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# Studies on a multi-scheme ensemble

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# Contents

# Introduction

## Simple methods to address aspects of model uncertainty

- stochastic physics (perturbing tendencies from the parameterization schemes)
- multiple NWP models
- multiple parameterization schemes within one NWP model

## Frames for studies on a muliple scheme approach at DMI

- heavy rain:
  contribution to the EU-project *An European Flood Forecasting System* (EFFS)
- wind:
  national project dealing with use of ensembles for wind energy prediction

# A Parameterization ensemble with DMI-HIRLAM

- Addressing uncertainties arising in the treatment of processes connected to convection, condensation and precipitation
- Model integration with different schemes for the parameterization of condensation and convection
- Initial state and boundary update from the ECMWF-EPS control
- No variation in other parameterization schemes
- 5 available schemes in DMI-HIRLAM

# Parameterization schemes in DMI-HIRLAM

STC

Stratiform condensation scheme
- condensation beyond a critical saturation
- includes Precipitation evaporation (Kessler)
- no unresolved convective processes

AKC

Anthes-Kuo scheme
- based on resolved moisture convergence
- precipitation rate adjusted by cummulus cloud fraction (sub-grid variability)
- includes STC

SQS

Sundquist scheme
- stratiform and convective regimes based on buoyancy state at LCL
- microphysical processes with prognostic cloud water
- convective part adopts the Kuo-scheme and includes detrainment
- simple anvil representation

TDS

Tiedke scheme
- mass-flux type
- stratiform part and microphysical processes adopted from SQS
- shallow, medium and deep convection including downdrafts

STRACO

Soft Transition Condensation scheme
- convective part based on AKC (modified moisture convergence)
- convection and condensation in multiple vertical layers
- stratiform part adopted from STC
- relaxed transition between stratiform and convective regimes
- microphysics simillar to SQS

# DMI-HIRLAM: HIgh Resolution Limited Area Model

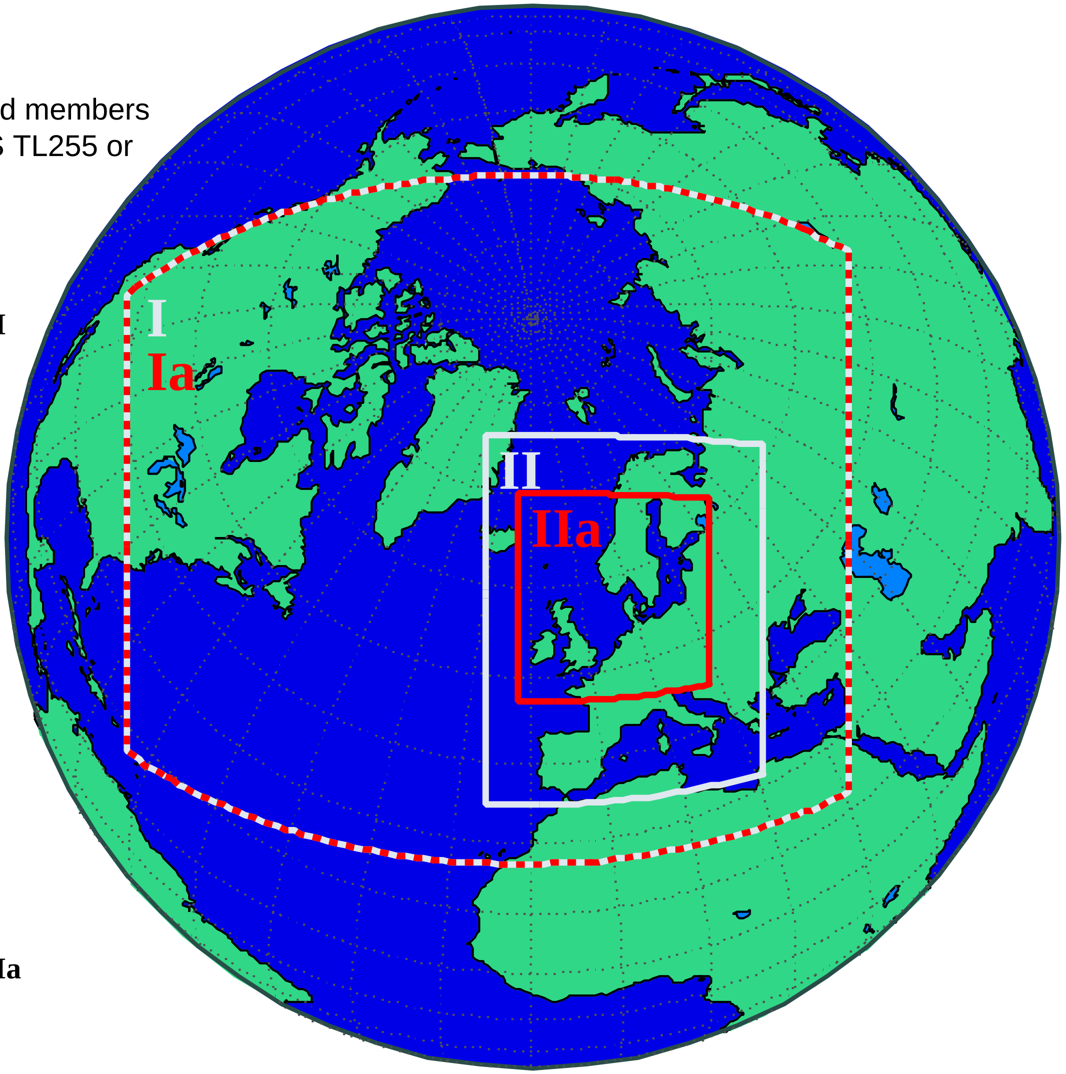
Model domains (nested system)

