Verification of COSMO/ICON-LAM over italian domain

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24° COSMO GM, 12-16 September 2022, Athens

Operational ICON-IT @ CNMCA - Italy

Operational SETUP:

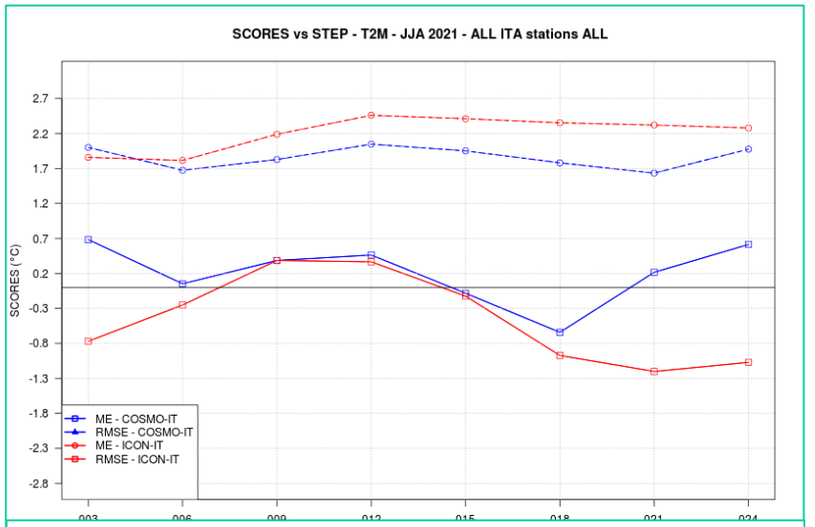
Grid: R19B7 (2.1 km) /65vl - same domain as COSMO-IT
IFS LBC and ICON-KENDA - 1h DA cycle, init_mode=5 (Incremental Analisys Update)
lshallowconv_only = .false.
lgrayzone_deepconv = .true.
tune_box_liq =0.08
tune_box_liq_asy = 2

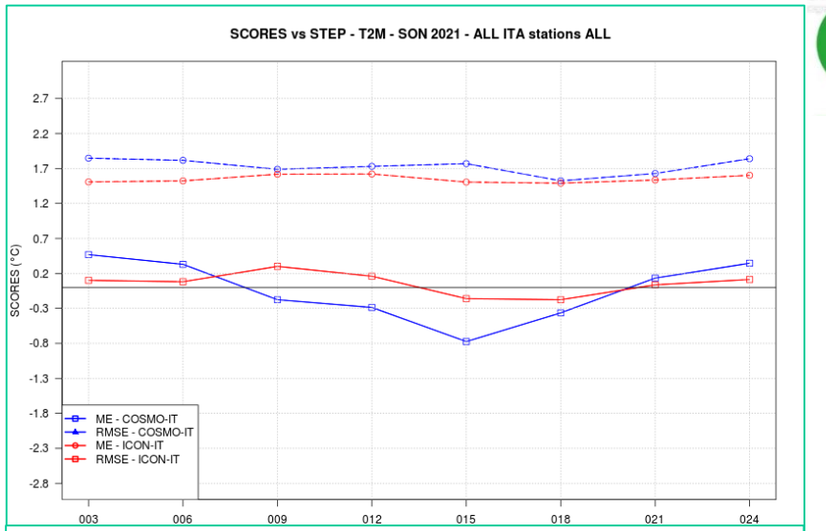
- Operational on ECMWF-Cray HPC since july 2020, ready to run on local hpc (Intel 2022.0.2 + Intel MPI 2021.5.1)
- model version: development version from January 2021 (not updated up to now because unresolved communication problems under cray environment at ECMWF)
- Surface + upper air verification with MEC-RFDBK software

