# ACCORD

A Consortium for COnvection-scale modelling Research and Development

## Overview of EPS activities in ACCORD

Henrik Feddersen, 28 March 2023, ACCORD All-Staff Workshop, Tallinn

# Rolling Work Plan – EPS headlines

- **Perturbations**
  - Initial conditions
  - Lateral boundary conditions
  - Surface
  - Model
- **Preparation for operations**
- **Calibration and post-processing**
  - Calibration
  - User-oriented approaches

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# Operational EPS in ACCORD

After operationalization of UWC-West



**National**
**Shared**

**National**
**Shared**

**Cy40**
**Cy43**
**Cy46**
**Multi-model**

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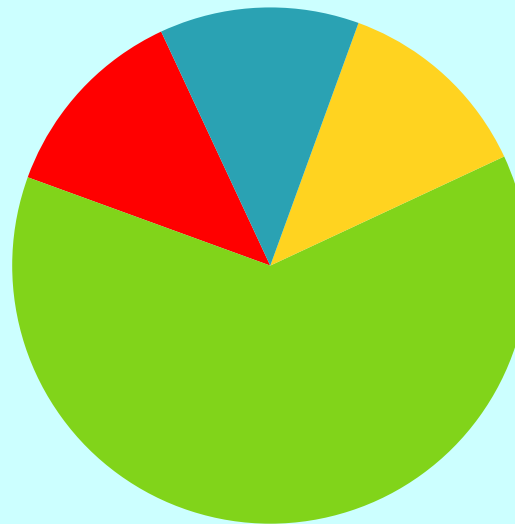
# Operational EPS in ACCORD

## Horizontal resolution



- 🟥 1.3km
- 🟩 2.5km
- 🟨 4.8km

## Vertical levels



- 🟥 60
- 🟩 65
- 🟨 90

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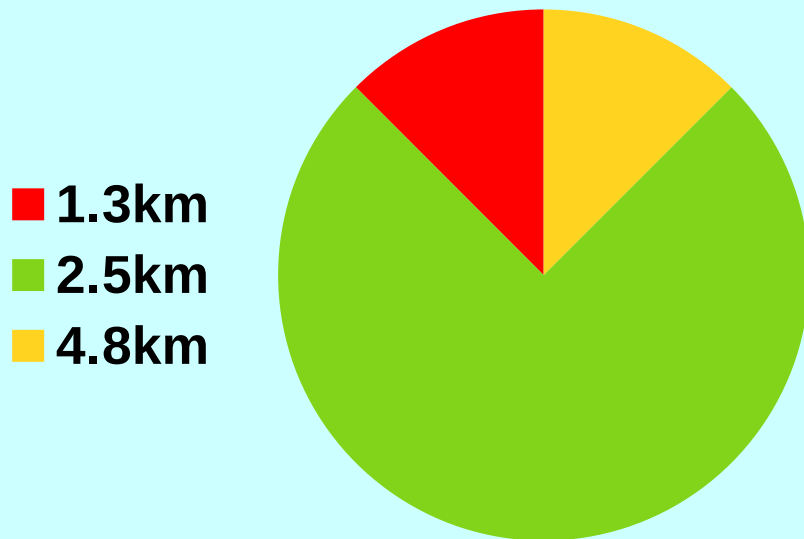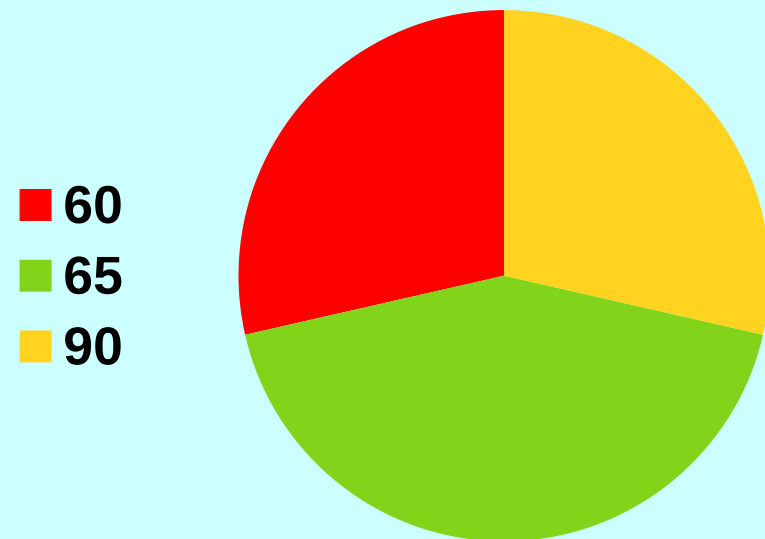
# Operational EPS in ACCORD

