The Alpine Model (aLMo) in Switzerland

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Short poster description

aLMo is the Swiss implementation of the COSMO Local Model. This model is non-hydrostatic and fully compressible. The prognostic variables are the pressure, the three wind components, the temperature, the specific humidity and the liquid water content. The initial conditions are defined by newtonian relaxation (nudging) to the observations (including AIREP/AMDAR).

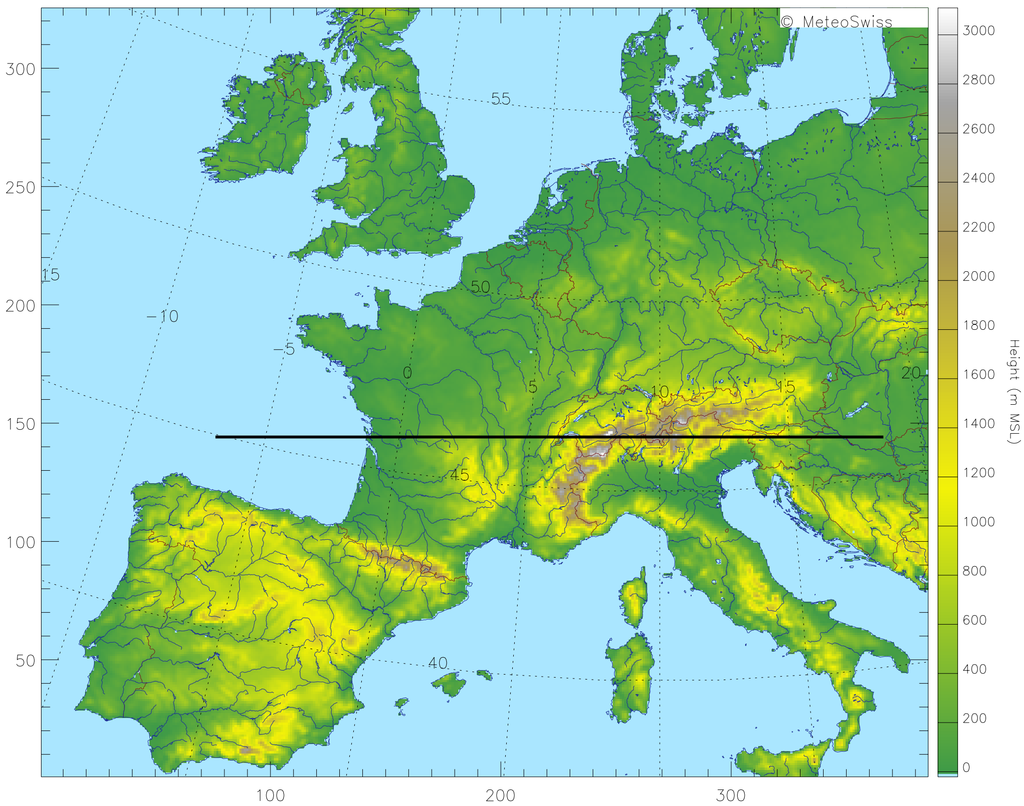

Figure 1: Operational domain and orography of aLMo with cross-section used in Fig. 2

The aLMo is operational since April 2001 and runs twice daily up to 48 hours with hourly boundary conditions from the DWD global model GME. The rotated latitude and longitude grid of 1/16°~ 7 km covers a domain of 385 grid points in the rotated West-East direction and 325 grid points in the rotated South-North direction. The aLMo uses 45 vertical hybrid levels (see Fig. 2, left) and the used orography is shown in Figure 1.

The start of an operational integration is dictated by the arrival of the boundary data. For one run this represents 61 MB which are directly transferred from the DWD to the Swiss Center for Scientific Computing (CSCS) of the Swiss Institute of Technology (ETH) in Manno in the southern italian part of Switzerland.

On the high performance vector processing machine, NEC SX-5, MeteoSwiss can use 12 processors in a dedicated mode. The operational forecast is produced with 25% of the peak performance (96 Gflops) in less than one hour and gives 8 GB of data which is then archived on the local StorageTek silos. About 1.2 GB of output (consumable products) is returned to the Central Office in Zurich where it is disseminated to all the other forecasting and operating sites (Geneva and Zurich airports, Locarno-Monti and Payerne) and to all the end-users.

Developments

Very soon a new **s**mooth **le**vel **ve**rtical (SLEVE) coordinate will be implemented. This coordinate has a scale-dependent vertical decay of the underlying terrain features given by the operational orography.

