Status report of COSMO–LEPS: operational implementation

Andrea Montani

ARPA–SMR Regional Meteorological Service, Bologna, Italy

COSMO Workshop, Geneve, 26 – 28 May 2003

COSMO–LEPS (developed by ARPA–SMR)

- What is it?

- It is a **L**imited–area **E**nsemble **P**rediction **S**ystem (**LEPS**), based on Lokal Modell and developed within **COSMO** (**CO**nsortium for **S**mall–scale **MO**delling, which includes Germany, Greece, Italy, Poland and Switzerland).

- Why?

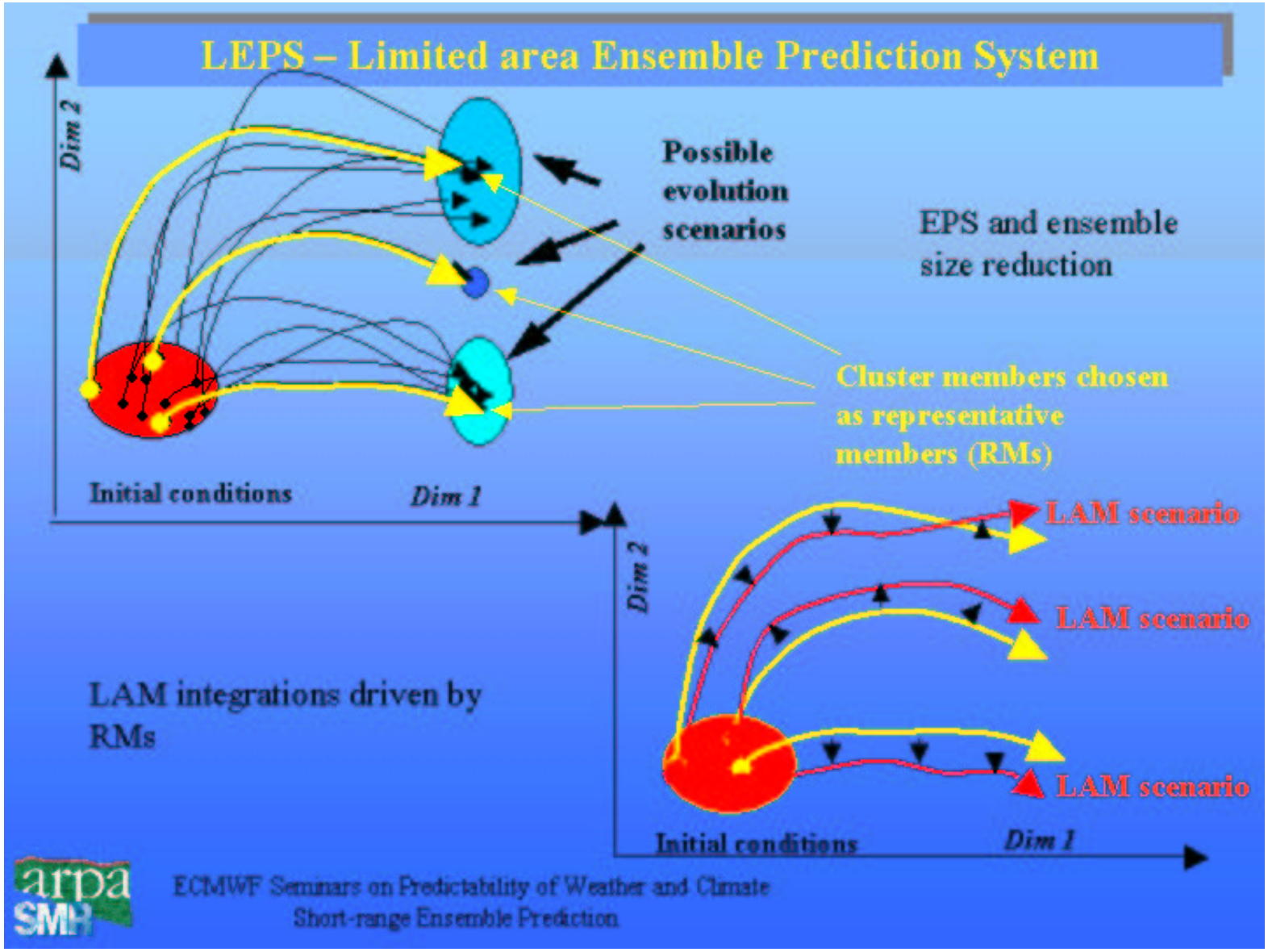
- The horizontal resolution of global–model ensemble forecast systems is limited by computer time constaints and does not allow a detailed description of mesoscale and orographic–related processes.
- The forecast of heavy precipitation events is often inaccurate (in terms of both location and intensity) after the short–range;

