

EPS boundary condition requirements for COSMO consortium

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DWD, MeteoSwiss, ARPA-SIMC



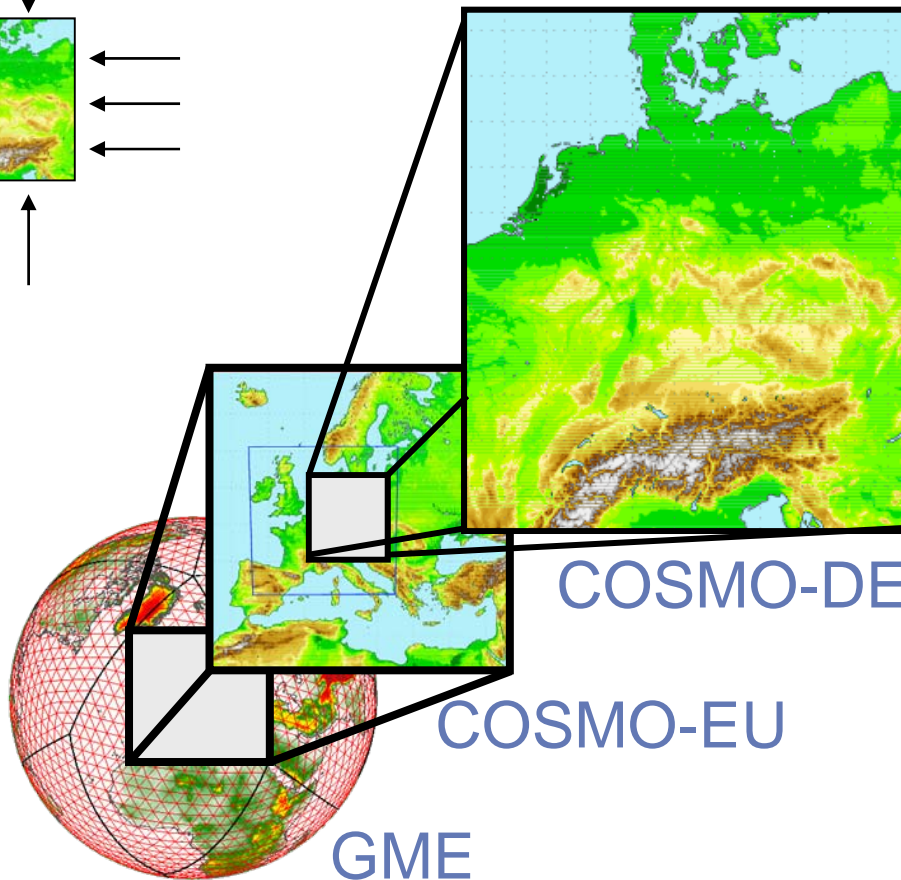
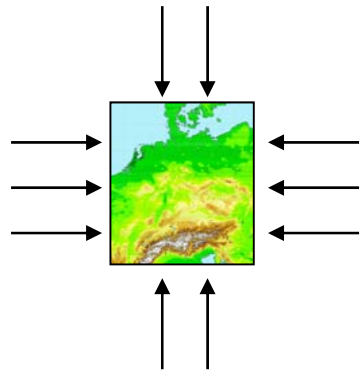
LAMEPS-BC Meeting
Reading, 11 June 2010

3 joint requirements in one talk

1. Requirements for DWD
2. Requirements for MeteoSwiss
3. Requirements for COSMO-LEPS

Variations of Boundaries

reminder: operational chain

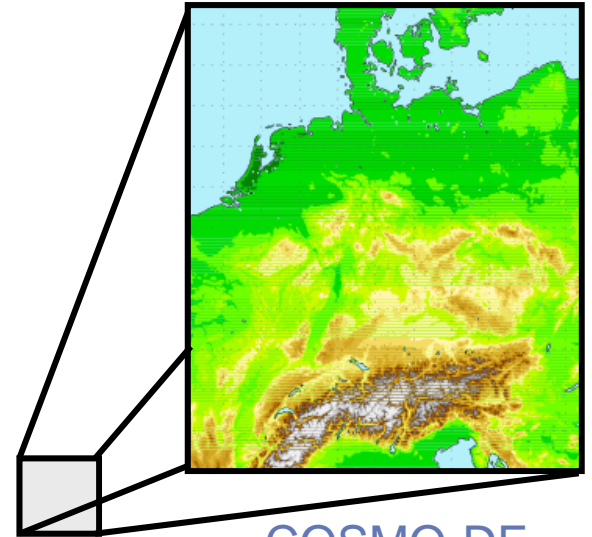
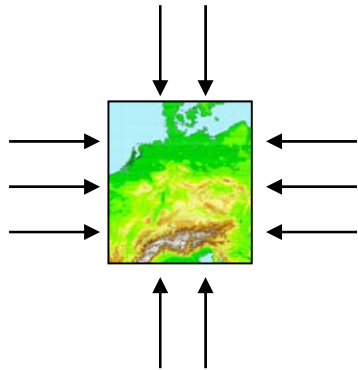


