Regional Cooperation for
Limited Area Modeling in Central Europe

RC LACE 2025 Overview

Martina Tudor
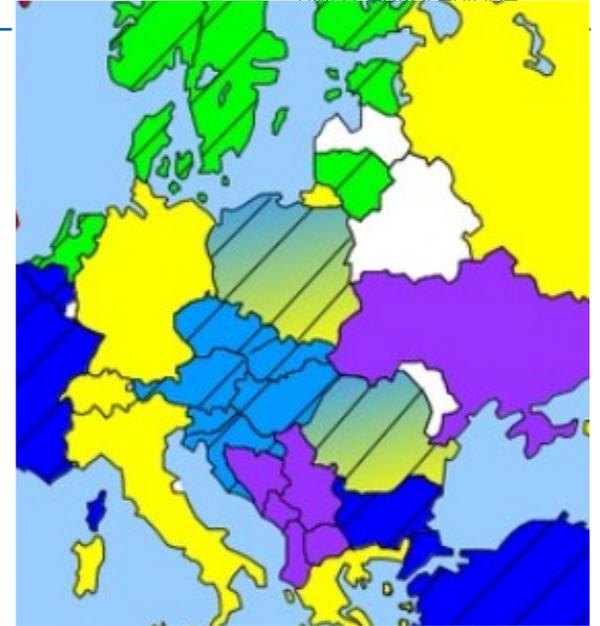
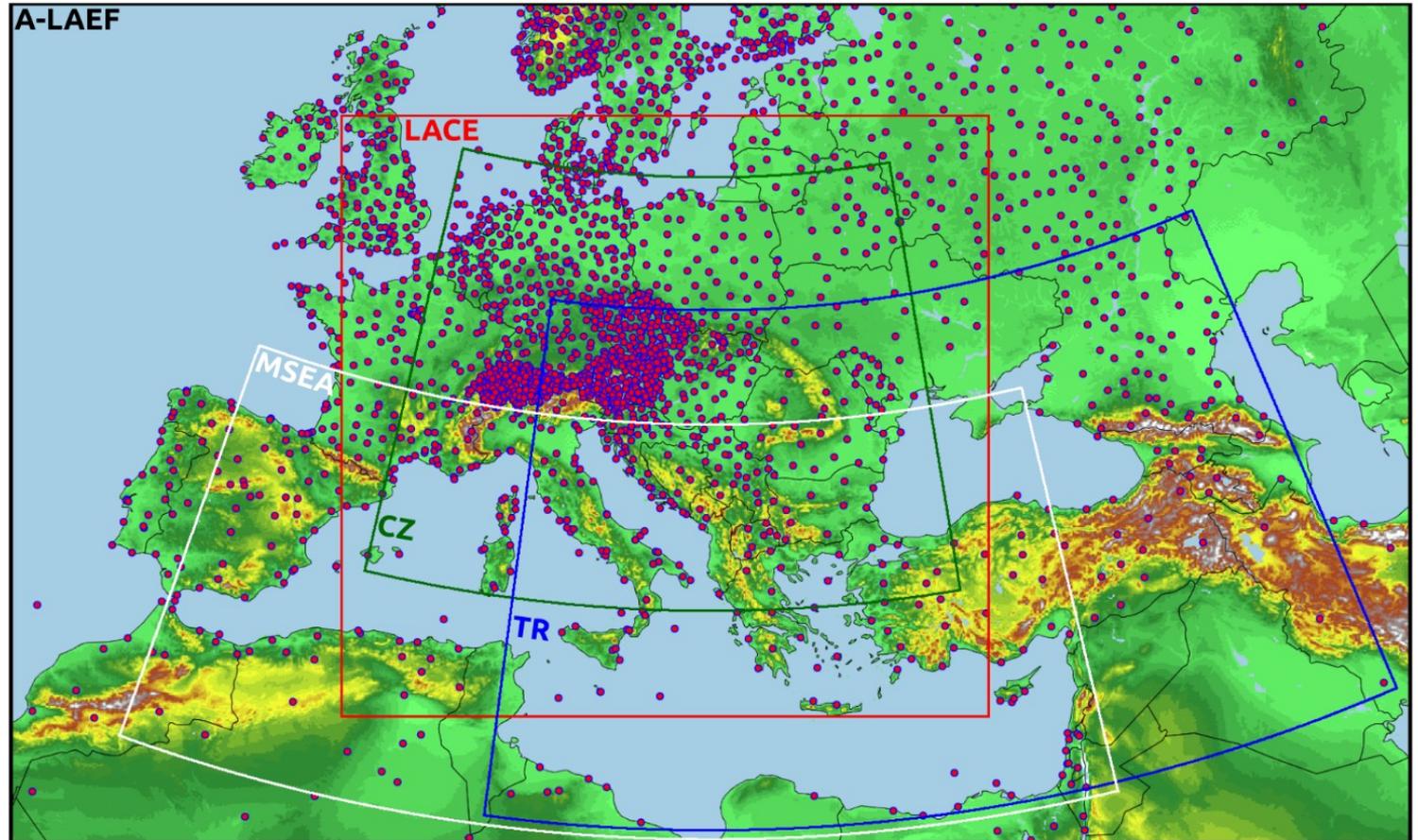# Who are LACE Members and what we do? LACE
nwp central europe

- ▶ NMSs of **Austria, Croatia, Czech Republic, Hungary, Poland, Romania, Slovakia** and **Slovenia**
- ▶ **Common operational applications**
  - **A-LAEF – Limited Area Ensemble Forecasting system (4 all)**
  - **OPLACE – observation pre-processing for LACE**
- ▶ **Common research activities**
- ▶ **RC LACE web page → http://www.rclace.eu/?**

Organization – MG

- **Project Manager: Martina Tudor**
- **Area Leaders:**
  - **Data assimilation (upper air and surface): Antonín Bučánek**
  - **Dynamics and coupling: Petra Smolíková**
  - **Physics (and surface parametrizations): Mario Hrastinski**
  - **Predictability: Clemens Wastl**
  - **Applications and verification: Simona Taşcu**
- **Data Manager: Alena Trojáková**
- **System and Code Coordinator: Oldřich Španiel**

A-LAEF operational domain (Martin Belluš) LACE
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- ALARO
  - 4.8 km linear grid
  - Huge domain
  - 16 members
  - 2xday, 72 hr
  - EC LBC
- 130 M SBU per year (Slovenia, Croatia, Turkiye)
- TC2 on ECMWF
- Changes
  - **CY46T2**
  - **Updated mulitphysics**

4

GeoSphere Austria | DHMZ | Czech Hydrometeorological Institute | HungaroMet Hungarian Meteorological Service | IMGW | METEO ROMANIA | SHMU | ARSO METEO Slovenia

Strategies used to simulate uncertainty in the A-LAEF system:

- **initial conditions uncertainty**
  a) ensemble of surface data assimilation (ESDA)
  [perturbed T2m and RH2m OBS, perturbed first guess]

  b) upper-air spectral blending by DFI
  [combination of GM and LAM uncertainty]

- **lateral boundary conditions uncertainty**
  perturbations inherited from the first 16 members of ECMWF ENS
  [via standard coupling, global IFS ENS gribs via ECPDS dissemination]

