

RESEARCH DEPARTMENT  
MEMORANDUM

---



To: RD Scientific Staff and Consultants

Copy: DR, DF, HPS, HES, Alain Joly, John Hodgkinson, François  
Bouyssel, Claude Fischer, Ryad El Khatib, Karim Yessad

From: Deborah Salmond et al.

Date: June 29, 2015

File: RD15-177

**Subject: IFS Memorandum Cycle CY42R1**

---

Cycle 42r1 was created in June 2015.

*Contributors:*

Alan Geer, Alessio Bozzo, Anna Agusti Aparenta, Elias Holm, Filip Vana, Gabor Radnoti, George Mozdzyński, Hans Hersbach, Johannes Flemming, Kristian Mogensen, Marta Janiskova, Michael Rennie, Niels Bormann, Nils Wedi, Olivier Marsden, Peter Bechtold, Peter Lean, Reima Eresmaa, Robin Hogan, Saleh Abdalla, Sylvie Malardel, Tomas Kral, Tomas Wilhemsson

*Merged branch names:*

**V0: das\_CY42\_NEW, dag\_CY42\_for\_42r1\_v0**

dag\_CY41R2\_esuite

dae\_CY41R2\_EDA\_OPT

str\_CY41R2\_for\_CY42R1

dipl\_CY41R2\_odb\_bit\_repro\_for\_42r1

dipl\_CY41R2\_poolmask\_switchoff

dipl\_CY41R2\_dca\_ioassign

ste\_CY41R2\_iasi\_bc\_fix

nas\_CY41R2\_for\_42R1

pae\_CY41R2\_physics\_for42r1\_cvgust

ne1\_CY41R2\_MPS\_forCY42R1

waa\_CY41R2\_jason3

da7\_CY41R2\_Apr23\_aeol\_L2Bv\_2\_20\_plus

das\_CY41R2\_V11 \*\*\*

datk\_SB41R2\_V11\_bugfix

stg\_CY41R2\_pre\_oops\_nojb \*\*\*

er9\_CY41R2\_varbc \*\*\*

**V1: das\_CY42\_NEW\_V1, dag\_CY42\_for\_42r1\_v0**

NVNUMB replacement script \*\*\*

*Notes:*

- All branches except those marked '\*\*\*' are also in dag\_CY41R2\_esuite\_highres

- CY42 had been passed though a SPAM python script (Olivier Marsden) see:

O. Marsden: June 2015 CY42 YRGMV, YRGFL, YRSURF, YRGMV5, and YRGFL5 are now passed by argument

- To merge CY41R2 branches to CY42: branches were first merged together to das\_CY41R2\_NEW\_V1, then merged with das\_CY41R2\_FF\_V5 (= CY42 before SPAM) and then passed though SPAM script and merged to das\_CY42\_NEW

- CY42R1 is expected to use the new Cray compiler cce/8.3.12, cdt/15.06 and ifs-support/CY42R1 (grib\_api, emos, fdb, eckit, atlas, odb\_api)

# NUMERICS

## Sylvie Malardel - nas\_CY41R2\_for\_42R1 - ACTIVE

### Combined numerics branch

#### Testing :

TCo1279 AN (as gby5, Elias ref for AN TCo1279)

with climate.v13 too : gd2e

FC only TC639 starting from this analysis (using inidata) to check both climate.v13 and the interpolations

## George Mozdzynski - mpm\_CY41R2\_gmcontrib - BR

Contains a merge of the following two branches:

## George Mozdzynski - mpm\_CY41R2\_FFTW\_reproducible\_simd - BR

### Fix bit-reproducibility issue for FFTW

Since the introduction of FFTW support in IFS, we have become aware of a bit reproducibility issue in IFS which can result in 'least significant bit' differences in the results of FFT transforms by using some combinations of NPES (MPI tasks) and THREADS (OMP\_NUM\_THREADS). The source of this bit reproducibility issue comes from the FFTW library module when the number of fields to transform (KFIELDS - also known as LOT size) varies due to changes in NPES or THREADS. A workaround was developed not to delay benchmark preparation and an offline reproducer developed and reported to CRAY. The CRAY initial response was that 'bit reproducibility' (the kind we wanted) was not guaranteed in the FFTW documentation, however, they were willing to discuss this further with the FFTW development team at MIT, which is ongoing. The workaround simply calls the FFT transforms one field (LOT=1) at a time and is enabled by setting a logical flag LL\_ALL=.false., in routines in the direct and inverse transforms (plus the AD/TL variants). This workaround has been further updated to use the FFW\_ALLOC\_COMPLEX and FFTW\_FREE routines to correctly align FFT input/output data on a DOUBLE COMPLEX word boundary, which allow us to remove the need to specify FFTW\_UNALIGNED on FFT plan creation in tpm\_fftw.F90. This branch still continues to use the LL\_ALL=.false. setting in the FFT calling routines, and we also continue to use planner flag FFTW\_NO\_SIMD until such time as we receive an official fix from CRAY.

*Files modified(TRANS):*

module/ftdir\_mod.F90 ftdirad\_mod.F90 ftinv\_mod.F90 ftinvad\_mod.F90 tpm\_fftw.F90

## George Mozdzynski - mpm\_CY41R2\_sldebug2 - BR

### Enhance LSLDEBUG halo debugging feature

Corrections and enhancements to LSLDEBUG halo debugging feature. LSLDEBUG=T (in nampar1) should not be used without this branch.

