Common Plots Activity
...model errors

Meeting 21.01.2025

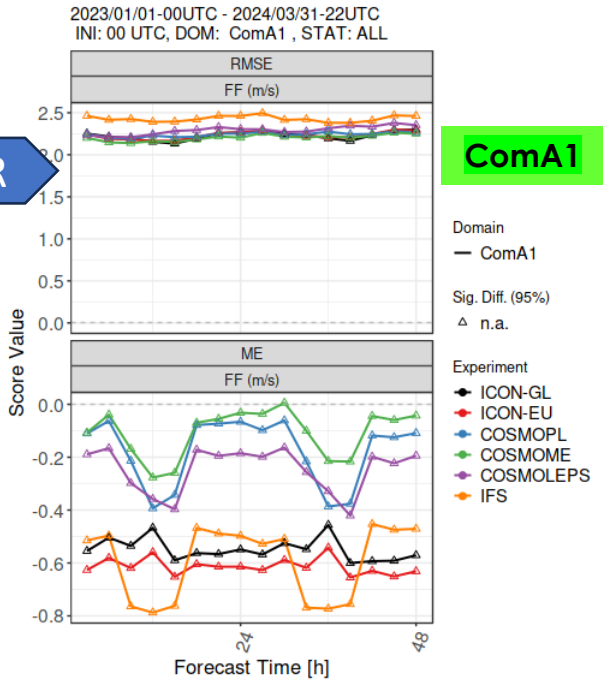
F. Gofa, S. Gabrian, S. Dinicila, N. Vela, F. Fundel, J. Linkowka, A.Mazur, F. Batignani, P. Kaufman, A.Pauling, D. Boucouvala, M.S.Tesini, E. Minguzzi, and more

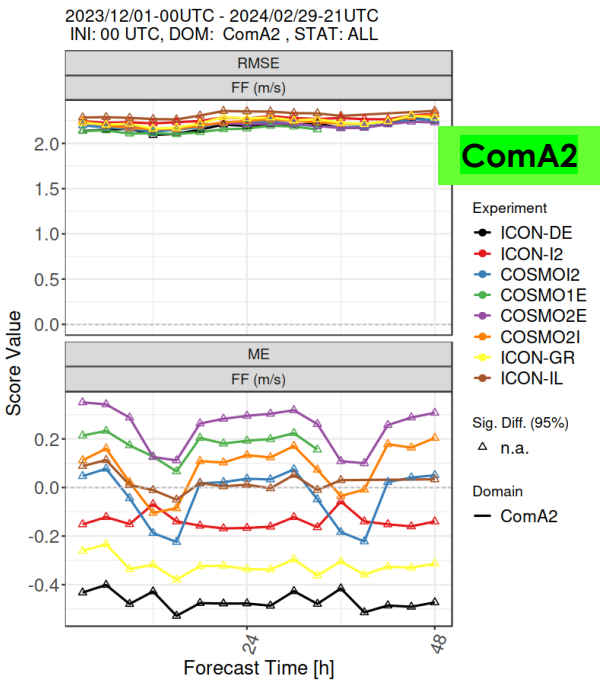
Wind speed

WINTER

Driving models: No significant differences in RMSE range (except IFS). Underestimation in ALL models (winter) more evident with ICON/IFS

HighRes LAM: No differences in RMSE variability among models. Underestimation mainly from ICON-LAMs

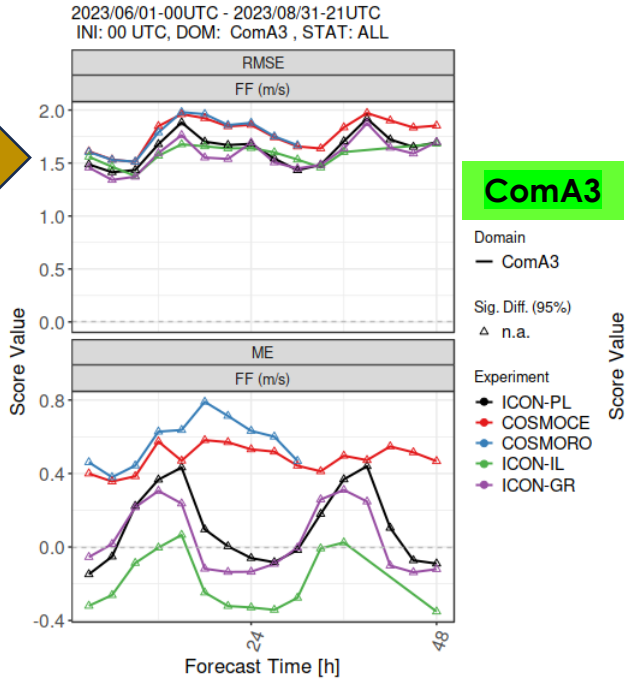


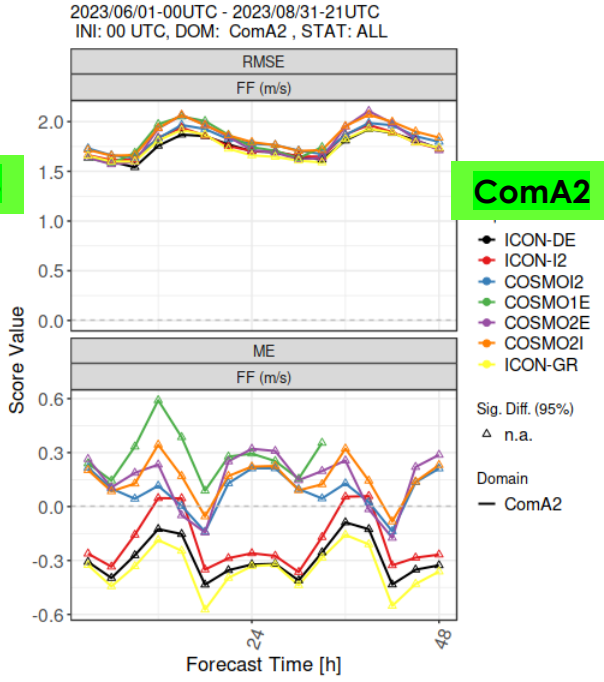


SUMMER

SysEr: Larger error cycle in **summer**

ModDp: **negative bias** in all seasons with max during nighttime in **ICON** models for both seasons, positive bias of **COSMO** models

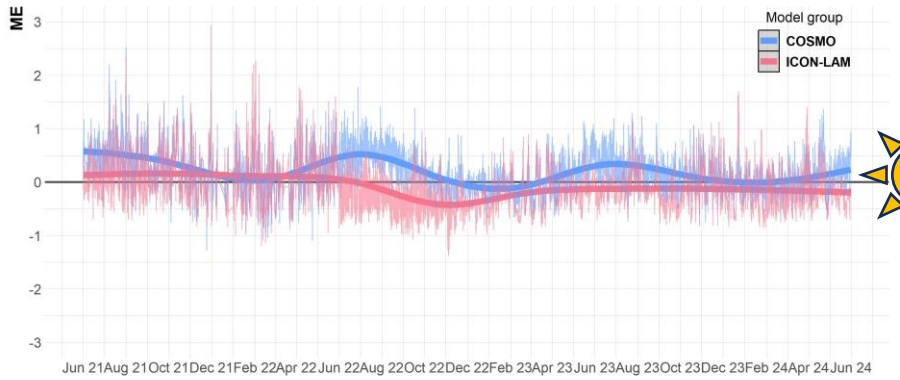




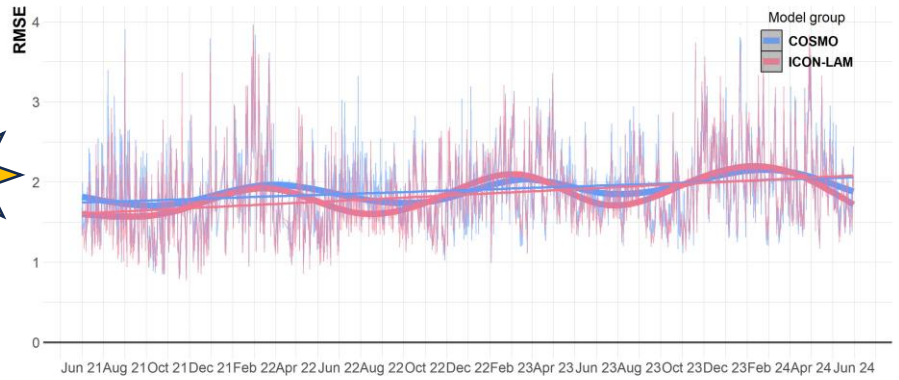
WindSp @12+24UTC: all COSMO/ICON ComA2, 2021-2024

Factorial timeseries linked to ME and RMSE, thicker lines represent the smoothed average. Used: geom_smooth() that adds a regression line to a plot, and it uses a loess smooth when there are fewer than 1000 observations, and a GAM when there are more.

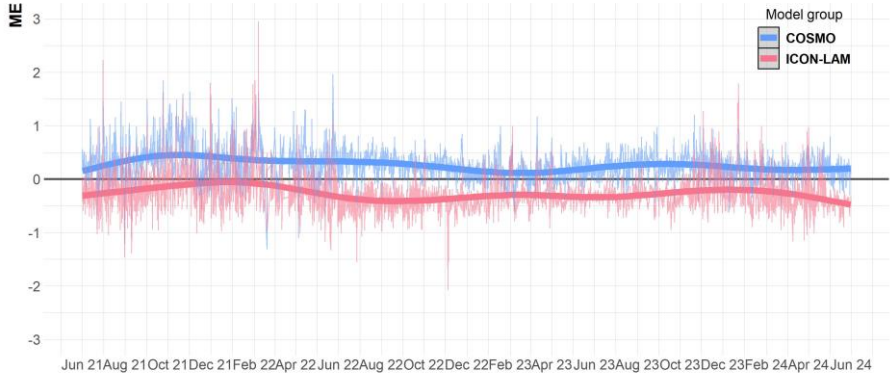
Mean Error



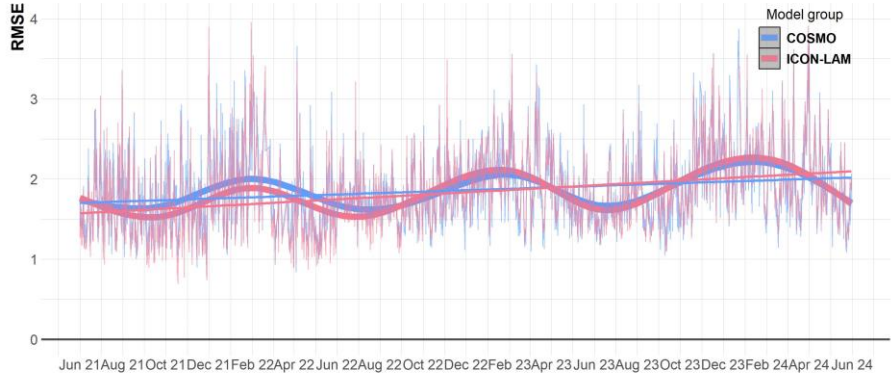
RMSE



Mean Error



RMSE



Not clear change in performance with wind speed , tendency to underestimate mainly at night

