Status of KENDA at CoMet

Francesca Marcucci, Valerio Cardinali

Outline:

- Experimental parallel runs with KENDA/COSMO-IT : soil moisture assimilation and latent heat nudging
  - Setup
  - Observation increments statistics
  - Fcst verification scores
  - Case studies
- Experimental parallel runs with KENDA/ICON-IT : assimilation of non conventional observation and latent heat nudging
  - Setup
  - Fcst verification scores

COSMO-IT experimental run with SOIL MOISTURE Ass.

WSOIL
BUFR-> NETCDF

→ **MEC** →

```
&OBSERVATIONS_SOIL

!to activate quality control of wsoil
obs.
  l_qc= T

 l_compl= T
 l_err= T
 l_wet= T
 l_flag= T
 l_errinflation = T
 flag_CDF_formula = F
 flag_NORM_formula = T
 flag_lsm = T

! obs soiltype is the average of the 16
nearest grid points
 flag_soiltype16= T
```

→ **fof_file** →

From 100 to 300
active obs each hour
Around 09-10-11UTC
and 20-21-22 UTC

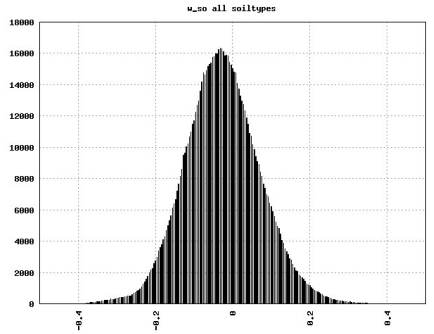
→ **KENDA**

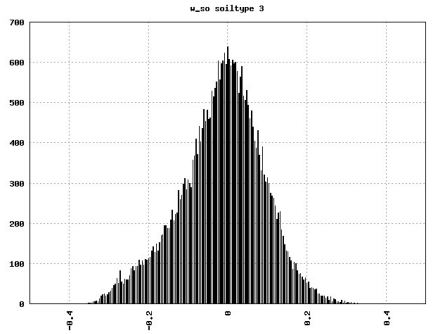
KENDA

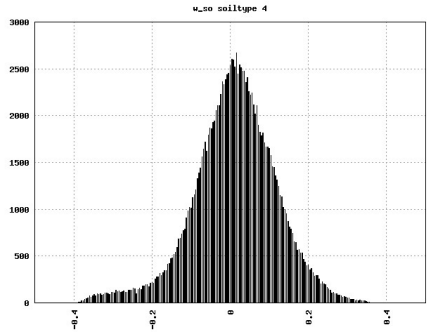
```
&REPORT
  type = 'SOIL'
  use = 'ACTIVE'
/end


&REPORT
  type='SOIL'
  check='FG'
  use='DISMISS'
/
```

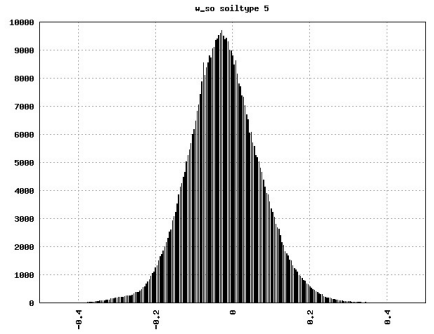
```
&ENKF_SOIL
 lh_wso = 30.0   ! Hor loc about 100 km
 lv_wso = 0.1    ! Vert loc up to lev 35
 lh_soil = 30.0
 lv_soil = 0.2
 lh_soil_synop = 80.0
 lv_soil_synop = 0.2    ! = l_soil_ana = T
 ns_ana=5
 lrtps_wso         = F    ! if true rtps is applied also to wso
 rtps_alpha_wso    = 0.95 ! relaxation to prior spread factor for wso
 soil_ana_obs_used = 'w_so t2m rh2m'    ! +t2m +rh2m
/end
```

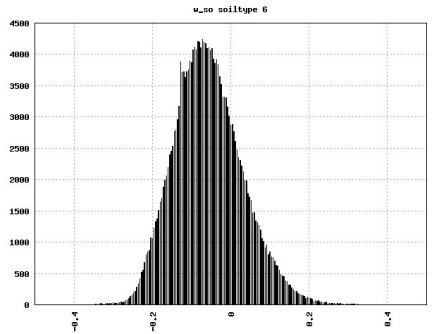
```
&RULES
  obstype = 15 ! observation type OT_SOIL !!
  o%% stdv_oi(1) =  8
  o%% stdv_oi(2) =  8
  o%% stdv_oi(3) = 0.10824
  o%% stdv_oi(4) = 0.11058
  o%% stdv_oi(5) = 0.09373
  o%% stdv_oi(6) = 0.08268
  o%% stdv_oi(7) = 0.08189
  o%% stdv_oi(8) = 0.18818
  o%% stdv_oi(9) =  8  ! to reject those obs with soiltype 9 or 10 that have not been rejected before (just in case)
  o%% stdv_oi(10) = 8
 /

 !&model_error
 !  name    = 'W_SO'         ! disturb soil moisture
 !  scales  = 0.003 100 0.4 24 !0.002 of soil capacity,100km,0.4m vertical,24 hour
 !          0.003 10 0.4 24  !0.002 of soil capacity,10km,0.4m vertical,24 hour
 !  clip_sym = T
 !  limit    = 0.15
 !!!hard    = T              ! :only for 2017070506 assimilation with var3d patch binary
 !/
 !&model_error
 !  name    = 'T_SO'         ! disturb soil moisture
 !  scales  = .02 50 0.1 24    ! 0.24K/d, 50km, 0.1m vertical,24 hour
 !/
```

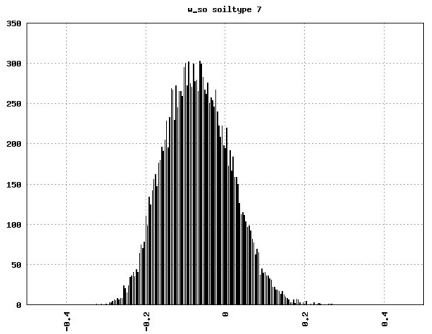












COSMO-IT experimental runs:

- Periods: 26jul-01aug 2021 && 16aug-28aug 2021
  South-west Atlantic flow — North-west Atlantic flow
- COSMOIT-EXP1 : operational config + HSAF WSOIL
- COSMOIT-EXP2 : operational config + HSAF WSOIL +

LHN

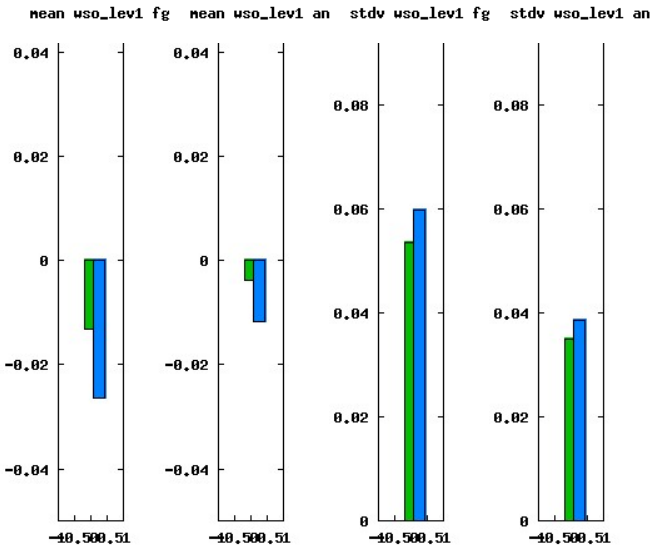
LHN

```
!!LHN namelist
llhn=.TRUE.,
 llhnverif=.true.,
 lhn_diag=.true.,
 hlhn_start=0.0,
 hlhn_end=1,
 hlhnverif_start=0.0,
 hlhnverif_end=1,
 lhn_coef=1.0,
ktop_lhn=1,
 kbot_lhn=65,
 lhn_search=.TRUE.,
 lhn_hum_adj=.TRUE.,
 rlhn_search=10,
 fac_lhn_search=5.0,
 rad_wobs_lhn=100.00,
 thres_lhn=0.000028,
 rqrsgmax=0.4,
ktop_temp=-999.900000,
 fac_lhn_up=2.0,
 fac_lhn_down=0.50,
 lhn_filt=.TRUE.,
 lhn_relax=.TRUE.,
 nlhn_relax=2,
 lhn_limit=.TRUE.,
 abs_lhn_lim=0.013889,
 lhn_dt_obs=5,
lhn_spqual=.FALSE.,
 lhn_incloud=.TRUE.,
 lhn_black=.FALSE.,
 lhn_qrs=.TRUE.,
 lhn_logscale=.TRUE.,
 lhn_wweight=.TRUE.,
 lhn_height=.FALSE.,
 lhn_bright=.FALSE.,
 radar_in='${radardir}'
```

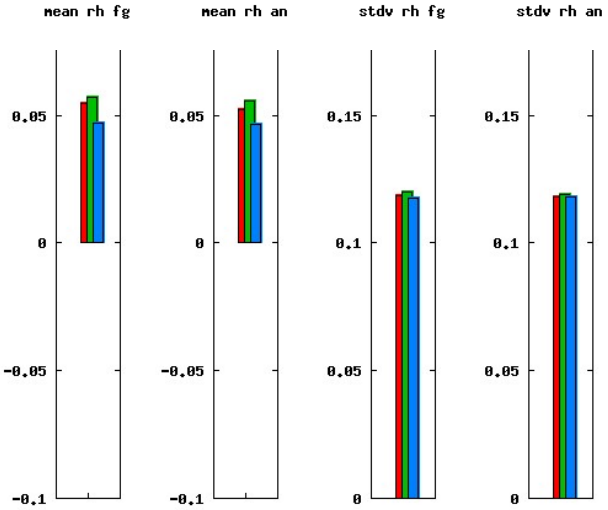
Observation-Increments Statistics

(Obs – fg/an_det)
mean/stdv

Soil moisture increments:



2mRelative Humidity increments:

