The DDHTOOLBOX

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1 Purpose

ARPEGE, ALADIN and AROME models produce DDH files. The ddhtoolbox makes operations relevant to use these DDH files for scientifical development and research: produce ready-to-plot profiles of variables, tendencies and fluxes (ddhi), cumulate DDH files, differenciate DDH files, make horizontal and vertical means (ddht), get the budget of prognostic variables (ddhb), etc.

2 Install the software

Untar the ddhtoolbox.tar file.

cd ddhtoolbox/tools

The install process uses the "uname -a" command to recognize the architecture of the current machine. So first type "uname -a" on the command line. Then check whether this is an already known type in both scripts install and lfa/install. If yes, and if the compiler option fits your needs, no change needs to be done. Else case, you will have to add an item in the "if ["$os_name"] else fi" statement, to give your compiler options.

1. Put the local directory in your PATH: export PATH=.:$PATH

2. Run install process:

   install clean

   install

3. An additional information: if you are running an ARPEGE - ALADIN - AROME code version earlier than cycle 32, you will need to convert the DDH files produced by ARPEGE - ALADIN - AROME, before using it with the ddhtoolbox utilities.

   This converter, DDHC, is already available on your computer: it is an entry point from the XRD library (libxrd.a) that is generated in the standard ARPEGE - ALADIN - AROME compilation process.

   The DDH files are converted this way (lets call DDH.lfi the file produced by ALADIN, and DDH.lfa the converted one):

