

Quality Assurance in UWC

Kristian Pagh Nielsen, DMI
6th ACCORD All Staff Workshop,
Marrakech, Morocco, 2026-04-14

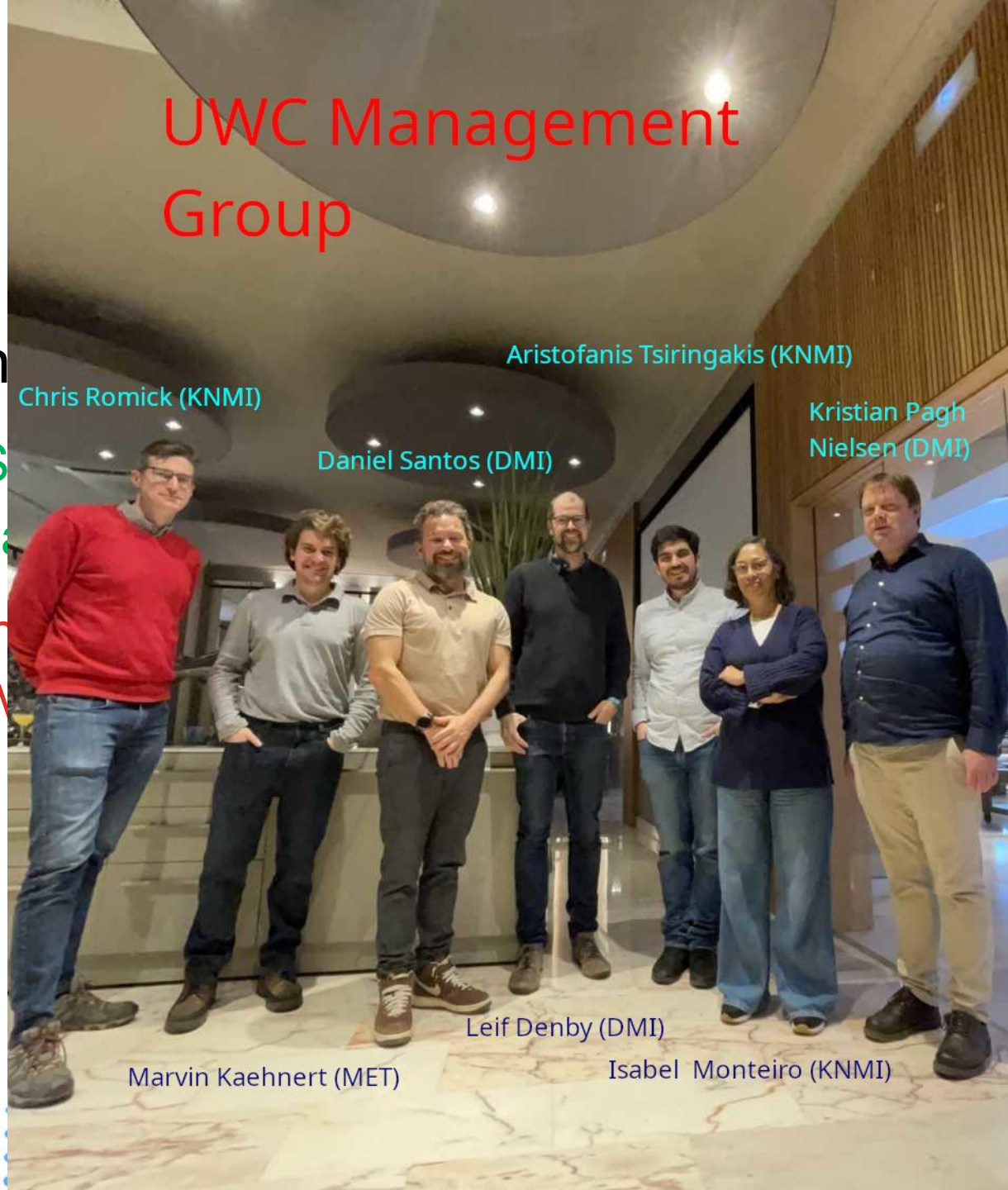
What is UWC

- The 10 United Weather Centre participants:
 - MetCoop: Sweden (SMHI), Norway (MET Norway), Finland (FMI), Estonia (ESTEIA) & Latvia (LEGMC)
 - UWC-West: The Netherlands (KNMI), Denmark (DMI), Ireland (Met Éireann) & Iceland (IMO)
 - Spain (AEMET)

What is UWC

- The 10 United Weath
 - MetCoop: Sweden (S), Estonia (ESTE) & Latvia (LA),
 - UWC-West: The Netherlands (NED), Ireland (Éireann) & Iceland (IM),
 - Spain (AEMET)

