RESEARCH DEPARTMENT MEMORANDUM

To:	RD Scientific Staff and Consultants
Copy:	HR, HO, HMD, HMAS, HMOS, J.Hodkinson Jean Pailleux, François Bouttier, Claude Fischer
From:	Deborah Salmond et al.
Date:	July 16, 2009 File: R48.3/DS/0921
Subject:	**IFS Memorandum Cycle CY35R3**

Cycle 35r3 was created in March-June 2009.

Modified libraries: aeolus algor ifs ifsaux obstat odb prepdata reanal satrad scat scmec scripts surf ssa trans wam

Contributors:

Saleh Abdallah, Gianpaolo Balsamo, Peter Bauer, Peter Bechtold, Anton Beljaars, Angela Benedetti, Jean Bidlot, Carla Cardinali, Andrew Collard, Mohamed Dahoui, Patricia De Rosnay, Dick Dee, Rossana Dragani, Emmanuel Dutra, Richard Engelen, Johannes Flemming, Richard Forbes, Anne Fouilloux, Manuel Fuentes, Alan Geer, Iliana Genkova, Mats Hamrud, John Hague, Jan Haseler, Sean Healy, Hans Hersbach, Elias Holm, Lars Isaksen, Marta Janiskova, Peter Janssen, Martin Koehler, Blazej Krzeminski, Martin Leutbecher, Dingmin Li, Philippe Lopez, Tony McNally, Jean-Jacques Morcrette, George Mozdzynski, Carole Peubey, Deborah Salmond, Soumia Serrar, Glenn Shutts, Martin Steinheimer, Yuhei Takaya, David Tan, Peter Towers, Yannick Tremolet, Agathe Untch, Nils Wedi, Tomas
Wilhelmsson

Scientific changes

Jean-Jacques Morcrette and Mike Iacono (AER, Inc)

Speed-up of exponential computations in RRTM_SW using look-up tables

Files created(IFS):

`module/yoesrtab.F90 phys_radi/susrtab.F90`

Files modified(IFS):

`module/yoerrtab.F90 phys_radi/srtm_reftra.F90 srtm_spcvrt.F90 srtm_spcvrt_mcica.F90 suecrad.F90`

Hans Hersbach and Yannick Tremolet

Bugfix for the adjoint of the scatterometer observation operator.

This code change does not produce bit identical results but has no meteorological impact. This modification makes the global adjoint test correct to the expected accuracy and improves the relative error of CONGRAD's gradient by 2 or 3 orders of magnitude on the cases tested.

Files modified(IFS):

`op_obs/preintad.F90`

Yannick Tremolet

Weak constraint 4D-Var and 4D-Var diagnostics.

- It is possible to switch off the Jb balance operators in the stratosphere. This is controlled by the flag LBALSTRATO and the balance operators are progressively reduced to zero weight between the levels NLEVBAL0 and NLEVBAL1.
- The model error forcing term has been updated for correction of model error in the stratosphere only. The forcing is applied progressively starting at level NLEVERR0 and applied fully starting at level NLEVERR1. The list of fields for which model error is applied has been made independent of the fields for which the initial condition is controlled in 4D-Var. By default, model error is active for temperature, vorticity, divergence and surface pressure.
- Changes were made to the Jc-DFI term for long window 4D-Var and for use as a diagnostic in the outer loops of 4D-Var or in forecast mode. Some unnecessary arrays (RSTOSPA) have been removed reducing the memory used by the Jc-DFI computation in half.
- Many technical developments for the future long window 4D-Var and split outer loops are included.
- A new adjoint test that includes the observation operators was developed. It is activated by the same logical as the existing adjoint test (LADTEST). This new implementation tests the adjoint for the complete sequence of change of variable + model integration + observation operators, it is thus more comprehensive than the previous test which did not account for the observation operators. This test can also be used

when wavelet Jb and the model error term are used together which was not possible with the previous version of the adjoint test. Because of the advantages of this adjoint test over the previous adjoint test, the older version should be removed in a future cycle.

The branch will not give bit identical results to 35r2 because of the re-organization of some of the Jc-DFI routines for long window 4D-Var where the order of some computations has changed.

Files created(IFS):

`control/adjobsens.F90 adjotest.F90`

`var/congrad_ad.F90`

Files created(ODB):

`tools/Revert_seqnos.F90`

Files created(SCRIPTS):

`gen/getoverlap ifstmerge`

`sms_an/getoverlap.sms ifstmerge.sms mergeodb_CCMA.sms setoverlap.sms`

Files modified(ALGOR):

`module/control_vectors_base_mix.F90 control_vectors_data_mix.F90 control_vectors_-oper_mod.F90`

Files modified(IFS):

`common/yomdb_defs.h yomdb_vars.h`

`control/cfcsens2obs.F90 cnt1.F90 cnt3ad.F90 cnt4.F90 cnt4ad.F90 cnt4tl.F90 cva1.F90 cva2.F90 forecast_error.F90 gp_model_ad.F90 gp_model_tl.F90 scan2m.F90 scan2mad.F90 scan2mtl.F90 sim4d.F90`

`dfi/dealldfi.F90 dfi3.F90 digfil.F90 digfilad.F90 sualldfi.F90 sudfi.F90`

`dia/gridpoint_norm.F90`

`module/control_vectors_comm_mod.F90 spectral_columns_mix.F90 testvar_mix.F90 traj_main_mod.F90 traj_surface_mod.F90 varbc_setup.F90 yomcosjo.F90 yomcva.F90 yomdfi.F90 yomjcdfi.F90 yomjg.F90 yomjq.F90 yommodel_error.F90`

`namelist/namdfi.h namjg.h namjo.h nammoderr.h namvar.h`

`obs_preproc/comtc.F90 defrun.F90 preamb.F90`

`op_obs/hdepart.F90 hjo.F90 hop.F90 hopad.F90 hoptl.F90`

`parallel/dot_product_ctlvec.F90 gathercosto.F90`

`setup/su0yomb.F90 su1yom.F90 sudim1.F90 sudyn.F90 suinimoderr.F90`

`sinvect/nalan1.F90`

`utility/dealctv.F90 prt_ctlvec_max.F90 prt_ctlvec_norms.F90 prtjo.F90 random_ctlvec.F90 sbsfgs.F90 setimzero.F90 sualspajb.F90 write_ctlvec_grib.F90`

`var/add_moderr_ad.F90 add_moderr_tl.F90 adtest.F90 bgvecs.F90 congrad.F90 cvar3.F90 cvar3ad.F90 cvar3in.F90 cvar3inad.F90 cvarbc.F90 cvarbcad.F90 cvarbcin.F90 cvtest.F90 evcost.F90 evjcdfi.F90 jqvcor.F90 sqrtq.F90 sqrtqad.F90 sqrtqin.F90 sqrtqinad.F90 sualcos.F90 sualctv.F90 suamv.F90 sucos.F90 sujb.F90 sujq.F90 sujqdata.F90 sujqstd.F90 sulimb.F90 sumoderr.F90 suqnorm.F90 surad.F90 suvar.F90 suvazx.F90 weak_constraint.F90 weak_constraint_ad.F90 weak_constraint_tl.F90`

Files modified(ODB):

`cma2odb/ctxinitdb.F90 initmdb.F90 revmatchupdb.F90 shuffle.F90`

ddl/adjust_seqnos.sql cma.h robody.sql

interface/revmatchupdb.h

tools/Adjust_seqnos.F90

Files modified(SCRIPTS):

def/an.def

gen/anml anpl ansfc fdbksave fetcherr getgrbme getini ifsmin ifstraj ifsvar mkabs_odbtools mklinks model odbshuffle revmatchup run_parallel ssaana var_include vardata

sms/libs.sms rmfdb.sms

sms_an/clean_an.sms

Files deleted(IFS):

var/add_modbias.F90 add_moderr.F90 multqnorm.F90

Patricia De Rosnay

Restructuring of Surface Analysis and Decoupling of the Jacobians computation

The Surface Analysis is moved before 4D-Var.

