New development of ALADIN-LAEF

Yong Wang, ZAMG

With contribution from Bellus, Kann, Kücükkaraca, Radanovics, Tang, Tascu, Weidle, Wittmann, etc.

ALADIN-LAEF

LAEF: Limited Area Ensemble Forecasting

Ensemble Size	16 +1
horizontal resolution	18 km
Vertical resolution	37 levels
Runs/day	2 (00,12UTC)
Forecast range	60h
Time step	720s
Coupling-model	ECMWF EDA/SV EPS
Coupling-update	6h

Atmosphere perturbation: **Blending ALADIN Bred + ECMWF EDA/SV**

Surface perturbation: **Non-Cycling surface Breeding**

Model perturbation: **multi-physics**

ALADIN-LAEF: R&D Highlights

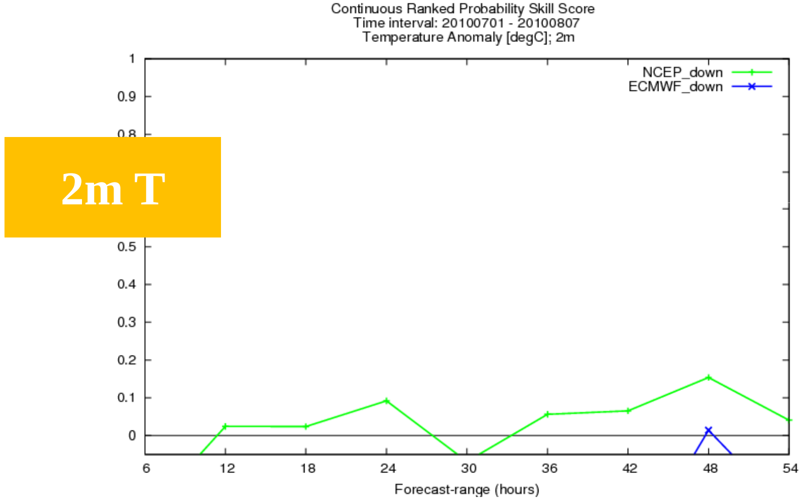
- Studies on global EPS coupling
- Atmospheric predictability related to surface conditions
- Works towards larger domain and higher resolution
- Optimising multi-physics
- Impact of ensemble surface DA
- Statistical calibration

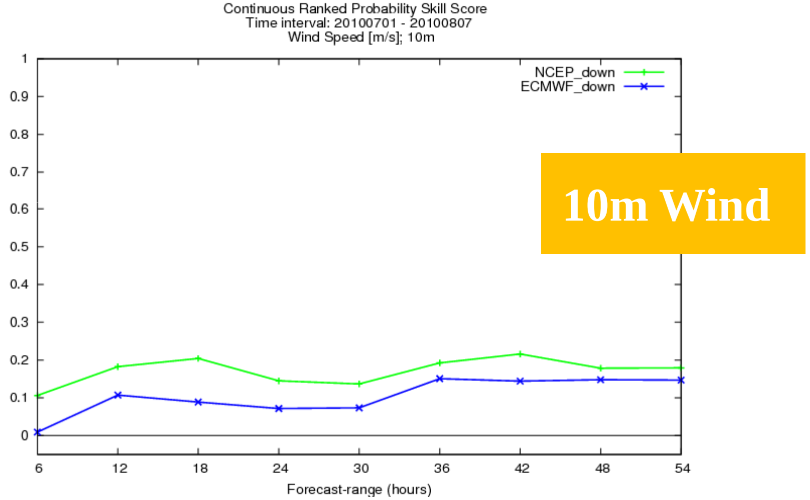
Studies on coupling with different global EPS

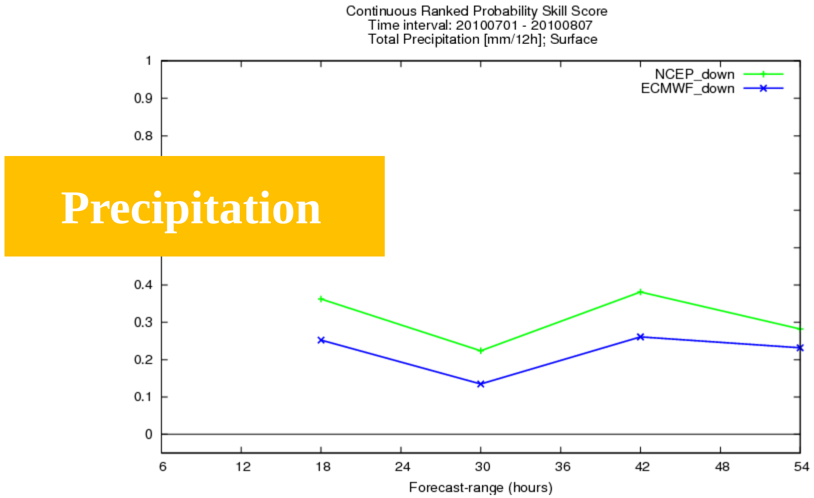
What is the impact of inconsistent IC and LBC perturbation?

