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NWP related activities in AUSTRIA

Christoph Wittmann
Central Institute for Meteorology and Geodynamics (ZAMG), Austria, Vienna
with contributions from: Alexander Kann, Georg Pistotnik, Stefan Schneider and Florian Weidle

The new operational forecast system at ZAMG:

Beginning with 1st of March 2011 a new operational ALADIN configuration named ALARO5-AUSTRIA was set to operations at ZAMG, replacing the old 9.6km version ALADIN-AUSTRIA. The new 4.8km version is coupled to the IFS model and uses the ALARO physics package.

ALARO5-AUSTRIA settings:

Domain:

Gridpoints:	600x540
Horizon. resolution:	4.8km
Levels:	60
Grid:	linear
Orography:	mean

LBC:

Coupl. model:	IFS (time lagged)
Coupl. frequency:	3h
Retrieval:	internet and RMDCN

Model characteristics:

Code version:	CY35T1
Time step:	180s
Integration time:	72h (00, 06, 12 and 18 UTC)
Physics:	ALARO-0 SK-sub inversion scheme
Initialization:	CANARI surface assimilation IFS for 3D fields digital filter initialization

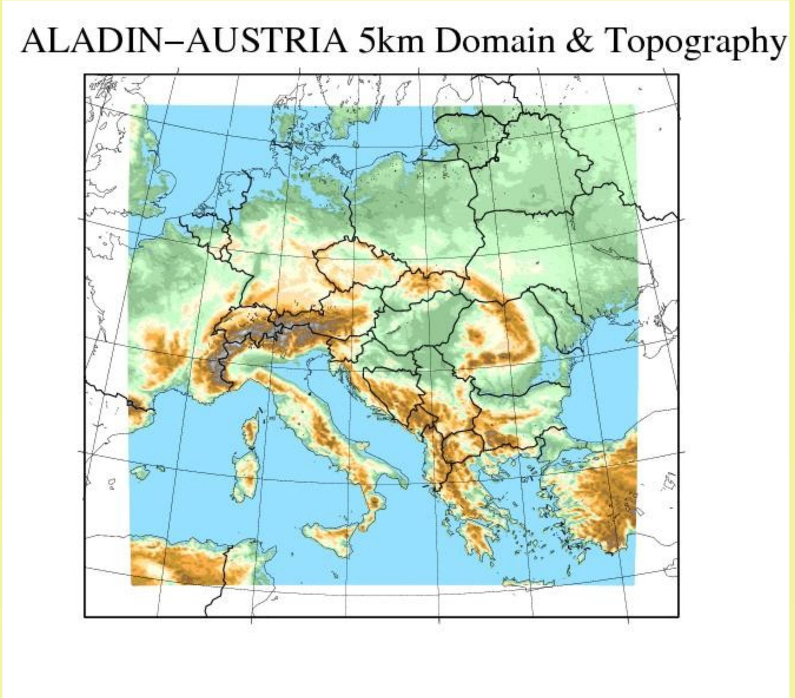


Figure 1: Representation of orography in the new 4.8km ALARO model

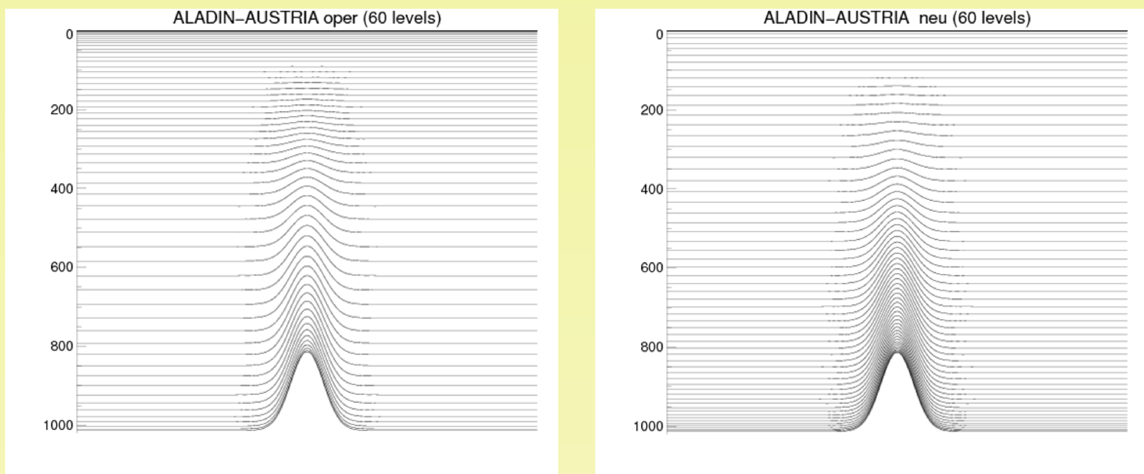


Figure 3+4: Distribution of vertical levels in the old 9.6km ALADIN-AUSTRIA (left) and the 4.8km ALARO5-AUSTRIA (right)