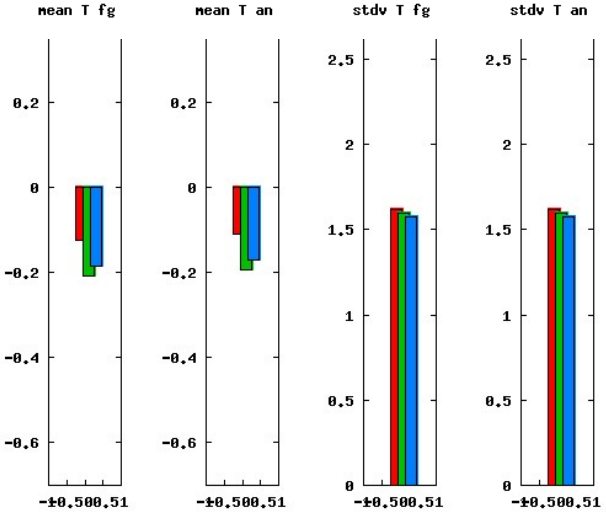


cosmoit_exp1:
HSAF-WSOIL

cosmoit_exp2:
HSAF WSOIL + LHN

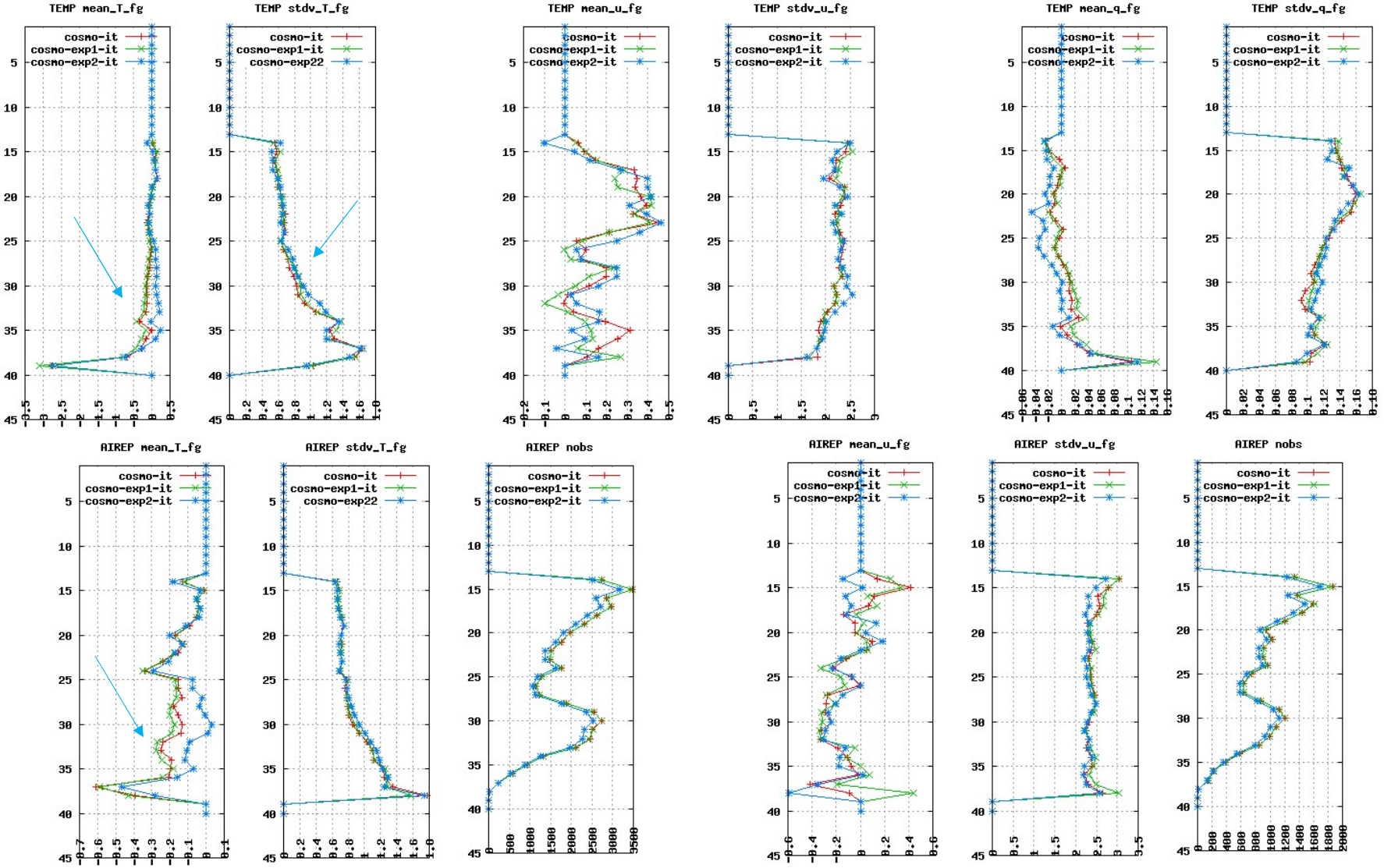
cosmoit_ope

2mTemperature increments:



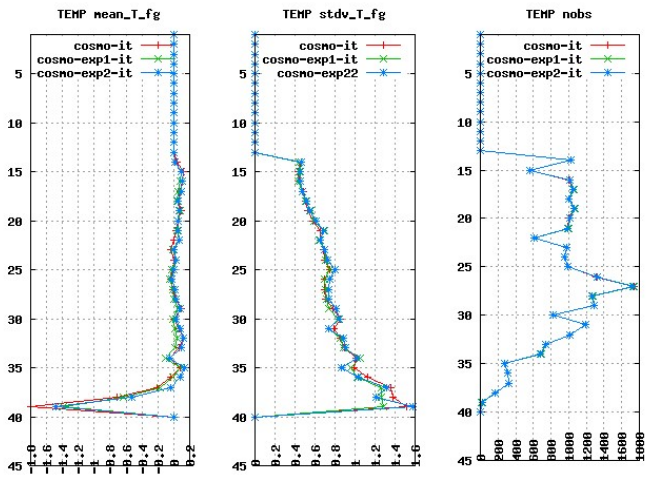
Observation-Increments Statistics (Obs − fg_det) mean/stdv

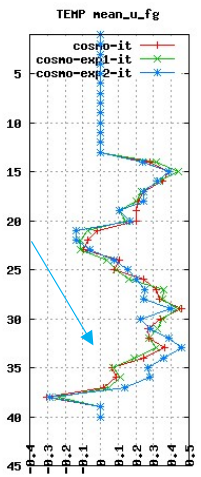
26jul-01aug 2021

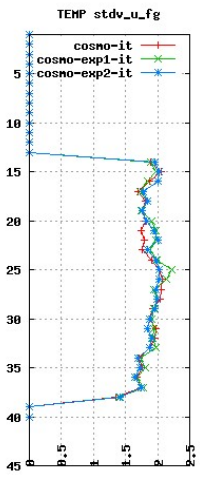


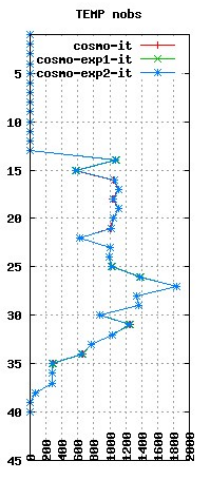
Observation-Increments Statistics (Obs - fg_det) mean/stdv

