COSMO Priority Project CALMO-MAX:
CALMO Methodology Applied oneXtremes
Proposed Project Extension

Version 2, 12.03.2019

Project leader: **A.Voudouri / HNMS**

Project duration: **09.2019 – 08.2020**

Project resources: **1.8 FTEs**

Contributing scientists:

Core tasks

A.Voudouri / HNMS	**2020: 0.5 FTE**
E. Avgoustoglou /HNMS	**2020: 0.5 FTE**
I. Carmona /IMS	**2020: 0.5 FTE**
E.Bucchignani–P. Mercogliano/ CIRA	**2020:0.2 FTE**

Consulting

Y. Levi/IMS	**2020: 0.05 FTE**
JM. Bettems / MeteoSwiss	**2020: 0.05 FTE**

Additional support from University of Cottbus (Andreas Will) will be provided.

Rationale

From the beginning of the project an option for one additional year has been envisaged, but it was decided to first draft a 2 years project.

One main reason for the uncertainty in the planning is the difficulty to define a precise time line when running multi-years integrations of an expensive COSMO configuration on a non-dedicated HPC platform. It also turned out that the distributed nature of the team (HNMS, IMS, CIRA, MCH) and the competition between national and COSMO priorities result in less efficient work than what was originally expected.

The proposed extension is mainly required to fulfill CALMO-MAX goals associated with the optimization ofthe methodology and the definition of a standard procedure on model parameter documentation. Based on the knowledge available at HNMS and at IMS, a permanent support for CALMO based calibration for the COSMO community could also be envisaged. Steps towards this direction are already on going through the establishment of cooperation with the University of Cottbus and ETHZ.

Note that no new tasks are proposed, but the task ‘documentation procedure of model parameters’ has been emphasized. Note also that the methodology derived in this project is model independent, and can as well be used to calibrate the COSMO model or the ICON model.

The resources for the proposed extension have already been secured.

Main deliverable

- Provide a computationally reasonably cheap objective calibration methodology that can complement expert tuning for the calibrating of the COSMO model.
- Provide a demonstration framework at ECMWF to apply this methodology.
- Provide the associated technical and scientific documentation.
- Establish and maintain a documentation procedure on model parameters including “useful hints"

Description of individual tasks

Some of the following tasks are already finished (green colour), thus no additional FTEs for 2020 are needed, some of them are ongoing and are expected to finish by the end of this COSMO year (orange tasks) while additional FTEs are needed for the remaining task (red colour).

Task 0: Administration and support

This administrative task is significant due to the distributed nature of the project team. The necessary effort to keep a good information flow between all participants (e.g. by organizing regular phone or web conferences and workshops) is included in this task. The existing mailing list of the CALMO project (see http://mail.cosmo-model.org/mailman/listinfo/calmo) will be used in order to support communication and information exchange within project participants.

Deliverables:

(1) Project coordination, meetings, workshops and regular web conference organization.

Estimated resources (FTE):

A.Voudouri / HNMS:2020:0.05

Task 1: Consolidation of CALMO outcome

The goal of this task was to establish the framework for the tasks 2 to 4. It was constituted by two sub tasks already finished.

1.1: Review of CALMO methodology –This task has finished

1.2: Preparation of the technical infrastructure -This task has finished

Task 2: Optimization of the CALMO methodology

The goal here is to find a compromise between the forecast quality improvement brought by the calibration method, and the computational cost of the method.

2.1: Calibration of COSMO-1 for a full year-This task is ongoing

The aim of this subtask was to complete the COSMO-1 calibration, using a full year of statistics, with the history of the soil, as originally planned for the CALMO project. The

simulations using COSMO-1 for 5 parameters have been completed using CSCS computer resources.
This calibration of the parameters is now work in progress and is expected to finish by the end of May.

2.2: Find a way to optimize the computational cost of the method-This task is pending

This sub-task aims at collecting ideas, and at evaluating different options to reduce the computational cost of the method, without significantly degrading the quality of the calibration. The COSMO-1 calibration performed in sub-task 2.1 will be used as test bed.

At the framework of this sub-task the question of the minimal number of simulations to fit the meta-model, and how this affects the accuracy of the meta-model has been considered. The best strategy to fit the meta-model is currently under review, using in particular the ideas developed by E. Avgoustoglou during the CALMO project.

Additionally ideas proposed for this task that require extra time are as follows:

Check whether it is possible to build 2 separate MM's when calibrating parameters that are not interacting with each other in order to save runs?

Clarify whether calibration is valid when instead of running a full year, run only ~10 case studies (cold starts for 30 hours, including 6 hours for spin up). The selection of "typical" case studies should follow specific rules.

Deliverables:

(1) A strategy to define an optimal calibration process (document).

Estimated resources (FTE):

A. Voudouri / HNMS: 2020:0.05

E. Avgoustoglou / HNMS: 2020:0.1

I. Carmona / IMS: 2020:0.1

Task 3: Establishment of a permanent CALMO platform-This task is on going

One important objective of this project is to provide a permanent infrastructure supporting the application of the calibration method, accessible to all COSMO members. Besides being used to run the calibration, this infrastructure could also serve as template for replication of the methodology on the user home HPC platform.