COSMO-DE

- grid box size: 2.8 km
- lead time: 21 hours
- update cycle: 3 hours

Variations of Boundaries

short-term plan



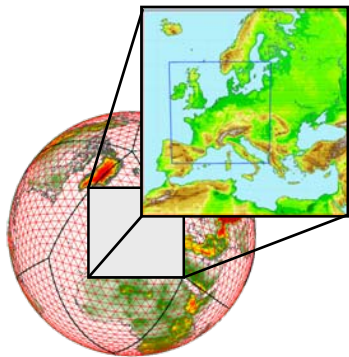
COSMO-DE

COSMO-7km

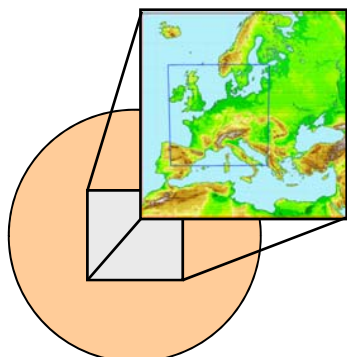
COSMO-7km

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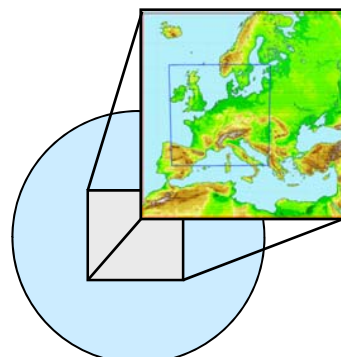
COSMO-7km



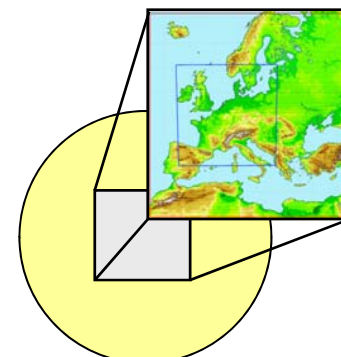
GME



ECMWF



GFS



GSM

...et cetera...



Variations of Boundaries

Short term plan

(building-up in cooperation with C. Marsigli, ARPA SIMC Bologna)

COSMO-7km ensemble with 4 - 5 members

- Model domain identical equal to COSMO-SREPS
- Nested in different deterministic global model forecasts
- 6 hour update frequency
- 48 hours lead time





Variations of Boundaries

COSMO-7km ensemble

Implementation at ECMWF

- Gathering and storing of latest global forecasts
- Interpolation of global forecasts to COSMO-grid
- Running the COSMO-7km ensemble
- Transfer of ensemble forecast data to Offenbach
- operation of job chain envisaged for 3.Q 2010