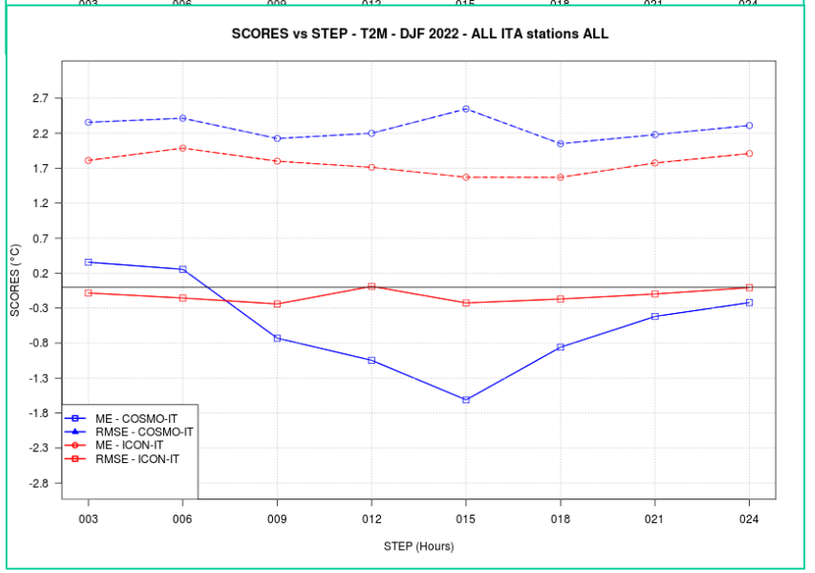
COSMO-IT vs ICON-IT

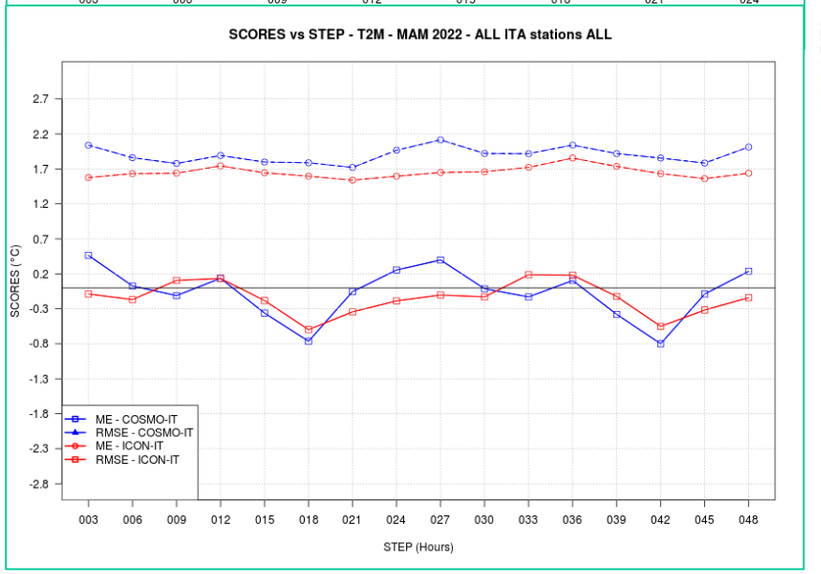
00UTC run

2m-Temperature







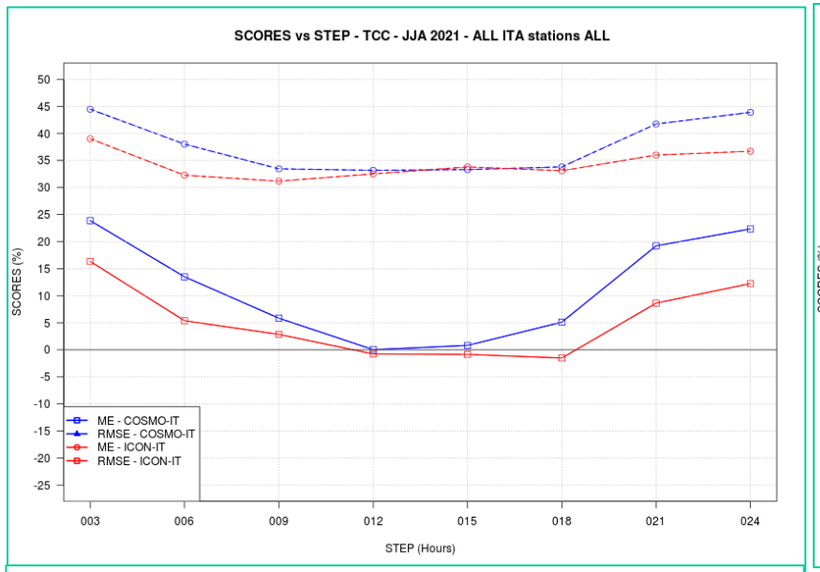


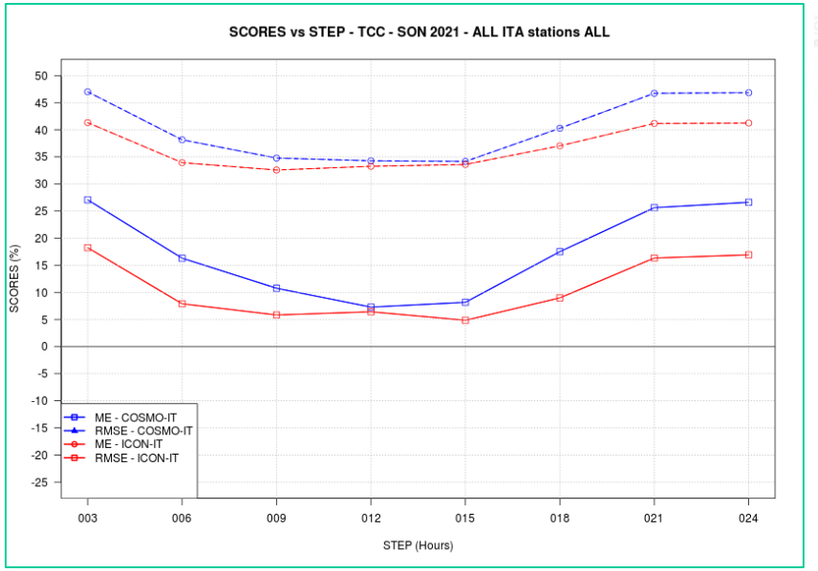
Forecast verifications against SYNOP

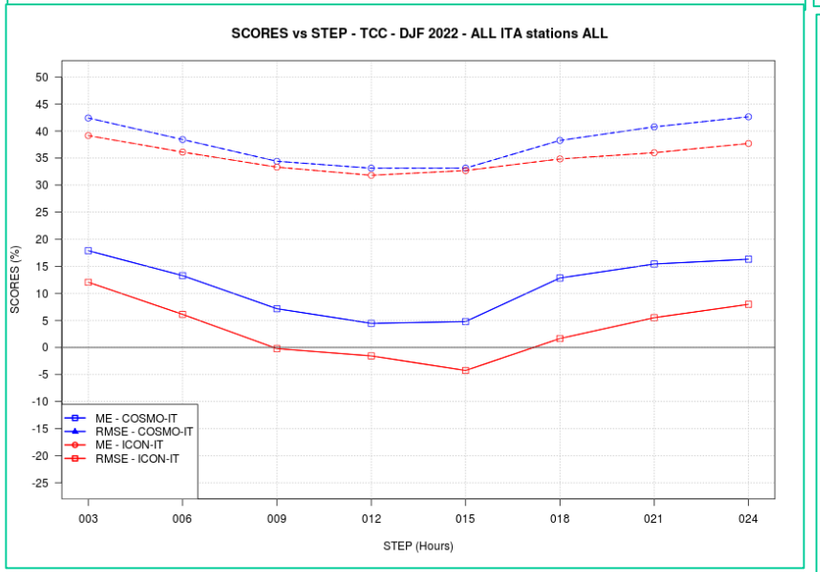
COSMO-IT vs ICON-IT

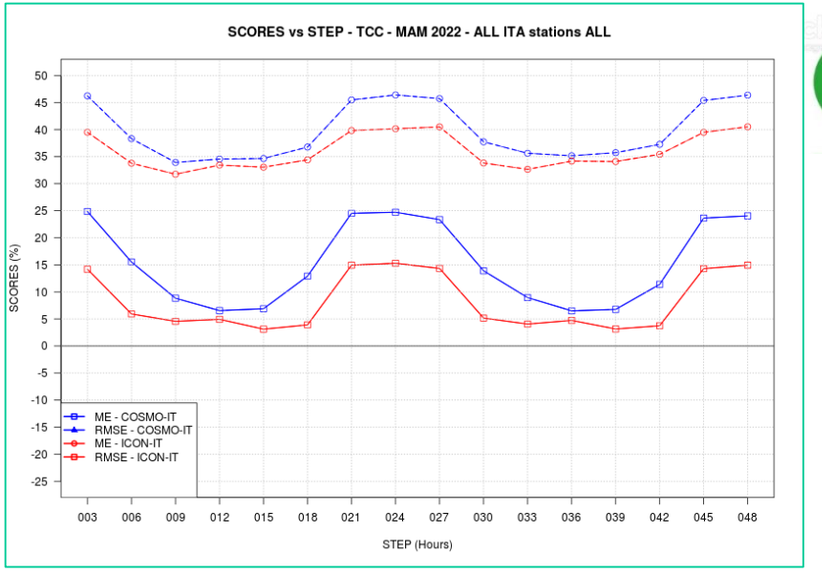
00UTC run

Total Cloud Cover









Forecast verifications against SYNOP

CONSORTIUM FOR SMALL SCALE MODELING

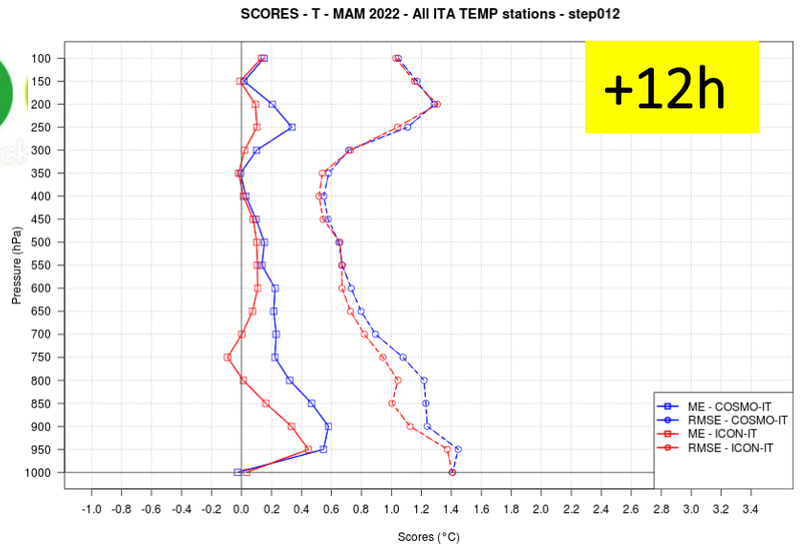
Forecast verifications against SYNOP: other parameters

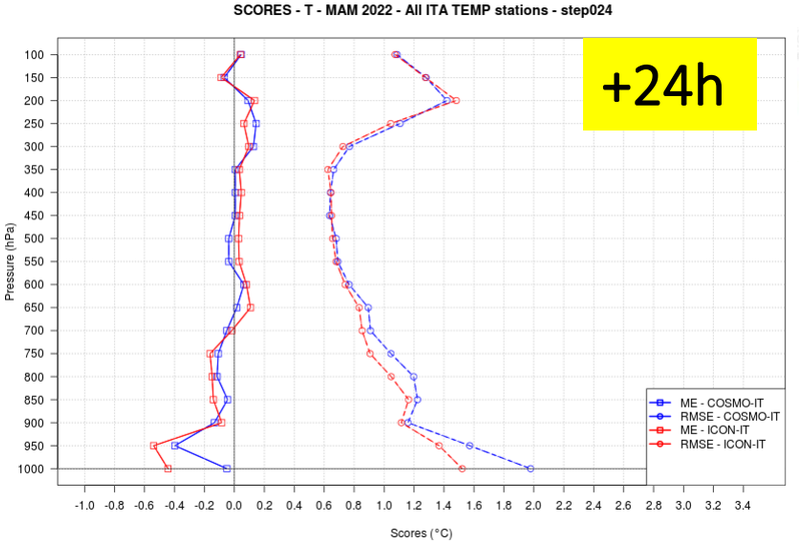
- ✓ regarding the RH2m forecast skill, there is a slight general improvement for ICON-IT model in terms of RMSE
- ✓ The 10m wind speed RMSE score is almost identical for the two models, while the ME score is slightly better for ICON-IT during day time for JJA 2021 and SON 2021 quarters, but worsening during DJF 2021-22 and MAM 2022
- ✓ Surface pressure scores show mixing results

