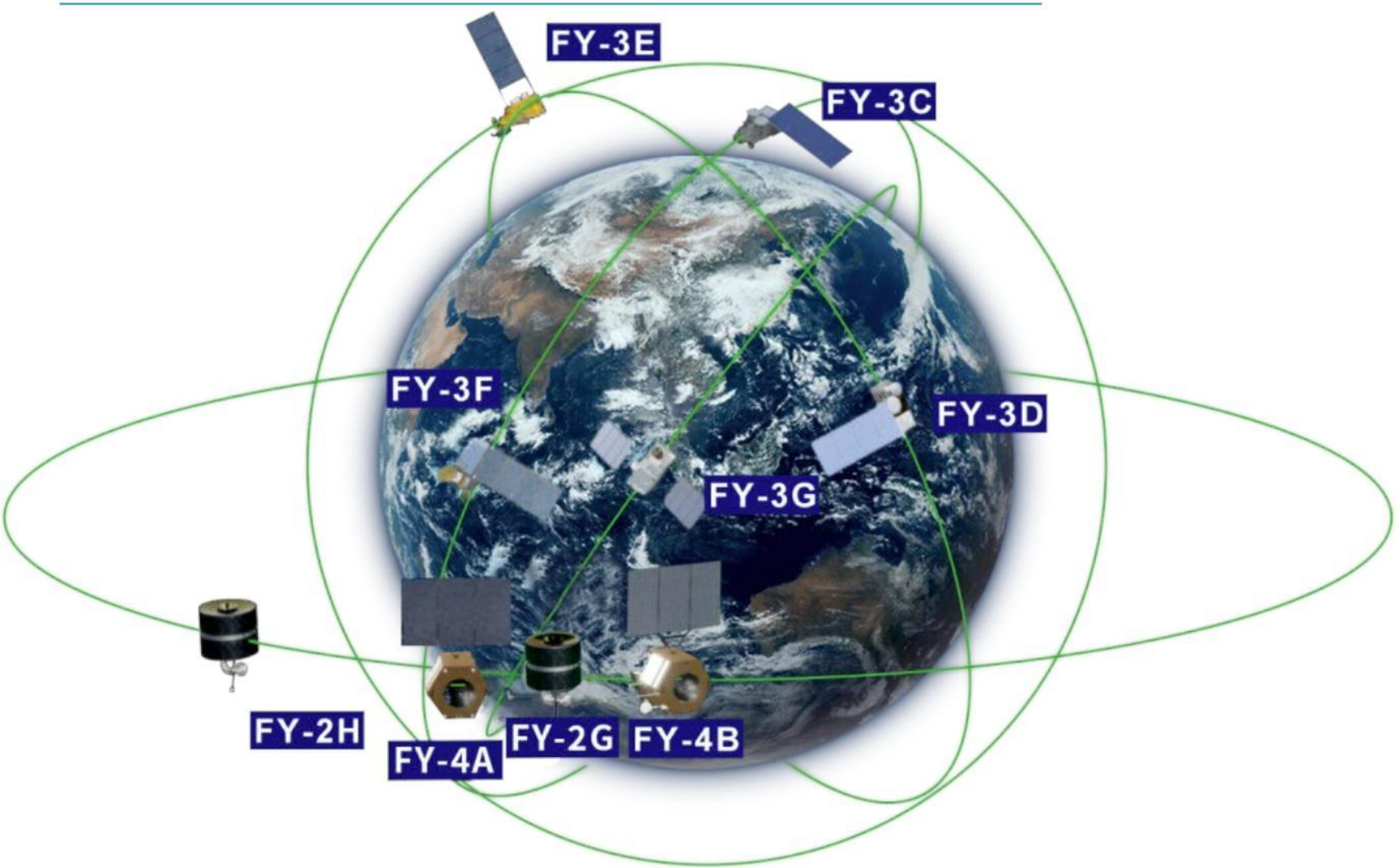
Assimilating MWRI/FY-3D All-Sky Observations over Sea within ARPEGE

Keyi Chen, Hélène Dumas, Philippe Chambon, Mary Borderies

1. Fengyun Satellite series



2. The Information of MWRI

MWRI onboard **FY-3D**
Launching time Nov 14 2017 with **ECT 13:40 asc**

MWRI/FY-3D	Lanched on 14th Nov 2017	ECT:13:40 asc
AMSR-2/GCOM-W	Lanched on 17th May 2012	ECT:13:30 asc

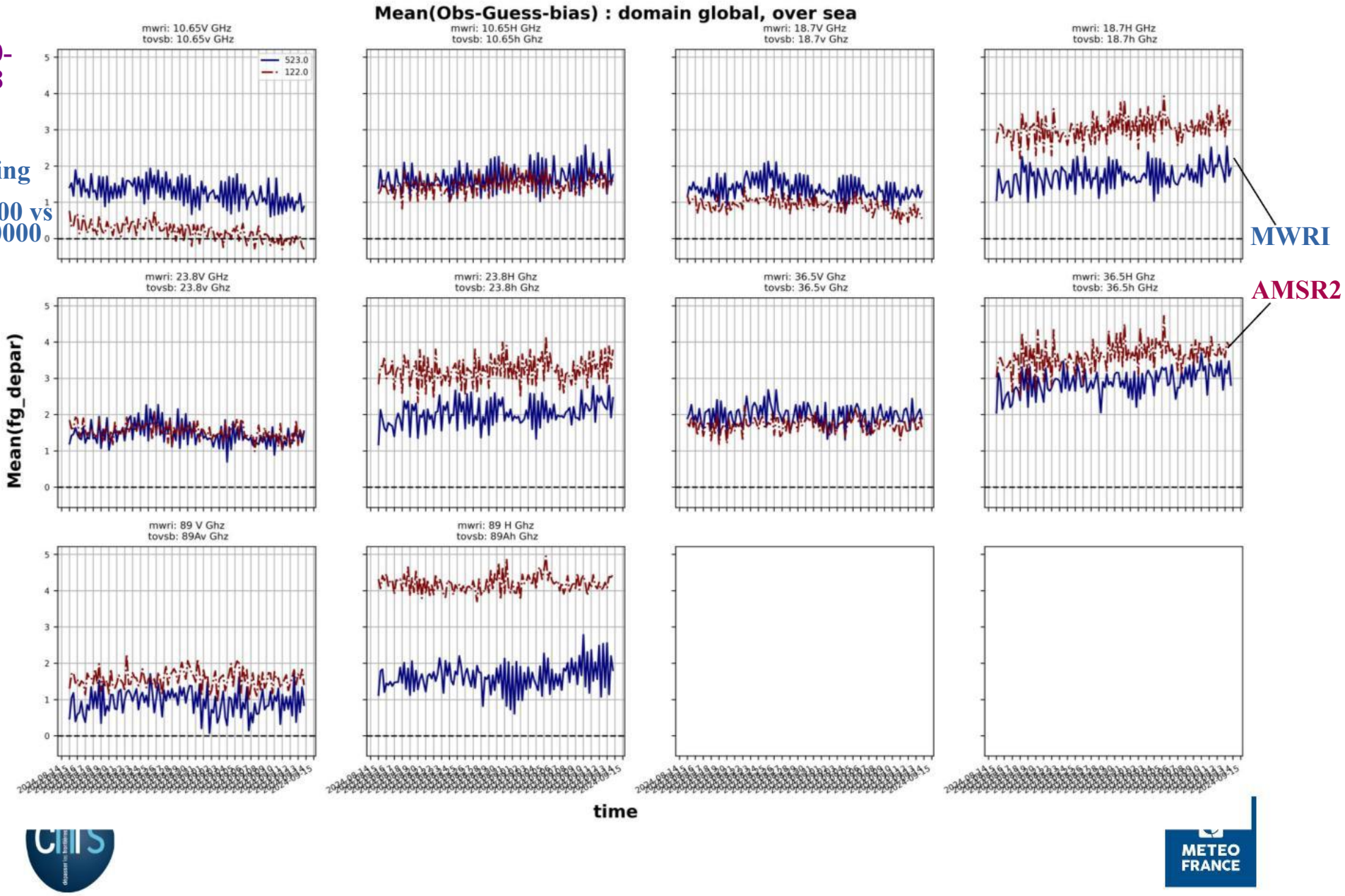
Channels Comparison between MWRI and AMSR2

				Channel 1/AMSR2	6.925 V	35*62KM	10*10KM
				2	6.925 H	35*62KM	10*10KM
				3	7.3 V	35*62KM	10*10KM
				4	7.3 H	35*62KM	10*10KM
Channel 1/MWRI	10.65 V	51*85KM	40*11.2KM	5	10.65 V	24*42KM	10*10KM
2	10.65 H	51*85KM	40*11.2KM	6	10.65 H	24*42KM	10*10KM
3	18.7 V	30*50KM	40*11.2KM	7	18.7 V	14*22KM	10*10KM
4	18.7 H	30*50KM	40*11.2KM	8	18.7 H	14*22KM	10*10KM
5	23.8 V	27*45KM	20*11.2KM	9	23.8 V	11*19KM	10*10KM
6	23.8 H	27*45KM	20*11.2KM	10	23.8 H	11*19KM	10*10KM
7	36.5 V	18*30KM	20*11.2KM	11	36.5 V	7*12KM	10*10KM
8	36.5 H	18*30KM	20*11.2KM	12	36.5 H	7*12KM	5*5KM
9	89.0 V	9*15KM	10*11.2KM	13	89.0A V	3*5KM	5*5KM
10	89.0 H	9*15KM	10*11.2KM	14	89.0A H	3*5KM	5*5KM
11	150 V	7.5*12KM		15	89.0B V	3*5KM	5*5KM
12	150 H	7.5*12KM		16	89.0B H	3*5KM	5*5KM

