Sensitivity of COSMO-LEPS forecast skill to the verification network: application to MesoVICT cases

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CONSORTIUM FOR SMALL SCALE MODELING COSMO

Outline

- **Introduction**
- **Experimentation to the Core Case**
- **First results**

Aims

Test the forecast skill of COSMO-LEPS in terms of total precipitation for different verification networks and different verification methods.

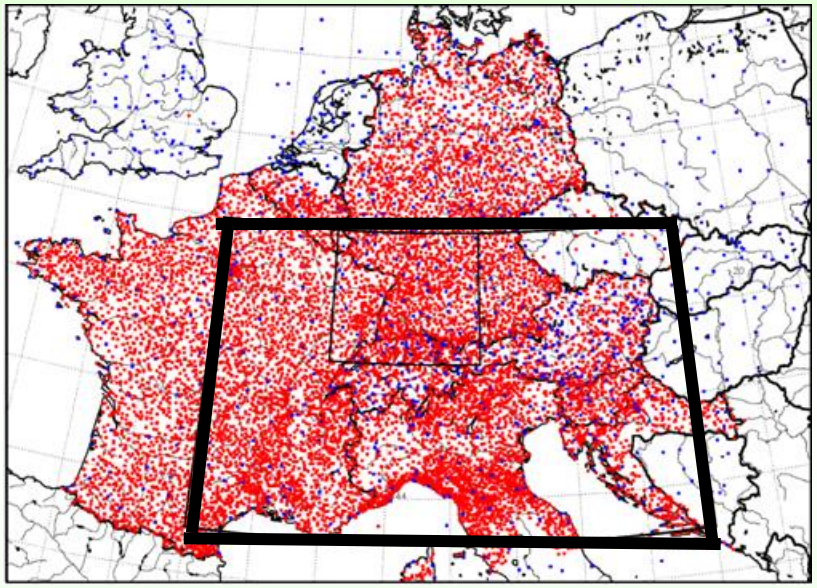
Networks/methods	Nearest grid point	Bilinear interpolation	Boxes (Dist)
VERA analysis	done		
JDC obs	done		

Understand the meaning of the differences in the verification scores

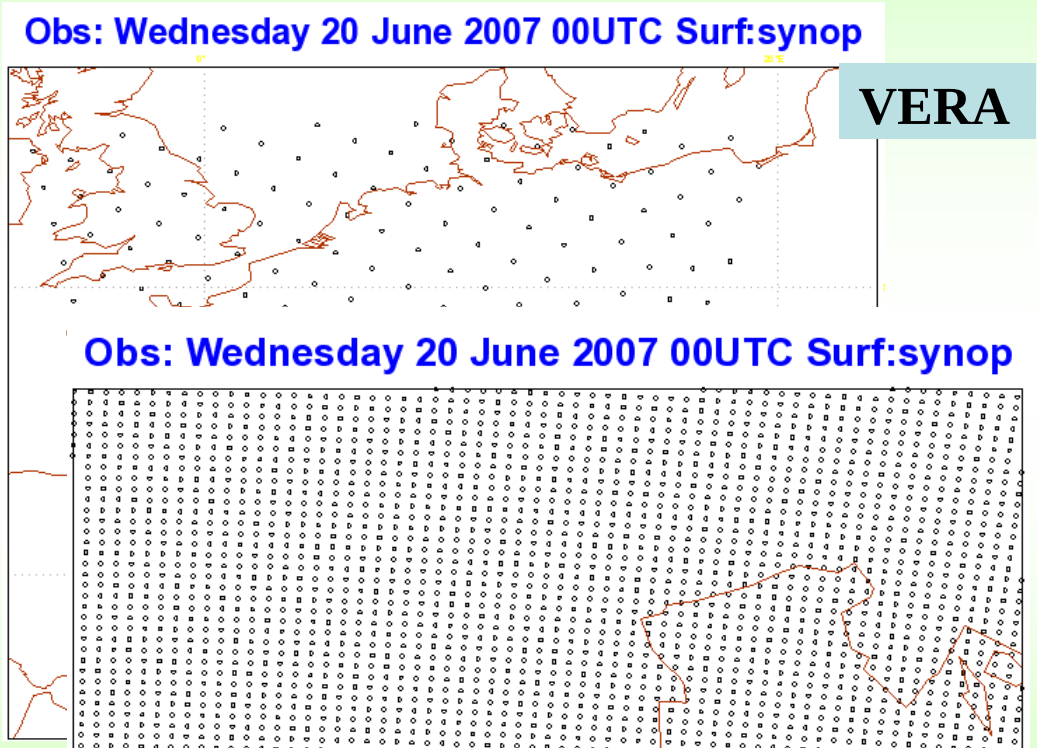
Verification networks covering 2007

JDC (**J**oint **D**Phase-**C**ops) dataset: about 12000 obs – mean station distance ~ 12 km.

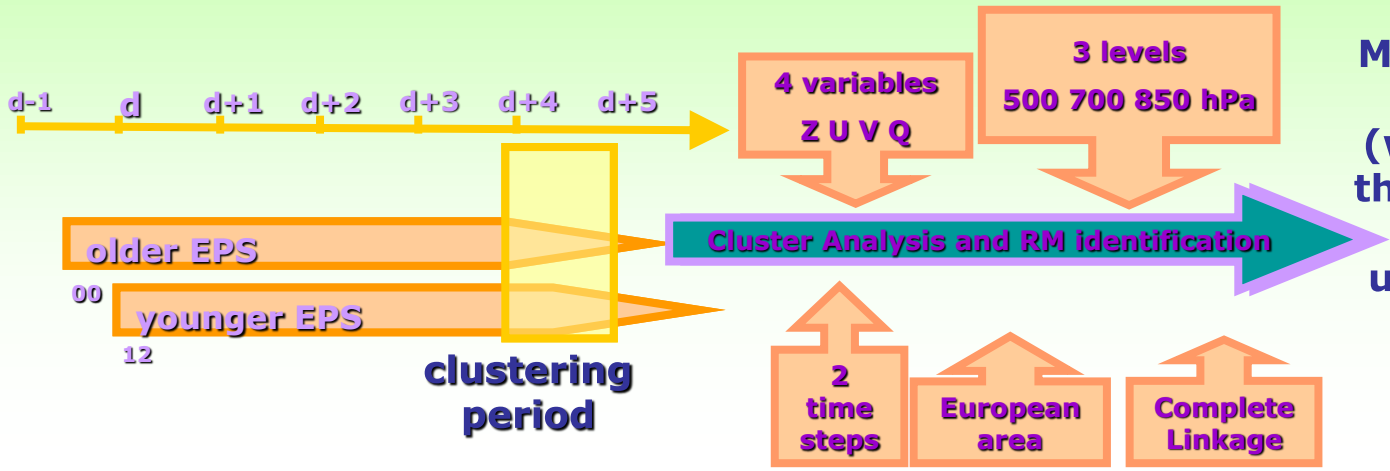
VERA (**V**ienna **E**nhanced **R**esolution **A**nalysis): gridded analysis at the resolution of 8 km.