- **numerical model uncertainty**
  a) ALARO-1 multi-physics
  [4 different physics clusters]

  b) stochastic physics for surface prognostic fields
  [stochastic perturbation of physics tendencies (SPPT) for 7 surface prognostic
  fields: surface temperature, surface liquid water content, surface frozen
  water content, snow albedo, snow reservoir water content, snow density and
  water intercepted by vegetation; control run without SPPT]

ESDA:

$$\Delta T_s = \Delta T_{2m}$$

$$\Delta T_p = \frac{1}{2\pi} \Delta T_{2m}$$

$$\Delta W_s = \alpha_s^T \Delta T_{2m} + \alpha_s^H \Delta H_{2m}$$

$$\Delta W_p = \alpha_p^T \Delta T_{2m} + \alpha_p^H \Delta H_{2m}$$

BLENDING:

$$IC_{blend}^n = a_{a-laef}^n + \left\{ \overline{\left(a_{ecmwf}^n\right)_{trunc}} - \overline{\left(a_{a-laef}^n\right)_{trunc}} \right\}$$

$$IC_{blend}^n = LS^n + a_{a-laef}^n$$

SPPT + MP:

$$\frac{\partial e_j}{\partial t} = A(e_j, t) + P'(e_j, t)$$

$$P'_j(e_j, t) = (1 + r_j(\lambda, \varphi, t)_{D,T}) P_j(e_j, t)$$

cluster / member	phys01	phys02	phys03	phys04
	00,01,05,09,13	02,06,10,14	03,07,11,15	04,08,12,16
namelist parameter	oper	double	oper	double
	EL0		EL1	
RDHAIL1	2.8	2.4	2.8	2.4
RDHAIL2	7.5	6.5	7.5	6.5
CGMIXLEN	EL0	EL0	EL1	EL1
LPBLH_TKE	F	F	T	T
XMAXLM	0.	0.	5000.	5000.
ETKE_C0SHEAR	0.5	0.5	0.35	0.35
ETKE_DTHETA_S1	-5.0	-5.0	-2.5	-2.5
ETKE_DTHETA_S2	2.0	2.0	1.0	1.0
ETKE_R2SIM	0.2	0.2	0.1	0.1
LEVAPLOP	F	T	F	T
LZ0SNOWH	F	T	F	T

Annotations:
- limits for hail/graupel classification in precip.type → RDHAIL1, RDHAIL2
- mixing length → CGMIXLEN
- PBL height based on TKE profile → LPBLH_TKE
- PBL height limit → XMAXLM
- TOUCANS (EL1 tunings) → ETKE_C0SHEAR, ETKE_DTHETA_S1, ETKE_DTHETA_S2, ETKE_R2SIM
- Lopez evaporation → LEVAPLOP
- roughness impact of snow via snow height → LZ0SNOWH

cluster / member	phys01	phys02	phys03	phys04
	00,01,05,09,13	02,06,10,14	03,07,11,15	04,08,12,16
HUCREDRA	0.42	0.46	0.42	0.46
RAUTEFR	0.5E-03	0.8E-03	0.5E-03	0.8E-03
RAUTEFS	2.E-03	1.E-03	2.E-03	1.E-03
RCFLASH1	16.76	22.29	16.76	22.29
RDECRD1	10000.	8000.	10000.	8000.
RDECRD2	20000.	215000.	20000.	215000.
RDTFAC	1.00	0.75	1.00	0.75
REVASXR	0.	7.E-07	0.	7.E-07
RQLCR	3.E-04	4.E-04	3.E-04	4.E-04
WCRIN	4.0	10.0	4.0	10.0
RZ0_TO_HEIGHT	0.13	0.1	0.13	0.1
FACRAF	10.0	3.6	10.0	3.6
LRAFTKE	F	T	F	T
LRAFTUR	T	F	T	F

critical RH profile tuning for radiation cloudiness

autoconversion to rain

autoconversion to snow

flash diagnostics

variation of exp-random cloud overlap in radiation

liquid/ice partition for cloud condensate

max. evaporation rate for rain

critical liquid w.c. for liquid cloud w. autoconv.

snow fraction

ratio of mechanical roughness length to obstacle height

wind diagnostics (TKE vs friction velocity)

system specifications	oper (TC2)	e-suite (change log)
Code version	CY40T1	CY46T1+
Horizontal resolution / vertical levels	4.8 km / 60	
Number of grid points	1250x750	
CLIM files	ECOCLIMAP v1 (LZ0THER=.T.)	ECOCLIMAP v2.6 + fields update via PGD: orographic roughness (GMTED2010 7.5"), vegetation roughness, subgrid orographic characteristics for GWD + LZ0THER=.F. (absence of subgrid-scale orography in the thermal roughness length field)
Grid	linear	
Output	grib 1 (GL)	grib 2 (inline) + eccodes tables for LACE center (ID 249) + new parameters (precip.types, lightnings, prog.graupel, sim.rad.reflectivity)
Time step	180s	
Forecast length	72 h (00/12 UTC)	78 h (00/12 UTC) TBD
Members	16+1	
IC perturbation	ESDA [surface] spectral blending by DFI [upper-air]	
Model perturbation	ALARO-1 multi-physics + surface SPPT	new ALARO-1 phys.clusters + surface SPPT ported to CY46T1
LBC perturbation	ECMWF ENS (c903@CY48T2)	extension of local ECPDS diss.

