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Alertness

APPLICATE.eu
Advanced prediction in polar regions and beyond

Relative Impact of Atmospheric Motion Vectors in HARMONIE-AROME

Roger Randriamampianina,
Niels Bormann, Heather Lawrence, Irina Sandu, Morten A Ø Køltzow, Zheng Qi Wang

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Outline

- Motivation
- Observing System Experiment design
- Impact of the Arctic observations on the AROME-Arctic analyses
- Impact of mid-latitude and Arctic observations on the AROME-Arctic surface forecasts
- Impact of mid-latitude and Arctic observations on the AROME-Arctic upper-air forecasts
- Concluding remarks

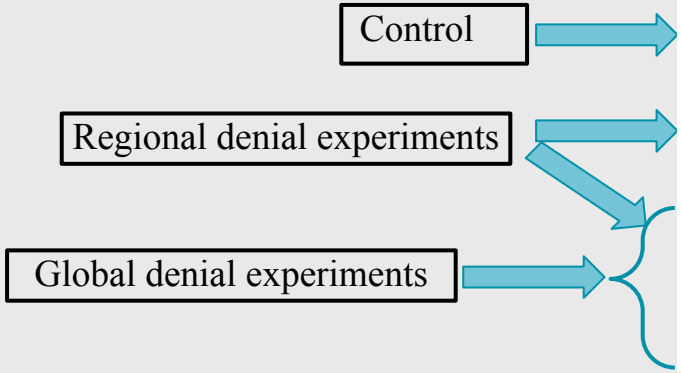
Motivation

- In the Alertness project (2018-2021) we were originally planning to perform Observing System Experiments (OSE) at its final phase.
- Laurence et al. (2019) and Bormann et al. (2019) (ECMWF) conducted a global model with, respectively, Arctic and global OSEs in the framework of the APPLICATE project, and kindly provided us almost all their results to be used as lateral boundary conditions (LBCs) in our study.
- We decided to join this effort and performed the parallel OSEs

The Upper Air OSE

Experiments and naming: **G**= global NWP system, **R**= Regional NWP system , **all**= all observations, **noXX**= observation type XX is removed, **SOP1**= YOPP Special Observing Period 1, **SOP2**= YOPP Special Observing Period 2.

MW= microwave radiances, **MT**= microwave temperature sensitive radiances, **MH**= microwave humidity sensitive radiances, **IR**= Infrared radiances, **AM**= Atmospheric Motion Vectors, **CV**= all conventional observations, **RS**= all radiosonde observations, **PS**= all surface pressure observations, **S1**= all additional SOP1 observations.
The **Gall/Rall** experiment indicates for example the regional experiments in which all observations are assimilated in regional DA, which uses as LBCs the global experiment in which all observations are used. **GnoMW/RnoMW** indicates the regional experiment used while no MW sensitive observations are used either in the regional nor north of 60 N in the global DA.



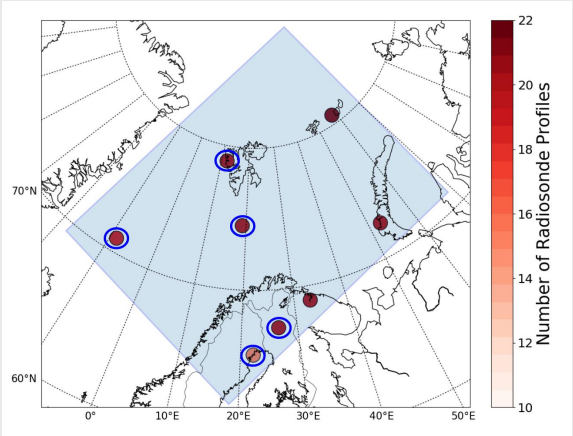
Global experiments used as LBC for regional experiments	Regional experiments	Observations
Gall	Rall	All obs included
Gall	RnoXX	**XX observations removed for SOP1**: MW, MT, MH, IR, AM, CV, RS, PS, S1 **XX observations removed for SOP2**: MW, IR, CV, AM
(Arctic) GnoXX	RnoXX	**XX observations removed for SOP1**: MW, MT, MH, IR, AM, CV, RS **XX removed for SOP2**: MW, IR, CV
(Global) GnoXX	RnoXX	**XX removed for SOP1**: MW, IR, CV, AM

