Impact of INSAT-3DR Satellite Radiance in NCMRWF Global Forecast System

Presented by

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Collaborators

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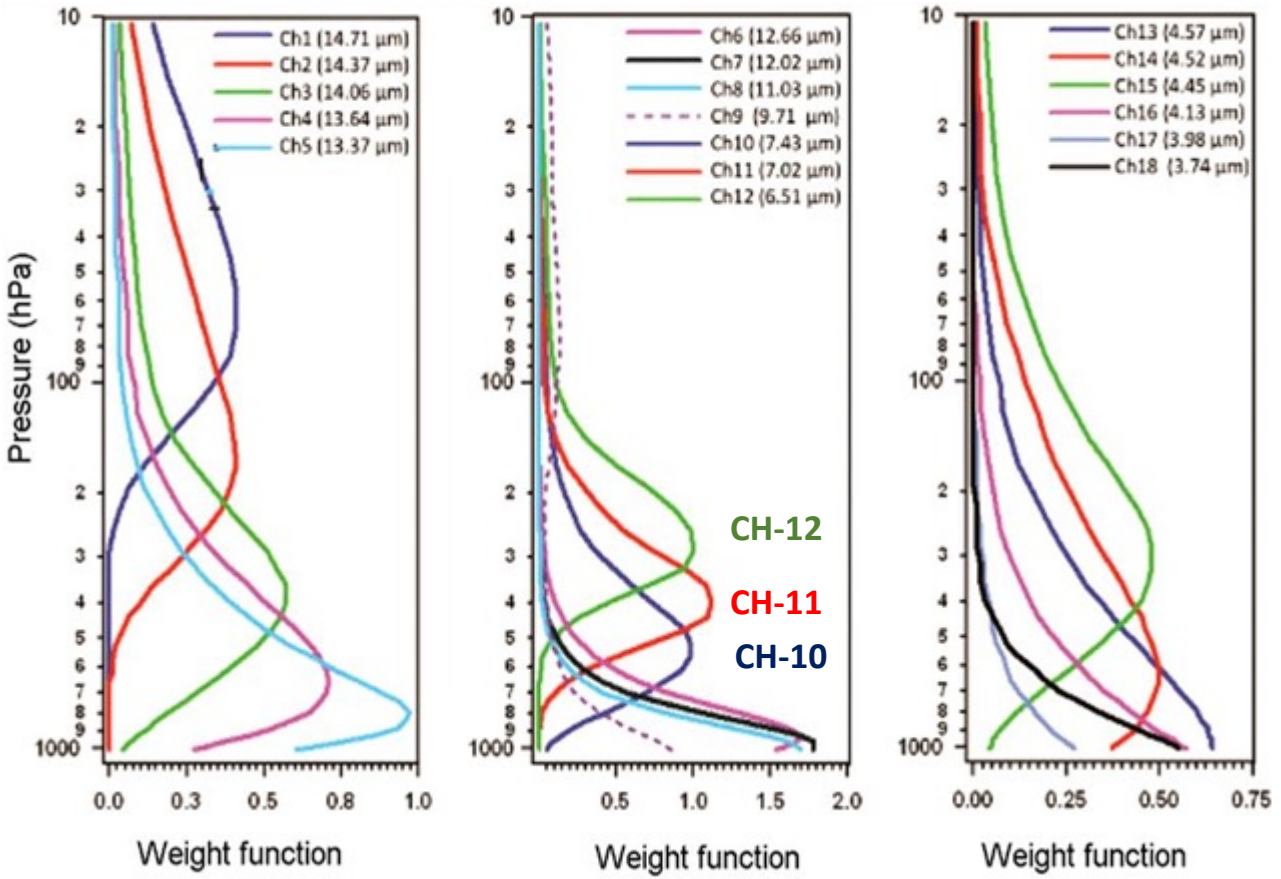
Outlines of Presentation

- A brief on INSAT-3DR sounder channel
- Experimental Design
- Analysis of INSAT-3DR radiance observations
  - Daily/monthly reception and statistical analysis
- Assimilation of INSAT-3DR in NGFS
  - Impact of initial analysis in global forecast
  - Experimental result for Heat-wave over Odisha (26-30 April 2024)
- Conclusions

INSAT-3DR Sounder Channel Characteristics

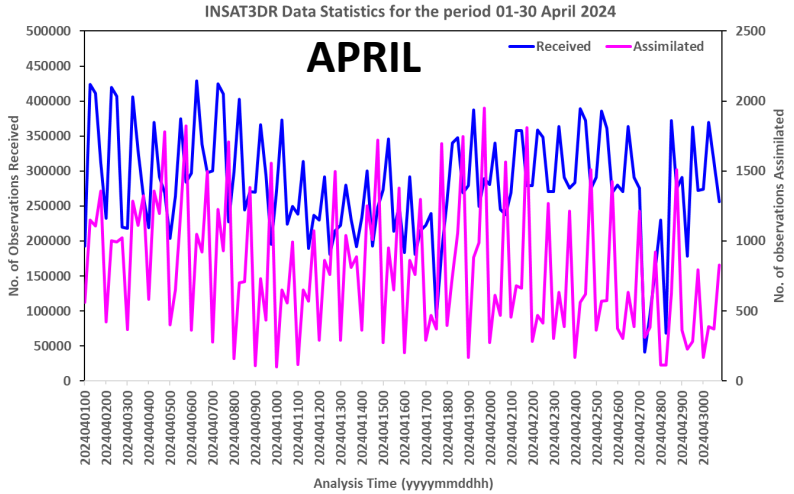
Channel No.	Detector	Wavelength (µm)	Principal Element / absorbing gas	Purpose
1	Longwave	14.67	CO_2	Stratosphere Temperature
2		14.32	CO_2	Tropopause Temperature
3		14.04	CO_2	Upper-level Temperature
4		13.64	CO_2	Mid-level Temperature
5		13.32	CO_2	Low-level Temperature
6		12.62	Water Vapor	Total Precipitable Water
7		11.99	Water Vapor	Surface Temperature, Moisture
8	Midwave	11.04	Window	Surface Temperature
9		9.72	Ozone	Total Ozone
10		7.44	Water Vapor	Low-level Moisture
11		7.03	Water Vapor	Mid-level Moisture
12		6.53	Water Vapor	Upper-level Moisture
13	Shortwave	4.58	N_2O	Low-level Temperature
14		4.53	N_2O	Mid-level Temperature
15		4.46	CO_2	Upper-level Temperature
16		4.13	CO_2	Boundary-level Temperature
17		3.98	Window	Surface Temperature
18		3.76	Window	Surface Temperature, Moisture
19	Visible	0.695	Visible	Cloud

