LIBRARY ARCHITECTURE IN ARPEGE/ALADIN (CY36T2).

K. YESSAD
METEO-FRANCE/CNRM/GMAP/ALGO
One code, but several models shared between different European (and also some non-European countries):

- **ARPEGE**: spectral global model for METEO-FRANCE applications.
- **IFS**: spectral global model for ECMWF applications.
- **ALADIN**: spectral limited area model (mesh-size often between 5 km and 10 km).
- **ALARO**: cf. ALADIN but for some ALADIN partners, (mesh-size around 5-7 km).
- **AROME**: non-hydrostatic spectral limited area model for METEO-FRANCE applications (mesh-size 2.5 km); in operations since 2008.
- Around 13000 routines spread among sub-projects.
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ENTERING THE ARPEGE LIBRARY.

On “merou”, under CLEARCASE: cc_getview -u public -r CY36T2
Available views ... : select arp_public_CY36T2_bf
Root: merou:/home/marp001/dev: several directories (ald, arp, ...) containing the “projects”.

K. YESSAD (METEO-FRANCE/CNRM/GM).LIBRARY ARCHITECTURE IN ARPEGE/AL
17 août 2010 3 / 24
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AVAILABLE PROJECTS.

- **ARP**: ARPEGE or common ARPEGE-ALADIN routines.
- **ALD**: specific LAM routines (LAM, not used at ECMWF).
- **TFL**: spectral transforms for spherical geometry.
- **TAL**: spectral transforms for plane geometry.
- **XRD**: some application routines (IO on files, DM environment).
- **XLA**: linear algebra, minimizers other than CONGRAD.
- **SUR**: ECMWF surface scheme.
- **BIP**: Bi-periodicisation package (LAM models).
- **MPA**: upper air MESO-NH/AROME physics (now also used in ARPEGE and ALADIN).
- **MSE**: surface processes in MESO-NH/AROME (interface for SURFEX).
- **SURFEX**: surface processes in MESO-NH/AROME.
### AVAILABLE PROJECTS.

**Used in forecasts:**

- ARP: ARPEGE or common ARPEGE-ALADIN routines.
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AVAILABLE PROJECTS (CONT’D).

Used in assimilation:
- AEO: package for pre-processing satellite lidar wind data.
- BLA: package for blacklisting.
- OBT: statistics of observation feedback data (only used at ECMWF).
- ODB: ODB (Observational DataBase software).
- SAT: satellite data handling package.
- SCT: QUICKSCAT scatteromètre handling.

Miscellaneous utilities:
- UTI: utilitary package, containing for ex. PROGRID (not used at ECMWF).
- SCR: scripts used at ECMWF.
AVAILABLE PROJECTS (CONT’D).

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ARPEGE or common ARPEGE-ALADIN routines.

A subset of these directories are also in ALD.

- adiab: adiabatic dynamics, adiabatic diagnostics, SI scheme, horizontal diffusion.
- c9xx: specific configurations 901 to 999 routines.
- canari: routines used in the CANARI optimal interpolation.
- climate: some specific ARPEGE-CLIMAT routines.
- control: control routines, like CNT4 or STEPO.
- dfi: routines used in the DFI.
- dia: diagnostics other than FULL-POS.
- fullpos: FULL-POS software.
- function: functions (in includes).
- kalman: Kalman filter.
- module: all the types of modules.
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- **mwave**: micro-wave observations (SSM/I) treatment.
- **namelist**: all namelists.
- **nmi**: routines used in the NMI.
- **obs_error**: treatment of the observation errors in the assim.
- **obs_preproc**: observation pre-processing.
- **ocean**: oceanic coupling, for climatic applications.
- **onedvar**: 1D-VAR assimilation scheme used at ECMWF.
- **op_obs**: observation horizontal and vertical interpolator.
- **parallel**: parallel environment, communications between processors.
- **phys_dmn**: physics parameterizations used at METEO-FRANCE.
- **phys_ec**: ECMWF physics.
- **phys_radi**: some ECMWF radiation physics routines.
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A subset of these directories are also in ALD.

- pp_obs: vertical interpolator (FULL-POS, obs interpolator).
- prism: OASIS coupler (for climate applications).
- programs: main programs.
- sekf: simplified extended Kalman filter.
- setup: setup routines not linked with a very specific domain.
- sinvect: singular vectors calculation (configuration 601).
- transform: hat routines for spectral transforms.
- utility: miscellaneous utilities (lin. algebra, dealloc).
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Spectral transforms.

- build (in TFL): contains procedures.
- external: routines which can be called from another project.
- interface: not automatically generated interfaces.
- module: all the types of modules.
- programs: specific entries which can be used for TFL/TAL code validation.
Spectral transforms.

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Linear algebra.

- **external**: routines which can be called from another project.
- **interface**: not automatically generated interfaces.
- **external**: routines which can be called only by another XLA routine.
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- **inside the previous directories we find**:
  - **fourier**: Fourier transforms routines.
  - **lanczos**: Lanczos algorithms routines.
  - **linalg**: linear algebra routines.
  - **minim**: minimizers.
Linear algebra.

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### Auxiliary library.

