STATUS OF KENDA-LETKF DA CYCLE AT CNMCA

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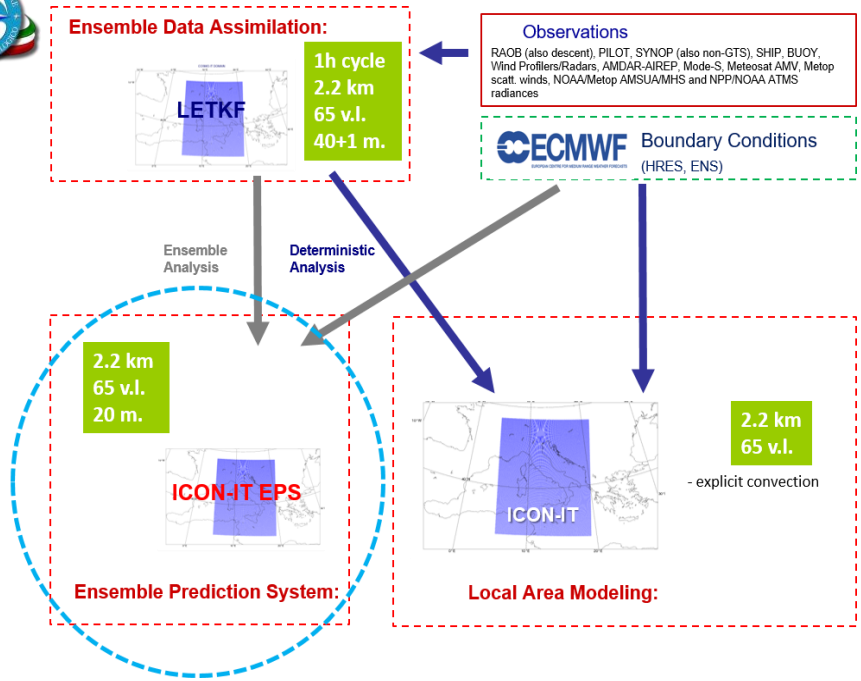
27°Cosmo GM, 01-04 September 2025, Basel (Switzerland)

OUTLINE

- Current national operational setup
- Assimilation of RADAR radial winds in ICON: setup and results
- Assimilation of non conventional synoptic obs (MeteoNetwork)
- Future developments

Operational ICON-IT @ CNMCA - ITALY



- The ICON model (1h DA cycle + 00/12 UTC model runs) is fully operational at the Italian Met Service since **jul 2020** on ECMWF-HPC and on local HPC and available to forecasters for daily use
- ICON-IT EPS: **operational** since March 2025, 20 members, 2.2 km res (on ECMWF-HPC)
- ICON-MED tests on ECMWF-HPC (5 km resolution)
- KENDA-LETKF provides analyses at a 1-hourly interval

NAMELIST_EMVORADO for ICON (REFL + RADW obs)

RADAR REFLECTIVITY obs: operational since AUGUST 2024

```
&RADARSIM_PARAMS
 lout_geom=.false.,
 loutradwind=.true.,
 loutdbz=.true.,
 …….
 dom=1,
 icountry=3,
 itype_supobing=1,
 supob_cart_resolution = 10000.0, ! Superobbing at 10 km
 supob_lowthresh_z_obs = 5.0,  ! 5 dBZ threshold on reflectivities
 supob_lowthresh_z_sim = 5.0,
 itype_obserr_vr=1,
 ramp_lowdbz_obserr_vr=0.0,
 ramp_highdbz_obserr_vr=10.0,
 maxval_obserr_vr=25.0,
 baseval_obserr_vr=2.5,
……
 /END
```

- MIE scattering option activated, assuming spherical particles for all hydrometeors
- Superobbing at 10 km
- 5 dBZ threshold on reflectivities
- simulation and output for radial winds and reflectivity activated
- Ramp function for the error of the RADW obs activated (following ARPAE settings)

NAMELIST_KENDA for ICON (REFL + RADW obs)

```
   !Set elevation 0.5 fo radial wind to active
   &RULES
   comment     = 'specific parameters for RADAR operator'
   obstype     = 13           ! RADAR
   sat_zenith  = 0.4 0.8
   uv%use      = 11
   /
   !Set elevation 1.5 fo reflectivity and radial wind to active
&RULES
   comment     = 'specific parameters for RADAR operator'
   obstype     = 13           ! RADAR
   sat_zenith  = 1.1 2.1
   o%use       = 11
   uv%use      = 11
/
   !Set elevation 3.5 for reflectivity and redial wind to active
   &RULES
   comment     = 'specific parameters for RADAR operator'
   obstype     = 13           ! RADAR
   sat_zenith  = 3.1 4.0
   o%use       = 11
   uv%use      = 11
   /
```

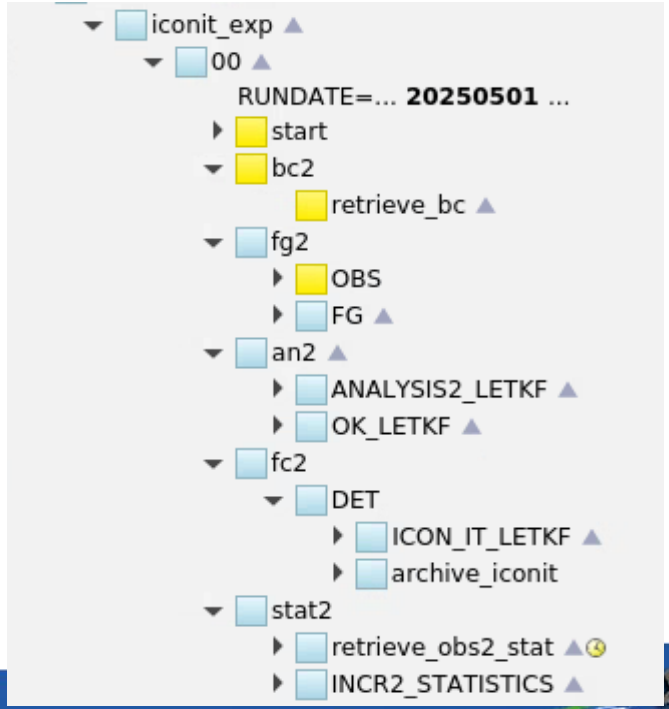
```
   !Set reflectivity between 0 and 600 m 'passive'
&RULES
    comment    = 'specific parameters for RADAR operator'
    obstype    = 13           ! RADAR
    zlim       = 0. 600.      ! between 0.0 and 600.0 m
    o%use      = 7
    uv%use     = 7
/
   !Set radial winds and reflectivity above 10000 m to passive
&RULES
   comment     = 'specific parameters for RADAR operator'
   obstype     = 13            ! RADAR
   zlim        = 9000. 99999. ! above 9000 m
   o%use       = 7
   uv%use      = 7
/
```