Time series of the first-guess departures after bias correction for Imagers

MWRI vs AMSR-2 2024081500-2024091318

Daily Sampling of MWRI 250000 vs AMSR-2 150000



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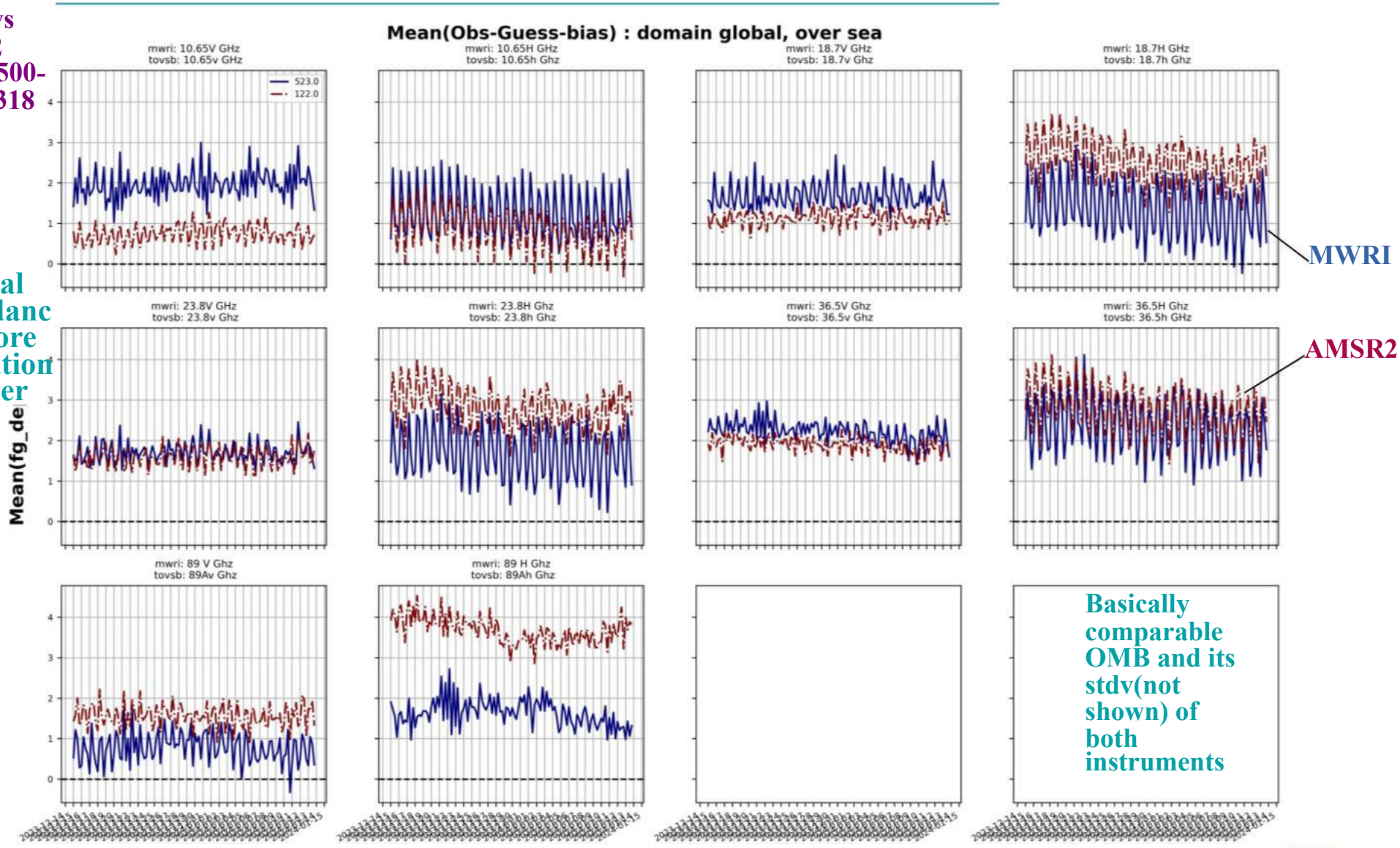
Time series of the first-guess departures after bias correction for Imagers

MWRI vs AMSR-2 2023121500-2024011318



MWRI

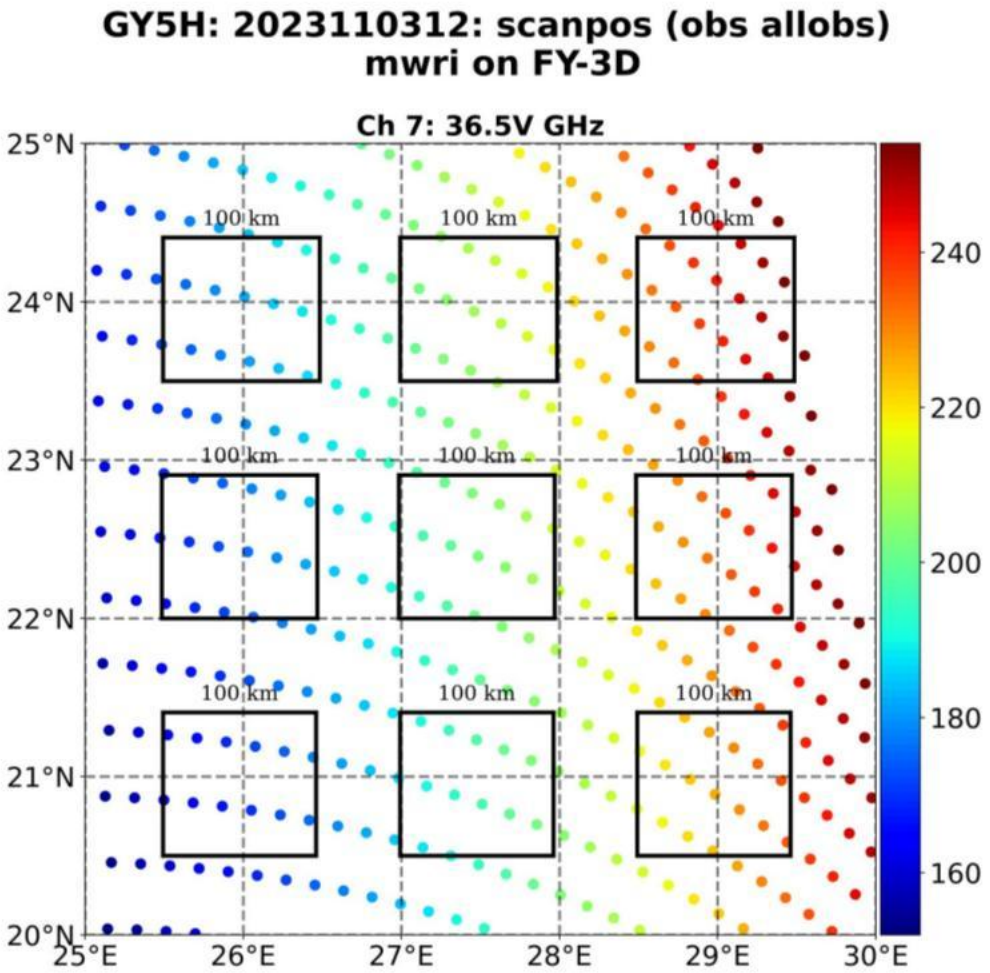
AMSR2

Seasonal dependanc E: more fluctuation in winter

Basically comparable OMB and its stdv(not shown) of both instruments

3. New Configurations for MWRI settings

- **1) Mask for MWRI/FY-3D** Previously, there is **no mask** at all for MWRI.



