-1 winds and tropical buoy winds
- Improved the simulated cyclone track due to scatsat-1 assimilation



Sea Surface wind impact (FSOI)





Oceansat-3 Wind Validation

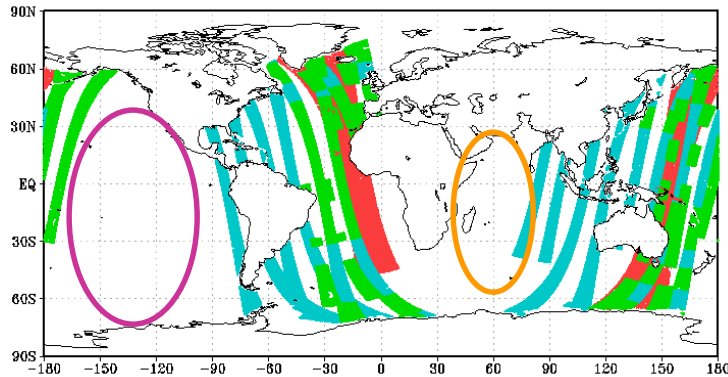
Scatterometer Sea Surface Wind reception at NCMRWF

Oceansat-3

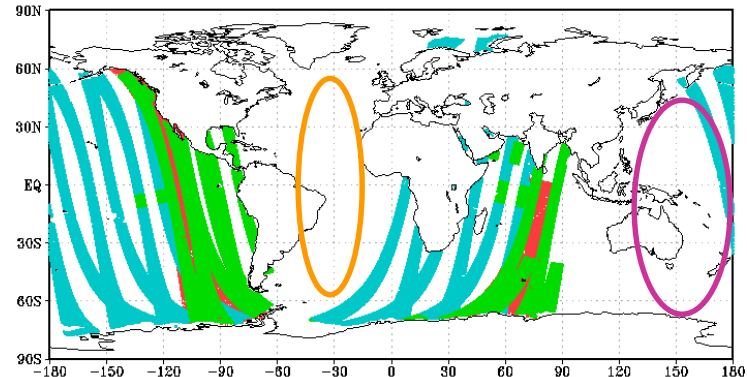
ASCAT-B

ASCAT-C

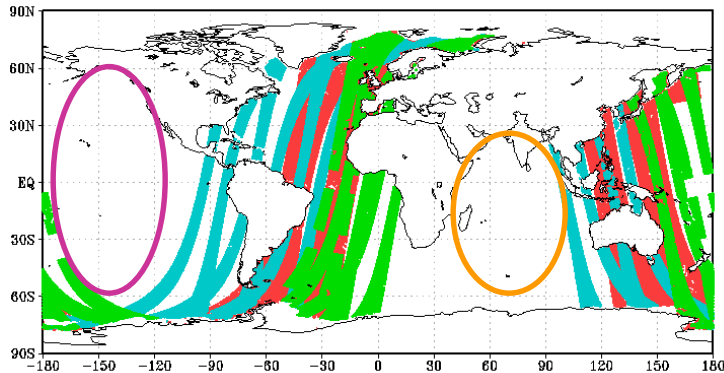
00 UTC



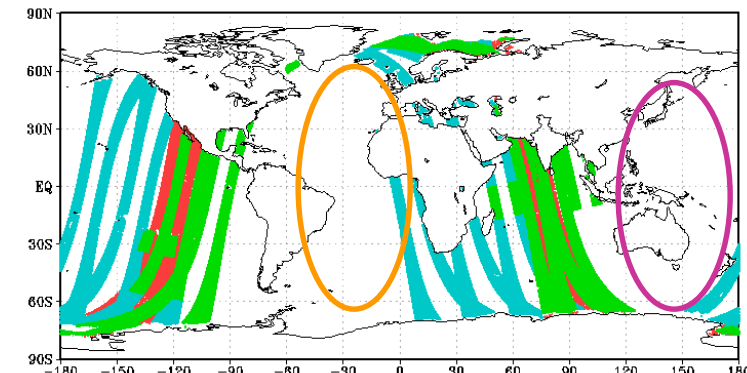
06 UTC



12 UTC



18 UTC



During 00 and 12 UTC assimilation cycles, there is no scatterometer coverage over the Indian Ocean region (area of interest) and West Pacific Ocean.

During 06 and 18 UTC data sparse region over East Pacific and Atlantic Oceans

One of the requirements of NCMRWF is the scatterometer in the afternoon orbit, so to ensure the global coverage in all assimilation cycles



Validation of Oceansat-3 Sea Surface winds



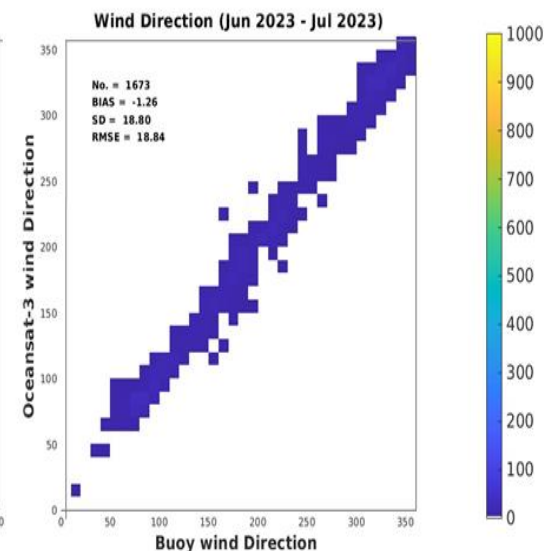
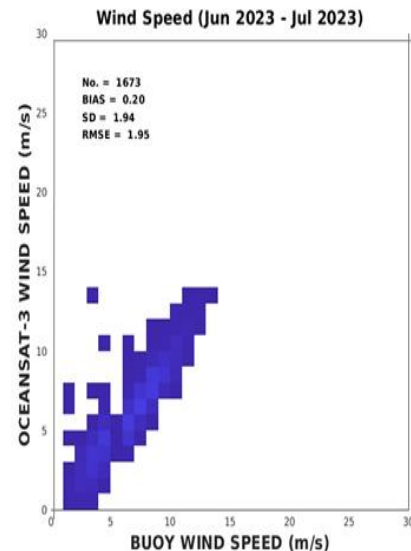
Validation Period: June – December 2023

Data sets: **Oceansat-3 wind**, **BUOY wind**, **NCUM 10 m wind**, **GFS 10 m wind**

Criteria for validation with Model
Spatial: **at Model resolution (12 km)**
Temporal : **60 Minutes**

