COSMO-LEPS:

present status and plans.

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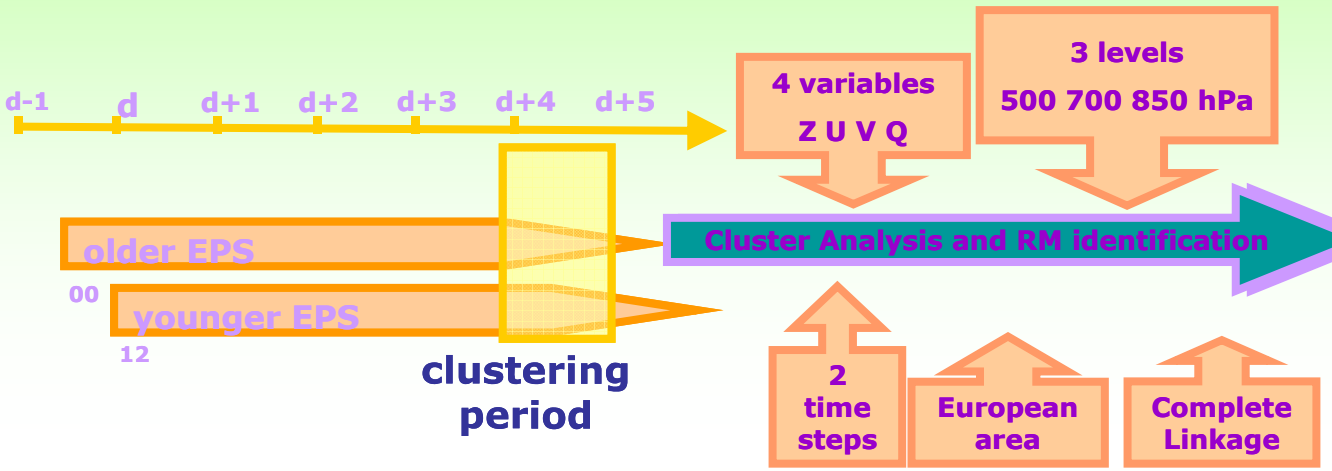
Outline

- **Present status of COSMO-LEPS:**
  - about the operational verification,
  - about the inter-comparison with ECMWF ENS,
  - about the convection schemes,
  - *about the experimentation with high-resolution boundaries*,
  - about the future plans.

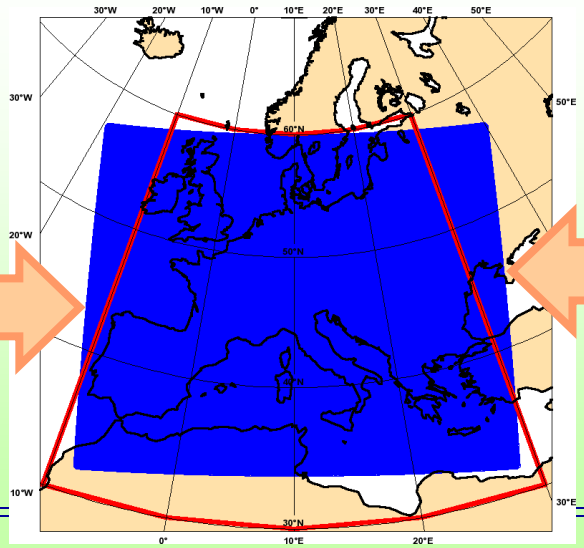
COSMO-LEPS suite @ ECMWF: present status



16 Representative Members driving the 16 COSMO-model integrations (weighted according to the cluster populations)

using either Tiedtke or IFS-Bechtold convection scheme (members 1-8 T, members 9-16 IFS)
+
perturbations in turbulence scheme and in physical parameterisations

COSMO-LEPS clustering area



COSMO-LEPS Integration Domain

- suite runs twice a day (00 and 12UTC) as a "time-critical application" managed by ARPA-SIMC;
- Δx ~ 7 km; 40 ML; fc+132h;
- COSMO v5.0 since Feb 2014;
- computer time (50 million BUs for 2014) provided by the ECMWF member states in COSMO.

Main changes in the COSMO year

- **December 2013:** migration to new ECMWF Member-State server (ecgate).
- **19 February 2014:** COSMO upgrade: 4.26 → 5.0;
  int2lm upgrade: 1.20 → 2.0;
  use of IFS-Bechtold scheme for members 9-16 (Kain-Fritsch no more supported).
- **13 March 2014:** upgrade of external parameters, using the same as COSMO-EU. Use of prescribed background albedo.
- **15 July 2014:** upgrade of int2lm to decode GRIB2 format of DWD soil moisture fields.
- **25 August 2014:** migration to new ECMWF super-computer (still ongoing).

Outline

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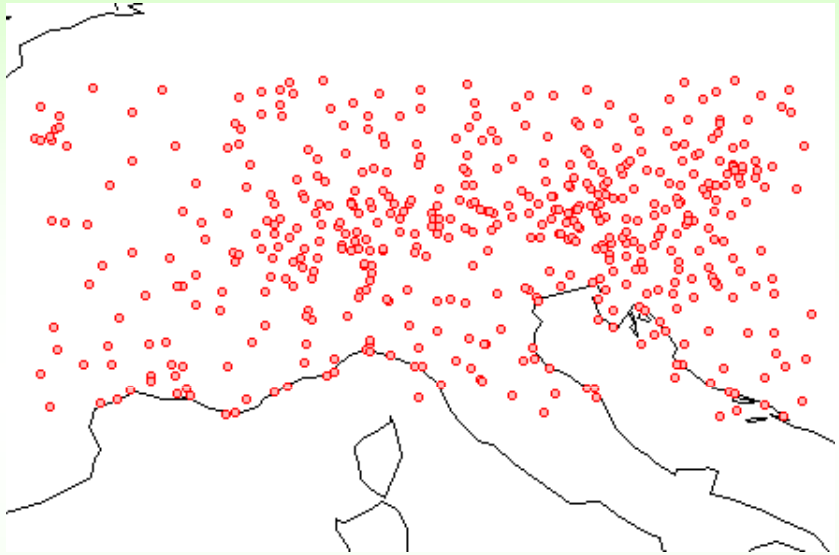
  - about the operational verification,

Time-series verification of COSMO-LEPS

- SYNOP on the GTS



Main features:

variable: 12h cumulated precip (18-06, 06-18 UTC);

period : from Dec 2002 to May 2014;

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

method: nearest grid point; no-weighted fcst;

obs: synop reports (about 470 stations/day);

fcst ranges: 6-18h, 18-30h, …, 102-114h, 114-126h;

thresholds: **1, 5, 10, 15,** *25, 50* **mm/12h**;

system: COSMO-LEPS;