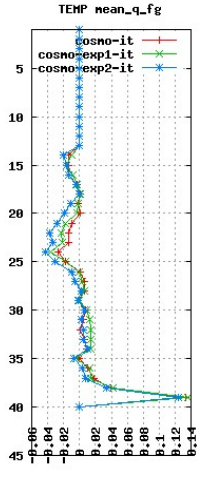
16-28aug 2021

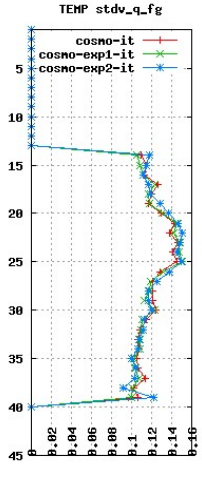


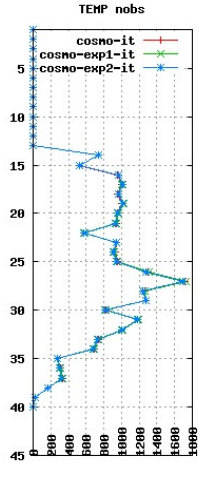


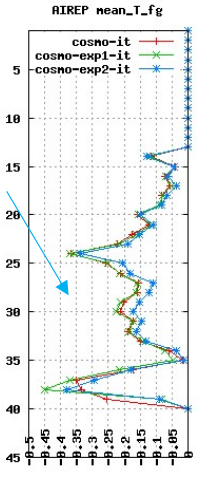


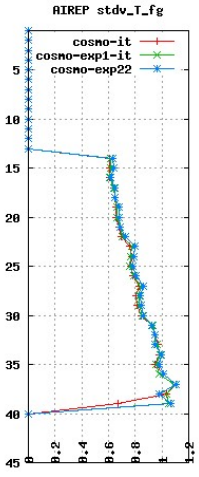


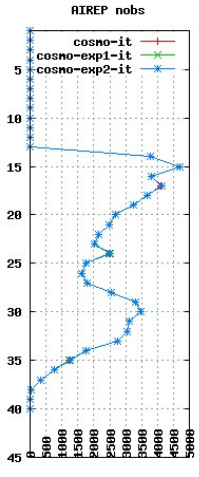


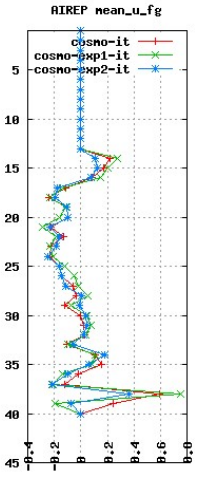


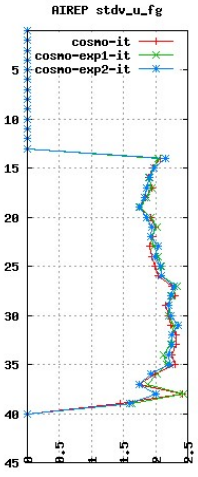


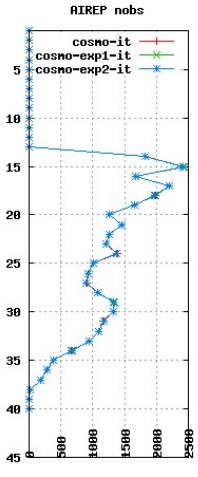






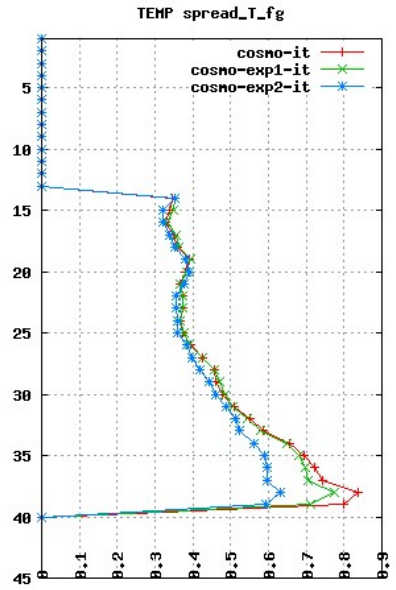


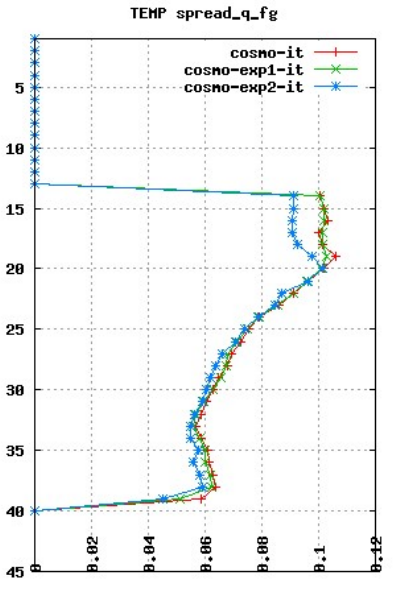


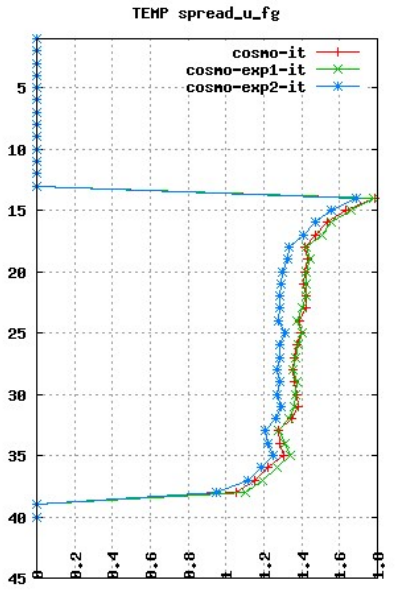


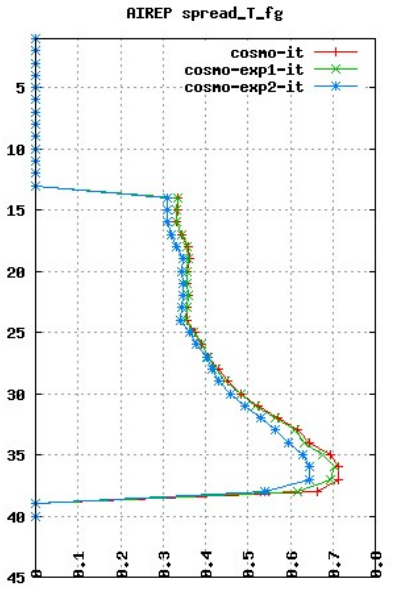
Obs-Inc Statistics: fg-members SPREAD

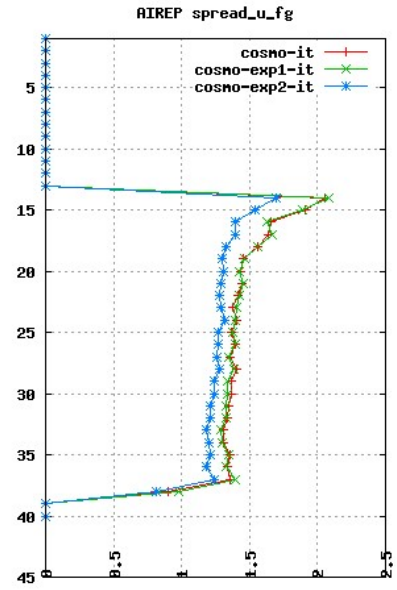
26jul-01aug 2021





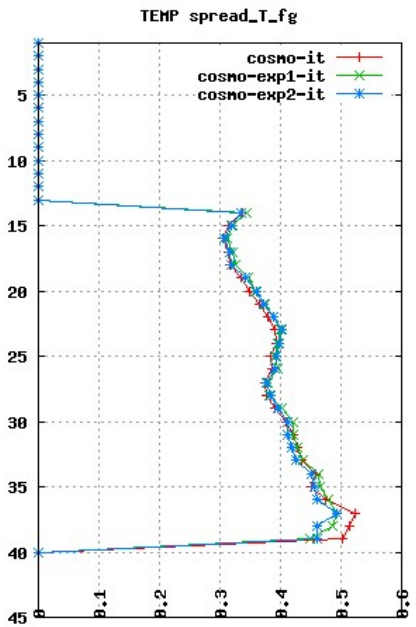


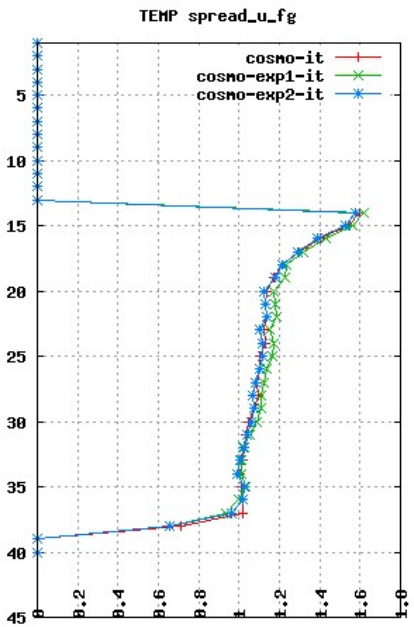


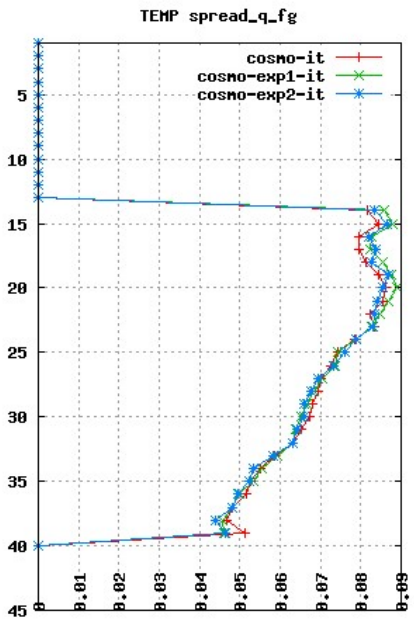


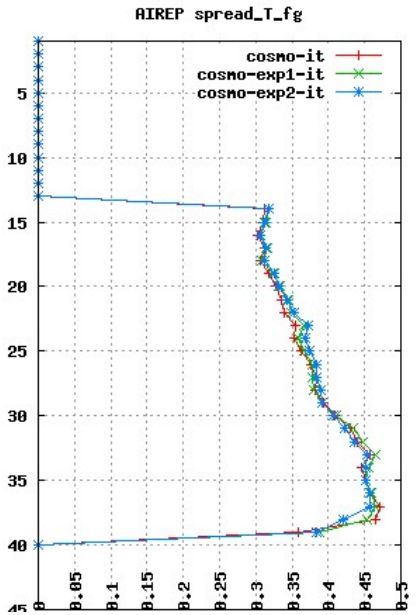
Obs-Inc Statistics: fg-members SPREAD

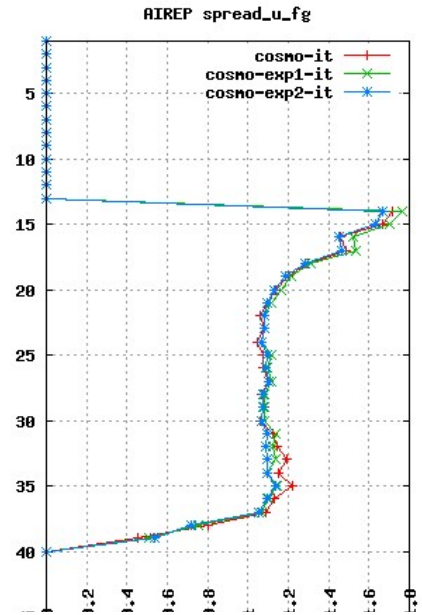
16-28aug 2021







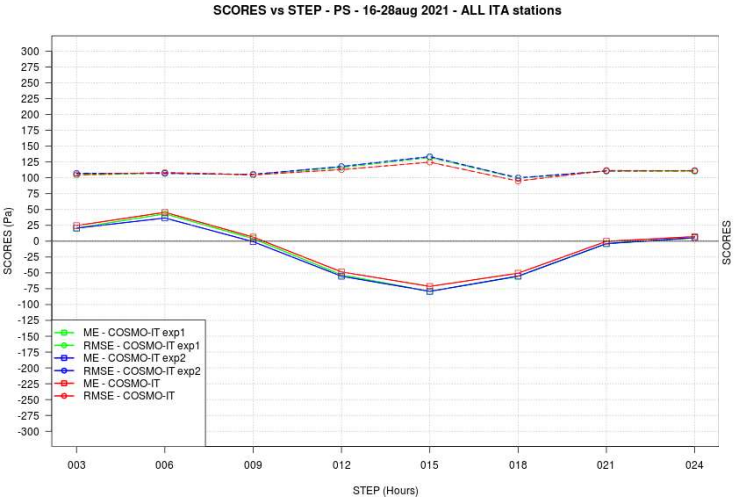


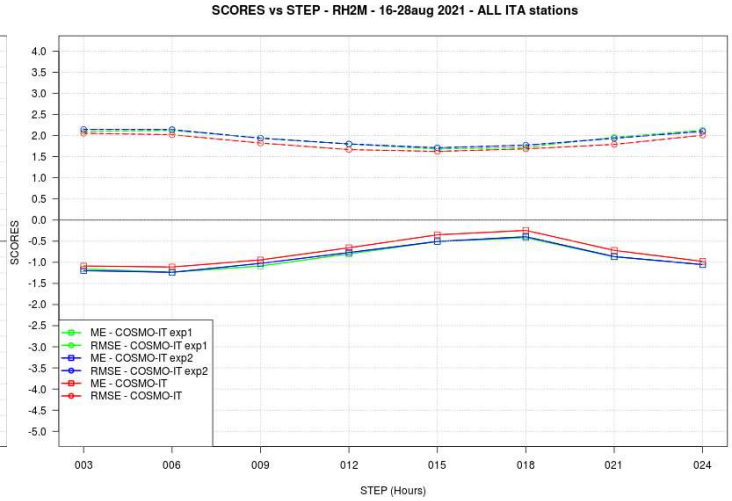


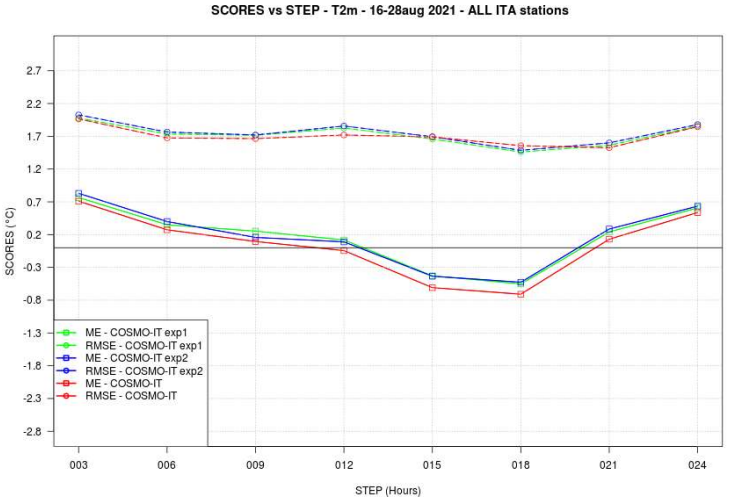
Cosmo-it experimental runs 16-28aug 2021

FCST Verification against SYNOP

(00UTC run up to +24h)