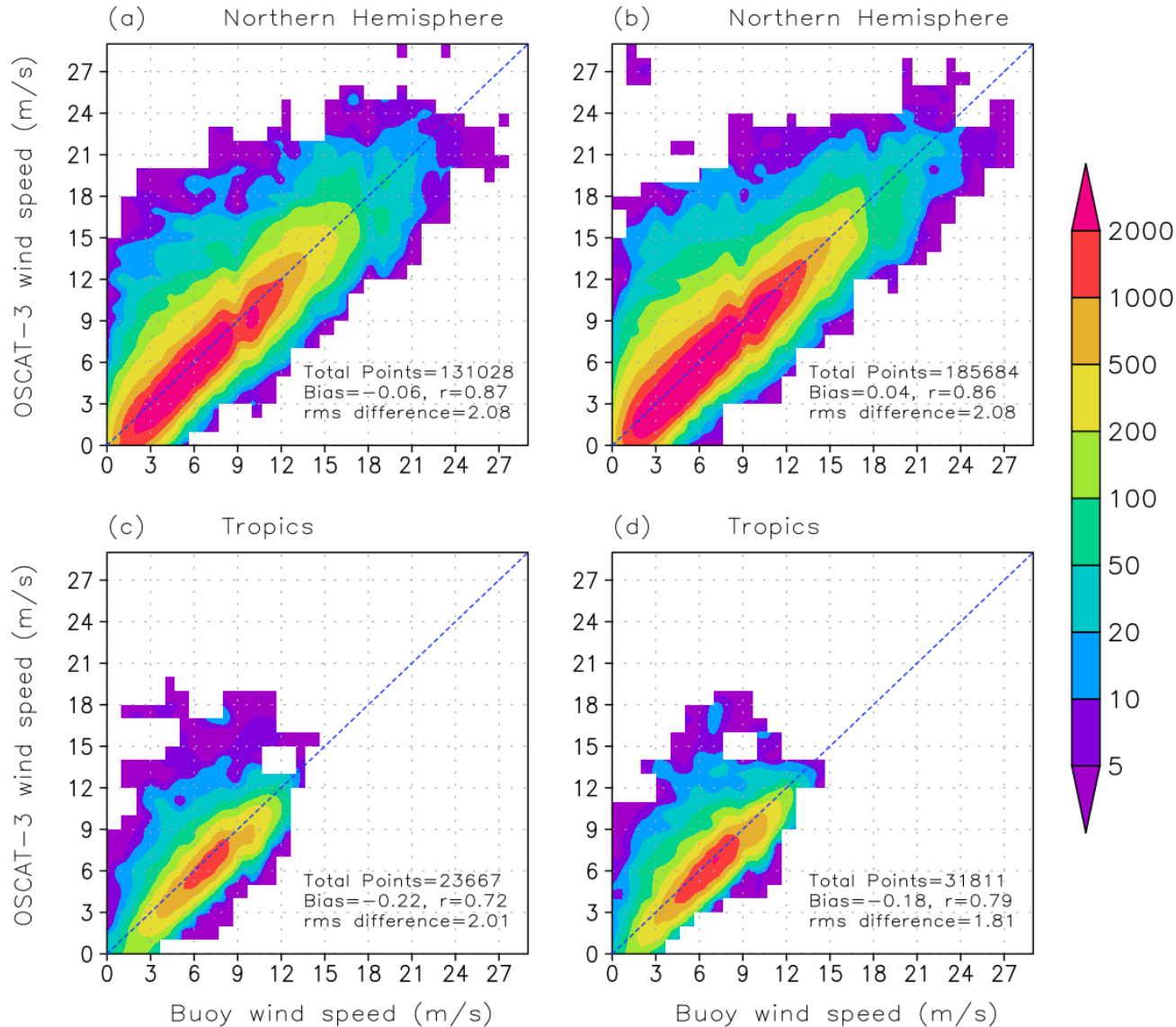
Criteria for validation with buoy data sets
Spatial: **12 × 12 (for 12 km wind)**
25 × 25 (for 25 km wind)
Temporal : **60 Minutes**

Parameter	12 Km		25 Km	
	Global	Tropics	Global	Tropics
	NCUM			
RMSVD	2.38	2.39	2.45	2.29
BIAS	-0.02	-0.24	-0.07	-0.33
	GFS			
RMSVD	2.46	2.28	2.49	2.30
BIAS	-0.10	-0.23	-0.16	-0.35