## Ensemble runs per day

- 🟥 2
- 🟩 4
- 🟨 8
- 🟦 24

## Members per run

- 🟥 10-20 (+ctrl)
- 🟦 3-5 (+ctrl)
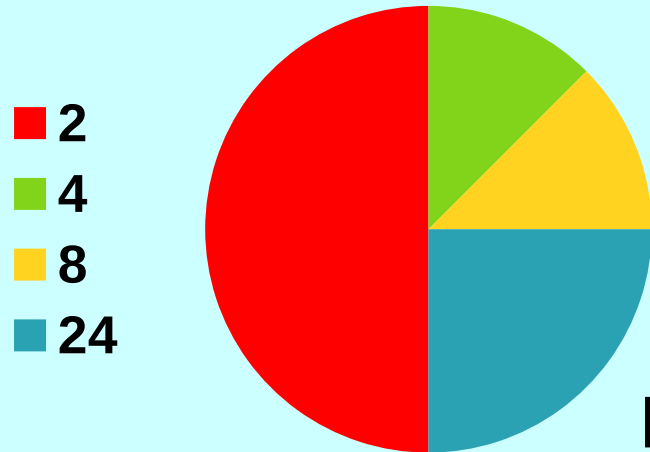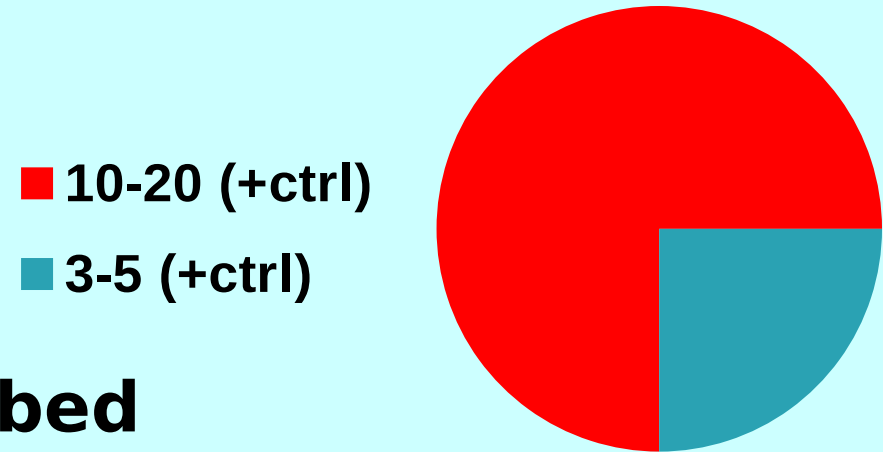
## Perturbed members per day

- 🟥 20-40
- 🟩 40-80
- 🟦 120
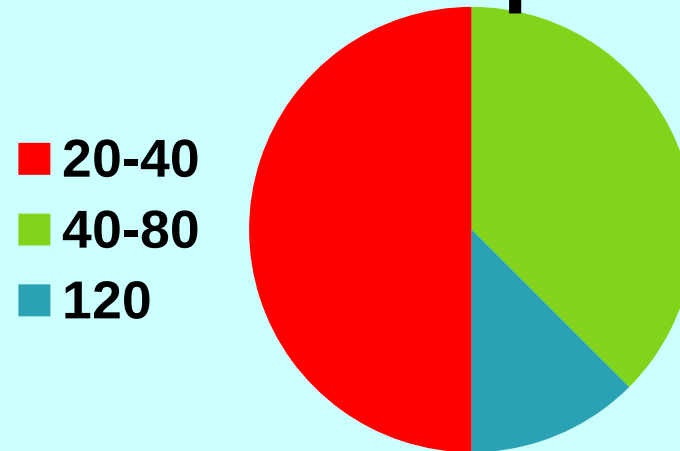
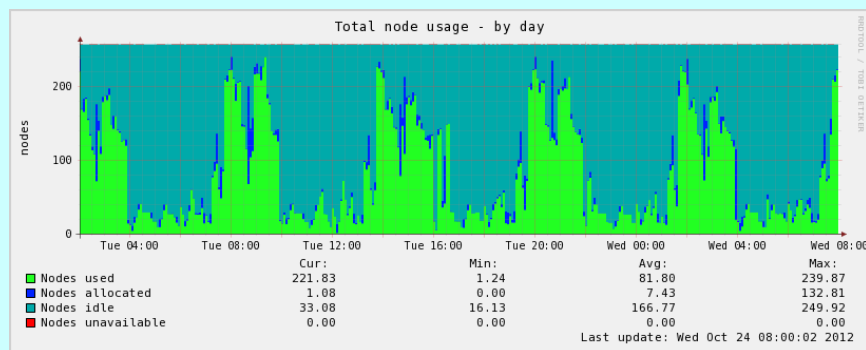# Operational EPS in ACCORD

