REQUEST FOR A SPECIAL PROJECT 2013–2015

MEMBER STATE: Sweden

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Project Title: European regional re-analysis for monitoring and observations

If this is a continuation of an existing project, please state the computer project account assigned previously.	**SPSEEUR4**_____	
Starting year: (Each project will have a well defined duration, up to a maximum of 3 years, agreed at the beginning of the project.)	2011	
Would you accept support for 1 year only, if necessary?	YES ☐	NO ☐

Computer resources required for 2013-2015: (The maximum project duration is 3 years, therefore a continuation project cannot request resources for 2015.)	**2013**	**2014**	**2015**
High Performance Computing Facility (units)	2,500,000	2,500,000	
Data storage capacity (total archive volume) (gigabytes)	12,000	15,000	

*An electronic copy of this form **must be sent** via e-mail to:* *special_projects@ecmwf.int*

Electronic copy of the form sent on (please specify date): 2012-04-24

Continue overleaf

Principal Investigator: Per Undén

[1] The Principal Investigator will act as contact person for this Special Project and, in particular, will be asked to register the project, provide an annual progress report of the project's activities, etc.

Project Title: European regional re-analysis for monitoring and observations

Extended abstract

It is expected that Special Projects requesting large amounts of computing resources (500,000 SBU or more) should provide a more detailed abstract/project description (3-5 pages) including a scientific plan, a justification of the computer resources requested and the technical characteristics of the code to be used. The Scientific Advisory Committee and the Technical Advisory Committee review the scientific and technical aspects of each Special Project application. The review process takes into account the resources available, the quality of the scientific and technical proposals, the use of ECMWF software and data infrastructure, and their relevance to ECMWF's objectives. - Descriptions of all accepted projects will be published on the ECMWF website.

European Regional Reanalysis for Monitoring and Observations

Per Undén

SMHI

Summary

SMHI has continued the work on developing the regional re-analysisis for the European-Atlantic area with HIRLAM 3D-VAR. A large number of tests were performed to evaluate the quality of the data assimilation and in comparison with ERA-Interim. ERA-Interim is used at the boundaries and a novel large-scale forcing term is used as an additional term in the cost function. The aim is to run 1989-2009 and this is the reason for the resolution and choice of 3D-VAR (instead of 4D-VAR). The year of 2009 and the first four years of the period have been run and stored on disc. A great deal of work has been devoted to the archiving (and retrieval) stream. The intent is to use MARS as installed at NSC in Sweden. This turned out to be much more cumbersome than anticipated. Due to the fragmentation of the HIRLAM postprocessed files and limitations in the MARS installation, the efficiency was not good enough and the runs have been suspended for a while. ECMWF helped to find a very efficient way or transferring the data in real time to Sweden. The data stored in ecfs seem to be hard to use efficiently due to the aforementioned many data files resulting from the HIRLAM runs.

HIRLAM re-analysis

The HIRLAM data assimilation has been validated in several different ways. The long term performance of the data assimilation is monitored in terms of background (first guess forecast) fits and analysis fits to all the different observation types that have been used. One can see a stable behaviour over the years (i.e. no increase in RMS departures or any drift in the bias and that the analysis draws to the observations.

Secondly, statistics of analysis increments and of forecast tendencies have been computed for the four different times of the day over many monthly periods. These have been visualised and inspected for selected periods, both for 2009 and for the early ears 1989-1991. Some model biases still exist in HIRLAM over Sahara and Greenland, in spite of the improvements made in the beginning of the project. Still they are not very large and not crucial to the project since they are outside the area of the main interest. Otherwise the increments are reasonably small and some diurnal cycle can be seen in areas. There is a slow pressure negative drift in HIRLAM which is visible, but this is more for the 36-48 hour forecasts.

Finally, the differences to the ERA-Interim itself have been computed and visualised for certain periods. These differences are quite small (apart from the aforementioned areas) and dont't show any worrying features in the HIRLAM reanalysis.

Downscaling of surface parameters with MESAN

The MESAN meso-scale analysis system has been streamlined and optimised in order to execute efficiently on a multi-core system at NSC. The code now runs quite fast using OpenMP and different types of analyses (different parameters) can be done in parallel. Methods for downscaling of the first guess (from HIRLAM) to the MESAN high resolution (5 km) have been developed further, inter alias as a result of the comparisons with MF. The downscaling of 2 m temperature and humidity has been developed further considering boundary layer and surface properties in the target high resolution.

