



# Ongoing Research and Development on ALADIN-LAEF

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ZAMG, Austria

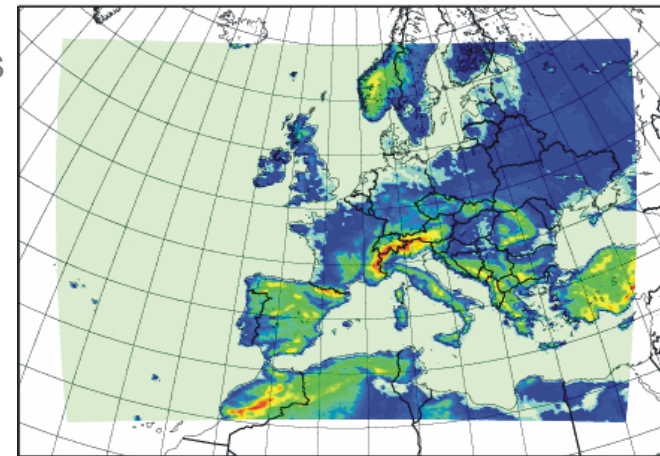
With contribution from Bellus, Wittmann, Kann, Ivatek-Sahdan, Tascu, Mladek, Hagel, etc.

# LAEF pre-operations

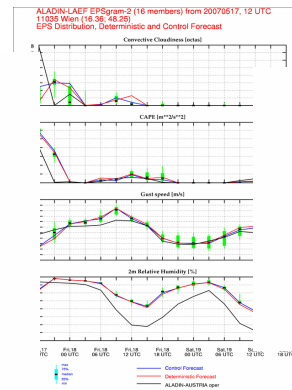
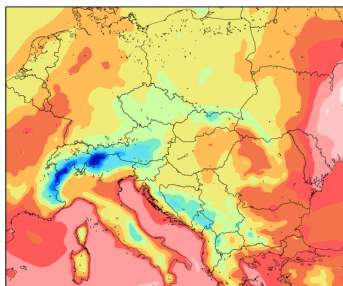
## ALADIN-LAEF: Since Mar. 2007 in pre-operation

- Dynamical downscaling of ECMWF EPS
- Coupling 16 perturbed ECMWF-EPS members
- Simple post-calibration (NCEP method)
- 18km horizontal, 37 levels, 60h fcst
- 2 runs at 00 and 12 UTC
- Products on LACE Webpage for partners

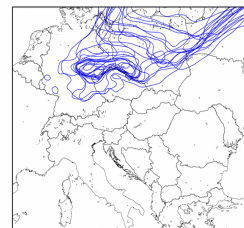
### LAEF Domain & Topography



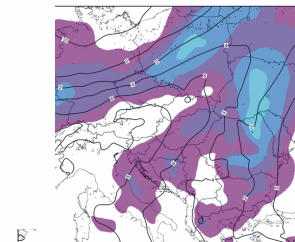
2m Minimum Temperature [°C], ENS-Mean, 20070517, 12 UTC + 54  
Valid from 20070519,06UTC to 20070519,18UTC



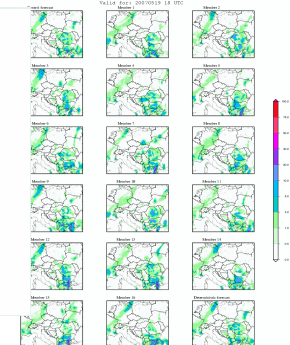
50hPa Temperature, 20070418 00 UTC + 30  
Valid for: 20070418 00 UTC  
Zonohome: -5 °C



50hPa Temperature [°C], Mean + Spread, 20070418 00 UTC + 48  
Valid for: 20070418 00 UTC