Applying the same mask settings of AMSR-2 for MWRI, which is： 3 * 3

- 1 1 1
- 1 1 1
- 1 1 1

with center in (2 , 2)

FOV Selection

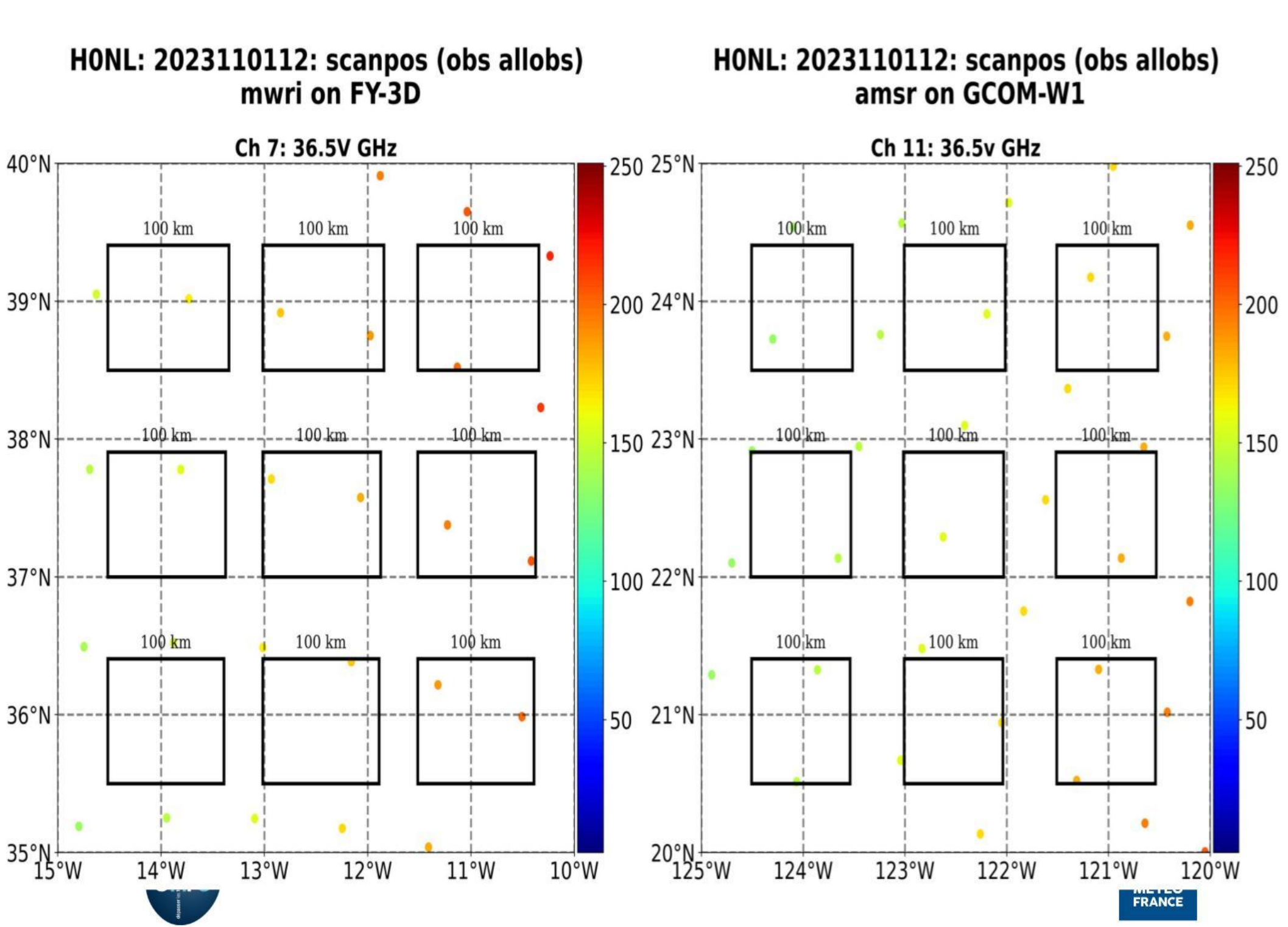
liste des Fov :

2	14	26	38	50	62
74	86	98	110	122	134
146	158	170	182	194	206
218	230	242			

- liste des Fov en entrelacement :

8	20	32	44	56	68
80	92	104	116	128	140
152	164	176	188	200	212
224	236	248			

With JUMP=3


H0NL: 2023110112: scanpos (obs allobs)
mwri on FY-3D
Ch 7: 36.5V GHz
H0NL: 2023110112: scanpos (obs allobs)
amsr on GCOM-W1
Ch 11: 36.5v GHz
100 km
40°N
39°N
38°N
37°N
36°N
35°N
15°W
14°W
13°W
12°W
11°W
10°W
25°N
24°N
23°N
22°N
21°N
20°N
125°W
124°W
123°W
122°W
121°W
120°W
250
200
150
100
50
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2). Updated Observation Error Model of MWRI

Channels of MWRI-FY-3D	Previous observation errors (K)	New observation errors (K)
3	2.5	2.8
4	4.0	4.2
5	3.0	3.5
6	4.5	4.8
7	2.5	3.0
9	3.0	3.2

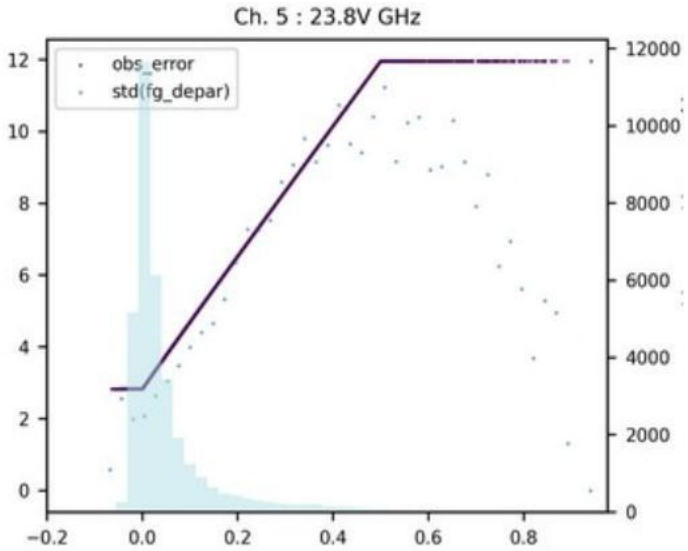
Inflated observation errors

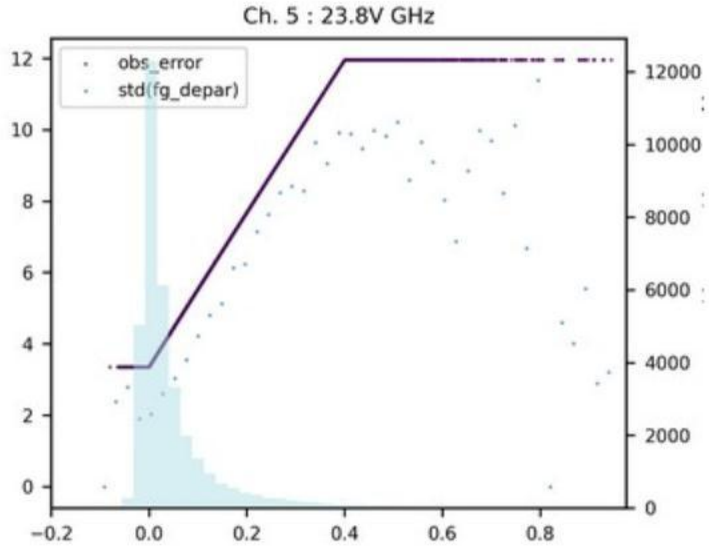
Updated cloud proxy

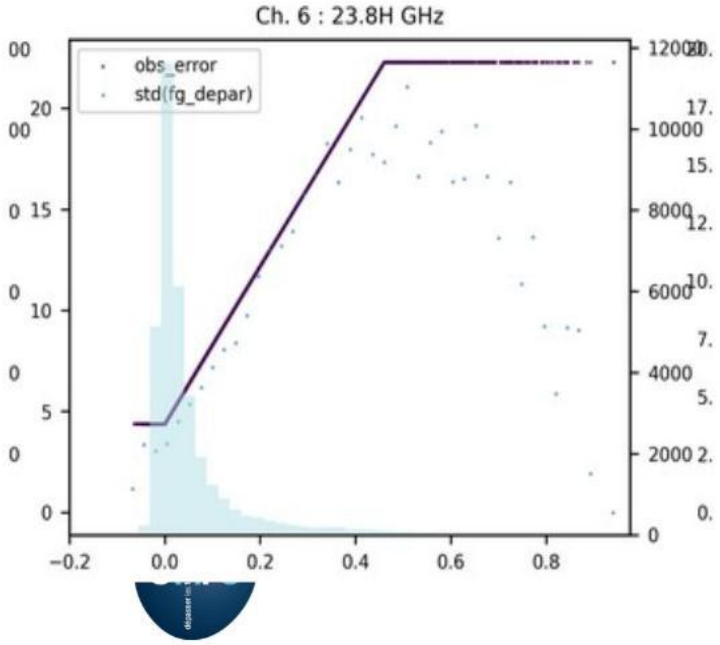
Channels of MWRI-FY-3D	Previous cloud proxy	New cloud proxy
5	0.5	0.4
6	0.46	0.4
7	0.46	0.3
9	0.45	0.5