**Runs every hour/time-lagged EPS**

**Ensemble typically includes members from 3 or 6 latest runs**

- ☺ Better distribution of computational load over the day
- ☺ Always updated members with latest observations assimilated
- ☺ Reduced forecast jumpiness
- ☹ Time-lagged members slightly less skillful

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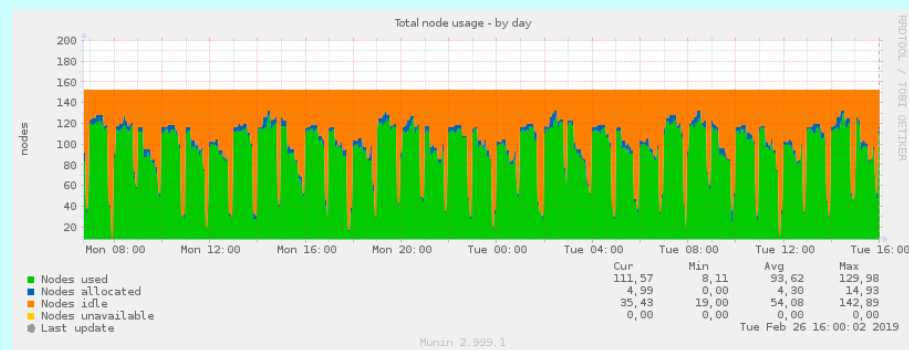
# Operational EPS in ACCORD

## Initial condition perturbations



- EDA
- Blending
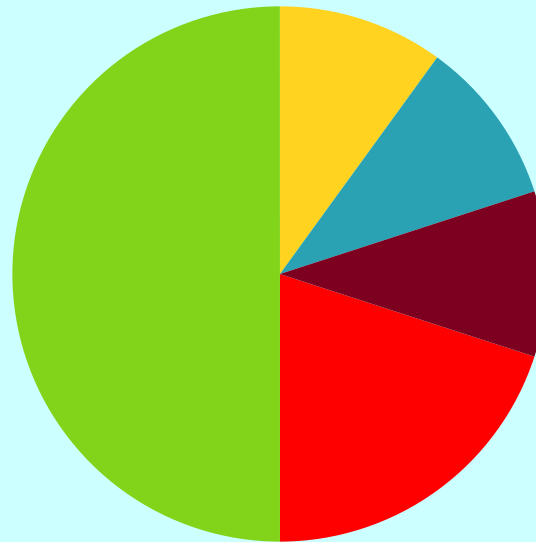- Downscaling
- Multi-model