RADAR: test

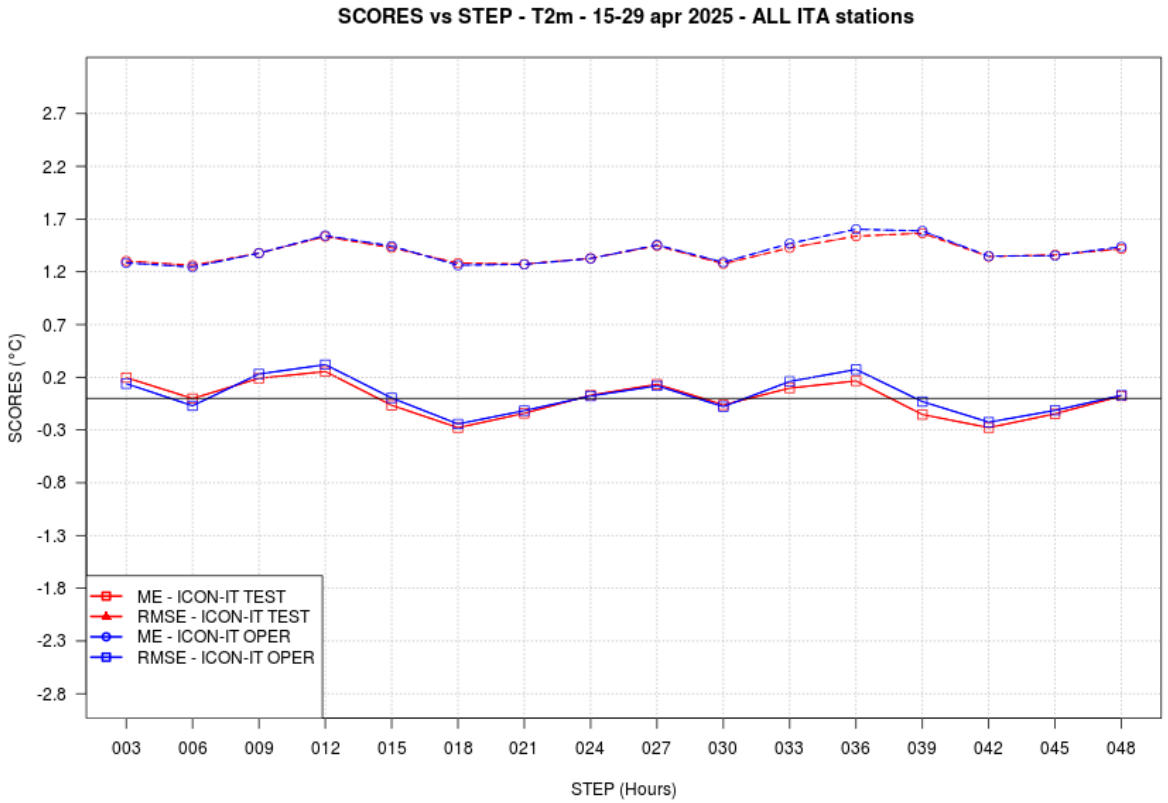
EXP1: 13 - 29 April

ICON-IT EXP (REFL+RADW) vs ICON-IT OPE (REFL)

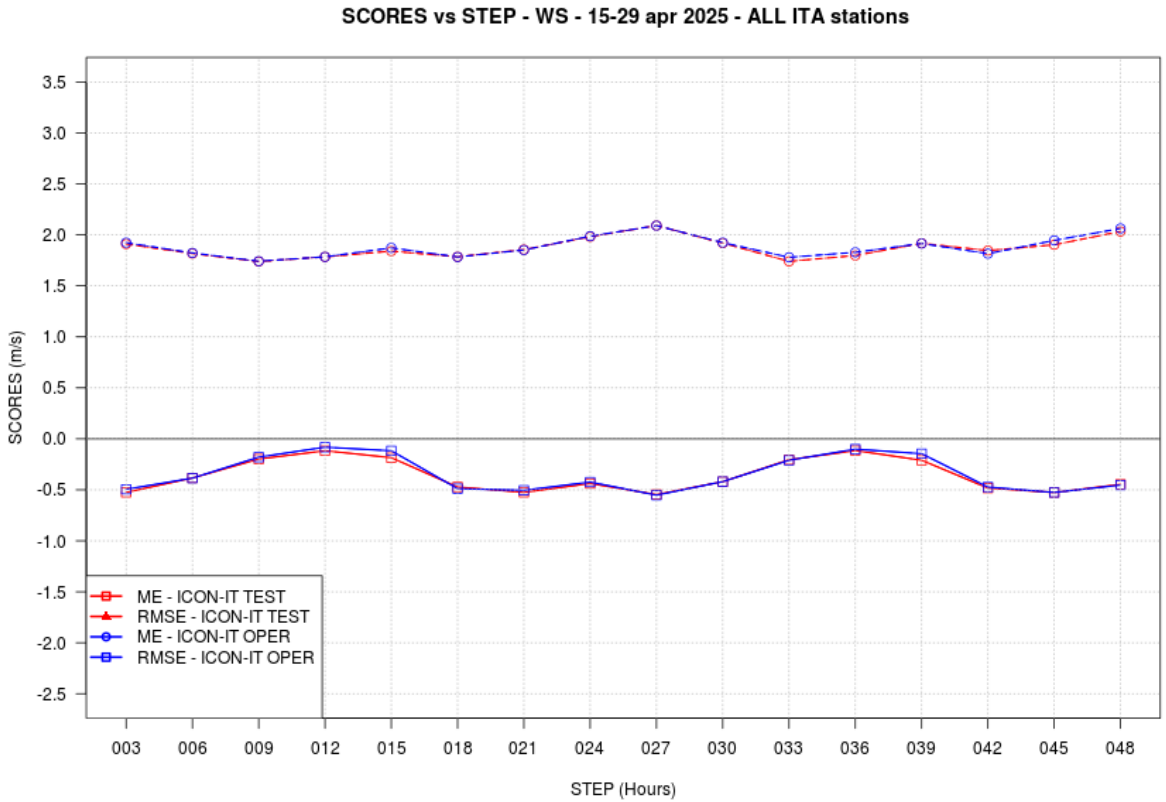
Statistics:
VS SYNOP:T2m, TTC, RH2m, WS, Prec
VS RADIOSONDE: T and WS



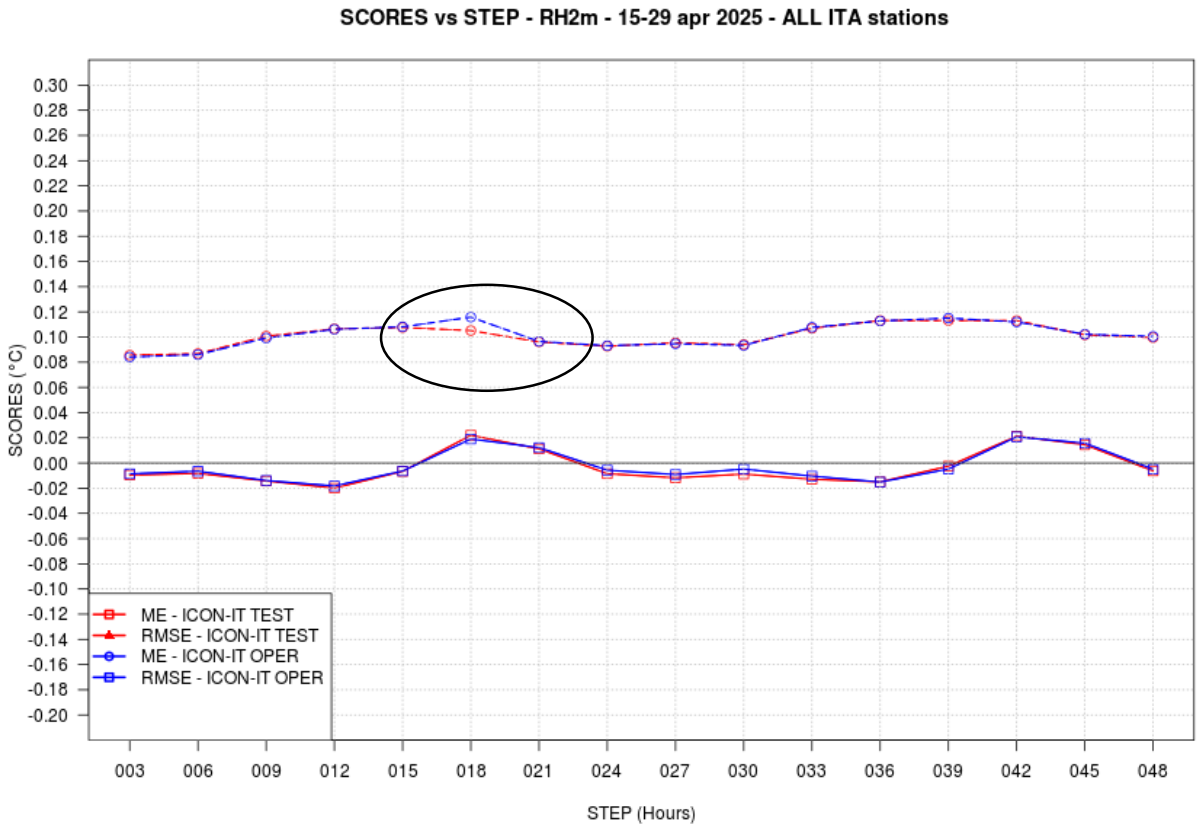
RADAR STATS: 15 - 29 April 2025 (T2m)



