The future development and research plan of ALADIN Limited Area Ensemble Forecasting (LAEF)

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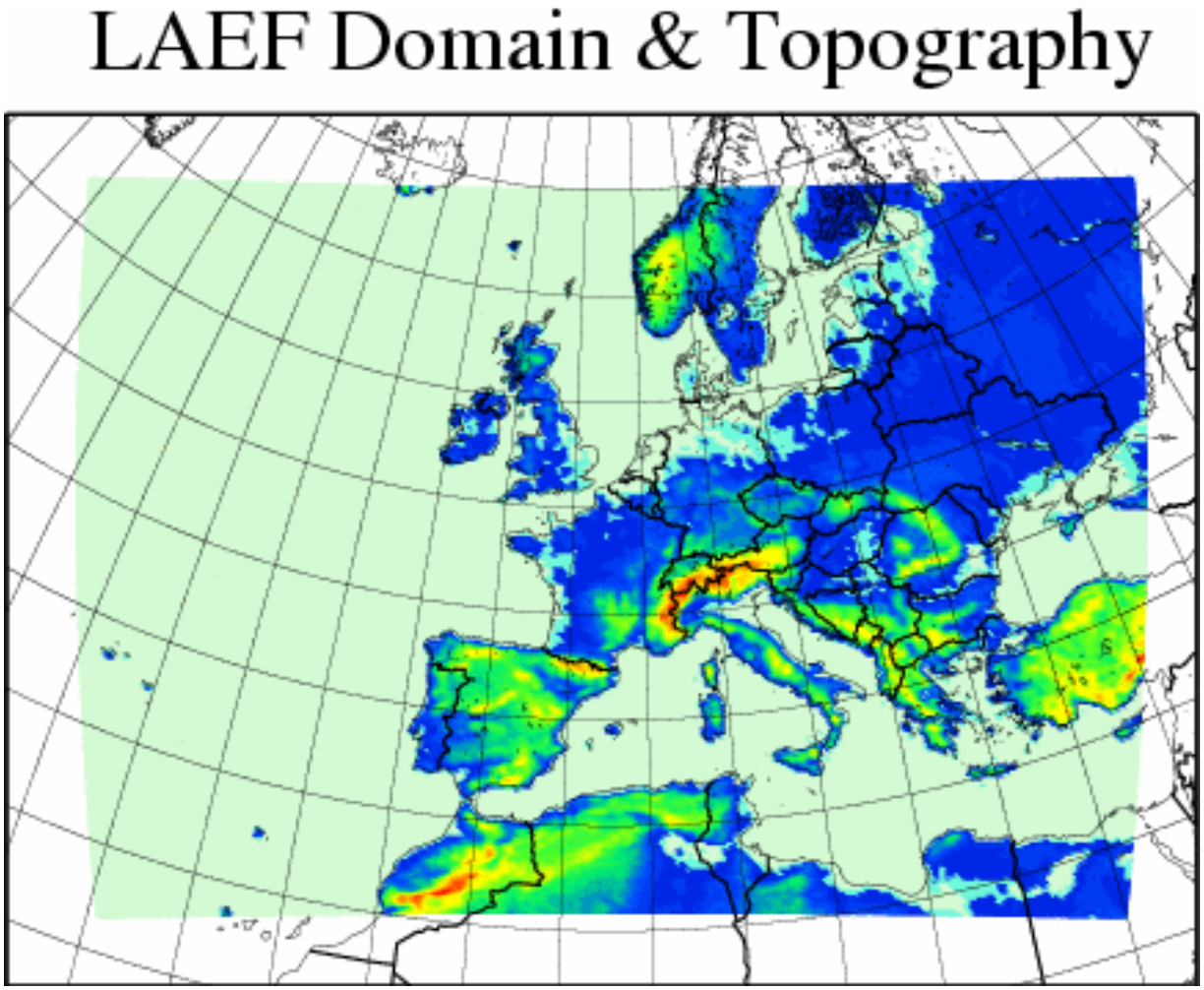
The primary aim of ALADIN research and development on predictability:

Limited Area Ensemble Forecasting ALADIN LAEF

an interactive limited area ensemble prediction system. Each participant will provide its LAMEPS forecasts based on its own design of perturbations of initial conditions and model physics etc.

ALADIN LAEF



Development of ALADIN LAEF

Research Areas:

- Dealing with uncertainties in analysis
- Dealing with uncertainties in LBC
- Dealing with uncertainties in model physics
- Dynamical downscaling
- EPS post-processing
- Common EPS verification
- Comparison with SRNWP-PEPS

Dealing with uncertainties in analysis

- **Breeding**

Status: implemented, evaluated, interesting results show potential for generation of perturbation in analysis.

