LEPS VERIFICATION ON MAP CASES

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LEPS project > Tiziana

- brief review about the methodology
- results of the experimentation

COSMO-LEPS > Andrea

- description of the system
- Status of system implementation

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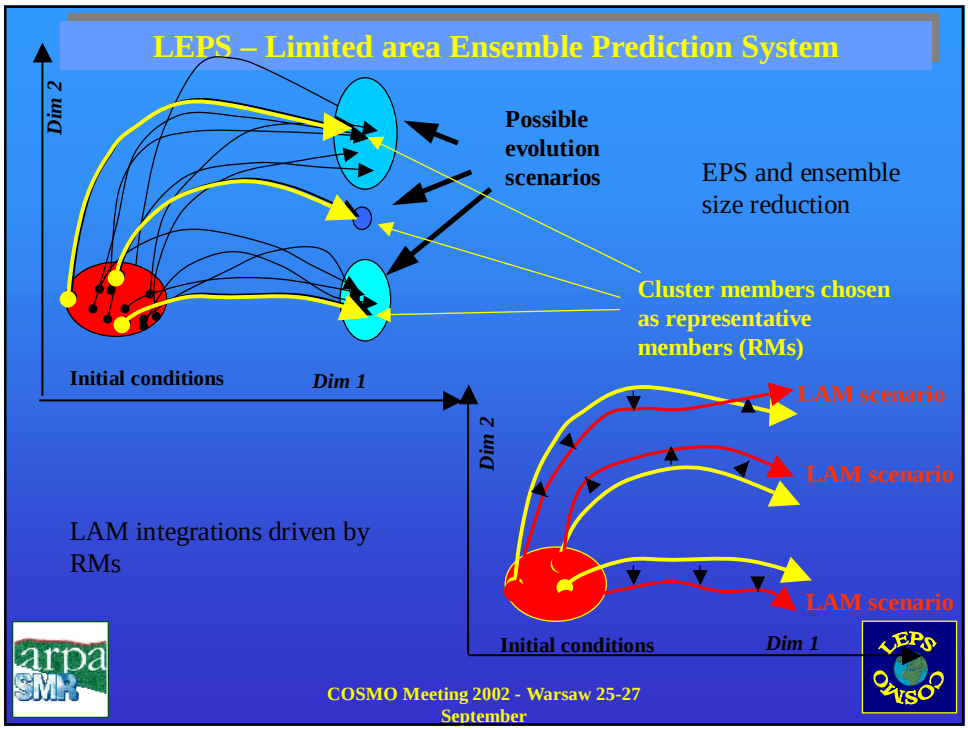
LEPS – Limited area Ensemble Prediction System
Dim 2
Possible evolution scenarios
EPS and ensemble size reduction
Cluster members chosen as representative members (RMs)
Initial conditions
Dim 1
Dim 2
LAM scenario
LAM scenario
LAM scenario
LAM integrations driven by RMs
Initial conditions
Dim 1
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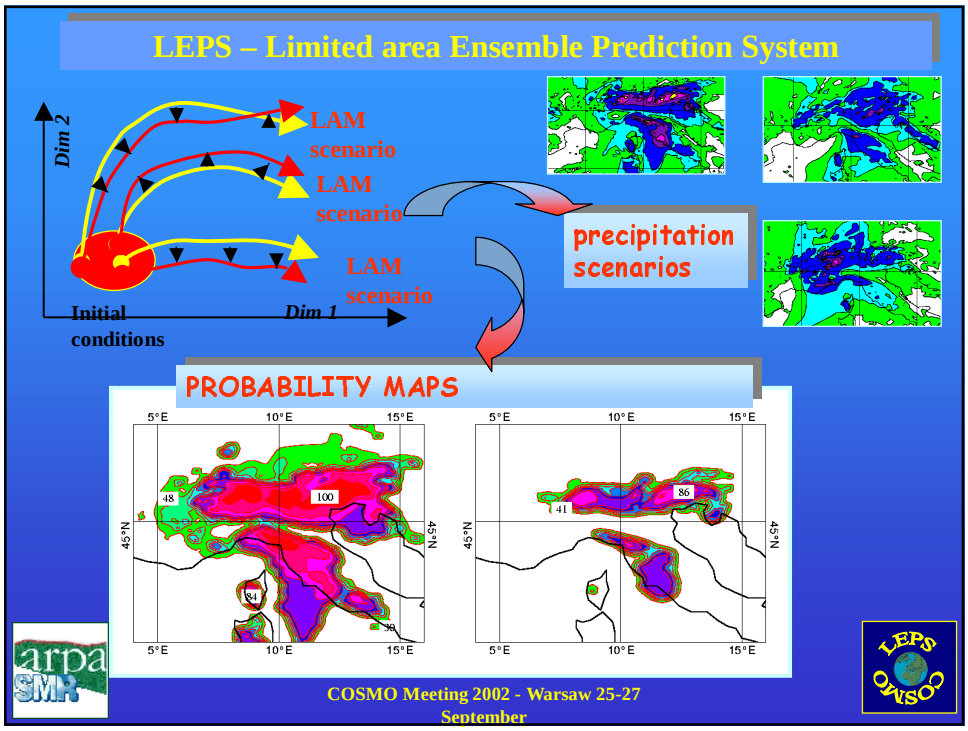
LEPS – Limited area Ensemble Prediction System
Dim 2
LAM scenario
LAM scenario
LAM scenario
Initial conditions
Dim 1
precipitation scenarios
PROBABILITY MAPS
5°E
10°E
15°E
45°N
48
100
84
41
86
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Methodology