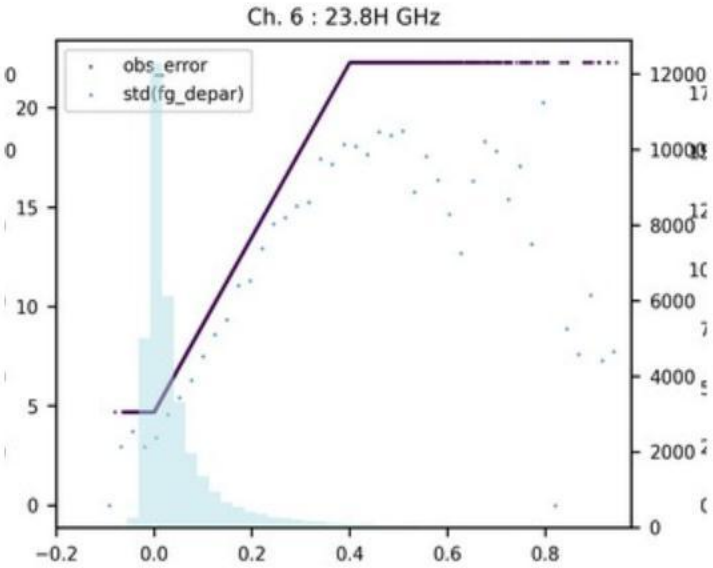
Previous

Present

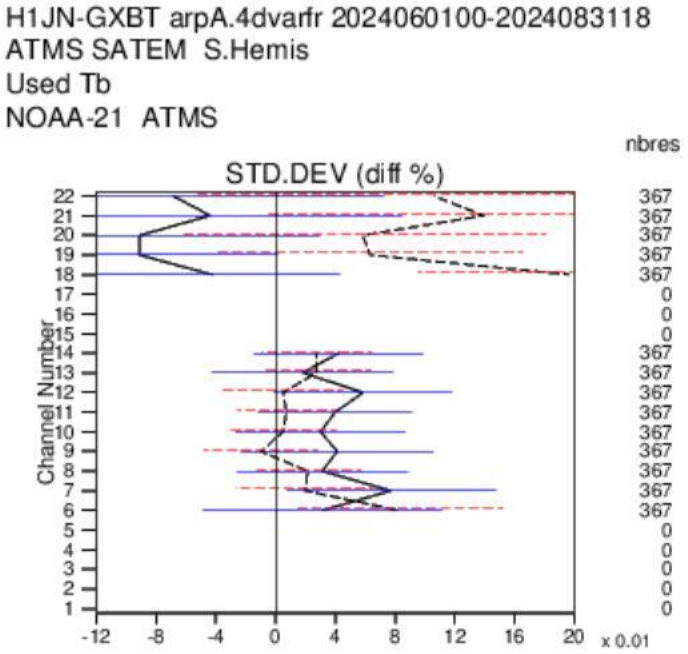


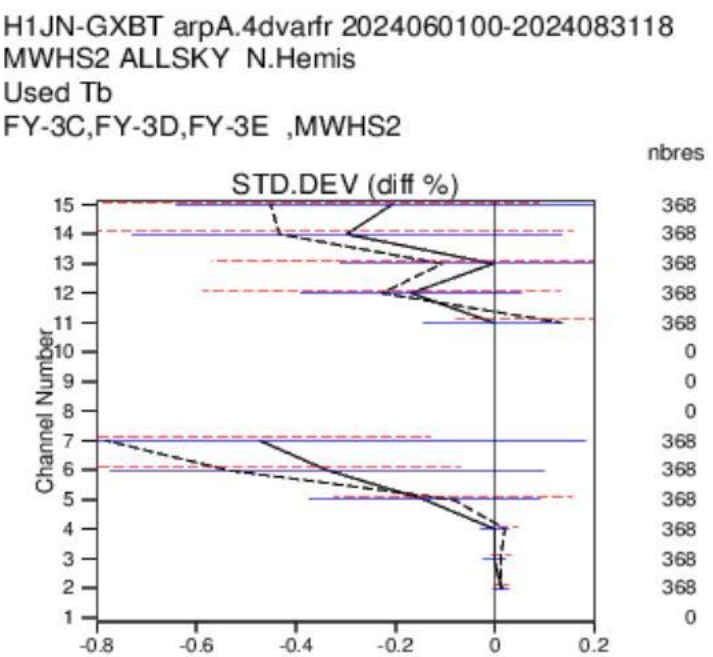


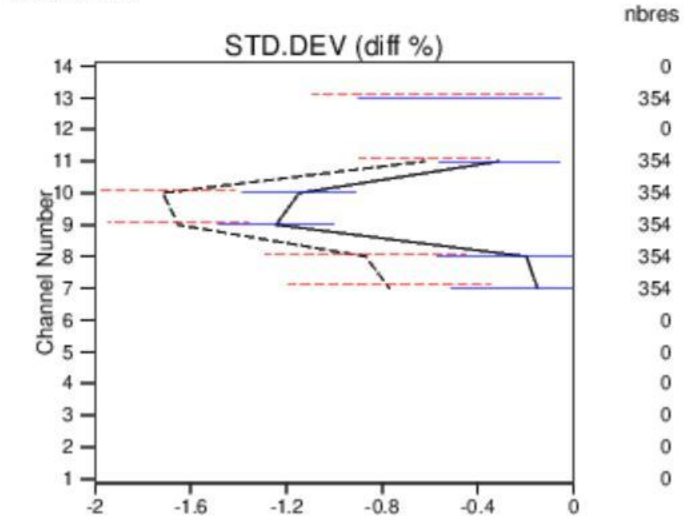


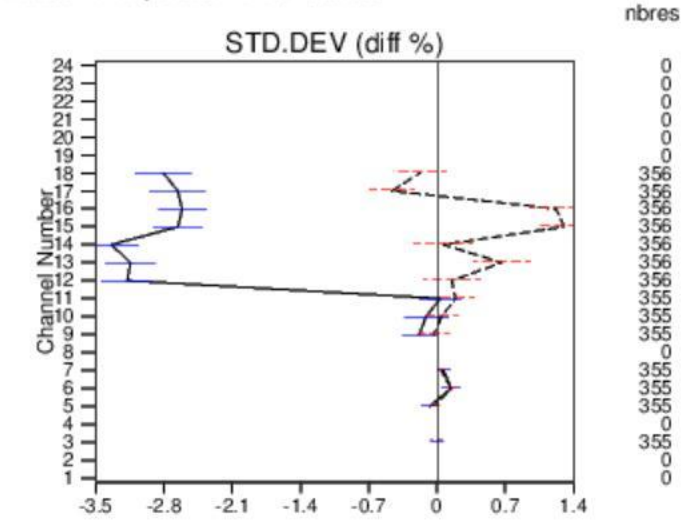


• 4. Assimilation of MWRI/FY-3D All-sky Data over Sea









Experiment period 2024060100-2024083118

Positive impacts on Humidity channels, humidity sounders, and imagers.

Mainly neutral for temperature channels and sounders

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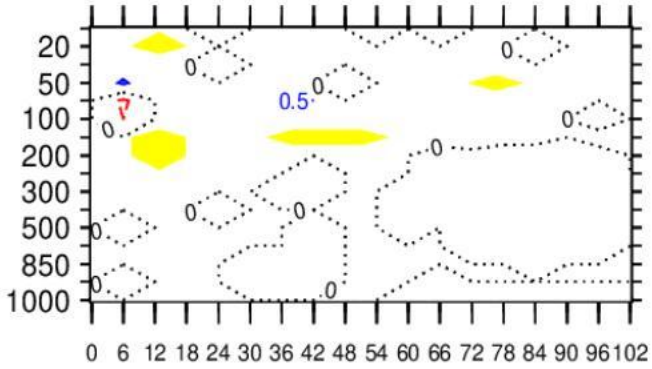
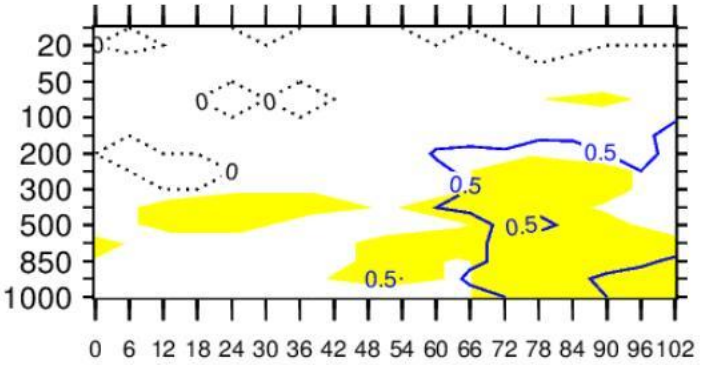
5.Forecasting Impacts of Assimilating MWRI/FY-3D All-sky Observations over Sea