## LBC perturbations



- Global EPS
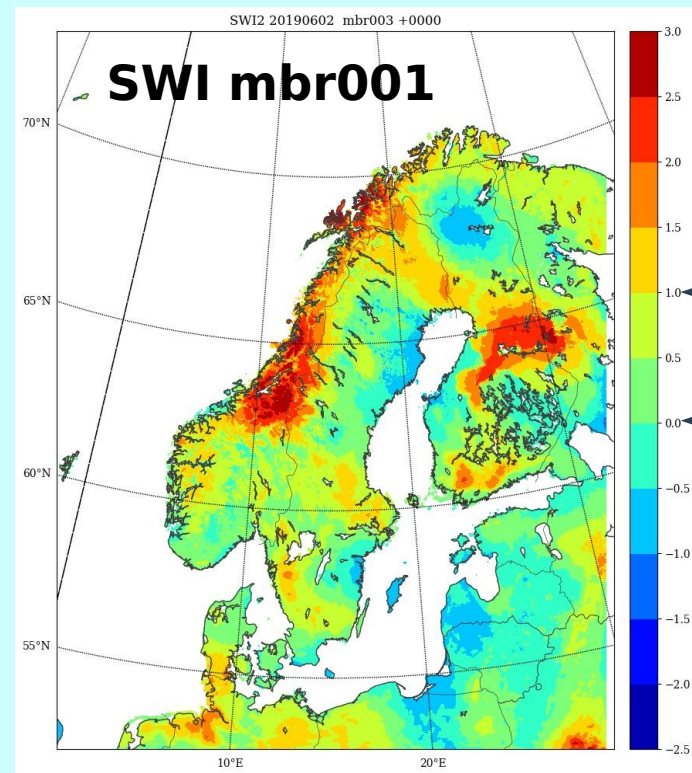- SLAF
- Multi-model

# Operational EPS in ACCORD

## Surface perturbations



Legend:
- Sfc EDA
- Stoch pert
- SPPT
- Multi-model
- None

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# Surface perturbations

- **Example: Soil moisture** (courtesy of Harold McInnes, Met Norway)
- **Stochastic perturbations (following Bouttier et al., 2016) lead to a negative humidity bias for all perturbed members**
- **Soil moisture is easily perturbed above field capacity or below wilting point**



Field capacity

Wilting point

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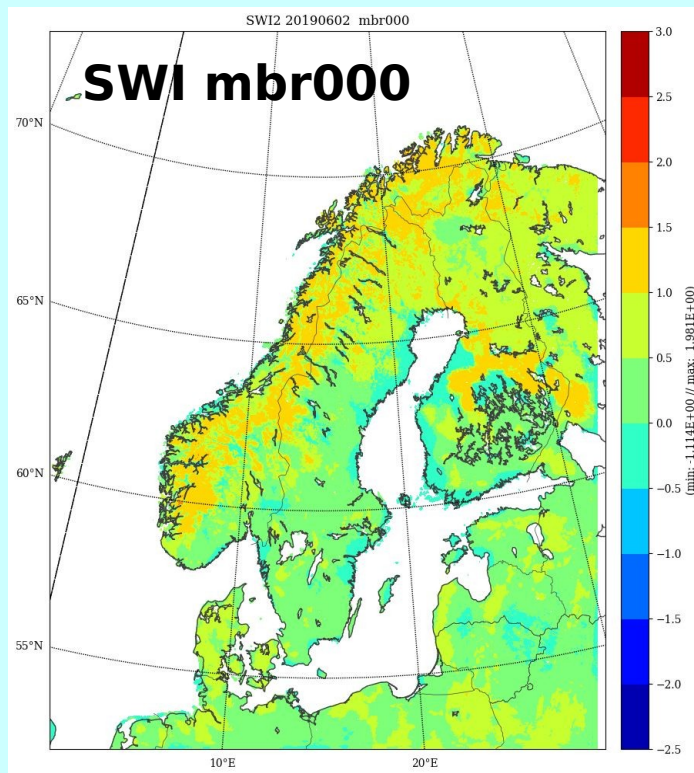
# Surface perturbations

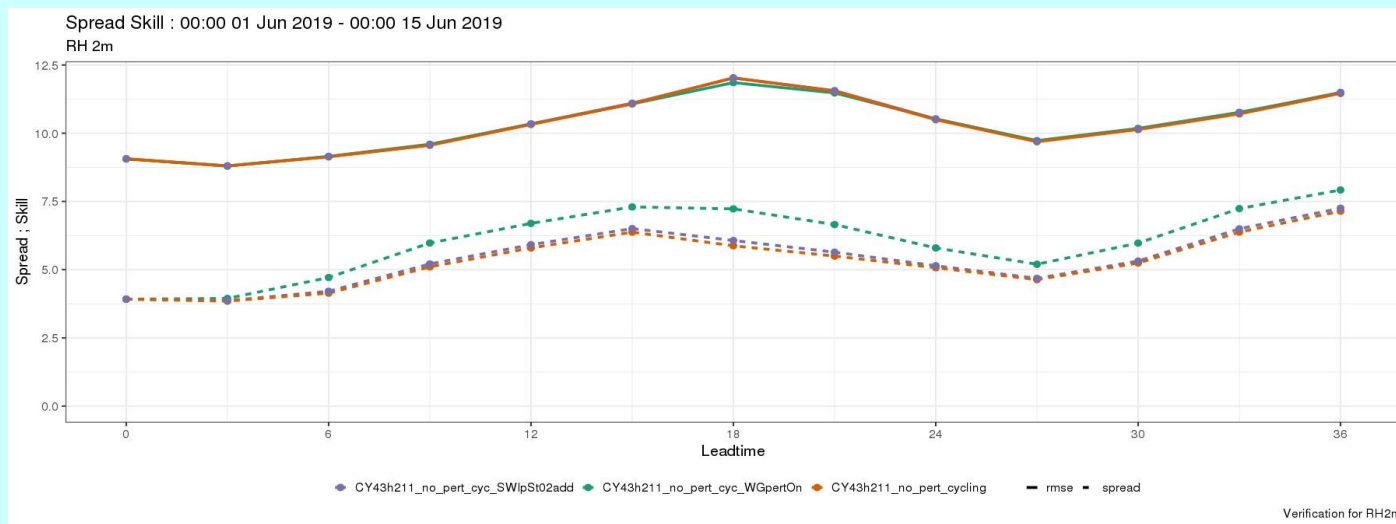- **Perturb soil wetness index (SWI) between wilting point and field capacity instead of soil moisture ➜ reduces bias        and spread**



