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Numerical Weather Prediction at MeteoSwiss

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Swiss implementation of the COSMO-Model

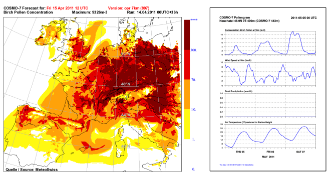
Prognostic variables: pressure, 3 wind components, temperature, specific humidity, cloud water, cloud ice, rain, snow, turbulent kinetic energy (TKE), COSMO-2: also graupel

Coordinates: general terrain-following height-based vertical levels, Lorenz staggering; Arakawa-C, rotated Lat/Lon horizontal grid

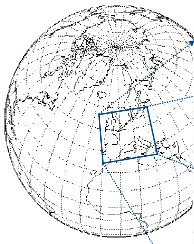
Dynamics: 2-timelevel 3rd order Runge-Kutta

Physics: bulk microphysics for atmospheric water content, multilayer soil module, COSMO-7: Tiedtke mass flux convection scheme COSMO-2: explicit deep convection

Pollen: In spring 2011 operational birch pollen forecasts with module COSMO-ART from KIT

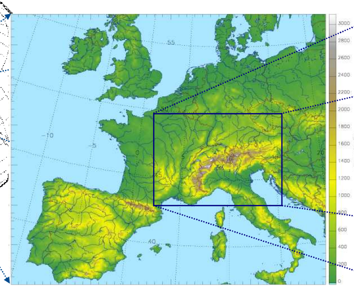


Computers: Cray XT4 at Swiss National Supercomputing Centre CSCS



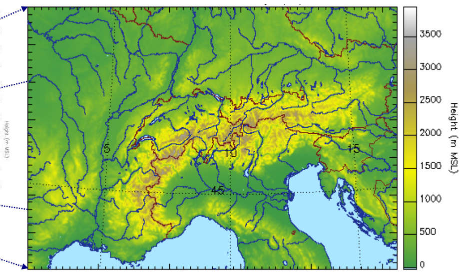
Global Integrated Forecast System **IFS** (ECMWF, ~16km resolution)

COSMO-7



COSMO-7 domain (maximum height at 3140m).

COSMO-2



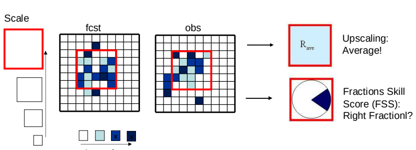
COSMO-2 domain (maximum height of 3944m).

	COSMO-7	COSMO-2
Mesh size	3/50°, **~6.6km**	1/50°, **~2.2km**
Domain	393 x 338 x 60 = 7'970'040 grid points	520 x 350 x 60 = 10'920'000 grid points
Forecasts	+72h at 00, 06 and 12 UTC	*+33h* at 00, 06, 09, 12, 15, 18, 21 UTC, *+45h* at 03 UTC
Boundary conditions	Updated every 3h from IFS	Hourly updated from COSMO-7
Initial conditions	Newtonian relaxation (nudging) to surface and upper air observations, intermittent cycle of 3h assimilation	Same as COSMO-7, but with use of radar data over Switzerland (latent heat nudging)

Neighborhood Verification of COSMO Precipitation Forecast Tanja Weusthoff

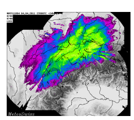
Motivation

Precipitation is highly variable in space and time. High resolution numerical weather prediction models are able to resolve the small-scale structure, but "double penalty" occurs when using traditional scores and point-to-point comparison.

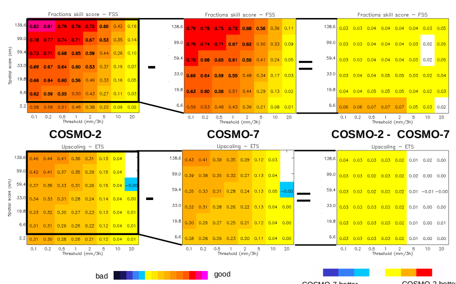


Method

The forecast is evaluated within spatial windows of varying size and the box statistics are derived. The increasing size of the windows enables the evaluation of the change in skill due to the spatial scale and the comparison of models with different resolution. Reference observation is the high resolution radar composite of MeteoSwiss.