I: 0.3° hor. grid, 31 vert. levels
SL-dynamics
6h boundary update from selected members of the 51 member ECMWF-EPS TL255 or from the control

II: 0.1° hor. grid, 31 vert. levels
Eulerian-dynamics
1h boundary update from model **I**

Ia: 0.6° hor. grid, 31 vert. levels
SL-dynamics, sim. to model **I**

IIa: 0.2° hor. grid, 31 vert. levels
Eulerian-dynamics
1h boundary update from model **Ia**



# Simulation Periods

## Three historical cases with heavy rainfall (model system I/II)

- Piemonte flood November 1994 (Northern Italy)
  period: 1994-10-25 - 1994-11-03

- Rhine/Meuse flood January 1995 (Belgium, The Netherlands, Germany)
  period: 1995-01-20 - 1995-01-30

- Odra flood July 1997 (Poland, Chzech Republic, Germany)
  period: 1997-06-26 - 1997-07-08

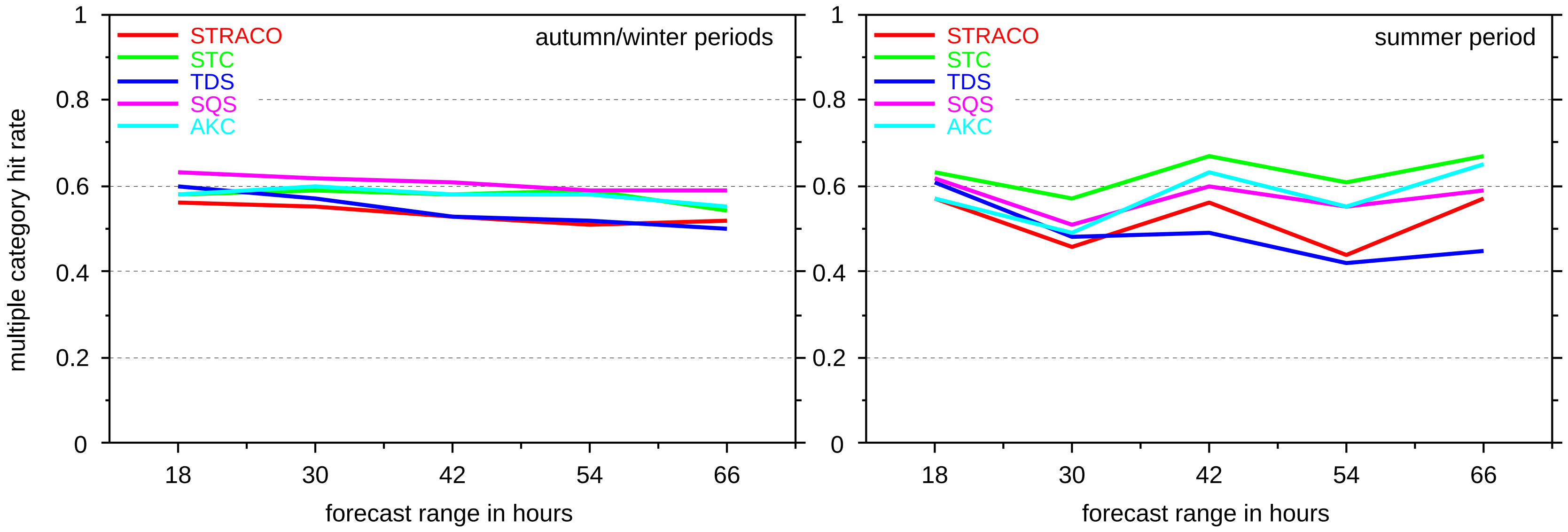
## Recent winter period (model system Ia/IIa)