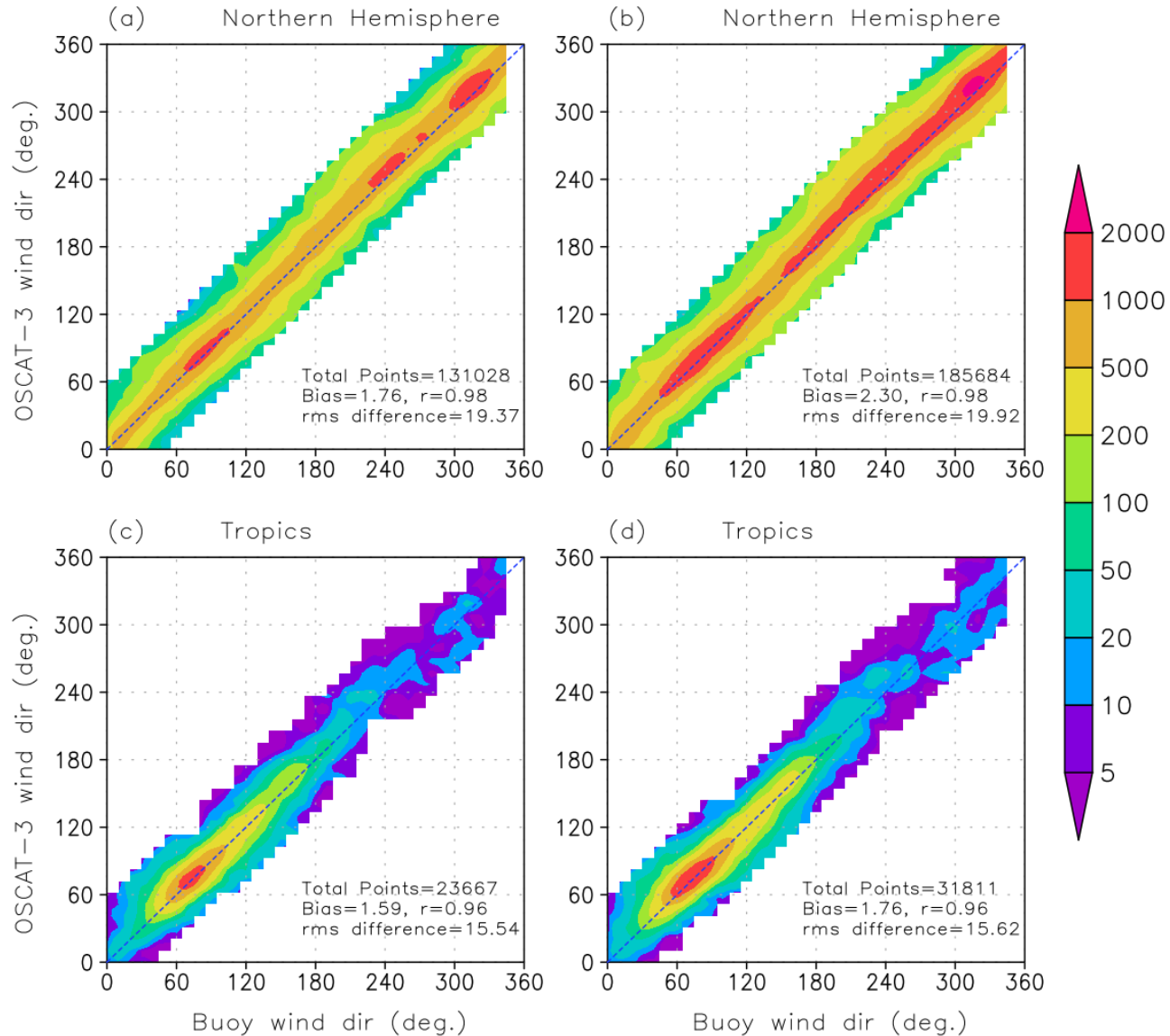


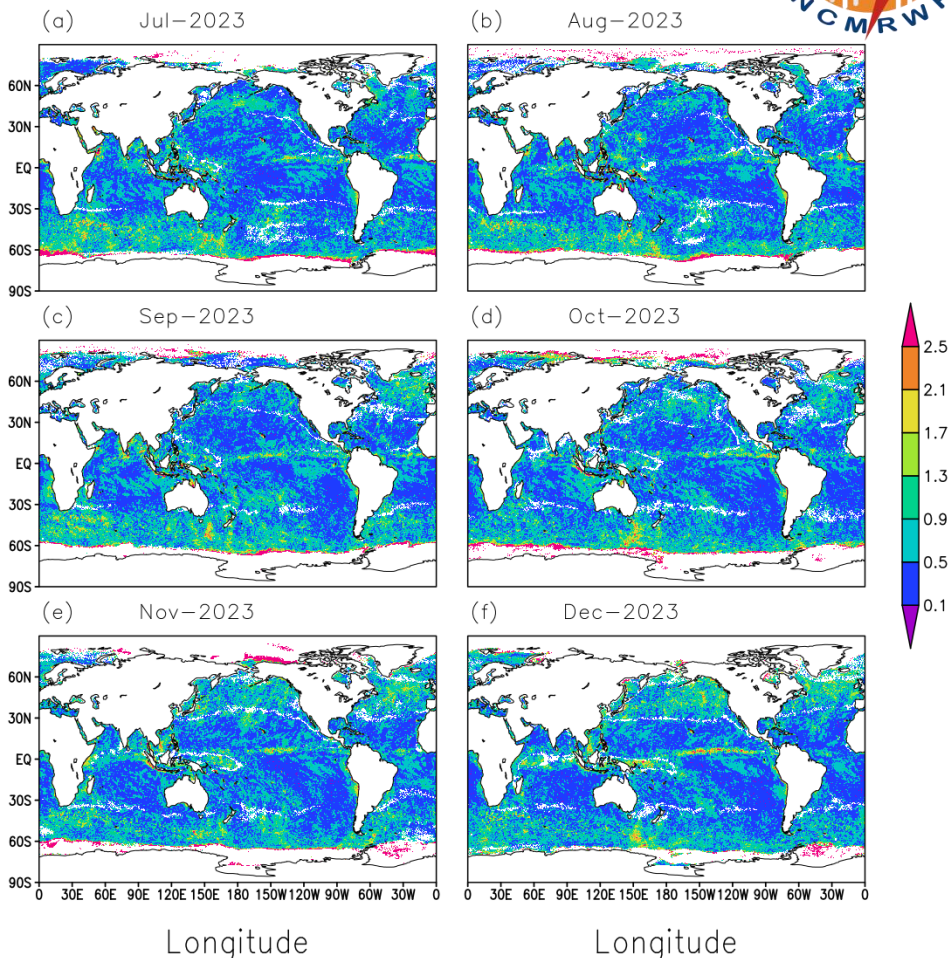
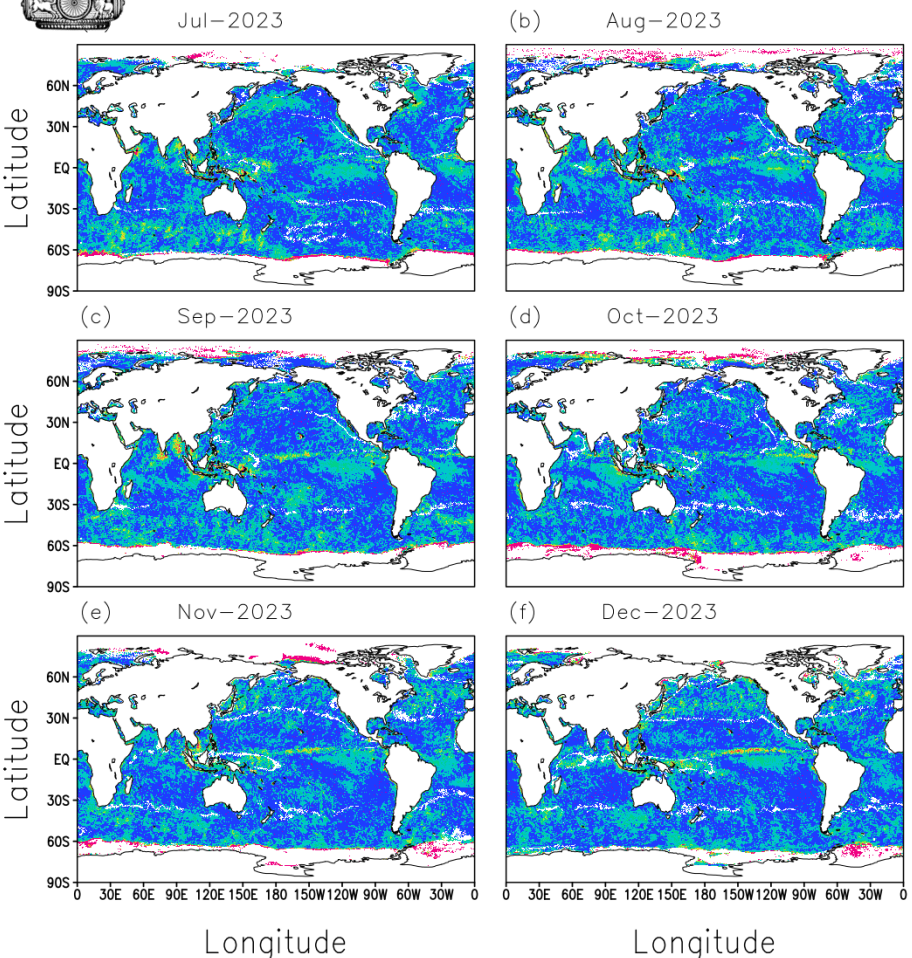
Density plot for OSCAT-3 wind products with respect to buoy wind:
Northern Hemisphere: (a) 12×12 km wind speed, and (b) 25×25 km wind speed;
Tropics: (c) 12×12 km wind speed, and (d) 25×25 km wind speed
for July - December 2023