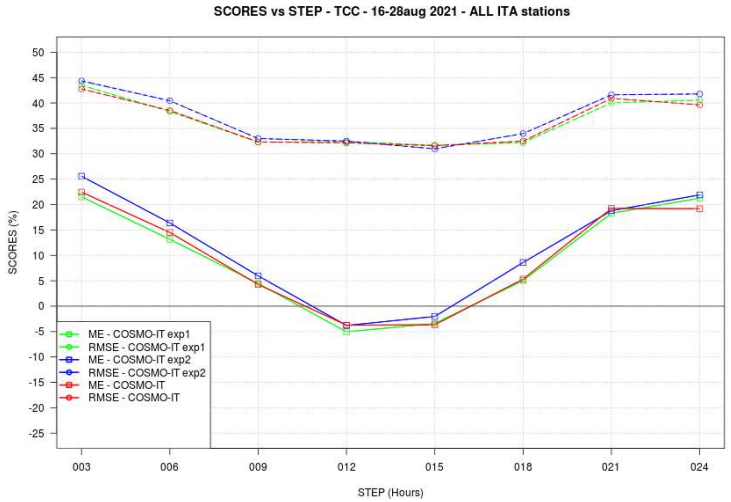


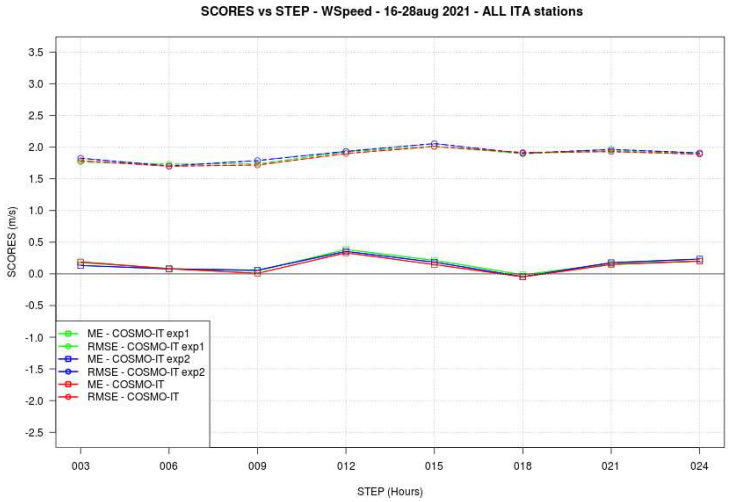


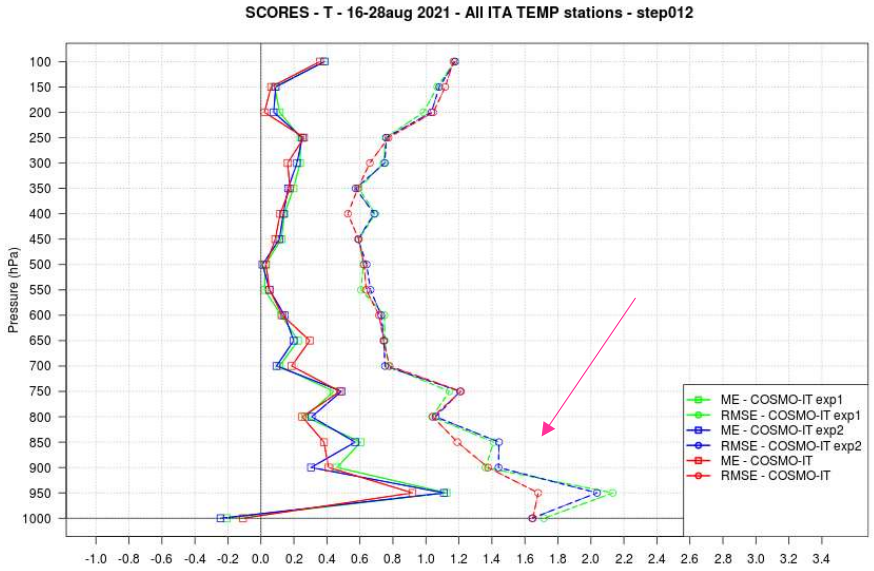
cosmoit_exp1:
HSAF-WSOIL assimilation

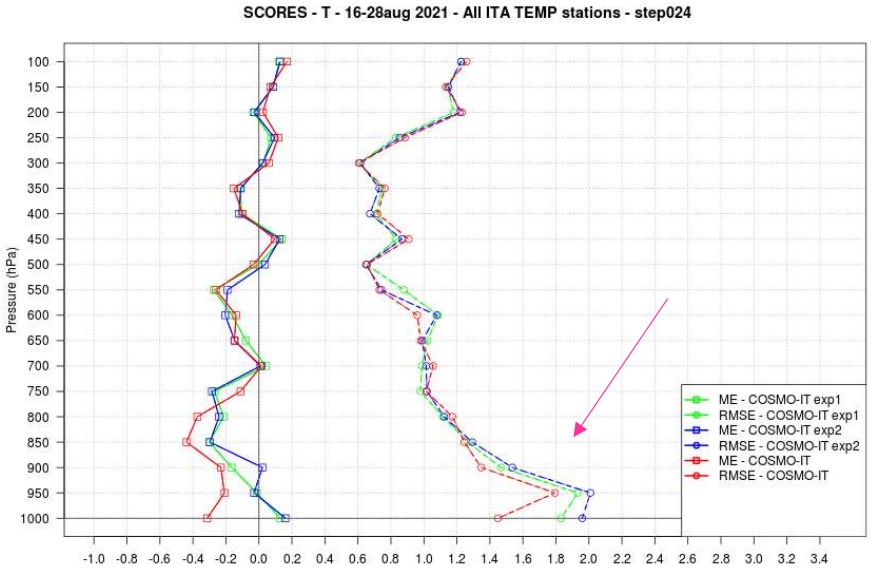
cosmoit_exp2:
HSAF WSOIL + LHN

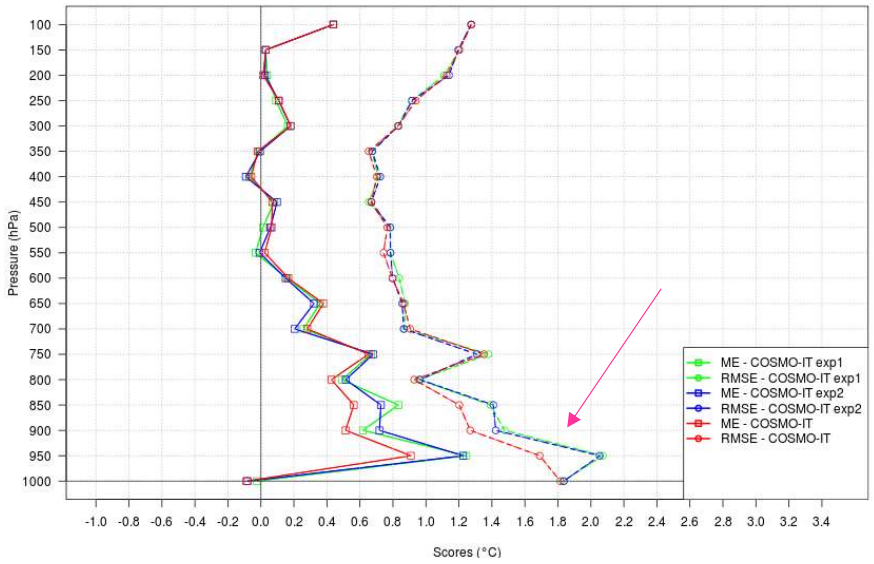
cosmoit_ope

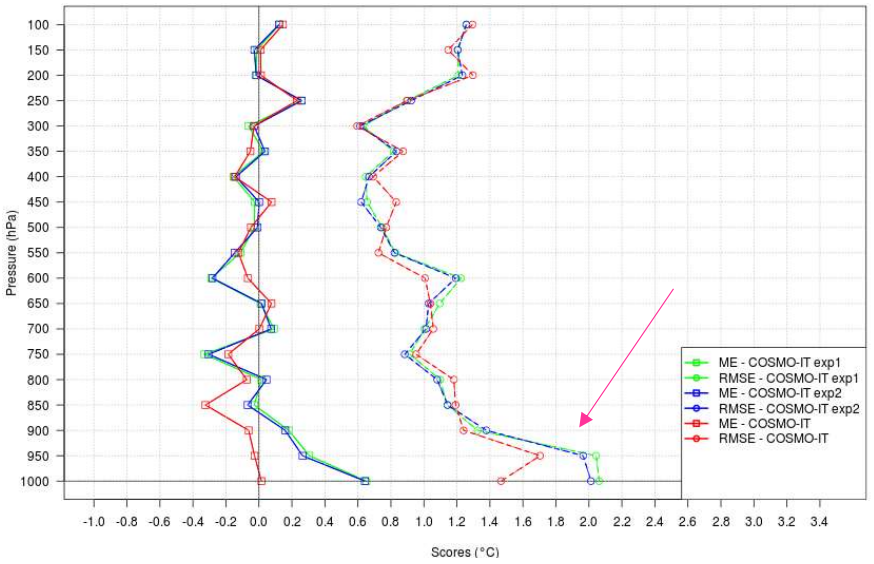




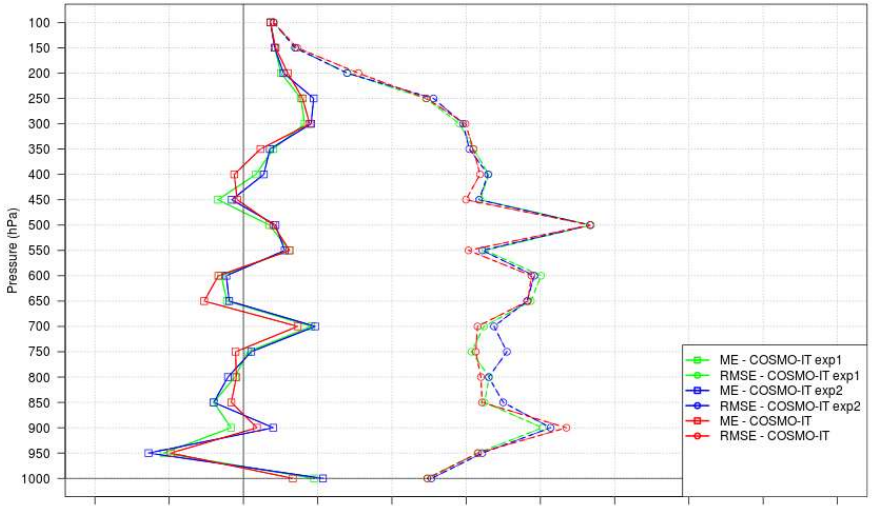

SCORES - T - 16-28aug 2021 - All ITA TEMP stations - step012
Pressure (hPa)
ME - COSMO-IT exp1
RMSE - COSMO-IT exp1
ME - COSMO-IT exp2
RMSE - COSMO-IT exp2
ME - COSMO-IT
RMSE - COSMO-IT


SCORES - T - 16-28aug 2021 - All ITA TEMP stations - step024
Pressure (hPa)
ME - COSMO-IT exp1
RMSE - COSMO-IT exp1
ME - COSMO-IT exp2
RMSE - COSMO-IT exp2
ME - COSMO-IT
RMSE - COSMO-IT