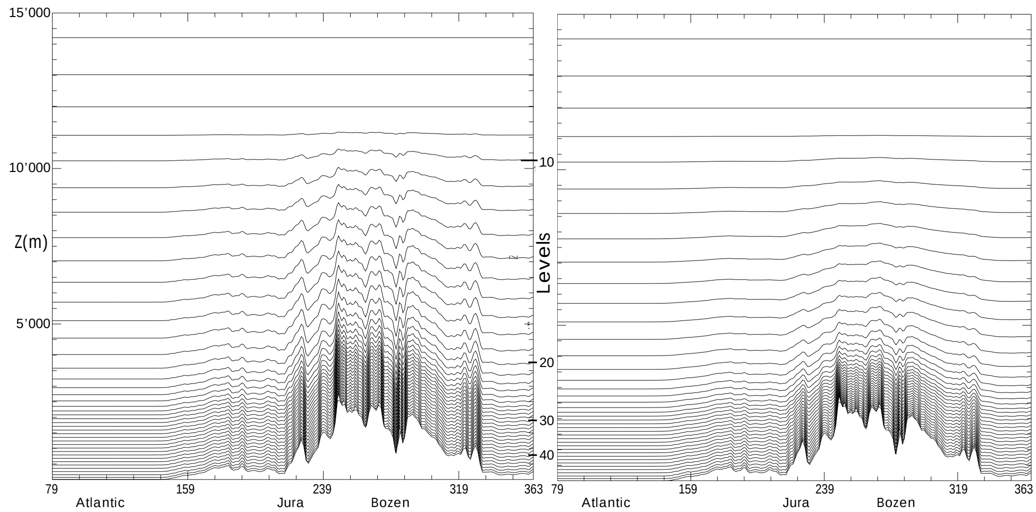

Figure 2: Vertical distribution of the bottom levels below 15 km height for a West-East cross-section at 46.5° N (thick line on Fig. 1). From the 45 operational hybrid levels (left) and with the new SLEVE coordinate (right) described in the text.

Small-scale topographic (h_1) variations decay much faster with height than their large-scale (h_2) counterparts. The decomposition expressed in horizontal longitude (λ) and latitude (φ) is: $h(\lambda,\varphi) = h_1(\lambda,\varphi) + h_2(\lambda,\varphi)$

The height-based non-normalized SLEVE coordinate μ represented in Figure 2 (right) has also 45 levels and the following inverse transformation:

$$z(\lambda, \varphi, \mu) = \mu + h_1(\lambda, \varphi)\frac{\sinh((\mu_T - \mu)/s_1)}{\sinh(\mu_T/s_1)} + h_2(\lambda, \varphi)\frac{\sinh((\mu_T - \mu)/s_2)}{\sinh(\mu_T/s_2)}$$

with: $\mu_T = 23'589\text{m}$, $s_1 = 10'000\text{m}$ and $s_2 = 2'000\text{m}$

The continuous data assimilation scheme by the means of nudging should in the near future comprise also information from wind profiler and radar data. An assimilation example using aLMo nudging with Global Positioning System (GPS) data in September 2001 is shown in Fig. 3.

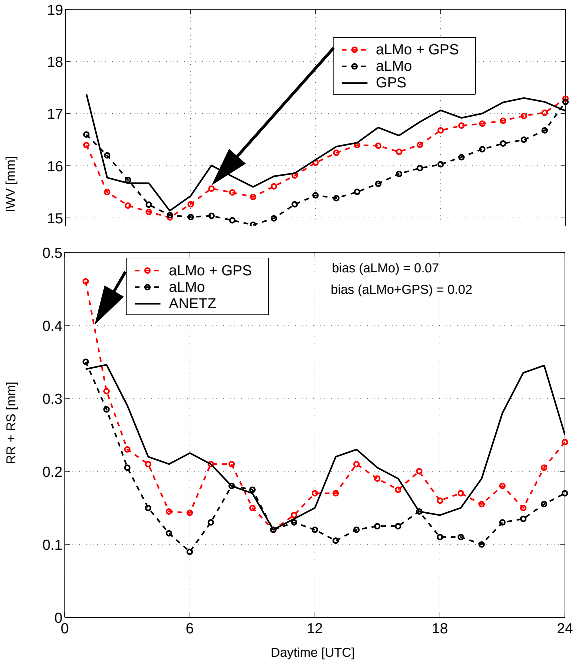

Figure 3: Assimilation experiment with Integrated Water Vapour (IWV) data from the Global Positioning System (GPS) for 14 days in September 2001 with aLMo.

Top: Daily cycle for 9 grid points below 800m above mean sea level (amsl) collocated with the GPS sites in Switzerland: GPS observations (solid black line), reference run (dashed black line) and GPS run (dashed red line).

Bottom: Daily precipitation cycle for 29 grid points below 800m amsl collocated with automatic surface weather (ANETZ) stations: ANETZ observations (solid black line), reference run (dashed black line) and GPS run (dashed red line).

The model is ready to use an extra prognostic equation for the specific cloud ice content (see contribution from G. Doms in this volume). As soon as the GME can provide us with these boundary fields a parallel suite will begin. A model version using a 2 time level scheme with prognostic precipitation, operations using boundary conditions from the IFS/ECMWF deterministic forecast model and the possibility of a 72h forecast for the 0 UTC run should also be tested.

References

Guerova G., J.-M. Bettems, E. Brockmann and CH. Mätzler, 2002: Assimilation of the GPS-derived Integrated Water Vapour (IWV) in the MeteoSwiss Numerical Weather Prediction model - a first experiment, *Submitted to Physics and Chemistry of the Earth*.

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See also: www.meteoswiss.ch, www.cosmo-model.org and www.cscs.ch.