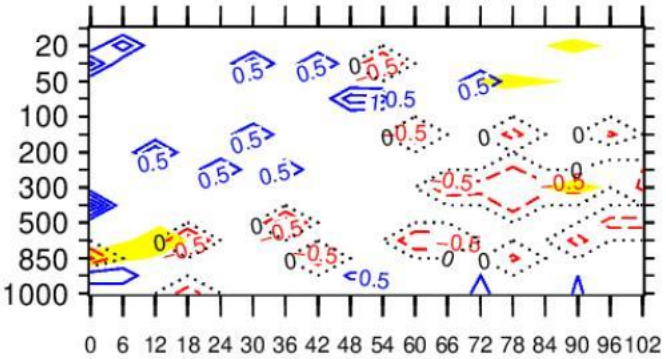
Summer wind forecast RMSE for NH

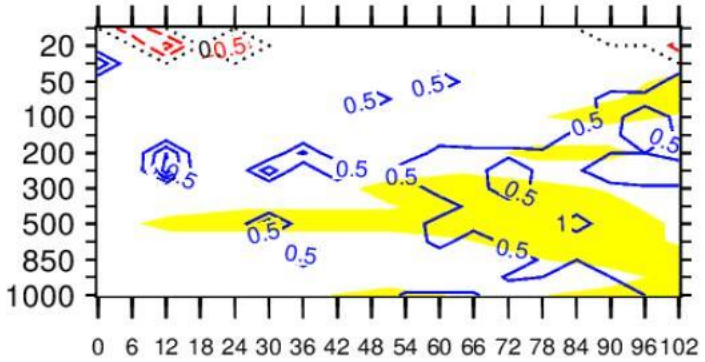


Winter wind forecast RMSE for NH



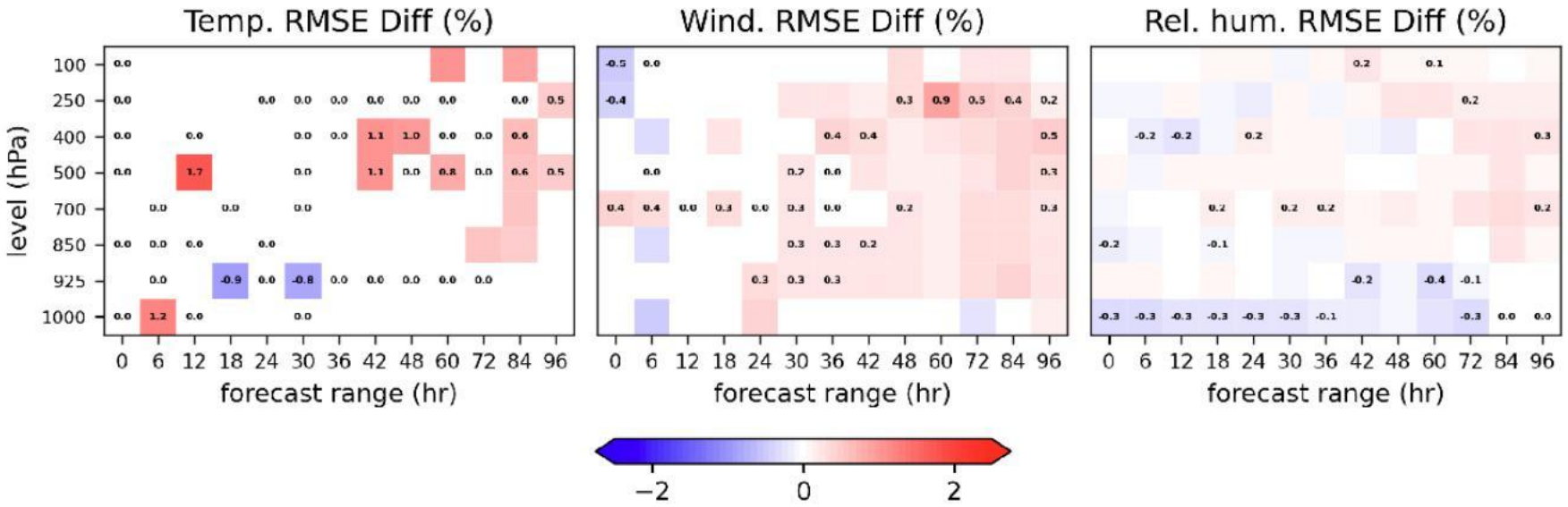
Refer to the Control Run





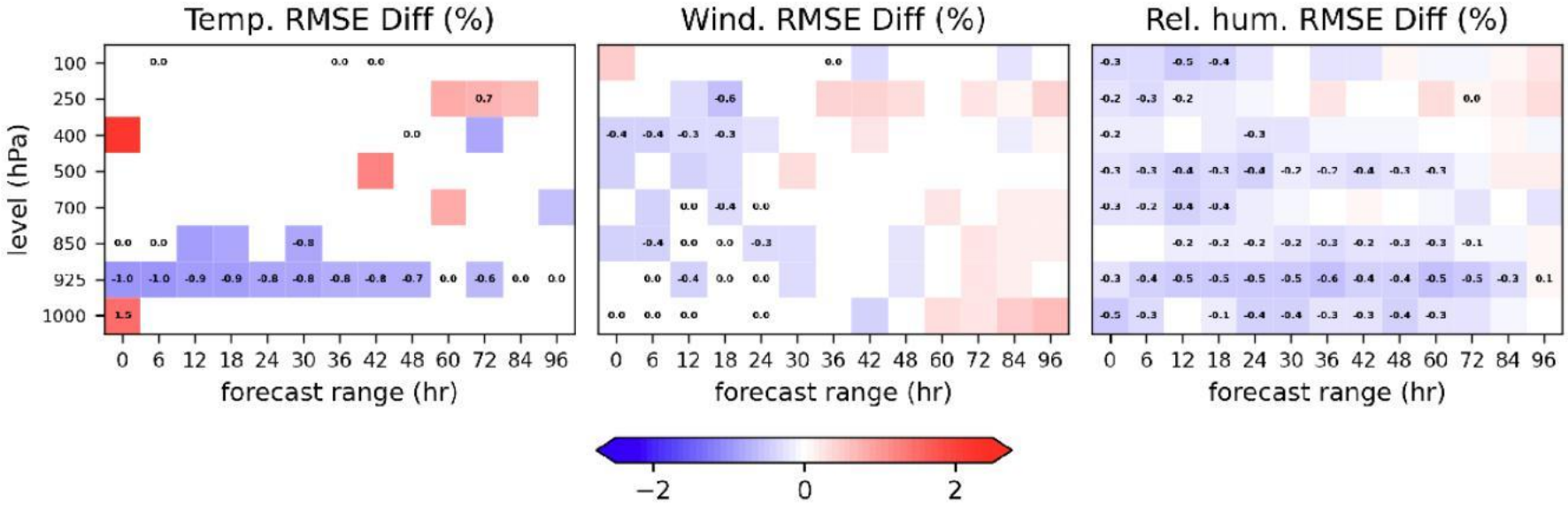
Summer Temperature forecast RMSE for NH

Winter Temperature forecast RMSE for NH



Forecast RMSE of SH at each levels of 'New Configuration' in summer

Forecast RMSE of SH at each levels of 'New Configuration' in winter



6. Channel Denial Experiments with MWRI assimilated in All-sky Stream

- Experiment Settings：

  Reference: Previous experiments with the updated configurations

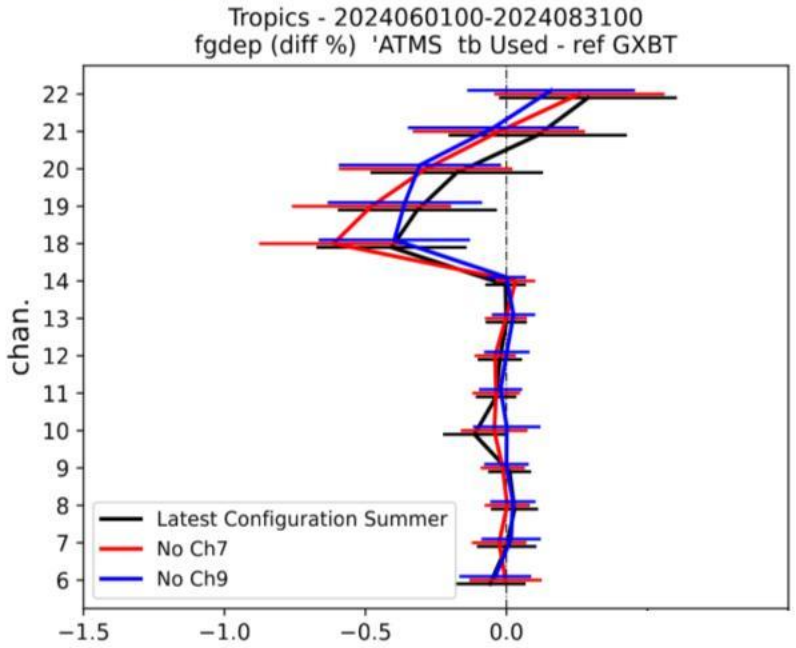
  ‘No Channel 3-4’ (remove 18.7GHz,V,H)

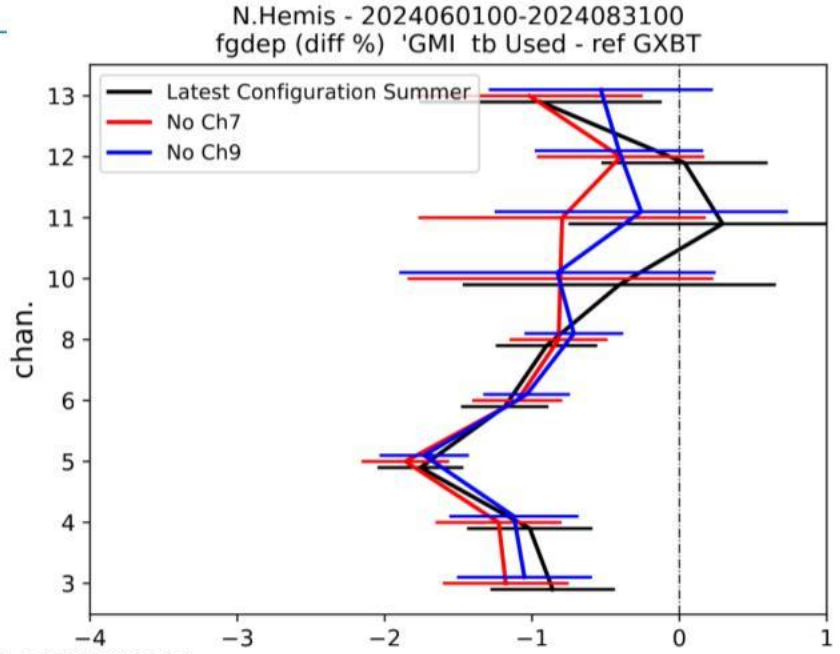
  ‘No Channel 5-6’ (remove 23.8GHz,V,H)

