SPECIAL PROJECT PROGRESS REPORT

Progress Reports should be 2 to 10 pages in length, depending on importance of the project. All the following mandatory information needs to be provided.

Reporting year	…**2019**…………………………………………………………
Project Title:	…**Testing and developing the HARMONIE data assimilation system at MET Norway**… ………………………………………………………………
Computer Project Account:	……**spnorand**………………………………………………
Principal Investigator(s):	…**Roger Randriamampianina**…………………… ………………………………………………………………
Affiliation:	**Norwegian Meteorological Institute (MET Norway)**…
Name of ECMWF scientist(s) collaborating to the project (if applicable)	……………………………………………………………… ………………………………………………………………
Start date of the project:	…**01.01.2018**………………………………………………
Expected end date:	…**31.12.2020**………………………………………………

Computer resources allocated/used for the current year and the previous one
(if applicable)
Please answer for all project resources

		Previous year		Current year	
		Allocated	Used	Allocated	Used
High Performance Computing Facility	(units)	8000000	8096771.9	8000000	6846422.07
Data storage capacity	(Gbytes)	20000			

Summary of project objectives

(10 lines max)

The objective of this special project is to support all data assimilation (DA) related activities at MET Norway. The tasks in the application involve five activities: 5-years hindcast, refinement of background error statistics, improvement of sea ice modelling, use of more satellite observations, and participation in OOPS development. These were the dominating DA topics at application time, while from 2018-2019, we are also engaged in other external projects involving more topics like assimilation of Aeolus HLOS data (PRODEX), observation operator refinement and all-sky radiance assimilation (Alertness), Copernicus regional reanalysis projects (C3S_322_Lot1 – European and C3S_D322_Lot2 – Arctic) and observing system experiments (Alertness).

Summary of problems encountered (if any)

(20 lines max)

None this time

Summary of results of the current year (from July of previous year to June of current year)

This section should comprise 1 to 8 pages and can be replaced by a short summary plus an existing scientific report on the project

During this period, part of the SPNORAND project was used to complete the observing system experiments (OSE) we have started to perform under our national resources. In this study, the impact of observations (i.e conventional, microwave and infrared radiances, and atmospheric motion vectors) over the European side of the Arctic using the AROME-Arctic model (Randriamampianina et al. 2019). This study has an unique result thanks to help from Heather Laurence and Niels Bormann, who provided sets of lateral boundary conditions (LBCs) to our regional experiments. We were able to study the following impacts of the Arctic observations: 1) impact through the LBCs on the AROME-Arctic; 2) impact through the local regional data assimilation (DA); 3) impact from the loss of the observations in both global (IFS) and the regional systems; 4) impact of non-Arctic observations on the AROME-Arctic. As one can see lots of experiments were performed that requested enormous volume of data to be archived. We are writing a paper describing all the above mentioned results now. As soon as the paper is accepted, the archive volume will be reduced by minimum if not completely.

An example from the results of this study is shown in the figure 1 below .

Other part of the used resource was applied to compute comprehensive verification scores for our earlier OSE study. We implemented a verification tool that can account for all active observations in the data assimilation, including radiance data. The paper describing this study was published this year. Example of verification results is shown on the figure 2 below.