Verification is performed over the DPHASE area (43-50N, 2-18E)



COSMO-LEPS suite @ ECMWF: IN 2007



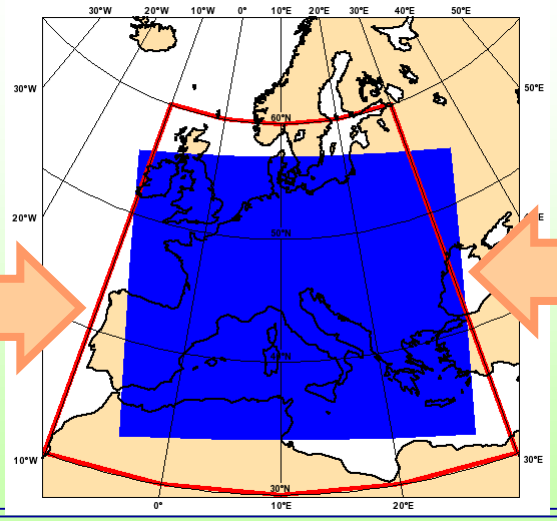
10 Representative Members driving the 10 COSMO integrations (weighted according to the cluster populations)

using either Tiedtke or Kain-Fristch scheme randomly choosen

+

...nothing else!!!

COSMO-LEPS clustering area



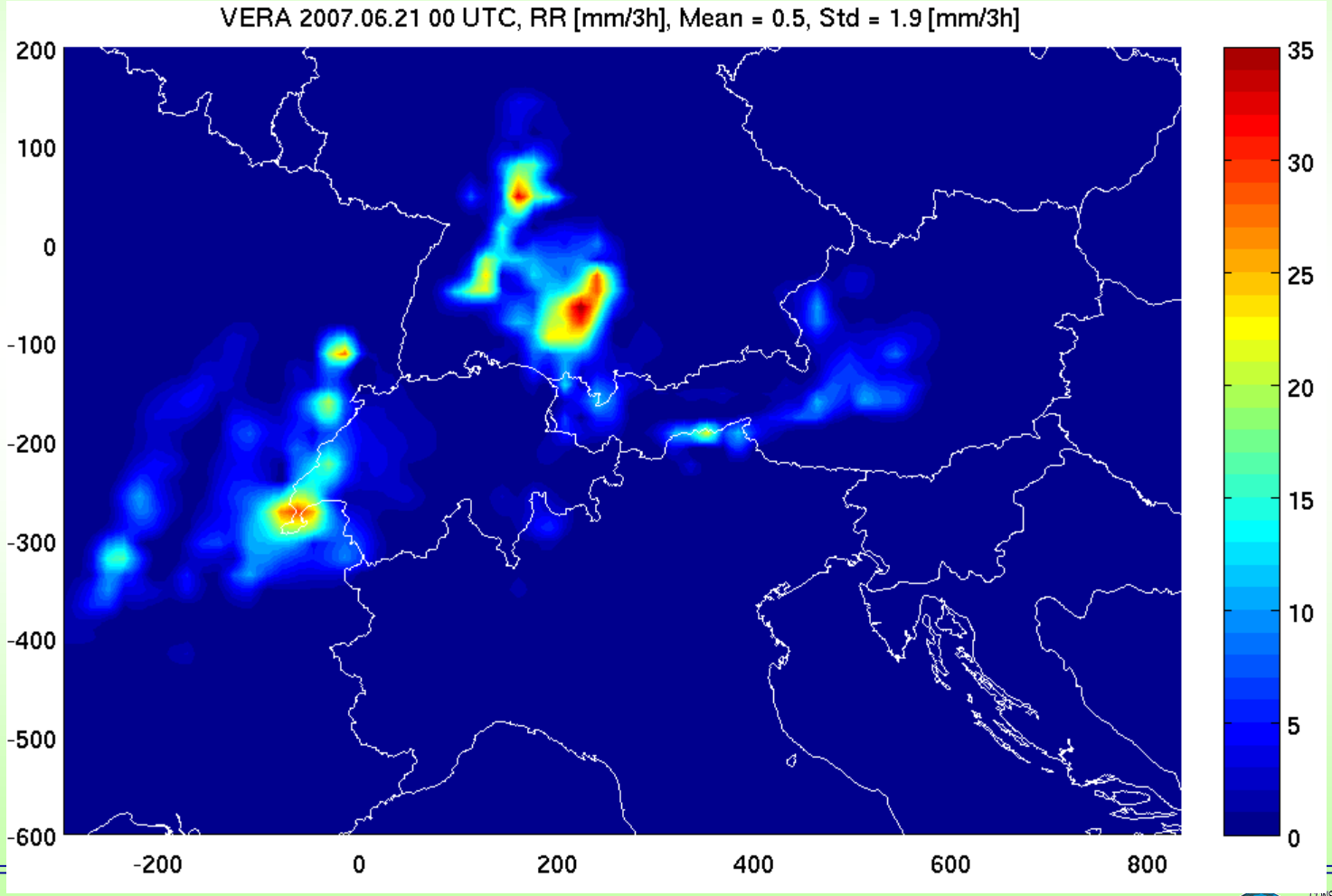
COSMO-LEPS Integration Domain

- **suite runs as a "time-critical application" managed by ARPA-SIMC; runs ONLY at 12UTC;**
- **Δx ~ 10 km; 40 ML; fc+132h;**
- **COSMO v3.20 in 2007,**
- **computer time provided by the COSMO partners which are ECMWF member states.**