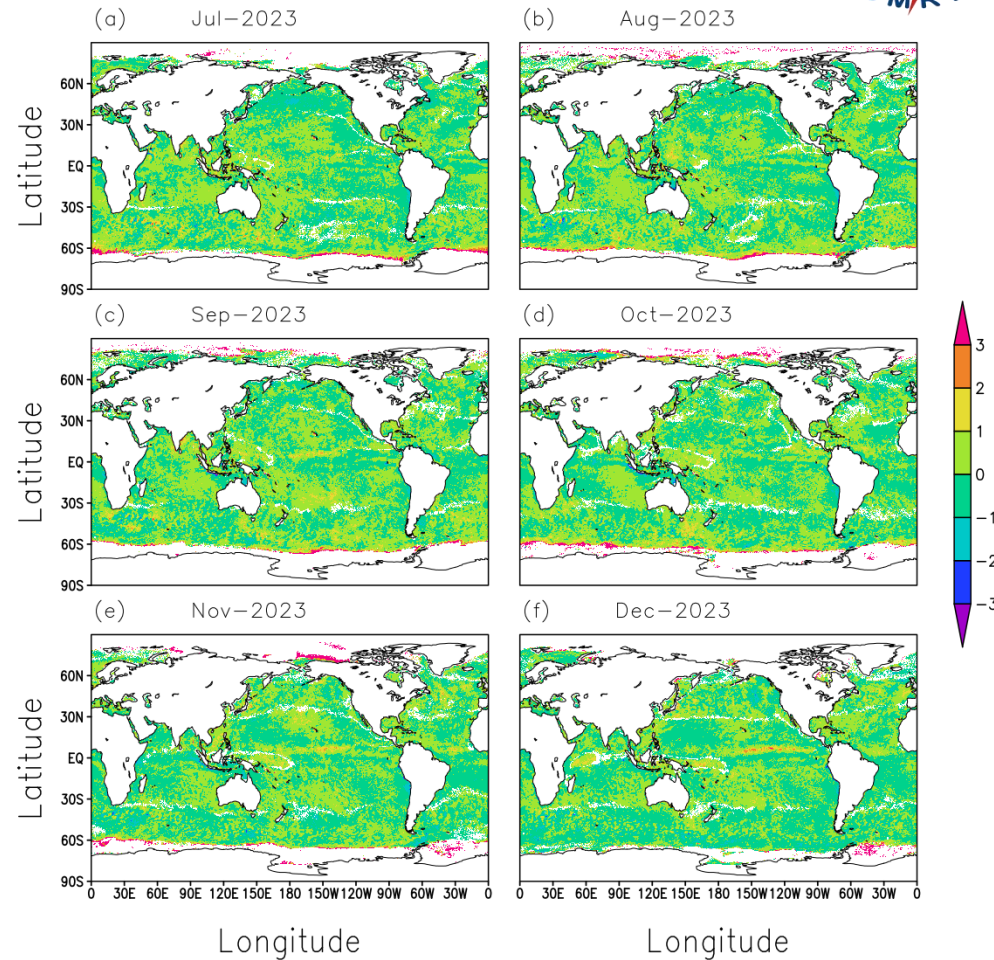
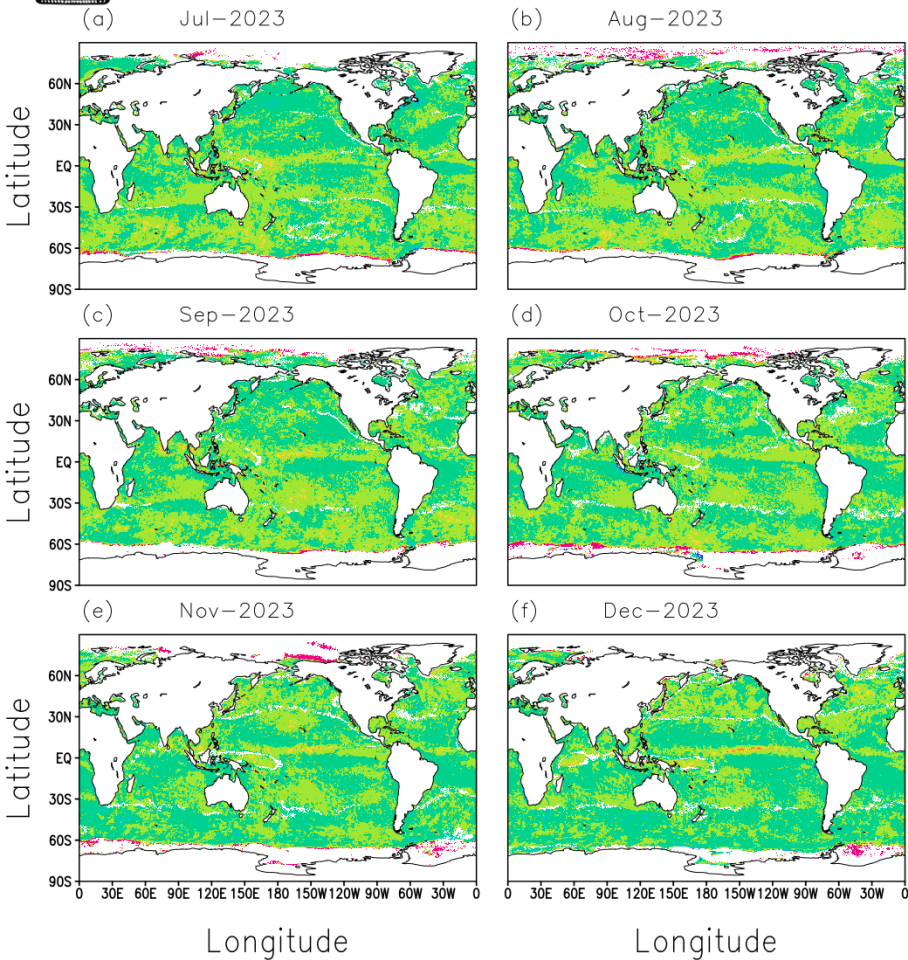
Density plot for OSCAT-3 wind products with respect to buoy wind:
Northern Hemisphere: (a) 12×12 km wind direction, and (b) 25×25 km wind direction;
Tropics: (c) 12×12 km wind direction, and (d) 25×25 km wind direction
for July - December 2023





The spatial plots of monthly RMSVD: 12×12 km OSCAT-3 wind product collocated with NCUM wind analysis. (a) July 2023, (b) August-2023, (c) September 2023, (d) October 2023, (e) November 2023, and (f) December 2023.

The spatial plots of monthly RMSVD: 12×12 km OSCAT-3 wind product collocated with NGFS wind analysis. (a) July 2023, (b) August-2023, (c) September 2023, (d) October 2023, (e) November 2023, and (f) December 2023.

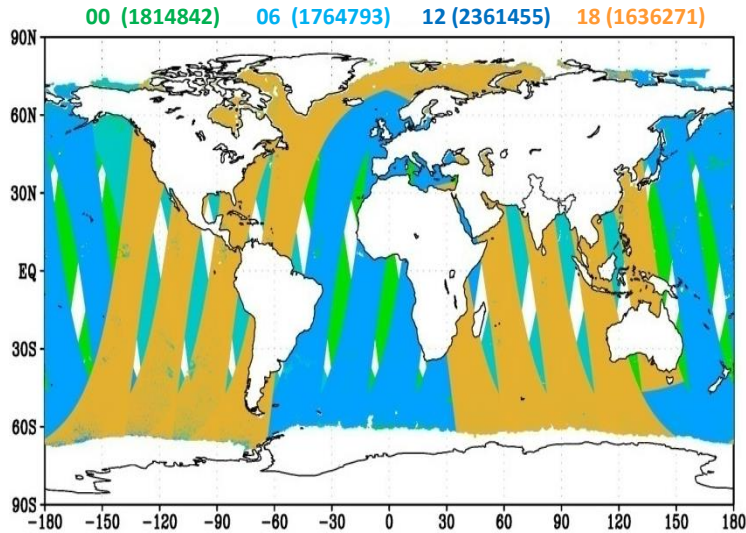


The spatial plots of monthly BIAS: 12×12 km OSCAT-3 wind product collocated with NCUM wind analysis. (a) July 2023, (b) August-2023, (c) September 2023, (d) October 2023, (e) November 2023, and (f) December 2023.

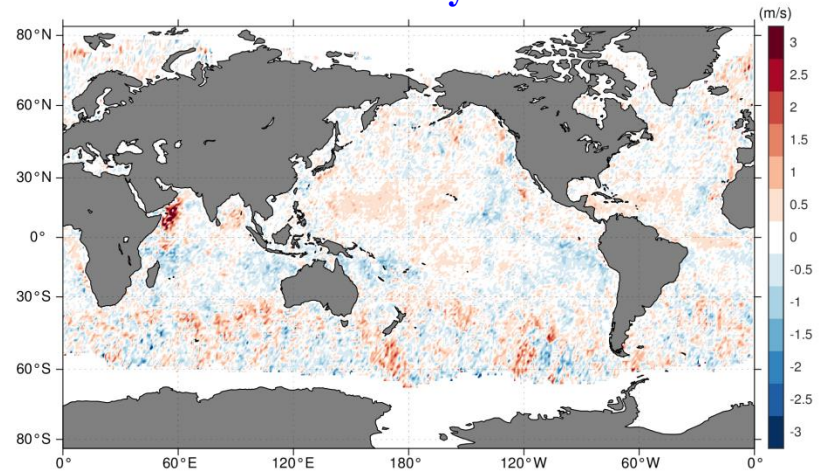
The spatial plots of monthly BIAS: 12×12 km OSCAT-3 wind product collocated with NGFS wind analysis. (a) July 2023, (b) August-2023, (c) September 2023, (d) October 2023, (e) November 2023, and (f) December 2023.

