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	2016
Project Title:	Regional European re-analysis with HARMONIE for UERRA (RERA)
Computer Project Account:	spserera
Principal Investigator(s):	Heiner Körnich Per Undén
Affiliation:	SMHI
Name of ECMWF scientist(s) collaborating to the project (if applicable)	Richard Mladek Martin Ridal, Jelena Bojarova, Esbjörn Olsson, Ulf Andrae
Start date of the project:	1/1/2014
Expected end date:	31/12/2016

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)	30,000,000	19,036,489 (+ 30 MSBU from nat. res.)	40,000,000	35,368,086.98
Data storage capacity	(Gbytes)	80,000	~76,000	168,000	168,000

Summary of project objectives

(10 lines max)

This project will create a regional European re-analysis data set from 1961 to present-day with the HARMONIE (HIRLAM ALADIN Regional / Mesoscale Operational NWP in Europe) modelling system. The resolution will be 11 km horizontally and 65 levels vertically. A 3-dimensional variational data assimilation will be employed. Over a shorter time span of 5 years, a multi-physics mini-ensemble will be run with different physical parameterisations. The results from the proposed project will contribute directly to the European FP7 project UERRA - Uncertainties in Ensembles of Regional Re-Analyses with 12 institutes from 7 EU countries, Switzerland, Norway and an international organisation (ECMWF), coordinated by Per Undén. UERRA will provide long-term datasets of Essential Climate Variables (ECVs) on the European regional scale in order to support adaptation action and policy development. The datasets will contribute to Climate services for Copernicus, climate monitoring and research.

Summary of problems encountered (if any)

(20 lines max)

In the experiments of the 5-year reanalysis mini-ensemble a rather serious bug was discovered after production. It was found that the cost function gradient of the large-scale mixing term, the so-called Jk-term was erroneously calculated and, thus, that the minimization of the cost function did not converge correctly. After the discovery of the error, its effect on the analysis was examined and found to be detrimental, especially in regions with few observations. It was therefore decided to rerun the 5-year reanalyses and also to rerun that part of the long reanalysis that was produced during 2015.

The archiving issue of the HARMONIE fields in MARS is close to be solved. So, we expect to archive in MARS during the second half of 2016.

It has also been found that a few observations with large errors or deviation from the background manage to slip through the quality controls. The effect of these observations is expected to be small but investigations are ongoing to prevent this from occurring.

Resources for a special project were used up in Spring 2016. An additional 10 milj. SBUs have been granted but the estimated need for 60-years reanalysis is at least ten times as much.

Summary of results of the current year

In preparation for the long reanalysis, two five-year reanalyses were run using two different physics packages, ALADIN which is designed mainly for the synoptic scale and ALARO which is a multi-scale package. The initial five-year runs were finished during 2015 and verified against observations and also compared to a corresponding verification of ERA-interim. The verifications showed that the ALADIN package verified better (see examples in the Figure 1). It was therefore chosen for the long reanalysis ranging from 1961 until present.