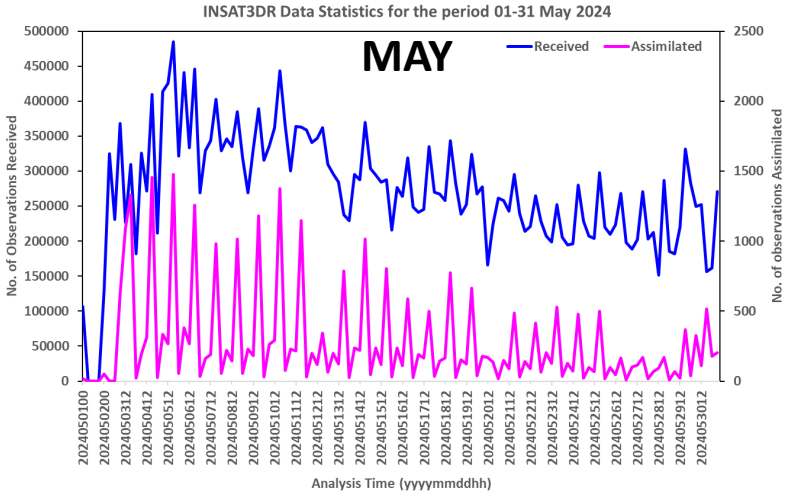


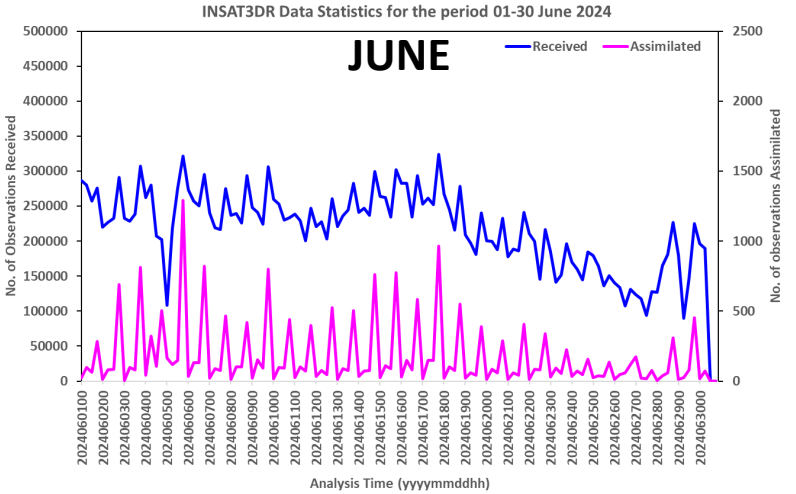
Experimental Design

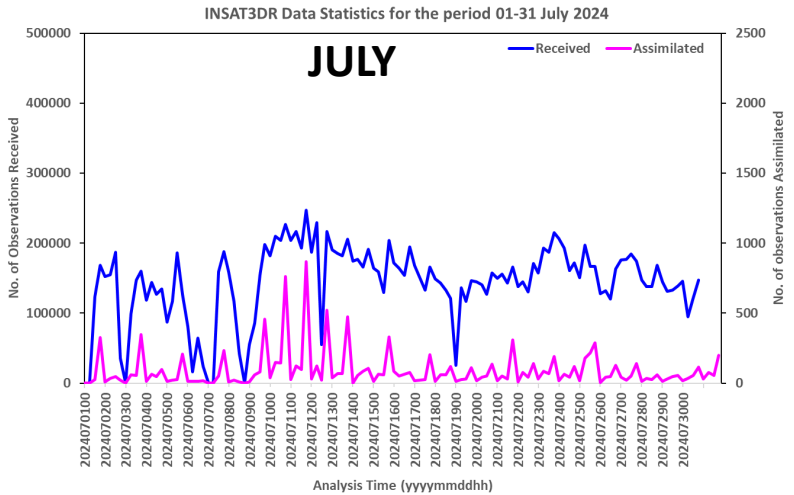
- Analysis in the daily/monthly scale
- Assimilation experiments are carried out as,
  - EXPT-I: CNTL [GFS (Operational)]
  - EXPT-II: ASSIM [GFS+INSAT3DR]
- Assimilation impact in simulation of
  - Heat-wave over Odisha (26-30 April 2024)

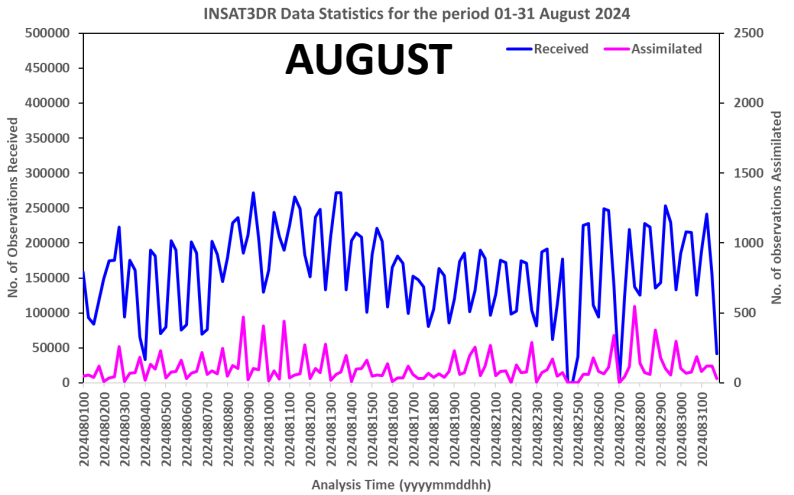
Analysis of INSAT-3DR radiance observations

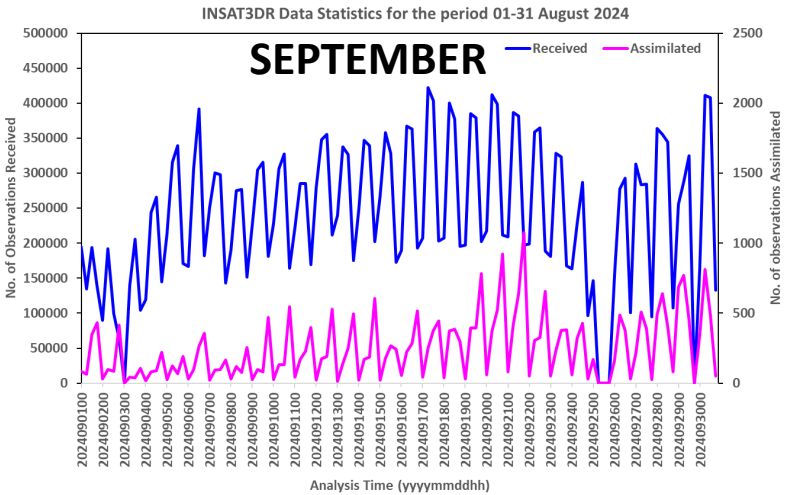












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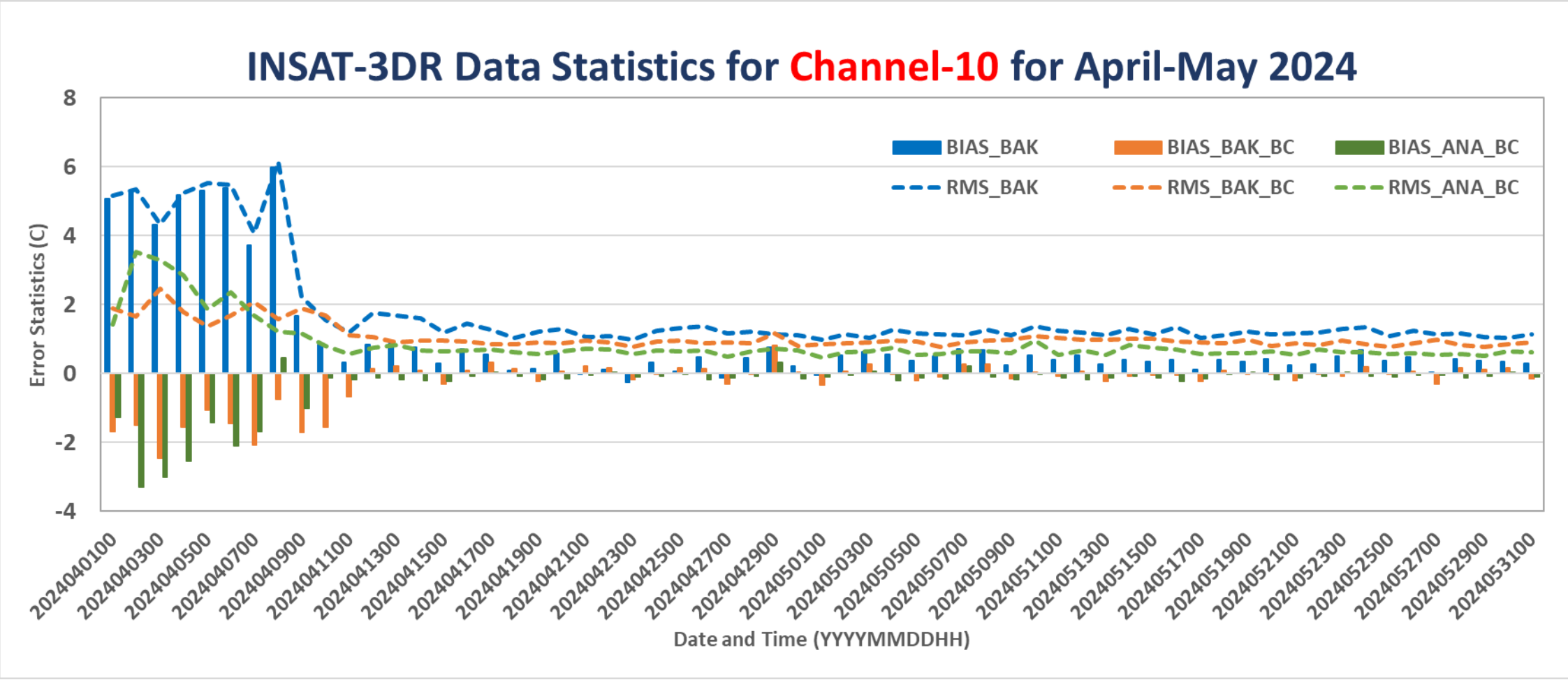