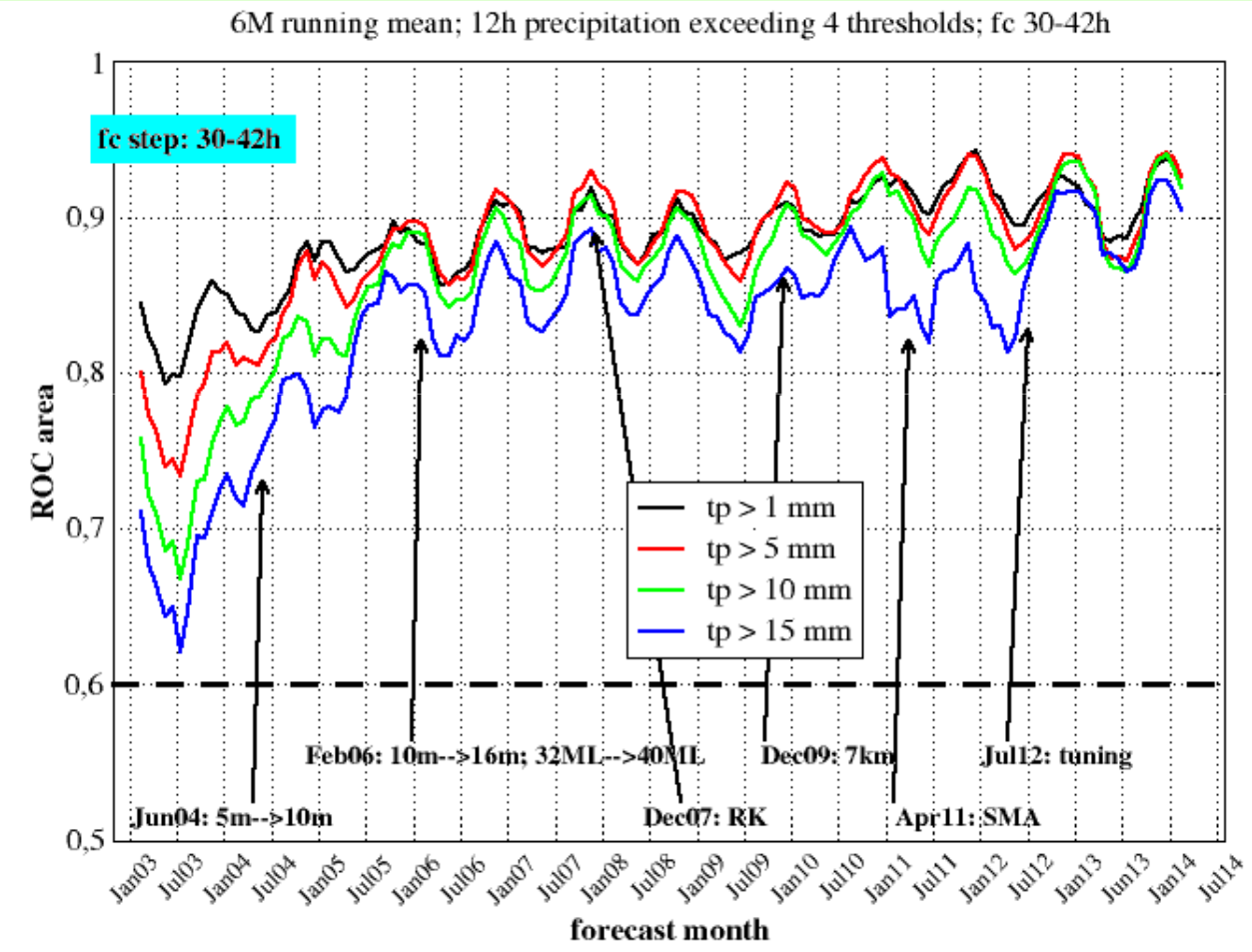
scores: **ROC area, BSS, RPSS, Outliers**, …

both monthly and seasonal scores were computed

Time series of ROC area (6-month running mean)

- Area under the curve in the HIT rate vs FAR diagram; the higher, the better …
- Valuable forecast systems have ROC area values > 0.6.

- Highest scores in the 2nd part of 2011 and, for the highest threshold, in 2013.
- Drier seasons during 2011 and 2012 with few heavy-precipitation events: limited significance of the results for the 15mm threshold.
- **fc 30-42h**: ROC area is high for last winter and spring. Positive trend can be noticed.
- **fc 78-90h**: the best scores date back to the end of 2011.
- Limited loss of predictability with increasing forecast range.



