CIAO Priority Task

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COSMO GM

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COSMO Priority Task **CIAO:**

implementation of the Bechtold **C**onvection scheme **I**n COSMO model: deterministic **A**nd ensemble-m**O**de tests

Main goal:
To assess the sensitivity of COSMO forecast skill to the use of the newly implemented Bechtold convection scheme

Duration: 01.04.2017 – 31.08.2018

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CONSORTIUM FOR SMALL SCALE MODELING COSMO

Project structure

COSMO-T: COSMO run performed with Tiedtke convection scheme

COSMO-B: COSMO run performed with Bechtold convection scheme

SubTask1: benchmark of COSMO-B

SubTask2: tests of COSMO-B in deterministic mode

SubTask3: test of COSMO-B in ensemble mode

SubTask4: COSMO-B and COSMO-T in ensemble mode

SubTask1: benchmark of COSMO-B

Perform a benchmark of the COSMO integrations in deterministic mode to assess and refine the technical details of COSMO-B....

• **Deliverables**: Identification of the optimal configuration of COSMO-B runs for the different set-ups.

• Start: 04/17 - End: 06/17

Bechtold scheme available since version 5.04b (at ECMWF, experiments performed with v5.04e-beta-corrected).

First results (see also next presentations)**:**

• COSMO-B successfully implemented on different platforms

• COSMO-B as expensive as COSMO-T.

About namelists (and docu)

&PHYCTL

.....

itype_conv=2, ← with "2" the Bechtold scheme is chosen

icpl_aero_conv=1,

icapdcycl=3,

…….

New namelist switches:

Name	Description	Default:
icpl_aero_conv	: type of coupling between aerosols and convection scheme	0
=0:		
=1:		
icapdcycl	:	0

=0 no CAPE diurnal cycle correction (IFS default prior to cy40r1, i.e. 2013-11-19)

=1 CAPE - surface buoyancy flux (intermediate testing option)

=2 CAPE - subcloud CAPE (IFS default starting with cy40r1)

=3 Apply CAPE modification of (2) over land only, with additional restriction to the tropics

More on namelists

- /TUNING/

For Tiedtke-Bechtold, the following new namelist variables have been implemented as tuning parameters:

Name	Description	Default:
tune_capdcfac_et	: fraction of CAPE diurnal cycle correction applied in the extratropics	0.0
tune_rhebc_land	: relative humidity threshold for onset of evaporation below cloud base over land	0.75
tune_rhebc_ocean	: relative humidity threshold for onset of evaporation below cloud base over sea	0.85
tune_texc	: excess value for temperature used in test parcel ascent	0.125
tune_qexc	: excess fraction of grid-scale QV used in test parcel ascent	0.0125
tune_rcucov	: convective area fraction	0.05
tune_entrorg	: entrainment parameter for deep convection valid at dx=20 km	0.001825
tune_rhebc_land_trop	: relative humidity threshold for onset of evaporation below cloud base over land in the tropics	0.7
tune_rhebc_ocean_trop	: relative humidity threshold for onset of evaporation below cloud base over sea in the tropics	0.8
tune_rcucov_trop	: convective area fraction in the tropics	0.05

No documentation

SubTask2: tests of COSMO-B in deterministic mode

For past cases of heavy precipitation, the performance of COSMO-B and COSMO-T will be investigated in deterministic mode….