Case studies and verification results:

Before starting operations in March 2011, extensive verification of the 4.8km version was carried out (surface and upper air). It turned out that with respect to the 9.6km model version, ALARO5-AUSTRIA brings better or at least neutral. Using traditional station point verification it can be shown that there is clear benefit for parameters like 2m temperature or 2m relative humidity. Depending on the location of the station, the reduction of MAE and RMSE is in the range of 0-20% (see Figures 5-7). While the scores are rather neutral for stations in the flatlands, the benefit gets more and more visible when considering stations in the Alpine region (height correction of the temperature values is applied). The reduction of MAE and RMSE is even bigger for screening level humidity.

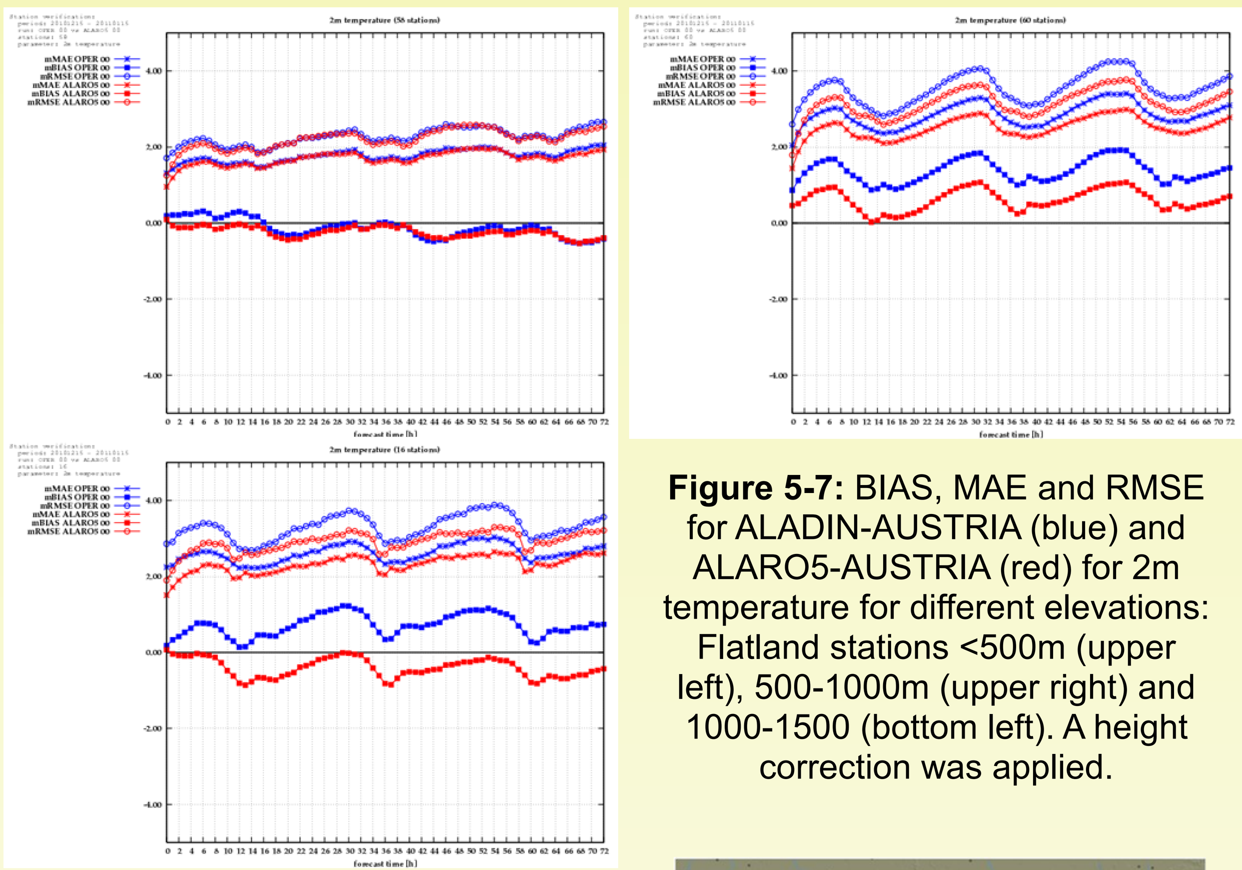


Figure 5-7: BIAS, MAE and RMSE for ALADIN-AUSTRIA (blue) and ALARO5-AUSTRIA (red) for 2m temperature for different elevations: Flatland stations <500m (upper left), 500-1000m (upper right) and 1000-1500 (bottom left). A height correction was applied.

In order to verify the precipitation forecasts the SAL method is used to allow a fair comparison of forecasts with different horizontal resolutions. The verification is done using INCA precipitation analysis (1km resolution) as the observation reference. In terms of the S component of SAL (evaluating the shape and size of the precipitation objects) the benefit of the 4.8km model is clearly visible. Considering the A component (mean areal precipitation) the results are different for the various geographical regions in Austria. Overall, a slight improvement of the mean area precipitation forecasts can be observed. The reason for that is probably more connected to the coupling model (IFS vs. ARPEGE) than to the horizontal resolution (4.8km vs. 9.6km). Finally, the location component L of SAL does not yield significant differences for long verification periods (several months).

During the evaluation period of ALARO5-AUSTRIA, special attention was also drawn on low stratus cases. Figures 10-13) show the cloudiness forecasts for three different models (ALADIN-AUSTRIA, ALARO5-AUSTRIA and IFS). It can be seen that the model with the highest horizontal and vertical (in the PBL) provides the best low cloudiness forecast in this case (more regions with cloudiness reaching 100%).