SURFGZ0.THERM, (CLIM[01] - 923)
MIN= 0 MAX= 24.9
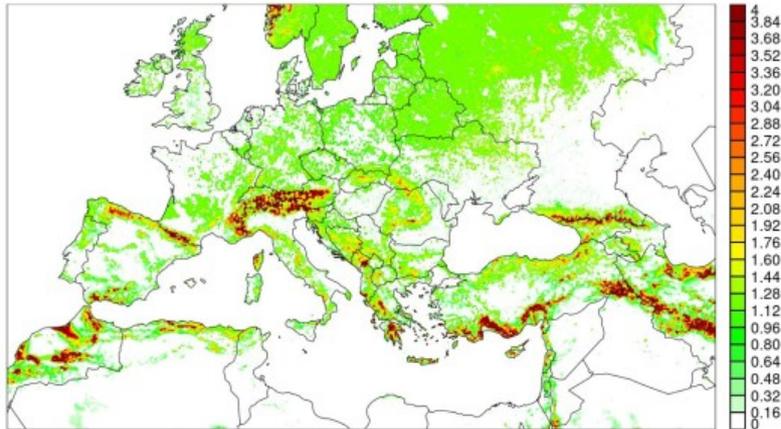
SURFGZ0.THERM, (CLIM[01] - update)
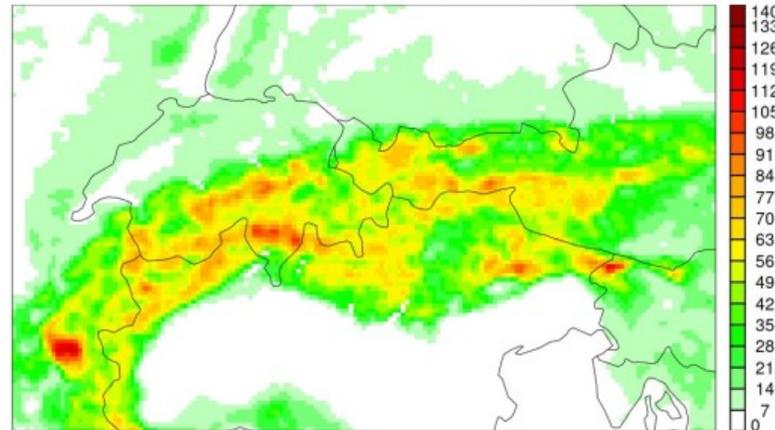MIN= 0.01 MAX= 2.87
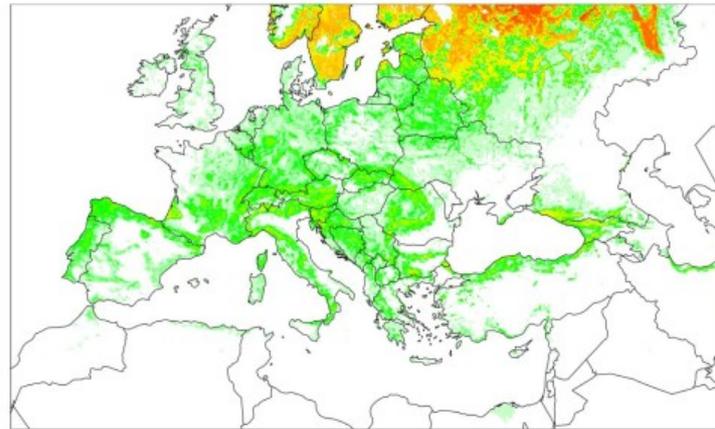
Thermal roughness length in the old climatological files (left) and in the new updated files (right).

old ➝ new
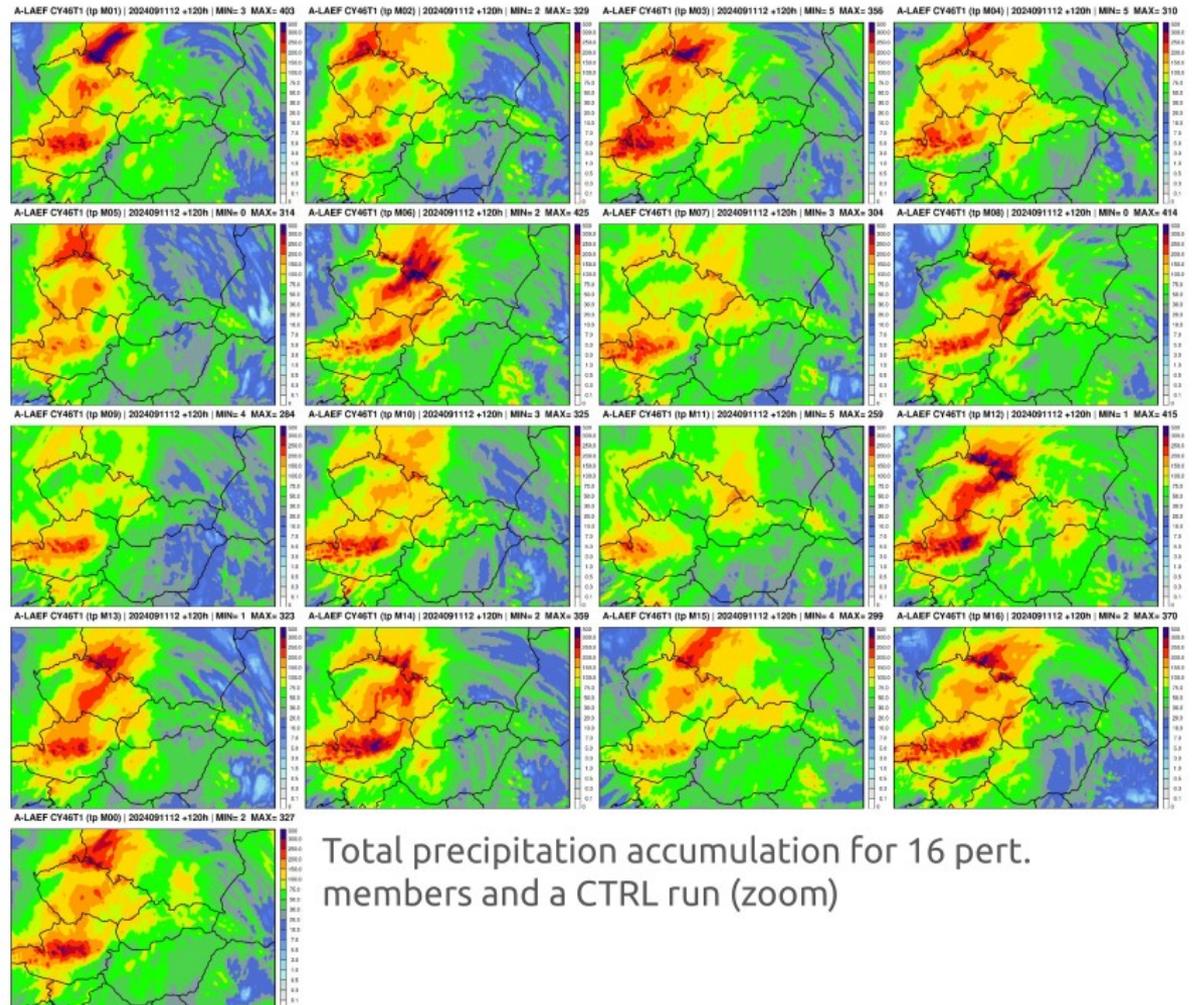
SURFZ0.FOIS.G, (CLIM[01] - 923)
MIN= 0.01 MAX= 134.94
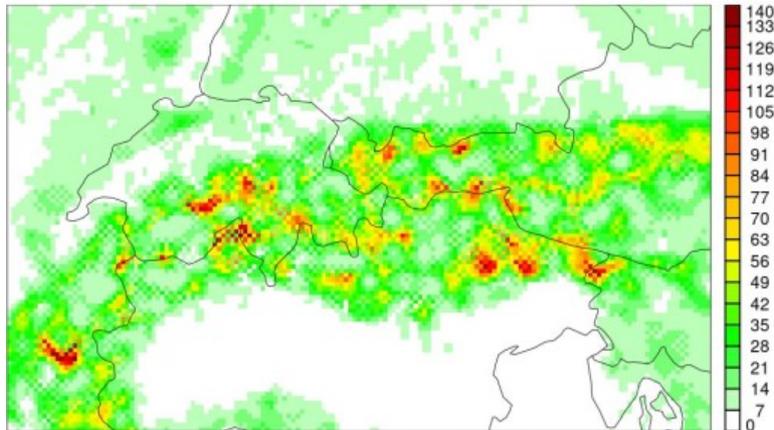
SURFZ0.FOIS.G, (CLIM[01] - update)
MIN= 0.01 MAX= 119.61

Mechanical roughness length in the old climatological files (left) and in the new updated files (right). Zoom over the Alps.