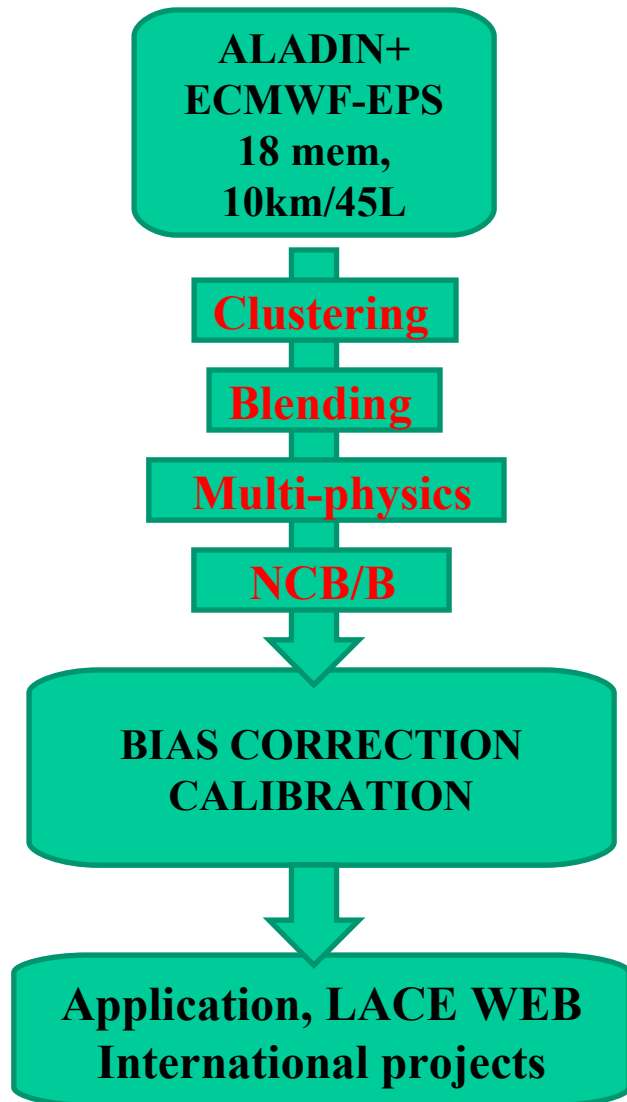


Precipitation (mm)00L, 20070517 12UTC + 54  
Valid for: 20070519 18 UTC





# LAEF: R&D Focuses



- Clustering: RM ECMWF EPS member

## Perturbation generation:

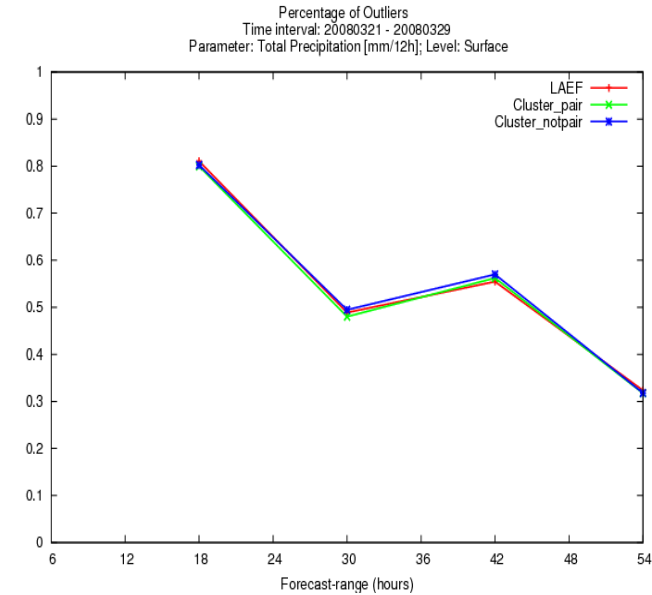
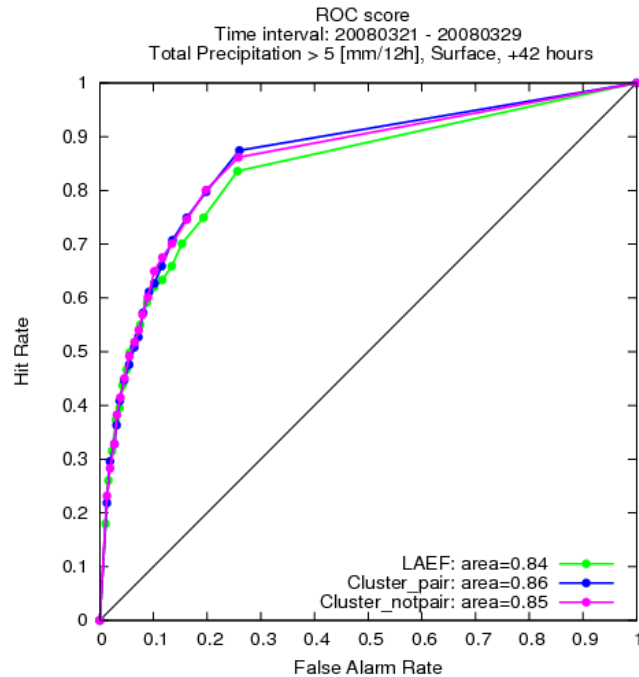
- Analysis: Blending
- Model: Multi-physis
- Surface: Non Cycling Blending/Breeding

## Post-processing:

- Bias correction: Analog & Kalman-type
- Calibration: NGR\_T2m, LR\_preci.
- Verification: EPS Verification package

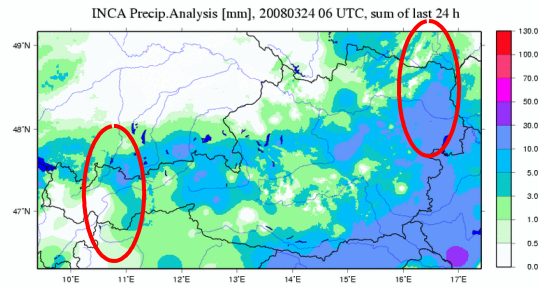
# Results: Clustering

- no clustering
- clustering
- clustering-pairs

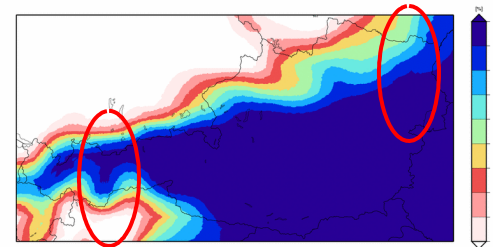


# Results: Clustering

INCA

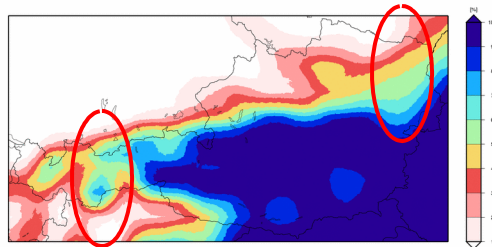


Precipitation probability > 5mm/24hours-notpair  
Ini: 20080322 00UTC + 54h; valid for: 20080324 06 UTC



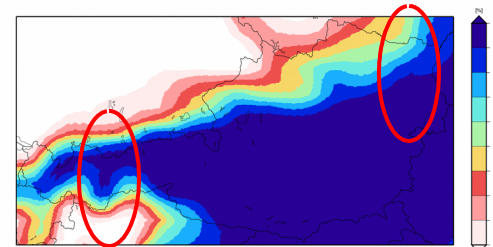
clustering

Precipitation probability > 5mm/24hours-op  
Ini: 20080322 00UTC + 54h; valid for: 20080324 06 UTC



no  
clustering

Precipitation probability > 5mm/24hours-pair  
Ini: 20080322 00UTC + 54h; valid for: 20080324 06 UTC



clustering  
pairs



# Blending technique

Blending of large-scale uncertainty from ECMWF SV with small-scale uncertainty from Breeding in LAEF.