Variations of Boundaries

long-term plan

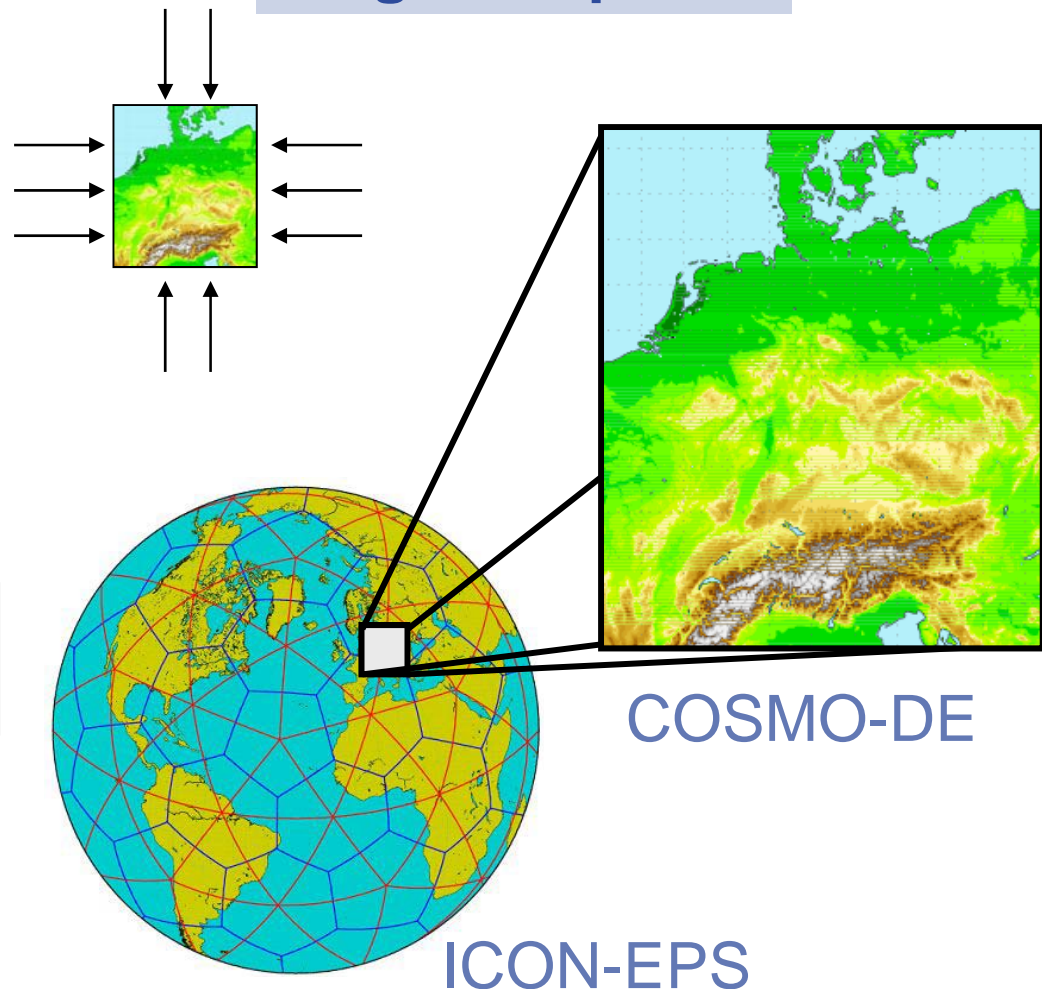
Nesting in ICON

ICOsahedral Non-hydrostatic model
(MPI-M Hamburg, DWD)

- Local zooming option
- Hybrid 3DVar-LETKF data assimilation scheme
- Deterministic global forecasts (2012?)

→ Short range ICON ensemble forecast
=> boundary data for COSMO-DE-
EPS (>2012)

- Question: Will the ICON ensemble produce sufficient spread in the very short forecast time range (<24 h)?



Boundaries for COSMO-DE-EPS

- DWD plans to use own global ensemble
 - high flexibility, no dependencies
 - compatible physics in global and regional model
- No participation in LAMEPS-BC programme (present day decision) because of
 - high costs
- **But:** LAMEPS-BC programme scientifically interesting. ECMWF LAMEPS could improve DWD boundary data approach
- DWD decision on participation not fixed for ever!



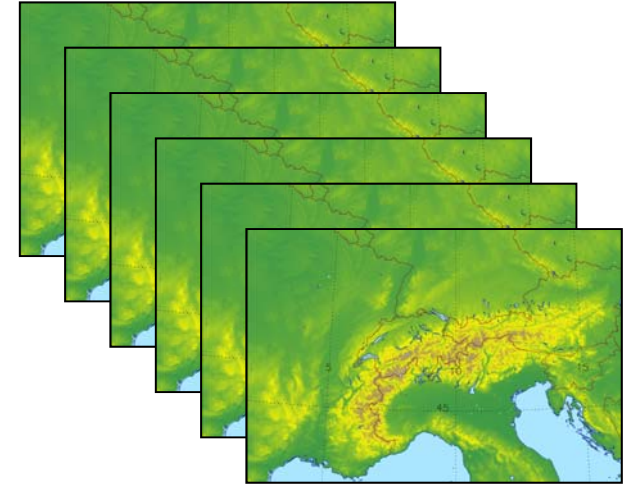
Plans for future MeteoSwiss NWP system

COSMO-E (EPS)

- 3km, 256x381, 60L
- 2 x per day out to +120h
- Ensemble DA (LETKF)
- BC from global EPS

