PHYSICS-DYNAMICS INTERFACE SETUP: SOME PROPOSALS.

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June 10, 2013

Version 4 (basis = CY40).

1 Introduction and purpose.

In this paper we start a discussion how to isolate physics-dynamics interface variables in specific modules.

2 Physics-dynamics interface setup.

2.1 Current status.

We speak about the physics-dynamics interface and in particuliar of its setup. The current code has the following drawbacks:

- The code currently suffers (from its origin design) from the fact that physics-dynamics interface is not enough separated from physics itself. Set-up still observes an antiquated rule saying that all the setup (for all physics) must be done even if only a small subset of physics is called (and even in adiabatic runs!). This rule which was probably adapted to the physics contents which were in the code in 1992 is no longer suitable to the physics environments we have now. For example METEO-FRANCE configurations do some ECMWF surface scheme setup (passing in project SUR) and this is regularly a source of problems.
- It is difficult to do an extensive list of physics-dynamics interface routines: they are currently spread among directories "adiab", "phys_dmn", "phys_radi" and "phys_ec".
- It would not be so straightforward to plug the physics (especially the ECMWF physics) to other dynamical cores, in particuliar to a Z-coordinate based NH dynamical core.

2.2 Proposal.

My proposal is to isolate physics-dynamics interface variables into specific modules (and set-up routines). Two levels of physics-dynamics interface variables can be listed.

∗ First level of physics-dynamics interface variables (new module intphysdyn1_mod.F90 to create):

They must answer the following questions:

- Is there any physics activated? (diabatic or adiabatic run?)

and, in case of diabatic run:

- What set of physics is switched on among the following possibilities:
  - ECMWF complete physics.
  - ECMWF simplified physics.
  - METEO-FRANCE complete physics.
  - METEO-FRANCE simplified physics.
  - METEO-FRANCE climate model physics.
  - HIRLAM physics (this is now a variant of METEO-FRANCE physics).
  - ALARO physics.
  - AROME physics.
  - Very simplified (Buizza) physics.
- Is physics done at $t + dt$, t or $t - dt$ or split among $t + dt$ and t or $t - dt$?:
- Is all physics done at the same resolution than dynamics?
- Is physics reproducible (results unchanged when NPROC or NPROMA changes)?
- Is there a diabatic contribution in continuity equation?
- Is there a diabatic contribution in pressure departure variable equation (NH model)?

We can extract the following list of variables to answer most of these questions and gather them in a new module INTPHYSDYN1_MOD.

- YOEPHY: LEPHYS, LAGPHY.
- YOMARPHY: LMPA, LMSE.
- YOMCOAPHY: NPHYINT, NPHYRES.
- YOMPHY: LMPHYS, NDPSFI, NPHYREP, and maybe also LREASUR.
- YOM_PHYS_GRID: environment defining the grid used in physics, if different from the one used in dynamics.
- YOMSIMPHL: LSIMPH, and maybe also LTRAJPS, LTRAJPST, LPROCLDTL.
- YOMSLPHY: LSLPHY.
- YOPHLC: LSPHLC (Buizza physics).
- Maybe also LRCOEF in YOMRCOEF.

We can see that relevant variables are currently spread among at least 8 different modules! Some of them are computed in SU0PHY.

∗ Second level of physics-dynamics interface variables (new module intphysdyn2_mod.F90 to create):

They must answer the following questions:

- What diabatic processes are switched on among the following ones?
  - Deep convection and convective precipitations.
  - Stratiform precipitations.
  - Microphysics.
  - Shallow convection and turbulence.
  - Gravity wave drag.
  - Radiation.
  - Surface scheme; exchanges between surface and atmosphere.
  - Chemistry.
- For activated processes, what parameterisation is chosen?

Without entering into details I can say that variables are currently spread among several modules (YOMPHY, YOEPHY, YOMARPHY, YOMSIMPHL, etc). Several tens of variables are expected and they can be gathered in new structures (for example one structure per process).

∗ Physics setup:

Do it in the following order:

- First level of physics-dynamics interface variables (always set-up). It must be done before calling SUDIM1 and SUGFL. It can be done at the level where SU0PHY is currently called.
- If there is physics switched on (and only in this case) set-up the second level of physics-dynamics interface variables. It can be done quickly after the first level of physics-dynamics interface variables set-up.
- The other physics variables will be set-up only in diabatic runs and only useful modules will be set-up.
- Library "SUR" will never be called in runs which do not use ECMWF surface scheme. It will never be used for configurations used at METEO-FRANCE. This library can even remain internal to ECMWF.
- Libraries "MPA", "MSE" and "SURFEX" will never be called in runs which do not use any process of these libraries. These libraries will never be used for configurations used at ECMWF.

3 Conclusion.

These proposals still need discussions, but this work may be planned in the frame of the OOPS setup reorganisation. Way of dealing with the physics set-up and the physics-dynamics interface must follow a compromise acceptable for all partners.