Recent ALADIN-LAEF Research and Development

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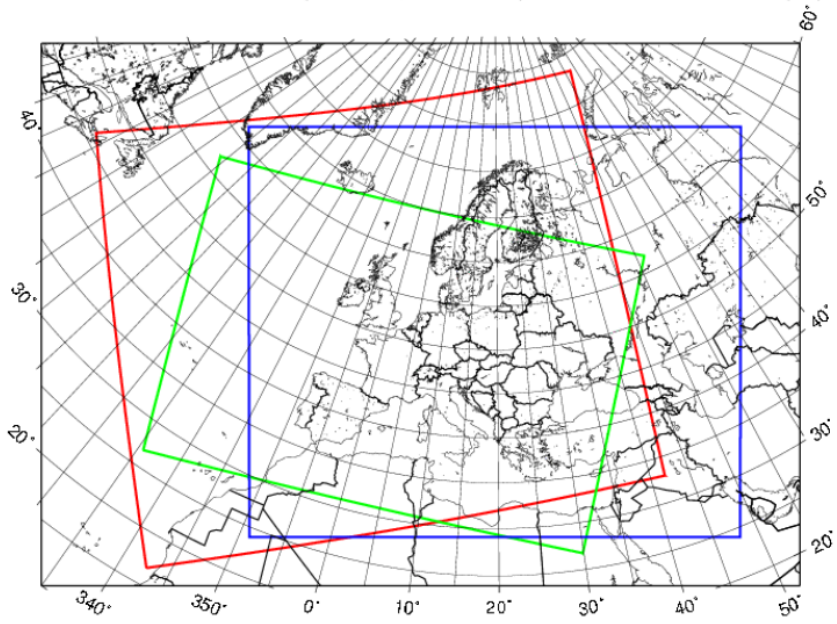
With contribution from Bellus, Smet, Tang, Tascu, Weidle, Wittmann, Xia, etc.

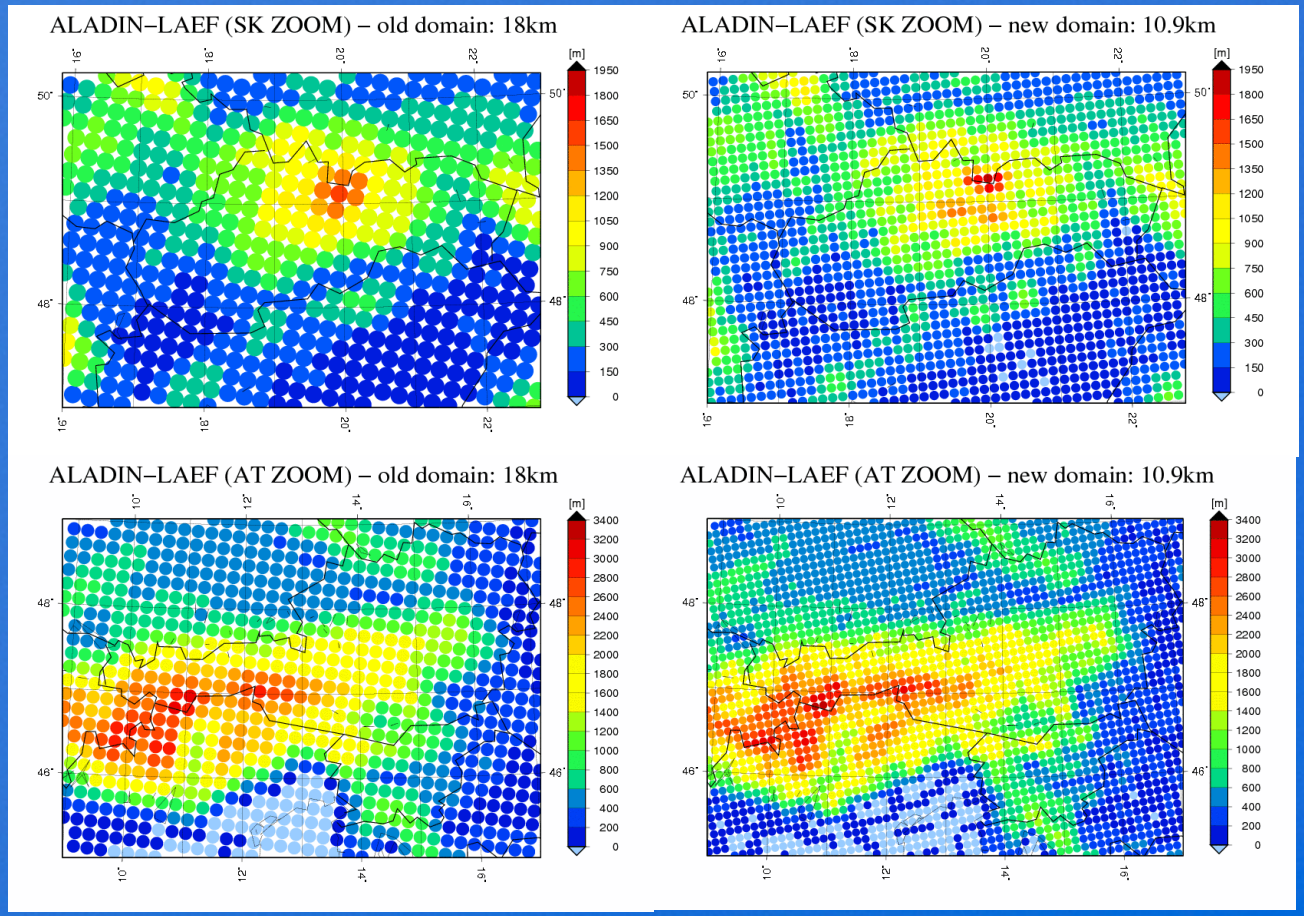
Works towards to larger domain & higher resolution



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

- Higher resolution and different domain.
- Optimizing ALADIN multi-physics.
- Introducing stochastic physics in the surface.
- Ensemble surface DA
- Implementation and validation