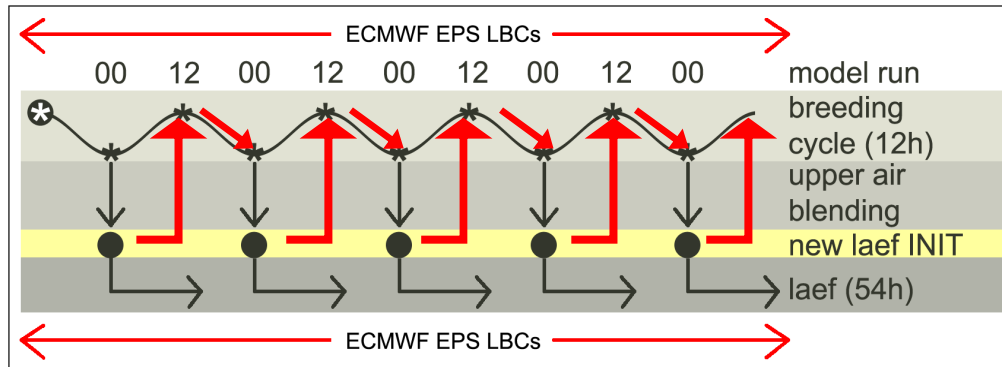
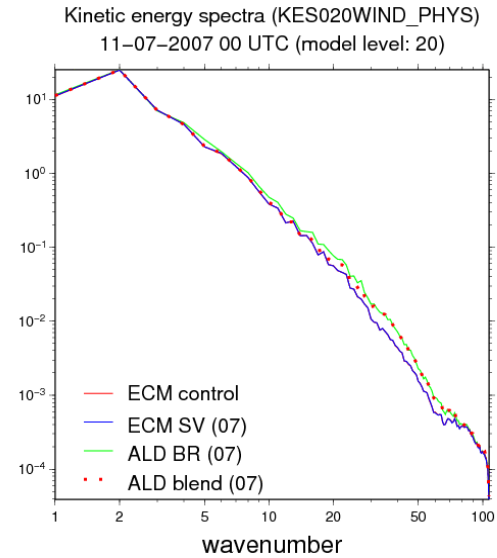
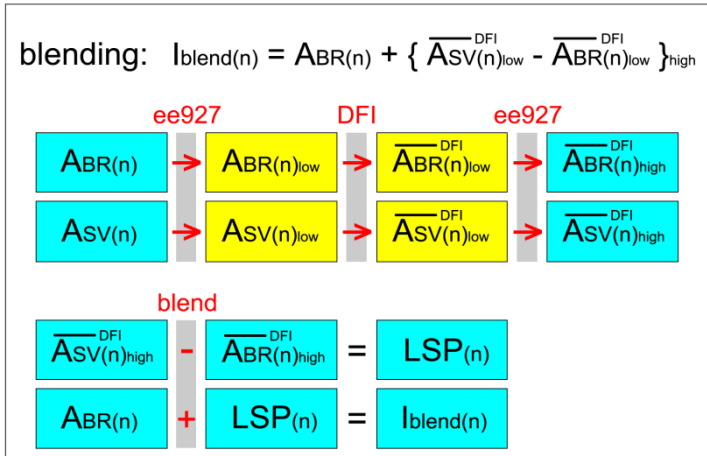
To combine the large-scale uncertainty from ECMWF SV with the small-scale uncertainty generated by Breeding in LAEF.

It is expected that

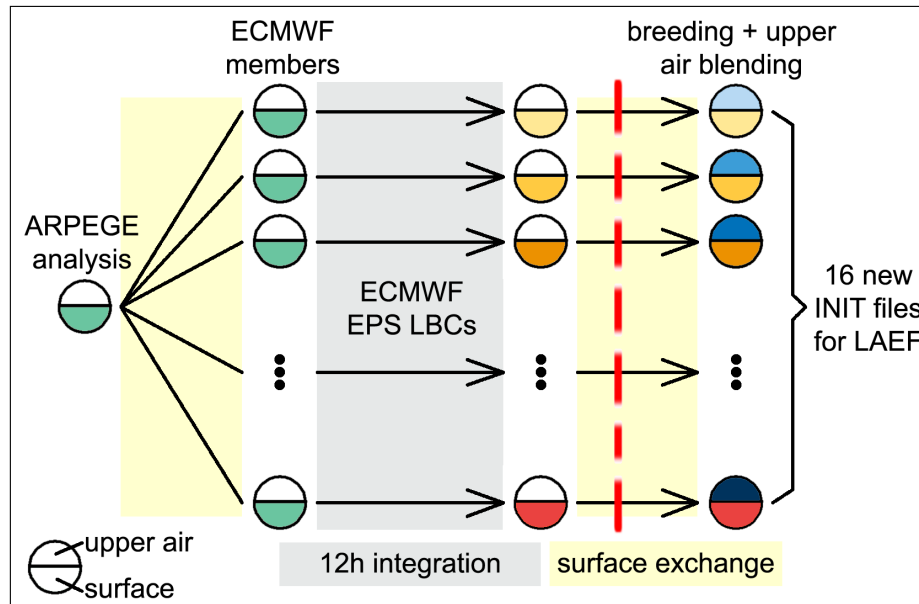
- 1). reducing the inconsistency between global and limited area EPS.
- 2). combining the future uncertainty generated by SV and the uncertainty in the past generated by Breeding.

**Hypothesis:** the small-scale part of IC uncertainty from LAM Bred vector is more realistic than interpolation of global EPS members.