UWC Management Group



Destination Earth, Copernicus, Horizon, ... projects

ACC  RD

R&D of 3 CSCs in common
codes

Focus on Europe and North
Africa weather regimes



R&D of
HARMONIE-AROME

Focus on North, West and
South Europe weather
regimes

MetCoOp UWC-West AEMET

Operational implementation of
HARMONIE-AROME

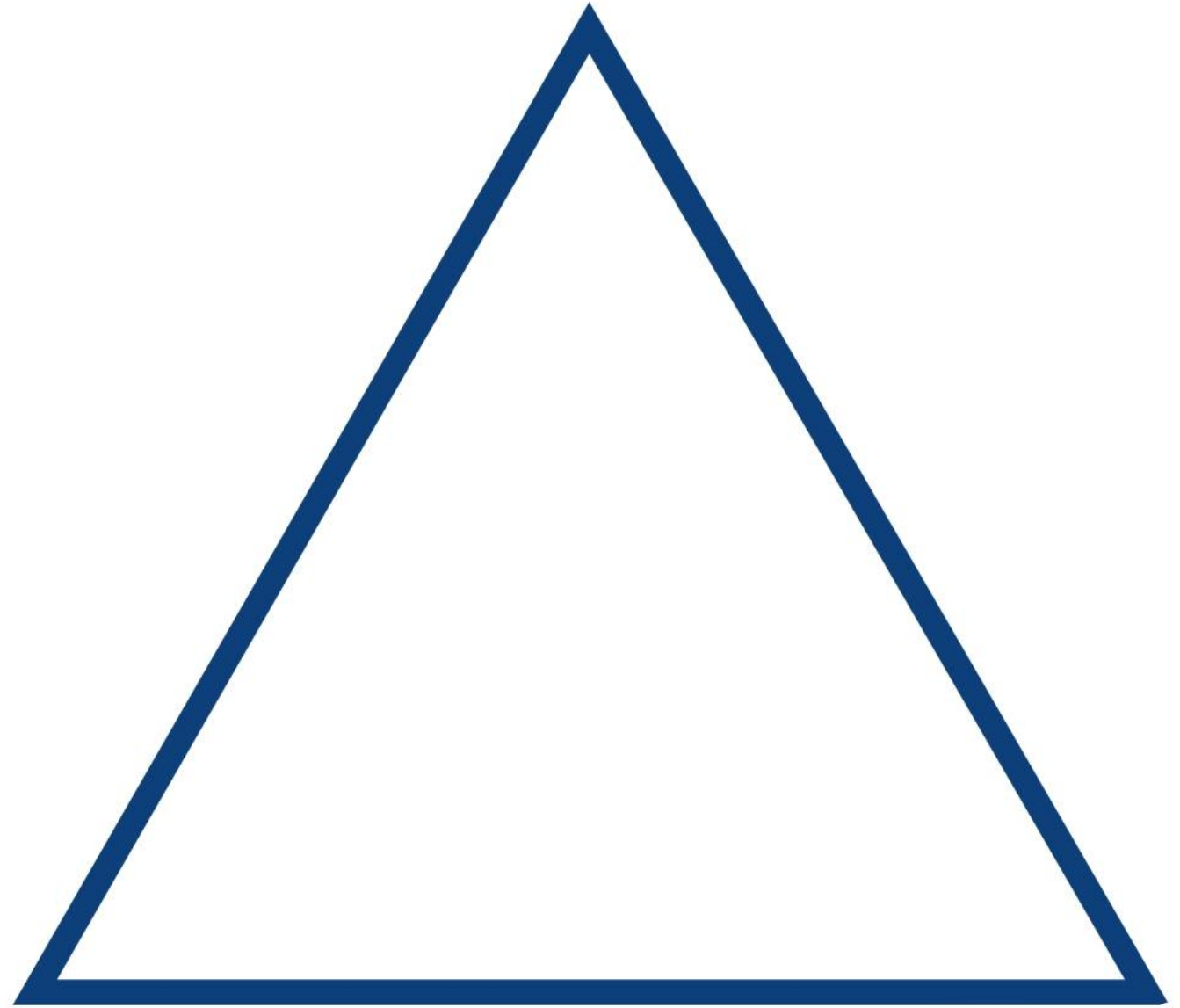
Focus on local area
adaptations

R20

O2R

Slide by
Daniel
Santos

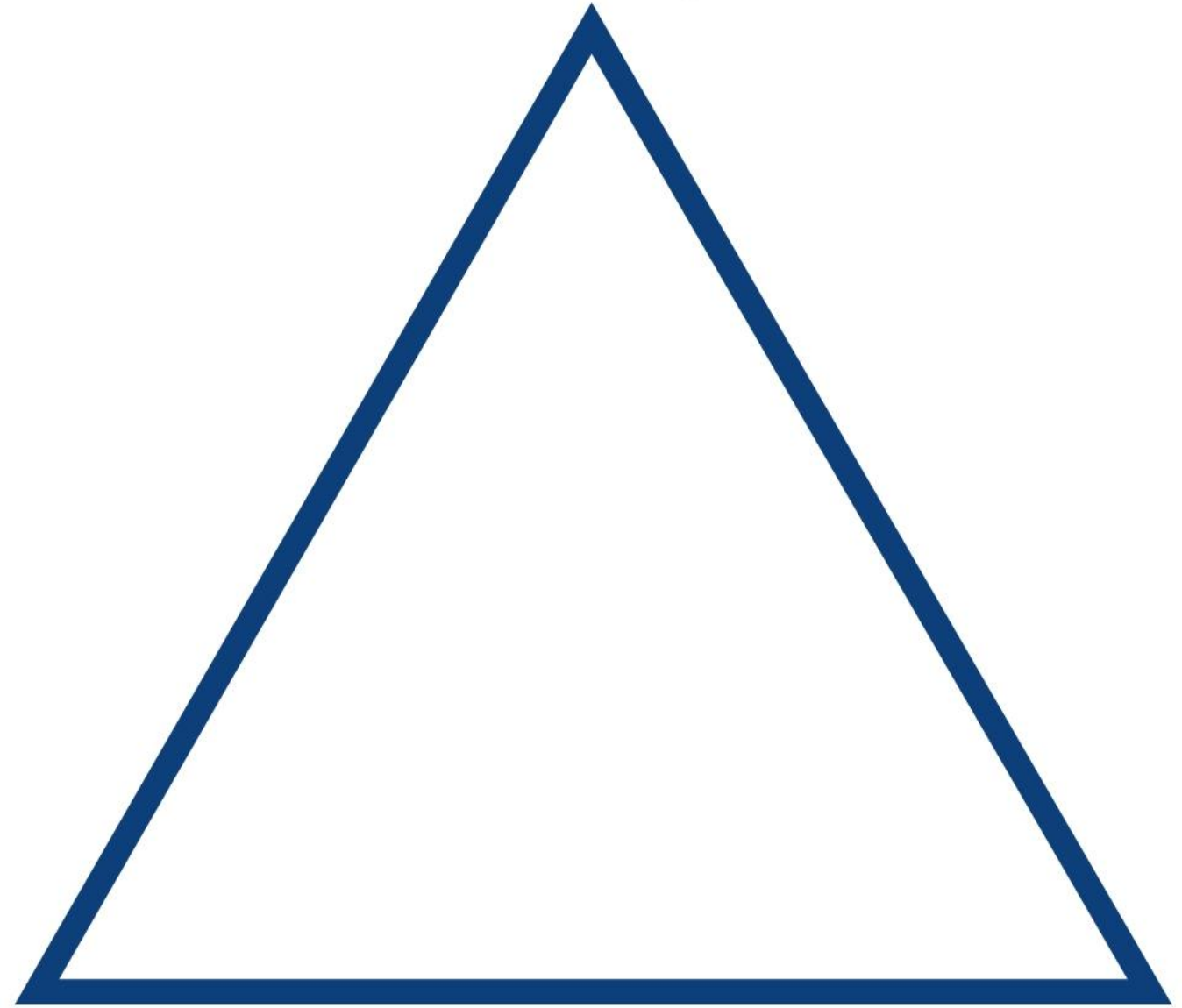
QA triangle



Employee making a product
and documenting this



QA triangle

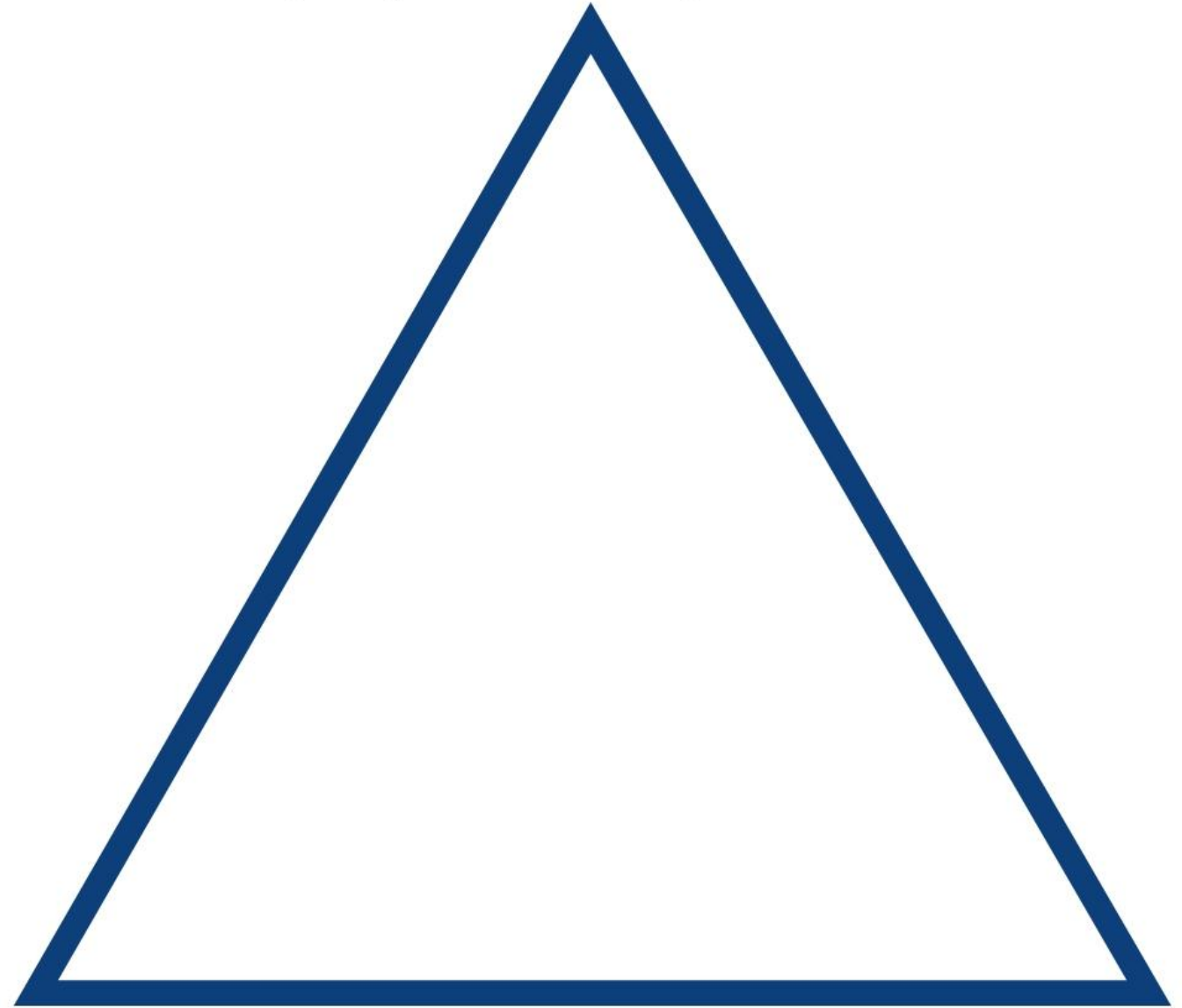


Employee making a product
and documenting this

Employee verifying a product
and its documentation

QA triangle

Manager that ensures that the
quality assurance is performed



Employee making a product
and documenting this