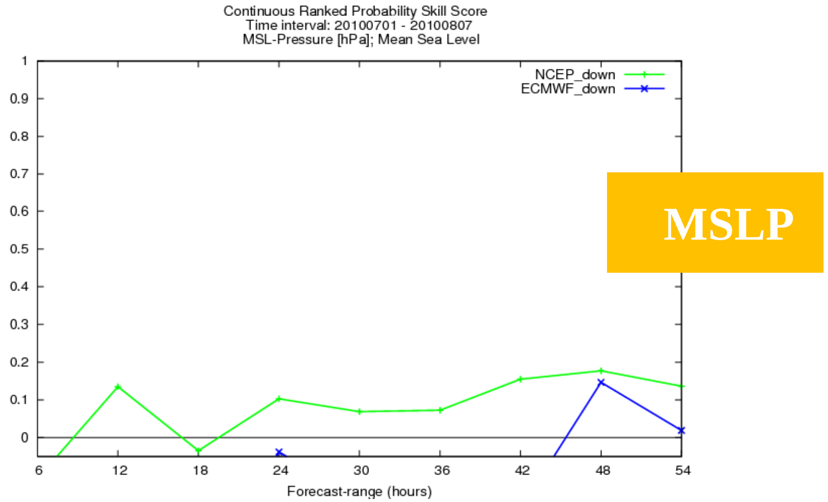
What is the impact of coupling different global EPS?