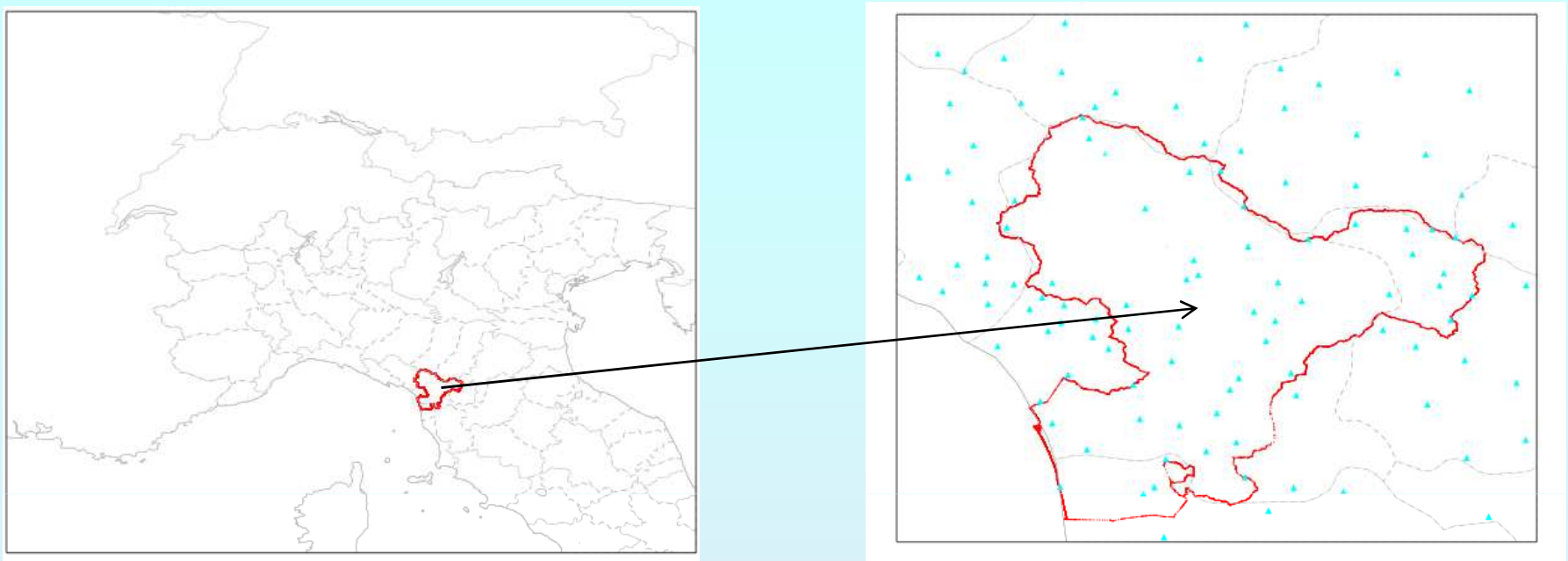
"Standard" verification scores will be used …..

Novel spatial verification techniques will be also used ….

• **Deliverables**: for the investigated case studies, assessment of the skill of COSMO-B and COSMO-T in terms of the above-mentioned scores so as to have a detail description of the potential strengths and weaknesses of the individual convection schemes.

SubTask2: case studies over Serchio river basin

(~ 2000 km^2, Tuscany region)



Verification features

- Area: Serchio river basin (~ 2000 km^2) .
- Measure: 24h area-averaged precipitation.
- Obs: about 50 non-GTS stations.
- Period: 31/01 – 07/02/2017.

Model features

- COSMO v5.04e-beta-corrected.
- 7km, 40ML (about 50 grid points in the basin).
- fc+132h, 00UTC runs only.
- COSMO-LEPS integration domain.
- BC/IC from ECMWF HRES.
- Soil from ICON-Regional.

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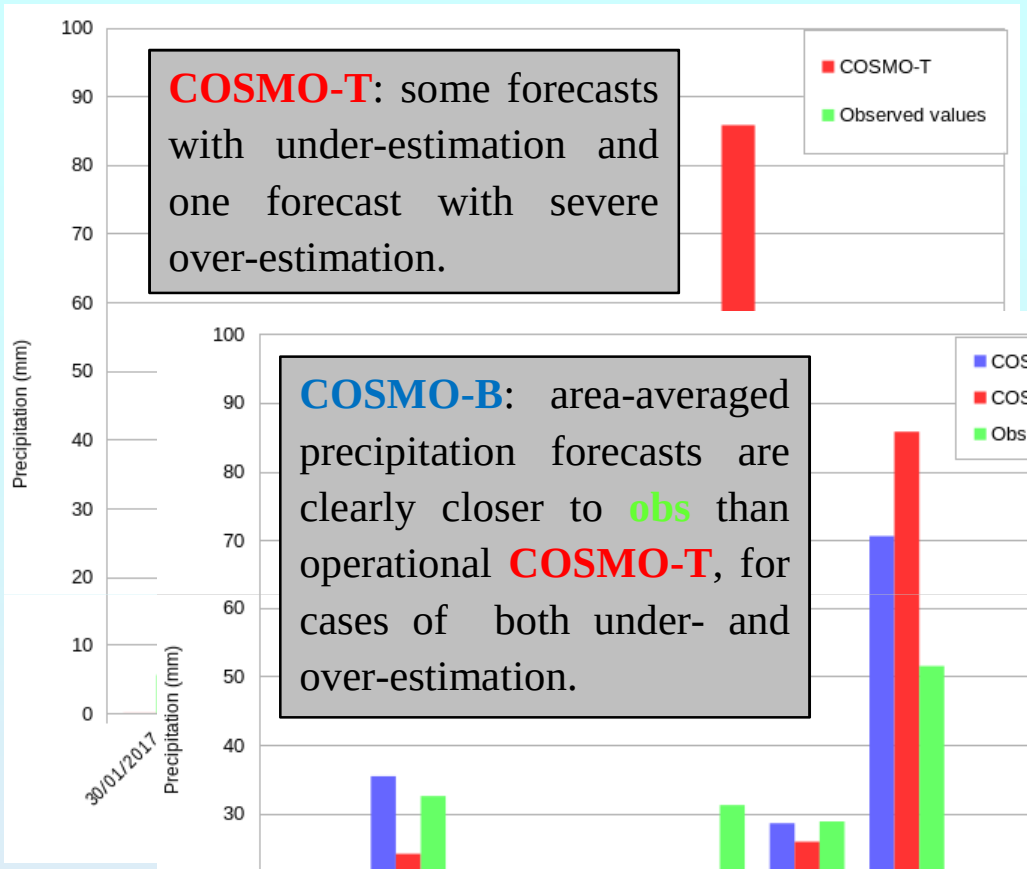
24-h area-average precipitation (fcst 24-48h)



