Ongoing Research and Development on ALADIN-LAEF

Yong WANG
ZAMG, Austria

With contribution from Wittmann, Kann, Bellus, Steinheimer, Kalin, Tascu

Outline

ALADIN-LAEF: Limited Area Ensemble Forecasting

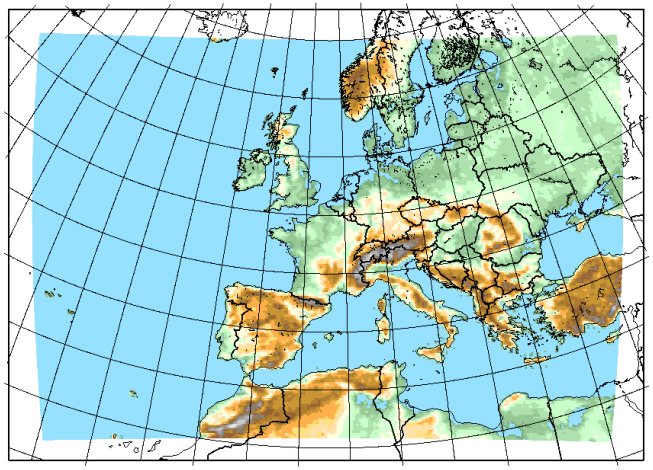
- LAEF pre-operational system
- Research focuses:
  - Clustering
  - IC and surface perturbation
  - Dealing with the model uncertainty
  - Verification, bias correction and calibration
  - Combination of 2 LAMEPS systems
- Conclusions and plan

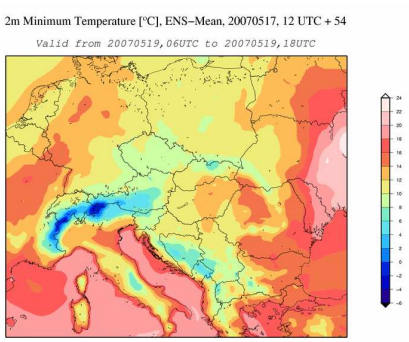
LAEF pre-operations

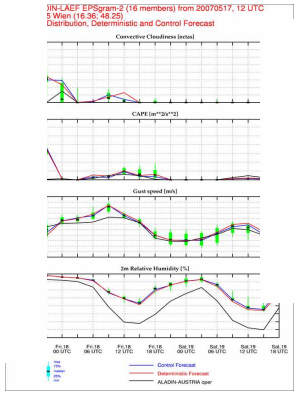
ALADIN-LAEF: Since Mar. 2007 in pre-operation

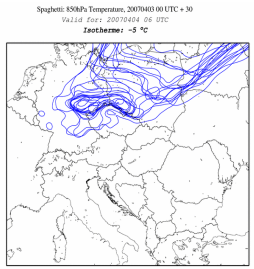
- Dynamical downscaling of ECMWF EPS
- Coupling 16 perturbed ECMWF-EPS members
- Simple post-calibration (NCEP method: adding LAEF probablistic information to higher resolution deterministic fcst.)
- 18km horizontal, 37 levels, 60h fcst
- 2 runs at 00 and 12 UTC
- Products on LACE Webpage for partners

