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Eidgenössisches Departement des Innern EDI
Bundesamt für Meteorologie und Klimatologie MeteoSchweiz

MeteoSwiss Plans on km-scale EPS

Daniel Leuenberger, MeteoSwiss

COSMO General Meeting, Lugano, 10.9.2012

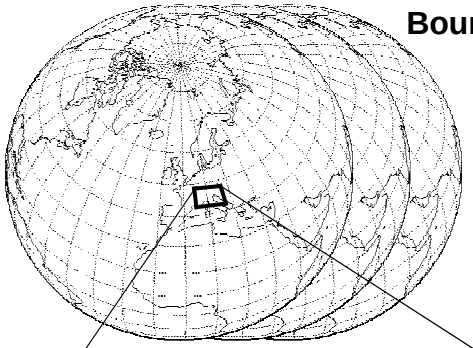
MeteoSwiss COSMO-NExT Project

- **Client expectations**
  - Two classes of products
    - **High(est) resolution in space and time** out to +24h, high update frequency
    - Regional **probabilistic forecasts** out to +3/5 days
    - Focus on Alpine region
  - Consistency of products across all scales (space & time)
  - High reliability (quality and availability of products)

→ **Novel Expert Tools (NExT), project started 1.1.2012**

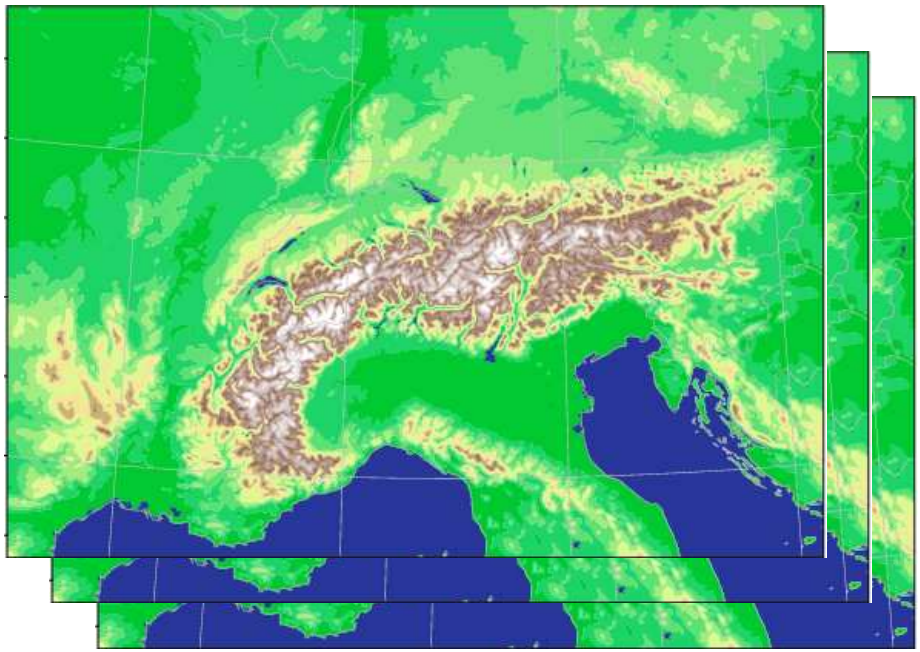
- **COSMO-1** 1.1 km mesh-size, deterministic
- **COSMO-E** Ensemble-System, 2.2km mesh-size
- **KENDA** Ensemble Data Assimilation