Core case of 20-22 June 2007:obs

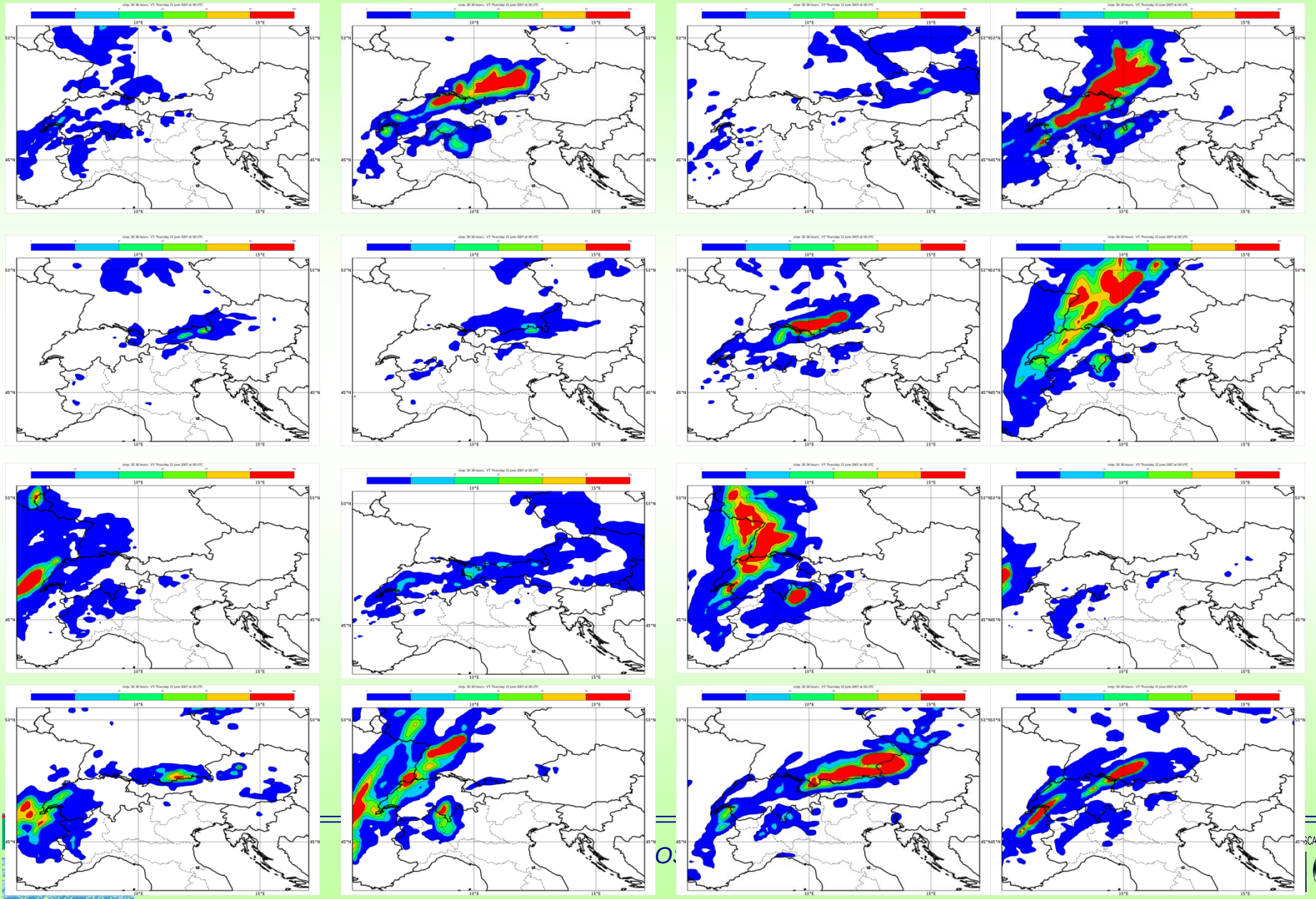
Convective events North of the Alps.

tot_prec for the 3-hour period ending at 00UTC of 21 June 2007

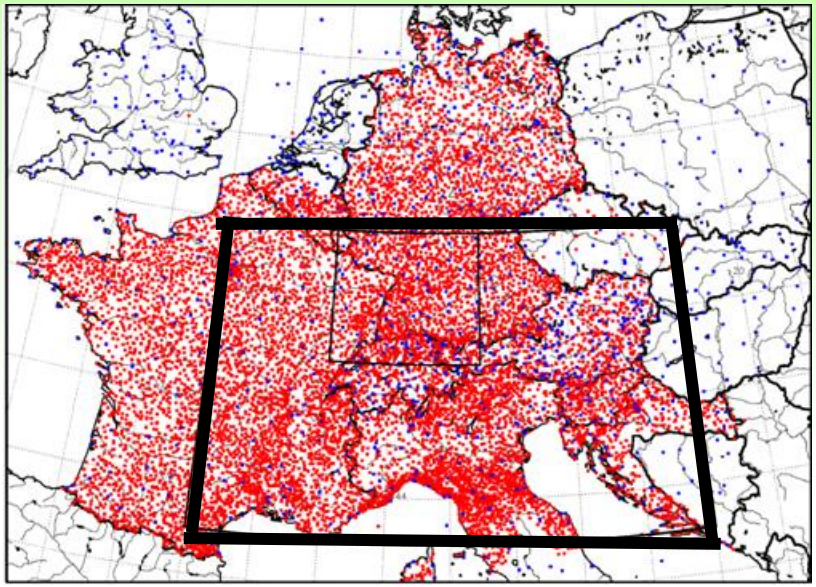


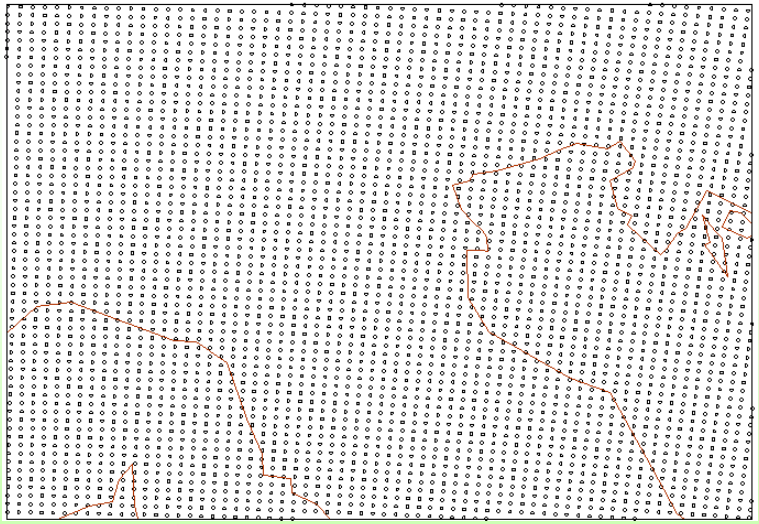
Core case: model

COSMO-LEPS starting at 12UTC of 19 June 2007, fc 30-36h.
tot_prec for the 6-hour period ending at 00UTC of 21 June 2007