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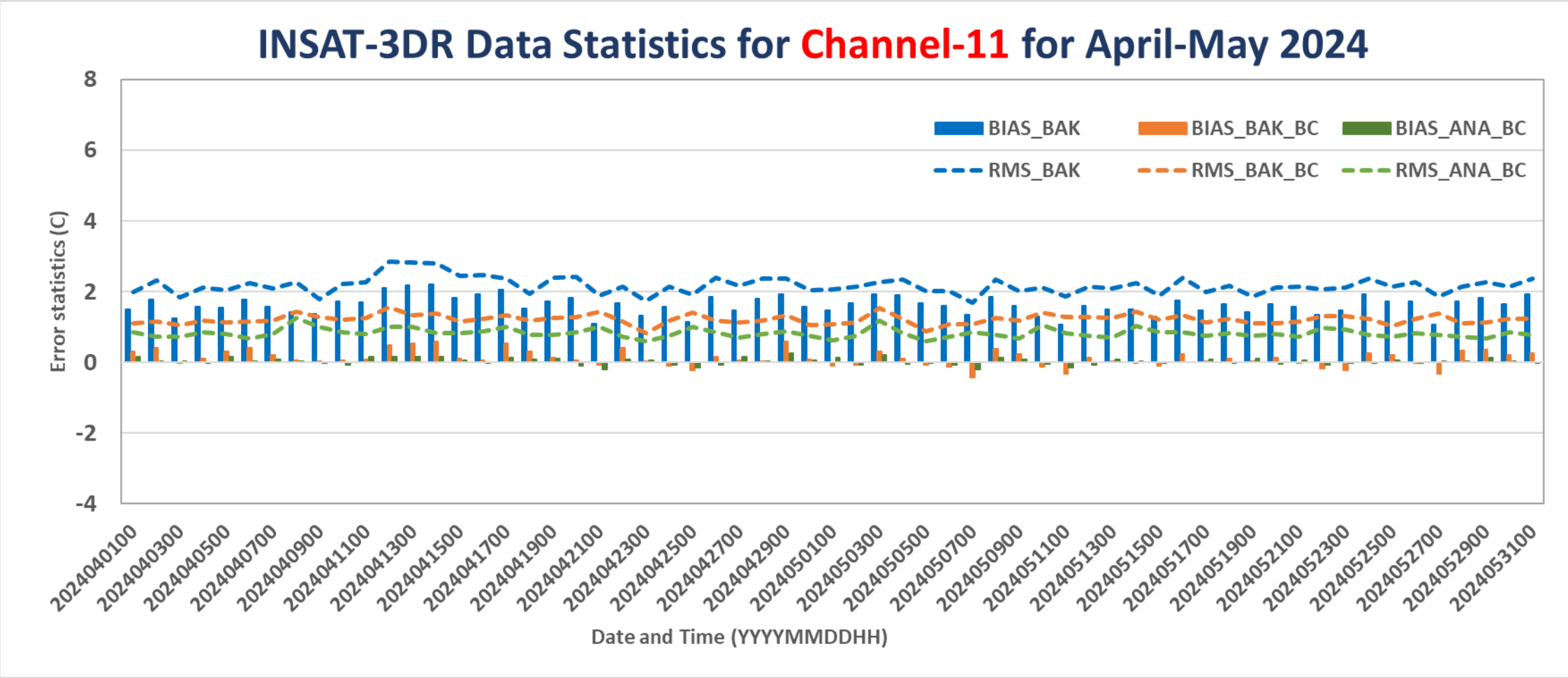

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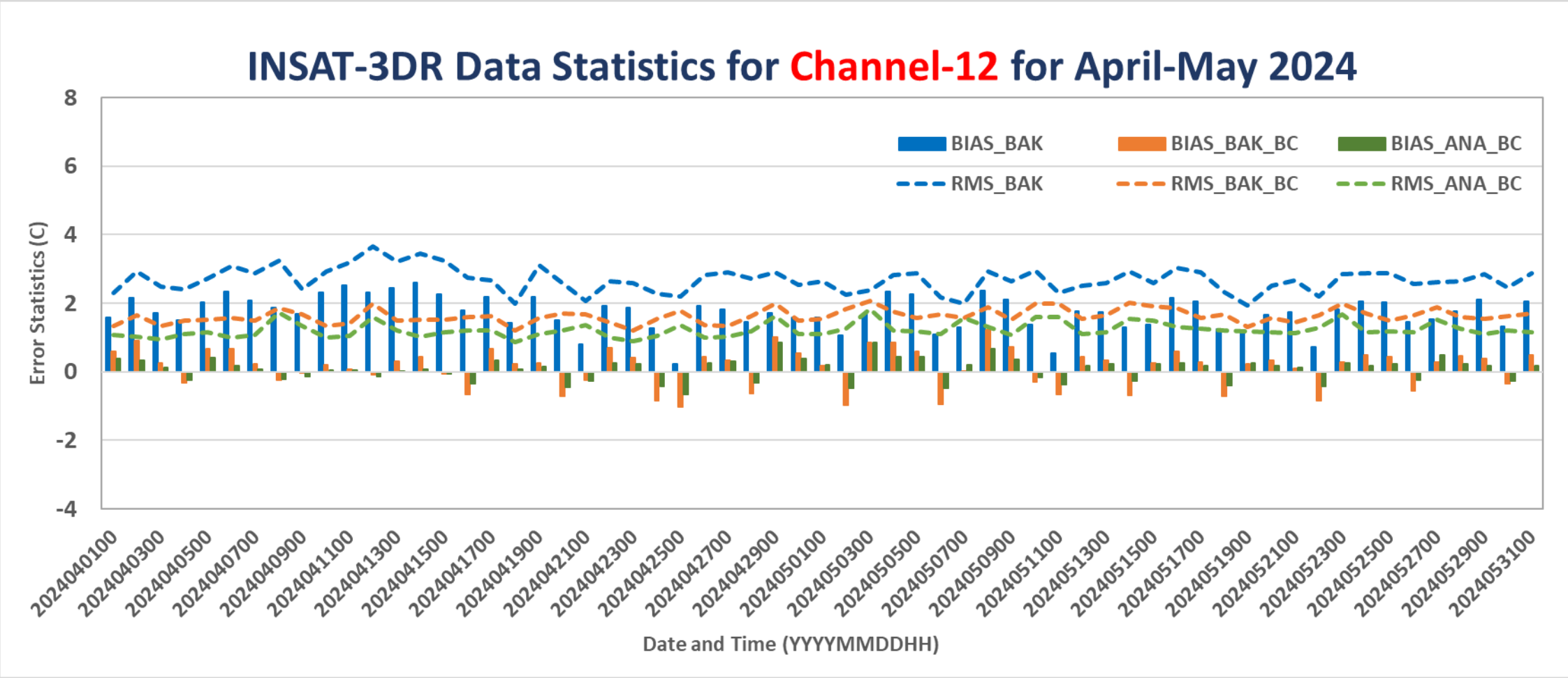
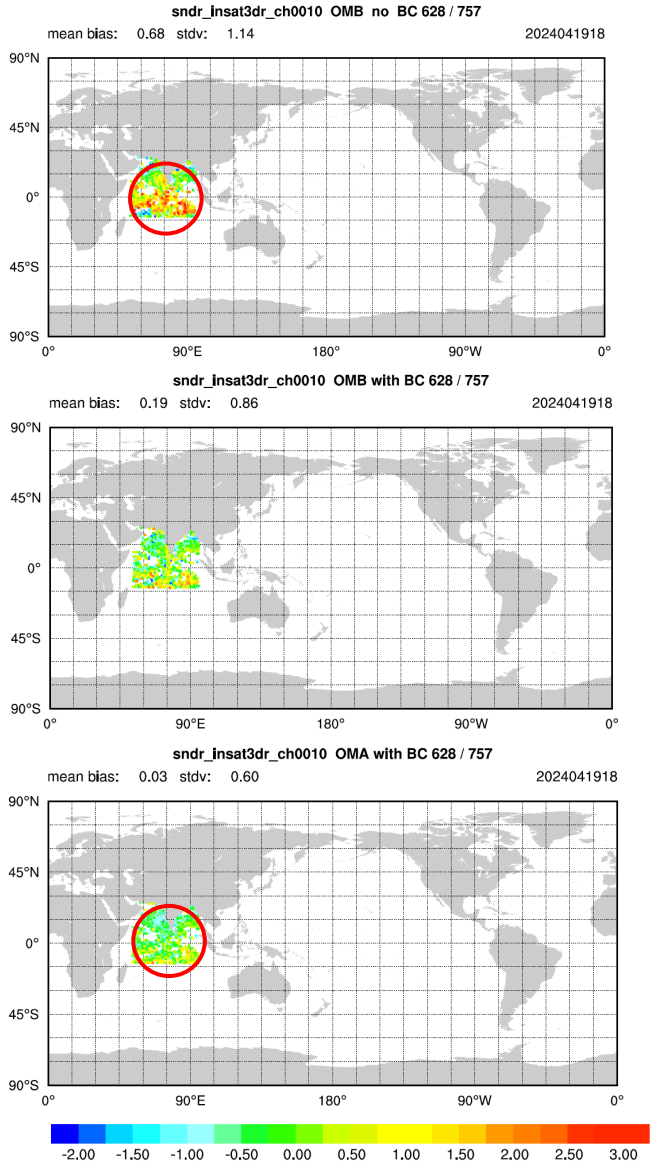
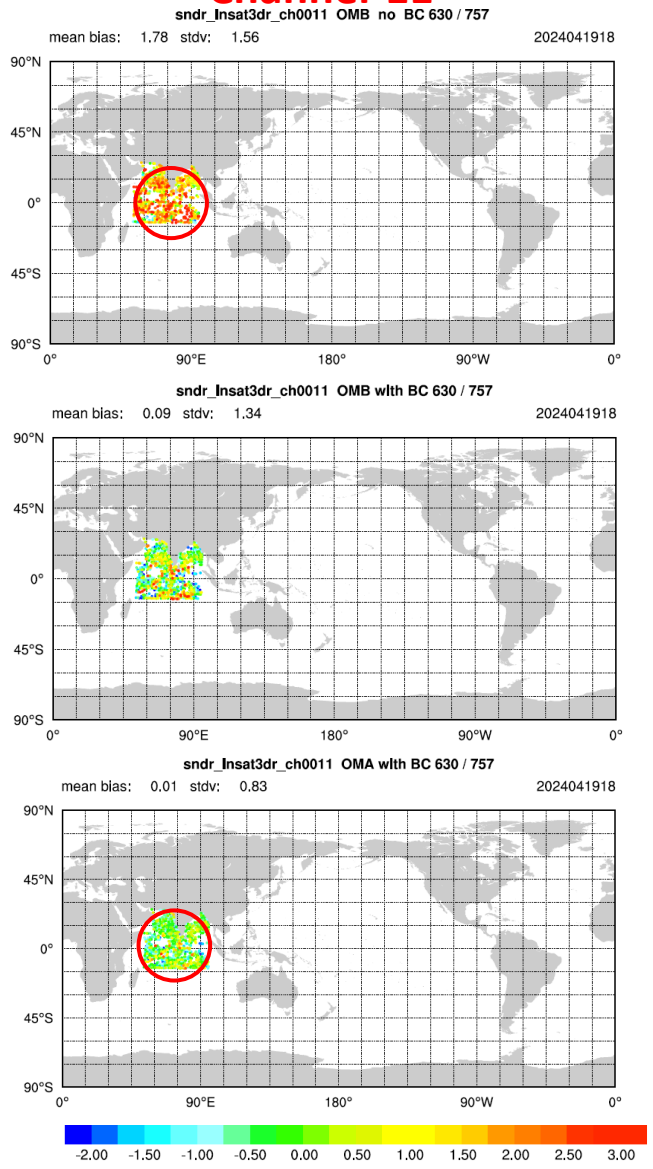


