

# RESEARCH DEPARTMENT MEMORANDUM



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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: July 9, 2014 File: RD14-241

**Subject: IFS Memorandum Cycle CY40R3**

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Cycle 40r3 was created in May-June 2014. Cycle 40r3 contains many scientific changes based on Cycle 40r1 and the interim Cycle 40r2. Cycle 40r2 contained mainly technical modifications to run on Cray, more OOPS-IFS refactoring and many Satellite contributions ready to be enabled in Cycle 40r3 and also RTTOV-11. Cycle 40r2 has been to France to merge with Cycle 40t1 and will become Cycle 41. Cycle 40r3 will be merged with Cycle 41 to create Cycle 41r1 which will be the basis of the next scientific cycle 41r2.

*Contributors:*

Alan Geer, Alessio Bozzo, Anton Beljaars, Axel Bonet, Bruce Ingleby,  
Christian Kuhnlein, Cristina Lupu, Deborah Salmond, Elias Holm, Emanuel Dutra, Filip Vana,  
Frédéric Vitart, Gabor Radnoti, George Mozdzyński, Gianpaolo Balsamo, Giovanna De Chiara,  
Glenn Carver, Hans Hersbach, Hao Zuo, Heather Lawrence, Irina Sandu, Jean Bidlot,  
Joaquin Munoz Sabater, John Hague, Kirsti Salonen, Kristian Mogensen,  
Magdalena Alonso Balmaseda, Maike Ahlgrimm, Marta Janisková, Martin Leutbecher,  
Massimo Bonavita, Mats Hamrud, Michael Rennie, Michail Diamantakis, Mohamed Dahoui,  
Niels Bormann, Nils Wedi, Nouredine Semane, Patricia de Rosnay, Paul Poli, Paul Burton,  
Peter Bechtold, Peter Janssen, Peter Lean, Peter Towers, Philippe Lopez, Pirkka Ollinaho,  
Reima Eresmaa, Richard Engelin, Richard Forbes, Saleh Abdalla, Sarah Keeley,  
Sarah-Jane Lock, Sean Healy, Simon Lang, Souhail Boussetta, Sylvie Malardel, Tim Stockdale,  
Tomas Kral, Tomas Wilhelmsson, Tony McNally, Yannick Trémolet

*Again the merge was done incrementally testing each version:*

**Base version: das\_CY40R2\_NEW**

das\_CY40R1\_osuite\_cray

dag\_SB40R1\_source\_cray\_esuite\_v1, dag\_CY40R1\_scripts\_cray\_esuite\_v1

nat\_SB40R1\_Fullpos\_2

**V1: das\_CY40R2\_NEW\_V1 (Bit-reproducible branches)**

da7\_SB40R1\_aeolus\_proc\_cray\_osuite

nar\_SB40R1\_ENKF\_for\_CY40R3

nas\_CY40R1\_NA\_NH\_SW

mo3\_CY40R1\_40R3\_obstat

mpm\_CY40R1\_iostream, mpm\_CY40R1\_suprocp

**V2: das\_CY40R2\_NEW\_V2 (Satellite)**

stg\_CY40R2\_sat\_section\_for\_40r3\_6

str\_CY40R2\_for\_CY40R3

**V3: das\_CY40R2\_NEW\_V3 (Predictability)**

wab\_SB40R1\_PRD\_all

**V4: das\_CY40R2\_NEW\_V4 (Physics and Numerics)**

pafv\_SB40R1\_MDcy40r3\_final\_cray\_osuite

**V5: das\_CY40R2\_NEW\_V5 (Surface Analysis)**

dap\_SB40R1\_dap\_SB40R1\_ssa\_mergedall\_for\_40r3

**V6: das\_CY40R2\_NEW\_V6 (MACC, OOPS and Reanalysis)**

stj\_CY40R2\_MACC\_40r3\_A\_JF

day\_CY40R2\_from\_40r1

er9\_SB40R1\_ingest\_odb2\_with\_cray\_osuite

erc\_CY40R1\_debug\_gps

**V7: das\_CY40R2\_NEW\_V7 (Data Assimilation)**

dae\_SB40R1\_DAcy40r3\_v2

dipl\_CY40R2\_GMI\_for\_40r3

**V8: das\_CY40R2\_NEW\_V8 (Final branches)**

nel\_SB40R2\_NEW\_V7\_update

nat\_CY40R2\_Fullpos\_2

ste\_CY40R1\_osuite\_cray\_add\_cris\_o3\_ovc

stg\_CY40R2\_sat\_for40r3\_bugfix -f mwave\_obsop\_tl.F90

dap\_SB40R1\_dap\_SB40R1\_ssa\_mergedall\_for\_40r3

dae\_SB40R1\_DAcy40r3\_v3

nas\_CY40R1\_grid\_FIXES

da0j\_CY40R1\_Perf2

nat\_SB40R2\_misc\_grib\_suff\_on\_V8

**V9: das\_CY40R2\_NEW\_V9 (COPE)**

datk\_SB40R2\_cope\_release

# NUMERICS and PHYSICS

Sylvie Malardel, George Mozdzynski, Glenn Carver, Christian Kuhnlein, Nils Wedi - nas.-  
CY40R1\_NA\_NH\_SW - BR

## Optimizations, cleaning and bug fixes

- Optimization/cleaning for NH (linalg/si\_mxptco.F90, diab/sidd.F90 sigam.F90 siptp.F90 siseve.F90 sitnu.F90 spnhsi.F90, control/spcm.F90, setup/sudyn.F90),
- Extension of matrix norm computation to general matrices (external/linalg/minv.F90)
- Bug fixes for SW diab/cpg2.F90 dia/wrmlppg.F90 setup/su0yomb.F90,suspecb.F90
- Fix for grib outputs at very high resolution (dia/preset\_grib\_template.F90)

### *Files modified(ALGOR):*

external/linalg/minv.F90 linalg/si\_mxptco.F90 interface/si\_mxptco.h

### *Files modified(IFS):*

diab/cpg2.F90 sidd.F90 sigam.F90 siptp.F90 siseve.F90 sitnu.F90 spnhsi.F90  
control/spcm.F90  
dia/preset\_grib\_template.F90 wrmlppg.F90 setup/su0yomb.F90 sudyn.F90 suspecb.F90

## Filip Vana - pafv\_CY40R1\_MDcy40r3\_final - ACTIVE

### Merged contribution from Physics and Numerics groups

**Expts:** Tested incrementally for pafv\_CY40R1\_MDcy40r3\_V0 - pafv\_CY40R1\_MDcy40r3\_V10

Final branch tests:

g3ss - summer T511 Cray experiment (to be compared with g3cn)

g3sr - winter T511 Cray experiment (to be compared with g39m)

g3su - winter T1279 Cray experiment (to be compared with g1hr)

g2tv - climate T255

See: <https://software.ecmwf.int/wiki/display/IFS/Physics+and+numerics+testing>

## Filip Vana - pafv\_CY40R1\_start - BR

### Various bugfixes for passive code or testing configurations and optimizations of callpar

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

control/gp\_model.F90 control/testli.F90 control/testlievol.F90  
module/gfl\_subs\_mod.F90 phys\_ec/callpar.F90 phys\_ec/callparad.F90  
phys\_ec/convection\_s\_layer.F90 phys\_ec/cucalln2.F90 phys\_ec/phys\_ad.F90  
phys\_ec/phys\_nl.F90 phys\_ec/sltend.F90 phys\_ec/vdfouter.F90

## Filip Vana - pafv\_CY40R1\_newslhd - BR

### New development for variable accuracy SL interpolation scheme

Various new options were added including separate triggering function for momentum and heat variables and possibility to compute triggering functions along pressure surfaces. Those modifications are only passive affecting no operational IFS configuration. The only active modification is the small fix to the spectral horizontal diffusion (HD) vertical profile. The new code ensures that HD activity is not decreasing with the height.

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

```
adiab/cpg5.F90 cpg_dyn.F90 cpg_dyn_tl.F90 gp_kappa.F90 gp_kappaad.F90
gp_kappat.F90 gp_kappatad.F90 gp_kappatl.F90 gp_kappattl.F90 lacdynad.F90
lacdyntl.F90 laitre_gfl.F90 laitre_gmv.F90 laitre_gmv_ad.F90 laitre_gmv_tl.F90
lapinea.F90 lapinea5.F90 lapineaad.F90 lapineatl.F90 larcin2.F90 larcin2ad.F90
larcin2tl.F90 larcina.F90 larcinaad.F90 larcinatl.F90 larcinb.F90 larcinbad.F90
larcinbtl.F90 larcinha.F90 larcinhb.F90 larmes.F90 larmes5.F90 larmesad.F90
larmestl.F90 latte_kappa.F90 latte_kappaad.F90 latte_kappatl.F90 tropo_tep.F90
interpol/lascaw.F90 lascaw_cla.F90 lascaw_cla_ad.F90 lascaw_cla_tl.F90
lascaw_clo.F90 lascaw_clo_ad.F90 lascaw_clo_tl.F90 lascaw_vintw.F90
lascaw_vintw_ad.F90 lascaw_vintw_tl.F90 lascawad.F90 lascawtl.F90 suvsleta.F90
module/intdyn_mod.F90 ptrslb2.F90 traj_semilag_mod.F90 yomdyn.F90 yomdyna.F90
namelist/namdyn.nam.h namdyna.nam.h op_obs/slinter.F90 slinterad.F90 setup/sudyn.F90
sudyna.F90 suhdf_ec.F90 surcordi_th.F90 suslb.F90
```

## Michail Diamantakis - namd\_CY40R1\_mods\_to\_40r2 - ACTIVE

### Modified SETTLS scheme for improved Sudden Stratospheric Warming (SSW) forecasts and various passive code enhancements/improvements for interpolation and mass fixers

**Expts: g3kv (fc T1279), g1r3 (an T511), g2un (an T511, this exp does not have an SSW episode)**

Active part: Modified SETTLS (trajectory) scheme for improved SSW forecasts.

During SSWs noisy flow fields occur in forecasts resulting to incorrect temperature forecasts at heights typically 10hPa and above. This improved scheme works by identifying gridpoints that are prone to noise and applies there a non-extrapolatory scheme. It captures better the warming and therefore 4DVAR forecast to observation departures and data rejections (from satellite instruments) reduce. As a result forecast skill increases in that part of the stratosphere.

For reproducibility add in namelist NAMDYN: LSETTLSTF=false

Further (passive) changes:

- A modified quasi-monotone interpolation limiter for GFL (Bermejo and Staniforth). The modification is to apply the limiter in all three directions at the end of the interpolation rather than at each direction separately. The benefit of it is that when applied to specific humidity it reduces the cold bias error of long range forecasts (climate runs).
- Changes/improvements in mass fixers for CO<sub>2</sub>, CH<sub>4</sub> simulations in MACC.
- Gridpoint mass fixer for pressure. This is an optional alternative to the standard spectral mass fixer and can enforce global mass conservation to near machine precision. The latter can be done with a more

advanced (but also more expensive) algorithm.

- Global mass diagnostics for total air mass and tracers. This is extra diagnostic information which can be useful for model developers interested to see a global mass conservation error analysis per timestep. It does not offer the comprehensive functionality of DDH but is simple, concise and can be applied to all advected GFL fields.

*Files created(IFS):*

adiab/gpmasscor.F90  
control/gmassdiag.F90 pfixer.F90  
interpol/laqmlimiter.F90

*Files modified(IFS):*

adiab/cpg.F90 cpg5.F90 cpg\_drv.F90 cpg\_drv\_ad.F90 cpg\_drv\_tl.F90 cpg\_dyn.F90  
cpg\_dyn\_ad.F90 cpg\_dyn\_tl.F90 cpgad.F90 cpgtl.F90 lacdyn.F90 lacdynad.F90  
lacdyntl.F90 laitrgfl.F90 lavent.F90 laventad.F90 laventtl.F90  
climate/cormassdry.F90  
control/cnt4.F90 gp\_model.F90 jmgfixer.F90 qmfixer.F90 qmfixer2.F90 spcm.F90  
trmfixers.F90  
module/ptrslb2.F90 traj\_semilag\_mod.F90 type\_gfls.F90 yom\_ygfl.F90 yomdimv.F90  
yomdyn.F90 yommass.F90  
namelist/namdim.nam.h namdyn.nam.h namgfl.nam.h  
setup/sualdynb.F90 sucslint.F90 suctrl\_gflattr.F90 sudefo\_gflattr.F90 sudim1.F90  
sudyn.F90 sugfl1.F90 sugfl3.F90 suslb.F90  
utility/deallo.F90

**Nils Wedi, Sylvie Malardel, Patricia de Rosnay, Gianpaolo Balsamo - naw\_CY40R1\_climate - new - not BR**

**Introduction of new climate fields (all resolutions), bugfix to sea-ice + sst, check in surf on consistent tile fractions**

See: <https://software.ecmwf.int/wiki/display/IFS/How+to+use+the+new+climate+fields>

*Files modified(IFS):*

climate/updclie.F90

*Files modified(SATRAD):*

programs/bufr\_screen\_nexrad.F90

*Files modified(SCRIPTS):*

gen/gaussgr mknam\_fp

*Files modified(SSA):*

sub/inisst.F90

*Files modified(SURF):*

module/surfbc\_ctl\_mod.F90

## Nils Wedi - naw\_CY40R1\_cubic - not BR

### RTAU

In order to scale the RTAU parameter in the convection parameterization the ratio 799/NSMAX was used where NSMAX is the spectral truncation. In preparation for spectral truncation choices other than linear, this has been changed to use the number of latitudes (NDGLG) in the ratio as 800/NDGLG. It is argued that it is not NSMAX but the gridpoint distance that is relevant.

For the linear grid NSMAX=NDGLG-1 with no significant change, but for the cubic grid for example NSMAX = NDGLG/2 - 1.”

*Files modified(IFS):*

phys\_ec/sucumf.F90 sucumf2.F90 suphec.F90

## Irina Sandu - pa3\_CY40R1\_skin\_cond - not BR

### Skin conductivity table

#### Expts:

Climate : g22f vs control fycq

T511 an : g1aa vs 40r1 control fysy (Feb 2012)

T511 an : g0uj vs 40r1 control fyio (Jul 2013)

For Iver package results, see:

file:///scratch/rd/pa3/40R3\_PHYS/Feb12\_cy40r1\_skin/index.html file:///scratch/rd/pa3/40R3\_PHYS/Jul13\_cy40r1\_skin/index.html

This change concerns the passage of the skin conductivity and the fraction of net-shortwave radiation that is transmitted to the top soil or snow layer (parameters in table 8.2 of IFS doc) from tiles to vegetation types. These parameters are now treated like the other parameters describing the surface atmosphere coupling, i.e. roughness length etc from table 8.1. The values of the skin conductivity and radiation fraction obtained for each tile with the new approach are identical to ones we had before (table 8.2). The impact is small, it is basically just noise.