Objective verification of COSMO-LEPS





Main features:

variable: 6h cumulated precip (0-6, ..., 18-24 UTC);

period: from 20 to 22 June 2007;

region: 43-50N, 2-18E (D-PHASE area);

method: nearest grid point; no-weighted fcst;

obs: JDC or VERA;

fcst ranges: 0-6h, 6-12h, ..., 42-48h;

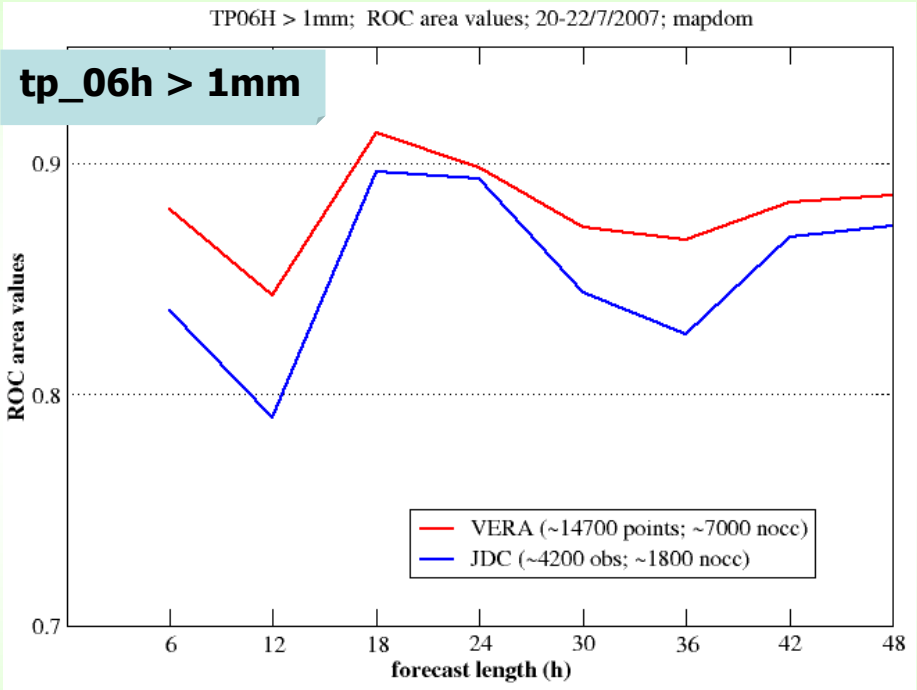
thresholds: 1, 5, 10, 15, *25*, *50* mm/6h;

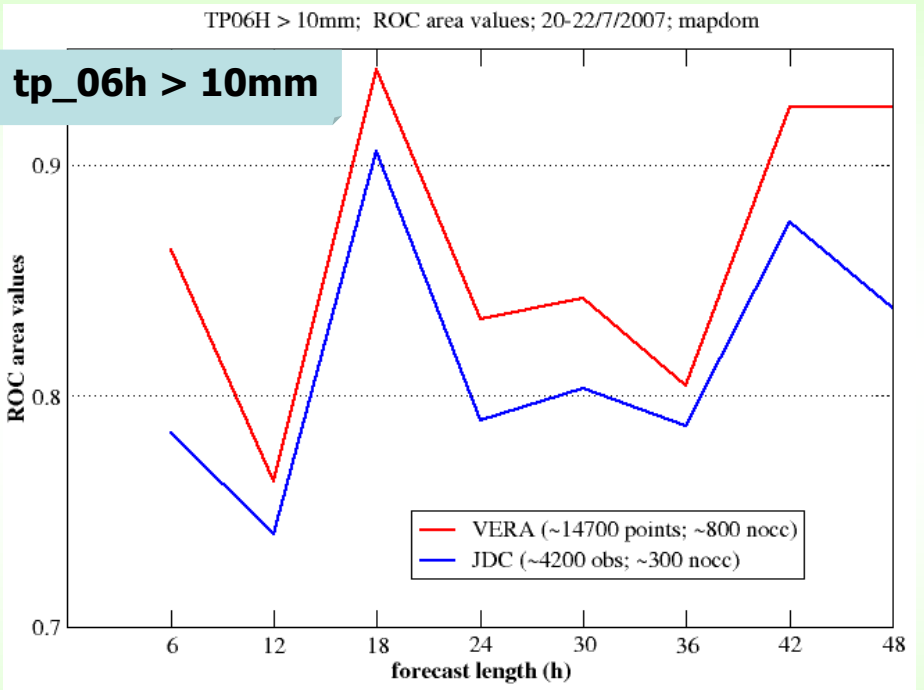
system: COSMO-LEPS;

scores: ROC area, RPS, RPSS, Outliers, ...

Probabilistic prediction of tp: ROC area

- Area under the curve in the HIT rate vs FAR diagram; the higher, the better …
- Valuable forecast systems have ROC area values > 0.6.
- Consider two events: 6-hour precipitation exceeding 1 mm and 10 mm.