Action: more verification, 2 one-month tests, Feb. 2006 (cold case) Aug. 2006 (warm case).

more investigations, e.g. one side perturbation, multi-physics parameterization Breeding.

Dealing with uncertainties in analysis

- **ETKF + spherical simplex transformation:**

  post-multiplying the short-term ensemble forecast perturbations by a transformation matrix. This transformation matrix is obtained by solving the error covariance update equation for an optimal assimilation scheme within the ensemble subspace.

$$P^a = P^f - P^f H^T (HP^f H^T + R)^{-1} HP^f$$

Status: implemented

Action: 2 one-month tests, Feb. 06 (cold case), Aug. 06 (warm case).
efforts will be put on how to inflate the analysis perturbation generated by ETKF

Dealing with uncertainties in analysis

- **ET + spherical simplex transformation:**

  it uses the ensemble transform technique to make orthogonalization of the bred vectors

  Status: implemented

  Action: 2 one-month tests, cold case and warm case.
  similar as ETKF, inflation of the analysis perturbation generated by ET will be studied

Dealing with uncertainties in analysis

- **ALADIN native SingularVector:**

  Status: can already be calculated by using the Lanczos algorithum

  Action: further studies and investigations

Dealing with uncertainties in analysis

- **Blending ARPEGE PEARP and ALADIN LAEF:**

  To combine the large-scale uncertainty from PEARP with the small-scale uncertainty generated by Breeding/ET in LAEF.
  It is expected that,
  1). reducing the inconsistency between global and limited area EPS.
  2). combining uncertainty in future generated by SV and uncertainty in the past generated by Breeding.