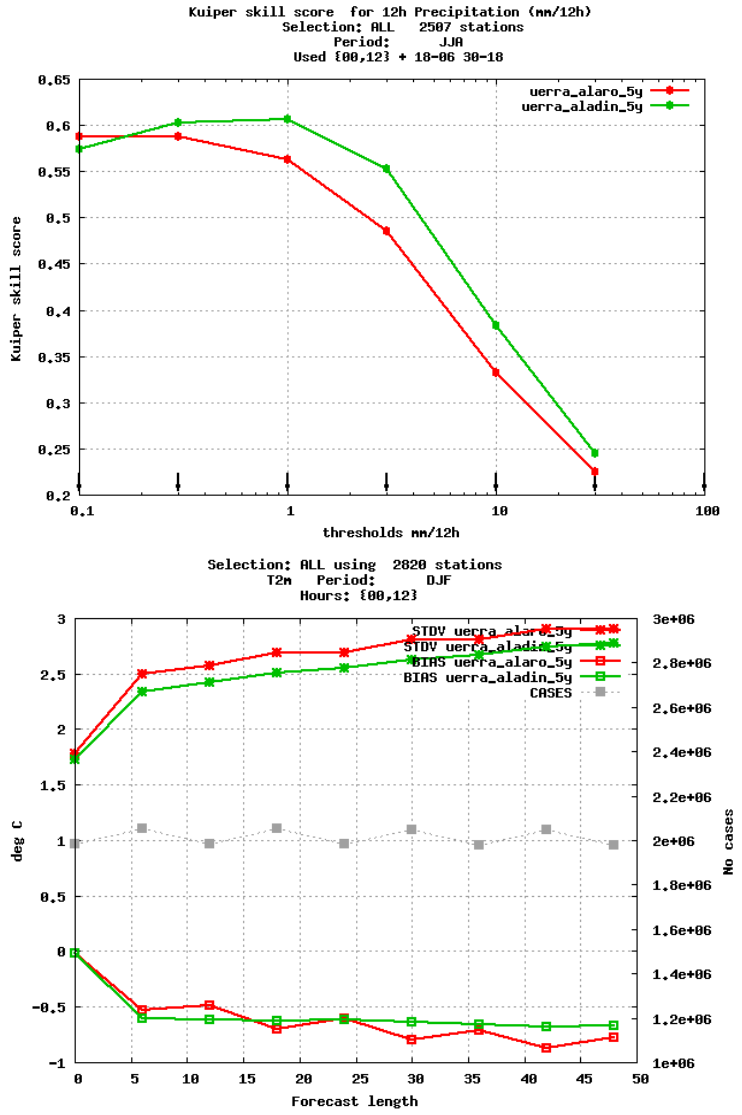

Figure 1: Upper: Verification of 12-hour precipitation using Kuiper skill score for months of June to August 2005 to 2010. Experiment with ALADIN physics is the green line while the ALARO physics is the red line. Lower: Verification of temperature at 2 metre level for period December to February, 2005 to 2010. Experiment with ALADIN physics i the green line while the ALARO physics is the red line.

The production run for the long reanalysis was started in the second half of 2015. Unfortunately, a serious error was discovered in the code after production of the five-year reanalysis and during the production of the long reanalysis. It was found that there was a bug in the calculations of the large-scale mixing, the so-called Jk-term. Figure 2 shows the difference of 2m-temperature at 18 UTC between reanalysis with the corrected Jk-term and with the erroneous Jk-term for October 1999. While the mean difference is small, the standard deviation can achieve serious values up to 1 K. This error does not affect the analysis very much in areas with dense observations but in areas without observations, or very few, it has a rather large effect on the resulting analysis and forecasts. The results of the verification are therefore less affected in areas of dense observations, which made it more difficult to detect. Nevertheless, it was decided that the five-year reanalyses and the already

produced years of the long reanalysis needed to be rerun in order to have correct fields in all areas.

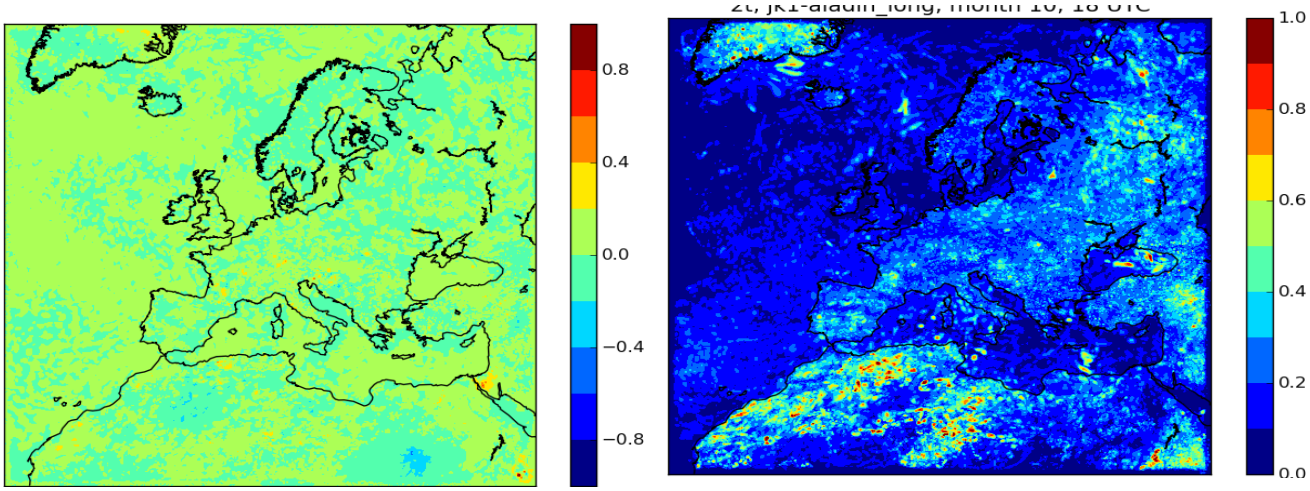

Figure 2: Difference of 2m-temperature at 18UTC between reanalysis with corrected Jk-term and erroneous Jk-term. Mean difference (left) and standard deviation (right) for October 1999.