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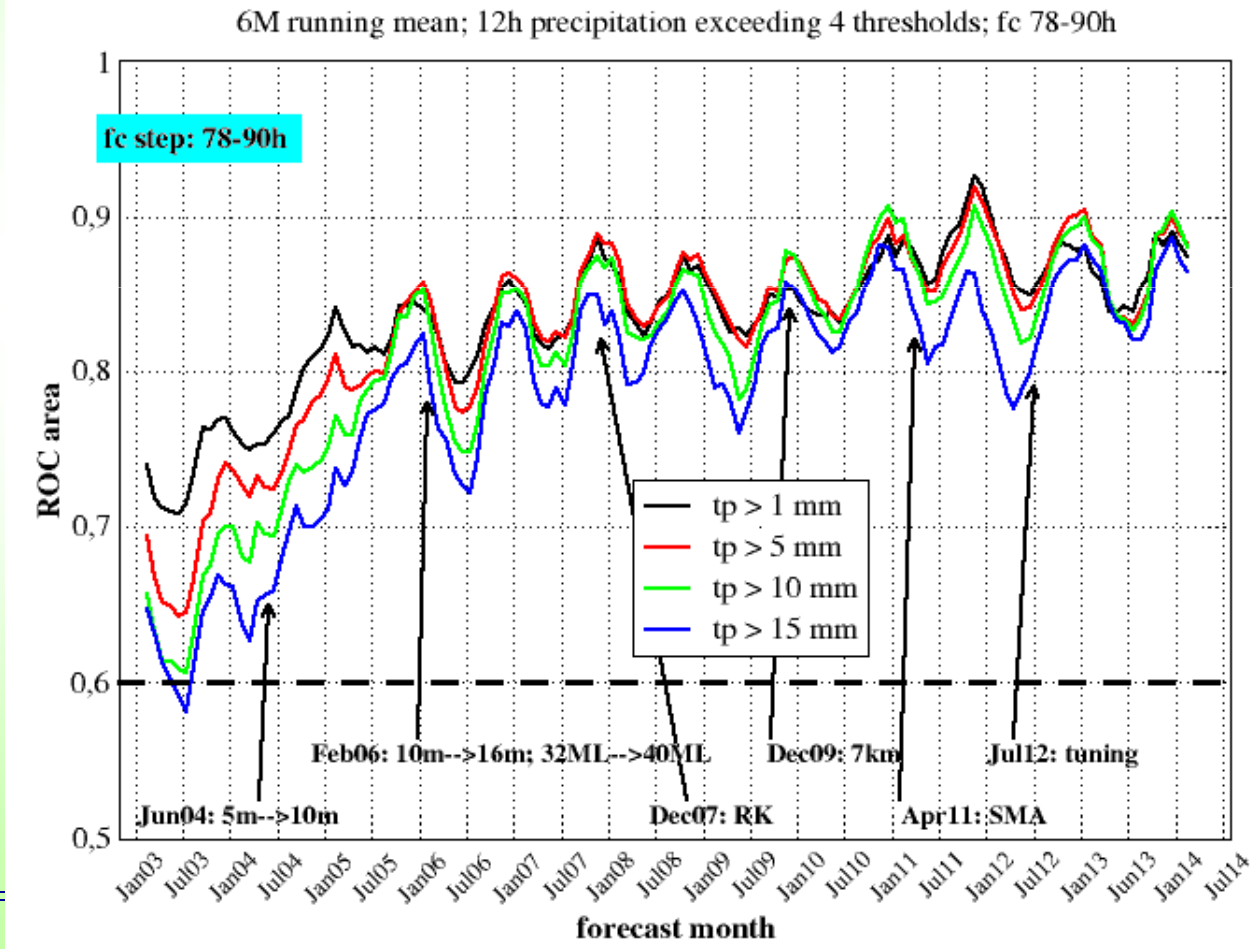
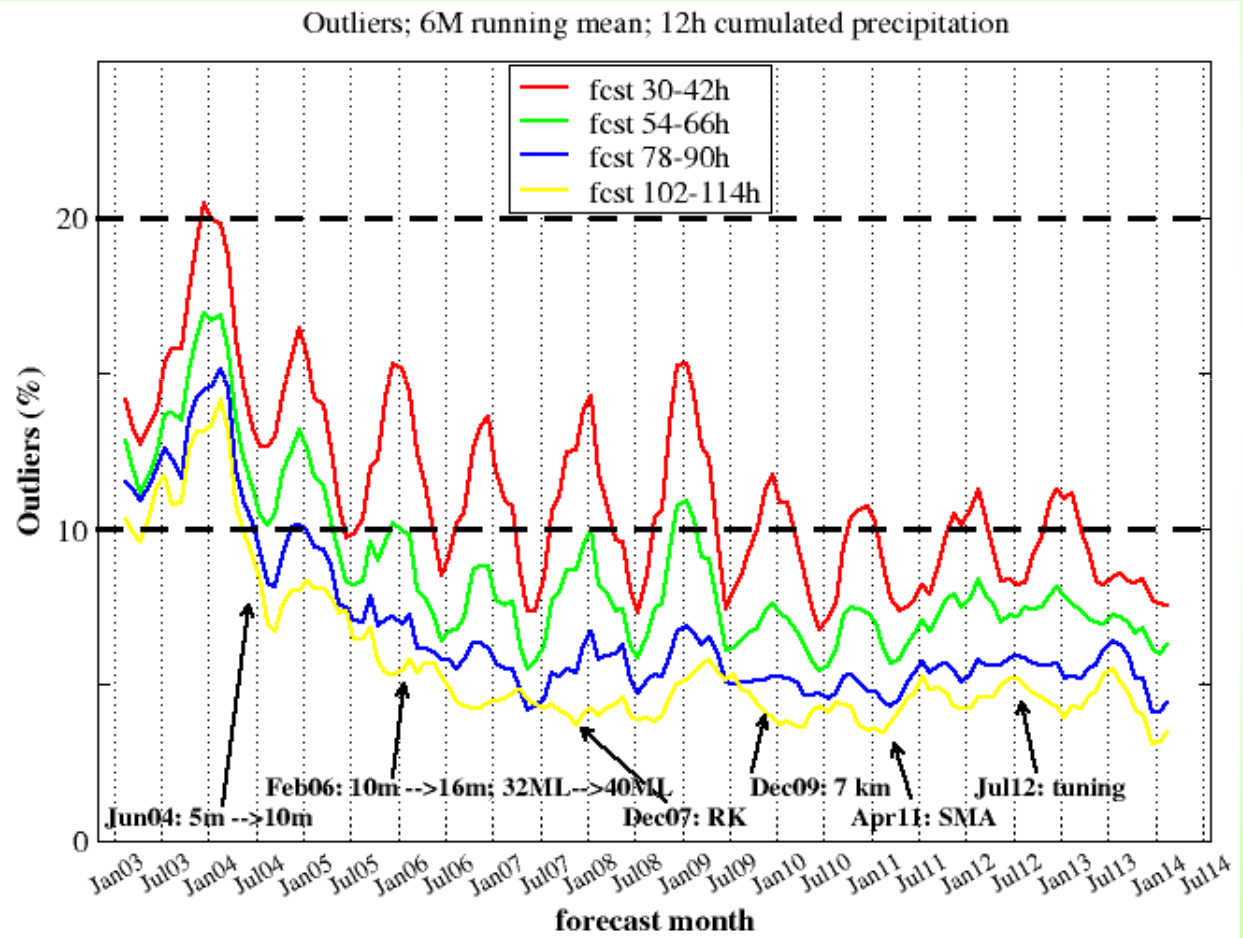


Outliers: time series + seasonal scores (DJF)

- How many times the analysis is out of the forecast interval spanned by the ensemble members.
- … the lower the better …
- Performance of the system assessed as time series and for the last 4 winters.

- Evident seasonal cycle (more outliers in winter).
- Overall reduction of outliers in the years up to 2007; then, again in the last 1.5 year.