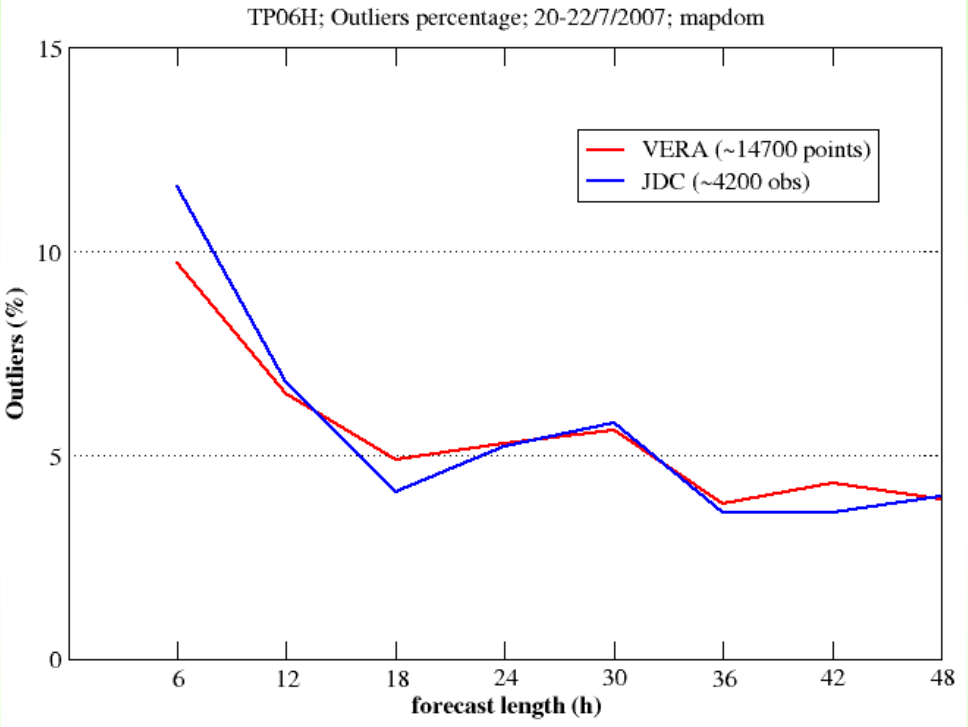




- Similar performance of the system with respect to the 2 verification networks.
- Higher skill when COSMO-LEPS is verified against **VERA** gridded analysis (different number of occurrences for the 2 networks) .

Probabilistic prediction of tp: OUTLIERS

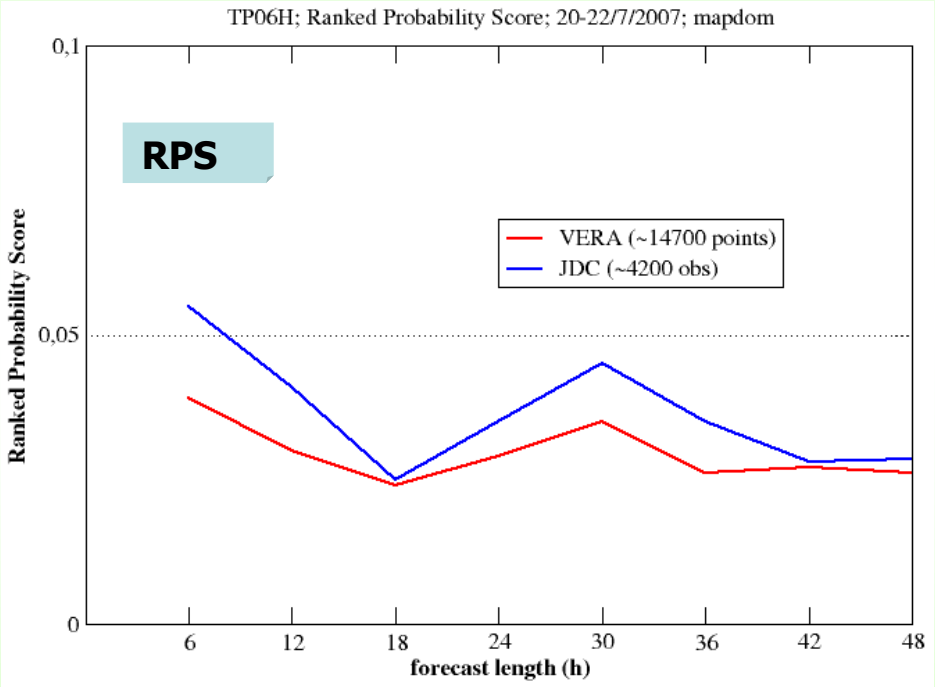
- How many times the analysis is out of the forecast interval spanned by the ensemble members.
- … the lower the better …

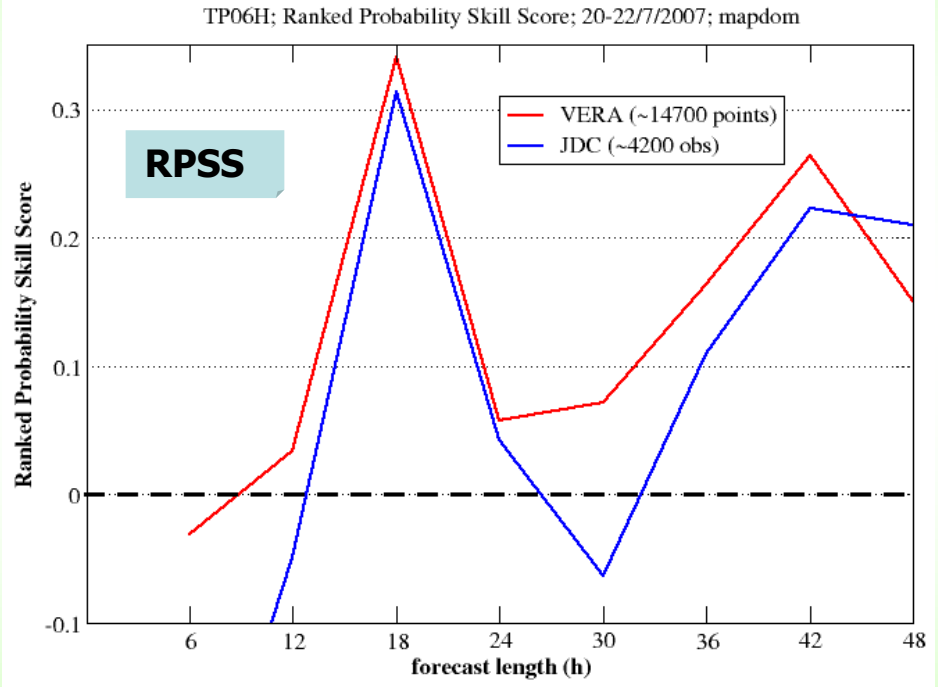


• Very similar skill of COSMO-LEPS with respect to either networks for all forecast ranges.

Probabilistic prediction of tp: RPS and RPSS

- 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.
- RPS: the lower, the better.
- Useful forecast systems for RPSS > 0





- Slightly higher skill when COSMO-LEPS is verified against VERA
- Higher skill of the system to predict TP occurring between 00 and 06UTC (for both networks)

Conclusions and open issues

- COSMO-LEPS forecast skill: similar scores using either VERA or JDC obs for verification network.
- Try to interpret the results.
- Need to assess also other verification methods (bilin, boxes).
- Look at all forecast ranges.
- Study other mesoVICT cases.