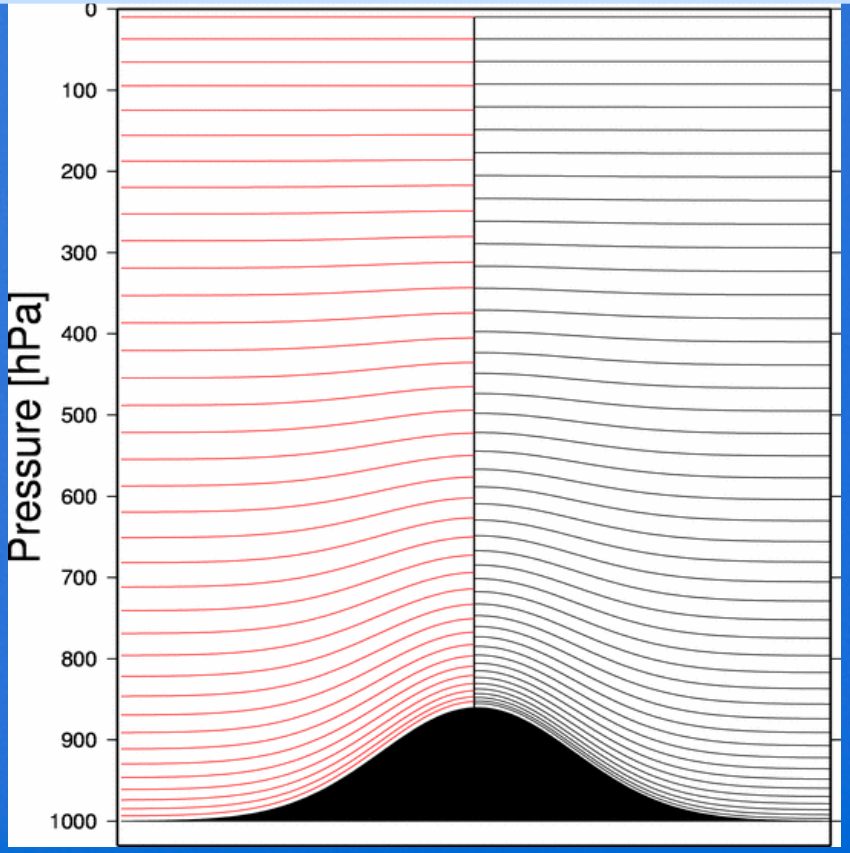
LAEF new: resolution 18km vs. 10.9km



X-direction: 324 → 600, Y-direction: 225 → 500

LAEF new: resolution 37 vs. 45 levels

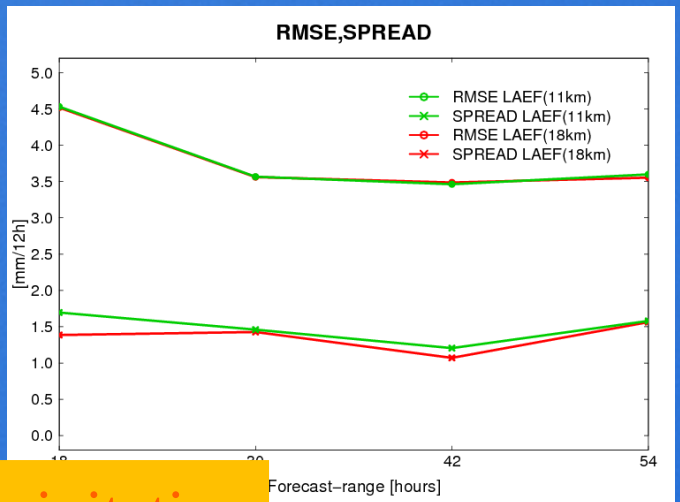
LAEF old vs. LAEF new

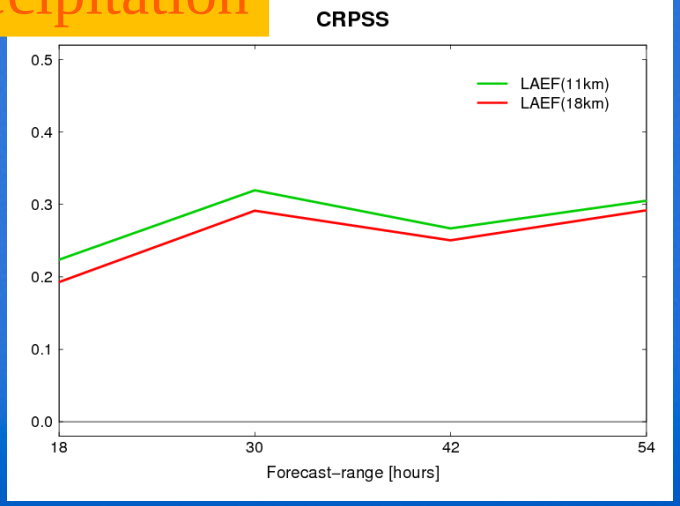


More levels in the lower atmosphere

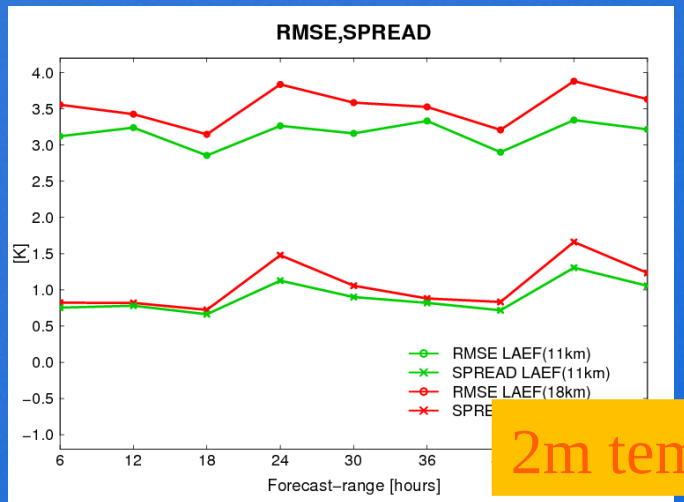
Impact of the higher resolution: 11km -- 18km; 45—37 levels