Super ensemble:
N global ensembles starting 5/3 days before the verification time

*(50 + 1)*N members*

Hierarchical Cluster Analysis
method: Complete Linkage
area: Southern Europe
fields: 4 variables at 4 levels (3D cluster)
number of clusters: fixed to 5

5 clusters

Representative Member Selection
•one per cluster
• base on the nearest (3D fields) to the mean of its own cluster AND the most distant to the other clusters' means

5 representative members (RMs)

5 LAM integrations nested on 5 RMs:
LEPS - Limited-area (High Resolution) Ensemble Prediction System

LEPS - COSMO-LEPS "TOOLS"

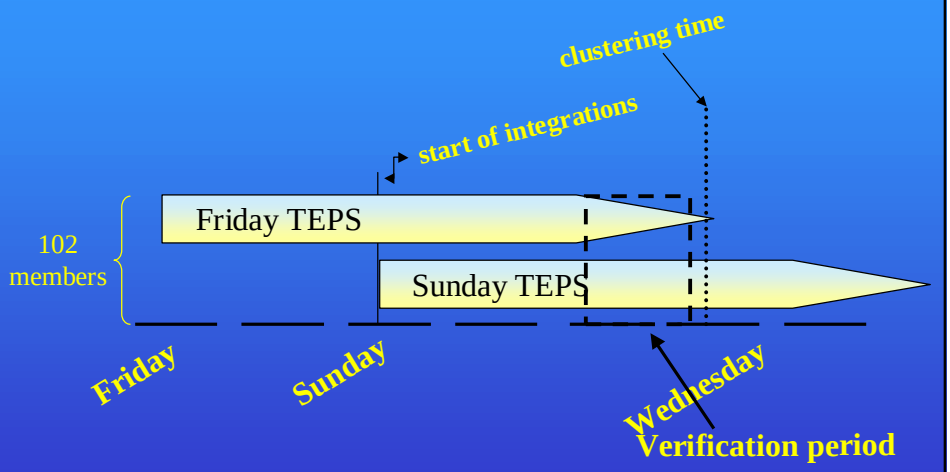
- ECMWF EPS system
  - TL159L40 (hor. res. ~ 120 km)
  - TL255L40 (hor. res. ~ 80 km)