NCEP vs. ECMWF: CRPSS, surface variables

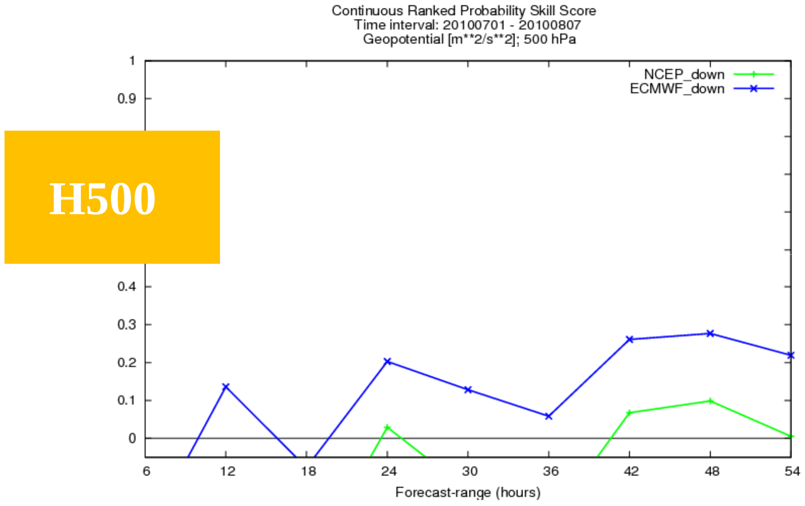


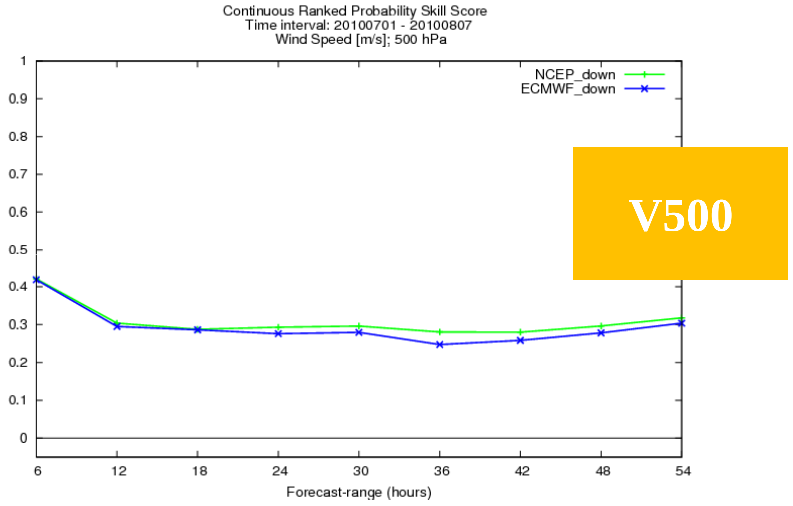


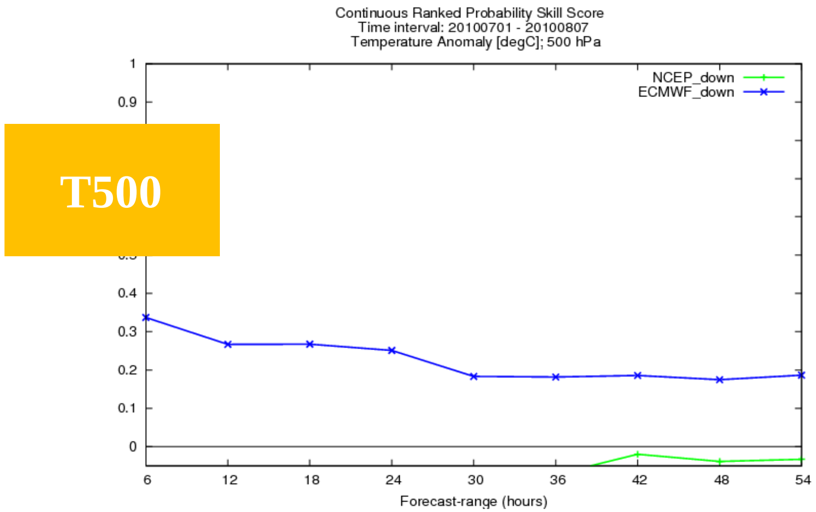


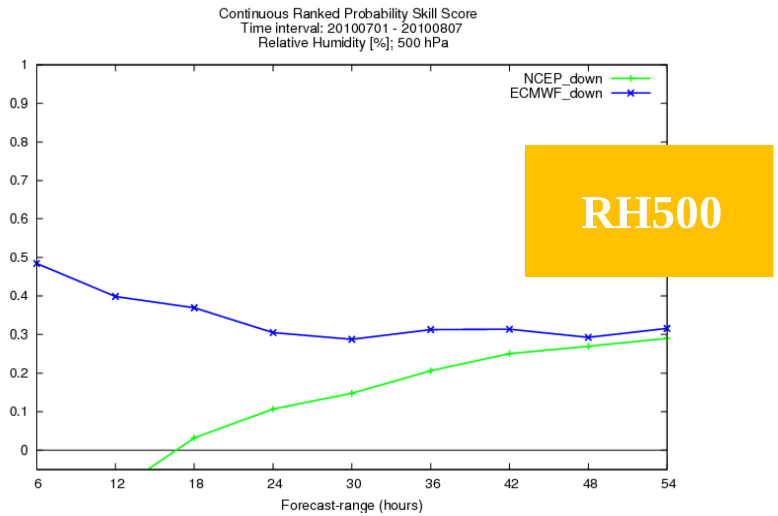


NCEP vs. ECMWF: CRPSS 500hPa

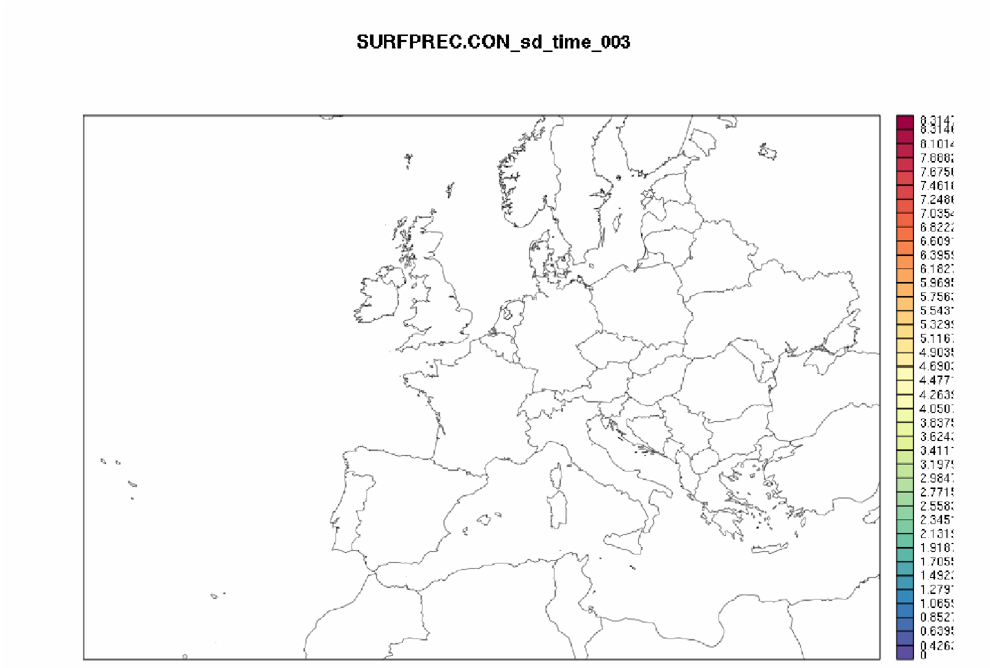




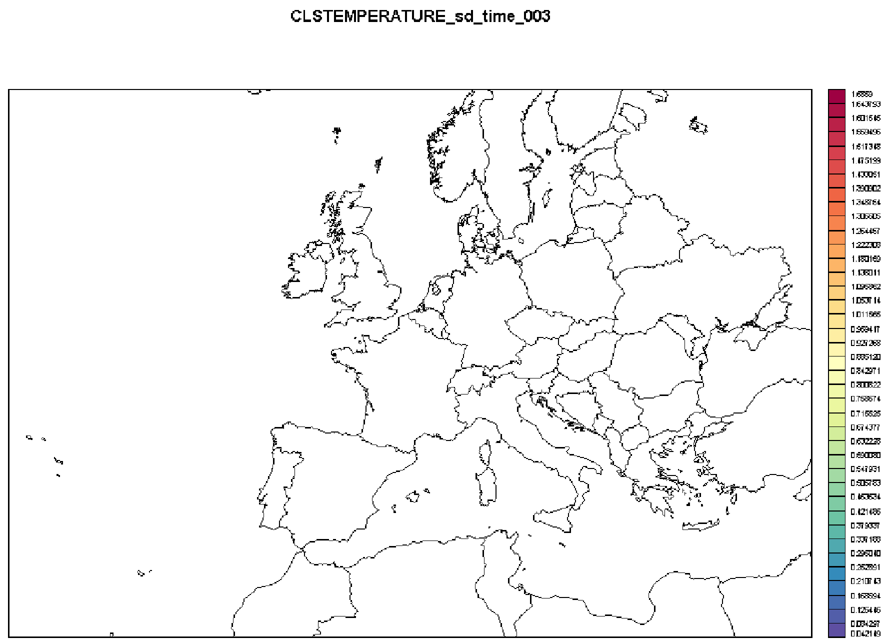