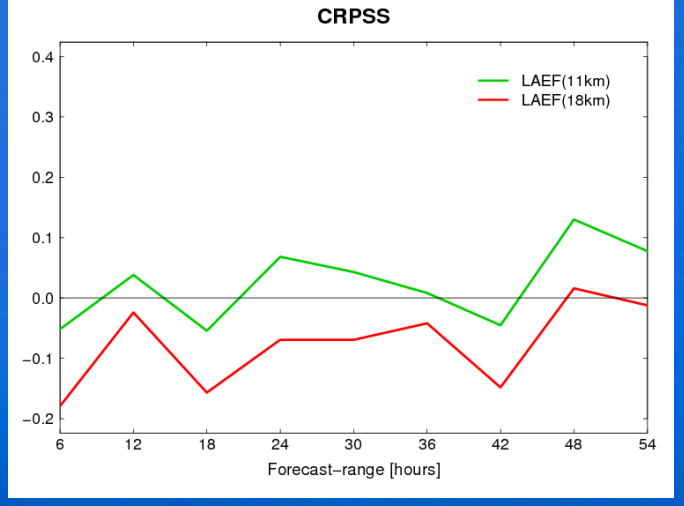
Precipitation



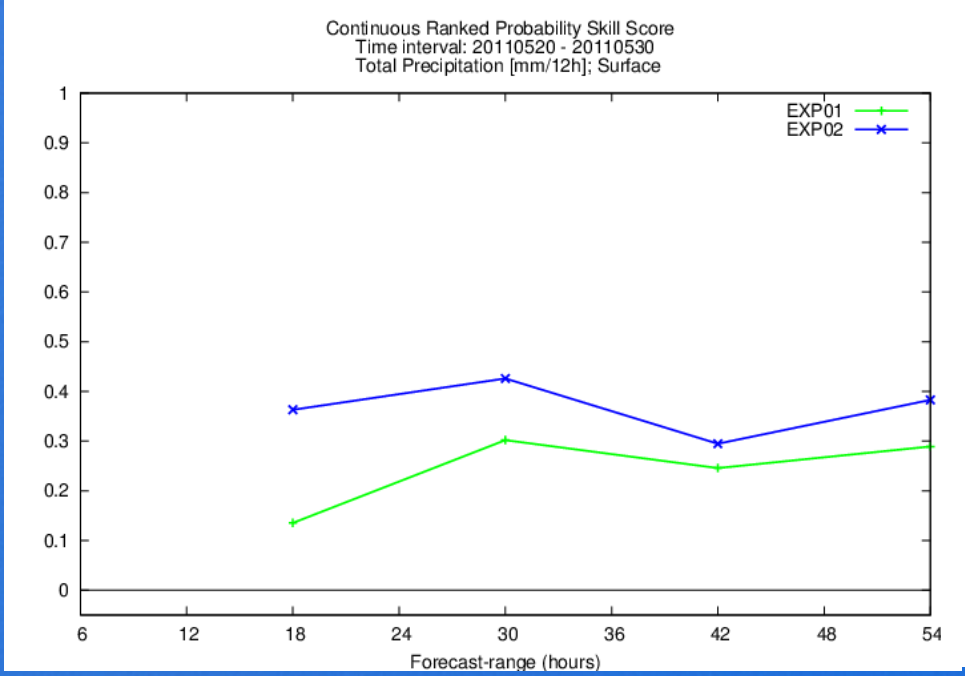


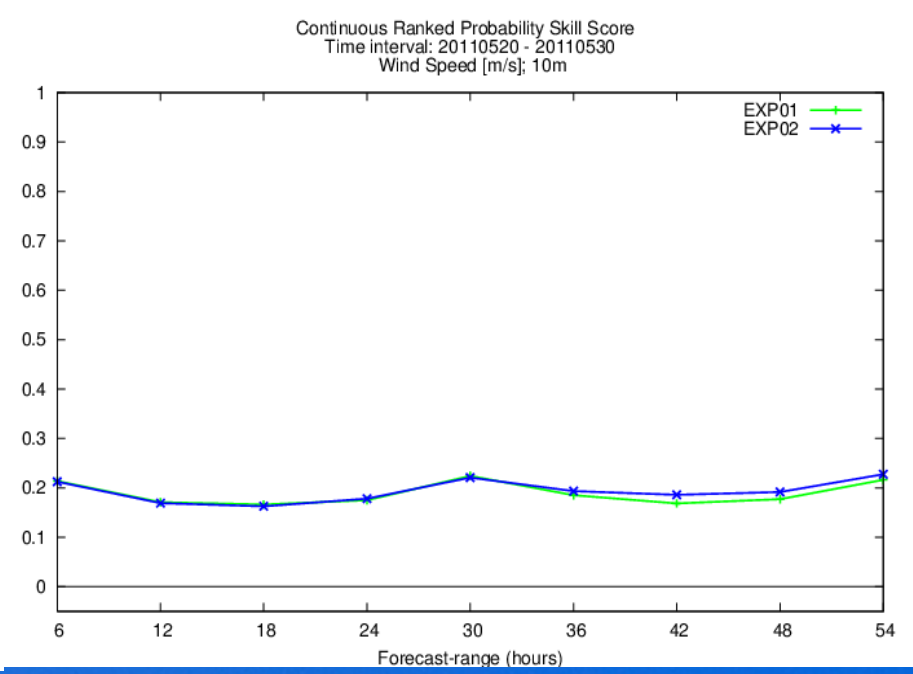
2m temperature





Impact of the optimized multi-physics



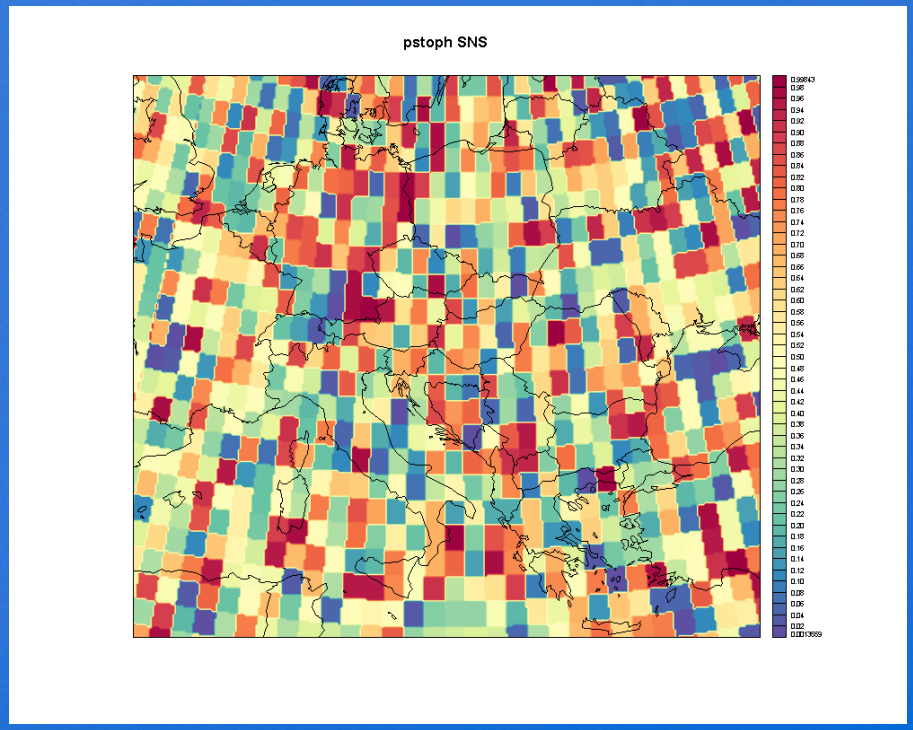


Precipitation

10m Wind

Stochastic surface physics

Stochastically Perturbed Parameterization Tendencies (SPPT)



