

2020 Joint LACE Data Assimilation & DAsKIT Working Days,
Vienna, 14-17 September 2020



Data assimilation activities at RMI (Belgium)

Presented by :
Idir DEHMOUS

Operational setup at RMI

Operational Forecast models

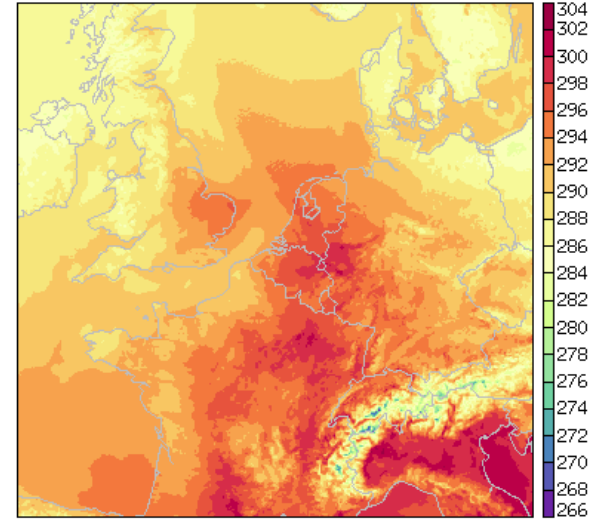
ALARO cy43t2

Resolution 4km , 432x432 grid points
Number of levels 87
Time step 180 s
Coupling model ARPEGE
Coupling frequency 1 hour
Forecast range 60h at 00, 06, 12, 18h
Initialisation First ARPEGE coupling file

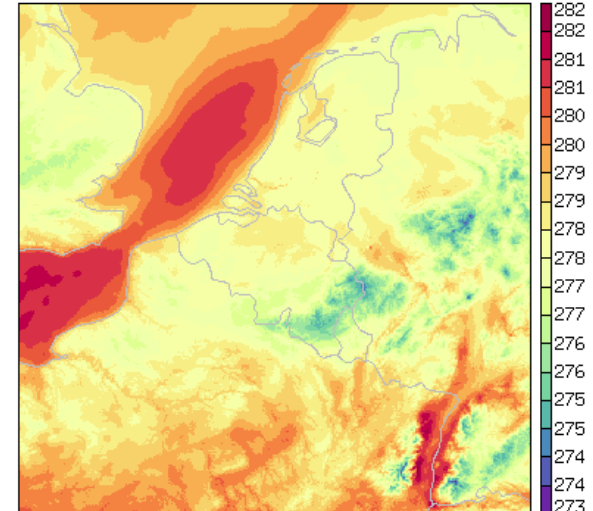
ALARO (high resolution) cy43t2

Resolution 1.3km , 576x576 grid points
Number of levels 87
Time step 45 s
Coupling model ALARO 4km
Coupling frequency 1 hour
Forecast range 36h at 00, 06, 12, 18h
Initialisation First ALARO coupling file

CLSTEMPERATURE
2020/08/01 z00:00 +1h



CLSTEMPERATURE
2020/03/01 z00:00 Initialized



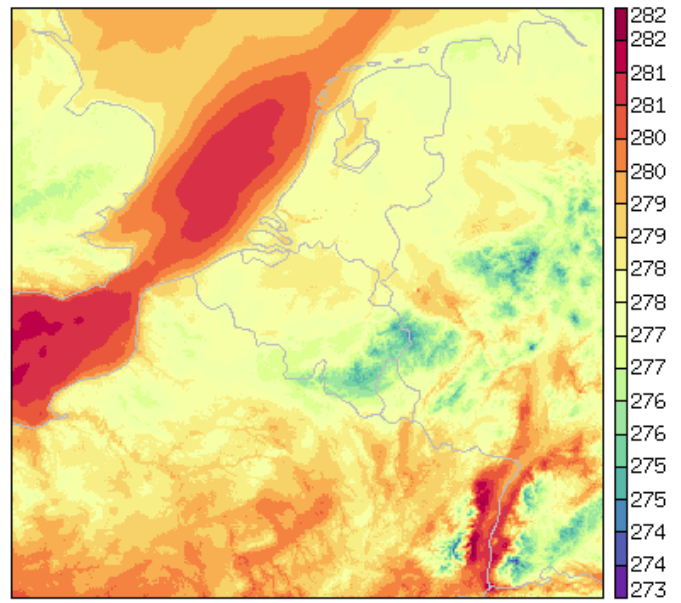
Operational Forecast models

AROME cy43t2

AROME is the new operational forecast model at RMI since June 2020

Resolution	1.3km , 576x576 grid points
Number of levels	87
Time step	45 s
Coupling model	Nested with ALARO 4km
Coupling frequency	1 hour
Forecast range	48h at 00, 06, 12, 18h
Initialisation	Surface : Canari_Oimain Upper-air: None