Decoupling the Jacobians for the SEKF is done in callpar where perturbed simulations are conducted (only when SEKF is activated). I added four subroutines to store and restore VDFOUTER and SURFTSTP outputs before and after each perturbed simulation:

Files created(IFS):

phys_ec/restore_surftstp.F90 restore_vdfout.F90 store_surftstp.F90 store_vdfout.F90

Files created(SCRIPTS):

gen/sekfana

sms_an/b2o_surf_conv.sms mergeodb_surf.sms o2b_surf_conv.sms obstat_surf_conv.sms odbcmp_surf_conv.sms

Files modified(IFS):

control/csekf2.F90

module/yomsekf.F90

phys_ec/callpar.F90 callparad.F90 callpartl.F90 ec_phys.F90 gems_dealloc.F90 gems_init.F90 vdfdifh.F90 vdfdifm.F90 vdfincr.F90 vdfmain.F90

sekf/pertsekf_v2.F90 sekf_backgerr.F90 sekf_magn_rh.F90 sm_ekf_main.F90 susekf.F90

utility/dealsc2.F90

Files modified(ODB):

ddl/ssa_robody_2m.sql ssa_robody_snow.sql

Files modified(PREPDATA):

programs/soilinc.F90

Files modified(SCMEC):

source/cpg1c.F90

Files modified(SCRIPTS):

```
def/an.def
gen/bufr2odb fdbksave fetchmars fetchobs ifsvar matchup mkabs_ssa obstat
revmatchup satimsim sekf_sm soilana ssaana sstana vardata
oce/wm_create_veps_ua
sms/setup.sms
sms_an/mergeodb.sms
```

Files modified(SSA):

```
module/yomssa.F90
namelist/namssa.h
plot/print_nml.F90
sub/control_ssa.F90 initial_rejection.F90 scan_cma_odb.F90
util/setcomssa.F90
```

Nils Wedi and Mats Hamrud

Revised computation of the points and weights for the Gauss-Legendre quadrature

The contribution in this branch implements a revised computation of the points and weights for the Gauss-Legendre quadrature and also the starting point for the computation of the associated Legendre polynomials (Schwarztrauber, SIAM J. Sci. Comput. Vol. 24 (3) (2002), pp. 945-954). This change enables the computation of the Gaussian latitudes and the associated Legendre polynomials for resolutions `NSMAX>1000` without the need for quadrupole precision arithmetic. In particular, the computational procedure that checks on the aliasing and on the orthogonality properties of the associated Legendre polynomials on a reduced grid (cf. Courtier and Naughton, Q.J.R. Meteorol. Soc. (1994), pp. 1389-1407) now also works for `NSMAX>1000` with double precision arithmetic and convergence thresholds up to 10-12 as intended.

The branch also contains a memory saving (by half) in the setup of the trans package, which will facilitate in particular the non-IFS computation of spectral transforms at high resolution (gptosp, sptogp etc.).

Files modified(TRANS):

```
external/setup_trans.F90
module/cpledn_mod.F90 gawl_mod.F90 ltinv_mod.F90 set_resol_mod.F90 sugaw_mod.F90 suleg_-
mod.F90 supol_mod.F90
```

Dick Dee

VarBC development

Further development and clean-up of VarBC generalization introduced in Cy35r2. Introduction of 'class' to distinguish among different groups of data that require separate VarBC modules. Currently supported classes are: rad, allsky, reo3, tcwv. Introduction of version 004 of the VARBC.cycle file, to support the class attribute, and to improve readability.

Files modified(IFS):

```
module/varbc_rad.F90 varbc_setup.F90
```

Files modified(ODB):

cma2odb/ctxinitdb.F90

Files modified(SCRIPTS):

gen/ifsmin ifstraj

Files deleted(IFS):

module/varbc_rad_allsky.F90

Files created(ODB):

ddl.CCMA/varbc_allsky_robhdr.sql varbc_allsky_robody.sql varbc_tcwv_robhdr.sql varbc_tcwv_robody.sql ddl.ECMA/varbc_allsky_robhdr.sql varbc_allsky_robody.sql varbc_tcwv_robhdr.sql varbc_tcwv_robody.sql ddl/varbc_allsky_robhdr.sql varbc_allsky_robody.sql varbc_tcwv_robhdr.sql varbc_tcwv_robody.sql

Files deleted(ODB):

ddl.CCMA/varbc_rad_allsky_robhdr.sql varbc_rad_allsky_robody.sql
ddl.ECMA/varbc_rad_allsky_robhdr.sql varbc_rad_allsky_robody.sql
ddl/varbc_rad_allsky_robhdr.sql varbc_rad_allsky_robody.sql

Rossana Dragani and Dick Dee

VarBC update for retrieved products

The VarBC code was updated to include the possibility of variational bias correction of retrieved products already in CY35R2. Some changes were implemented here to account for specific ozone data characteristics and to allow a unique selection of the instrument data types to be bias corrected.

Files created(IFS):

module/varbc_allsky.F90 varbc_tcwv.F90

Files created(ODB):

ddl.CCMA/getsatid_reo3.sql
ddl.ECMA/getsatid_reo3.sql
ddl/getsatid_reo3.sql

Files modified(IFS):

common/yomdb_defs.h yomdb_vars.h
module/varbc_rad.F90 varbc_setup.F90 varbc_to3.F90 yomtvrad.F90
op_obs/hop.F90
var/surad.F90 sureo3.F90

Files modified(ODB):

bufr2odb/bufr2odb_reo3.F90 get_odb2bufr_varindex.F90 get_varindex.F90
cma2odb/ctxinitdb.F90 initmdb.F90
ddl/cma.h varbc_to3_robhdr.sql varbc_to3_robody.sql
module/odb2bufr_varindex_module.F90 varindex_module.F90

Files modified(SCRIPTS):

build/cc_compile.ksh
gen/get_ds_black ifsmin ifstraj
sms/libs.sms

sms_an/mergeodb.sms

Hans Hersbach

Scatterometer and sea-surface analysis related modifications

The branch contains the following elements:

- Assimilation/monitoring of EARS ASCAT data.
  - To be assimilated in the 35R3 e-suite.
  - Are labelled in ODB with DATASTREAM=1, compared to DATASTREAM=0 for global ASCAT data.
  - Blacklisting could be achieved by the phrase: if (DATASTREAM = EARS) then fail(CONSTANT); endif;
  - Both DATASTREAMS are separated in OBSTAT
- Add Instrument code in ODB for ERS-2 (150), QuikSCAT (313) and ASCAT (190). In collaboration with Mohamed.
- Allow more-detailed bias correction for QuikSCAT wind speed (by default not active in 35R3).
- Replace some hard coded threshold values to variables in the sea-ice analysis.

Files created(ODB):
ddl.ECMA/black_scatt.sql obstat_scatt.sql
ddl/black_scatt.sql obstat_scatt.sql

Files modified(OBSTAT):
src/iniitemloc.F90

Files modified(ODB):
bufr2odb/bufr2odb_ascat.F90 bufr2odb_qscat.F90 bufr2odb_scat.F90
cma2odb/ctxinitdb.F90 getdb.F90
ddl.ECMA/ECMA.dep
lib/datastream.F90

Files modified(SCAT):
programs/qscat25to50km.F

Files modified(SCRIPTS):
gen/fetchobs getbias obstat prescat
sms_an/prescat.sms

Files modified(SSA):
sub/ice_analysis.F90

Sean Healy

Bugfix in GPSRO tangent-linear code

The bending angles in the tangent linear code are now initialised to RMDI, rather than 0.0_JPRB, to be consistent with the full model.