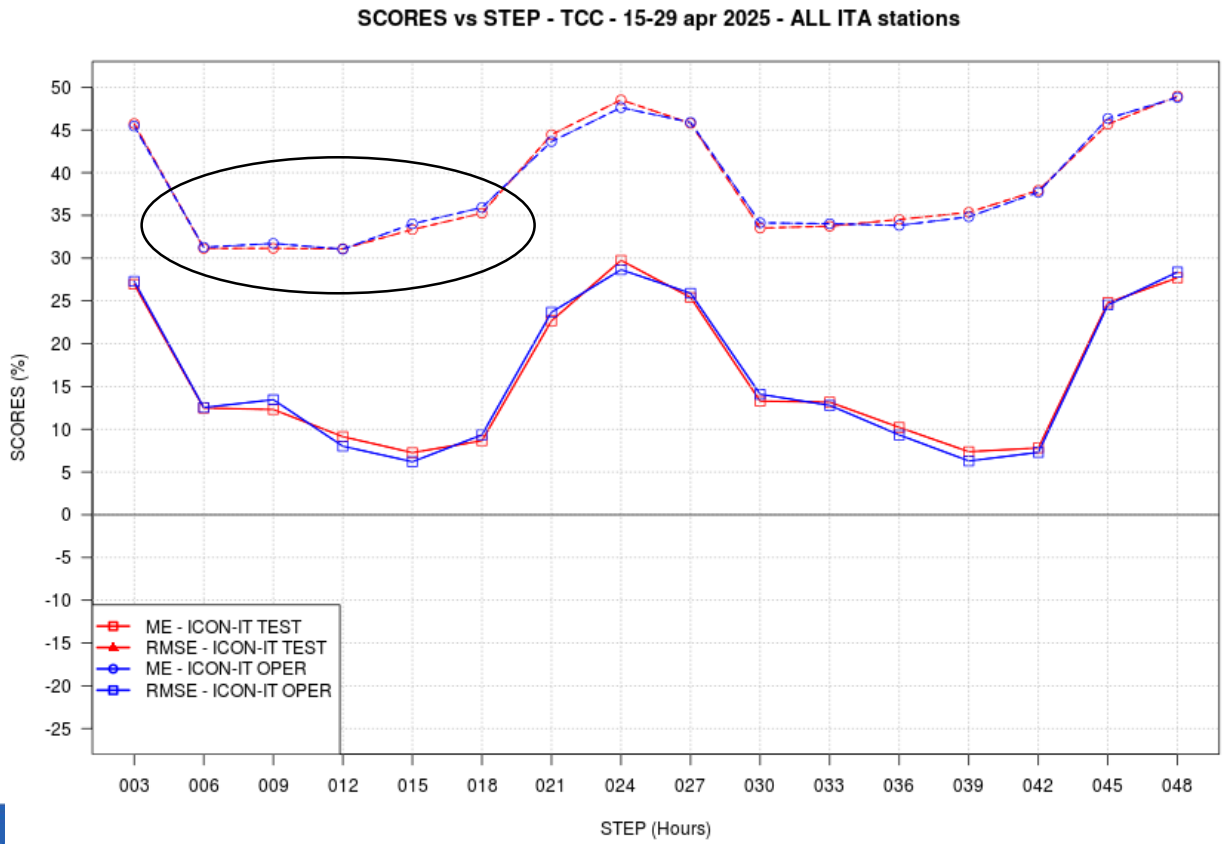
RADAR STATS: 15 - 29 April 2024 (wind speed)



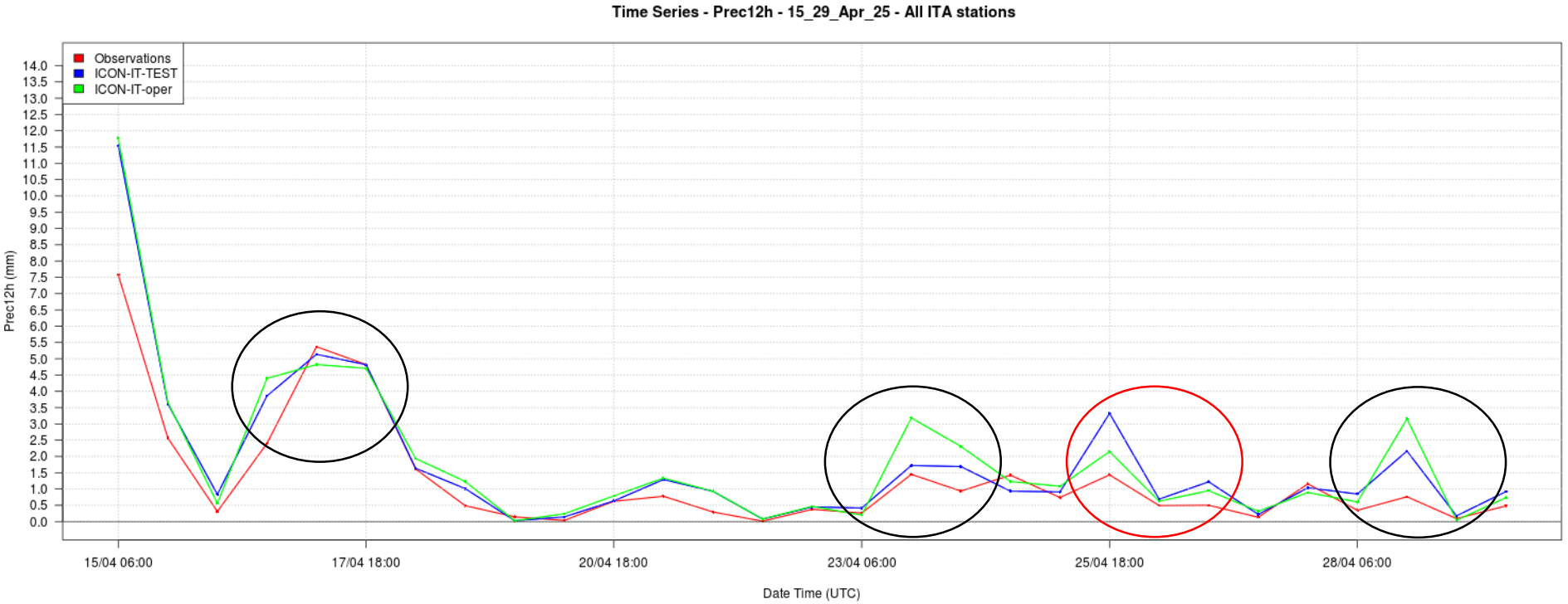
RADAR STATS: 15 - 29 April 2024 (RH2m)