random perturbation

local tendency

every hour

Atmospheric response to surface perturbation

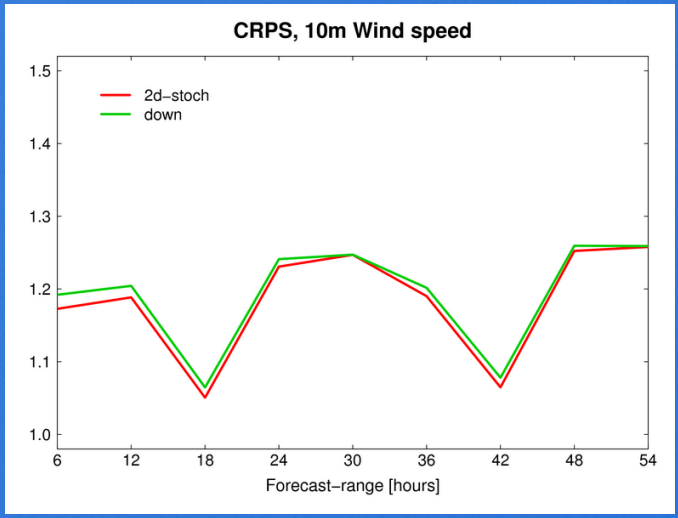
SURFPREC.CON_sd_time_003

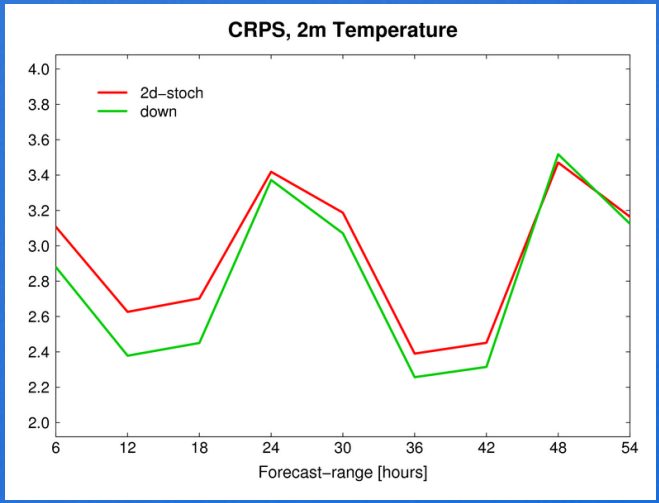
Convective rainfall

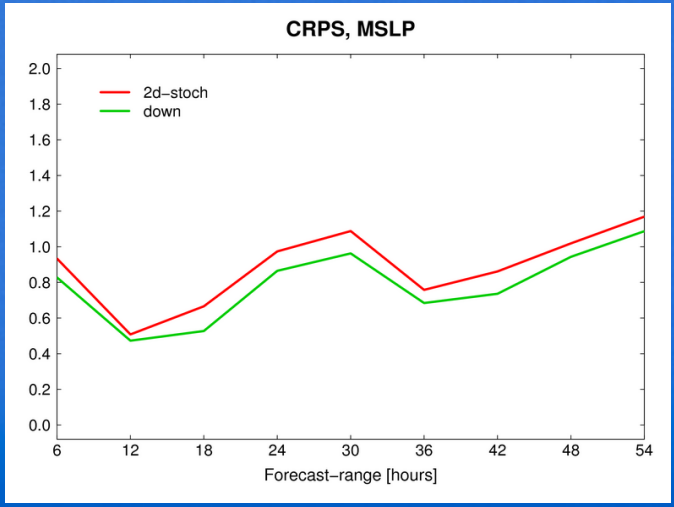
CLSTEMPERATURE_sd_time_003

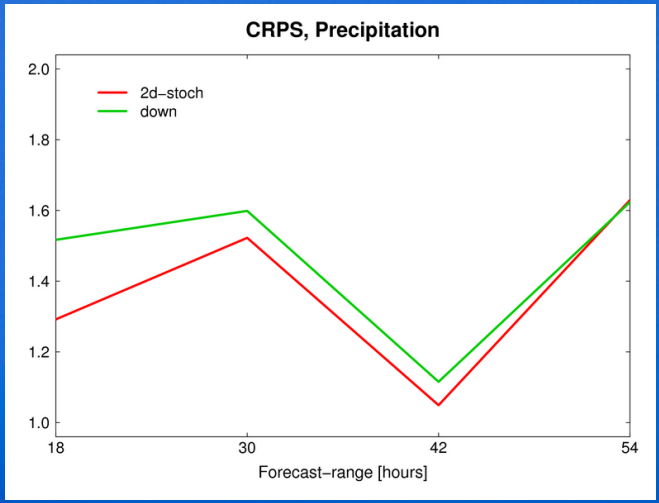
Surface temperature

Impact of the surface stochastic physics

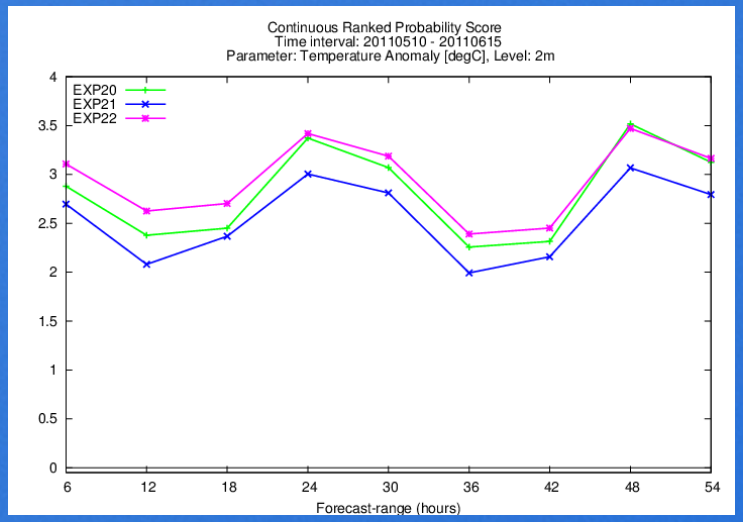


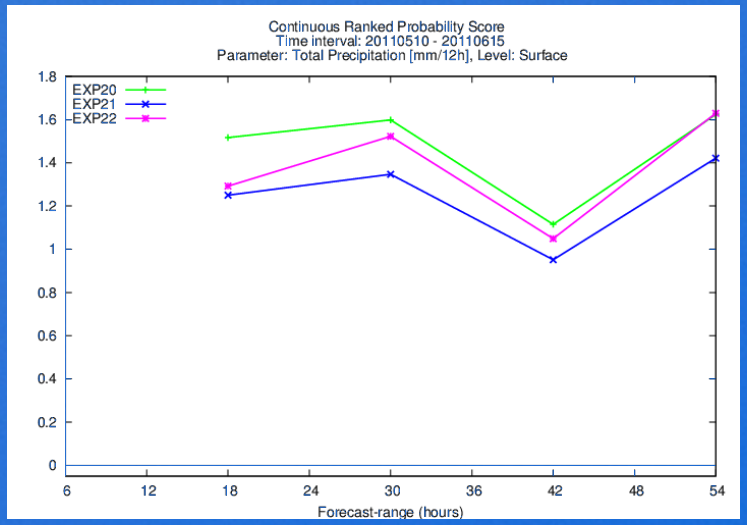


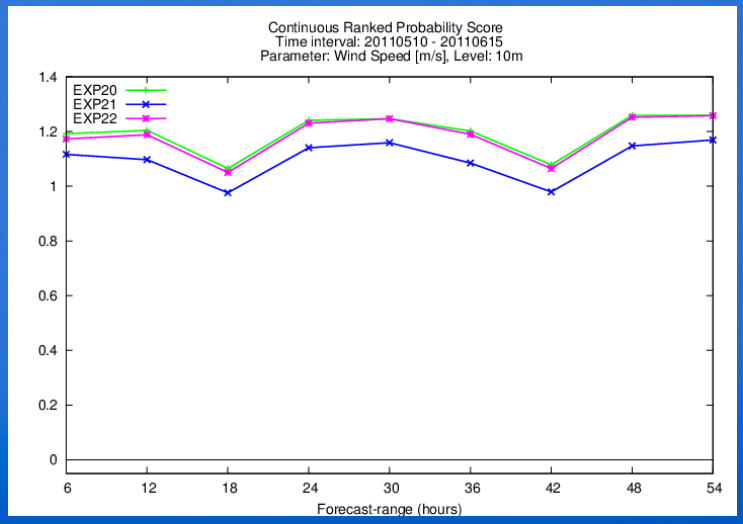


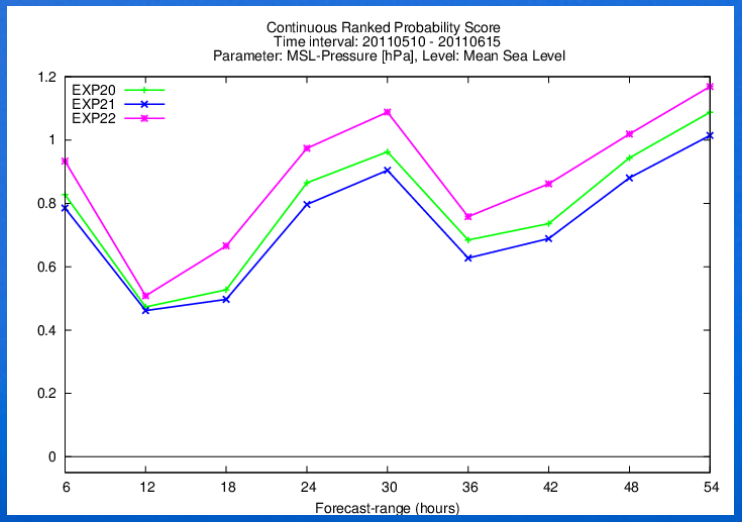


Downscaling vs. Stochastic surface physics vs. Multi-phys









Ensemble surface CANARI

- CANARI surface assimilation implemented in ALADIN-LAEF (T2m, RH2m)
- Coupling with ECMWF EPS