Files modified(IFS):

`op_obs/gpscalc_alphatl.F90`

Jean Bidlot and Peter Janssen

Changes with impact on results

The main change is the introduction of wave damping in the wind input source term (sinput). By default, it is active (IDAMPING=1 in the input namelist). For numerical reason, we reverted to using the formulation of the surface roughness (z0) based on the Charnock relation as determined by WAM. We also had to increase the minimum wind speed used by WAM to 2 m/s.

In order to have consistent results between runs with 30 frequencies (default) or 36 frequencies, the high frequency part of wave induced stress is now computed from dynamically determined cut-off frequency fr_cut(see frcutindex), rather than the last discretised frequency fr_last, and that is done using the same scheme as before (see stresso) where fr_cut replaces fr_last.

The corner transport upstream (CTU) advection scheme was re-written to accommodate the possibility of ocean surface currents.

Stand alone runs will now be forced by neutral winds, as it is already done in the global model. The neutral winds are taken from the output of the global deterministic runs. In the forecast, 3 hourly fields will be used when available, otherwise it will be every 6 hours (currently, the postprocessing of the deterministic forecasts is every 3 hours until day 6 and the operational limited area wave model is only ran to day 5).

Technical changes

Output of wind direction as used by WAM (parameter 249) is now enforced. Two new parameters were introduced to describe the Stoke drift (the u and v components of the stoke drift, parameter 215 and 216). The model bathymetry can be output at all forecast steps and should therefore be archived as such.

The handling of field(s) returned from WAM to IFS has been optimised. In particular, the message passing required for the distribution of the wave model information to the IFS has been adapted to only exchange what is needed. The norms of the returned field(s) from WAM to IFS are now shown for every coupling time step but note that because only information that are required are exchanged, the norms are essentially local. The norms of the fields passed to WAM from IFS are written to the logfile every coupling time step but it is only the local norm.

WAM can now use surface currents that are passed by the IFS. A mechanism was put in place to detect whether or not the current fields have changed, in which case all pre-computed quantities that are affected can be recomputed. This is particularly the case for the check on the numerical stability of the advection scheme (CFL criteria).

A message passing mailbox size problem that existed when restart files were requested was removed. Restart file creation requires less memory.

The subroutine readwind that handled forcing fields (wind, etc ...) was split between those fields that are provided as input files (still in readwind) and the fields that are entering WAM via the interface with IFS, now dealt with in subroutine ifstowam.

wvwaminit was moved to avoid calling it in the IFS when no call the the rest of the wave model code would be done.

Minimum and maximum values for the output parameter kurtosis and BFI squared were introduced to avoid occasional unrealistic values.

A few more OpenMP and Dr Hook directives were added.

The scripts to extract the WAM code as a separate piece of code were updated. In order to minimise the number of external libraries that are needed, the ecfs routine SYMINV was replaced by a copy called wam_syminv.

Input files in the form of simple fortran unit name (fort.) were removed. All input files have specific names.

Files created(WAM):

`Wam_oper/dummy_no_assimil.F frcutindex.F getcurr.F ifstowam.F stokesdrift.F wam_syminv.F Wam_setup/create_wamassi_library extract_WAMASSI_code get_ASAR_data get_alt_data_type_obs readme_wamassi run_sat_preproc run_wamassi to_do_list_to_extract_wam to_do_list_to_extract_wamassi`

Files modified(IFS):

`phys_ec/ec_phys.F90 suwcou.F90 wvcouple.F90 utility/gstats_label_ifs.F90`

Files modified(SCRIPTS):

`build/Makefile.root.wam arch/Makefile.in.ibm_power5 gen/fast_sgint fetchmars fetchobs lowres_fp mkabs_wam mklinks prescat varconsts oce/checkrestarts cleanrestarts saverestarts sms/wamrun.sms wavini.sms wcold.sms sms_oc/ocwavini.sms wav/prep_wave topo_swamp wam_input wave_bsdcol wave_const wave_cpini wave_find_stream wave_getalt wave_getrst wave_getsar wave_getwave wave_getwind wave_run wave_runcold wave_set_config wave_set_tstep wave_setgflag wave_setup wave_setup_3v wave_setup_4v wave_setup_an`

Files modified(WAM):

`Alt/i_get_unit.F readpreb.F uraqrd.F Sar/decowvs.F subs_check.F wvscheck.F Wam_oper/adjust.F airsea.F altas.F bsdcol.F buildstress.F checkcfl.F chesig.F chief.F closend.F create_wam_bathymetry.F ctuw.F current2wam.F decode_integrated_parameter.F decode_point_spectra.F dummy_eclib.F fldinter.F getinptb.F getspec.F getstress.F getwnd.F gradi.F grb2wgrd.F gribpac.F grstname.F h_max.F implsch.F incdate.F initialint.F initmdl.F inmars.F intpol.F intwaminput.F kurtosis.F loc2glo.F mergesarcor.F micep.F mpabort.F mpbcastgrid.F mpdecomp.F mpdistribfl.F mpdistribintfld.F mpdistribscfld.F mpexchng.F mpfldtoifs.F mpgatherfl.F mpuserin.F mtabs.F mubuf.F newwind.F notim.F optint.F out_onegrdpt.F out_onegrdpt_sp.F outbs.F outcom.F outgrid.F outint.F outubuf.F outwnorm.F phys.F preproc.F preset.F prewind.F propags.F propags1.F propags2.F readfl.F readice.F readpre.F readsta.F readstress.F readwgrib.F readwind.F rfl4wam.F savspec.F savstress.F sinput.F spec2fdb.F statse.F stress.F stresso.F tauhf.F timin.F transf2.F updatewd.F userin.F wamassi.F wamcur.F wamodel.F wamoi.F wamwnd.F wavemdl.F write_currents.F write_mpdecomp.F writefl.F writestress.F writsta.F wstream_strg.F wvalloc.F wvwaminit.F Wam_setup/create_wam_library extract_WAM_code readme run_preproc run_preset run_wamodel module/yowcard.F yowcoup.F yowcout.F yowcurr.F yowfred.F yowgribhd.F yowice.F yowintp.F yowmap.F yowmean.F yowmpp.F yowparam.F yowpcons.F yowshal.F yowstat.F yowtabl.F yowubuf.F yowunit.F yowwind.F`

Nils Wedi, Manuel Fuentes and Peter Bechtold

Add final Gribcodes for non-oro GWD tendencies

Files modified(IFS):
`setup/sudefo_gflattr.F90 dia/pregrbenc.F90`

Peter Bechtold

Enable non-orographic gravity wave scheme and optimisation.

Files modified(IFS):
`phys_ec/gwdrag_wms.F90 sugwwms.F90 setup/su0phy.F90 sudefo_gflattr.F90`

Put again 0.8 mass flux factor for better tracer conservation

Files modified(IFS):
`phys_ec/cumastrn.F90 cumastrntl.F90 cumastrnad.F90`

Code cleaning and renumbering of sections

Files modified(IFS):
`phys_ec/callpar.F90`

Climplot package changes, enabling LCLIM option from prepIFS and removing old putksec grib commands

Files modified(SCRIPTS):
`sms/climplot.sms metview/monmeans_clim.met climate_obs.sms`

Peter Bechtold and Marta Janiskova

Adapting TL/AD for non-orographic gravity wave scheme

Also simplifying top level computation in orographic gravity wave scheme

Files modified(IFS):
`setup/sugfl.F90 phys_ec/sugwdrag.  F90 gwdrag.F90 gwdragtl.F90 gwdragad.F90 gwdrags.F90 module/yoegwd.F90`

Marta Janiskova

Enable TL/AD of longwave radiation in the topmost 10 levels.