COSMO–LEPS project

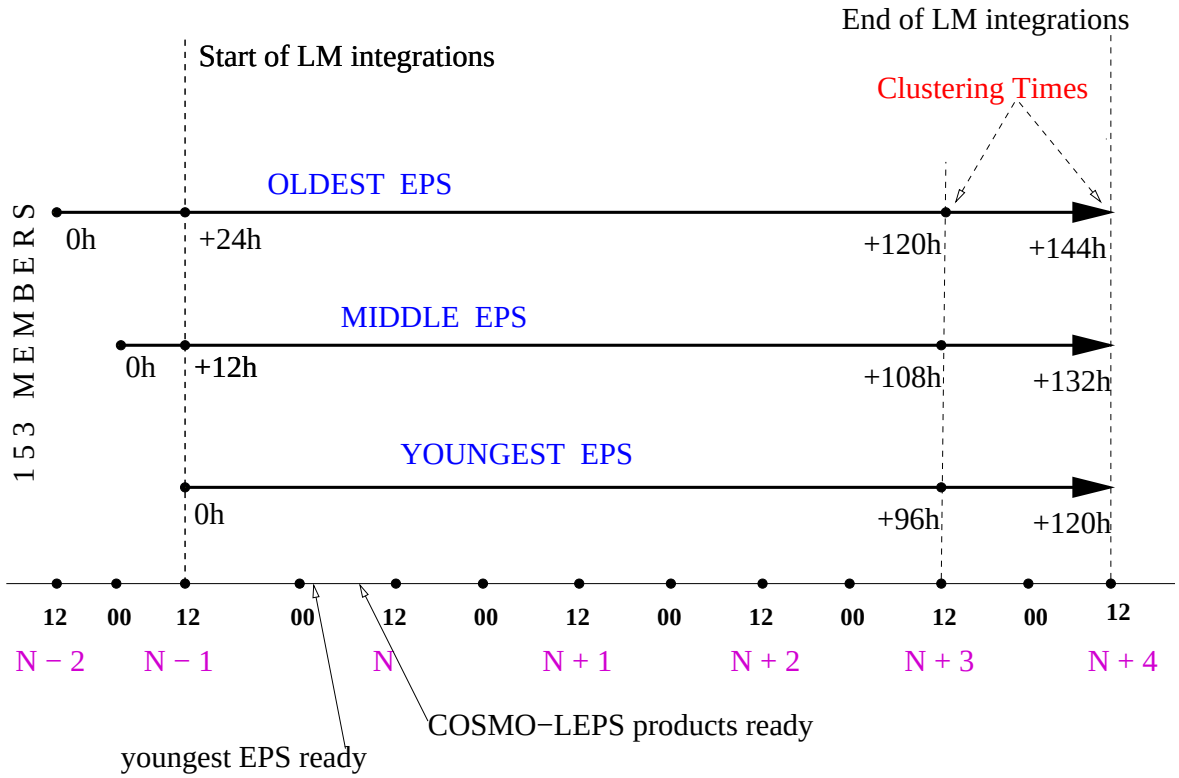
$\Rightarrow$ combination of the advantages of global–model ensembles with the high resolution details gained by the LAMs, so as to identify the possible occurrence of **intense** and **localised** weather events (heavy rainfall, strong winds, temperature anomalies, snowfall, . . .);

generation of COSMO–LEPS in order to improve the short to medium–range forecast ($48\ h < \Delta t < 120\ h$) of the so–called "severe weather events".