- Merged OPLACE obsouls and AT “local” SYNOP measurements
- SST analyzed by ECMWF control run
- LAEF development version installed at ECMWF c1a cluster (based on cy36t1)
- Verification of assimilation experiment by veral package

New ALADIN-LAEF scheme

(breeding-canari-blending cycle)

breeding (upper-air + p_s perturbation)
- perturbation & rescaling
- surface fields copy

canari (surface assimilation)
- copy SST from ECMWF analysis
- OBS merging & filtering
- BATOR (create ECMA database)
- CANARI (c701)

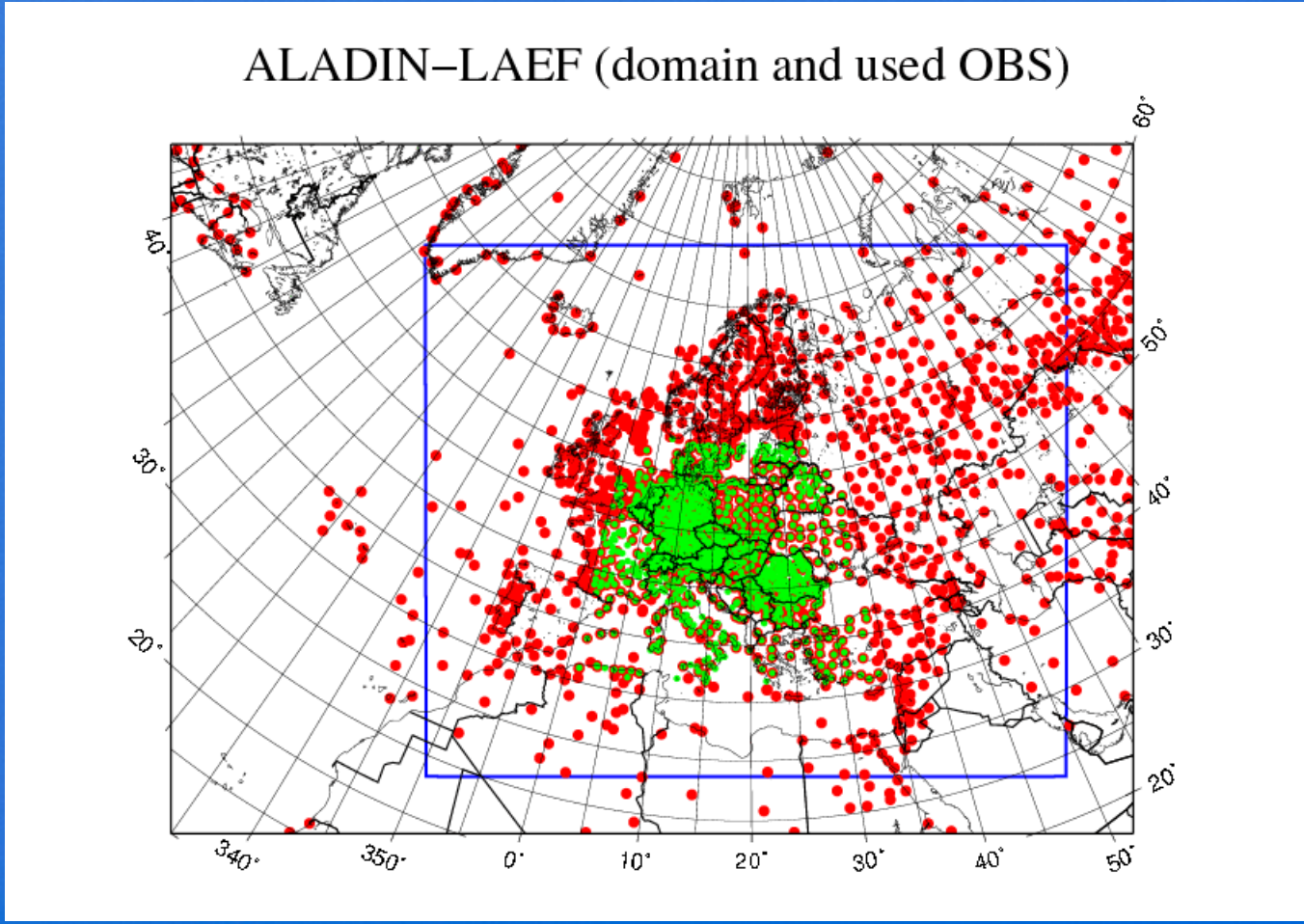
blending (upper-air spectral blending)
- 2x low spectral resolution (ee927)
- 2x digital filter (e001 DFI)
- 2x target spectral resolution (ee927)
- blending (LAM + GM perturbation)