Analysis of INSAT-3DR radiance observations

Channel-10



Channel-11



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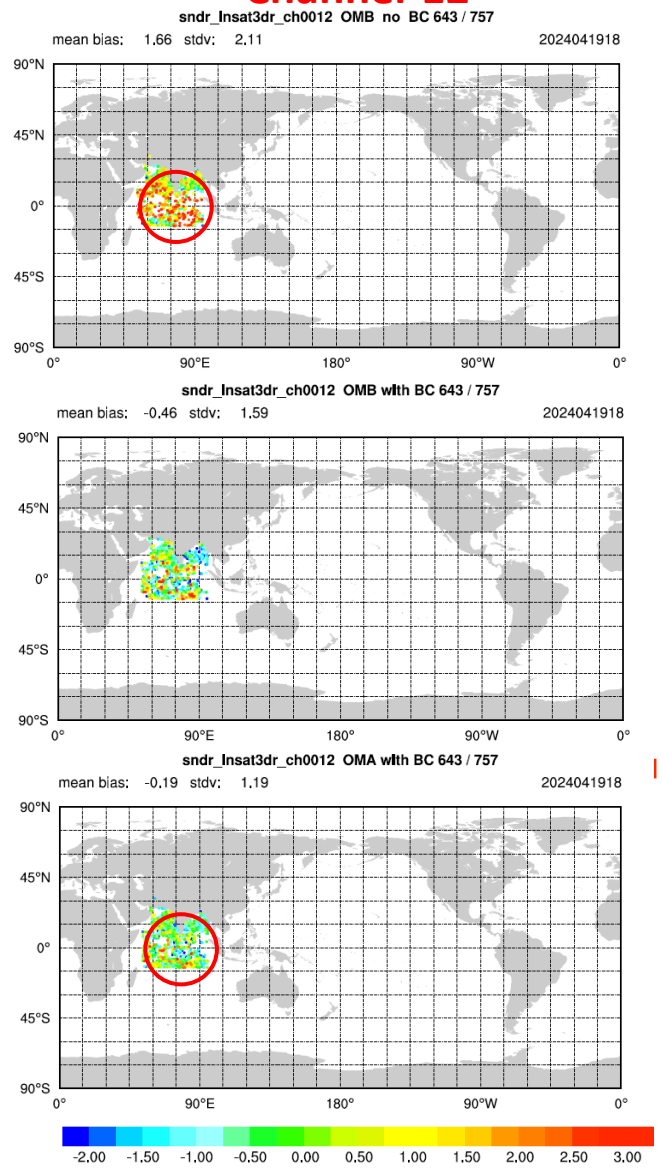
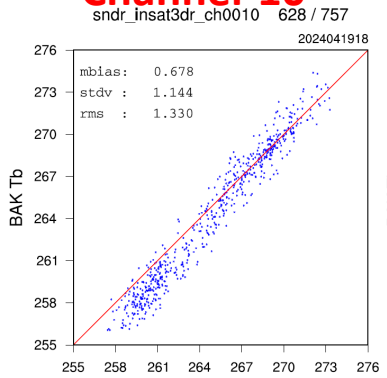
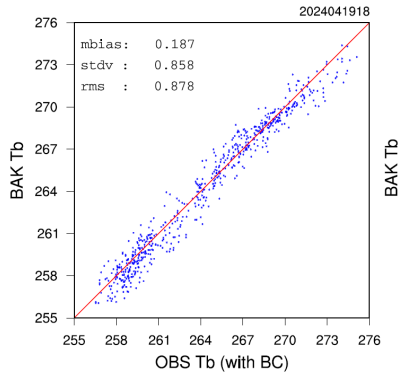
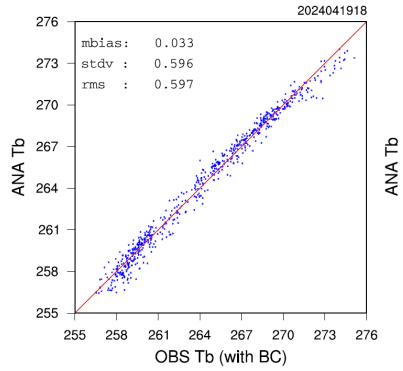


