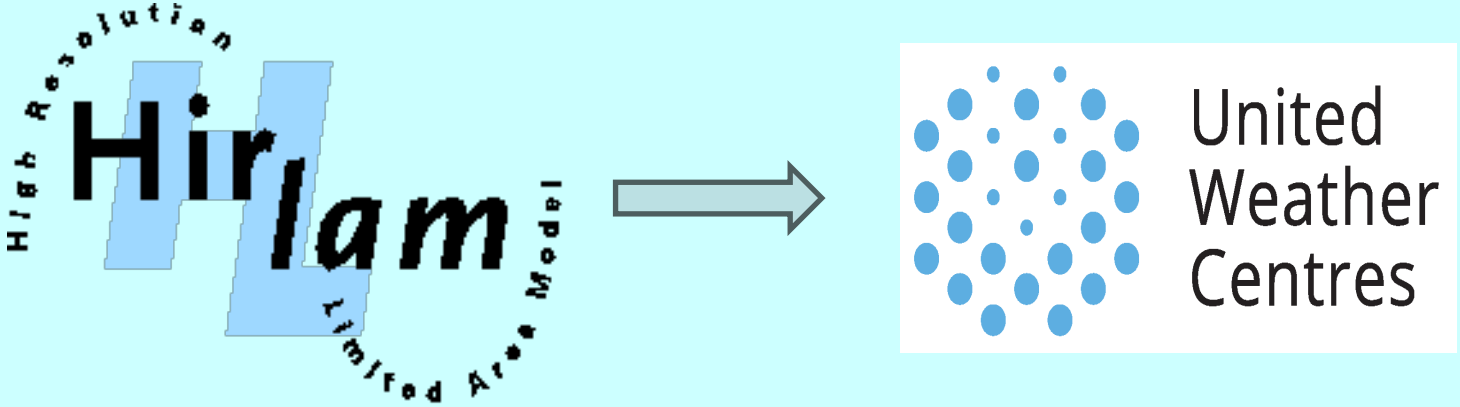
Recent developments in HIRLAM, plus... a transition coming up



SRNWP/EWGLAM meeting,

22 September, Norrkoping

DA and the use of observations

- Harmonie 3D-Var and 4D-Var working in OOPS DA framework, full-scale comparisons with MASTERODB versions to be done. Increasing focus on EnVar assessment and development

- Extended and improved use of satellite data, with a focus on mw and ir radiances.
  - More satellites and instruments, better coverage in time
  - Better use of dynamical emissivity, improved cloud detection
  - Promising but not yet in operations: footprint operator and all-sky assimilation

- Improved handling of Mode-S/EHS temperatures and thinning procedures.
- Optimised, extended use of radar winds and reflectivities, adaptation to OPERA NIMBUS.
- Snow extent assimilation with snow barrel approach introduced operationally

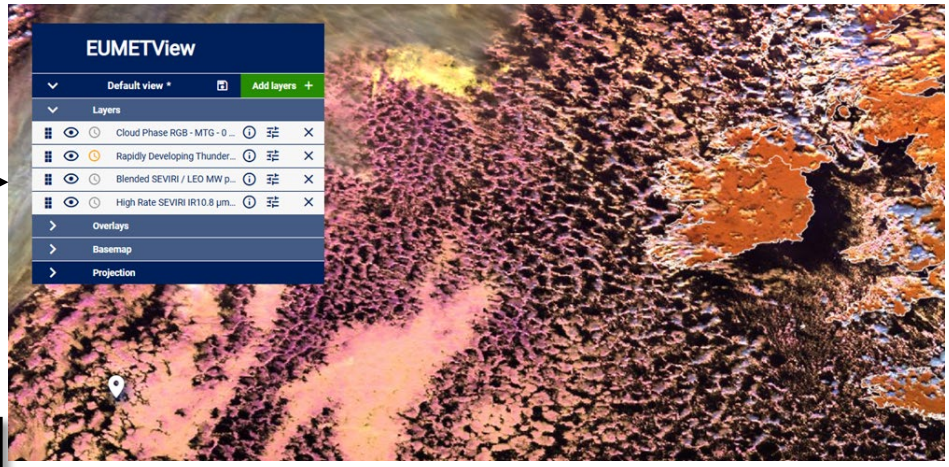
- Tuning of overall data assimilation system completed (CY46h), introduced operationally