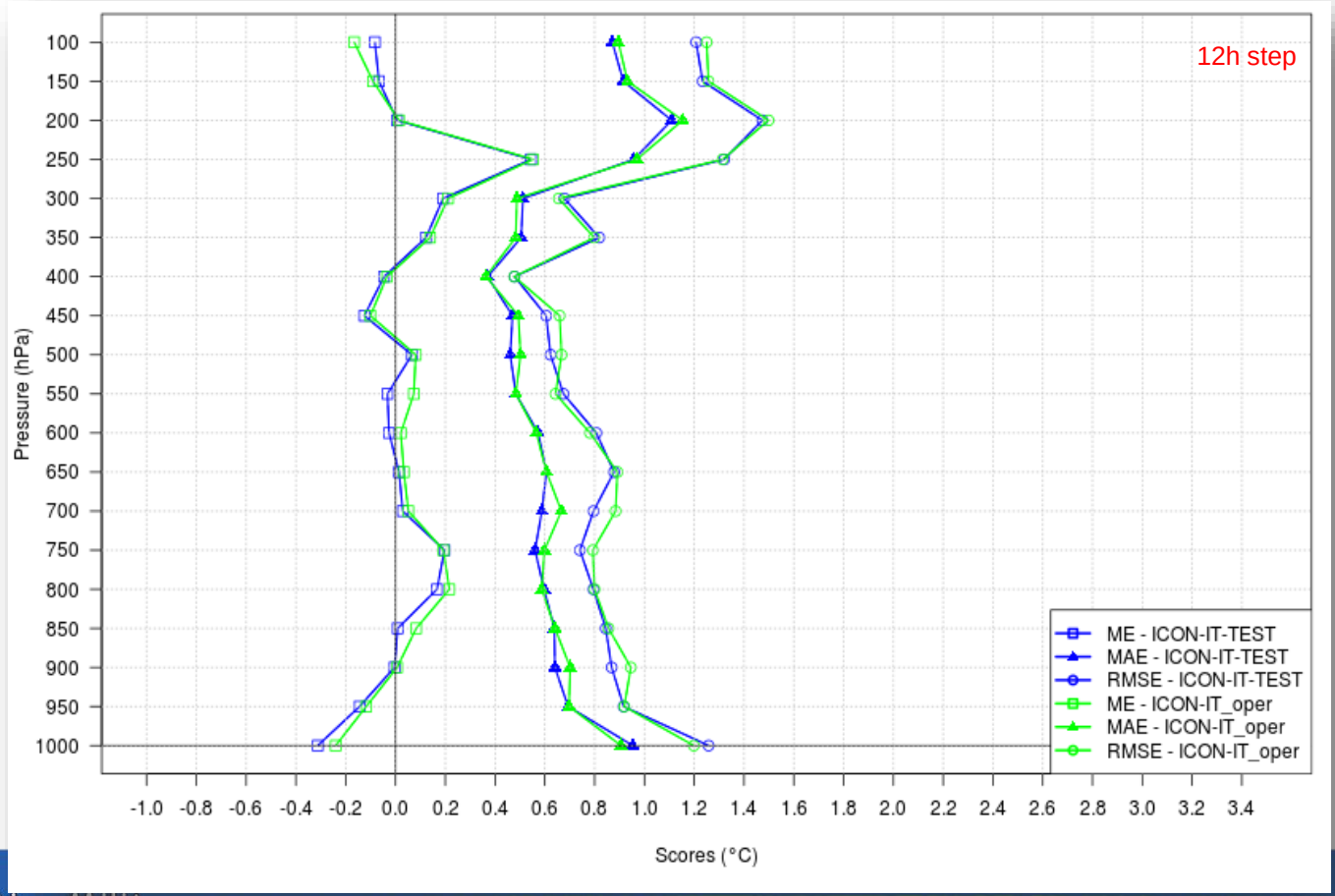
RADAR STATS: 27 March - 3 April 2024 (TCC)



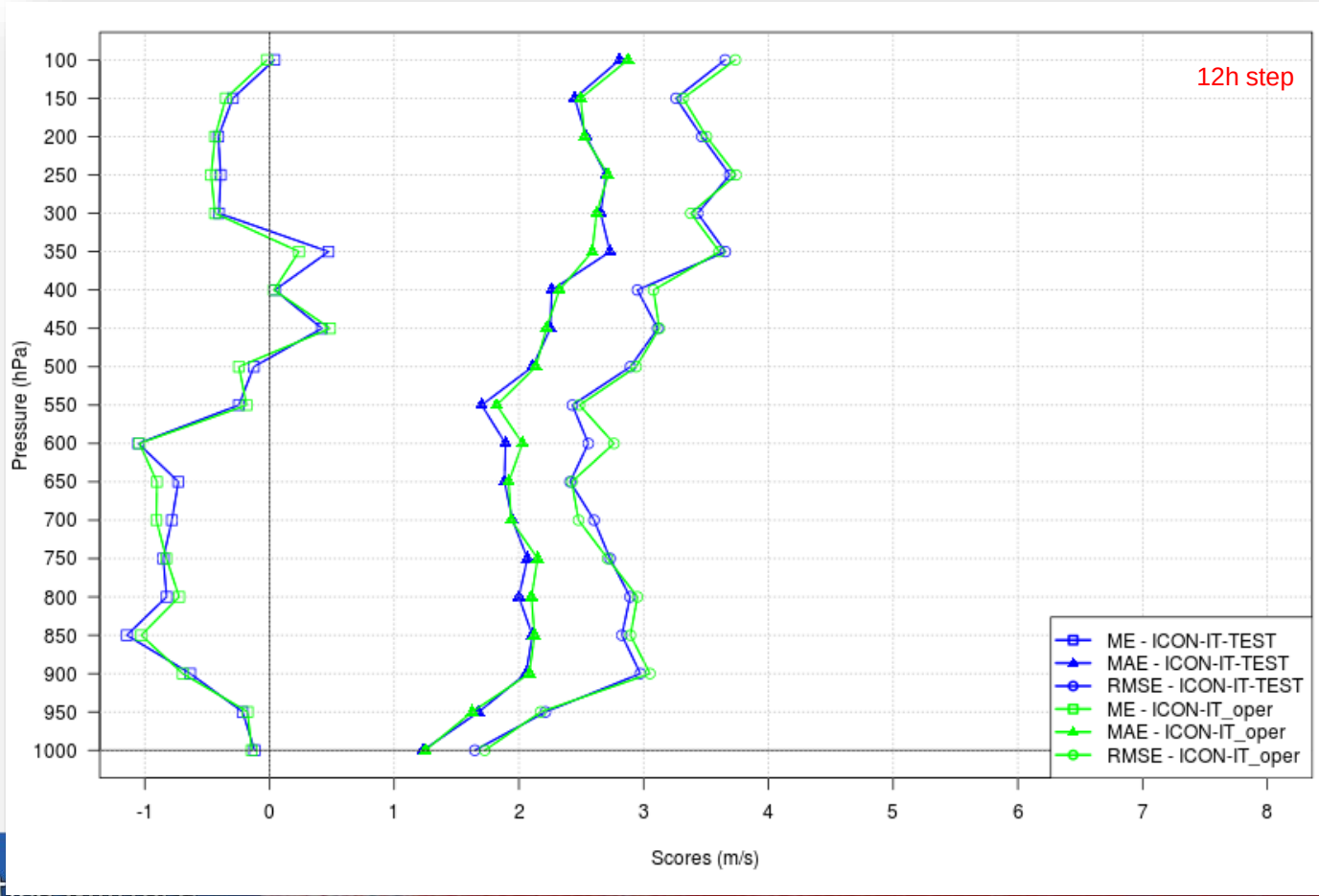
RADAR STATS: 15 – 29 April 2025 (TS prec)