Employee verifying a product
and its documentation



QA terminology

- **Validation** - Ensuring that things are done right, e.g. for a software update: Does it have an impact? If yes, does it have the expected impact?
- **Verification** - Quantitative test of an update
- **Subjective evaluation** - Which improvements do the end-users need?, that is the forecasters, emergency services, etc.
- Beware: Some use verification/validation in the opposite order!

Verification at sub-km scale

Progress during DEODE and HIRLAM

Fractional skill score

Precipitation case from
Tuscany, October 2024

Opera composite data
used for validation of
HARMONIE-AROME
and AROME at 2 km and
500 m resolution

Figures by Samuel Viana
& Co.

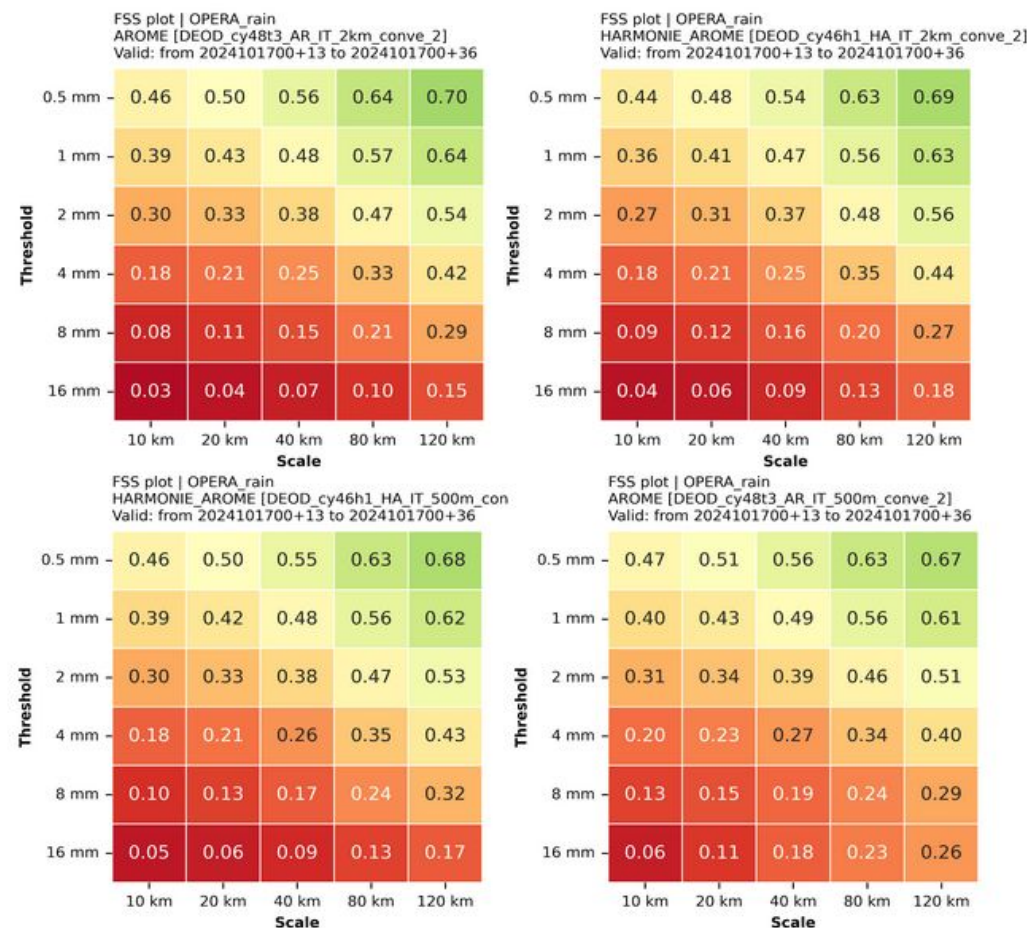
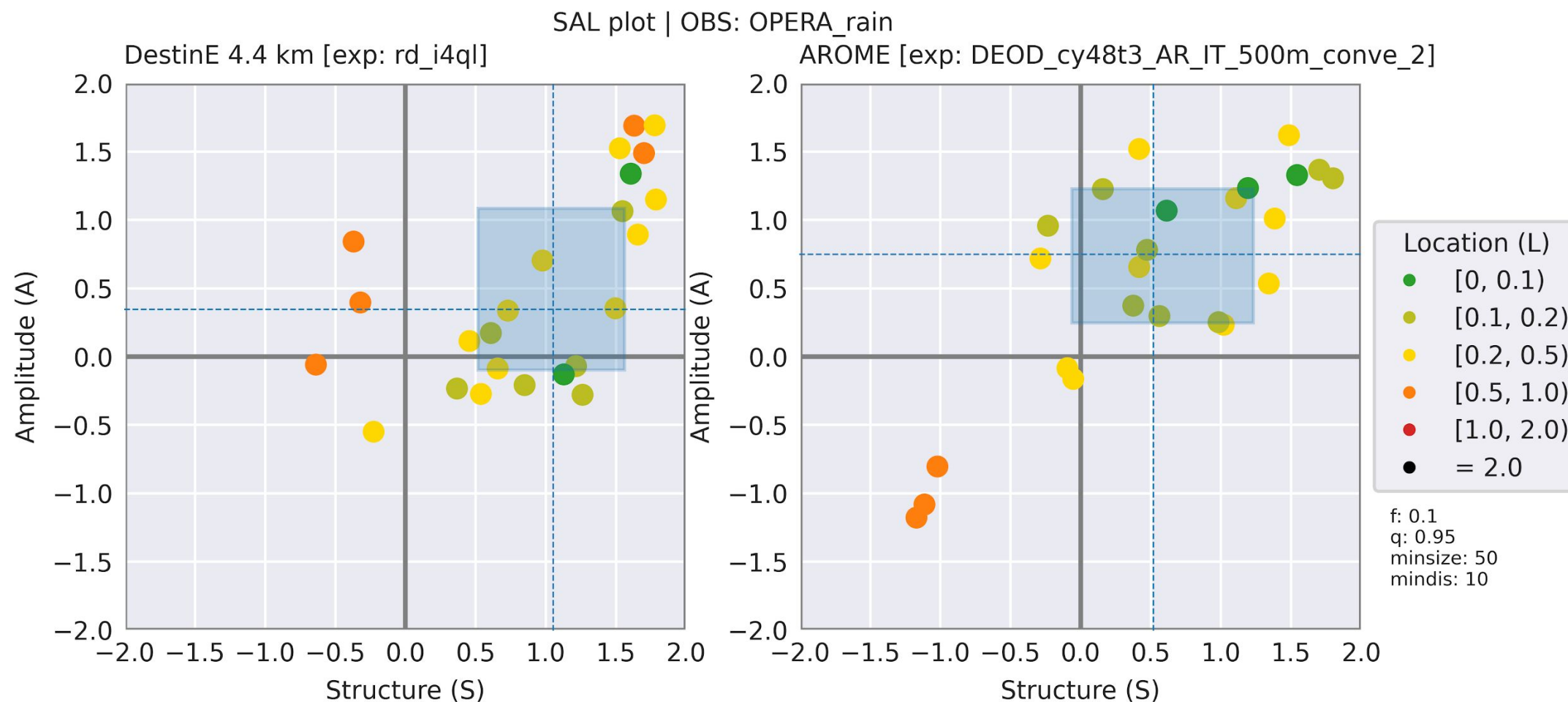