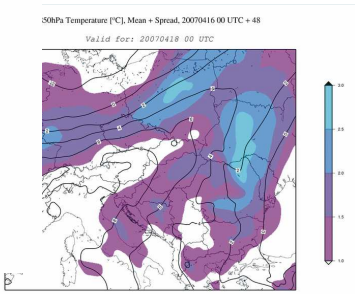
ALADIN–LAEF Domain & Topography

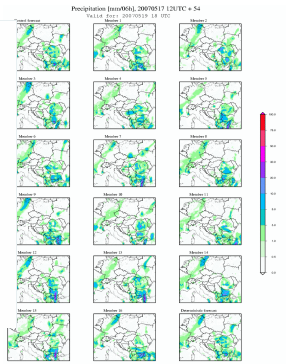




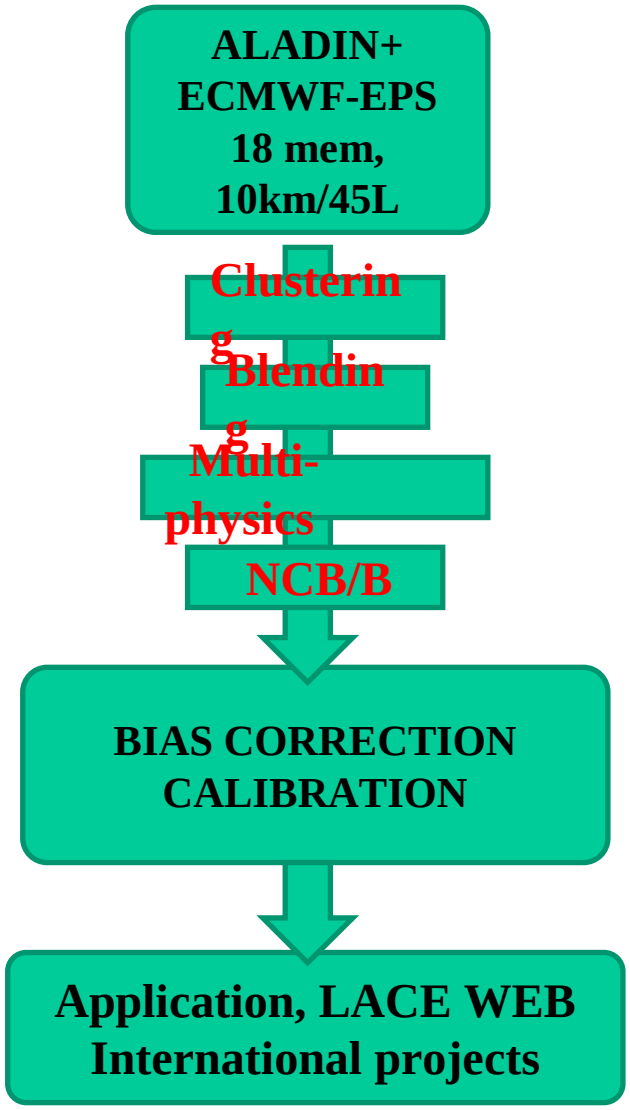








LAEF: R&D Focuses



- Clustering: RM ECMWF EPS member

Perturbation generation:

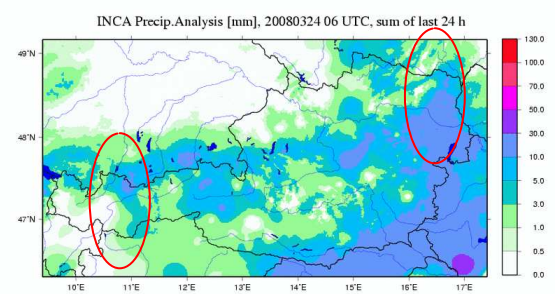
- Analysis: Blending
- Model: Multi-physis
- Surface: Non Cycling Blending/Breeding

Post-processing:

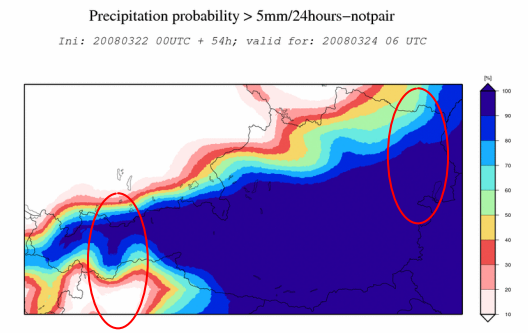
- Bias correction: Analog & Kalman-type
- Calibration: NGR_T2m, LR_preci.
- Combination: LAEF (ECMWF+ARPEGE)
- Verification: EPS Verification package