2m Temp

WINTER

Driving models: ICON error smaller than COSMO+IFS, less evident diurnal cycle in ME, overestimation (winter)
HighRes LAM: consistency in performance among CA regions

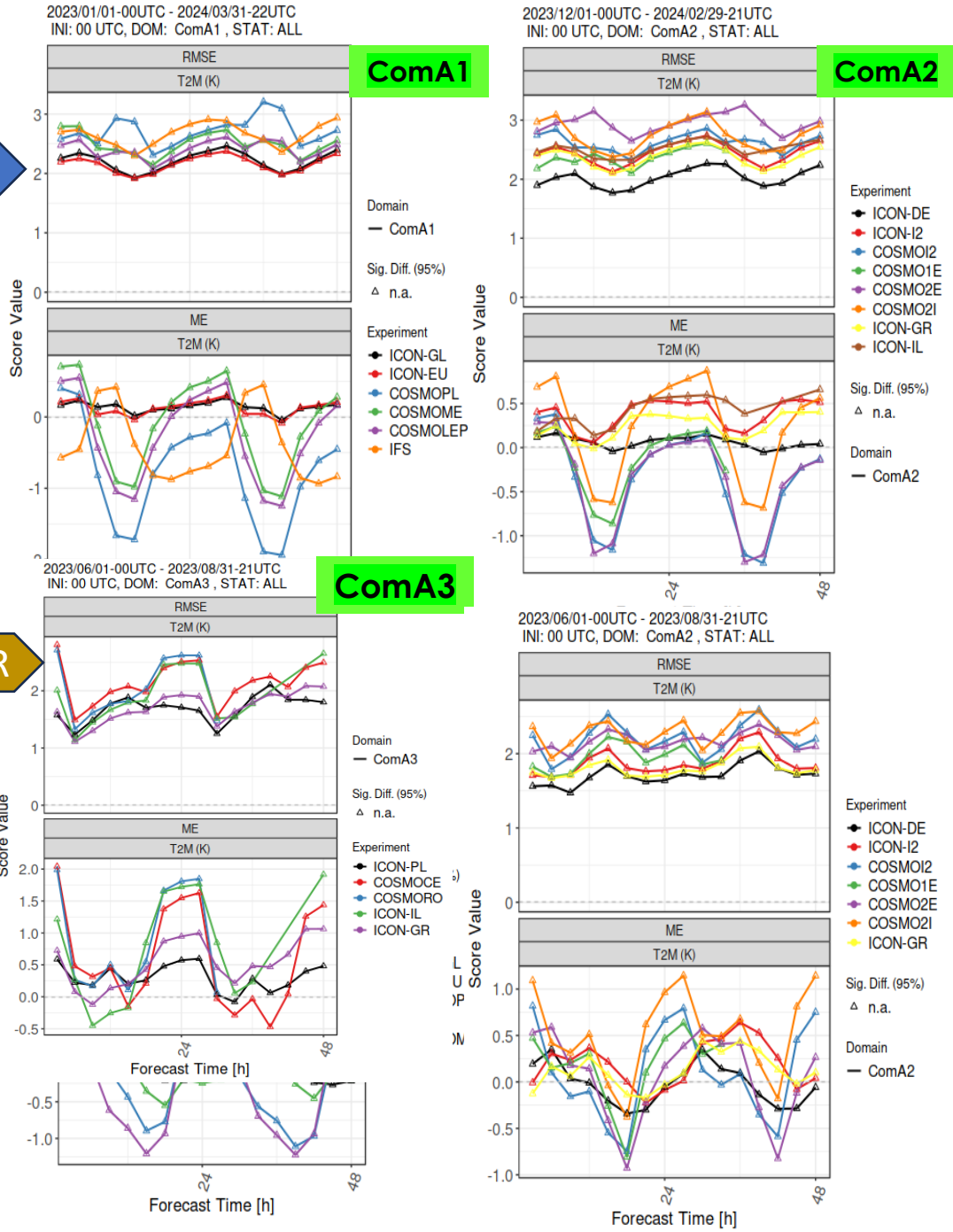
SysEr: Diurnal cycle (DC) of **RMSE** is present in <u>all models.</u>
<u>Large</u> Errors from **initialization** of run.
Reduced **RMSE DC** with ICON models **especially reduction in BIAS DC (black+red+yellow).**

SUMMER

SysEr: **Larger error** of 2mT at **night** and early morning in **winter** and at **midday** in the **summer**.

SysEr: Underestimation during **summer** warm hours. Overestimation during summer at night hour, but reduced with ICON

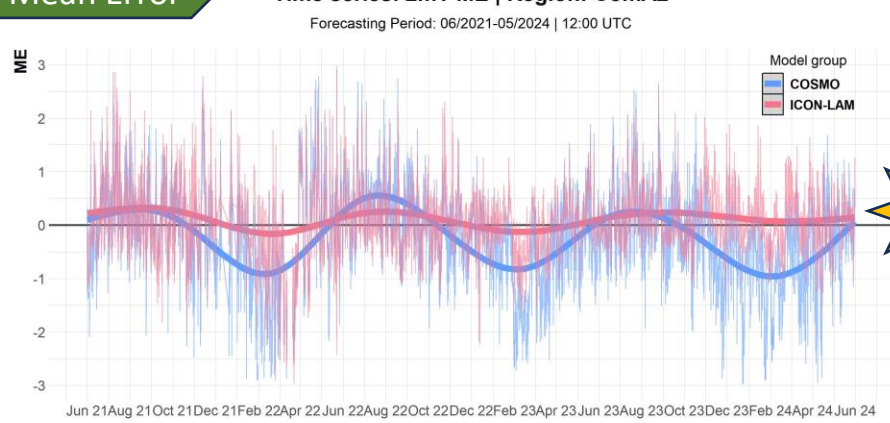
SysEr : Systematic
ModDp: Model dependant



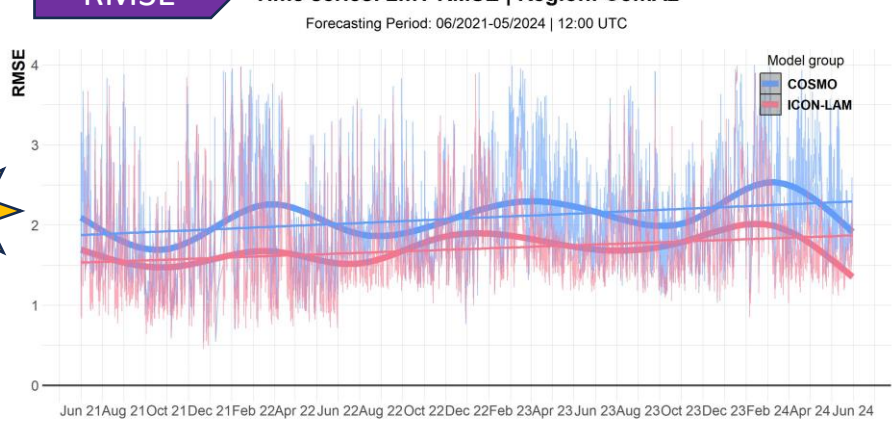
2mT @12+24UTC: all COSMO/ICON ComA2. 2021-2024

Factorial timeseries linked to ME and RMSE, thicker lines represent the smoothed average. Used: geom_smooth() that adds a regression line to a plot, and it uses a loess smooth when there are fewer than 1000 observations, and a GAM when there are more.

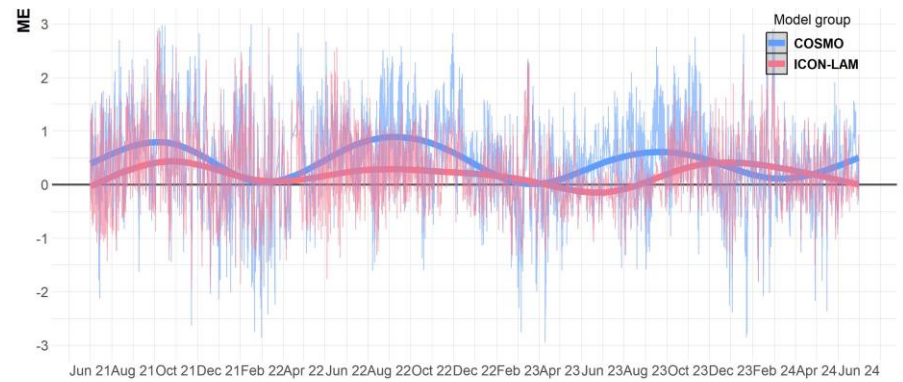
Mean Error



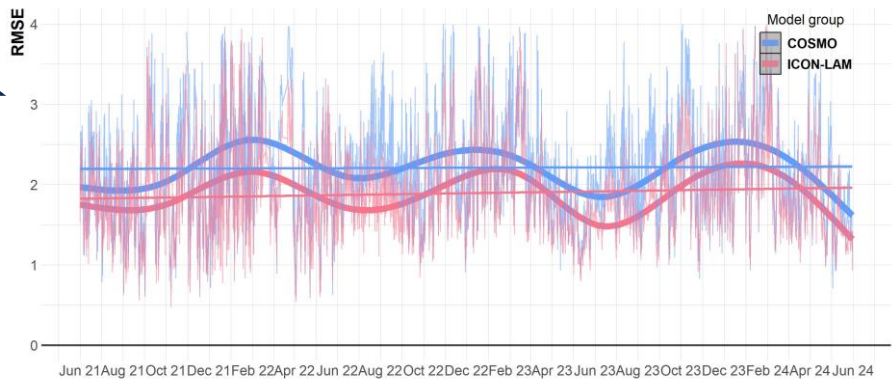
RMSE



Mean Error



RMSE



ICON tendency to underestimate mainly in the winter night hours, much less than COSMO that understimates at noon and overestimates at night (diurnal cycle minimized)

CONSORTIUM FOR SMALL SCALE MODELING COSMO

ΕΘΝΙΚΗ ΜΕΤΕΩΡΟΛΟΓΙΚΗ ΥΠΗΡΕΣΙΑ

Cloud Cover

SysEr : Large errors (2.5-3oct) **winter**, **larger** errors in **summer** (up to 4 oct)

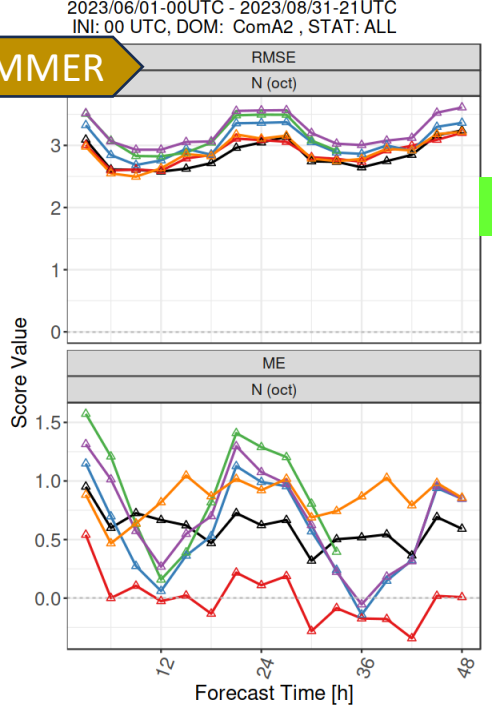
SysEr : Higher errors during **nighttime** for all models

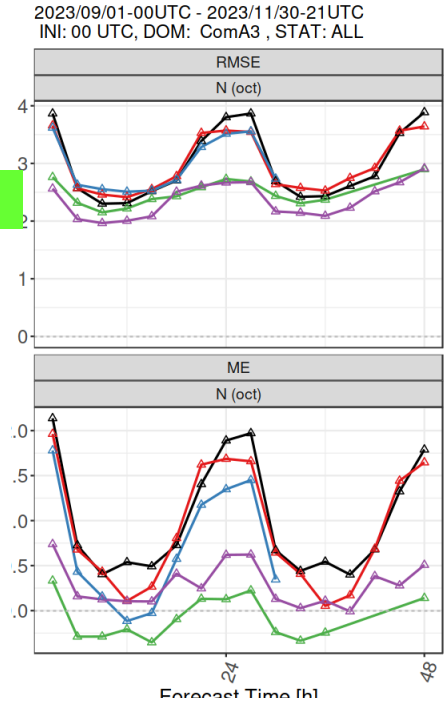
SysEr : TCC performance in **winter** is similar but improved with ICON especially w.r.t. to the **overestimation at night**.