COSMO-T: some forecasts with under-estimation and one forecast with severe over-estimation.

COSMO-B: area-averaged precipitation forecasts are clearly closer to **obs** than operational **COSMO-T**, for cases of both under- and over-estimation.

	COSMO-T	COSMO-B
MAE	9.3 mm	5.3 mm
BIAS	8.3 mm	3.6 mm

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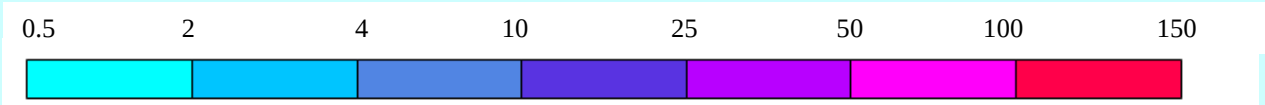
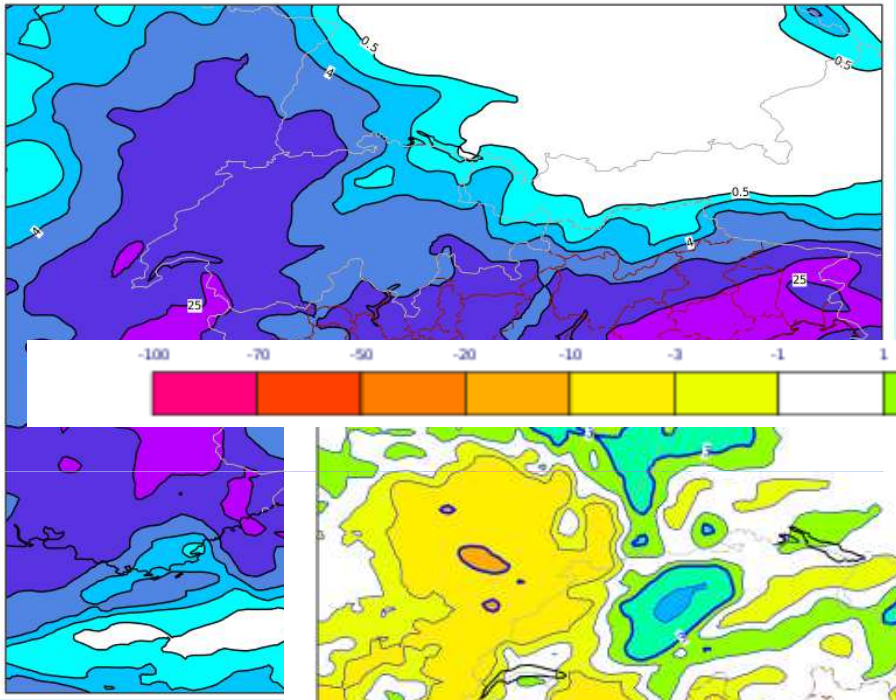
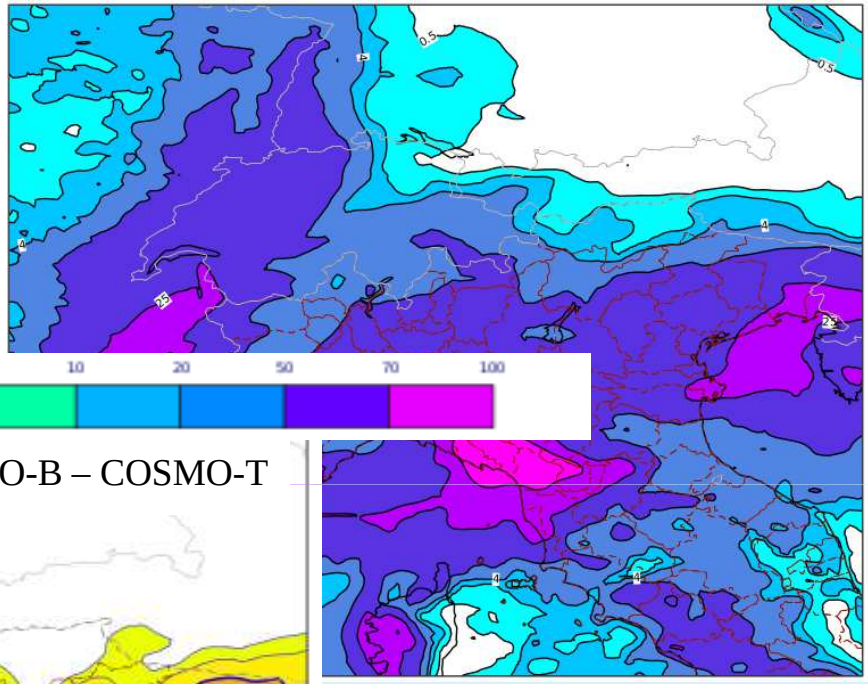
Precipitation maps (fcst 24-48h, VT: 20170206 00UTC)

