REQUEST FOR A SPECIAL PROJECT 2013–2015

MEMBER STATE: BELGIUM

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Project Title: Boundary conditions for ALADIN, ALARO and AROME based on IFS, ECMWF EPS and ERA-Interim data

If this is a continuation of an existing project, please state the computer project account assigned previously.	**SP** FRCOUP_____	
Starting year: (Each project will have a well defined duration, up to a maximum of 3 years, agreed at the beginning of the project.)	2012	
Would you accept support for 1 year only, if necessary?	**YES**	~~NO~~

[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.

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)	130000	130000	---
Data storage capacity (total archive volume) (gigabytes)	800	800	---

*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): 27/04/2012……

Continue overleaf

Principal Investigator: Alex Deckmyn……

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Extended abstract

Boundary conditions for ALADIN, ALARO and AROME based on IFS, ECMWF EPS and ERA-Interim data

The ALADIN, ALARO and AROME Limited Area Models (AAA for short) are developed by the ALADIN (Algeria, Austria, Belgium, Bulgaria, Croatia, Czech Republic, France, Hungary, Morocco, Poland, Portugal, Romania, Slovakia, Slovenia, Tunisia and Turkey in 2011) and the HIRLAM consortia (the modelling system is called HARMONIE at the HIRLAM side) in the framework of the IFS/ARPEGE software system.

Traditionally, AAA have been coupled to large scale boundary conditions provided by the French ARPEGE global model, however in the last few years thanks also to the SPFRCOUP Special Project of ECMWF more and more ALADIN members states became acquainted with the use of ECMWF/IFS data as far as lateral boundary conditions for the AAA models are concerned. The further exploitation of this facility might happen in various contexts:

- Coupling to IFS for deterministic forecasts (for instance, but not exclusively, for regions where the stretched grid of ARPEGE does not offer sufficient resolution)
- Coupling to ECMWF EPS members for LAM-EPS purposes.
- Coupling to ERA-Interim for regional climate downscaling.

The special project SPFRCOUP (2006-2011) has been instrumental in developing and validating capabilities to couple these AAA to model data from ECMWF. A basic framework for this coupling is now in place and frequently used by a number of ALADIN countries. Some of the developments from SPFRCOUP haven given rise to operational applications. Notable results are, besides the coupling of deterministic forecast models, the downscaling of ERA-40 for regional climate studies. Also the LAM-EPS projects GLAMEPS and ALADIN-LAEF use versions of ALADIN coupled to EPS data.

Hereafter the main motivations for the initiation of a new Special Project will be recalled with special emphasis on the treatment of surface data, on the use of ECMWF EPS data and on the possible use of ERA-Interim data for regional climate modelling.

1. Surface issues

The treatment of surface fields (such as soil moisture and temperature) has not yet been fully resolved in the context of AAA and the IFS model. The TESSEL surface scheme used by ECMWF is not directly compatible with the ISBA and SURFEX packages in AAA. As the resolution of both the global models and the LAM's increases, and as the surface schemes are evolving, this aspects requires special and continued increased attention (this is also stated by the EUMETNET SRNWP-I Interoperability Programme, where the various surface issues are essential difficulties of the European interoperable systems of NWP).

Currently, three different approaches to the surface initialisation are being used in various settings. The first is to replace the surface fields from IFS by those of an ARPEGE analysis (the French global model). This is (in essence) the approach currently taken for instance in ALADIN-LAEF and GLAMEPS. The dependence on 2 different global models, however, poses logistic problems and can not be considered optimal. Experience from the LAEF project indicates that it may also introduce some biases in 2 meter temperature forecasts.

A second approach is to adjust values for surface fields taking into account the differences in surface parameterisation. This is the approach taken in the “901” configuration of ARPEGE and in the GL tool developed by the HIRLAM community as part of the HARMONIE system. It was already considered several times to reconsider this solution and propose a better way for the handling of the surface initialisation (also in the framework of the above-mentioned SRNWP-I project). This approach, which is the most direct and

efficient, is in many ways also the most problematic. The algorithms must be continuously monitored and adapted to recent changes in surface parameterisation of both the coupling model and the LAM. With increasing resolution and the wider adoption of the SURFEX surface scheme, this requires an ongoing effort.

A third approach, is to include an optimal interpolation (OI) data assimilation cycle (CANARI) for the surface fields. This may be combined with an upper air assimilation (3d Var), as done operationally at the Hungarian Meteorological Service.

These difficulties can demonstrate that there are many facets of the surface issues that should be addressed in the proposed Special Project.

2. ECMWF EPS as lateral boundary conditions for the ALADIN LAMEPS systems

In recent discussions with ECMWF (through the TAC subgroup on lateral boundary conditions) an emerging need was defined in the use of ECMWF EPS data as (initial) and lateral boundary conditions for the different LAMEPS systems of Europe. Ensuing discussions in the LAM community indicated that a very high resolution EPS system as lateral boundary condition for the first 2-3 days would be desirable in the building of convection resolving EPS systems, which are the recent ultimate goals of the European national weather services. This trend is also considered by the ALADIN and HIRLAM researchers therefore scientific research and development work is planned in the use of ECMWF EPS boundary conditions to the AAA models. In the short-term this would involve testing of the proposed options of such Optional Project and then to prepare the full exploitation of such system.

3. Regional climate modelling

In the framework of ALADIN and HIRLAM projects more and more emphasis is put on the use of the ALADIN/HARMONIE system for regional climate modelling, i.e. dynamical downscaling of global climate information. The first phase of such work is to the thorough test of the applied regional climate models through perfect boundary conditions, i.e. re-analyses fields as for instance the ERA-Interim one, which is provided by ECMWF. These studies would pave the path towards the better understanding of the climate behaviour of the ALADIN/HARMONIE system and towards the further improvements of the climate version of the model. In that context the boundary coupling to the ERA-Interim dataset is a mandatory exercise for this validation.

The intention of this project is to allow scientists from some selected (Cooperating and Non-Member) States access to resources on the HPCF to (1) develop and maintain a unified software environment for experimentation and preparing AAA boundary conditions, (2) perform boundary condition file preparation at ECMWF before sending it to their own sites for running the LAMs, and (3) to test new approaches in IC and LBC preparation.

The activities planned in this project are:

1. Maintenance of a set of scripts and data for IC/LBC creation from ECMWF data (stored in MARS) to AAA. These will build upon results of SPFRCOUP, but will be extended with e.g. SMS scripts.
2. Development and comparison of various approaches for surface fields: especially surface assimilation and direct transformation.
3. Study of specific issues arising from the LAM-EPS context:
   - surface error and perturbations
   - LBC perturbations
   - comparison of different ECWMF EPS downscaling systems
4. Specific issues arising from ERA downscaling:
   - surface spin-up and drift in OI compared to direct computation (“901” and GL tools)
   - optimal use of additional fields in ERA-INTERIM.
   - validation and further development of the regional climate model version of the AAA modelling family

The main purpose of this special project is to offer a platform for joint scientific experimentation. Real-time applications such as daily production of boundary conditions or LAM execution are not within the scope. The list of scientists involved may be extended with other scientists from ALADIN cooperating services during the lifetime of the project.