Analysis of INSAT-3DR radiance observations

Channel-10







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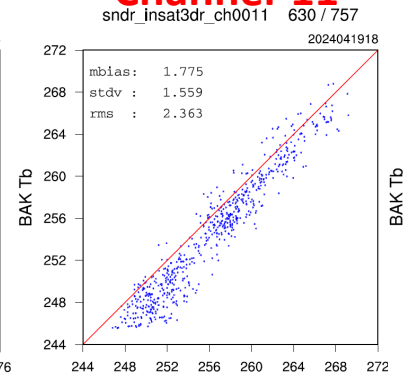

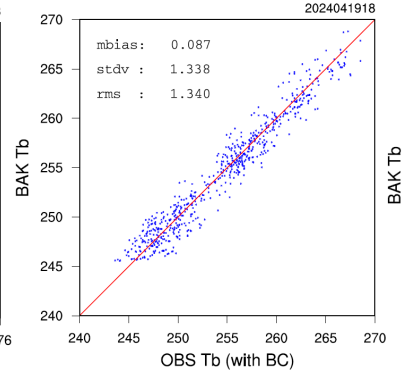

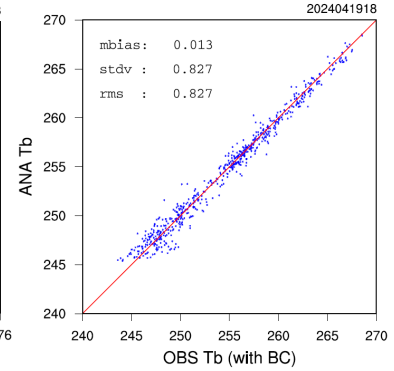

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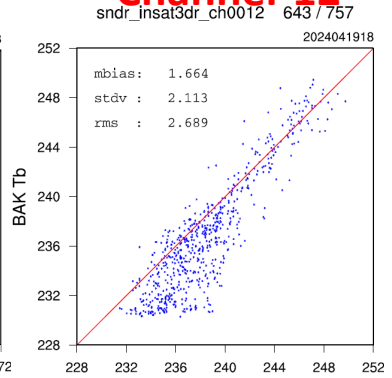

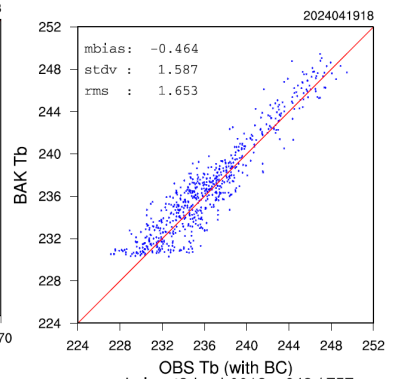

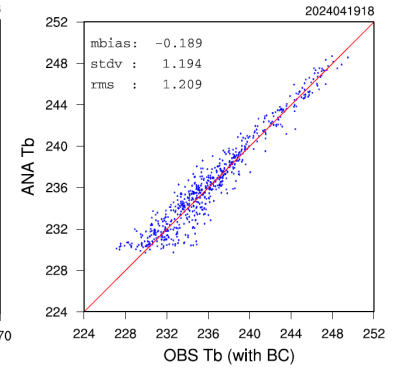

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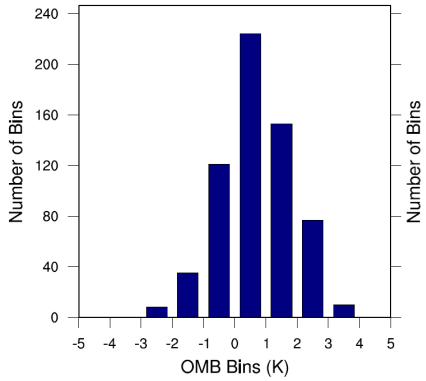

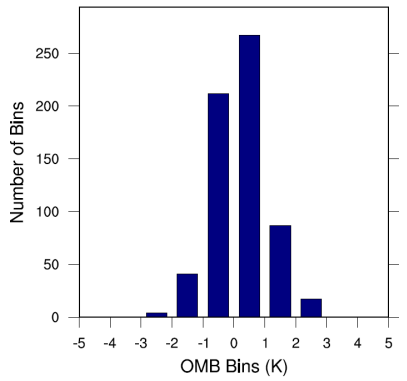

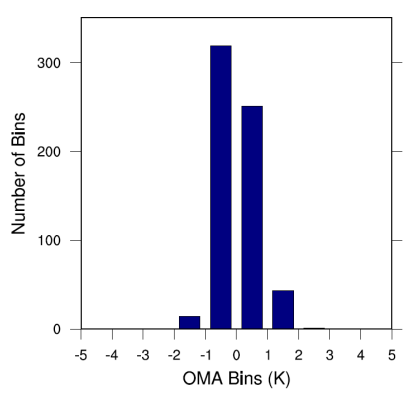

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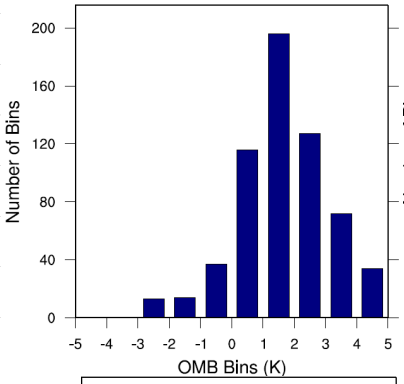
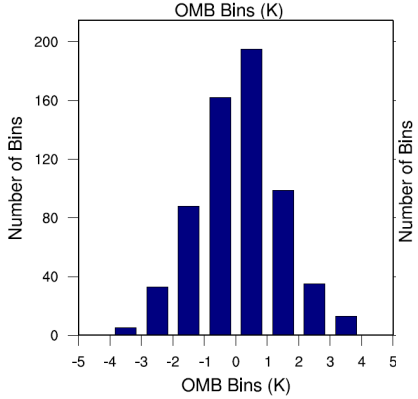
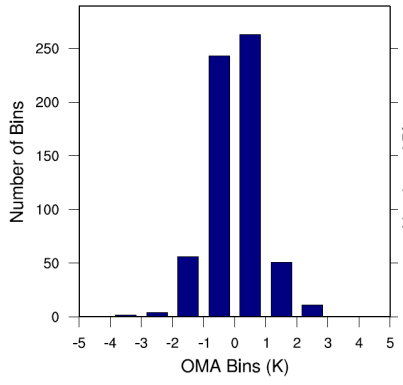
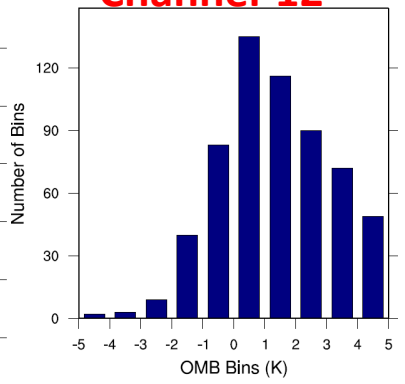
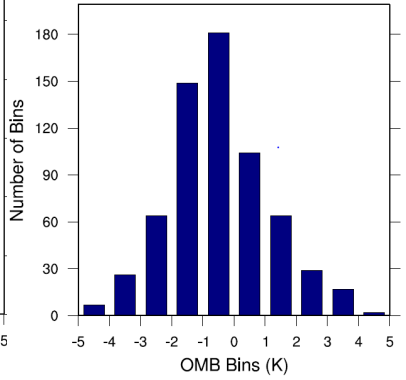