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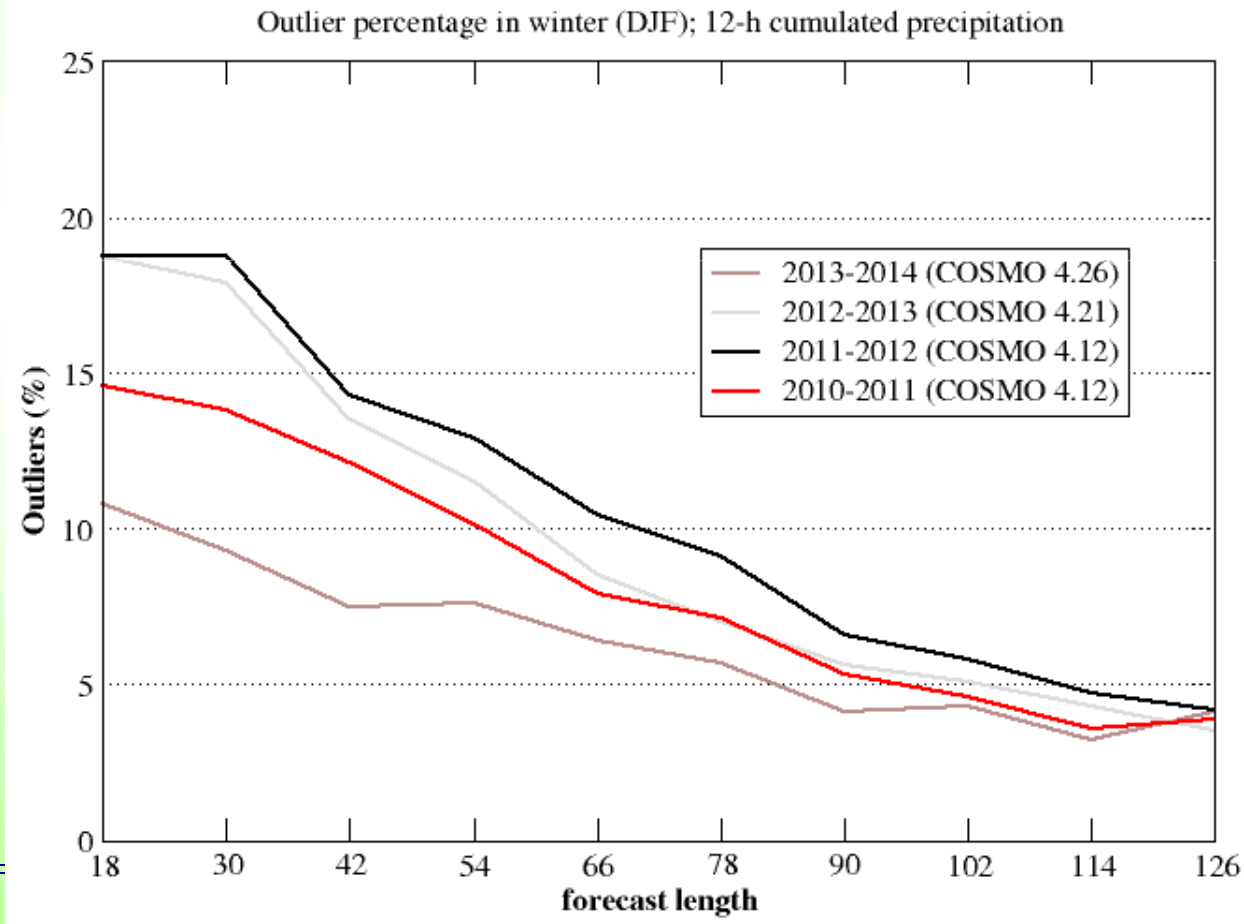
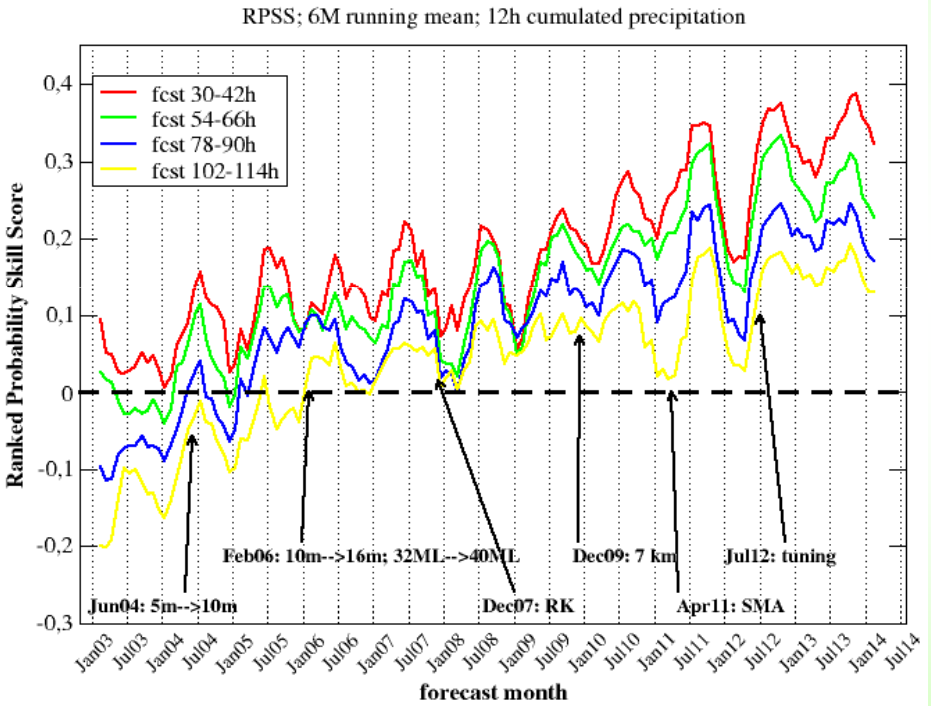
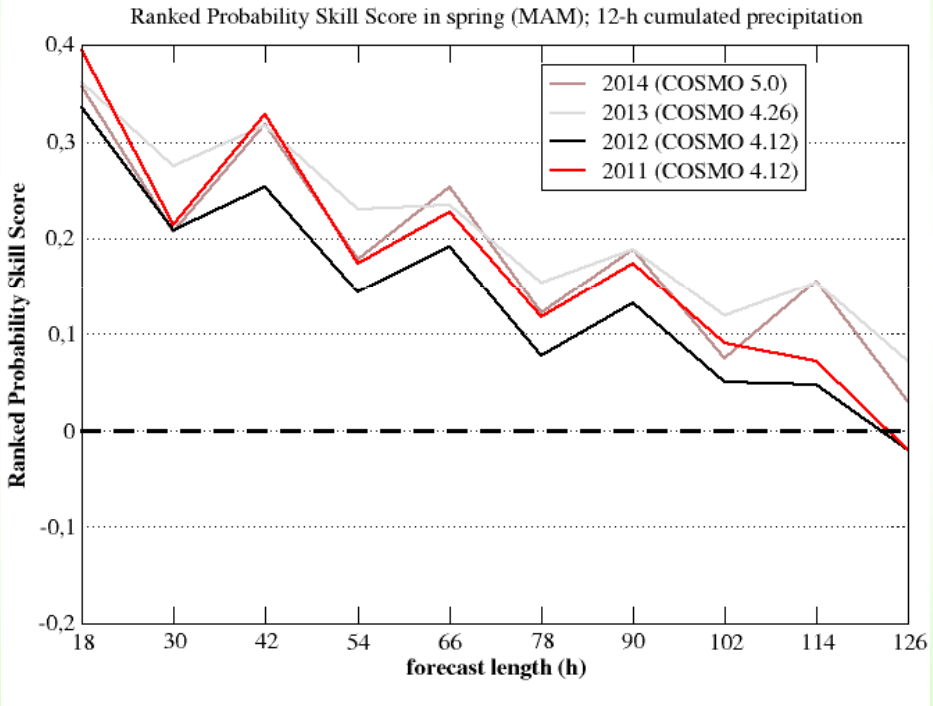


- Need to take into account the different statistics for each season.
- For all forecast ranges, **best results for last winter**.
- For longer ranges, the performance of the system is "stable": outliers before 10% from day 3 onwards.

