Recent ALADIN-LAEF Research and Development

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With contribution from Bellus, Smet, Tang, Tască, Weidle, Wittmann, Xia, etc.
Works towards to larger domain & higher resolution

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

::Fig.01 Domain boundaries of the operational ALADIN-LAEF (green), new redefined ALADIN-LAEF (blue) and GLAMEPS (red).
LAEF new: resolution 18km vs. 10.9km

- ALADIN–LAEF (SK ZOOM) – old domain: 18km
- ALADIN–LAEF (SK ZOOM) – new domain: 10.9km
- ALADIN–LAEF (AT ZOOM) – old domain: 18km
- ALADIN–LAEF (AT ZOOM) – new domain: 10.9km

X-direction: 324 → 600, Y-direction: 225 → 500
LAEF new: resolution 37 vs. 45 levels

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

Continuous Ranked Probability Skill Score
Time interval: 20110520 - 20110530
Total Precipitation [mm/12h]; Surface

10m Wind

Continuous Ranked Probability Skill Score
Time interval: 20110520 - 20110530
Wind Speed [m/s]; 10m
Stochastic surface physics

Stochastically Perturbed Parameterization Tendencies (SPPT)

random perturbation
local tendency
every hour
Atmospheric response to surface perturbation

Convective rainfall

Surface temperature
Impact of the surface stochastic physics

- CRPS, 10m Wind speed
- CRPS, 2m Temperature
- CRPS, MSLP
- CRPS, Precipitation
Downscaling vs. Stochastic surface physics vs. Multi-phys

Continuous Ranked Probability Score
Parameter: Temperature Anomaly (degC), Level: 2m
Time interval: 20110510 - 20110515

Continuous Ranked Probability Score
Parameter: Total Precipitation [mm/12h], Level: Surface
Time interval: 20110510 - 20110515

Continuous Ranked Probability Score
Parameter: Wind Speed [m/s], Level: 10m
Time interval: 20110510 - 20110515

Continuous Ranked Probability Score
Parameter: MSL-Pressure [hPa], Level: Mean Sea Level
Time interval: 20110510 - 20110515
• 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

ALADIN–LAEF (domain and used OBS)

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
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

Continuous Ranked Probability Score
Time interval: 20110510 - 20110503
Parameter: Wind Speed [m/s], Level: 10m

Continuous Ranked Probability Score
Time interval: 20110510 - 20110503
Parameter: Total Precipitation [mm/12h], Level: Surface

Continuous Ranked Probability Score
Time interval: 20110510 - 20110503
Parameter: Temperature Anomaly [°C], Level: 2m

Continuous Ranked Probability Score
Time interval: 20110510 - 20110503
Parameter: MSL Pressure [hPa], Level: Mean Sea Level

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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