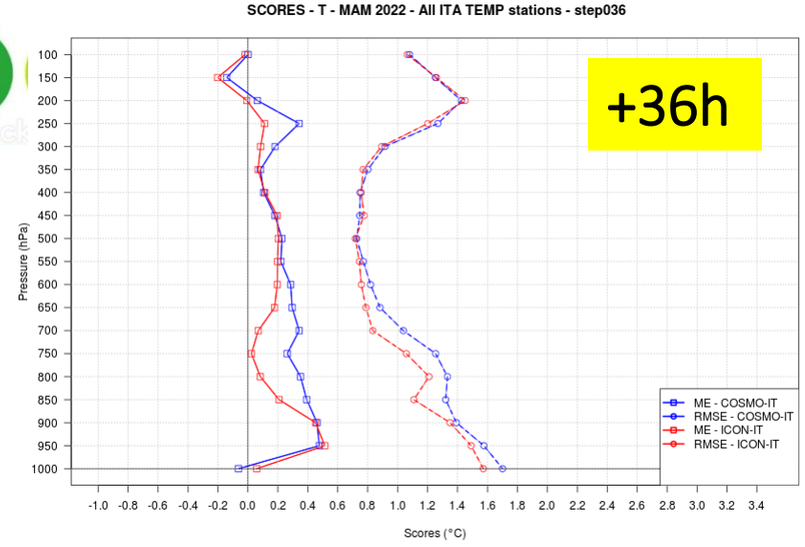
COSMO-IT vs ICON-IT

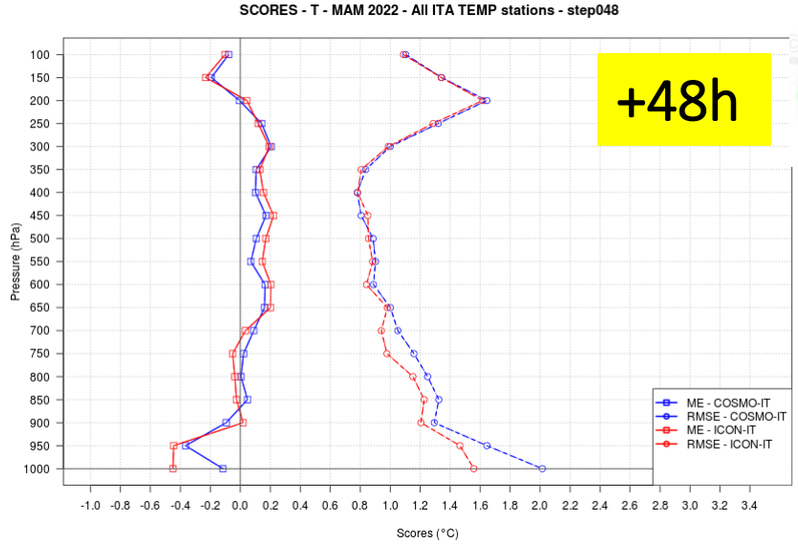
00UTC run

Upper Air Temperature









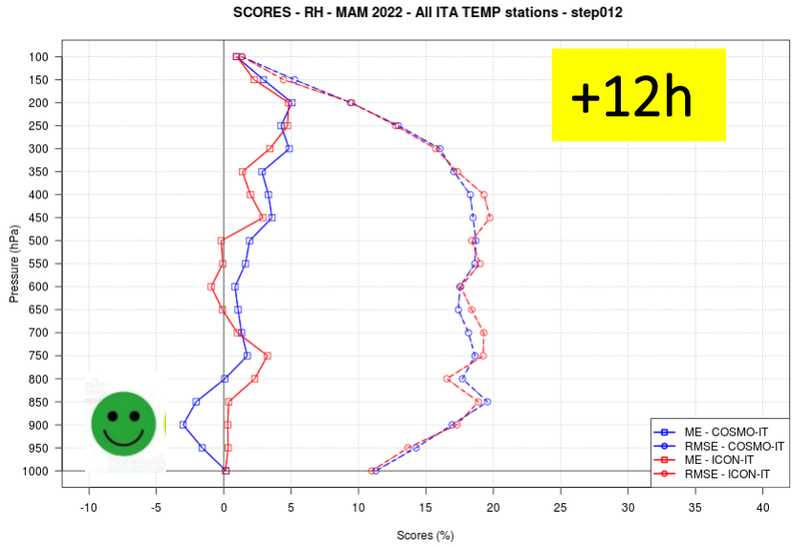
Forecast verifications against Soundings