## Testing:

Tco639 FC control=gblf branch=gb6j 240Tx8t

Tco1279 FC control=gc6g branch=gc68 400Tx8t

TL511 4D-Var control=gbog branch=gc6a 96Tx12t

The above were run with both the default LSLDEBUG=F, and with LSLDEBUG=T enabled in nampar1.

### *Files modified(IFS):*

interpol/check\_sl\_struct.F90 slcset.F90 module/eint\_mod.F90  
obs\_preproc/mkglobstab.F90 op\_obs/slinter.F90 slinterad.F90 setup/susc2b.F90

## Tomas Wilhelmsson - nat\_CY41R2\_fullpos

### Activate monotonic interpolation of surface fields in inidata

If interpolation with inidata are needed, result will not be bit reproducible.

### *Files modified(IFS):*

namelist/namafn.nam.h

### *Files modified(SCRIPTS):*

scripts/gen/mknam\_fp

## Nils Wedi

### Update to CLimate files

- climate.v13 (albedo =/ 0 under ice. Solve some problem when ice is melting.)
- Pick up the proper Ozone clim files for TCo ("\_4" type of grid).
- EPS for glacier

### *Files modified(IFS):*

updo3ch.F90

### *Files modified(SCRIPTS):*

inter\_fp

## PHYSICS

### Peter Bechtold - pae\_CY41R2\_physics\_for42r1\_cvgust - ACTIVE

### Combined physics branch

## 1 Anna Agusti Apareda - paf\_CY41R2\_MACC\_BFAS\_cleaning - CLEANING

### Turbulence scheme cleaning for CO2 fluxes

1. simplify inclusion of CO2 flux corrections
2. remove duplicate call to vdfouter, vdfmain

Bit-reproducible: yes

*Files modified(IFS):*

phys\_ec/turbulence\_layer.F90 vdfmain.F90 vdfouter.F90

## 2 Peter Bechtold - pae\_CY41R2\_cubasen\_opt - OPTIMISATION,CLEANING

### Convection cleaning and optimisation

1. Cleaning of convection code
2. Optimisation of vdf code (number of draughts) and further preparations for PBL revision
3. correction for small planet

Bit-reproducible: yes

Impact: forecast speed-up 1%

norm-check ok

*Files modified(IFS):*

phys\_ec/callpar.F90 cubasen.F90 cudlfsn.F90 cumastrn.F90 turbulence\_layer.F90 vdfexcu.F90 vdfmain.F90

## 3 Filip Vana and Peter Bechtold - pae\_CY41R2\_convgest\_inact - PASSIVE,BUG-FIX

### Addition of convective gusts in surface fluxes

1. convective gusts in surface fluxes - passive
2. add security for entrainment rates in cubasen.F90 when  $dz_i > 1200$  m

*Files modified(IFS):*

adiab/postphy.F90

dia/sunddh.F90

module/surface\_fields\_mix.F90

phys\_ec/callpar.F90 cubasen.F90 postphy\_layer.F90 turbulence\_layer.F90

vdfmain.F90 vdfouter.F90

setup/su\_surf\_flds.F90

*Files modified(SURF):*

external/surfexcdriver.F90

interface/surfexcdriver.h

module/surfexcdriver\_ctl\_mod.F90 vexcs\_mod.F90

## 4 Peter Bechtold and Johannes Flemming - pae\_CY41R2\_climplot\_waves\_zmeanflux\_ozone - PASSIVE

### Scripts branch for climplot with new diagnostic packages

1. new wavenumber-frequency Spectra for OLR, precip, U and T
2. zonal mean stationary and eddy fluxes
3. ozone