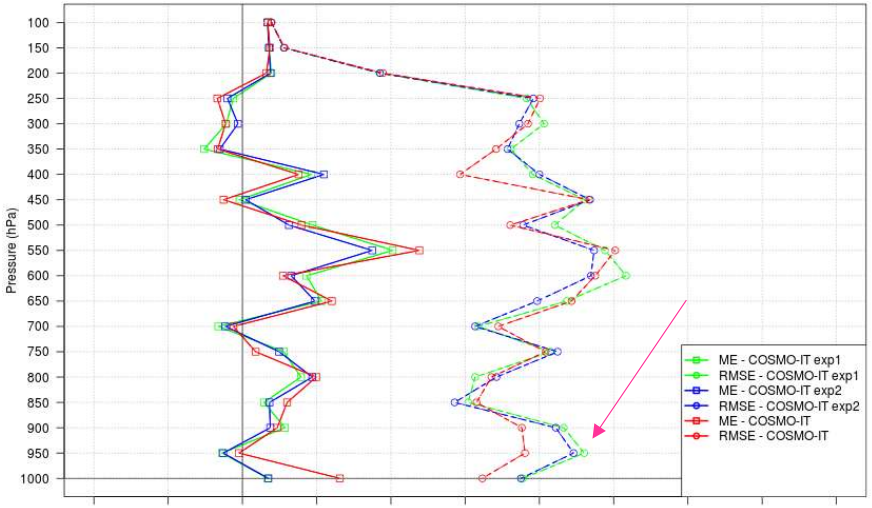

SCORES - T - 16-28aug 2021 - All ITA TEMP stations - step036
Pressure (hPa)
Scores (°C)
ME - COSMO-IT exp1
RMSE - COSMO-IT exp1
ME - COSMO-IT exp2
RMSE - COSMO-IT exp2
ME - COSMO-IT
RMSE - COSMO-IT


SCORES - T - 16-28aug 2021 - All ITA TEMP stations - step048
Pressure (hPa)
Scores (°C)
ME - COSMO-IT exp1
RMSE - COSMO-IT exp1
ME - COSMO-IT exp2
RMSE - COSMO-IT exp2
ME - COSMO-IT
RMSE - COSMO-IT

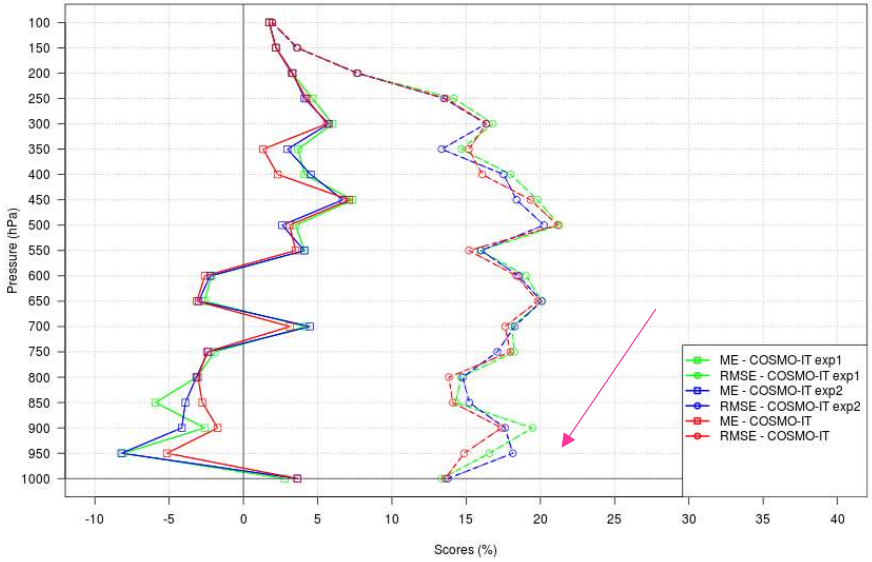
SCORES - RH - 16-28aug 2021 - All ITA TEMP stations - step012



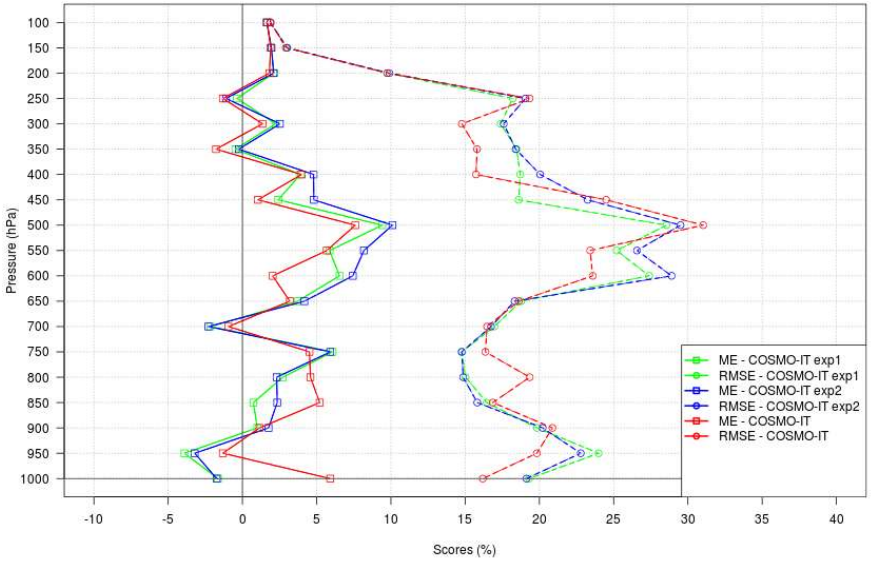
SCORES - RH - 16-28aug 2021 - All ITA TEMP stations - step024

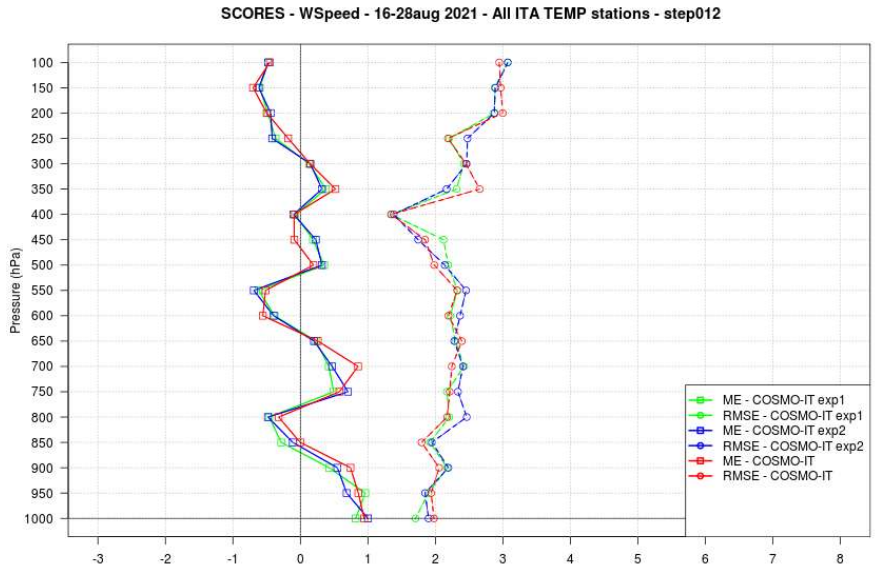


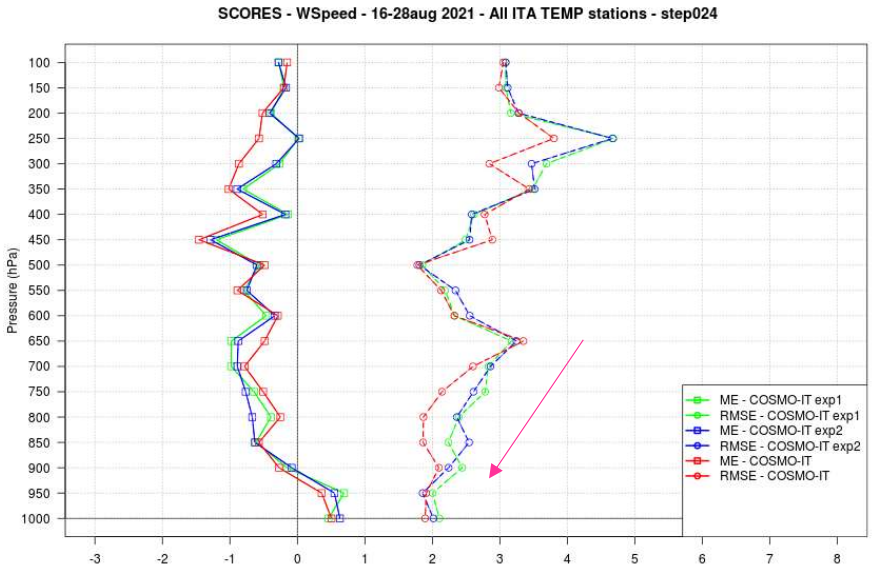
SCORES - RH - 16-28aug 2021 - All ITA TEMP stations - step036

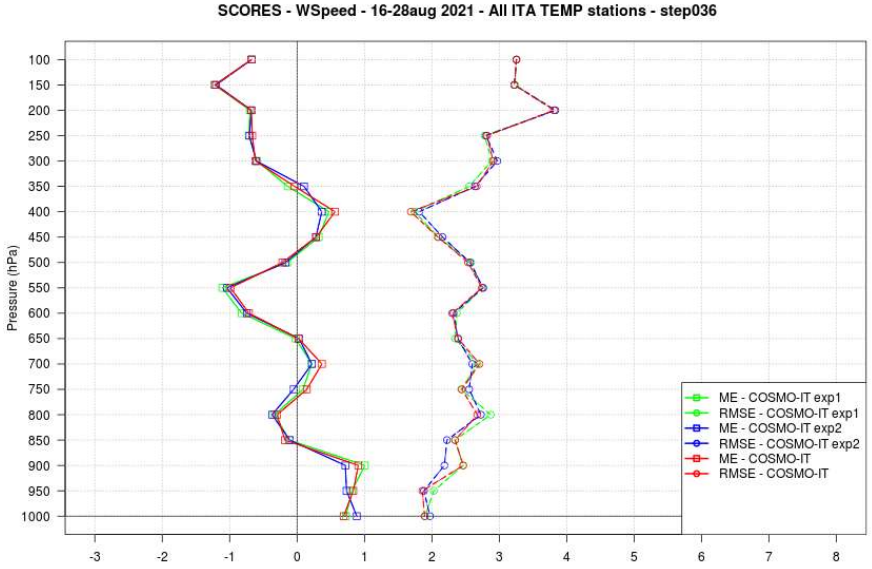


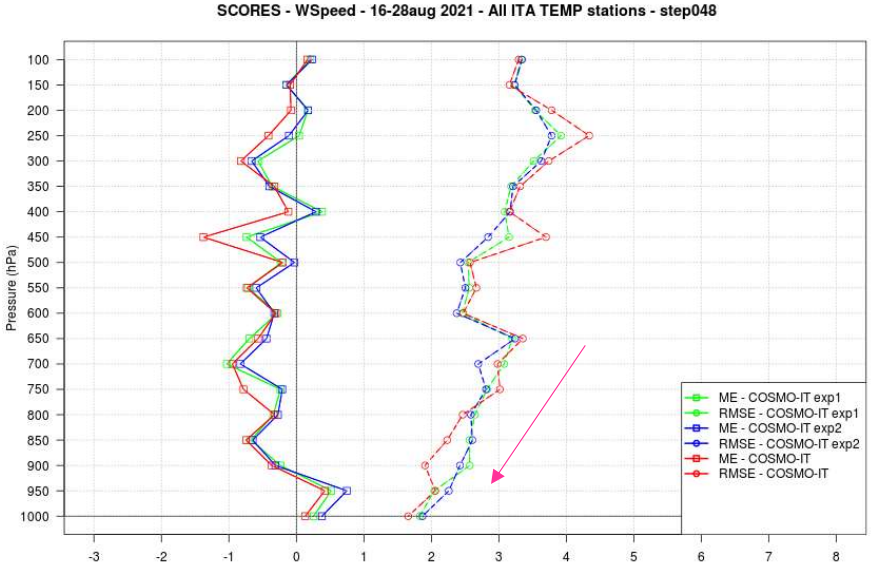
SCORES - RH - 16-28aug 2021 - All ITA TEMP stations - step048