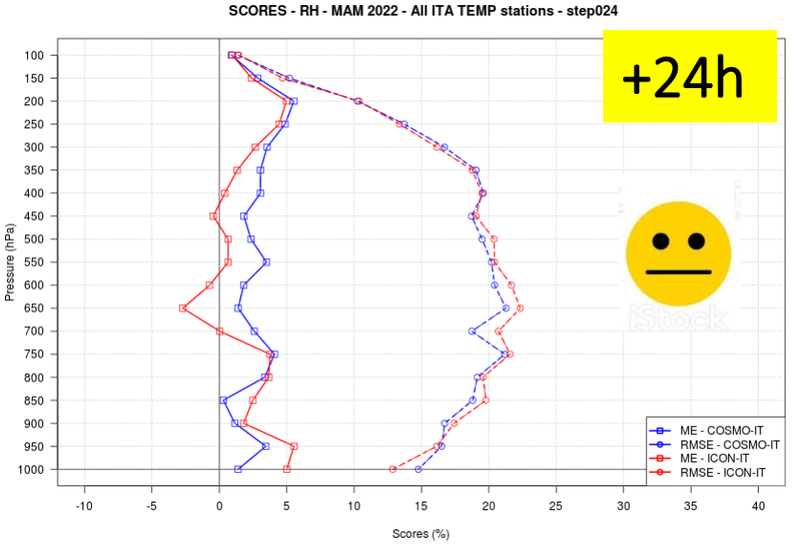
CONSORTIUM FOR SMALL SCALE MODELING

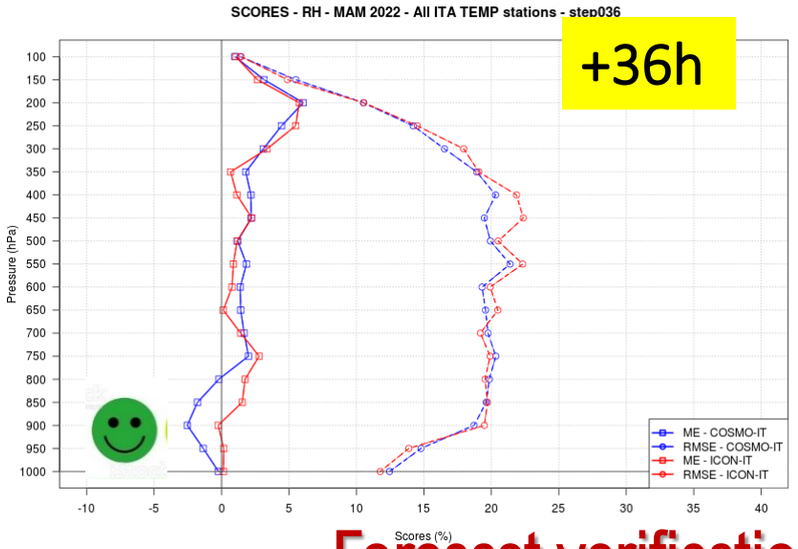
COSMO-IT vs ICON-IT

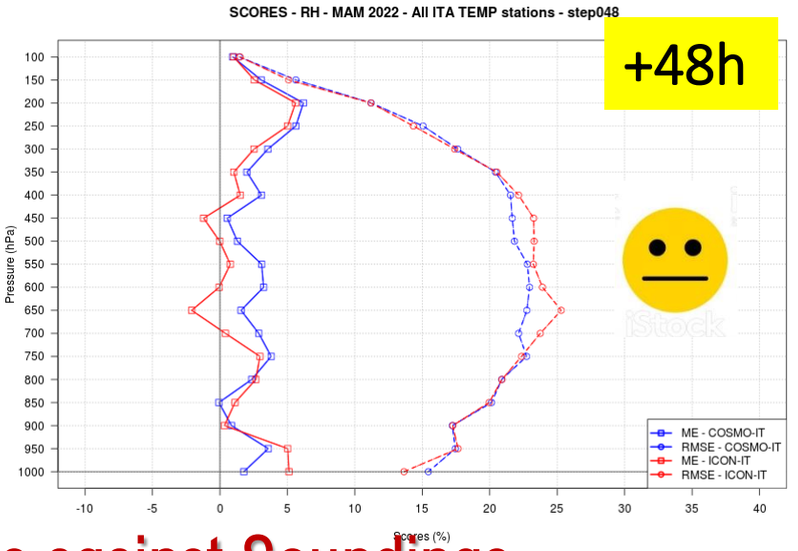
00UTC run

Upper Air Relative Humidity









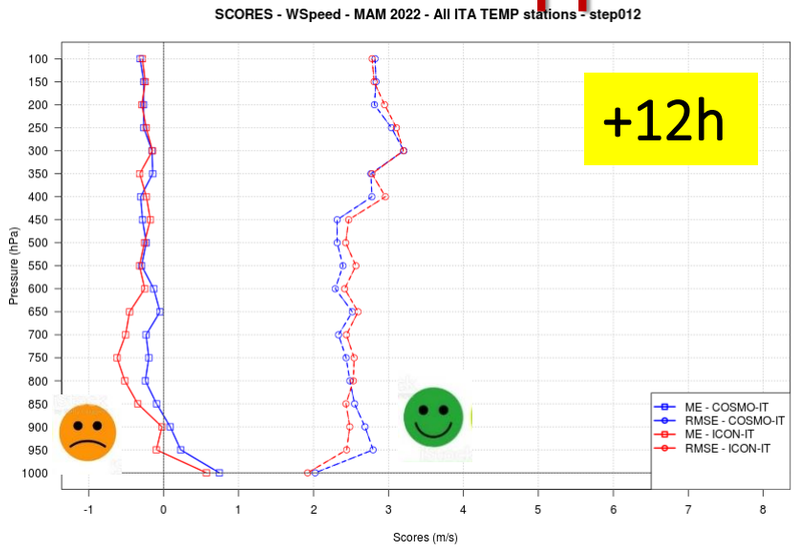
Forecast verifications against Soundings

