

Some facts about CY28T1

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1. Introduction

This is an updated version of the mail sent by Claude Fischer to several ALADIN correspondants on July 9th, 2004. But it is worth making some more advertising.

2. Duplicated routines (prepared by C. Fischer)

The following duplicated routines are now merged inside the ARPEGE code:
CNT3, SU0YOMA, SU0YOMB, CNT4TL, CNT4AD

Only CNT4 is still duplicated in cycle 28T1 (so AL28T1 version differs from CY28T1 one).

3. New data-flow (prepared by C. Fischer)

GFL and GMV/GMVS data structures now carry all prognostic or pseudo-historical variables through scan2mdm, and from one time-step to the next. Unlike the old gridpoint buffers (GPPBUF, GPP, GPUABUF), these gridpoint data are basically kept at the end of GP computations, and remain existent during spectral computations. However, time-steps are clearly separated, as are semi-implicit variables from the pseudo-advective ones.

Thus, we have for short:

- U/V/T/Ps/PD/VD in GMV/GMVS structure. "VDAUX" also is there, in a bit hybrid form. GMV contains t0 and t9 data, plus horizontal derivatives. In addition, there is a GMVT1 for updated data at the end of scan2mdm and a GMVT5 for trajectory data. GMVS contains the surface 2D variables (mostly: Ps and derivatives and time levels).
- Q, O3, Ice, Cloud fraction of EC scheme, new variables for ALARO/AROME (cloud liquid water, TKE, graupels, cloud ice, etc...) as well as pseudo-historical variables from the physics are stored inside another structure: "GFL". GFL also contains t0/t9, plus derivatives. In addition, there is a GFLT1 (updates) and a GFLT5 (trajectory). Furthermore, GFL does have a flexible (yet not always totally debugged) data layout, using a list of attributes that are defined at setup stage and tell the IFS how the GFL variable is treated. For instance, you can create a GFL variable that would not have horizontal derivatives, no trajectory and no coupling in the LAM.

I refer to Mats' documentation for the details. There is no "GFLS" (surface fields in GP space are kept in GPPBUF). Another good documentation is Martina's technical report about the inclusion of pseudo-historical variables in GFL.

Reported/encountered bugs in CY28 and due to the "youth" of the GMV/GFL:

- new GFL variables are better defined by asking a "trajectory" component. Our TL/AD models crash due to bad addressing if a new variable is created in the T0 structure, but no T5 counterpart is defined (both timestamps use the same pointers, as Mats has supposed the T5 would be basically a copy of the T0). This problem is of course not seen if only conf 001 is run.
- the SL interpolations were bugged for specific keys (LVECADIN) when a new GFL non-advective variable was created. This bug should be fixed in CY28T1, thanks to the efficient advices of Clive T.

4. Code cleaning and explicit interfaces (prepared by C. Fischer)

From CY28 onwards, the code of the IFS, including "arp" and "ald" projects, but not "tfl" and "tal" for instance, should follow the new coding standards that have been agreed and enforced commonly by ECMWF and Meteo-France.

There are some automatic tools to verify the compliance of any piece of code with respect to the new standards, but the best is to be aware of it, to read a bit Ryad's documentation, and to follow the coding style as you see it in CY28.

Explicit interfaces have been enforced in the IFS for CY28. They are mandatory in Reading and Toulouse. The principle is that any called routine has its interface declared in the calling one (#include toto.intfb.h) and this interface is automatically generated and introduced in-line at compilation (thus gmckpack for Toulouse). This is one reason why "gmckpack.5.3" should be used to create packs. An earlier version would fail.

Interfaces are only mandatory for "arp" and "ald" routines. ARPEGE and the IFS run with dummy interfaces for ALADIN routines called from there. Of course, an ALADIN pack/binary should have all its interfaces provided.

For CY28T1, we have organised the work such that the explicit interfaces are not yet mandatory for remote installations. Thus, partner Centers can install CY28T1 without taking care of them, and it is possible to generate dummy interface blocks in order to compile properly the code. From CY29 onwards, we will not guarantee anymore this possibility, and thus by end of 2004, everybody should be ready at home to install a source code which will be more demanding from F90 compilation point of view (more strict about interface consistency including type declarations, array shapes, intents, number of arguments ...).

5. New setup for horizontal diffusion - 1 (prepared by P. Bénard)

Here is a small explanation about the piece of code concerning the new set-up of the Horizontal Diffusion (HD).