3.1: HPC framework-This task is on going

It is the aim of this sub-task to prepare a demonstrative technical framework. The HPC platform which is the most widely accessible for the COSMO community is the HPC at ECMWF (already used by COSMO for COSMO-LEPS and for the NWP test suite). Thus the installation of the demonstration framework on the ECMWF HPC platform to run the COSMO model, including Terra standalone and the required pre- and post-processing operations (fieldextra) in order to apply the CALMO methodology is included in this task. This platform should be opened to any registered user. Possibly

many elements are already in place (e.g. to run the production suite at HNMS, or to run the COSMO-LEPS system) and could be re-used. A full installation on some HPC could help propagate the use of this method. In case of an ECWMF non-member state the software and the documentation will be available through the COSMO web site and support on applying the methodology will be provided.

3.2: Data thinning policy and application-This task is on going

The amount of raw data produced by the calibration method is huge and a more efficient data thinning policy is required to make the method applicable. The policy developed during the CALMO project, implemented with fieldextra, has to be refined.

3.3: Meta-model-This task is on going

The guidelines for the installation of the meta-model as part of the demonstration framework, as well as all appropriate modifications needed to make the meta-model user friendly are included in this sub-task. A copy of the updated version of meta-model will be uploaded to COSMO web page and GitHub and be available for all COSMO members. The MM will also be uploaded at the University of Cottbus local machines.

3.4: Database of unconfined model parameters-This task is pending

An exhaustive list of unconfined model parameters and their associated characteristics (default values, unconfined range, model sensitivity) has been prepared during CALMO. Part of the C-MAX workshop organized in Athens, January 2019 was devoted to this task. CLM community has an on-line namelist tool that could be extended to add internal model parameters, with a new attribute about model sensitivity. The CLM namelist tool is now available to COSMO members. However the establishment of a standard procedure on the documentation of model parameters is still pending. As a supplement to the core documentation additional "useful hints" such as description of the key (most sensitive) free parameters, whose appropriate/inappropriate setting may improve/deteriorate the model performance considerably, would be good to have.

3.5: Access to observations -This task has finished

Deliverables:

(1) An updated documentation of the tuning parameters in the COSMO model.

(2) A framework at ECMWF to apply the calibration methodology

(3) A protocol on model calibration.

Estimated resources (FTE):

A.Voudouri / HNMS: 2020:0.1

E.Avgoustoglou / HNMS: 2020: 0.1

J.M. Bettems / MeteoSwiss: 2020:0.025

I. Carmona / IMS: 2020:0.15

Y. Levi / IMS: 2020:0.025

Task 4: Adaptation of the methodology on Extremes.This task is pending

This task aims at applying the optimized calibration strategy developed in task 2 to tackle different open questions, using the platform prepared in task 3. In this process, different improvements of the meta-model will also be considered. This task will also serve as a demonstration vehicle on the application of CALMO methodology to ICON.

4.1: Support for extreme events

This sub-task will be focused on preparing the necessary elements required for a calibration privileging extreme events, namely: (1) determining an appropriate set of unconfined model parameters, (2) selecting the model fields and the global model performance score, (3) collecting the associated observations, (4) selecting a set of extreme events.

4.2: Experiments using the meta-model (MM)

This sub-task, deals with several open issues related to the MM, such as the use of sunshine duration, the definition of new regions etc. In addition, different global model performance scores will be evaluated, and the reliability of the meta-model will be evaluated. Further adjustments of the meta-model will be performed as necessary to consider extreme events.

4.3: Experimental set-up.

The optimized method developed in task 2 will be used. The computation framework developed under task 3 will be used. The latest version of the official COSMO code will be used.

4.4: Compute experiments and analyse results

Apply the calibration methodology to a Mediterranean domain; evaluate the gain in forecast quality using the operational verification.

Deliverables:

(1) An extended definition of the model performance score.

(2) An updated version of the meta-model.

(3) A scientific discussion of the results obtained.

Estimated resources (FTE):

A. Voudouri / HNMS: 2020:0.2

E. Avgoustoglou / HNMS: 2020:0.2

J.M. Bettems / MeteoSwiss: 2020: 0.025

I.Carmona / IMS: 2020:0.15

Y. Levi / IMS: 2020: 0.025

E.Bucchignani / CIRA2020:0.1

P. Mercogliano / CIRA2020:0.1

Task 5: Documentation-This task is on going

The need to make public the work performed within COSMO PPs, not only to the COSMO member but also to the wider scientific community, is nowadays well supported within the Consortium. Thus, this task aims at the preparation and the submission of manuscripts in peer reviewed scientific journals as well as contribution in conference proceedings.

An updated 'cookbook' to facilitate the usage of this method by other COSMO members, based on the previous 'cookbook' provided at the end of the CALMO project, will be prepared.

Deliverables:

(1) Peer reviewed scientific papers.

(2) Updated cookbook (user manual).

(3)Final report.

Estimated resources (FTE):

A. Voudouri / HNMS:202:0 0.1

E. Avgoustoglou/HNMS:2020:0.1

I. Carmona/IMS: 2020:0.1

GANT Chart (09.2019 – 09.2020)

Task/Time	9/19	12/19	03/20	06/20	9/20
0					
1					
2					
3					
4					
5					