Adaptation of the COSMO SMC when transiting to the ICON model

Version 1.0 (8 November 2019)

1   Motivation

The ICON model is currently developed by several entities of the ICON community, including DWD, MPI-M, DKRZ, and KIT. ICON is used for many applications, such as climate modelling and numerical weather prediction at global to regional scales. With the transition from the COSMO model to the ICON model, the COSMO consortium and the CLM community will no longer have full control over the source code of their model, which in turn requires adaptation of the COSMO SMC structure and procedures. As the COSMO consortium and the CLM community enter the ICON community, several critical aspects should be accounted for. Among other things, the coordination of efforts between COSMO and CLM and the other members of the ICON community, and the flow of information between the ICON partners, the COSMO consortium and the CLM community are vitally important. Furthermore, the SMC structure and the mode of operation should be commensurate with the legal aspects of the interaction between the ICON partners (DWD, MPI-M, DKRZ, KIT) and the COSMO and the CLM communities.

2   Role of SMC

With due regard for the advent of ICON, the role of the COSMO SMC can be defined as follows:

The COSMO SMC is responsible for planning, implementation and coordination of efforts by the COSMO consortium aimed at further developing the ICON modelling framework and improving the performance of ICON NWP in LAM applications.

Responsibilities of the SMC, as well as its tasks, authority and the rules of action, are detailed by the SMC Terms of Reference (ToR). With the advent of ICON, the SMC ToR should be modified as needed, and the modified ToR should be approved by the STC. Changing the SMC ToR are best left until some experience with ICON-LAM is

acquired by the COSMO community and the various legal and organizational issues are settled (e.g. the COSMO Agreement, including the annexes, should be modified and signed by the representatives of the parties concerned).

A close link between the COSMO SMC and the COSMO STC and strong support of the STC is required to make the SMC work efficient and productive. This is particularly true for the transition period from COSMO model to ICON-LAM.

3 Flow of information, representation of the COSMO SMC in the ICON structures

Coordination of efforts within the ICON community is essential to profit from potential synergy and to avoid duplication of work and/or conflicting code changes. The flow of information within the (already quite large and still growing) ICON community is more complex as compared to the situation within the COSMO community over previous years. An efficient two-way interaction between the ICON community members must be ensured. To this end, we recommend that one (or more) COSMO SMC representative(s) and a representative of the CLM community regularly participate in the ICON developer meetings, ICON infrastructure meetings, gatekeeper meetings, and any other activities that affect the ICON model development and hence influence the COSMO community. It is also essential that the COSMO community is informed, on a regular basis, about the plans and the development efforts undertaken by the ICON partners, most notably DWD. To this end, a proper and transparent source code and release management will be implemented (see COSMO web page for the COSMO example).

4 ICON repositories organization and workflow

The source code of ICON is organized as several Git repositories, one for each ICON-community member, see Fig. 1. For each icon-X.git repository, a so-called gatekeeper (or several gatekeepers) is (are) responsible for merging and synchronizing changes with the official main code maintained within the icon.git repository. The DWD is responsible for the icon-nwp repository whose main branch is icon-nwp-dev. It is maintained by the icon-nwp gatekeepers. The source code to be used by the COSMO community will be stored as a branch named icon-cosmo-master which is subordinate to icon-nwp-dev as shown in Fig. 1. The source code administrator (or gatekeeper) of the icon-cosmo-master code will be responsible for integrating the development results stored in the branches subordinate to icon-cosmo-master (including icon-clm-dev) and for synchronizing icon-cosmo-master with icon-nwp-dev.

