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	2014
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)	……………………………………………….……
	……………………………………………….……
Start date of the project:	1/1/2014
Expected end date:	31/12/2017

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	0
Data storage capacity	(Gbytes)			40,000	?

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 timespan, 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 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)

As HARMONIE was not available on the new CRAY-computer in the beginning of the year, the project team started with the configuration and test runs on the IBMp Power7 machine c2a. The migration to the CRAY will require some effort during the second half of 2014. For the configuration on c2a, the following problems were encountered:

- Bug in the digital filter initialization routine was corrected for HARMONIE-ALARO.
- Alaro crashed, since sub-grid orography was set to zero in remote parts of the large European-North Atlantic domain. Division by zero caused the crashes. That mistake was corrected.
- Runs with ALADIN were not reproducible on Météo-France's Bull supercomputer. Météo France works on the code to ensure reproducibility.
- The project plan intended the inclusion of a time-dependent land use. Appropriate data sets, such as from GEOLAND-2, seem to lack the required information (especially for that long historical period).. As an alternative, sensitivity studies for different land use might be conducted. Also a parameterised leaf-area index will be considered.
- For the calculation of the background covariance matrix of the host model error (the so-called Jk-term in the cost function), IFS EDA is used. More appropriate ERA-interim data was not available on model levels for longer forecast lengths than 12 hours that would be needed for the calculation of forecast differences.

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

The FP7-project UERRA started on January 1, 2014. In the first months, the main tasks consisted of preparations for the model configuration, experiment setup, background statistics and archive plan. The first task was the definition of a model domain encompassing the European Economic Area (EEA). Here, the total size, intersection through complex physiography, and compatibility with downstream applications had to be taken into account. The final choice of the domain for UERRA is displayed in Figure 1. As can be seen, the Azores are only partly captured.

Two different packets of HARMONIE model physics will be tested for a shorter period of 5 years. Namely, the model physics of ALARO and ALADIN will be run with the cycle HARMONIE cy38h1.1. Namelist parameters were set in accordance with partners from Météo-France, HIRLAM and ALADIN consortia. Several problems were encountered while setting up the model over the new domain, such as:

- The code of the digital filter initialization of ALARO contained a bug.

- Subgrid orography was set to zero over part of the domain causing model crashes due to division by zero.
- ALADIN experiments were not reproducible. This issue was examined by Météo-France. Test runs are performed on the BULL HPC of Météo-France.

For the land use, UERRA envisioned to utilize time-dependent boundary conditions derived from other projects such as Geoland-2. After closer inspection, it is noted that Geoland-2 provides only high-resolution climatological data, i.e.no time-dependency over the years 1961-2010. If no time-dependent land use data is readily available, we might run sensitivity experiments in order to test the effect of urbanisation or land use changes on the reanalysis products or try a prognostic leaf-area index.

For the data assimilation, the background error statistics are currently being produced. The background error covariance matrises B for ALARO and ALADIN are estimated by downscaling members of ECMWF's EDA (Ensemble of Data Assimilation). This is the standard approach for operational forecasting systems. In regional NWP, even the background error of the host model can be included in the cost function (Dahlgren P. and N. Gustafsson, 2012: Assimilating host model information into a limited area model, Tellus A 2012, 64, 15836, DOI: 10.3402/tellusa.v64i0.15836). The ALADIN implementation is in Guidard, V. and Fischer, C., 2008: Introducing the coupling information in a limited area variational assimilation. Q. J. R. Meteorol. Soc., 134, 723-735.
The respective error covariance matrix should be estimated for the host model in question. For UERRA, different global reanalysis will be used as the boundary condition in order to cover the time period from 1961 to 2010. Forecast differences with ERA-interim were limited by the fact that ERA-interim forecast data on model levels is only archived up to forecast lengths of 12 hours. Therefore, we used also the EDA members for the estimation of the host model background error covariance matrix.

The UERRA data will be archived in MARS@SMHI. To this end, it is required to define consistent GRIB-tables for both atmospheric and surface data. Currently, a common GRIB2-table for SURFEX output is defined. The storage of UERRA in MARS will allow a direct dissemination of relevant Essential Climate Variables, once the project is completed and during the latter part of the project. Also access through ESFG nodes will be provided.
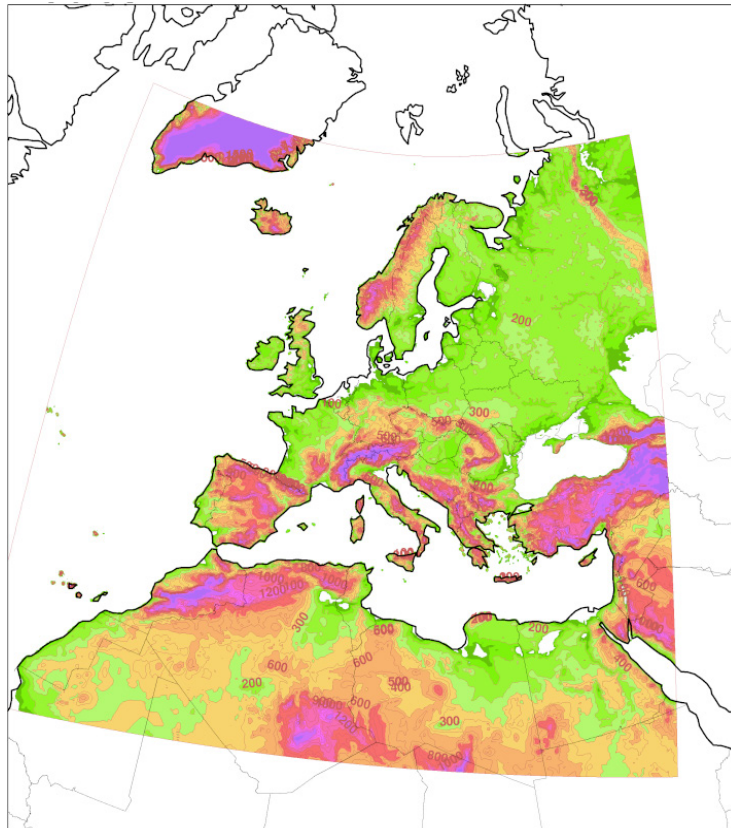
Figure 1: Model topography (shaded) and domain (pale line) for UERRA.

List of publications/reports from the project with complete references

No reports have yet been produced.

Summary of plans for the continuation of the project

(10 lines max)

The earlier project EURO4M generated regional European reanalysis for the years 1989 to 2010 with the HIRLAM modelling system. Currently we are working on a continuation of that reanalysis. 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. No concrete plans for this continuation are created yet.