Ranked Probability Skill Score: time series + ... seasonal scores (MAM)

- A 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.
- Performance of the system assessed as time series and for the last 4 springs (MAM).





the increase of the COSMO-LEPS skill is detectable for all forecast ranges along the years, **BUT**

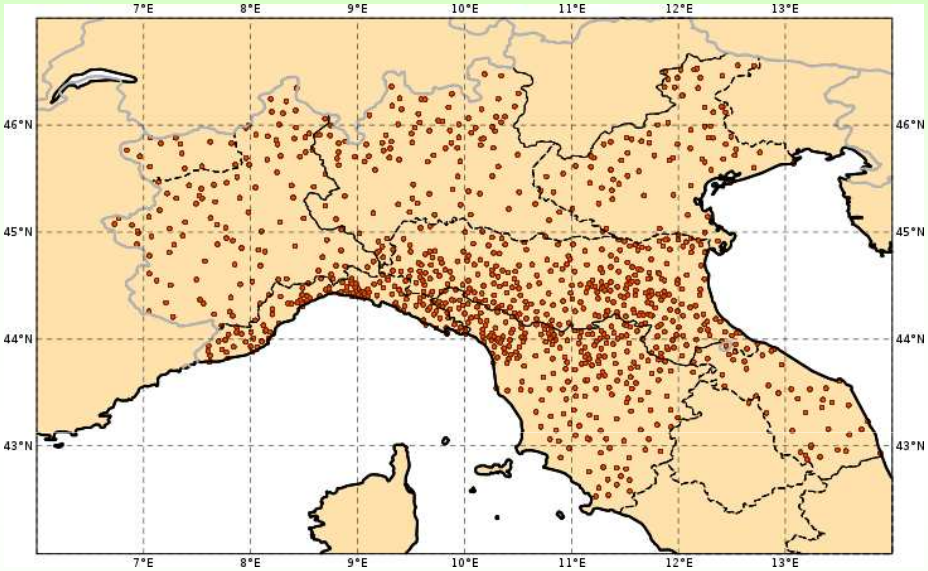
- low skill in the first months of 2012 (the problem comes from MAM), then recovery.
- Best results for MAM 2011; quick decrease of RPSS with forecast range for MAM 2012; "normal" scores in 2014.

Outline

- **Present status of COSMO-LEPS:**
  - ➢ about operational verification (time-series scores show positive trend; good performance for winter 2013-14, “normal scores” for MAM2014),
  - ➢ about the inter-comparison with ECMWF ENS,

Comparison of COSMO-LEPS and ECMWF EPS

- high-resolution network



Main features:

variable: 24h cumulated precip (06-06 UTC);

period: from December 2009 to May 2014;

region: Northern Italy;

method: BOXES (1.0 x 1.0);

obs: non-GTS network (~1000 stations x day);

fcst ranges: 18-42h, 42-66h, 66-90h, 90-114h;

thresholds: **1, 5, 10, 15, 25, 50 mm/24h;**

systems:

- COSMO-LEPS (16m, 7 km, 40ML) – cleps16

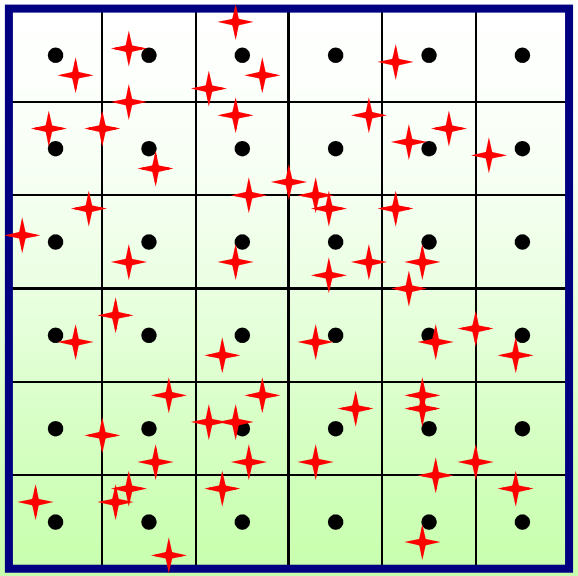
- full EPS (51m, 30 km, 62ML) – eps51

Verification of the distributions

The verification has been made in terms of:

- Average value
- **Maximum value**
- 50th percentile (Median)
- 75^{th}, 90^{th}, 95^{th} percentiles

} in a box



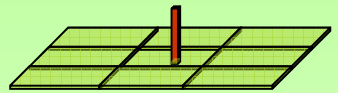
✦ Station observation

• Grid point forecast

two measures of precipitation:

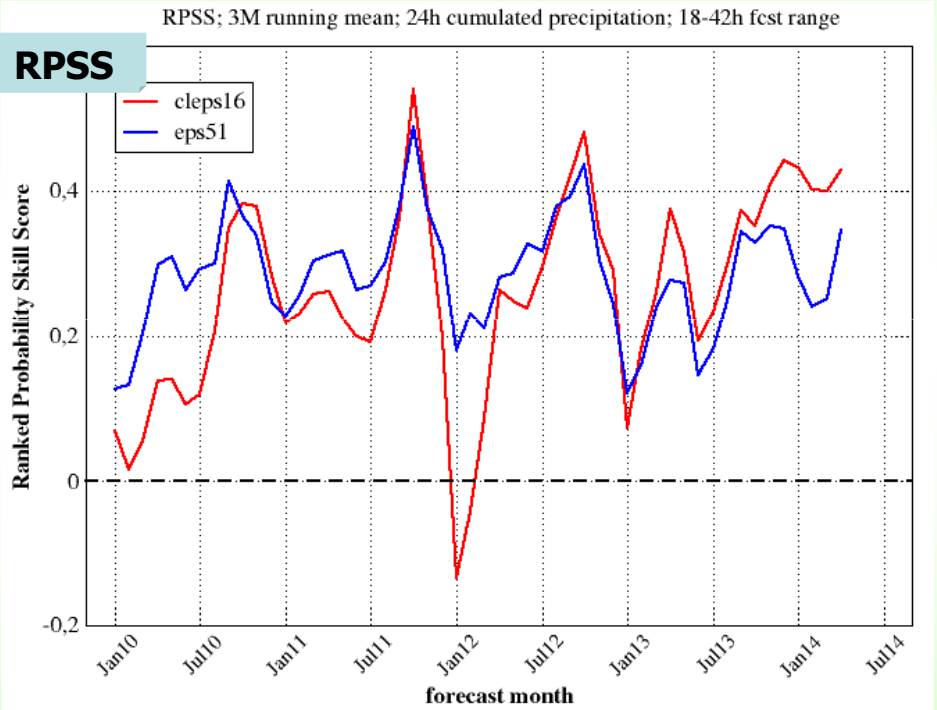
- the cumulative volume of water deployed over a specific region;
- the rainfall peaks occurring within the same region.