The estimated relative impacts:

-- Through the regional DA: Gall(Arctic)/Rall and Gall(Arctic)/RnoXX
-- Through the LBCs : Gall(Arctic)/RnoXX and GnoXX(Arctic)/RnoXX
-- Total Arctic obs impact: Gall(Arctic)/Rall and GnoXX(Arctic)/RnoXX
-- Impact of mid-latitude obs: GallnoXX(Arctic)/RnoXX and GnoXX(global)/RnoXX

The AROME-Arctic model

- Model upper-air physics: HARMONIE-AROME
- Model surface physics: SURFEX
- Upper-air assimilation: 3D-Var
- Surface assimilation: Optimum interpolation (OI)
- Update strategy: 3 hourly cycling (00, 03, 06, 09, 12, 15, 18, 21 UTC)
- Lateral boundary condition: ECMWF (in this study every 3 hour)
- Used model version: 40h1.2
- Forecast lengths: Long forecast (48 hours) twice a day (00, 12 UTC) for verification purposes
- Winter period (SOP1): 10 February - 31 March 2018
- Summer period (SOP2): 1 - 25 July 2018



The AROME-Arctic model domain with the available radiosonde stations counted during the summer (SOP2) study. Marked stations are those providing additional observations during the YOPP SOPs

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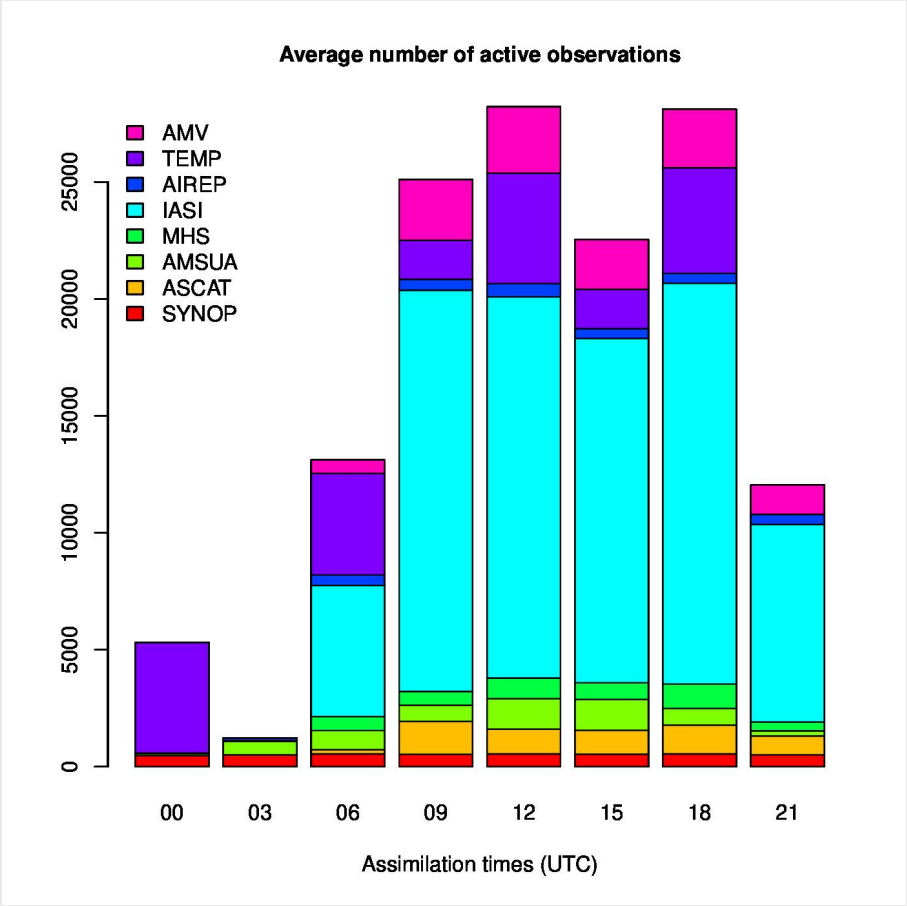
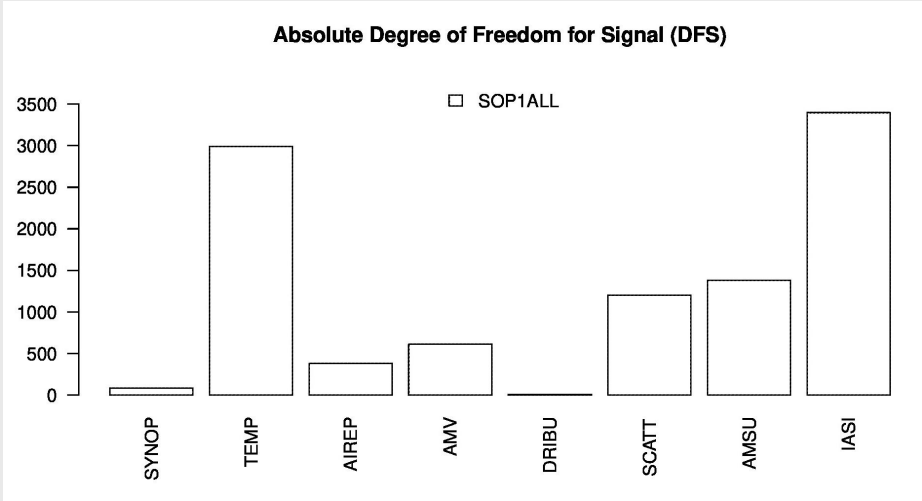
Arctic observations and their impact in DA