ModDp : Higher **underestimation in warm hours** of the day with ICON in **winter**

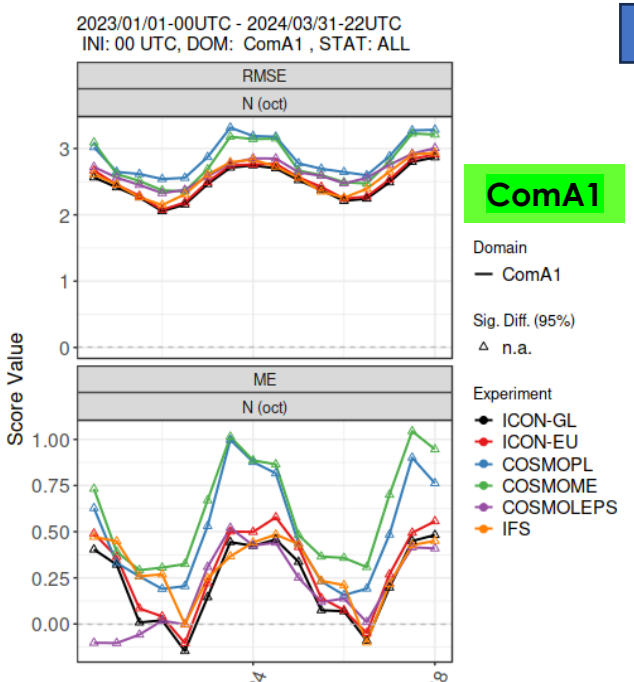
ModDp : In the **summer** larger variability of ME and min/max among models

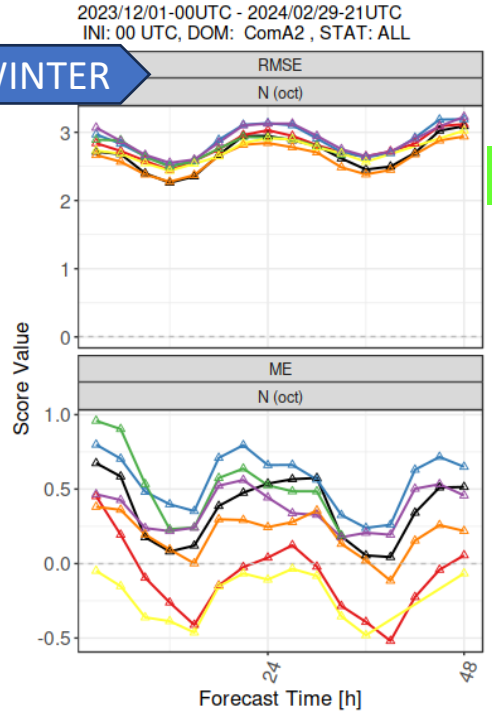
SUMMER

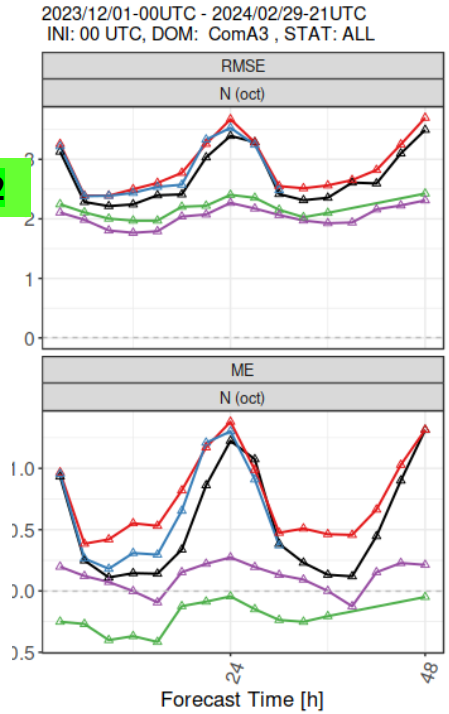




WINTER





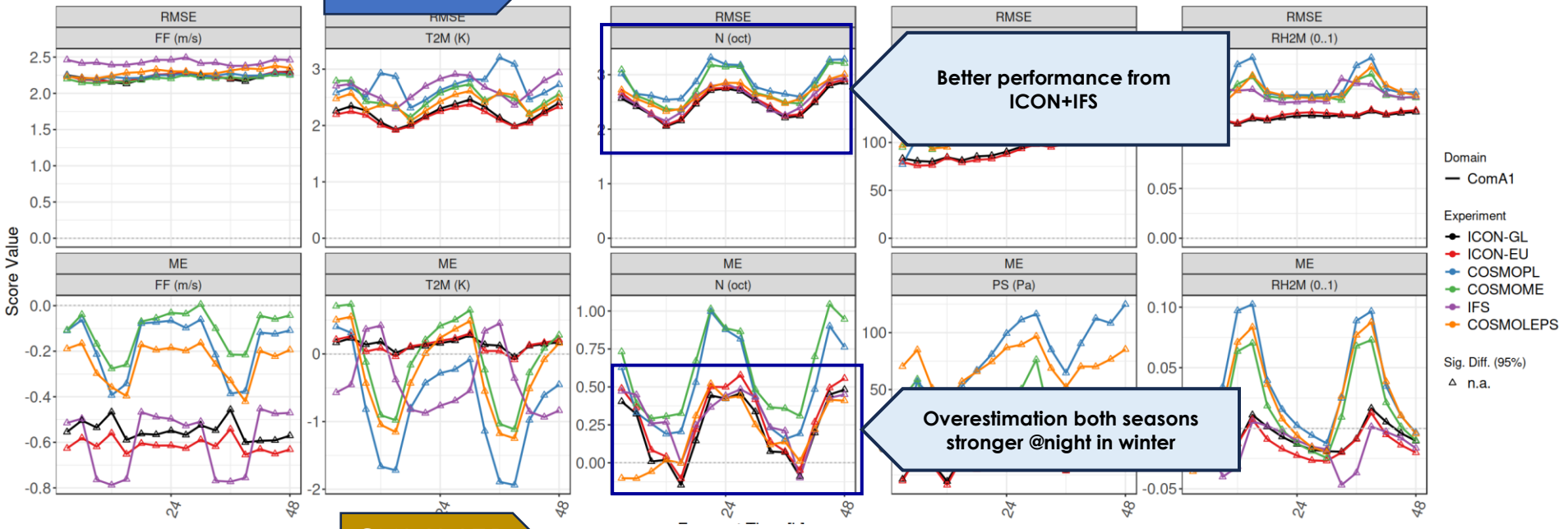


Driving Models

Cloud Cover

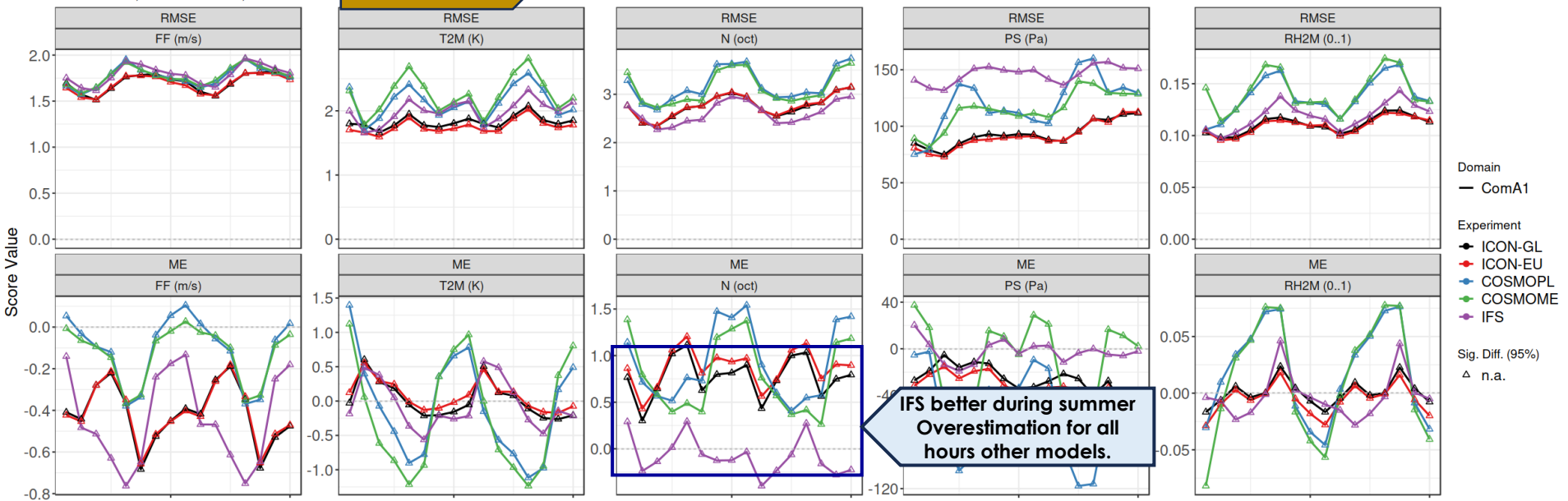
2023/01/01-00UTC - 2024/03/31-22UTC
INI: 00 UTC, DOM: ComA1 , STAT: ALL