Austria   DHMZ   Hydrometeorological Institute   Hungarian Meteorological Service   ROMANIA   Slovenia

Realtime extended forecast by new A-LAEF e-suite (CY46T1+) - Storm Boris

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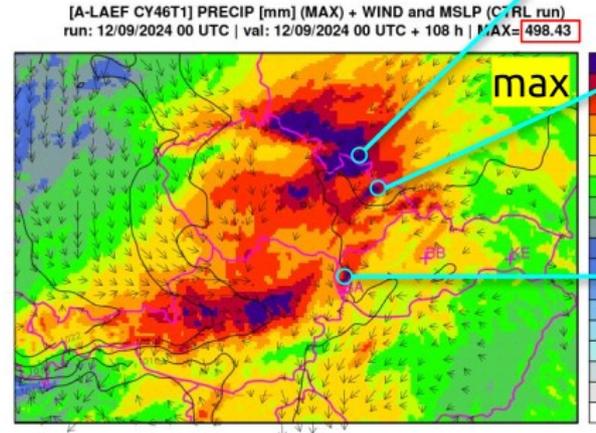
On-demand forecast made on Wednesday Sep. 11 (**+120 h**) with the A-LAEF e-suite (CY46T1)
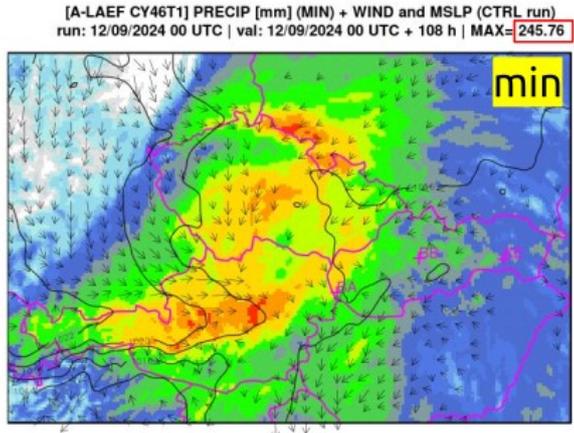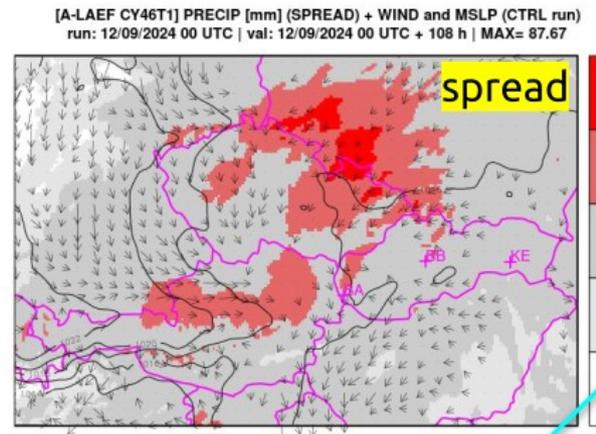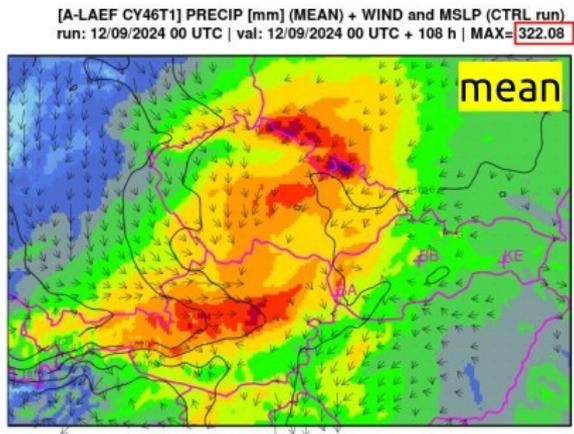

Total precipitation accumulation for 16 pert. members and a CTRL run (zoom)
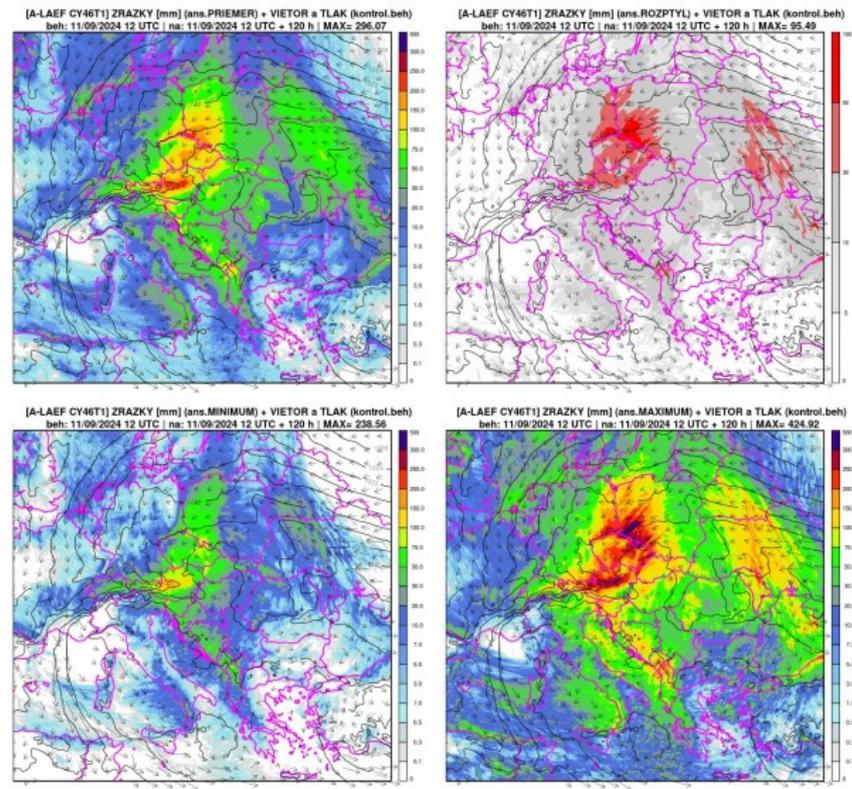
ENS mean, spread, minimum a maximum of total precipitation accumulation during the extreme event (from Sept. 11, 12 UTC to Sept. 16, 12 UTC)
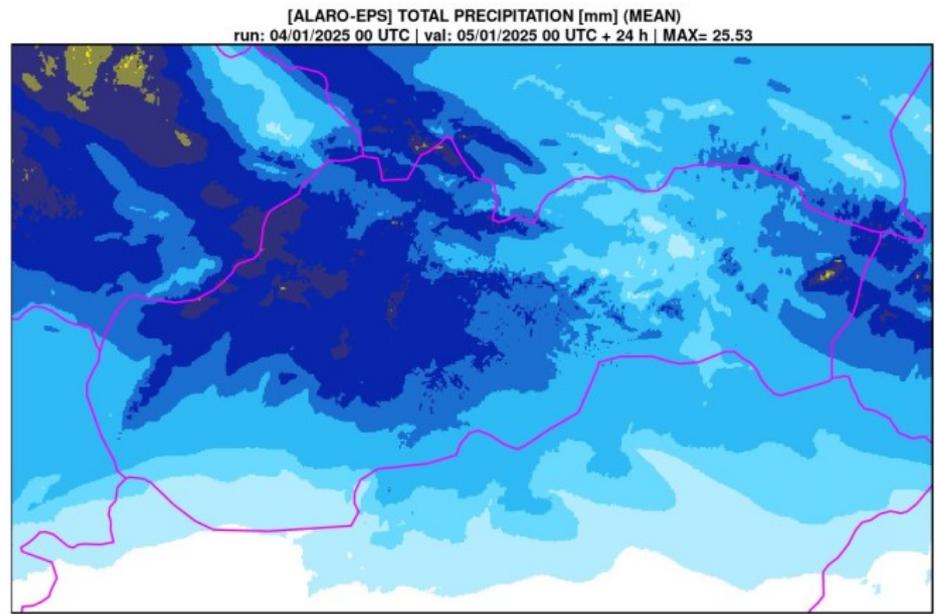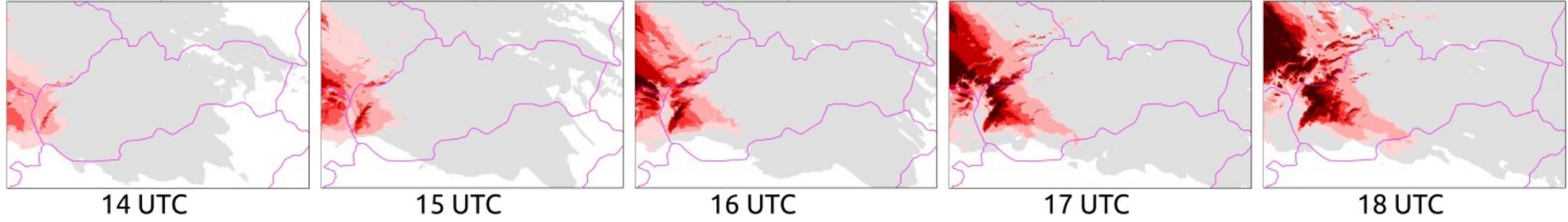
Realtime extended forecast by new A-LAEF e-suite (CY46T1+) - Storm Boris