Clustering

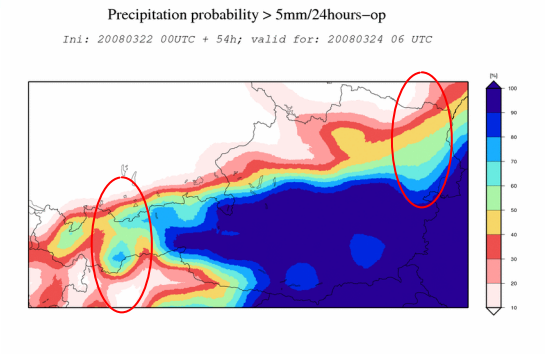
INCA



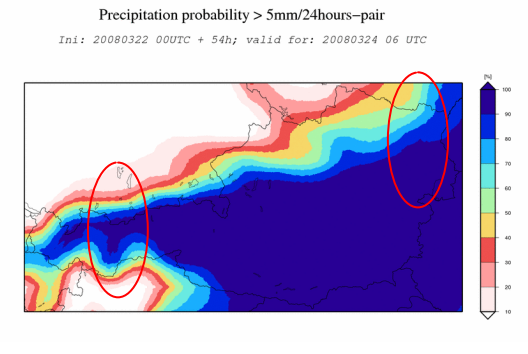
clustering

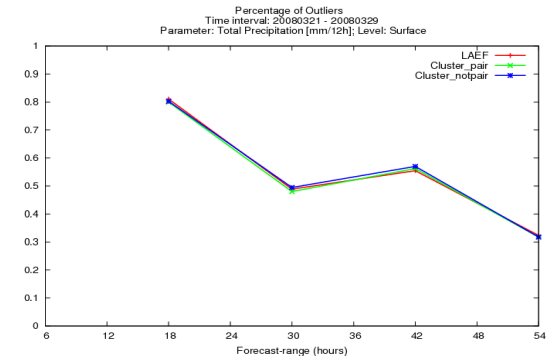


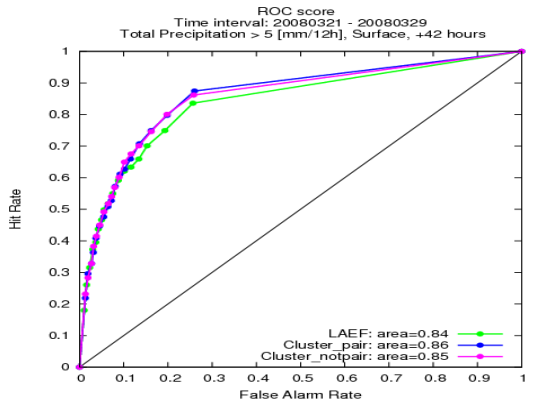
no clustering



clustering pairs







Blending: Application of standard Dolph-Chebyshev digital filter.

Blending global ECMWF SV with LAEF Breeding

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

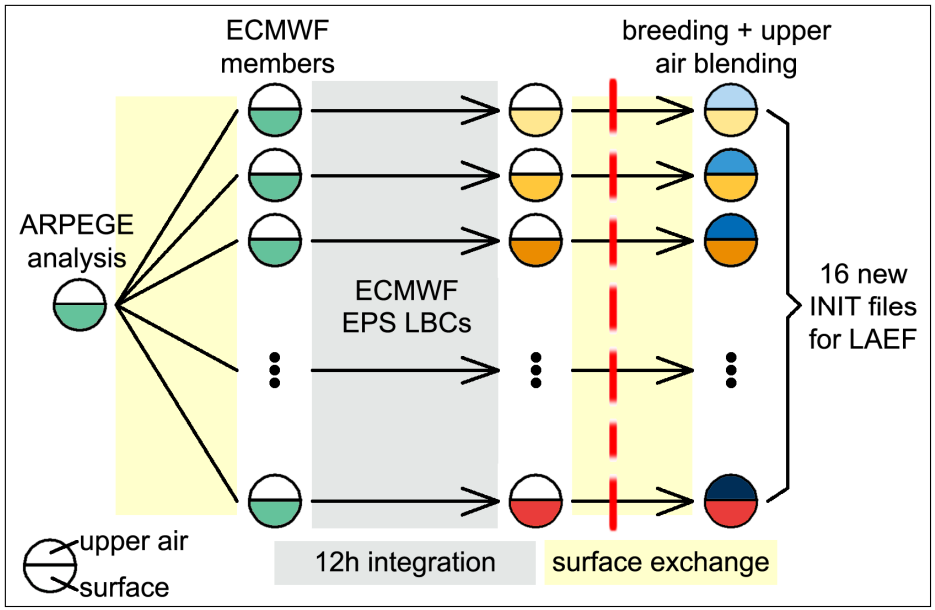
It is expected that

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 gloabl EPS members.

Non Cycling Blending/Breeding (NCB/B)