Bit-reproducible: yes

Impact: None

*Files created(SCRIPTS):*

metview/waveddiag/Climana\_data\_retrieve.met waveddiag/Climana\_data\_retrieve\_1lev.met  
waveddiag/Climcoupl\_data\_retrieve.met waveddiag/Climdecad\_data\_retrieve.met waveddiag/Climfc\_  
data\_retrieve.met waveddiag/Climfc\_data\_retrieve\_1lev.met waveddiag/cdfaltmap waveddiag/cdfbadc  
waveddiag/cdfcat waveddiag/cdfcatf waveddiag/cdfcenter waveddiag/cdfclaus waveddiag/cdfcomment  
waveddiag/cdfdb waveddiag/cdfdefint waveddiag/cdfderiv waveddiag/cdfentform waveddiag/cdfentropy  
waveddiag/cdfextr waveddiag/cdffill waveddiag/cdffilter waveddiag/cdfgriv waveddiag/cdfhisto  
waveddiag/cdfinteg waveddiag/cdfinterp waveddiag/cdfinindex waveddiag/cdfisocut waveddiag/cdfj  
waveddiag/cdfjday waveddiag/cdflagr waveddiag/cdflook waveddiag/cdfmath waveddiag/cdfmean  
waveddiag/cdfmerge waveddiag/cdfmr waveddiag/cdfnewent waveddiag/cdfnull waveddiag/cdfocut  
waveddiag/cdforder waveddiag/cdfparams waveddiag/cdfpix waveddiag/cdfpsel waveddiag/cdfrdim  
waveddiag/cdfroll waveddiag/cdfrotate waveddiag/cdfsmooth waveddiag/cdfsplit waveddiag/cdfsst  
waveddiag/cdft waveddiag/cdftable waveddiag/cdfthin waveddiag/cdfthresh waveddiag/cdftrans  
waveddiag/cdftsel waveddiag/cdfuncat waveddiag/cdfuniq waveddiag/cdfvlim waveddiag/cdfwindow  
waveddiag/ecmwf\_call\_pb2candis\_new.sh waveddiag/ecmwf\_collectscript\_runonwkdir\_new.sh  
waveddiag/ecmwf\_concatenate.py waveddiag/ecmwf\_concatenate\_all.py waveddiag/ecmwf\_filter\_  
harmonics.py waveddiag/ecmwf\_filter\_harmonics.pyc waveddiag/ecmwf\_fix\_grid.py waveddiag/ecmwf\_  
fix\_grid.pyc waveddiag/ecmwf\_get\_cin.py waveddiag/ecmwf\_get\_power.py waveddiag/ecmwf\_  
get\_power.pyc waveddiag/ecmwf\_get\_species.py waveddiag/ecmwf\_getdcin.sh waveddiag/ecmwf\_  
make\_smallfiles.sh waveddiag/ecmwf\_mapmaker.py waveddiag/ecmwf\_myfft.py waveddiag/ecmwf\_  
pb2candis\_new.sh waveddiag/ecmwf\_plotregress.py waveddiag/ecmwf\_plotregress.pyc waveddiag/ecmwf\_  
plotwk99.py waveddiag/ecmwf\_plotwk99.pyc waveddiag/ecmwf\_read3dvar.py waveddiag/ecmwf\_  
read3dvar.pyc waveddiag/ecmwf\_readfile.py waveddiag/ecmwf\_readfile.pyc waveddiag/ecmwf\_  
regress.py waveddiag/ecmwf\_rename4ncdump.sh waveddiag/ecmwf\_swap.py waveddiag/ecmwf\_  
swap.pyc waveddiag/ecmwf\_t2m\_latlon.gri waveddiag/ecmwf\_taper.py waveddiag/ecmwf\_taper.pyc  
waveddiag/ecmwf\_tcwv\_latlon.gri waveddiag/ecmwf\_testwave.py waveddiag/ecmwf\_wavefilter.py

```
wavediag/ecmwf_wavefilter.pyc wavediag/ecmwf_wheeler_kiladis_filt.py wavediag/ecmwf_wheeler_kiladis_prep.sh wavediag/ecmwf_wk99_analysis_new.py wavediag/olrget wavediag/pycandis wavediag/pycandis.pyc wavediag/qplot wavediag/uniget wavediag/uniput
```

*Files modified(SCRIPTS):*

```
def/climplot.def fc.def  
metview/climate_obs.met climplot_batch compvar_ens.met eddy_corr.met  
monmeans_clim.met monmeans_clim_batch plot_eddy_corr.met zondia_def_contour  
zondia_seas_icon_batch.met  
sms/climplot.sms
```

## 5 Alessio Bozzo - paab\_CY41R2\_MACC\_AER - BUG-FIX

### Radiation bug-fix and preparation for MACC aerosols

1. revised optical properties for the MACC aerosol.
2. Fixed numerous bugs and inconsistencies.
3. Added external control for aerosol tropospheric background
4. fixed a bug in rrtm\_ecrt\_140gp.F90 introduced in 40r3 with the implementation of the revised RRTM-LW. It only affects the Meteo France configuration.

Bit-reproducible: yes

Impact: None

norm-check ok

*Files modified(IFS):*

```
module/yoerad.F90  
namelist/naerad.nam.h  
phys_dmn/surdi15.F90  
phys_ec/aer_rrtm.F90 radact.F90 su_aerop.F90 su_aerw.F90 suaerv.F90  
phys_radi/rrtm_ecrt_140gp.F90 rrtm_ecrt_140gp_mcica.F90 srtm_srtm_224gp_mcica.F90  
suecrad.F90
```

## 6 Robin Hogan - parr\_CY41R2\_average\_sza - ACTIVE

### Average solar zenith angle

1. Compute cosine of solar zenith angle PMU0 used to compute the incoming solar radiation as an average over the model timestep, rather than a single value at the centre of the timestep. This fixes small amplitude high wavenumber wiggles in incoming solar at TOA that were discussed by Zhou et al. (GRL 2015), but which is only noticeable for long model timesteps.

2. Likewise, compute PMU0 used in radiation scheme as an average over the radiation timestep but only when the sun is above the horizon. This fixes previous problem evident only in long runs when radiation is called every 3 hours, of wavenumber-8 wiggles (amplitude around  $2 \text{ W m}^{-2}$ ) in net solar at TOA (a problem in 41R2), net solar at surface (a problem in 41R1 and probably earlier cycles) and total solar atmospheric absorption (all cycles).
3. Split code controlled by logical LAPPROXSWUPDATE into (a) LMANNERSSWUPDATE controlling Manners et al. (QJ 2009) scheme for improving diurnal cycle of surface solar radiation implemented in radheatn.F90, and (b) LAPPROXSWUPDATE now controlling only coastal solar albedo effects in radintg.F90. Since both are TRUE by default, this change is bit identical with 41R2.
4. Clear-sky solar fluxes are now updated when LMANNERSSWUPDATE is TRUE, not just the total-sky solar fluxes. Clear-sky fluxes are only used diagnostically.

New logicals in NAERAD: (a) LAVERAGESZA: TRUE by default, turns 1 and 2 on, bit-reproducible with 41R2 if set to FALSE; (b) LMANNERSSWUPDATE: TRUE by default, bit reproducible with 41R2 if left as TRUE.