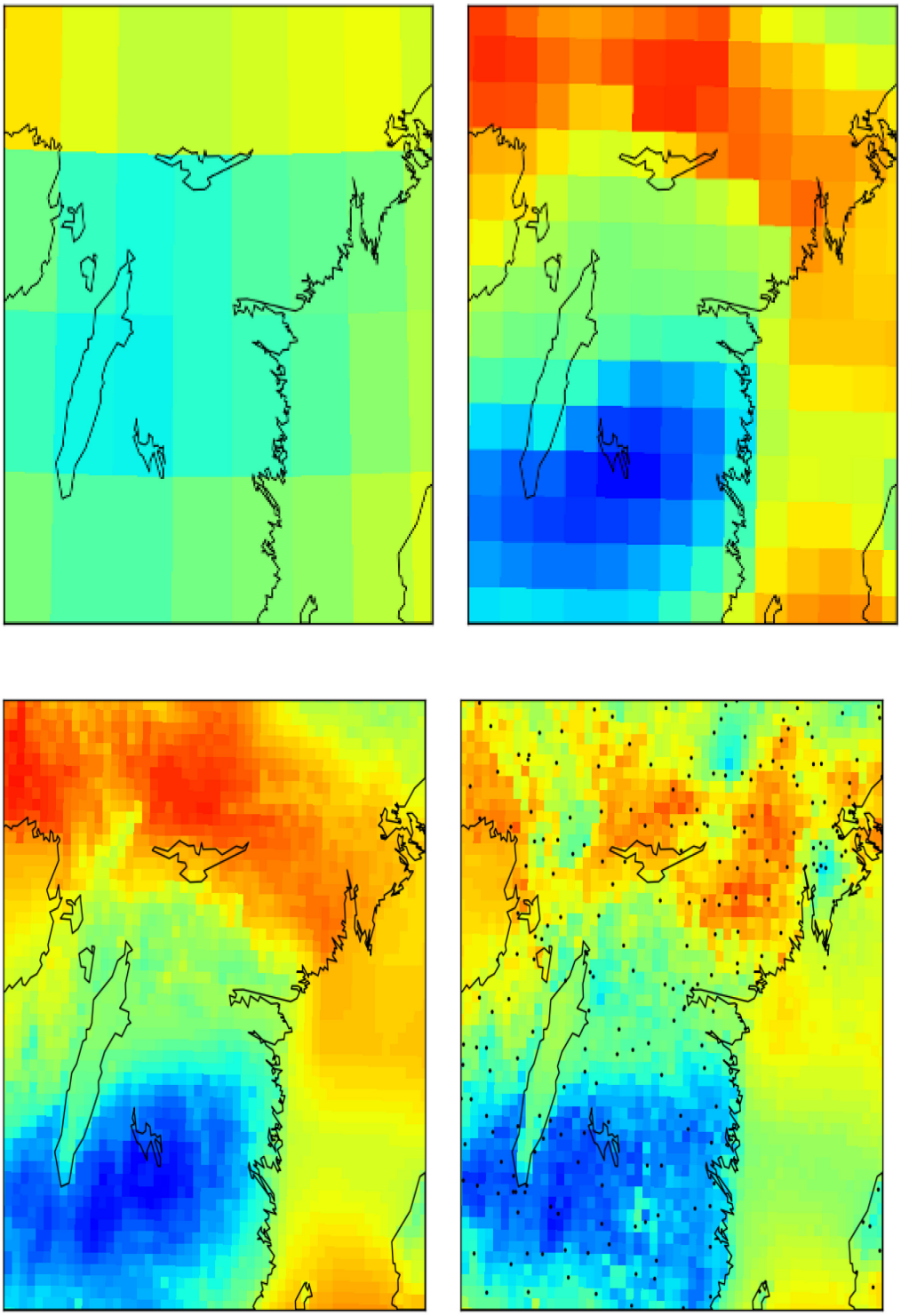

Figure 1 shows an example (2 m temperature) of dynamical downscaling from ERA using HIRLAM followed by mesoscale downscaling and analysis for the date 20091001:1200 UTC. The area shown is about 300 x 300 km centred around the city of Norrköping in Sweden.

Recently the downscaling of 10 m winds to the target high resolution has started using a dynamical adaptation. A simplified almost adiabatic version of HIRLAM is run until a quasi steady state. The analysis of 24 hour precipitation data would benefit from a variable transformation to make it more Gaussian and methods for this are being studied.

A very important issue for the high resolution analysis is the availability of observations. Much more than the general public observations in the ECMWF MARS archive (plus SMHI and MF national reports) is required in order to reap the full benefit of the mesoscale analysis. There now seems to be progress in terms of getting access to ECA&D data sets for this purpose (only). Data handling procedures have been developed to extract the surface observations from ECMWF as well as from SMHI.

Development of the new surface parameter analysis tool with Météo-France

Météo-France and SMHI have made extensive intercomparisons of the MESAN, SAFRAN and CANARI surface analysis tools. An enhanced version of CANARI using properties of MESAN and possibly some aspects from SAFRAN, will be built and this common tool will be employed on downscaling the HIRLAM re-analysis.

References:

Dahlgren, Per and Gustafsson, N, 2012. Assimilating Host Model Information into a Limited Area Model , Tellus A 2012, 64, 15836, DOI: 10.3402/tellusa.v64i0.15836 .