Thanks for your attention !

Recent news_1

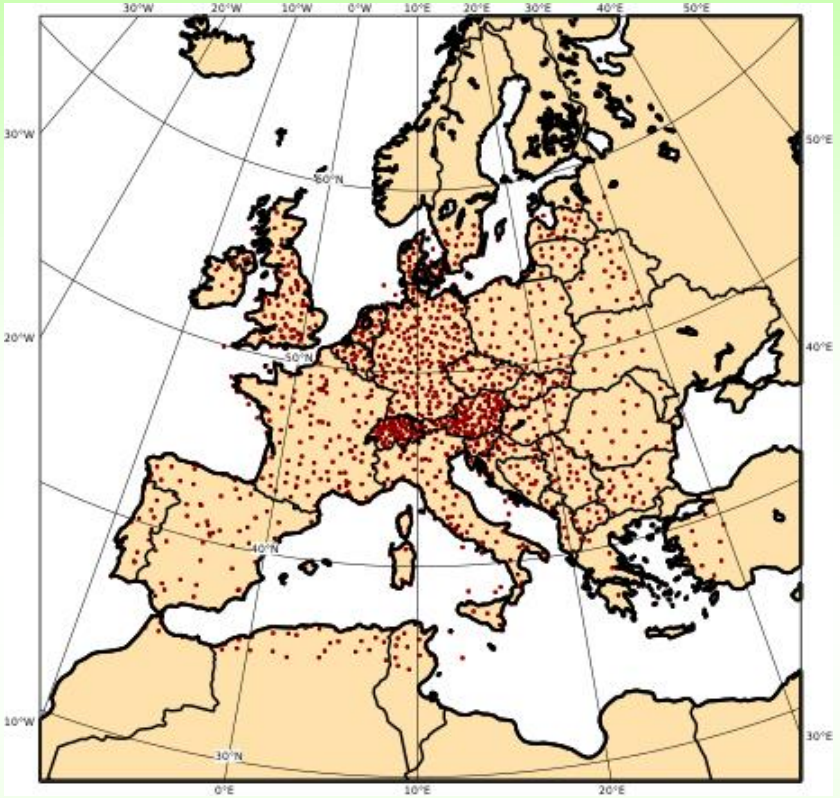
- **December 2015**
  - 30-day tests of COSMO-LEPS with ICON-EU soil fields: no noticeable impact on short-range forecast skill of TP, T2M, TD2M.
- **1 February 2016: suite upgrade**
  - COSMO version update (5.01 → 5.03); int2lm 2.0;
  - Production and archive of 100 metre U and V wind component;
  - Archive of P, T, U, V at model levels 35, 36, 37, 38, 39, 40.
- **19 February 2016: int2lm**
  - ECMWF fields (from test dissemination) with longitudeOfFirstGridPoint = 335000 (instead of longitudeOfFirstGridPoint = -25000) made int2lm fail;
  - a patch was applied to handle ECMWF GRIB1 files with longitudes greater than 180°.
- **25 February 2016: field production to ARPA-Liguria**
  - Dissemination of COSMO-LEPS fields in GRIB2 format.

Recent news_2

- **6 June 2016: ECMWF upgrade**
  - Change of processors on ECMWF super-computers (from IvyBridge to Broadwell) ➔ change of geometry in COSMO and int2lm configurations; no impact on users;
- **11 June 2016: beginning of esuite**
  - Start of experimentation of COSMO-LEPS with 20 members in single precision (**20_sp**) and comparison against operational COSMO-LEPS (16 members in double precision, **16_dp**).
    - Meteorological aspects
    - Computational aspects

