OPERA NIMBUS radar data evaluation in HARMONIE-AROME

4th All Staff Workshop, 15-19 April 2024, Norrköping, Sweden
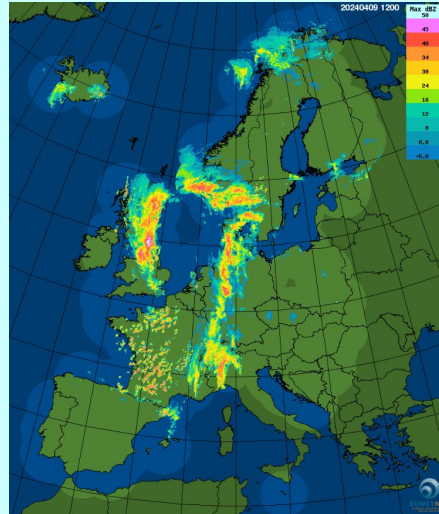
Günther Haase, Jana Sánchez-Arriola, Martin Ridal, Mats Dahlbom, Magnus Lindskog
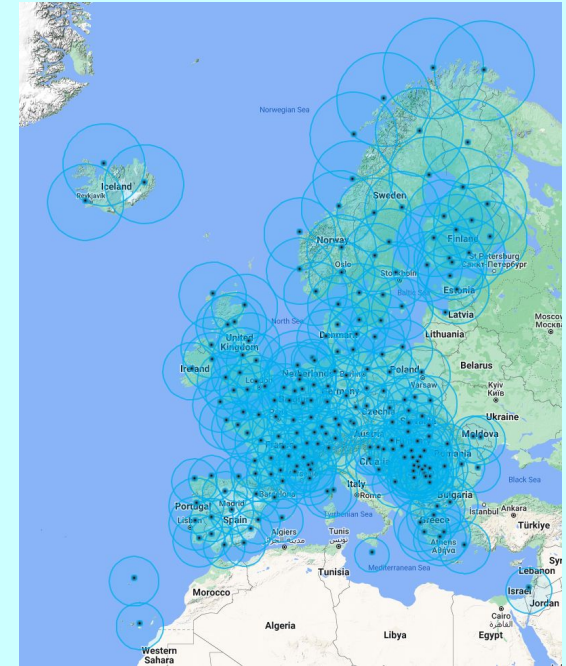
Motivation

- During OPERA 5, the previous data center, ODYSSEY, has been replaced by three distinct production lines (CUMULUS/STRATUS, CIRRUS, and NIMBUS).

- Before the new production lines gain authorization for operational status, their performance needs to be validated.

- For NIMBUS, OPERA requested the NWP consortia to evaluate the quality-controlled volume radar data tailored for assimilation in NWP models.

- Additionally, Hirlam would like to have the usage of NIMBUS radar data as an operational option (both 5 and 15 minute data).

- This study focuses on technical and data quality challenges when assimilating NIMBUS radar data in HARMONIE-AROME.

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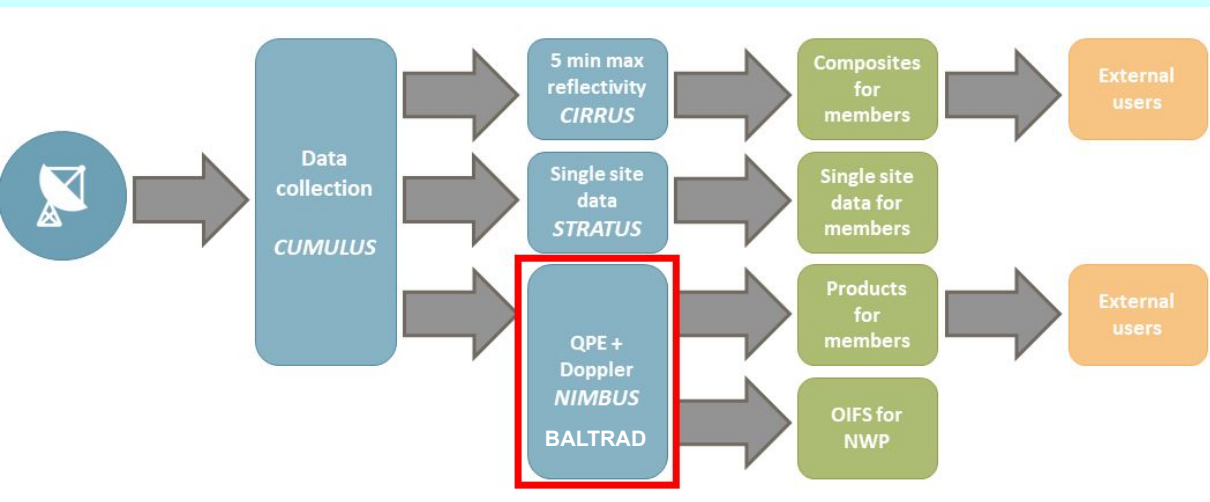Research and Development