*Files modified(IFS):*

phys\_ec/vdfdifh.F90 phys\_ec/vdfdifhs.F90 phys\_ec/vdfdifhsad.F90  
phys\_ec/vdfdifhstl.F90 phys\_ec/vdfmain.F90 phys\_ec/vdfmains.F90  
phys\_ec/vdfmainsad.F90 phys\_ec/vdfmainstl.F90

*Files modified(SURF):*

external/surf\_inq.F90 external/surfseb.F90 external/surfsebad.F90  
external/surfsebt1.F90 interface/surfseb.h interface/surfsebad.h  
interface/surfsebt1.h module/surfexcdriver\_ctl\_mod.F90  
module/surfseb\_ctl\_mod.F90 module/surfsebad\_ctl\_mod.F90  
module/surfsebt1\_ctl\_mod.F90 module/susveg\_mod.F90

## Anton Beljaars - paa\_CY40R1\_cleanVDF8 - not BR

### Cleanup of vertical diffusion and passive implementation of Wood/Diamantakis/Staniforth (WDS) solver

This branch takes out the scaling of the diffusion coefficients with dt, g and alpha (time step, gravity and implicitness coefficient), and changes the solver accordingly. Also the solver does not solve for prognostic variables divided by alpha any more, but for the variables directly. The solver routines vdfdifm, vdfdifm, and vdfdifc have been modified such that they can be called with a generic time step e.g. alpha\*dt for the over-implicit scheme, and provide tendencies as output rather than variables extrapolated in time. The Wood/Diamantakis/Staniforth (WDS) solver is included now as alternative to the over-implicit scheme. It is controlled by a switch LWDS which is put to false in suvdf.F90. If LWDS is put to true, the WDS solver is used and the number of sub-steps is put to 1. The new code with LWDS=FALSE (default) should give the same results as 40R1 within machine precision.

The modified files are:

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

```
module/yoevdf.F90 phys_ec/suvdf.F90 vdfdifc.F90 vdfdifh.F90 vdfdifm.F90
vdfexcu.F90 vdfhgtn.F90 vdfincr.F90 vdfmain.F90 vdfouter.F90 vdfstofdc.F90
```

#### *Files modified(SURF):*

```
external/surfexcdriver.F90 interface/surfexcdriver.h
module/surfexcdriver_ctl_mod.F90 vevap_mod.F90 vexcs_mod.F90
offline/phys_ec/vdfmain1s.F90
```

## Anton Beljaars - paa\_CY40R1\_potevap4 - BR

### Potential evaporation

This branch computes potential evaporation by making a second call to the surface energy balance routine surfseb\_ctl\_mod.F90. For this call, the vegetation parameters are set to "crops/mixed farming" (vegetation type 1) and no stress from soil moisture is assumed. The evaporation of the low vegetation tile is post-processed as potential evaporation. The model results are bit-identical to 40R1. Note that in turbulence\_layer.F90, a connection has to be made to the new field that Richard will introduce for post-processing.

The modified files are:

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

```
phys_ec/turbulence_layer.F90 vdfdifh.F90 vdfmain.F90 vdfouter.F90
```

#### *Files modified(SURF):*

```
external/surfexcdriver.F90 interface/surfexcdriver.h
module/surfexcdriver_ctl_mod.F90 vevap_mod.F90 vsurf_mod.F90
```

## Anton Beljaars - paa\_CY40R1\_uniformz0 - not BR

### Spring cold bias in forest areas

This branch addresses the spring cold bias in forest areas. It uses the aggregated z0m (which is used for the grid box averaged transfer coefficient for momentum), also for the transfer coefficients for heat and moisture. The



roughness length for heat is kept tile dependent. This change has a small impact on surface fluxes and improves the 2m temperature mainly in forest areas in spring.

*Files modified(SURF):*

module/surfexcdriver\_ctl\_mod.F90

**Alessio Bozzo - paab\_SB40R1\_radbugfix\_newCO2O3CH4\_NEWLW\_ibm\_osuite - not BR**

**Radiation updates**

**Expts:**

T511 an: WINTER g2me, SUMMER g1u0

T159 climate : g1sd

Further experiments with paab\_SB40R1\_radbugfix\_newCO2O3CH4\_ibm\_osuite (only bugfixes and new MACC climatology, without the updated RRTMG-LW)

T511 an: WINTER g2md, SUMMER g1u1

T159 climate : g1sf

- New climatologies for CO2,O3,CH4 from MACC II 2003-2011 reanalysis.
- Fixed a bug affecting the concentrations of CO2 and CH4.
- Fixed a bug in the interpolation of the trace gases climatology on model grid
- Fixed a bug in the pressure thickness values passed to radiation
- New binary files with the updated LW gaseous absorption coefficients
- New binary files with the new MACC climatologies

Upgrade of the long-wave scheme to the latest version of RRTMG-LW (V 4.85, <http://rtweb.aer.com/rrtm.-frame.html>).

- Update of H2O continuum from CKD 2.2 to MT-CKD 2.5
- Improved treatment of CO2 absorption/emission in infra-red window
- Fixed a small discontinuity in LW heating rates across 100hPa

*Files created(IFS):*

phys\_radi/su\_mch4clim.F90 su\_mco2clim.F90 su\_mozoclim.F90

*Files modified(IFS):*

module/yoerrta1.F90 yoerrta10.F90 yoerrta11.F90 yoerrta12.F90 yoerrta13.F90 yoerrta14.F90 yoerrta15.F90 yoerrta16.F90 yoerrta2.F90 yoerrta3.F90 yoerrta4.F90 yoerrta5.F90 yoerrta6.F90 yoerrta7.F90 yoerrta8.F90 yoerrta9.F90 yoerrtm.F90 yoerrto1.F90 yoerrto10.F90 yoerrto11.F90 yoerrto12.F90 yoerrto13.F90

yoerrto14.F90 yoerrto15.F90 yoerrto16.F90 yoerrto2.F90 yoerrto3.F90 yoerrto4.F90  
yoerrto5.F90 yoerrto6.F90 yoerrto7.F90 yoerrto8.F90 yoerrto9.F90 yoerrtrf.F90  
phys\_ec/radcfg.F90 radintg.F90 radlswr.F90 su\_ghgclim.F90 suclopn.F90  
phys\_radi/radghg.F90 rrtm\_cmbgb1.F90 rrtm\_cmbgb10.F90 rrtm\_cmbgb11.F90  
rrtm\_cmbgb12.F90 rrtm\_cmbgb13.F90 rrtm\_cmbgb14.F90 rrtm\_cmbgb15.F90  
rrtm\_cmbgb16.F90 rrtm\_cmbgb2.F90 rrtm\_cmbgb3.F90 rrtm\_cmbgb4.F90 rrtm\_cmbgb5.F90  
rrtm\_cmbgb6.F90 rrtm\_cmbgb7.F90 rrtm\_cmbgb8.F90 rrtm\_cmbgb9.F90  
rrtm\_ecrt\_140gp.F90 rrtm\_ecrt\_140gp\_mcica.F90 rrtm\_gasabsla\_140gp.F90  
rrtm\_kgb1.F90 rrtm\_kgb10.F90 rrtm\_kgb11.F90 rrtm\_kgb12.F90 rrtm\_kgb13.F90  
rrtm\_kgb14.F90 rrtm\_kgb15.F90 rrtm\_kgb16.F90 rrtm\_kgb2.F90 rrtm\_kgb3.F90  
rrtm\_kgb4.F90 rrtm\_kgb5.F90 rrtm\_kgb6.F90 rrtm\_kgb7.F90 rrtm\_kgb8.F90  
rrtm\_kgb9.F90 rrtm\_rrtm\_140gp.F90 rrtm\_rrtm\_140gp\_mcica.F90  
rrtm\_setcoef\_140gp.F90 rrtm\_taumol1.F90 rrtm\_taumol10.F90 rrtm\_taumol11.F90  
rrtm\_taumol12.F90 rrtm\_taumol13.F90 rrtm\_taumol14.F90 rrtm\_taumol15.F90  
rrtm\_taumol16.F90 rrtm\_taumol2.F90 rrtm\_taumol3.F90 rrtm\_taumol4.F90  
rrtm\_taumol5.F90 rrtm\_taumol6.F90 rrtm\_taumol7.F90 rrtm\_taumol8.F90  
rrtm\_taumol9.F90 suecrad.F90 surrtftr.F90 surrtmcf.F90 surrtpk.F90 surrtrf.F90

## **Alessio Bozzo, Sarah-Jane Lock, Martin Leutbecher - paab\_CY40R1\_reftra\_bugfix - not BR**

### **Bug fix in srtm\_reftra**

A fix for an expression that could potentially cause division by 0.

*Files modified(IFS):*

phys\_radi/srtm\_reftra.F90

## **Alessio Bozzo, Martin Leutbecher, Sarah-Jane Lock - paab\_CY40R1\_mcica\_fix - not BR**

### **Bug fix in McICA**

Fixes an error in the computation of the vertical thickness of the model layers in McICA.

*Files modified(IFS):*

phys\_ec/radlswr.F90 phys\_radi/mcica\_cld\_gen.F90 mcica\_cld\_generator.F90

## **Peter Bechtold - pae\_CY40R1\_conv\_gwdTim\_EPPES\_TLADPhilip\_finalf40r3 + updates in pae - CY40R1\_pae\_CY40R1\_alland\_vdfhghtn - ACTIVE**

### **Improved stratospheric winds**

#### **Expts:**

T511 an: g0it vs fyio control (July 2013)

T511 an: g100 vs fsys control (Feb 2012)

Improved winds and T(above 200 hPa) by 5% and improved stratospheric winds in Tropics and NH. Improved summer scores in NH. Cooling (degradation for T200), otherwise all tropical T better

## **Peter Bechtold - ACTIVE**

### **Convection and GWD updates**

- Revised organised convective detrainment
- Revised closure for mid-level convection
- Increased limit of orographic GWD tendencies

*Files modified(IFS):*

phys\_ec/callpar.F90 cuascn.F90 cubasmcn.F90 cumastrn.F90

## **Tim Stockdale - ACTIVE**

### **Non-orographic gravity wave scheme updates**

Coordinate stretch for spectral elements and minimum intrinsic phase speed

*Files modified(IFS):*

module/yoegwwms.F90 namelist/namgwwms.nam.h phys\_ec/gwdrag\_wms.F90  
gwdrag\_wmss.F90 gwdragwms\_layer.F90 sugwwms.F90

## **Noureddine Semane - PASSIVE**

### **Small planet updates**

- Revised RCAPDCYCL=1 option for diurnal cycle
- Revised small planet scalig, including addition of RUSPLRADI, RUSCORIOI, RUSPLRG in order to avoid conflicts if small planet scaling, but no scaling of physical tendencies is required

*Files modified(IFS):*

namelist/namdyncore.nam.h oops/ifs\_constants.F90 phys\_ec/sucldp.F90 sucumf.F90  
sucumf2.F90 setup/sucst.F90 sudyncore.F90

## **Tim Stockdale and Peter Bechtold - PASSIVE**

### **Cleaning of reduced stratospheric diffusion - option**

Also added possibility of multiple launch-levels in Non-orographic GWD

*Files modified(IFS):*

module/yoegwd.F90 namelist/namgwd.nam.h phys\_ec/suvdf.F90 vdfexcu.F90  
vdfmain.F90 vdfouter.F90

## **Pirkka Ollinaho and Peter Bechtold - PASSIVE**

### **Updates to ENS parameter perturbation scheme EPPES, including addition of cost function based on total energy norm**

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

programs/eppes\_ini\_form.F90

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

gen/mkabs\_prepdata metview/EPPES\_costfunct\_totennorm.met sms/compute\_pp\_cost.sms  
ini\_pertpar.sms

## **Peter Bechtold - BR**

### **Climplot updates**

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

metview/climplot\_batch wind\_maps\_clim.met zondia\_seas\_icon\_batch.met  
sms/climplot.sms

## **Maike Ahlgrimm - pag\_CY40R1\_ddh3 - BR**

### **Updates to DDH outputs**

Include additional surface fields archived in DDH (low and high leaf area index, soil type). 9 lake (surface) variables are written in DDH if LEFLAKE=.true. Also, precipitation fraction is now routinely written out by the DDH.

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

adiab/cpg.F90 adiab/cpg\_dia.F90 adiab/cpg\_drv.F90 adiab/postphy.F90  
control/gp\_model.F90 dia/cpdyddh.F90 dia/sucddh.F90 dia/sunddh.F90  
module/surface\_fields\_mix.F90 module/yomphyder.F90 phys\_ec/callpar.F90  
phys\_ec/ec\_phys\_drv.F90 setup/su\_surf\_flds.F90

## **Kristian Mogensen , Sarah Keeley - ne1\_CY40R1\_surface\_and\_lakes\_for\_40R2 - BR and Passive**

### **Update STL1/CI with lake values when flakes is active**

A namelist switch (LEOLAKESST in NAEPHY) has been introduced. If set the STL1/CI will be updated with lake values over lakes if FLAKE is active. A regression formula is used to convert lake ice thickness to ice concentration. Default is off, but we might want to set on whenever

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

climate/updclie.F90 updnemoocean.F90  
module/yoephy.F90  
namelist/naephy.nam.h  
setup/su0phy.F90

#### *Files modified(SURF):*

module/surftstp\_ctl\_mod.F90

## **Philippe Lopez and Marta Janisková. - pah\_CY40R1\_radlswtl\_fix - ACTIVE**

The number of extra vertical levels above maximum cloud top used in the simplified radiation routine RADLSW(TL/AD) has been increased from 5 to 7 for safety reasons.

### *Files modified(IFS):*

phys\_ec/radlsw.F90 radlswad.F90 radlswtl.F90

## **Marta Janisková - pan\_CY40R1\_surf\_TLAD\_nonact - BR**

### **Simplified surface parametrization scheme**

The current set of ECMWF physical parametrizations used in the linearized model provides a complex description of atmospheric processes, but does not update surface variables. A simplified parametrization scheme for surface processes has therefore been developed. The scheme is limited to processes important within the atmospheric time-window and therefore only the fast (near-surface) energy reservoirs are considered. The surface tendencies and updated values are computed for the top-layer soil, snow and sea-ice temperatures. The tangent-linear and adjoint versions of the new simplified scheme have also been developed.

The new simplified surface scheme can be turned on using the logical switch LESURF2=.true. The default for the moment is LESURF2=.false., i.e. the scheme is not activated.

### *Files created(SURF):*

external/surftstps.F90 surftstpstl.F90 surftstpsad.F90  
interface/surftstps.h surftstpstl.h surftstpsad.h  
module/srfis\_mod.F90 srfistl\_mod.F90 srfisad\_mod.F90 srfrcgs\_mod.F90  
srfrcgstl\_mod.F90 srfrcgsad\_mod.F90 srfsn\_lwimps\_mod.F90 srfsn\_lwimpstl\_mod.F90  
srfsn\_lwimpsad\_mod.F90 srfts\_mod.F90 srftstl\_mod.F90 srftsad\_mod.F90  
srfwdifs\_mod.F90 srfwdifstl\_mod.F90 srfwdifsad\_mod.F90 srfwls\_mod.F90  
srfwlstl\_mod.F90 srfwlsad\_mod.F90 surftstps\_ctl\_mod.F90 surftstpstl\_ctl\_mod.F90  
surftstpstl\_ctl\_mod.F90

### *Files modified(IFS):*

dia/wrphtrajt.F90  
module/yomsrftlad.F90 yophnc.F90  
namelist/namtrajp.nam.h  
phys\_ec/callpar.F90 callpartl.F90 callparad.F90 ec\_phys\_tl.F90 ec\_phys\_ad.F90  
radlswtl.F90 surftstp\_s\_layer.F90 turbulence\_s\_layer.F90 vdfdifhstl.F90  
vdfdifhsad.F90 vdfmains.F90 vdfmainstl.F90 vdfmainsad.F90  
setup/su0phy.F90 susc2b.F90 sutrajp.F90  
utility/dealsc2.F90 rdphtrajt.F90

### *Files modified(SURF):*

external/surfexcdriver.F90 surfexcdriverstl.F90 surfexcdriversad.F90  
interface/surfexcdriver.h surfexcdriverstl.h surfexcdriversad.h  
module/surfexcdrivers\_ctl\_mod.F90 surfexcdriverstl\_ctl\_mod.F90  
surfexcdriversad\_ctl\_mod.F90 vexcsstl\_mod.F90 vexcssad\_mod.F90

*Files modified(SCRIPTS):*

gen/ifsmmin ifsoops modelsv

## **Emanuel Dutra - need\_CY40R1\_MERGE240r3\_SURFACE\_v1\_IBM - BR**

### **Surface suite changes**

Only applies to "surface" experiments. Changes in the surface suite necessary for the lake activation. New post-processing for the calculation and archival of monthly means similar to the re-analysis.