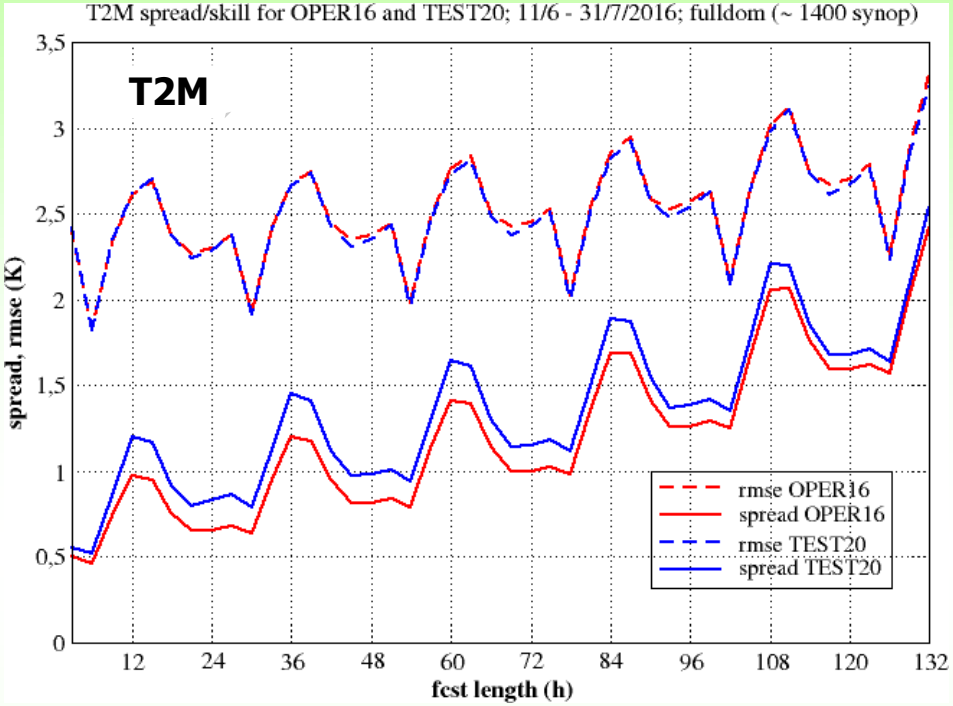
Meteorological aspects

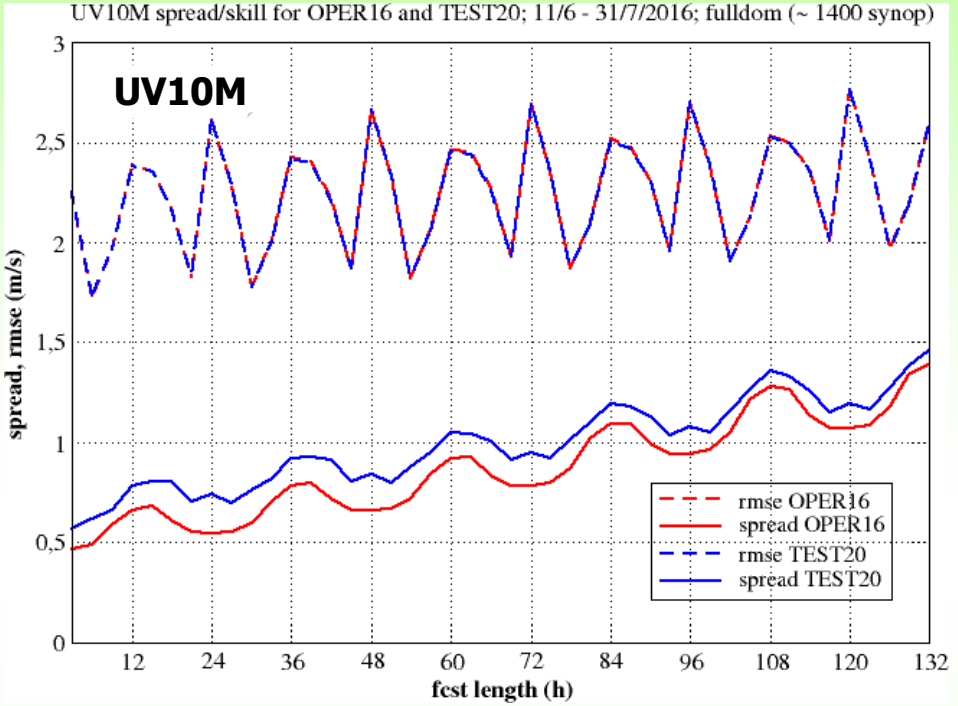
- COSMO v5.03: inter-comparison of **16_dp (no SPPT)** and **20_sp (with SPPT) .**
- Same soil initial conditions from COSMO-EU.
- Both the cluster analyses and the random choice of perturbation parameters are performed separately for 16dp and 20sp.
- 51 days of test (from 11/6 to 31/7/2016), starting at 00UTC.



Verification area: full domain (~ 1400 synop reports).

Spread/skill for T2M and UV10M



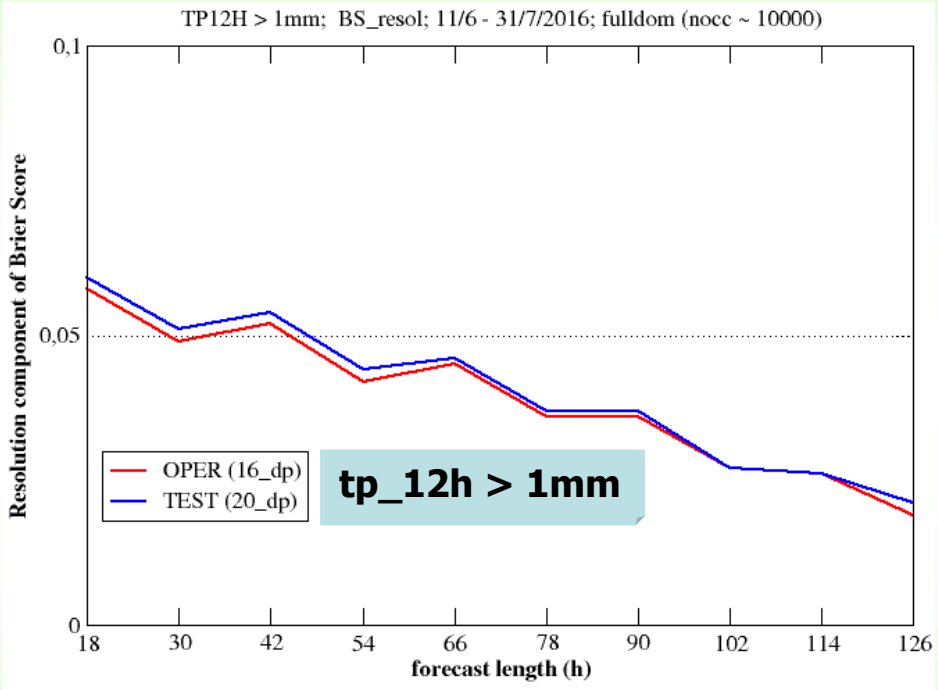


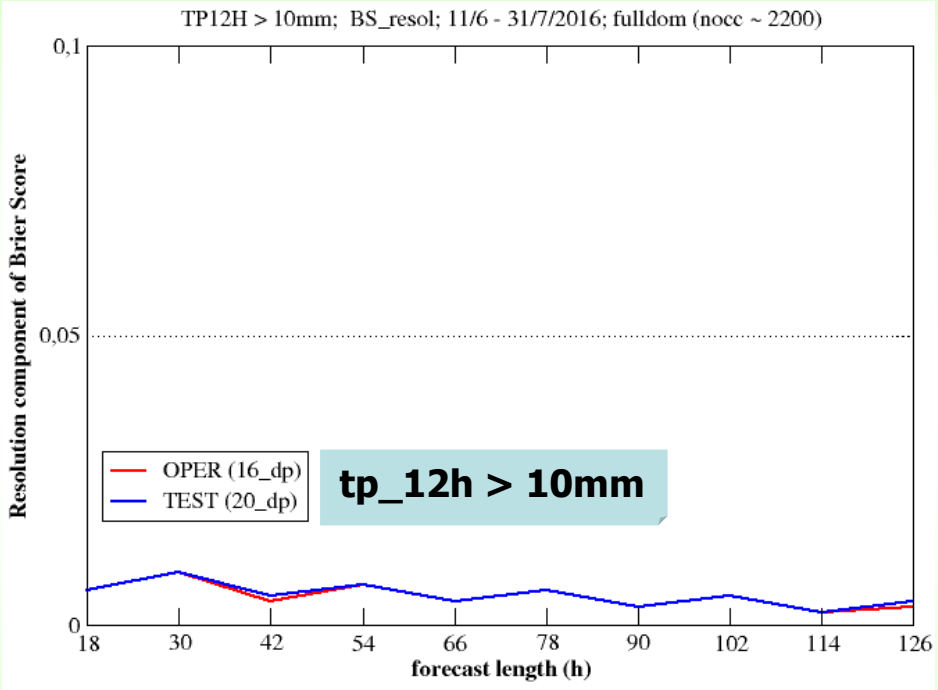
- more solid results with respect to those presented in June (51 days of experimentation).
- Larger spread for **20_sp** for both variables.
- In either cases, lack of spread in the short range.
- Limited impact (if any) on forecast skill of the ensemble mean.