EUMETNET OPERA

- EUMETNET Operational Program on the Exchange of Weather Radar Information (OPERA)

- OPERA has currently 30 members operating more than 200 radars

- Data hub

- Continental composites
  Maximum reflectivity
  Rain rate
  Hourly accumulation

- Quality-controlled volumes

http://www.eumetnet.eu/opera

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OPERA production lines

Performance validation of quality-controlled volumes from NIMBUS:

- Completeness **OK**

- Availability **OK**

- Timeliness of production **OK**

- Timeliness of delivery **OK**

- Data assimilation aspects

Radar data

	Number of radars	Update frequency	Quality control (configurable per radar)
OPERA NIMBUS	~ 200	5 and 15 min	**BALTRAD** - removal of artefacts (bropo, hac-filter, satfilter) - correction of beam blockage (beamb)
ODE (OPERA Development Environment)	~ 200	15 min	**BALTRAD** - removal of artefacts (bropo) - correction of beam blockage (beamb)
ARCUS (MetCoOp data archive)	~ 50	15 min	**BALTRAD** (except Norwegian data) - removal of artefacts (bropo) - correction of beam blockage (beamb) **ProRad** (only Norwegian data)

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Experiments

|	Period	Model version	Radar data	Parameter
AEMET	23 February - 5 March 2024	cy46h1_rc1 (3DVar)	NIMBUS (15 min vol) vs ODE	DBZH (ES, FR, PT), VRADH (FR)
UWC-West	1-15 June 2023	UWC-W cy43	NIMBUS (5 and 15 min vol) vs ODE	DBZH, VRADH
MetCoOp	15-30 June 2023	cy46h1_rc1 (3DVar)	NIMBUS (5 min vol) vs ARCUS	DBZH, VRADH

DBZH: Corrected reflectivity [dBZ]
VRADH: Radial velocity [m/s]

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Observation usage (AEMET)

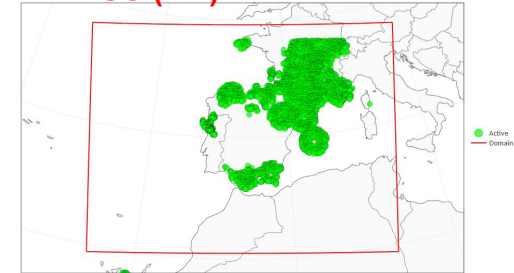**3 March 2024 0000 UTC**

- ODE has a better coverage, especially for RADV
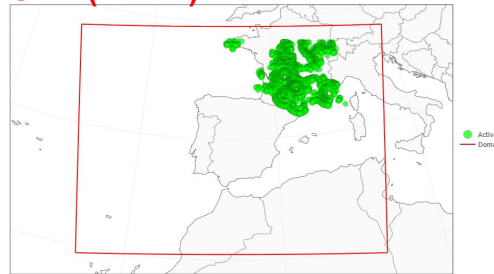
- Slightly lower number of observations in NIMBUS

AIBC_46h1rc1v00: Observation Usage
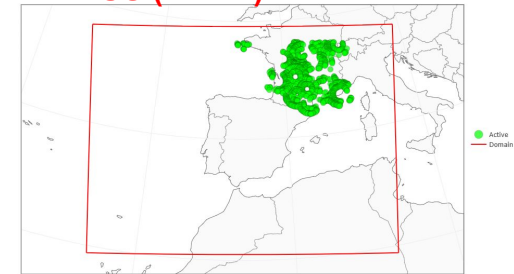db=ccma, DTG=2024-03-03 00 UTC, obname=radar, varname=rh
ODE (RH)
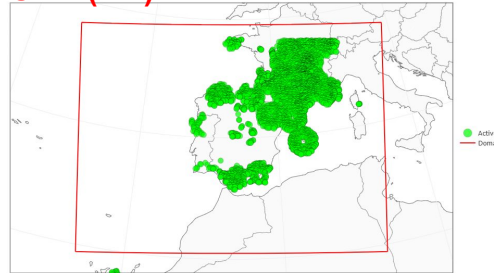
AIBC_46h1rc1v0_N: Observation Usage
db=ccma, DTG=2024-03-03 00 UTC, obname=radar, varname=rh
NIMBUS (RH)