Changes to the ICON code that stem from the COSMO and CLM communities are first integrated into the icon-cosmo-master. Those changes should be carefully reviewed by the icon-nwp gatekeepers (there are three gatekeepers at the time being), and then the changes may be merged to icon-nwp-dev branch to eventually go into the official icon.git repository.
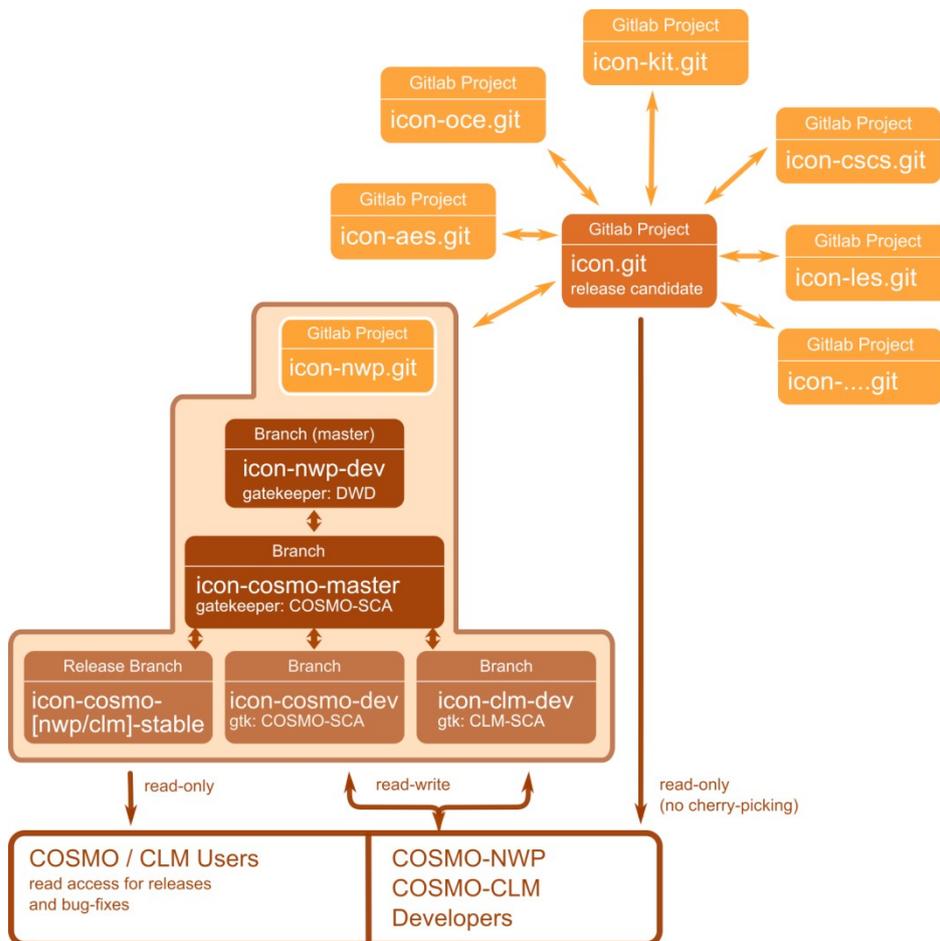
Figure 1. The structure of the ICON Git repositories using the GitLab code hosting infrastructure.

The structure of ICON Git repositories shown in Fig. 1 was extensively discussed with the icon-nwp gatekeepers. It has been agreed that this structure, where the icon-cosmo-master branch is subordinate to the icon-nwp-dev branch, will be used as the basis for the development work by the COSMO and the CLM community members. Should the structure shown in Fig. 1 reveal shortcomings, it will be modified in the future to make the development work of the COSMO the CLM community members more efficient.

5   ICON code changes and criteria of acceptance

One point should be particularly emphasized. Any development effort undertaken by the COSMO and the CLM community member(s) should be thoroughly discussed with the

other members of the ICON community, most notably with the DWD ICON developers and the DWD ICON project leader, prior to making any changes to the ICON code. It must be ensured that the efforts of various development teams are well-coordinated (see also section 3 above) and no conflicting developments take place. Otherwise some, or even massive, efforts may appear to be in vain (leading, in the worst case, to the application of the power of veto possessed by DWD, a very unfortunate situation that must be avoided). This is particularly true with regard to massive changes to the ICON code that affect not only low-level routines but the entire model infrastructure. If such changes are proposed, they should be painstakingly reviewed by most (all) ICON developers and the icon-nwp gatekeepers prior to starting the work.