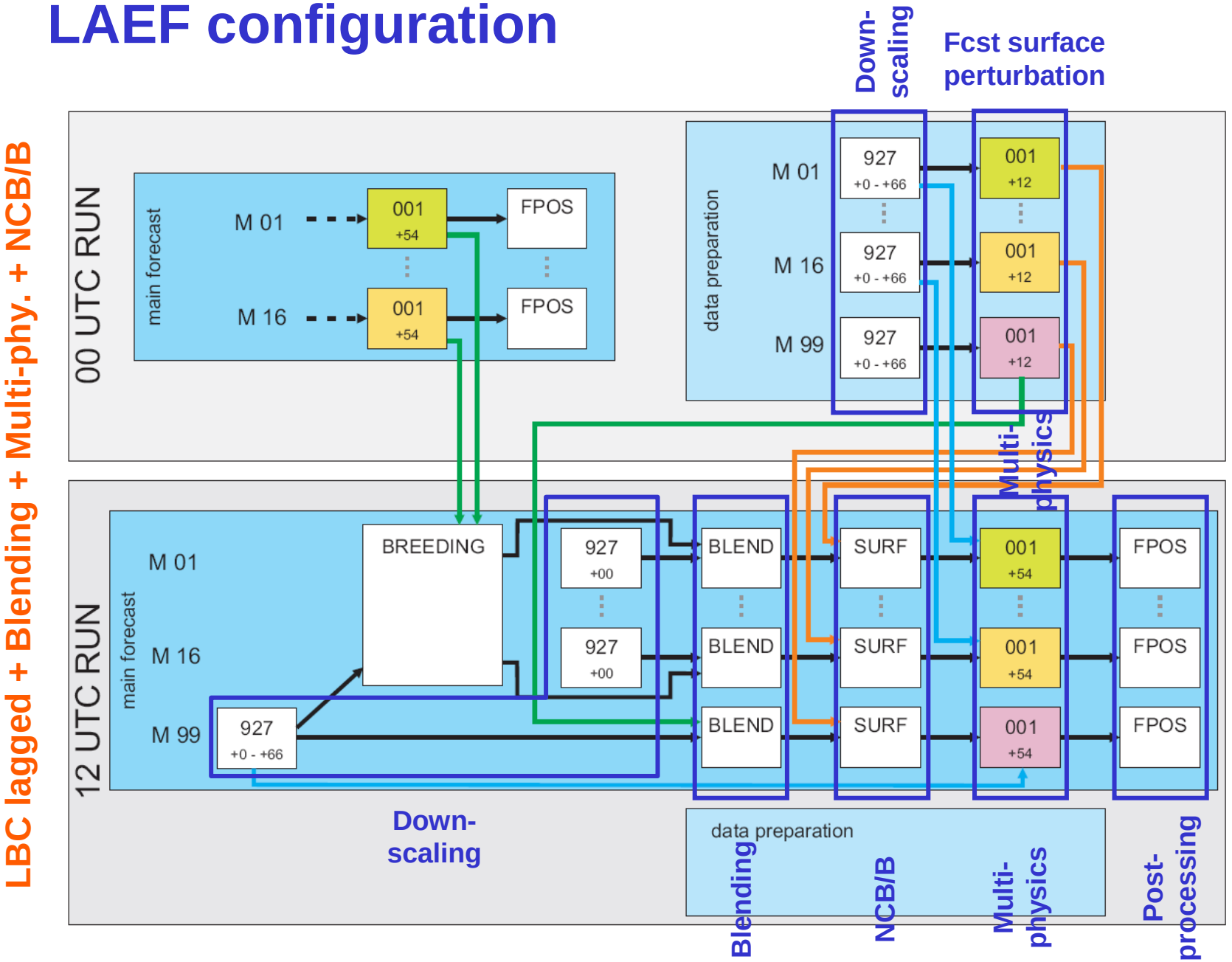


Generation of surface perturbation: short range surface forecasts driven by perturbed atmosphere forcing are used for blending or breeding on the surface analysis.

