

IFS/Arpège Memorandum

From: Claude Fischer

To: (ECMWF) DR & RD Section Heads

To: (Météo-France) Arpège diffusion list

To: (ALADIN) Piet Termonia, Daan Degrauwe

To: (HIRLAM) Daniel Santos-Muñoz

File: RD19-xxx

Subject: Draft minutes of the IFS/Arpège coordination videocon meeting of 29 November 2019.

Participants:

Météo-France: François Bouyssel, Claude Fischer, Ryad El Khatib, Harold Petithomme, Alexandre Mary (remote), Philippe Chambon (remote) etc.
Stéphane Martinez excused.

ECMWF: Stephen English, Michael Sleigh, Olivier Marsden, Nils Wedi, Peter Lean, Alan Geer (item 7.4 until end of meeting)

ALADIN: Daan Degrauwe

HIRLAM: Daniel Santos-Muñoz excused

1. Adoption of Agenda

agreed

2. Approval of Minutes of meeting of 4 July 2019

approved

3. Review of list of actions from last meeting

1. Nils to send Claude the draft paper about adapting and porting the IFS codes on new architectures (SAC paper). => *the paper was forwarded by Alain Joly, after it was presented at SAC. Action closed.*
2. Claude and Steve to exchange relevant information and material about code training planned both in MF (9-12 Sept. 2019) and EC (a bit later). => *in Sept 2019, MF organized IFS/Arpège/LAM code training days (focus was on objects in forecast and post-processing configurations). Material is available at: <http://www.umr-cnrm.fr/aladin/spip.php?>*

[article347](#). The feedback from the participants at the 2019 training days (MF and Aladin staff) was very positive, as they all felt that the training was efficiently addressing the new code structures after CY46 and how to now develop new features in a re-factoring compliant manner. Thus the suggestion to extend such training days to the data assimilation components. MF will further investigate the possibilities, and keep in touch with EC about exchange of material or collaboration. Michael explained that EC have a regular training session that addresses tools like control versioning, prepIFS, ecFlows etc., thus more devoted to tools for using the IFS rather than the code itself. Nils mentioned that EC will organize a one-week Hackathon on ATLAS in the first week of March 2020, after discussing with Y. Trémolet when Yannick visited EC. Hackathon details will be shared when more concrete as this is likely going to be discussed in more detail only in the beginning of next year. But in the meantime Nils & Willem are happy to receive suggestions for topics to be addressed during the Hackathon. Daan expressed his interest to join, Claude will forward any relevant information to GMAP staff. The organizers in Reading will be Nils and Willem De Coninck. Action is reformulated: Nils to send Claude relevant information about the ATLAS Hackathon; Claude to forward to GMAP; keep-in-touch about DA code training days in 2020 (MF); Michael to send the link to information about the technical training sessions on prepIFS etc.

3. Olivier and Claude to liaise about the details of technical validation of pre-CY47 in July, possibly August, and agree on exact date for declaration. => Done. Action closed.
4. Olivier, Claude and Etienne to liaise in due time and agree on code versions to share: CY47_OOPS Fortran branch, appropriate OOPS/C++ version from OOPS-GIT repository. => this was not done. The action is kept open with a target on CY48. Technical discussion could be taken up at the next VC on 21 January.
5. MF to provide feedback about the ML paper to EC, until the next coordination VC. => Claude provided an informal summary of information gathered in CNRM and the verification group (DirOP/COMPAS). Steve asked if the informal note could be handed over to Peter Dueben. Action on Claude to send updated note to Peter Dueben and Steve.
6. The next coordination meeting should discuss potential changes to GOMs handling / all-sky aspects, both scientific & technical (Alan Geer and Philippe Chambon should be invited then). => discussed in item 7.4. Action closed.
7. EC to prepare presentation for next meeting on significant tech changes/refactoring around CY48-CY49. => discussed in item 7.5. Action closed.

4. MF information about progress and plans of E-suites and cycles (François, Claude)

François gave a summary of the major MF NWP applications, with highlights about the current e-suite based on CY43T2_op3, the characteristics of the new BULL HPC solution (a small porting machine already is open to some users for testing), and the perspectives for 2020.