Time series of Ranked Probability Skill Score maximum values (boxes 1.0 X 1.0) (1)

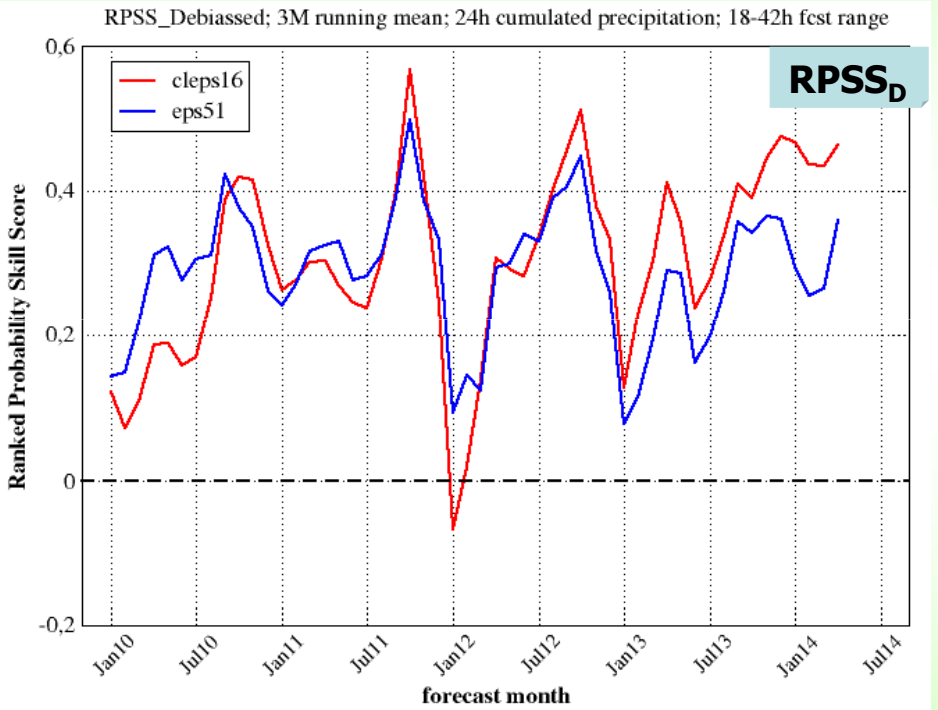


- BSS "cumulated" over all thresholds. RPSS is written as 1-RPS/RPS_{ref}. **Sample climate** is the reference system. RPS is the extension of the Brier Score to the multi-event situation; useful forecast systems for RPSS > 0
- RPSS depends on the ensemble size N and penalises small ensemble sizes.
- Consider **debiased RPSS**: $\mathbf{RPSS_D}$ = 1 –(RPS/(RPS_{ref} + RPS_{ref} /N)); a 3-month running mean is applied.

RPSS



$RPSS_D$



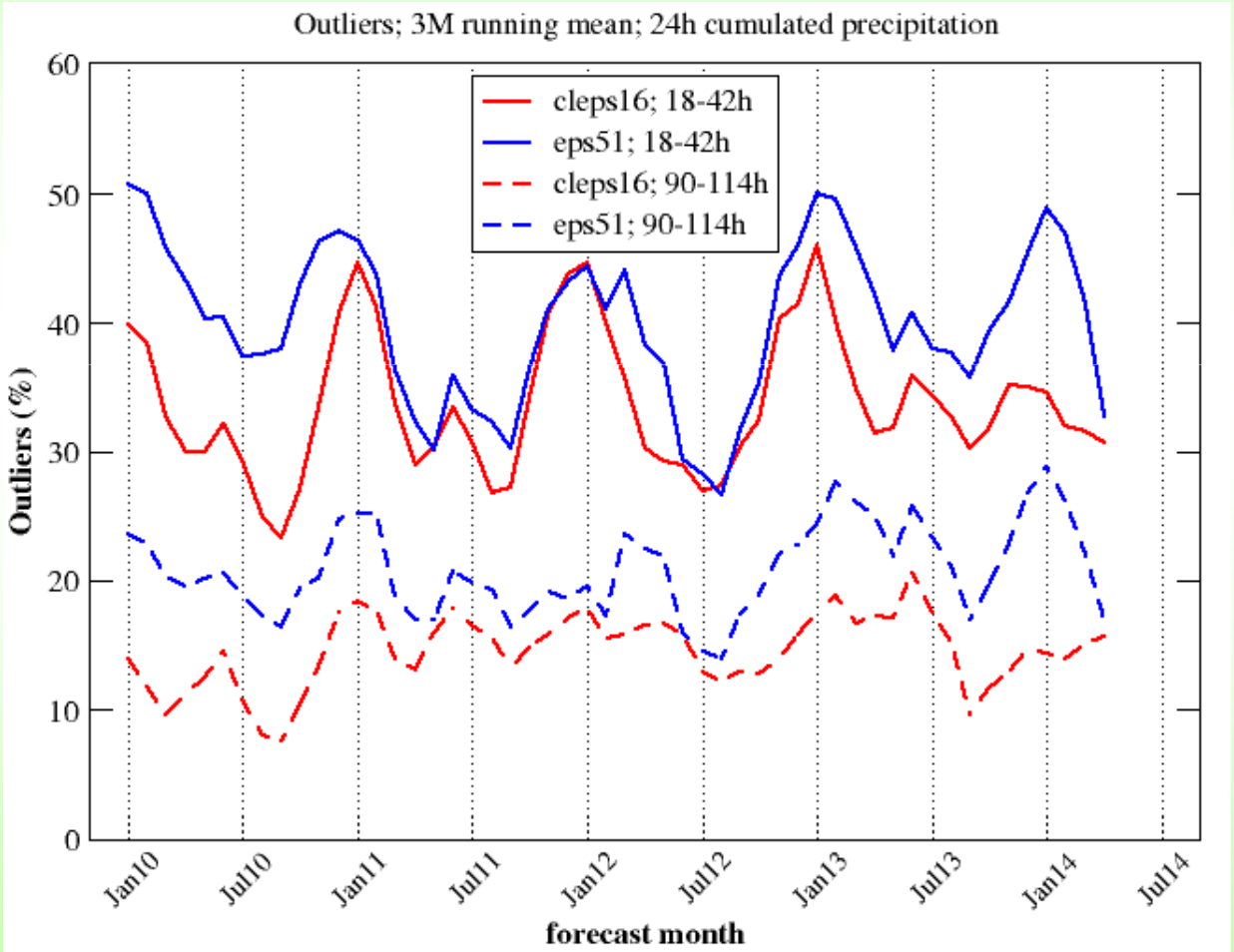
- Seasonal cycles of the scores; worse performance in winters, possibly related to the presence of snow (some stations are not heated).
- Either way (RPSS or $RPSS_D$), ECMWF-EPS had initially higher scores; then, COSMO-LEPS has had higher scores than ECMWF-EPS since 2013 in the short range, despite the lower ensemble size.