# Blending technique



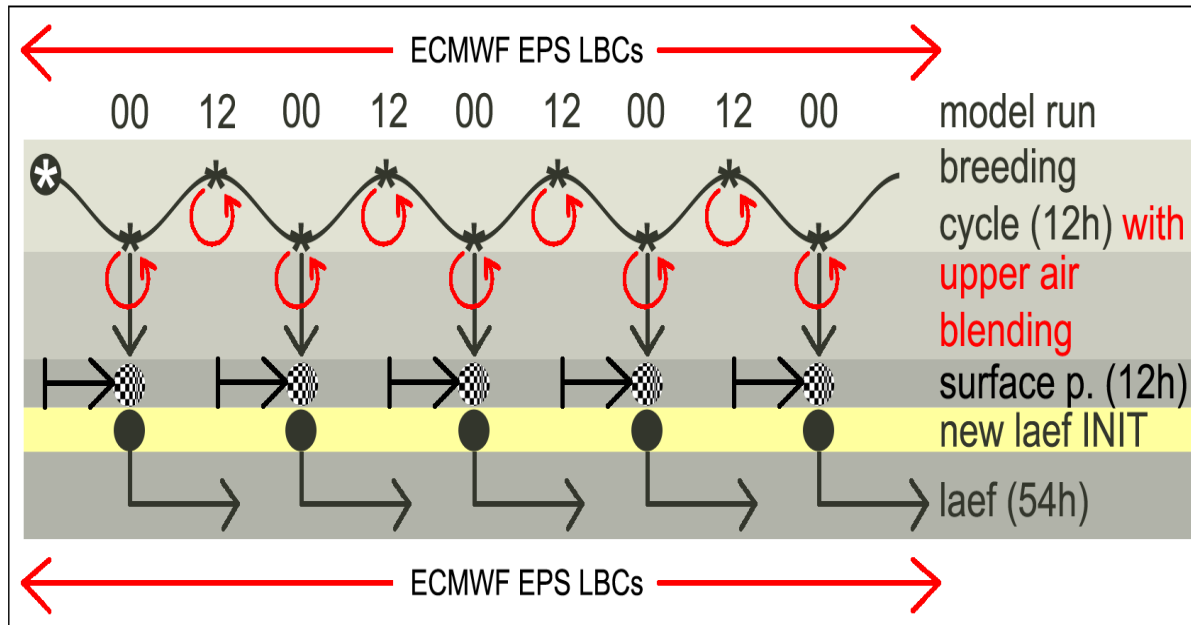
# Non Cycling Blending/Breeding (NCB/B)



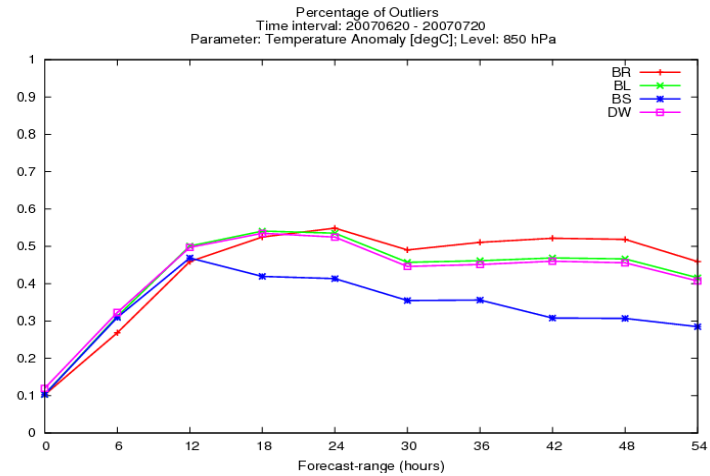
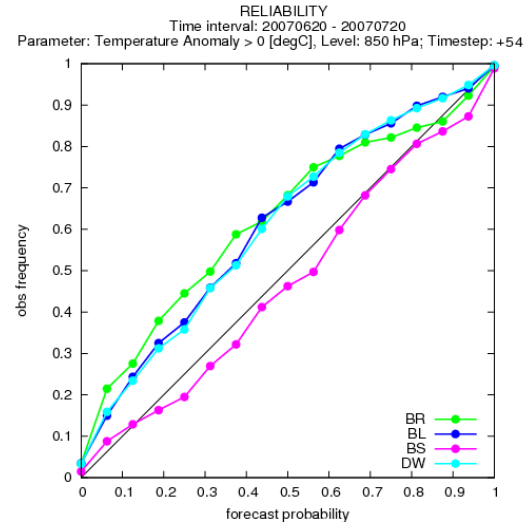
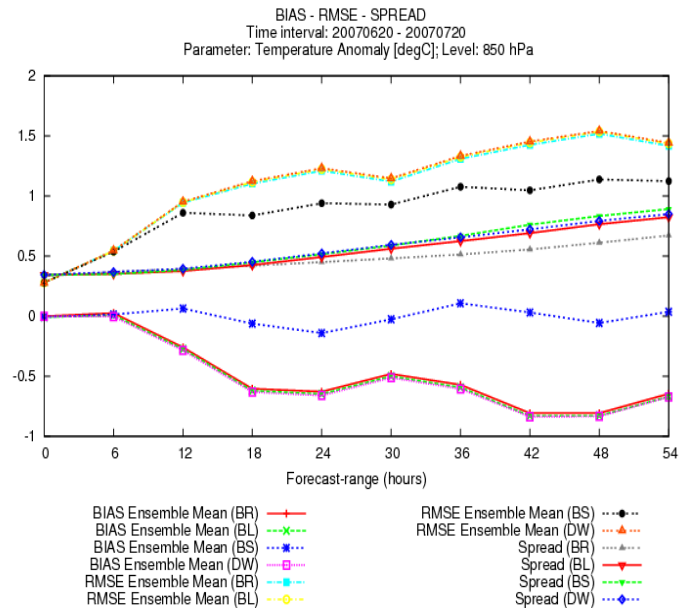
**Generation of surface perturbation:** short range surface forecasts driven by perturbed atmosphere forcing are used for blending or breeding on the surface analysis.