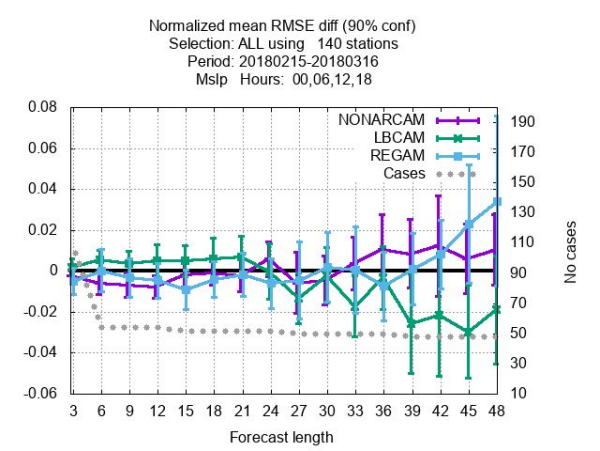


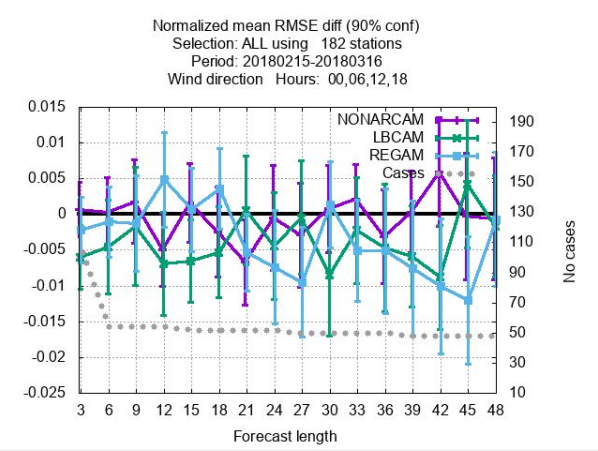
A ten-day averaged number of the assimilated observations per observation type