Assimilation of Oceansat-3 Sea Surface winds

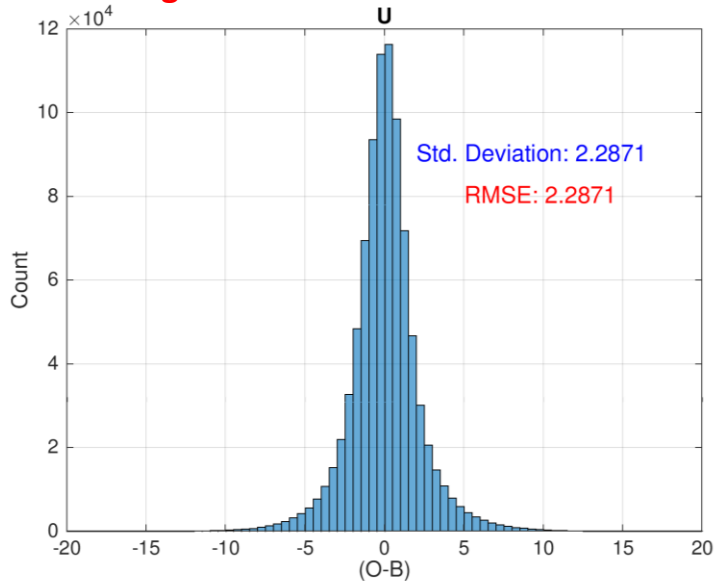
Data coverage (Daily)



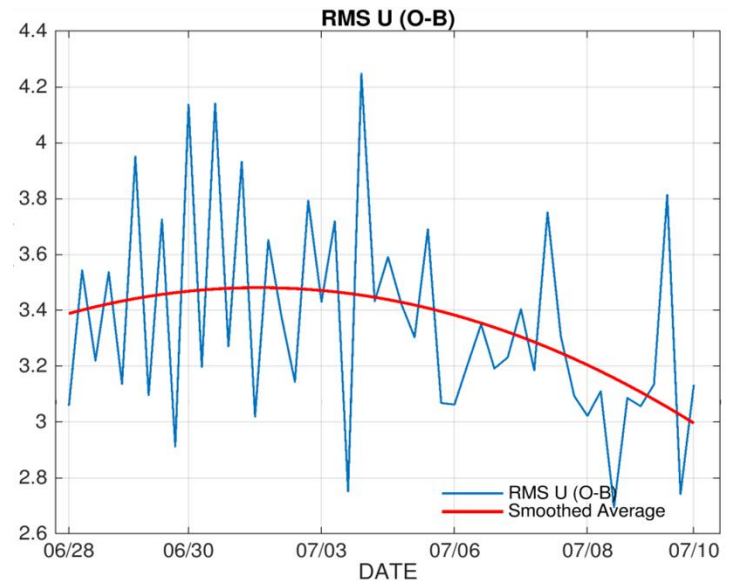
Averaged Background innovation of zonal wind (m/s) for July 2023



Background innovation distribution



Background innovation reduction : Regular and continuous assimilation





Impact of Oceansat-3 Surface Winds on Monsoonal Low-Pressure Systems using a Regional Model



Data and Methodology



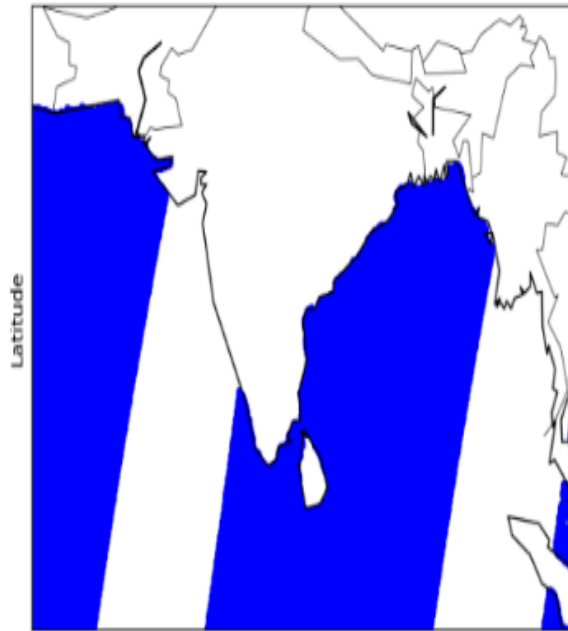
- Model used: WRF (9 km single domain) & GSI (3DVAR)
- Data: IMDGFS data for initial and boundary conditions
- Data for assimilation: Conventional data (prepbufr excluding other Scatterometer winds) and Oceansat-3 (surface winds).
- Two runs, namely control (CNTL) and experiment (EXP), are conducted for the period of July-August 2023.
- In the CNTL, only conventional observations, excluding scatterometer winds, are assimilated.
- On the other hand, the EXP incorporates surface winds from the scatterometer on board Oceansat-3 in addition to the conventional observations.



Spatial Coverage of Oceansat-3 Sea Surface winds over the Indian region at 06 UTC and 18 UTC assimilation cycles.

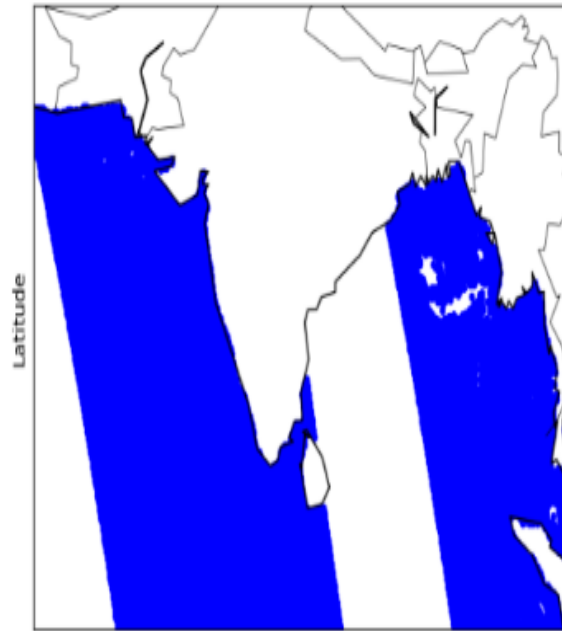


06UTC Pass of OCEANSAT3 over Indian Region



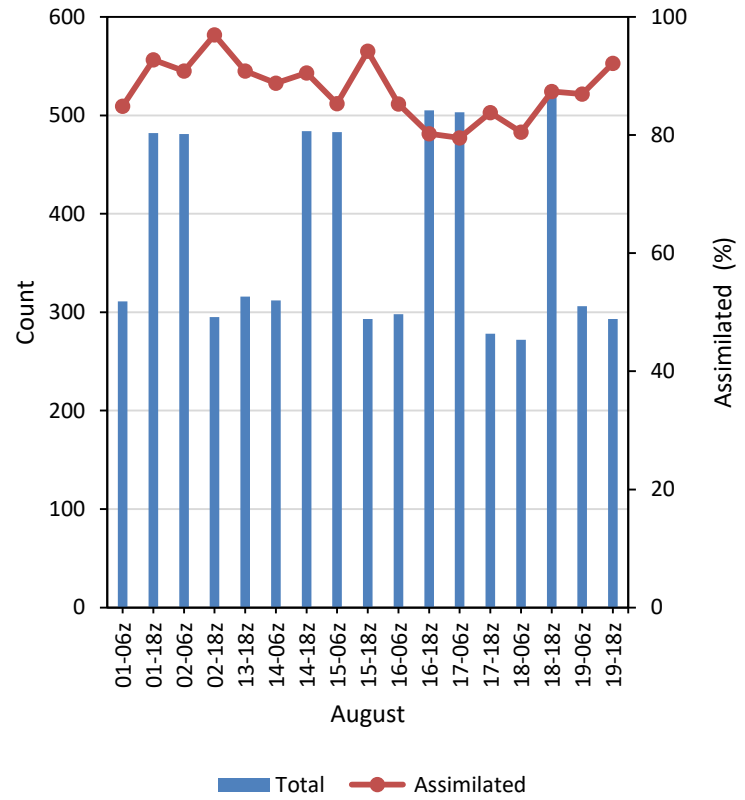
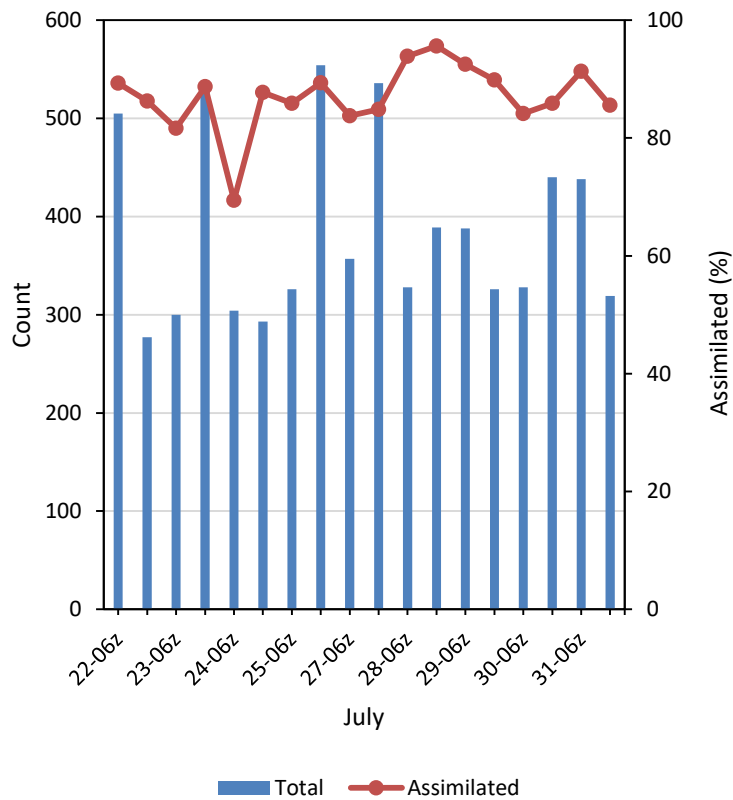
Longitude