COSMO-T

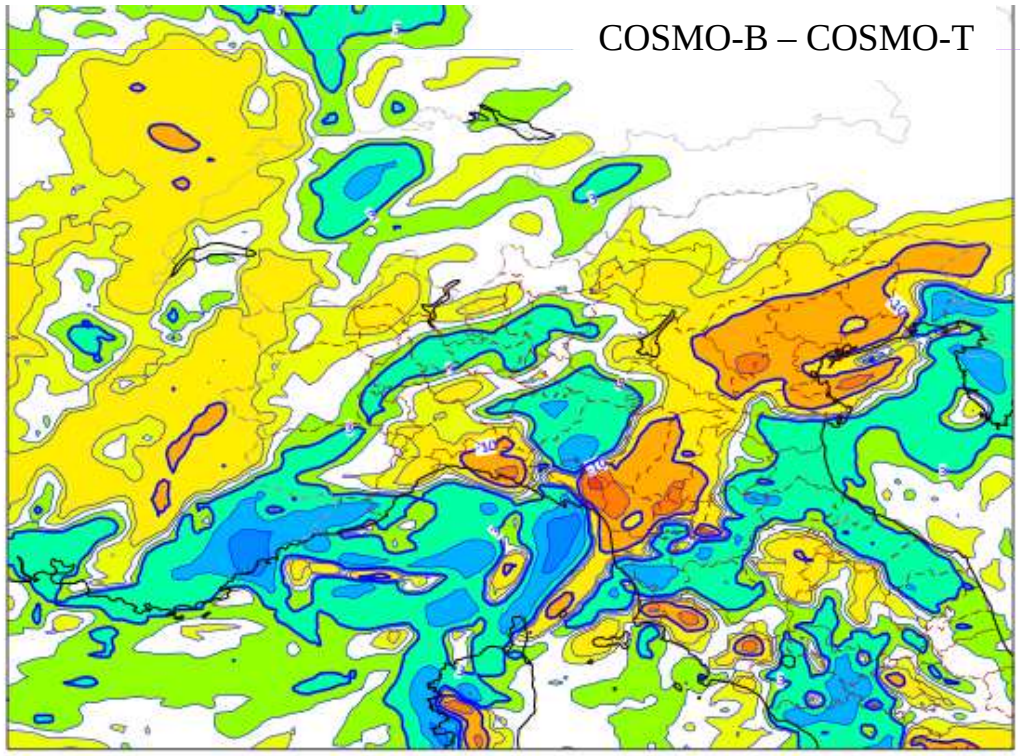


COSMO-B





COSMO-B – COSMO-T



In the Serchio river basin, differences larger than 70 mm

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COSMO

SubTask3: test of COSMO-B in ensemble mode

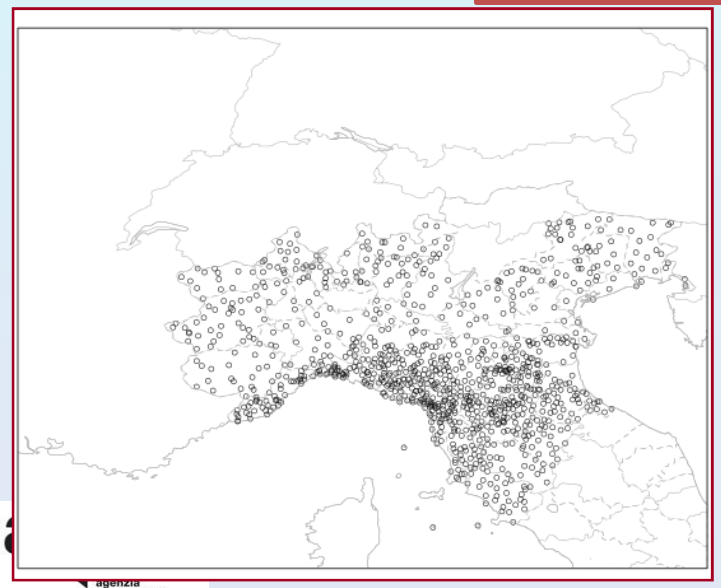
Implement **cleps_10b**:

- 10-member ensemble (7km, 40 ML, ….) starting at 00UTC,
- all members are run with COSMO-B,
- IC/BCs (+ soil conditions) are the same as those from members 11-20 of COSMO-LEPS (**cleps_10t**).