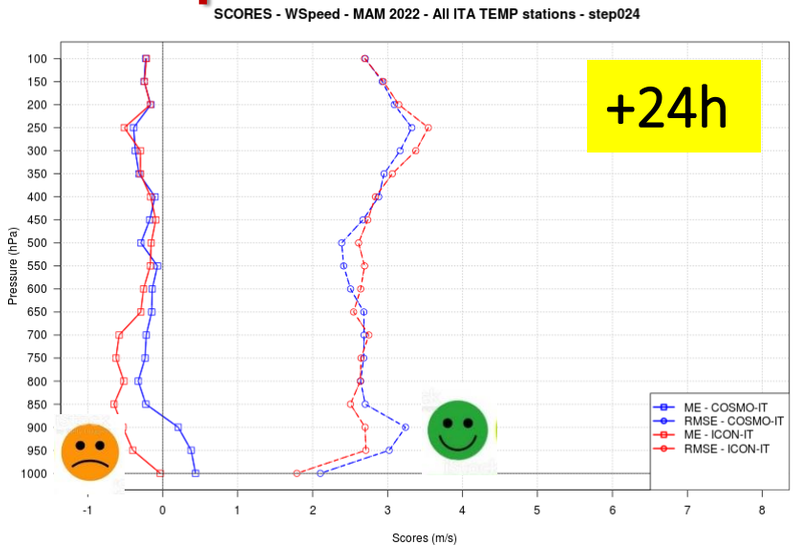
CONSORTIUM FOR SMALL SCALE MODELING

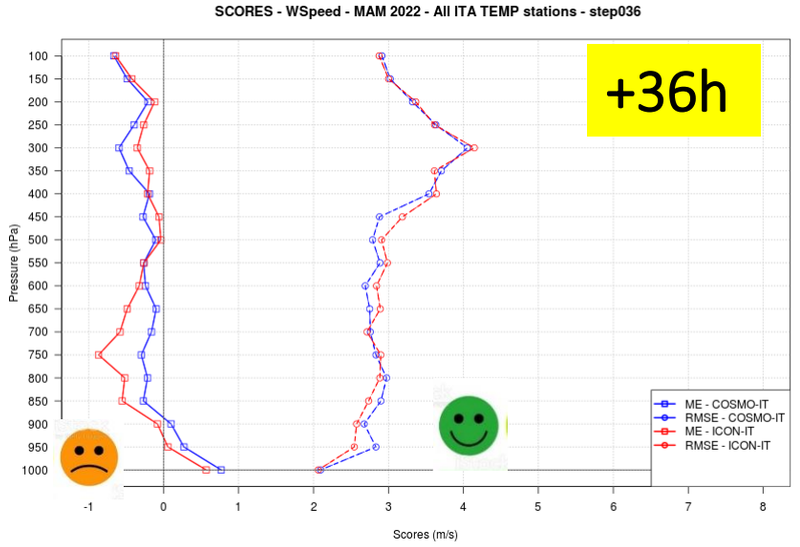
COSMO-IT vs ICON-IT

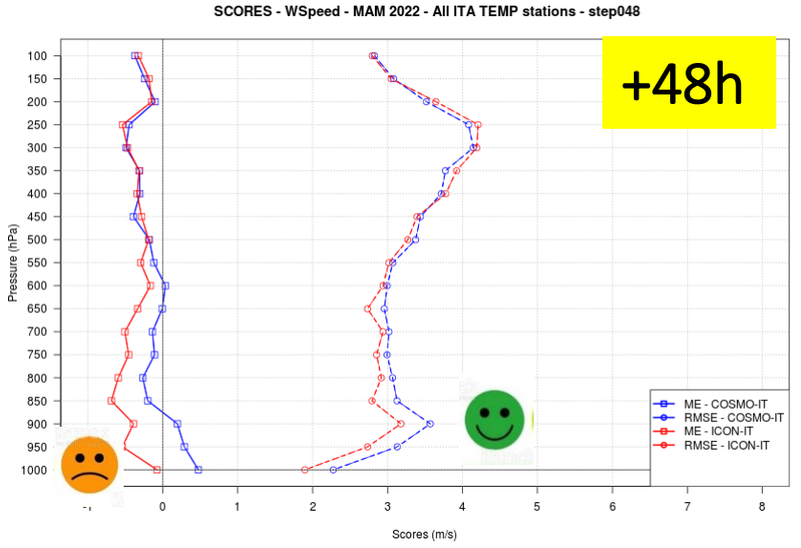
00UTC run

Upper Air Wind Speed









Forecast verifications against Soundings

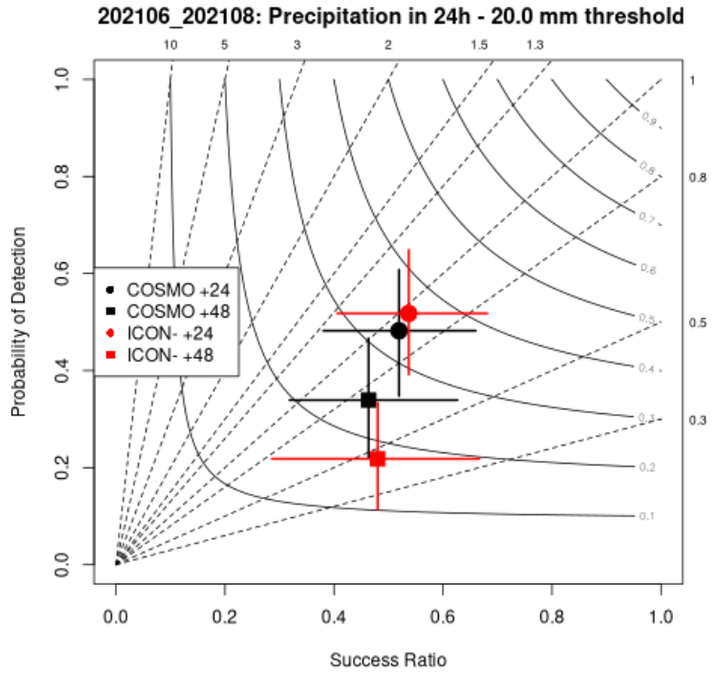
CONSORTIUM FOR SMALL SCALE MODELING

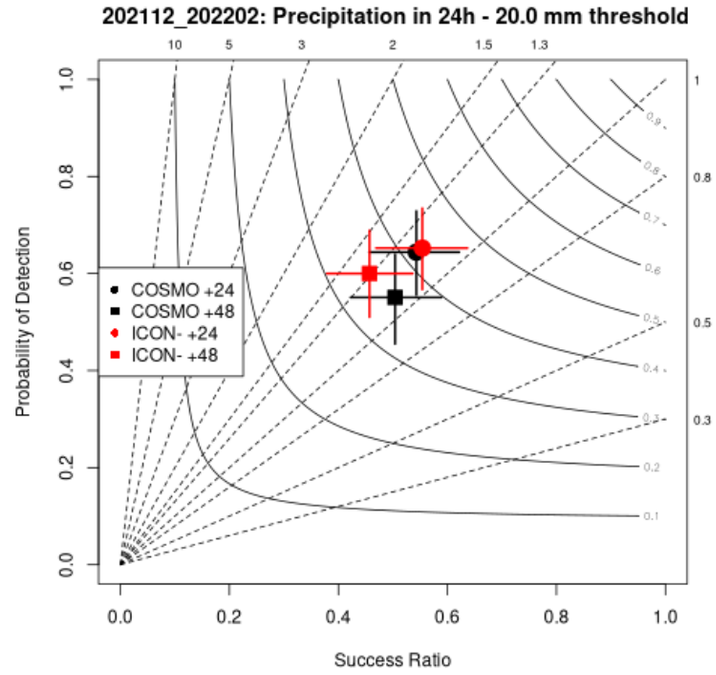
PERFORMANCE DIAGRAMS FOR QPF VERIFICATION

Observations provided by the rain-gauges network of Civil Protection Department and we compared the 24h cumulated precipitation average values as well as the 24h maximum values, calculated over 70 homogeneous Italian areas both for observation and forecast. The diagrams have been performed for 4 seasons (JJA 2021, SON 2021, DJF 2022 and MAM 2022), for thresholds 0.2 mm, 2 mm, 10 mm, 30 mm.

During JJA2021 we obtained no significant improvement for ICON except for the high thresholds for first 24h (average values).

During last autumn and very dry winter we did not obtain any improvement for ICON.





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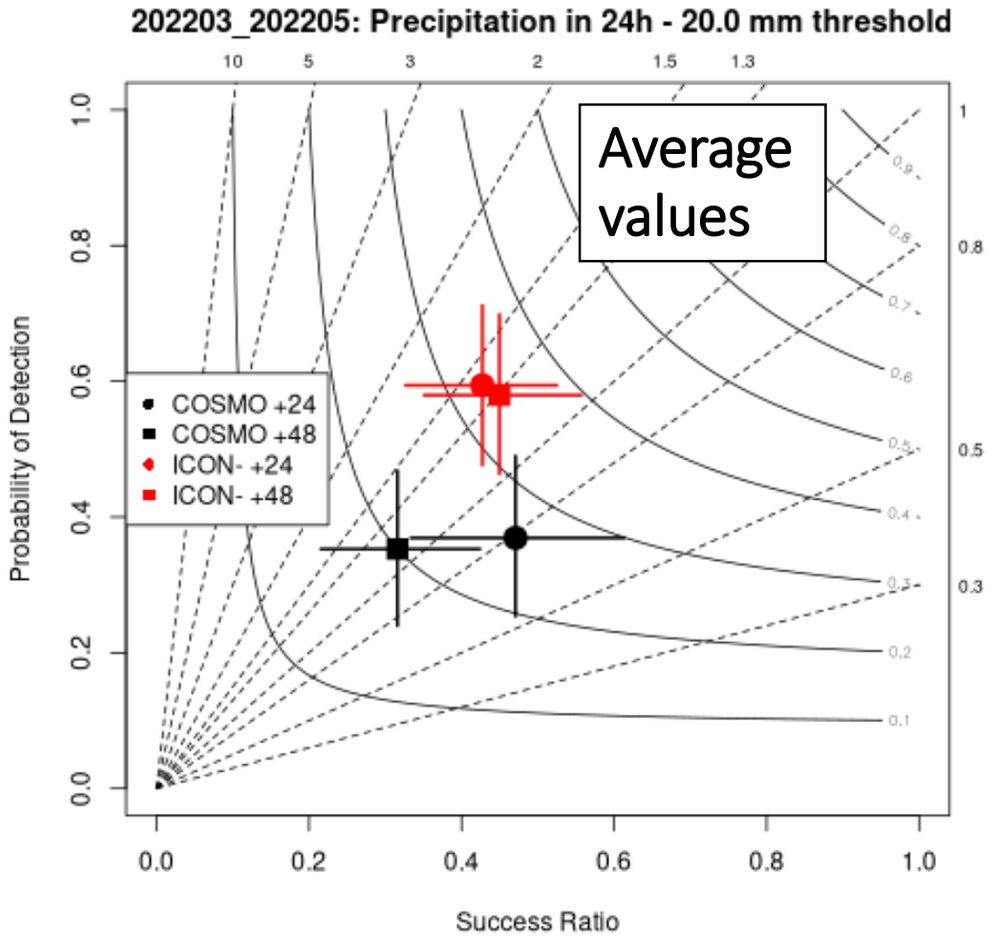
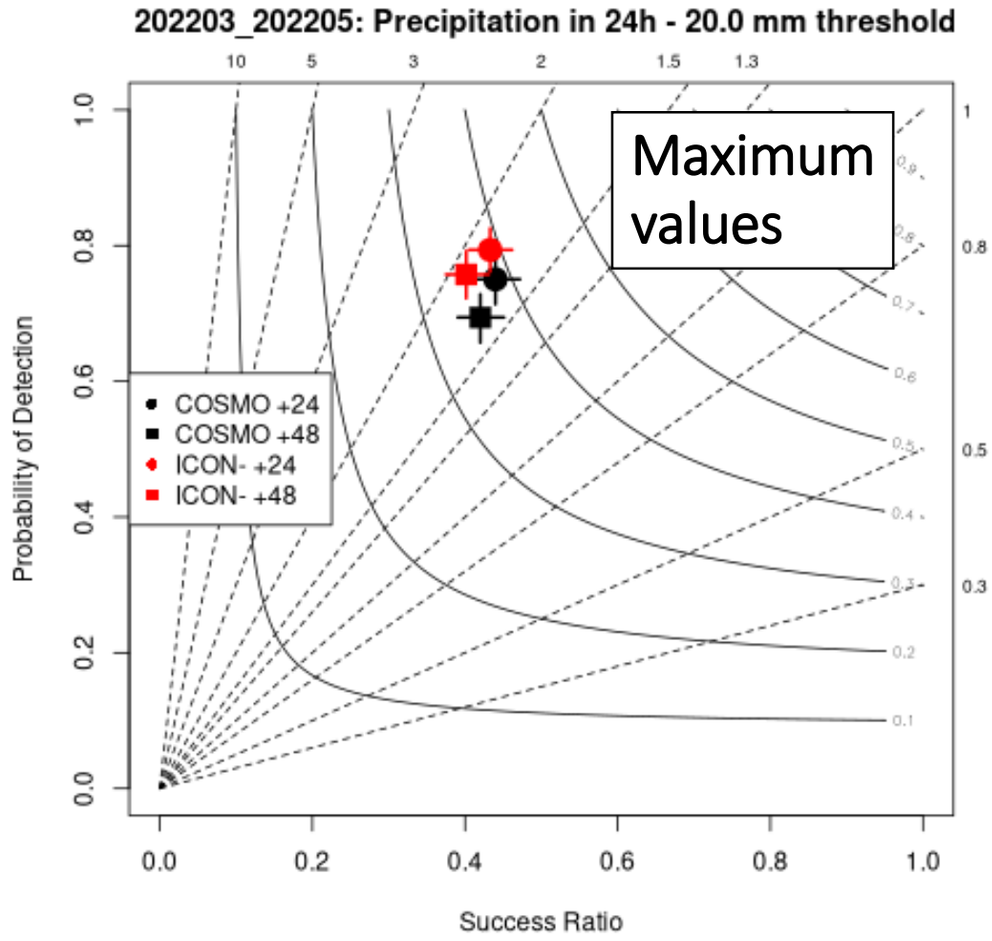
PERFORMANCE DIAGRAMS FOR QPF VERIFICATION

Finally, during this spring we have reached a good skill for ICON, even if an overestimation in term of maximum values is observed.