Methodology



COSMO–LEPS super–ensemble

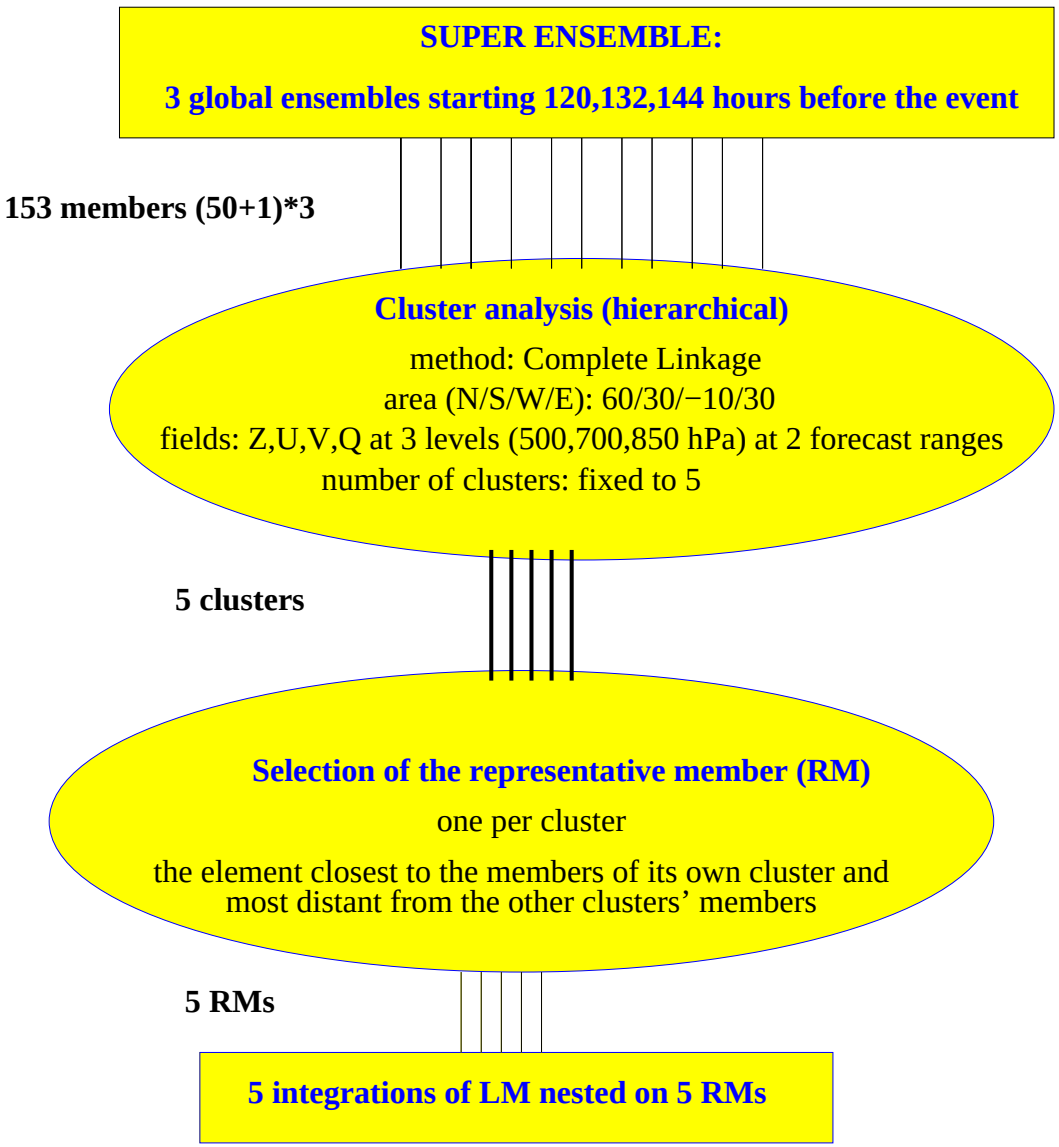


⇒ use three consecutive (12–hour lagged) ECMWF ensembles so as to generate a **super–ensemble** with 153 members, which can explore a wider part of the "unstable phase space";

⇒ 12–00–12 configuration ("YOUNGEST EPS" ready by 1 UTC); **LM runs end by 4 UTC**;

⇒ COSMO–LEPS products get to weather services in time to be used (up to day $N + 4$).