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On-demand forecast made on Thursday Sep. 12 (**+108 h**) with the A-LAEF e-suite (CY46T1)
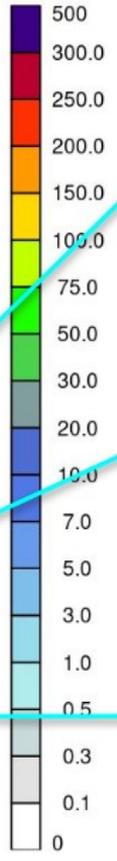
[A-LAEF CY46T1] PRECIP [mm] (MEAN) + WIND and MSLP (CTRL run)
run: 12/09/2024 00 UTC | val: 12/09/2024 00 UTC + 108 h | MAX= 322.08

mean

[A-LAEF CY46T1] PRECIP [mm] (SPREAD) + WIND and MSLP (CTRL run)
run: 12/09/2024 00 UTC | val: 12/09/2024 00 UTC + 108 h | MAX= 87.67

spread

[A-LAEF CY46T1] PRECIP [mm] (MIN) + WIND and MSLP (CTRL run)
run: 12/09/2024 00 UTC | val: 12/09/2024 00 UTC + 108 h | MAX= 245.76

min

[A-LAEF CY46T1] PRECIP [mm] (MAX) + WIND and MSLP (CTRL run)
run: 12/09/2024 00 UTC | val: 12/09/2024 00 UTC + 108 h | MAX= 498.43
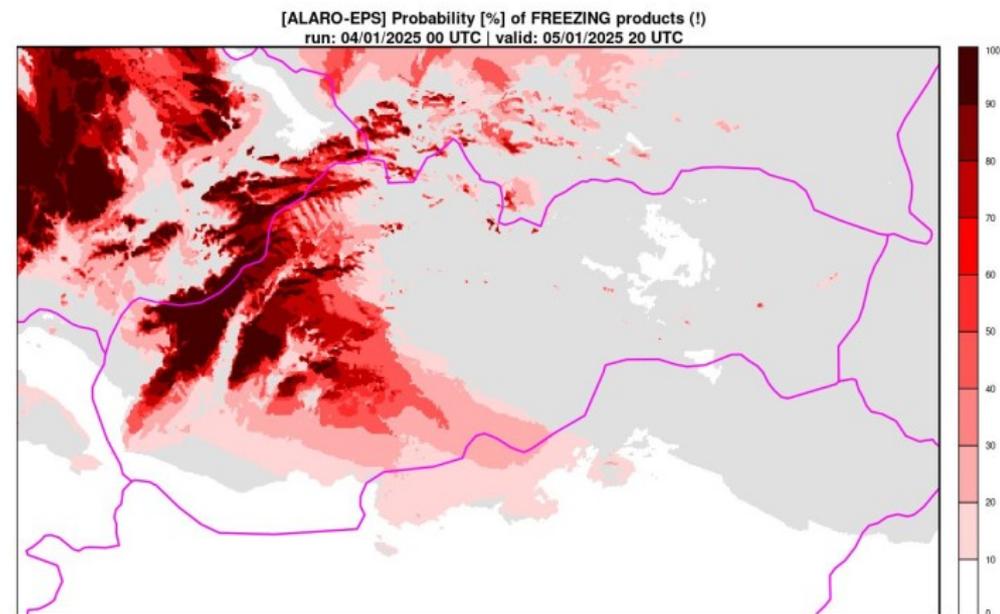
max

Głuchołazy (PL)

Opava (CZ)

Stupava (SK)

ENS mean, spread, minimum a maximum of total precipitation accumulation
during the extreme event (from Sept. 12, 00 UTC to Sept. 16, 12 UTC)

ALARO-EPS - Freezing rain on 5th January 2025

ALARO-EPS (probability of freezing rain)

14 UTC   15 UTC   16 UTC   17 UTC   18 UTC

[ALARO-EPS] TOTAL PRECIPITATION [mm] (MEAN)
run: 04/01/2025 00 UTC | val: 05/01/2025 00 UTC + 24 h | MAX= 25.53

total daily precipitation (ENS MEAN)

[ALARO-EPS] Probability [%] of FREEZING products (!)
run: 04/01/2025 00 UTC | valid: 05/01/2025 20 UTC

probability of freezing rain (20 UTC)

Data Manager

- Maintenance and development of OPLACE

  - Improved snow height measurement data (Avoid QC – improve timeliness, Add more data sources)

- Support for OBSOUL format treatment in **harpIO** interface developed by M. Petraš (SK)