*Files modified(SURF):*

offline/util/create\_init\_clim.F90

*Files deleted(SURF):*

surf/offline/additional/include/surfexcdriver.h

*Files created(SCRIPTS):*

gen/check\_lakeini.ksh

*Files modified(SCRIPTS):*

sms\_osm/archive\_an.sms archive\_fc.sms archive\_flx.sms create\_forcing.sms  
create\_init\_clim.sms prepare\_an.sms prepare\_fc.sms prepare\_flx.sms  
surface\_model.sms

gen/archive\_an.ksh archive\_fc.ksh archive\_flx.ksh archive\_forcing.ksh  
create\_forcing.ksh create\_init\_clim.ksh extract\_forcing.ksh

extract\_forcing\_arch\_osm.ksh prepare\_an.ksh surface\_clean.ksh surface\_model.ksh  
def/surface.def

## **Anton Beljaars, Gianpaolo Balsamo, Souhail Boussetta, Emanuel Dutra - pad\_CY40R1\_snow\_- stability\_fix - ACTIVE**

### **Snow scheme numerical stability fix to prevent oscillation of surface temperature**

A snow scheme numerical stability fix has been introduced to prevent oscillation of surface temperature that are were associated to the explicit formulation and in presence of a long times step and tiny amount of snow. The fix mimic the behaviour of an implicit solver for the heat diffusion equation by including a stability factor in the skin layer conductivity of the snow tiles.

## **Gianpaolo Balsamo, Emanuel Dutra, Irina Sandu, Souhail Boussetta, Anton Beljaars, Nils Wedi, Filip Vana, Philippe Lopez, Frederic Vitart, Kristian Mogensen - pad\_CY40R1\_surface\_- and\_lakes\_for\_40R2 - ACTIVE**

### **Interactive lakes modelling including sub-grid water with a dedicated tile (coastal and inland water bodies)**

Final implementation of the lake model for resolved and sub-grid inland water-bodies, and activation in all ECMWF daily forecasts. The latest developments in this branch include the 4D-VAR related parts (TL/AD), and a large set of scripts modifications related to preparation (lake reanalysis), interpolation, initialization,

time-stepping, post-processing and archival of the seven new prognostic variables associated to lake physical state.

## **Emanuel Dutra, Souhail Boussetta, Takuya Komori, Gianpaolo Balsamo - BR**

### **Offline Surface Modelling suite improvements, preparation for new albedo/LAI, plus ERA-Clim developments**

Improved Offline Surface Model suite used for land-only reanalysis and including the vertical downscaling for high-resolution land simulations, and preparatory script changes for Albedo and LAI assimilation, and the inclusion of lakes (all modifications are neutral to atmospheric forecasts).

## **Richard Forbes - pas\_CY40R1\_climplot\_humidity - BR**

### **Additional humidity plots for climplot diagnostics**

Includes new zonal cross section plots of percentage change of humidity and changes contours for absolute humidity cross sections, both to highlight water vapour changes in the upper troposphere/stratosphere in the climplot diagnostics.

*Files modified(SCRIPTS):*

```
metview/climplot_batch zondia_def_contour zondia_seas_icon_batch.met
```

## **Richard Forbes - pas\_CY40R1\_for40r3\_clouds\_v3 - ACTIVE**

### **Stratiform cloud microphysics upgrade**

Major upgrade to cloud scheme microphysics with:

- New rain autoconversion and accretion processes activated
- New rain evaporation formulation activated
- New snow riming microphysics
- Modified sub-grid precipitation fraction parametrization
- Modified parametrization of supercooled rain ("freezing rain")
- Reduced autoconversion of cloud ice to snow at cold temperatures
- Removal of small negative values in rain/snow precipitation
- Corrections to cloud budget diagnostics in cloudsc (passive)
- Clean up of cloud size spectral dispersion code in radlswr (passive)

Directly affects precipitation PDF, cloud liquid water path and humidity, reduces supercooled liquid water in deep cloud systems and increases upper-tropospheric cloud ice, with impacts on longwave and shortwave radiation, tropospheric temperatures and geopotential heights.

*Files modified(IFS):*

phys\_ec/callpar.F90 cloud\_layer.F90 cloudsc.F90 radlswr.F90 sucldp.F90

## **Richard Forbes - pas\_CY40R1\_newdiags\_for\_40r3 - BR**

### **New surface weather diagnostics**

Adds 16 new surface diagnostics. Visibility, instantaneous wind gust (max 3s wind), instantaneous convective and large-scale rain and snow rates, max and min total precipitation rates are diagnostics requested by Member States.

Grib	Shortname	Longname
-----	-----	-----
003020	vis	Visibility (m)
228029	il0fg	Instantaneous 10 metre wind gust (m s <sup>-1</sup> )
260015	ptype	Precipitation type (0-8)
228217	ilspf	Instantaneous large-scale surface precipitation fraction (0-1)
228218	crr	Convective rain rate (kg m <sup>-2</sup> s <sup>-1</sup> )
228219	lsrr	Large scale rain rate (kg m <sup>-2</sup> s <sup>-1</sup> )
228220	csfr	Convective snowfall rate water equivalent (kg m <sup>-2</sup> s <sup>-1</sup> )
228221	lssfr	Large scale snowfall rate water equivalent (kg m <sup>-2</sup> s <sup>-1</sup> )
228222	mxtpr3	Max total precipitation rate in the last 3 hours (kg m <sup>-2</sup> s <sup>-1</sup> )
228223	mntpr3	Min total precipitation rate in the last 3 hours (kg m <sup>-2</sup> s <sup>-1</sup> )
228224	mxtpr6	Max total precipitation rate in the last 6 hours (kg m <sup>-2</sup> s <sup>-1</sup> )
228225	mntpr6	Min total precip rate in the last 6 hours (kg m <sup>-2</sup> s <sup>-1</sup> )
228226	mxtpr	Max total precip rate since previous post-processing (kg m <sup>-2</sup> s <sup>-1</sup> )
228227	mntpr	Min total precip rate since previous post-processing (kg m <sup>-2</sup> s <sup>-1</sup> )
228088	tclsw	Total column supercooled liquid water (kg m <sup>-2</sup> )
228182	pev	Potential evaporation (m)

*Files modified(IFS):*

adiab/cpedia.F90 postphy.F90  
dia/grib\_code\_message.F90  
fullpos/hpos.F90 wrmlfp.F90 wrmlfpl.F90 module/parfpos.F90  
surface\_fields\_mix.F90 yom\_grib\_codes.F90 yomafn.F90 yomphyder.F90 yomppc.F90  
namelist/namafn.nam.h  
phys\_ec/callpar.F90 claervis.F90 climaer\_layer.F90 diag\_clouds.F90 ec\_phys.F90  
local\_arrays\_fin.F90 local\_arrays\_ini.F90 phys\_arrays\_fin.F90  
phys\_arrays\_ini.F90 postphy\_layer.F90 turbulence\_layer.F90  
setup/su\_surf\_flds.F90 suafn1.F90 suafn2.F90 suafn3.F90 supp.F90

*Files modified(SCRIPTS):*



gen/model

## **Philippe Lopez - pah\_CY40R1\_assim\_opera\_compo\_v3 - PASSIVE and BR**

### **Assimilation of European OPERA rain composites**

Technical implementation of the direct 4D-Var assimilation of OPERA rain composites over Europe. Assimilation will not be activated in cycle 40R3. The new prepIFS switch LOPERA (default=FALSE) should be used to activate the assimilation of OPERA data. However, the quality of the data is still not good enough to justify an operational implementation.

#### *Files created(SATRAD):*

programs/bufr\_screen\_opera.F90

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

sms/fc\_sens\_save\_gbrad.sms

sms\_an/archive\_gbrad.sms b2o\_gbrad.sms convert\_gbrad.sms

obstat\_archive\_gbrad.sms obstat\_gbrad.sms odb2odb1\_gbrad.sms

sms\_era/obtime\_gbrad.sms

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

module/varbc\_gbrad.F90 varbc\_setup.F90

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

bufr2odb/bufr2odb\_rain\_rates.F90

ddl/getgbradid.sql robhdr\_gbrad\_get\_rr.sql robhdr\_gbrad\_put\_rr.sql robody\_gbrad\_get\_rr.sql robody\_gbrad\_put\_rr.sql varbc\_gbrad\_robhdr.sql

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

def/an.def fsobs.def

gen/archive\_obs bufr2odb cycle\_times fetchmars fetchobs mkabs\_satrad obstat  
obstat\_init pregbrad var\_include

sms/fc\_sens\_save.sms

sms\_an/archive\_obsgroup.sms clean\_an.sms convert\_obsgroup.sms odb2odb1.sms

pregbrad.sms

sms\_era/obtime.sms

wav/wave\_newverify

#### *Files deleted(SCRIPTS):*

sms/fc\_sens\_save\_nexrad.sms

sms\_an/archive\_nexrad.sms b2o\_nexrad.sms convert\_nexrad.sms

obstat\_archive\_nexrad.sms obstat\_nexrad.sms odb2odb1\_nexrad.sms

sms\_era/obtime\_nexrad.sms

## **Philippe Lopez - pah\_CY40R1\_revised\_linearised\_physics\_v3 - ACTIVE**

### **Changes to linearised physics**

The simplified (linearized) versions of the convection and vertical diffusion schemes have been revised to

improve the match with the full non-linear schemes. Some new regularization has been added in the non-orographic gravity wave drag scheme.

#### Convection:

The simplified convection scheme has been revised to take into account recent changes in the full non-linear (NL) convection scheme made by Peter Bechtold.

- \* New updraught entrainment and detrainment formulation to match full NL convection scheme (routines CUASCN2(TL/AD) and CUPDRA(TL/AD)). No more distinction between turbulent and organized entrainment. Plus slight change in autoconversion activation threshold. Autoconversion rate has now the same value as in the full NL scheme.

- \* Revised downdraught entrainment formulation, including additional organized entrainment, as in the full NL scheme.

#### Vertical Diffusion:

The simplified scheme has been revised to take into account recent changes in the full NL vertical diffusion scheme, particularly those made by Irina Sandu in cy39r1. Most changes have been made in VDFEX-CUS(TL/AD).

- \* In stable layers, the upward transition from Louis to Monin-Obukhov has been replaced by a pure Louis formulation. Planetary Boundary Layer (PBL) height in the presence of stable surface layers is now computed using the same formulation as in the full NL scheme (instead of the previous fixed value of 1500 m). The mixing length is now set to 60 m (resp. 120 m) between the surface and the PBL top for heat (resp. momentum) and to 60 m above the PBL for both heat and momentum.

- \* In unstable layers, the same Monin-Obukhov formulation as in the full NL scheme has been implemented.

- \* A new version of VDFDPBLS has been coded to compute PBL top height in the presence of unstable surface layers (mixed layer depth).

- \* The extra shear term used in the linearized computation of the Richardson number has been removed.

#### Non-orographic gravity wave drag:

- \* Some regularization has been added to avoid TL instability in rare situations when the vertical temperature gradient becomes very close to dry adiabatic (at upper levels only).

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

```
module/yoecumf2.F90
phys_ec/cuascn2.F90 cuascn2ad.F90 cuascn2tl.F90 cubasen2.F90 cubasen2ad.F90 cubasen2tl.F90
cuddrafn2.F90 cuddrafn2ad.F90 cuddrafn2tl.F90 cumastrn2.F90 cumastrn2ad.F90 cumastrn2tl.F90
cupdra.F90 cupdraad.F90 cupdratl.F90 gwdrag_wmssad.F90 gwdrag_wmsstl.F90 sucumf2.F90
vdfdpbls.F90 vdfexcus.F90 vdfexcusad.F90 vdfexcustl.F90 vdfmains.F90 vdfmainsad.F90
vdfmainstl.F90 vdfstofdcs.F90
```

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

```
programs/bufr_screen_synop_rain_gauges.F90
```

## **Filip Vana - pafv\_CY40R1\_slphys - BR**

### **SL Physics bugfix**

This branch allows to run LSLPHY=.T. with the TL/AD codes (being naturally equal to .F. there).

*Files modified(IFS):*

adiab/call\_sl\_ad.F90 adiab/call\_sl\_tl.F90 adiab/lavabotl.F90 setup/suct0.F90

## **DATA ASSIMILATION**

**Patricia de Rosnay - dap\_SB40R1\_dap\_SB40R1\_ssa\_mergedall\_for\_40r3 - Active**

**Merged Surface analysis improvements**

**Expts:**

- Summer: test g43x control g3ik - Winter: test g43y control g291

**Patricia de Rosnay and Axel Bonet - dap\_SB40R1\_ctrl\_expt\_date - BR**

**Enables running near real time analysis experiments**

**Expts: g3js vs control g3ik**

It contains scripts modifications in an.def and a new sms script. It controls the experiment date and allows running near real time experiments without failing in the obs family when reaching near real time. The experiment observation families (delayed cut off and early delivery) are suspended until the analysis input is available from the operational suite archiving. This relies on a mirror on each RD server that allows to see the status of the operational suite archiving.

**Patricia de Rosnay - dap\_SB40R1\_snow\_for40R3 - not BR**

**Improvements in the Surface Analysis code and in the snow analysis**

Surface analysis (ssa) Fortran code and scripts updates to removes the usage of a snow climatology in the southern hemisphere and surface analysis OI code cleaning. The snow climatology is completely outdated and it is not justified to use it any longer. Furthermore it is shifted by six month. With this modification the snow file in the climate data base (/home/rd/rdx/data/40r3/climate) will not be required from 40r3 any longer. This branch also contains some update in the sst and sea ice analysis to make it flexible to the old or new climate data base lake mask over Black sea and Azov Seas. The Black and Azov Sea update was tested with the new and old climatology showing it allows to make the same data usage when the old or new climate data base are used (current climate control: g0qd, new climate test: g0qg).

**Expts:**

T511 an: summer (test g2ta, control g1nt) and winter (test g2tq, control g1nf)

Iver scores show neutral results.

## **Patricia de Rosnay - dap\_SB40R1\_ssa\_land\_for\_40r3 - not BR**

### **Removal of screen level observations data assimilation over ocean surfaces and revision of land surface observation quality control in coastal areas**

Modifications in the surface analysis (ssa) Fortran code and in odb/ddl sql requests to remove the screen level observations data assimilation over ocean surfaces and revise the land surface observation quality control in coastal areas. Ocean data assimilation was not useful since T2m and Rh2m are diagnostic variables and analysed only to provide input for the land surface analyses task (soil moisture, snow and soil temperature). Ocean T2m surface analysis was creating spurious patterns in the analysed field over ocean areas that can affect some users application in case they use this information as input of their model. Furthermore in coastal area the quality control was improved to account for the observations codetype when the match with the model land sea mask is done. This avoids wrong rejection of land observations in coastal areas.