Atmospheric response to surface perturbation



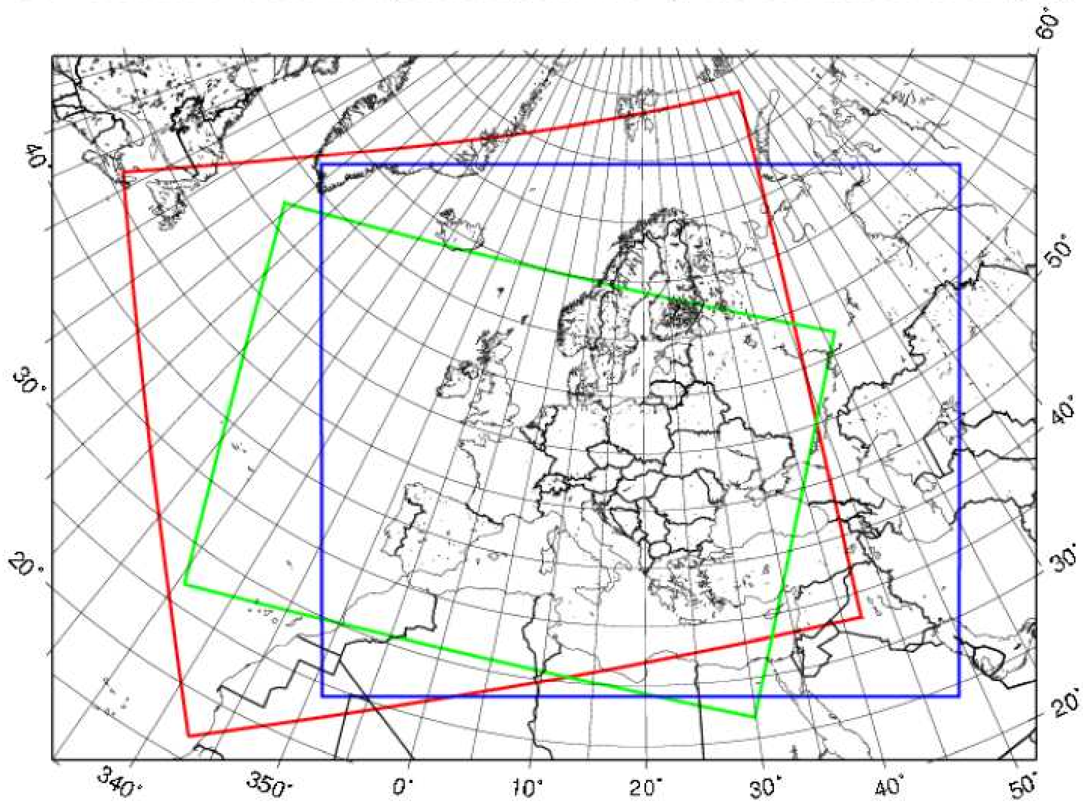
Convective rainfall



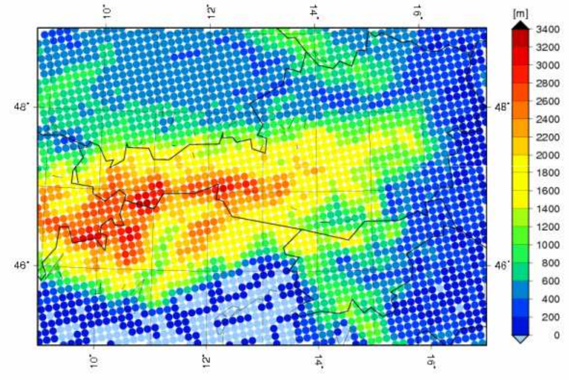
Surface temperature

LAEF towards larger domain and higher resolution

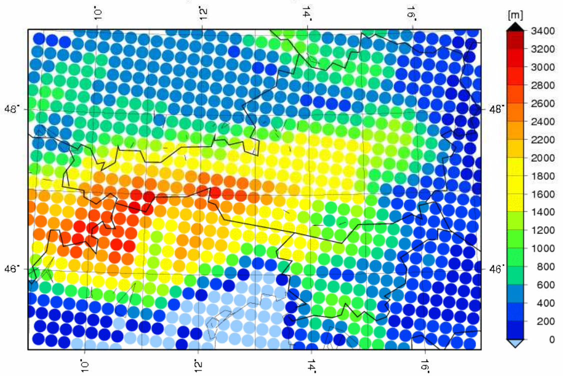
ALADIN–LAEF (old:G, new:B) vs GLAMEPS (R)