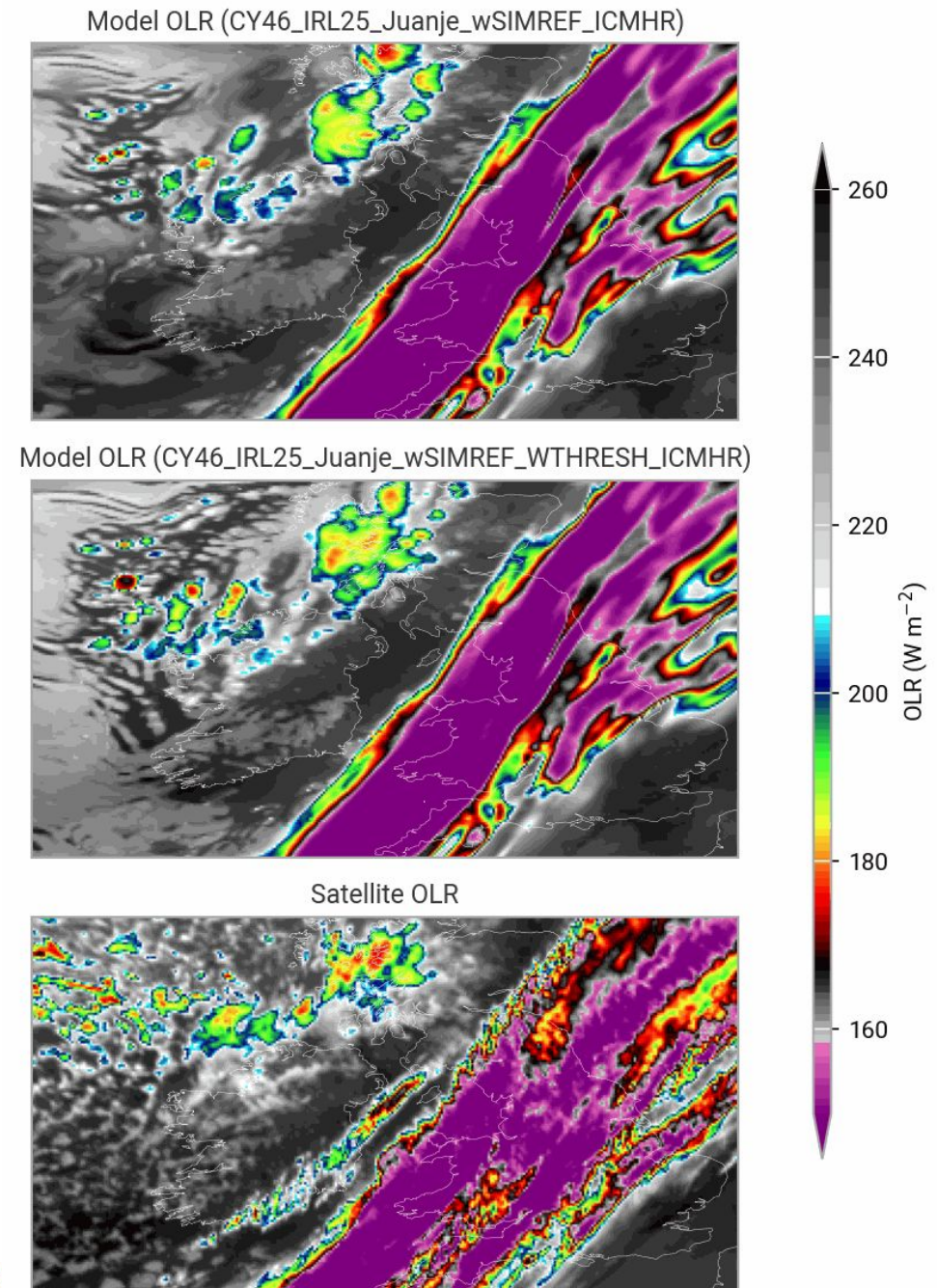
Figure 9. FSS scores (mean for all the hours associated with the event) for different thresholds and scales for AROME OD-DT at 2 km (upper-left), HARMONIE-AROME OD-DT at 2 km (upper-right), AROME OD-DT at 0.5 km (bottom-left) and HARMONIE-AROME OD-DT at 0.5 km (bottom-right). Observational source: OPERA. Better performance: close to 1.

Structure, Amplitude, Location (SAL) plots



Evaluating with MTG satellite data and DDH

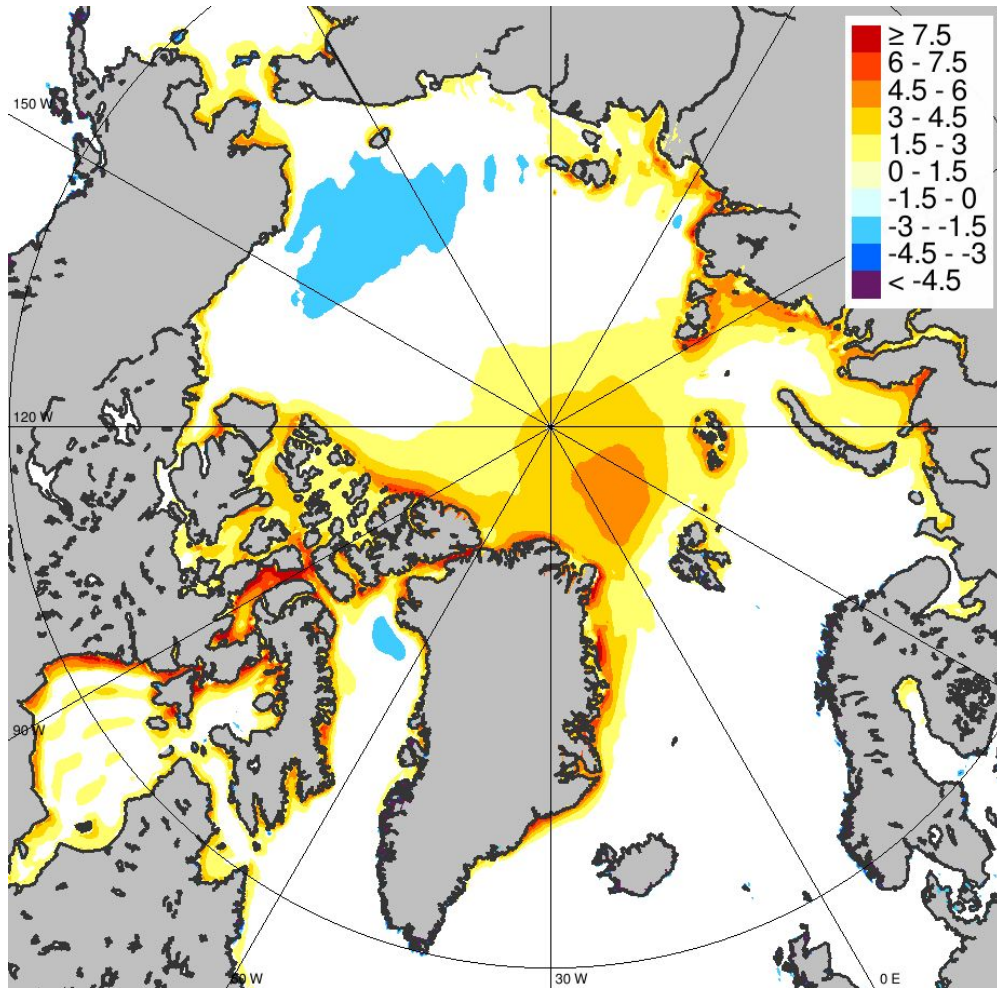
- Emily Gleeson cy46h runs for Ireland and Great Britain 2025/3/28
- Comparing w threshold methods for convection
- Juan Jesús González-Alemán comparing with MTG FCI Outgoing Longwave Radiation (OLR)
- Ongoing work by Juanje, Marvin & Carlos to track the cells using cloud tracking and study them with DDH