Data Manager
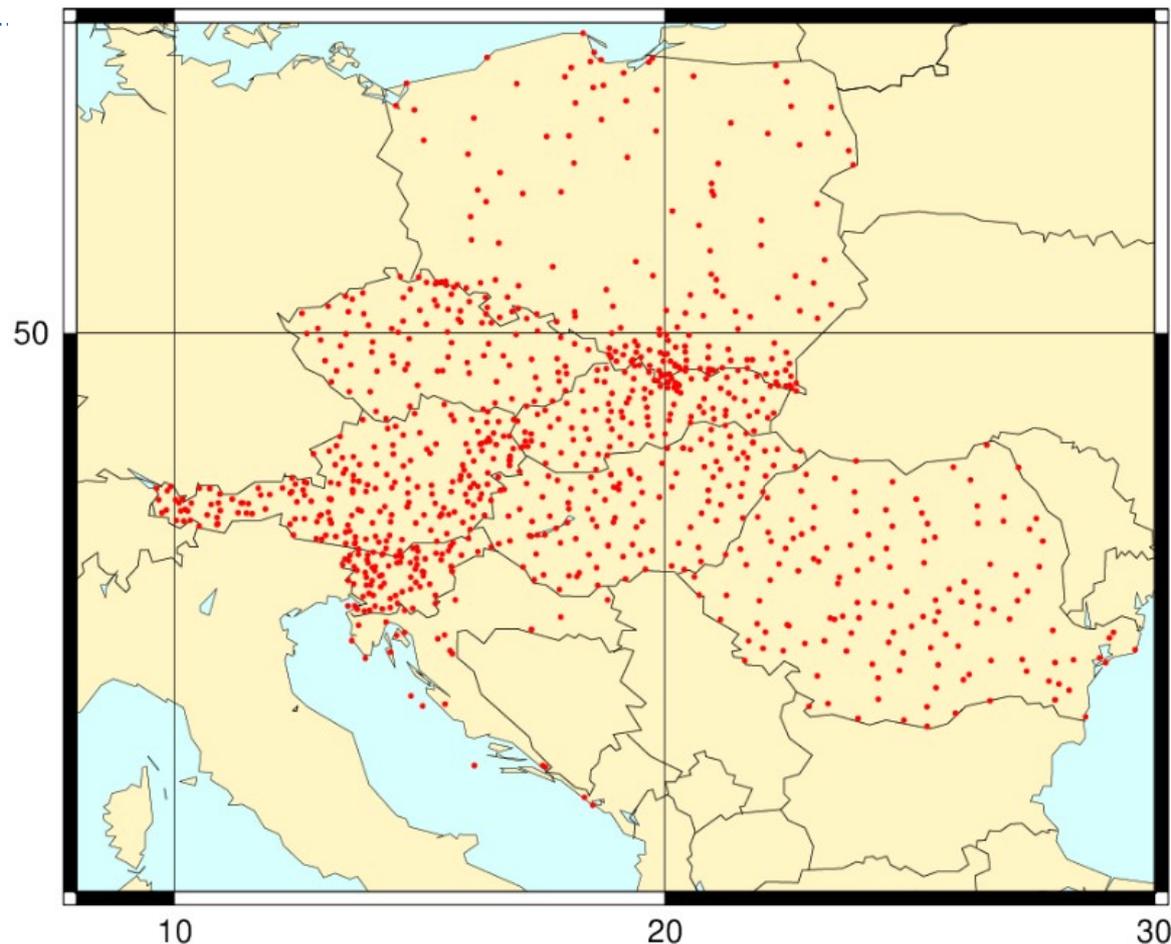
- ▶ New GNSS-ZTD data

  - ▶ See the green points to the right

  - ▶ New satellite data – upgrade of SEVIRI/netcdf product and added data from Chinese FenYung-3 (FY-3E)

  - ▶ No more data from NOAA 15, 18 and 19

System and Code Coordinator
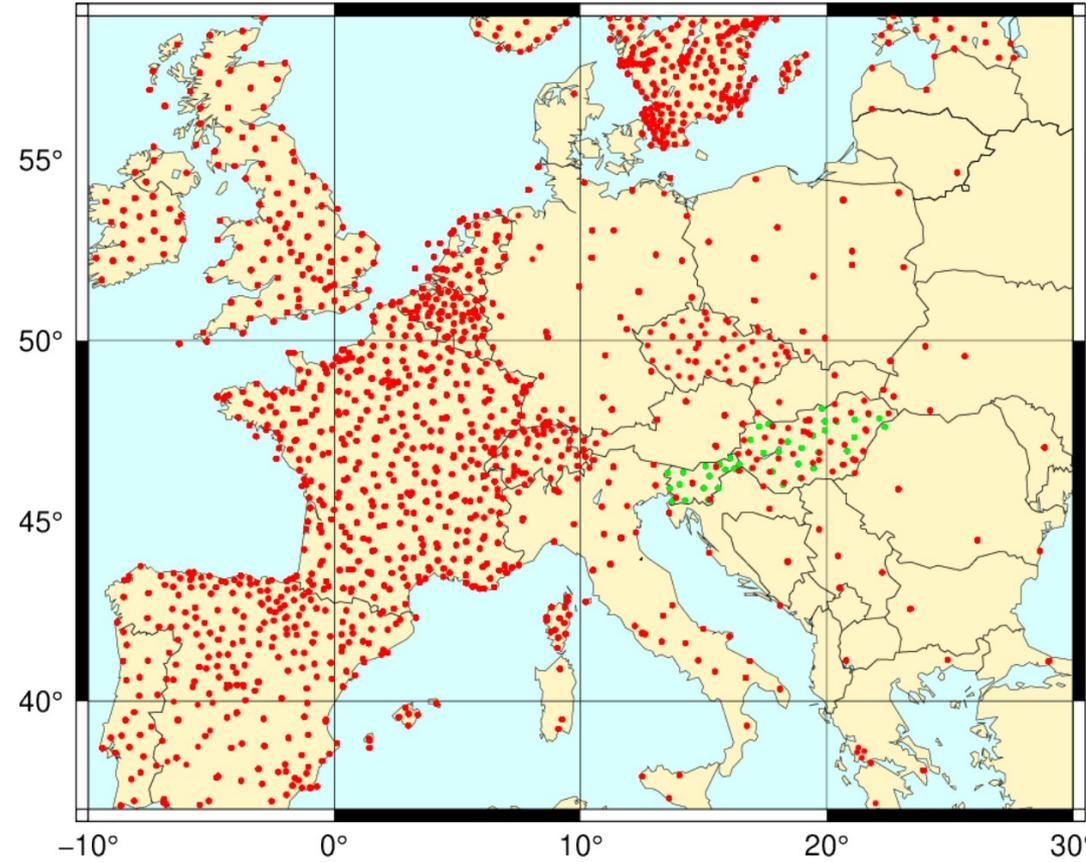
- ▶ Phasing of the common cycle CY50
  - ▶ Merge of CY49T2 and CY49R1
  - ▶ Phasing of CY50T1