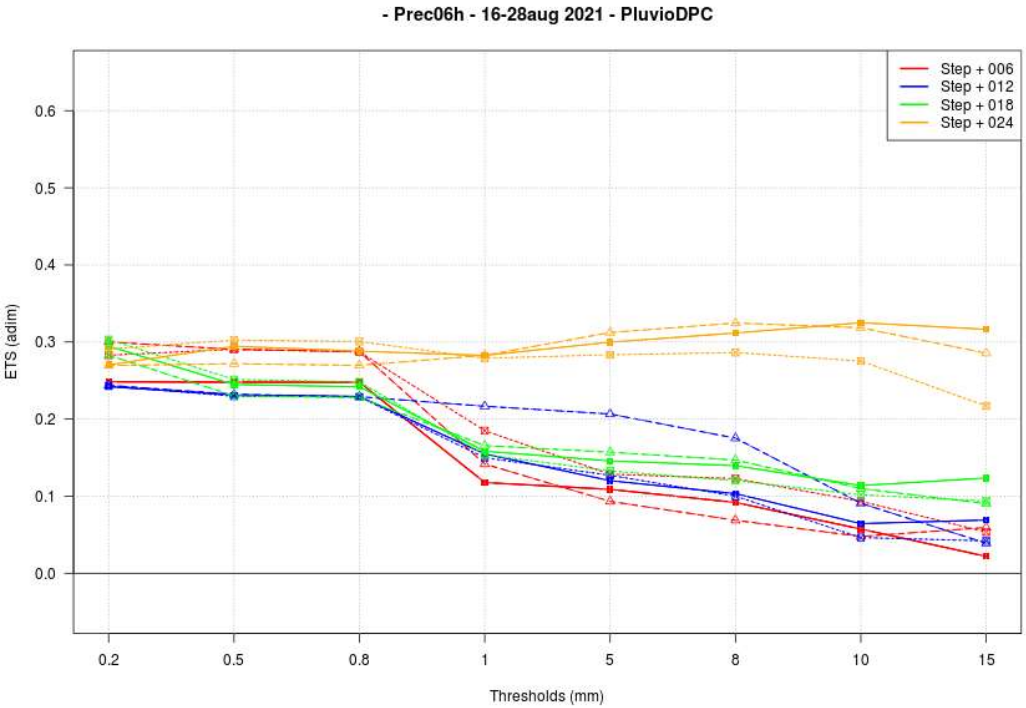



SCORES - WSpeed - 16-28aug 2021 - All ITA TEMP stations - step012
Pressure (hPa)
ME - COSMO-IT exp1
RMSE - COSMO-IT exp1
ME - COSMO-IT exp2
RMSE - COSMO-IT exp2
ME - COSMO-IT
RMSE - COSMO-IT

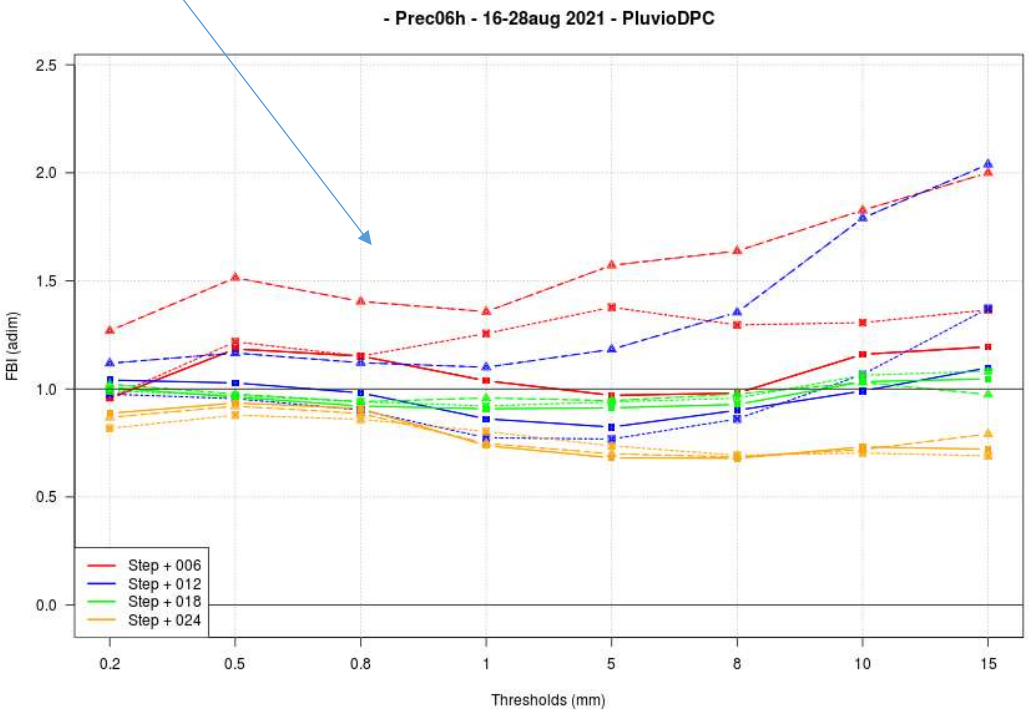

SCORES - WSpeed - 16-28aug 2021 - All ITA TEMP stations - step024
Pressure (hPa)
ME - COSMO-IT exp1
RMSE - COSMO-IT exp1
ME - COSMO-IT exp2
RMSE - COSMO-IT exp2
ME - COSMO-IT
RMSE - COSMO-IT


SCORES - WSpeed - 16-28aug 2021 - All ITA TEMP stations - step036
Pressure (hPa)
ME - COSMO-IT exp1
RMSE - COSMO-IT exp1
ME - COSMO-IT exp2
RMSE - COSMO-IT exp2
ME - COSMO-IT
RMSE - COSMO-IT


SCORES - WSpeed - 16-28aug 2021 - All ITA TEMP stations - step048
Pressure (hPa)
ME - COSMO-IT exp1
RMSE - COSMO-IT exp1
ME - COSMO-IT exp2
RMSE - COSMO-IT exp2
ME - COSMO-IT
RMSE - COSMO-IT



LHN overforecast at +06h



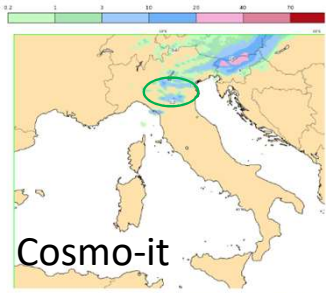
_____ : cosmo-exp1

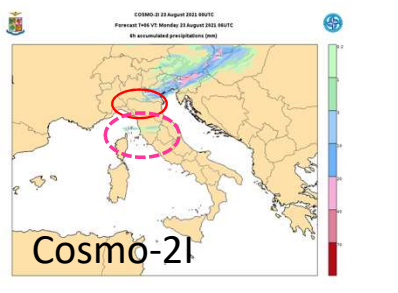
---------- : cosmo-exp2

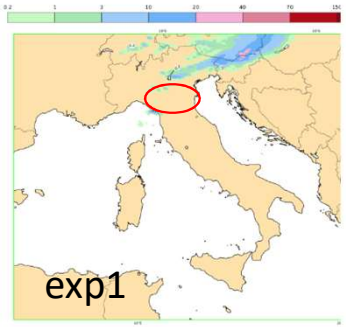
…….. : cosmo-ope

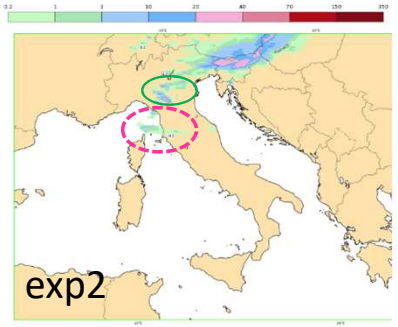
23 aug 2021 : performances of 00UTC run wrt Italian DPC hi-res rain gauge