CY43T2_op3 e-suite content:

- AROME-France:
 - Implementation of a snow analysis
 - Assimilation of OPERA radars

- New satellite observations assimilated (ScatSat1, AMSU-A & MHS/Metop-C, ATMS/NOAA-20, IASI/Metop-C)
- ARPEGE:
 - New diagnostics for aeronautics (clear air turbulence and icing)
 - Assimilation of ASCAT/Metop-C
 - Preparation of observation monitoring for AMV GOES17, NOAA-20, Metop-C, AEOLUS and GOES17 ABI radiances)

This e-suite is planned for operational switch by mid-January. In June/July, the operational suites should then be officially declared on the new computer.

Provisional content of the first scientific e-suite on the next HPC, to start in the autumn 2020 (based on CY46T1?):

- Arome (PEARO) and Arpège (PEARP) EPS change of resolution to the deterministic ones
- IFS convection and radiation schemes in Arpège and PEARP
- Snow analysis and sea-ice model in Arpège
- First use of SPP scheme for model error in PEARP
- New observation assimilated (AEOLUS, Mode-S, ...)
- New diagnostics

Note: the slides of the talk by François can be obtained from him or from Claude, on request.

Questions or comments by EC:

- MF plans for OOPS in operations?: e-suite implementation in the second half of 2021 (optimistic case) or 2022. Some conditions need to be met, among others: get a shared flagged version of an OOPS and an IFS release version; joint testable version for OOPS-IFS-Arpège; solve pending issues with Arpège options.
- Details about the sea-ice model for the 2020 e-suite?: this would be a 1D-version of the GELATO scheme.
- Steve pointed out that EC had encouraging results with Aeolus; EC also were planning to implement all Metop-C instruments in operations in beginning of December. In all cases this is on top of similar instruments from Metop-A and Metop-B, except for IASI where the Metop-C IASI replaces the Metop-A IASI. This is because issues were found using three IASIs in similar orbits. The reason for this is unknown but it may indicate obs error correlation issues.

5. EC information about progress and plans of E-suites and cycles (Michael)

Michael stressed that EC still faced scientific validation issues with CY47R1 (note: the code is for now rather a CY46R2 version). Therefore, official final declaration and full hand-over to operations might occur only after X-mas, thus beginning of 2020. The switch to operations remains scheduled for June.

At the technical level, CY47_main has been very recently validated for IFS 4D-VAR in the full HRES configuration. Merging CY47_main into the preliminary CY47R1 has now started. After further validation, it is this merged version that will be sent to MF for CY48.

Questions by MF:

- timing of the move of the data centre to Bologna?: EC will have more news after the December Council. The contract for the next HPC also shall be officially decided and announced at that Council meeting. RD is expecting to get access to a test machine still early in 2020 (located in Reading then).

- Status of current e-suites?: EC have no official e-suite for the time being. There are several full size scientific test suites on the Cray, but none with an e-suite status.

6. Technical status of R- and T-cycles, and merge of CY48 (Michael/Olivier, Claude)

note: contents of CY47T0 and CY47T1 from MF are listed in Appendix 1.

Claude gave a short update about testing of CY47T1 (MF now have a running screening and 4D-VAR minimization / they still need to investigate more into CANARI issues / most model and Full-POS configurations are validated). The status of this cycle, with parallel validation in progress for both models and DA, is fairly “new”, and has not happened for quite a few years. Starting to use DA unit tests and OOPS helped solving several issues from CY47_main.

In CY46T1_bf, MF face a difficult issue with understanding a temperature bias and an excessive rejection of IASI radiances in screening, after several assimilation cycles.

The time of start of building CY48 was decided in the meeting. EC wished to shift the start by about one month, in order to complete validation of CY47 and the merge within CY47R1. MF explained that they could start merging in early January (in week 6-10 Jan), though this will mean that a fair part of the build of CY48 will extend over the migration and test phase of the NWP applications on the new BULL. MF expect that they can work on the two tasks in parallel (that would occur in the March-April period). EC agreed to send their contribution for the merge in week 6-10 January.

Declaration of CY48 ideally would occur by end of March. However assuming that no other specific obstacle occurs in timing constraints, the actual final declaration could be done later, in April perhaps. Because of pending issues in the scientific validation of CY47R1, it is very likely that EC will send some bug-fix packages to MF, during the build process.