### Testing:

- T255 climate experiments to verify removal of wiggles discussed in 1 above: compare experiment gc21 with control gbf2.
- T639 3-month analysis experiment gc90 compared to Gabor's control gas2, results at file:///scratch/rd/parr/iver/plots/avera\_sza\_41R2/index.html, showing slight cooling and reduction in RMSE of upper stratospheric temperatures, although there is a consequent dipole in the tendency of upper stratospheric geopotential height.
- T1279 analysis experiments gcmw (from Elias's gc1m) and gcn0 (from Elias's gc1h), both are still running.
- Forecast experiment for the same period, gcaw, versus my control, gc91, with no significant change to forecast skill.

*Files created(IFS):* phys\_ec/cos\_sza.F90

*Files modified(IFS):* module/yoerad.F90 yoerip.F90

namelist/naerad.nam.h

phys\_dmn/surdi15.F90

phys\_ec/ec\_phys.F90 ec\_phys\_ad.F90 ec\_phys\_t1.F90 radcfg.F90 radheatn.F90

phys\_radi/suecrad.F90

utility/updtim.F90

## 7 Filip Vana and Marta Janiskova - pafv\_CY41R2\_linradfix - Bug-Fix

### Logical key for simplified radiation

1. Small fix of logical keys for simplified radiation scheme



Bit-reproducible: yes

Impact: None

norm-check ok

*Files modified(IFS):*

phys\_radi/sulwneur.F90

## DATA ASSIMILATION

### Elias Holm - dae\_CY41R2\_EDA\_OPT - ACTIVE

#### Changes needed to run TCo639 EDA

Correct grids when spectral transforms are involved in the EDA post-processing calculation of variances and correlation matrices, and using WJBCONF

In addition there are new climatological B files from 41R1 TL639 EDA's, 54 days giving  $24 \times 24 = 1296$  samples:

- EDA g9qh, 16 datums 2014010506–032818 every 5.5 days.
- EDA gban, 8 datums 2014060406–071218 every 5.5 days.
- EDA g9ss, 30 datums 2014072006–122618 every 5.5 days.

Note 1: Needs to be implemented in 41R2 as well as bug-fixes really. Will only affect those running EDA's, otherwise bit-identical.

Note 2: More optimizations of EDA post-processing are in the pipeline, which may be possible to get in depending on how we progress.

*Files modified(PREPDATA):*

programs/Wavelet\_Filter.F90 sptogp.F90 unbal\_eda.F90 vod2uv.F90

*Files modified(SCRIPTS):*

gen/ens\_errors ens\_errors\_rad ens\_fetch\_fields ens\_stats\_gather ens\_stats\_mem  
fetch\_jb\_fields\_mem ifsmin

### Tomas Kral - das\_CY41R2\_V11 + datk\_SB41R2\_V11\_bugfix - ACTIVE

#### Updates to BUFR2ODB

- Use Sonntag SVP formula in computation of q and RH (contributed by Bruce Ingleby).
- Consolidate initialization of ODB columns across the entire processing chain: BUFR-to-ODB (buf2odb.x), COPE, ODB2-to-ODB1 (odb2\_to\_odb1.x, odb2\_to\_odb1\_ralt.x), IFS, ODB1-to-ODB2.
- Select only distinct levels from high-resolution BUFR TEMP data.

- Introduce wind profiler data TM301001 that were previously ignored due to lack of support in B2O.
- Correctly account for Ps bias corrections that are appended to BUFR files after the operational biases. This only affects research experiments running with LCALLC\_PSBIAS=true.
- Use SYNOP barometer heights instead of station ground heights where available.
- Fix computation of WIGOS AMDAR's derived RH values (used for monitoring).
- Reallocate B2O's internal buffers dynamically to avoid decoding errors caused by excessively large BUFR messages.
- Redefine types of 'report\_event2' and 'datum\_event2' columns from INTEGER to BITFIELD for consistency reasons.
- Account for mixup between flight level and GPS height in TAMDAR's WMO BUFR template.
- Fix bug in B2O's GPSRO batching algorithm that causes failure for certain input data.
- Avoid recreation of IOASSIGN files whenever possible. This reduces the runtime of resubmitted B2O tasks by factor of 2.

### **Testing:**

winter experiment: gcz0

winter control: gbrb

#### *Files created(SCRIPTS):*

gen/cope.ksh

#### *Files modified(IFS):*

module/yommkodb.F90

namelist/nammkodb.nam.h

obs\_preproc/ascatin.F90 conventional\_ob.F90 defrun.F90 ersin.F90 geosrin.F90 kscatin.F90

nscatin.F90 oscatin.F90 prlmchk.F90 qscatin.F90 radlcin.F90 reo3sin.F90 satamin.F90

satob\_ob.F90 satobin.F90

#### *Files modified(ODB):*

bufr2odb/b2o\_access.F90 b2o\_amend.F90 b2o\_convert.F90 b2o\_convert\_aircraft.F90

b2o\_convert\_metar.F90 b2o\_convert\_radio\_lat\_long.F90 b2o\_convert\_synop\_land.F90

b2o\_convert\_synop\_ship.F90 b2o\_convert\_temp\_hires.F90

b2o\_convert\_windprofiler.F90 b2o\_decode.F90 b2o\_log.F90 b2o\_table.F90

module/b2o\_internal.F90 odbmap\_reporttype.F90

#### *Files modified(SCRIPTS):*

def/inc\_fam.py inc\_obs.py

gen/bufr2odb ifstraj mkabs\_odbtools odb2odb1

sms/libcope.sms

sms\_an/bufr2odb.sms cope\_obsgroup.sms

#### *Files deleted(IFS):*

obs\_preproc/airepbe.F90 airepin.F90 awprfin.F90 dribube.F90 dribuin.F90 dwlin.F90