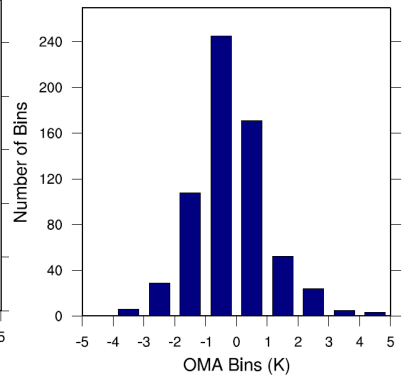




Channel-12

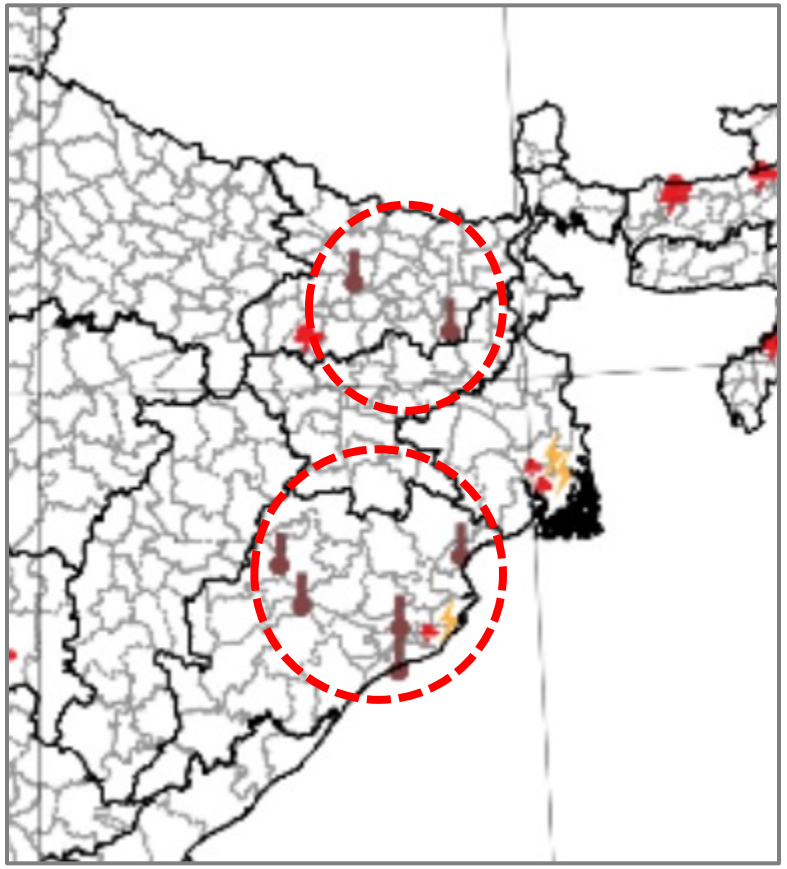






Heat-wave over Odisha (26-30 April 2024)

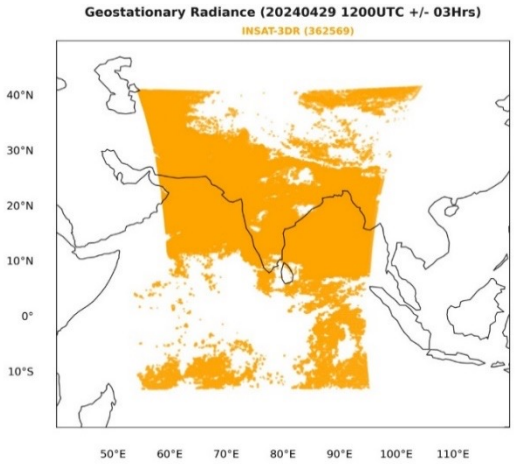
- Maximum temperature was above normal over most parts of the country, except some parts of northwest India and central India.
- highest maximum temperature was 47.2 °C (Bahargora , Jharkhand)

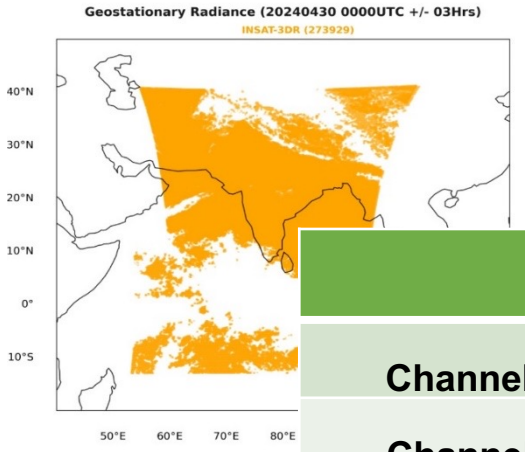


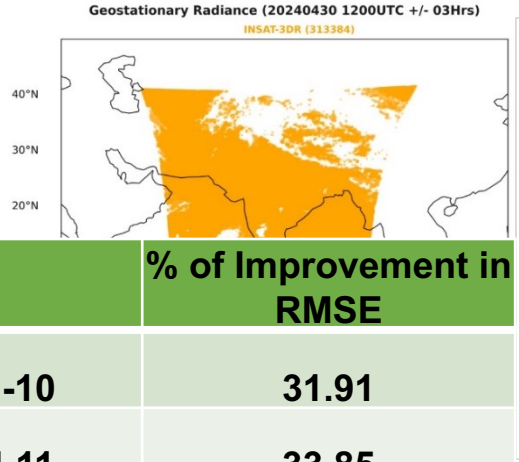
Heat-wave Conditions:

Normal Temperature	Departure from Normal Temperature
Tmax < 40°C	Appreciably Above Normal: 3 °C to 4 °C
	Moderate Heat Wave: 5 °C to 6 °C
	Severe Heat Wave: >= 7 °C
Tmax > 40°C	Heat Wave: 3 °C to 4 °C
	Severe Heat Wave: > 5 °C
Tmax >= 45 °C for two consecutive days	

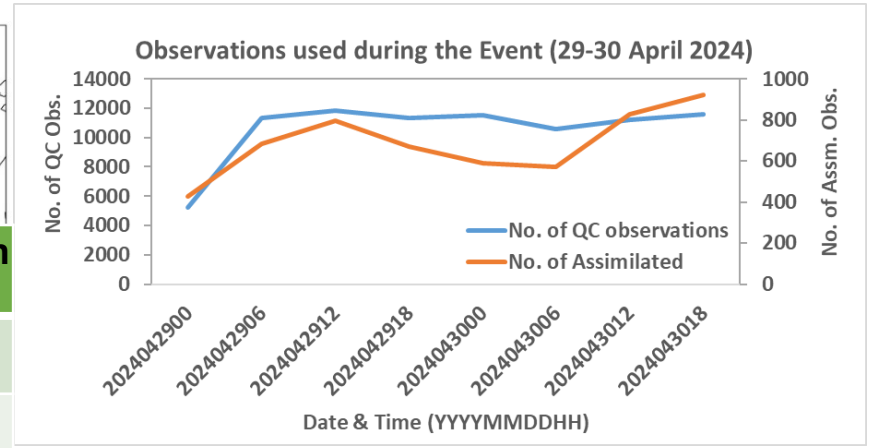
INSAT-3DR radiance observations during 29-30 April 2024