7. Specific topics

7.1. OOPS Progress (Steve – Olivier)

EC have validated the full OOPS-IFS 4D-VAR with their “CY47R1” (however not yet including CY47_main), and they will resume this validation with the final merge CY47_main/CY47R1 in December. The list of missing options in OOPS-IFS was recalled: finalization of Continuous Data Assimilation (CDA), weak constraint term for stratosphere, singular vector computations, FSOI. Options like VarBC are now tested with the 4D-VAR test.

Steve confirmed the plan now is to port OOPS to operations for all IFS applications, for the model and 4D-VAR components, with CY49R1. The precise timing of completion if this cycle is however not yet known. The start of build in Research could occur in late 2021. A handover to operations could be expected in 2022. The first operational version of OOPS-IFS 4D-VAR might still be with using multiple binaries because the NEMO model code might not be ready for multiple instantiation by then (NEMO still is based on global variables).

Claude confirmed MF are planning to regularly use the OOPS objects for unit testing, and this use might be considered as the first concrete R&D application of OOPS. This use indirectly could be an

added value to Arpège and Arome operational implementations, if the approach enables to accelerate the validation of assimilation in new cycles.

7.2. Model developments update (Nils Wedi)

Nils listed the major items and plans for model development:

- 5-layer snow scheme; improved coupling between vertical diffusion and convection schemes; study on TKE scheme in IFS (visit by E. Bazile to EC in 2020).
- collaboration EC/MF on land surface mapping will start in view of C3S: definition of urban tiles; exchange of global information on surface properties (urban cover, vegetation types, etc.); consider ECOCLIMAP-2 database.
- VFE-NH based on the recent visit by Jozef Vivoda to EC; collaboration with MF (F. Voitus, C. Kühnlein) about the “d5” NH variable; work out a common EC-MF proposal for participation in DIAMOND-II (based on the IFS-ST-NH model using the “d5” variable); tests of IFS-FVM at 2.5km resolution have started.
- Improved, optimized MPI communications for FFTW; Single precision fixes for mass-fixer and so-called “pole problem” (Legendre transform wave number 0 handling requires double-precision)
- changes in resolution in preparation of next HPC: increase number of vertical levels in all applications (to 137); increase horizontal resolution for ENS (but kept constant for HRES).

Question by MF (François): for DIAMOND-II, should there be a global NH model version using the Arome physics packages? A common setup for DYAMOND II at least for the dynamics is desirable, and two contributions with the same dynamics but different physics (with IFS + AROME physics) will be useful, but Nils also pointed out that the contribution from ECMWF is expected to be coupled to the 3D ocean with the atmosphere at storm-scale resolution.

7.3 MF update about modernized validation process & tools (Alexandre)

Alexandre gave an oral overview about the progress with the future technical validation tool “davaï”. Prototype versions are now being used by a small team in GMAP during the build of new T-cycles in Toulouse (CY47T0, CY47T1). Using “davaï” and the OOPS-derived unit tests for assimilation already had enabled to early fix a few specific problems in data assimilation, inherited from CY47_main. Recently, a specific test case has been implemented which enables to run an OOPS-based 4D-VAR minimization that reproduces the result of the CNT0/Masterodb version.

The prototype will be complemented with additional tests, and its user interface will still evolve a little. With “davaï” comes a new graphical interface to view results, as well as a number of Python-based scripts that are in charge of providing the test evaluation definitions (the “experts”).

“davaï” will again be used and tested with CY48, and it is planned to become fully available to GMAP staff officially with CY48T1.

Work has started in MF in order to include LAM-OOPS objects test cases, in collaboration with Roel Stappers from HIRLAM (met.no).

Questions raised by participants of the meeting:

- (Peter): how are the reduced sets of observations computed? => done in the Bator code
- (Daan): how portable will “davaï” be for other partners? => this question is being investigated indeed. Issues are about which platforms actually should be targeted (only MF and EC for instance?), and how to enable other partners to efficiently run the test tools from remote.
- Olivier reminded that he had checked for opening access to MF staff (Alexandre) to the EC/IFS test suite repository. The access still needs to be checked out. Action on Olivier to provide access information to Alexandre.

Hereafter is a brief by Claude of the discussion on EC/MF technical cross-tests, from the 19.11 videocon:

- resume exchange of data for simple forecast tests (IFS T21, Arpège T30)
- start addressing cross-testing components of DA: creation of exchangeable ODB files
- then, assess which DA tests could be shared; relevance of cross OOPS tests
- for later: extend to some other configurations like simple LAM integration?