  ← TEPS

- Limited Area Models
  - LAMBO (ARPA-SMR oldest model) 20 km h.r.
  - Lokal Modell (COSMO) 7/14/10 km h.r.
- Obs. precipitation from the high-res. MAP data set

  15 MAP cases
- Statistical verification package by ARPA-SMR

LEPS super-ensemble *MAP CASES*



LEPS VERIFICATION on the MAP SOP

- Use of probabilistic (and deterministic) indices:
  - **ROC Curve / ROC area**
  - **Brier Score and Brier Skill Score**
  - **Cost-Loss Analysis**

Hypothesis testing by RESAMPLING

(HAMILL, *Weather and Forecasting* 1999)

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Main results

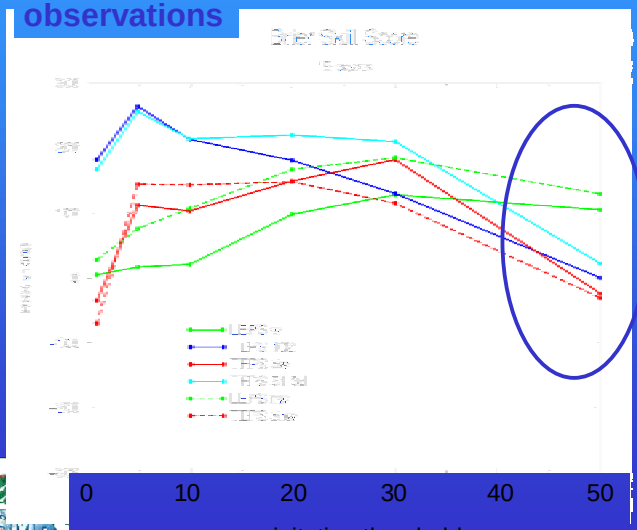
Scores computed against observations on 15 cases

		SE (2EPS)	EPS 3 days	SE-5rm-w	SE-5rm-nw	LEPS-w	LEPS-nw
10 mm	BSS	213	214	103	143	21	107
	ROC area	834	838	777	762	753	750
50 mm	BSS	-18	22	-24	-31	105	129
	ROC area	742	740	524	524	751	749

Hypothesis testing by RESAMPLING
(Hamill, *Weather and Forecasting* 1999)

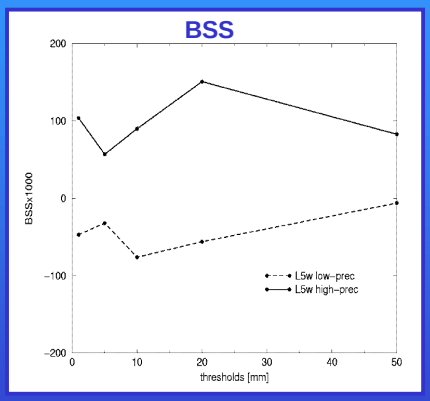
Verification against observations

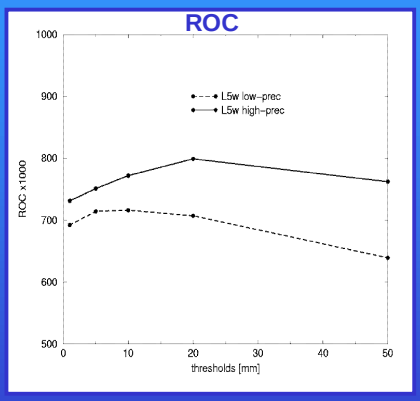
VERIFICATION: Brier Skill Score



BSS area as a function of the precipitation threshold for the **LEPS** (green lines), the **TEPS 102-member** ensemble (blue line), the **TEPS 3-day 51-member** ensemble (cyan line) and the **TEPS 5-member** ensemble (red lines).