Fcst +06h

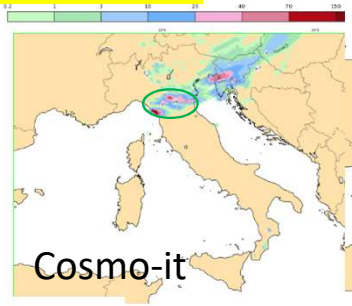


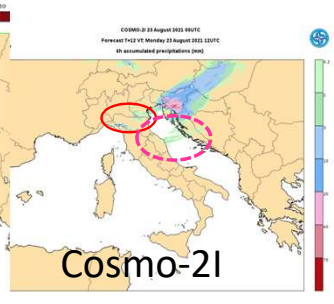


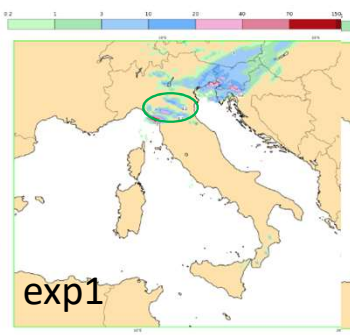


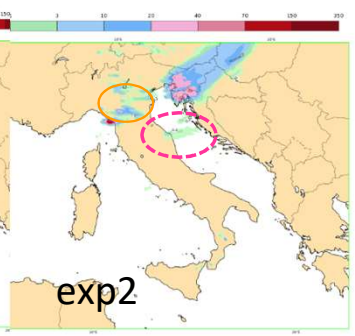


Fcst +12h

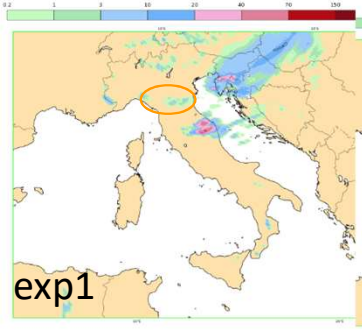


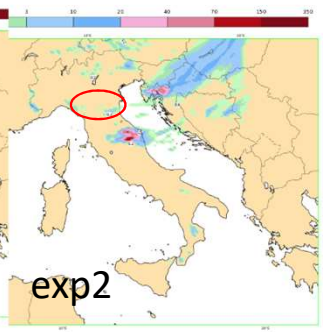




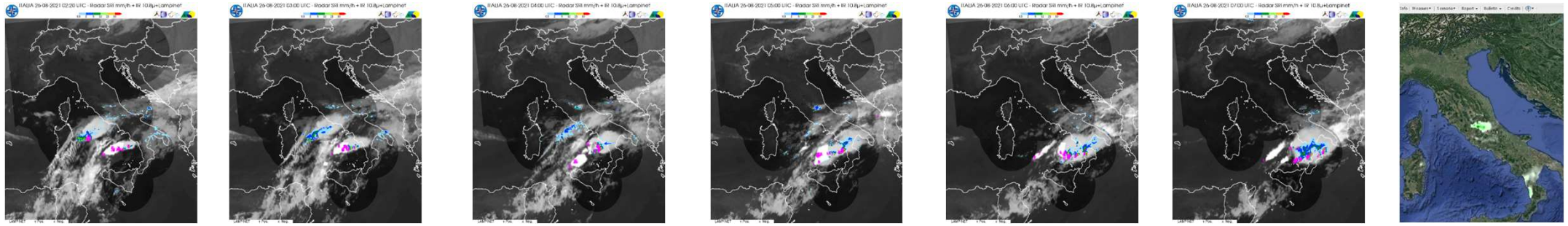


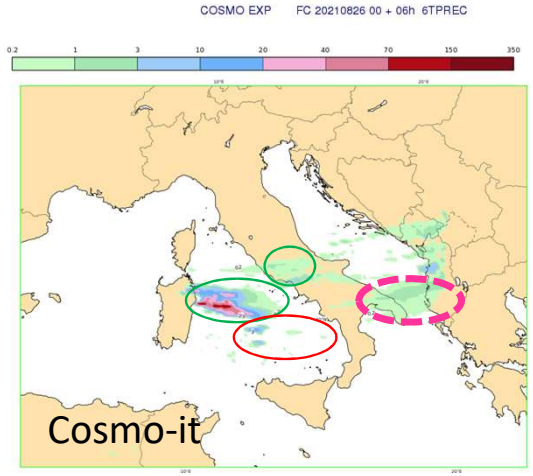
Fcst +18h

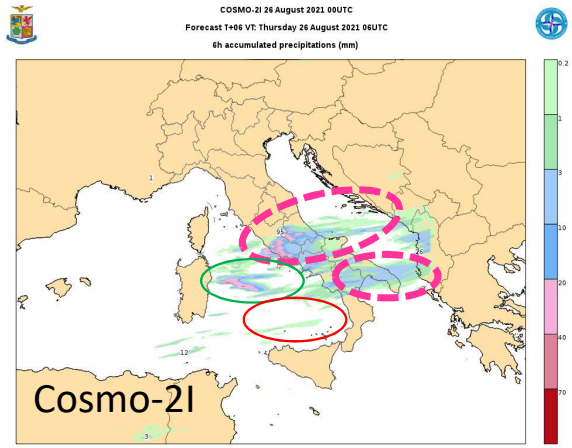


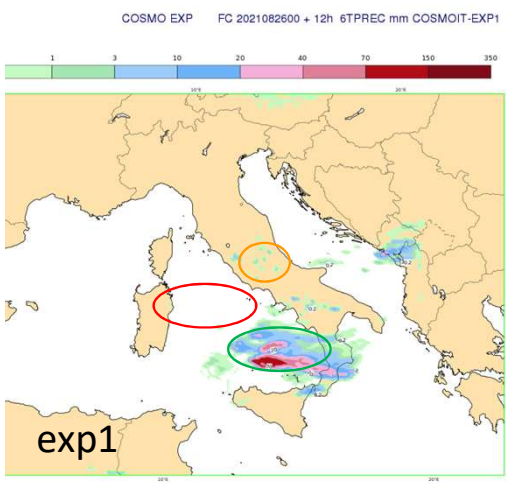


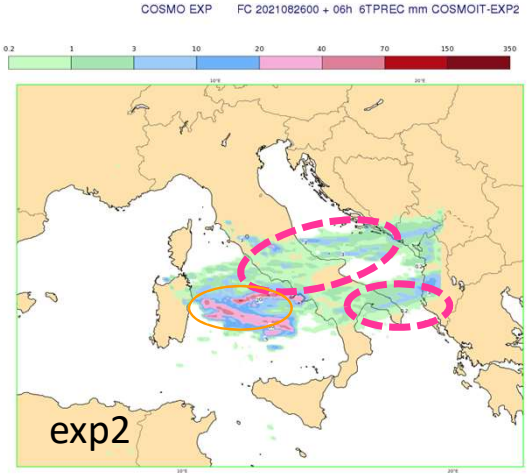
26 aug 2021 : performances of 00UTC run wrt Italian DPC network (radar+raingauges)











The model soil seems to «wet» (compared to obs) → but the RH2m is too low (positive bias «obs-fg») →the wso analysis tends to dry the soil and to further increase T (already high «negative bias obs-fg» because driven by RH)

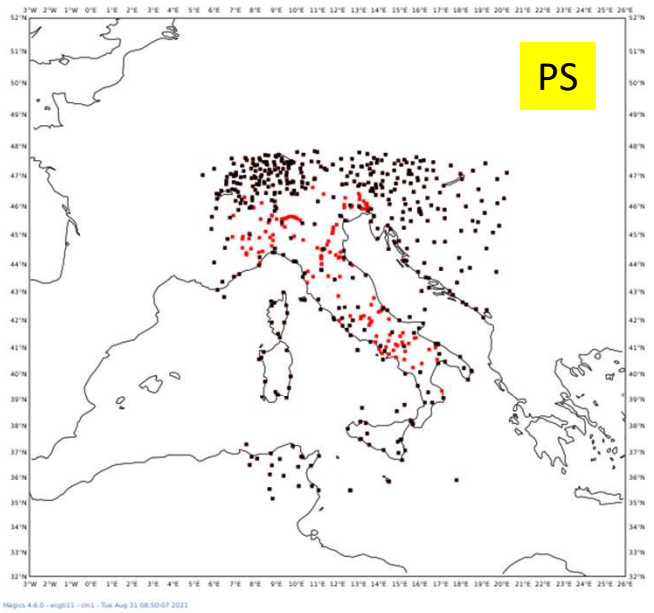
- Bias correction is needed?
- «Wso» operator (normalization) is not correct?

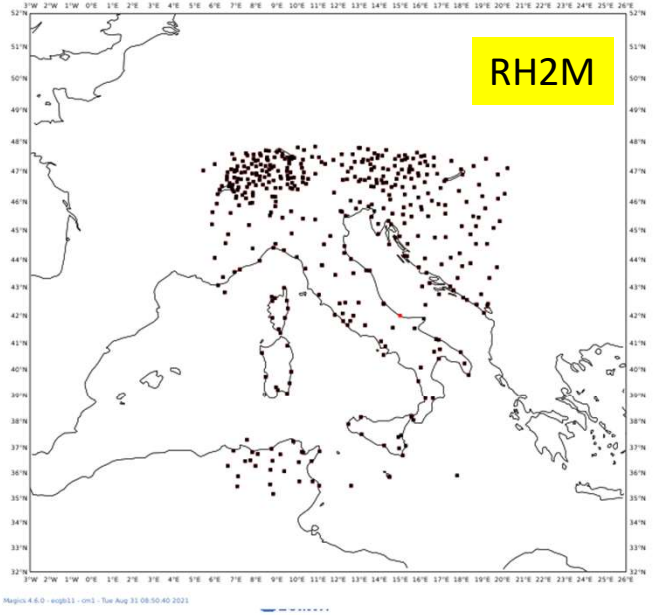
Next steps:

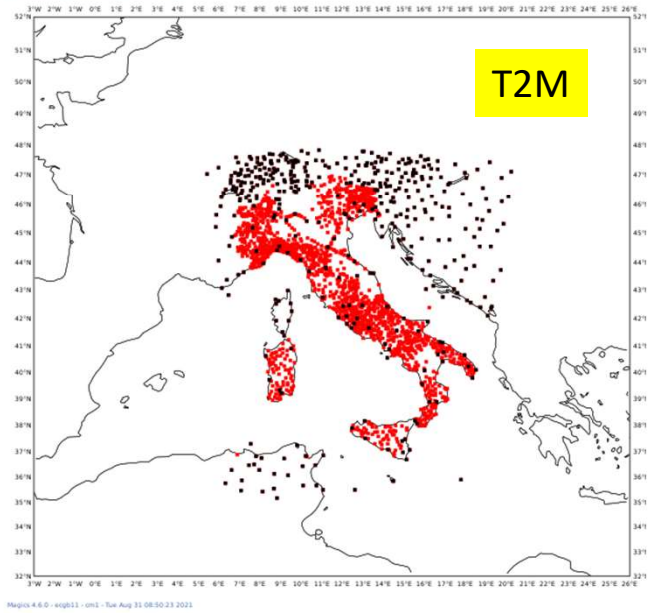
- Tests with different localization lenght
- Compute CDF coefficients for cosmo-it and test the CDF method
- Remove T2m and RH2m on wsoil analysis
- Use wso to «influence» only soil (not low atm)

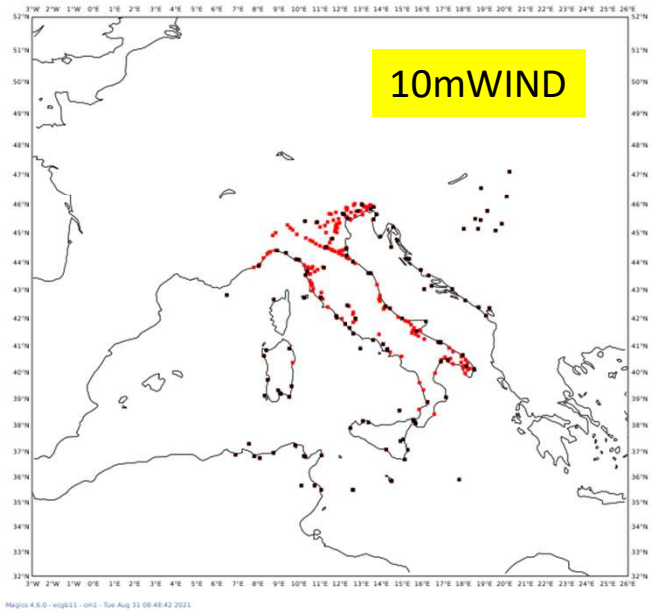
Status of ICON-KENDA@CoMet

Assimilation of ITALIAN not-GTS stations (synop_tst)