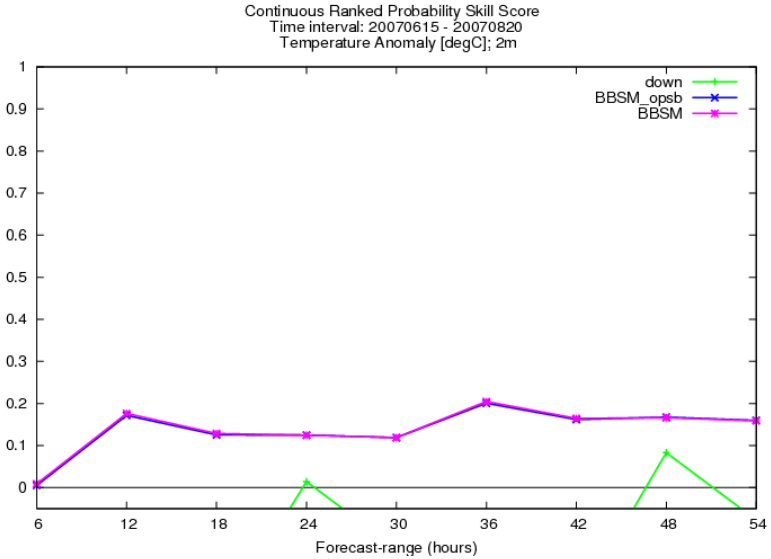
LAEF Multi-physics design

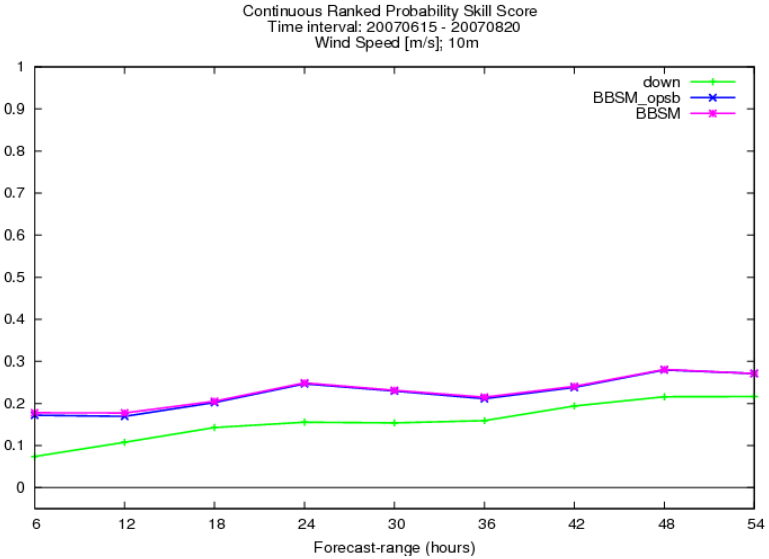
mem #	configuration	Cloud-physics	deep convection	radiation	turbulent transport	shallow convection	mixing length &entrainment rate
M 1	ALADIN-25	Kessler	BGMC	RG	Louis81	JFG03	Setting_0
M 2	ALADIN-25	Kessler	BGCP	RG	Louis81	JFG03	Setting_1
M 3	HARMONIE	Sunqunist	STRACO	Savijarvi90	CBR+S90	JFG03	---
M 4	ALARO+3MT	Alaro	3MT	JFG05	JFG06	JFG03	---
M 5	ALADIN-32	Lopez	BGMC	ECMWF	Louis81	KFB	Setting_0
M 6	ALADIN-32	Lopez	BGCP	ECMWF	Louis81	KFB	Setting_1
M 7	ALARO	Alaro	BG_MCON	JFG05	JFG06	JFG03	---
M 8	ALARO	Alaro	BG_MCON	JFG05	JFG06	JFG03	---
M 9	ALADIN-32	Lopez	BG_MCON	ECMWF	CBR+B81	KFB	Setting_0
M 10	ALADIN-32	Lopez	BG_CAPE	ECMWF	CBR+B81	KFB	Setting_1
M 11	ALADIN-32	Lopez	BG_MCON	ECMWF	CBR+S90	KFB	Setting_0
M 12	ALADIN-32	Lopez	BG_CAPE	ECMWF	CBR+S90	KFB	Setting_1
M 13	ALADIN-32	Lopez	BG_MCON	ECMWF	CBR+S90	JFG03	Setting_0
M 14	ALADIN-32	Lopez	BG_CAPE	ECMWF	CBR+S90	JFG03	Setting_1
M 15	ALARO+3MT	Alaro+XR	3MT	JFG05	JFG06	JFG03	---
M 16	ALARO+3MT	Alaro+XR1	3MT	JFG05	JFG06	JFG03	---
M 0	ALARO	Alaro	BG_MCON	JFG05	JFG06	JFG03	---
M 99	ALADIN-32	Lopez	BG_MCON	ECMWF	Louis81	KFB	Setting_0