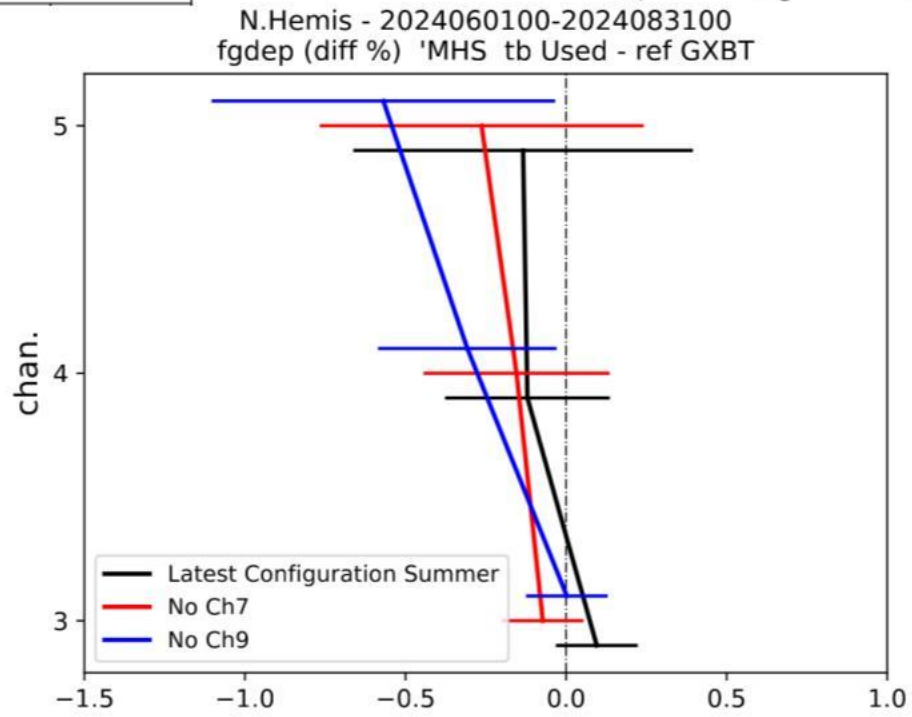
  ‘No Channel 7’ (remove 36.7GHz,V)

  ‘No Channel 9’ (remove 89GHz,V)

1) Assimilating Impacts

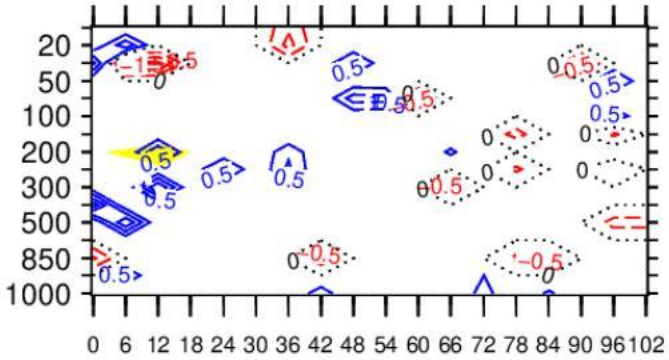




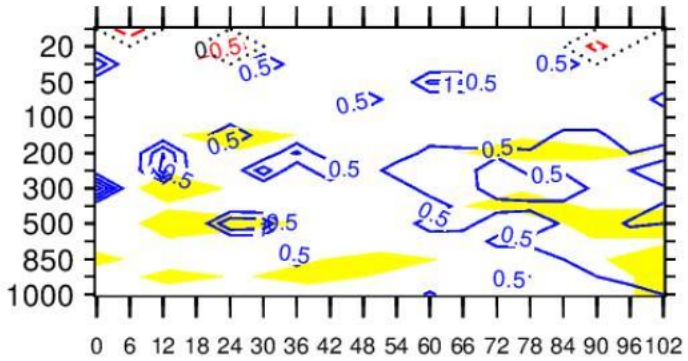


2) Forecasting Impacts

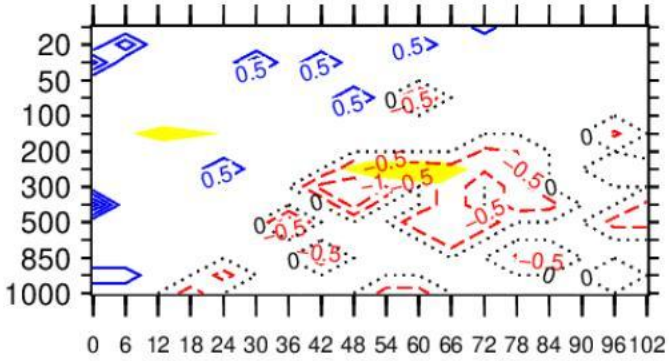
Summer Temperature forecast
RMSE for NH in 'No Channel 7'



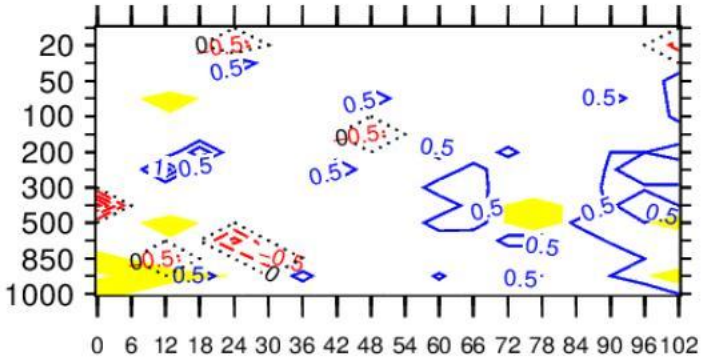
Winter Temperature forecast
RMSE for NH in 'No Channel 7'



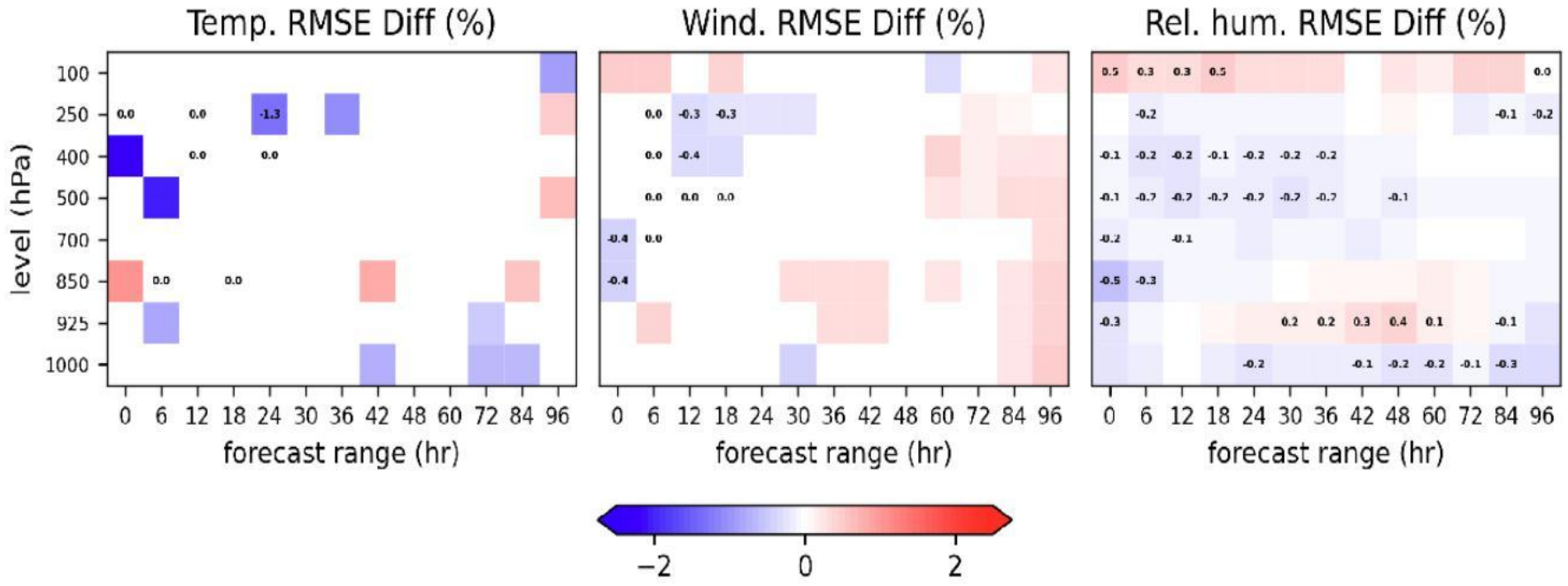
Refer to the Control Run



Summer Temperature forecast
RMSE for NH in 'No Channel 9'