- January/February 2003

# Hit rates precipitation

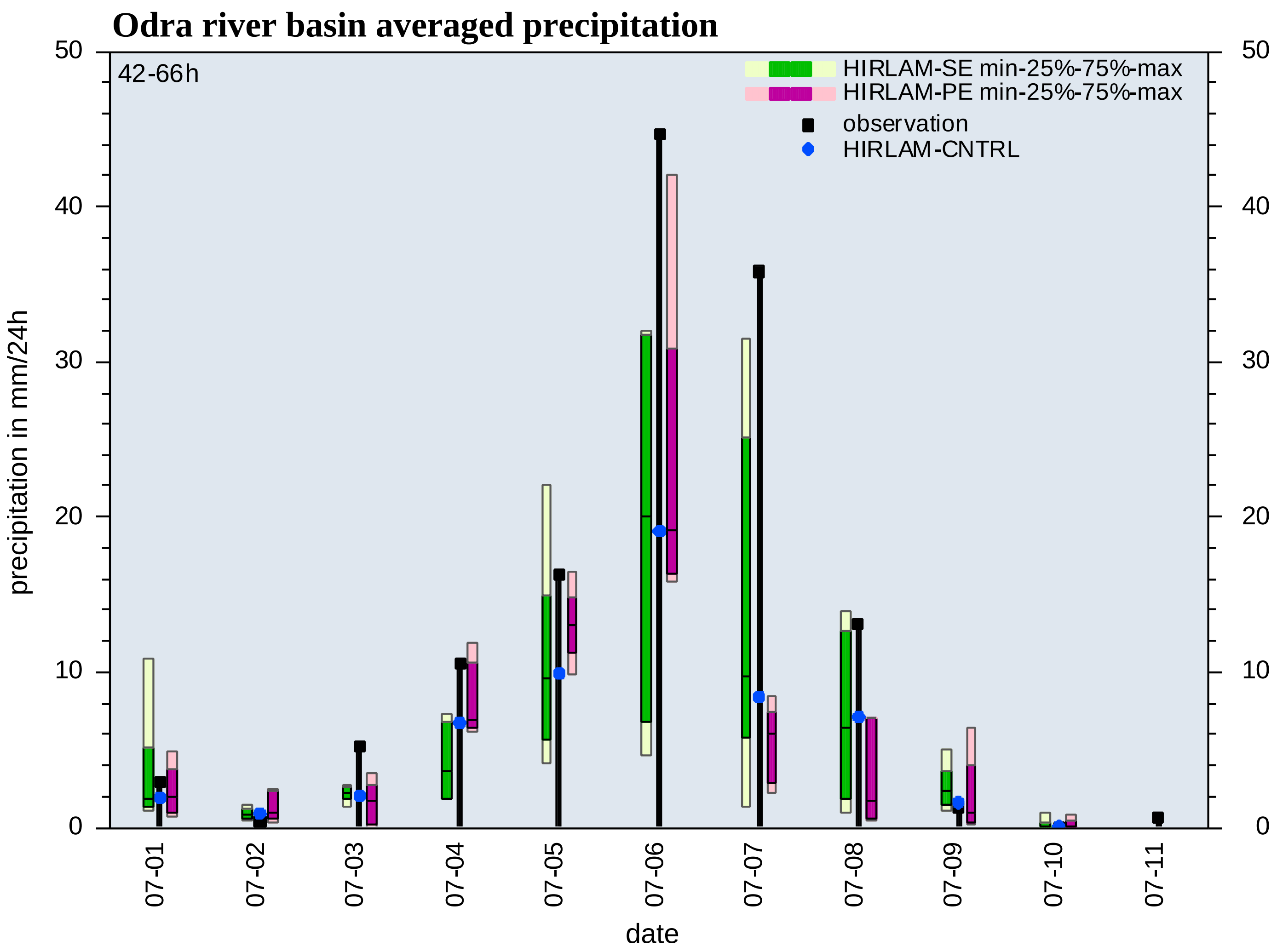
Historical events

Combined hit rates from a multi-event contingency table
(<0.2mm,0.2-1mm,1-5mm,5-10mm,>10mm)



# Example from the Odra case

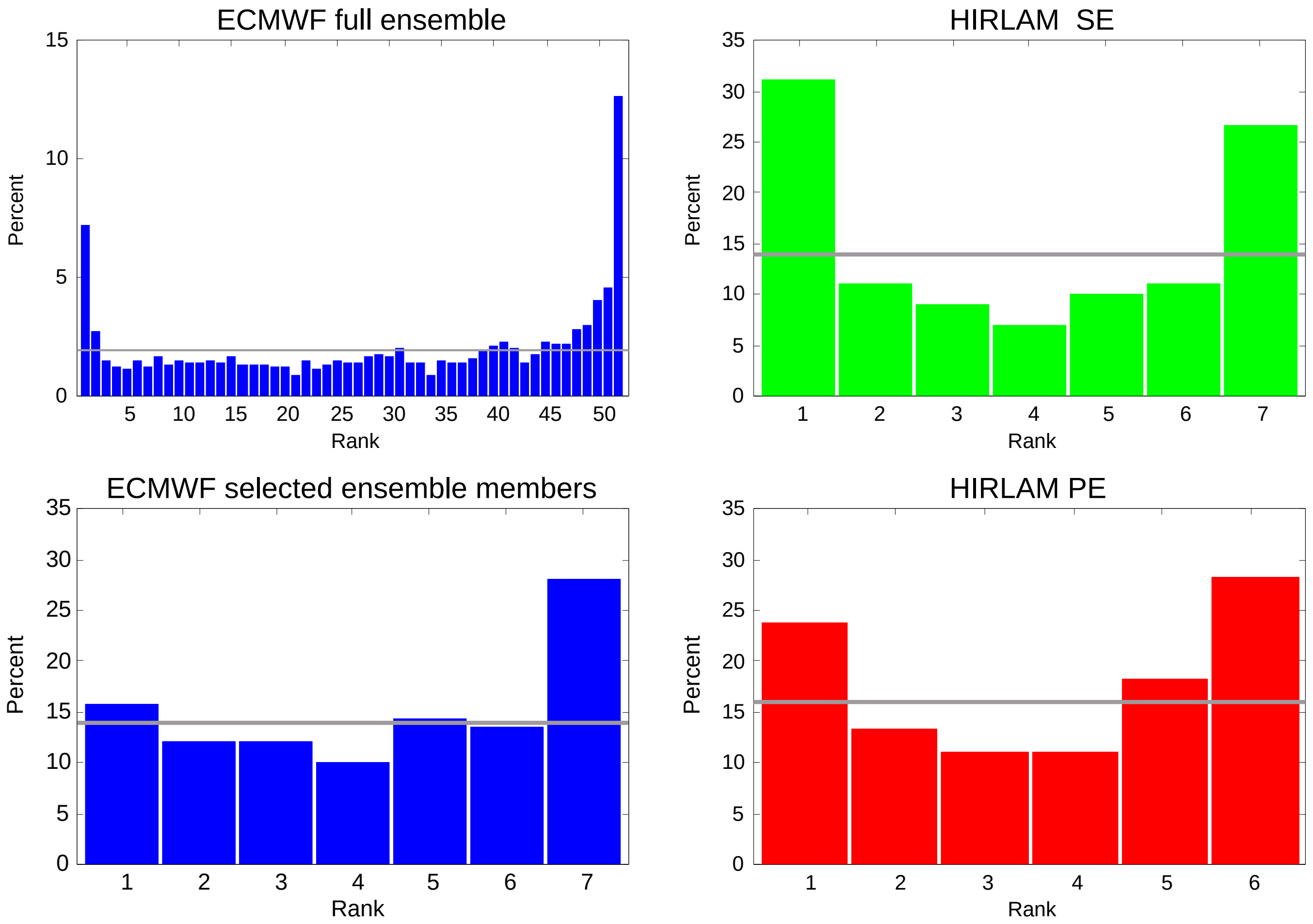
- Comparison to a DMI-HIRLAM selection ensemble (SE, initial condition perturb.)
- "Observation": DWD precipitation analysis