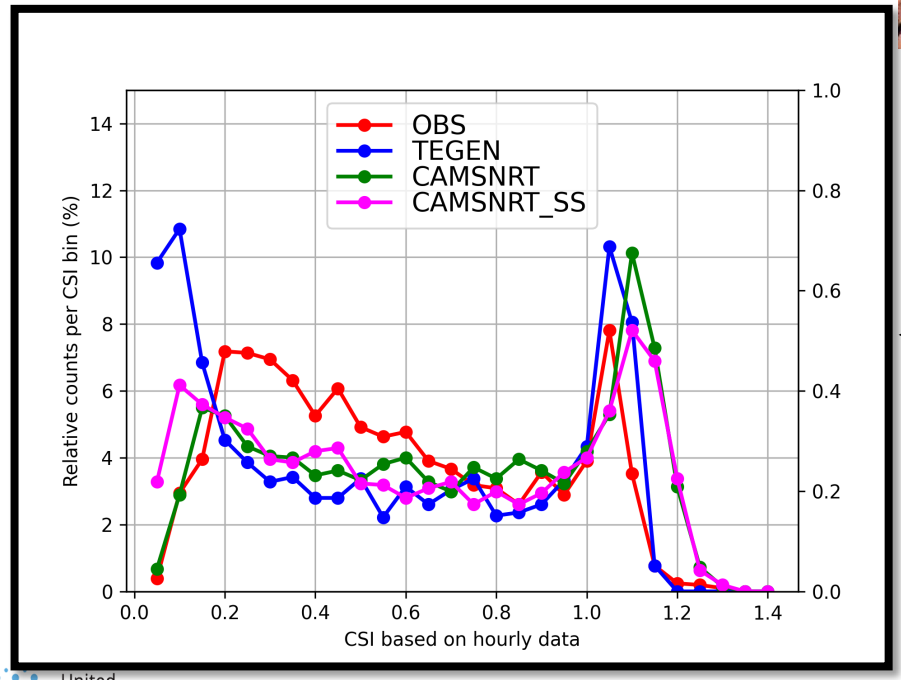
- Verification against observations that have passed screening developed, reaching use in operational UWC environments

- Increased exploration of ML/AI in various parts of data assimilation

Advances in the forecast model: addressing systematic errors with new atm/surface physics (response to O2R feedback)

'missing' precipitation from shallow convective clouds: scale-aware shallow convection scheme + turbulent mixing settings produce a more realistic cloud organization and significantly improve precipitation amounts and structures in such cases, without degrading other weather situations.



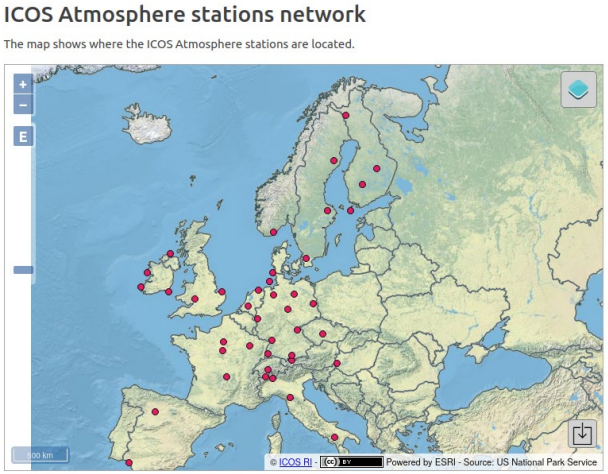


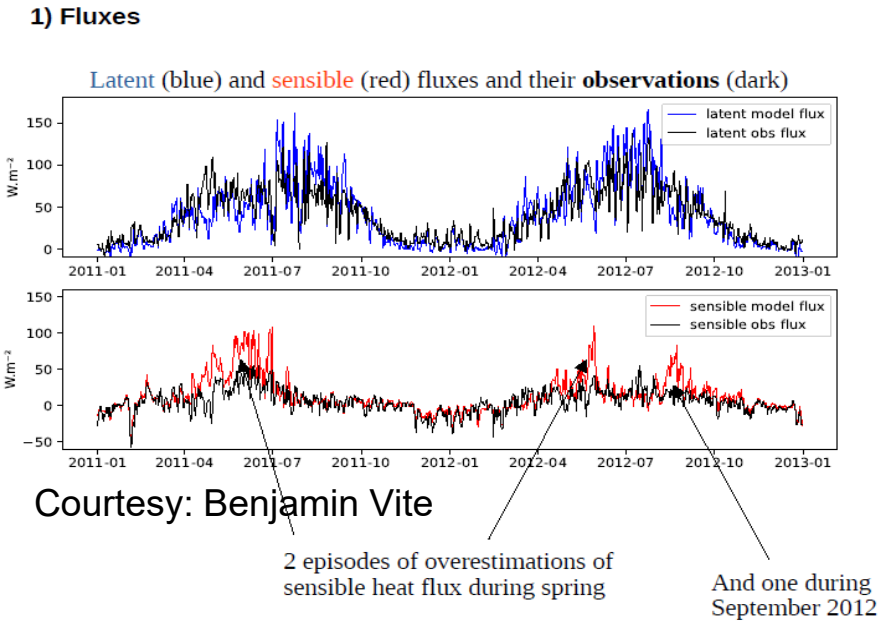
Introducing more realistic cloud-aerosol-radiation interactions: Operational Harmonie models using Tegen et al aerosol climatology produce too thick low clouds, especially over sea. Using CAMS NRT aerosols and accounting for them in radiation and microphysics leads to more realistic results, as seen in the Clear Sky Index. More validation of the cloud-aerosol-radiation interaction and the microphysics will remain a key focus in 2026.