ALADIN–LAEF (AT ZOOM) – new domain: 10.9km

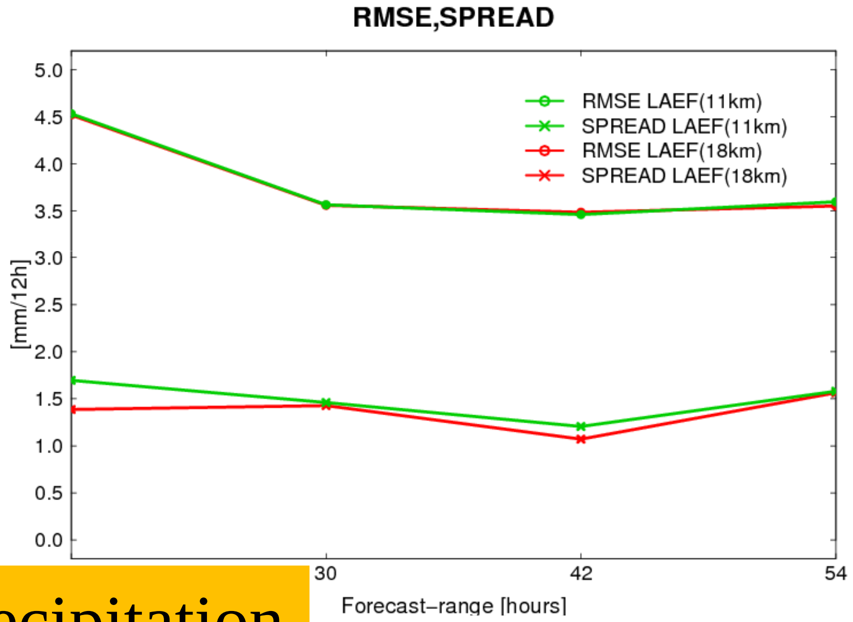


ALADIN–LAEF (AT ZOOM) – old domain: 18km

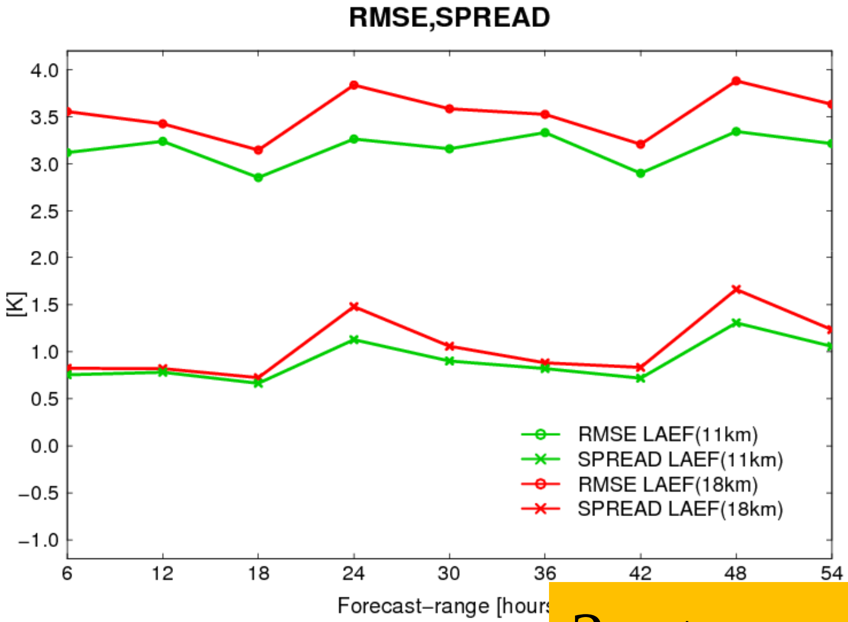


::Fig.01 Domain boundaries of the operational ALADIN-LAEF (green), new redefined ALADIN-LAEF (blue) and GLAMEPS (red).

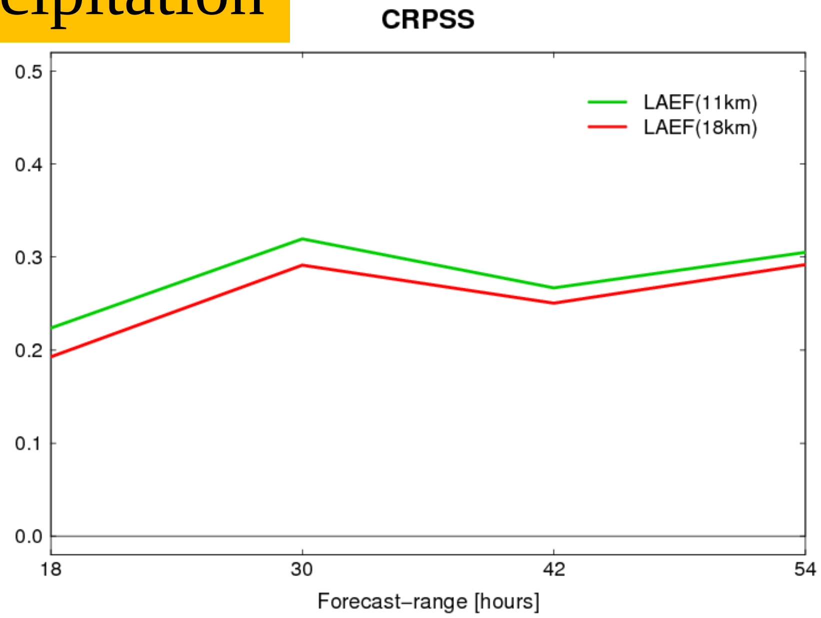
LAEF new (11km) vs. Operational (18km)