Comparison of scores computed against observations grouping cases in two different samples

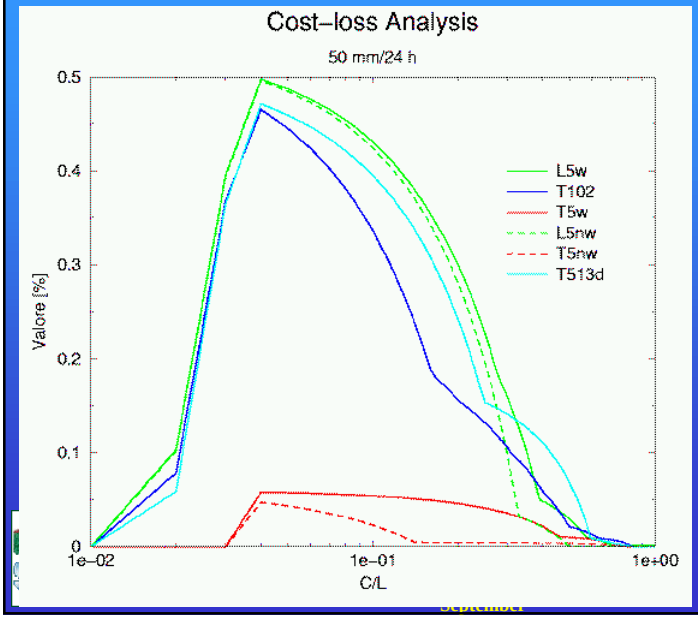




Solid line: the 4 most precipitating cases

Dashed line: the remaining 11 cases

VERIFICATION: COST-LOSS ANALYSIS



Value of the forecast systems (expressed as a percentage of the value of a perfect forecast system) as a function of the cost-loss ratio. The systems are: **LEPS** (green lines), **TEPS 102-member** (blue line) and **3-day 51-member** (cyan line) and **TEPS 5-member** (red lines). The considered event is precipitation exceeding 50mm/24h.

Some considerations and possible verification suggestions (1)

The accurate forecast of extreme weather conditions, especially when related to intense and localised precipitation structures, is still difficult.

This limitation is due, among other reasons, to the inherent low degree of predictability associated to this kind of phenomena.

Some considerations and possible verification directions (2)

The wish to forecast such critical events

with the correct amplitude

in the correct location

at the correct time

is misleading even with sophisticated models run at very high resolution.

Verifications should be designed with this awareness

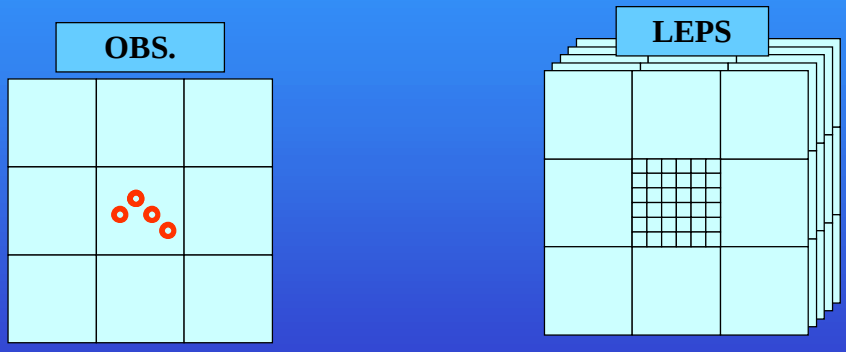
Some considerations and possible verification directions (3)

We should try to understand which is the best information we can get from model output at the different space scale for different precipitation thresholds.

This information can be very useful for models users.