CLSTEMPERATURE
2020/03/01 z00:00 Initialized

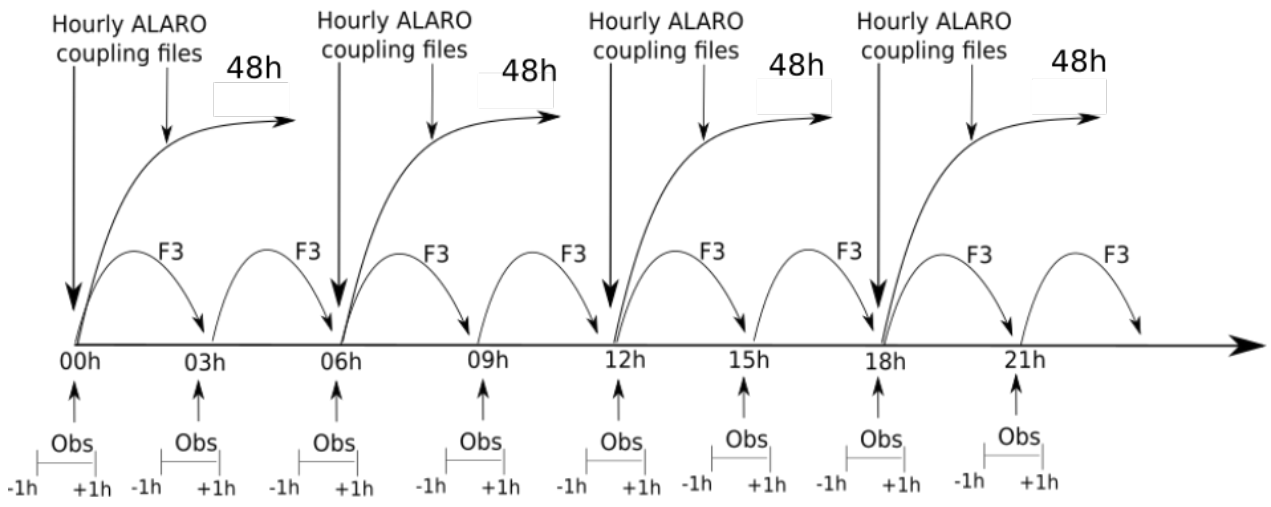
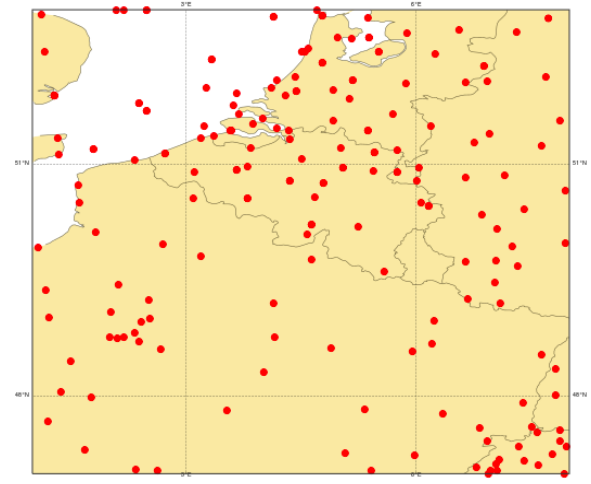


Data assimilation progress and activities

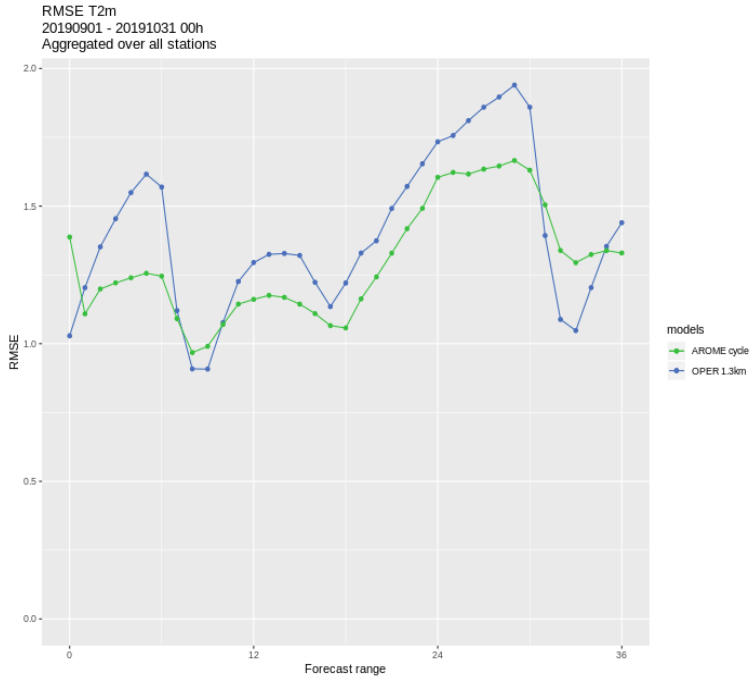
AROME operational setup with surface DA

- Resolution : 1.3 km
- Observations : Synop
- Upper-air analysis : None
- Surface analysis : CANARI_Oimain
- Cycling frequency : 3h hours
- Coupling model : ALARO 4km
- Production time : 00, 06 , 12, and 18h with 48h forecast range

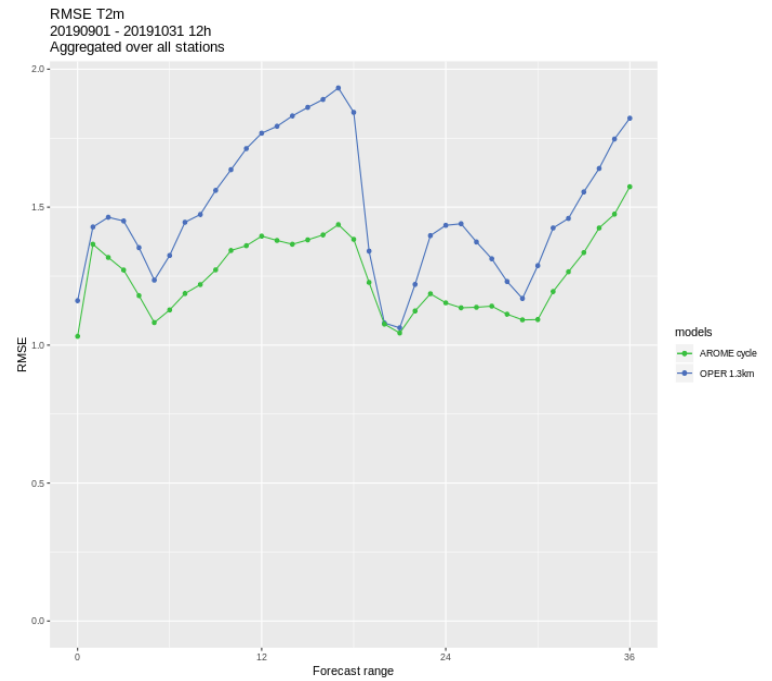
SYNOP observations over AROME-Belgium domain