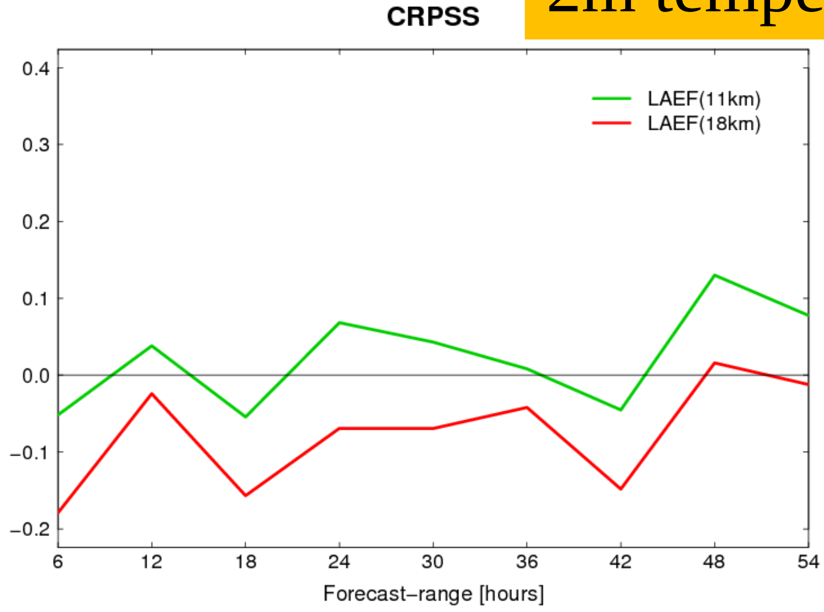


Precipitation

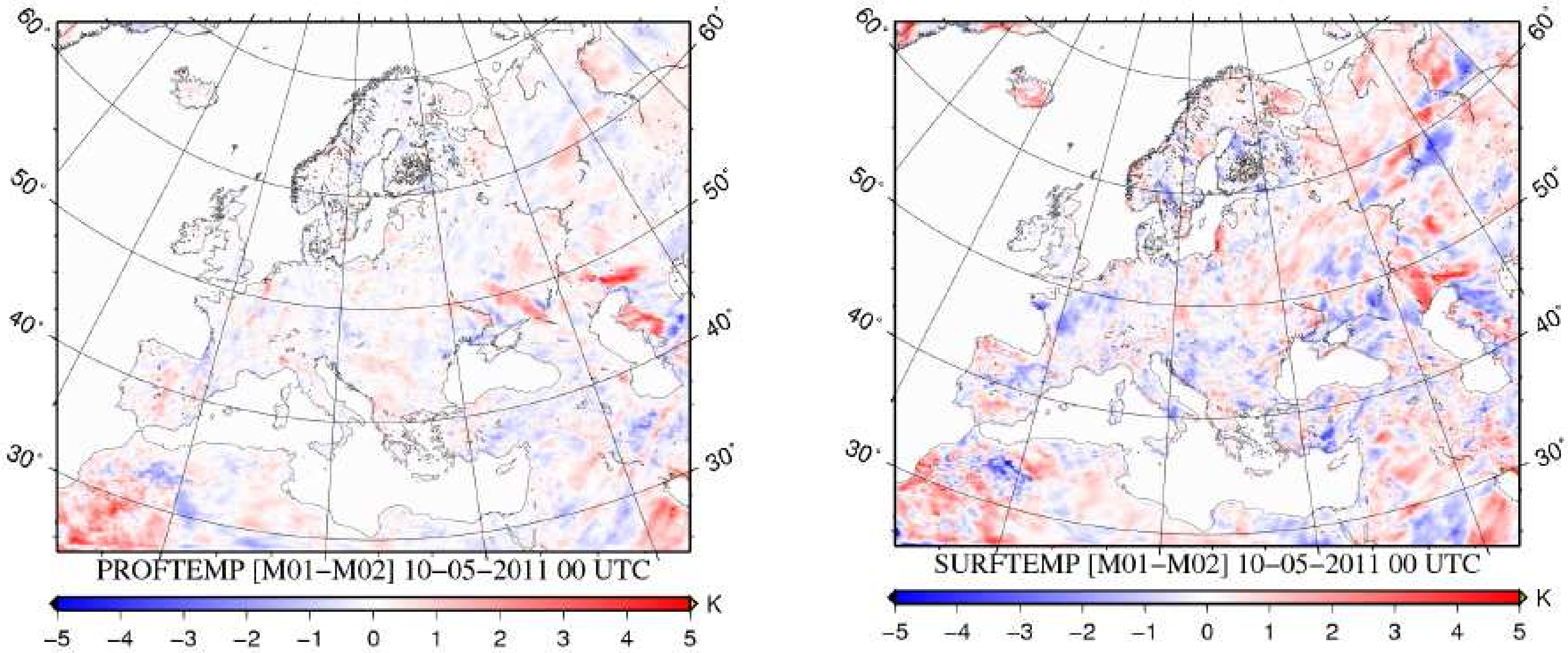


2m temperature





Impact of ensmeble land surface data assimilation



::**Fig.8** Uncertainty of surface initial conditions computed as a difference between two ensemble members for deep-soil temperature (left) and surface temperature (right).