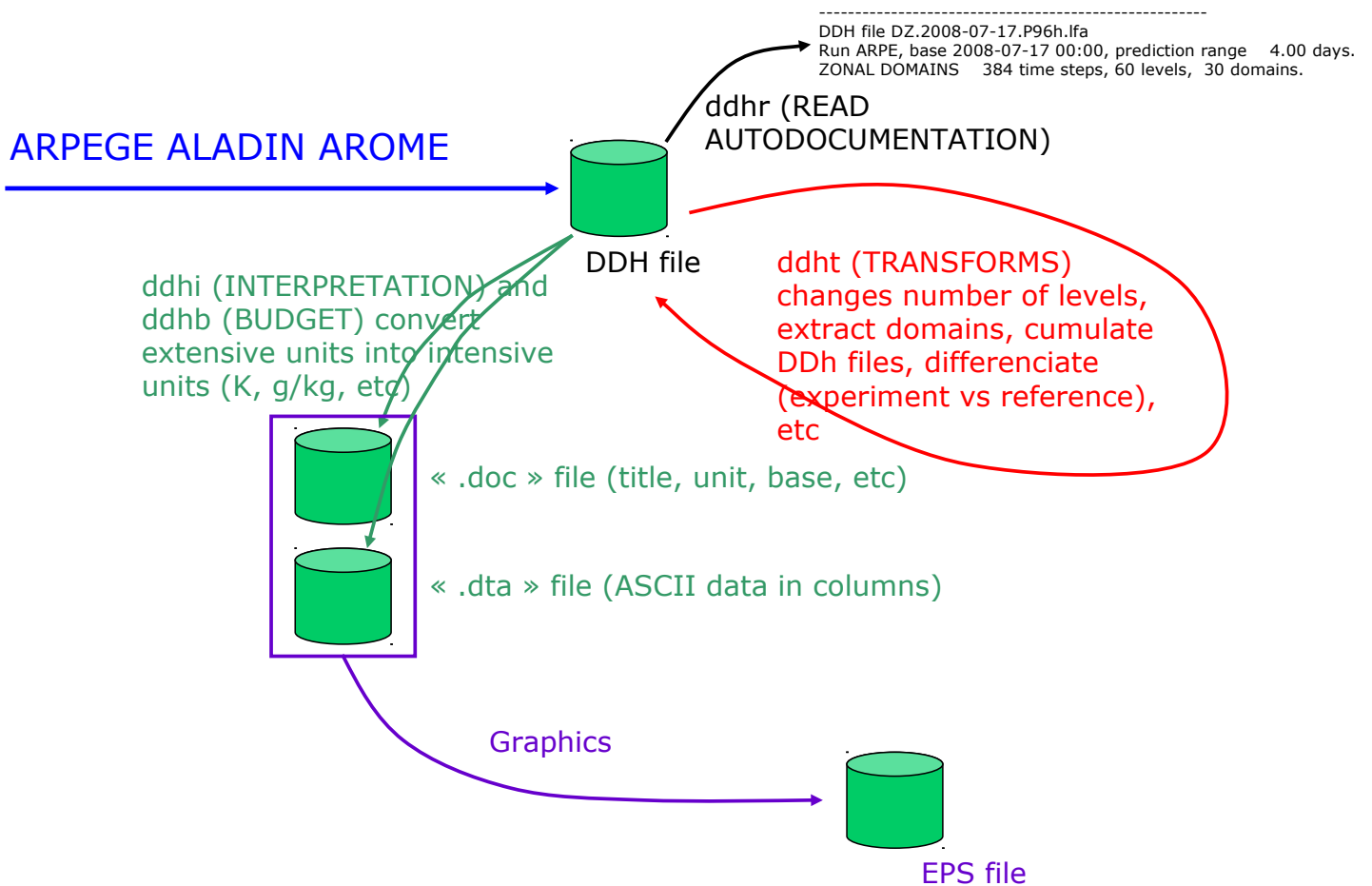   DDHC DDH.lfi DDH.lfa

3 Environment variables

1. Put the ddhtoolbox/tools directory and the ddhtoolbox/tools/lfa directory in your PATH, in order to access the ddhtoolbox executables from any directory on your computer.

2. DDH tools (ddhi, ddhb) use the following environment variables, to be put in your ".profile" or ".bash_profile" files:

export DDHI_LIST=..../ddhtoolbox/ddh_budget_lists/conversion_list

export DDHB_BPS=..../ddhtoolbox/ddh_budget_lists

where "...." is to be filled by the absolute PATH of the ddhtoolbox directory.

3. If the environment variable DDH_PLOT is set, some ddhtoolbox utilities call a script of your own, which makes the plot, starting from the information given by the autodocumentation file (suffix ".doc").

4   Synoptic view of ddhtoolbox utilities

```
----------------------------------------------------
DDH file DZ.2008-07-17.P96h.lfa
Run ARPE, base 2008-07-17 00:00, prediction range    4.00 days.
ZONAL DOMAINS    384 time steps, 60 levels,  30 domains.
```

ddhr (READ AUTODOCUMENTATION)

ARPEGE ALADIN AROME

DDH file

ddhi (INTERPRETATION) and ddhb (BUDGET) convert extensive units into intensive units (K, g/kg, etc)

ddht (TRANSFORMS) changes number of levels, extract domains, cumulate DDh files, differenciate (experiment vs reference), etc

« .doc » file (title, unit, base, etc)

« .dta » file (ASCII data in columns)

Graphics

EPS file

ARPEGE, ALADIN or AROME models produce DDH files. Each file contains n domains, m levels, and for each domain-level all variables, fluxes and tendencies relevant to get a budget. The actions that can be performed on DDH files are described in the followinf sections.

4.1   ddhr: get autodocumentation

Get some DDH file autodocumentation on standard output: base, prediction range, etc.

Typing "ddhr" with no argument gives a documentation about the usage.

4.2 ddht: transform

Operates transforms on DDH files: make the difference between a reference and an experiment, cumulate several DDH files, extract one or more domain(s) from a DDH file, extract one or more level(s), make an horizontal mean on all domains, make a vertical mean on all levels, etc. ddht generates in output a DDH file.

Typing "ddht" with no argument gives a documentation about the usage.

4.2.1 Difference experiment minus reference

```
=> ddht -cDIFFE_EXP_REFE -2FEXP -1FREF -sDIFF
```

makes the difference between DDH file FEXP and FREF, the result is DIFF file. The DIFF file is a DDH file. The prediction range of FEXP and FREF have to be equal. If they differ more than 0.001%, ddht aborts.

The script ddh- makes the same operation, with a shorter command line:

```
=> ddh- FEXP FREF DIFF
```

The ddh- script calls "ddht -cDIFFE_EXP_REFE".