18UTC Pass of OCEANSAT3 over Indian Region



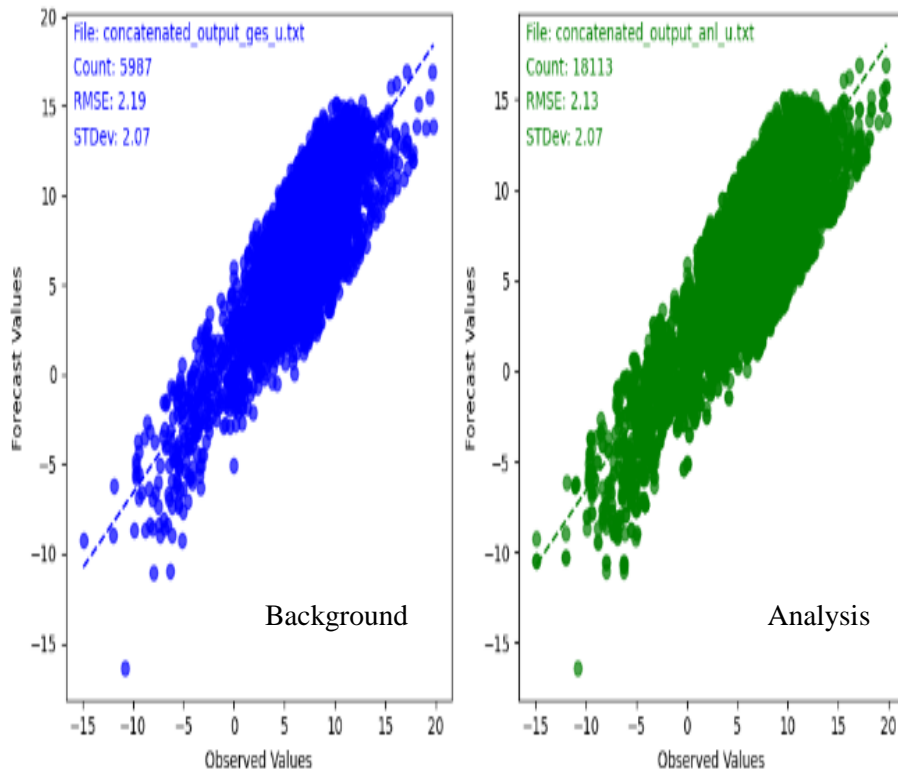
Longitude

Time series of the number of Oceansat-3 Surface Winds available for assimilation (bars) and percentage of winds assimilated (line) for July and August 2023

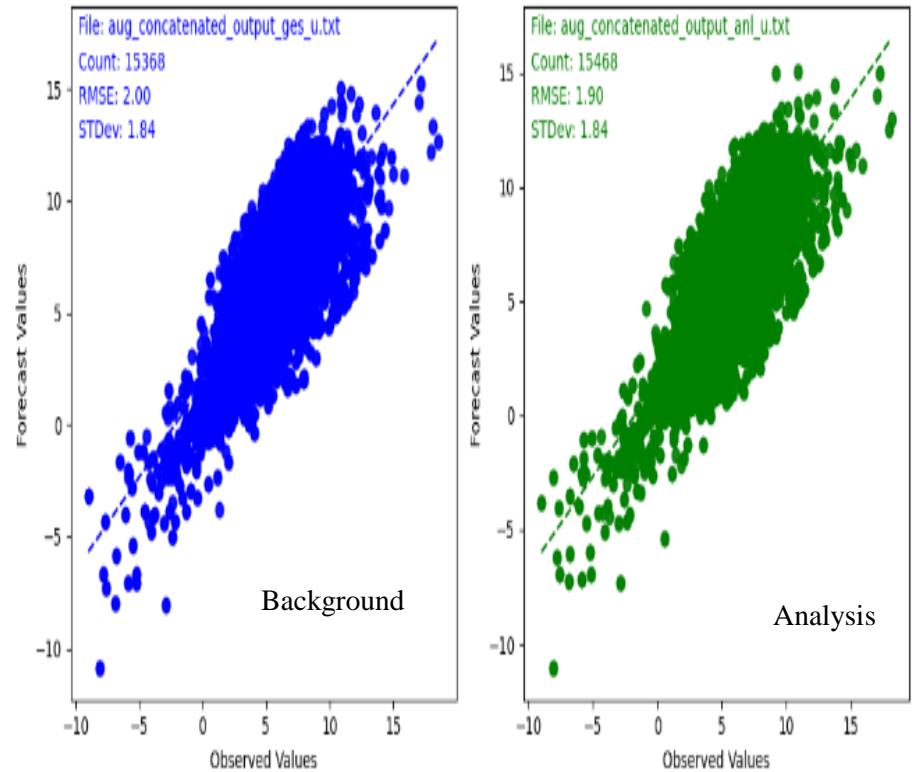


Scatter plot: Oceansat-3 Observed and Model Forecast Wind Speed for July and August 2023

Comparison of Observed vs Forecast Scatter Plots with Trend Lines for JULY month



Comparison of Observed vs Forecast Scatter Plots with Trend Lines for AUG month





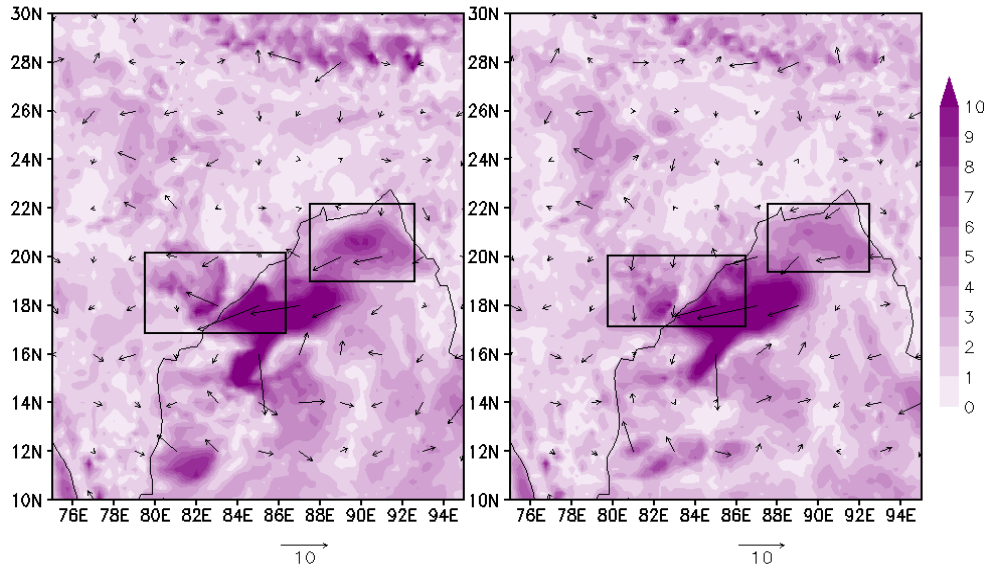
Difference of 10m Wind Vector and Magnitude (m/s) for CNTL and EXP Analysis from ERA5 valid at 00UTC of 25 July and 1 August 2023.