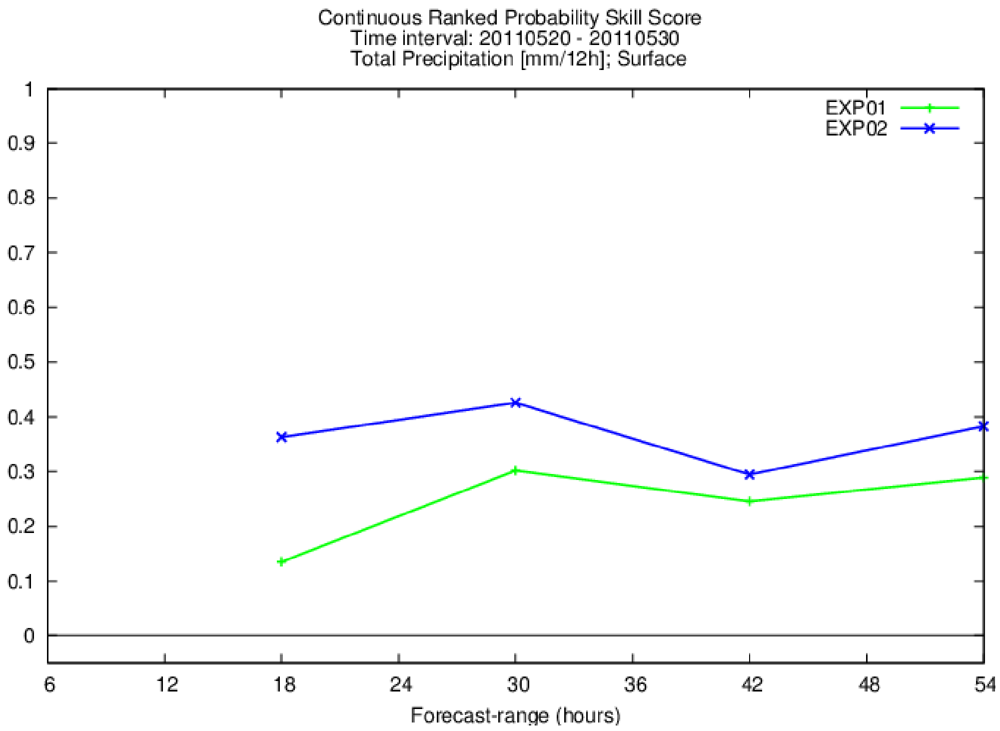
Optimising multi-physics

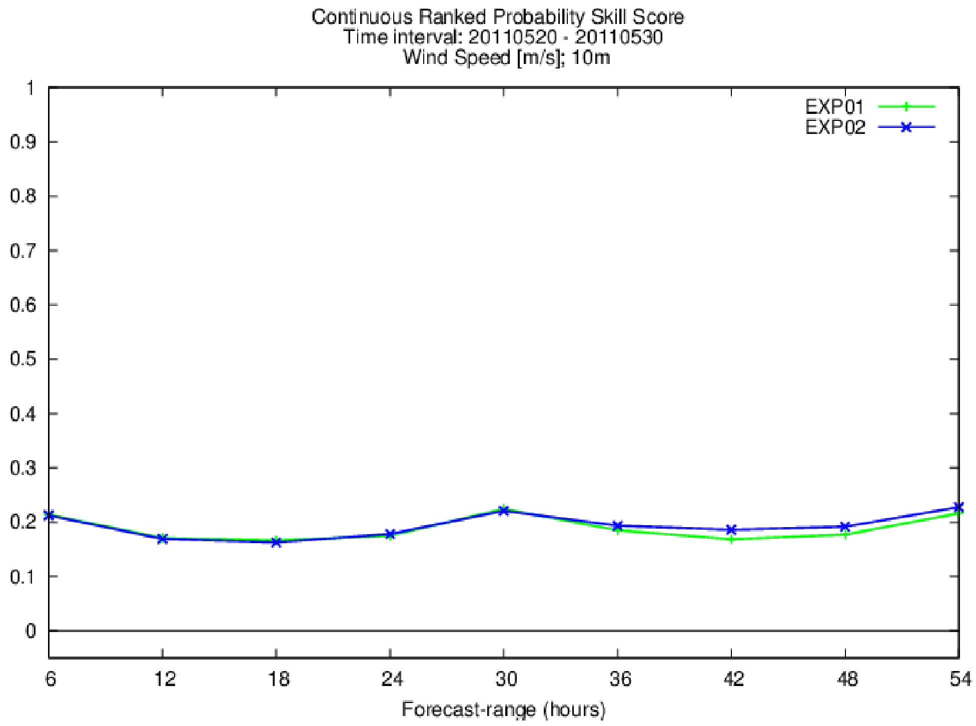
LACE
nwp central europe

NAMELIST	MICROPHYSICS	TUNING	DEEP CONV.	TUNING	SHALLOW CONV.	TUNING	RADIATION	TUNING	TURBULENCE	TUNING	GUST DIAG.	TUNING	SCREENING LEVEL DIAG.	TUNING
MP01	**ALARO-XR**		**3MT**		**JFG87**		**JFG05**		**JFG06**		**RAFTUR**		**NSCRE0**	
MP02	ALARO-XR	*M3H*	3MT	*D2L, D3H*	JFG87		JFG05	*R1H, R3H, R4T*	JFG06		RAFTUR/RA FTKE/RAFB		NSCRE0/NS CRE1/NSCR	
MP03	ALARO-XR	*M1L, M2L, M3L*	3MT	*D2H, D3L*	JFG87		JFG05	*R1L, R3L, R4T*	JFG06		RAFTUR/RA FTKE/RAFB		NSCRE0/NS CRE1/NSCR	
MP04	ALARO-XR	*M3L*	3MT	*D2H, D3L*	JFG87		JFG05	*R1L, R3L, R4T*	JFG06		RAFTUR/RA FTKE/RAFB		NSCRE0/NS CRE1/NSCR	
MP05	ALARO-XR	*M1H, M2H, M3L*	3MT	*D2H, D3L*	JFG87		JFG05	*R1L, R3L, R4T*	JFG06		RAFTUR/RA FTKE/RAFB		NSCRE0/NS CRE1/NSCR	
MP06	ALARO-SM		3MT		JFG87		JFG05	*R4F*	JFG06	*T2H, T3L*	RAFTUR/RA FTKE/RAFB		NSCRE0/NS CRE1/NSCR	
MP07	ALARO-SM		3MT	*D5T*	JFG87		JFG05	*R4T*	JFG06	*T2L, T3H*	RAFTUR/RA FTKE/RAFB		NSCRE0/NS CRE1/NSCR	
MP08	**LOPEZ**		**BG**		**KFB**		**ECMWF**		**CBR**		**RAFTKE**		**NSCRE0**	
MP09	LOPEZ		BG	*D1T*	KFB		ECMWF		CBR		RAFTUR/RA FTKE/RAFB		NSCRE0/NS CRE1/NSCR	
MP10	LOPEZ		BG		KFB		ECMWF		CBR		RAFTUR/RA FTKE/RAFB		NSCRE0/NS CRE1/NSCR	
MP11	LOPEZ		BG	*D1T*	KFB	*S1*	ECMWF		CBR		RAFTUR/RA FTKE/RAFB		NSCRE0/NS CRE1/NSCR	
MP12	***KESSLER***		***BG***		***JFG87***		***JFG05***		***LOUIS***		***RAFTUR***		***NSCRE0***	
MP13	*KESSLER*		*BG*		*JFG87*		*JFG05*		*JFG06*		*RAFTUR/RAFTK E/RAFBRA*		*NSCRE0/NSCRE 1/NSCRE2*	
MP14	*ALARO-RK*		*3MT*		*JFG87*		*JFG05*		*JFG06*		*RAFTUR*		*NSCRE0*	
MP15	*LOPEZ*		*BG*		*KFB*		*ECMWF*		*CBR*		*RAFTUR/RAFTK E/RAFBRA*		*NSCRE0/NSCRE 1/NSCRE2*	
MP16	*ALARO-XR*		*3MT*		*JFG87*		*JFG05*		*JFG06*		*RAFTUR/RAFTK E/RAFBRA*		*NSCRE0/NSCRE 1/NSCRE2*	