AIBC_46h1rc1v00: Observation Usage
db=ccma, DTG=2024-03-03 00 UTC, obname=radar, varname=radv
ODE (RADV)

AIBC_46h1rc1v0_N: Observation Usage
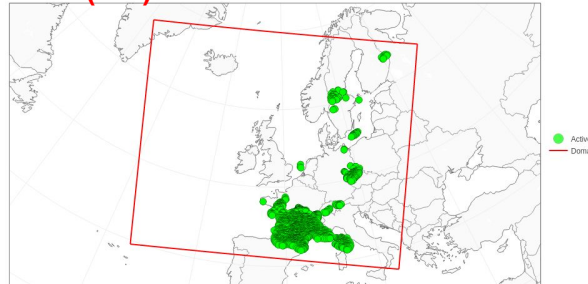db=ccma, DTG=2024-03-03 00 UTC, obname=radar, varname=radv
NIMBUS (RADV)

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Observation usage (UWC-West)

13 June 2023 1500 UTC

- NIMBUS has a better coverage of RH (e.g. UK)

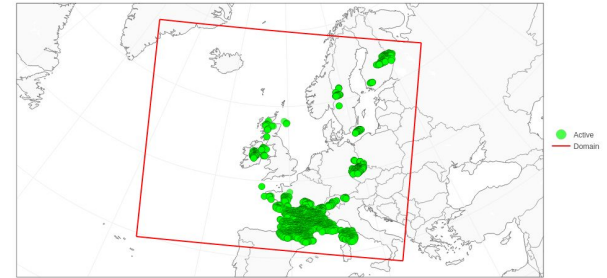- Slightly lower number of observations in NIMBUS

ODE: Observation Usage
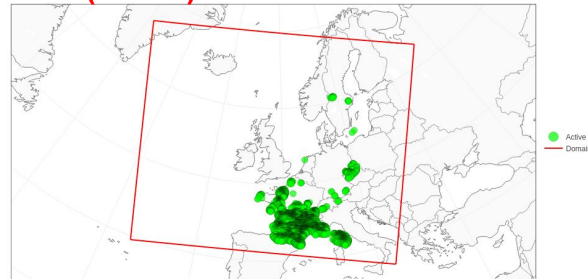db=ccma, DTG=2023-06-13 15 UTC, obname=radar, varname=rh

ODE (RH)

Nimbus: Observation Usage
db=ccma, DTG=2023-06-13 15 UTC, obname=radar, varname=rh
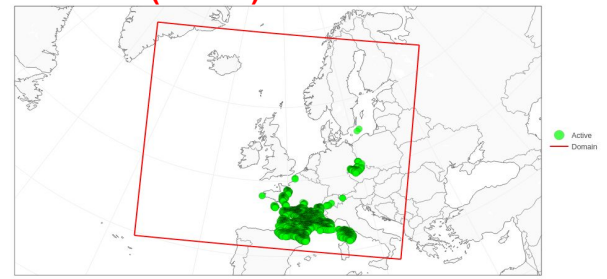
NIMBUS (RH)

ODE: Observation Usage
db=ccma, DTG=2023-06-13 15 UTC, obname=radar, varname=radv

ODE (RADV)

Nimbus: Observation Usage
db=ccma, DTG=2023-06-13 15 UTC, obname=radar, varname=radv

NIMBUS (RADV)