7.4. Discussion about the planned upcoming changes in GOM-handling, all-sky radiances and obs codes in general (Steve, Peter, Alan, Philippe C.)

The foreseen changes in the observation codes have been addressed, including any item affecting the GOMs codes, HOP, the ODB interfaces etc.

EC confirmed that the major code overhaul for OOPS in the observations code was done. The upcoming re-factoring or cleaning aspects, in view of CY47R1/CY48, are to finalize the roll-out of the new ODB Fortran interface (ifsobs) across IFS and rationalize the “new_thinn.F90” routine. For CY48R1/CY49, the plans are to upgrade the set-up for VarBC, the setup of satellite observations and the “obslocs” code to use the new interface. Peter is mostly going to work on these aspects.

MF will work out two proposals: an increased flexibility of the GOM-2D arrays in order to accommodate for sub-type specific definitions and array handling (this will increase code efficiency for the 1D-Bayesian retrieval configurations used for ground-based radar data for Arome, and for all-sky microwave handling for Arpège). Another aspect for MF is to re-assess the algorithm for the multiple box strategy in thinning. With the current code, two very close observation positions may still be selected within the double-box algorithm.

Peter mentioned that screening might be a candidate for a fair deep recoding, but such an action was not yet on the table for the foreseeable future. Philippe mentioned that MF might be interested to follow such initiative later, for instance on aspects like the handling of observation error correlations.

Two actions on MF (lead P. Chambon):

- send EC a proposal for the GOM-2D flexibility increase (for CY48 if possible)
- send EC a proposal for a modified double-box strategy in thinning (in view of CY49)

7.5. Other significant changes/re-factoring around CY48-CY49 (EC/MF)

A number of other potential or planned code adaptations have been reviewed, with a view rather towards CY49:

- tidy-up of the VarBC code (split the big Fortran object?): no short term plans at ECMWF,
- FIELD_CONTAINERS: those will be complemented with specific FORTRAN interfaces to ATLAS (as an optional implementation),
- new fields structure implemented in EC_PHYS, in order to wrap the code for either the (classical) CPU version or the GPU version; split of some IFS physics parametrization routines per NPROMA loop rather than one single and big loop => this change will start entering CY48 already,
- MF input: tidying up of the surface fields setup in routine “su_surf_flds.F90” (proposal lead by Harold).

LAM-related aspects:

- co-development of Vertical Finite Elements (VFE) codes between EC (Filip Vana), MF and ALADIN (Jozef Vivoda, Petra Smolikova), with potentially some need for cross-coordination between partners in view of a future code phasing,
- HIRLAM dev: Stochastic Parameter Perturbations (SPP) and Stochastic Pattern Generator (SPG) => a discussion with EC and MF has started. EC (M. Leutbecher) will propose all partners a re-design of the SPP code aiming at accommodating several physics definitions. In the meanwhile, U. Andrae from SMHI would phase the SPP extension developed in their consortium to CY47.

Questions: MF pointed out that the start of adapting the IFS codes for GPUs, and its reflection within the official joint cycles, was indeed coming up very soon, with the EC_PHYS/wrapper changes entering as soon as CY48 in beginning of 2020. EC confirmed that they need to start implementing these changes now since they wish to have GPU-ready official IFS versions for in about 2 years from now. MF and EC participants agreed that there indeed was a high pressure on preparing the codes for the even-next HPC calls for tender in 2023-2024 (and the HPC choices for 2025).

Actions decided:

- Olivier to send MF information about the confluence page with the description of the work on the IFS physics interface changes (wrapper, DSL-kind of choices, CPU/GPU oriented code versions)
- MF (Harold, Claude) to send EC the code proposal for the tidying-up of su_surf_flds.F90





8. Comments by LAM partners

none.

9. Content and timing of cycles

Below is an updated version of the overview Table of Cycles, after discussion.