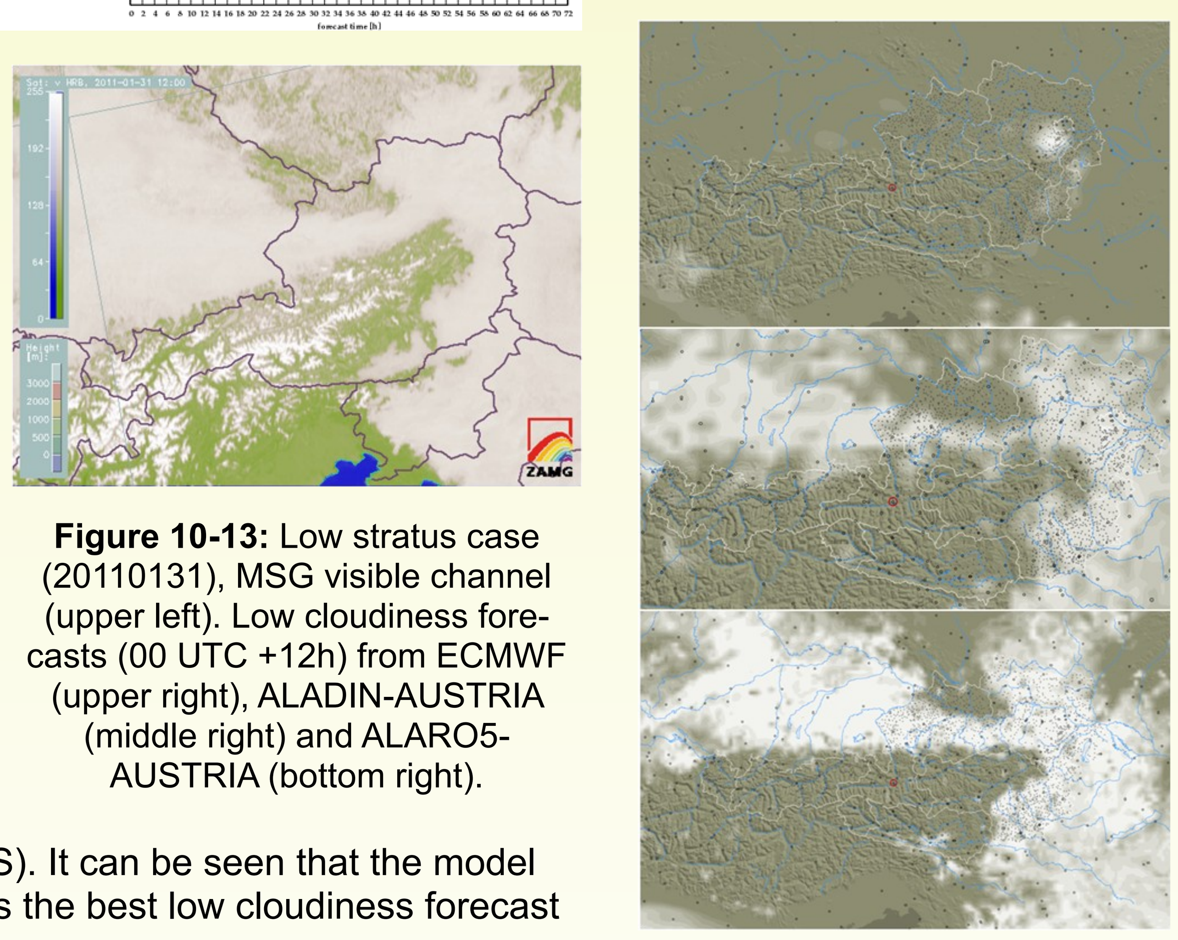


Figure 10-13: Low stratus case (20110131), MSG visible channel (upper left). Low cloudiness forecasts (00 UTC +12h) from ECMWF (upper right), ALADIN-AUSTRIA (middle right) and ALARO5-AUSTRIA (bottom right).

ALPNOW - Nowcasting of Alpine convection with AROME and INCA:

A 2.5km AROME version is running in a test environment at ZAMG. Beside objective verification the forecasters at ZAMG are invited to comment on the models performance. The main characteristics of the current model are:

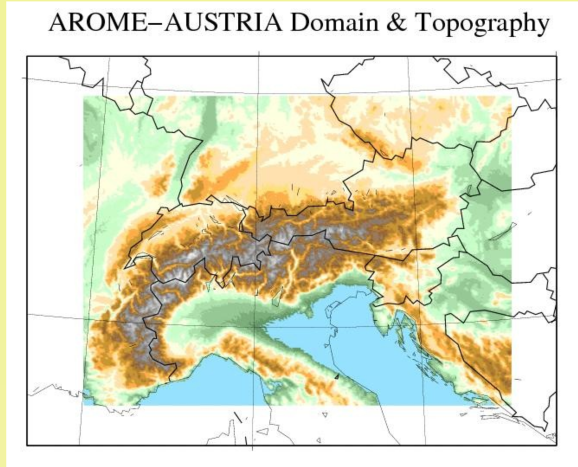
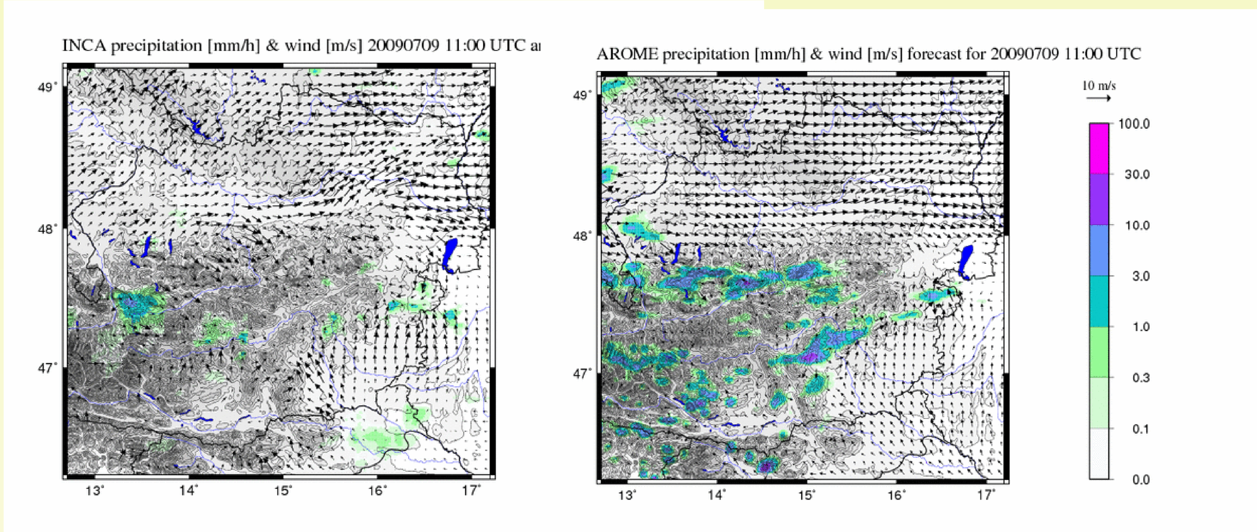


