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ZAMG
Zentralanstalt für Meteorologie und Geodynamik

25th ALADIN Workshop & HIRLAM All-Staff Meeting, 13.-16.4.2015, Helsingør
NWP related activities in AUSTRIA

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1. Operational Status

Three NWP systems are currently in operations at ZAMG: Two deterministic (ALARO, AROME) and one ensemble system (LAEF).

ALARO (5 km):

The operational model version at ZAMG is run with a grid mesh size of approx. 5km using the ALARO-0 physics package. It is operated since 2011, while a major system change took place in 2013. In 2015 an upgrade of the model physics version is planned. In March 2015, a parallel suite using ALARO-1 physics was started which should become operational in case of positive evaluation. The main characteristics of the model setup can be summarized as:

Domain		Model characteristics		LBC	
Grid points:	600x540	Code version:	CY36T1	Coupl. model:	IFS
Horizon. resolution:	4.8km	Time step:	180s	Coupl. frequency:	3h
Levels:	60	Integration time:	72h (00, 06, 12,18UTC)	Retrieval:	Internet/ RMDCN
Grid:	linear	Physics:	ALARO-0 baseline,		
Orography:	mean	Dynamics:	hydrostatic kernel		
		Initialization:	CANARI for surface IFS for 3D fields digital filter initialization		

Table 1: ALARO model setup

AROME (2.5 km):

In August 2014, an extensive upgrade of the operational AROME system was performed:

- extension of the domain (see Figure 1)
- increase of vertical resolution
- extension of the forecast range (to 48h)

In contrast to ALARO (only surface assimilation), AROME is also running with its own 3DVAR atmospheric assimilation system.

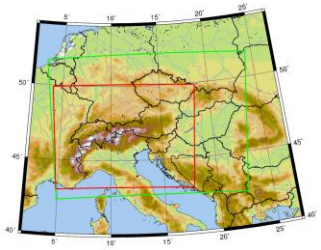


Figure 1: Extension of the AROME domain (old=red vs. new=green)

Domain		Model characteristics		LBC	
Grid points:	600x432	Code version:	CY37T1	Coupl. model:	IFS
Horizon. resolution:	2.5km	Time step:	60s	Coupl. frequency:	3h
Levels:	90	Integration time:	48h (00, 03,...,21 UTC)	Retrieval:	Internet/ RMDCN
Grid:	linear	Physics:	AROME		
Orography:	mean	Dynamics:	non-hydrostatic kernel		
		Initialization:	OI for surface 3DVAR for atmosphere		

Table 2: AROME model setup

LAEF (11 km):

ALADIN-LAEF, the limited area ensemble system operated at the HPC facilities of ECMWF, is being developed at ZAMG in cooperation with LACE members and the National Weather Service of Turkey. The main characteristics of the current system are:

Domain		Model characteristics		LBC	
Grid points:	500x600	Code version:	CY36T1	Coupl. model:	ECMWF-EPS
Horizon. resolution:	10.9km	Time step:	450s	Coupl. frequency:	6h
Levels:	45	Integration time:	72h (00, 12UTC)	Dissemination:	AUT,TR, SLO, SK, CZ,RO
Grid:	quadratic	Physics:	Multi-physics	Archive:	MARS
Orography:	mean	Initialization:	**CANARI** with perturbed observations for surface **Breeding-Blending** for atmosphere		
		Ensemble size:	16 perturbed + 1 control		

Table 3: LAEF system setup

2. HPC System

SGI ICE-X (in operations since 2013)
252 nodes (à 2x8 processor cores, 32 GB RAM, Intel Sandy Bridge)
2 frontend nodes (à 2x8 processors, 64 GB RAM, ...)
Panasas file system (120 TB netto capacity)
Total: 4064 cores, 8 TB memory, theor. peak perform.: 82 Tflops

Time spent for model integration (conf 001):
ALARO approx. 10min (on 1024 cores)
AROME approx. 18min (on 1536 cores)