Struggling with the ISBA-DIF many-layer soil scheme

Performance assessment of the many-layer surface physics scheme ISBA-DIF has shown systematic and persistent problems, esp. soil drying in spring and summer over grass and low vegetation. Extensive validation efforts and sensitivity studies have been and are being performed to uncover the root causes of this behaviour:

- Using detailed flux and soil observations from ICOS stations (OSVAS tool)
- Sensitivity studies against supersites like Lindenberg, showing e.g. great sensitivity of model soil behaviour to LAI changes, to the relative fraction of sand and clay in each soil layer, and to the presence of soil organic carbon in the top few cm of the soil.





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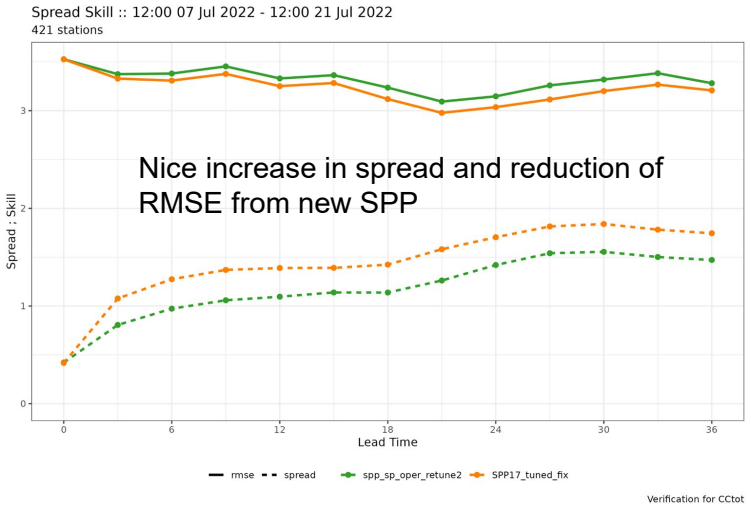
HarmonEPS advances: model uncertainty (1)

- In **MEPS** we use **SPP** (Stochastically perturbed parameters) for describing model uncertainty - an important part of the ensemble system
- SPP in MEPS operational since summer 2022, but with only 5 perturbed upper air physics parameters
- Extensive update to the SPP nearly ready from Hirlam side to hand over to the operational groupings (MetCoOp, UWC-W) for testing in operational environment
- Update includes perturbations to 11 new upper air physics parameters, 2 surface parameters and 1 dynamics perturbation, a total of 19 parameters



Spread-skill comparing old SPP setup and new SPP setup

Only SPP is activated here, no other perturbation schemes

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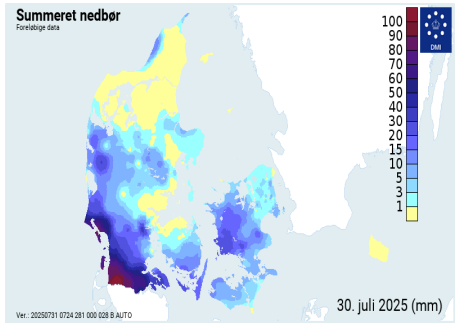
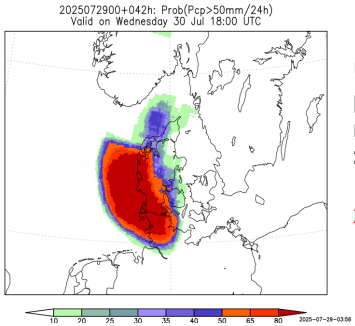
High Resolution Hirlam Limited Area Model