Files modified(IFS):
`phys_ec/callparad.F90 callpartl.F90 radheat.F90 radheatad.F90 radheattl.F90`

Peter Bechtold and Agathe Untch

Tune remaining Rayleigh friction

Files modified(IFS):
`adiab/fspglh.F90`

Jean-Jacques Morcrette and Johannes Flemming

Enable Trace Gases CO2, CH4, O3 from GEMS

Bug correction to unit conversion in time variation of trace gases,and correction for vertical interpolation for 62 levels. LETRACGMS=true by default, means that when Cariolle climatology is activated `(lhghg=true and nghgrad>=19)`, GEMS values superseed Cariolle climatology for CO2, CH4 and O3. Move old ozone climatologies from directory phys_ec to phys_radi

Files modified(IFS):
`phys_radi radghg.F90, suecrad.F90, su_gco2clim.F90, su_ch4clim.F90, su_gozoclim.F90 phys_ec su_ghgclim.F90 module yoerad.F90 namelist naerad.h`

Files moved(IFS):
`phys_ec/suecozc.F90 suecozcaqua.F90 suecozo.F90 to phys_radi/suecozc.F90 suecozcaqua.F90 suecozo.F90`

Martin Koehler, Anton Beljaars and Nils Wedi

Avoid occasional unrealistic surface fluxes

To avoid occasional unrealistic surface fluxes over land at the beginning of vertical diffusion, surfseb_ctl_mod.F90 is called for time step 0 and the previous time level fluxes are used for all other time steps (instead of re-computing fluxes from surface/air differences). An additional security was introduced in vdfhghtn.F90. Changes were made to avoid blow-ups at T1279.

Files modified(IFS):
`phys_ec/vdfhghtn.F90`

Files modified(SURF):
`module/surfexcdriver_ctl_mod.F90`

Anton Beljaars and Saleh Abdallah

Gustiness

Velocity scale w* is passed to the wave model instead of zi/L to represent gustiness effects on waves. This is to avoid a blow-up at T1279. Furthermore, a more secure estimate of gustiness effects on u* is made in vupdz0_mod.F90 for low wind speeds.

Files modified(IFS):
`phys_ec/callpar.F90 ec_phys.F90 vdfmain.F90 vdfouter.F90`

Files modified(SURF):
`external/surfpp.F90 interface/surfpp.h module/sppgust_mod.F90 surfpp_ctl_mod.F90 vupdz0_mod.F90`

Files modified(WAM):
`Wam_oper/sinput.F`

Peter Bechtold, Martin Koehler, Richard Forbes

Reduce SW cloud bias and upper-tropospheric temperature bias through retuning of RCLDIFF

Files modified(IFS):
`phys_ec/sucldp.F90 cloudsc.F90`

Peter Bechtold and Martin Koehler

Removal of nvmass part of saturation calculation.

Not necessary anymore as standard saturation calculation has been optimised and gives slightly better results.

Files modified(IFS):
`phys_ec/vdfmain.F90`

Gianpaolo Balsamo and Emmanuel Dutra

Align the snow density operator in the analysis to the mode for new snow from satellite

Files modified(SCRIPTS):
`gen/ssaana`

Files modified(SURF):
`offline/driver/su0phy1s.F90 offline/driver/sudim1s.F90`
`offline/phys_ec/vdfdifh1s.F90`

Completed snow revision:

1. Rainfall interception by the snow-pack,
2. Re-tuned snow-forest albedo,
3. Continuous update of open-area snow-albedo during snow-fall (instead of instantaneous re-whitening),
4. Snow fraction function of snow-depth.

Files modified(SURF):
`module/yoephy.F90 namelist/naephy.h phys_ec/callpar.F90 callparad.F90`
`callpartl.F90 radcfg.F90 radpar.F90 suphec.F90 setup/su0phy.F90`

Files modified(SCRIPTS):
`gen/inter_fp`

Files modified(SURF):
`external/surfbc.F90 surfrad.F90 surftstp.F90 susurf.F90 interface/surfbc.h`
`surfrad.h surftstp.h susurf.h module/flake_driver_mod.F90 srfsn_lwimp_mod.F90`

srft_mod.F90 surfbc_ctl_mod.F90 surfrad_ctl_mod.F90 surfseb_ctl_mod.F90
surftstp_ctl_mod.F90 sussoil_mod.F90 susurf_ctl_mod.F90 vupdz0_mod.F90
yos_soil.F90 srfsn_lwexp_mod.F90 srfsn_rsn_mod.F90
surf/offline/driver/callpar1s.F90 cpg1s.F90 rdclim.F90 rdfvar.F90 rdsupr.F90
sucdfres.F90 sucdh1s.F90 sudcdf.F90 sugdi1s.F90 sugp1s.F90 sugpd1s.F90
suinif1s.F90 suphec.F90 updiag.F90 wrtdcdf.F90 wrtres.F90 sufcoldeporte.F90
sufsnowmip2.F90 offline/module/ptrgp1s.F90 yoephy.F90 yomgdi1s.F90 yomgp1s0.F90
yomgp1s1.F90 yomgp1sa.F90 namphy1s.h offline/phys_ec/vdfmain1s.F90

Lars Isaksen

Activation of HUBER Norm

For details, please see C Tavolato and L Isaksen: Implementation of the Huber norm VarQC in IFS. (RD memorandum R48.3/LI/0913 March 24, 2009)

Files modified(IFS):

obs_preproc/defrun.F90

Files modified(SCRIPTS):

gen/ifsmin ifstraj

Blazej Krzeminski

New land surface emissivity scheme for AMSU-A/B

Land surface emissivity for AMSU-A/B sounding channels is now dynamically retrieved from observations in selected window channel. Linear Kalman filter for dynamic emissivities was also implemented to constrain emissivity estimations with their past history. Filtered emissivities are currently used as a fallback in cases when dynamic emissivity retrieval would be difficult. Separation of bias correction over land and sea for AMSU-A surface sensitive channels 4 and 5 was also introduced.

Files created(ODB):

ddl.ECMA/emiskf_amsua.sql emiskf_amsub.sql emiskf_mhs.sql

ddl/emiskf_amsua.sql emiskf_amsub.sql emiskf_mhs.sql

Files created(SATRAD):

emiss/emiskf_alloc_read_input.F90 emiskf_delete_sensor.F90
emiskf_estimate_emissivity.F90 emiskf_init.F90 emiskf_init_sensor.F90
emiskf_msg.F90 emiskf_prep_h.F90 emiskf_update_atlas.F90 emiskf_write_sensor.F90
kfgrid_delete.F90 kfgrid_get.F90 kfgrid_init.F90 kfgrid_init_from_file.F90
kfgrid_update.F90 kfgrid_write.F90

module/mod_emiskf.F90 mod_emiskf_stats.F90 mod_kfgrid.F90

programs/emiskf_update_amsua.F90 emiskf_update_amsub.F90 emiskf_update_mhs.F90

Files created(SCRIPTS):

gen/emiskf

sms_an/emiskf.sms

Files modified(IFS):

common/yomdb_defs.h yomdb_vars.h

module/varbc_pred.F90 varbc_rad.F90
obs_preproc/black.F90 defrun.F90
op_obs/hop.F90 hopad.F90 hoptl.F90 hretr.F90 rad1cemis.F90
setup/suemis_conf.F90

Files modified(ODB):
cma2odb/initmdb.F90
ddl/cma.h sathdr_screen_atovs.sql

Files modified(REANAL):
Mon/obstat_timeseries.F90

Files modified(SCRIPTS):
def/an.def
gen/getini ifstraj mkabs_satrad mklinks vardata
sms/libs.sms
sms_an/satrad.sms

Dick Dee

VarBC bug fix for layer observations (to3, tcwv)

This fixes a bug in VarBC, which caused the bias estimate to have the wrong sign in case of layer observations. This bug was introduced (but not active) in CY35R2.

Results are bit-reproducible with CY35R2 in default configuration (no ozone VarBC).