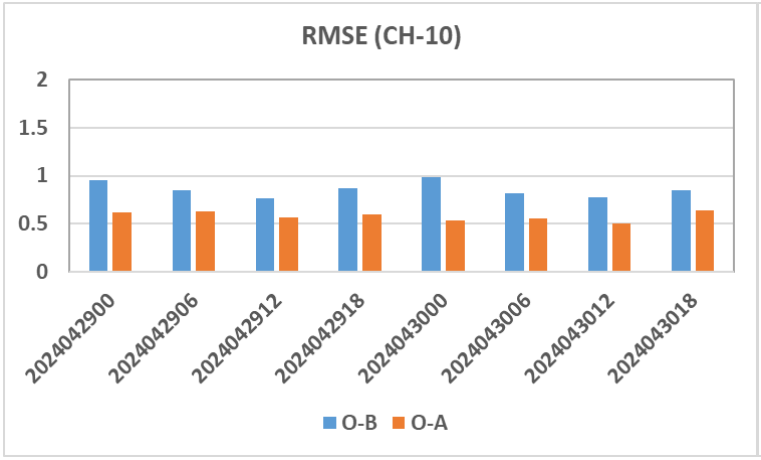


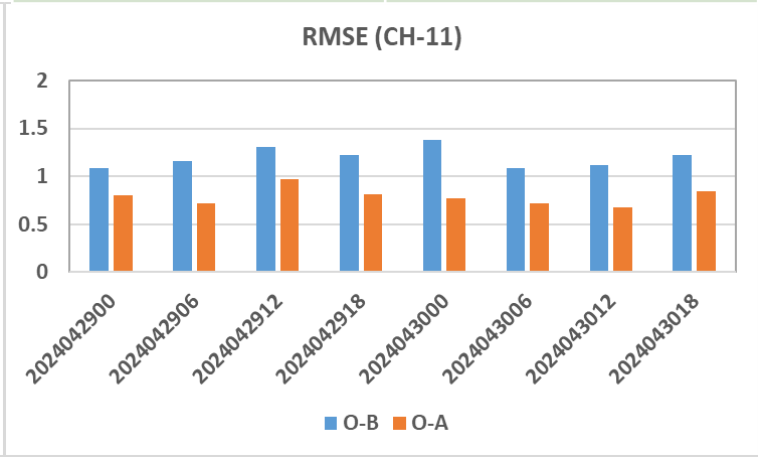


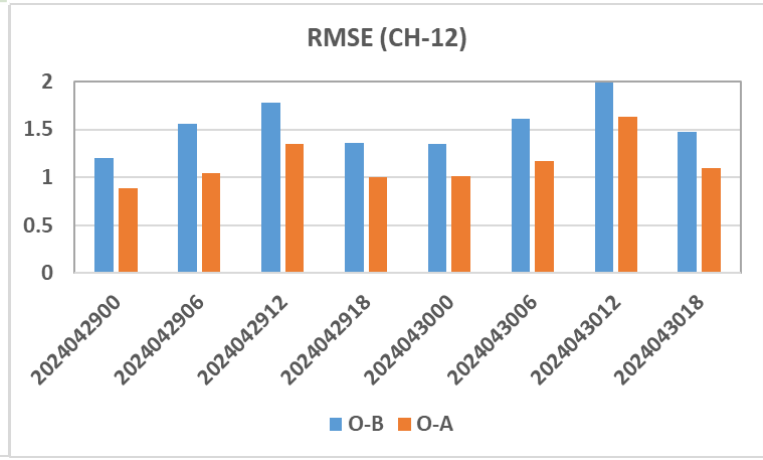


	% of Improvement in RMSE
Channel-10	31.91
Channel-11	33.85
Channel-12	25.63

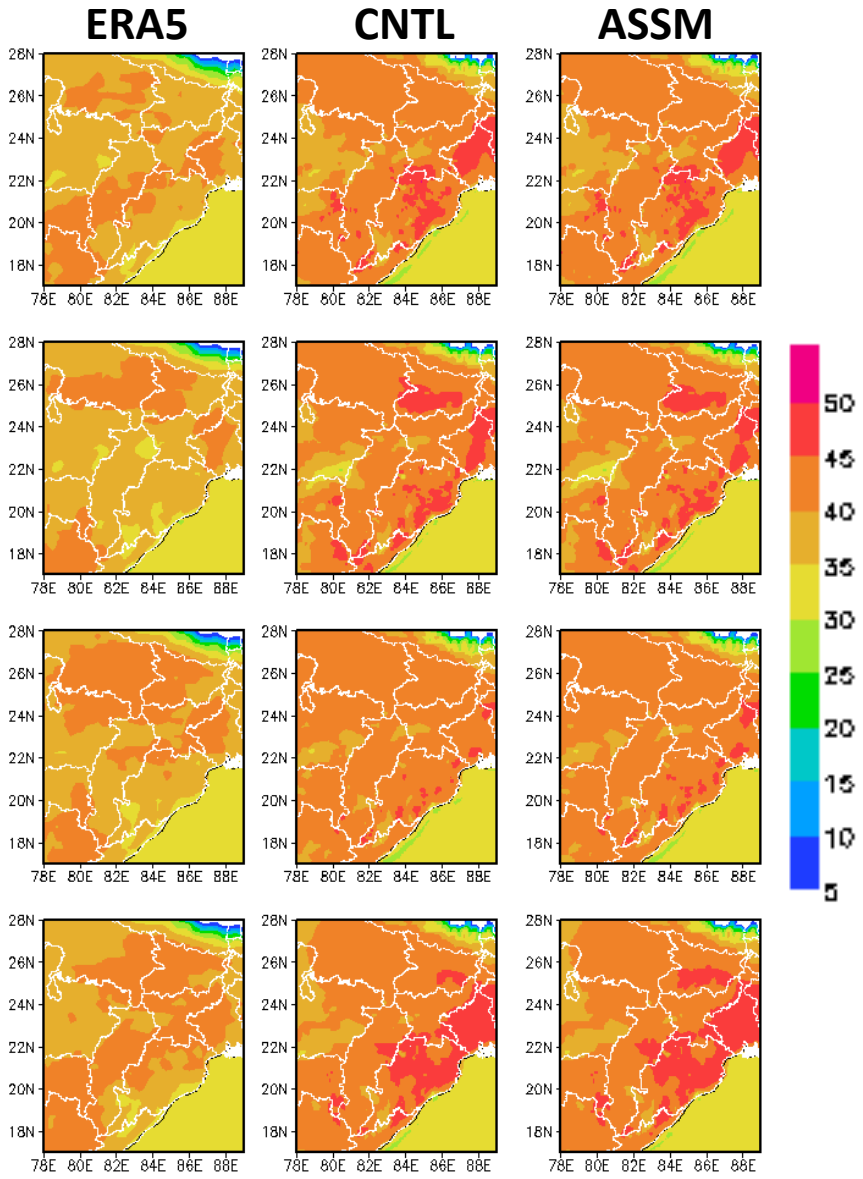


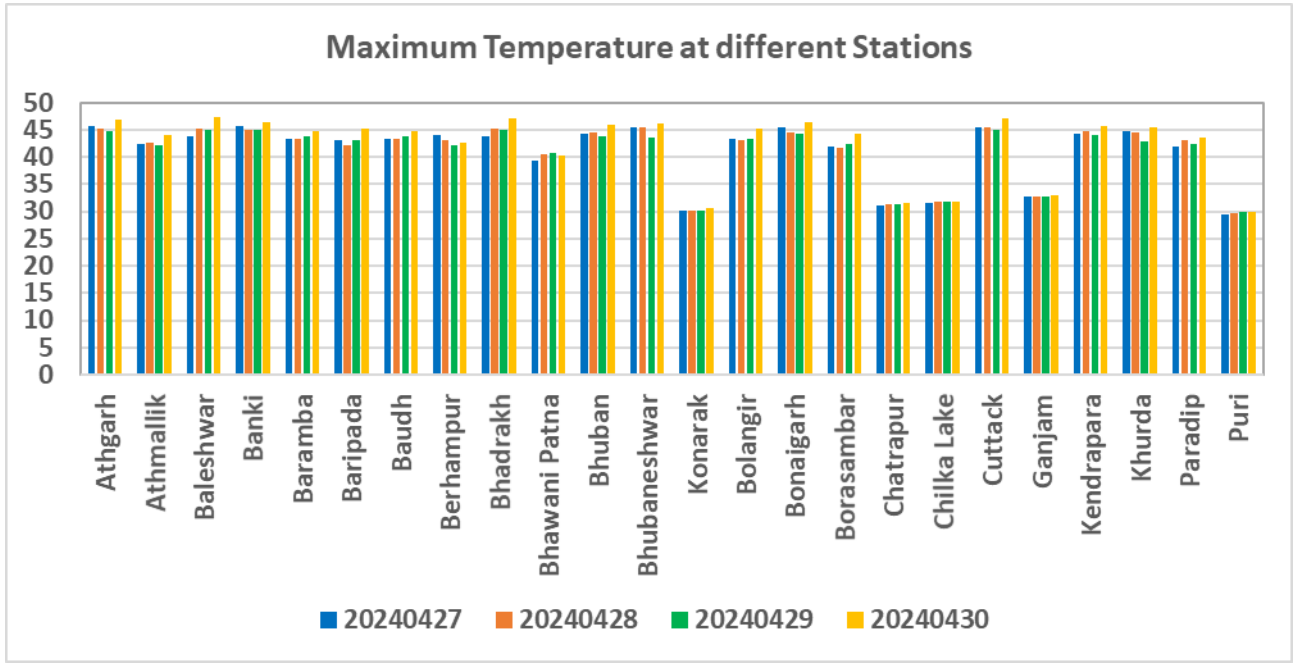






Heat-wave over Odisha (26-30 April 2024)