5.1 Spirit

The spirit of the new set-up is that the coefficients HDIR* do not belong any longer to namelists (NAMDYN) but are computed through a minimal set of information, via 2 new variables set by NAMDYN :

- RRDXTAU: the absolute strength of the diffusion
- RDAMPDIV: the ratio for HD of divergence compared to other variables

The HDIR* variables still exist, but as internal variables which are computed internally, using other informations about the configuration being run currently (truncation,...).

5.2 Defaults

The new set-up of default value for ECMWF is as follows:

- If LNEWHD =.F., then the default HDIR* (i.e. as activated for a void namelist) are determined according to the old step-function hard-coded in the old set-up.
- If LNEWHD =.T., then the default HDIR* (i.e. as activated for a void namelist) are determined by a formula which gives a strength equal to the last current one at T799 (HDIR* =1200. for a T799) and which diffusion coefficient is proportional to $\Delta x^{(r-1)}$ where r is the order of the diffusion and Δx is the grid-length, as desirable according to the documentation of new HD.

5.3 Non-default

In case you want to modify the HD in a way not provided by the two above defaults, the method is to specify RRDXTAU and RDAMPDIV.

The formula is:

ARPEGE:

$$\text{HDIRVOR} = \frac{\pi}{\text{RRDXTAU}} \frac{a}{N} ; \quad \text{HDIRDIV} = \frac{\text{HDIRVOR}}{\text{RDAMPDIV}}$$

where

a is the earth radius (in meters) and N the spectral truncation.

ALADIN:

$$\text{HDIRVOR} = \frac{\sqrt{1/2 (\Delta x^2 + \Delta y^2)}}{\text{RRDXTAU}} ; \quad \text{HDIRDIV} = \frac{\text{HDIRVOR}}{\text{RDAMPDIV}}$$

where

Δx = grid-mesh in X direction (EDELX)

Δy = grid-mesh in Y direction (EDELY)

The obtained HDIR* are then printed in the listing. If the printed HDIR* do not correspond to your expectations then you can modify RRDXTAU accordingly, in order to obtain the wished values for HDIR*. Note that HDIR* is proportional to (1/RRDXTAU).

N.B.: The new HD is less flexible than the old one in the sense that only two strengths can be specified (i.e. the so-called DIV and the VOR strengths). However, the possibility of more various strengths had not been used for many years, and could be re-established in subsequent cycles in case of strong (although unlikely I presume) demand.

6. New setup for horizontal diffusion - 2 (prepared by K.Yessad)

Practical impact on namelists, valid for both cycles CY28T0 (for validation purposes if any) and CY28T1 (for the export/operational versions).

6.1 ARPEGE CY28T0:

- HDIR*, HDUR*, REXPDH, REXPDHU removed from namelists (NAMDYN)
- parameter RRDXTAU should not appear in namelists
- in NAMCT0: NOPGMR=0 if no stretching, NOPGMR=2 if stretching
- in NAMDYNA: LNEWHDU=T only for stretched geometry

6.2 ALADIN AL28T0:

- HDIR*, HDUR*, REXPDH, REXPDHU removed from namelists (NAMDYN)
- RRDXTAU should be set in namelist NAMDYN (e.g. set to 123. for ALADIN/France) for comparisons with AL28T1 (different default computation in both cycles)
- NOPGMR, LNEWHDU not needed in namelists (default values ok)

6.3 ARPEGE CY28T1 and ALADIN AL28T1:

- parameters HDIR*, HDUR*, REXPDH, REXPDHU, RRDXTAU, NOPGMR, LNEWHDU, and RDAMPDIV, should not appear anymore in namelists : either their default values are ok, or they have disappeared.

6.4 Caution:

One always should have :

$$\begin{aligned} & \text{REXPDH}=4, \\ & \text{HDIRVOR}=\text{HDIRT}=\text{HDIRQ}=5*\text{HDIRDIV} \end{aligned}$$

- 5. is the default value of RDAMPDIV

- HDIRDIV being always truncated to the nearest integer)

7. New setup for semi-implicit (prepared by K.Yessad)

As far as the semi-implicit scheme is concerned:

7.1 ARPEGE CY28T0:

- set LSIDG=F in NAMCT0 in non stretched geometry
- set LSIDG=T in NAMCT0 in stretched geometry

7.2 ALADIN AL28T0:

- set LSIDG=F in NAMCT0.

7.3 ARPEGE CY28T1 and ALADIN AL28T1:

- parameter LSIDG is removed from namelist; it is replaced by another variable which is not in namelist but automatically computed in SUDYN.