Although changes in the ICON code proposed by the COSMO-consortium and the CLM-community members may be encapsulated (using namelist switch or ifdef), the code paths for using ICON for LAM and global NWP and climate-modelling applications should not diverge too much. The code maintenance efforts should be reduced whenever possible. Changes to the model code should fulfil the following minimum set of criteria (that will be further specified in the coding standards):

- follow the ICON coding standard;
- be carefully reviewed by the developers using the four-eye principal;
- should be reviewed by the icon-cosmo-master gatekeeper,
    - ✓ changes affecting the NWP applications should be reviewed by icon-nwp-dev gatekeepers;
- be thoroughly tested, using the technical testing infrastructure (buildbot) and meteorological test suit (to see an impact on the ICON performance),
    - ✓ the impact on performance should be documented,
    - ✓ if changes affect global NWP applications, effects should be evaluated and documented;
- be approved by the COSMO SMC and/or the CLM community;
- be well documented.

The COSMO SMC must ensure that any changes to the ICON model code are carefully documented. The model documentation, including technical documentation, user guide and scientific documentation, is necessary (scientific details can be described in the peer reviewed papers, COSMO or ICON Technical Reports, or elsewhere).

6 A position in the COSMO SMC for an icon-nwp gatekeeper/delegate

As is evident from the forgoing account, the icon-nwp gatekeepers play a central role for the integration of code changes proposed by the COSMO or/and the CLM community members into icon-nwp (and eventually into icon.git). Coordination with those persons is critical. It is therefore proposed to create a position within the COSMO SMC for an icon-nwp gatekeeper, or, alternatively, for a delegate of the ICON

community with decisional competence (the position is actually of invitee type, i.e. an icon-nwp gatekeeper or a delegate should not necessarily take part in all SMC meetings). This will ensure that the code changes, which satisfy the acceptance criteria (see the corresponding section) and are recommended by the COSMO SMC and/or the CLM community, are integrated back into the official ICON code. The icon-nwp gatekeepers and the icon-cosmo-master gatekeeper must also secure that the efforts of various groups are well coordinated and the developments planned by the COSMO SMC and the CLM community are not in conflict with the developments planned for the icon-nwp-dev by the other ICON community members.

7   Personnel arrangements

Considering limited human resources of both COSMO and ICON communities and a heavy workload of the ICON gatekeepers and the COSMO SMC members, it seems difficult to involve new people into the COSMO-ICON coordination activities. We therefore propose the following personnel arrangements based on the existing human resources.

Martin Köhler, the ICON physics coordinator, and Daniel Rieger, the PP C2I leader, are participating in the COSMO SMC activities on a regular basis. Since both Martin and Daniel are heavily involved in the ICON development, they can naturally become COSMO SMC representatives in the ICON governing bodies. Furthermore, Daniel will stay the key contact person for the CLM community. The CLM-community coordinator takes part in the SMC meetings.

Ulrich Schättler is the COSMO source code administrator. It seems natural that Ulrich takes on responsibility for the icon-cosmo gatekeeping and the coordination of efforts with the gatekeepers of icon-nwp-dev (icon-nwp.git, etc.). Ulrich may also represent COSMO SMC in the ICON governing bodies.

8   Further issues

Apart from the SMC ToR mentioned above, the Terms of Reference for the TAG (Technical Advisory Group), SCA (Source Code Administrator), and possibly also WGCs (Working Group Coordinators) may need to be modified in the future, and the modified ToRs should be approved by the STC.

During the discussion of the present document, a number of points were made concerning the future role of the SMC. The need for more strategic planning of the COSMO-community contributions to the development of the ICON modelling framework was emphasized. More specifically, the SMC role was stressed (i) in governing the future work of the various COSMO working groups, and (ii) in planning the model development so that to avoid over-tuned ICON model. These very important issues are beyond the scope of the present document. They should be comprehensively discussed at the forthcoming COSMO SMC meetings.

N.B. by MCH

The workflow discussed above is very well adapted for scientific developments by the COSMO community members, viz., the developments that require modifications of limited components of the model. For the technical developments related to the GPU port of ICON, which require modifying the infrastructure code as well as the code that affects other ICON organizations (such as ICON-AES), a direct access to the icon repository is required. Currently, most GPU developments by MeteoSwiss and CSCS are entering the icon.git main repository via the icon-cscs.git repository. As MeteoSwiss is currently in charge of part of the maintenance and future development of the GPU capability of ICON, a workflow with direct access to the main repository should be provided in the future.