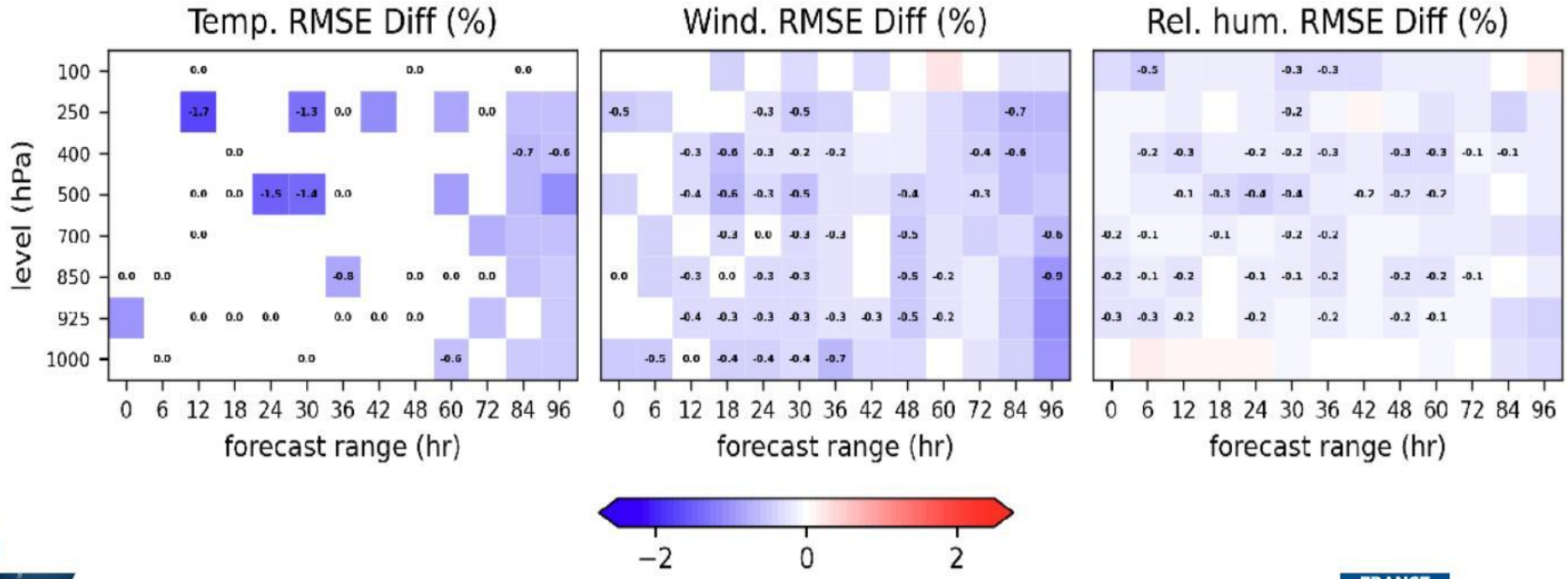


Winter Temperature forecast
RMSE for NH in 'No Channel 9'



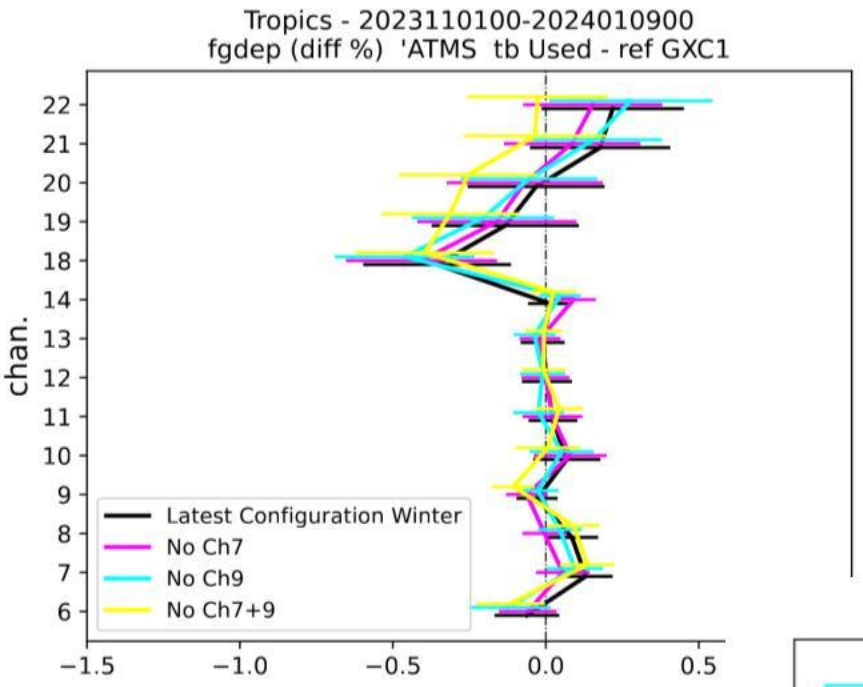
Forecast RMSE of NH at each levels of 'No Channel 7' in summer

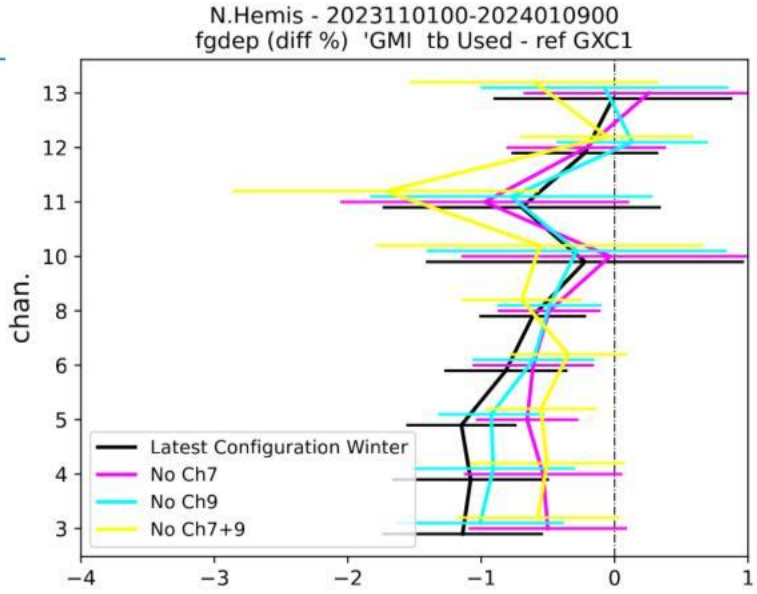
Forecast RMSE of NH at each levels of 'No Channel 7' in winter

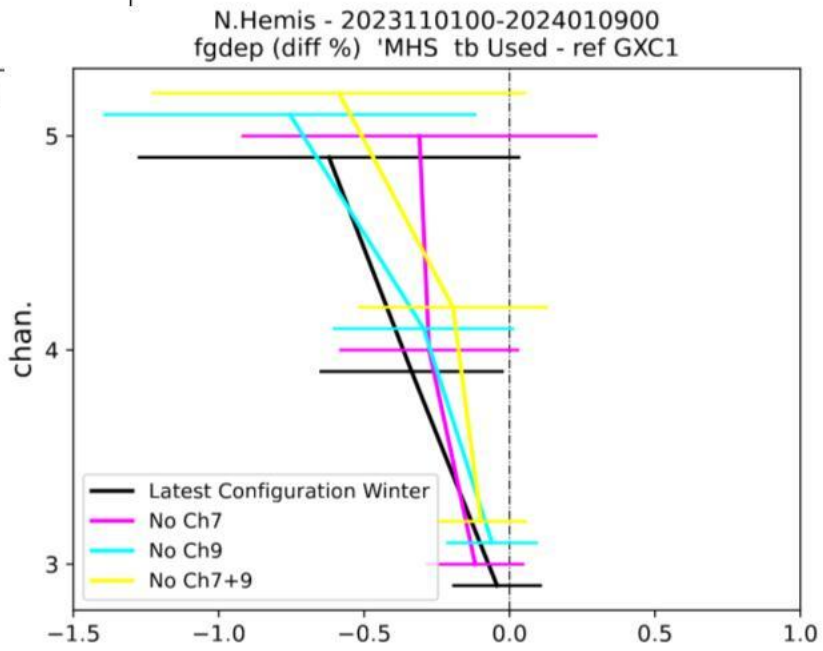


3) Overlaid impacts?

‘No Channel 7+9’ (remove 36.7GHz,V + 89GHz,V)