Joint cycle	ECMWF	MF	Start of phasing	Declaration	Misc. / Oper plans
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CY46			Start Jan 15 th , 2018	10 April 2018	<i>OOPS aspects added as extra branch on CY45R1 for CY46</i>
		CY46T1	October 2018	28 February 2019	Technical update for fixes (assimilation) plus some science
		<i>CY46T1_bf</i>	<i>June 2019</i>	<i>September 2019</i>	<i>This is a specific branch for wrapping up CY43T2_op2 changes on top of CY46, as a step towards CY47T1</i>
	CY46R1		31 May 2018	Feb 2019	OOPS updates + science. Operational since 11 June 2019
CY47			Mid-February 2019	19 Aug 2019	Target joint cycle for baseline OOPS in Research mode
		CY47T0	End August 2019	3 September 2019	OOPS-MF prototype & array bound check
		CY47T1	10 October 2019	December 2019	MF aim is to wrap-up all changes from CY43T2_op2. LAM partners will be asked to follow the same restricted specs for their contributions.
	CY47R1		July 2019	End of October 2019 	Expected to become the porting cycle for Bologna
CY48			6-10 Jan 2020	End of March 2020	
		CY48T1	Sept 2020 ?	Nov 2020 ? 	
	CY48R1		Q2/2020 ?	Q3/2020 ? 	Single precision runs in ENS
CY49			Dec 2020 ?	End of Feb 2021 ?	Tbc at the next coord meeting (23 March 2020) 
		CY49T1	?	?	Tbc in 2020
	CY49R1		Late 2021	2022	OOPS operational for 4D-VAR/IFS

10. AOB

visit by Sébastien Massart to MF on 4-6 Dec, including technical work on Control Vector codes with MF in view of pre-CY48 and discussion on collaboration in assimilation methods.

11. Next meetings

Next technical video conferences:

⇒ Tuesday 21 January 2020, 14h30 (CET) / 1.30pm (UK)

Next Coordination video conferences:

⇒

Next physical Coordination Meeting:

⇒ Monday 23 March 2020, Toulouse. Tentative start at 9h00 loc.

List of actions decided:

1. training material; exchange of information or collaboration on IFS-Arpège code training sessions in 2020: Nils to send Claude relevant information about the ATLAS Hackathon in March & Claude to forward to GMAP; keep-in-touch about DA code training days in 2020 (MF); Michael to send the link to information about the technical training sessions on prepIFS etc.
2. Olivier, Claude and Etienne to liaise in due time and agree on code versions to share: CY48_OOPS Fortran branch, appropriate OOPS/C++ version from OOPS-GIT repository. Possibility to meet on this subject at the technical VC of 21 January 2020.
3. Claude to send an updated MF note on ML areas of interest (refer to the EC/RD note RD19-101) to Peter Dueben and Steve.
4. Action on Olivier to provide MF (Alexandre) with access information to the IFS test case repository.
5. Two actions on MF about the observations code (lead P. Chambon):
 - a. send EC a proposal for the GOM-2D flexibility increase (for CY48 if possible)
 - b. send EC a proposal for a modified double-box strategy in thinning (in view of CY49)
6. Olivier to send MF information about the confluence page with the description of the work on the IFS physics interface changes (ref to: wrapper, DSL-kind of choices, CPU/GPU oriented code versions) planned to enter CY48.
7. MF (Harold, Claude) to send EC the code proposal for the tidying-up of su_surf_flds.F90, planned to enter CY49.

Appendix 1: contents of CY47T0 and CY47T1 in MF

(listed by Claude)

CY47T0: this is a technical cycle built in the end of August 2019. The goal was to enable the first early prototypes of tests based on the “**davaï**” concept and tools (for technical validation). Another goal was to enable to run the Fortran binary executable files using array bound check options throughout the code (this actually required a number of corrections and adaptations of interfaces, following a proposal made by Ryad).

Content:

- code changes enabling array bound check options throughout the code, for a number of Arpège and LAM configurations (R. El Khatib)
- Fortran/C++ interface codes adapted in order to enable OOPS unitary tests in the “davaï” framework for CY47 (E. Arbogast with A. Mary)
- bator change to enable the use of “one obs out of two” (useful for creating smaller obs databases for testing) (F. Guillaume following an idea by F. Suzat)
- miscellaneous other bug-fixes found in CY47_main or reported from earlier cycles, excluding those linked with reporting codes from CY43T2 (this is planned for CY47T1)

Declaration of CY47T0_main occurred on 3 September 2019.

CY47T1: October-November 2019. The timing of CY47T1 was very constrained, as MF and EC would start building CY48 as early as December 2019. Contributions to CY47T1 had to be prepared for Tue 8 October.