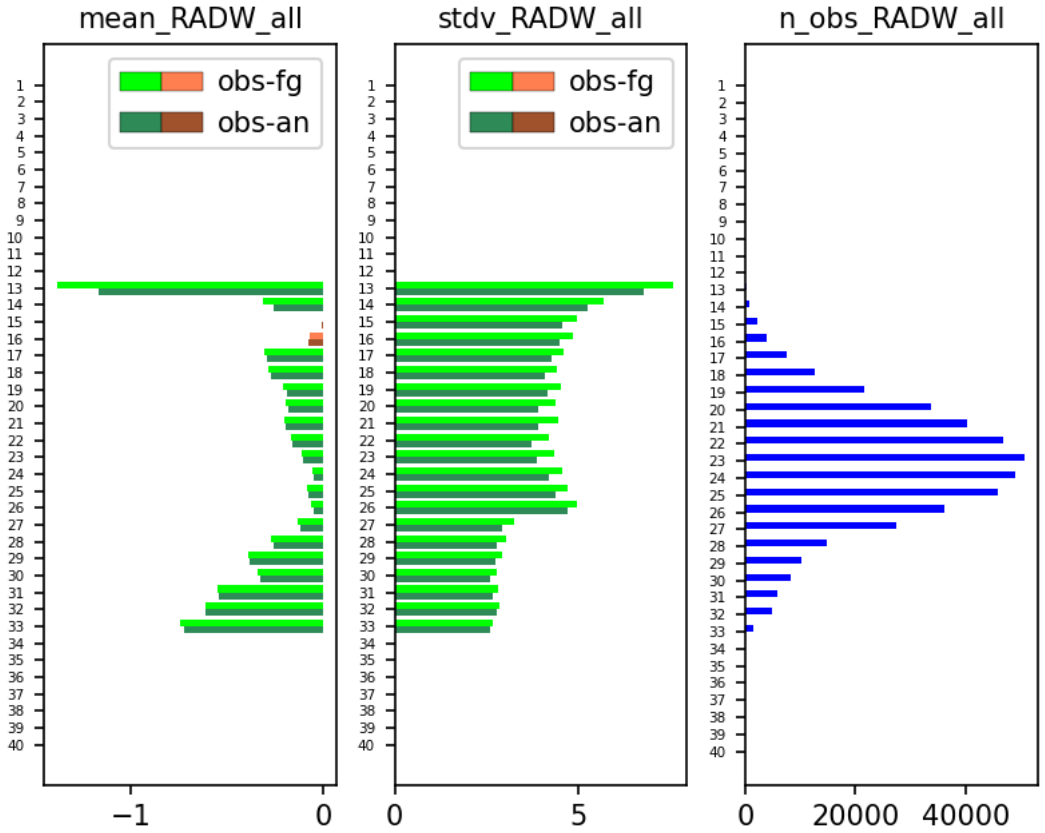
RADAR STATS: 15 – 29 April 2025 (T – against RAOB)



RADAR STATS: 15 – 29 April 2025 (WS – against RAOB)



RADAR exp1: RADW obs inc statistics (ALL radars)



Conclusions – RADAR obs assimilation

- EXP 1: REFL + RADW assimilation.
  - About surface verification, small improvements for RH2m, T2m and WS;
  - Improvements in terms of precipitation;
  - Obs increments: reduction of stdv for each vertical levels, small reduction of bias in almost all vertical levels;
  - Small improvements visible in the upper air verification (for T and WS);
  - *other experiment done in May with similar results;*
  - **OPERATIONAL** since August 2025.

Assimilation of Non conventional Synoptic observations

- **MeteoNetwork:** crowd sourced synoptic stations, station number:1030
- **MeteoMont:** Army Alpine Observation department, station number: 46
- **Autostrade:** station number: approx 250
- **DPC:** Civil Protection Department, station number: approx 5500

Variables: T, u,v, sp, rh

Period of study: January - December 2024

	mean(obs-fg)		stdv(obs-fg)	num_obs
T	mean 0.011554	stdv	1.323750	1856712
P	mean 0.087984	stdv	0.824691	1812925
u	mean 0.029436	stdv	1.789542	452120
v	mean -0.090808	stdv	1.757326	452120
q	mean 0.013023	stdv	0.101105	1934252