LAEF integration (e001)
- 16 members (up to MAX_RANGE)
- 12 h forecast used to maintain cycle

modified

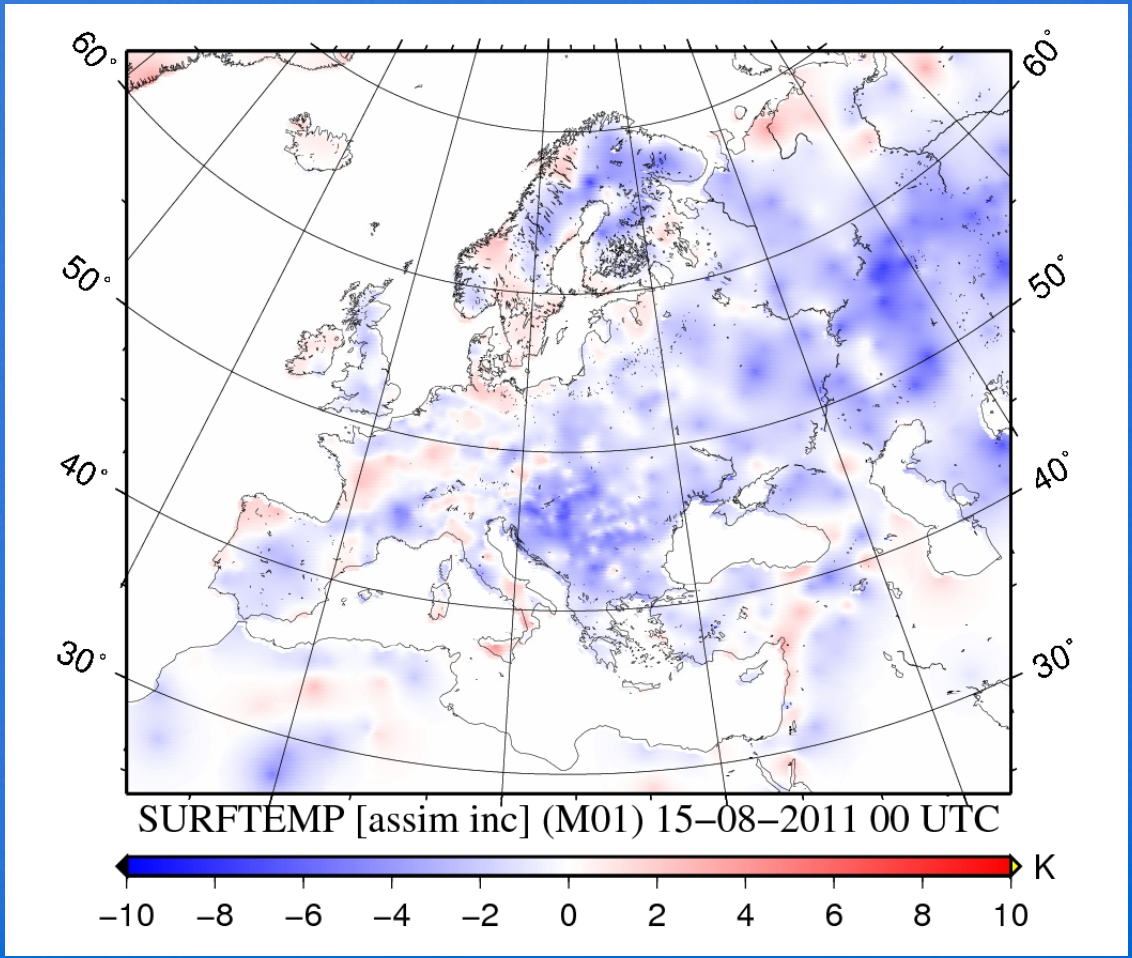
new

Ensemble surface DA: observation coverage



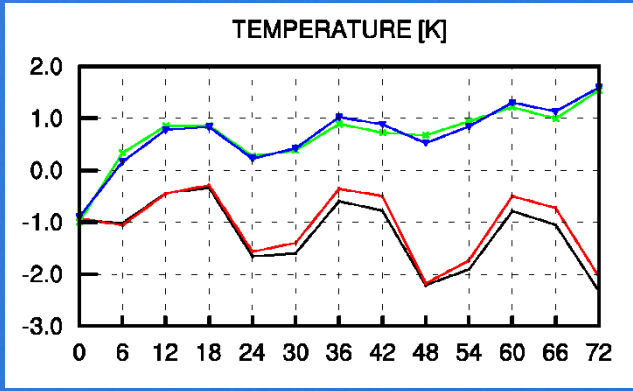
New LAEF domain covered by OPLACE (red dots) and "local" AT SYNOP observations (green dots)