Figure 2: AROME domain

Resolution:	2.5km, 60 levels
Grid:	linear, 432x320
Coupl. model:	ALADIN-AUSTRIA, dyn. downscaling
Forecast range:	30h
Orography:	mean

Current objective (and subjective) verification shows that AROME tends to trigger deep convection over the Alps too early and generally overestimates convective precipitation, but it has good skills in predicting the pre-convective wind field (see e.g. Figures 8+9). The latter makes it a useful tool to investigate the predictability of convective initiation and sustenance over the Eastern Alpine region. Its output is used as background information for real-time analyses of 2-m temperature and humidity, 10-m wind and various convective indices provided by the INCA ("Integrated Nowcasting through Comprehensive Analysis") system.
Convective cells are supposed to initiate and intensify when positive Convective Available Potential Energy (CAPE) and near-surface moisture flux convergence coincide, and to weaken elsewhere. Compared to ALADIN-AUSTRIA model (9.6km) which, the horizontal resolution of AROME is increased by a factor of four, which helps in a more realistic representation of the near-surface wind field, and thus of the near-surface moisture flux convergence pattern. The associated better detection of convection-prone areas raises hopes to replace the "conventional" nowcasting of precipitation in INCA, which is a pure translation of the latest precipitation analysis, by a "convective" nowcasting, which also accounts for intensification or weakening of existing convective cells as well as for initiation of new ones.



Figures 8+9: INCA analysis (left) and AROME forecast (right) of

ALADIN-LAEF meets INCA:

The INCA system provides, among others, short range deterministic 2-m temperature analyses and forecasts with high update frequency (60 minutes) and horizontal resolution (1 km x 1 km) with special emphasis on the nowcasting range. Starting from values very close to observations the INCA temperature forecast merges into the (topographically downscaled) NWP output (ALADIN) through a fixed weighting function. In the nowcasting range, the temporal evolution of the model is superimposed on the current analyis field.

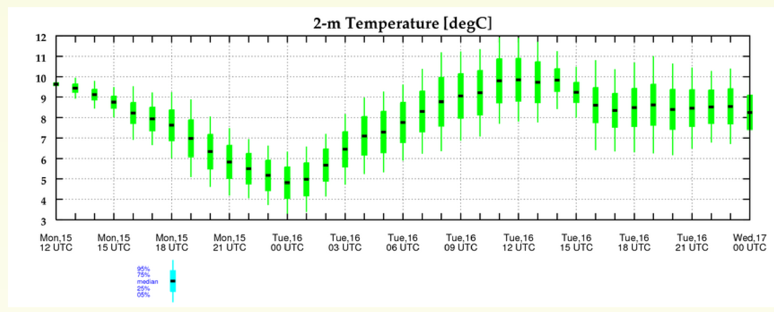


Figure 14 : Example of an EPSgram for 2-m temperature, for station Vienna .

Although the system shows high skill in the nowcasting range (MAE below 1K in the first 3 hours) it is affected by uncertainties mainly due to errors in the initial conditions and model formulation in the underlying NWP model.
In order to estimate the uncertainties of temperature forecasts in the nowcasting and (very) short forecast range, different methods for constructing an 18 member INCA ensemble are investigated:

- a statistical method using the RMSE of operational INCA forecast for the past 30 days
- a dynamical method combining the INCA deterministic forecast and the ALADIN-LAEF spread
- A dynamical-statistical method applying an additional calibration (using non-homogeneous Gaussian regression technique) on the dynamical method