COSMO-1 (deterministic)

- 1km, 768x1143, 120L
- 8 x per day out to +24h
- IC from COSMO-E analysis
- BC from COSMO-E or from IFS



Time horizon: operational in 2015



Use of ECMWF EPS BC data at MeteoSwiss

Current usage

- COSMO-LEPS run by ARPA-SIMC on behalf of COSMO
- Important tool at MeteoSwiss, used by forecasters and customers

Future usage

- Which global NWP system?
 - Operational dependence on a single global NWP system (currently ECMWF)
 - Revision possible with decision of MetAlliance for global model choice (fall 2010)
- **MeteoSwiss is strongly interested and supports LAMEPS-BC project**
 - For improvements of COSMO-LEPS
 - For driving future MeteoSwiss NWP system if ECMWF IFS confirmed by decision of MetAlliance



Alternative BC for LAM Ensemble Data Assimilation

- Instead of using a global EPS use deterministic global model forecast as ensemble mean
- Draw ensemble perturbations from PDF given by the statistical background covariance matrix of global data assimilation system (Torn et al., MWR, 2006)
- Would need background error covariances of IFS at boundary points of COSMO-E domain

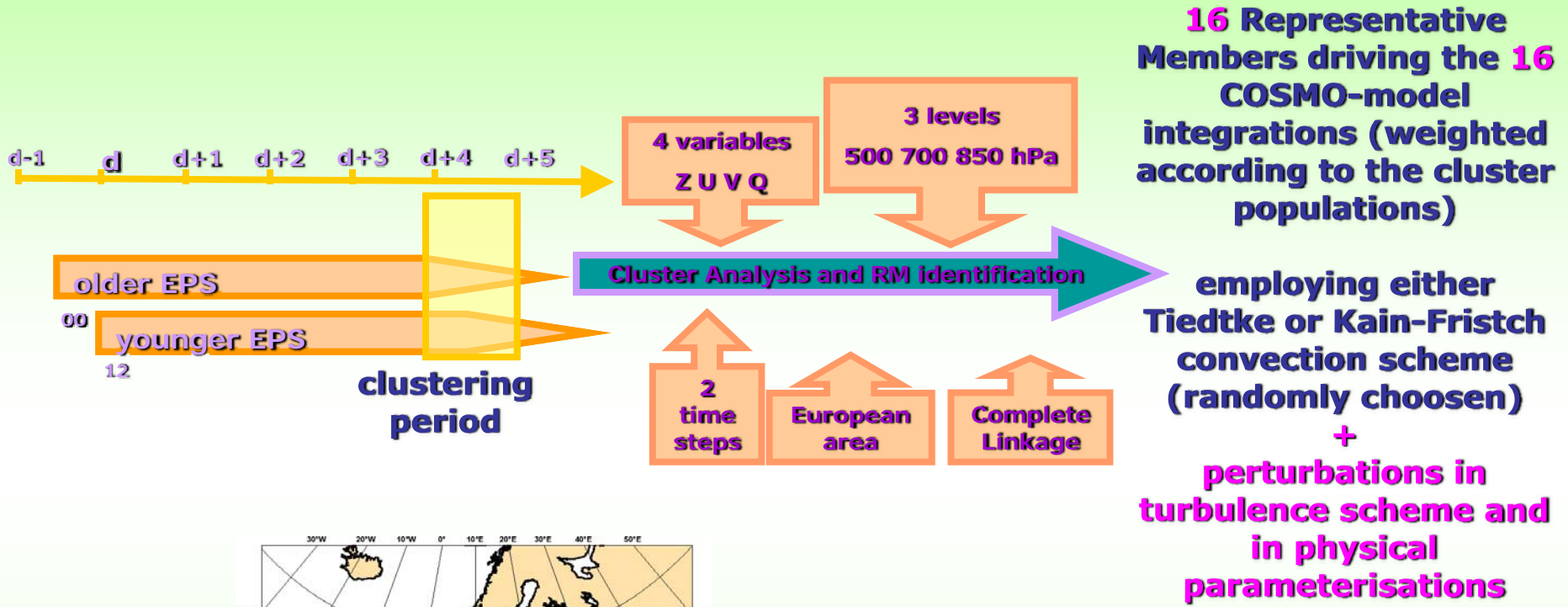
Introduction to COSMO-LEPS

- What is it?