# Verification and comparison

Rank histogramms

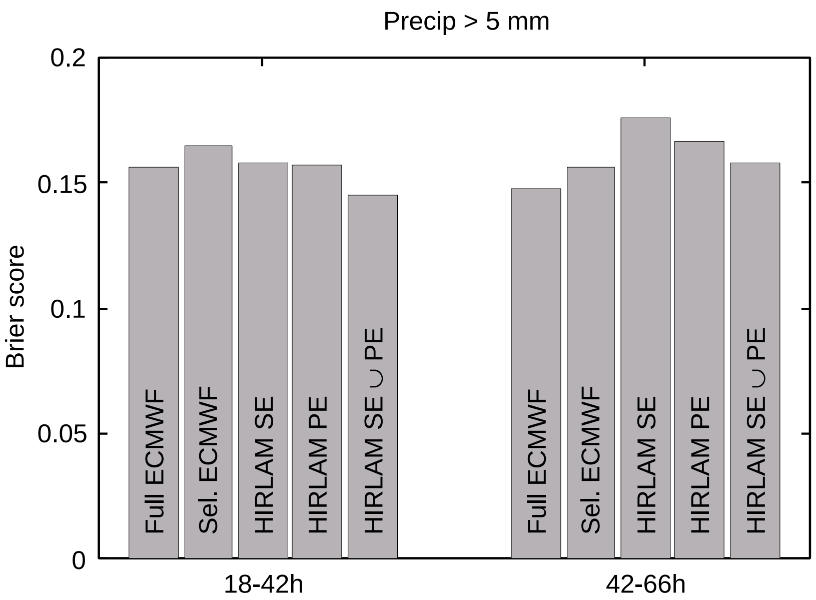
- Verifying data from DWD precipitation analysis
- Verification over target areas and on ECMWF grid

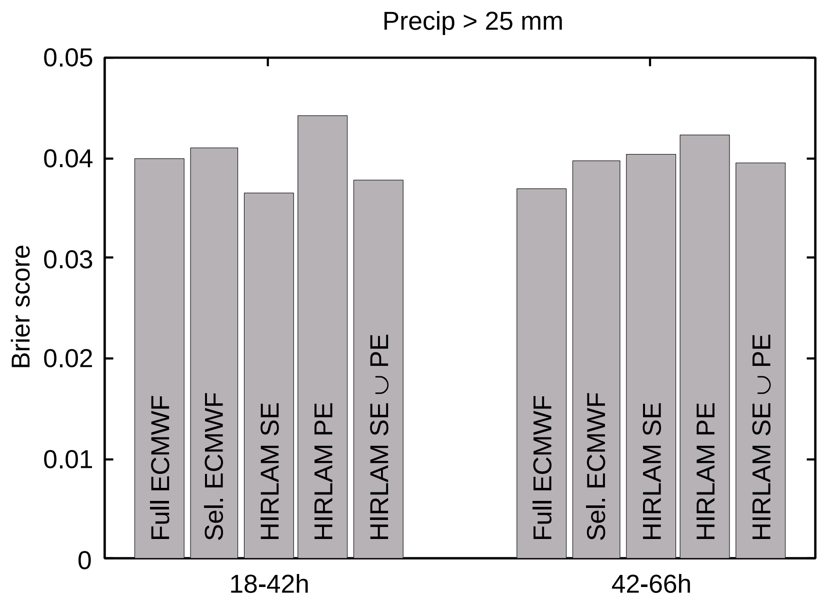


# Verification and comparison

Brier scores

- Verifying data from DWD precipitation analysis
- Verification over target areas and on ECMWF grid