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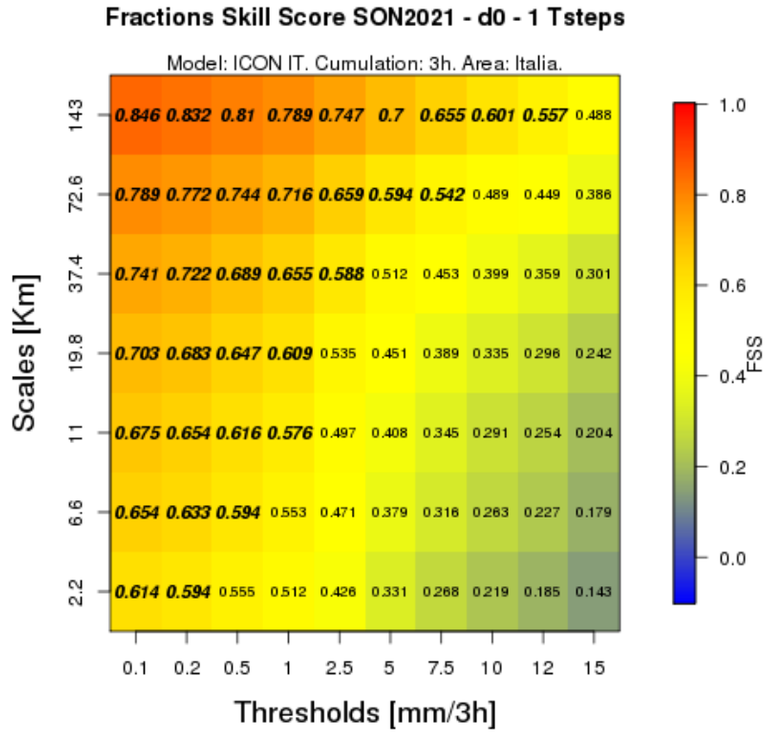
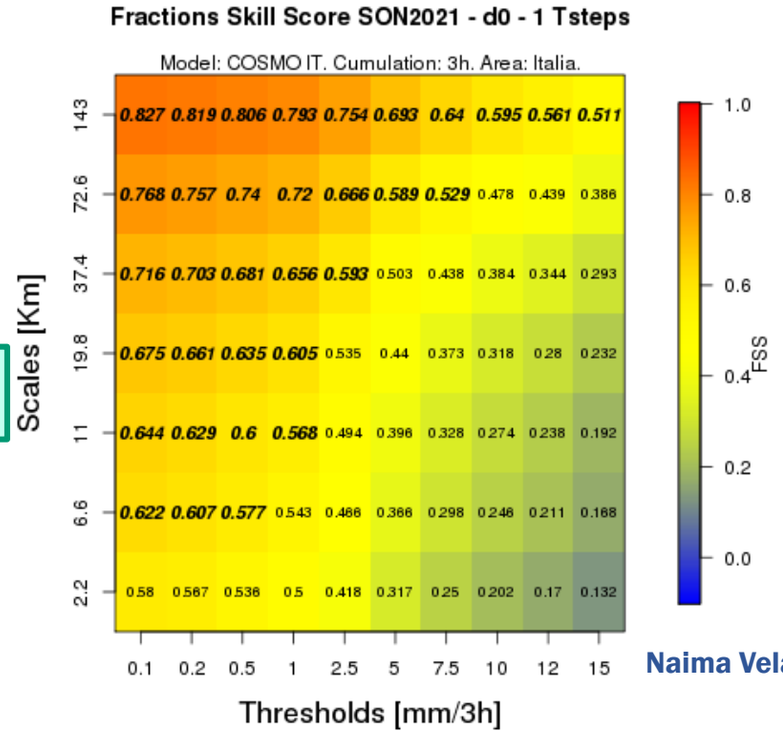
FUZZY VERIFICATION

ICON-IT



COSMO-IT



The observation data for the fuzzy verification are a grid which is a merge of the radar estimated precipitation and rain gauges (provided by Civil Protection Department).

If we compare the fuzzy verification results of COSMO and ICON IT observing the Fractions Skill Score, we can enlighten a very similar behavior between the two models.

Sometimes (not always) ICON seems to behave better for lower thresholds, while COSMO is usually better for higher thresholds. This is visible by looking at the spatial scale at which the FSS_{useful} is reached for each threshold.

Here you can see an example: Fractions Skill Score for SON 2021, D0.

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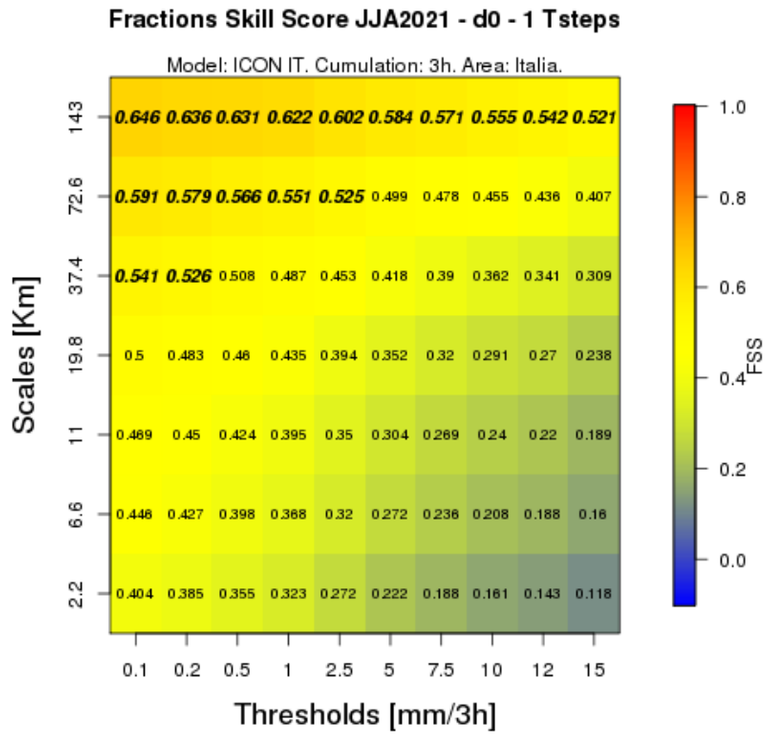
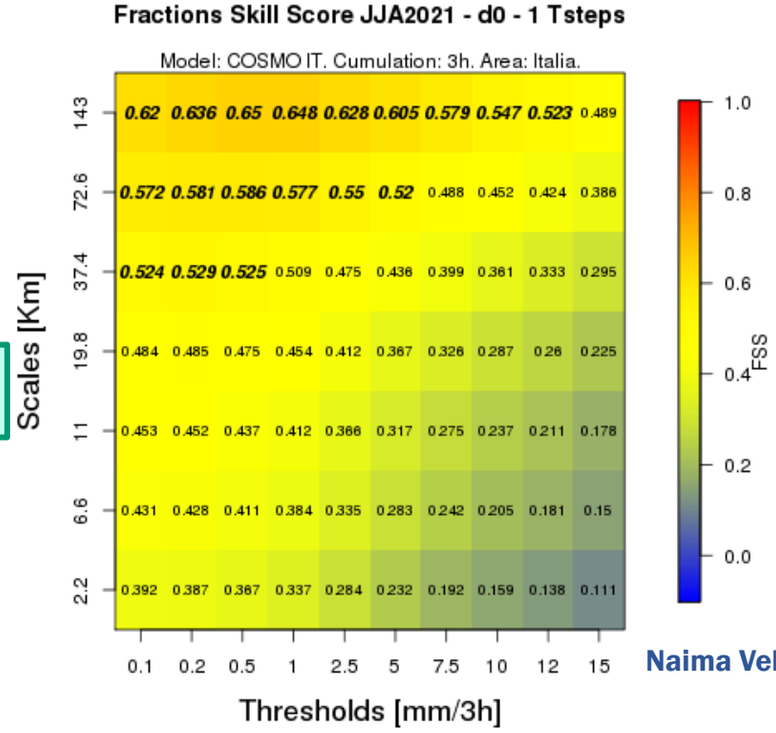
FUZZY VERIFICATION

ICON-IT



COSMO-IT



The new ICON IT features don't seem to be able (for the time being) to fix the problems that COSMO IT (together with all of the other high-resolution models) used to have in predicting the summer related convective precipitation. For both the models in fact the JJA verification shows a *useful scale* that starts from boxes having a side of 37 Km for the lower thresholds.

Here you can see an example: Fractions Skill Score for JJA 2021, D0

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Conclusions

- ✓ Results are **encouraging** as generally ICON-IT outperforms COSMO-IT for surface parameters and temperature profiles.