Files modified(IFS):
op_obs/hdepart.F90 hop.F90 hoptl.F90 hopad.F90

Alan Geer

Passive changes affecting all-sky assimilation of microwave imagers

- Change to the passive monitoring of the microwave imagers TMI and SSMIS. These were previously monitored using the old "clear sky" stream. They will now be passively monitored using the all-sky stream. This means that the old two-stream approach (1D+4D-Var for rainy/cloudy and direct 4D-Var for clear) has now been entirely superseded by the all-sky approach.
- TMI diurnal bias correction. A VarBC predictor has been added that allows the correction of the solar bias in TMI observations.
- Fix a bug in diagnostics output. The ECMA variable TBCLOUD was previously incorrect and has now been fixed. This variable will now be used by SATMON to distinguish between clear and cloudy scenes in the all-sky

All changes are passive, i.e. there should be no effect on the analyses. However, the changes are not bit-reproducible since changing the passive monitoring causes changes in VarBC.

Files modified(IFS):
`module/varbc_pred.F90 varbc_rad_allsky.F90`
`mwave/mwave_postproc.F90`
`onedvar/onedvar_fstscrn.F90`
`op_obs/hop.F90 hopad.F90 hoptl.F90 hretr.F90 mwimager_cloud.F90 rad1cemis.F90`

Files modified(SCRIPTS):
`gen/premwimg ifstraj`

Andrew Collard

Modification to cloud detection for AIRS and IASI

The AIRS/IASI cloud detection is modified to screen for cirrus clouds that were previously being missing due to near-surface humidity and skin temperature errors.

Quality control flags provided by NASA for AIRS are now used to ensure that noisy channels are omitted from active assimilation.

Files modified(IFS):
`module/yomiasi.F90`
`namelist/namclddet.h`
`obs_preproc/cloud_detect_setup.F90`
`op_obs/cf_digital.F90 cloud_detect.F90 hretr.F90`

Files modified(ODB):
`bufr2odb/bufr2odb_airs.F90`

Files modified(SATRAD):
`programs/bufr_screen_iasi.F90`

Carole Peubey

Modifications to include goes-13

Modifications to include goes-13 CSRs in preparation of the future use of the data. In addition, the pregeos script has been cleant and the script for the simulated images (satimsim) has been speeded up.

Files modified(SCRIPTS):
`gen/pregeos satimsim`

Files modified(IFS):
`ops_obs/emis_ir.F90`

Files modified(OBSTAT):
`satmon/sat_add_geo.F90 src/odbread.F90`

Peter Bauer and Dick Dee

Activation of Envisat MERIS total column water vapour assimilation

Activation of Envisat MERIS total column water vapour assimilation over land surfaces (clear-sky, daytime only). Variational bias correction enabled with constant and total column water vapour as predictor.

Files created(IFS):

`module/varbc_allsky.F90 varbc_tcwv.F90`

Files created(ODB):

`ddl.CCMA/varbc_allsky_robhdr.sql varbc_allsky_robody.sql varbc_tcwv_robhdr.sql varbc_tcwv_robody.sql`

`ddl.ECMA/varbc_allsky_robhdr.sql varbc_allsky_robody.sql varbc_tcwv_robhdr.sql varbc_tcwv_robody.sql`

`ddl/varbc_allsky_robhdr.sql varbc_allsky_robody.sql varbc_tcwv_robhdr.sql varbc_tcwv_robody.sql`

Files modified(IFS):

`module/varbc_rad.F90 varbc_setup.F90`

`op_obs/hdepart.F90 hop.F90 hopad.F90 hoptl.F90 hretr.F90`

Files modified(ODB):

`cma2odb/ctxinitdb.F90`

`ddl/robhdr_screen.sql`

Files modified(SCRIPTS):

`def/an.def`

`gen/ifsmin ifstraj`

Files deleted(IFS):

`module/varbc_rad_allsky.F90`

Files deleted(ODB):

`ddl.CCMA/varbc_rad_allsky_robhdr.sql varbc_rad_allsky_robody.sql`

`ddl.ECMA/varbc_rad_allsky_robhdr.sql varbc_rad_allsky_robody.sql`

`ddl/varbc_rad_allsky_robhdr.sql varbc_rad_allsky_robody.sql`

Dingmin Li, Tony McNally, Dick Dee and Peter Bauer

Implementation of mode based variational bias correction of observations from microwave and infrared sounders, which is still in development.

The code changes involve adding required code in op_obs/ and activating a switch in varbc code that is controlled by namelist of NAMVARBC_RAD in scripts/gen/ifstraj and ifsmin. As this work is still under development, the implemented code is currently passive, they are switched off by default and produce bit comparable results with the control.

Files modified(IFS):

`op_obs/hop.F90 hoptl.F90 hopad.F90 module/varbc_setup.F90 varbc_eval.F90 varbc_rad.F90`

Niels Bormann, Iliana Genkova

Revisions for direct broadcast MODIS and AVHRR AMVs

- Revision to the identification of direct broadcast (DB) MODIS AMVs to include data with sub-center 0.
- Consistent assignment of observation errors between DB MODIS AMVs and global MODIS AMVs.
- Introduction of a namelist switch to allow the use of larger observation errors for MODIS winds through a scripts-change (possibly needed for the use of DB MODIS winds).
- Loading of QI values into ODB for DB MODIS and AVHRR AMVs.
- Thinning for AMVs to prefer AMVs with QI (this has no effect for currently assimilated AMVs).

Files modified(IFS):
`module/yomcosjo.F90`
`namelist/namjo.h`
`obs_preproc/defrun.F90 pre_thinner.F90 satamin.F90 thinner.F90 thinner_no_sq.F90`

Files modified(ODB):
`bufr2odb/bufr2odb_satob.F90`
`ddl/sathdr_satob.sql`
`lib/datastream.F90`

Elias Holm

Humidity Control Variable with supersaturation and temperature correlation

The humidity control variable has changed to more accurately reflect model developments, in particular the presence of supersaturation. The changes are activated by the new switch LJB_SUPSAT=true. In the process a few inconsistencies were discovered and corrected, which are common to the previous and the present formulation. Turning LJB_SUPSAT=false will therefore not give exactly the previous formulation, but an improved version. The changes are fivefold:

1. Correcting inconsistencies in the present formulation
   - Correctly use total instead of unbalanced temperature increments in the humidity control variable transform. The total increments are not available where this is done in CY35R2 (jgnr*.F90), so move the transform to dedicated subroutines cvargp*.F90 at the point where the total increments are available in cvar3*.F90.
   - Mend optional vertical coordinate transform jbvcoord_interpolate*.F90.
   - Change the linearization state used by the humidity control variable transform, from latest trajectory value to mean of the background and the latest trajectory value. This makes the inner loop change of variable converge to the outer loop nonlinear inverse change of variable. The high resolution background is linked in ifstraj, following similar naming convention as the initial state:
     - ICMSH${EXPVER}BGHR
     - ICMGG${EXPVER}BGHR

– ICMGG${EXPVER}BGHRUA

The background is read inside suspec.F90 and suspecg.F90 as a new filetype (KFILE=12), and where needed (rdfpinc.F90, jbchvar*.F90) the mean of the background and the trajectory are calculated after being interpolated to the correct resolution.

2. Change of humidity control variable transform

   - New subroutines jbchvar*.F90 introduced for the humidity transform.
   - Change from relative humidity based, e/e_s, to q/q_s based variable.
   - Model the humidity-temperature background error correlation based on ensemble statistics and include in the variable transform.
   - For the transition to the stratosphere, introduce new humidity based tropopause definition in troplev.F90.
   - Collect recurring preparatory calculations used by the transform (pressure, relative humidity, tropopause level) inside pregprh.F90, called by jbchvar*.F90 and symtransin.F90

3. New normalization including supersaturated states and stratosphere

   - Recalculate normalization coefficients, now including supersaturated states, from ensemble statistics, see sujbchvar.F90.
   - Updated normalization function to combine sub- and supersaturated statistics in fjbchvar.F90.
   - The stratospheric humidity analysis is still turned off (no observations) but can be activated by setting ZQS(:)=1 in sujbchvar.F90 (works OK, subject to further testing).