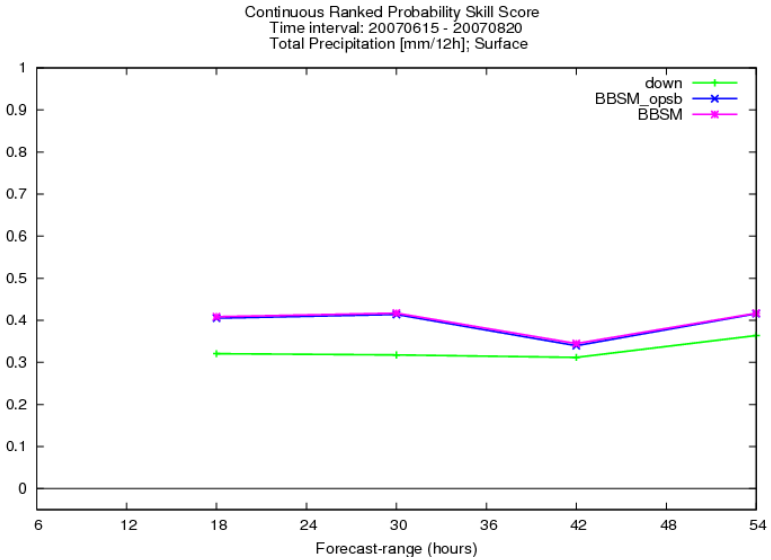
LAEF configuration



Verification : June-August 2007

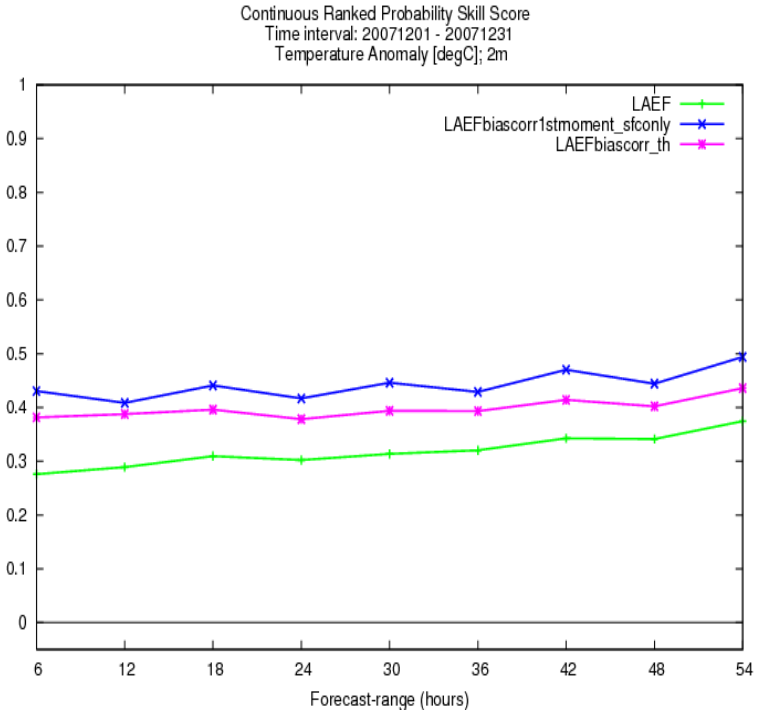




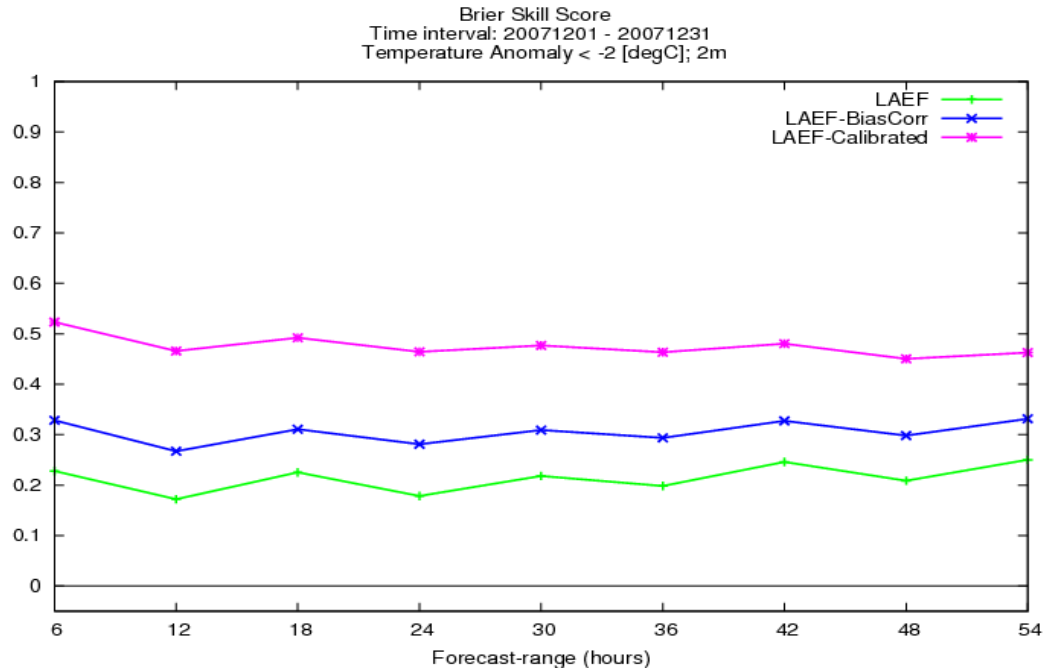


Clear improvment

Bias correction: Kalman Filter type vs. Analog



Probabilistic calibration: NGR on T2m

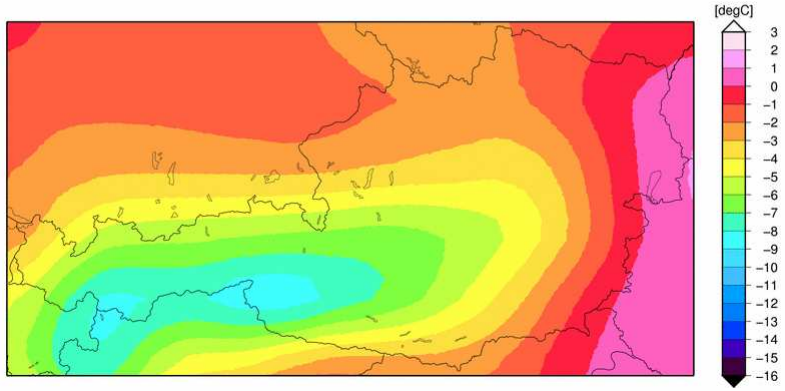


NGR: Non-homogeneous Gaussian Regression