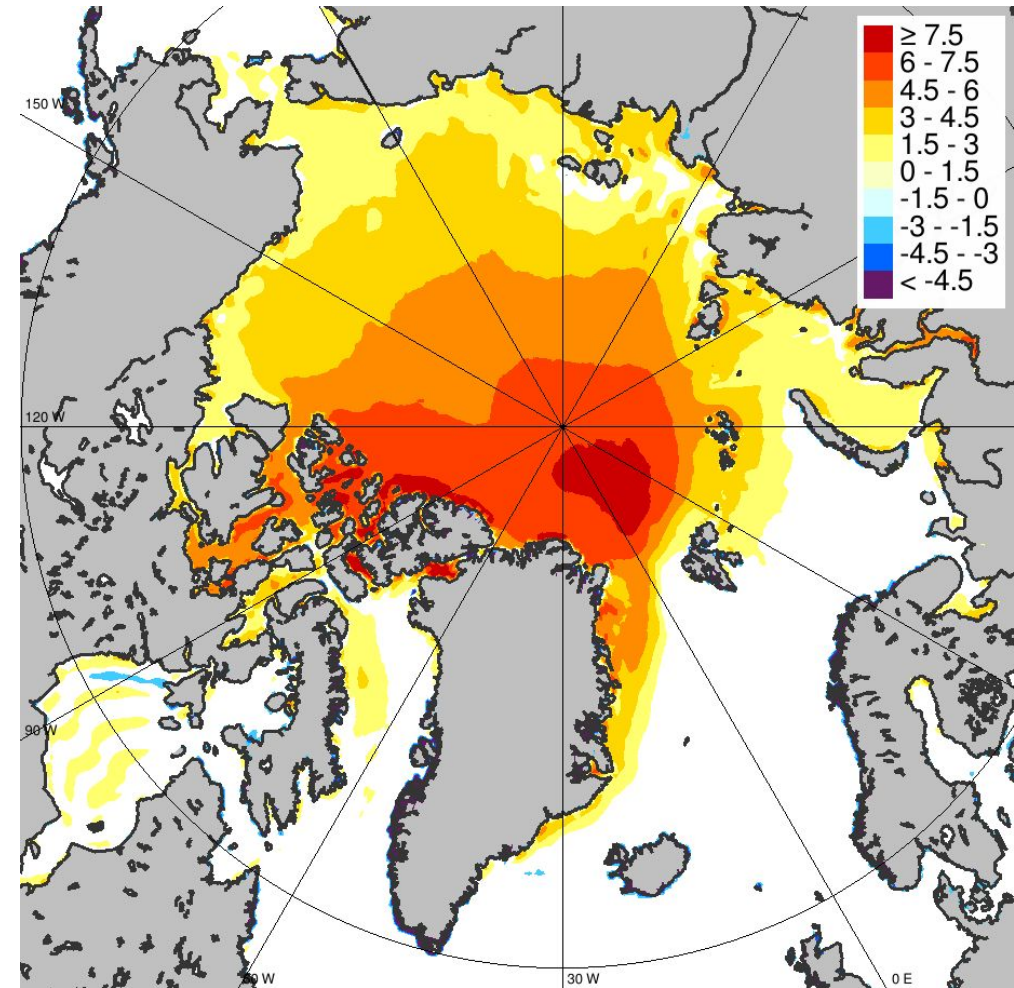
What is the truth in verification?

- Ground-based measurements?
 - Quality control of these is essential,
 - ..., but even with the best QC measurements still have uncertainty
- Reanalysis data?