AROME operational setup with surface DA



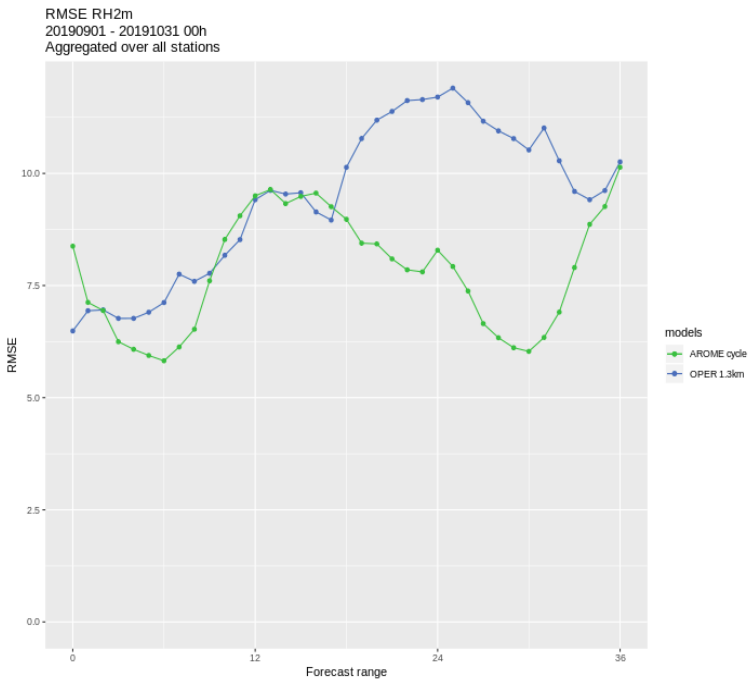
T2m RMSE 00h Runtime



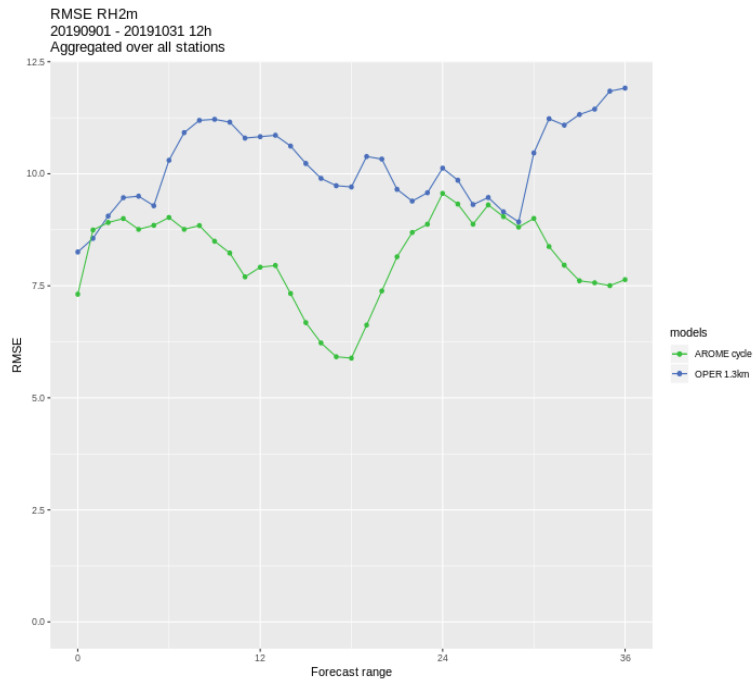
T2m RMSE 12h Runtime

ALARO1.3 Dynamical adaptation (Blue)
AROME1.3 Canari_Oimain cycle (Green)

AROME operational setup with surface DA



H2m RMSE 00h Runtime



H2m RMSE 12h Runtime

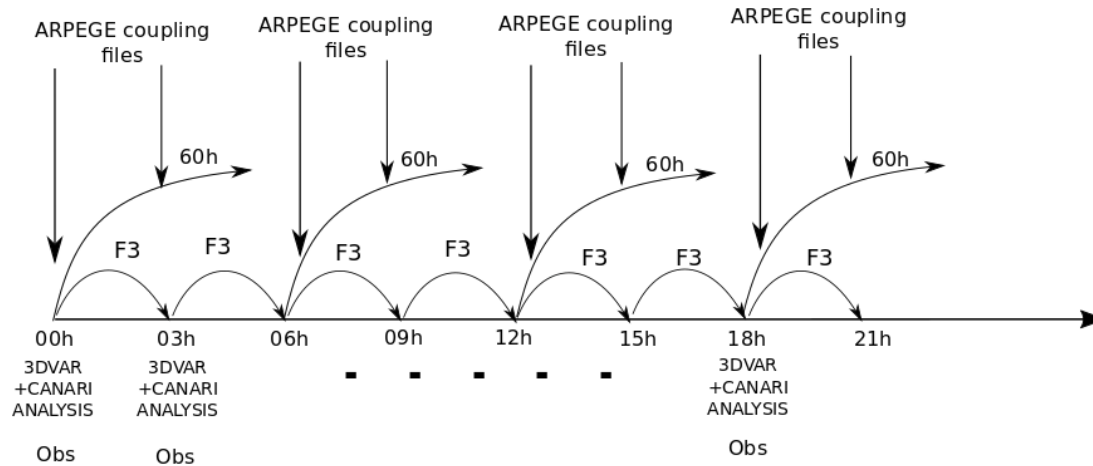
ALARO1.3 Dynamical adaptation (Blue)
AROME1.3 Canari_Oimain cycle (Green)

Configurations under testing

Combination of surface CANARI and 3Dvar for ALARO

The experiment setup

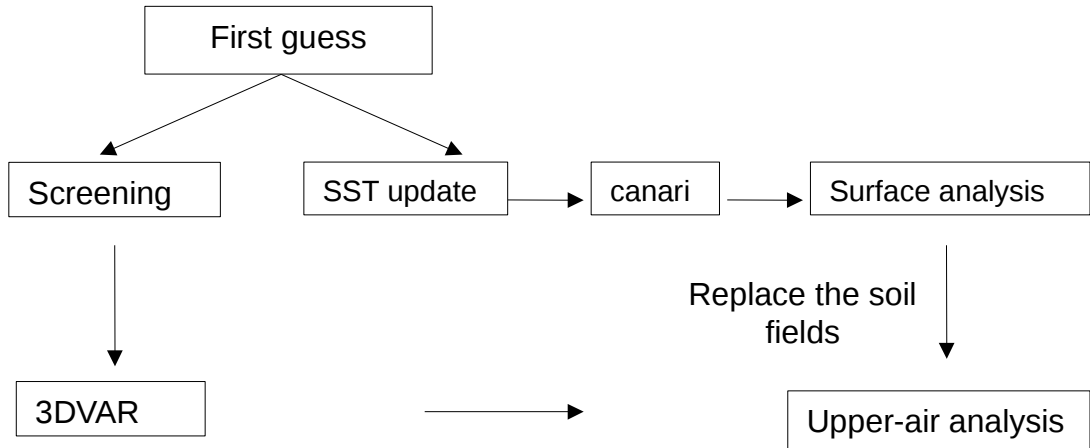
- 3h assimilation cycle
- 1h hour observations cut-off
- Period : from 01-03-2020 to 31-03-2020
- 60h forecast range with 4 production time , 00, 06 , 12 and 18h
- Observation used : SYNOP , AMDAR and TEMP