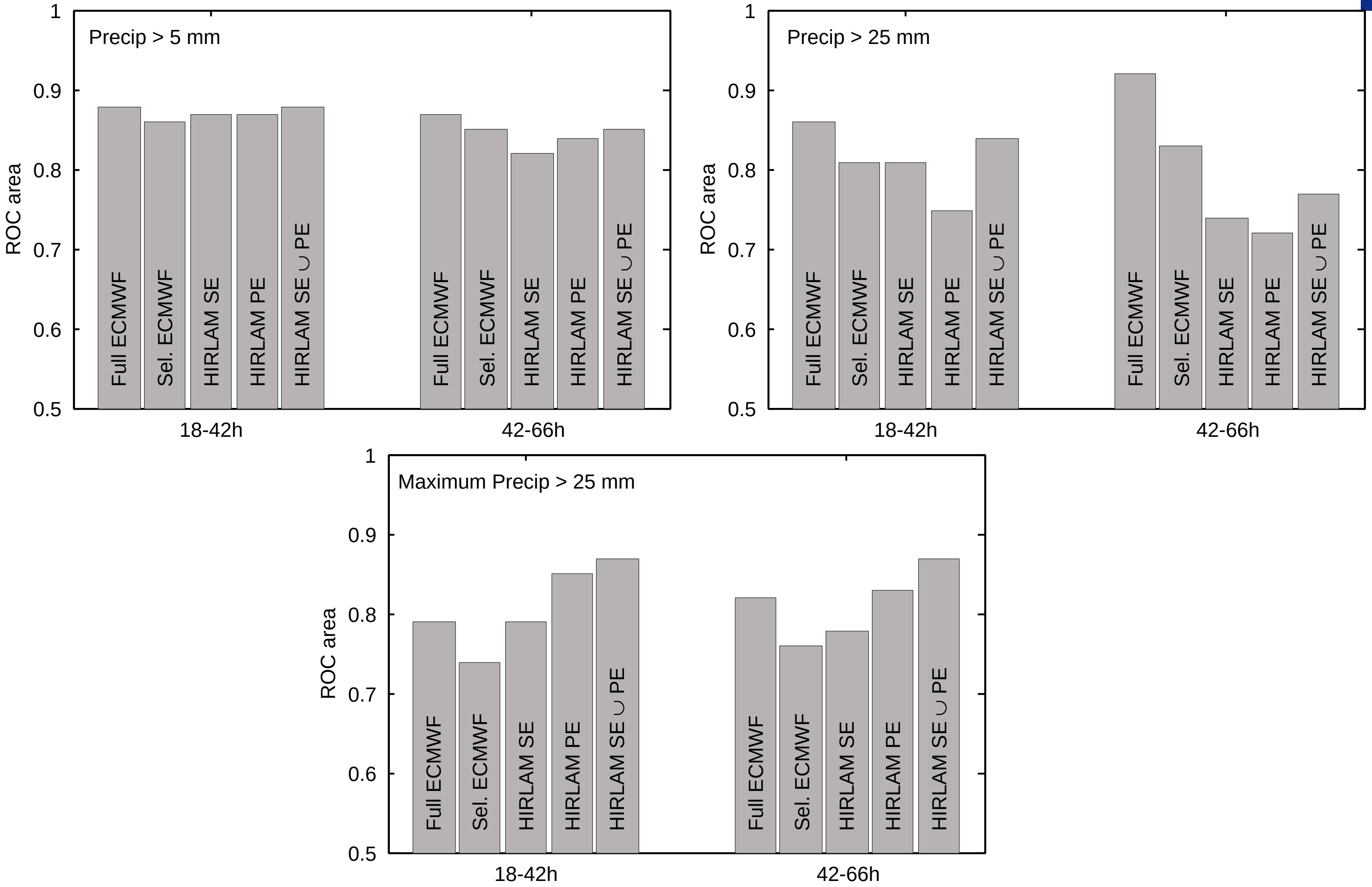


# Verification and comparison

Area under ROC curve

- Verifying data from DWD precipitation analysis
- Verification over target areas and on ECMWF grid