LEPS	COSMO-LEPS
SE 102 members 48 hours lagged in time	SE 153 members 12+12 hours lagged in time
EPS TL159	EPS TL255 (and more)
LAMBO 20 km	LOKAL 10 km

Statistical information from observations and LEPS forecasts in super-boxes at lower resolution with respect to LAM (.5°,1°,1.5°)



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STAT INFO FROM OBSERVATIONS

ADJACENT — OE/ FOE /MO SUPER-BOXES — OVERLAPPING

OE (testing the occurrence of the event in a superbox)

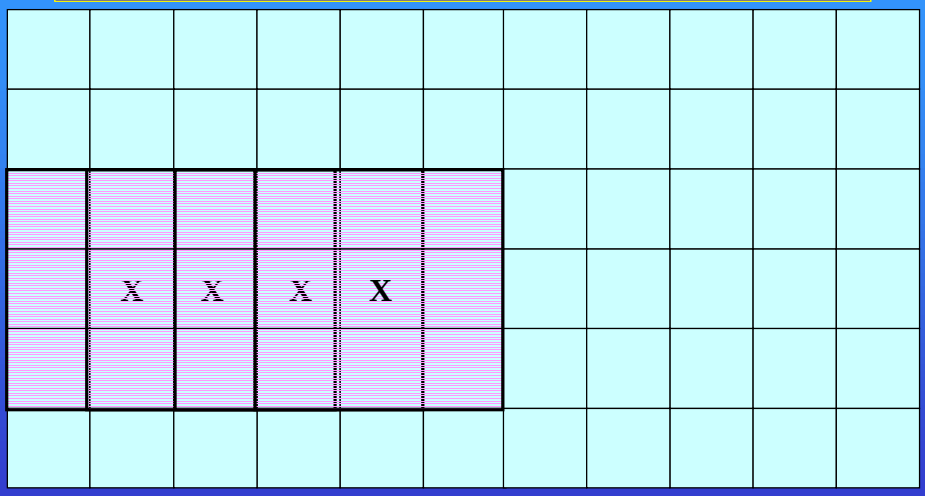
- FREQUENCY OF THE EVENT =1 if at least one in the box
- FREQUENCY OF THE EVENT = 0: None in the box

FOE (frequency of the event in a superbox)

- FREQUENCY OF THE EVENT 0 =< > = 1: percentage of occurrence

MO (mean of observations in the super-box)

MEAN AND MAXIMA ON OVERLAPPING BOXES



STAT INFO FROM LEPS MEMBERS

ADJACENT ⟷ OE-F / POE-F / M-F SUPER-BOXES ⟷ **OVERL APPING**

OE-F
For each predefined "super-box" probability is computed as the percentage of members exceeding the threshold in "at least one model pixel of in the super-box".

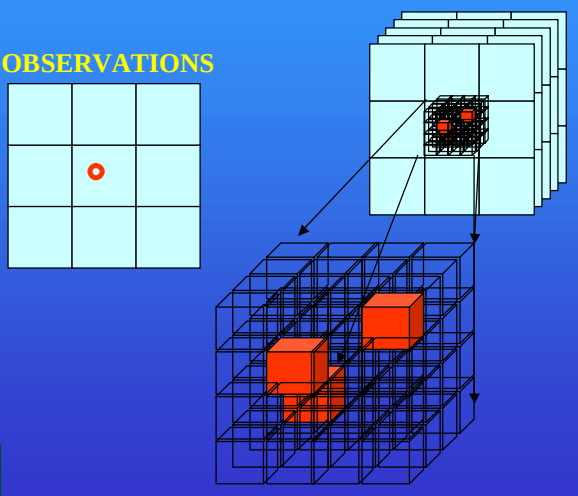
POE-F
For each predefined "super-box" probability is computed as the percentage of "model pixels" exceeding the threshold

M-F Mean of forecasts in the super-box

HOW MANY PIXELS

For each predefined "super-box" probability is computed as the percentage of "model pixels" exceeding the threshold