The same applies (COSMO-LEPS has higher scores than ECMWF-EPS) for all forecast ranges.

Time series of Outliers maximum values (boxes 1.0 X 1.0)

- How many times the analysis is out of the forecast interval spanned by the ensemble members.
- … the lower the better …
- The performances of the systems are assessed for two different forecast ranges (18-42h and 90-114h)

- More outliers in winters, possibly related to the presence of snow (some stations are not heated).
- Better performance (fewer outliers) for COSMO-LEPS both in the short and early-medium range



Outline

- **Present status of COSMO-LEPS:**
  - about operational verification (time-series scores show positive trend; good performance for winter 2013-14, "normal scores" for MAM2014),
  - about the inter-comparison with ECMWF ENS (higher skill of COSMO-LEPS since 2013 for verification over boxes),
  - about the convection schemes,

Types of convection schemes

With the introduction of COSMO V5.0, Kain-Fritsch convection scheme is no more supported:

- members 1-8 use Tiedtke convection scheme (**8TD**),
- members 9-16 use IFS-Bechtold scheme (**8BE**).

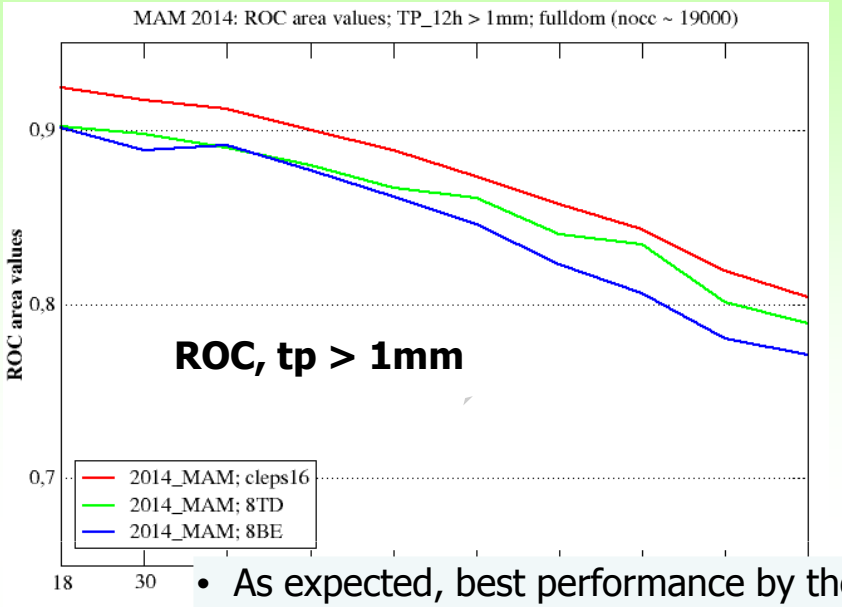
MAM 2014 (very rainy):

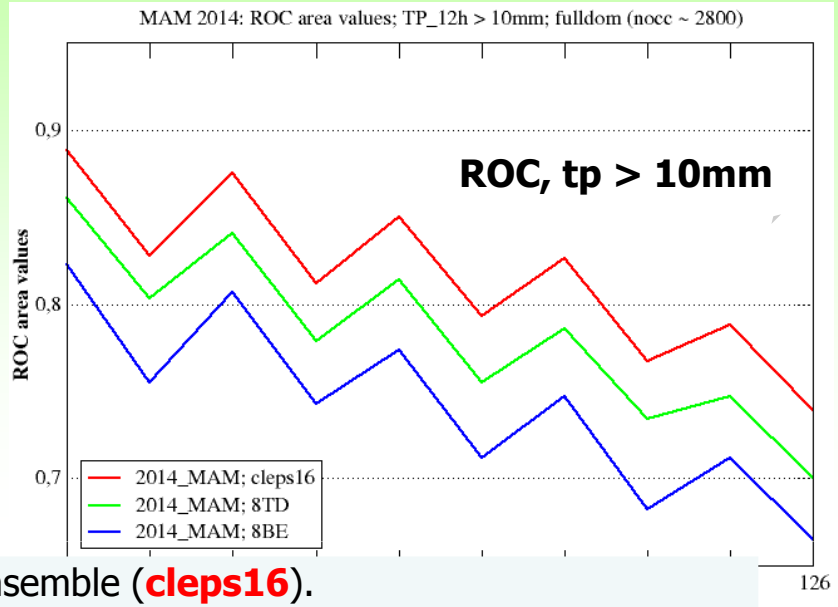
compare cleps16, 8TD, 8BE over the full domain