8. Changes in the physics (prepared by E. Bazile)

On the side of physics, there were a number of changes that could be "traced-back" by a thorough survey of the Toulouse "oper" and "dbl" suites. The basic physics for AL28T1 follow those of our present operational version CY26T1_op6.

Below, Eric has listed the main differences, including those that cause an irreversible change in the code, which means that Aladinists who are doing development on the physics on the last export versions (AL25T1 or possibly "wild" versions of AL26T1) have to be careful and possibly phase their modset:

8.1 New routine:

ACMIXLENZ.F90 : externalization of the computation of the mixing length for momentum and heat (before performed inside ACCOEFK.F90), no scientific change.

8.2 Modified routines:

ACHMT.F90 :

- minimum value of the wind shear depends of the depth of the layer (ZEPS1=1.E-4 replaced by GCISMIN*PDPHIV/RG with GCSMIN=6.7E-05) no reproducibility (J.M. Piriou)
- New parameter EDK in the function F_m and F_h for the stable case (default=1 reproduces exactly the previous version) (E. Bazile)
- **Warning:** The correction for the anti-fibrillation scheme for EDK and for USURID=0 will be available in CY28T2.

ACCLPH.F90 :

- Wind gusts in case of LRAFTUR=.F. (M. Bellus) only output (no impact)

ACCOEFK.F90 :

- New input PLMU, PLMT : mixing length (computed in *acmixlenz.F90*)
- minimum value of the wind shear depends of the depth of the layer (ZEPS1=1.E-4 replaced by GCISMIN*PDPHIV/RG with GCSMIN=6.7E-05), no reproducibility (J.M. Piriou)
- New parameter EDK in the function F_m and F_h for the stable case (default=1 reproduces exactly the previous version) (E. Bazile)
- Correction of a "required bug" (for reason of computer time saving see the History of the operational PBL ECMWF seminar by JFG) in the function F_h in instable case (λ_m^2 replaced by $\lambda_m \times \lambda_u$) very small impact. (E. Bazile and thanks to A. Simon)
- **Warning:** The correction for the anti-fibrillation scheme for EDK and for USURID=0 will be available in CY28T2.

ACRANEB.F90 :

(for more information please contact J.F. Geleyn)

- LREWS = exact computation of exchange with the surface
- LRPROX = F new development done by JFG
- with LREWS=F no exact reproducibility

ACNEBN.F90 :

- change definition for PQLI and PQICE: they become grid size values
- **Warning:** modification in APLPAR (Y. Bouteloup and J.M. Piriou)
- substitution of QSUSX by QSUSXC (convective part) and QSUSXS (stratiform part). (F. Bouysse)
- No impact with QSUSXC=QSUSXS with the value of QSUSX

ACDIFUS.F90 :

- New input LDZ0H and PGZ0HF: only for output to be fully consistent with PGZ0F. (F. Bouysse)
- NCHSP : modification of the deep soil heat transfer in presence of snow (default=0 no impact). (E. Bazile)

ACCVIMP.F90 and ACCVIMPD.F90 :

Security for crazy case with $T_w > T$ (very small impact)

9. Later corrections (prepared by R. El Khatib)

- ✓ ald/setup/SUEGEO1.F90 :
important bugfix on non-initialized RNLGINC in ALADIN (ref : JF Geleyn)
- ✓ arp/utility/MAXGPFV.F90 :
bugfix for portability on Full-Pos 1 processor on IBM (ref : JF Estrade)
- ✓ ald/dia/EWRIMOVA.F90 :
bugfix for portability (ref : F. Vana)
- ✓ ald/setup/SUEGEO2.F90 :
bugfix for OPEN-MP (ref : D. Paradis)
- ✓ ald/transform/EUVGEOVD.F90 :
bugfix for OPEN-MP (ref : D. Paradis)
- ✓ arp/setup/SUAFN1.F90 :
bugfix for portability (ref : Y. Wang)
- ✓ arp/control/GP_MODEL.F90 :
bugfix for portability concerning DFI (ref : L. Kullmann)
- ✓ ald/c9xx/EBICLI.F90 :
bugfix for ALADIN e923, from cycle 28T0 only (ref: R. El Khatib)
- ✓ arp/control/RERESF.F90 :
major bugfix for ARPEGE restart mechanism (ref: R. El Khatib)
- ✓ arp/utility/WRRESF.F90 :
minor bugfix for ARPEGE restart mechanism (ref: R. El Khatib)

All these modifications should enter the next export version.

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