Combination of surface CANARI and 3Dvar for ALARO

The experiment setup

- B matrix computed using NMC method
- 3h assimilation cycle
- 1h hour observations cut-off
- Period : from 01-03-2020 to 31-03-2020
- 60h forecast range with 4 production time , 00, 06 , 12 and 18h
- Observation used : SYNOP , AMDAR and TEMP

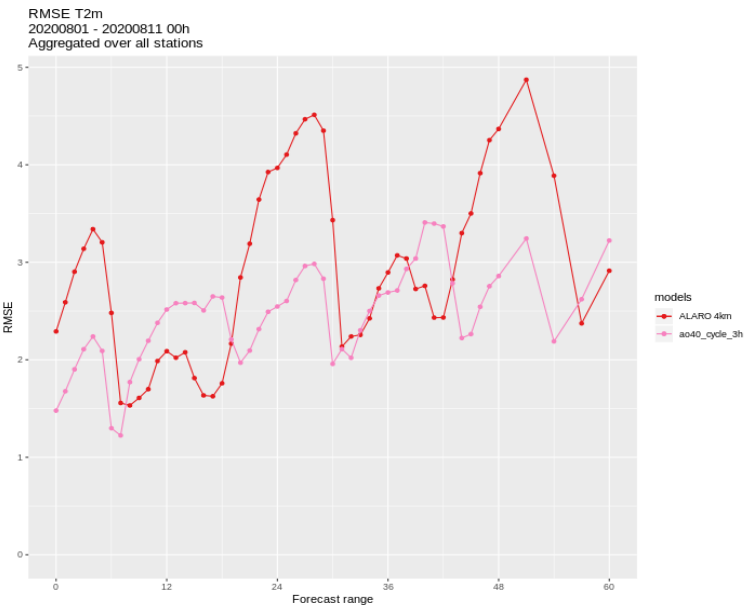


Surface and soil temperature ,
and water content (ice content
for snow analysis)

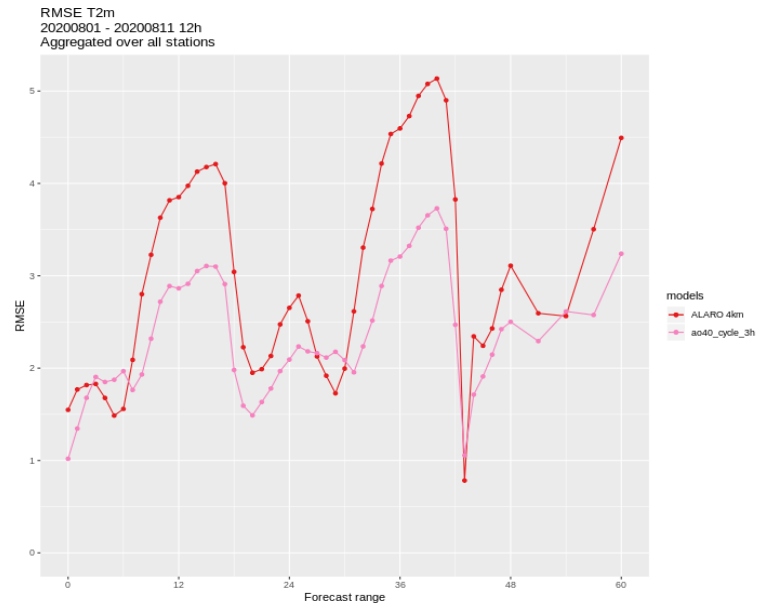
- SURFRESERV.EAU
- PROFRESERV.EAU
- SURFRESERV.GLACE
- PROFRESERV.GLACE
- SURFRESERV.NEIGE
- PROFTEMPERATURE
- SURFTEMPERATURE
- SURFRESERV.INTER
- SURFALBEDO.NEIG

Preliminary scores

The T2m RMSE of ALARO cycle is decreased considerably compared to the operational (dynamical adaptation).



T2m RMSE 00h Runtime

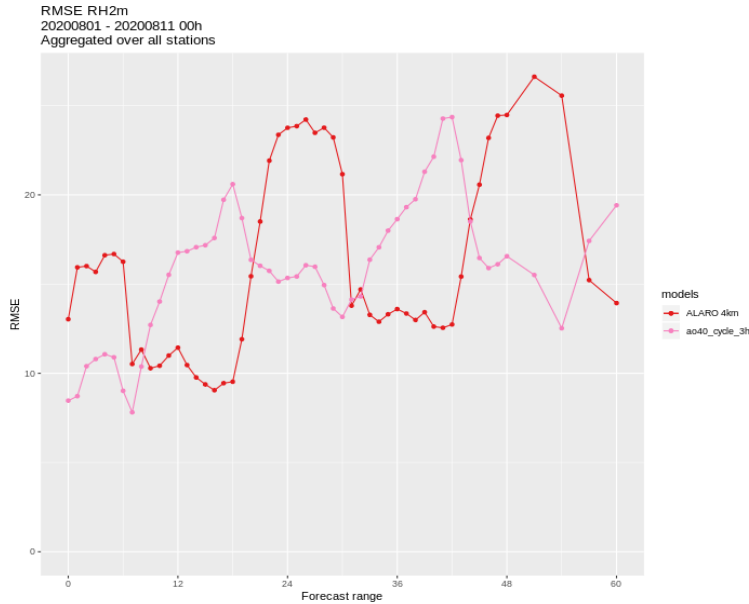


T2m RMSE 12h Runtime

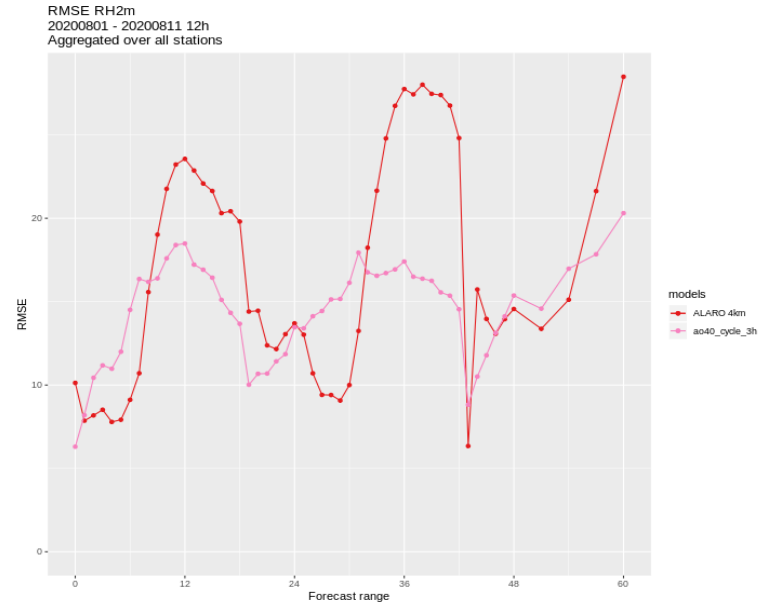
ALARO4.0 Dynamical adaptation (oper) (Red)
ALARO4.0 3Dvar+ canari (Magenta)

Preliminary scores

The H2m RMSE of ALARO cycle tends to decrease for the night cycles compared with the diurnal ones.