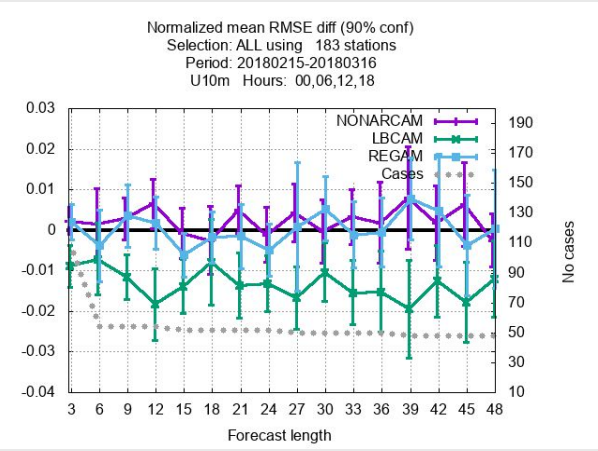
Averaged DFS over four distant assimilation times



Impact of Arctic and mid-latitude AMV on the surface fields







-- Impact of Arctic AMV (Polar wind) observations through regional DA
-- Impact of Arctic AMV (Polar wind) observations through LBCs
-- Impact of mid-latitude AMV (Geo wind) observations through LBCs

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Impact of AMV obs on upper-air of AROME-Arctic

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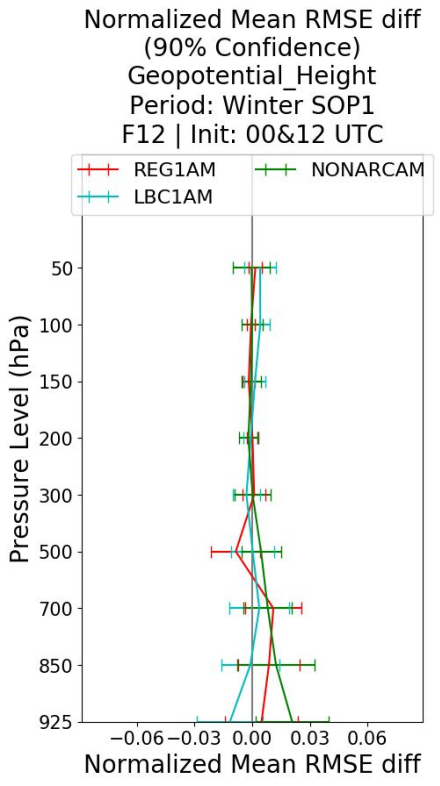