# Verification MSLP and v10m

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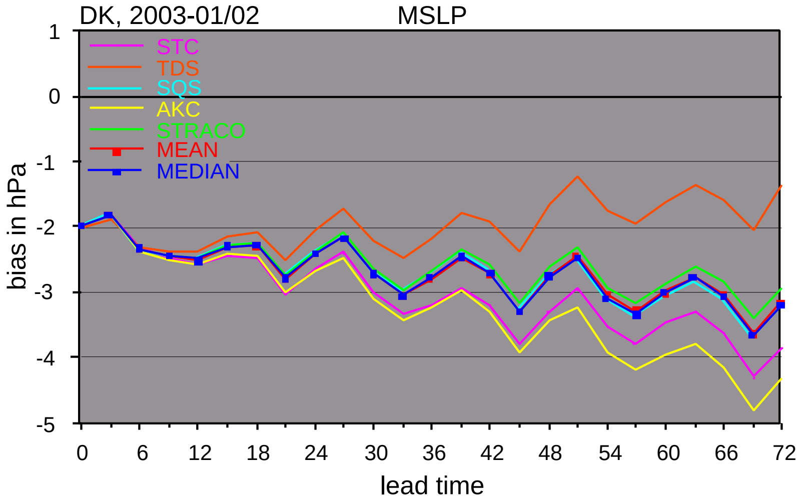
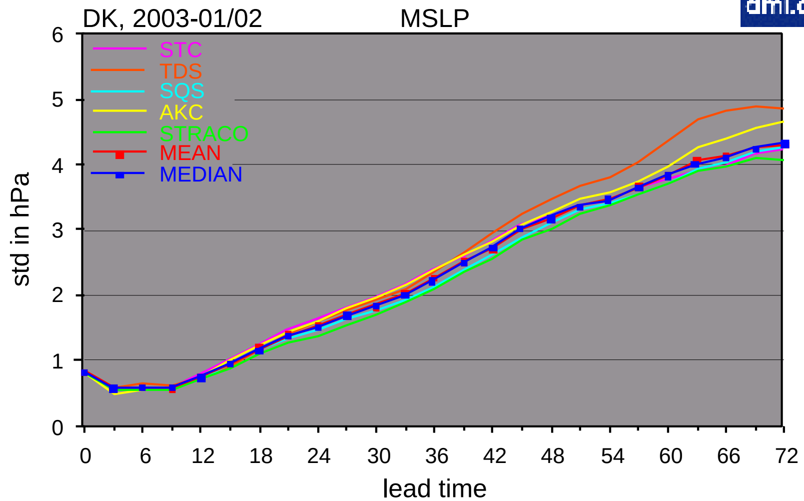
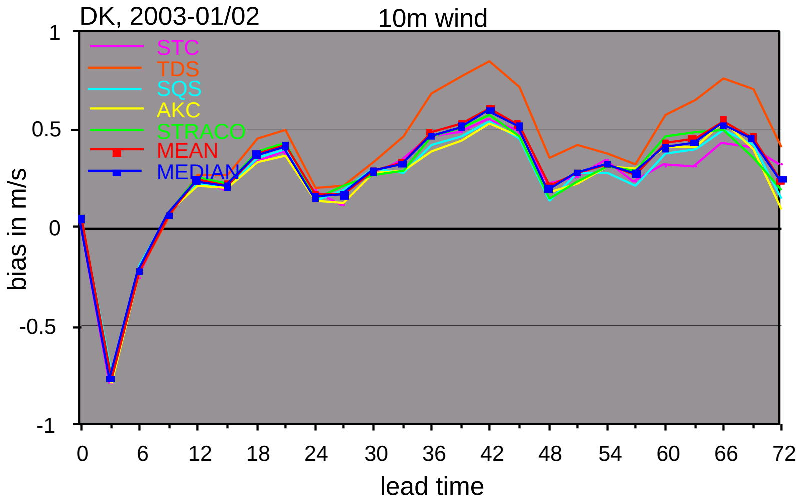
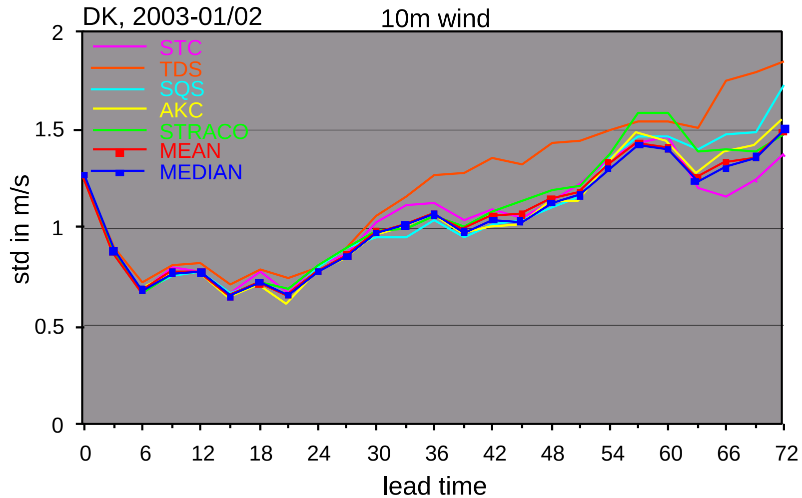