# Blending+NCB/B

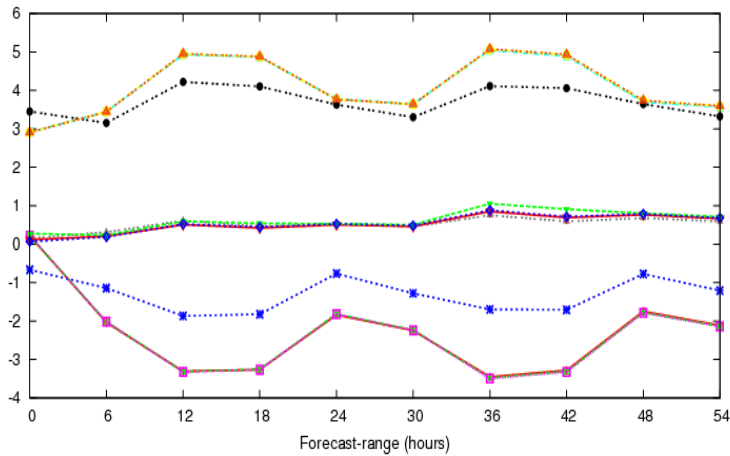


# Blending+NCB/B: upper air



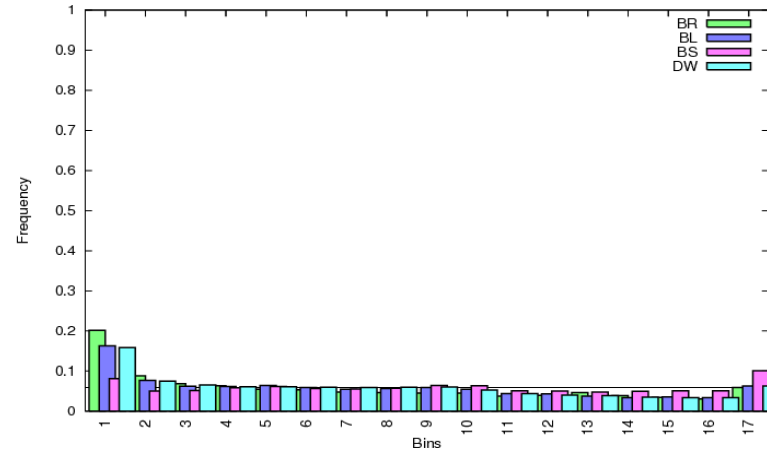
# Blending+NCB/B: surface

BIAS - RMSE - SPREAD  
 Time interval: 20070620 - 20070720  
 Parameter: Temperature Anomaly [degC]; Level: 2m



- BIAS Ensemble Mean (BR) —●—
- BIAS Ensemble Mean (BL) —●—
- BIAS Ensemble Mean (BS) —●—
- BIAS Ensemble Mean (DW) —●—
- RMSE Ensemble Mean (BR) —●—
- RMSE Ensemble Mean (BL) —●—
- RMSE Ensemble Mean (BS) —●—
- RMSE Ensemble Mean (DW) —●—
- Spread (BR) —●—
- Spread (BL) —●—
- Spread (BS) —●—
- Spread (DW) —●—

Talagrand diagram  
 Time interval: 20070620 - 20070720  
 Parameter: MSL-Pressure [hPa], Level: Mean Sea Level; Timestep: +54 hours



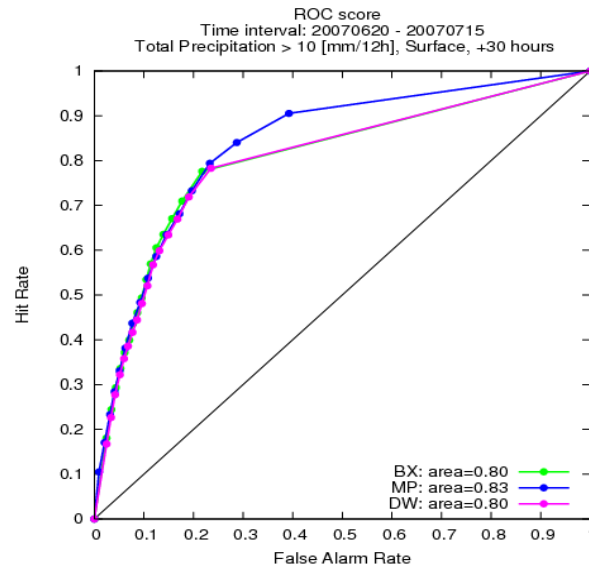
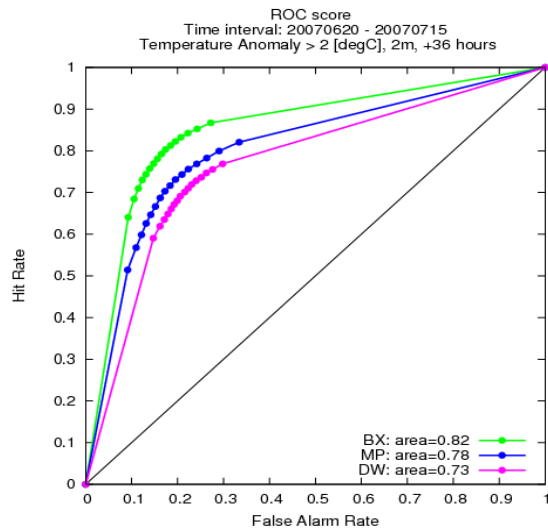
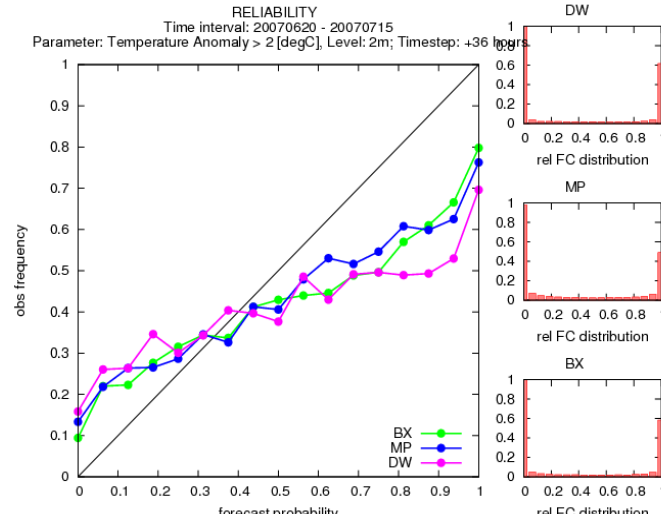
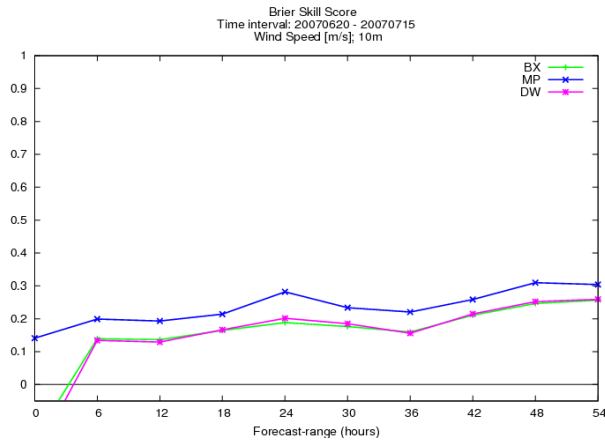