OBSERVATIONS



5 LEPS forecasts

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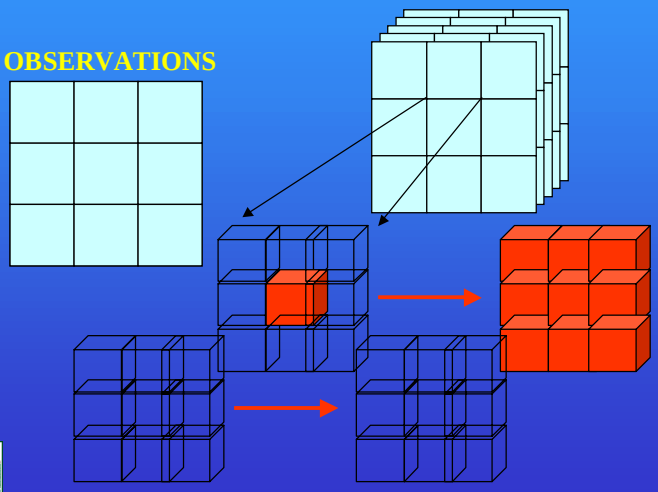
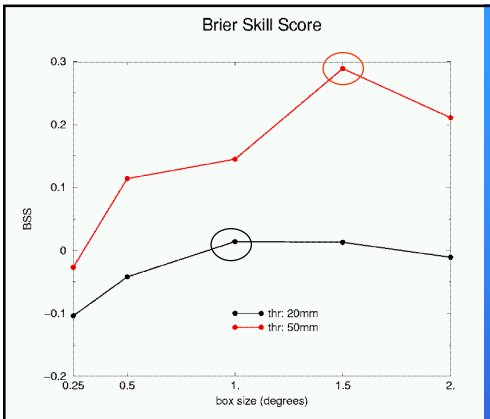
AT LEAST ONE PER MEMBER

For each predefined "super-box" probability is computed as the percentage of members exceeding the threshold in "at least one model pixel of in the super-box".

OBSERVATIONS



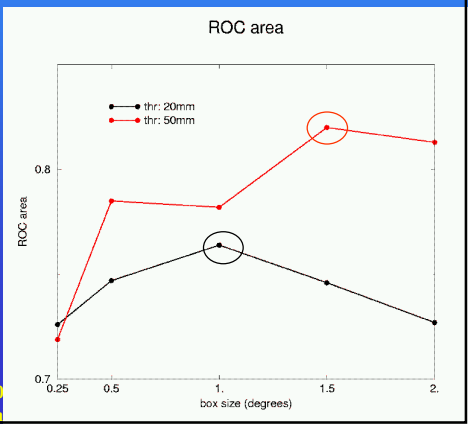
5 LEPS forecasts

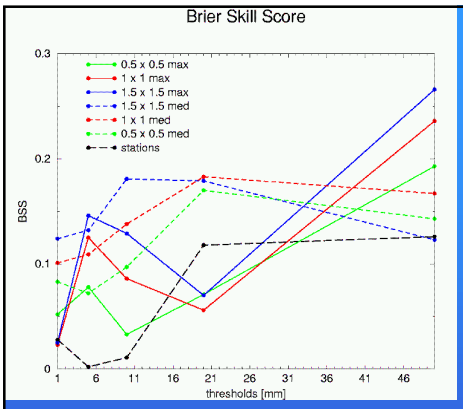


ADJACENT BOXES

OE + OE-F

(testing the occurrence of the event in a superbox)



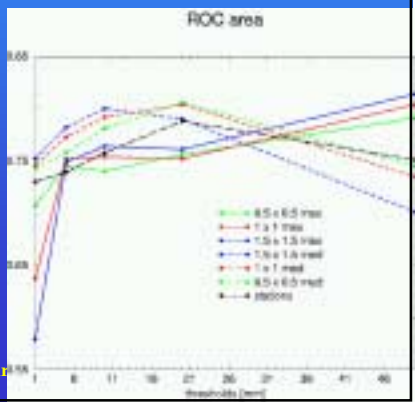


OVERLAPPING BOXES

OE OE-F (occurrence)