It may be useful, in some situations, to make the difference between 2 files having different prediction ranges: for example, to compare the mean infra-red cooling from a 24h prediction with a 6h prediction, to study spin-up effects. The script ddh- makes such a difference: if the 2 prediction ranges are different, ddh- modifies the prediction range from one file, modifies all fluxes and tendencies accordingly (done through the ddhmech script), and then makes the "ddht -cDIFFE_EXP_REFE" difference.

4.3 ddhi: interpretation

ddhi makes an interpretation of the raw data from a DDH file, in order to get ready to plot data, with intensive units (K/day, g/kg, etc).

Typing "ddhi" with no argument gives a documentation about the usage.

Example: starting from a DDH file "DHFDLFCST+0024.domaine4", one needs to get an ASCII file containing the profile of water vapour q_v and temperature T. Create an ASCII file containing the list of articles:

```
lxgmap2:/home/piriou/ftn/ddh/ddhtoolbox/ddh_files/arome/cy35t1_arome_france_c744 => cat mylist
VQV1
VCT1
```

then type "ddhi DHFDLFCST+0024.domaine4 -lmylist":

```
lxgmap2:/home/piriou/ftn/ddh/ddhtoolbox/ddh_files/arome/cy35t1_arome_france_c744 => ddhi DHFDLFCST+0024.domaine4 -lmylist
default list file:
/home/piriou/ftn/ddh/ddhtoolbox/ddh_budget_lists/conversion_list
---------------------
---DDHI-CHAMPS--------
---------------------
Fichier d'entree: DHFDLFCST+0024.domaine4
calling lisc
lisc:/home/piriou/ftn/ddh/ddhtoolbox/ddh_budget_lists/conversion_list
lisc: read           413  fields.
---------------------
---DDHI-COORDONNEES---
---------------------
DHFDLFCST+0024.domaine4.tmp.VCT1.dta
DHFDLFCST+0024.domaine4.tmp.VCT1.doc
DHFDLFCST+0024.domaine4.tmp.VQV1.dta
DHFDLFCST+0024.domaine4.tmp.VQV1.doc
```

ddhi reads the DDH file, reads the VCT1 and VQV1 articles, converts the units of these data: for example the VCT1 article is $c_p\,T\,\frac{\delta p}{g}$, ddhi converts it into T, and thus divides by c_p and by the $\frac{\delta p}{g}$ field. The conversion uses a conversion list file (whose name is given to ddhi by the DDHI_LIST environment variable), which tells ddhi how to convert each DDH article.

ddhi produces in output ASCII files:

- a ".doc" file per field, containing autodocumentation (title, unit, base, prediction range, etc)

- a ".dta" file per field, containing the data in columns.

To know the complete list of variables, tendencies and fluxes that can be tranformed into ASCII data by ddhi, type "lfaminm FDDH", where FDDH is the name of the DDH file. This gives the list of all articles. The variables are article names beginning with "V", the tendencies are article names beginning with "T", the fluxes are article names beginning with "F". These article names can be put the "mylist" file as described above. If one of these articles is not present in the conversion list file DDHI_LIST, ddhi will not know how to convert it. In this case, simply edit the DDHI_LIST file, and add a line describing how this article has to be converted.

4.4   ddhb: budgets of prognostic variables

ddhb is a tool to make the budget of pronostic variables, starting from a DDH file. Typing "ddhb" with no argument gives a documentation about the ddhb use.

This DDH file should contain only one domain. If it is not the case, use ddht to extract a single domain from your multi-domain DDH file.

4.4.1   Get a first budget plot

Example of ddhb use:

"ddhb -v QV -i DHFDLALAD+0036".

In this example, one asks for the budget of the prognostic variable is QV (water vapour), from the file DHFDLALAD+0036. What ddhb basically does, as one types -v QV, is to read in the DDH file the list of articles containing fluxes or tendencies of QV: all articles "FQV*" and "TQV*" of the DDH file are used to build the QV budget.

The ddhb script then writes ASCII ready to plot files; two kinds of files are produced:

1. **Data** files (suffix: dta): in ASCII colums.

2. **Autodocumentation** files (suffix: doc): title, unit, date of the prediction run, etc.