## Multi-physics design

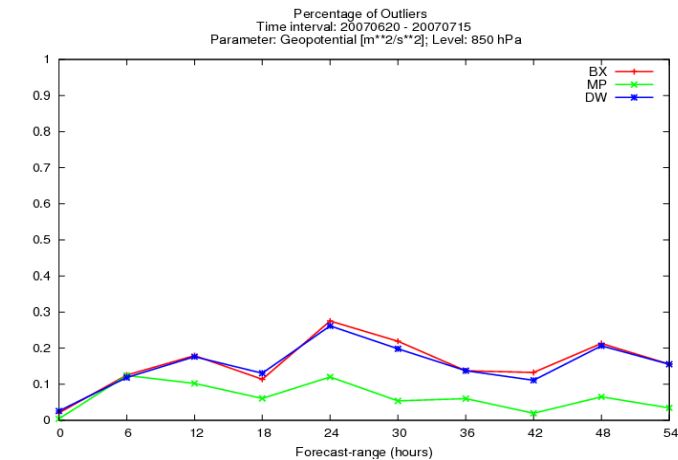
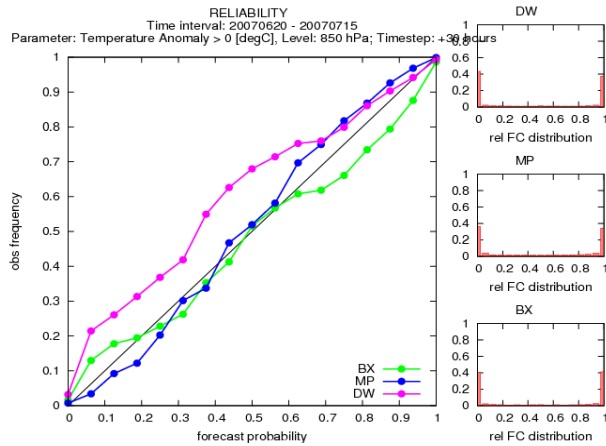
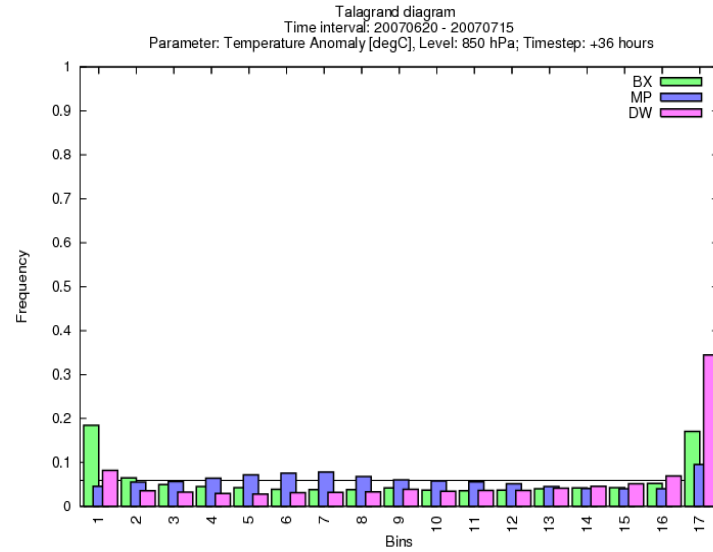
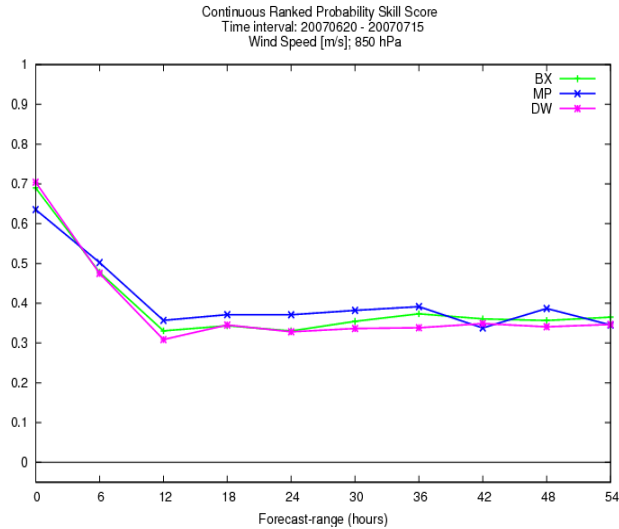
16 model physics options are used for dealing with the model uncertainty:

ALARO no 3MT, Lopez microphysics, Hirlam physics, prognostic TKE, AROME shallow convection, moisture convergence and CAPE closure, Kessler type scheme for large scale precipitation, tuning of the mixing length, entrainment rate, and the computation of the cloud base.

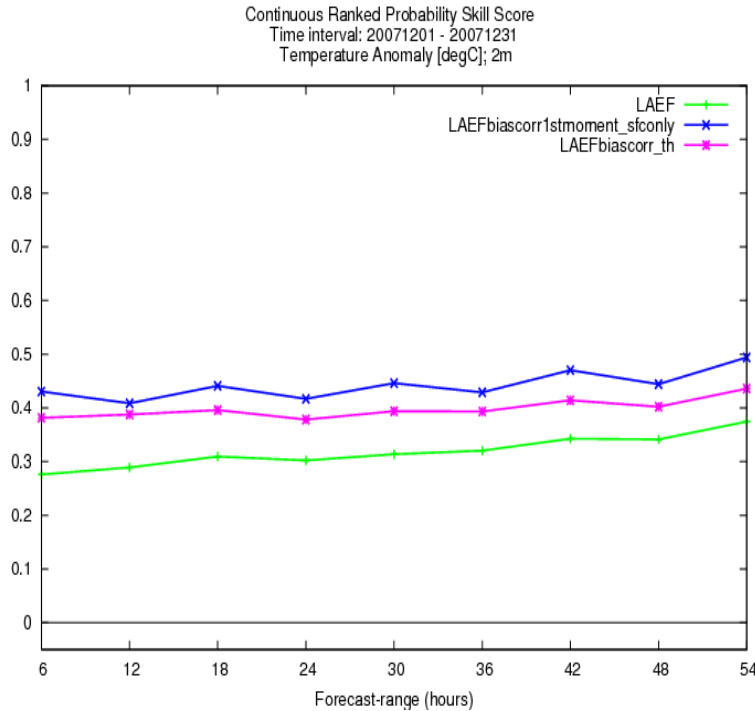
# Multi-physics: surface



# Multi-physics: upper air



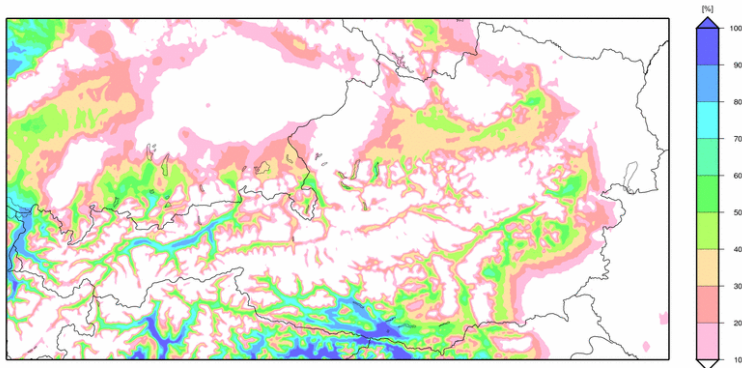
# Bias correction: Kalman-type & Analog



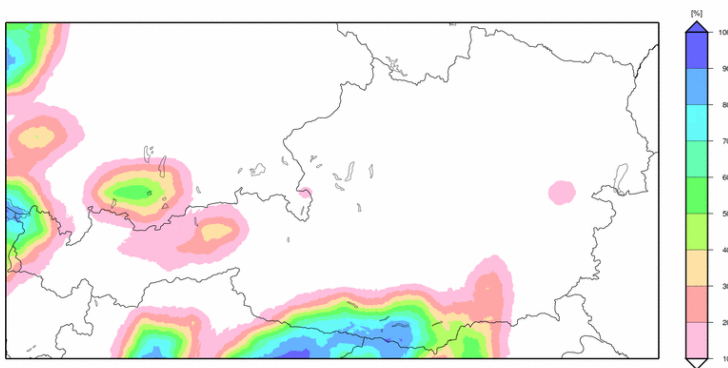
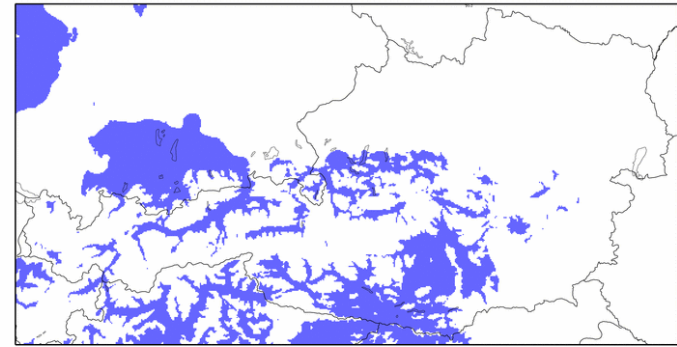
**More details by the presentation of A. Kann!**

# Post-calibration: NGR for T2m

2m - Temperature: Probability > 1°C  
Ini: 20071223 00UTC + 36h; valid for: 20071224 12 UTC