ewprfin.F90 lndsyin.F90 metarin.F90 paobbe.F90 paobin.F90 pgpsin.F90 pilotbe.F90 pilotin.F90

repsel.F90 shipin.F90 synopbe.F90 synopin.F90 tempbe.F90 tempin.F90

# SATELLITE

**Niels Bormann - str\_CY41R2\_for\_CY42R1 - ACTIVE**

## **Bug-fix in pre-screening script for radiances, more flexible reading of EDA-spread files**

The change to the pre1crad\_screen script fixes an unintended behaviour for non-standard settings of the prepIFS switches to activate certain satellite data. Previously, data from CrIS, ATMS, and Chinese sounding instruments were excluded if the prepIFS switches LAIRS, LATOVS, and LIASI are switched off together, regardless of the setting of the LCRIS, LATMS, etc switches. This is now corrected. This bug only affects certain experiments that use the prepIFS switches to disable certain observing systems, and it has no effect for the default settings.

The change to inifger.F90 allows more flexible reading of the EDA spread files used for diagnostic purposes for observations. Previously, the spread files were not read if the parameters or levels were not the same as for the background error files also read in this routine. The change has no effect in 41R2, as the provided files are consistent, in 4DVAR as well as in the EDA. This was not the case in 41R1, where different parameters were provided in the EDA, and the EDA spread files were hence not read.

*Files modified(IFS):*

obs\_preproc/inifger.F90

*Files modified(SCRIPTS):*

gen/pre1crad\_screen

**Reima Eresmaa - ste\_CY41R2\_iasi\_bc\_fix**

## **Bug-fix in the setup of VarBC on window channels of IASI**

It is not a bit-reproducible change although there is no major meteorological impact expected from the change. The change is being tested currently in experiment gcmv (control gcjn), it has completed 35 days by now and there are no signs of any significant impact so far.

*Files modified(IFS):*

module/varbc\_rad.F90

# MPS

**Kristian Mogensen - ne1\_CY41R2\_MPS\_forCY42R1**

## **Contributions from the Marine Prediction Section**

New options for dealing with OSTIA sea ice to fix the Baltic problem. Ice related fix for WAM restarts. Fix for IFS restarts with LIM2 seaice model active. Bugfix for uninitialized lake fields causing a crash in SV computations. Make IFS IO server compatible with NEMO IO server. Bugfix for interpolation of ocean fields to IFS in coupled mode. Pass some additional IFS fields to NEMO in coupled mode. NetCDF4 options in NEMO. Dr Hook in NEMO (on in coupled, off in uncoupled at the moment) RCIMIN as a namelist parameter in naephy. NEMOVAR developments towards ORAS5. Fix to allow slightly maximum WAM time steps

(needed when coupled to IFS using certain Tco configurations) Bug fix for analysis departure written to ODB  
Other minor WAM fixes.

### **Testing:**

Analysis/forecast experiments at T639: gctf, reference is gctg based on dag\_CY41R2.esuite

Forecast only experiment at Tco399 : gct5 reference is gcp2 based on dag\_CY41R2.esuite (improve overall run time because WAM can use a slightly longer time step)

#### *Files created(IFS):*

nemo/ininemoio2.F90 nemoaddflds.F90  
phys\_ec/nemoaddflds\_layer.F90

#### *Files created(NEMO):*

NEMOGCM/NEMO/OPATAM\_SRC/TRA/traadv\_tvd\_tam.F90 NEMO/OPA\_SRC/TAM/undiff.F90  
NEMO/OPA\_SRC/modhookdummy.F90  
coupled/src/nemointerface/nemogcmcoup\_init\_ioserver\_2.F90  
src/nemointerface/nemogcmcoup\_update\_add.F90  
testscripts/namelist/namelist.nemo.ORCA025\_Z75  
namelist/namelist.nemo.ORCA1\_Z42 namelist/namelist.nemo.ORCA1\_Z46  
namelist/namelist.nemo.ORCA1\_Z75 namelist/namelist.nemo.OUTPUT  
namelist/namelist\_ice.nemo.ORCA025 namelist/namelist\_ice.nemo.ORCA1  
tools/interpolate/gaussinfo.F90 interpolate/waminfo.F90 ncverify/Makefile ncverify/config  
ncverify/ncfile.F90 ncverify/nctools.F90 ncverify/ncverify.F90 ncverify/ncverifymod.F90  
ncverify/ncverifyparam.F90 obstools/fbqccconvert.F90 obstools/ghrsst2fb.F90 obstools/ghrsstdata

#### *Files created(SCRIPTS):*

nemo/bistats check\_exp check\_expr nemo\_var.ksh nemostats.ksh npertgen\_v3  
online\_ensclim.h online\_var.h plot\_settings plot\_var set\_config set\_dirs  
set\_names  
sms\_nemo/ncomb\_gzip\_restart.sms ndaily1x1.sms nens\_stats.sms ntime\_stats.sms nvarstats.sms

#### *Files modified(IFS):*

control/reresf.F90  
fullpos/wrmlfp.F90  
io\_serv/io\_serv\_init.F90 io\_serv\_suiosctmpl.F90  
module/yoephy.F90 yommcc.F90  
namelist/naephy.nam.h nammcc.nam.h  
nemo/couplnemo.F90 ininemo.F90 ininemoio.F90  
ocean/sugco0.F90  
phys\_ec/callpar.F90 suphec.F90  
programs/io\_serv.F90 master.F90  
setup/su0phy.F90 sumcc.F90 sumcclag.F90