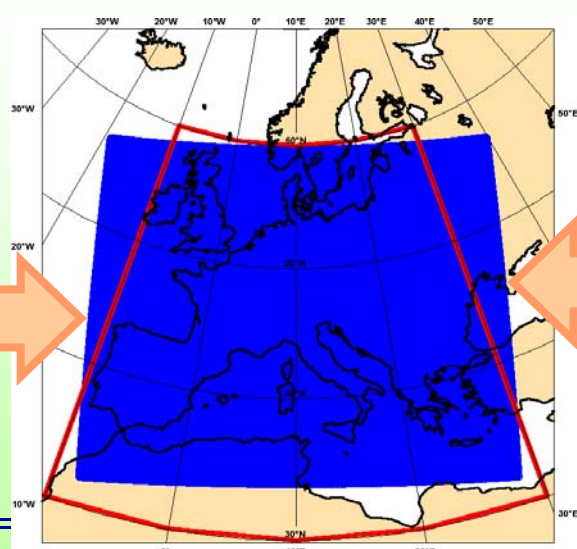
It is a Limited-area Ensemble Prediction System (LEPS), based on COSMO-model, developed and implemented by ARPA-SIMC in the framework of COSMO (CONsortium for Small-scale Modelling, including Germany, Greece, Italy, Poland, Romania, Russia, Switzerland).

→ It is NOT a "one-country business", but a product of the COSMO National Weather Services

COSMO-LEPS suite @ ECMWF (since Nov 2002)



COSMO-LEPS clustering area



COSMO-LEPS Integration Domain

- suite runs as a "time-critical application" managed by ARPA-SIMC;
- $\Delta x \sim 7 \text{ km}$; 40 ML; fc+132h;
- COSMO v4.8 since Dec09;
- computer time (14.0 million BU for 2010) provided by the COSMO partners which are ECMWF member states.

Present situation

COSMO-LEPS makes a “heavy use” of ECMWF facilities:

- 1) Use of EPS fields, at both 00UTC and 12 UTC runs (grid: 0.25 x 0.25):
 - **retrieval of pressure-level fields for all members;**
 - forecast steps: from fc+72h to fc+144h every 12h;
 - **retrieval of surface, pressure-level and model-level fields for the members selected by the cluster analysis (but need to have all EPS members available);**
 - forecast steps: from fc+00h to fc+144h, every 3h;
- 2) Use of ECMWF archive (MARS, ecfs, ectmp).
- 3) Use of ECMWF post-processing and visualisation tools (e.g. Metview, MAGIC5).
- 4) Use of ERA40/ERA-Interim fields to run COSMO-LEPS reforecast.

Shortcomings and LAMEPS-BC

- Part of COSMO-LEPS runs use boundaries from 00UTC EPS and part of COSMO-LEPS runs use boundaries from 12UTC EPS (**00-12 configuration**).
- Sometimes, 00UTC EPS members provide quite different solutions from those produced by 12UTC members, this being transferred to COSMO-LEPS runs;
 - ➔ "bi-modal" distribution in COSMO-LEPS forecasts can persist locally for more than 24 hours.

This problem could be partly solved by using 6UTC and/or 18UTC EPS

- lesser lag between the 2 EPS runs (**6-12 or 12-18 configuration**);
- more accurate boundary condition provided to COSMO-LEPS runs.

COSMO-LEPS community

- considers of potential benefit the provision of ECMWF BC for LAMEPS.
- is interested and strongly supports the development of a proposal for consideration by ECMWF TAC.

+ support to LAMEPS-BC from HNMS (email by Euripides Avgoustoglou)

Final requirements for LAMEPS-BC



- resolution: 10 km
- Update cycle: 6 h
- Time of provision of forecasts: T+ 3h, not later than T+6h
- Sufficient spread in the first 24 hours
 - reflecting uncertainty in regional scale
 - focus on precipitation, clouds, temperature, humidity (hydrological cycle)

Extent of BC forecasts: +138h

Frequency and Timeliness of BC runs

- 4 times per day
- Available not later than 6h after nominal analysis time



Spread

- Sufficient spread in first days

Mesh size

- Not coarser than 20km

Have the same configuration as 00UTC and 12UTC EPS up to day 5 in terms of:

- horizontal and vertical resolution,
- output frequency (3h).



➔ the implementation of 6UTC and/or 18UTC EPS could pave the way towards a "refresh" of COSMO-LEPS information, which might be run twice a day.

Thank you !