- **bufr_io**: BUFR format files reading and writing.
- **cma**: CMA format files reading and writing.
- **ddh**: DDH diagnostics.
- **eclite**: routines coming from an old ECLIB package.
- **fa**: ARPEGE (FA) files reading and writing.
- **grib_io**: ECMWF GRIB format files reading and writing.
- **grib_mf**: METEO-FRANCE GRIB format files reading and writing.
- **include**: not automatically generated interfaces.
- **lfi**: LFI format files reading and writing.
- **misc**: miscellaneous decks.
- **module**: all the types of modules; mpl...F90 modules for parallel environment.
- **parallel**: parallel environment.
- **programs**: main programs.
- **support**: miscellaneous routines.
- **svipc**: contains only svipc.c.
- **utilities**: miscellaneous utilitaries.
PROJECT XRD/IFSAUX.

**Auxiliary library.**

- `bufr_io`: BUFR format files reading and writing.
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- `grib_io`: ECMWF GRIB format files reading and writing.
- `grib_mf`: METEO-FRANCE GRIB format files reading and writing.
- `include`: not automatically generated interfaces.
- `lfii`: LFI format files reading and writing.
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- `module`: all the types of modules; mpl...F90 modules for parallel environment.
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PROJECT BIP.

Bi-periodicisation software.

- build: contains procedures.
- external: routines which can be called from another project.
- interface: not automatically generated interfaces.
- module: all the types of modules.
- programs: main programs.
Bi-periodicisation software.

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ECMWF surface scheme.

- **build**: contains procedures.
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ECMWF surface scheme.

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Upper air MESO-NH/AROME physics.

Code imported from MESO-NH (MESO-NH DOCTOR norm).

- programs: main programs.
- first layer of directories: chem (chemistry), conv (convection), micro (microphysics), turb (turbulence).
- externals: routines which can be called from another project.
- include: all the “include” decks.
- interface: not automatically generated interfaces.
- internals: other non-module routines.
- module: all the types of modules.
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Surface processes in MESO-NH/AROME (interface for SURFEX).

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PROJECT SURFEX.

Surface processes in MESO-NH/AROME.

Code imported from MESO-NH (MESO-NH DOCTOR norm).

- aux : auxiliary actions (mostly file I/O).
- canopy : surface boundary layer prognostic scheme.
- dummy : empty versions of some routines.
- flake : lake model.
- ideal : idealised configuration.
- include : all the “include” decks.
- isba : ISBA vegetation model.
- prep : initial surface file preparation.
- sea : ocean and sea model.
- surf_atm : coupling between surface and atmosphere.
- teb : town model.
- trip : rivers and floodings model.
- water : simple parameterisation of fluxes above lakes and rivers.
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Package for blacklisting.
- compiler.
- include: not automatically generated interfaces, functions, and some other includes.
- library: the only containing .F90 decks.
- old2new.
- scripts.
PROJECT BLA.

Package for blacklisting.

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- include: not automatically generated interfaces, functions, and some other includes.
- library: the only containing .F90 decks.
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- scripts.
Statistics of observation feedback data.

- bias_sat.
- data.
- doc.
- examples.
- module.
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Satellite data handling package.

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- interface.
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- mwave.
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- pre_screen.
- programs : main programs.
- rtlimb.
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Utilitary package.

- `add_cloud_fields` : program to add 4 cloud variables in ARPEGE files.
- `addozoaer` : program to add ozone and aerosols constants in ARPEGE files.
- `addsurf` : programs to add fields in ARPEGE files.
- `combi` : combination of perturbations in an ensemble forecast (PEARP).
- `ctpini` : routines for CTPINI applications (inversion of potential vorticity fields).
- `gobptout` : PROGRIB.
- `pinuts` : PINUTS applications, for example to create ALADIN domains.
- `pregpssol` : surface GPS processing.
- `progrid` : PROGRID.
- `progrid_cadre` : cf. progrid?
- `rdc` : former configuration 911 (makes dilatation/contraction matrices).
- `sst_nesdis` : program to read the SST on the BDAP.
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We should be able to make executables with only the following subsets of projects (=> restrictions about the interdependencies):

- ARP+TFL+XRD+XLA+MPA+MSE+SURFEX : for ARPEGE forecasts with METEO-FRANCE physics.
- ARP+ALD+TFL+TAL+XRD+XLA+BIP+MPA+MSE+SURFEX : for ALADIN or AROME forecasts.
- ARP+TFL+XRD+XLA+SUR : for IFS forecasts with ECMWF physics.
- ARP+TFL+XRD+XLA+MPA+MSE+SURFEX+BLA+ODB+SAT : for ARPEGE assimilations with METEO-FRANCE physics.
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ALLOWED/FORBIDDEN INTERDEPENDENCIES.

- Tricky to list extensively; mentioned in some documentation.
- There is a sort of hierarchy, saying that some projects can or cannot call routines of other projects, or saying that modules of other projects can or cannot be used.
- For example routines of project ARP should not directly call a TAL routine.
- For example routines of project TFL should not call a ARP routine or use a ARP module.
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Where to find it ?.

- Yessad, K., 2009 : Library architecture and history of the technical aspects in ARPEGE/IFS, ALADIN and AROME in the cycle 36 of ARPEGE/IFS.
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THANK YOU / MERCI.