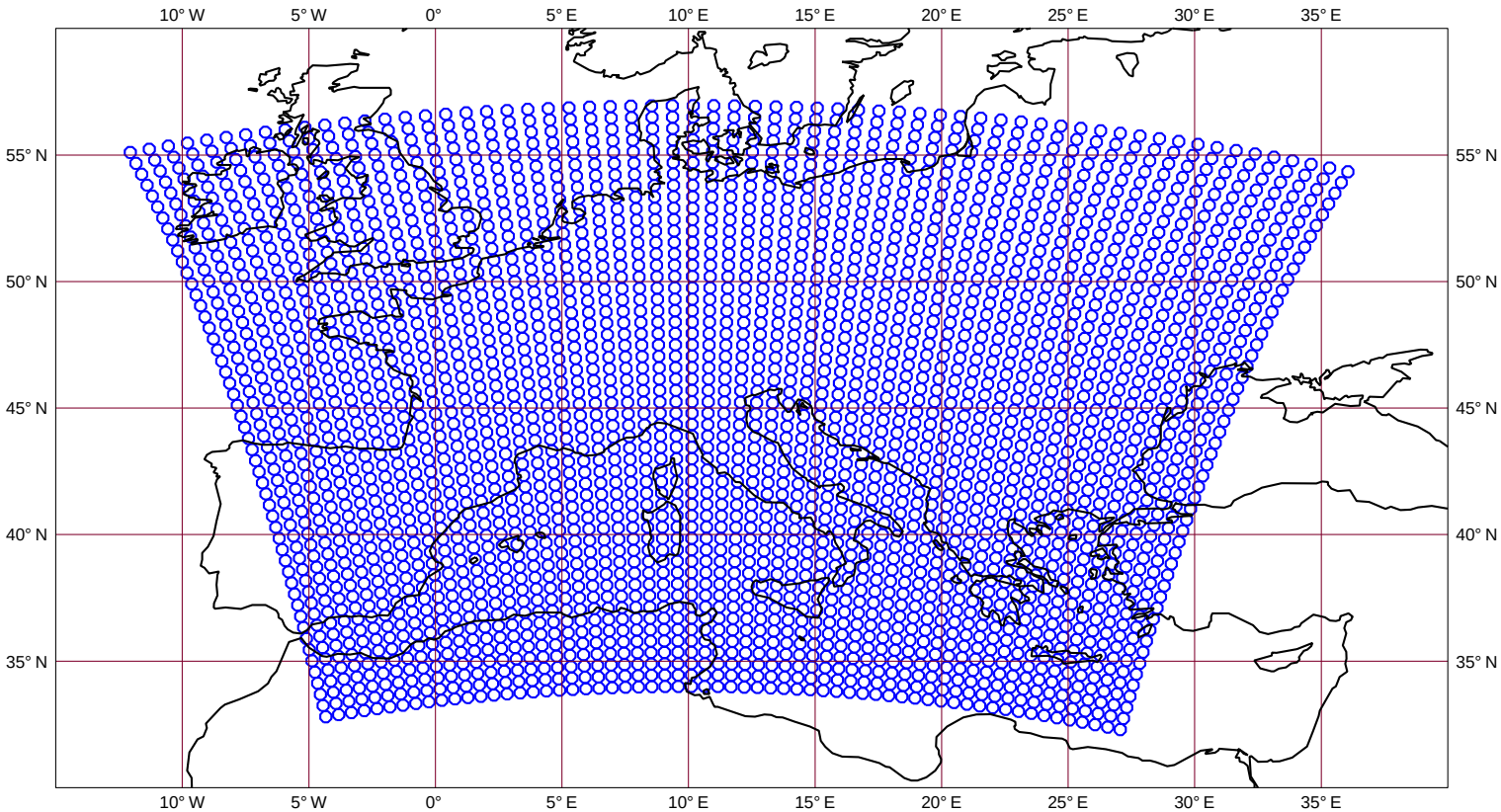
Ensemble–size reduction technique



COSMO–LEPS operational suite @ ECMWF (since 4/11/2002)

		get_pl_00	
	pre	get_pl_12	
		cluster	
		lokal_member_1	retrieve_ec → int2lm → align_date → lokal
		lokal_member_2	retrieve_ec → int2lm → align_date → lokal
cosmoleps	lokal	lokal_member_3	retrieve_ec → int2lm → align_date → lokal
		lokal_member_4	retrieve_ec → int2lm → align_date → lokal
		lokal_member_5	retrieve_ec → int2lm → align_date → lokal
		post_proc_lokal	
	post	archive_ecfs	
		send	send_to_arpaemr
			send_to_dwd
			. . . . .