  Action: will start in June 2006

Dealing with uncertainties in LBC

- **Impact of inconsistent LBC and IC perturbation**

LAEF coupled with NCEP EPS system

Status: implemented
Action: will run the experiment soon

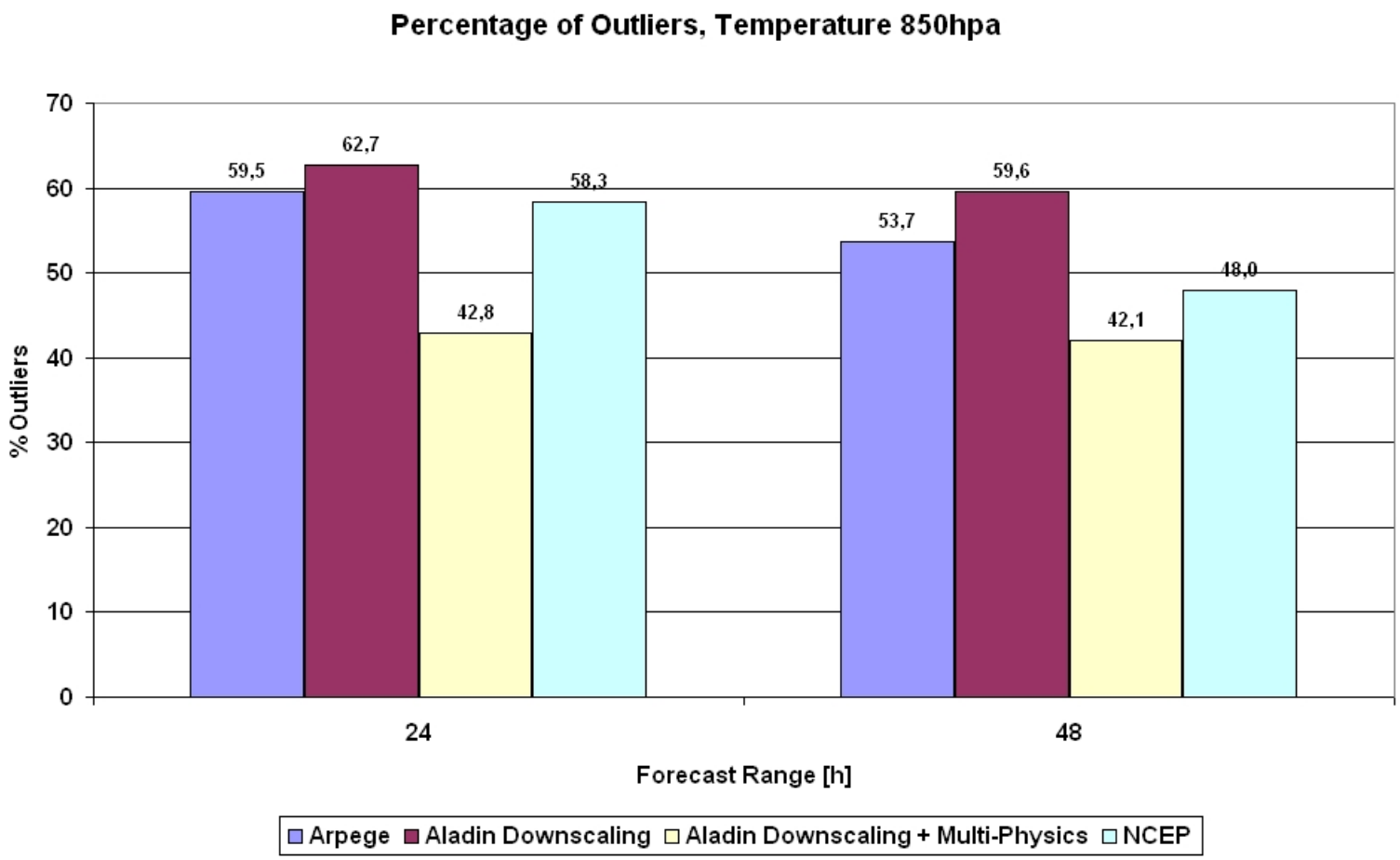
Dealing with uncertainties in physics

- **Multi-physics parameterization:**

  11 combinations of different physics parameterizations and tunings in ALADIN have been chosen for downscaling the PEARP members schemes of Lopez, Bougeault, Kain-Fritsch etc....

  Status: finished partly
  Action: warm case study in 2006

Results of multi-physics option in LAEF



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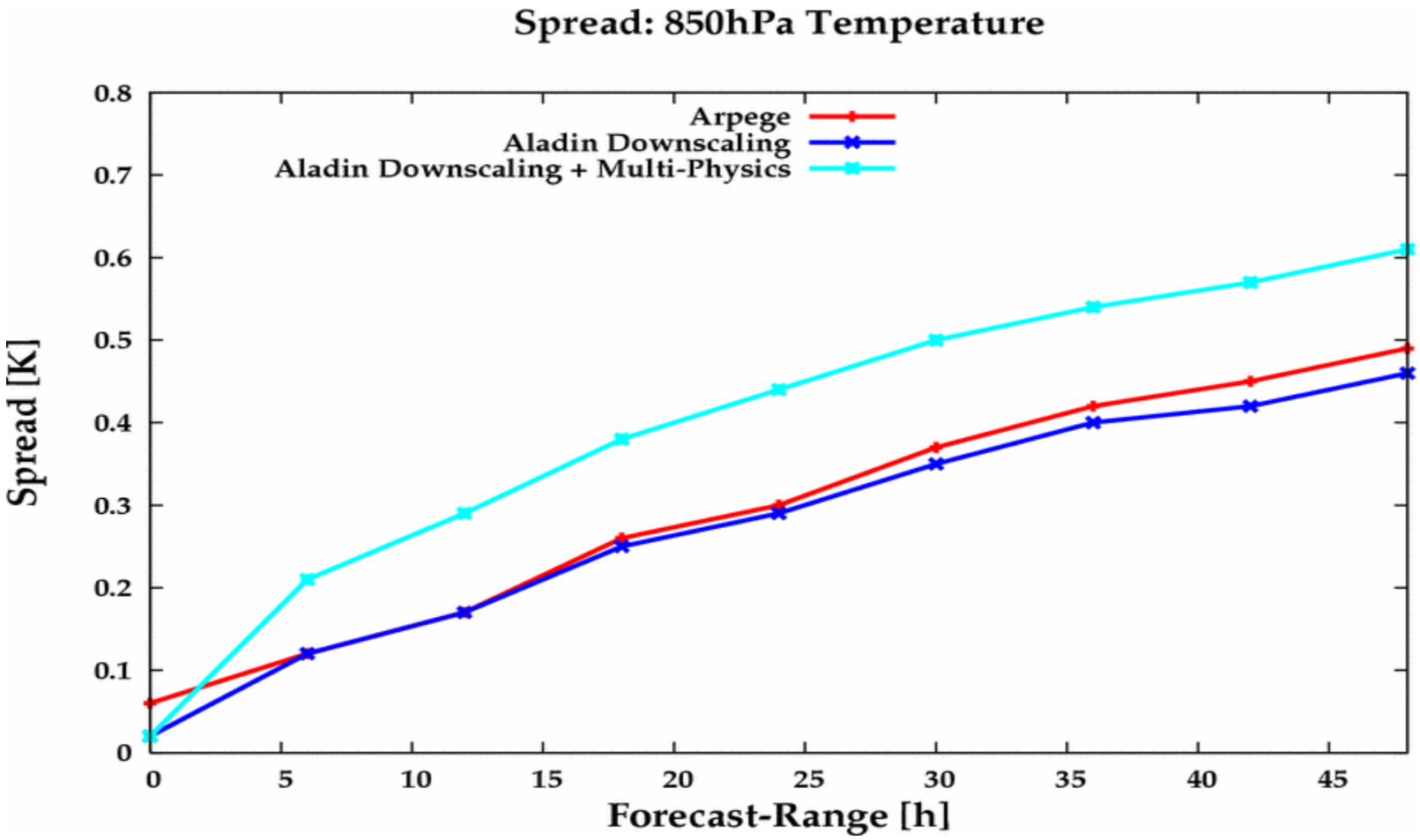