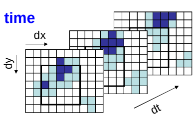
Verification Results 2010

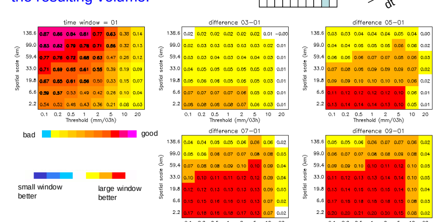


Results of the neighborhood verification for one year of COSMO forecast (January – December 2010). 3-hourly sums are evaluated with respect to Swiss radar data. From the model always the latest available run is taken leaving out the first 3 hours. Top row shows Fractions Skill Score, bottom row the Upscaling method. Left column COSMO-2 results, middle column COSMO-7 and the most right column gives the differences COSMO-2 minus COSMO-7. Yellow and orange colors indicate better skill of COSMO-2.

"Fuzzy" in time

Add time window (dt) to the spatial window (dx·dy) and evaluate the forecast within the resulting volume.





Fractions Skill Score results for COSMO-2 (July 2011). Absolute values for reference dt=1h (no time window) and differences of time window dt = 3,5,7,9h minus reference. FSS increases on all scales with increasing time window – largest effect for small spatial scales and low thresholds. Application on gridscale would be useful. Decreasing impact with increasing spatial scale.

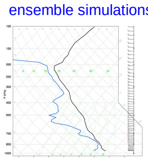
Idealized Ensemble Simulations of a Convective Storm Manuel Bischof, Daniel Leuenberger, Heini Wernli (ETH Zurich)

Motivation

- Simplified model setups are useful in the development of model and data assimilation development. They can be used to test and further develop new assimilation schemes.
- Here, we present results from COSMO ensemble simulations of a convective storm in an idealized model setting.
- With this or a similar model setup we plan to test the future COSMO assimilation scheme KENDA (Kilometric Ensemble Data Assimilation) based on the Local Ensemble Transform Kalman Filter (LETKF)

Experimental Setup

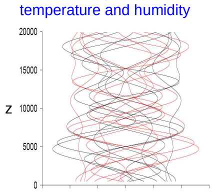
- We use the non-hydrostatic COSMO model
- Horizontal homogenous environment from radio sounding of a convective day in Switzerland (IC and LBC)
- Convection initiation with warm bubble
- Flat, free-slip lower boundary condition
- Only microphysics and turbulence parametrization switched on
- Reference simulation (nature run) with 1km, ensemble simulations with 2km mesh size



Sounding of Payerne from 30.7.2008 12UTC. The wind direction has been set to West.

Ensemble Generation

- Vertical, random, sinusoidal variations are added to the unperturbed sounding for each ensemble member
- Simulates uncertainty in meso-scale convective environment
- Perturbed quantities include horizontal wind, temperature and humidity

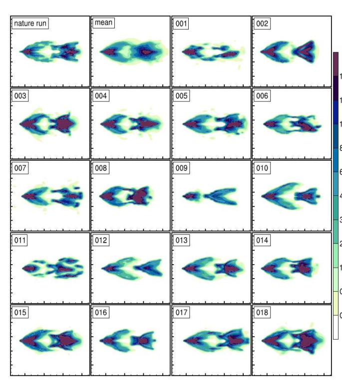


Ensemble of symmetric perturbations added to the unperturbed sounding with stddev σ=1.

Positive and negative perturbations.

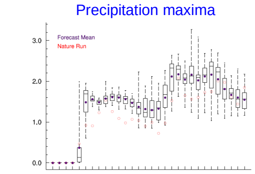
Results

Nature run and 18-member ensemble with combined sounding perturbations of wind speed (σ=1m/s) and temperature (σ=0.25K)

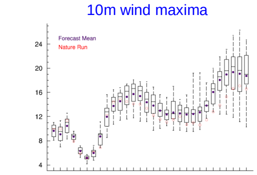


5h-accumulated surface precipitation [mm] of all ensemble members 001-018, the nature run and the ensemble mean.

Precipitation maxima



10m wind maxima



Temporal evolution (in [h]) of sfc precipitation maxima (upper panel) and 10m wind maxima (lower panel). The violet dots represent the ensemble mean and the red dots the nature run.