  - ▶ ALARO single precision

  - ▶ Administration of RC LACE web pages

 - ▶ Administration of RC LACE Forum

System and Code Coordinator

Operational RC LACE products have been completed.
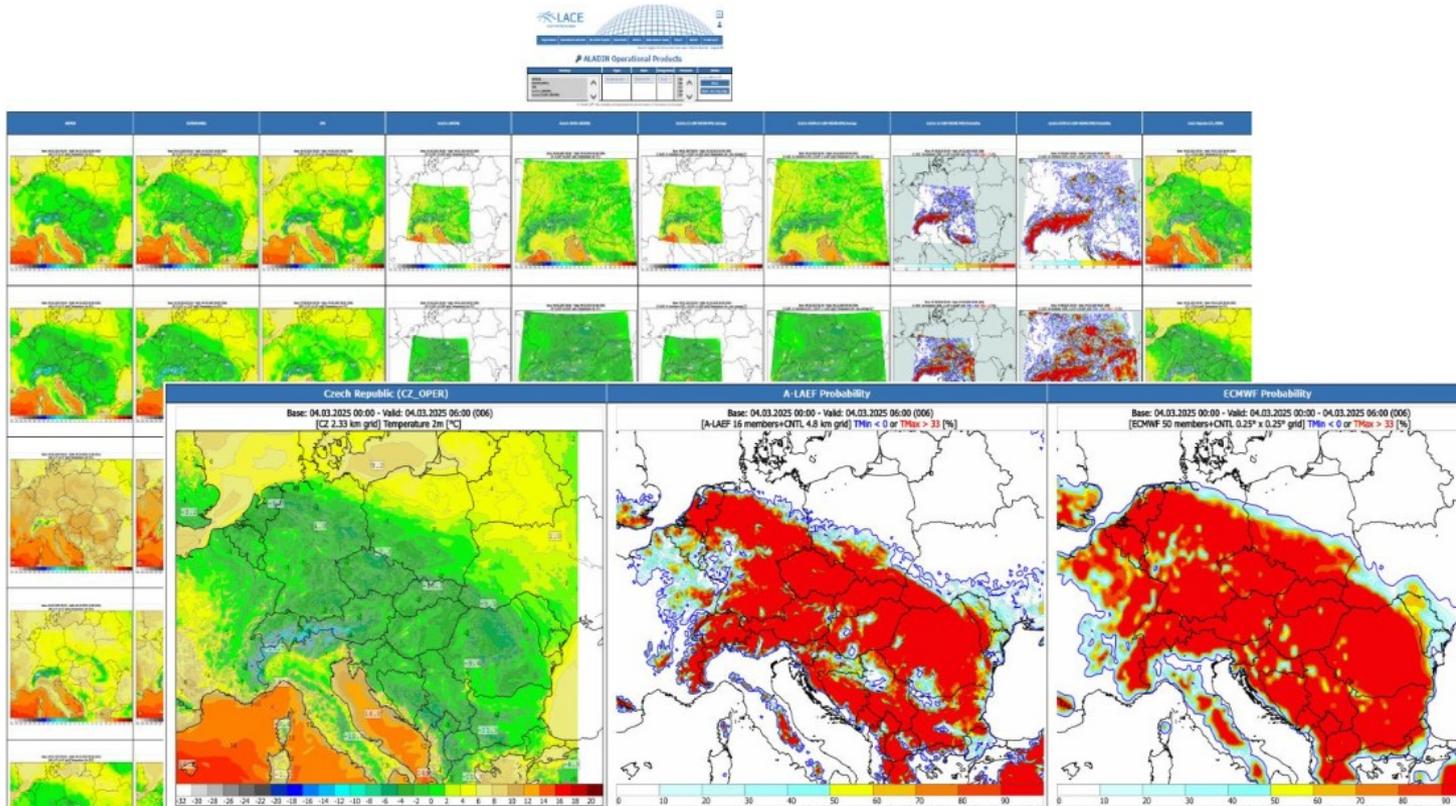
ARPEGE
ECMWF(HRES)
GFS
Austria (AROME)
Austria ZOOM (AROME)
Austria (C-LAEF AROME EPS) Aver. or Max.
Austria ZOOM (C-LAEF AROME EPS) Aver. or Max.
Austria (C-LAEF AROME EPS) Probability
Austria ZOOM (C-LAEF AROME EPS) Probability
Czech Republic (CZ_OPER)
Croatia (HR44)
Hungary (ALARO/HU)
Hungary (AROME)
Hungary ZOMM (AROME)
Hungary (AROME EPS) Aver. or Max.
Hungary ZOOM (AROME EPS) Aver. or Max.
Hungary (AROME EPS) Probability
Hungary ZOOM (AROME EPS) Probability
Poland (ALARO4)
Poland (AROME2)
Poland ZOOM (AROME2)
Romania (ALARO-RO)
Slovenia (SIS4)
Slovenia (SIS4ar)
Slovakia (SK_OPER)
Slovakia (SK_ALARO2)
Slovakia ZOOM (SK_ALARO2)
DWD icon/eu_nest
A-LAEF Aver. or Max.
A-LAEF Probability
ECMWF Aver. or Max.
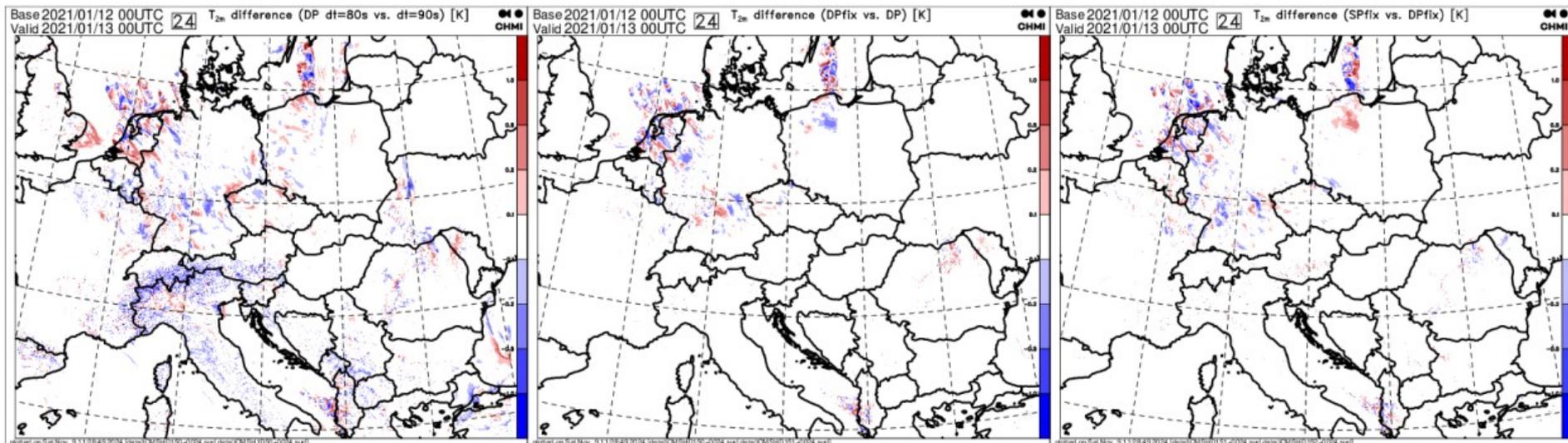ECMWF Probability