Dealing with uncertainties in physics

- implementation of ECMWF **stochastic physics** in LAEF
- implementation of UKMO/ECMWF **Stochastic Kinetic Energy Backscatter algorithm SKEB**

Status: in plan
Action: will start at end of 2006

Dynamical downscaling

- **Downscaling of ECMWF EPS**

  Similar as COSMO-LEPS using clustering method

  Status: case studies
  Action: further investigations, build up computational framework at ECMWF.

EPS post-processing

- **Bias correction**

  developing a statistical method for correcting the bias in LAEF forecast.

  Status: in plan
  Action: will start soon.

Common EPS verification

- **Verification**

  developing a common verification package for LAEF research and development

  Status: some verification tools exist already
  Action: will start soon to discuss the definition, domain, the ***TRUTH***, verification scores, verifying parameters and data format etc.

Comparison between LAEF and PEPS

- **comparison with SRNW P-PEPS**

  To evaluate the performance of LAEF, understand the multi-model, multi-analysis EPS system

  Status: in plan
  Action: will start in 2006

International Collaboration

- **GLAMEPS**

  Grand **L**imited **A**rea **M**odel **E**nsemble **P**rediction **S**ystem
  a similar idea as ALADIN LAEF.

  Status: in discussion
  Action: coordination, planning

International Collaboration

- **Participation on B08RDP of WMO/WWRP**

  Beijing 2008 Olympics Mesoscale Ensemble Prediction Research and Demonstration Project

  Partners: NCAR, NCEP, UKMO, MSC, JMA, CMA, ZAMG/Meteo-France acting as a single partner.

  Status: in research and development
  Action: scientific information exchange with other partners

Beijing 2008 Olympics RDP

B08RDP is a five years research project 2005-2009, each participant will provide their LAMEPS products in near real time to Beijing during Olympics 08 for demonstration.

LAMEPS tier 1: 15km, 30 levels, 10 members, 6-36h forecast, domain 3500x3000km

LAMEPS tier 2: 2-4km, 30-60 levels, 1-2 members, 0-36h forecast, domian 1320x1100km

2005-2007: research and development, discussions and coordinations on issues like verification, data format, computational fremework, telecommunication, products, traning, etc.

2008: demonstration, transfer forecast to CMA

2009: verification and inter-comparison

International Collaboration

- **Participation on MAP D-Phase of WMO/WWRP**

  Mesoscale Alpine Programme Demonstration Phase

  A forecast demonstration project, probabilistic forecast is used for pre-alert. The project is coordinated with another international project COPS (Convective and Orographically-induced Precipitation Study)

  Demonstration period: June to August 2007

  Status: in research and development
  Action: scientific information exchange with other partners

ALADIN-HIRLAM EPS Kick-off Meeting

Suggested by LACE, ZAMG will organize the kick-off meeting for research and development on predictability,

The date proposed: 9-10. Nov. 2006

Place: ZAMG, Vienna

Summary

- An interactive LAMEPS system ALADIN LAEF will be developed in the next years.
- Studies on perturbation in analysis, LBC and model physics are going on within ALADIN community, e.g. Breeding, ETKF/ET, SV, Blending, Multi-physics option, dynamical downscaling of ARPEGE and ECMWF EPS.
- Other issues toward to establish ALADIN LAEF will start soon, post-processing, common verification.
- We have involved some international projects, B08RDP, MAP D-Phase. This is very beneficial for ALADIN LAEF in many aspects, especially in how to build up the super multi-model EPS, common verification, techical