HarmonEPS advances: sub-km resolution and common workflow (2)

- In the context of DestinE/Extremes, EPS@750m is part of the near real time runs since June
- The EPS work done in DestinE will greatly benefit EPS cooperation between ACCORD partners, through use of the same workflow
- The example is showing a high precipitation event over Denmark this summer. The EPS runs at 750m are giving a sharper prediction for the high amounts, and in the right place, than the operational forecast (2km UWC-W run)



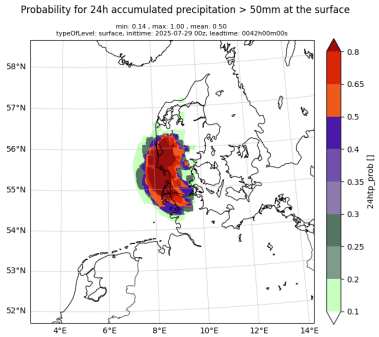
Observed



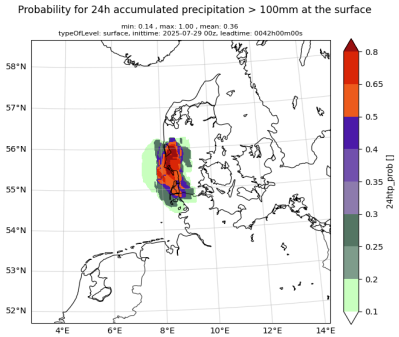
Upscaled probability for rain
> 50 mm/24h

2km

Operational forecast@2km



Upscaled probability for rain
> 50 mm/24h **750m**



Upscaled probability for rain
> 100 mm/24h **750m**

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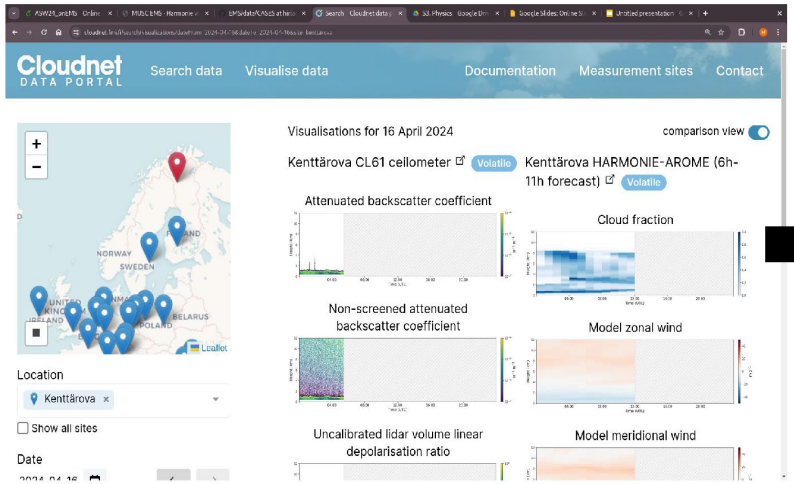
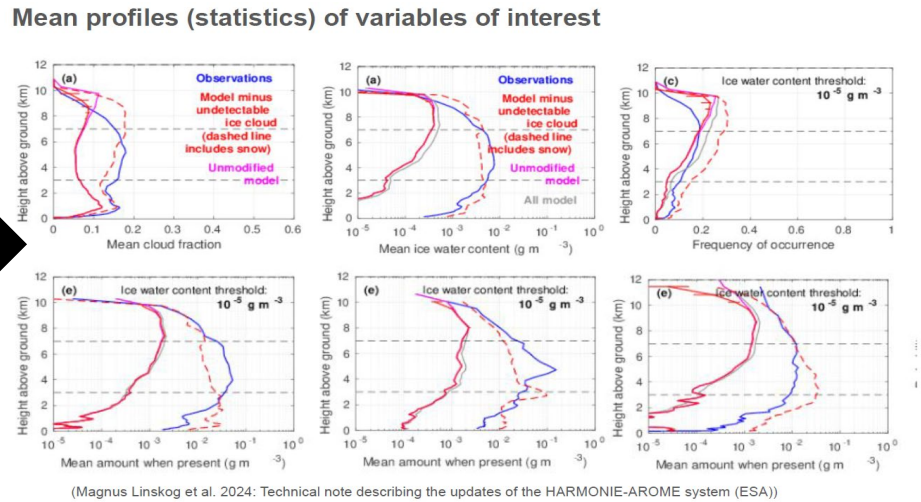
High Resolution Limited Area Model HIRLAM

Advances in meteorological quality assurance

- Greater standard use of **process-relevant observations** from dedicated networks like Cloudnet and ICOS for component-wise model validation in error attribution studies





(Magnus Linskog et al. 2024: Technical note describing the updates of the HARMONIE-AROME system (ESA))

- Make more obs types available for **routine verification**: observations from screening, radiation stations, ...