in terms of total precipitation

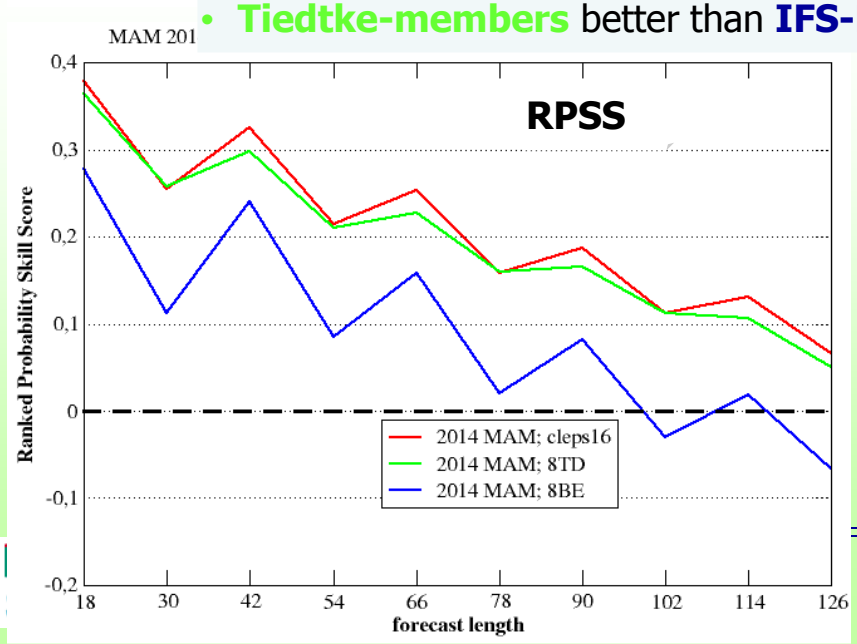
___ cleps16
___ 8TD ___ 8BE

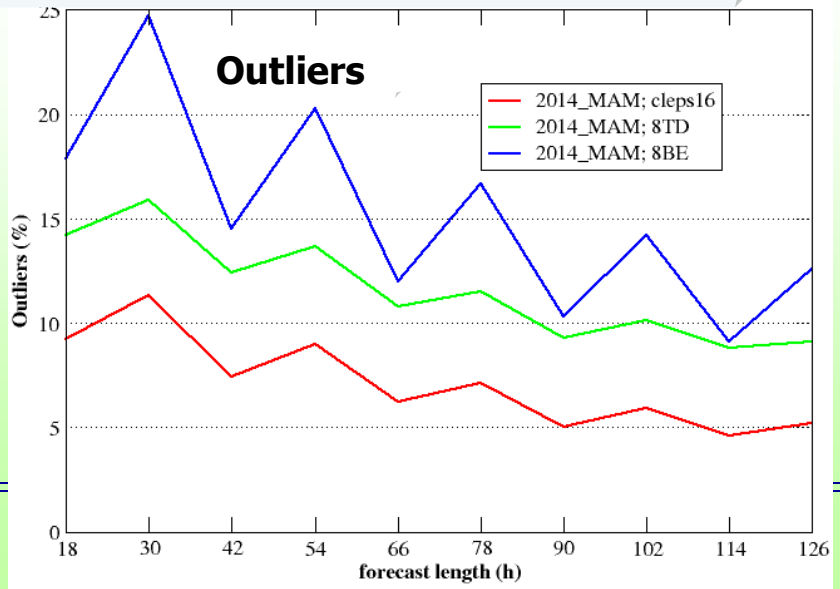
about the convection scheme





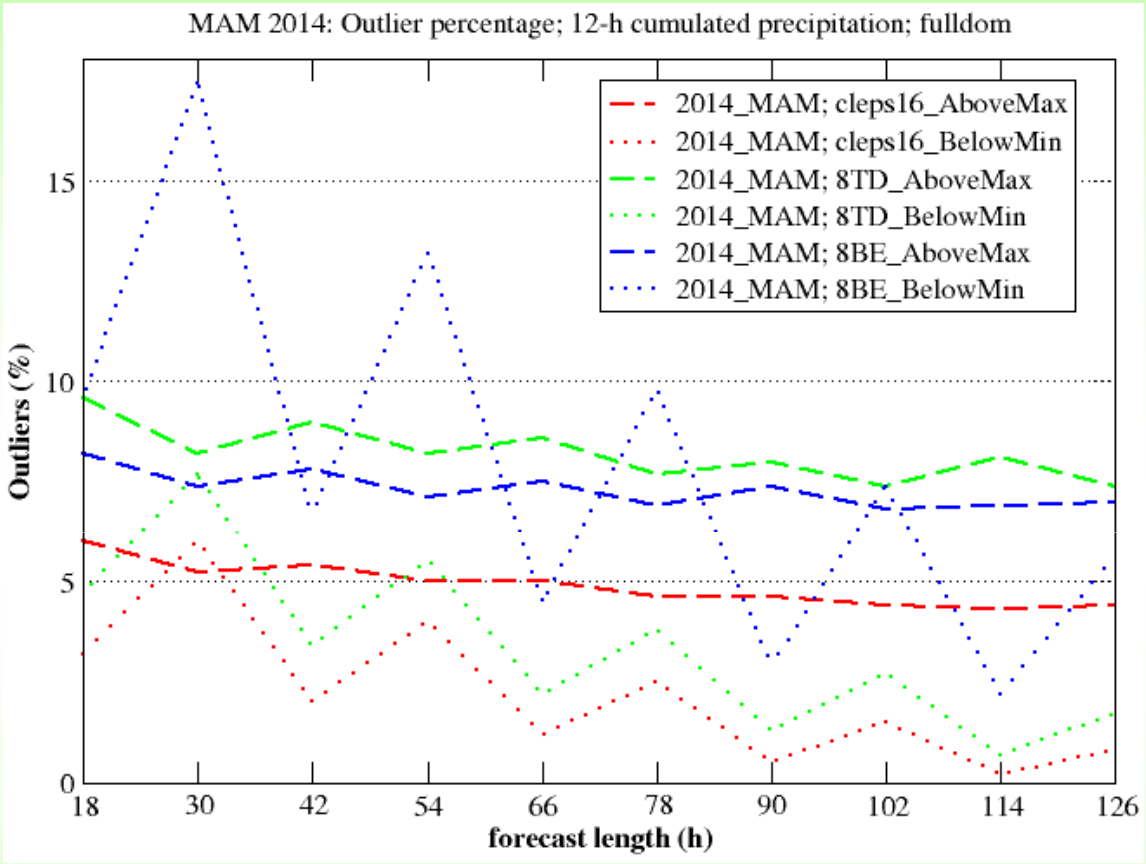
- As expected, best performance by the full ensemble (**cleps16**).
- **Tiedtke-members** better than **IFS-Bechtold members** (very clearly for some scores).





___ cleps16
___ 8TD ___ 8BE

More on Outliers



IFS-Bechtold members have many more outliers BELOW the minimum than **Tiedtke-members** (dotted lines).

➔Overestimation of precipitation (in reality it does not rain) in members 9-16, especially during day-time verification.

➔In all cases, outliers ABOVE the maximum remain almost unchanged for all forecast ranges (dashed lines).

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  - about the inter-comparison with ECMWF ENS (higher skill of COSMO-LEPS since 2013 for verification over boxes),
  - about the convection schemes (Tiedtke members superior to IFS-Bechtold members in COSMO 5.0 as for precipitation),
  - *about the experimentation with high-resolution boundaries*,
  - about the future plans.

about the future plans

- **September 2014: adapt COSMO-LEPS suite to ECWMF forthcoming upgrades:**
  - change of super-computer: IBM → Cray;
- November 2014: test increase of COSMO-LEPS vertical resolution (40 → 50ML);
- Migration to GRIB2.
- Carry on study about the clustering methodology.

Any request for modifications to the present configuration of COSMO-LEPS?

• If IFS-Bechtold members are clearly worse than Tiedtke members also for other seasons, what about using only one convection scheme? And/or check other variables?

• There is a Greek request for an increase of the integration domain of COSMO-LEPS: how to handle it?

.....

Thank you !

EMS annual meeting / European Conference on Applied Climatology

06 – 10 October 2014, Prague (CZ)

Session NWP4 (on Tuesday 07 October): Probabilistic and ensemble forecasting at short and medium-range

http://www.ems2014.eu/home.html