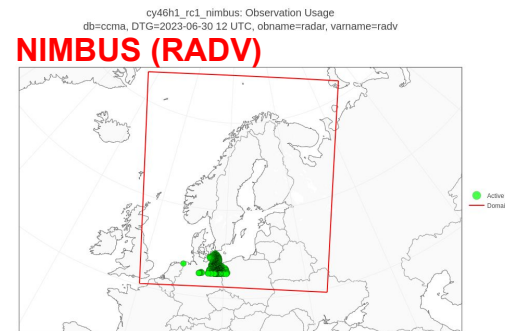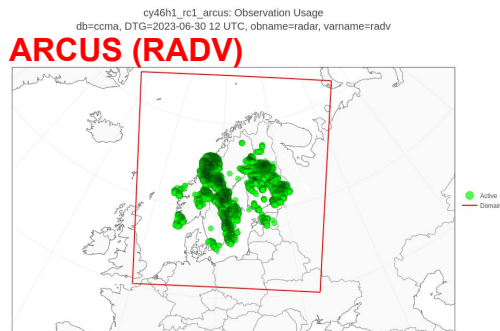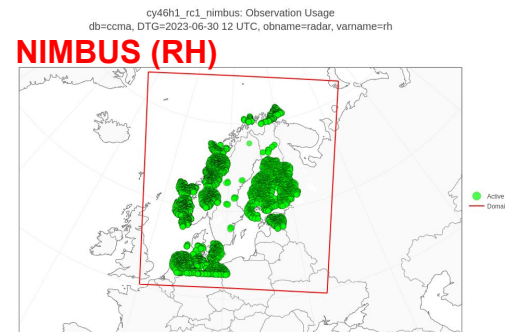ACC≋RD
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Observation usage (MetCoOp)

30 June 2023 1200 UTC

- NIMBUS has some additional radars (e.g. deasb, eehar)

- Less RH and no RADV over SE due to missing scans in NIMBUS

- No RADV over FI due to missing scans with a high Nyquist interval in NIMBUS

- No RADV over NO due to missing wind scans in NIMBUS

ARCUS (RH)

cy46h1_rc1_arcus: Observation Usage
db=ccma, DTG=2023-06-30 12 UTC, obname=radar, varname=rh

NIMBUS (RH)

cy46h1_rc1_nimbus: Observation Usage
db=ccma, DTG=2023-06-30 12 UTC, obname=radar, varname=rh

ARCUS (RADV)

cy46h1_rc1_arcus: Observation Usage
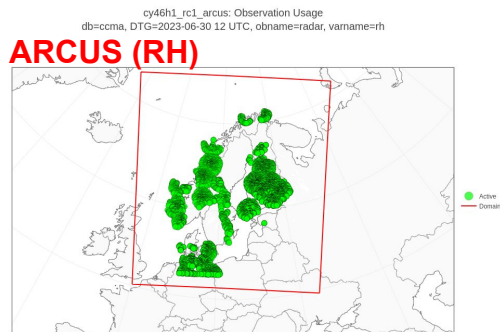db=ccma, DTG=2023-06-30 12 UTC, obname=radar, varname=radv

NIMBUS (RADV)

cy46h1_rc1_nimbus: Observation Usage
db=ccma, DTG=2023-06-30 12 UTC, obname=radar, varname=radv

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15-30 June 2023

- Time series of relative humidity and radial wind

- First guess (blue) and analysis (red)

- RMS (squares) and bias (circles)