4. Simplified nonlinear inverse

   - Due to the introduction of supersaturated states, it is temporally necessary to replace the nonlinear inverse by a simpler limiting of the increments. This is done in symtransin.F90 in a way which does not alter the background in the absense of increments.
   - Change the lower limits of humidity to 10^{-8} (from 10^{-7}) in the limiting qneglim.F90 used by the analysis, to be consistent with the minimum values used by the forecast.
   - Cleaning of rdfpinc.F90, including GEMS related gridpoint field pre- and postprocessing when adding increments to backgrond.

5. New background error covariance matrix for humidity

   - Make the background error calculation in sujbwavelet.F90 consistent with the new humidity transform, adding option for using tangent linear balance operators (LJB_TLBALSTAT).
   - The background error covariance files have been replaced, but only at the operational resolutions (wavelet_T95_L91.cv, wavelet_T159_L91.cv and wavelet_T255_L91.cv) leaving the rest of **B** untouched. The 60-level (and other vertical/horizontal) statistics have not changed.

Files created(IFS):

`var/jbchvar.F90 jbchvarad.F90 jbchvari.F90 jbchvariad.F90 pregprh.F90 troplev.F90`

Files modified(IFS):

`control/scan2m.F90 scan2mad.F90 scan2mtl.F90 function/fjbchvar.h module/yomjbchvar.F90 yomjg.F90 yomop.F90 yomwavelet.F90 namelist/namjg.h setup/sugridug.F90 suinif.F90`

suoph.F90 suspec.F90 suspecg.F90 var/cvar2.F90 cvar2ad.F90 cvar3.F90 cvar3ad.F90 cvar3in.F90 cvar3inad.F90 cvargpad.F90 cvargptl.F90 evjq.F90 jbvcoord_interpolate.F90 jbvcoord_interpolate_ad.F90 jgnr.F90 jgnrad.F90 jgnri.F90 jgnriad.F90 rdfpinc.F90 sujb.F90 sujbbal.F90 sujbchvar.F90 sujbwavgen.F90 surinc.F90 symtransin.F90

Files modified(SCRIPTS):

def/an.def gen/ifstraj ifstsave

Jan Haseler

Back-fixes to operational suite

- Correction to optimization of saturation computation.
- Correction to surface flux computation used in parcel-lifting algorithm in boundary layer scheme.
- Correction to computation of wind-effect on snow density.
- Increase in default stack size

Files modified(IFS):

phys_ec/vdfhghtn.F90 vdfmain.F90

Files modified(ODB):

cma2odb/update_obsdb.F90

Files modified(SCRIPTS):

gen/run_parallel
sms/getiniLeg.sms getvarepsdata.sms
wav/wave_set_config

Files modified(SURF):

module/surfexcdriver_ctl_mod.F90

Files modified(WAM):

Wam_oper/create_wam_bathymetry.F preproc.F

Jean-Jacques Morcrette

Correction of a (long-lasting) bug in the TOA incident solar radiation

Files modified(IFS:)

phys_ec/callpar.F90 ec_phys.F90 radheat.F90 radheatad.F90 radheatn.F90 radheattl.F90 radlswr.F90
phys_radi/suecrad.F90
setup/sucst.F90
utility/updtim.F90

Nils Wedi

Increase coefficient for horizontal diffusion on vorticity (LECMWF) for RESOL¿=1279.

Files modified(IFS):
`setup/suhdir.F90`

Elías Valur Hólm

Regularizing TL/AD advection at the model top

Occasional instabilities have been observed in the TL dynamics at model level 1, during very stong polar vortex events. To overcome this instability a change to the TL advection at the model top has been implemented as a preventive measure. To explain the change, the full TL advection for a scalar φ can be written as

$$\delta\varphi^{n+1} = \delta\varphi^{n} + \Delta t(\bar{v}_b \cdot \nabla\delta\varphi + \delta\bar{v} \cdot \nabla\varphi_b)^{n+1/2} \tag{1}$$

where $\delta\varphi$ is the increment and φ_b is the trajectory. The advection by the increment wind is gradually reduced towards zero in the models top levels to reduce the effect of unphysical increments on stability,

$$\delta\varphi^{n+1} = \delta\varphi^{n} + \Delta t(\bar{v}_b \cdot \nabla\delta\varphi + \alpha\delta\bar{v} \cdot \nabla\varphi_b)^{n+1/2} \tag{2}$$

where α varies with model level, $\alpha = (0, 0.1, 0.2, 0.5, 0.8, 0.9)$ for model levels $1-6$, and $\alpha = 1$ (unchanged) below model level 6. For wind, temperature, and the continuity equation, the above equation has additional terms in the right hand side which are of exactly the same form, with an advection by the trajectory wind and the increment wind. In all these terms, the increment wind advection is reduced towards the model top in the same manner.

The implementation of this idea in the semi-Lagrangian code is just a change in the interpolation routines to reduce the amplitude off terms representing the wind increment advection.

Files modified(IFS):
`adiab/laidditl.F90 laidditlad.F90 laitlitl.F90 laitlitlad.F90 laitritl.F90 laitritl.F90`

Bit Reproducible : Passive and technical changes

George Mozdzynski

Performance optimisations

- Non-blocking MPI communications now used for both sends and receives in the modified routines. A T1279 model shows a performance improvement of approximately 2 percent with this branch for a 512 task x 4 thread configuration.
- Compute optimal values for the spectral space partitioning variables NPRTRW and NPRTRV, where NPROC = NPRTRW x NPRTRV. Performance for a T1279 model on c1a is improved by about 4 percent with this branch (compared with a 35R2 control), when run using 960 tasks x 4 threads
- Fix for Gstats counter.
- Correction to the optimal value of NPROMA.
- Use a collective MPL_ALLGATHERV instead of MPL_SEND's and MPL_RECV's for communicating grid-point (NSTA, NONL) distribution to all tasks

George Mozdzynski and Peter Towers

Enhancement to the GSTATS package

- Enhancement to the GSTATS package to report unexpected delays for all counters
- Used to find more optimal value for MP_POLLING_INTERVAL
- Performance for a T1279 model running on 60 nodes on c1a (960 tasks x 4 threads) is improved by 3 percent, and a 9 percent for 15 nodes (240 tasks x 4 threads)

Files modified(IFS):
`parallel/slcomm.F90 slcomm1.F90 slcomm2.F90 slcomm2a.F90`
`phys_radi/suecrad.F90`
`setup/sump.F90 sumpini.F90`

Files modified(TRANS):
`module/trgtol_mod.F90 trltog_mod.F90 sustaonl_mod.F90 external/gpnorm_trans.F90`

Deborah Salmond

Performance optimisation, fixes and cleaning.