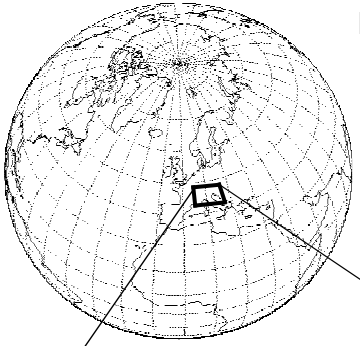
MeteoSwiss COSMO-NExT Project



Boundary conditions: VarEPS
20km
2x daily

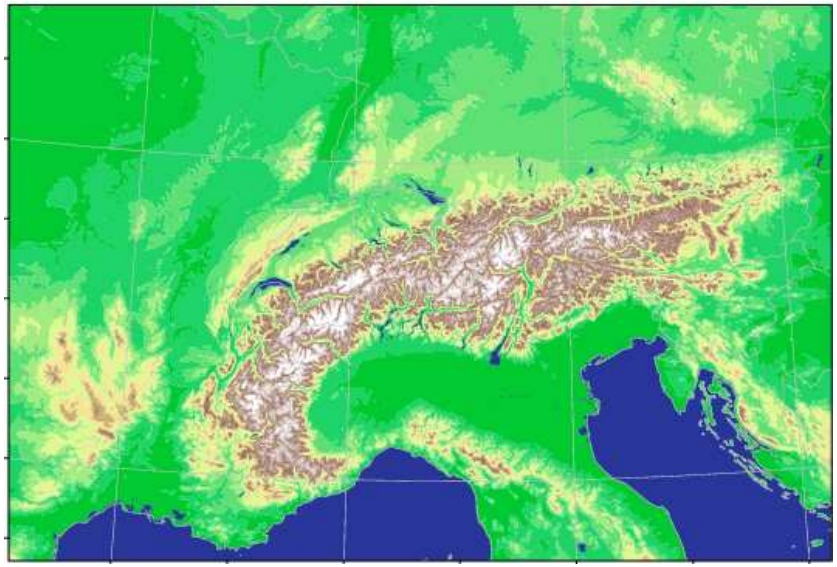
COSMO-E





Boundary conditions: IFS
10km
4x daily

COSMO-1



COSMO-E

Initial Setup

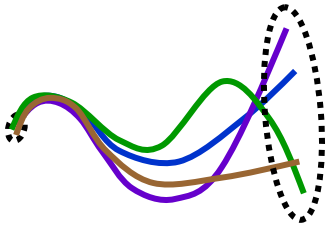
- 120h forecasts 2x daily
- 2.2 km grid size, 532 x 388 grid points (13% larger than COSMO-2)
- 60 levels
- dt = 20s
- 21 members (depends on performance of COSMO code on our 2015 HPC system → HP2C project / PP POMPA)
- Runtime < 120min for 120h lead-time

Requirements

- New HPC machine
- Performance gain with acceleration by GPUs (HP2C/POMPA project) or at least by single precision code (~30% on CPU)
- LBCs with a mesh-size <= 20 km
- Initial perturbations from 2.2km KENDA system