#### **Expts:**

T511 an:summer (test g3mw, control g3ik) and winter (test g3mx, control g291) - neutral results.

OBSTAT surface analysis monitoring maps were also checked, showing that ocean observations are not any longer used in the surface analysis.

## **Patricia de Rosnay and Deborah Salmond - dap\_SB40R1\_ekf\_for\_40r3, dap\_SB40R1\_dap\_SB40R1\_ssa\_mergedall\_for\_40r3 - Active**

### **Update of SEKF and ASCAT soil moisture data assimilation**

Modifications in the simplified EKF Fortran code and scripts (code cleaning, bug fixes and revised errors specification) to activate ASCAT soil moisture data assimilation.

#### **Expts:**

T511 an summer: Tests g3f6 and g3f5, control g3ik.

Tests including sekf modification and new errors specification, iver shows slight positive impact, significant in T and R at 1000hPa and at two-meter. Tests conducted with and without ASCAT soil moisture data assimilation, showing neutral impact of ASCAT data assimilation.

T511 an summer:Test g43x, control g3ik, same as above, but with with merged ssa branch, with ASCAT soil moisture data assimilation; shows similar positive impact than g3f6.

T511 an winter: test g43y, control g291, with merged ssa branch and ASCAT soil moisture data assimilation, positive impact nearthe surface T and R at 1000hPa and at two-meter.

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

```
control/csekf2.F90 ifs/sekf/sm_ekf_main.F90 ifs/obs_preproc/sekf_prep_ascat.F90
ifs/phys_ec/callpar.F90 ifs/phys_ec/ec_phys.F90 ifs/phys_ec/vdfdifh.F90
ifs/phys_ec/vdfdifm.F90 ifs/phys_ec/vdfincr.F90 ifs/phys_ec/vdfmain.F90
```

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

```
odb/ddl/ssa_robhdr_2m.sql odb/ddl/ssa_roboddy_2m.sql
odb/ddl/ssafb_surfboddy_2m.sql
```

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

```
scripts/def/an.def scripts/gen/sekf_sm scripts/gen/ssaana
```

*Files modified(SSA):*

interface/snow\_fg.h module/yomarrays.F90 module/yomiodssa.F90 module/yomssa.F90  
namelist/namssa.nam.h plot/print\_nml.F90 plot/print\_summary.F90 sub/fg2obs.F90  
sub/inisnw.F90 sub/inisst.F90 sub/init2m.F90 sub/snow\_analysis.F90  
sub/snow\_fg.F90 sub/ssa.F90 util/alloc\_mem.F90 util/array2field.F90  
util/field2array.F90 util/setcomssa.F90

**Yannick Tremolet - day\_CY40R2\_from\_40r1 - BR**

**24h window 4D-Var and OOPS**

Modifications for the 24h window and some OOPS related updates. All the changes are passive and the results are bit identical to the control

*Files modified(IFS):*

common/yomdb\_vars.h control/cva2.F90 control/forecast\_error.F90  
control/sim4d.F90 dia/grib\_code\_message.F90 dia/wrphtrajt.F90 dia/wrradcoef.F90  
dia/wrsltraj2.F90 fullpos/pregpfpos.F90 module/gridpoint\_buffers\_mix.F90  
module/iostream\_mix.F90 module/testvar\_mix.F90 module/yomcosjo.F90  
module/yomiop.F90 module/yomios.F90 module/yomrcoef.F90 module/yomvar.F90  
module/yomvwrk.F90 namelist/namcosjo.nam.h namelist/nammoderr.nam.h  
namelist/namtrajp.nam.h namelist/namvar.nam.h namelist/namvwrk.nam.h  
obs\_preproc/defrun.F90 obs\_preproc/fgchk.F90 obs\_preproc/fgwnd.F90  
oops/allobs\_mod.F90 oops/error\_covariance\_3d\_mod.F90 oops/fields\_io\_mod.F90  
oops/geometry\_mod.F90 oops/localization\_mod.F90 oops/model\_mod.F90  
oops/obsvec\_mod.F90 op\_obs/hdepart.F90 op\_obs/hjo.F90 op\_obs/hop.F90  
op\_obs/hopad.F90 op\_obs/hoptl.F90 phys\_dmn/suparar.F90 phys\_ec/radintg.F90  
setup/su0phy.F90 setup/suios.F90 setup/susc2b.F90 setup/sutrajp.F90  
utility/emptb.F90 utility/emptb3.F90 utility/fillb.F90 utility/fillb3.F90  
utility/rdphtrajt.F90 utility/rdradcoef.F90 utility/rdsltraj2.F90  
utility/sc2rdg.F90 utility/sc2wrg.F90 var/djbdy.F90 var/djcdy.F90  
var/rdnhtrajm.F90 var/rdphtrajm.F90 var/rdphtrajtm.F90 var/sualcos.F90  
var/sualcosjo.F90 var/sualges.F90 var/suanebuf.F90 var/surad.F90 var/suvar.F90  
var/suvwrk.F90 var/wrnhtrajm.F90 var/wrphtrajm.F90 var/wrphtrajtm.F90

*Files modified(ODB):*

cma2odb/initmdb.F90 ddl/robody.sql ddl/robody\_rad.sql ddl/update.h

*Files modified(OOPS):*

ifs/mains/CMakeLists.txt ifs/mains/ifsEnsemble.cc ifs/model/AllObs.cc  
ifs/model/AllObs.h ifs/model/AllObsCovariance.interface.F90  
ifs/model/CMakeLists.txt ifs/model/ErrorCovariance3D.cc  
ifs/model/ErrorCovariance3D.h ifs/model/ErrorCovariance3D.interface.F90  
ifs/model/ErrorCovariance3D.test.cc ifs/model/FieldsIFS.cc ifs/model/FieldsIFS.h  
ifs/model/FieldsIFS.interface.F90 ifs/model/GeometryIFS.cc  
ifs/model/GeometryIFS.h ifs/model/GeometryIFS.interface.F90  
ifs/model/IfsFortran.h ifs/model/IfsTraits.h ifs/model/IncrementIFS.cc  
ifs/model/IncrementIFS.h ifs/model/LinearModelIFS.cc ifs/model/LinearModelIFS.h  
ifs/model/LocalizationMatrixIFS.cc ifs/model/LocalizationMatrixIFS.h  
ifs/model/LocalizationMatrixIFS.interface.F90 ifs/model/ModelBias.cc  
ifs/model/ModelBias.h ifs/model/ModelBiasCovariance.h  
ifs/model/ModelBiasIncrement.cc ifs/model/ModelBiasIncrement.h  
ifs/model/ModelIFS.cc ifs/model/ModelIFS.h ifs/model/ModelIFS.interface.F90

```
ifs/model/ObsBias.cc ifs/model/ObsBias.h ifs/model/ObsBiasCovariance.cc
ifs/model/ObsBiasCovariance.h ifs/model/ObsBiasIncrement.cc
ifs/model/ObsBiasIncrement.h ifs/model/ObsVector.cc
ifs/model/ObsVector.interface.F90 ifs/model/StateIFS.cc ifs/model/StateIFS.h
ifs/model/VariablesIFS.interface.F90 ifs/model/ifs_init_wrapper.F90
```

*Files modified(SCRIPTS):*

```
build/Makefile.root.oops def/an.def def/fc.def gen/fetchmars gen/ifsmin
gen/ifstraj gen/ifsvar gen/mkios gen/mklink gen/model gen/prelcrad_screen
gen/varconsts sms/model.sms sms/oops_ifs.sms sms/oopsifslib.sms sms/oopslib.sms
sms_an/4dvar.sms
```

**Elias Holm, Joaquin Munoz Sabater, Massimo Bonavita - dae\_SB40R1\_DAcy40r3\_v2 and dae\_-SB40R1\_DAcy40r3\_v3 - BR**

**Updates for 4D-Var and EDA**

**Massimo Bonavita - dav\_SB40R1\_40R3\_EDA - BR**

**Hybrid B and 25 member filter for EDA variances**

**Expts: g32j as a full EDA to check that it works as expected**

1. Use of 25 member filters for EDA variances,

stored in /home/rd/rdx/data/an/eda\_noise\_filter/SMOOTH\_FILTER\_STATS\_EDA25\_XXXX

This has been tested in CY39R1 (dav\_CY39R1\_EDA\_testbed) in Winter (2013/01/01 - 2013/02/28; expver: fz3v; control: fye8) and Summer (2012/06/02 - 2012/07/31; expver: fzjo; control: fxqe)

2. Hybrid JB: JB is computed from perturbations from t+0/1/2/3/4/5/6/7 hours EDA forecasts + Climatological pert. (These are now stored in /home/rd/rdx/data/40r1/eda\_clim\_pert They should be made available to operations when the cycle is handed over)

This change has been tested in 40R1 (dav\_CY40R1\_EDA\_testbed) over the period 2013/10/20 - 2014/03/01 (expver: g1hu; control: fzdk) The period was chosen because the branch needed hourly outputs from the EDA, which only became available last September in 0063.

Positive impacts throughout for both sets of experiments.

These changes are bit-reproducible in standard 4D-VAR and EDA, only the calculation of the B and EDA variances by the EDA is changed.

*Files modified(PREPDATA):*

```
programs/sptogp.F90
```

*Files modified(SCRIPTS):*

```
gen/ens_errors gen/ens_errors_rad gen/fetch_jb_fields_mem gen/ifsmin
gen/pre_fetch_jb_grid gen/pre_fetch_jb_spectral
```

## Joaquin Munoz Sabater - daq\_CY40R1\_SMOS\_for\_CY40R3 - BR

### SMOS updates

- CMEM interface in IFS completed
- Updated CMEM parameterisations with calibrated values following offline calibration study
- Full configuration of observations managed now by an unique namelist,
- Bias correction routines implemented
- SMOS Monitoring updated with snow and ice masks,
- Angular binning implemented
- Several bugs fixed

#### *Files created(ODB):*

cma2odb/create\_averaged\_values\_over\_angles.F90  
ddl.CCMA/set\_active\_smos.sql  
ddl.ECMA/averaging\_smos.sql obsort\_smos.sql set\_active\_smos.sql  
ddl/averaging\_smos.sql obsort\_smos.sql set\_active\_smos.sql  
interface/create\_averaged\_values\_over\_angles.h

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

control/csekf2.F90  
module/yomcmempar.F90 yomcmemtypes.F90 yomsekf.F90 yomsmos.F90  
obs\_preproc/sekf\_prep\_smos.F90 smostb\_cdfpar.F90  
phys\_ec/ec\_phys.F90  
sekf/pertsekf\_v2.F90 sm\_ekf\_main.F90 susekf.F90  
smos/smos\_obsop\_setup.F90 smos\_process.F90 smos\_screen.F90 smos\_update.F90

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

bufr2odb/bufr2odb\_smos.F90  
cma2odb/ctxinitdb.F90 initmdb.F90 putatdb.F90 shuffle\_odb.F90 shuffledb.F90  
ddl/robody\_smos\_sekf.sql set\_active.sql smos.h stat\_obs\_3.sql

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

cmem/atm\_sub.F90 cmem\_alloc\_types.F90 cmem\_atm.F90 cmem\_dealloc\_types.F90  
cmem\_init.F90 cmem\_main.F90 cmem\_setup.F90 cmem\_snow.F90 cmem\_soil.F90  
fresnel\_sub.F90 rghref\_sub.F90 veg\_sub.F90 wilheit\_sub.F90  
interface/atm\_sub.h cmem\_snow.h dielsoil\_sub.h dielwat\_sub.h fresnel\_sub.h  
rghref\_sub.h veg\_sub.h wilheit\_sub.h  
programs/bufr\_screen\_smos.F90

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

def/an.def  
gen/bufr2odb fetchobs ifstraj mklinks presmos sekf\_sm  
sms\_an/bufr2odb.sms mergeodb.sms sekf.sms

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

module/parsmos.F90

## **Elias Holm - dae\_SB40R1\_DAcy40r3\_v3 - ACTIVE**

### **Inner loop modifications T255LLL with no fce and cubic grid option**

A new default configuration for the inner loops in 4D-VAR is to run three 255 minimizations with timestep 1200s and to remove obsolete and expensive forecast error calculation using the randomization method:

```
prepIFS/Forecast error handling/UPTRAJ_FCE=-1
```

With this configuration, less than 30 compared with 70 iterations are required for the first minimisation, so full linear physics are used in the first inner loop, identical with later inner loops:

```
prepIFS/Variational analysis/NMINSIMPHY=0,ITER_MIN_0=50
```

The EDA uses the same default configuration as before. A consequence is that the analysis and forecast errors, `type=ef` and `type=ea`, will no longer be produced by the main 4D-VAR, but will still be available from the EDA. The inner loops configuration has also been generalized with cubic grid option - configurable from:

```
prepIFS/Variational analysis/GTYPEINC_*
```

The changes are bit-reproducible when run using the current inner loop configuration in 4D-VAR and EDA. With the new configuration without randomization method there are fewer iterations in the first minimization, which gives different results for 4D-VAR, while EDA remains bit-reproducible

*Files modified(IFS):*

```
setup/suhdf_ec.F90
```

*Files modified(PREPDATA):*

```
programs/sptogp.F90
```

*Files modified(SCRIPTS):*

```
gen/anml ansfc fast_sgint gaussgr ifsmin ifsoops ifstraj lowres_fp mknam_fp  
prelcrad_screen premwimg
```

## **SATELLITE**

**Alan Geer, Niels Bormann, Mohamed Dahoui, Sean Healy, Heather Lawrence, Peter Lean, Cristina Lupu, Kirsti Salonen - stg\_CY40R2\_sat\_section\_for\_40r3\_6 - ACTIVE**

```
str_SB40R1_for_CY40R3_with_emiskf sts_SB40R1_AMV_code_cleaning dipl_CY40R1_hans_varno_vertco mo3_-  
CY40R1_40R3_obstat
```

### **Satellite merge**

This contains the merged contributions of the satellite section along with obstat updates from Mohamed Dahoui. Note that most source code changes were already included in the non-operational cycle 40R2, so please refer to the cycle 40R2 FLUB for more details. These updates were switched off in cycle 40R2 and are now being activated (by blacklist or by switch) in cycle 40R3. Contents:

### **All-sky assimilation upgrade:**

- MHS moved from clear to all-sky



- SSMIS 183 GHz channels over land and sea-ice
- Azimuthal dependency of surface emissivity activated

### **Assimilation of GPSRO with 2D operator activated**

### **Assimilation of surface-sensitive ATMS channels over land**

### **Modified emissivity Kalman filter atlas**

further details under str\_SB40R1\_for\_CY40R3\_with\_emiskf

### **RTTOV-11 interpolation mode 5 activated, which gives better Jacobians**

### **Technical changes:**

- Code cleaning for AMVs (further details under sts\_SB40R1\_AMV\_code\_cleaning)
- New ODB varno (further details under dipl\_CY40R1\_hans\_varno\_vertco)
- Obstat upgrades (further details under mo3\_CY40R1\_40R3\_obstat)
- Bugfix for all-sky IR TL/AD