- Similar results for AEMET and UWC-West domains

- ODE/ARCUS and NIMBUS radar data are comparable
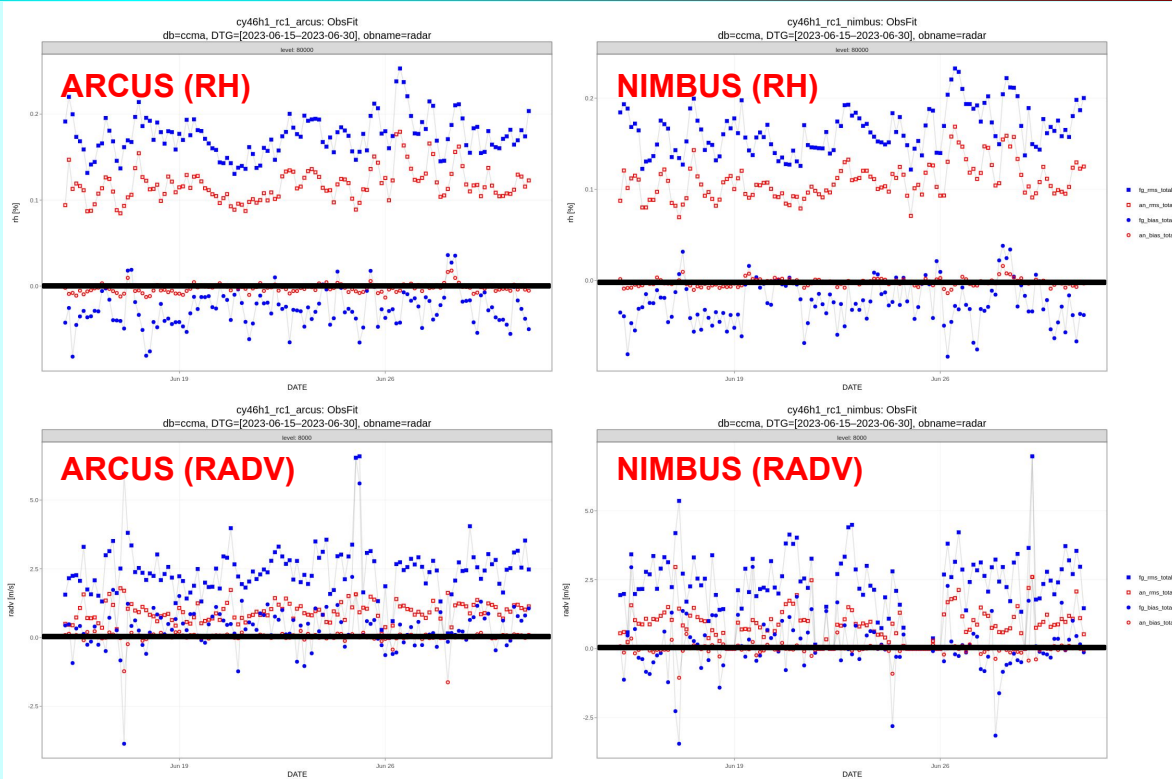
1-15 June 2023 (deeis)

- Time series of relative humidity and radial wind (observation, first guess, analysis, bias correction)

- Distribution of first guess and analysis departures

- Similar results for other radars and domains

- ODE/ARCUS and NIMBUS radar data are comparable
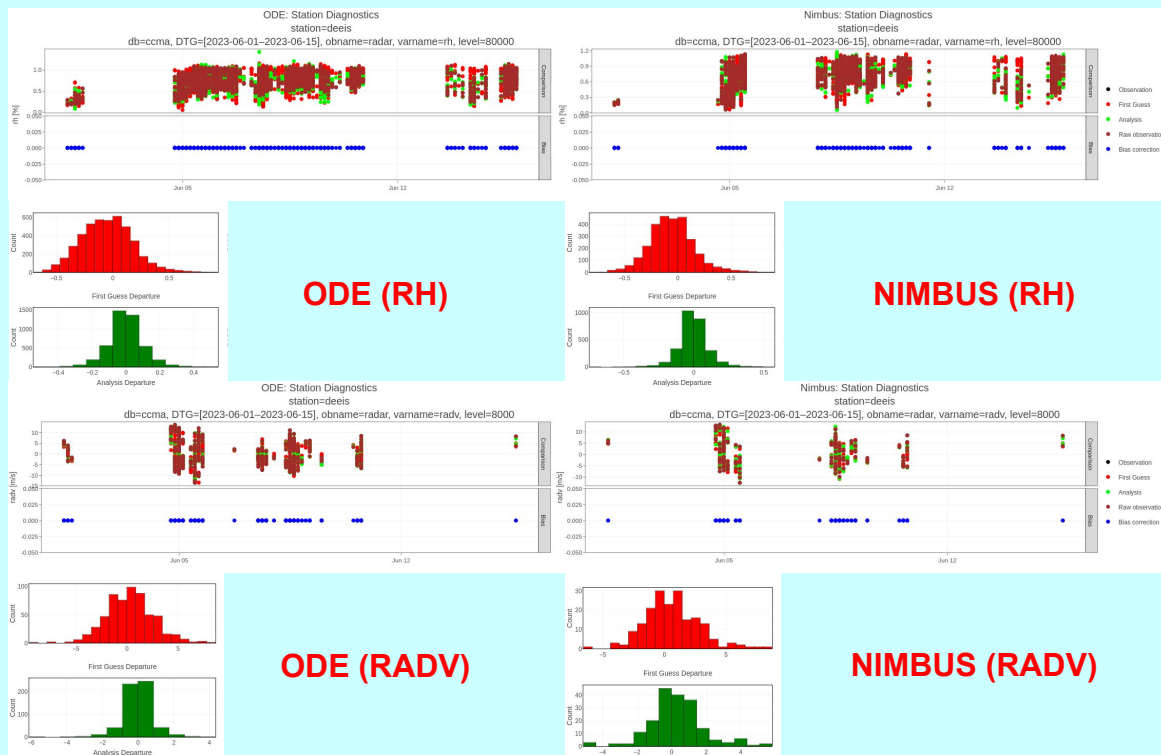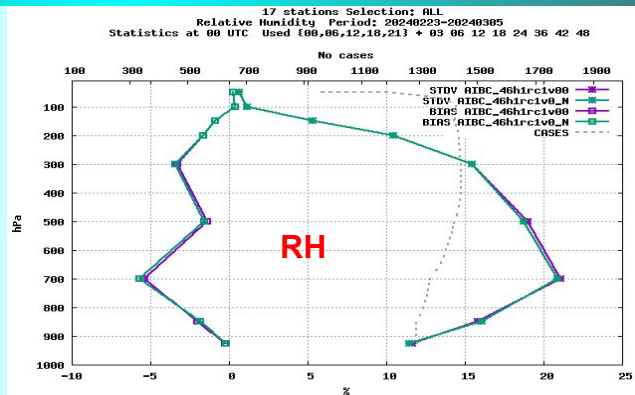
23 February - 5 March 2024