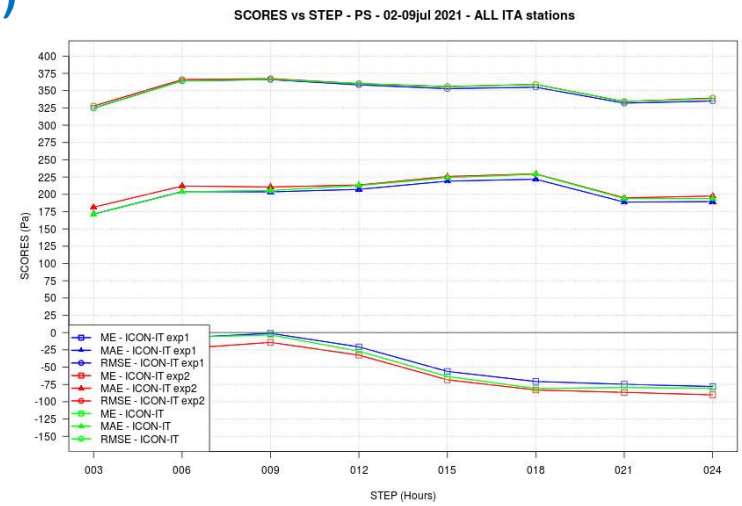

```
&RULES
comment  =  'specific parameters for SYNOP TST'
obstype    = 1      ! OT_SYNOP
codetype = 811   ! OC_SYNTST
q%%use  = 11          ! set active/passive (11/7)
t%%use  = 11          ! set active/passive (11/7)
uv%%use = 11          ! set active/passive (11/7)
p%%use = 11          ! set active/passive (11/7)
/
```

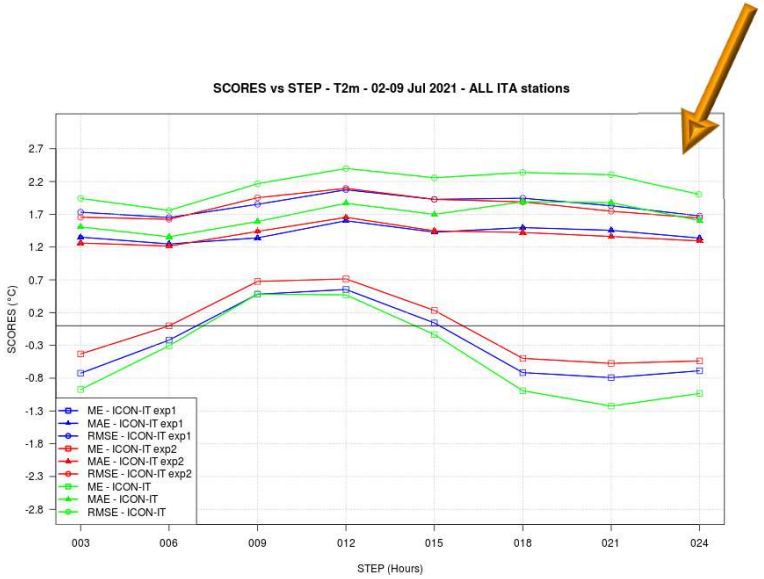
ICON-IT experimental run 02-09 july 2021
(00UTC run up to +24h)

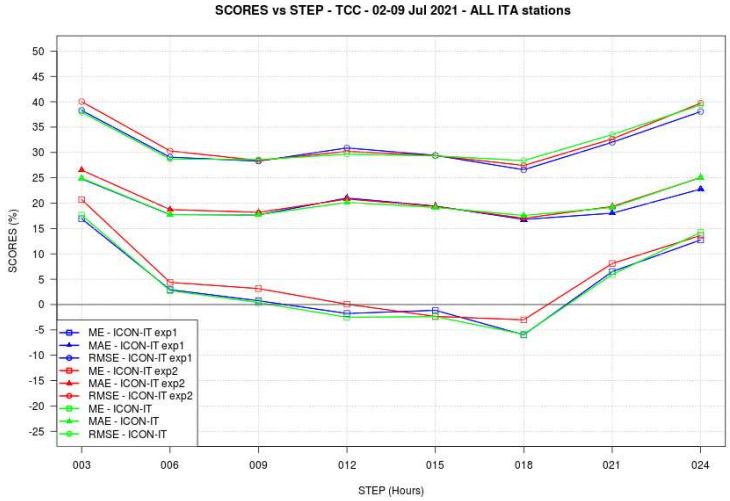
iconit_exp1:
LHN

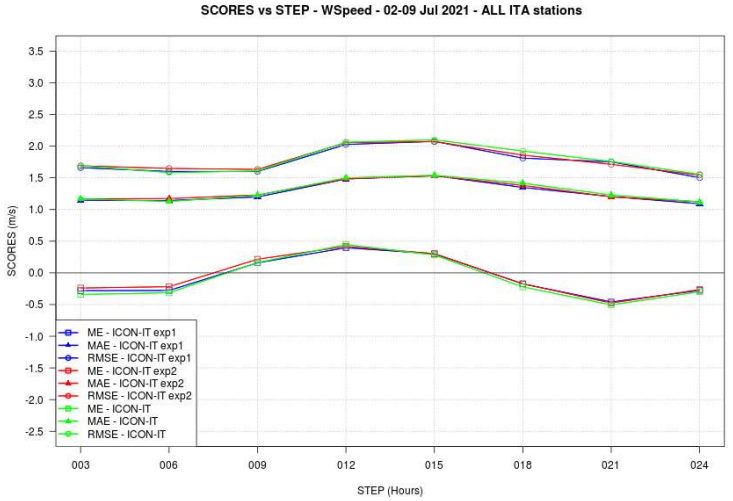
iconit_exp2:
ALL ITALIAN not-GTS station
(slight increase of bias)

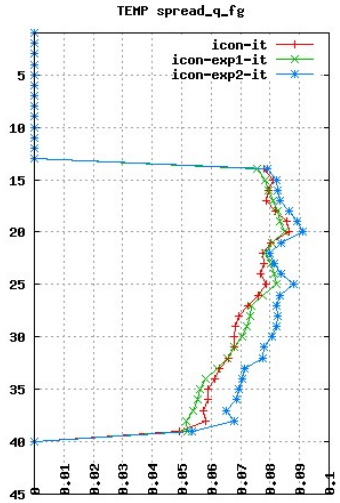
iconit_ope

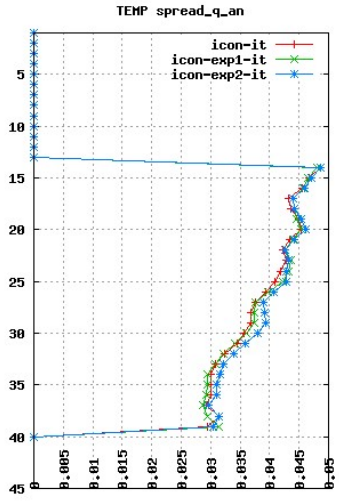


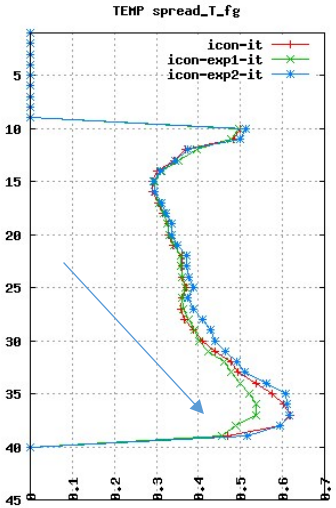


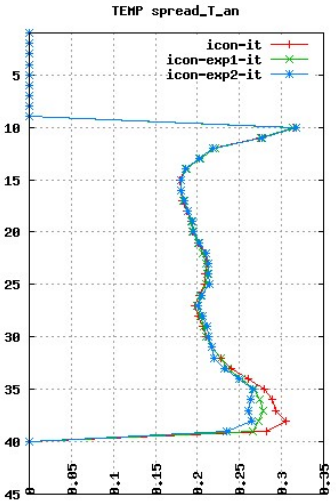


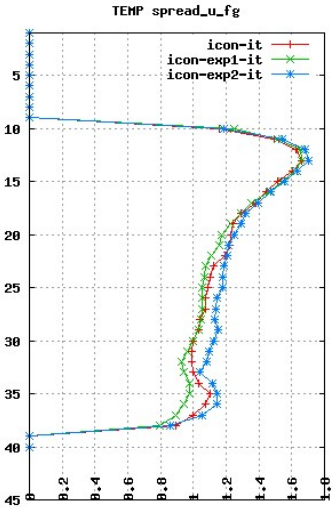


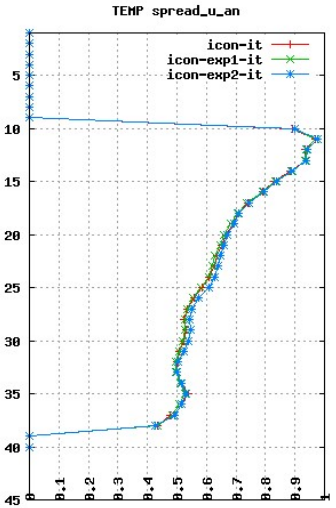








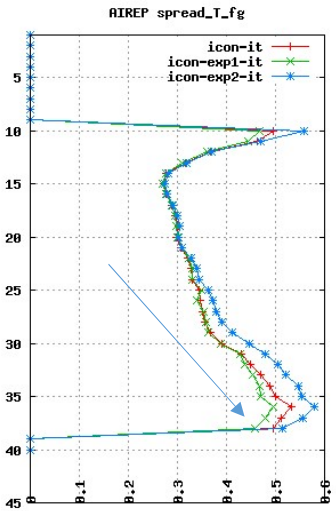


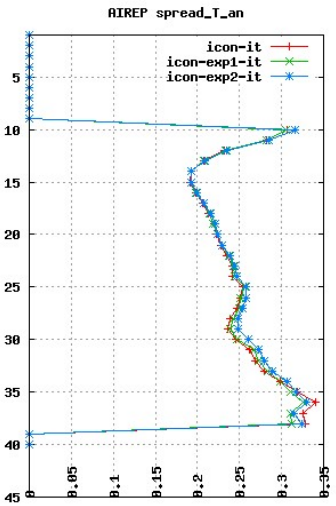


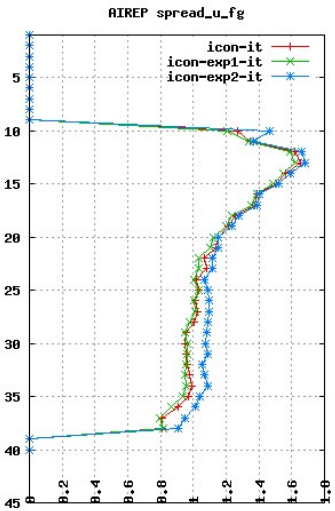
iconit_exp1:
LHN

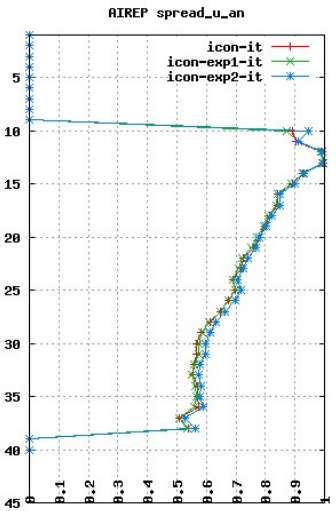
iconit_exp2:
ALL ITALIAN not-GTS station
(slight increase of bias)

iconit_ope









News on ICON-IT and future implementations

- 04 UTC nudging to extenal ICON-EU soil moisture (soil too dry up to now!!)
- Fixed SST perturbation in KENDA-LETKF
- Fixed SST insertion from IFS (once a day @10UTC)

- Further tests with latent heat nudging (with support of Klaus Stephan)

- Assimilation of 3D radar (to be implemented)