#### *Files created(SATRAD):*

emiss/emiskf\_config.F90 emiskf\_init\_atlas.F90 emiskf\_predict.F90 emiskf\_traj.F90  
emiskf\_write\_atlas.F90  
programs/emiskf\_dump.F90 emiskf\_update.F90

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

sms\_an/obstat\_archive\_mhs\_allsky.sms obstat\_mhs\_allsky.sms

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

common/yomdb\_defs.h yomdb\_vars.h  
module/gom\_mod.F90 pardimo.F90 yomsats.F90  
mwave/mwave\_screen.F90  
obs\_preproc/defrun.F90  
op\_obs/gpscalc\_alpharkm2.F90 gpscalc\_alpharkm2ad.F90 gpscalc\_alpharkm2tl.F90  
radlcemis.F90 radtr\_ml\_ad.F90  
setup/suvnmb.F90  
var/suamv.F90

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

src/inisoftdef.F90 odb2read.F90 updsft.F90

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

cma2odb/initmdb.F90  
ddl/emiskf\_amsua.sql emiskf\_amsub.sql emiskf\_atms.sql emiskf\_mhs.sql radiance.h satbody\_  
screen\_atovs.sql varno.h vertco\_type.h

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

emiss/emiskf\_alloc\_read\_input.F90 emiskf\_estimate\_emissivity.F90 emiskf\_init.F90  
emiskf\_prep\_h.F90 emiskf\_update\_atlas.F90 kfgrid\_delete.F90 kfgrid\_get.F90  
kfgrid\_init.F90 kfgrid\_init\_from\_file.F90 kfgrid\_write.F90

```
module/eda_rad_aux.F90 mod_emiskf.F90 mod_emiskf_stats.F90 mod_kfgrid.F90
rttov_types.F90
mwave/mwave_get_rtcoeff.F90
programs/kfgrid_converter.F90
```

*Files modified(SRIPTS):*

```
def/an.def
gen/emiskf ifsmin ifstraj mkabs_black mkabs_satrad mklinks obstat obstat_init
run_fp
sms_an/emiskf.sms
```

*Files deleted(SATRAD):*

```
emiss/emiskf_delete_sensor.F90 emiskf_init_sensor.F90 emiskf_write_sensor.F90
programs/emiskf_update_amsua.F90 emiskf_update_amsub.F90 emiskf_update_atms.F90 emiskf_
update_mhs.F90
```

## **Kirsti Salonen - sts\_SB40R1\_AMV\_code\_cleaning - BR**

### **AMV code cleaning**

Asymmetric first guess check for AMVs was removed in cycle 40r1. However, logical variable lasym\_fgcheck was still present in module/yomsats.F90 and in var/suamv.F90 The remaining references to lasym\_fgcheck have been now removed.

*Files modified(IFS):*

```
module/yomsats.F90
var/suamv.F90
```

## **Niels Bormann - str\_SB40R1\_for\_CY40R3\_with\_emiskf - not BR**

### **Reformulation of the emissivity Kalman Filter atlas**

The emissivity Kalman Filter atlas has been reformulated, based on the experience gained over the years. The scientific changes are described in detail in a separate RD memorandum. They include a new emissivity parametrisation that is not sensor-dependent, a new error growth model and a revision of the quality control applied to the emissivities. The new atlas also caters for ATMS.

As a result of the changes, most of the emiskf... or kfgrid... routines have changed, and in particular any references to a sensor-specific formulation of the atlas have been removed. There is now only one program, emiskf\_update, that handles updates for all sensors (currently, AMSU-A, AMSU-B, MHS, and ATMS are supported). Comparisons against the previous Kalman filter estimates are performed in a new routine emiskf\_traj, and the error growth is handled in the new routine emiskf\_predict, called once before an update. The new emissivity Kalman Filter atlas can now also return a more meaningful estimate of the error of the atlas emissivities, and when used from the IFS this error is stored in the new ODB column emis\_atlas\_error. A new program emiskf\_dump is also available that can be used to query a given atlas offline to obtain maps of the emissivities for a given frequency, polarisation, and zenith angle.

*Files created(SATRAD):*

```
programs/emiskf_dump.F90 emiskf_update.F90
```

emiss/emiskf\_config.F90 emiskf\_predict.F90 emiskf\_traj.F90

*Files modified(IFS):*

common/yomdb\_defs.h yomdb\_vars.h

obs\_preproc/defrun.F90

op\_obs/radlcmis.F90

*Files modified(ODB):*

cma2odb/initmdb.F90

ddl/emiskf\_amsua.sql emiskf\_amsub.sql emiskf\_mhs.sql emiskf\_atms.sql radiance.h

satbody\_screen\_atovs.sql

*Files modified(SATRAD):*

programs/kfgrid\_converter.F90

emiss/kfgrid\_delete.F90 kfgrid\_get.F90 kfgrid\_init.F90 kfgrid\_init\_from\_file.F90

kfgrid\_write.F90 emiskf\_init\_atlas.F90 emiskf\_write\_atlas.F90

emiskf\_estimate\_emissivity.F90 emiskf\_init.F90 emiskf\_prep\_h.F90

emiskf\_update\_atlas.F90 emiskf\_alloc\_read\_input.F90

mopdule/eda\_rad\_aux.F90 mod\_emiskf.F90 mod\_emiskf\_stats.F90 mod\_kfgrid.F90

*Files modified(SCRIPTS):*

gen/emiskf mkabs\_satrad

sms\_an/emiskf.sms

*Files deleted(SATRAD):*

programs/emiskf\_update\_amsua.F90 emiskf\_update\_amsub.F90 emiskf\_update\_mhs.F90  
emiskf\_update\_atms.F90

emiss/emiskf\_delete\_sensor.F90 emiskf\_init\_sensor.F90 emiskf\_write\_sensor.F90

## **Niels Bormann and Reima Eresmaa - str\_CY40R2\_for\_CY40R3 - BR**

### **No observation-error correlations for passive data**

When inter-channel observation error correlations are activated and specified for certain channels, these are now only applied to actively used data. Previously, if error correlations were specified for certain channels, and one or more of them were subsequently set to VarBC passive, the observation error correlations were still included also for the passive channels, albeit with very large  $\sigma_o$ . This led to undesired effects for the variational bias correction for such passive data, and the present modification avoids such effects. Observation error correlations are not activated in 40R3, so this modification has no effect for the default configuration.

*Files modified(IFS):*

op\_obs/hjo.F90 interchan\_obserr\_cor.F90

## **Tony McNally - ste\_CY40R1\_osuite\_cray\_add\_cris\_o3\_ovc - PASSIVE**

### **Assimilation of CrIS**

Enable active assimilation of CrIS. As CrIS data blacklisted these changes have no meteorological impact.

*Files modified(IFS):*

obs\_preproc/cloud\_detect\_setup.F90 op\_obs/cloud\_estimate.F90 hretr.F90

*Files modified(SATRAD):*

programs/bufr\_screen\_cris.F90

*Files modified(SCRIPTS):*

gen/ifstraj mklinks prelcrad\_screen

## **Peter Lean and Alan Geer - dipl\_CY40R2\_GMI\_for\_40r3 - BR**

### **Code changes in preparation for GMI instrument on GPM satellite**

Data from the GMI microwave instrument will soon be ready for monitoring and assimilation within the all-sky framework. These changes form the bulk of the code changes required to passively monitor and eventually assimilate these observations. Further changes to bufr2odb and preobs will be required once the format of the operational GMI BUFR data is known. LGMI should be set to FALSE, so the code has no impact.

*Routines changed: Files created(SATRAD):*

interface/calc\_azimuth.h

pre\_screen/calc\_azimuth.F90

*Files created(SCRIPTS):*

sms/fc\_sens\_save\_gmi.sms

sms\_an/archive\_gmi.sms convert\_gmi.sms obstat\_archive\_gmi.sms obstat\_gmi.sms odb2odb1\_gmi.sms

*Files modified(IFS):*

module/get\_lwpcoeff\_mix.F90 sats\_mix.F90 varbc\_allsky.F90 yomsats.F90

mwave/mwave\_setup.F90

obs\_preproc/defrun.F90

op\_obs/hsatang.F90

var/getsatid.F90

*Files modified(ODB):*

cma2odb/subuoctp.F90

ddl/sensor.h

module/yomboctp.F90

*Files modified(SATRAD):* rttov\_const.F90

programs/get\_satinfo.F90

*Files modified(SCRIPTS):*

def/an.def enkf.def fsobs.def

gen/cleanodb mkabs\_black mkabs\_satrad mklinks obstat obstat\_init run\_fp varconst

# PREDICTABILITY

**Jean Bidlot, Kristian Mogensen and Martin Leutbecher - wab\_SB40R1\_PRD\_all**

**Jean Bidlot, Sarah Keeley, Saleh Abdalla, Peter Janssen, Giovanna De Chiara - wab\_SB40R1 -  
altas\_and\_ice**

## **Sea ice**

Change the sea ice cover minimum threshold from 20% to 5% for the sea ice analysis and to 2% within IFS.

Sea ice consistency checks based on SST is now turned off (there is a flag if it needs to be re-activated).

Add switch to use OSTIA data for SST and sea ice on all lake points (N.B. ice taken from high res NCEP product but pre-merged by UKMO).

Technical changes to use OSTIA data in grib format instead of bufr. It will need to be activated when OSTIA grib data are produced operationally.

Update to the wave/sea-ice interaction software (passive by default).

## **Altimeter data**

Switch to using altimeter wave height data from Saral Altika. Technical changes to use data from Cryosat 2 (still passive).

Update WAM ODB software to allow input of all observations with the appropriate flag (active, rejected, blacklisted, passive).

## **Scatterometer data**

With the current configuration a flag in the odb is set only when the along-track thinning is applied for wind Scatterometer and other observations (as defined in THINNER/DEFRUN). The flag used is report\_event1.redundant. A change has been made in order to introduce a new flag to set when the thinning is applied across-track for scatterometer observations. The new flag is report\_event1.thinned and is used for the thinned out (rejected) ERS and ASCAT observations.

## **Wave model fixes**

Bug fix to mean bathymetry calculation that affected certain coastal points.

Lake Victoria added.

Output of spectra for forecast step 0.

Updates to Buoy and Altimeter monitoring softwares.

UMAX=75m/s.

all to all communication for output of wave parameters.

## **Wave spectral partitioning**

As part of the postprocessing, the swell spectra can be partitioned into a maximum of 3 wave systems, characterised with wave height, mean period and mean direction. This is a change for operational production.

## **Freak wave**

Revision of the freak waves software. Introduction of a new parameter, the skewness of the sea surface elevation.

### **New parameters for operational running**

121 SWH1 Significant wave height of first swell partition (m)

122 MWD1 Mean wave direction of first swell partition (degrees)

123 MWP1 Mean wave period of first swell partition (s)

124 SWH2 Significant wave height of second swell partition (m)

125 MWD2 Mean wave direction of second swell partition (degrees)

126 MWP2 Mean wave period of second swell partition (s)

127 SWH3 Significant wave height of swell third partition (m)

128 MWD3 Mean wave direction of swell third partition (degrees)

129 MWP3 Mean wave period of swell third partition (s)

207 WSS Wave Spectral Skewness (-)

#### *Files created(SURF):*

function/fcz0.h

#### *Files created(WAM):*

Alt/urakaa.F

Buoy/get\_BUO\_from\_DMI\_data.F get\_BUO\_from\_FA\_data.F

mc\_cbsdms\_add\_anemometer\_height.F

Wam\_oper/betadef.F mpmdl4alt.F90 wam2odb.F90 wnfluxes.F

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

cma2odb/map\_reporttype.F90

tools/Odb2\_to\_Odb1\_ralt.F90

#### *Files modified(PREPDATA):*

programs/GH\_RH.F90

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

def/an.def

gen/fetchobs preobs sstana

wav/archive\_wave wam\_input wam\_reference\_levels\_global wam\_reference\_levels\_medit10

wave\_const wave\_data\_dates wave\_getalt wave\_getobs wave\_getrst wave\_runcold

#### *Files modified(SSA):*

module/yomsst.F90

namelist/namssa.nam.h

sub/ice\_analysis.F90 inisst.F90 ssa.F90

util/setcomssa.F90

#### *Files modified(SURF):*

module/surfexcdriver\_ctl\_mod.F90 surfexcdrivers\_ctl\_mod.F90 surfexcdriversad\_ctl\_

mod.F90 surfexcdriverstl\_ctl\_mod.F90 sussoil\_mod.F90 vupdz0\_mod.F90 vupdz0s\_mod.F90  
vupdz0sad\_mod.F90 vupdz0stl\_mod.F90

#### *Files modified(WAM):*

Alt/Makefile.wam.ibm alt\_hist\_prep.F axis.F axis\_plotting.F coltro.F colura.F  
colwnd.F curvef.F debac.F debfl.F decplp.F defsp.F enderac.F enrac.F enrfl.F  
expnl.F graph\_plotting.F hist\_draw.F inmarsi.F legend\_plotting.F make\_progs.mk  
make\_progs151.mk makefile\_sources\_libalt\_rs6000 pl\_bar.F pl\_grid.F playout.F  
plmesy.F plot\_layout.F plotdat.F plothea.F pltcontw.F pltetr.F pltmeanc.F  
pltura.F pserie.F raccon.F scor.F show\_esf.F text\_plotting.F textbox.F titmak.F  
trocal.F trocol.F ura\_col\_prep.F urabu5.F uracal.F uracol.F uracry.F uraetr.F  
uragat.F urapfs.F uraplt2.F urapre.F uraqcm.F uraqes.F uraqmh.F uraqrd.F  
uraqwf.F urascat.F urascatm.F urascor.F urasor.F  
Buoy/bsdcol\_off\_line.F get\_BUO\_from\_CEFAS\_data.F get\_BUO\_from\_Spanish\_data.F  
mc\_analysis\_rearrng.F mc\_analysis\_rearrng\_ym.F mc\_analysis\_rearrng\_ym\_tz.F  
mc\_analysis\_scatter\_plot.F mc\_analysis\_scatter\_plot\_ym\_tz.F mc\_analysis\_stats.F  
mc\_analysis\_stats\_ym.F mc\_analysis\_stats\_ym\_tz.F mc\_cbsdmscatter\_plot.F  
mc\_cbsdmsstats.F mc\_ecmwf\_rearrng.F mc\_ecmwf\_scatter\_plot.F mc\_ecmwf\_stats.F  
mc\_read\_and\_blacklist.F mc\_scatter\_plot.F mc\_scatter\_plot\_2.F mc\_stats.F  
plotmap.F qcbuoy.F  
Sar/sarinvert.F  
Wam\_oper/altas.F90 cigetdeac.F cimsstrn.F create\_wam\_bathymetry.F ctuw.F  
difdate.F fdur.F fndprt.F fustar.F fwsea.F grdata.F grfield.F90 implsch.F  
initmdl.F intpol.F inwgrib.F loc2glo.F mbounf.F mpbcastgrdfld.F mpcrtbl.F  
mpgatherscfd.F mpuserin.F newwind.F notim.F oifield.F outbeta.F outbs.F  
outgrid.F outint.F outsp.F outwnorm.F parmean.F preset.F prewind.F rfl4wam.F90  
saras.F savspec.F savstress.F secspom.F sep3tr.F sepwisw.F setice.F  
smoothsarspec.F stresso.F timin.F topoar.F update.F updatewd.F upwspec.F  
userin.F wamassi.F wamodel.F wamoi.F wavemdl.F wdfluxes.F wgrib2fdb.F wgribout.F  
write\_mpdecomp.F writefl.F writsta.F  
module/yowaltas.F yowcout.F yowgribhd.F yowintt.F yowparam.F yowtabl.F yowtrains.F

## **Kristian Mogensen (on behalf of all people work on NEMO) - ne1\_CY40R1\_devel\_L34E11\_cubic**

### **NEMO model and assimilation developments**

The branch contains all NEMO contributions for the coupled IFS/WAM/NEMO model, the NEMO standalone model and the NEMOVAR assimilation developments.