WINTER



2023/06/01-00UTC - 2023/09/15-21UTC
INI: 00 UTC, DOM: ComA1 , STAT: ALL

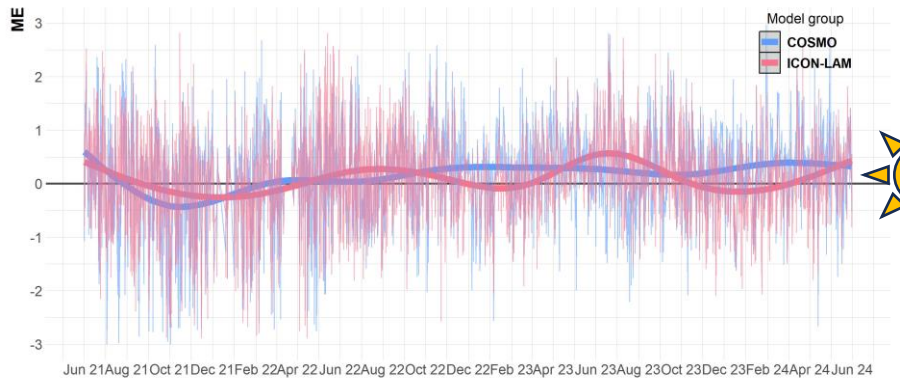
SUMMER



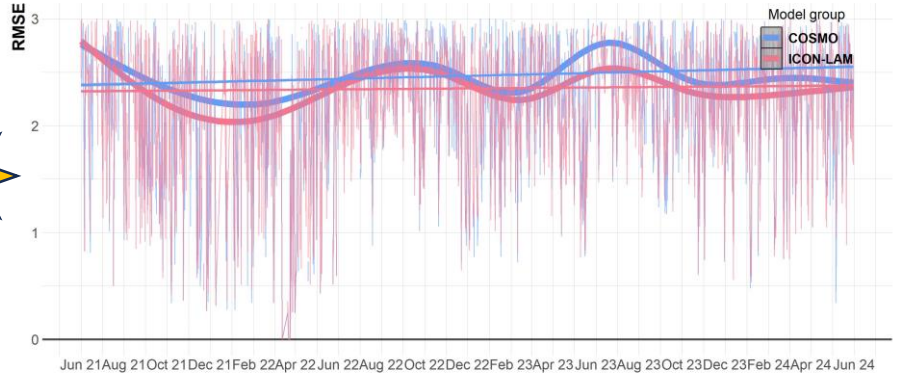
TCC @12+24UTC: all COSMO/ICON ComA2, 2021-2024

Factorial timeseries linked to ME and RMSE, thicker lines represent the smoothed average. Used: geom_smooth() that adds a regression line to a plot, and it uses a loess smooth when there are fewer than 1000 observations, and a GAM when there are more.

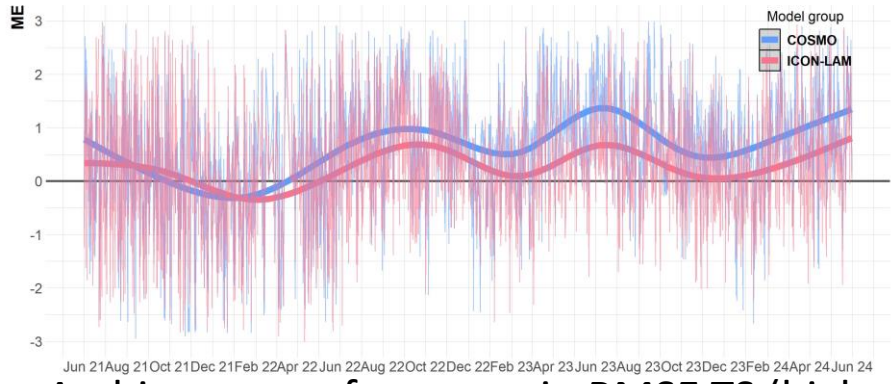
Mean Error



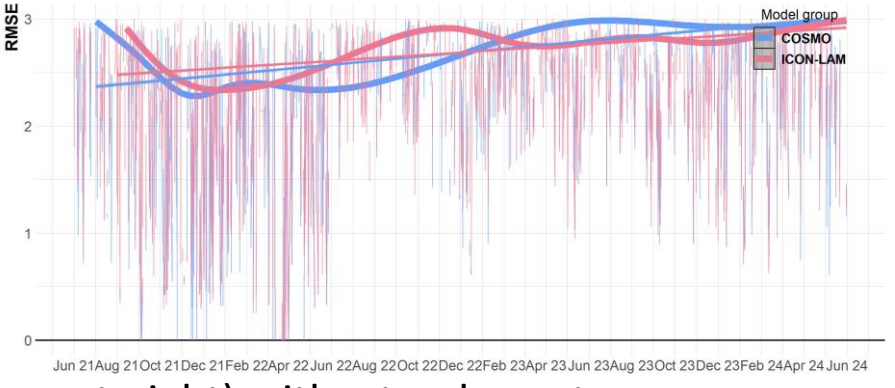
RMSE



Mean Error



RMSE



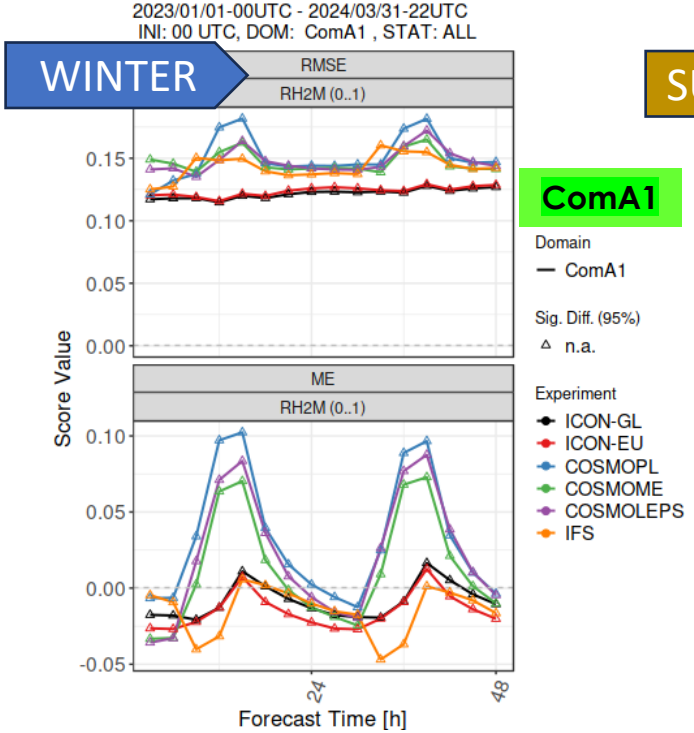
Ambiguous performance in RMSE TS (higher errors at night) with a tendency to overestimation during warm months night hours.

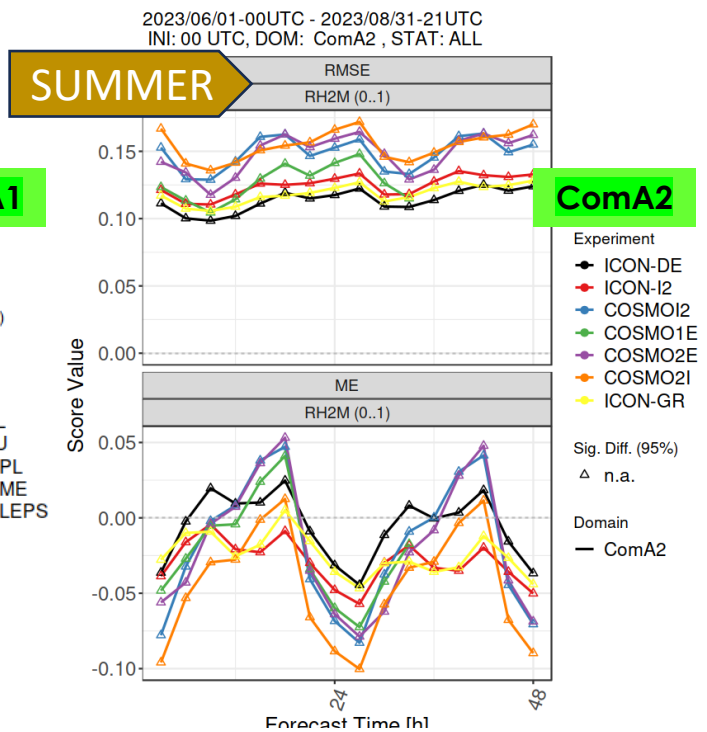
Humidity

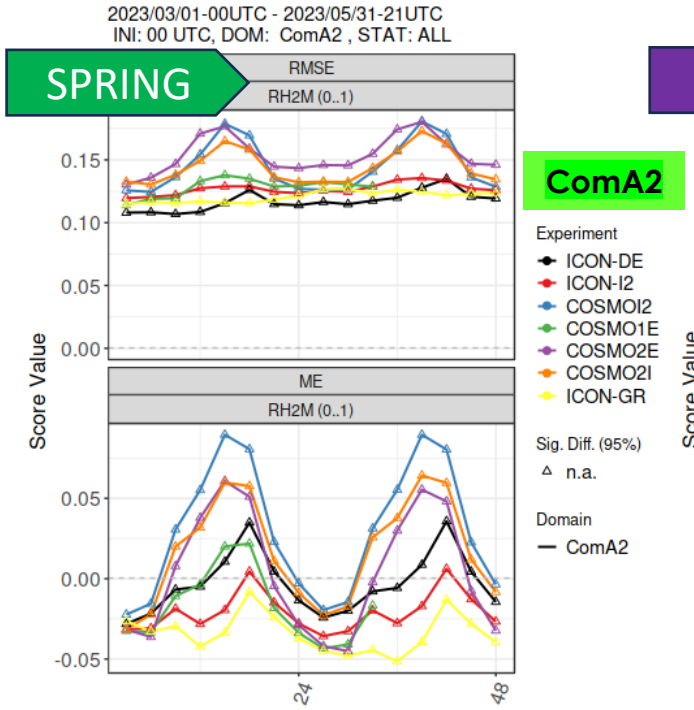
SysEr : RelHum and Td **BIAS diurnal cycle**, strongly reduced in ICON models.

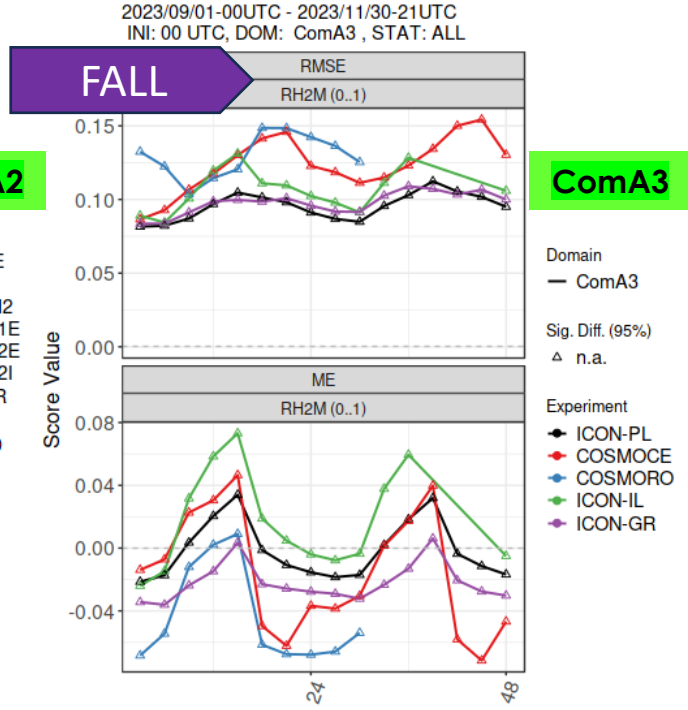
SysEr : **ICON** RMSE values are attributed to the **overestimation** during daylight hours and the **underestimation** at night during almost <u>all seasons</u>