#### *Files modified(NEMO):*

Lots of files

#### *Files modified(SCRIPTS):*

def/eps\_nemo.def fc.def gen.def opa.def  
gen/libsgen mkabs\_an mkabs\_fc mkabs\_wam sstana

nemo/combine\_fdbk etc.  
oce/checkrestarts  
sms/libnemocoup.sms links.sms model.sms modeleps\_tidy.sms nemo\_tools.sms  
p4setup.sms  
sms\_nemo/intermake.sms etc.  
wav/wave\_set\_tstep

**Files modified(SSA):**

module/yomsst.F90  
namelist/namssa.nam.h  
sub/ice\_analysis.F90 inisst.F90 ssa.F90 sst\_analysis.F90  
util/setcomssa.F90

**Files modified(SURF):**

external/susurf.F90  
interface/susurf.h  
module/sussoil\_mod.F90 susurf\_ctl\_mod.F90

**Files modified(WAM):**

Alt/Makefile.wam.ibm inmarsb.F  
Buoy/buoydecode.F cbm2mppt\_scatter.F get\_BUO\_from\_CEFAS\_data.F  
mc\_analysis\_rearrng\_ym.F mc\_analysis\_rearrng\_ym\_tz.F mc\_cbsdms\_stats.F  
mc\_ecmwf\_rearrng.F mc\_xyplot.F plotmap.F qc buoy.F shipdecode.F uipcs.F  
Wam\_oper/Makefile.wam.ibm altas.F90 chief.F difdate.F getspec.F initmdl.F  
initnemocpl.F mpdecomp.F outcom.F outgrid.F preproc.F runwam.F unwam.F90  
wamendnemoio.F wamininemoio.F wamodel.F  
module/Makefile.wam.ibm wav\_netcdf.F90 yowwind.F

**Files deleted(NEMO):**

Lots of files

## **Saleh Abdalla - waa\_CY41R2\_jason3**

### **Preparation for Jason-3 Wave Data Assimilation**

Technical changes needed for the assimilation of Jason-3 altimeter wave data. (Actual assimilation will be realised towards the end of the year).

**Testing:**

Analysis/forecast experiments at T159:

gd14 (reference that uses ne1\_CY41R2\_MPS\_forCY42R1)

gd11 (experiment that uses waa\_CY41R2\_jason3)

Bit identical after 10-day forecast.

**Files modified(SCRIPTS):**

gen/fetchobs preobs  
wav/wave\_data\_dates wave\_getalt wave\_getobs

**Files modified(WAM):**

```
Alt/alt_hist_prep.F plot_rfl_file.F pltetr.F urabu5.F uraetr.F urapfs.F urapre.F
uraqcm.F uraques.F uraqrdr.F uraqwf.F urasor.F
Wam_oper/rfl4wam.F90
module/yowaltas.F
```

## VARBC

### Hans Hersbach - er9\_CY41R2\_varbc

#### Reorganization VARBC, enabling VARBC for radiosonde temperature and improved ingestion of ODB2 data for reanalysis

- The VARBC file has been growing steadily over time and is now in the order of 100MByte. It is in ASCII, which has to be read in every single ifstraj and ifsmin job. One major reason for this size is the non-ideal storage of predictor statistics. That has now been improved and as a result the VARBC.cycle file has shrunk by about a factor of 15. Basically now only those values for the predictor statistics are stored that are actually used (for preconditioning) by the specific bias groups. Inside IFS now space is also only reserved for statistics that are actually needed; so things also scale much better here when the total number of predictors is increased. This development is bit identical with standard 41r2.
- An option to forget bias groups in case they've been inactive for a - via the namelist specified - too long period. If switched on, this will enable self cleaning of the VARBC cycle file over time. Since currently no group is ever forgotten in the VARBC cycle file, the number of groups increases over time. Especially with the advent of VARBC of aircraft data this number will grow quickly and sooner or later maximum values as set in IFS will be exceeded. By default this option is not active, in which case results are bit identical to standard 41r2. For the ERA-20C reanalysis (with over 2 Million accumulated bias groups) such an option was really essential.
- I've added the option to apply temperature bias corrections for radiosondes (together with Marco Milan, Uni Vienna). This required a bit of rewiring in hop\*.F90 since for radiosondes predictors vary within reports; something that is explicitly assumed to be not the case for standard 41r2. By default this is switched off and things are, again, bit identical with standard 41r2.
- Finally, I've also updated some routines and scripts that enable the ingestion of ODB2 data.

This is very useful for reanalysis where we have ingested several datasets in ODB2 rather than in BUFR. In the operational setting, none of this is used.

#### Testing:

Tests have been done on the basis of standard T639 CY42R1 experiments, two days (20140601-20140602)

- gclx; control, BRANCH= (i.e., pure 41r2)

- gczz, gd1e; test, BRANCH=er9\_CY41R2\_varbc

Since the reorganization of the predictor statistics inside IFS required some significant code changes for LRE-PRO4DVAR=true, tested for this configuration too.