Compare **cleps_10b** vs **cleps_10t** in terms of surface variables (e.g. TP, T2M, TD2M) over a long period as well as for case studies .

- **Deliverables:** Assessment of the individual skill of cleps_10b and cleps_10t for different verification times, computed over the full verification period as well as for particular cases.

First evaluations performed over Northern Italy

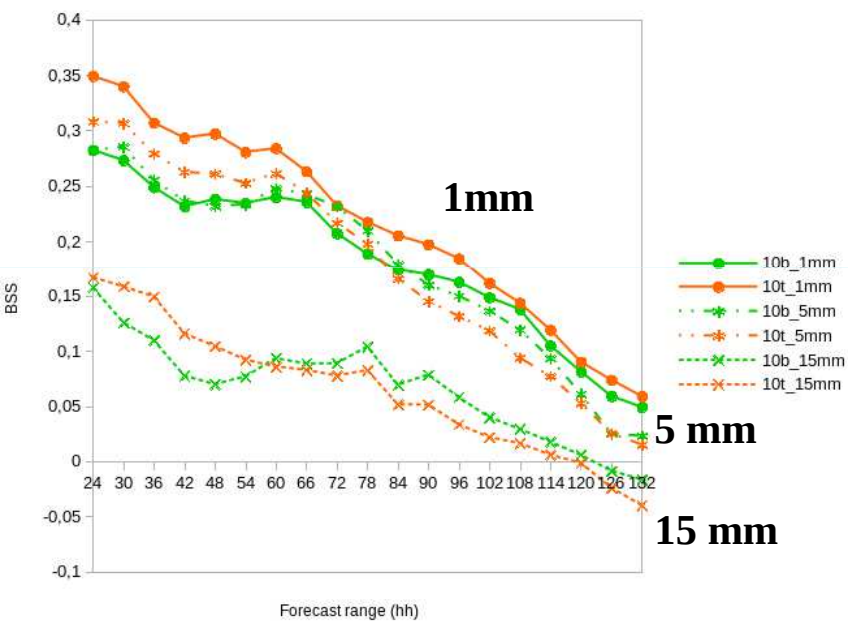


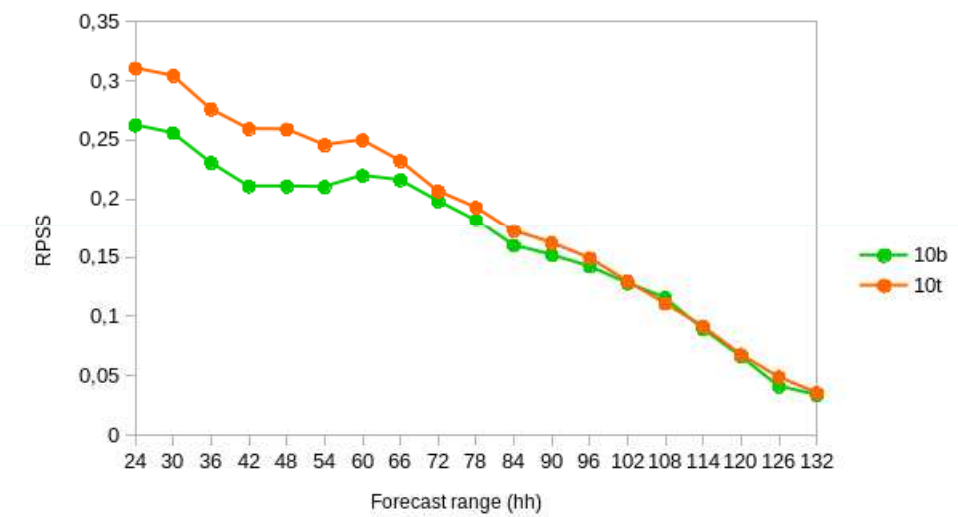
variable: 6h cumulated precip (00-06, 06-12, ... UTC);
period : from 28 March to 31 May 2017 (~ 60 days);
region: Northern Italy**;**
method: nearest grid point; no-weighted fcst;
obs: non-GTS network (~ 1000 stations/day);
fcst ranges: 0-6h, 6-12h, …, 126-132h;
thresholds: 1, 5, 10, 15, *25*, *50* mm/12h;
systems: **cleps_10b** vs **cleps_10t**;
scores: **ROC area, BSS, RPSS, Outliers**, …

cleps_10b vs cleps_10t

- Brier Skill Score (BSS) is written as 1-BS/BS_{ref}. **Sample climate** is the reference system.
- BS measures the mean squared difference between forecast and observation in probability space.
- Consider three events: 6-hour precipitation exceeding 1, 5 and 15 mm.