It seems we are going in the right direction.

Probabilistic prediction of tp: Resolution

- Resolution component of the Brier Score: describes the ability of the system to distinguish among events in different categories; the higher, the better …
- Consider two events: 12-hour precipitation exceeding 1 mm and 10 mm.

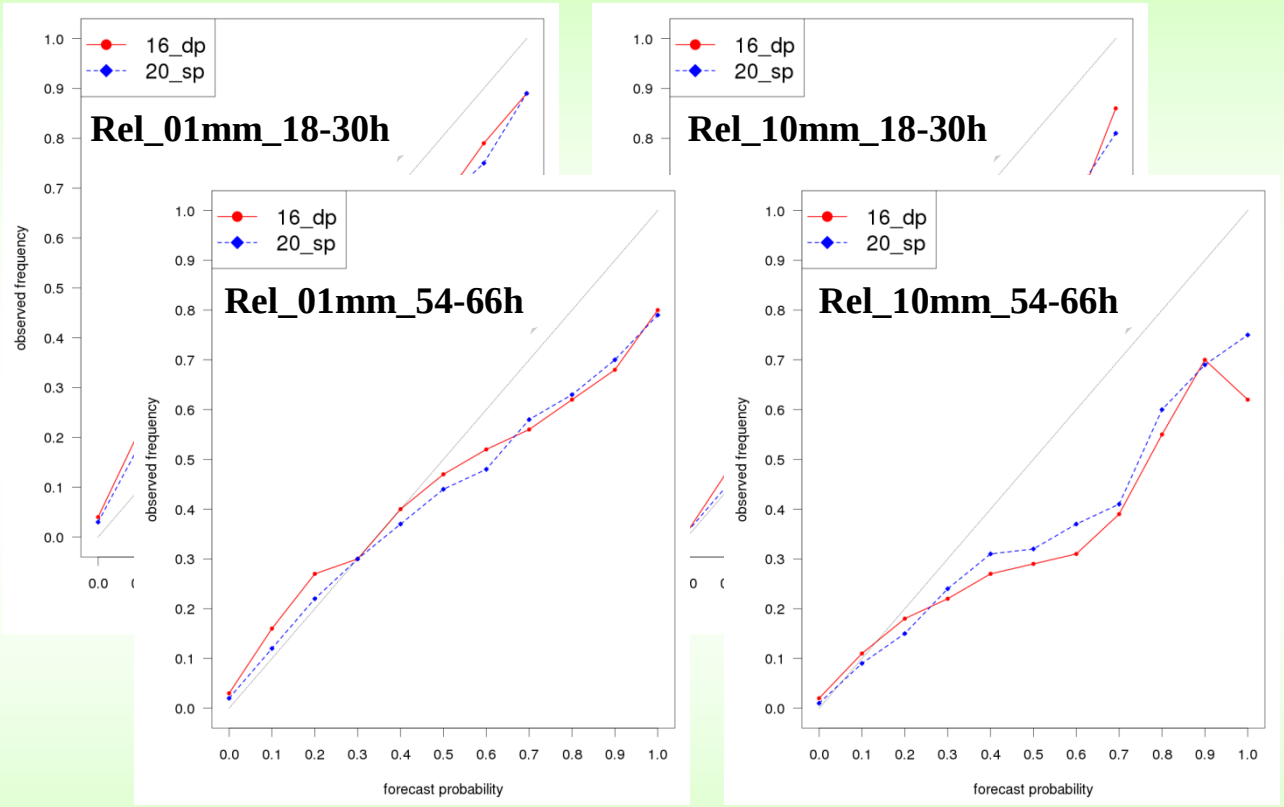




- Slightly better performance by **20_sp** only for the lower threshold.
- Impact more evident in the short range.

Probabilistic prediction of tp: Reliability

- Match between fcst probability and obs frequency for a certain event; the closer to the diagonal, the better ....
- Consider **four** events: 12-hour precipitation exceeding 1 and 10 mm at the ranges 18-30h and 54-66h.



- COSMO-LEPS overconfidence increases with both threshold and forecast range (fcst_prob > obs_freq) for both 16_dp and 20_sp.
- Not clear positive impact of enlarged ensemble size.

Computational aspects

#PBS –l EC_nodes=20

#PBS –l EC_total_tasks=720

.....

Last year (with COSMO v5.1 and old ECMWF processors with different geometry) : the gain was highly variable from day to day (min: ~10%; max: ~50%), but on average

➔ *average saving of about 35%*

THIS YEAR

	double precision	**single precision**
• Cost of 1 COSMO-LEPS run (ECMWF Billing Units)	3100	1600
• Elapsed time (sec)	960	500

➔**average saving of about 48%**

20sp is cheaper than 16dp!

Open issue

Frequent (5-6 every day!) explosions of COSMO in single precision with SPPT.

- Plaster: when the task fails, COSMO is resubmitted with SPPT=.false. (and the task runs successfully).
- When we go operational, SPPT=.false.
- Once COSMO v5.5 is available, the explosion problems should be fixed.

COSMO-LEPS with SPPT: namelist

(from COSMO-E)

```
&RUNCTL
  ....
  leps    =.TRUE.,
  lsppt   =.TRUE.,
/END
```

```
cat >! $workingDir/INPUT_EPS << EONL
 &EPSCTL
  iepsmem=$MEMBER,
  iepstot=$LM_NL_EPSMEMBERS,
  iepstyp=203
  imode_rn=0,
  itype_vtaper_rn=2,
  itype_qxpert_rn=2,
  itype_qxlim_rn=0,
  npattern_rn=1,
  hinc_rn=6,
  dlat_rn=5.0,
  dlon_rn=5.0,
  stdv_rn=1.0,
  range_rn=0.9,
  lgauss_rn=.TRUE.,
  lhorint_rn=.TRUE.,
  ltimeint_rn=.TRUE.,
 /END
EONL
```