*Files created(IFS):*

module/varbc\_rsonde.F90

**Files created(ODB):**

ddl.CCMA/getrsondeid.sql varbc\_rsonde\_robhdr.sql varbc\_rsonde\_roboddy.sql  
ddl.ECMA/getrsondeid.sql varbc\_rsonde\_robhdr.sql varbc\_rsonde\_roboddy.sql  
ddl/getrsondeid.sql varbc\_rsonde\_robhdr.sql varbc\_rsonde\_roboddy.sql  
tools/Convert\_varbcfile.F90

**Files modified(IFS):**

control/cdsta.F90  
module/varbc\_eval.F90 varbc\_pred.F90 varbc\_setup.F90 varbc\_table.F90  
mwave/mwave\_emis.F90 mwave\_obsop.F90 mwave\_obsop\_ad.F90 mwave\_obsop\_tl.F90  
op\_obs/hop.F90 hopad.F90 hoptl.F90 hretr.F90  
programs/merge\_varbc.F90  
var/cain.F90 cainad.F90 cainin.F90 caininad.F90 congrad.F90 cvar2.F90 cvar2ad.F90  
cvar2in.F90 cvar2inad.F90 cvarbc.F90 cvarbcad.F90 cvarbcin.F90 cvarbcinad.F90 fjvarbc.F90  
suscal.F90 svvarbc.F90 taskob.F90

**Files modified(ODB):**

cma2odb/ctxinitdb.F90  
module/odb2.F90 report\_template.F90  
tools/Odb2ifsreports\_era.F90

**Files modified(SCRIPTS):**

def/inc\_fam.py  
era/varbc\_merge\_sort.py  
gen/fetchmarsodb\_era getini ifsmin ifstraj mkabs\_odbtools

## AEOLUS

### Michael Rennie - da7\_CY41R2\_Apr23\_aeol\_L2Bv\_2\_20\_plus - BR

#### Aeolus L2B/C processing and L2/Met PF scripting changes

An update of the aeolus project code i.e. Aeolus L2B/C processing software, to a version 2.20 + some extra minor changes (compatible with L1B v6.04 files). Functional Aeolus L2/Met PF in ec-flow.

SCRIPTS: Improvements of Aeolus L2/Met PF scripts e.g. warning emails, tidying.

AEOLUS: Update to v2.20 + some extra modifications.

#### Testing:

A bit-reproducibility test was passed with Aeolus switched "off". 3 cycles 2014/02/[01 and 02]

Control: da7/gcom, T639, LWDA, CY41R2 standard

Experiment: da7/gcol, T639, LWDA, da7\_CY41R2\_Apr23\_aeol\_L2Bv\_2\_20\_plus

N.B. These tests were performed on 03/06/15.

Have also successfully tested Aeolus switched "on" i.e. the L2B/C processing and Aeolus assimilation works

(using a L1B test dataset provided by ESA).

*Files modified(SCRIPTS):*

```
def/aeolus.py gen/L1B_gtt2odb2 aeolus_auxmet_odb aeolus_l2b_parallel
aeolus_l2b_prepare aeolus_l2b_tidy aeolus_l2c fetch_L1B_files fetch_L2BP_inputs
fetchorbpre gtt
```

*Files modified(AEOLUS):*

Lots of files

## ODB

### **Peter Lean - dipl\_CY41R2\_odb\_bit\_repro\_for\_42r1 - BR**

#### **Package of minor bit-reproducible ODB upgrades and bug fixes**

A package of bit-reproducible minor upgrades and bug fixes for ODB. The changes include a modification to allow the different stages of 4dvar to be run on a different number of PEs from the first trajectory. The odbsql script is updated to reflect changes made in the centrally installed odb module.

A bug which caused the ioassign file to be read by every MPI task is also fixed; now the ioassign file is only read by a single task and broadcast to all other tasks which will help reduce the load on Lustre.

#### **Testing:**

gcwv: test

gcxq: control

Bit-compares after 10 days.

*Files modified(ODB):*

```
aux/ioassign_read.c
cma2odb/opendb.F90
module/odbshared.F90
scripts/odbsql
tools/Create_odb.F90 Merge_gmi_swaths.F90
```

### **Peter Lean - dipl\_CY41R2\_poolmask\_switchoff - BR**

#### **Optimisation to reduce disk and memory usage by ODB**

Optimization to reduce memory and disk usage from duplicated data in the "poolmask" table. The poolmask table was originally introduced to store a global inventory of the observations in the database. This data was duplicated in each ODB pool. The volume of data in the poolmask table therefore increases linearly with the number of pools. With the resolution upgrade the number of PEs (and ODB pools) becomes so large that the volume of data in the poolmask data becomes larger than the volume of observations in the entire database. The poolmask table is no longer needed and so this branch turns it off by default and also modifies the one section of code in IFS which used it.



In typical research experiments, the size of the ECMA is reduced from 30GB to 26GB. In a possible resolution upgrade configuration the ECMA size is reduced from 83GB to 26GB.

#### **Testing:**

gcn5 - test

gcmo - control (vanilla 41r2)

Results bit-compare after 10 days. Sizes of ECMA and CCMA reduced as expected.

#### *Files modified(ODB):*

cma2odb/matchupdb.F90

ddl/matchup\_sensorlist.sql

#### *Files modified(SCRIPTS):*

gen/ifsvar

### **Peter Lean - dipl\_CY41R2\_dca\_ioassign - BR**

#### **Optimisation to save time in creation of ODB ioassign file**

Optimisation for the ODB ioassign file related to the dca-index files used by odbsql. The main impact is that substantially less time is spent in the scripts in tasks that setup ODBs, leading to typical savings of around 60s in the first trajectory and about 30s in each bufr2odb task.

Previously, the ioassign file required one line for each of the hundreds of ODB tables. The source code changes allow this to be reduced to a single line template for all tables.

#### **Testing:**

gcqi - test

gcmo - control (vanilla 41r2)

bit-compares after 10 days. Output ODBs are identical. Substantially less time spent in scripts in first trajectory and bufr2odb tasks.

