Regional Cooperation for Limited Area Modeling in Central Europe

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Adaptation to OOPS-3DVar in IAL export cy48t3

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Export version IAL cy48t3

- Information published this week on https://github.com/orgs/ACCORD-NWP/discussions/254

- Contents:
  - IAL source code CY48T3_bf.03
  - input data including namelists and OOPS json configuration files
  - documentation about OOPS and the validation carried out in the "Arome-France 3DVar" configuration
  - log files extracted from the Arome-France validation

OOPS system – code organization in IAL cy48t3

- The C++ general purpose code: oops_src
- Fortran wrappers for OOPS located in arpifs/oops
- OOPS applications: oopsifs/mains
- Entry point for OOVAR:

oopsifs/mains/ifs4dvar.cc

- OOPS needs additional external libraries: ecbuild, eckit, fckit (to be built in the hub)
- OOPS becomes an external library from cy49

Compilation (IAL-build)

Comparible version of IAL codes, eckit, fckit libraries are required to compile OOPS.

pip install git+https://github.com/ecmwf/ecbundle

git clone git@github.com:ACCORD-NWP/IAL-build.git
export PATH=$PATH:./IAL-build/bin/

module use ~acrd/public/modulefiles
module load IAL-build

Compilation (gmkpack)

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```
ial-bundle2pack -t main tag:BDL48T3_bf.03-0 -p masterodb, oovar
```

- Creates a main pack with compatible versions of IAL, eckit and fckit in a gmkpack hub, as specified in a bundle *bundle.yaml* tag ***BDL48T3_bf.03-0***.
- Works with system/default GMKFILE on Atos.
- When run locally it will require modifications to GMKFILE, to specify Fortran/C/C++ compilers, MPI and other libraries and environment.

NOTE: The resulting pack name will include CY48T3 (capital T), currently difficult to handle by gmkpack when creating additional ics scripts (to be corrected by a GMK environment variable).

The OOPS run and diagnosis

Screening and minimization is performed in one OOVAR execution.

OOPS prints output to stdout, to be redirected to a logfile:

```
${MPIRUN} ./OOVAR oops.json > oops.log 2>&1
```

The output file includes cost function over iterations, compatible with GREPGRAD/GREPCOST:

```
grep "Quadratic cost function: J " oops.log
grep "Quadratic cost function: Jb" oops.log
grep "Quadratic cost function: JoJc" oops.log
```

New namelist inputs: object files

Namelist (object)	Content
naml_standard_geometry	geometry, grid dimensions etc
naml_standard_geometry_tENS	geometry, dimensions etc. for ensemble component (relevant for EnVar
naml_bmatrix_aro	information on the static B matrix
naml_observations_tlad	use of observations in tl/adjoint computations (e.g. NOTVAR tables)
naml_observations_aro	use of observations (e.g. NOTVAR tables)
naml_nonlinear_model_3dv_aro	non-linear model setup, handling of hydrometeors, non-hydrostatic variables and other prognostic variables
naml_traj_model_3dv_aro	trajectory model integration setup, handling of hydrometeors, nonhydrostatic variables and other prognostic variables (relevant for 4D- Var)

New namelist inputs: object files

Namelist (object)	Content
naml_write_analysis_aro	name and spectral representation of the analysis
namelist_gom_setup_hres	GOM field setup (relevant for reflectivity DA)
namelist_gom_setup	GOM field setup (relevant for reflectivity DA)
naml_leftovers_aro	remaining namelist items (linked as fort.4)

NOTE: Some of the object names are defined in the oops.json, others are hardcoded.
Full documentation is not available, the best approach is to start from MF samples.

Structure and contents of the *json* configuration

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name	value	description
expver	label	experiment label (e.g. "OOPS")
resolution	namelist	namelist to set up model geometry, e.g. "naml_standard_geometry"
	orogfile	file from where terrain is initialized (e.g. init FA file)
model	namelist	non-linear model setup, handling of hydrometeors, non-hydrostatic variables and other prognostic variables, e.g.
	tstep	integration timestep

NOTE: Full documentation not available, the best approach is to start from MF samples.

Structure and contents of the *json* configuration

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name	value	description
cost function	window_length	span of assimilation window
resolution	window_begin	start time of assimilation window
	variables	list/array of control variables for minimization
model	cost_type	type of cost function: 3D-Var or 4D-Var
	Jb	a complex structure to define the Jb part of cost function, with objects Background (state for first guess and StateObsAux for background Var-BC file etc.), Covariance(for B-matrix and related namelist, or ensemble covariances for En-Var), and ObsAuxCovariances (updated Var_BC file after the screening)
	Jo	a complex structure to define the Jo part of cost function, with keys screening (to activate the screening), timeslot and ObsTypes (define namelists on observations, ODB type and names, and obs. errors)

Structure and contents of the *json* configuration

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name	value	description
variational	iteration	a complex object with names iteration, screening (activation, definition of outputs), resolution (of minimization), linear model (properties of the linear integration if called), ninner, gradient_norm_reduction (the limit to stop the minimization descent), diagnostics (control outprints of JOT tables, departures etc., VARBC output), restart_radar, stateObsAux (input VARBC for minimization), stateObsAuxReset and ObsAuxCovaraince (input VARBC files).
minimizer	algorithm	defines a minimizer to be used (SQRTPLanczos, ...)
output	namelists	namelist defining the content of the analysis file
model	steps	time for which the analysis fields is written out
final	diagnostics	controls the content written out to the ODB
	state	control of analysis outprint

It‘s time to switch to OOPS

In cy48t3, the MASTERODB and OOPS are expected to provide meteorologically equivalent result (see note on long-term meteorological validation by Pierre Brousseau, part of the export pack).

⇒ Good time to switch to OOPS 3D-Var, MASTERODB will not be validated for DA configurations by MF anymore.

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Thank you for your attention.

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