SysEr : ICON models generally **drier especially in winter**



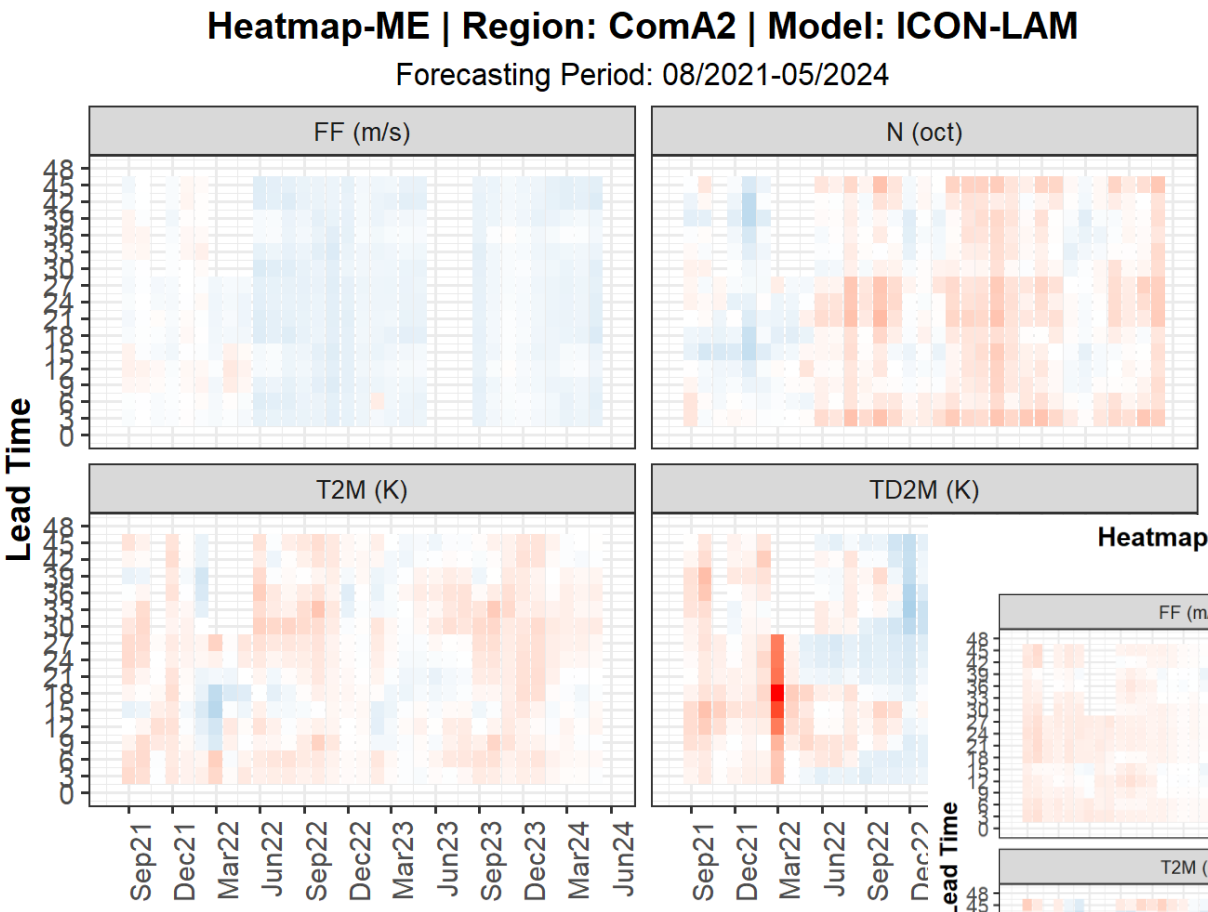






HeatMaps all ICON ComA2, 2021-2024

Mean Error

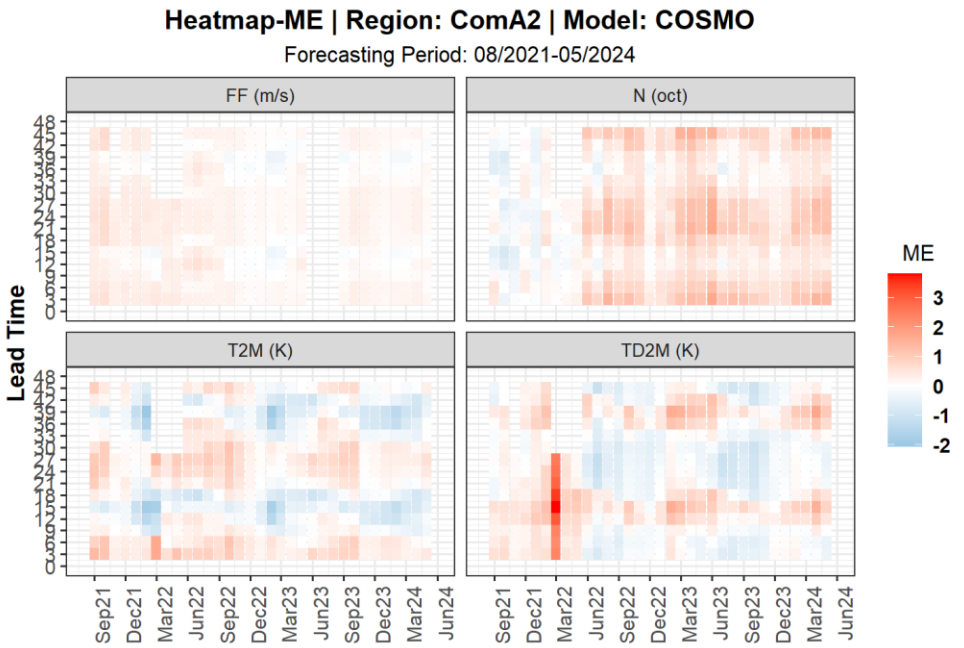


WSp: Slight but steady underestimation of ICON-LAM

2mT: Overestimation n warm months, underestimation in winter months midday.

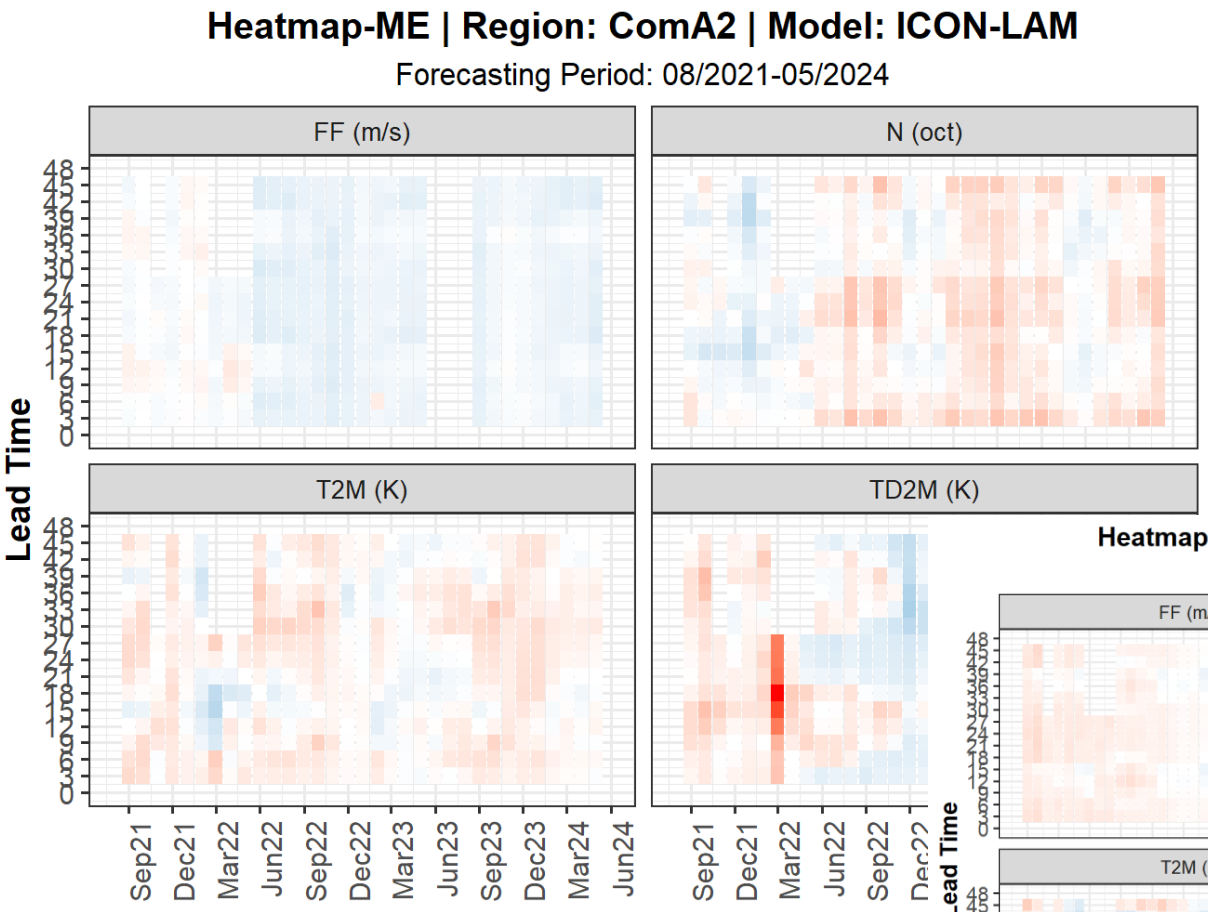
TCC: Manly overestimation at night and in warm months

2mTd: Underestimation mainly in winter and night hours.