H2m RMSE 00h Runtime



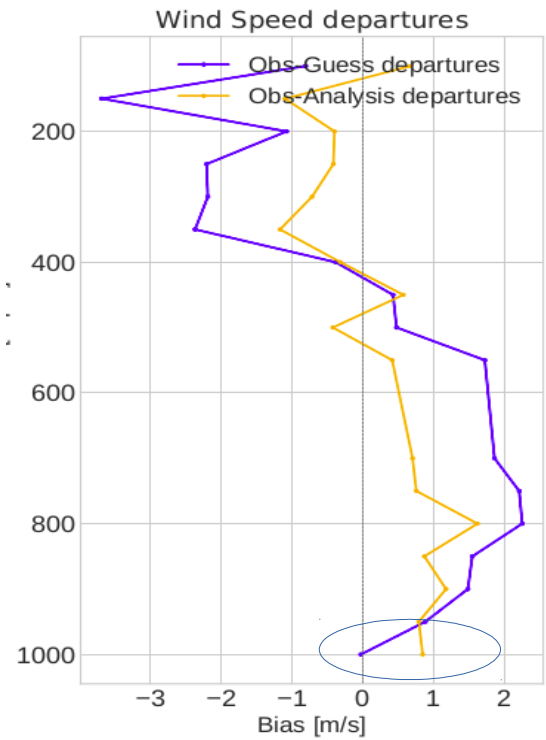
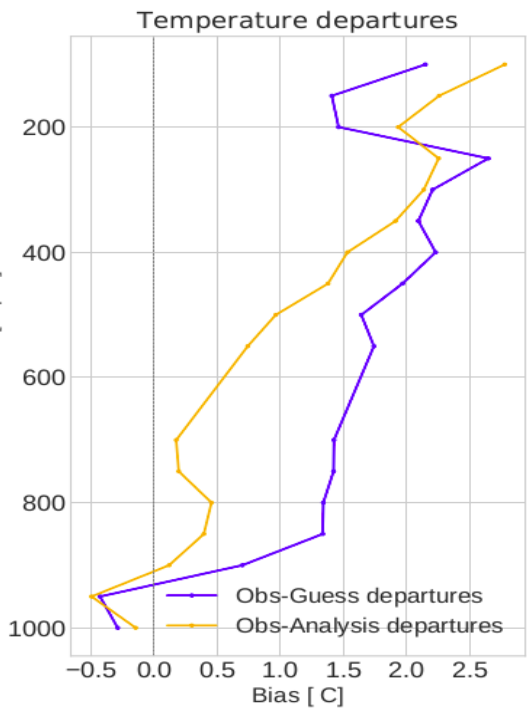
H2m RMSE 12h Runtime

ALARO4.0 Dynamical adaptation (oper) (Red)
ALARO4.0 3Dvar+ canari (Magenta)

Preliminary scores

The upper-air temperature departures are decreased for almost all the atmospheric levels, until up to 300 hpa.

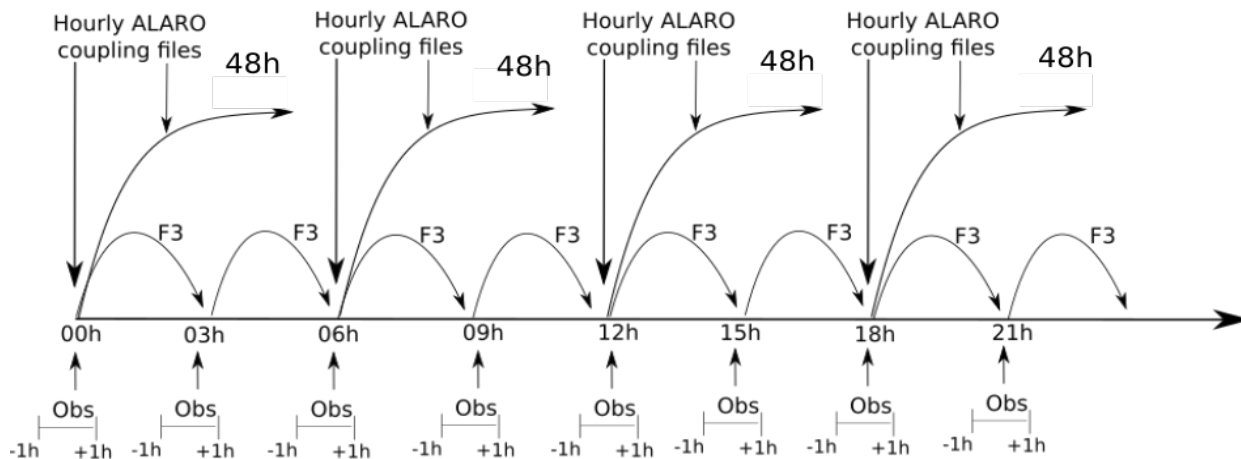
The departures are also decreased for the wind speed over upper-air levels, except near the surface we can note a slight degradation.