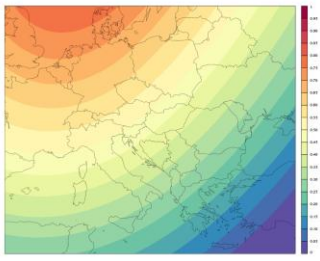
Figure 2: SGI at ZAMG

3. Solar Eclipse 2015

On March 20th a solar eclipse could be observed in large parts of Europe. It was already in late 2014 when customers from the energy sectors asked for an estimate of the effect on radiation forecasts. So it was decided to reactivate the "NOIR=1" option for ALARO (acraneb) and update the relevant astronomical parameters in the code. The effect of the solar eclipse was simulated for 2 different weather scenarios:

- Clear sky conditions (realized by initialization with qv=0)
- Cloudy/rainy conditions (realized by using initial conditions from a flood event 2014 while changing model date)

Finally, the scenarios were run with/without eclipse resulting in 4 model runs from which radiation fluxes were extracted and processed for the users. Further, the "NOIR=1" was activated in the operational ALARO model version around March 20th. In reality Central Europe was facing clear sky conditions during the solar eclipse. But even with the "worst case" occurring, no problems were reported in terms of electric network stability because the loss of solar energy production was successfully compensated by a temporary increase in other energy production sectors.



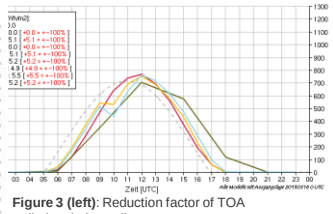


Figure 3 (left): Reduction factor of TOA radiation during eclipse
Figure 4 (above): Hourly mean global radiation forecast, effect can be seen in light blue curve (ALARO), by Hannes Rieder ZAMG Styria

4. Towards AROME – EPS

A first version of an AROME-EPS was set up at ZAMG and tested for several cases and finally run for a three months summer period to evaluate the potential benefit with respect to the operational LAEF system. This was done by downscaling the 16 LAEF members with AROME while using similar model setup (domain, physics, etc.) as for the operational AROME version.
Verification results for the three month verification period indicate that an AROME-EPS can yield added value compared to the coarser LAEF system (precipitation). This is true in particular over complex orography while scores are rather neutral over flatland areas.

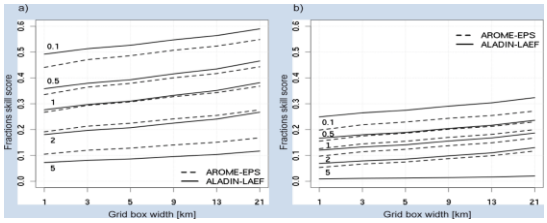


Figure 5: Fractional skill score for AROME-EPS (dashed) and LAEF for strong (left) and weak (right) synoptical forcing in Austria.

The computing resources available at ZAMG do not allow a regular operation of such a system (within reasonable time) at the moment. Thus, the AROME-EPS prototype is just run and evaluated "on demand" in critical weather situations. Further work will be invested to extent the system with an EDA part and introduce a better representation of the model error through the use of multi-physics (including ALARO-1 physics) and/or stochastic physics scheme.

5. In preparation of LAEF 5km

The next generation of the LAEF system is currently in preparation. The upgraded LAEF system will be run on HPC facilities of ECMWF like the current operational counterpart. Table 4 summarizes the setup planned for the first 5km version of LAEF.

Domain		Model characteristics		LBC	
Grid points:	1250x1000	Code version:	CY38T1	Coupl. model:	ECMWF-EPS
Horizon. resolution:	4.8km	Time step:	180s	Coupl. frequency:	3h
Levels:	60	Integration time:	72h (00, 12UTC)	Dissemination:	
Grid:	linear	Physics:	Multi-physics (ALARO)	Archive:	
Orography:	mean	Initialization:	**CANARI** with perturbed observations for surface **Breeding-Blending** for atmosphere		
		Ensemble size:	16 perturbed + 1 control		

Table 4: Planned LAEF 5km system setup