INCA: 2m Temperature  
Analysis for: 20071224, 1200 UTC



**More details by the  
presentation of  
A. Kann!**





# Common EPS verification package

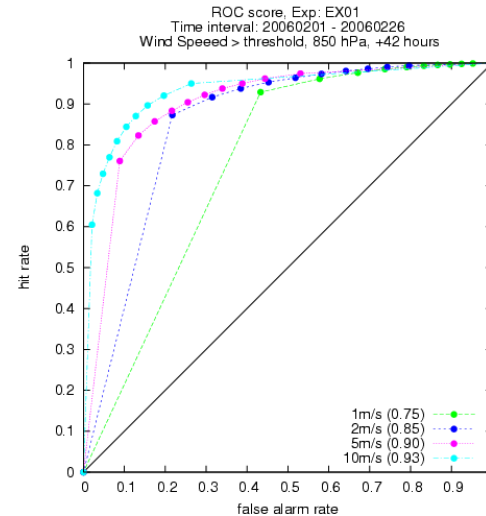
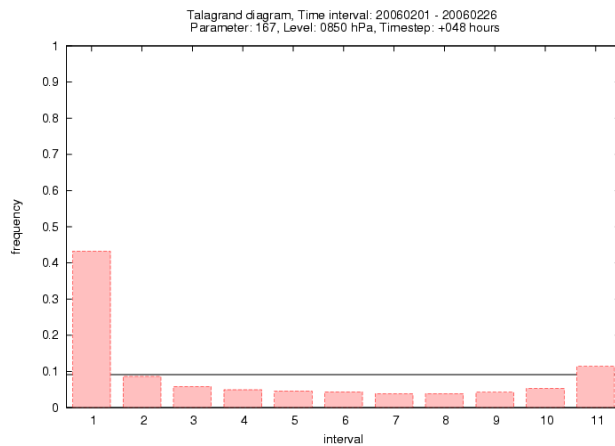
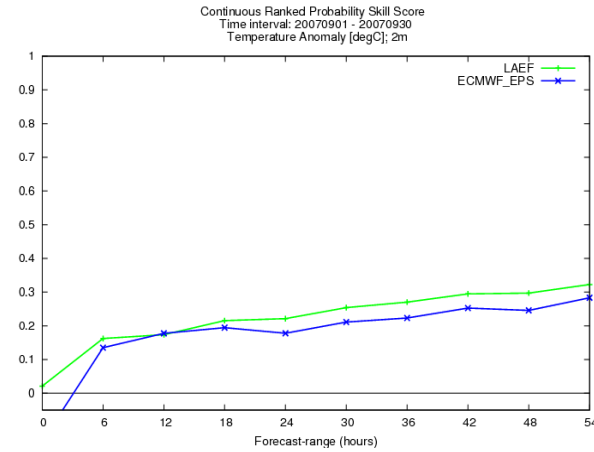
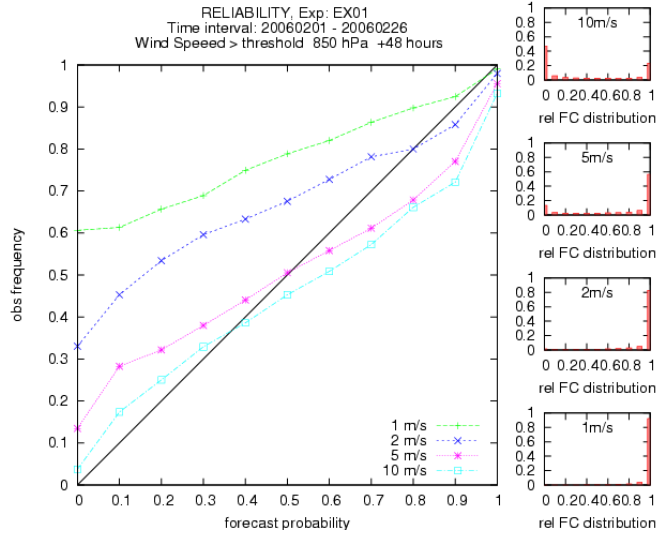
**Requirements:** To develop a simple, easy-use, flexible, portable and state-of-the-art verification tool for EPS.

Software	Shell-Scripts, FORTRAN 90, graphics: gnuplot
Question of „TRUTH“	Surface: SYNOP Upper air: Analyses (ECMWF or ARPEGE)
Data format of forecasts/analysis	GRIB I
Data format of SYNOP obs	ASCII
Surface parameters to be verified	T2m, 10m Wind, RR, RH2m, and pressure
Upper air parameters to be verified	T, U,V, H, RH
Matching forecasts and observations	Verification performs at the observation location. Forecasts are interpolated to station, except for RR, it is to use the value of the nearest grid point.

## Features:

- ✓ Flexibility in data format (ascii, grib), modular design, freeware only
- ✓ Modular design, namelist controlled, freedom in the settings.
- ✓ Results in graphic plots included.
- ✓ Choice for different references for skill scores

# Common EPS verification: examples





# Conclusions and Plan

## **R&D on LAEF are being carried on:**

- ✓ Small but positive impact with clustering
- ✓ Clear improvement with blending and NCB/B
- ✓ Useful results with multi-physics
- ✓ Encouraging demonstration by post-calibration
- ✓ Easy use tool: EPS verification package

## **Plan in the next future:**

- Implementation into the operations
- Tuning on blending and NCB/B
- Optimization on multi-physics
- Continuing study on post-calibration, e.g. RR



# Acknowledgment

Thanks very much to all the ALADIN Colleagues, who has contributed the ALADIN LAEF work.

Thanks also the COSMO colleagues for help with EPS clustering, e.g. Paccagnella, Montani, Marsigli and so on.

Thanks also the HIRLAM colleagues, who has helped the ALADIN Hirlam physics, in particular, XiaohuaYang and Bjarne Stig Andersen.