- Optimisation of message passing and OpenMP for IBM Power 6

- Cleaning suggested by Karim Yessad - use everywhere the roots:
  * L for liquid water * I for ice * LSM for land-sea mask
- Update small executables for T1279
- Fix for bounds problem in snow analysis
- Fix for gstats in sujbwavelet
- Fix for bounds problem in rttov_layeravg_ad

Files created(IFS):

`utility/emptb3.F90 fillb3.F90`

Files modified(IFS):

`dia/wrphtrajt.F90`
`parallel/slcomm.F90 slcomm1.F90 slcomm2.F90 slcomm2a.F90 slextpol1a.F90 slextpol2.F90 slextpolad.F90 trmtos.F90 trstom.F90`
`utility/rdphtrajt.F90`

Files modified(TRANS):

`module/trgtol_mod.F90 trltog_mod.F90`

Files modified(IFS):

`adiab/cpg.F90 cpg_dia.F90 cpg_dyn.F90 cpg_dyn_ad.F90 cpg_dyn_tl.F90 cpg_gp.F90 cptends.F90 cpwts.F90 postphy.F90 specrt.F90`
`c9xx/incli2.F90 incli5.F90 incli6.F90 incli7.F90 inclitc.F90 relnew.F90`
`canari/caclsi.F90 cacsts.F90 casmswi.F90 casnas.F90 castas.F90`
`climate/updcli.F90 updclie.F90 updcpl.F90 updsst.F90`
`dia/cpnudg.F90 cpphddh.F90 cpphddhe.F90`
`fullpos/endpos.F90 endvpos.F90 fpachmt.F90 fpcordyn.F90 hpos.F90 vpos.F90`
`module/surface_fields_mix.F90 yomafn.F90 yomsp.F90 yomspjb.F90 yomtddh.F90`
`namelist/namafn.h`
`ocean/slab.F90`
`op_obs/cobs.F90`
`phys_dmn/acacon.F90 accdev.F90 accvud.F90 acdifsp.F90 acdifspad.F90 acdifspadt.F90 acdifsptl.F90 acdifus.F90 acdnshf.F90 acdro.F90 acdrov.F90 achmt.F90 achmtad.F90 achmttl.F90 acmicro.F90 acnebsm.F90 acpluiz.F90 acradin.F90 acsol.F90 acsolw.F90 acveg.F90 apl2phy.F90 apl_arome.F90 aplmini.F90 aplmphys.F90 aplpar.F90 aplpars.F90 aplparsad.F90 aplparsadt.F90 aplparstl.F90 aplpassh.F90 arp_ground_param.F90 hl_aplpar.F90 hlrad.F90 mf_phys.F90 mf_physad.F90 mf_phystl.F90 mts_phys.F90 profilechet.F90 writephysio.F90 writeprofile.F90`
`phys_ec/callpar.F90 ec_phys.F90 ec_phys_ad.F90 ec_phys_tl.F90 radcfg.F90 raddrv.F90`
`pp_obs/pos.F90`
`prism/couplo4_definitions.F90`
`setup/su_surf_flds.F90 suafn1.F90 suafn2.F90 suafn3.F90 supong.F90`
`sinvect/vdiflcz.F90 vdiflczad.F90 vdiflcztl.F90`
`transform/transinv_nhconv.F90 transinv_nhconvprhs.F90`
`utility/dealspa.F90 sualspa.F90`

var/deallt.F90 suallr.F90 suallt.F90 sushfce.F90 vec2gp.F90

Files modified(IFS):

module/stoph_mix.F90 yoe_uvrad.F90 yommkodb.F90 yomonedvar.F90
namelist/nammkodb.h namonedvar.h
onedvar/onedvar_setup.F90
setup/surand1.F90 surand2.F90
var/gp_nearest.F90

Files modified(SCRIPTS):

gen/ifstraj

Files modified(IFS):

setup/sudim2.F90

Files modified(PREPDATA):

odds/getres/getres.f
programs/sptogp.F90 uvtovod.F90

Files modified(SSA):

sub/sub_prep_nes.F90

Files modified(IFS):

var/sujbwavelet.F90

Files modified(SATRAD):

rttov/rttov_layeravg_ad.F90

Nils Wedi

Postprocessing/archiving at selected time-steps (not full hours)

Allow postprocessing of time-steps in fdb and mars that are not hours (by emulating hours) to facilitate debugging and NH-IFS runs with short time-steps: LPPSTEPS=TRUE (default==FALSE).

Files modified(IFS):

dia/pregrbenc.F90 prepfdb.F90
module/yomdyncore.F90
namelist/namdyncore.h
setup/sudyncore.F90

Jean Bidlot

Fix for Array bounds violation

Files modified(WAM):

Wam_oper/mpdecomp.F wamodel.F ctuw.F module/yowmap.F

George Mozdzynski and Jean-Jacques Morcrette

Bug-fixes for the dynamical extra fields and gstats_print

Files modified(IFS):

`control/gp_model.F90 phys_ec/callpar.F90 ec_phys.F90 ec_physg.F90 ec_phys_drv.F90`

Files modified(IFSAUX):

`support/gstats_print.F90`

Jean-Jacques Morcrette

Further developments for the prognostic aerosol model.

Also cleaning of YOE-modules suggested by Karim Yessad

Files created(IFS):

`phys_ec/cloudaer.F90`

`phys_radi/su_gch4clim.F90 su_gco2clim.F90 su_gozoclim.F90`

Files modified(IFS):

`climate/updclie.F90`

`control/gp_model.F90 reresf.F90 restart_cnt3.F90`

`module/yoeaersrc.F90 yoerad.F90 yoerdu.F90 yoerrtwn.F90 yoesrtwn.F90 yomcst.F90`

`namelist/naeaer.h naerad.h`

`op_obs/ch4_tcmr.F90 ch4_tcmr_ad.F90 ch4_tcmr_tl.F90`

`phys_ec/aer_bdgtmss.F90 aer_cgrowth.F90 aer_clcld.F90 aer_cld.F90 aer_drydep.F90 aer_phy2.F90 aer_phy3.F90 aer_rad.F90 aer_scavbc.F90 aer_scavin.F90 aer_sedimnt.F90 aer_so2so4.F90 aer_src.F90 callpar.F90 ec_phys.F90 ec_phys_drv.F90 ec_physg.F90 ecradfr.F90 gems_init.F90 gems_init_ad.F90 gems_init_tl.F90 gems_tend_ad.F90 raddrv.F90 radintg.F90 radlswr.F90 su_aerop.F90 su_aerp.F90 su_aerw.F90 su_ghgclim.F90 sucldp.F90 radact.F90`

`phys_radi/srtm_spcvrt.F90 srtm_spcvrt_mcica.F90 suecrad.F90 surrtpk.F90 susrtm.F90 uvradi.F90 suecso4.F90`

`setup/sucst.F90 sumcc.F90`

Yuhei Takaya

Implementation of the ocean mixed layer model (KPP)

- Implementation of the ocean mixed layer model including the ifs project such as the definition of new variables, coupling and I/O.
- Modularization and bug fixes of KPP source codes.
- Introduction of a new vertical level definition.

Files created(IFS):

setup/sugrido.F90

Files created(SURF):

module/kpp_abk80_mod.F90 kpp_bldepth_mod.F90 kpp_blmix_mod.F90 kpp_cpsw_mod.F90
kpp_interior_mix_mod.F90 kpp_kppmix_mod.F90 kpp_ocnint_mod.F90 kpp_swfrac_mod.F90
kpp_tridcof_mod.F90 kpp_tridmat_mod.F90 kpp_tridrhs_mod.F90 kpp_wscale_mod.F90

Files modified(IFS):

adiab/postphy.F90
climate/updclie.F90
dia/pregrbenc.F90 wroutgpgb.F90
fullpos/wrmlfp.F90
module/iostream_mix.F90 surface_fields_mix.F90 yomgrb.F90
namelist/naephy.h
phys_ec/callpar.F90 cpspe.F90 ec_phys.F90 ec_phys_drv.F90 ec_physg.F90
setup/su_surf_flds.F90 sudim1.F90 suinif.F90
utility/updtim.F90

Files modified(SURF):

module/ocean_ml_driver_mod.F90 susocean_ml_mod.F90 yos_ocean_ml.F90
offline/driver/callpar1s.F90 driver/cpg1s.F90

Files deleted(SURF):

module/kpp_abk80.F90 kpp_bldepth.F90 kpp_blmix.F90 kpp_cpsw.F90
kpp_interior_mix.F90 kpp_kppmix.F90 kpp_ocint.F90 kpp_swfrac.F90 kpp_tridcof.F90
kpp_tridmat.F90 kpp_tridrhs.F90 kpp_wscale.F90

Philippe Lopez

Ducting Diagnostics

Introduced possibility of computing and archiving five new diagnostic 2D fields for ducting (radar beam anomalous propagation) in the forecast (both in ”fc” and ”an” mode). This option is activated by setting switch LDUCTDIA to ”on” (default is ”off”) in prepIFS. This switch is passed to the model through namelist NAEPHY.