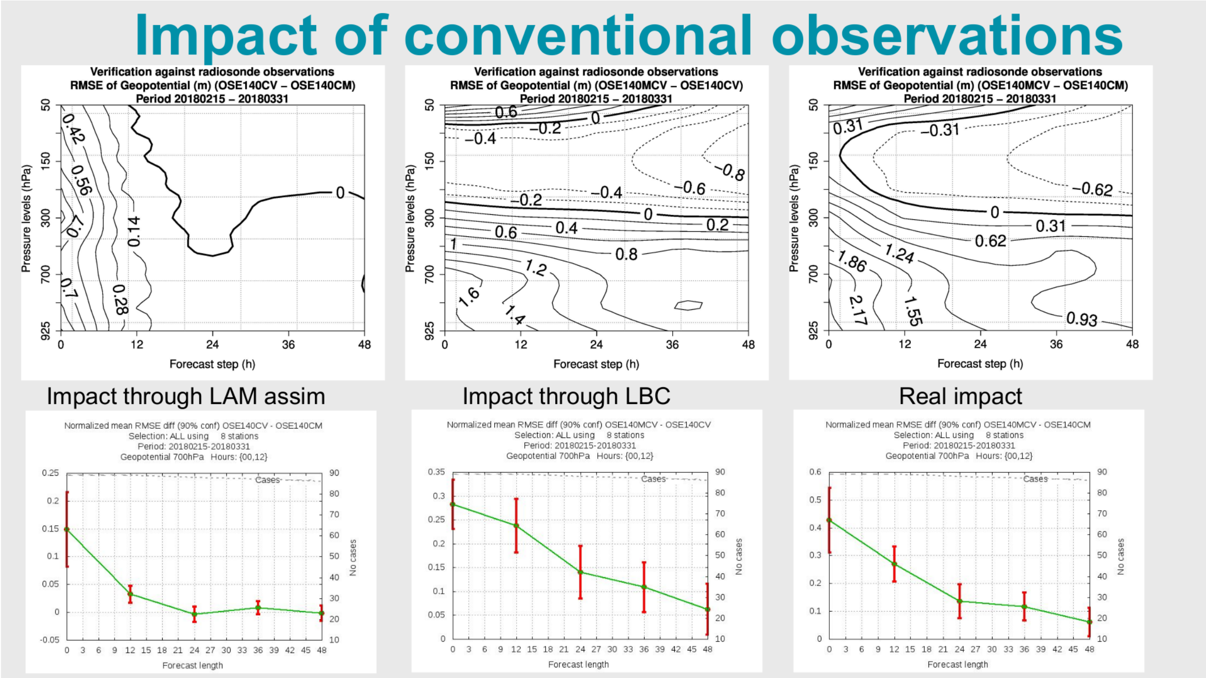

Figure1: Relative impact of the conventional observations on AROME-Arctic analyses and forecasts as detected through the regional DA (left), through the LBC (centre), and and when losing the observations in both global (IFS) and regional (right). On upper panels show the root-mean-error (RMSE) difference, where positive values mean positive impact. In the left panel both the runs with and without conventional observations are coupled with the control IFS; in the central panel, both the regional runs were without conventional observations, while as LBCs the control and the data denial runs were used; and the right panel shows one in one of the experiments both IFS and regional models run without conventional observations. Lower panels show the significance test at 700 hPa level.

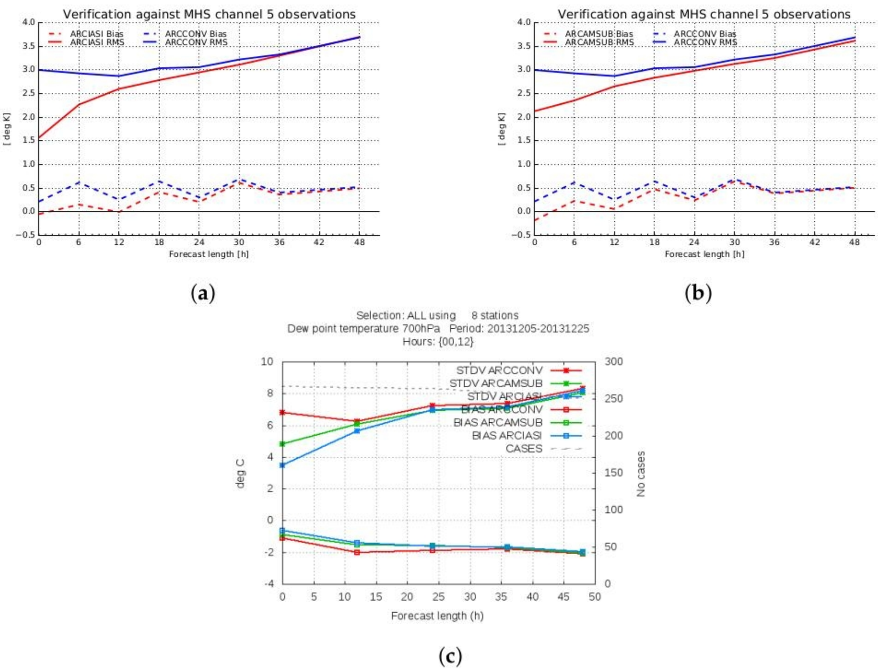

Figure 2: The verification against the AMSU-B/MHS channel 5 brightness temperature (a,b) and the verification against radiosonde observations (c). The horizontal axes in (a,b) show forecast lengths similar to the one in (c). The RMSE and the error standard deviation (STDV) are comparable. Note that channel 5 of the AMSU-B/MHS instrument picks at around 700 hPa depending on the water vapour in the air.

List of publications/reports from the project with complete references

Randriamampianina, R.; Schyberg, H.; **Mile, M.** Observing System Experiments with an Arctic Mesoscale Numerical Weather Prediction Model. *Remote Sens.* 2019, *11*(8), 981; https://doi.org/10.3390/rs11080981

Summary of plans for the continuation of the project

(10 lines max)

We have few data assimilation related projects running. While this year part of the resource will be used to better analyse and verify the OSE results, part of it will be used to start the implementation of all-sky radiance assimilation in the Harmonie-AROME data assimilation system.