Conventional synop obs assimilated in ICON-IT

Assimilation of Non conventional Synoptic observations

T

stdv\mean	0-0.2	0.2-0.4	> 0.4
0-1.5	G	Y	O
1.5-2.5	Y	Y	R
> 2.5	O	R	R

sp

stdv\mean	0-0.5	0.5-1.5	> 1.5
0-1.0	G	Y	O
1.0-2.0	Y	Y	R
> 2.0	O	R	R

wind

stdv\mean	0-0.4	0.4-0.7	> 0.7
0-2.0	G	Y	O
2.0-3.5	Y	Y	R
> 3.5	O	R	R

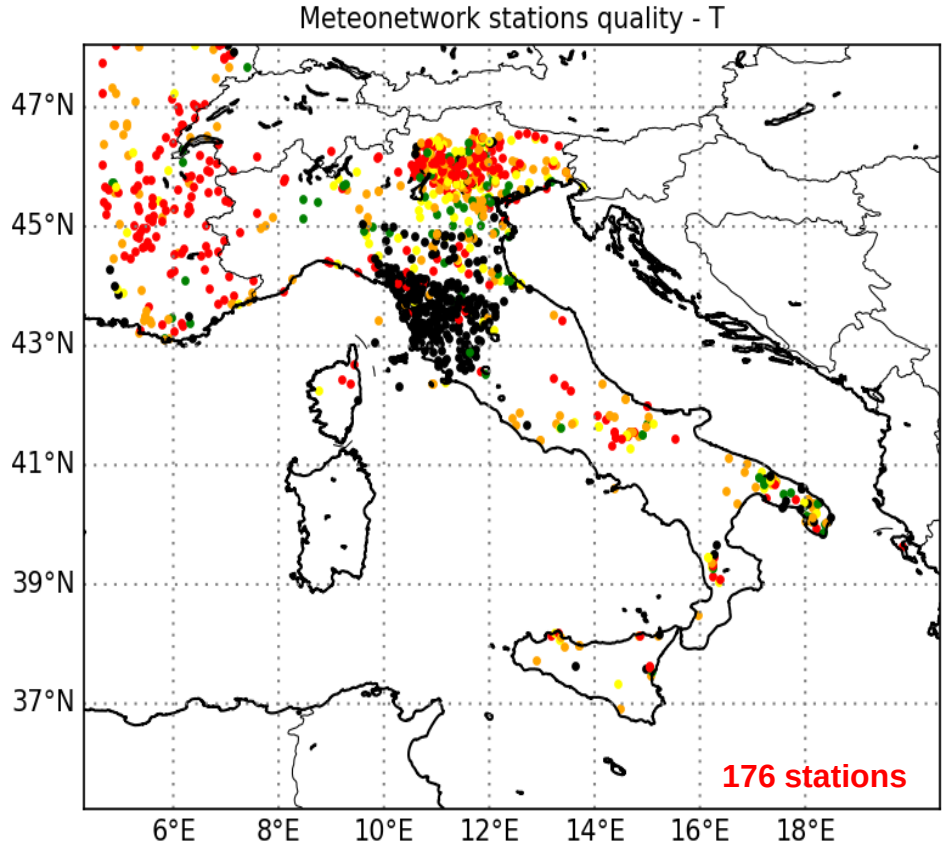
q

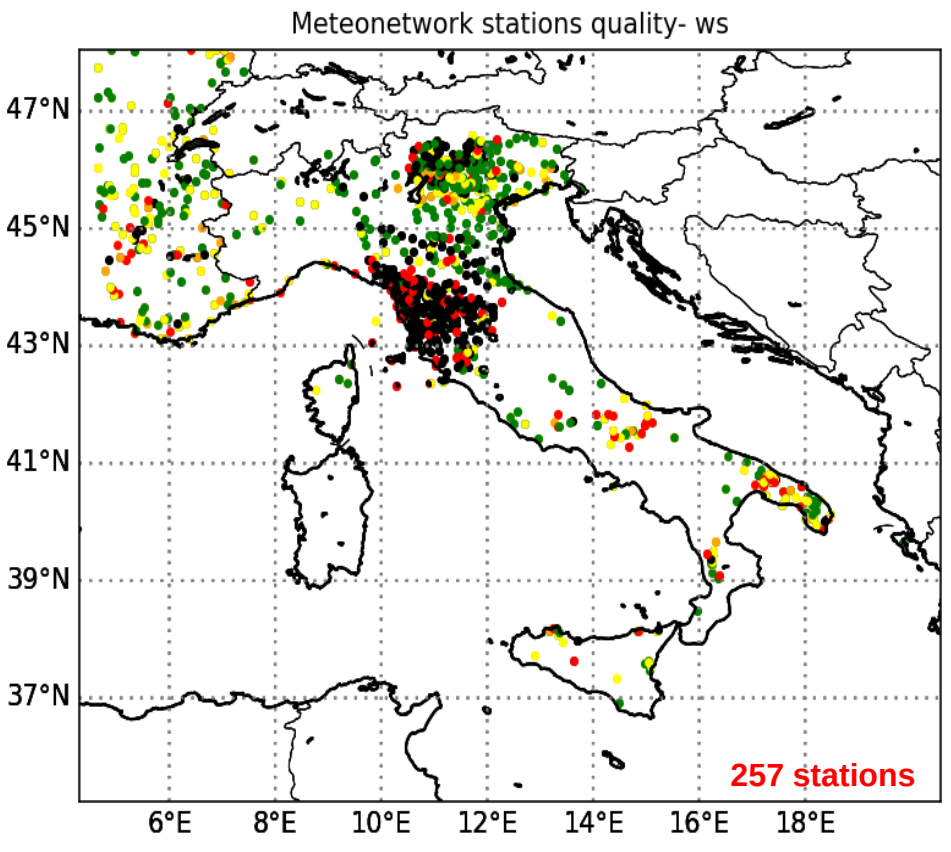
stdv\mean	0-0.05	0.05-0.1	> 0.1
0-0.1	G	Y	O
0.1-0.2	Y	Y	R
> 0.2	O	R	R

GREEN-YELLOW
ASSIMILATED

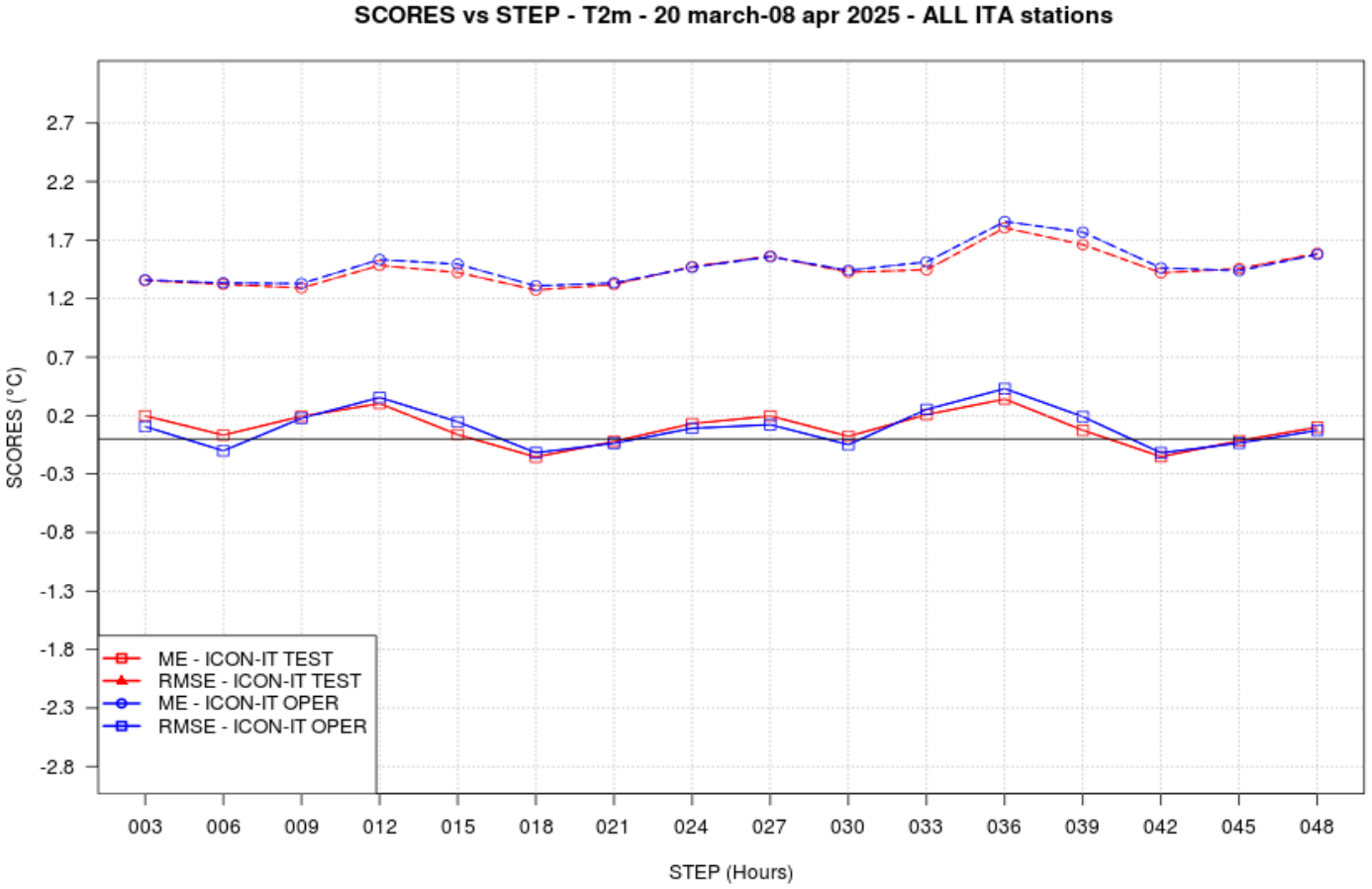
ORANGE-RED
BLACKLISTED

Exp1 (20/03 – 08/04 2025): MeteoNetwork (T and WS)