Spread Skill : 00:00 01 Jun 2019 - 00:00 15 Jun 2019
RH 2m

- **Do not apply perturbations blindly**
- **Do not only optimize the spread/skill ratio**

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# Operational EPS in ACCORD

## Model perturbations



Legend:
- PP
- SPP
- SPPT
- Multi-phys
- Multi-model
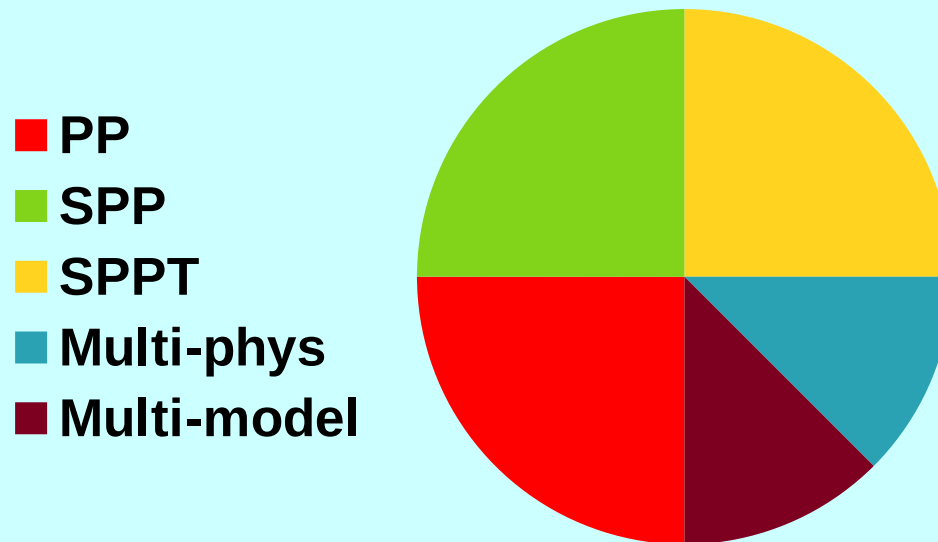
# Model perturbations

- **PP: Perturbed parameters**

  – Each member has a different (but fixed) value of one or more parameters

- **SPP: Stochastically Perturbed Parametrizations**

  – A set of parameters are stochastically perturbed with spatial and temporal correlation specified by a stochastic pattern generator

  – Perturbation at source of uncertainty

- **SPPT:  Stochastically Perturbed Parametrization Tendencies**

  – Physics tendencies are stochastically perturbed with spatial and temporal correlation

# Parameter sensitivity

- **Important to perturb parameters that matter!**

- **Pilot study by Michiel van Ginderachter (RMI) used the URANIE uncertainty and sensitivity platform from CEA to study**

  - Sensitivity of relative humidity to surface parameters in HarmonEPS

  - Optimal stochastic pattern generator correlation length scale for 2m-temperature