### **Updates to NEMO-WAM coupling**

There has been several changes to coupling between WAM and NEMO. The main change is that full fields for the energy and momentum flux are now exchanged rather than relative fields in both uncoupled and coupled mode. The use of momentum flux from WAM rather than from the atmosphere (the TAUOC option) is now activated in coupled mode.

The initial source code for a WAM-NEMO standalone coupled system has been included (no scripts yet). In this system both WAM and NEMO are forced with external atmospheric fields, but can exchange data between them.

### **Coupled IFS-NEMO model**

In order to support new surface climate fields and higher order Gaussian grids in the coupling interface the interpolation weights are now computed as part of the make family for type eps\_nemo and longrange.

### **ORCA025 configuration**

The configuration used for the 0.25 degree NEMO configuration (ORCA025) had been updated with a new configuration from the DRAKKAR project.

### **NEMOVAR changes**

Developments from the MYOCEAN2 project has been included. Some of the changes are: support for ORCA025, work on ensemble of analyses etc.

### **LIM2 changes**

It is now possible to read the cloud cover in forced mode rather than use a fixed value.

Initial work on coupling LIM2 and WAM has been implemented.

### **Technical changes to the NEMO system.**

NEMO source code to make the compilation of NEMO resolution independent has been imported from the official NEMO SVN repository.

### **Bugfixes.**

A fix to NPROMA related issue in radintg.F90 has been introduced. This fix is only applicable if LEPO3RA is true.

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

nemo/endnemoio.F90 ininemoio.F90

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

about 450 files were created

#### *Files created(WAM):*

Wam\_oper/recvnmofields.F updnmomstress.F wamendnemoio.F wamininemoio.F  
module/yownemoflds.F

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

climate/updclie.F90  
control/cnt4.F90  
dia/preset\_grib\_template.F90  
module/iostream\_mix.F90 yommcc.F90  
nemo/getnemo.F90 ininemo.F90  
phys\_ec/radintg.F90 sucumf.F90 sucumf2.F90 suphec.F90  
programs/master.F90  
transform/relaxgp.F90  
utility/updrlxref.F90

*Files modified(NEMO):* about 500 files were modified in NEMO

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

programs/bufr\_screen\_nexrad.F90

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



```
def/eps_nemo.def longrange.def
gen/bcsst gaussgr getini getobsst getpersSST.n getrelax mkabs_an mkabs_fc
mkabs_wam mkgenlinks mkidta_ocean mknam_fp modeleps_nemo
oce/chunk.h mm_archive_sfc model_nemoIFS
sms/getvarepsdata.sms libnemocoup.sms modeleps_tidy.sms nemo_tools.sms
pertainic.sms
sms_oc/cleantc.sms mm_sfc.sms mm_ua.sms tcyc.sms
wav/wave_setgflag
```

*Files modified(SSA):*

```
sub/inisst.F90
```

*Files modified(SURF):*

```
module/surfbc_ctl_mod.F90
```

*Files modified(WAM):*

```
Wam_oper/buildstress.F chief.F cigetdeac.F cimsstrn.F create_wam_bathymetry.F
getcurr.F implsch.F initmdl.F initnemocpl.F micep.F mpuserin.F newwind.F notim.F
outbs.F outgrid.F outint.F preset.F prewind.F timin.F unsetice.F updnemofields.F
userin.F wamassi.F wamodel.F wavemdl.F wdfluxes.F wvalloc.F wvdealloc.F
module/yowcoup.F yowcout.F yowintp.F yowmean.F
```

*Files deleted(NEMO):* about 250 files were deleted in NEMO

## **Kristian Mogensen, Magdalena Alonso Balmaseda and Hao Zuo - ne1\_SB40R1\_PRD\_nemo-scripts**

### **NEMO script cleanup**

Cleanup of scripts in project nemo and move and adopt the scripts to project scripts. The branch will need some prepIFS changes in order not to extract scripts from project nemo but from project scripts only when using NEMO. The results are unchanged by this branch.

*Files created(NEMO):*

```
scripts/sms/nchecksstweightscpl.sms sms/ngetsstcpl.sms sms/ngriddists_T_sst_cpl.sms
sms/ngridremap_sst_cpl.sms sms/nscriptgridssst_cpl.sms
```

*Files created(SCRIPTS):*

```
def/opa.def
nemo/* many scripts
```

*Files modified(NEMO):*

```
NEMOQC/code/src/NEMOQC/NemoQcMod_Extract/NemoQcMod_Extract.f90
code/src/NEMOQC/NemoQcMod_IO/NemoQc_OcnReadNetCDF.f90
scripts/def/opa.def generic/inner.h namelist.nemo.ORCA025_Z75
namelist.nemo.ORCA1_Z42 namelist.nemo.ORCA1_Z46 namelist.nemo.ORCA1_Z75 nemo.h
nemo_oper_model nemo_wam_model ngetforcing ngetforcingera40 ngetnml nprepseice
prep_nemo prep_nemoIFS
sms/linknemomake.sms narcforcing.sms narcrescp.sms ncatforcing.sms nchkres.sms
nclean_forcing.sms nclean_pert.sms nemoforce.sms nemoini.sms ngetforcing.sms
ngetobs.sms ngetoceanobs.sms ngetremap.sms nicediag.sms npertadd.sms
npertgen.sms npertprof.sms nprepicealongrange.sms nprepobs.sms nresdif.sms
```

ntrpmona.sms obsstats.sms outer.sms

*Files modified(PREPDATA):*

mc\_tools/adjust\_pertsfc.F90 scale\_pert.F90  
programs/GH\_RH.F90

*Files modified(SCRIPTS):*

def/an.def eps\_nemo.def gen.def longrange.def  
gen/stagemars  
oce/chunk.h  
sms/links.sms p4setup.sms  
sms\_oc/sc\_tools.sms

*Files deleted(NEMO):*

scripts/generic/model\_nemoOASIS generic/prep\_nemoOASIS generic/tidy\_nemoOASIS

## **Frédéric Vitart - nec\_CY40R1\_for40r3**

### **Extension of reforecasts**

Changes to extend reforecasts in operational suite to twice weekly 10+1 members.

### **Tropical cyclone tracker**

Updated code in order to remove cases of high-latitude TC genesis.

**Enhanced model output in ENS** Variable STRD is now archive on fdb every 6 hours after day 15 (like SSRD) for operations instead of every 24 hours. This was requested by user support.

*Files created(SCRIPTS):*

sms\_oc/mjo.sms

*Files modified(PREPDATA):*

programs/prob\_perc.F90  
tcyc/traj.F90

*Files modified(SCRIPTS):*

gen/modeleps\_nemo  
sms\_oc/prob\_perc.sms signi.sms wmanom.sms

## **Martin Leutbecher - nel\_CY40R1\_newML**

### **Ozone in ENS**

The activation of ozone as prognostic variable has been enabled in the scripts. It is envisaged that o3/tco3/uvb are activated in the operational ENS from cycle 40r3.

**Configuration for SPPT scheme** The namelist defaults for the Stochastically Perturbed Parameterization Tendency (SPPT) scheme have been made consistent with the settings used in ENS. A new method to specify the clipping of the random pattern has been introduced. The SPPT configuration in the EDA has been made fully consistent with the fast time-scale component of SPPT used in the ENS. This also removes an inconsistency

between the EDA settings for SPPT in forecast and trajectory.

**Update for SKEB scheme** The contribution of orographic gravity wave drag to the dissipation rate estimate used in the Stochastic Kinetic Energy Backscatter (SKEB) scheme has been removed.

*Files modified(IFS):*

```
module/yomspstd.F90
namelist/namspstd.nam.h namstoph.nam.h
setup/surand1.F90 suspsdt.F90
```

*Files modified(SCRIPTS):*

```
gen/ifstraj modeleps_nemo
oce/model_nemoIFS
```

## **Simon Lang - nesl\_SB40R1\_for\_cy40r3\_combined**

### **Compute SV scaling with scaled standard deviations from EDA**

The width of the Gaussian distribution used to sample the SV coefficient for the ENS perturbations is now calculated with the scaled standard deviations from EDA (SES).

**Fixes** A bug in the supersaturation treatment of the SPPT scheme has been fixed. The maximum length of file names in the programs for computing the initial perturbations of the ENS has been increased. Furthermore, the evolution of SVs has been fixed for the case when initial SVs are read instead of being computed.

*Files modified(IFS):*

```
phys_ec/sppten.F90
sinvect/cun2.F90
```

*Files modified(PREPDATA):*

```
mc_tools/add_pert.F90 adjust_pertsfc.F90
```

*Files modified(SCRIPTS):*

```
def/eps_sv.def
sms/getae.sms
```

## **MACC**

### **Richard Engelin - stj\_CY40R2\_MACC\_40r3\_A\_JF - BR**

#### **Updates for MACC**

The relaxation with respect to IFS ozone (203.128) in grid point space has been introduced. It is triggered by LRLXO3. The code for the relaxation for surface pressure has been bug-fixed.

Daily surface fluxes and dry deposition velocity fields for chemistry and aerosols can be read in during the model run. This is useful for longer forecast runs, in particular for relaxation runs. The switch is LMCC.-COMPO and the main new routine is climate/updclie\_compo.F90

The preparation of chemistry surface fluxes for the chemistry, which became more and more elaborate, has

been moved from gems\_init to the new routine phys\_ec/chem\_initflux.F90, which is interfaced to callpar with chemini\_layer.F90

A new option for the choice of the pressure level troposphere-stratosphere interface was introduced. It used to be a pre-scribed pressure interface but can now also be the tropopause height calculated by the routine TROPLEV if LCHEM\_TROPO.

*Files created(IFS):*

climate/updclie\_compo.F90  
phys\_ec/chem\_initflux.F90 chemini\_layer.F90

*Files modified(ALGOR):*

module/spectral\_fields\_mod.F90

*Files modified(IFS):*

chem/aer2massdia.F90 chem\_init.F90 chem\_main.F90 chem\_scav.F90 chem\_tm5.F90  
tm5\_boundary\_ch4.F90 tm5\_chem\_ini.F90 tm5\_do\_ebi.F90 tm5\_rbud.F90  
tm5\_wetchem.F90  
control/cpicgfl.F90 gp\_model.F90  
module/chem\_mix.F90 tm5\_chem\_module.F90 tm5\_photolysis\_new.F90 yommcc.F90  
yomrlx.F90 yomsrlx.F90  
namelist/namchem.nam.h nammcc.nam.h namrlx.nam.h  
op\_obs/radtr\_ml\_ad.F90  
phys\_ec/callpar.F90 callparad.F90 callpartl.F90 chem\_main\_layer.F90  
gems\_init.F90 local\_arrays\_ini.F90  
pp\_obs/ppobsatl.F90  
setup/sucpicgfl.F90 sudefo\_gflattr.F90 sugfl1.F90 sumcc.F90 sumcclag.F90  
surlx.F90  
transform/relaxgp.F90  
utility/updrlxref.F90 updtim.F90

## AEOLUS

### Michael Rennie - da7\_SB40R1\_aeolus\_proc\_cray\_osuite - BR

#### Aeolus L2B/C processing and assimilation

Major update of the aeolus project code i.e. Aeolus L2B/C processing software, to a preliminary version 2.10 (compatible with L1B v6.02 files). Porting Aeolus processing scripts to the Cray.

IFS: Minor modifications to allow Aeolus tasks to work.

ODB: Minor modifications to allow Aeolus tasks to work.

SCRIPTS: Modifications to allow Aeolus processing to work on the Cray (and IBM).

AEOLUS: Update to v2.10 (preliminary). This has many scientific improvements and much improved run-time.

*Files modified(AEOLUS):*

many files

*Files modified(IFS):*

op\_obs/hop.F90 op\_obs/hopad.F90 op\_obs/hopt1.F90 var/sacmac1.F90

**Files modified(SCRIPTS):**

build/Makefile.root.aeolus def/an.def gen/L1B\_gtt2odb2 gen/aeolus\_auxmet\_odb  
gen/aeolus\_l2b\_parallel gen/aeolus\_l2b\_prepare gen/aeolus\_l2b\_tidy  
gen/aeolus\_l2c gen/fetch\_L1B\_files gen/fetch\_L2BP\_inputs gen/fetchorbpre  
gen/fetchorbpre2 gen/get\_exe gen/get\_external\_l2b\_odb gen/getini  
gen/groupid=1.tables gen/groupid=10.tables gen/groupid=11.tables  
gen/groupid=12.tables gen/groupid=13.tables gen/groupid=14.tables  
gen/groupid=15.tables gen/groupid=16.tables gen/groupid=17.tables  
gen/groupid=18.tables gen/groupid=19.tables gen/groupid=2.tables  
gen/groupid=20.tables gen/groupid=21.tables gen/groupid=22.tables  
gen/groupid=23.tables gen/groupid=24.tables gen/groupid=25.tables  
gen/groupid=26.tables gen/groupid=27.tables gen/groupid=28.tables  
gen/groupid=29.tables gen/groupid=3.tables gen/groupid=30.tables  
gen/groupid=31.tables gen/groupid=32.tables gen/groupid=33.tables  
gen/groupid=34.tables gen/groupid=35.tables gen/groupid=36.tables  
gen/groupid=37.tables gen/groupid=38.tables gen/groupid=39.tables  
gen/groupid=4.tables gen/groupid=5.tables gen/groupid=6.tables  
gen/groupid=7.tables gen/groupid=8.tables gen/groupid=9.tables gen/gtt  
gen/gtt2simulobs gen/gtt2simulobs\_preproc gen/ifsmin gen/ifstraj gen/ifsvar  
gen/l2b\_ee\_to\_odb gen/l2b\_ee\_to\_odb2\_parallel gen/mergeodb gen/mkabs\_aeolus  
gen/mkabs\_odbtools gen/mklinks gen/mondb\_airs.sql gen/mondb\_groupid=99.sql  
gen/mondb\_iasi.sql gen/obstat gen/obstat\_init gen/odb2odb1  
gen/odb\_cracker\_aeolus\_auxmet gen/odbshuffle gen/ofb\_groupid=99.sql gen/p4\_mklib  
gen/prep\_couplo4 oce/em\_create\_veps oce/extrfields\_veps\_create  
sms/createfws.sms sms/eda\_mean.sms sms/logfiles.sms sms\_an/L2B\_EEtoODB.sms  
sms\_an/aeolus\_auxmet.sms sms\_an/aeolus\_l2b.sms sms\_an/aeolus\_l2b\_parallel.sms  
sms\_an/aeolus\_l2b\_prepare.sms sms\_an/aeolus\_l2b\_tidy.sms sms\_an/aeolus\_l2c.sms  
sms\_an/archive\_aeolus.sms sms\_an/archive\_obsgroup.sms sms\_an/convert\_aeolus.sms  
sms\_an/convert\_obsgroup.sms sms\_an/fetch\_L1B\_files.sms  
sms\_an/fetch\_L2BP\_inputs.sms sms\_an/fetchmarsodb.sms sms\_an/fetchorbpre.sms  
sms\_an/get\_external\_l2b\_odb.sms sms\_an/l1b\_pred\_orb2odb.sms  
sms\_an/obstat\_archive\_aeolus.sms sms\_an/odb2odb1.sms sms\_an/orbpre2simulobs.sms  
sms\_an/simulobs2odb.sms