COSMO–LEPS domain



- $\Delta x \simeq 10$ km (306 $\times$ 258 $=$ 78948 grid points); 32 vertical levels; time–step: 60 sec;
- forecast length: 120 h; elapsed time $\approx$ 58 min (84 "tasks" of ECMWF IBM);
- $\forall$ LM run, total CPU time $\approx$ 120h.

LM output

probabilistic products:

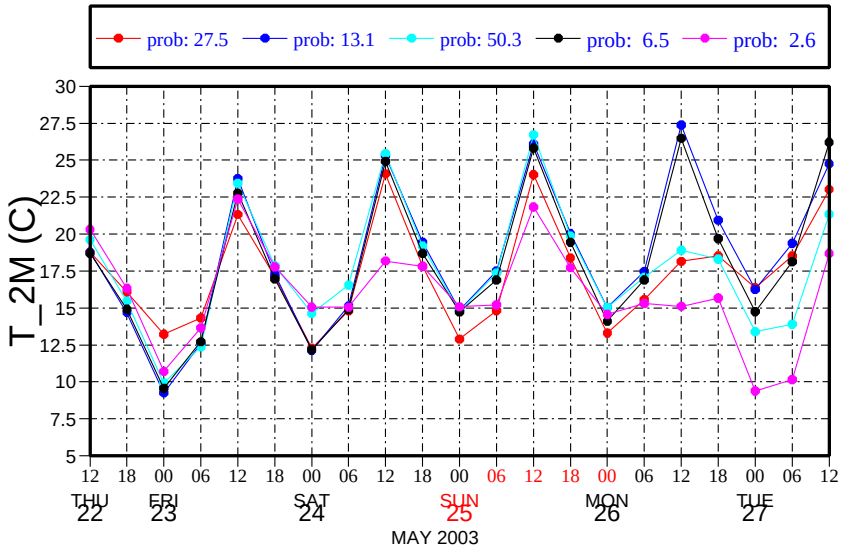
- prob of 24h rainfall exceeding 20, 50, 100, 150 mm (fc +24–48, 48–72, 72–96, 96–120);
- prob of 72h rainfall exceeding 50, 100, 150, 250 mm (fc +0–72, 24–96, 48–120);
- prob of 24h snowfall exceeding 1, 5, 10, 20 "**cm**" (fc +24–48, 48–72, 72–96, 96–120);
- prob of UVmax_{10m} in 24h above 10, 15, 20, 25 m/s (fc +24–48, 48–72, 72–96, 96–120);
- prob of Tmax_{2m} in 24h above 20, 30, 35, 40 ^{0}C (fc +18–42, 42–66, 66–90, 90–114);
- prob of Tmin_{2m} in 24h below -10, -5, 0, +5 ^{0}C (fc +18–42, 42–66, 66–90, 90–114);

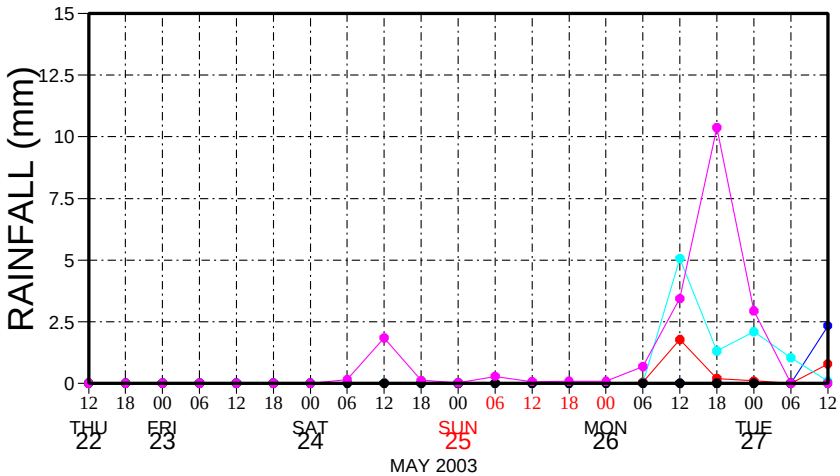
deterministic products; for each LM run:

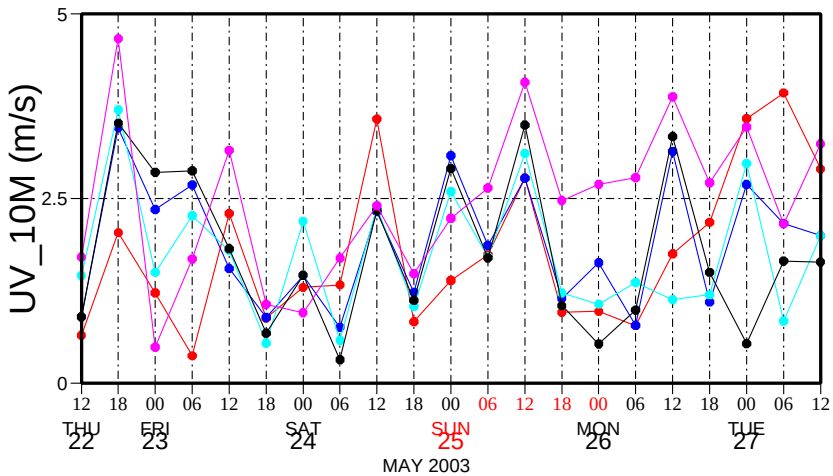
- rainfall (fc +24–48, 48–72, 72–96, 96–120);
- MSLP, Z700, T850 (fc+36; fc+60, fc+84, fc+108).

$\rightarrow$ **meteograms** (T_{2m}, tp, 10m wind speed).

COSMO–LEPS meteogram for Geneve







LM archiving

Per the time–being, COSMO–LEPS products are archived on ECFS (ECMWF File System);

in June, migration to MARS ($\rightarrow$ ECMWF GRIBEX will be modified).

Per each LM run, the following fields are archived:

rainfall (c6, c12, c18, . . . , c120)

Tmax_{2m} (p6, p12, p18, . . . , p120)

Tmin_{2m} (p6, p12, p18, . . . , p120)

UVmax_{10m} (p6, p12, p18, . . . , p120)

MSLP (p0, p6, p12, p18, . . . , p120)

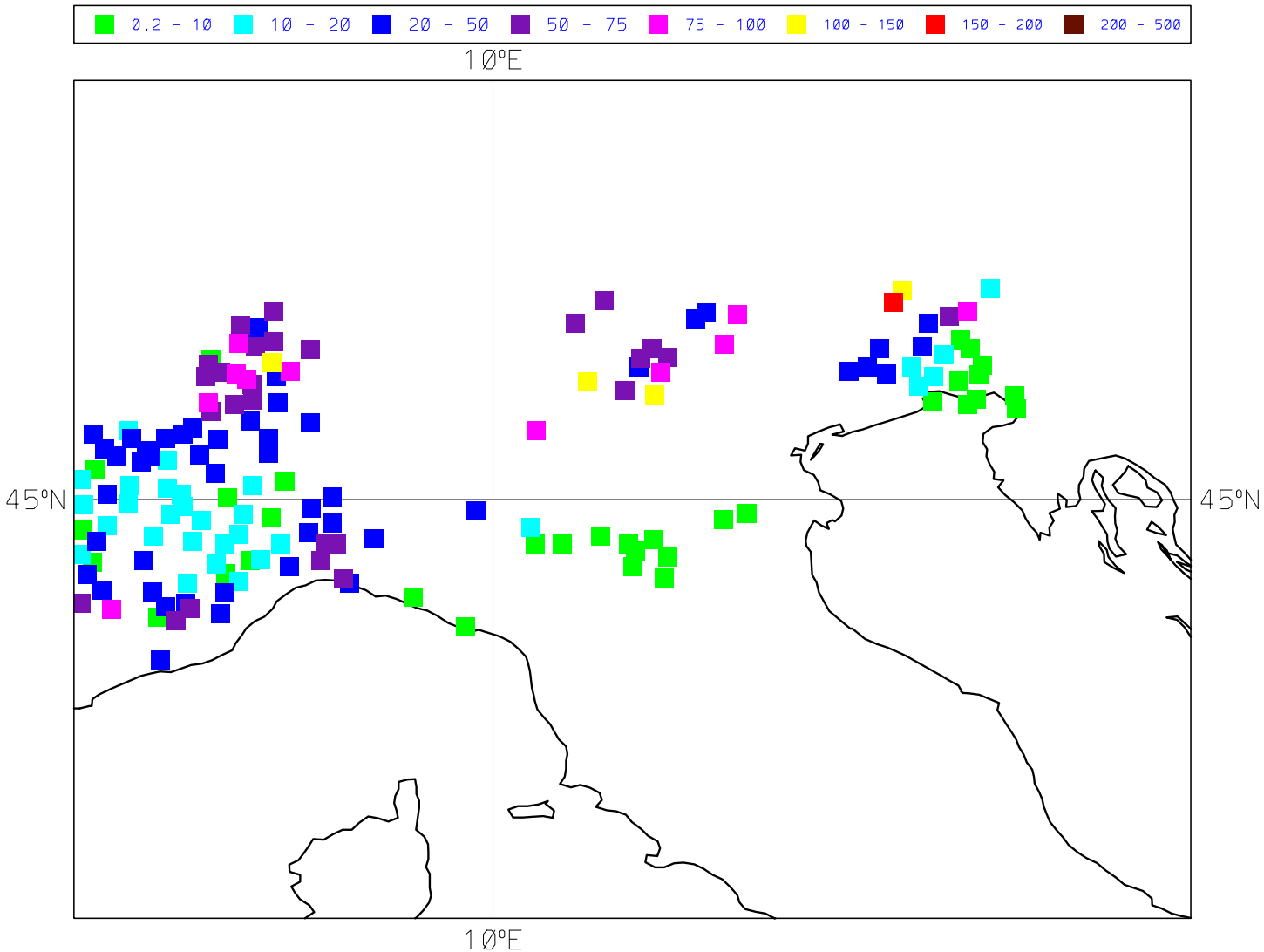
Z500 (p0, p6, p12, p18, . . . , p120)