Combination of surface CANARI_Oimain with 3Dvar for AROME

The experiment setup

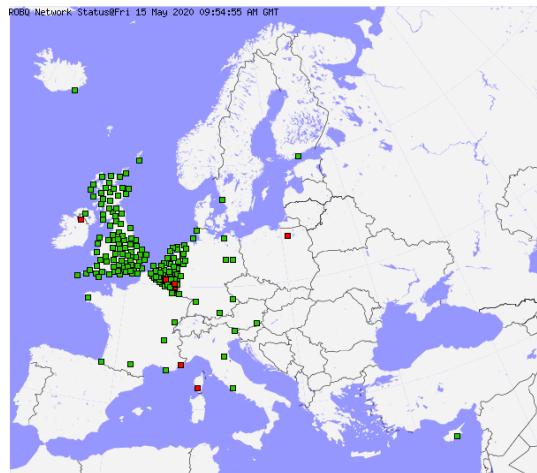
- B matrix computed using NMC method
- 3h assimilation cycle
- 1h hour observations cut-off
- Period : from 01-03-2020 to 31-03-2020
- 48h forecast range with 4 production runtime , 00, 06 , 12 and 18h
- Observation used : SYNOP , AMDAR and TEMP



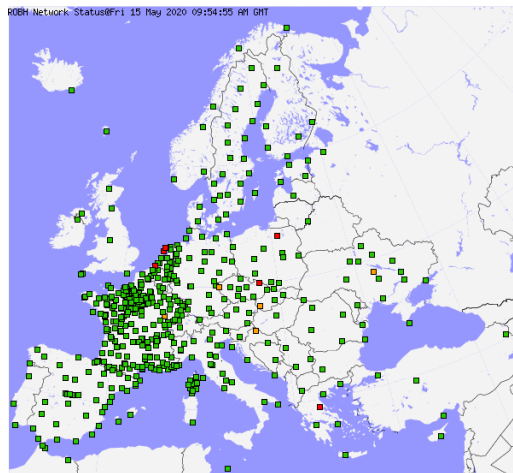
Combination of surface CANARI_Oimain with 3Dvar for AROME

New observation type was introduced

The ground based GNSS data from ROBQ and ROBH centres

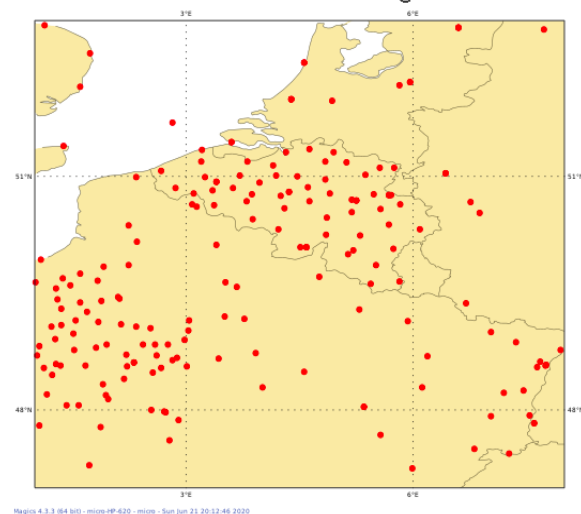


Stations from ROBQ centre
Data every 15 min



Stations from ROBH centre
Data every 1 hour

GNSS stations in AROME-Belgium domain



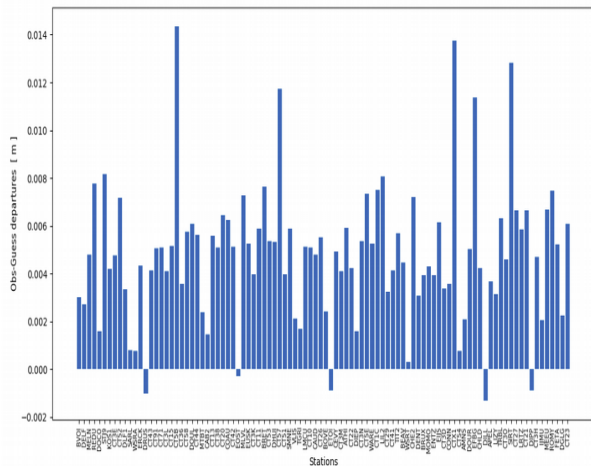
GNSS stations included in the
AROME-Belgium domain

Combination of surface CANARI_Oimain with 3Dvar for AROME

The GPS-Sol couldn't be assimilated directly in active mode in 3Dvar.

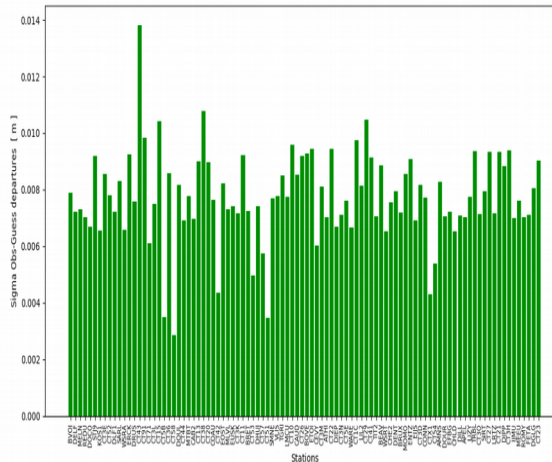
- Need a passive assimilation to get the ZTD static bias for each station.
- Update the list_gpsol whitelist in BATOR program.
- The period of monitoring extends from 01-01-2020 to 31-01-2020

Observations-Guess means
from 01-01-2020 to 31-01-2020



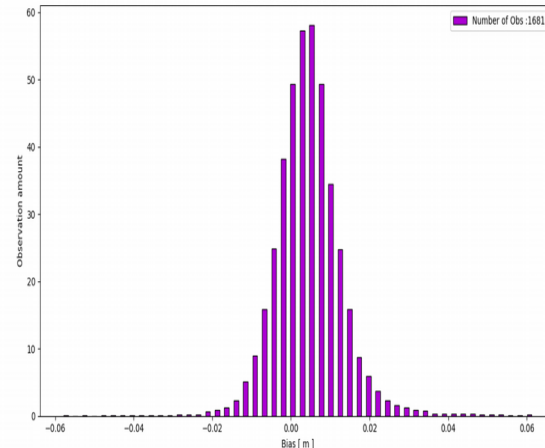
Static bias mean

Observations-Guess departures standard deviations
from 01-01-2020 to 31-01-2020



Standard deviation

Error density distribution for all observations used
from 01-01-2020 to 31-01-2020