HeatMaps all ICON ComA2, 2021-2024

Mean Error



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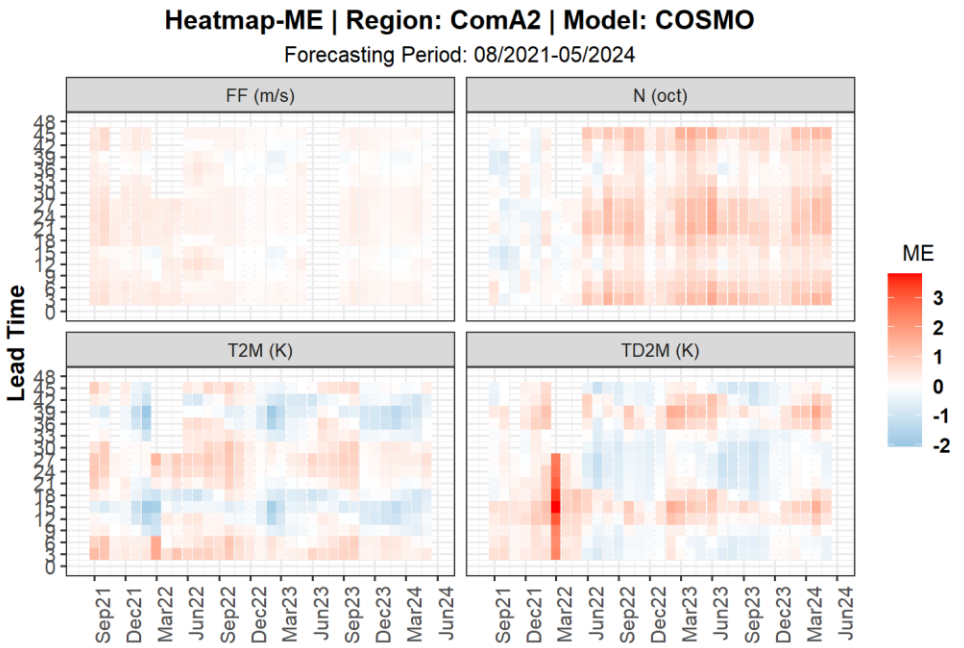
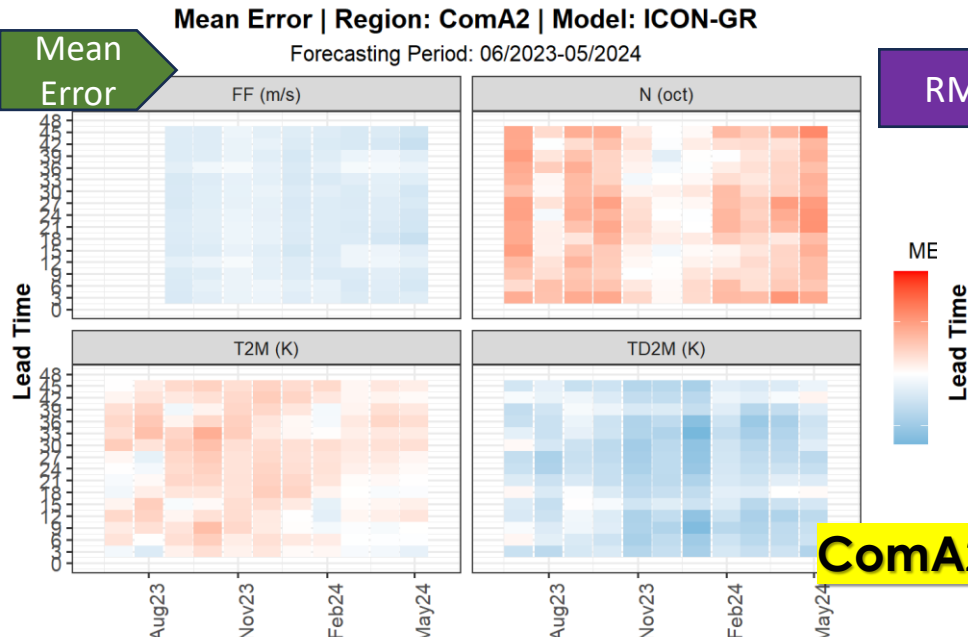
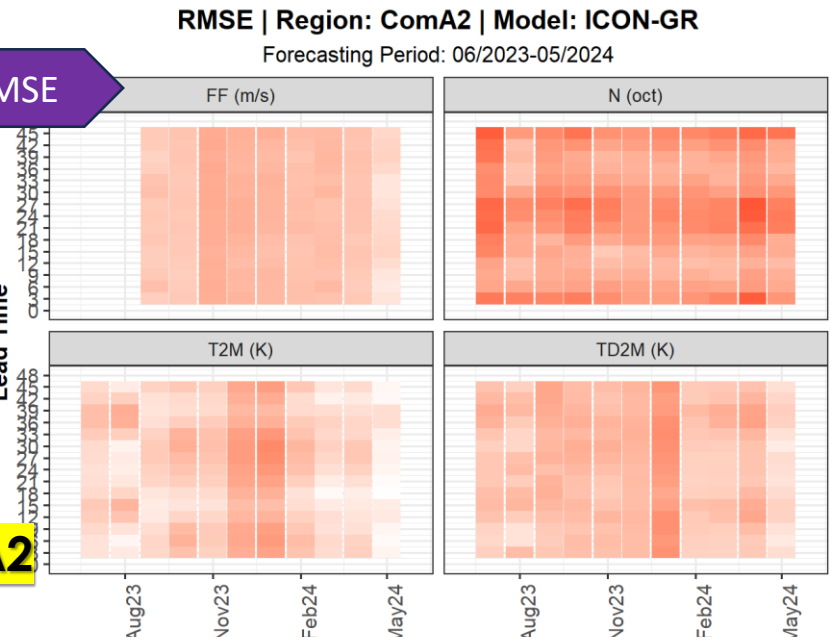