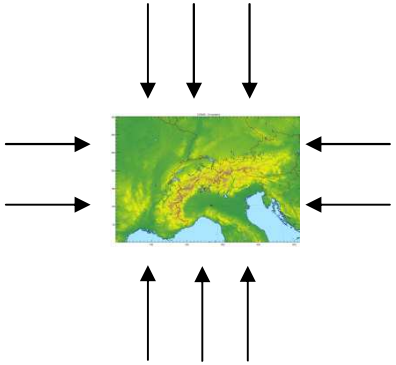
Ensemble perturbations

initial conditions



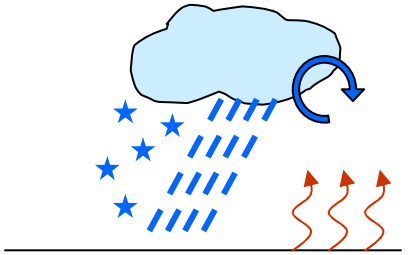
LETKF with ~40 members, PP KENDA

boundary conditions



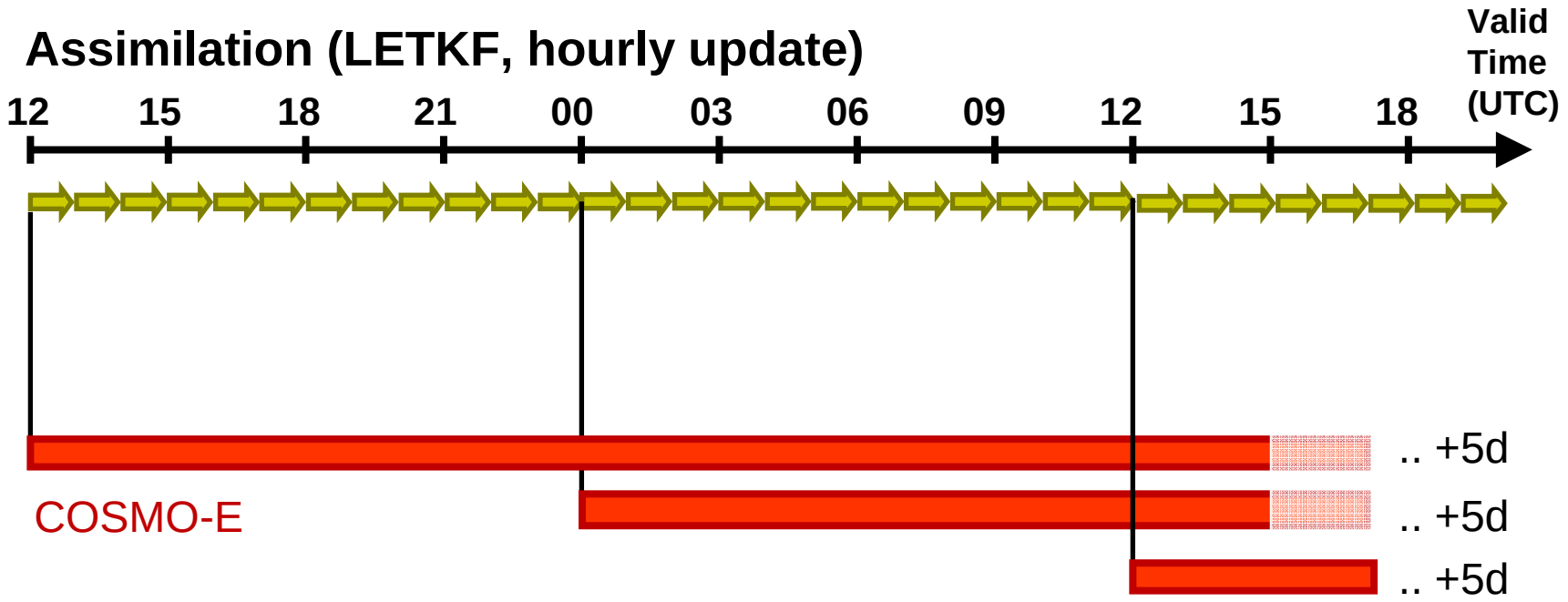
ECMWF BC project (+ multi-model?)

model physics



COSMO-DE-EPS & PP CONSENS (stochastic perturbations?)

Assimilation cycle



- Run every 1h to support nowcasting and on-demand activities
- Same resolution as for COSMO-E
- Provides initial condition for COSMO-E and COSMO-1

Deterministic analysis for COSMO-1

- Deterministic analysis for COSMO-1

- Downscale analysis increments and add to COSMO-1 deterministic first guess

$$\mathbf{x}_1^a = \mathbf{x}_1^b + \langle \Delta \mathbf{x} \rangle$$

$$\Delta \mathbf{x} = \mathbf{K}\left[\mathbf{y}^o - H(\mathbf{x}_1{}^b)\right]$$ Kalman Gain from 2.2km KENDA

COSMO-E Road Map

• Evaluation of COSMO-DE-EPS	Started
• Investigate perturbed LBC for COSMO-E	Sep 2012
• Test perturbed analyses from KENDA	Q1 2013
• Adapt and tune model physics perturbations (developed within COSMO ensemble projects)	Q3 2013
• Regular COSMO-E runs	2014
• Make internal applications “COSMO-E ready” and develop COSMO-E products	2014
• COSMO-E operational	2015

Developments in close collaboration with COSMO

KENDA Road Map

- Set up of LETKF with COSMO-E settings at CSCS — Finished
- Start with idealized experiments (OSSE) — Nov 2012
  - Stable atmosphere at rest
  - Mountain-plain flow (Alpine Pumping)
- Real case experiments with COSMO-E — Q1 2013
- Deterministic analysis for COSMO-1 — Q2 2013
- Regular assimilation cycle — 2014
- KENDA operational — 2015

Developments in close collaboration with COSMO

COSMO KENDA Toolbox

- Several COSMO partners and Universities (e.g. HErZ Centre in Munich) now (have) start(ed) to work with COSMO KENDA system
- Similar needs concerning tools to work with ensemble DA, e.g.
  - Reading/writing of feedobs files
  - Diagnostic tools for investigation of LETKF performance
  - Generation of artificial obs from idealized COSMO simulations
- We should start to develop a common toolbox
  - What programming language? (Fortran? Python? Ruby?)
  - Gather what is already around!
  - Publish tools on the web?