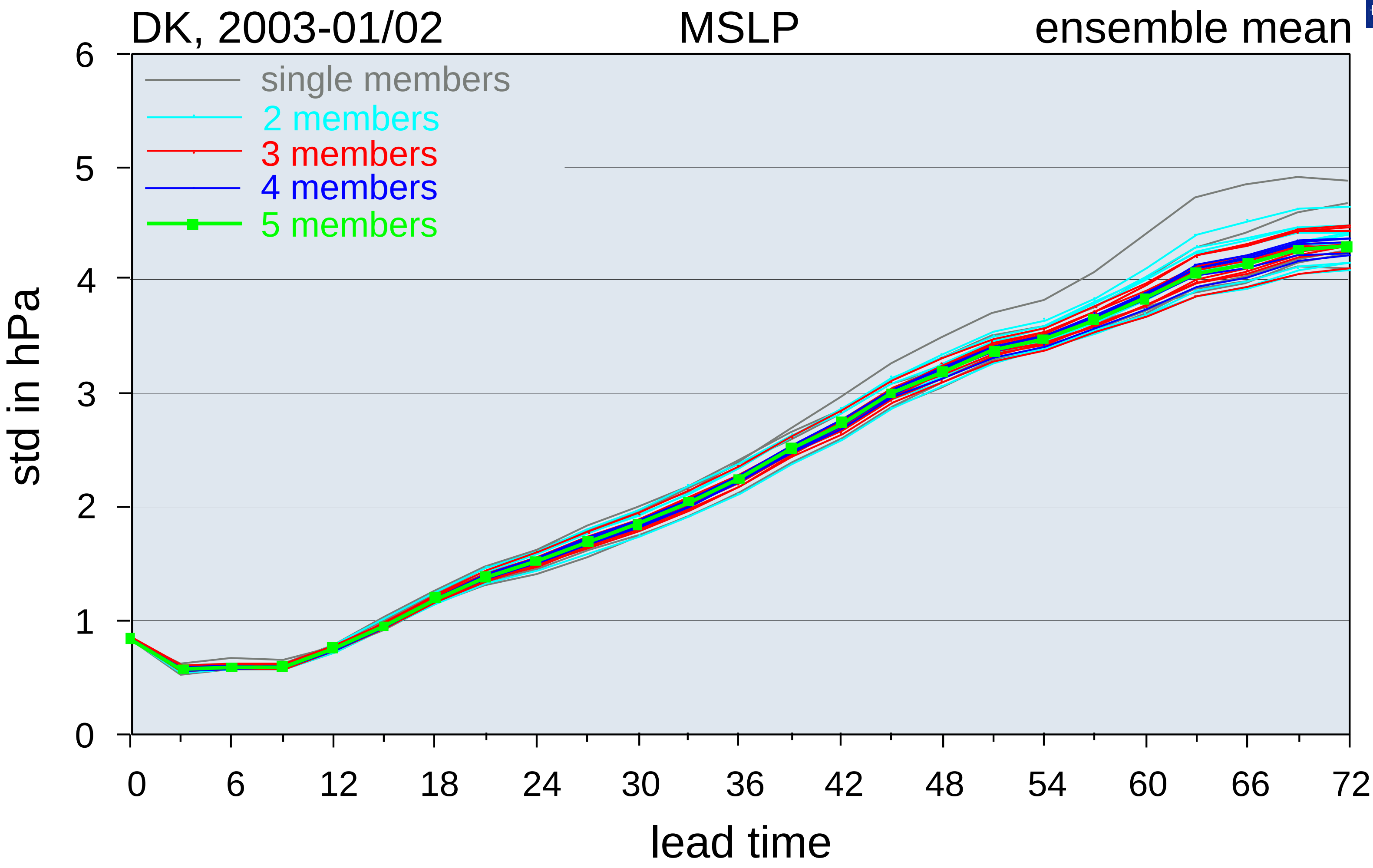



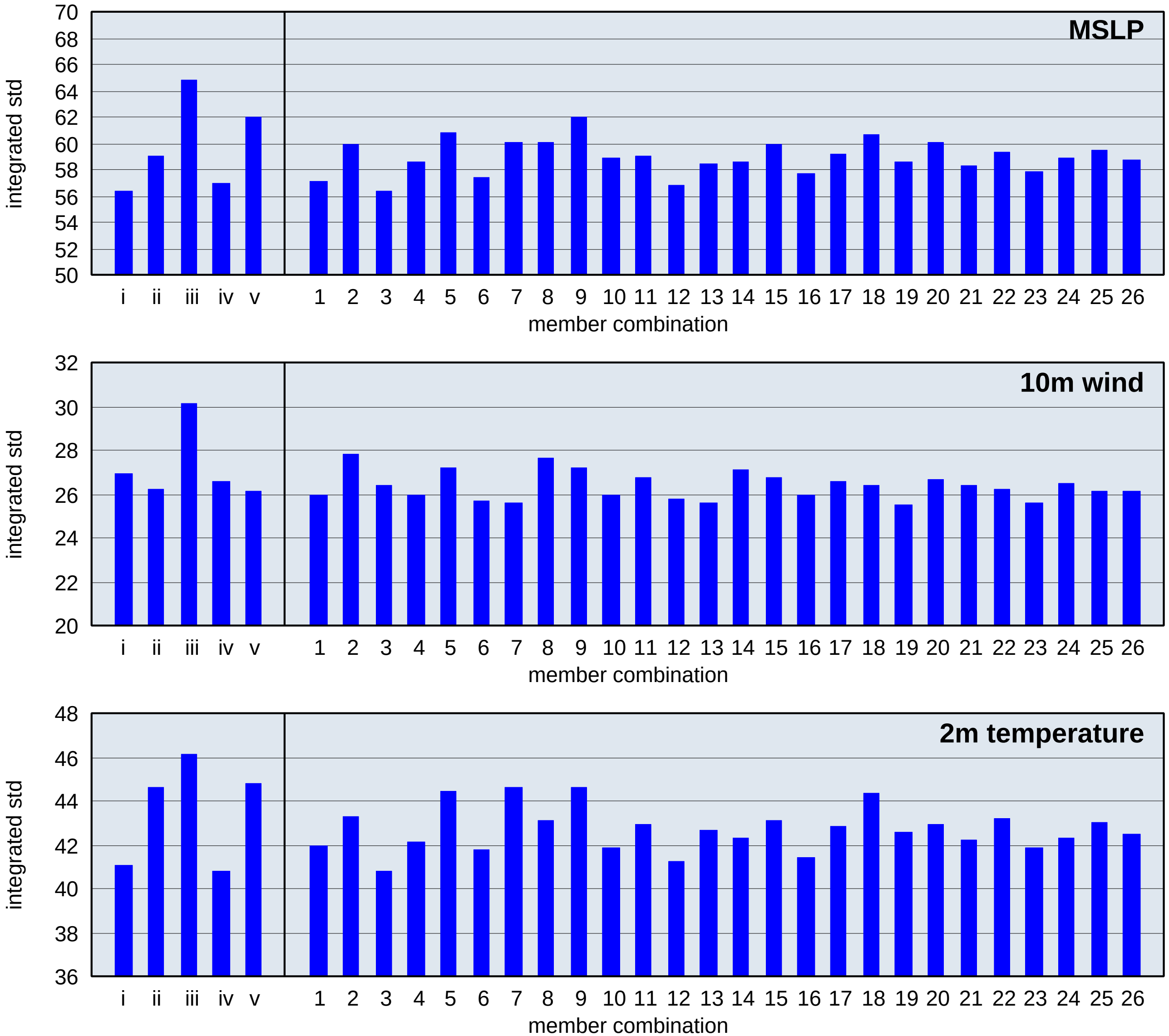
## Member combinations





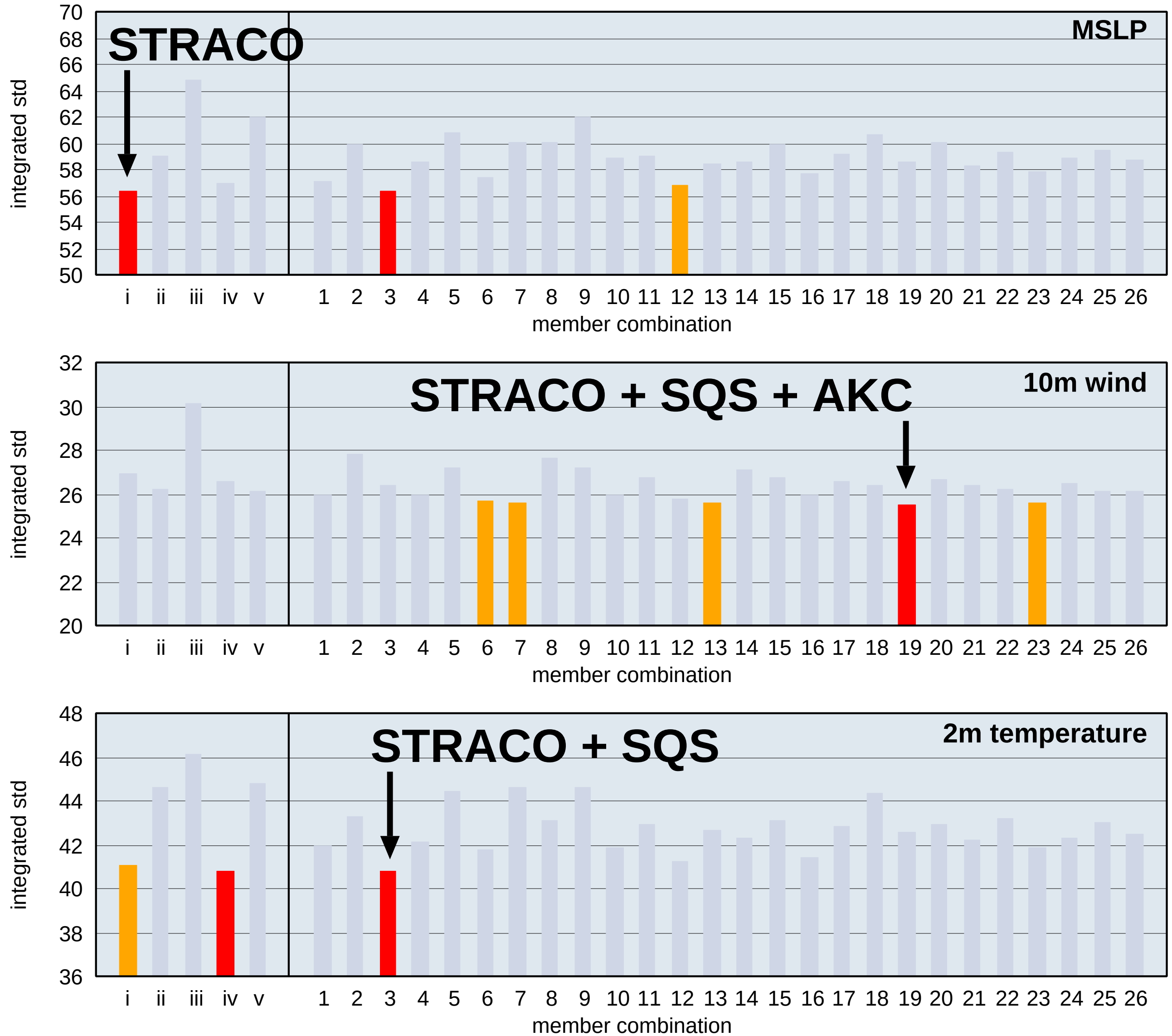
# Best member combination

DK, 2003-01/02



## Best member combination

DK, 2003-01/02



# Final Remarks

Preliminary for DK

- exclusive use of the ECMWF control as host model limits the ensemble spread of the PE
- impact of using multiple convection/condensation schemes on surface parameters MSLP, v10m, T2m is significant
- results for member combination different for different parameters
- tuning the model for each scheme to be used in an ensemble approach is important
- multiple-scheme or probabilistic parameterization?