- **Ranked Probability Skill Score (RPSS)**: it is sort of BSS "cumulated" over all thresholds.
- RPSS is written as 1-RPS/RPS_{ref}. **Sample climate** is the reference system. RPS is the extension of the Brier Score to the multi-event situation.
- Useful forecast systems for RPSS > 0.





- As for 6-hourly cumulated precipitation, **cleps_10t** slightly better than **cleps_10b** especially for rain/no-rain situations.
- Some negative impact by **cleps_10b** for short ranges.

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SubTask4: COSMO-B and COSMO-T in ensemble mode

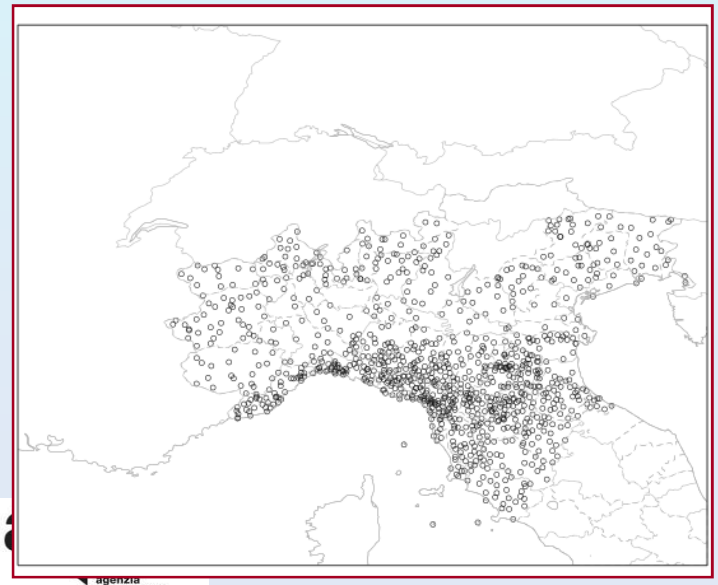
Implement **cleps_20bt**, :

- cleps_10b + members 1-10 of COSMO-LEPS;
- cleps_20bt has 20 members: 10 members run with Bechtold plus 10 members run with Tiedtke (no duplication of boundary conditions).

Compare **cleps_20bt** vs **COSMO-LEPS** in terms of surface variables (e.g. TP, T2M, TD2M) over a long period as well as for case studies .

The use of the Versus package is also envisaged…

• **Deliverables:** Assessment of the skill of cleps_20bt and COSMO-LEPS….