Z700 (p0, p6, p12, p18, . . . , p120)

T850 (p0, p6, p12, p18, . . . , p120)

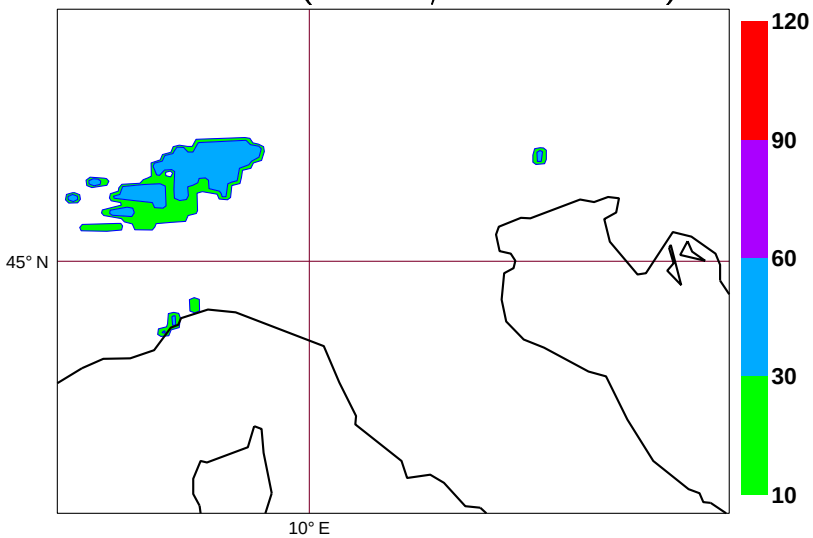
Case study: flood event in Northern Italy