HeatMaps ICONGR ComA2#ComA3, 2023-2024

Mean Error



RMSE



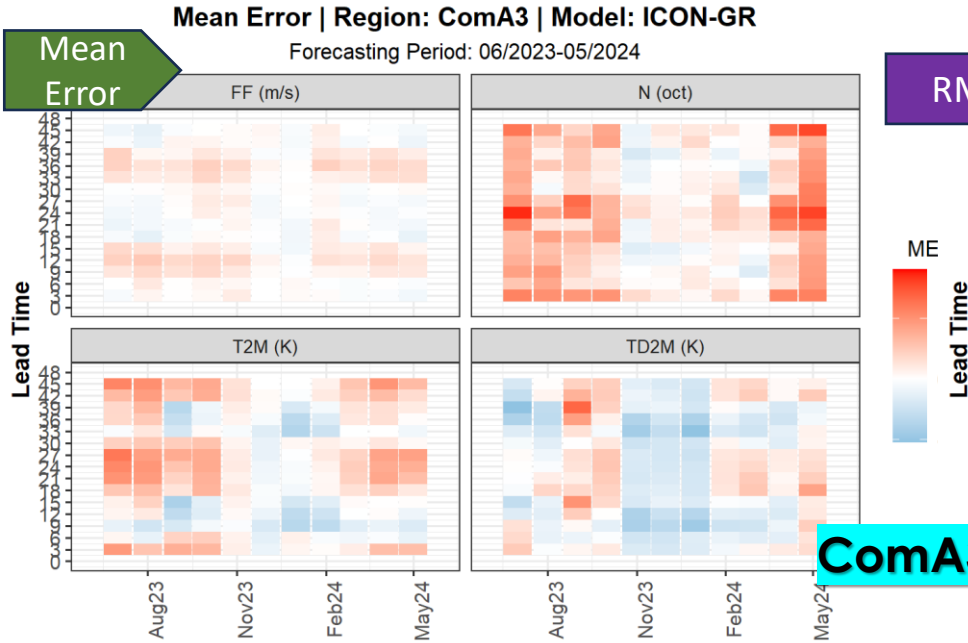
ME

RMSE

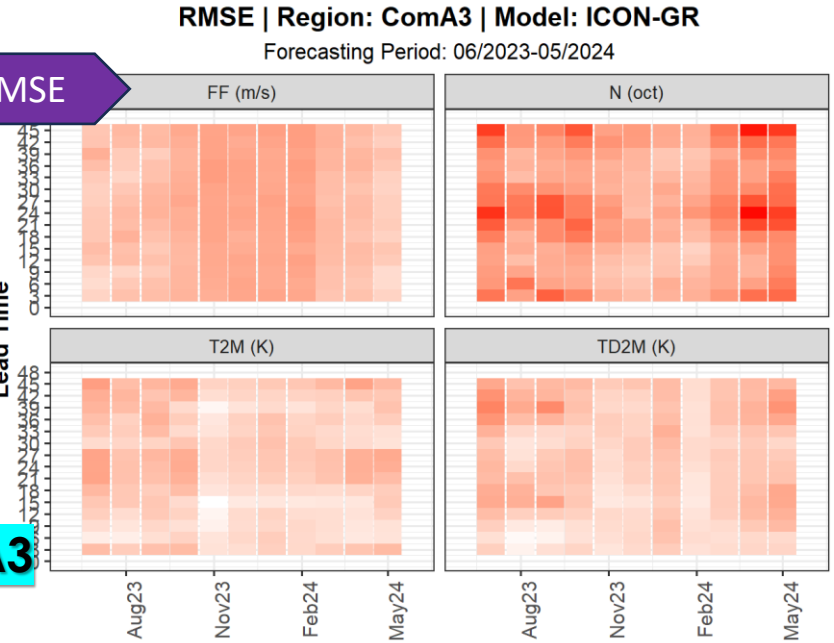
3.5
3.0
2.5
2.0
1.5

ComA2

Mean Error



RMSE



ME

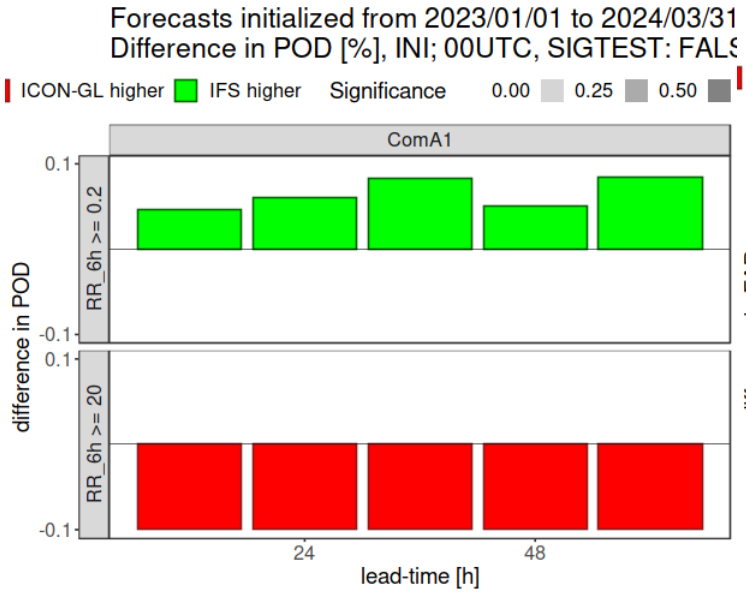
RMSE

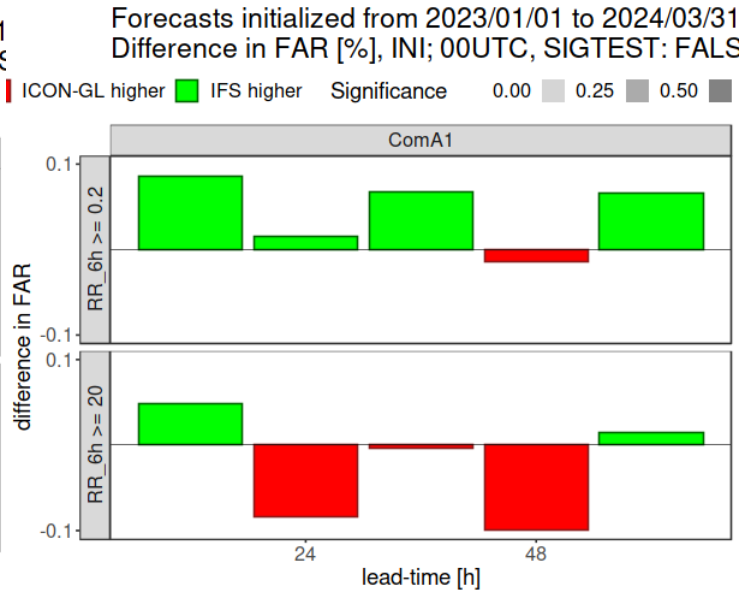
3.0
2.5
2.0
1.5
1.0

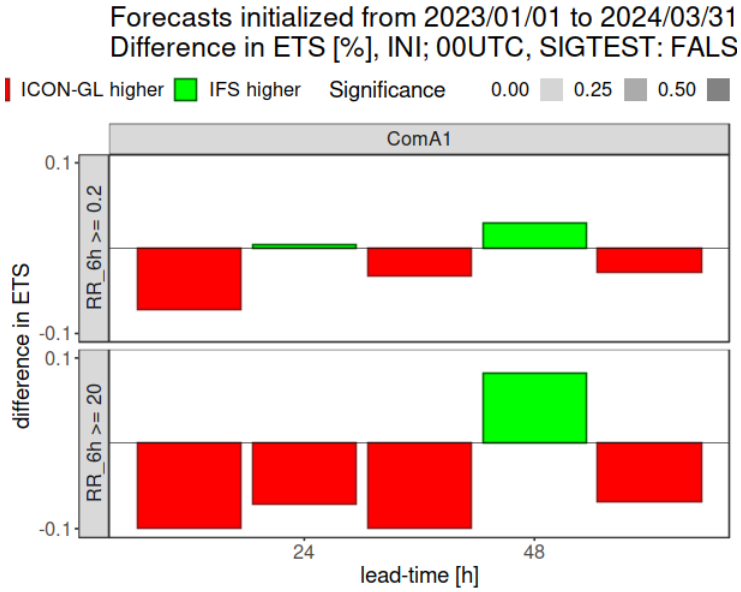
ComA3

Driving models IFS vs. ICON

WINTER





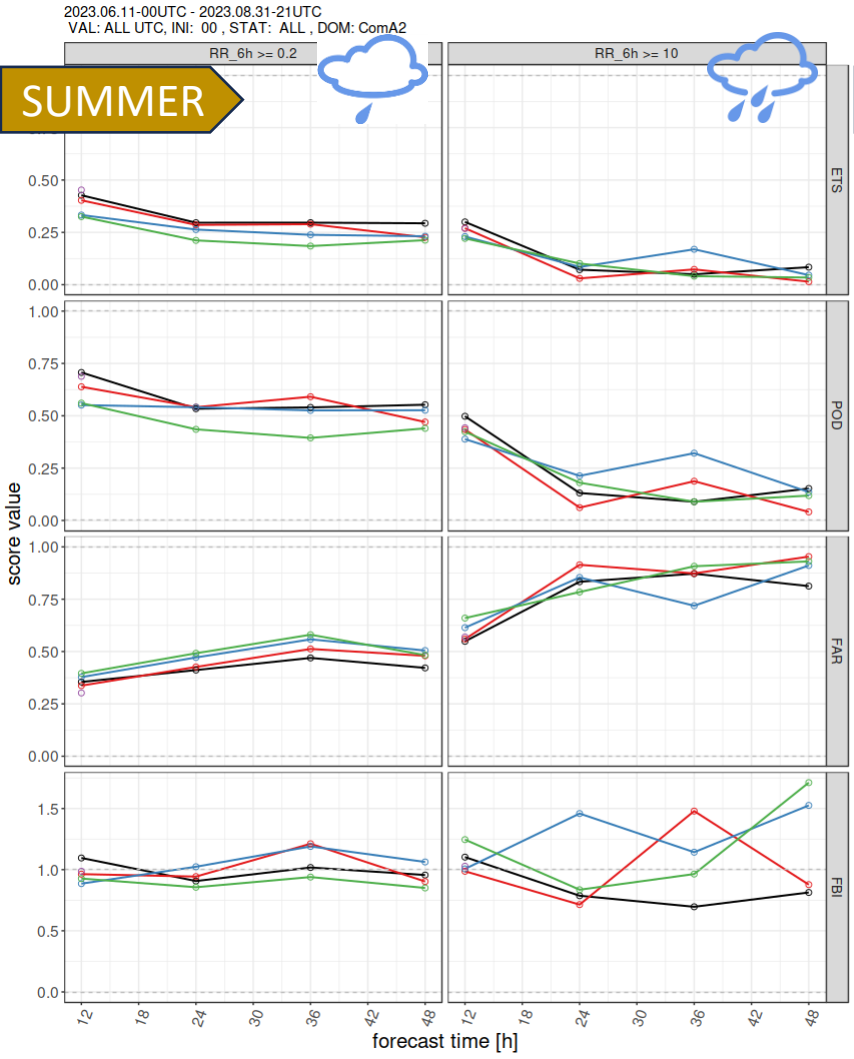


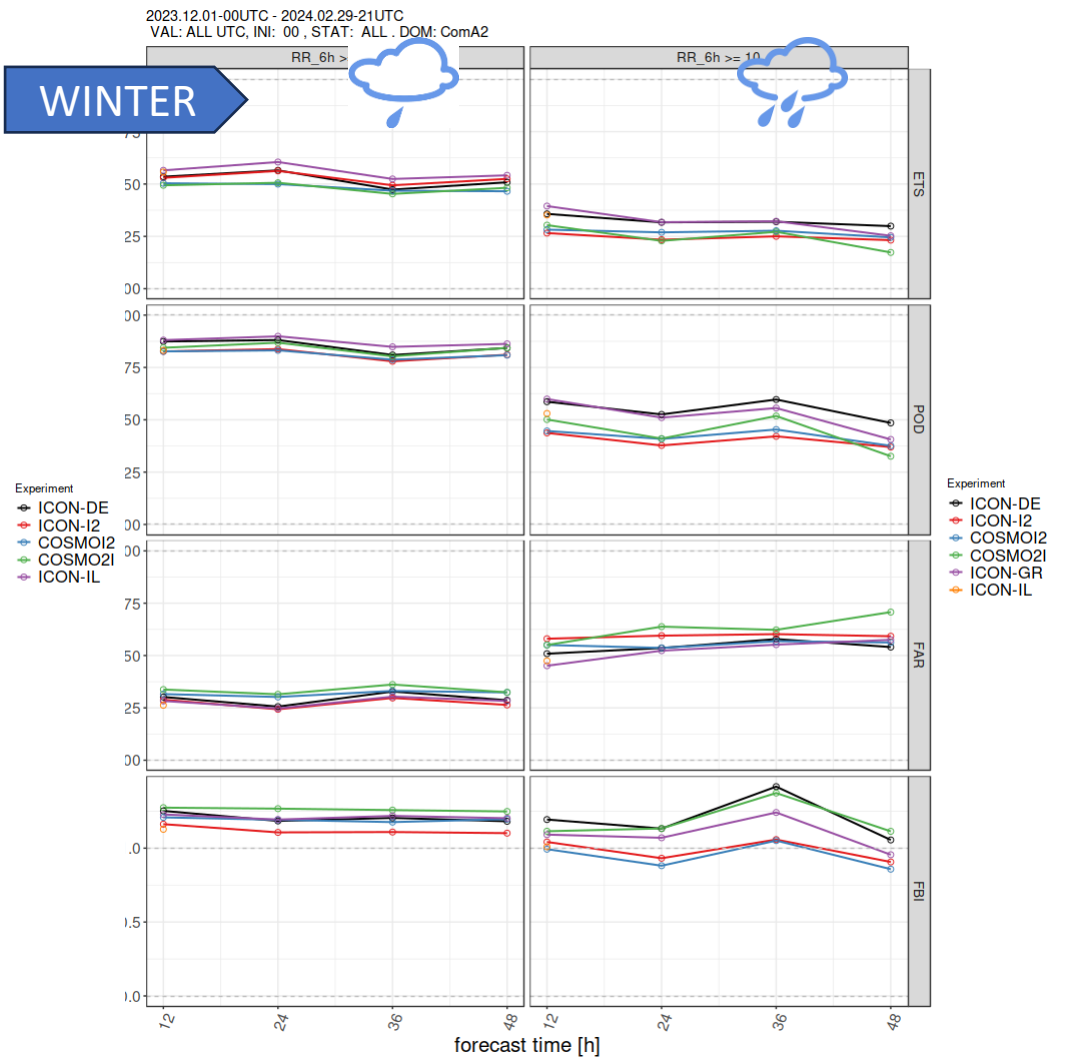
CONSORTIUM FOR SMALL SCALE MODELING COSMO

ΕΘΝΙΚΗ ΜΕΤΕΩΡΟΛΟΓΙΚΗ ΥΠΗΡΕΣΙΑ
HELLENIC NATIONAL METEOROLOGICAL SERVICE

COSMO/ICON ComA2

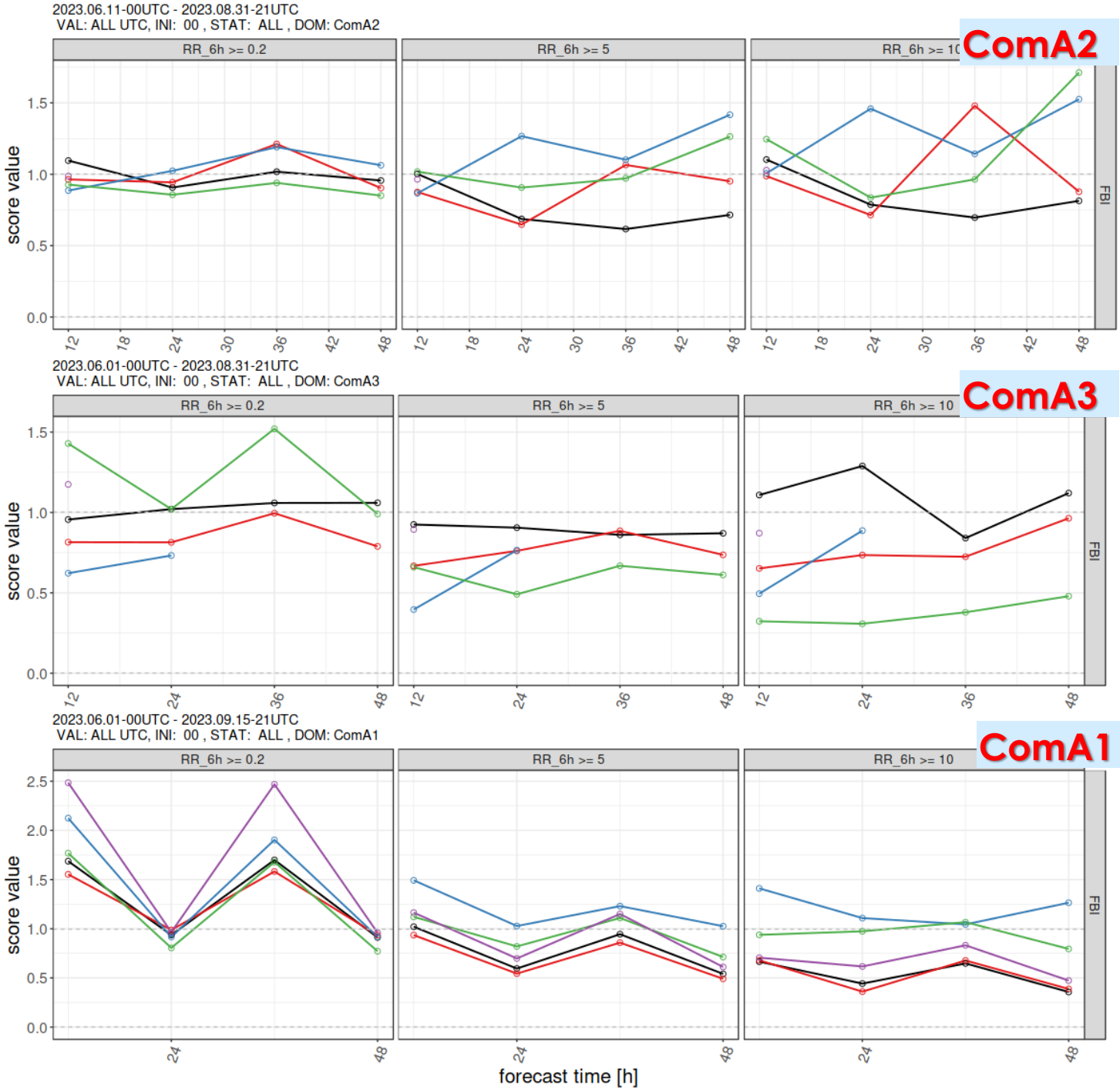
6h Precipitation





- Clearer differences in performance in higher precipitation amounts

MOD: ETS, FAR are higher for **ICON** but with a tendency to underestimate small preci amounts