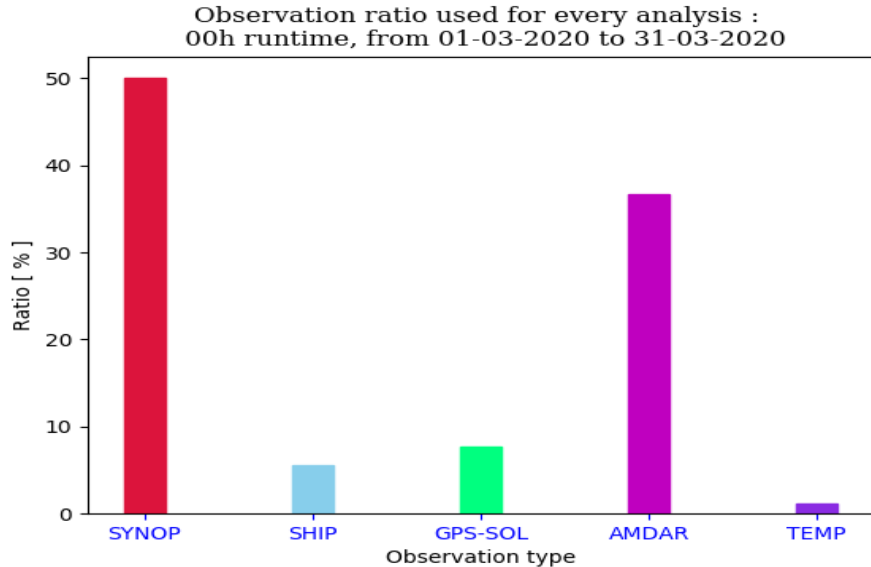


Error density distribution

Combination of surface CANARI_Oimain with 3Dvar for AROME

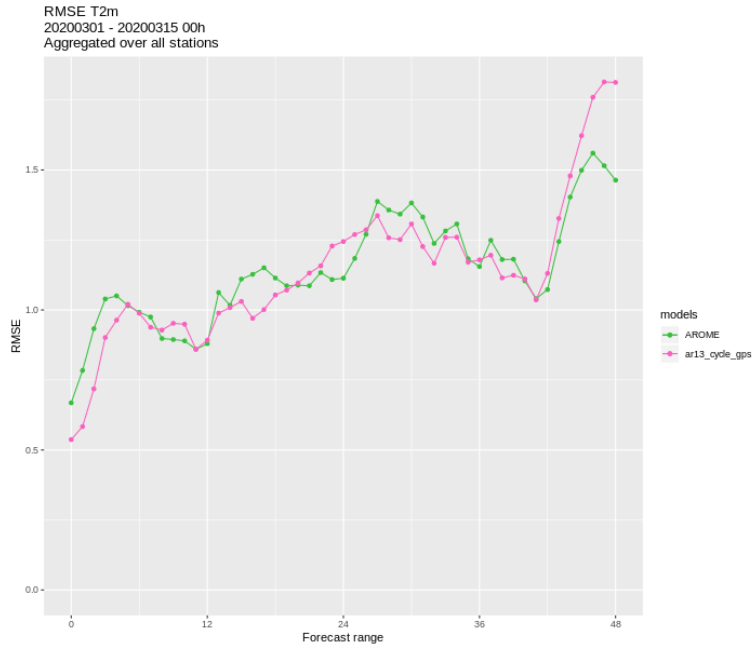
Summary about observation usage in arome 3DVAR+canari

Observation type	Average	Assimilated parameters
SYNOP/SHIP	~ 300 – 350	• T2m, h2m ,V10
AMDAR	~ 150 – 250	• Upper-air U , T
TEMP	~ 3 – 6	• Upper-air U ,T and H
GPS-SOL	~ 60 – 70	• Zenith Total Delay (ZTD)

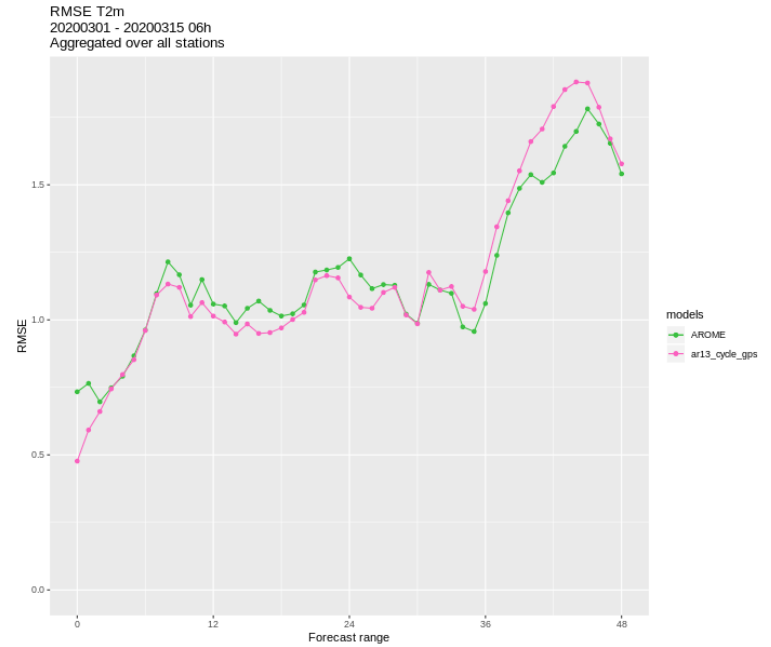


Preliminary results

The assimilation of ZTD in 3DVAR seems to have a neutral impact on T2m parameter.



T2m RMSE 00h Runtime



T2m RMSE 12h Runtime

AROME1.3 Canari + synop obs only

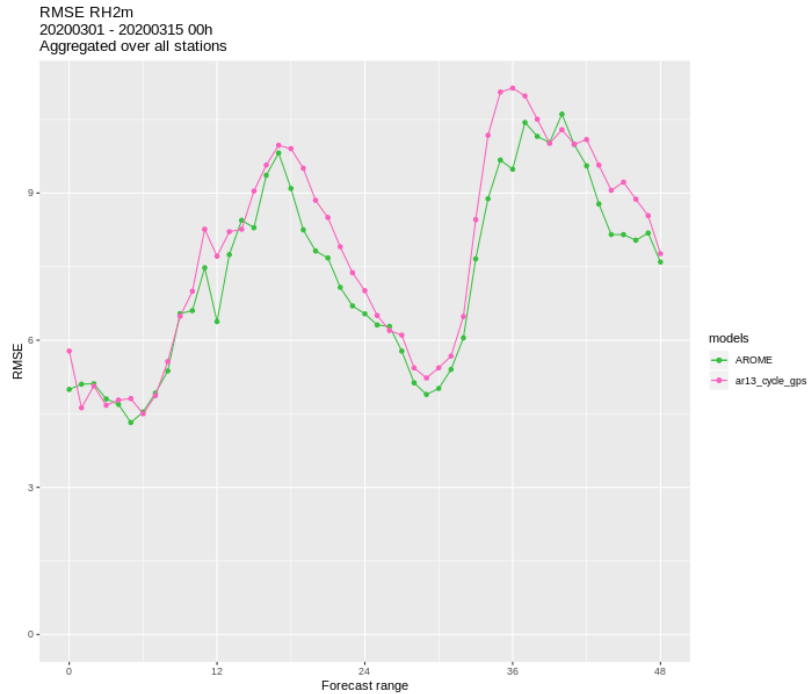
(Green)