## ENKF

### Mats Hamrud - nar\_SB40R1\_ENKF\_for\_CY40R3 - BR

#### EnKF Development

**Files modified(ENKF):**

module/analysis\_mod.F03 module/comp\_kernel\_mod.F03 module/control\_mod.F03  
module/covar\_local\_mod.F03 module/inflation\_mod.F03 module/obs\_base\_mod.F03  
module/obs\_constants.F03 module/obs\_distr\_mod.F03 module/state\_geometry.F03  
module/state\_mod.F03 module/state\_utils.F03 module/xb\_state\_mod.F03  
programs/master\_enkf.F03 programs/oper\_ens.F03

**Files modified(IFS):**

module/sats\_mix.F90 module/yommwave.F90 mwave/mwave\_obsop.F90  
mwave/mwave\_put.F90 obs\_preproc/defrun.F90 op\_obs/hjo.F90 op\_obs/hop.F90

op\_obs/hretr.F90

*Files modified(IFS AUX):*

module/mdl\_alltoallv\_mod.F90

*Files modified(ODB):*

ddl/global\_enkf\_1.sql ddl/global\_enkf\_10.sql ddl/global\_enkf\_100.sql  
ddl/global\_enkf\_105.sql ddl/global\_enkf\_110.sql ddl/global\_enkf\_115.sql  
ddl/global\_enkf\_120.sql ddl/global\_enkf\_15.sql ddl/global\_enkf\_2.sql  
ddl/global\_enkf\_20.sql ddl/global\_enkf\_25.sql ddl/global\_enkf\_3.sql  
ddl/global\_enkf\_30.sql ddl/global\_enkf\_35.sql ddl/global\_enkf\_4.sql  
ddl/global\_enkf\_40.sql ddl/global\_enkf\_45.sql ddl/global\_enkf\_5.sql  
ddl/global\_enkf\_50.sql ddl/global\_enkf\_55.sql ddl/global\_enkf\_60.sql  
ddl/global\_enkf\_65.sql ddl/global\_enkf\_70.sql ddl/global\_enkf\_75.sql  
ddl/global\_enkf\_80.sql ddl/global\_enkf\_85.sql ddl/global\_enkf\_90.sql  
ddl/global\_enkf\_95.sql ddl/satbody\_allsky.sql scripts/create\_global\_enkf\_sql.ksh  
tools/Create\_enkf.F90

*Files modified(PREP DATA):*

programs/gptosp.F90 programs/pertsst.F90 programs/unbal\_eda.F90  
programs/vod2uv.F90

*Files modified(SCRIPTS):*

build/arch/Makefile.in.cca build/arch/Makefile.in.cct def/enkf.def def/gen.def  
gen/add\_enkf\_to\_sql.pl gen/anml gen/anpl gen/ansfc gen/archive\_obs\_group  
gen/convert\_enkf gen/create\_ioassign gen/enkf\_anal gen/enkf\_ctl.h gen/enkf\_ecfs  
gen/ens\_stddev gen/fetcherr gen/fetchmars gen/getgrb gen/getxb gen/getxb2  
gen/hybrid\_an gen/ifsmim gen/ifstraj gen/merge\_iomap.pl gen/mkabs\_b2otools  
gen/mkabs\_enkf gen/model gen/modeleps\_nemo gen/postenkf gen/prehprior2  
gen/sekf\_sm gen/ssaana gen/sstana gen/vardata oce/storm sms/inidata.sms  
sms\_an/4dvar.sms sms\_an/clean\_an.sms sms\_an/enkftask.sms sms\_an/getxb.sms  
sms\_an/getxb2.sms sms\_an/hybrid\_an.sms sms\_an/ifstsave.sms sms\_an/lowres.sms  
sms\_an/postenkf.sms sms\_an/vardata.sms

*Files modified(TRANS):*

module/dist\_grid\_32\_ctl\_mod.F90 module/suleg\_mod.F90

*Files modified(WAM):*

Alt/urapre.F Alt/urasor.F Sar/decouwa.F Sar/decowvs.F Sar/erslsar.F Sar/uwapre.F  
Sar/wvscheck.F Sar/wvspre.F

## REANALYSIS

### Hans Hersbach - er9\_SB40R1\_ingest\_odb2\_with\_cray\_osuite - BR

#### Infra structure for the ingestion of historical and reprocessed data sets from ODB-2 into IFS for reanalysis

The ERA-20C century long reanalysis (Cy38r1) has used observations from the ISPD (surface pressure) and ICOADS (marine observations) data banks. These were imported from their original formats into ODB-2 and archived into MARS. For the ERA-20C reanalysis such ODB-2 data was retrieved from MARS, and converted to ODB-1 prior to assimilation in 4D-Var. In addition a few new ODB columns were introduced: unique.-

identifier@conv, timeseries\_index@conv and bias\_volatility@body.

For the forthcoming ERA-SAT reanalysis this same infra structure will be used to assimilate reprocessed data sets, such as AMV SATOB observations from CIMMS. It is therefore, very convenient to have this ability in Cy40r3, which is the target cycle for ERA-SAT. The processing of such data can be switched on in PrepIFS which then creates a dedicated family in the suite definition. When switched off (the default) there is no change in the suite definition.

In addition, a one-character bug fix is provided in the script longrange\_forcing, to enable the proper usage of an evolving radiative forcing (only executed when in PrepIFS LONGRANGE\_FORCING is switched on). This bug was not present in the branches that were used for the ERA-20C and ERA-20CM streams.

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

```
sms_an/merge_NO_OBSERVATIONS.sms merge_aeolus.sms merge_airs.sms merge_amsr2.sms
merge_amsre.sms merge_amsua.sms merge_amsua_allsky.sms merge_amsub.sms
merge_atms.sms merge_conv.sms merge_cris.sms merge_geos.sms merge_gpsro.sms
merge_hirs.sms merge_iasi.sms merge_ims.sms merge_iras.sms merge_meris.sms
merge_mhs.sms merge_msu.sms merge_mwhs.sms merge_mwri.sms merge_mwts.sms
merge_nexrad.sms merge_ralt.sms merge_resat.sms merge_resatak.sms
merge_satob.sms merge_scatt.sms merge_smos.sms merge_ssmi.sms merge_ssmis.sms
merge_ssu.sms merge_surf_conv.sms merge_synrg.sms merge_tmi.sms merge_vtpr1.sms
merge_vtpr2.sms merge_windsat.sms o2o_NO_OBSERVATIONS.sms o2o_aeolus.sms
o2o_airs.sms o2o_amsr2.sms o2o_amsre.sms o2o_amsua.sms o2o_amsua_allsky.sms
o2o_amsub.sms o2o_atms.sms o2o_cris.sms o2o_geos.sms o2o_gpsro.sms o2o_hirs.sms
o2o_iasi.sms o2o_ims.sms o2o_iras.sms o2o_meris.sms o2o_mhs.sms o2o_msu.sms
o2o_mwhs.sms o2o_mwri.sms o2o_mwts.sms o2o_nexrad.sms o2o_ralt.sms o2o_resat.sms
o2o_resatak.sms o2o_satob.sms o2o_scatt.sms o2o_smos.sms o2o_ssmi.sms
o2o_ssmis.sms o2o_ssu.sms o2o_synrg.sms o2o_tmi.sms o2o_vtpr1.sms o2o_vtpr2.sms
o2o_windsat.sms odb22odb.sms
```

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

```
common/yomdb_defs.h yomdb_vars.h
```

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

```
cma2odb/initmdb.F90
ddl/body.h conv.h hdr.h
module/aligned.F90 odb1.F90 odb2.F90 report_template.F90
tools/Odb2_to_odb1_era.F90 Odb2ifsreports_era.F90
```

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

```
def/an.def
gen/fetchmarsodb_era longrange_forcing mkabs_odbtools odb2odb1_era premarsodb
sms_an/mergeodb_formats.sms
```

#### *Files deleted(SCRIPTS):*

```
sms_an/odb22odb_era.sms
```

## **Paul Poli - erc\_CY40R1\_debug\_gps - almost BR**

### **Ground-based GPS**

The VARBC module for surface observation has been rewritten to organize the configuration by observable

(variable number) and report type, thereby allowing to easily add more observations and variables to monitor passively in the future, such as 2m-temperature or near-surface wind. There is also now a new functionality to set passive Atmospheric Path Delay (APD) observations from ground-based GPS. This is activated by setting fail(EXPERIMENTAL) on APD data in the blacklist and setting variable LBC\_SFCOBS\_APD=.true. in the namelist.

See: <https://software.ecmwf.int/wiki/display/erc/Ground-based+GPS>

Files modified substantially (near-rewrite):

*Files modified(IFS):*

ifs/module/varbc\_sfcobs.F90 odb/ddl/getsfcobsid.sql

Files with only a couple of lines changed:

*Files modified(IFS):*

ifs/obs\_preproc/black.F90 ifs/obs\_preproc/defrun.F90 ifs/op\_obs/hdepart.F90  
ifs/op\_obs/hop.F90 ifs/op\_obs/hopad.F90 ifs/op\_obs/hoptl.F90  
odb/bufr2odb/bufr2odb\_pgps.F90 odb/ddl/varbc\_sfcobs\_robhdr.sql  
odb/ddl/varbc\_sfcobs\_robbody.sql scripts/gen/ifsmin scripts/gen/ifsoops  
scripts/gen/ifstraj

## ODB

### Peter Lean - dipl.CY40R1\_map\_reporttype - BR

#### Use of ODBGOV database configuration file for reporttype mappings

Until now, observation reporttypes in IFS have been defined using map\_reporttype.F90 which contains hard-coded mappings from bufrtype, subtype, obstype, codetype etc to a reporttype. This change replaces map\_reporttype.F90 with a new module which loads the mapping data from a configuration file dumped directly from the ODBGOV database. This ensures that the code mappings are consistent with those approved by the ODB governance group. The configuration file is generated with the following url request:

<http://data-portal.ecmwf.int/odbgov/csv/full/>

The default config file location is rdx/data/\$CYCLE/an, but the user can use their own version of the config file by specifying an alternate path for the config file using ODB\_CONFIG\_PATH in the "ODB configuration" panel in prepIFS.

*Files created(ODB):*

module/odbmap\_reporttype.F90

*Files modified(ODB):*

module/b2o\_handle.F90 tools/Bufr2odb.F90 Simulobs2odb.F90

*Files modified(SCRIPTS):*

gen/bufr2odb

*Files modified(WAM):*

Wam\_oper/rfl4wam.F90



## **Peter Lean and Hans Hersbach - dipl\_CY40R1\_hans\_varno\_vertco - BR**

### **New ODB variables and vertical coordinate for ocean observations**

Added new ODB varnos : ocean salinity, potential temperature. Added new ODB vertco\_type: depth.

*Files modified(IFS):*

module/pardimo.F90 setup/suvnmb.F90 ddl/varno.h vertco\_type.h

## **COPE**

### **Tomas Kral - datk\_SB40R2\_cope\_release - BR**

#### **Improvements in the observation pre-processing system**

- externalized pre-processing of all conventional observations (full replacement for IFS-MKCMARPL code)
- introduction of aircraft humidity data for assimilation in IFS
- consistent initialization of fg\_depar and an\_depar to missing values for all observation types
- rejection of relative humidities when observed dew point is higher than temperature
- refactoring of BUFR-2-ODB code (25)
- improved BUFR-2-ODB interface for easier integration with other applications (e.g. COPE)
- added support for BUFR-SYNOP, BUFR-PILOT, BUFR-TEMP, TAMDAR and ACARS-MR

*Files created(IFS):*

obs\_preproc/btemdup.F90 btemthn.F90

*Files created(ODB):*

bufr2odb/b2o\_access.F90 b2o\_context.F90 b2o\_convert\_205.F90  
b2o\_convert\_aircraft.F90 b2o\_convert\_aircraft\_new.F90 b2o\_convert\_airs.F90  
b2o\_convert\_amsr2\_1d.F90 b2o\_convert\_amsre\_1d.F90 b2o\_convert\_ascat.F90  
b2o\_convert\_asr.F90 b2o\_convert\_atms.F90 b2o\_convert\_atovs.F90  
b2o\_convert\_cris.F90 b2o\_convert\_factory.F90 b2o\_convert\_fy3.F90  
b2o\_convert\_gch1.F90 b2o\_convert\_gch2.F90 b2o\_convert\_gch3.F90  
b2o\_convert\_gch4.F90 b2o\_convert\_gch5.F90 b2o\_convert\_grad.F90  
b2o\_convert\_iasi.F90 b2o\_convert\_ims.F90 b2o\_convert\_iscat.F90  
b2o\_convert\_meris.F90 b2o\_convert\_metar.F90 b2o\_convert\_modisaer.F90  
b2o\_convert\_msg.F90 b2o\_convert\_mwri\_1d.F90 b2o\_convert\_oscat.F90  
b2o\_convert\_paob.F90 b2o\_convert\_pgps.F90 b2o\_convert\_pilot.F90  
b2o\_convert\_qscat.F90 b2o\_convert\_radio.F90 b2o\_convert\_radio\_lat\_long.F90  
b2o\_convert\_radio\_lat\_long\_old.F90 b2o\_convert\_rain\_gauges.F90  
b2o\_convert\_rain\_rates.F90 b2o\_convert\_reo3.F90 b2o\_convert\_satob.F90  
b2o\_convert\_scatter.F90 b2o\_convert\_smos.F90 b2o\_convert\_snow.F90  
b2o\_convert\_ssmi.F90 b2o\_convert\_ssmis\_1d.F90 b2o\_convert\_synop\_land.F90  
b2o\_convert\_synop\_ship.F90 b2o\_convert\_temp.F90 b2o\_convert\_temp\_hires.F90

b2o\_convert\_tmi\_1d.F90 b2o\_convert\_windprofiler.F90 b2o\_convert\_windsat.F90  
b2o\_log.F90 b2o\_options.F90 b2o\_utility.F90  
ddl/ECMA/btemdup\_robhdr\_1.sql  
ddl/btemdup\_robhdr\_1.sql  
include/b2o\_config.h b2o\_debug.h  
module/assert\_mod.F90 b2o\_common.F90 b2o\_internal.F90 b2o\_iterator.F90 odbmap\_reporttype.F90