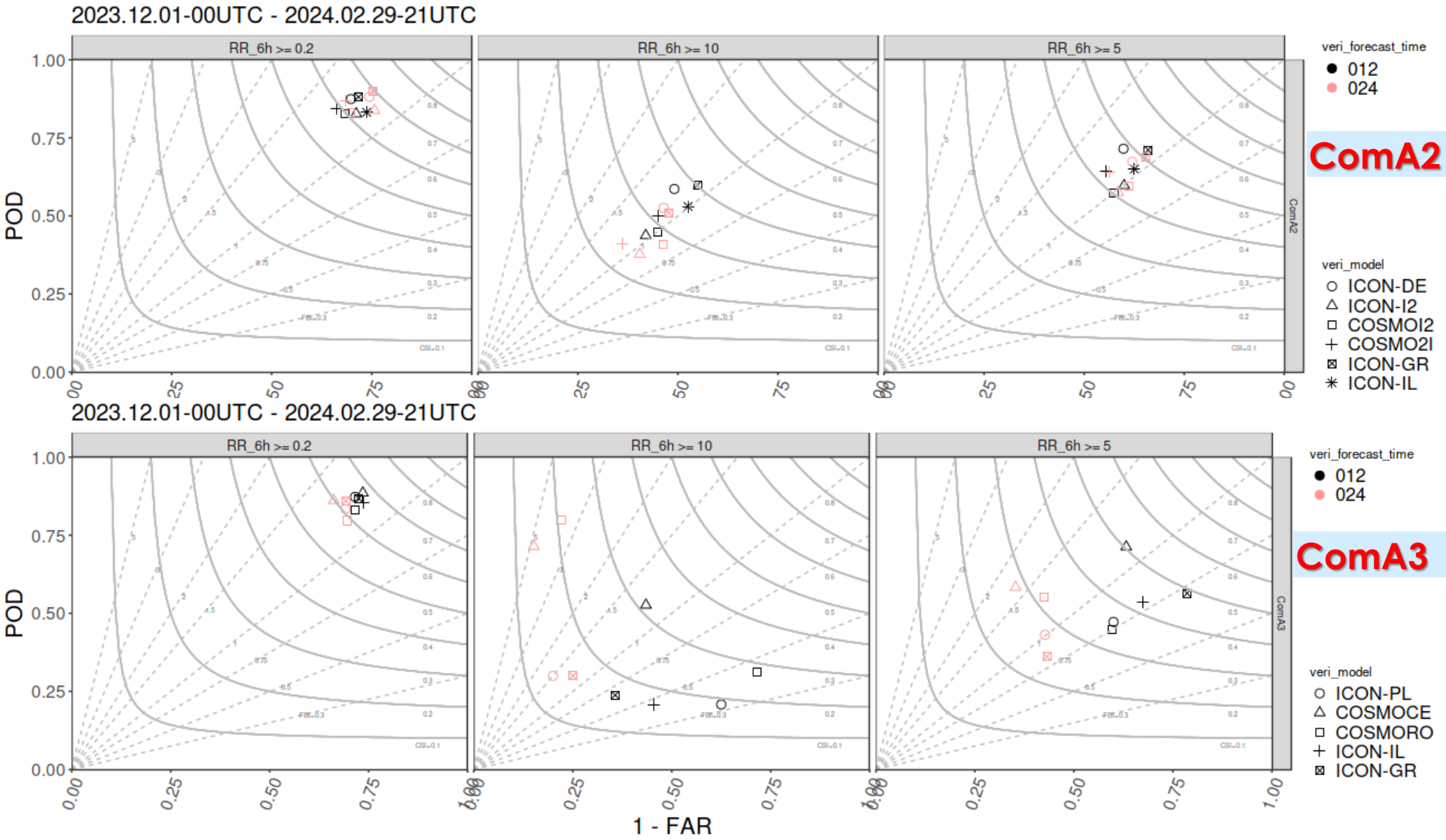
FBI

SUMMER

Underestimation of significant precipitation amounts from driving models. Variable tendency in high resolution models

PerfDiag

WINTER



Performance of models variable with region and time

Remarks based on CP verification

- **2mT**

Driving models: ICON error smaller than COSMO+IFS, less evident diurnal cycle in ME, overestimation (winter)
SysEr: RMSE diurnal cycle is present in all models. Large errors in run initialization. Reduced RMSE DC with ICON models especially reduction in BIAS DC.
SysEr: Larger errors at night and early morning in winter and at midday in the summer.
SysEr: Underestimation during summer warm hours. Overestimation during summer at night
SysEr: ICON tendency to underestimate mainly in the winter night hours
Possible Model Error attributes: issues in the surface energy budget, representation of land-atmosphere interactions, errors in cloud cover or radiation schemes, incorrect representation of soil moisture or boundary Layer parameterization.

- **WindSp**

Driving models: Underestimation in ALL models (winter) more evident with ICON/IFS
HighRes LAM: No differences in RMSE variability among models. Underestimation mainly from ICON-LAMs
SysEr: Larger error cycle in summer
ModDep: negative bias in all seasons with max during nighttime in ICON-LAMs for winter/summer
Possible Model Error attributes: errors in the momentum fluxes or frictional effects in the boundary layer, inaccuracies in the pressure field, particularly in the simulation of high and low-pressure systems (wind direction)

Remarks based on CP verification

- **TCC**

Overestimation both seasons stronger @night
SysEr: Diurnal cycle of both ME/RMSE for TCC remains strong
SysEr: Large errors in winter, larger errors in summer
SysEr: Higher errors during nighttime for all models (overestimation)
ModDp: Higher underestimation in warm hours of the day with ICON in winter
ModDp: Ambiguous performance in RMSE (higher errors at night) with a tendency to overestimation during warm months night hours.
Model Error attributes: shortcomings in cloud parameterization, radiation errors

- **Humidity**

Driving models: ICON is general drier
SysEr: RelHum and Td BIAS diurnal cycle, strongly reduced in ICON models.
SysEr: While RMSE is reduced with ICON, errors are attributed to the overestimation during daylight hours and the underestimation at night during almost all seasons
SysEr: ICON models generally drier, esp. in winter
limitations in the moisture transport and cloud microphysics parameterizations. **Possible Model Error attributes:** issues with cloud formation, representation of boundary layer processes, while underestimations could be linked to the model's inability to capture subtle moisture sources

Remarks based on CP verification

- **Precipitation**

Clearer differences in performance in higher precipitation amounts
MOD: ETS, FAR are higher for ICON but with a tendency to underestimate small preci amounts
Possible Model Error attributes: convective parameterization, small-scale convective or orographic precipitation processes (moisture transport, cloud formation, etc,)

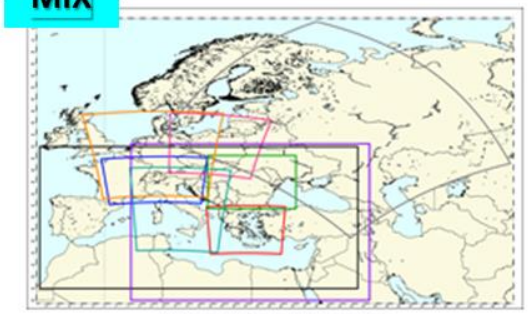
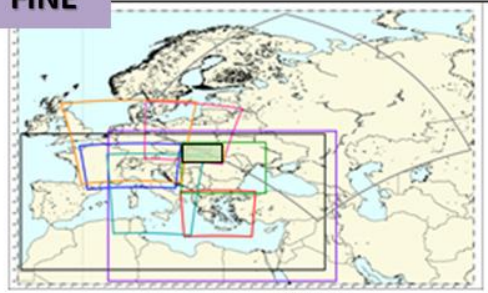
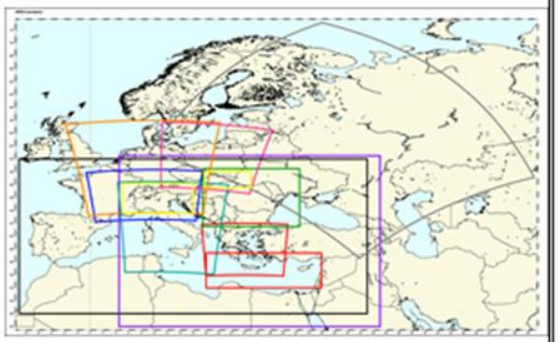
- **General Remarks**

Same model, different errors extent and performance characteristics in different geographical area

Addressing Systematic Errors

Model Tuning/Calibration
Higher-Resolution Runs/update version
Improved Parameterizations

Common Plots: redefined areas

	ComA-1	ComA-2	NoComA (National Domains)
Specs	COARSE  **Forecast run:** 00UTC **Forecast Horizon:** 48h **Seasons:** JJA22, SON22, DJF23, MAM23	FINE  **Forecast run:** 00UTC **Forecast Horizon:** 48h **Seasons:** JJA22, SON22, DJF23, MAM23 **Area: 43.5/5.0/48.2/16.0**	MIX  **Area:** national domains **Forecast Horizon:** variable **Seasons:** JJA22, SON22, DJF23, MAM23
Models	**Global**: ICON, IFS **LAMS**: DWD: ICON-EU, COMET: COSMO-ME IMGW-PIB: COSMO-PL7	**Driving models**: ICON-EU, IFS, ICON **LAMs:** DWD: ICON-D2, MCH: COSMO-1E (control), COSMO-2E, HNMS: ICON-GR COMET: COSMO-I2, ICON-I2, ARPA-E: COSMO-2I IMS: ICON_IL2p5	**COSMO and ICON-LAM** DWD, MCH, COMET, HNMS, IMGW-PIB, NMA, RHM, IMS, ARPA-E
	ComA-3	**ComA-TCC**	**ComA-OnDemand**
Specs	FINE  **Forecast run:** 00UTC **Forecast Horizon:** 48h **Seasons:** JJA22, SON22, DJF23, MAM23 **Area: 47.5/17.7/50.0/25.0**	MIX  **Forecast run:** 00UTC **Forecast Horizon:** 48h **Period:** June2022, Dec2022, Apr2023 **Area: 31.0/18.0/37.4/32.0**	Optional 
Models	**Driving models**: ICON-EU, IFS, ICON **LAMs:** HNMS: ICONGR2.5, NMA: COSMO-NMA/ICON-NMA. IMGW-PIB: ICON-PL, IMS: ICON–IL2.5	**Driving models**: IFS, ICON **LAMs:** HNMS: ICONGR2.5, IMS: ICON_IL2p5, ICON-EU	**Area and LAMs, Specs based on specific experiment**