- ✓ **Precipitation**: the fuzzy results do not show significant differences between ICON-IT and COSMO-IT. Also the performance diagrams don't highlight any significant improvement of ICON-IT, except for the spring period where it performs better than COSMO-IT. Both models tend to overestimate the maximum precipitation values for medium-high thresholds.

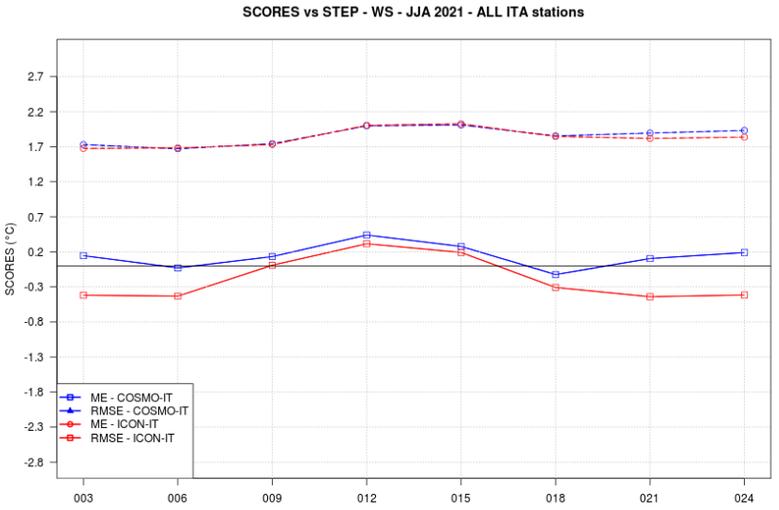
- ✓ The ICON model is fully operational at the Italian Met Service, together with COSMO-IT. The **full switch** to ICON is conditioned to the availability of the GPU version of the model, precondition for the implementation of the ICON-IT EPS. Therefore ICON will hopefully become the "reference" model by Q4 2023.

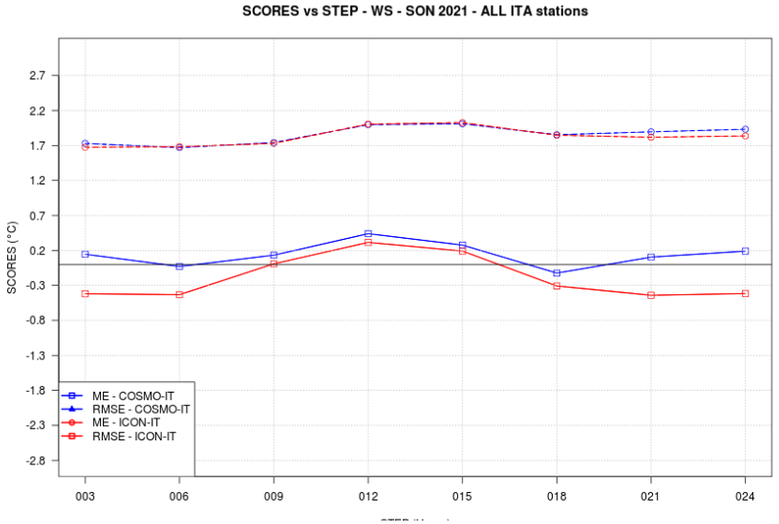
- ✓ ICON model will also be advantageous from a **computational** point of view. Taking into account that the cosmo-it and icon-it have the same setups (in terms of horizontal and vertical resolution and domain extent), on the basis of daily resource consumption (SBU) on the ECMWF cray-hpc, it can be estimated that the use of ICON model saves around 40% of computational resources.