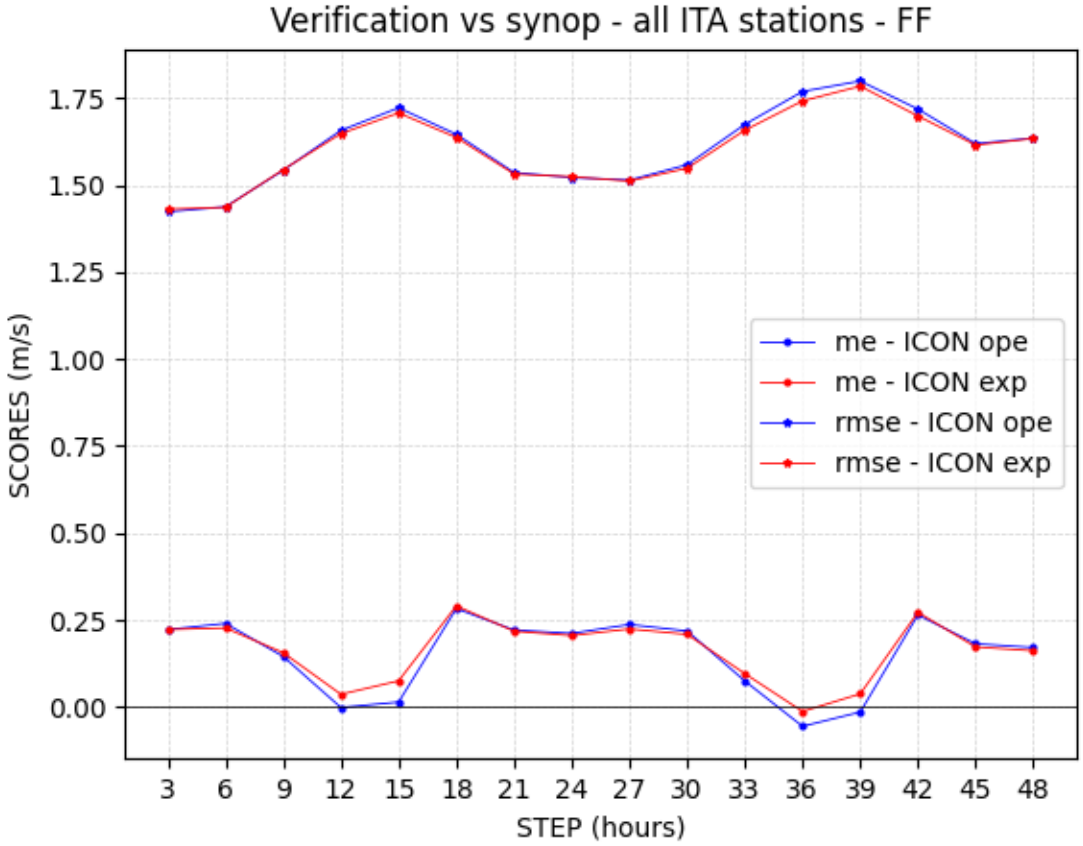




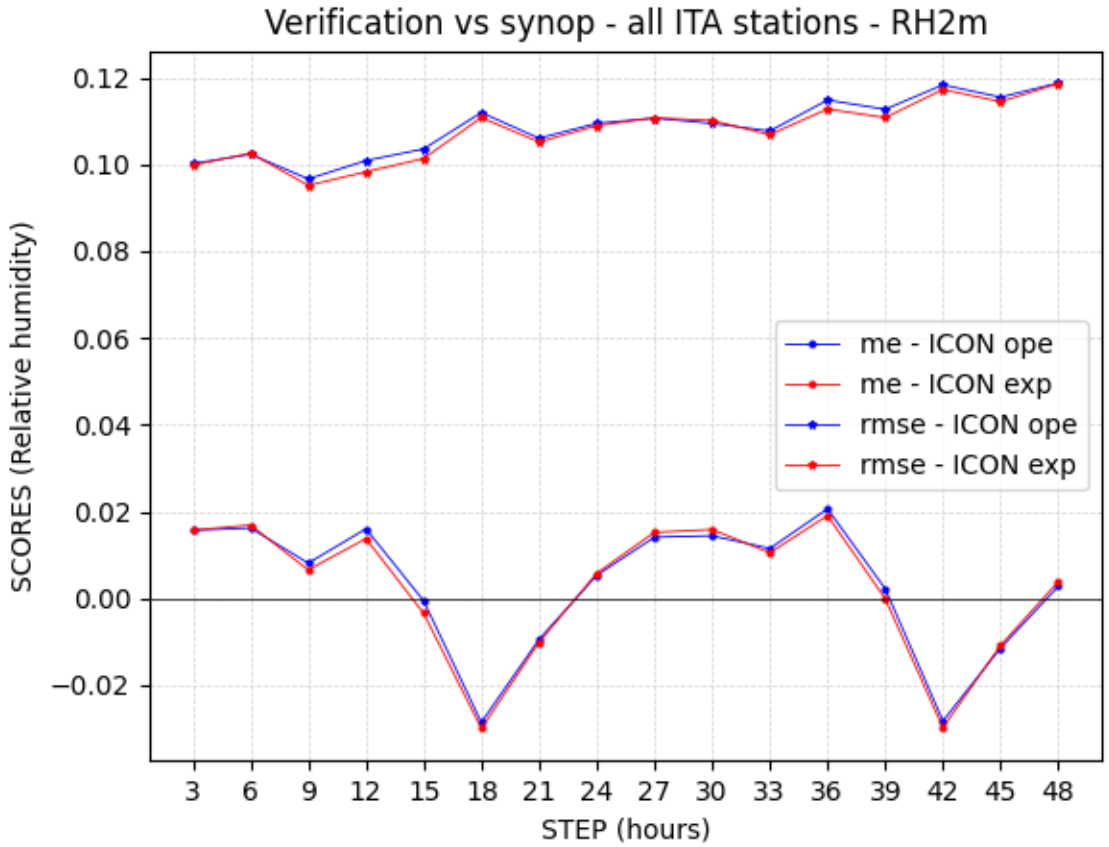
MeteoNetwork stats (T2m)



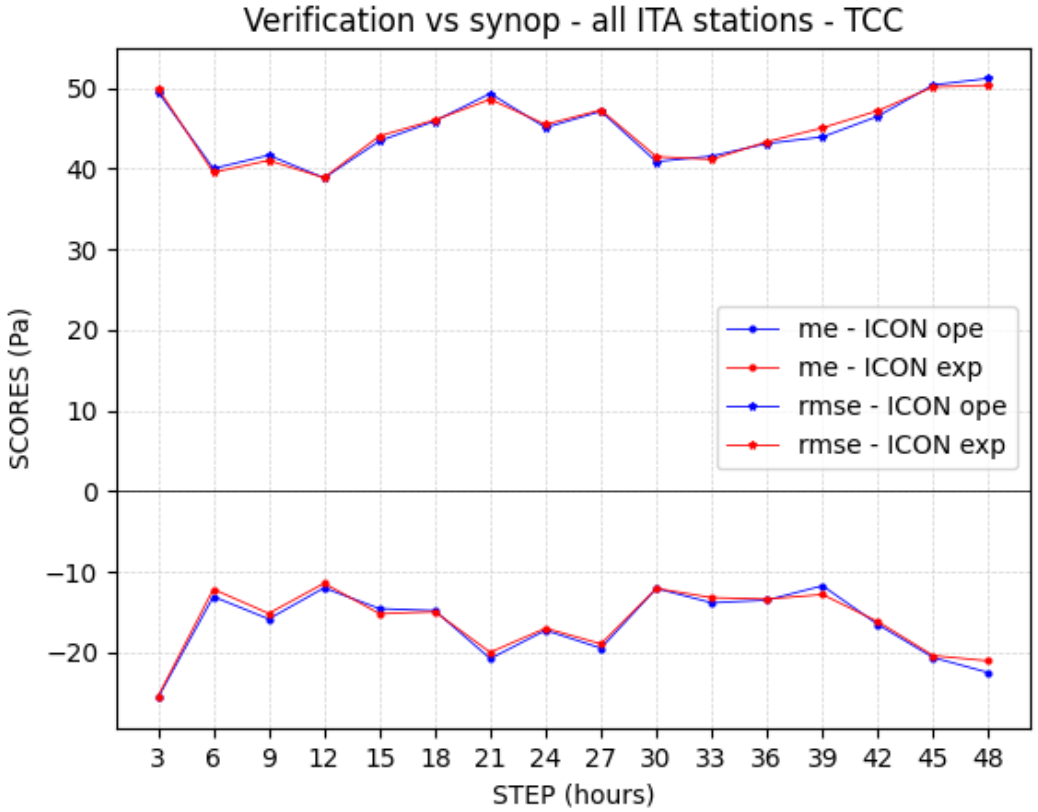
MeteoNetwork stats (WS)



