SPECIAL PROJECT PROGRESS REPORT

All the following mandatory information needs to be provided. The length should *reflect the complexity and duration* of the project.

Reporting year	2020
Project Title:	Advanced assimilation of satellite observations and the impact of improved atmospheric forcing over a limited-area Arctic region
Computer Project Account:	spnomile
Principal Investigator(s):	Mile, M.
Affiliation:	Norwegian Meteorological Institute
Name of ECMWF scientist(s) collaborating to the project (if applicable)	n/a
Start date of the project:	01/01/2020
Expected end date:	31/12/2022

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)	n/a	n/a	20000000	845011.92
Data storage capacity	(Gbytes)	n/a	n/a	40000	(~1600)

Summary of project objectives (10 lines max)

The aim of the project is to improve the assimilation of radiance observations (focusing on spatial representativeness error) over high-latitudes, and to evaluate the impact of improved atmospheric forcing in a coupled ocean-sea ice model. It is planned to run AROME model at 2.5km resolution over an Arctic domain during selected periods and to develop a new observation operator taking into account satellite footprint in data assimilation procedure. The performance of AROME data assimilation will be assessed using specific data assimilation diagnostics and forecast verifications. Scientific studies of the new observation operator will focus on obtaining reduced error in data assimilation and providing more accurate analyses for AROME forecasts. In the next phase of the project, data assimilation developments will give an understanding of how an improved use of radiance data influence the coupled ocean-sea ice system as well.

Summary of problems encountered (10 lines max)

Few results have been produced yet because the project only started in March 2020 i.e. 3 months ago. No specific problem was encountered so far.

Summary of plans for the continuation of the project (10 lines max)

The implementation of new observation operator was started, but has not been finished yet. After the successful source code implementation, technical and scientific validation of the new method is planned (i.e. single observation experiments with various radiance observations, data assimilation diagnostics, mono and parallel tests). The validation of the method will be followed by the tuning of predefined data assimilation errors and the execution of observing system experiments. Additionally, special case studies, particularly interesting in the Arctic region, are going to be examined. At a later stage, the coupled ocean-sea ice system is going to be set up in ECMWF's HPC.

List of publications/reports from the project with complete references

Mile, M., Randriamampianina, R., Marseille, G.-J., Stoffelen, A.: Supermodding - the first trial of a new methodology for mesoscale data assimilation using scatterometer winds, 2020, Submitted Q. J. R. Meteorol. Soc.

Randriamampianina R, Bormann N, M A Ø Køltzow, H Lawrenc, I Sandu, Zh Q Wang, Relative impact of observations on a regional Arctic numerical weather prediction model, 2020, Submitted Q. J. R. Meteorol. Soc.

Summary of results

If submitted **during the first project year**, please summarise the results achieved during the period from the project start to June of the current year. A few paragraphs might be sufficient. If submitted **during the second project year**, this summary should be more detailed and cover the period from the project start. The length, at most 8 pages, should reflect the complexity of the project. Alternatively, it could be replaced by a short summary plus an existing scientific report on the project attached to this document. If submitted **during the third project year**, please summarise the results achieved during the period from July of the previous year to June of the current year. A few paragraphs might be sufficient.

The spnomile project was used to develop and study the following tasks:

1 – Development of new supermodding observation operator for radiance instruments

The implementation of radiance footprint operator follows the idea of scatterometer supermodding operator (*Mile et al. (2020)*) with the necessary modifications to model levels and radiance footprint representation (ellipses). It starts with the computation of major and minor axes of the footprint ellipses. It is done differently for various radiance observations like AMSU or IASI sensors. After this setup procedure, the horizontal part of the observation operator continues with the selection of related model grid-points to be used in the *H(xb)* calculation. A schematic illustration of IASI FOVs ellipses for AROME-Arctic model levels can be seen on the figure 1. This process consumed the relatively small amount of SBUs and time was mostly spent on source code developments and related compilation procedures on ECMWF's HPC.

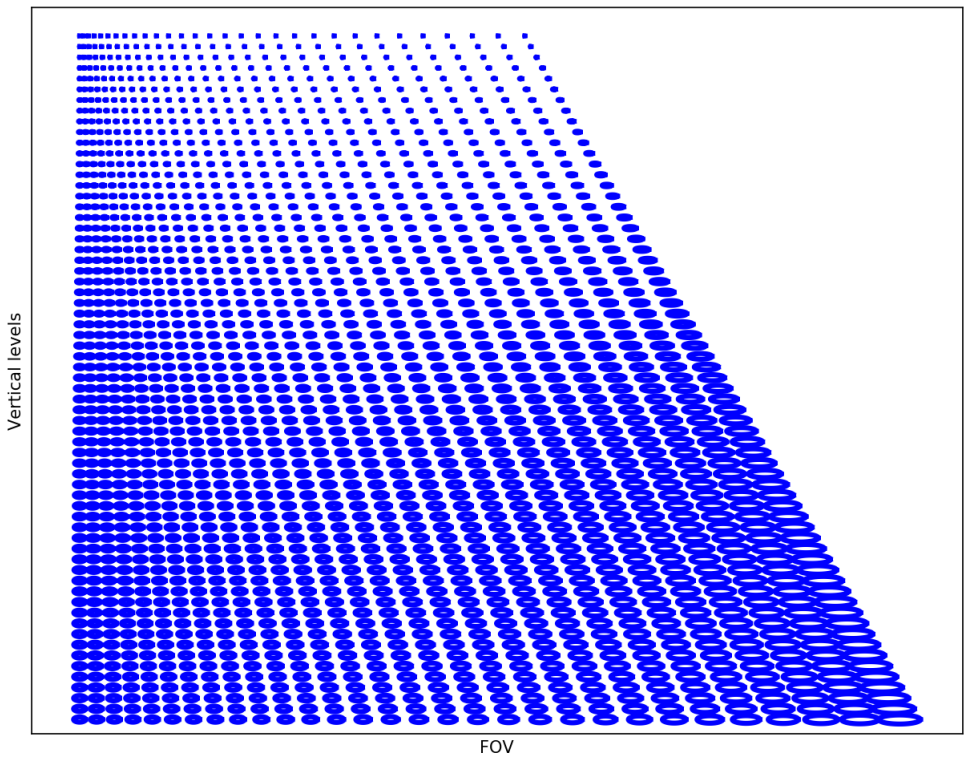

Figure 1. The schematic representation of IASI FOV ellipses for AROME-Arctic 65 vertical levels.

2 – Study the AROME-Arctic forecasting capabilities through observing system experiments

This study was done in the framework of the year of polar prediction (YOPP) programme, YOPP-endorsed Alertness (alertness.no) and APPLICATE (applicate.eu) projects, and performed during the special observation periods (SOP1 – winter, and SOP2 –summer) using data denial approach. However, it's not firmly connected to the original proposal of spnomile special project, but this study delivered many important outcomes, which are important for the original objectives of the spnomile project as well. For example, it showed the value of globally assimilated observations in a limited-area model, AROME-Arctic. It is particularly important to determine which scales are actually determined well by the global model and the assimilated global observing system. More details about the results are discussed in *Randriamampianina et al. (2020)*.