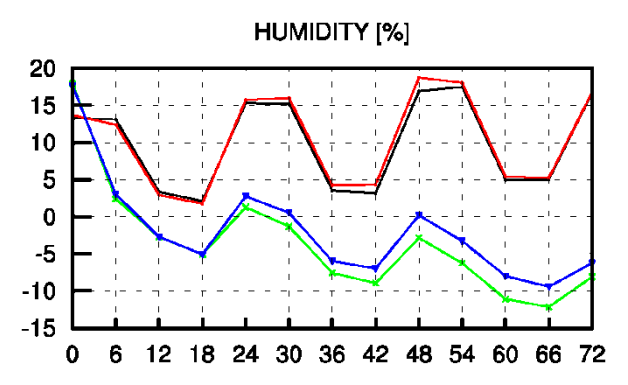
Impact of the perturbed background

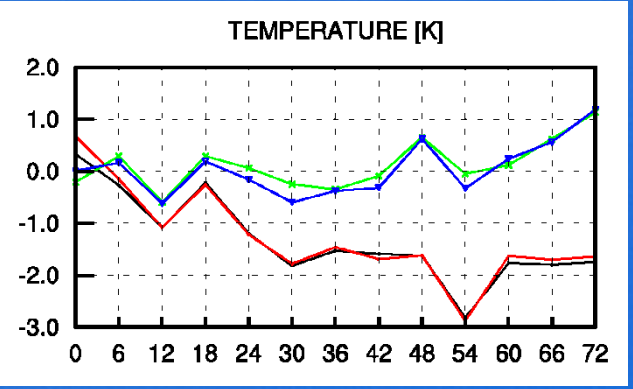


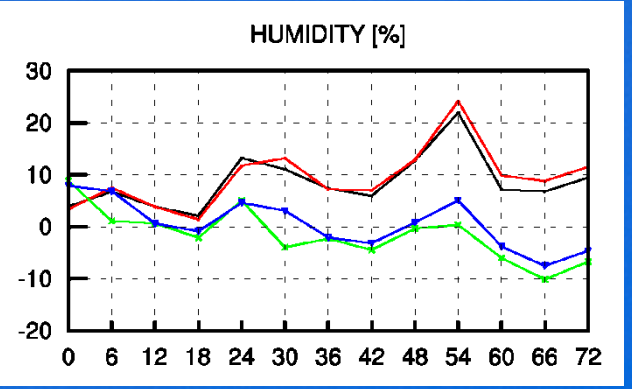
Surface temperature assimilation increment for one of the ensemble members

Evaluation





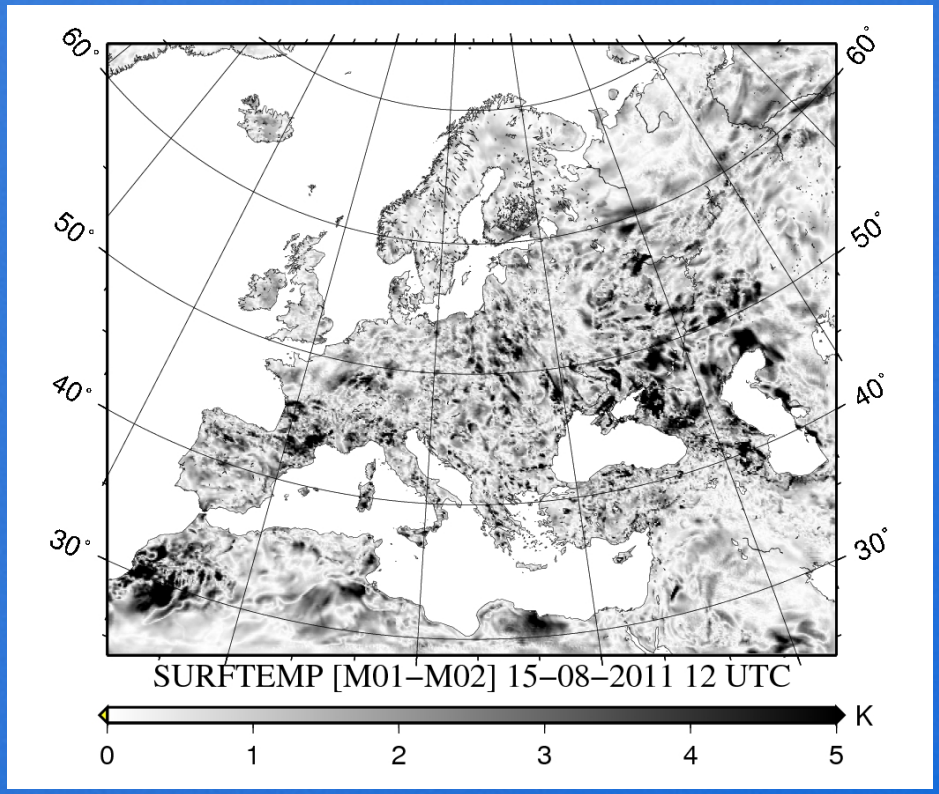




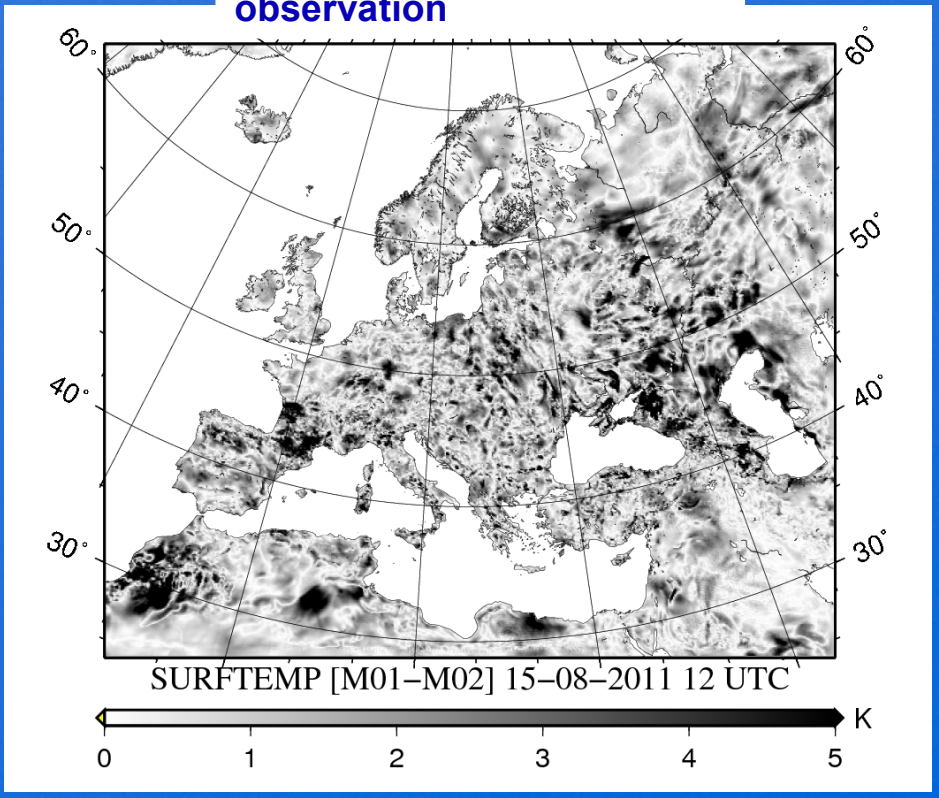
Strong reduction of BIAS due to implemented surface assimilation cycle (green&blue) vs. no-assimilation (red&black) in ALADIN-LAEF (up: surface, down: 1000 hPa level)