AROME1.3 3Dvar + canari_Oimain with all obs

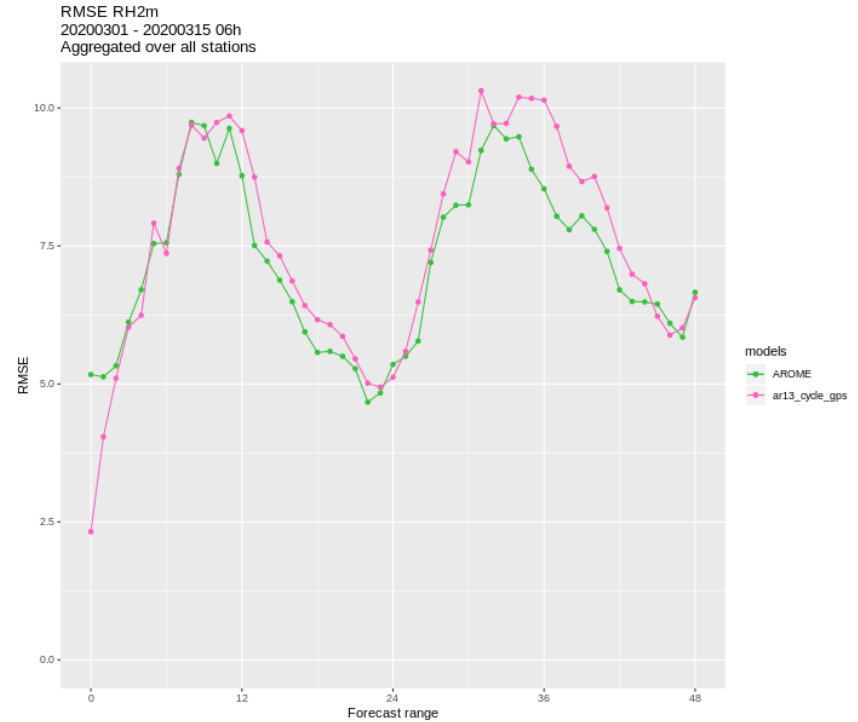
(Magenta)

Preliminary results

Not a big difference for the h2m , impact is almost neutral too.



H2m RMSE 00h Runtime



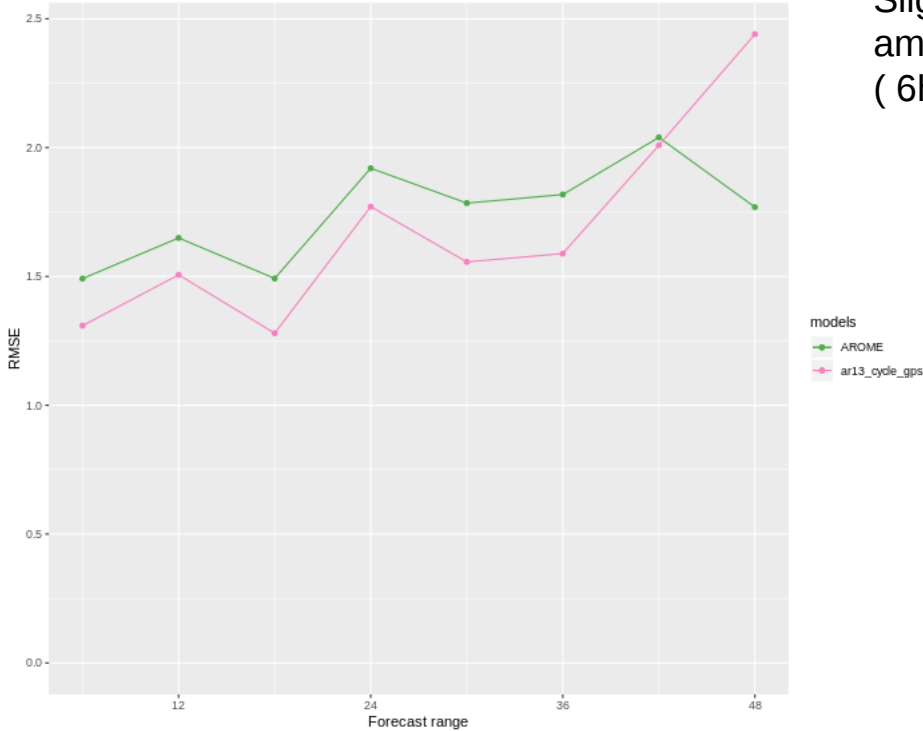
H2m RMSE 12h Runtime

AROME1.3 Canari + synop obs only (Green)

AROME1.3 3Dvar + canar_Oimaini with all obs (Magenta)

Preliminary results

RMSE Pcp
20200301 - 20200320 00h
Aggregated over all stations



Slight improvement of the cumulated precipitation amount
(6h cumulated precipitation)

AROME1.3 Canari + synop obs only (Green)
AROME1.3 3Dvar + canari_Oimain with all obs (Magenta)

Conclusion

- AROME suite using CANARI_Oimain with 3h cycle was installed in operational mode during June 2020.
-
- The scores show considerable improvement for surface parameters like 2 meter temperature and humidity.
-
- Combination of the 3DVAR and CANARI with the 3 observation type (synop , AMDAR and TEMP) in ALARO 4km seems to be beneficial for an operational implementation.
-
- The AROME CANARI_Oimain + 3DVAR was implemented successfully and is running in test mode
-
- The introduction of the GNSS data for AROME didn't show the "expected" improvement. The scores show an improvement for 6h precipitation amount ,however it decreases slightly the T2m bias and is almost neutral for H2m.
-

Main perspectives

- Verification of other parameters and Validation of the current tested configurations, ALARO 3DVAR+Canari and AROME 3DVAR+Canari.
-
- Testing the VarBC scheme for GNSS data assimilation.
-
- Improvement of the actual configurations scripts, running already on EcFlow environment, for more robustness and maintainability (Seamless prediction & Project IMA at RMI).
-
- Use of more available data, (ODIM Radar data and MODE-S)
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Thank you for your
attention