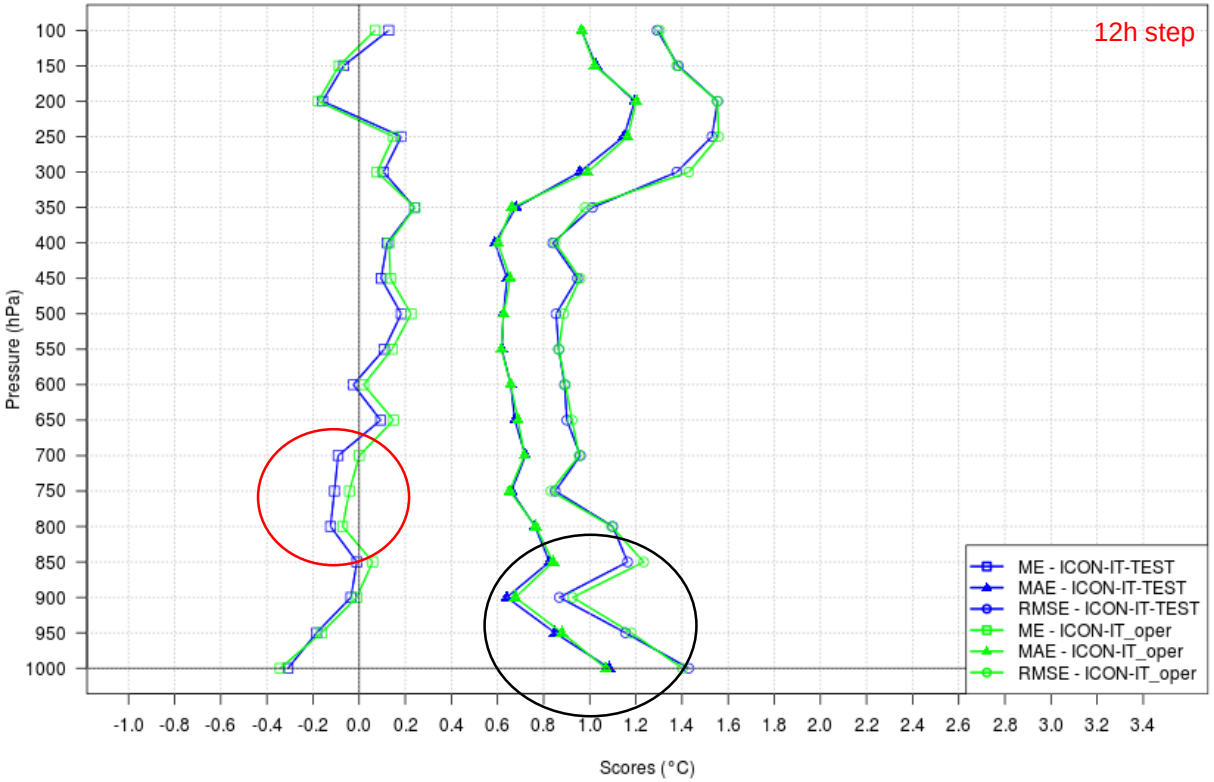
MeteoNetwork stats (RH2M)



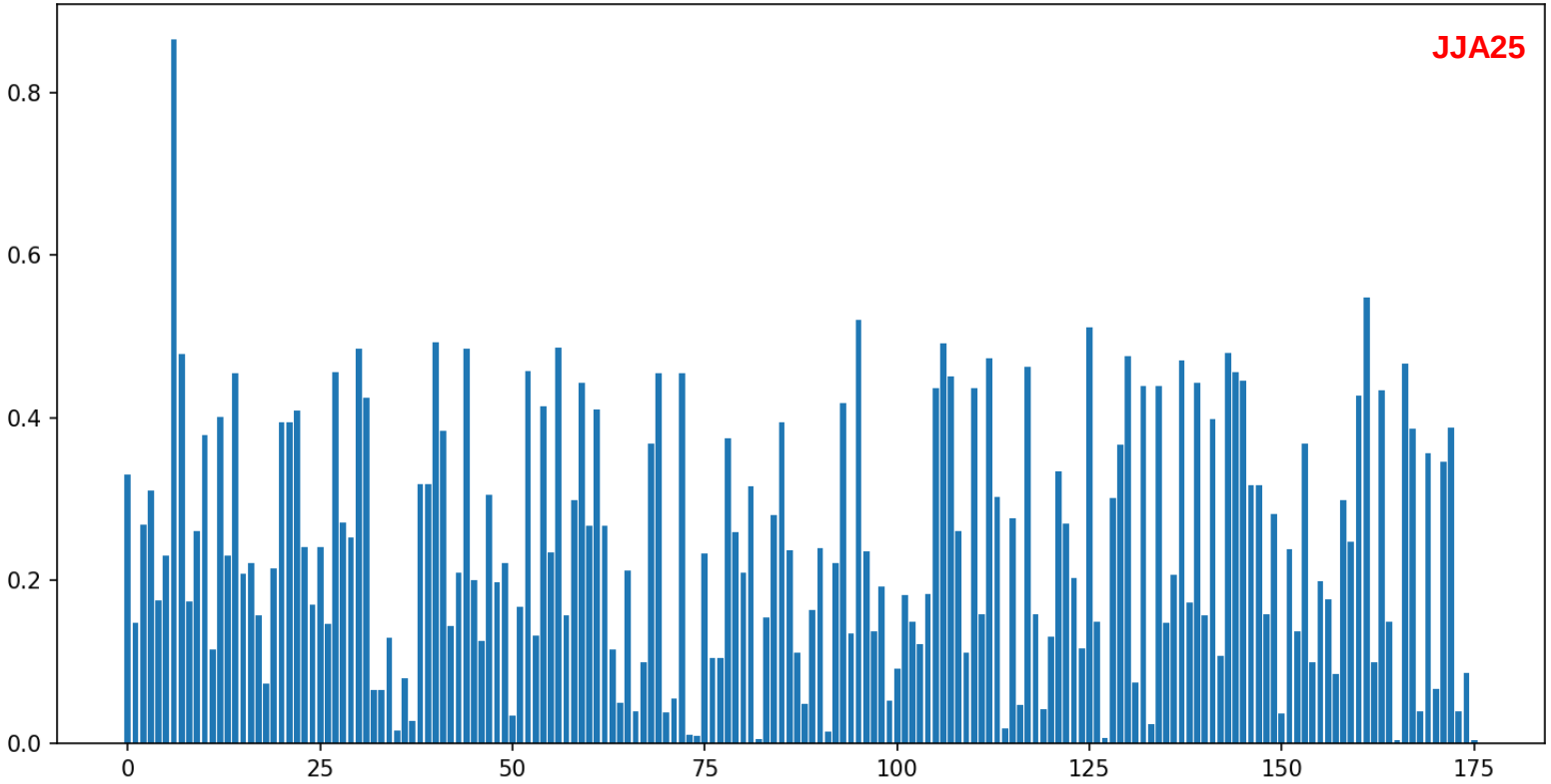
MeteoNetwork stats (TCC)



MeteoNetwork stats (T – against RAOB)



MeteoNetwork monitoring for assimilated stations



Conclusions – METEONETWORK obs assimilation

- EXP 1: METEONETWORK T2m and wind speed assimilation.
  - About surface verification, good results for T2m, and small improvements for rh2m and WS (only rmse);
  - small increase of bias for wind speed.
  - constant monitoring of stations in terms of bias and stdv.
  - *other experiment in May (5-20) gave similar results;*
  - **OPERATIONAL** since end of May 2025.

Future developments

- LHN + RADAR polar volumes assimilation within ICON
- Assimilation of other non conventional synoptic observations (DPC, Highways, MeteoMont)
- Assimilation of the GNSS ZTDs obs within ICON (and STD)