variable: 6h cumulated precip (00-06, 06-12, ... UTC);
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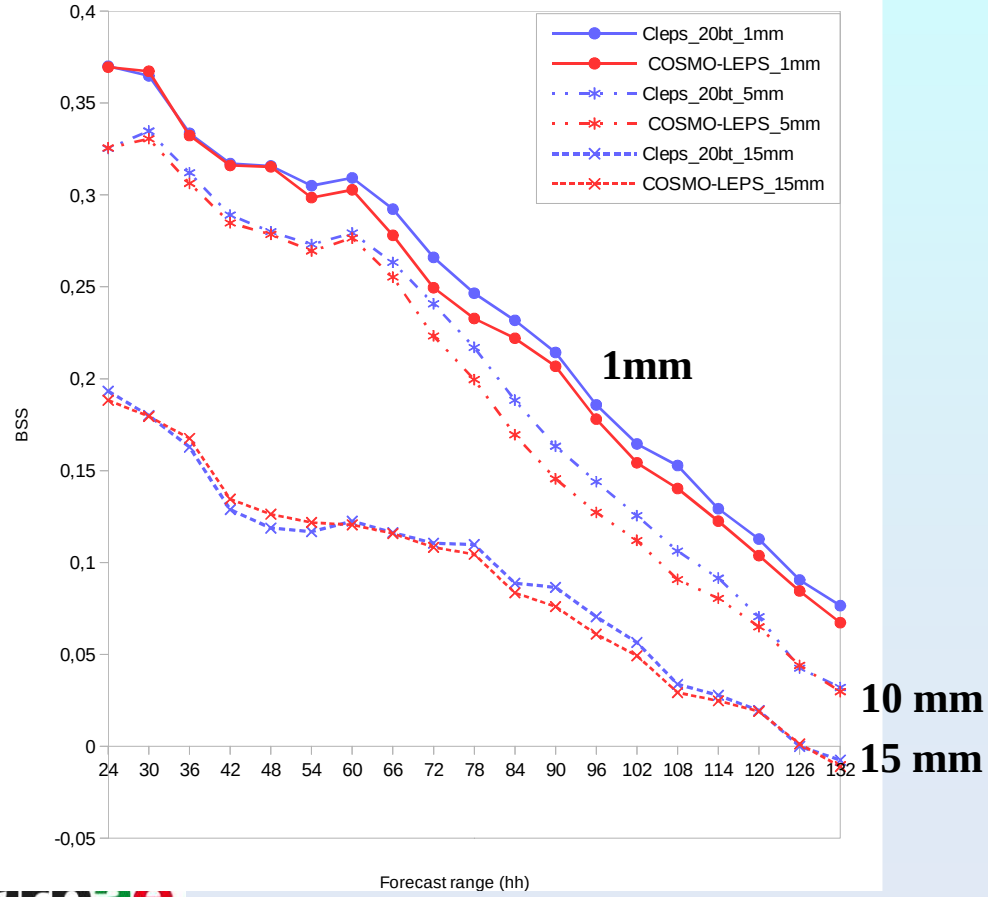
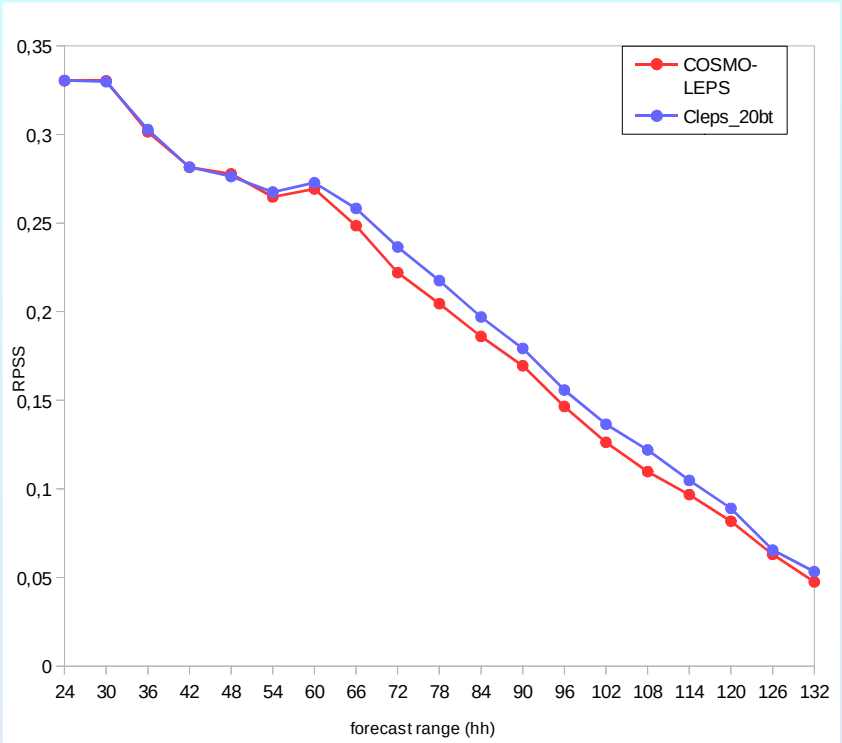
fcst ranges: 0-6h, 6-12h, …, 126-132h;
thresholds: 1, 5, 10, 15, *25*, *50* mm/12h;
systems: **cleps_20bt** vs **cosmo-leps**;
scores: **ROC area, BSS, RPSS, Outliers**, …

cleps_20bt vs cosmo-leps

- BSS is written as 1-BS/BS_{ref}. **Sample climate** is the reference system.
- BS measures the mean squared difference between forecast and observation in probability space.
- Consider three events: 6-hour precipitation exceeding 1, 5 and 15 mm.
- RPSS: BSS "cumulated" over all thresholds. RPSS is written as 1-RPS/RPS_{ref}. RPS is the extension of the Brier Score to the multi-event situation. Useful forecast systems for BSS > 0, RPSS > 0.





cleps_20bt slightly outperforms **COSMO-LEPS**, more clearly after fc+48h.

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Open issues:

- More thorough tests once the official COSMO version with Bechtold scheme is available (v5.05).
- So far, “v5.04e_...” was used and we made “not clean” comparison between COSMO-T (5.03) and COSMO-B (5.04e_...).
- understand namelists switches (link to WG3a? ICON people?).
- look at vertical profile differences between COSMO-B and COSMO-T runs: which variables to store for diagnostics?
- verify also T2m, Td2m, uv_10m, gust?