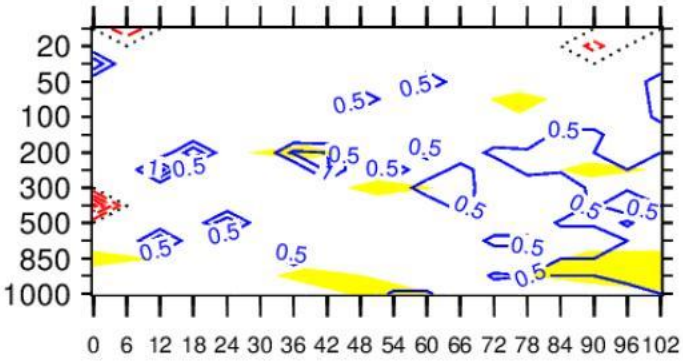




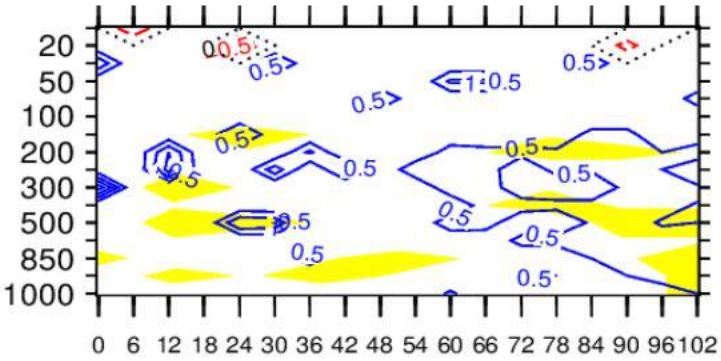
Assimilating Impacts

Forecasting Impacts

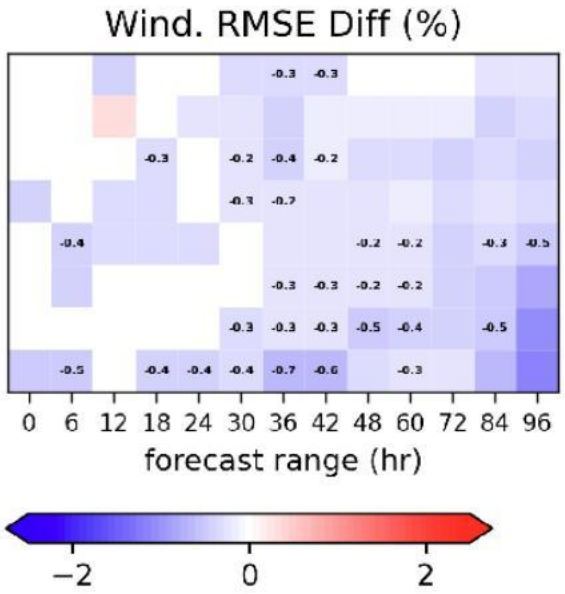
Winter temperature forecast RMSE for NH in 'No Channel 7+9'



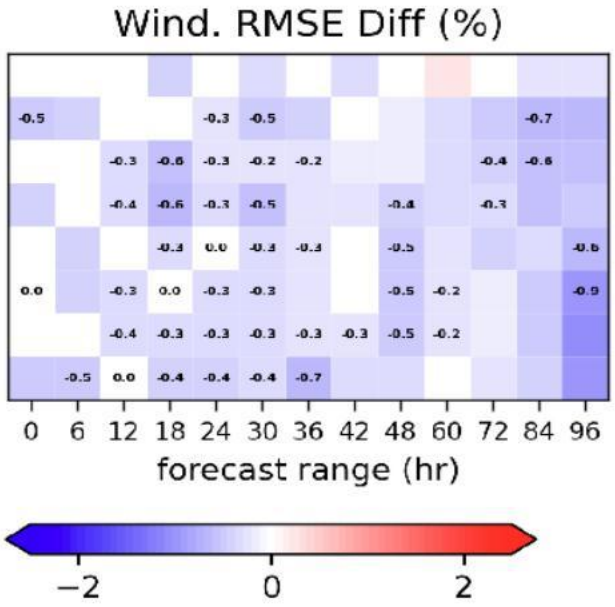
Winter temperature forecast RMSE for NH in 'No Channel 7'



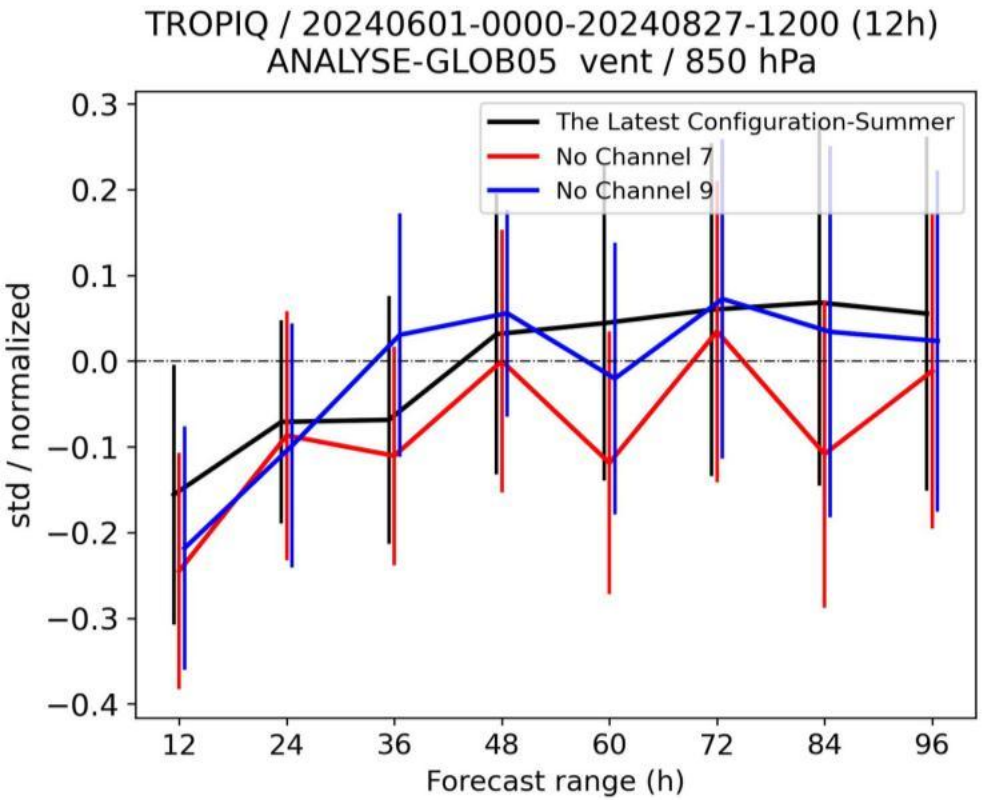
Wind Forecast RMSE of NH at each levels of 'No Channel 7+9' in winter



Wind Forecast RMSE of NH at each levels of 'No Channel 7' in winter

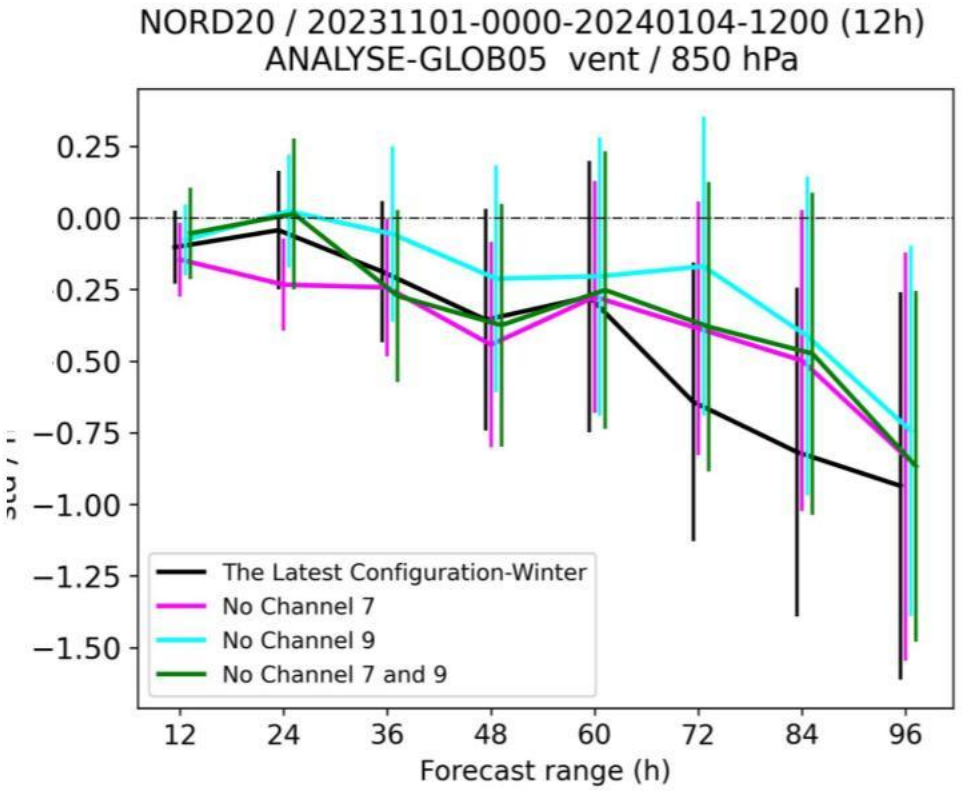


Forecasting Impacts



Overlaid summer wind forecast RMSE in Tropics at 850hPa

Overlaid winter wind forecast RMSE in NH at 850hPa



7. Conclusions and Discussion

- 1.MWRI obs have positive and negative fg before bias correction.In winter,the OMBs of MWRI/AMSR-2 fluctuate more with time than that in summer before and after bias correction.

- 2. With similar mask settings with AMSR-2 and optimized observation error model, positive impacts are mainly displayed for humidity sounders, humidity channels and imagers, while quite neutral impacts are found for temperature sounders and temperature channels.

- 3. As for forecasting scores, the RMSE statistical results of the forecasting errors for physical variables such as temperature and vector winds are reduced more significantly in winter than that in summer.

- 4. 'No Channel 7' experiments shows that it benefits the best for assimilation and forecast in both summer and winter and the seasonal changes of forecasts are efficiently reduced to a certain extent with the observations of channel 7 being removed.

- 5. Considering that only 5 channels MWRI obervations are assimilated in 'No Channel 7' run, significant assimilating and forecasting impacts are achieved, therefore, the configuration in these experiment settings could be selected for the operational use.

- 6. this study can become very important reference for evaluating MWRI-2 onboard Fengyun-3F,which will have 118 GHz channels for the first time in an imager of a polar satellite.

谢谢各位前辈及同行批评指正~~~