Vs

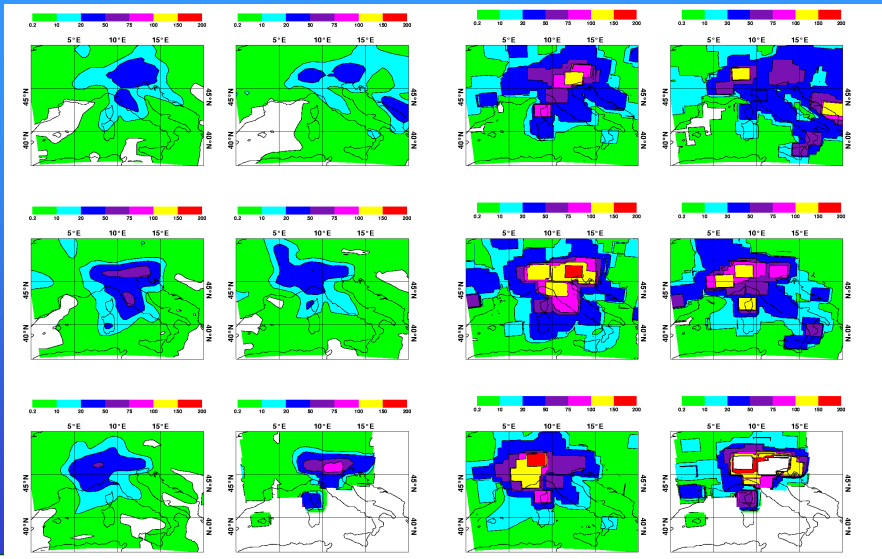
MO M-F (averages)



Some hints:

- **Low threshold: better averages on "big" boxes**
- **High threshold: better the occurrence in the super-boxes**

RUNNING MEAN RUNNING MAXIMA



CONCLUSIONS

The results obtained applying the LEPS system are promising:

- **Improvement with respect to EPS as regards high precip thresholds**
- **High precipitation areas are well identified by probability maps**
- **False alarms do not seem to be a critical factor**
- **LEPS added value also at EPS resolution**

CONCLUSIONS

WE NEED MORE STATISTICS WITH A STATE OF THE ART LEPS MODELLING SYSTEM

COSMO-LEPS

CONCLUSIONS

COSMO-LEPS will allow a subjective and objective evaluation of the system implemented with models "state of the art": EPS TL255 + Lokal Modell 10 km h.r.

Within COSMO consortium COSMO-LEPS verification will be co-ordinated to get the best possible evaluation of the system. The verification activity will allow to answer the still open questions (mainly the link between probability of occurrence and cluster population) and will drive future developments.

CONCLUSIONS

Objective statistical verification

Some more developments in the verification package

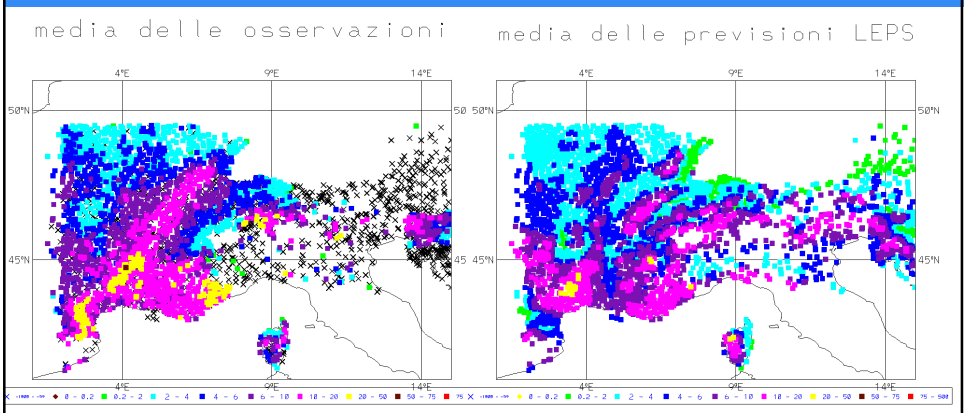
BUT

WE NEED A GOOD DATA BASE FOR VERIFICATION (S.C)

Subjective forecasters verification

We may benefit of the "real time" suite of COSMO-LEPS

15-cases obs.climate vs forec.climate



THE END

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