- **Plans to further test the use of URANIE**

  - See presentation by Inger-Lise

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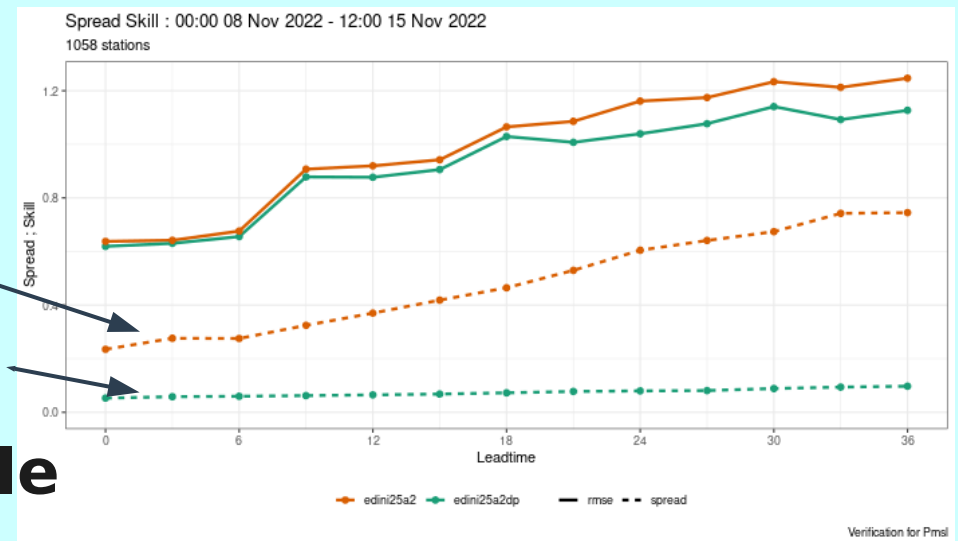Research and Development

# EPS E-suites

- **Model upgrades**

- **More SPP**

  – See presentations by Clemens and Inger-Lise

- **Run forecasts in single precision**

# Running EPS forecasts in single precision

- **30-40% gain in computational speed**

- **Spread between double and single precision smaller than spread between ensemble members**



Spread Skill : 00:00 08 Nov 2022 - 12:00 15 Nov 2022
1058 stations

Spread between control and mbr

Spread between SP and DP control

edini25a2    edini25a2dp    — rmse  -- spread

Verification for Pmsl

- **Control forecasts very stable**

- **Still occassional crashes experienced for perturbed members – can be very hard to debug!**

  – See presentation by James Fannon

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# UWC-West DINI-EPS

- Cy43h2.2
- 2km hor. resolution, 90 vertical levels
- Time-lagged ensemble, 5+1 members every hour
- EDA initial conditions
- IFSENS boundary conditions
- Stochastic surface perturbations
- 5 parameter SPP
- Forecasts in single precision
- Operational in Q3 2023(?)
- Common post-processed ensemble products(?)

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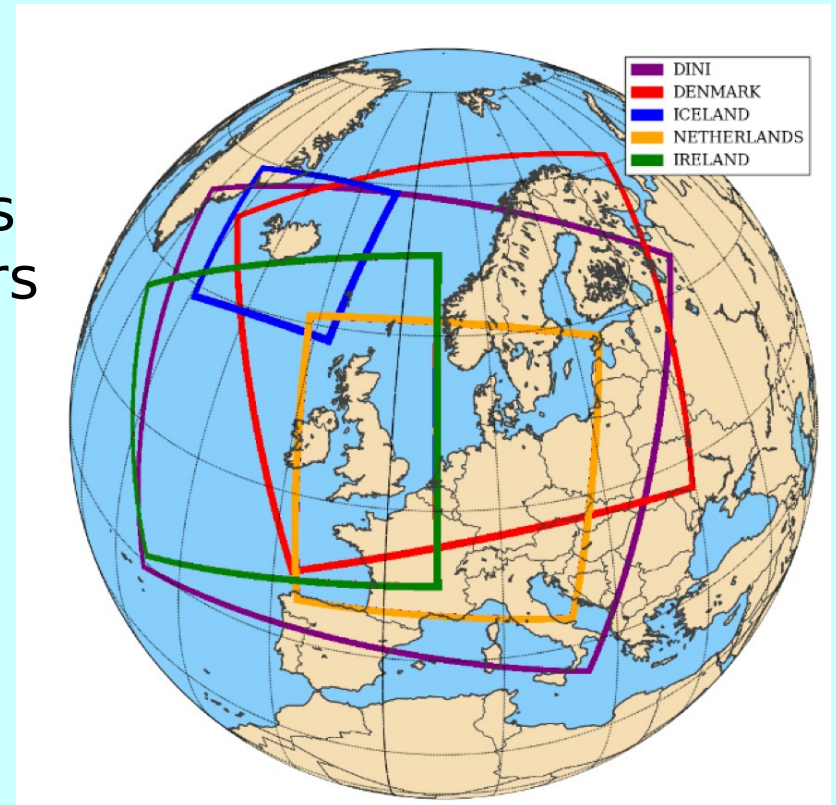
# Calibration and post-processing examples