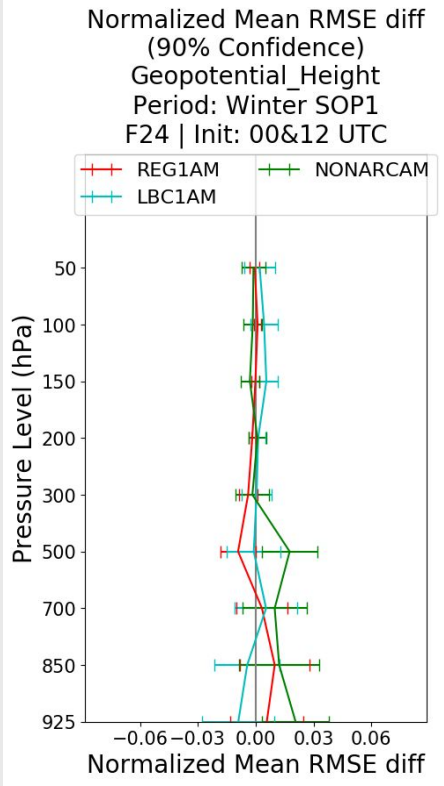

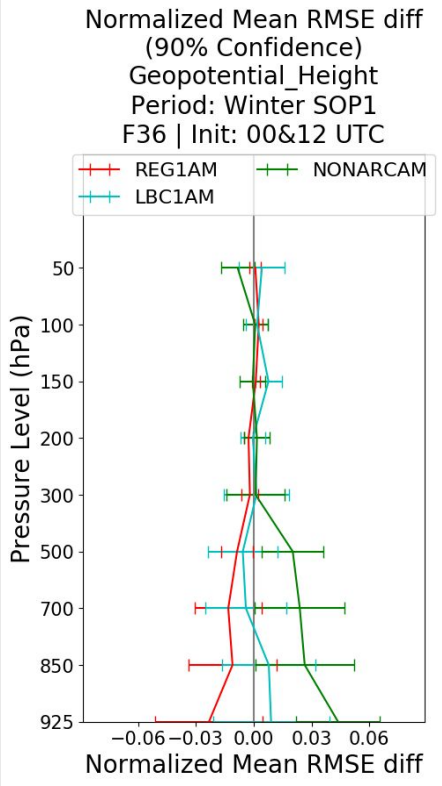

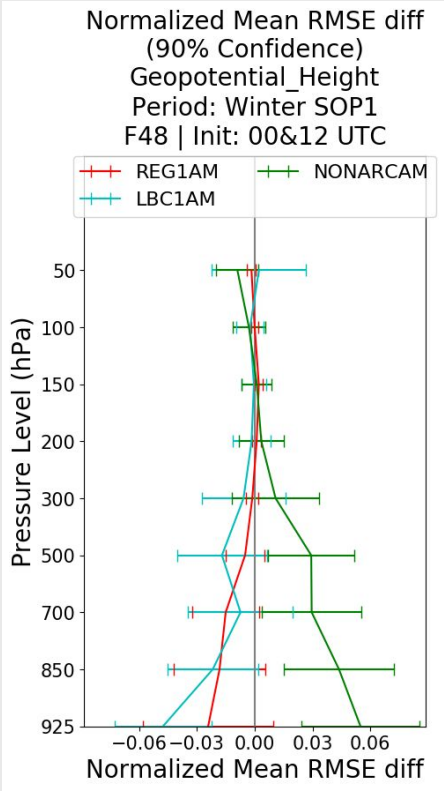

Impact of AMV obs on upper-air of AROME-Arctic

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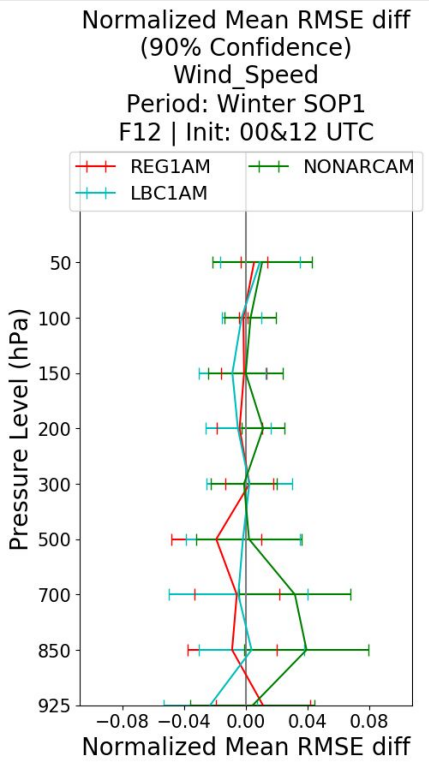