Impact of the perturbed observation

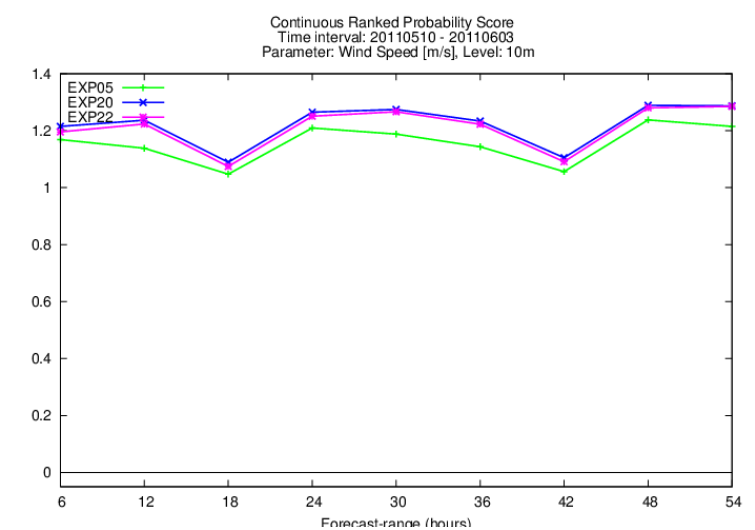
No perturbed observation

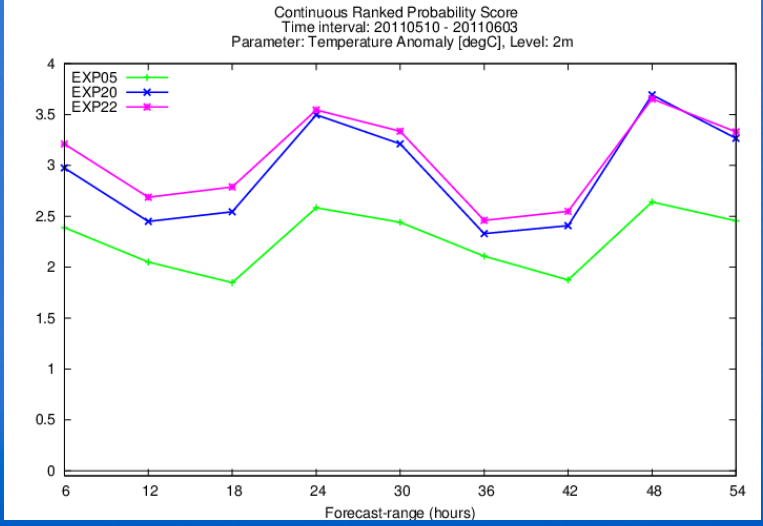


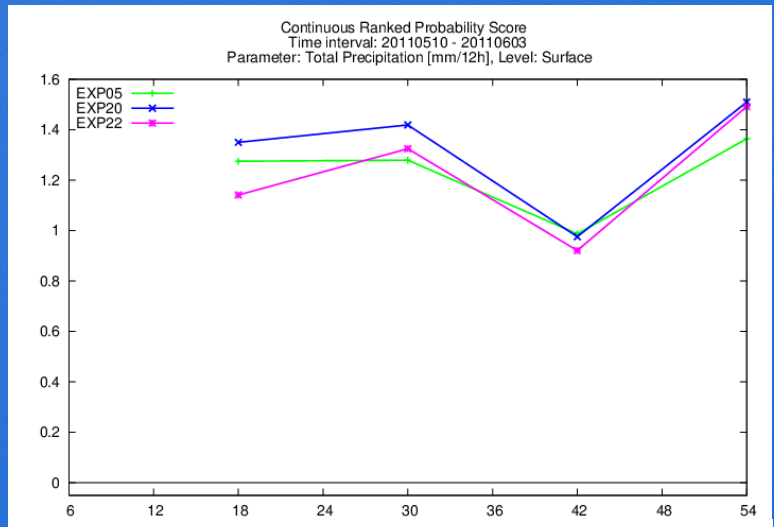
With perturbed observation

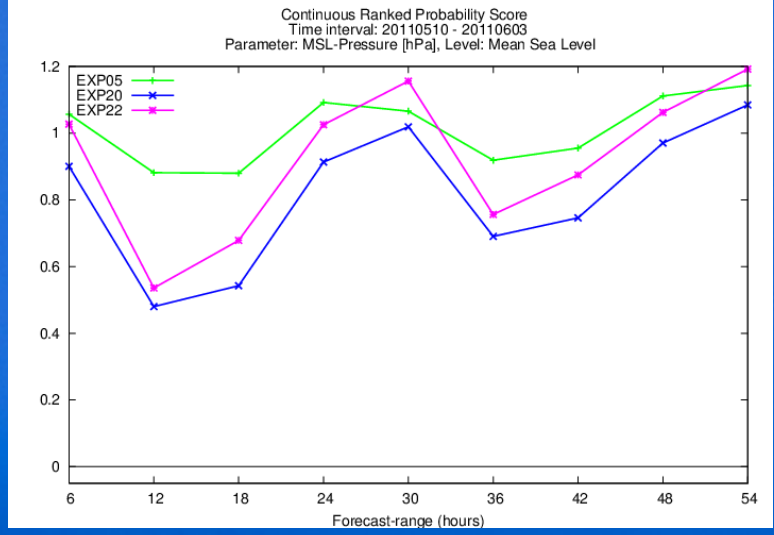


Downscaling vs. stochastic physics vs. Ens. DA









Summary

Encouraging results have been achieved:

- **Towards to higher resolution**
- **Optimizing multi-physics**
- **Taking more error sources into account for IC perturbation.**
- **Introducing surface stochastic physics**

More experiments will be conducted in the next future:

Impact of the member size, time lagged ensemble LBC for operations, Integrating all the components, CRM predictability