Membres, Run PEARO: 29/06/2022 03UTC, 2e jour
Validité : 30/06/2022 01 h au 01/07/2022 00 h UTC
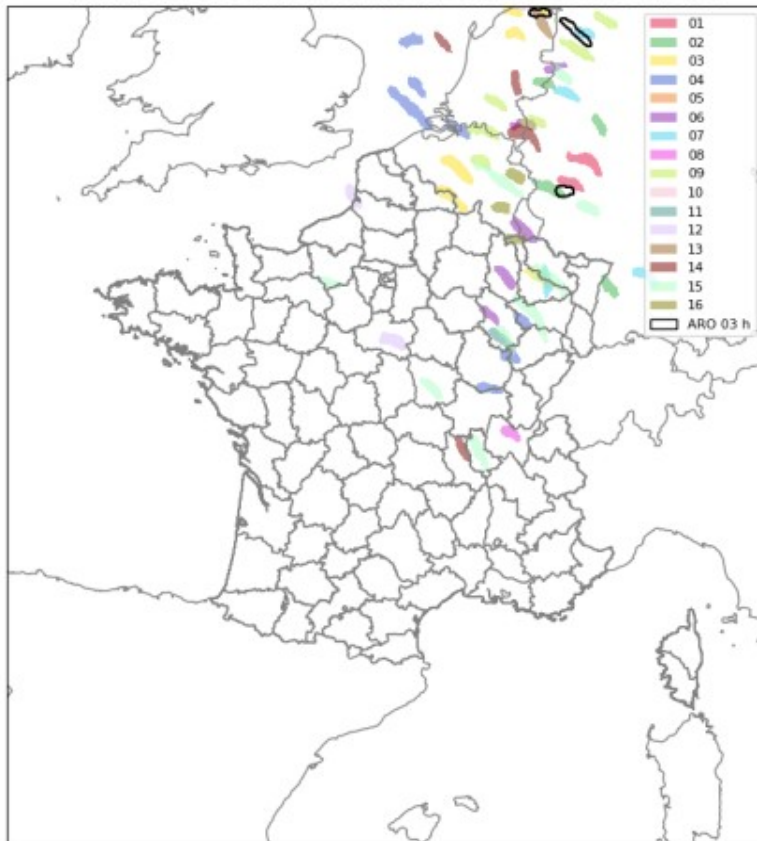
**User-oriented product:**

**Bow echos detected in AROME-EPS members, using a convolutional neural network (CNN;** courtesy of Arnaud Mounier and Laure Raynaud, Meteo-France**)**

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# Calibration and post-processing examples

**Raw and calibrated ensemble forecast using standardized anomaly model output statistics (SAMOS;** courtesy of Markus Dabernig, GeoSphere**)**
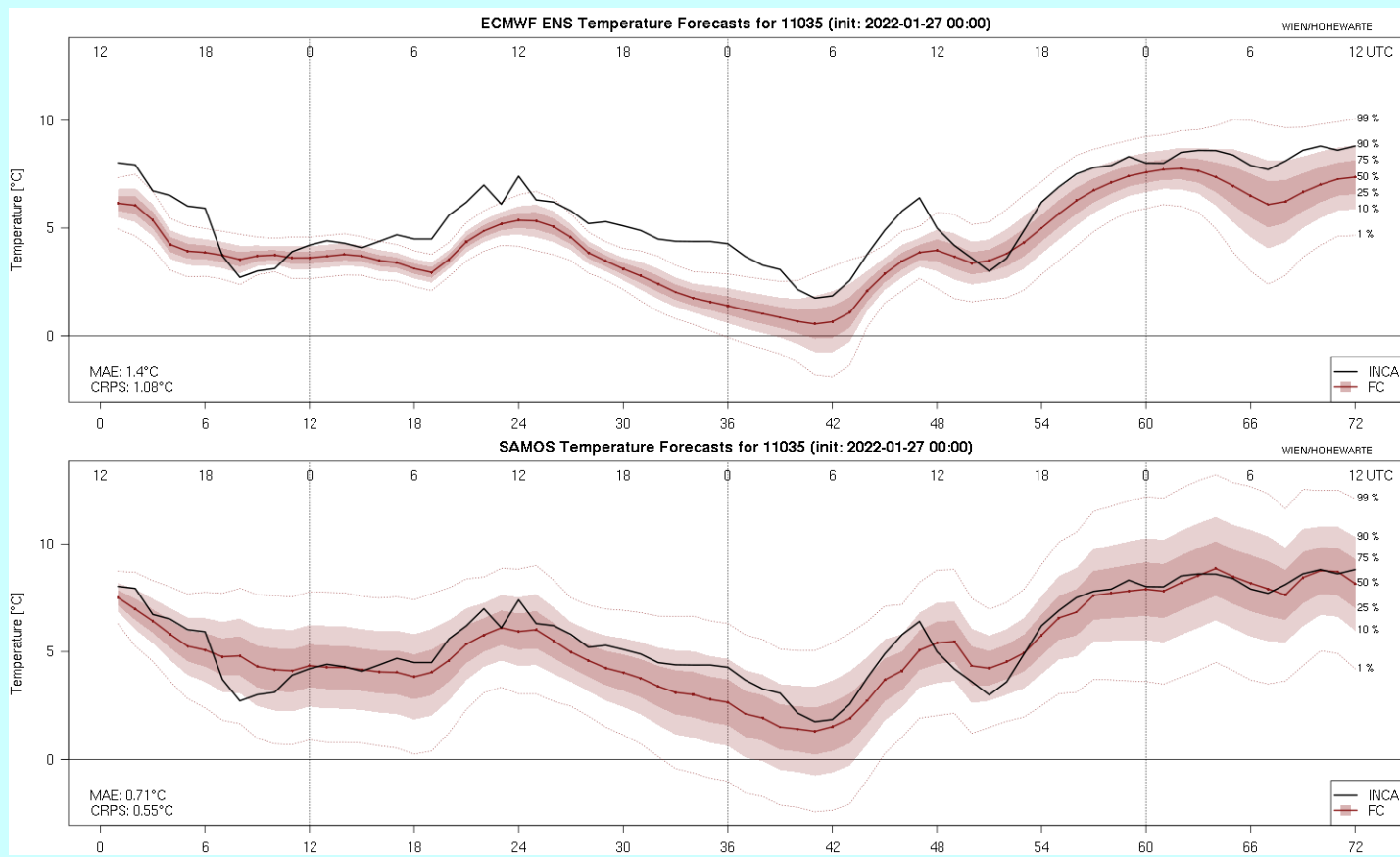
# Using machine learning to enhance ensembles