Observed precipitation from 24/11 12UTC to 25/11/2002 12UTC

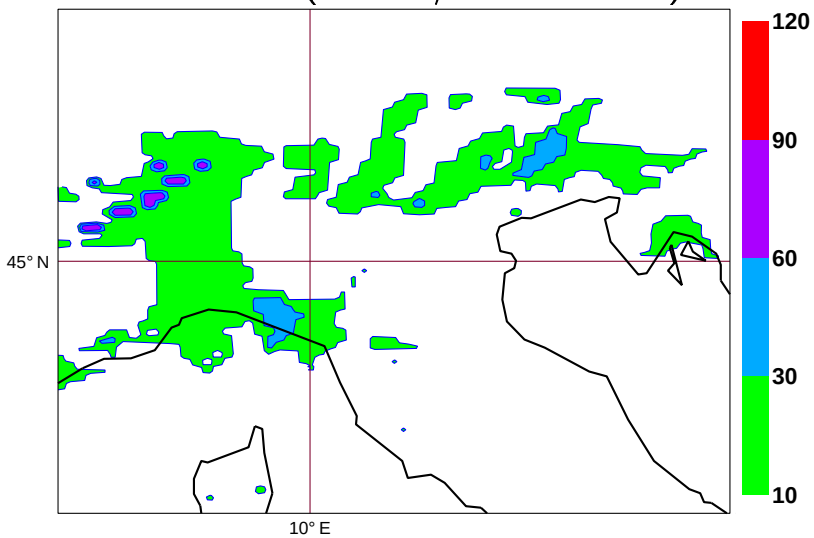


COSMO–LEPS probability maps: $tp_{24h} > 100$ mm; VT: 25/11 12UTC

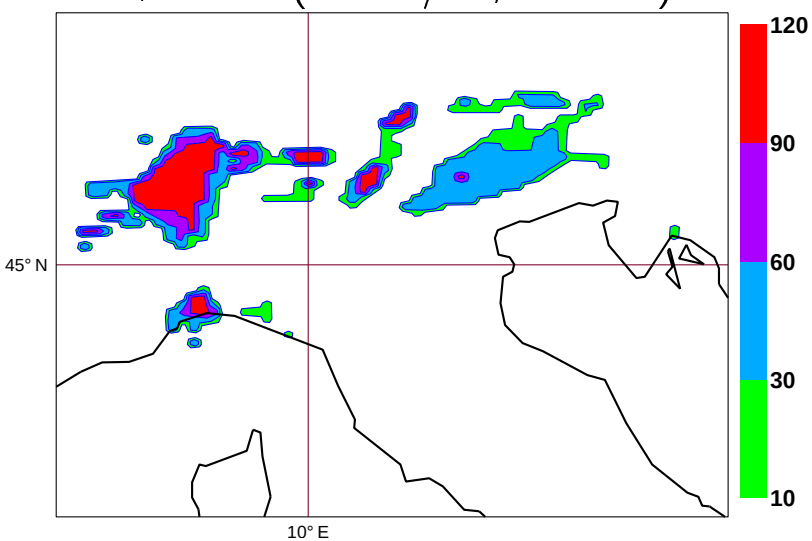
fc+96–120 (T0:20/11, 12UTC)



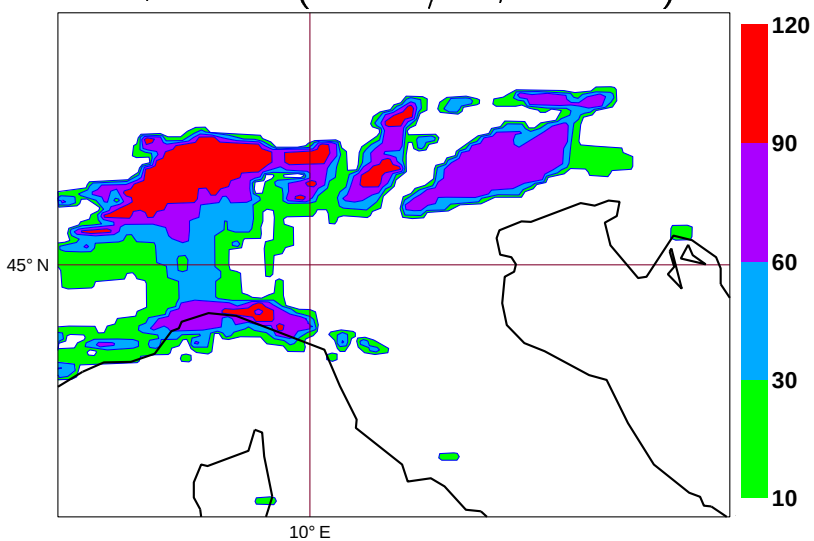
fc +72–96 (T0:21/11, 12UTC)



fc+48–72 (T0:22/11, 12UTC)



fc +24–48 (T0:23/11, 12UTC)



Future developments

- 2 test suites are running:
  - 10–member cluster analysis (using 3 EPS) ;
  - 5–member cluster analysis using 2 EPS (102 members);
- prepare new probabilistic products (CAPE, instability indices, . . .);
- post–process and disseminate also model levels (no more disk space problem at ECMWF);
- implement dissemination to Greece and Poland (and Switzerland?);
- use ECACCESS for file transfer?
- switch anyway to 10–member COSMO–LEPS next year (more units devoted to COSMO–LEPS)?
- . . . . . .