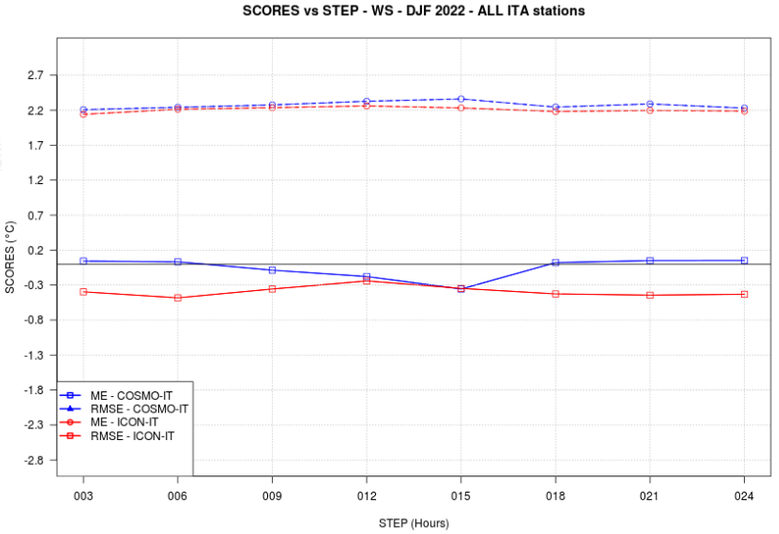
COSMO-IT vs ICON-IT

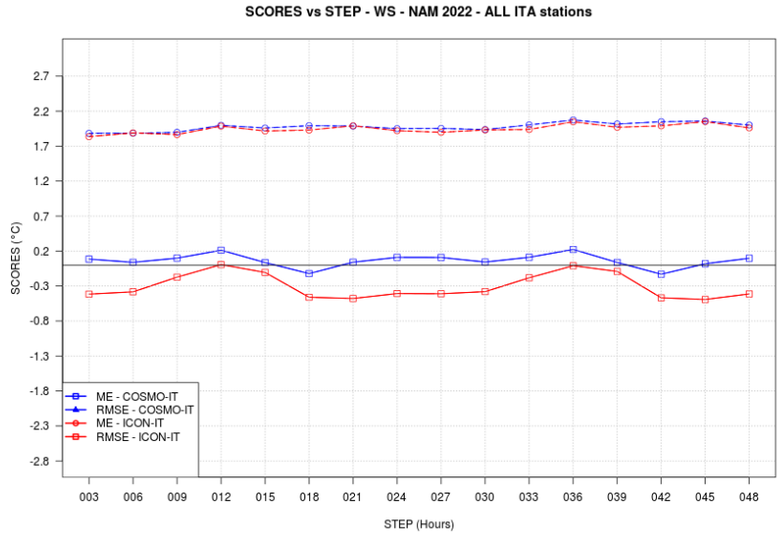
00UTC run

Wind Speed









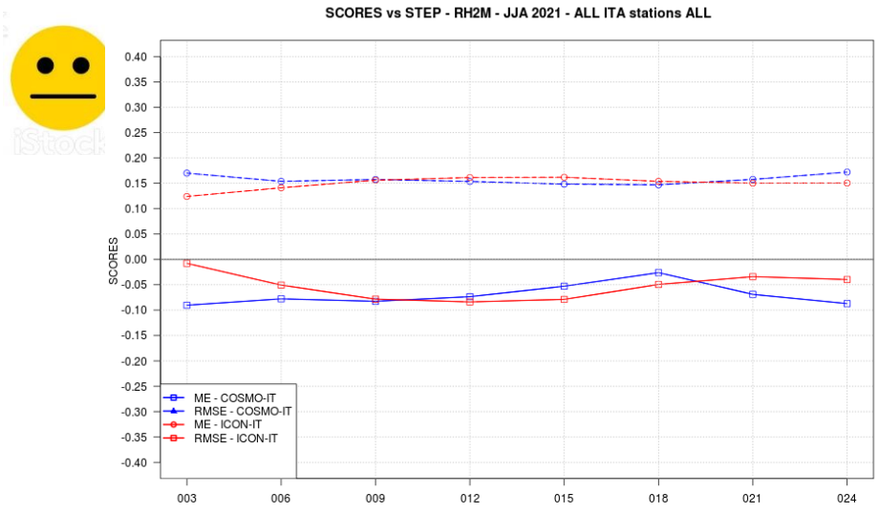
Forecast verifications against SYNOP

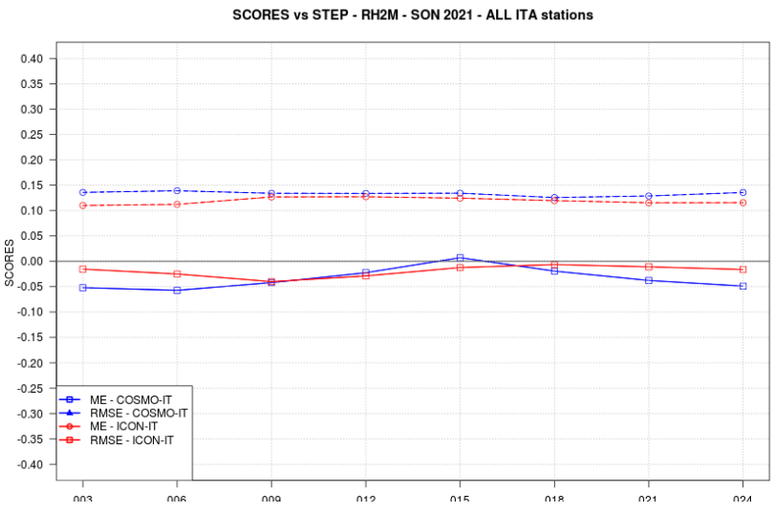
CONSORTIUM FOR SMALL SCALE MODELING

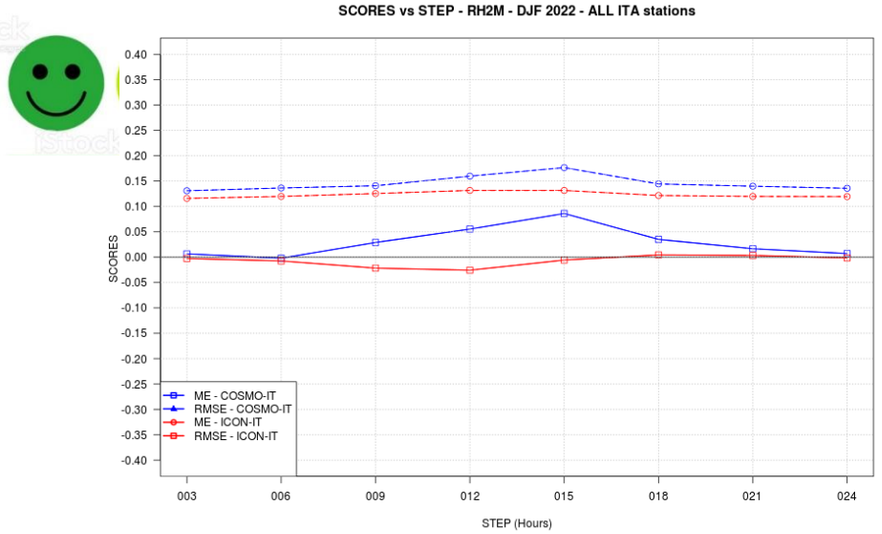
COSMO-IT vs ICON-IT

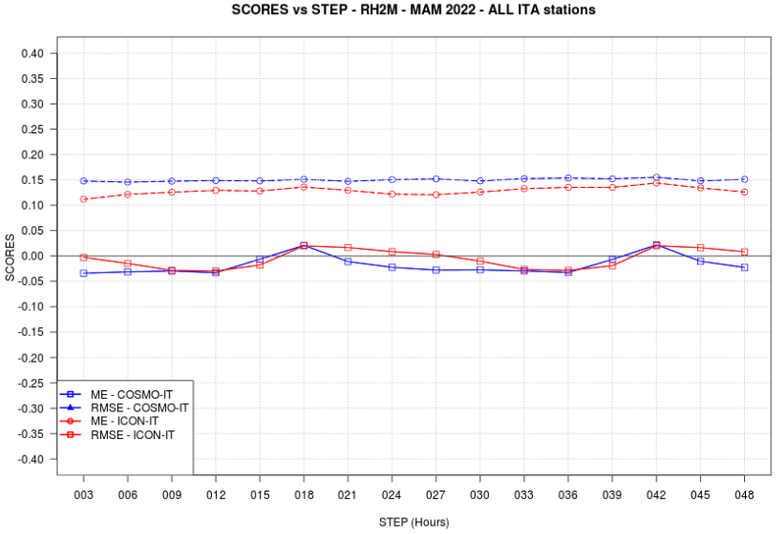
00UTC run

Relative Humidity







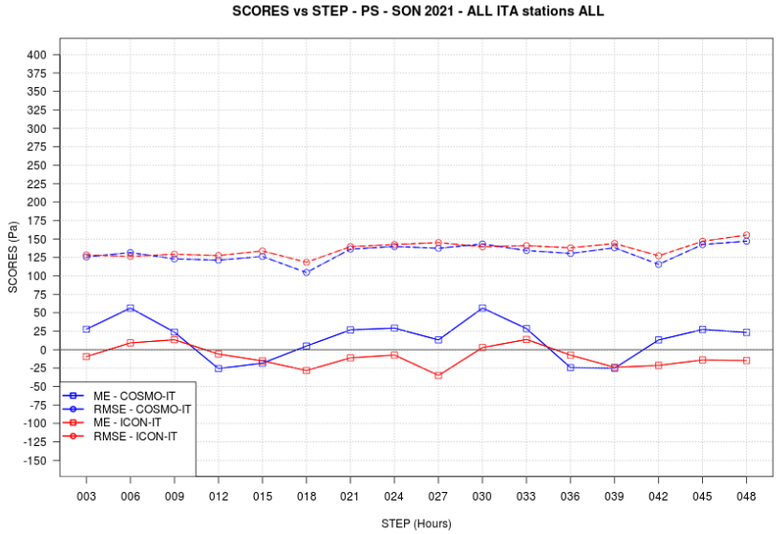


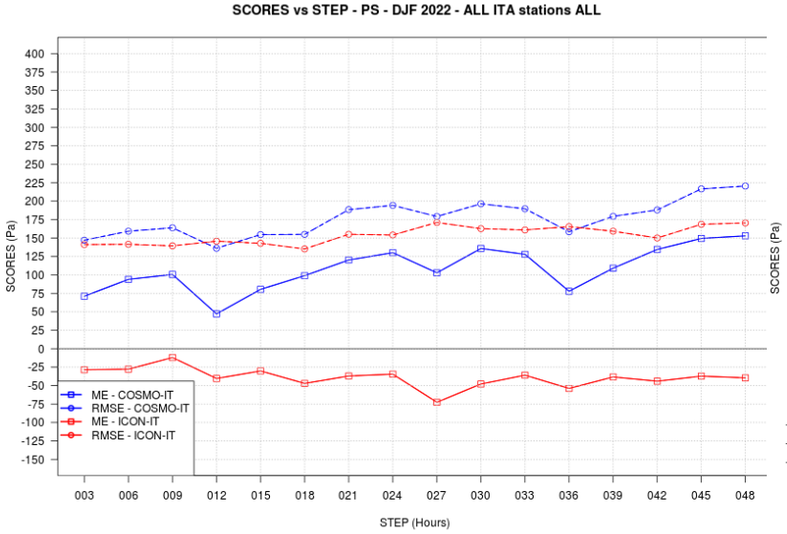
Forecast verifications against SYNOP

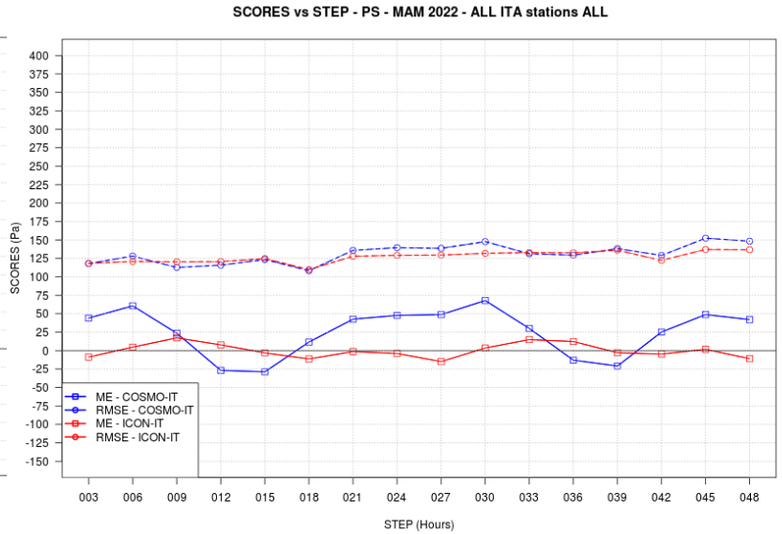
COSMO-IT vs ICON-IT

00UTC run

Surface Pressure







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