- **Increase horizontal resolution using a convolutional neural network (CNN) to downscale NWP forecasts**

- **Increase ensemble size using a generative adversarial network (GAN) to learn and sample high-dimensional, multi-variate distributions**
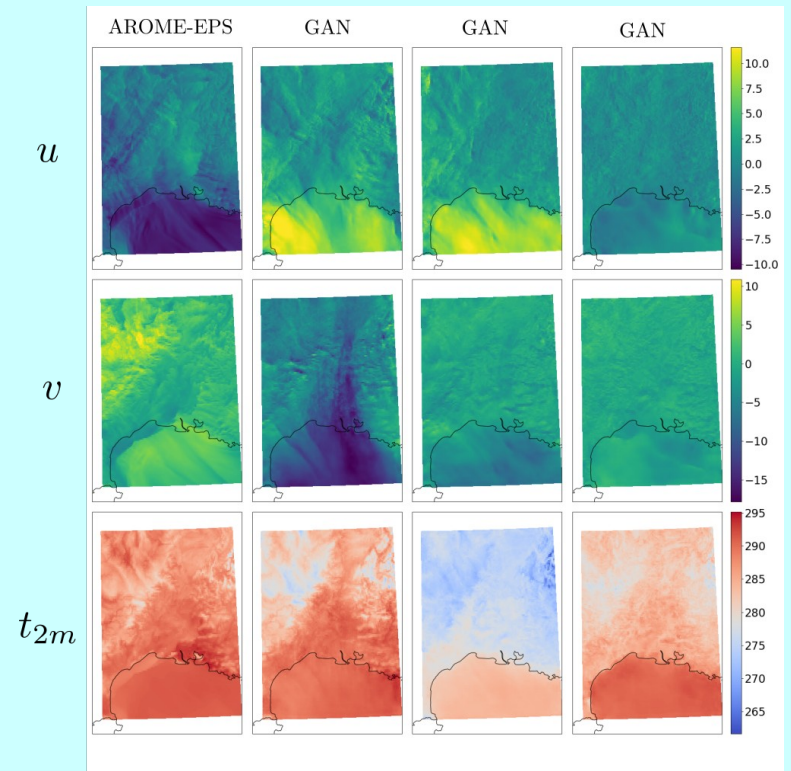


Courtesy of Clément Brochet and Laure Raynaud, Meteo-France

# EPS working week 24-28 April 2023 in Oslo

**Sign up on the ACCORD wiki:**

[https://opensource.umr-cnrm.fr/projects/accord/wiki/Oslo_24-28_April_2023](https://opensource.umr-cnrm.fr/projects/accord/wiki/Oslo_24-28_April_2023)

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