After a deeper analysis of the problem the bug was found and corrected in the code in the beginning of 2016. The output from the five-year mini ensemble will be used for other tasks within UERRA, e.g. a downscaling of surface parameters. The results from the downscaling may be affected by the poor analyses and forecasts resulting from the above mentioned error in the Jk calculations. This need to be further investigated, when the new corrected five-year mini ensemble reanalysis is delivered during the second half of 2016.

The long reanalysis is restarted and it is run in parallel streams with one decade per stream, except for the five-year period that was started at 2006 in order to finish as soon as possible.

As part of the data rescue within UERRA, it was recognized that few observations were available in Scandinavia for the early years of the long reanalysis, i.e. 1960 to 1970. This gap was not closed with additional observations for the Swedish data archive. Additionally, French observations were also added to the observational archive. All observations were added in usable bufr-format, so that the observations can be used in the UERRA reanalysis. In Figure 3, the data usage is shown before (left) and after the data rescue (right).

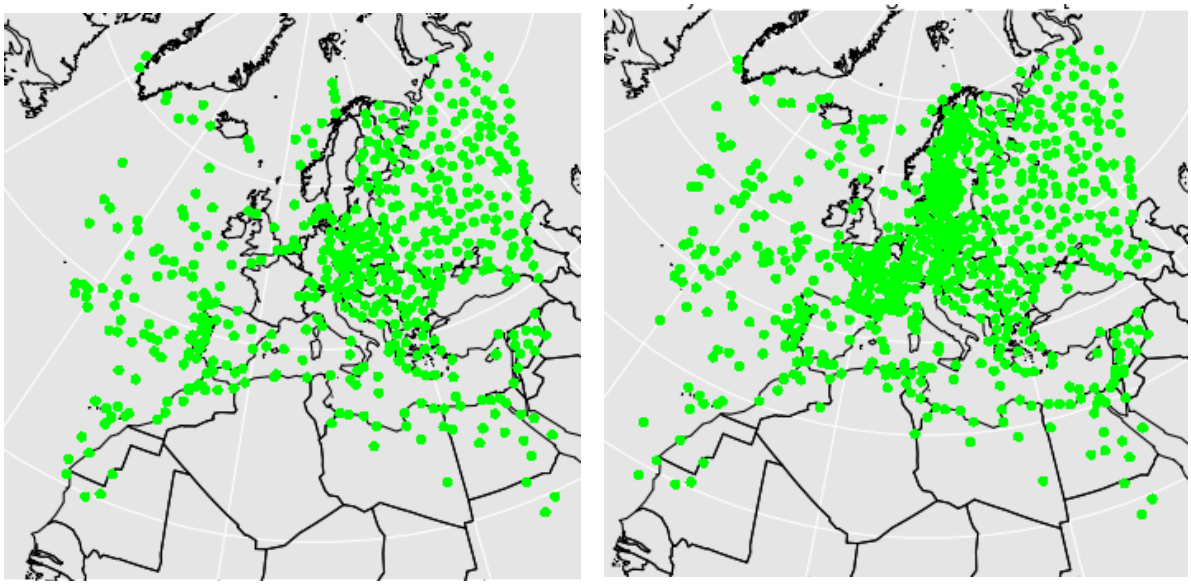

Figure 3: Usage of 2m-temperature observation from SYNOP. Left for 1961-02-28, 18UTC before data rescue. Right for 1960-11-30, 18 UTC after data rescue.

List of publications/reports from the project with complete references

The reports of the FP7-project UERRA can be found on the following webpage:
http://www.uerra.eu/publications/deliverable-reports.html

Ridal, M., Körnich, H., E. Olsson and U. Andrae, 2015: Deliverable D2.5: Report of results and datasets of two physics HARMONIE runs for spread estimation. Report of FP7-project UERRA. Available from http://www.uerra.eu/component/dpattachments/?task=attachment.download&id=162

Summary of plans for the continuation of the project

(10 lines max)

The project UERRA will finish in the end of 2017, covering the years 1961 to present-day. It is desirable that this regional reanalysis will continuously be produced, downscaling the global reanalysis of ECMWF. Therefore, we will apply for a continuation of the project during 2017 and into 2018 in order to ensure near-current date production, until a Copernicus climate service for regional reanalysis is in place.