ZAMG

Multi-physics: new vs. operational





Precipitation

10m Wind

Post-processing 10m wind

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 $N\left(a + b\overline{x}_{ens}, c + ds_{ens}^2\right)$. $\overline{x}_{ens}$ 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).

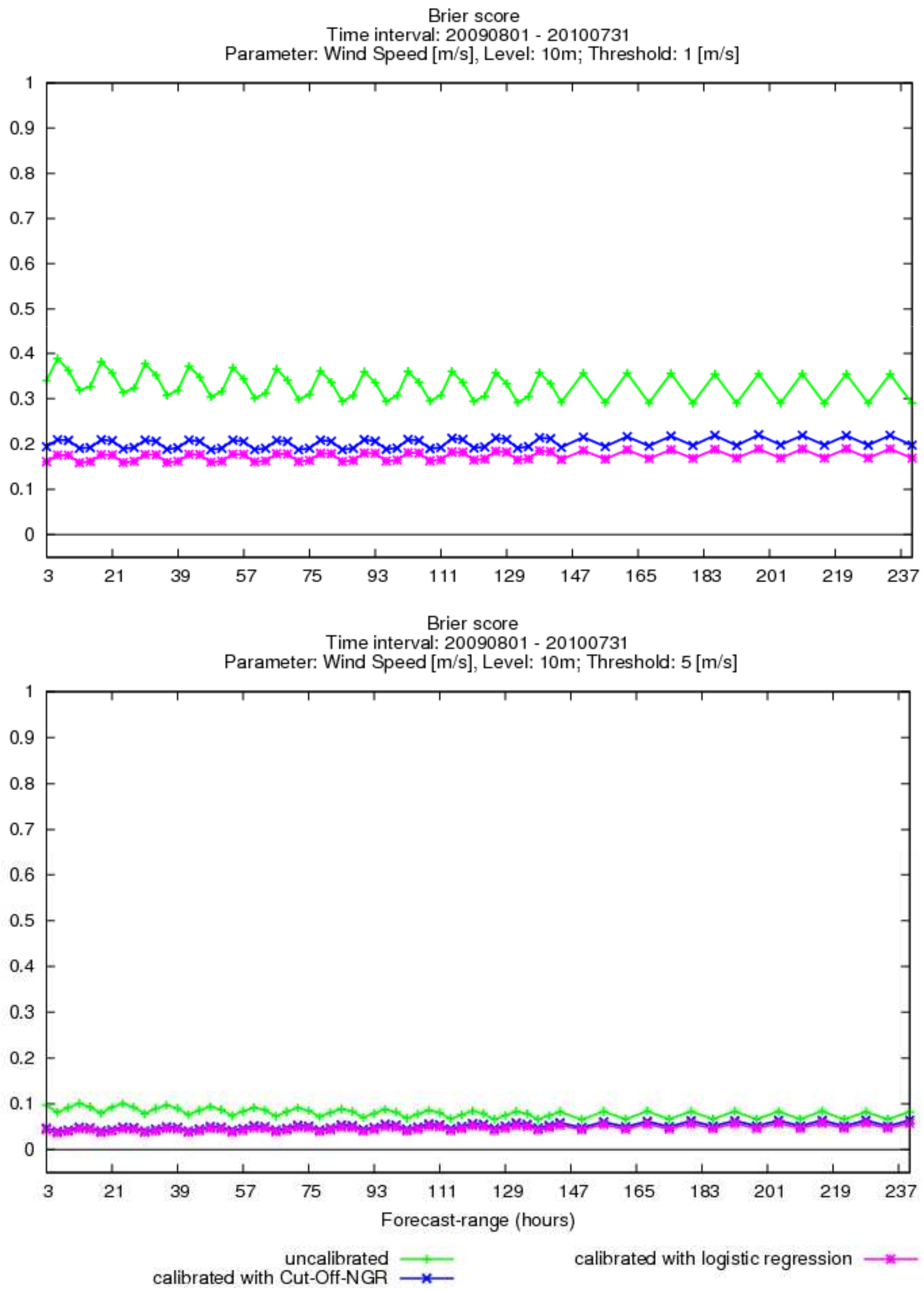
The fitted probability density function (PDF) has to take into account the non-negativity of the quantity wind speed. A cut-off normal distribution is chosen, which is equal to a normal distribution on the positive half axis and 0 on the negative half axis (Gneiting et al. 2004). The result is a predictive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

$$P(O > T) = 1.0 - \frac{1.0}{1.0 + \exp\left\{\beta_0 + \sum \beta_i x_i^f\right\}},$$

where β_i are the coefficients and x_i^f the forecasted predictors (Hamill et al. 2008). The β_i values are estimated by the least squares method with the predictors and observations from training data.



Conclusions

ALADIN-LAEF **new** is under development, positive Impact from:

1. Higher resolution and optimised multi-physics.
2. Potential improvement for the near surface parameter by ensemble surface DA and physical perturbation
3. Statistical calibration.

NCEP vs. ECMWF: trying to understand the result

THANKS!