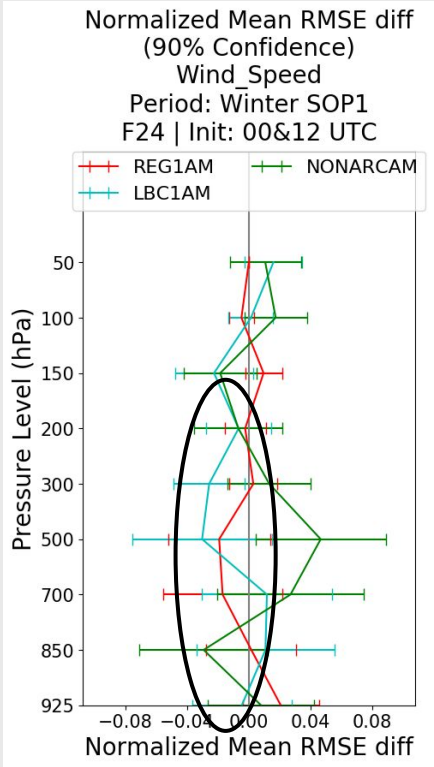

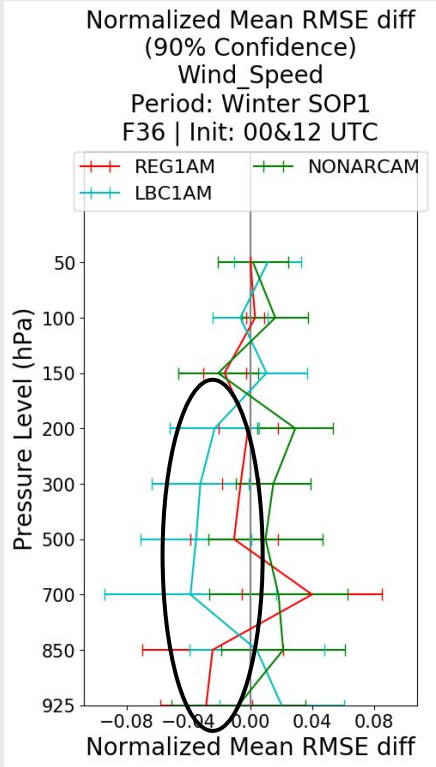

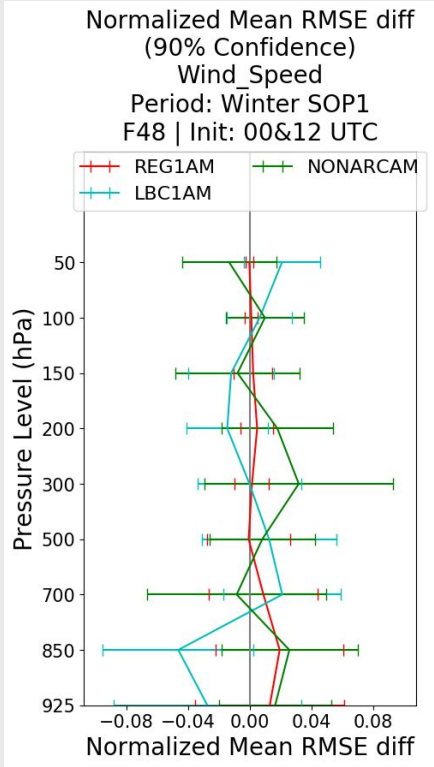

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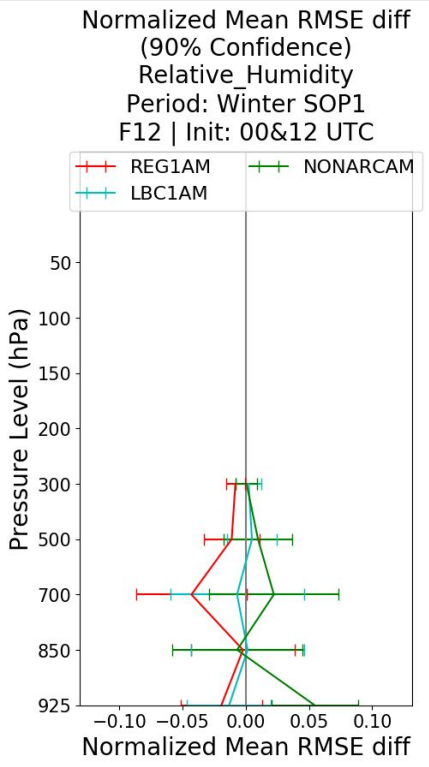