Thanks for your attention

SubTask4: COSMO-B and COSMO-T in ensemble mode

COSMO runs in ensemble mode (hor. Res. 7 km, 40 ml, 132 fcst range) with the Bechtold scheme; 10 members are run with the same IC/BCs as members 1-10 of operational COSMO-LEPS (all members use Tiedtke scheme)

Verification over the peridod 28/3 - end of May for the 10-member ensemble

Confronto skill 10b vs 10t (cioè primi 10 mebri di COSMO-LEPS

Verification of the new ensemble system so generated:
20 membri: 10 girati con lo schema di Bechtold + 10 girati con lo schema di Tiedtke (quello attualmente in uso in COSMO-LEPS): NB *stesse ic e bc di COSMO-LEPS*

Confronto tra fc skill del nuovo sistema e quella di COSMO-LEPS su casi di precipitazione sui 2 mesi di verifica

SubTask1: benchmark of COSMO-B

Perform a benchmark of the COSMO integrations in deterministic mode to assess and refine the technical details (cost of the runs, set-up to be implemented) of COSMO-B. The runs will be carried out over integration domains covering Central-Southern Europe and Italy, at the horizontal resolutions of about 7 and 5 km.

• **Deliverables**: identification of the optimal configuration of COSMO-B runs for the different set-ups.

• **Participating scientists**: V. Garbero (ARPA-Pie), P. Mercogliano (CIRA), A. Montani (Arpae-SIMC), M. Alemanno (Comet)

• Start: 04/17 - End: 06/17

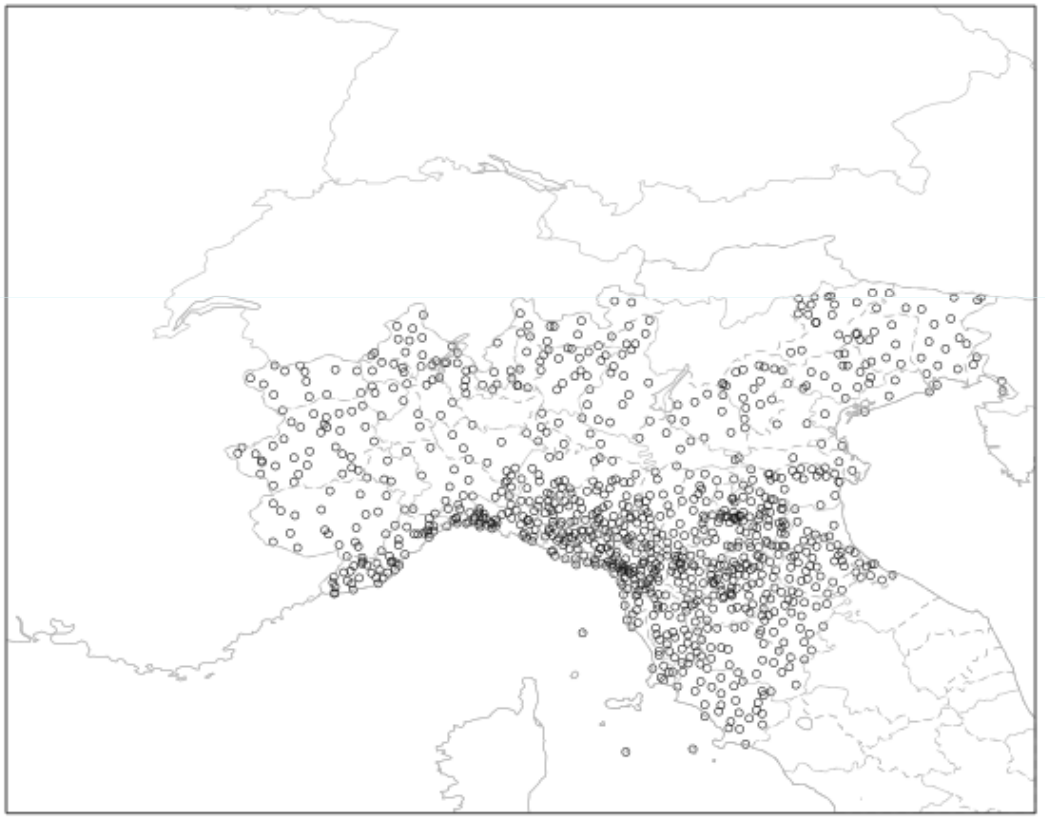
SubTask2: tests of COSMO-B in deterministic mode

Verification over the Serchio river basin (~ 2000 km^2) in terms of areal average precipitation.

About 70 non-GTS stations

Jkjkkjk

Jkkkj



About 1000 stations (non-GTS obs)