Preliminary results for sea ice skin temperature



CARRA2 bias: DJF 24 years

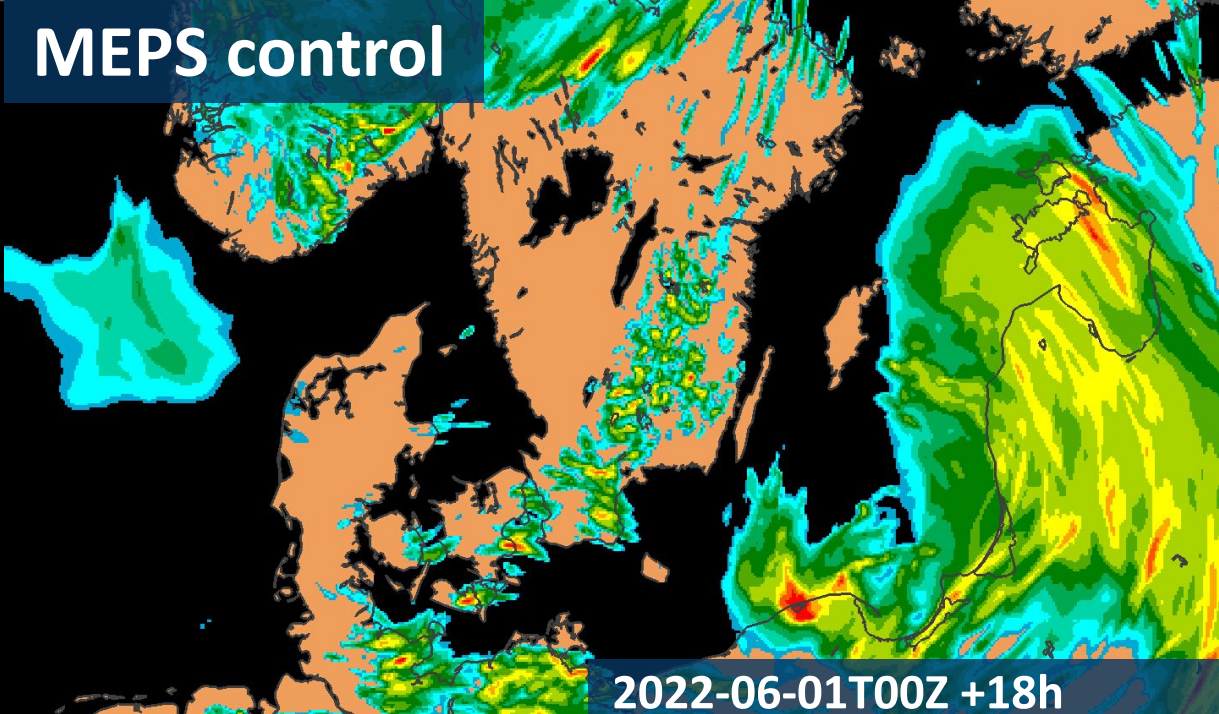


ERA5 bias: DJF 24 years

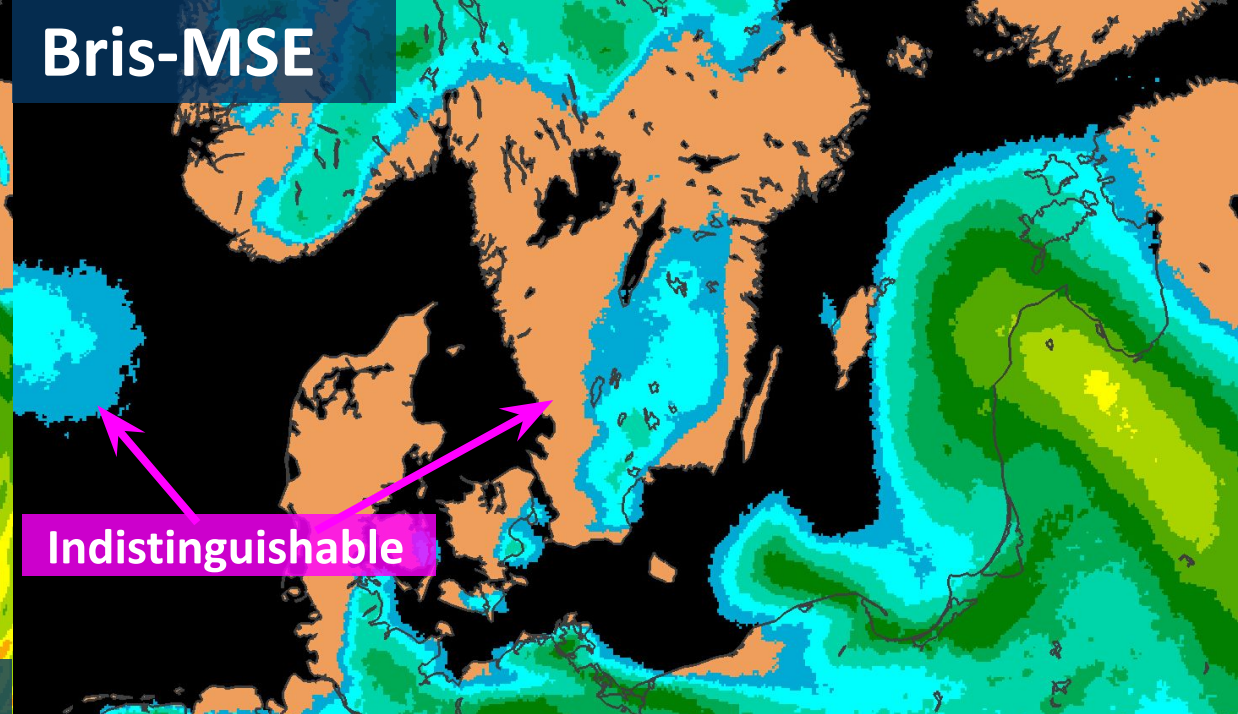
What is the truth in verification?

- Ground-based and remote measurements?
 - Quality control of these is essential,
 - ..., but even with the best QC measurements still have uncertainty
- Reanalysis data?
 - Reanalysis data are great, but are not “the truth”!
 - Sometimes is better to use “difference” in stead of “bias” and “Root Mean Square Difference (RMSD)” in stead of “RMS Error (RMSE)”!