Probabilistic calibration: NGR on T2m

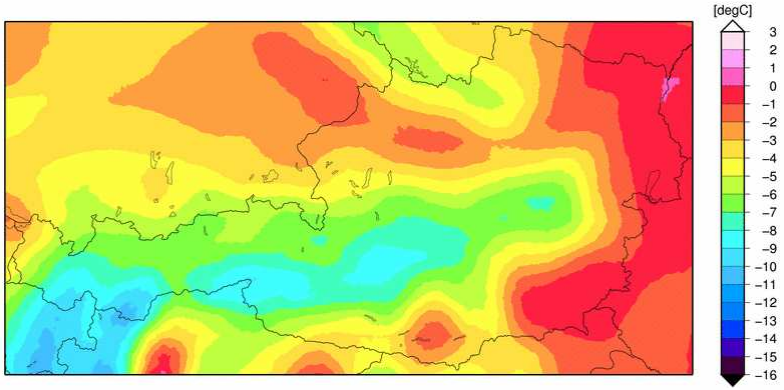
ECMWF: Uncalibrated 2m Temperature, Ensemble Mean

Forecast from: 20071216 00 UTC + 36h



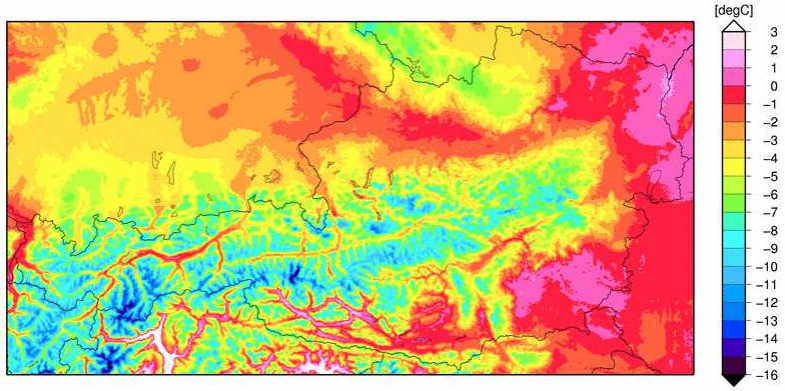
LAEF: Uncalibrated 2m Temperature, Ensemble Mean

Forecast from: 20071216, 00 UTC + 36h



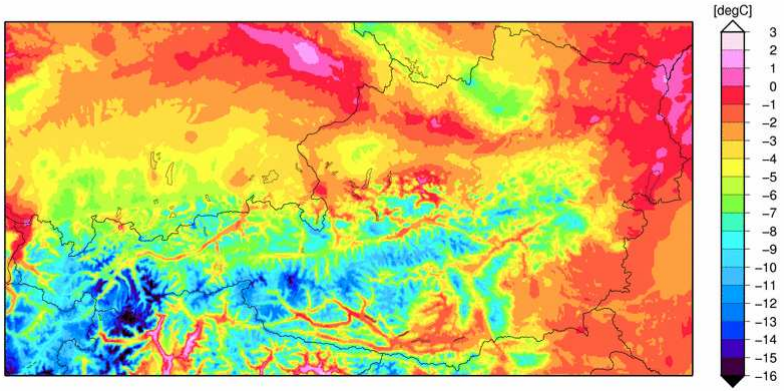
LAEF: Calibrated 2m Temperature, Ensemble Mean