- Setting up a common UWC meteorological quality assessment **working environment and infrastructure**: from getting the right observations, via shared tools and common modernized workflow, to sharing outcomes from experiments and operational runs on a common UWC data portal and communication platform

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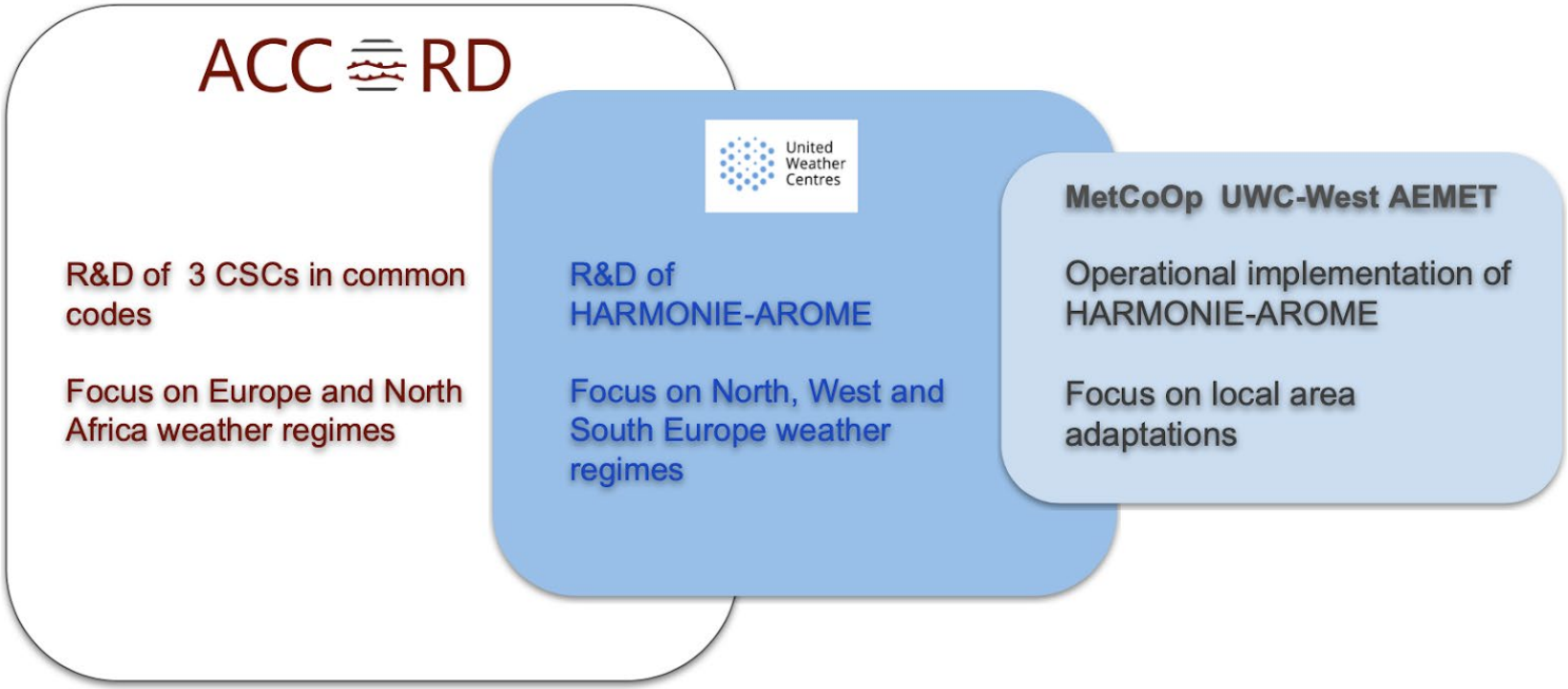
The new UWC organization



New UWC MG (under construction):

- Responsible for the evolution of the (NWP) system to be used in UWC operations
- Programme Manager (= ACCORD CSC-leader for Harmonie-Arome)
- 5 Team Leaders
- 1 Machine Learning Liaison Officer

On a personal note...

As this will likely be my last SRNWP/EWGLAM meeting...

A great thanks to all SRNWP/EWGLAM colleagues (past and present) for truly inspiring moments of collaboration and fun!

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Thank you for your attention!

Any questions?