16

Single precision tests with ALARO
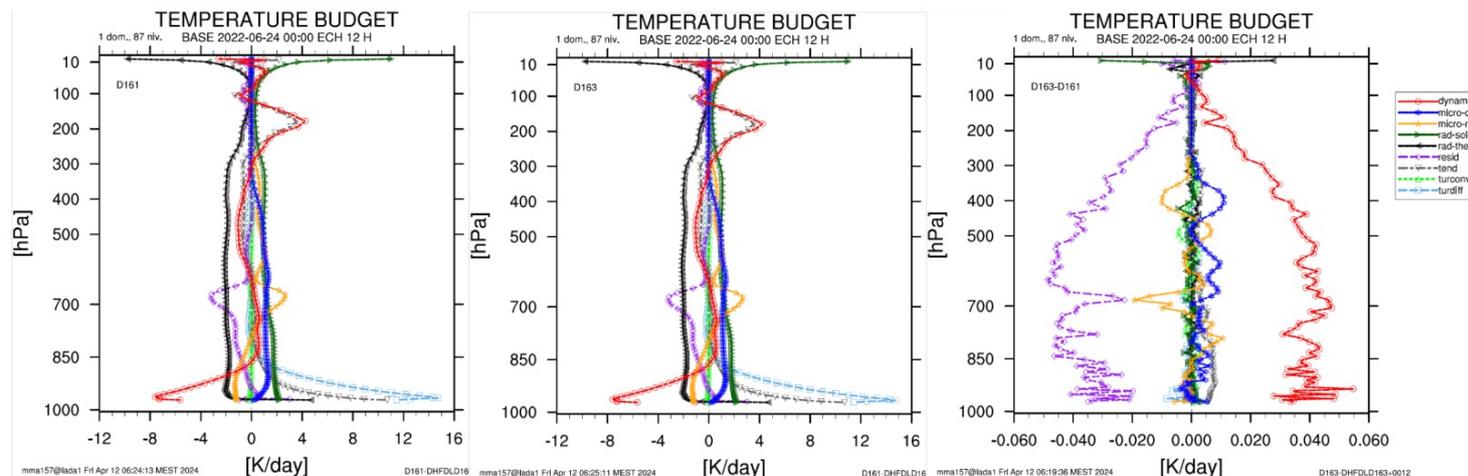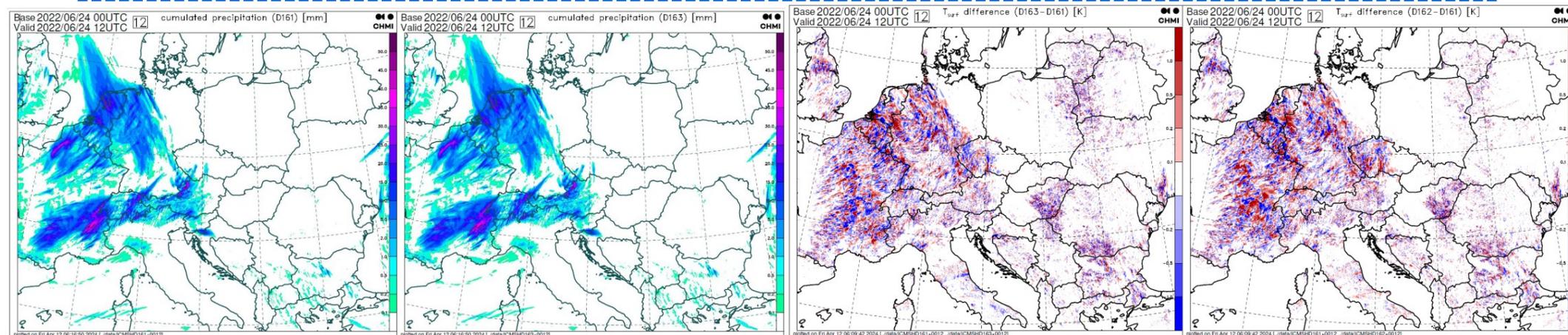
- ▶ CY46t1
  - ▶ DP (left), SP (right)
  - ▶ Various timesteps
  - ▶ backphasing

apl_alaro

aplpar

Chalenges
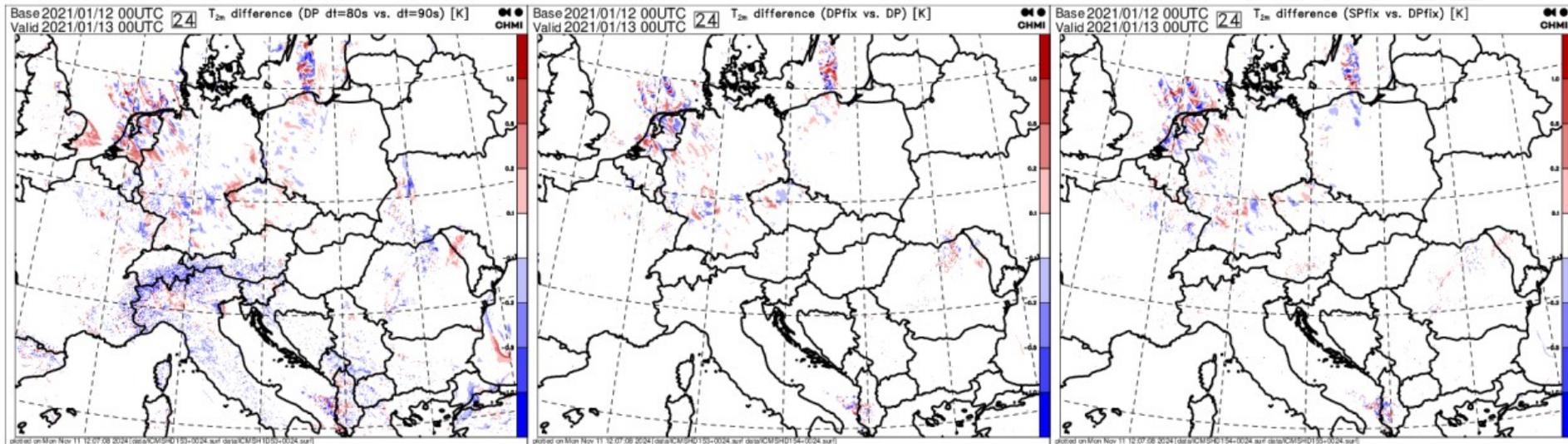
- New RC LACE MoU

- Changes in Member NWP teams

- SHMU

  - 5 persons from NWP team left SHMU this summer

  - Martin Bellus, Martin Petras, Adam Otruba, Viktor Tarjani and Maria Derkova

RC LACE at EWGLAM

- **Presentations**
  - EPS – Clemens Wastl Monday 14:00 "EPS activities in LACE" (online)
  - Dynamics – Petra Smolikova Monday 16:30 "Novelties for model dynamics stability and accuracy in high resolutions"
  - **Verification – Simona Tascu 8:50 Tuesday „LACE verification activities"**
  - **Data Assimilation – Antonín Bučánek Tuesday 15:00 "Advances in the use of observations in ACCORD"**
  - Physics – Mario Hrastinski – Thursday 10:10 "Physics activities in RC LACE"

- **National Posters**

  - For all 8 countries
- Side meetings

  - **Martina Tudor "Coupling ALARO Physics with SURFEX" in Surface side meeting (Wednesday 10:40)**

Thank you for your attention.