R&D status of ALADIN-LAEF

Y. Wang
ZAMG, Austria

With contribution from Bellus, Kann, Tan, Tascu, Weidle, Wittmann
LAEF: R&D Highlights

• Added values of LAEF on ECMWF-EPS and higher resolution deterministic LAM

• Studies on global EPS coupling

• Atmospheric predictability related to surface conditions

• Works towards larger domain and higher resolution

• Statistical calibration

• Application of LAEF
## Added values of LAEF

### LAEF vs. ECMWF

<table>
<thead>
<tr>
<th></th>
<th>ALADIN-LAEF</th>
<th>ECMWF-EPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>18km; 37 Levels</td>
<td>Tₜ399; 62 Levels</td>
</tr>
<tr>
<td>Ens. Size</td>
<td>16</td>
<td>50</td>
</tr>
<tr>
<td>Model</td>
<td>ALADIN</td>
<td>ECMWF-IFS</td>
</tr>
</tbody>
</table>

### LAEF vs. ALADIN-AUSTRIA

<table>
<thead>
<tr>
<th></th>
<th>ALADIN-LAEF</th>
<th>ALADIN-AUSTRIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resolution</td>
<td>18km;37Levels</td>
<td>9.6km;60 Levels</td>
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<tr>
<td>Ensemble size</td>
<td>16 members</td>
<td>5 members (time lagged)</td>
</tr>
<tr>
<td>Forecast</td>
<td>Ensemble mean</td>
<td>deterministic</td>
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</table>

### ALADIN-Austria: time lagged EPS

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<thead>
<tr>
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<th>12 UTC</th>
<th>18 UTC</th>
<th>00 UTC</th>
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<td>48 54 60</td>
<td>48 54 60</td>
<td>48 54 60</td>
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</table>
Studies on coupling with different global EPS

What is the impact of inconsistent IC and LBC perturbation?

What is the impact of coupling different global EPS?
NCEP vs. ECMWF: CRPSS, surface variables

- 2m T
- 10m Wind
- Precipitation
- MSLP
NCEP vs. ECMWF: CRPSS 500hPa

H500

V500

T500

RH500
Atmospheric predictability related to surface conditions

- **convective rainfall**
- **large scale rainfall**
- **surface air temperature**
SURFPREC.EAU.CON
VS
SURFTEMPERATURE
(Spread)
SURFPREC.EAU.GEC VS PROFTEMPERATURE (Spread)
LAEF towards larger domain and higher resolution

::Fig.01 Domain boundaries of the operational ALADIN-LAEF (green), new redefined ALADIN-LAEF (blue) and GLAMEPS (red).
No progress, X pattern problem need to be totally solved!

::Fig.06 Difference between the two runs (NVGRIB=2 minus NVGRIB=0) for the wind components perturbation and some model levels. While for the first three maps the difference between “packed” and “unpacked” fields is obviously spoiled by the X-pattern, the last map shows how the difference should be if there is no contamination (it is just the next model level for the same case!). (Experimental run using cy36t1_bf6 for cc927 configuration and DFI.)
A. Cut-Off-NGR

The non-homogenous Gaussian Regression (NGR) is a Gaussian-type regression model, where the variance is not equal for all values of the predictor. It is assumed, that the variance contains information about the forecast uncertainty (Hagedorn et al. 2008).

The NGR regression coefficients \( a, b, c \) and \( d \) are fitted to the normal distribution \( N(a + b \bar{x}_{ens}, c + d s_{ens}^2) \). \( \bar{x}_{ens} \) denotes the ensemble mean and \( s_{ens}^2 \) the ensemble variance. The coefficients are fitted under the constraint of minimizing the continuous ranked probability score (CRPS).

The fitted probability density function (PDF) has to take into account the non-negativity of the quantity wind speed. A cut-off normal distribution is chosen, which is equal to a normal distribution on the positive half axis and 0 on the negative half axis (Gneiting et al. 2004). The result is a predictive cut-off normal distribution for the wind speed forecast.

B. Logistic Regression

In case of the logistic regression, the probability that a given threshold is exceeded is expressed by the formula

\[
P(O > T) = 1.0 - \frac{1.0}{1.0 + \exp\left(\beta_0 + \sum \beta_i \hat{x}_i \right)},
\]

where \( \beta_i \) are the coefficients and \( \hat{x}_i \) the forecasted predictors (Hamill et al. 2008). The \( \beta_i \) values are estimated by the least squares method with the predictors and observations from training data.
Application of LAEF in nowcasting INCA
Next future:

- Higher resolution of LAEF
- Optimization of multi-physics, stochastic physics
- Ensemble data assimilation
- Predictability study on cloud permitting scale
- AROME-EPS

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