#### *Files modified(ODB):*

aux/iogetattr.c iostrdup.c

include/iostuff.h

#### *Files modified(SCRIPTS):*

gen/create\_ioassign

### **Peter Lean - NVNUMB script - BR**

#### **NVNUMB replacement by python script**

Currently, three separate codes are used to describe observed variables in IFS; varno, nvnumb and clv. This duplication is unnecessary (varno and nvnumb have 1:1 mappings). This python script introduces a new varno module and replaces existing NVNUMB codes where possible.

# OOPS

Alan Geer - stg\_CY41R2\_pre.oops.nojb - BR

**Pre-OOPS cleaning of the observation operator. Much more cleaning is required, but this is a starting point**

1. The GOM\_PLUS module and derived type have been introduced. They replace a large number of arrays that were previously used to hold model data at observation locations. This encapsulates the transfer of model data into the observation operator. The preint\*.F90 routines have been deleted and replaced by a call to GOM\_PLUS\_CREATE.
2. Initial reorganisation of the observation operator code (direct only): Radiance operators have their own subroutine obsop\_rad.F90, taking code moved from hop.F90, and in future other operators will be encapsulated too. VarBC code in hop.F90 has been grouped into one place in preparation for the encapsulation of VarBC. The old "varno" loop around which hop is based is in the process of being removed and will be implemented internally in the few observation operators that require it. The output of new observation operators is in ZHOFX space, not ZXPP.
3. Other cleaning:
  - Mode-based bias correction has been removed
  - The distinction between KDLEN and ILEN has been removed so there will be no padding at the end of observation-space arrays - this padding was needed for supercomputer architectures of a previous century.
  - Removal of code for calling RTTOV on coefficient levels, because RTTOV does vertical interpolation internally now
  - Removed TSCV (an unused skin T control variable). All use TOVSCV instead now. Note that TSCV was not, in the end, removed from control variable code, as it was not bit reproducible to do so.
  - Removed the possibility of using "NOTVAR" to turn off certain observations in the data assimilation. There are many other ways to do this, e.g. blacklist.

## Testing:

gd3o: experiment

gd3y: control

Bit-compares after 2 cycles

Further pre-OOPS cleaning will come as separate branches, including one to remove the use of NVNUMB.

### *Files created(IFS):*

module/gom\_plus.F90

op\_obs/gems\_profs.F90 gems\_profs\_dealloc.F90 map\_varno\_to\_nvar.F90 obsop\_rad.F90 obsop\_varno\_subset.F90

### *Files modified(IFS):*

control/cnt1.F90  
module/gom\_mod.F90 sats\_mix.F90 varbc\_airep.F90 varbc\_allsky.F90 varbc\_eval.F90  
varbc\_gbrad.F90 varbc\_rad.F90 varbc\_setup.F90 varbc\_sfcobs.F90 varbc\_tcwv.F90  
varbc\_to3.F90  
mwave/mwave\_wrapper.F90  
namelist/namsats.nam.h  
obs\_preproc/sugoms.F90  
op\_obs/bgobs.F90 hdepart.F90 hjo.F90 hop.F90 hopad.F90 hoptl.F90 hradp\_ml.F90  
hretr.F90 hretr\_aeolus.F90 hvnmtlt.F90 meanuv\_average.F90 meanuv\_weights.F90  
radtr\_ml.F90  
phys\_dmn/mts\_phys.F90  
pp\_obs/ppobsa.F90 ppobsaad.F90 ppobsatl.F90  
var/rtsetup.F90 taskob.F90 taskobad.F90 taskobt1.F90

***Files modified(SATRAD):***

interface/rttvi.h  
programs/calc\_radiance\_fields.F90 gensatim.F90  
rttov/ifs/phrtsetup.F90 ifs/rttvi.F90

***Files deleted(IFS):***

op\_obs/hradp.F90 hradpad.F90 hradptl.F90 preint.F90 preintad.F90 preintr.F90 preintrad.F90  
preintrtl.F90 preints.F90 preintsad.F90 preintstl.F90 preintttl.F90 preintuv.F90 preintuvad.F90  
preintuvtl.F90 radtr.F90 radtrad.F90 radtrtl.F90

***Files deleted(ODB):***

ddl/ECMA/varbc\_mode\_hist\_robhdr.sql varbc\_mode\_hist\_robbody.sql  
ddl/varbc\_mode\_hist\_robhdr.sql varbc\_mode\_hist\_robbody.sql

## ESUITE

### Gabor Radnoti - dag\_CY41R2\_esuite -ACTIVE

#### Esuite updates to CY41R2

**Testing:**

***Files modified(IFS):***

module/surface\_fields\_mix.F90 testvar\_mix.F90 varbc\_setup.F90  
phys\_ec/claervis.F90  
setup/su0phy.F90

***Files modified(OBSTAT):***

module/dataqc.F90 obsdata.F90  
src/iniitemloc.F90 mpsoft.F90 updsoft.F90

***Files modified(SCRIPTS):***

build/Makefile Makefile.root.ifs arch/Makefile.in.cray\_XC30\_cce  
perl/depend\_casefix.pl  
def/an.def fsobs.def gen.def inc\_an.py inc\_libs.py

gen/anml check\_lakeini create\_ioassign get\_tm5\_initcond getgrbe getini ifsvar  
mkabs\_odbttools mkabs\_satim model modeleps\_nemo modelsv odb2odb1  
p4\_allcompilefiles p4\_mklib  
sms/p4setup.sms  
wav/prep\_wave wave\_getrst

*Files modified(WAM):*

Wam\_oper/sep3tr.F sepwisw.F