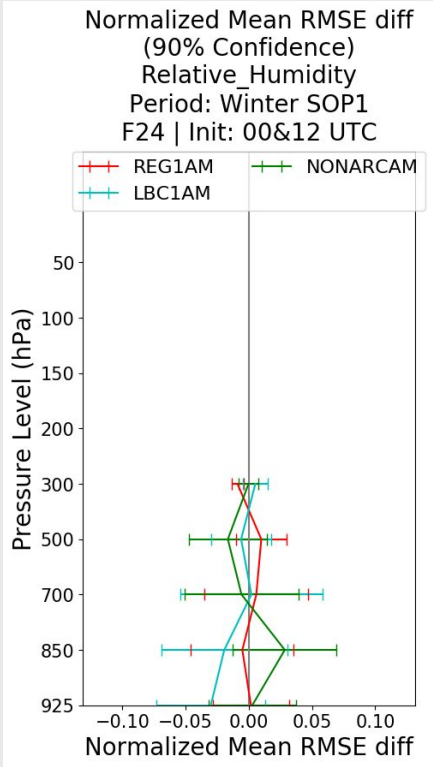

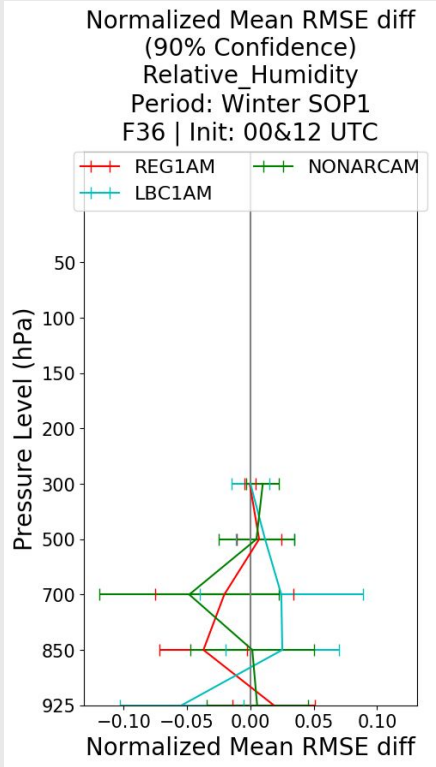

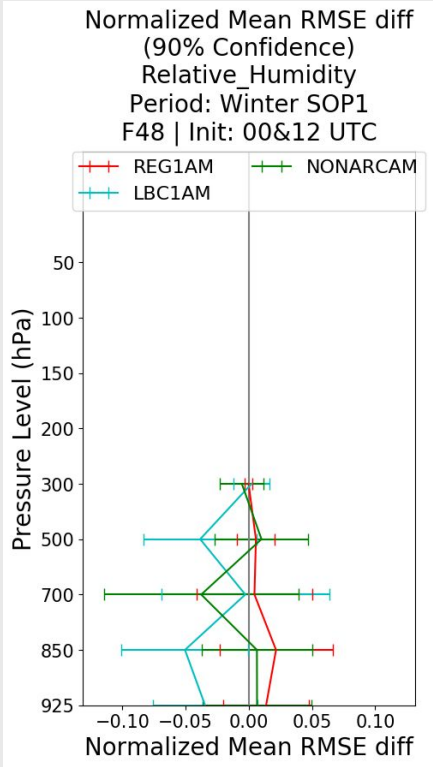

Concluding remarks

- More satellite observations are available in the Arctic for assimilation compared to conventional ones.
- The DFS diagnostic showed that both radiosonde and IASI data are the most contributing observations in the AROME-Arctic DA, AMV data are the fifth impacting observation in DA.
- Observations impact the quality of the AROME-Arctic forecasts both through regional DA and through LBCs.
- For most of the studied observations, the total impacts of observations on the surface fields are dominated by the impacts through regional DA (e.g. winter case), while in the upper-air the total impacts are dominated by the impacts through LBCs.
  -- A non negligible impact on V10m of polar wind through LBC was found.
- Mid-latitude observations (geo wind) impact the quality of day-2 AROME-Arctic forecasts through LBCs.
  -- Although, not always positive.
- Based on impact on geopotential forecasts: The conventional observations are the most impacting observations, followed by the IASI, the microwave radiances.
  Based on impact on wind speed forecasts: AMV and IASI radiance are the most impacting.
- First paper on this study is out in Q. J. R. Meteorol. Soc.

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Thank you for your attention!

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