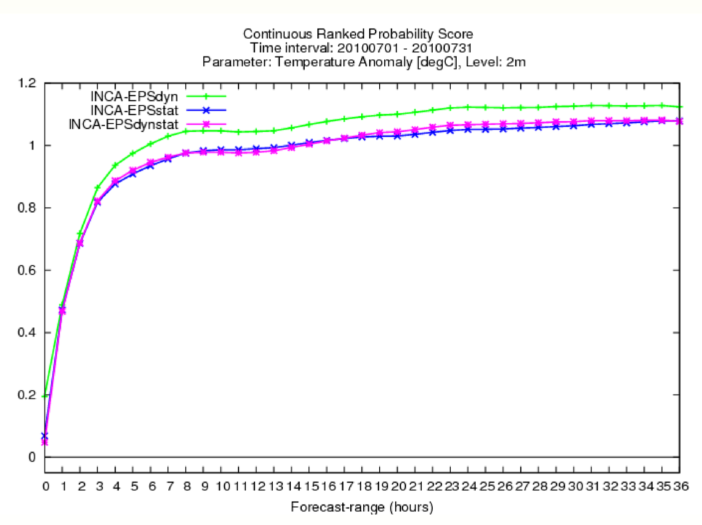


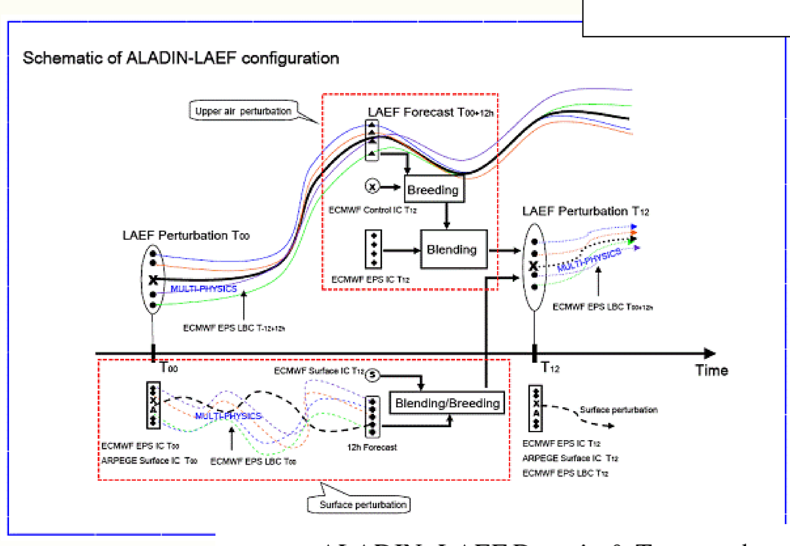
Figure 17: Example of an EPSgram for 2-m temperature, for station Vienna .

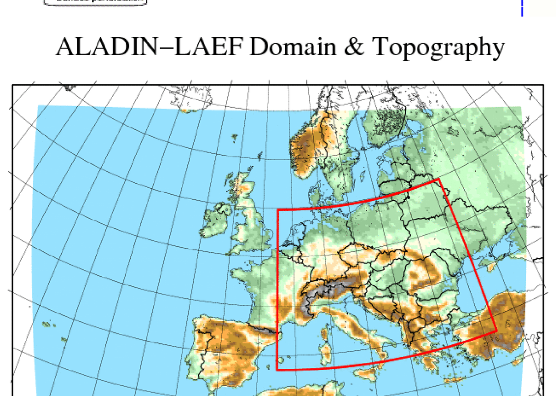
The three different methods are investigated for a 1-month period. The results show that the coupled dynamic-statistical give slightly better results than the pure dynamical method, i.e. statistical adaptations are able to overcome the underdispersive behaviour of the limited area ensemble system, especially from +12 hours ahead.

ALADIN-LAEF operational status and plans:

Since April 2011, the Limited Area Ensemble Forecasting system ALADIN-LAEF is running at ECMWF HPC under time critical option 2 in the following configuration:

Ensemble size:	17 (16 perturbed, 1 control)
Resolution:	18km for perturbed members and control
Forecast range:	60h
Perturbation upper air:	Breeding-Blending cycle (blending of small scale perturbations and large scale perturba tions)
Perturbation surface:	Non-cycling breeding-blending for surface fields
Perturbation model:	Different physics schemes used (Multiphysics)
LBC:	16 ECMWF-EPS members, Coupling frequency: 6h
Archive:	Data archived in MARS





The current and future developments of ALADIN-LAEF are focusing on the following topics:

- Introduction of stochastic physics (surface and 3D physics)
- Revision of the current multiphysics scheme
- Introduction of ensemble surface data assimilation
- Increase of horizontal resolution

Figure 15+16 : schematic depiction of ALADIN-LAEF system (top), ALADIN-LAEF integration domain and full-pos domain (bottom)