ANALYSIS of 10m Wind valid at 00 UTC of 25 JUL 2023

a) ERA5-CNTL

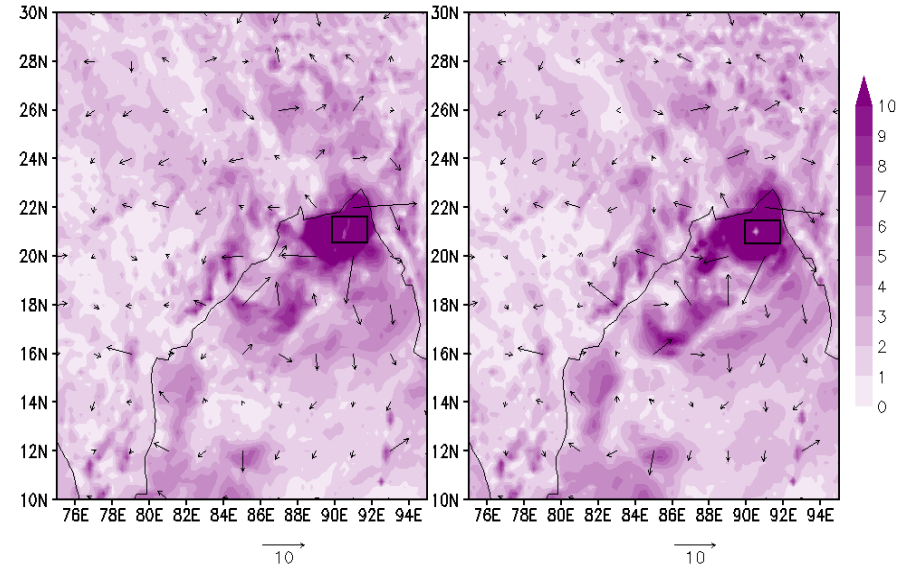
b) ERA5-EXP



ANALYSIS of 10m Wind valid at 00 UTC of 01 AUG 2023

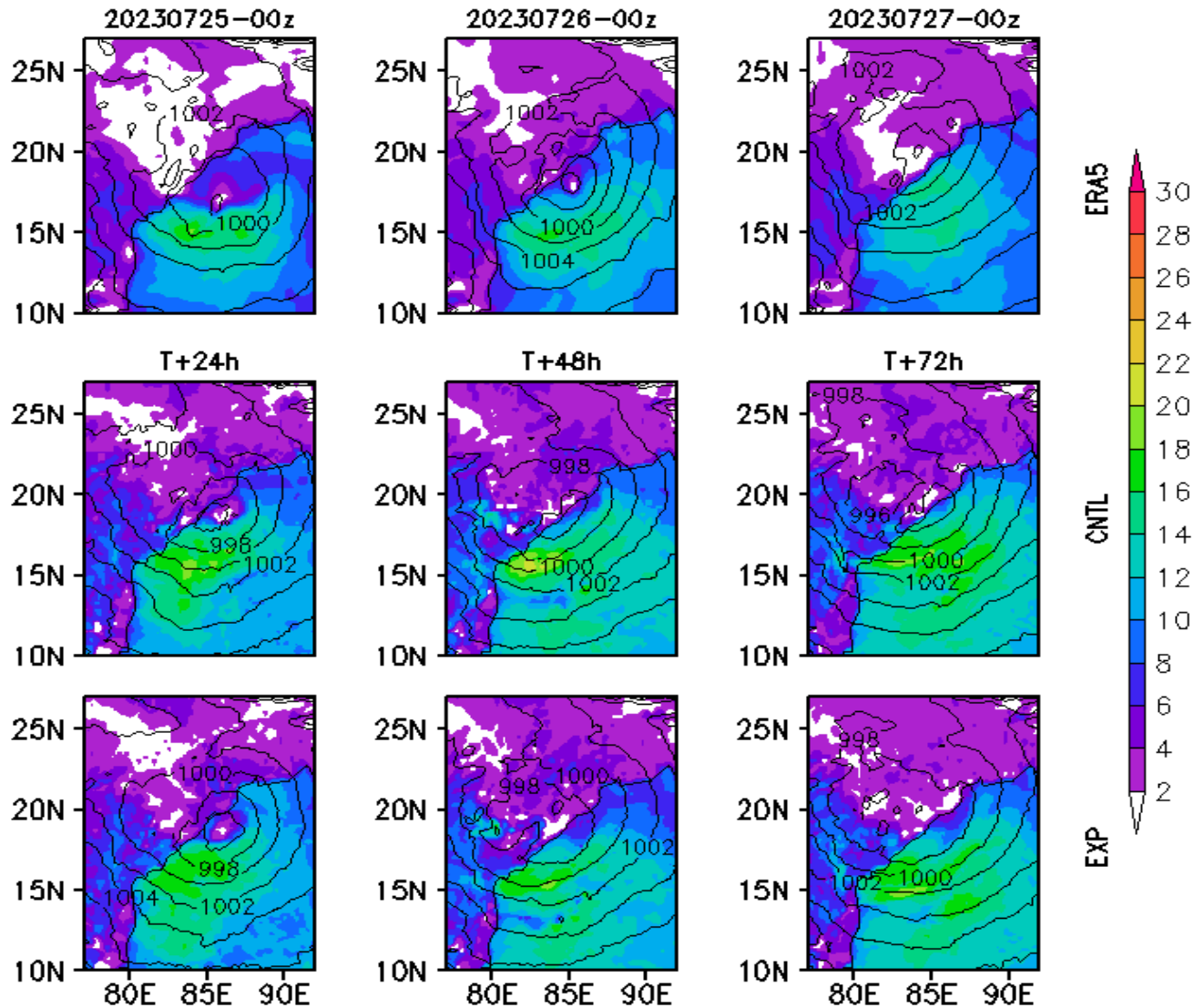
a) ERA5-CNTL

b) ERA5-EXP



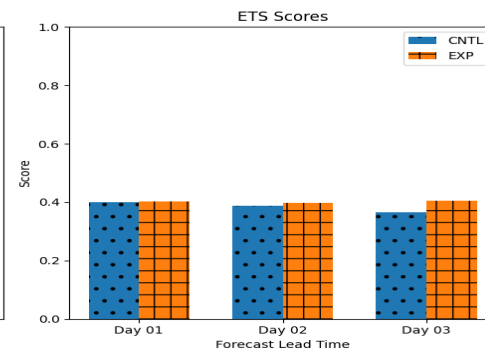
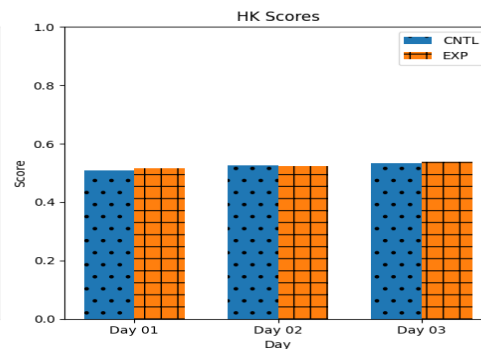
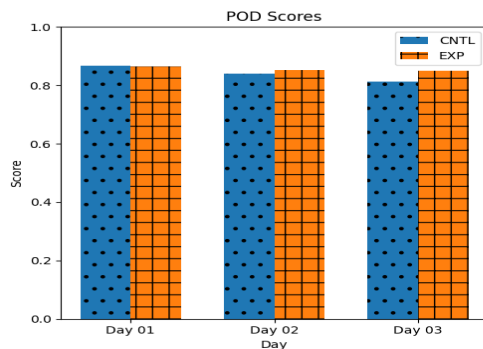
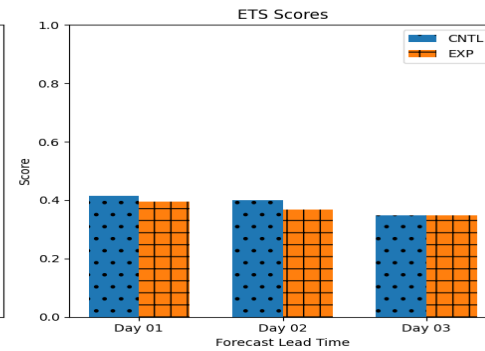
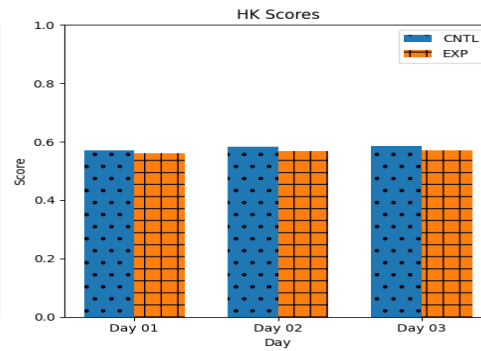
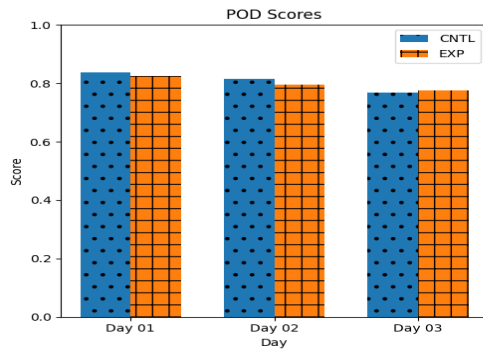
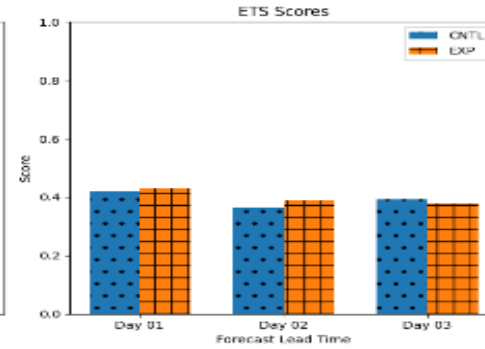
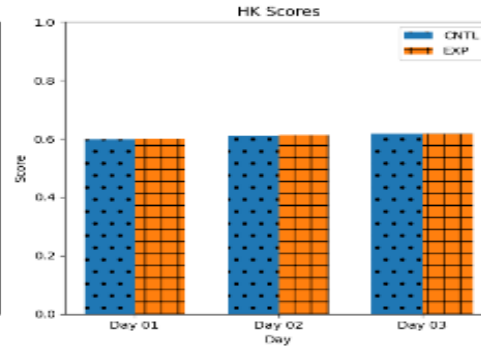