Content: because of the timing constraints, delayed contributions were avoided.

- System operational aspects (Météo-France o/e-suites):
 - wrap-up of MF’s e-suites based on CY43T2 op1/op2 and CY46T1 bf (all GMAP staff)
=> finishing this wrap-up into the official trunk is a major goal of this cycle for GMAP
- System technical aspects:
 - direct reading of NetCDF file formats in c931 and c932 (J.-M. Piriou)
 - inclusion of new configuration c933 aimed to replace c931 and c932 in some near future (A. Napoly, J.-M. Piriou)
- Model algorithmic aspects:
 - **optimization most noticeably for AROME (APL_AROME etc.)** (R. El Khatib)
 - mass correction option from Arpège-Climat adapted to Arpège-NWP for the new cycles (CY47 and beyond, with the model objects) (H. Petithomme)
- Full-POS & Model output diagnostics:
 - precipitation types; various flavours of snow cover height (I. Etchevers)
 - for aeronautics: pressure and flight level height of Tropopause and jet (O. Jaron)
 - new fields in Fullpos (CHMI & J. Cedilnik):
 - convective temperature,
 - mean radiant temperature (needed for evaluating thermal comfort),
 - global normal irradiance (for energy producers),
 - lightning diagnostics
 - vertical temperature gradient (aviation application)
 - MLCAPE
 - storm motion vector, storm relative helicity, vertical wind shear diagnostics
- Arpège and Arome model dynamics:
- Arpège atmospheric physics:
 - updated interface to the IFS radiation scheme ECRAD (Y. Bouteloup, following work by M. Raouindi)

- rewrite of PCMT code in order to make the Météo-France NWP and Arpège-climate versions converge (J.-M. Piriou, J.-F. Guérémy)
- for Arpège-Climat: additional dry adjustment term; changes in the Lopez microphysics (R. Roehrig, A. Alias)
- Arome atmospheric physics:
- SURFEX codes in NWP repository:
 - note: the SURFEX code base version is kept unchanged, v8.0.x, like in cycles CY43T2-CY46T1
- Surface analysis & CANARI:
 - snow analysis code (C. Birman)
- Assimilation methods:
 - fixes for trajectory handling in AEARO, for I/O of control vector initial condition slices (Y. Michel)
 - re-factoring of some control vector attributes & methods, agreed after liaison with ECMWF (Y. Michel, in liaison with S. Massart & C. Fischer)
- Observations:
 - GNSS ZTD horizontal gradients observation operator (P.Moll) tbc
- ALADIN:
 - Graupel code: required some restructuring (with respect to what's coded in CY45T1) + corrections (B. Bochenek & J. Masek)
 - Miscellaneous ALARO physics aspects (J. Masek – 10 Sept. 2019):
 - DDH budgets for prognostic TKE and TTE (in TOUCANS) added by Mario Hrastinski.
 - New cloudiness treatment in vertical diffusion by Radmila (introducing new options NDIFFNEB=4 and 5).
 - Fixes in adjustment and microphysics by Luc Gerard. These will be deactivated by local key, since they require more extensive validation.
 - TOMS (3rd order moments in TOUCANS) fixes by Peter Smerkol. These will be deactivated by local key as well.
 - Further modularization and optimization of ACRANEB2. Exact content depends on how much will I (Jan) manage to implement until deadline.
 - Fixes of blend utility (new FA date structure, split of ECHIEN to ERIEN, reintroduction of Z_NSIGN, making official version working). Today I (Jan) found that blend utility in cy47t0 is crashing, the problem might be related to xrd adaptation for single/double precision. I am trying to make it working again.
 - Dynamics:
- HIRLAM:
- OOPS re-factoring and prototypes (E. Arbogast & T. Montmerle):
 - in the FORTRAN code libraries: bug-fixes for running the OOPS binaries for standard configurations (4D-VAR Arpège, 3D-VAR Arome, Unit tests with Arpège or Arome data, Arpège and Arome forecast models etc.)
 - first implementations in official SCR of OOPS/C++ towards FORTRAN/IFS interface codes, enabling the 4D-VAR and 3D-VAR prototypes to run
 - note: the above changes prepared in view of implementing the tests within the new “davaï” framework
 - preliminary code implementation for EnVar from OOPS in global geometry

The declaration of CY47T1 is expected in December.