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

build/arch/Makefile.in.cray\_gfortran arch/Makefile.in.cray\_intel  
gen/airep.json awp.json check\_lakeini conv.json conv.schema.sql dribu.json  
error\_statistics.csv ewp.json geos.json metar.json pgps.json pilot.json  
resat.json satob.json ship.json synop.json temp.bias.country.rh.sql  
temp.bias.country.t.sql temp.bias.sonde.rh.sql temp.bias.sonde.t.sql temp.json  
sms\_an/merge\_NO\_OBSERVATIONS.sms merge\_aeolus.sms merge\_airs.sms merge\_amsr2.sms merge\_amsre.sms merge\_amsua.sms merge\_amsua\_allsky.sms merge\_amsub.sms merge\_atms.sms merge\_conv.sms merge\_cris.sms merge\_geos.sms merge\_gpsro.sms merge\_hirs.sms merge\_iasi.sms merge\_ims.sms merge\_iras.sms merge\_meris.sms merge\_mhs.sms merge\_msu.sms merge\_mwhs.sms merge\_mwri.sms merge\_mwts.sms merge\_nexrad.sms merge\_ralt.sms merge\_resat.sms merge\_resatak.sms merge\_satob.sms merge\_scatt.sms merge\_smos.sms merge\_ssmi.sms merge\_ssmis.sms merge\_ssu.sms merge\_surf\_conv.sms merge\_synrg.sms merge\_tmi.sms merge\_vtpr1.sms merge\_vtpr2.sms merge\_windsat.sms o2o\_NO\_OBSERVATIONS.sms o2o\_aeolus.sms o2o\_airs.sms o2o\_amsr2.sms o2o\_amsre.sms o2o\_amsua.sms o2o\_amsua\_allsky.sms o2o\_amsub.sms o2o\_atms.sms o2o\_cris.sms o2o\_geos.sms o2o\_gpsro.sms o2o\_hirs.sms o2o\_iasi.sms o2o\_ims.sms o2o\_iras.sms o2o\_meris.sms o2o\_mhs.sms o2o\_msu.sms o2o\_mwhs.sms o2o\_mwri.sms o2o\_mwts.sms o2o\_nexrad.sms o2o\_ralt.sms o2o\_resat.sms o2o\_resatak.sms o2o\_satob.sms o2o\_scatt.sms o2o\_smos.sms o2o\_ssmi.sms o2o\_ssmis.sms o2o\_ssu.sms o2o\_synrg.sms o2o\_tmi.sms o2o\_vtpr1.sms o2o\_vtpr2.sms o2o\_windsat.sms obstat\_calc.sms odb22odb.sms show\_dates\_an.sms

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

module/parcma.F90 yomcoctp.F90 yomsccl.F90  
namelist/namscc.nam.h  
obs\_preproc/conventional\_ob.F90 defrun.F90 dupli.F90 redml.F90 redor.F90  
redrp\_no\_sq.F90 redun.F90 screen.F90 selec.F90 sonde\_country\_db\_match.F90  
tempin.F90  
setup/cmoctmap.F90 cmoctmap\_inv.F90 su0phy.F90

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

bufr2odb/fy3\_corrections.F90 get\_varindex.F90  
cma2odb/create\_averaged\_values.F90 ctxinitdb.F90 setcomcm.F90 shuffle\_odb.F90  
ddl/conv.h getairepid.sql redun\_robhdr\_6.sql varno.h  
interface/create\_averaged\_values.h  
module/getval\_module.F90 init\_module.F90 varindex\_module.F90  
tools/Bufr2odb.F90 Simulobs2odb.F90

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

def/an.def coup.def enkf.def eps\_nemo.def eps\_sv.def eps\_varfc.def fc.def  
fsobs.def gen.def ifs\_ctm.def longrange.def oc.def sens.def test\_sv.def wam.def  
functions.pifs/ERROR

gen/add\_nrt\_fire\_chem anml ansfc bcsst bufr2odb chem\_setup chemarch\_ml  
 coldstart\_lakes ens\_fetch\_fields ens\_stats\_mem fast\_sgint fetchmars fetchmarsodb  
 fetchmarsodb\_era fetchobs forceinv2clim get\_fire\_emis get\_fire\_emis\_ctm  
 get\_gems\_surface get\_nrt\_fire\_chem get\_tm5\_initcond getini getmars getrelax  
 getxb ifsmin ifsoops ifstraj inter\_fp logfiles longrange\_forcing lowres\_fp  
 mkabs\_an mkabs\_fc mkabs\_odbtools mkabs\_prepdata mkabs\_satrad mkabs\_wam  
 mkgenlinks mkidta\_eps mklinks mknam\_fp model modeleps\_nemo obstat\_init odb2odb1  
 odb2odb1\_era prelcrad\_screen pre\_fetch\_jb\_grid pre\_fetch\_jb\_spectral pregbrad  
 premarsodb premwimg prep\_flux prep\_initcond run\_fp smrescale\_res vardata  
 vareps.h  
 nemo/namelist.nemo.ORCA1\_Z46 namelist.nemo.ORCA1\_Z75 namelist.nemovar.ORCA1\_Z46  
 namelist.nemovar.ORCA1\_Z75 nemoarc  
 oce/model\_nemoIFS  
 sms/geticp.sms getini.sms nemo\_tools.sms pt.sms sfc.sms wamverify.sms  
 sms\_an/cope\_obsgroup.sms mergeodb\_formats.sms postenkf.sms  
 sms\_nemo/arcnemo.sms narcrescp.sms nemoarc.sms nemomppcomb.sms ngriddists.sms  
 ngriddists\_T.sms ngriddists\_U.sms ngriddists\_V.sms ngriddists\_wam.sms  
 ngriddists\_wam\_T.sms ngriddists\_wam\_U.sms ngriddists\_wam\_V.sms  
 wav/wave\_getalt

**Files modified(WAM):**

Wam\_oper/implsch.F initmdl.F sdissip.F seticemask.F wdfluxes.F wnfluxes.F

**Files deleted(ODB):**

bufr2odb/b2o\_f008001.F90 b2o\_f008042.F90 b2o\_gbyte.F90 b2o\_sbyte.F90  
 bufr2odb\_205.F90 bufr2odb\_aircraft.F90 bufr2odb\_airs.F90 bufr2odb\_amsr2\_1d.F90  
 bufr2odb\_amsre\_1d.F90 bufr2odb\_ascat.F90 bufr2odb\_asr.F90 bufr2odb\_atms.F90  
 bufr2odb\_atovs.F90 bufr2odb\_cris.F90 bufr2odb\_fy3.F90 bufr2odb\_gch1.F90  
 bufr2odb\_gch2.F90 bufr2odb\_gch3.F90 bufr2odb\_gch4.F90 bufr2odb\_gch5.F90  
 bufr2odb\_grad.F90 bufr2odb\_iasi.F90 bufr2odb\_ims.F90 bufr2odb\_iscat.F90  
 bufr2odb\_meris.F90 bufr2odb\_metar.F90 bufr2odb\_modisaer.F90 bufr2odb\_msg.F90  
 bufr2odb\_mwri\_1d.F90 bufr2odb\_oscat.F90 bufr2odb\_paob.F90 bufr2odb\_pgps.F90  
 bufr2odb\_qscat.F90 bufr2odb\_radio.F90 bufr2odb\_radio\_lat\_long.F90  
 bufr2odb\_rain\_gauges.F90 bufr2odb\_rain\_rates.F90 bufr2odb\_reo3.F90  
 bufr2odb\_satob.F90 bufr2odb\_scat.F90 bufr2odb\_smos.F90 bufr2odb\_snow.F90  
 bufr2odb\_ssmi.F90 bufr2odb\_ssmis\_1d.F90 bufr2odb\_synop.F90 bufr2odb\_temp.F90  
 bufr2odb\_temp\_hi\_res.F90 bufr2odb\_tmi\_1d.F90 bufr2odb\_windprofiler.F90  
 bufr2odb\_windsat.F90 create\_bitmap.F90 flag\_rev.F90 o2b\_f008001.F90 p.F90  
 cma2odb/buf2cmat\_new.F90

**Files deleted(SCRIPTS):**

sms\_an/odb22odb\_era.sms show\_dates.sms

**Bruce Ingleby - in datk\_SB40R2\_cope\_release**

**Changes related to new BUFR TEMP and BUFR SYNOP data:**

- Duplicate checking against alphanumeric reports. (In general if BUFR data is not blacklisted it is used in preference to alphanumeric reports. The checking of radiosonde data is complicated because the time of report can be different launch time vs nominal time - hence the check is outside the time slot loop. There can be two BUFR radiosonde reports - up to 100 hPa and full - the longer one is chosen.)

- Vertical thinning of high resolution BUFR radiosonde data.
- Namelist variables were added to control the duplicate checking/thinning.
- Changes to radiosonde bias correction (Drasko).

*Files modified(IFS):*

```
module/yomcoctp.F90 module/yomsccl.F90 namelist/namscc.nam.h
obs_preproc/btemdup.F90 (new) obs_preproc/btemthn.F90 (new)
obs_preproc/defrun.F90 obs_preproc/dupli.F90 obs_preproc/redml.F90
obs_preproc/redor.F90 obs_preproc/redrp_no_sq.F90 obs_preproc/redun.F90
obs_preproc/screen.F90 obs_preproc/selec.F90
obs_preproc/sonde_country_db_match.F90 (Drasko's change) obs_preproc/tempin.F90
```

*Files modified(IFS):*

```
cma2odb/ctxinitdb.F90 ddl.ECMA/btemdup_robhdr_1.sql (new)
ddl/btemdup_robhdr_1.sql (new) ddl/redun_robhdr_6.sql
```

## OBSTAT

### Mohamed Dahoui - mo3\_CY40R1\_40R3\_obstat - BR

#### Improvements to Obstat

- Allow the monitoring of different categories of Aeolus winds (Mie-clear,Mie-Cloudy,Rayleigh-clear,Rayleigh-cloudy and all categories combined)
- Distinguish between Radar based rain from the American NEXRAD data and the European ones
- Fix a problem causing the duplication of DMSP-17/SSMIS
- Update the config files to allow the production of statistics for "USED" MHS all sky radiances.
- Update the config files to produce statistics for "ACTIVE" AMSUA all sky data (instead of "ALL" and "USED")

*Files modified(IFS):*

```
inisoftdef.F90, odb2read.F90 and upsoft.F90
obstat
stat.ref, stat.ref.DCDA, stat.ref.grid.rdx and stat.ref.fcdep
```

## FULLPOS

### Tomas Wilhelmsson - nat\_SB40R1\_Fullpos.2 - Not BR

#### Replacement of FULLPOS 927 by FULLPOS-2

### *Files modified(IFS):*

adiab/postphy.F90 control/cnt4.F90 dia/wroutgpgb.F90 fullpos/endpos.F90  
fullpos/fpcordyn.F90 fullpos/fpcorphy.F90 fullpos/rdecclimo.F90  
fullpos/stepo\_fpos.F90 fullpos/sufpc.F90 fullpos/sufptrans.F90 module/yomfpc.F90  
namelist/namfpc.nam.h utility/updrlxref.F90

### *Files modified(SCRIPTS):*

gen/ifstraj gen/inter\_fp gen/lowres\_fp gen/mkidta gen/mknam\_fp gen/model  
gen/modeleps\_nemo gen/sekf\_sm

## OPTIMISATION

### **John Hague - da0j\_CY40R1\_Perf2 -BR**

#### **Optimisation for Cray**

The vectorisation has been improved giving a 3% on a 1-day T1279 forecast.

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

interpol/laitri.F90 phys\_ec/cloudsc.F90 phys\_ec/cuadjtq.F90  
phys\_ec/update\_state.F90

#### *Files modified(WAM):*

Wam\_oper/propags2.F Wam\_oper/secspom.F

## TECHNICAL

### **Peter Towers - BR**

#### **Memory usage information on the Cray XC30**

Five existing IFS routines are modified. They are

- mpl\_init\_mod.F90 - add call to ec\_cray\_meminfo
- mpl\_end\_mod.F90 - add call to ec\_cray\_meminfo
- gethwm.c - add call to get\_tcmalloc\_heap\_size
- getcurheap.c - add call to get\_tcmalloc\_current\_allocated\_bytes
- gstats\_print.F90 - remove code added at 40r1C\_827 and 40r3

When using Cray Fortran the gethwm and getcurheap routines will now provide sensible values for the maximum heap size and the current heap size. The per task memory usage table printed out at the end of CNT0 is now good.

#### *Files created(IFSAUX):*

utilities/ec\_cray\_meminfo.F90 utilities/get\_tcmalloc.info.c  
include/malloc\_extension.c.h

*Files modified(IFS AUX):*

module/mpl\_init\_mod.F90 mpl\_end\_mod.F90 utilities/gethwm.c gethwm.c  
support/gstats\_print.F90

## **George Mozdynski - mpm\_CY40R1\_suprocgp - BR**

### **Optimisation of SUPROCGP**

This branch optimizes suprocgp\_dep by removing the call to suprocgp which computes which task owns each global grid point. SUPROCGP is obsolete as this information is already computed earlier and more efficiently in SUMP and stored in array NGLOBALPROC. This branch saves 24 secs on TITAN (a CRAY XK7) for a T3999 model case as shown by a reduced su0yomb wall time.

*Files modified(IFS):*

fullpos/suprocgp\_dep.F90

## **George Mozdynski - mpm\_CY40R1\_iostream - BR**

### **Correct I/O statistics**

This branch corrects some I/O statistics produced by iostream\_mix.F90.

e.g. before fix (T3999L137 on 64K cores of TITAN, a CRAY XK7)

```
IOSTREAM_MIX:SETUP_IOREQUEST - KLEVS3D MISSING, ASSUMING MODEL LEVELS  
IO-STREAM CLOSED - ICMSHftg6INIT  
MPI-TASK: 1 - 335307078 BYTES IN 413 RECORDS TRANSFERRED IN 21.8686 SECS  
15.3 Mbytes/s, TOTAL TIME= 110.6816(19.8\%)
```

with fix

```
IOSTREAM_MIX:SETUP_IOREQUEST - KLEVS3D MISSING, ASSUMING MODEL LEVELS  
IO-STREAM CLOSED - ICMSHftg6INIT  
MPI-TASK: 1 - 13220208966 BYTES IN 413 RECORDS TRANSFERRED IN 24.6435 SECS  
536.5 Mbytes/s, TOTAL TIME= 95.8029(25.7\%)
```

Tested at ECMWF, T1279L137 model, control fzkv, branch fzwi.

*Files modified(IFS):*

module/iostream\_mix.F90

# OSUITE and CRAY

**Gabor Radnoti, Paul Burton and Deborah Salmond - das\_CY40R1\_osuite\_cray, dag\_SB40R1 - source\_cray\_esuite\_v1, dag\_CY40R1\_scripts\_cray\_esuite\_v1 - not BR**

## **Changes for osuite and Cray migration**

### *Files modified(IFSAUX):*

ifsaux/support/gstats\_print.F90 ifsaux/support/ifssig.c

### *Files modified(IFS):*

control/cdsta.F90 cgr1.F90 cnt4ad.F90 scan2mad.F90 sim4d.F90  
fullpos/fpcorphy.F90 module/iostream\_mix.F90 yomvrtl.F90 yomvrtlx.F90  
namelist/namsens.nam.h namvrtl.nam.h setup/modgrin.F90 sulyom.F90  
utility/iopack.F90 var/cosjr.F90 grtest.F90 rd801.F90 suvar.F90

### *Files modified(ODB):*

cma2odb/create\_averaged\_values.F90

### *Files modified(PREPDATA):*

programs/GH\_RH.F90

### *Files modified(SATRAD):*

rttov/mw\_scatt/rttov\_boundaryconditions\_tl.F90 rttov\_eddington\_tl.F90

### *Files modified(SCRIPTS):*

def/an.def functions.pifs/ERROR gen/vardata mkabs\_black run\_parallel ifstraj  
ifsnewverify logfiles mkidta\_sens odb2odb1 preobs sms/createfws.sms  
libblackdummy.sms libs.sms logfiles.sms logfiles\_ecfs.sms p4setup.sms  
sms\_an/obstat\_archive.sms pobstat.sms scat.sms wav/wave\_newverify