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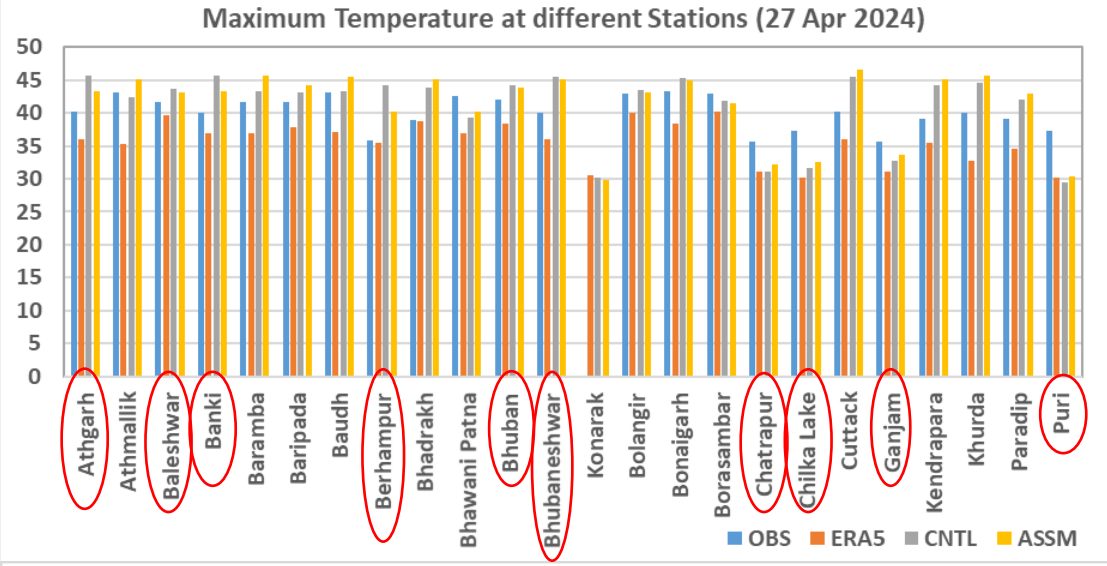

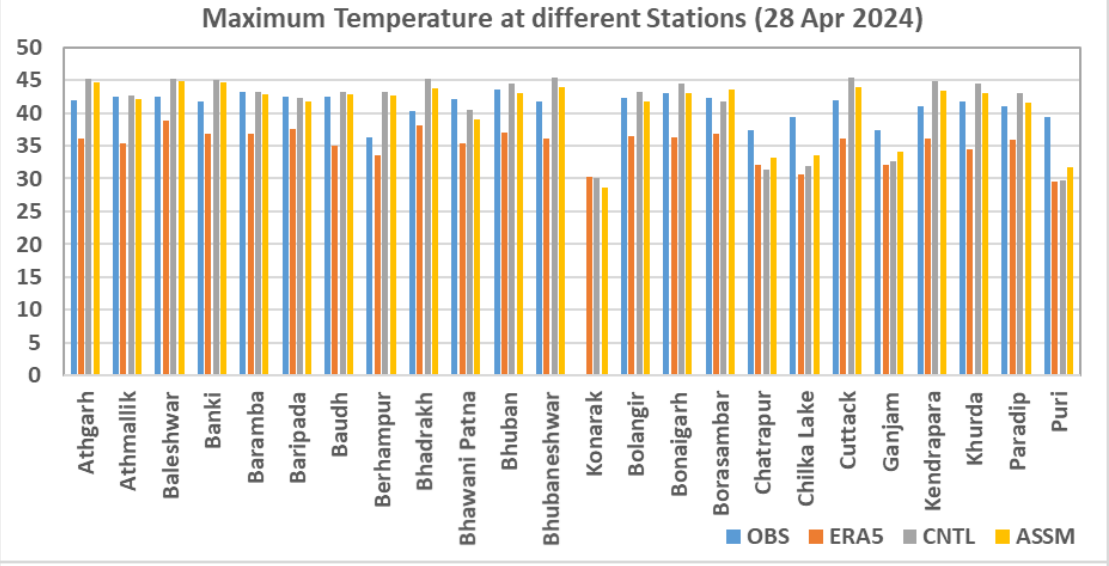

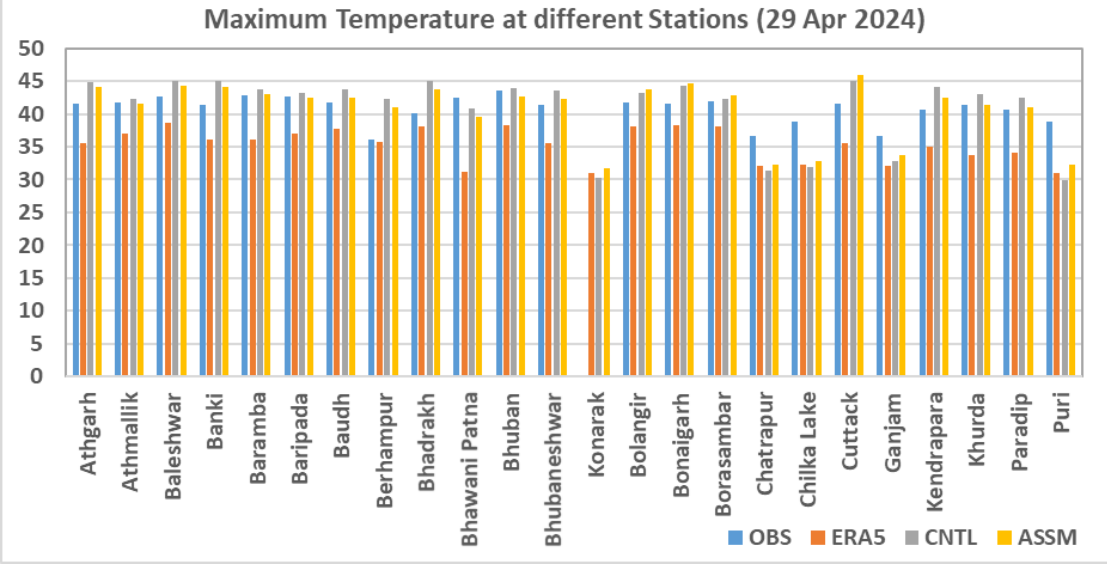

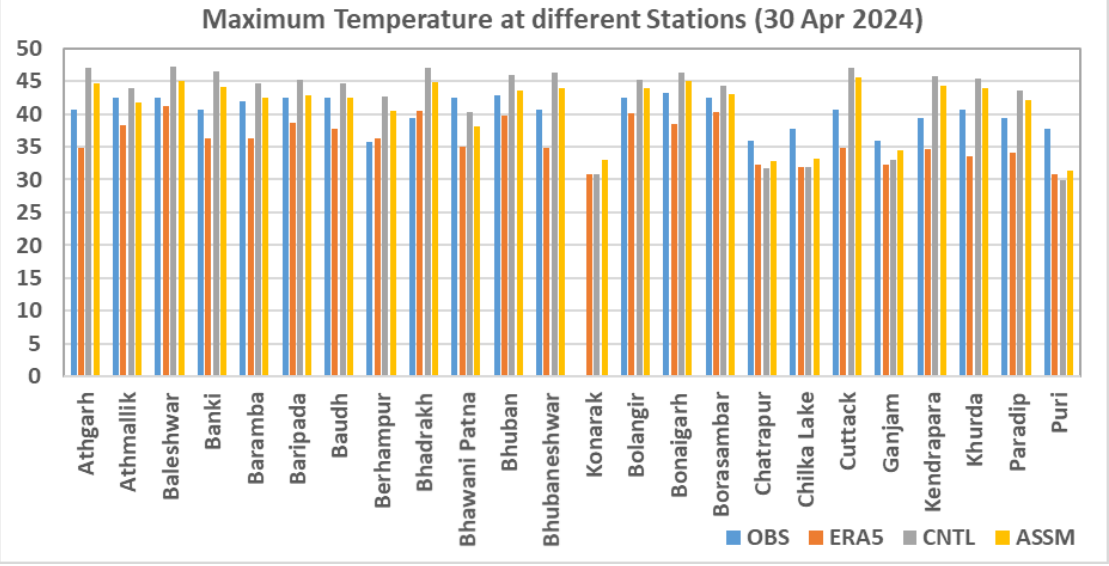

Conclusions

- The daily as well as monthly statistics suggest that the analysis field with bias correction improved over the background for all the assimilated channels.
- The RMSE shows an improvement of about 32%, 34% and 26%, respectively for low-level, mid-level and upper-level moisture channels in analysis.
- This initial analysis suggests that the assimilation of INSAT-3DR observation will provide a positive impact on the global analysis field and, consequently, the model forecast.
- The analysis field gives lesser error i.e varies from -2 to + 2° K.
- The heat wave condition is reasonably simulated by the model.

Thank you for your attention !!