4.4.2   More advanced use to get budget plots

The user may also create his own directive files. For example, to change the legends of the budgets (and translate them to French, German, etc), or to customize the scientifical budgets (change the list of file articles to be used for a given physical process). In this case, two methods:

1. **Create your own directive file, "from scratch":** "ddh2fbl FDDH DIR" will read the FDDH file, and produce the directive files on the $DDHB_BPS/DIR directory. Then, one simply needs to type

   "ddhb -v DIR/VAR -i FDDH" to get the budget of the variable VAR. If one wants to modify the legends of the curves, one edits the $DDHB_BPS/DIR/VAR.fbl file, and then reruns ddhb.

   How does ddh2fbl work? It reads inside the DDH file all article names, lists the articles of the type V??0 (examples: ??=CT, QV, etc). For each of these variables, lists all F??* and T??* articles. And writes the directive file containing this list. The resulting list is thus consistent with the DDH file. ddh2fbl makes the assumption that all budget items are articles beginning with F or T. This rule, presently true in ARPEGE - ALADIN - AROME, should thus be respected in the future to guarantee a proper work of ddh2fbl.

2. **Modify existing reference directive files:**
   find $DDHB_BPS -name "*.fbl" -print

to see the complete list of physics or budget packages available for use in ddhb, and which variables. Copy a directory containing directive files under your own name, and then modify it. Example:

```
lxgmap2: => find $DDHB_BPS -name "*.fbl" -print
/home/piriou/ftn/ddh/ddhtoolbox/ddh_budget_lists/arome_cy35t1/QG.fbl
/home/piriou/ftn/ddh/ddhtoolbox/ddh_budget_lists/arome_cy35t1/QR.fbl
/home/piriou/ftn/ddh/ddhtoolbox/ddh_budget_lists/arome_cy35t1/QL.fbl
/home/piriou/ftn/ddh/ddhtoolbox/ddh_budget_lists/arome_cy35t1/QI.fbl
/home/piriou/ftn/ddh/ddhtoolbox/ddh_budget_lists/arome_cy35t1/QS.fbl
/home/piriou/ftn/ddh/ddhtoolbox/ddh_budget_lists/arome_cy35t1/CT.fbl
/home/piriou/ftn/ddh/ddhtoolbox/ddh_budget_lists/arome_cy35t1/QV.fbl
/home/piriou/ftn/ddh/ddhtoolbox/ddh_budget_lists/arome_cy35t1/TE.fbl
/home/piriou/ftn/ddh/ddhtoolbox/ddh_budget_lists/arpege/KK.fbl
/home/piriou/ftn/ddh/ddhtoolbox/ddh_budget_lists/arpege/QT_old.fbl
/home/piriou/ftn/ddh/ddhtoolbox/ddh_budget_lists/arpege/QT.fbl
/home/piriou/ftn/ddh/ddhtoolbox/ddh_budget_lists/arpege/CT_simplified.fbl
/home/piriou/ftn/ddh/ddhtoolbox/ddh_budget_lists/arpege/QV_2006-06_and_previous.fbl
/home/piriou/ftn/ddh/ddhtoolbox/ddh_budget_lists/arpege/QV_simplified.fbl
/home/piriou/ftn/ddh/ddhtoolbox/ddh_budget_lists/arpege/CT.fbl
/home/piriou/ftn/ddh/ddhtoolbox/ddh_budget_lists/arpege/QV.fbl
lxgmap2: => cp -r $DDHB_BPS/arpege/ $DDHB_BPS/myown_arpege
lxgmap2: => vi $DDHB_BPS/myown_arpege/CT.fbl
lxgmap2: => ddhb -v myown_arpege/CT -i DHFDLALAD+0036
```

5 Graphics

All above mentioned tools (ddhi, ddhr, ddhb, etc) produce read-to-plot ASCII files. The user may then use his own graphic tool to plot these ".doc" and ".dta" files. As mentioned in page 2, if the environment variable DDH_PLOT is set, some ddhtoolbox utilities call a script of your own, which makes the plot, starting from the information given by the autodocumentation file (suffix ".doc").