Forecast from: 20071216, 00 UTC + 36h

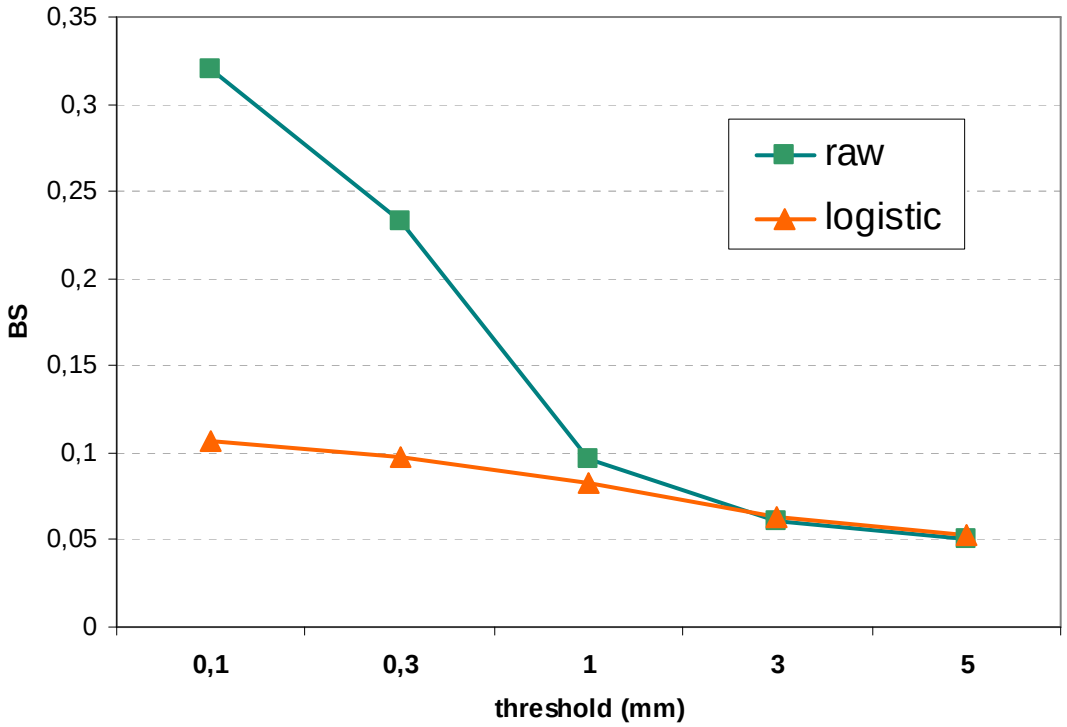


INCA: 2m Temperature

Analysis for: 20071217, 1200 UTC



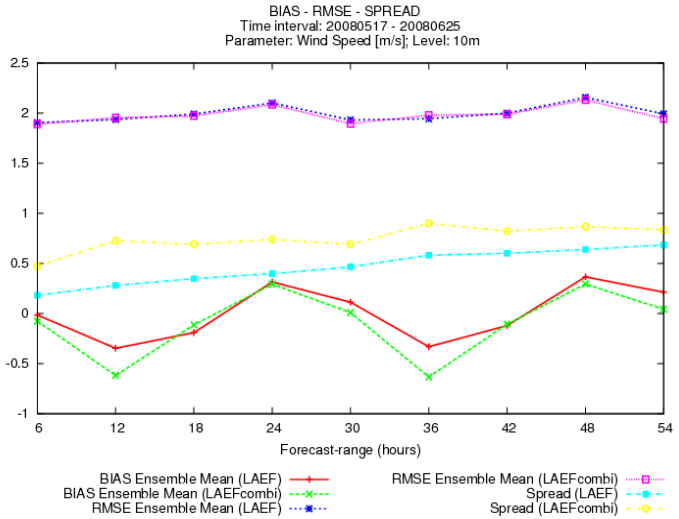
Probabilistic calibration: LR on precipitation

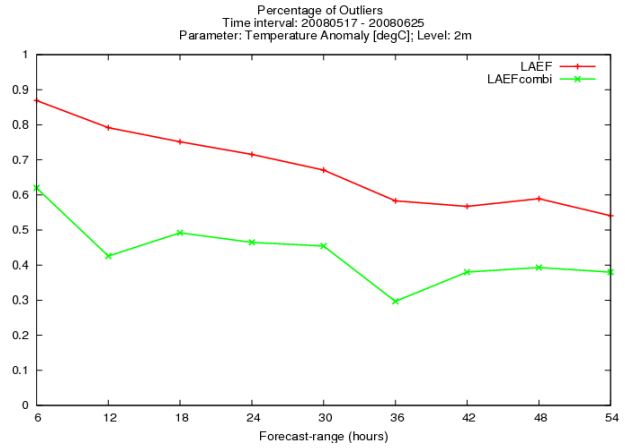


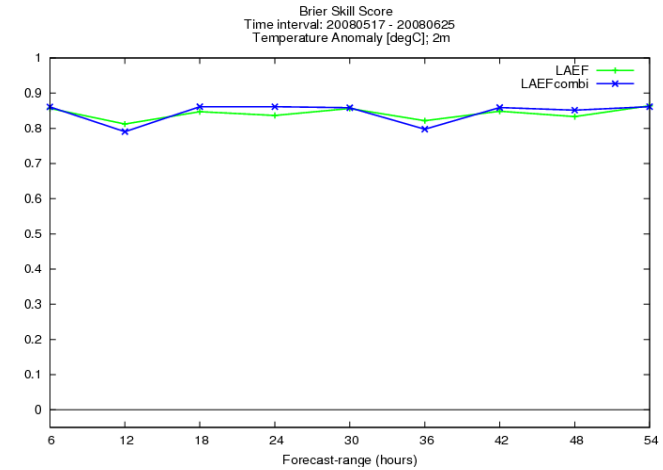
Brier score for 6-hour precipitation (12 – 18 hour fcst) for Zagreb, Jun - Sep 2007
LACE report 2008, Lovro Kalin

LR: Logistic Regression

Combination: LAEF/ECMWF + LAEF/PEARP







More spread, better outlier
Similar skill, same error ,

More investigations needed!

Beijing Olympics meso-scale EPS Research and Demonstration Project

Conclusions and Plan

R&D on LAEF are being carried on:

- ✓ Small but positive impact with clustering
- ✓ Clear improvment with blending and NCB/B
- ✓ Useful results with multi-physics
- ✓ Encouraging demonsration 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, Sander Tijm.