- Vertical profiles of relative humidity and wind speed

- Kuiper skill score for 6h precipitation classes

- Relative humidity at 2m

- Assimilation of NIMBUS radar data has in average a neutral impact on the forecasts ➜ good

ODE (purple)
NIMBUS (green)

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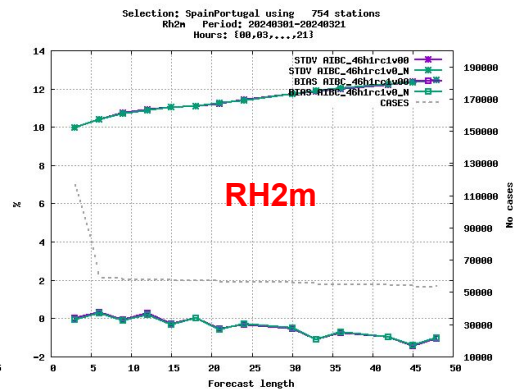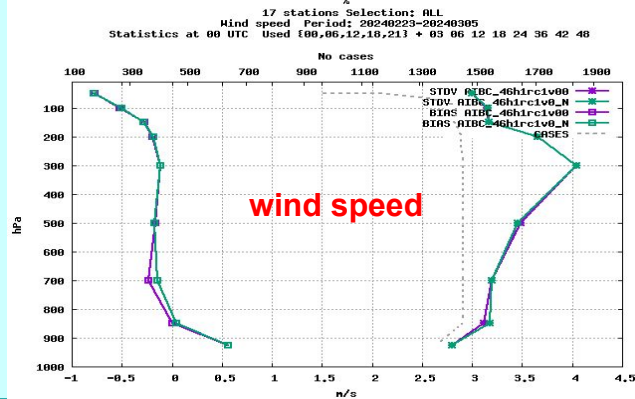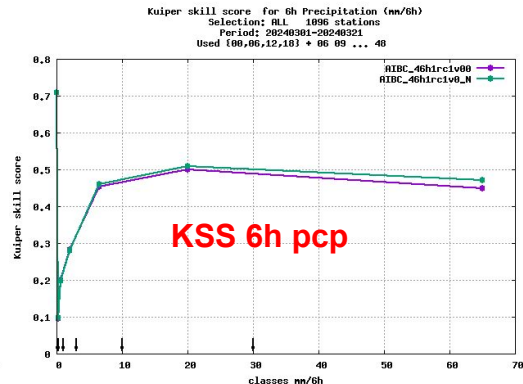
Summary and conclusions

- OPERA NIMBUS radar data have been evaluated in HARMONIE-AROME for three domains.

- The comparison with ODE and ARCUS radar data gives mostly good results (neutral impact).

- **Message to data providers:**
  - Send wind-optimized scans to OPERA, i.e. VRADH with a high Nyquist interval and simultaneously measured DBZH (needed for quality control)

- **Message to NIMBUS:**
  - Add VRADH from Norway and Spain to NIMBUS files
  - *ACCORD has provided feedback to OPERA NIMBUS (March 2024)*

- **Message to OPERA:**
  - Keep the ODE alive until all NWP relevant issues with NIMBUS are resolved

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Thank you!

Contact

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