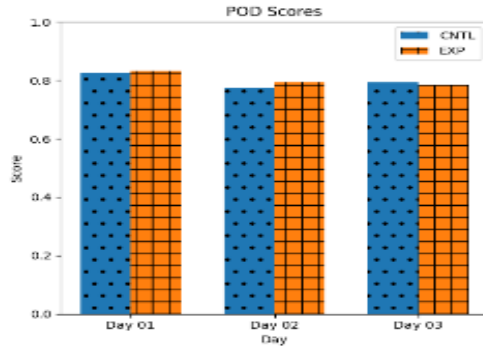


Spatial comparison of magnitude of Surface Winds (m/s) and Mean Sea Level Pressure (hPa) Forecast from CNTL and EXP with the initial conditions of 00UTC of 24 July valid for 00 UTC of 25, 26, and 27 July against ERA5.



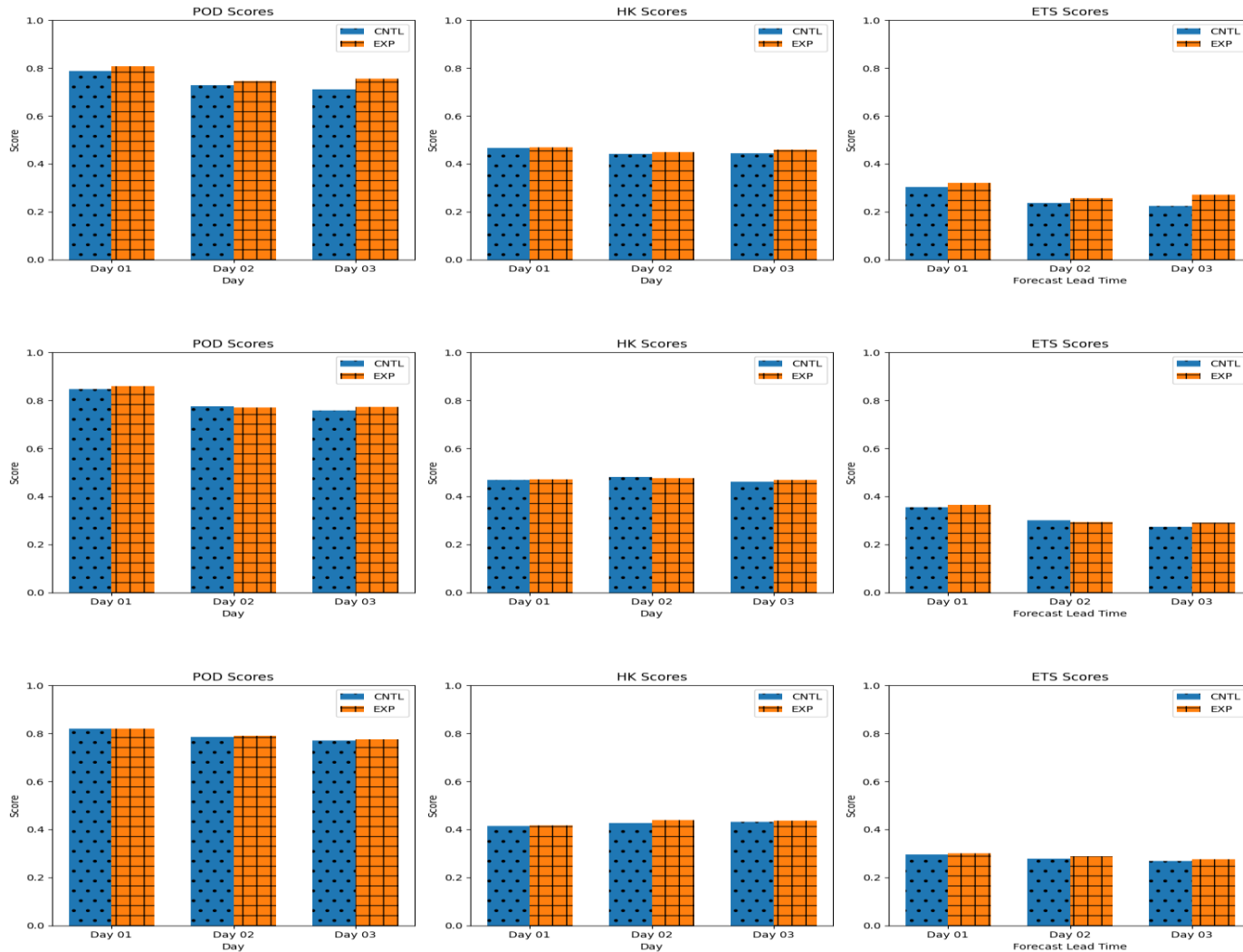


Bar graph showing different statistics for CNTL and EXP for Day1 to Day 3 Rainfall Forecast valid for 25-27 July 2023 (a-c) based on 0.5mm/day.





Bar graph showing different statistics for CNTL and EXP for Day1 to Day 3 Rainfall Forecast valid for 01-03 August 2023 based on 0.5 mm/day





Thank You