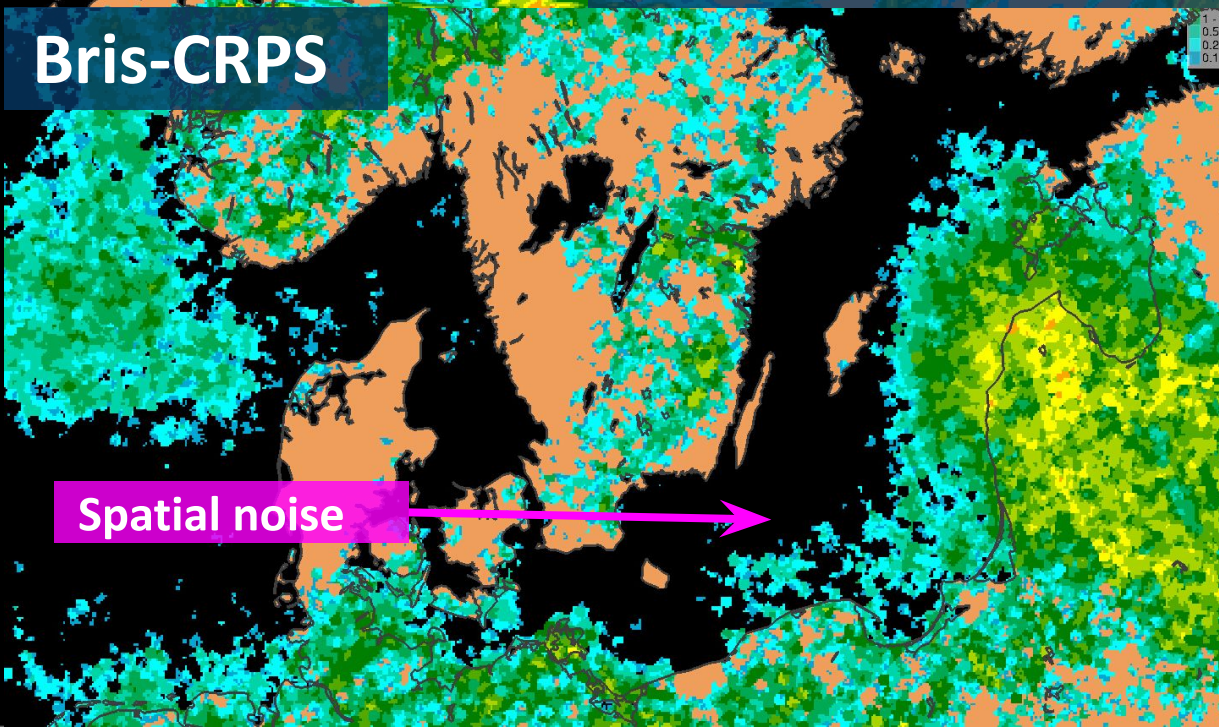
MEPS control



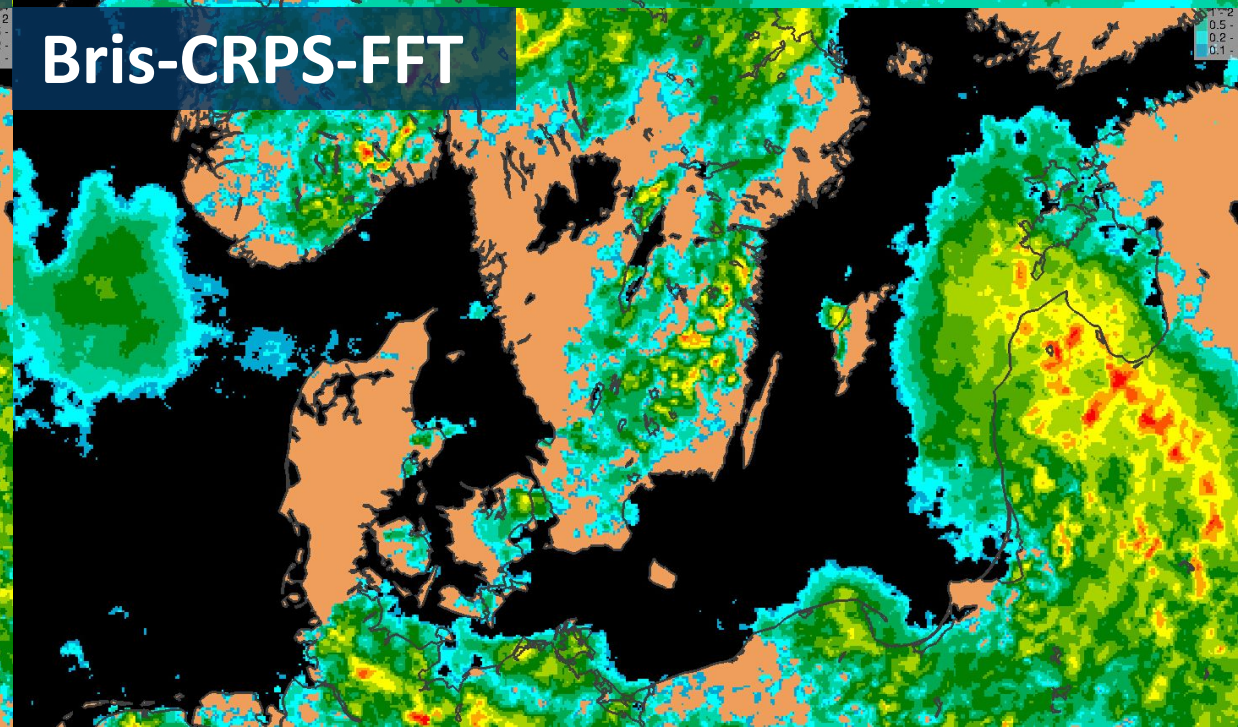
Bris-MSE



Bris-CRPS



Bris-CRPS-FFT

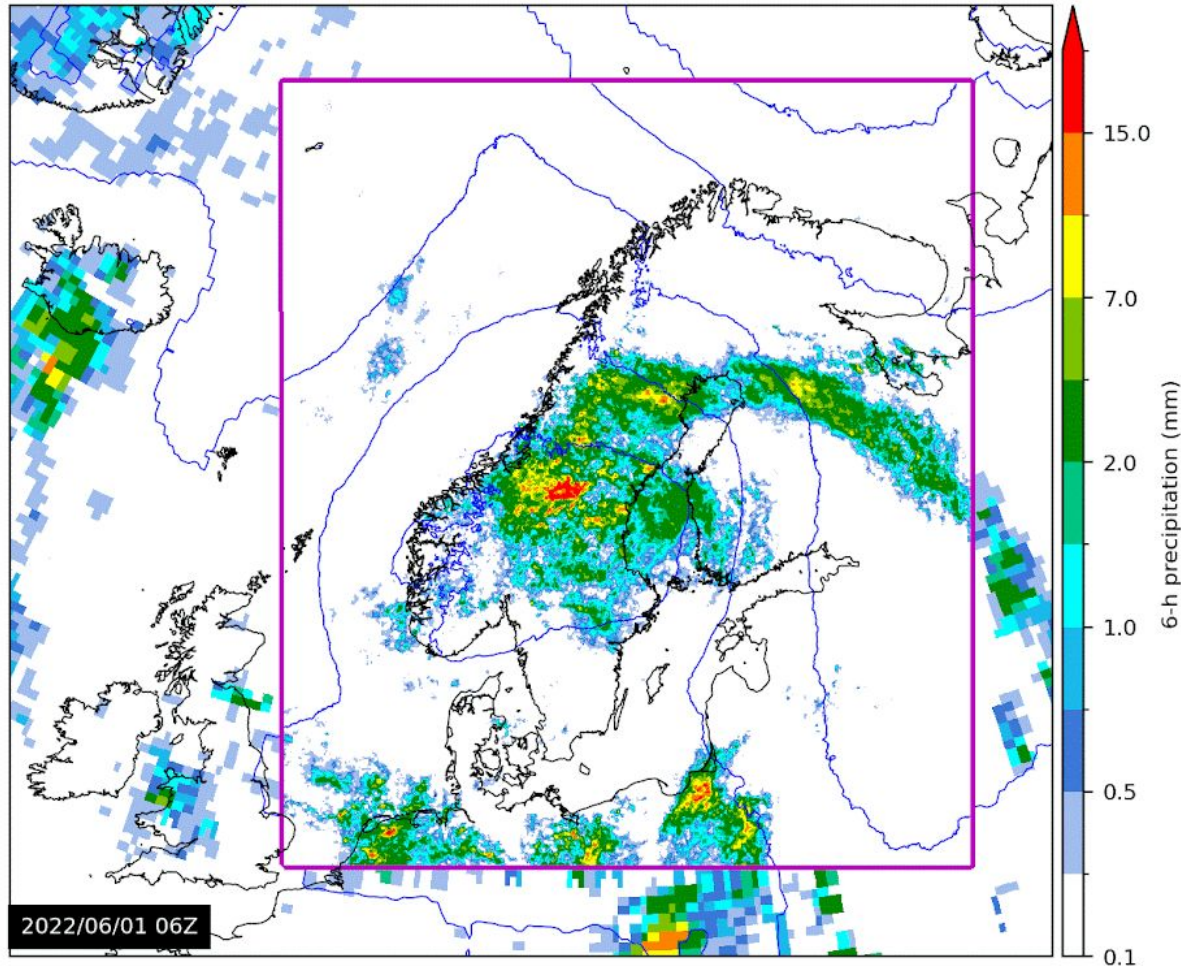


CRPS-FFT movie loop

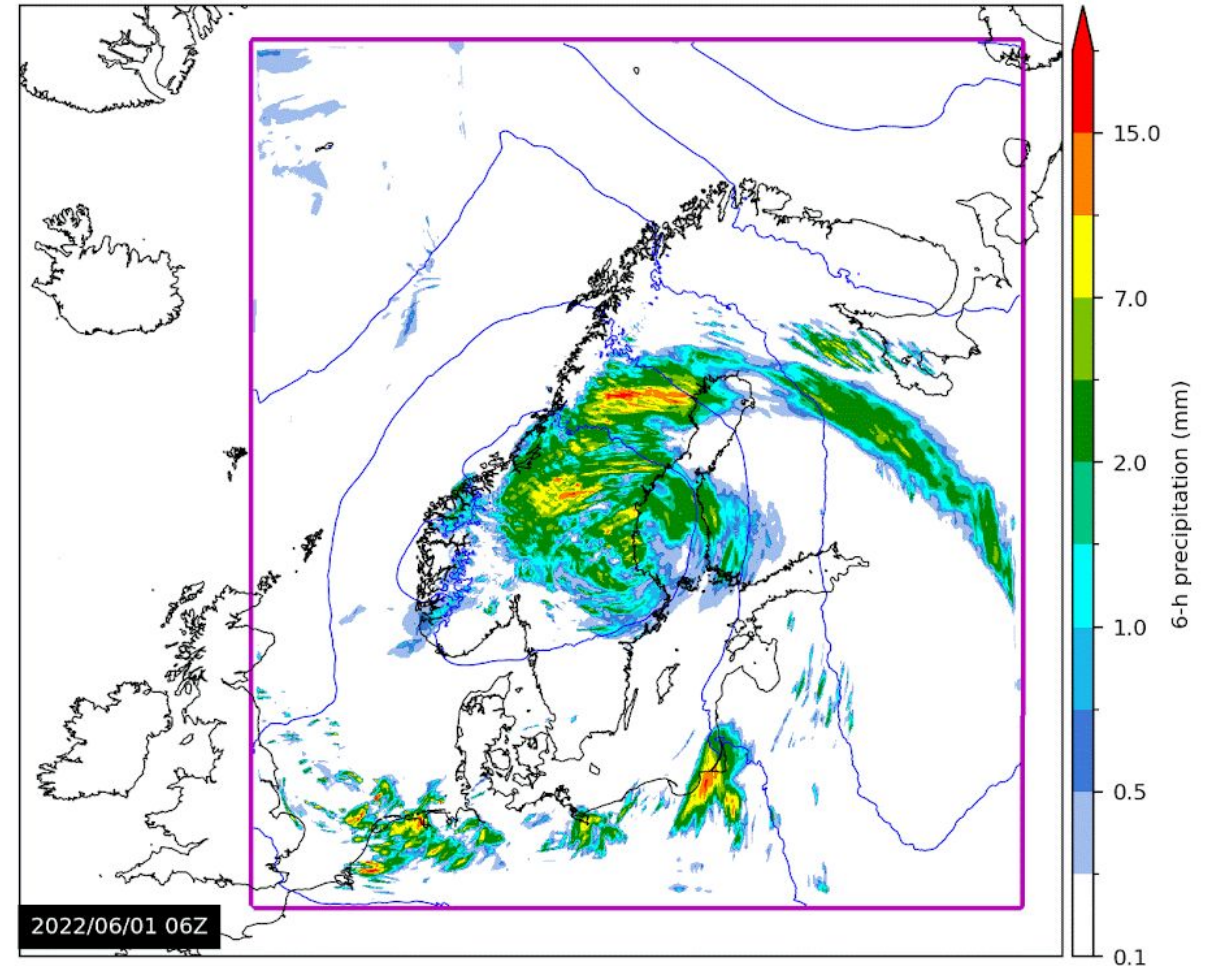
17

Bris slides from Thomas Nipen et al. (DEODE: DE330140); <https://arxiv.org/html/2511.23043v1>

Bris

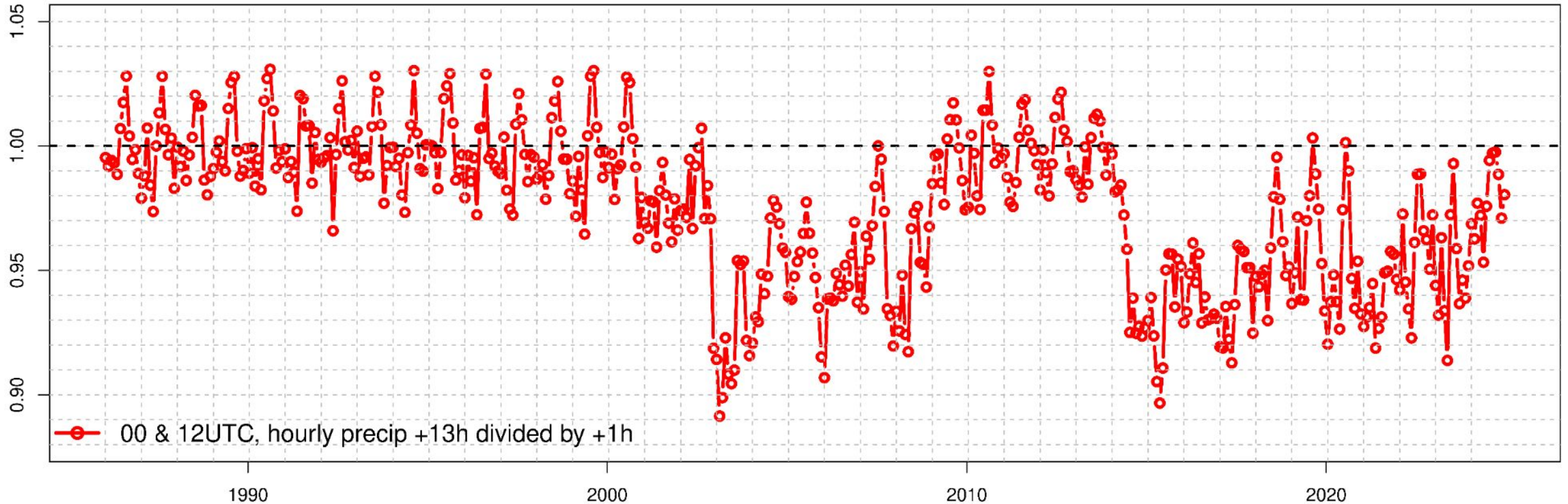


MEPS

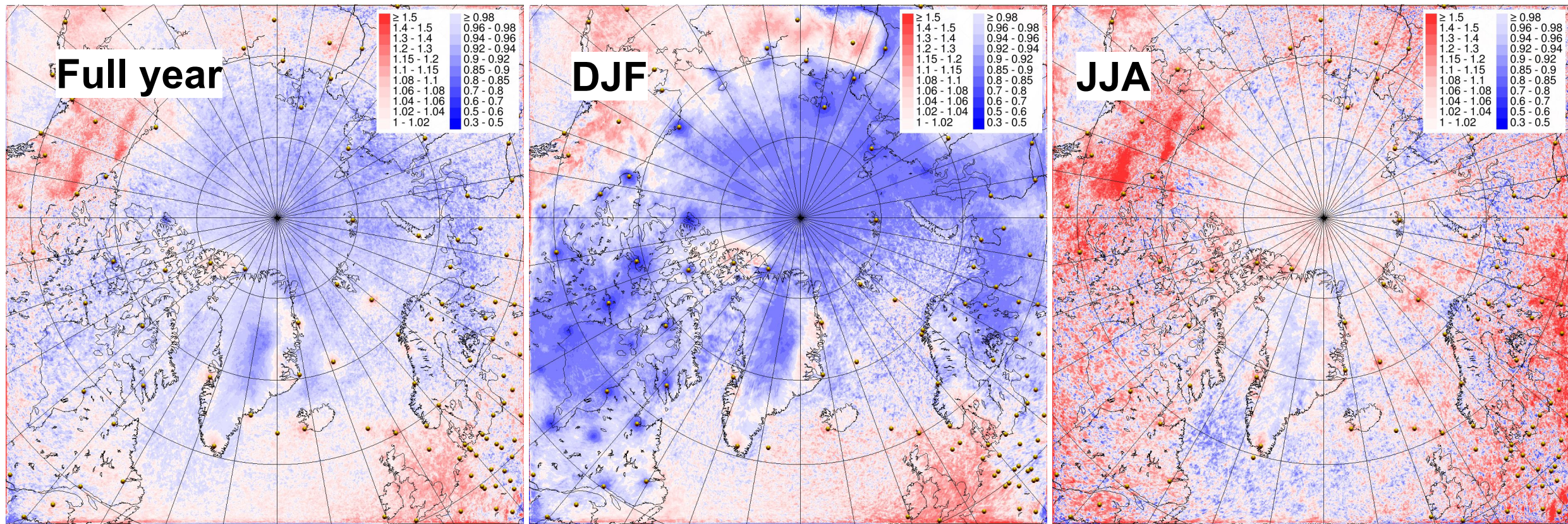


Precipitation spinup/down
CARRA2

Spinup/spindown of precipitation



- **Domain average** (monthly) hourly precipitation from +13h forecasts (00 & 12 UTC runs) divided by +1h forecasts, i.e. same time of the day, values above 1 indicate “spinup”, values below 1 indicate “spindown”
- 1986 - 2001 & 2009 - 2013; fluctuations around 1 (2-3%) ==> small spinup in summer, small spindown in winter
- 2001 - 2008 & 2014 - 2024; well below 1 (0-10%) ==> spindown
- *Is this due to changes in the assimilation data used?*



Years with neutral Spinup/down & radiosondes locations marked

- Average hourly precipitation from +13h forecasts (00 & 12 UTC runs) divided by +1h forecasts, for the years with “spindown” in the time series, i.e. 1986 - 2001 & 2009 - 2013. **Blue indicate spindown, red indicate spinup**



Thank you for your attention!

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Subjective evaluation of forecasts

- National forecaster contact points:

M
e
t
C
o
o
p

U
W
C
-
w
e
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t

- Met Norway: Gunnarn@met.no (Gunnar Noer)
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