The five new fields (GRIB table 228) are:

- the absolute value of the minimum refractivity gradient inside the trapping layer (grib code 15; in m^{-1}),
- the absolute value of mean refractivity gradient inside the trapping layer (grib code 16; in m^{-1}),
- the duct base height (grib code 17; in metres),
- the trapping layer base height (grib code 18; in metres),
- the trapping layer top height (grib code 19; in metres).

Note that values equal to -1 correspond to missing values.

Files created(IFS):

phys_ec/ductdia.F90

Files modified(IFS):
`dia/pregrbenc.F90`
`fullpos/hpos.F90 wrmlfp.F90 wrmlfpl.F90`
`module/iostream_mix.F90 parfpos.F90 surface_fields_mix.F90 yoephy.F90 yomafn.F90 yomgrb.F90`
`namelist/naephy.h`
`phys_ec/callpar.F90 ec_phys.F90`
`setup/su0phy.F90 su_surf_flds.F90 suafn1.F90 suafn2.F90 suafn3.F90 supp.F90`

Files modified(SCRIPTS):
`gen/model`
`sms/sfc.sms`

Anne Fouilloux

Modifications to ODB

- Problem raised by Meteo-France about `su_events` and ODB bitfield `datum_event1_t (su_events.F90, cma.h)`:
  - removed `ND1EVENT(29)` and its associated bit column in the bitfield `datum_event1_t (contam_rain_flag)`
  - changed the name of the bit 28 in the bitfield datum_event1_t: it was contam_cld_flag and it is now obserror_increased.
- Bug fix in CMA variable numbering (yomvnmb.F90, suvnmb.F90): Removed double definition of NVNUMB(94) and NVNUMB(95): it only affected GEMS users.
- New ROBAUX's introduced for David Tan (yomdb_defs.h, yomdb_vars.h, yomdb.F90, ctxgetdb.F90,
- ctxputdb.F90, opendb.F90, context.F90: modifications to use ROBAUX(1), ROBAUX(2) ... ROBAUX(5) arrays (alternatively ROBAUX1, ROBAUX2, ..., ROBAUX5) so that your AEOLUS development can go ahead.
- Bug fix in mergeodb.sms (was introduced in CY35R2 when dealing with sub-windows)

David Tan

Doppler wind lidar assimilation

Technical development (no meteorological impact) for ADM-Aeolus processing tasks. Mainly the definition at suite and script level of workstation jobs to generate products for dissemination to ESA. Anne Foullioux contributed prototype code for "cleaning" ODB-stored meteorological profiles prior to formatting for ESA.

IFS: pass more variables through the interface to the aeolus project, shorten some variable names. ODB: minor upgrades to bufr2odb_aeolus and aeolus sqls. SCRIPTS: new workstation tasks to generate Aeolus products, accommodation of aeolus project upgrades in the build suite. AEOLUS: upgrade to "Release 1.40", which includes interfacing to the Version 5.02 Level-1B data format, screening of Rayleigh-Brillouin auxiliary input data, and improved portability.

Files created(ODB):
`ddl.ECMA/aeolus_auxmet_update_hdrflag.sql odb2ee_aeolus_auxmet.sql`
`ddl/aeolus_auxmet_update_hdrflag.sql odb2ee_aeolus_auxmet.sql`

Files created(SCRIPTS):
`gen/aeolus_auxmet aeolus_geodetic2simulobs aeolus_l2b aeolus_orbpre odb_cracker_aeolus_auxmet odbmerge`
`sms_an/aeolus_auxmet.sms aeolus_l2b.sms aeolus_orbpre.sms`

Files modified(IFS):
`common/yomdb_defs.h yomdb_vars.h`
`module/aeolus_l2bp_wrapper_mod.F90`

Files modified(ODB):
`bufr2odb/bufr2odb_aeolus.F90 get_varindex.F90`
`cma2odb/initmdb.F90`
`ddl/cma.h sathdr_screen_aeolus_1b.sql sathdr_screen_aeolus_hdr.sql`
`module/varindex_module.F90`

Files modified(SCRIPTS):
`build/Makefile.root.aeolus arch/Makefile.in.ibm_power5 arch/Makefile.in.linux`
`def/an.def`
`gen/create_s2o_aeolus_md ifsvar mergeodb mkabs_aeolus vardata`
`sms/libs.sms`
`sms_an/simulobs2odb.sms`

Files created/modified/deleted(AEOLUS):
`Almost the entire project.`

Martin Leutbecher

Revised stochastic physics

The stochastic physics has been revised. In order to activate the revised version use `LSPSDT=true` and `LSTOPH=false`. The revised scheme uses a spectral autoregressive process (`algor/module/spectral_arp_mod.F90`) which contains a parallelised random number generator. The temporal and spatial correlation scales of the pattern can be set via `XWC_KAPPA_T` and `TAU_SDT` in namelist `NAMSPSDT`. The standard deviation of the multiplicative noise in grid point space can be set with `SDEV_SDT`.

Files created(ALGOR):
`module/spectral_arp_mod.F90`

Files created(IFS): `yomspsdt.F90`
`namelist/namspsdt.h`
`setup/suspsdt.F90`

Files modified(IFS):
`control/stepo.F90`
`module/gridpoint_fields_mix.F90 stoph_mix.F90`
`phys_ec/callpar.F90 ec_phys.F90 ec_phys_drv.F90 ec_physg.F90 stochadiaten.F90`
`setup/su0yomb.F90 surand1.F90`

Files modified(SCRIPTS):
`gen/ifsmin ifstraj mknam_fp model modeleps modelsv modeleps`

Jean-Jacques Morcrette and Soumia Serrar

Moving aerosol diagnostics from extra-fields to proper post-processed variables

Files modified(IFS):
`module/parfpos.F90, yom_ygfl.F90, yomafn.F90`
`namelist/namgfl.h`
`phys_ec/callpar.F90`
`pp_obs/pos.F90`
`setup/suafn1.F90, suafn2.F90, sudefo_gflattr.F90, sudim1.F90,`
`sudyn_setgflattr.F90, sugfl.F90, sumcc.F90, su0phy.F90`

Jean-Jacques Morcrette, Johannes Flemming, Richard Engelen and Peter Bechtold

Introduction of GEMS-derived climatologies of CO2, CH4 and O3 to complement the Cariolle's climatologies.

This corrects the vertical interpolation for number of vertical levels smaller than 91.

Files modified(IFS):
`phys_ec/su_ghg_clim.F90`
`phys_radi/radghg.F90`
`utility/updtim.F90`

Files new(IFS):
`phys_radi/su_gch4clim.F90 su_gco2clim.F90 su_gozoclim.F90`

Glenn Shutts and Martin Steinheimer

Update to spectral stochastic backscatter scheme (SPBS) including option for vertical random structure (RVP)

The code for SPBS was updated to the latest version. Changes include:

- new method for calculating numerical dissipation rate based on the square of the horizontal vorticity gradient
- inertial stability factor applied to the convective dissipation rate (normalized absolute vorticity squared)
- vorticity confinement anti-diffusion option (set using `LVORTCON` ; default=`FALSE`)
- wavenumber-dependent decorrelation time set through $\alpha(n)$
- corrected expression for decorrelation time parameter α

- variable call frequencies for SPBS and vorticity confinment using NFRSTOPH_SPBS and NFRSTOPH_-VC respectively
- remove the truncation upper and lower limits of the streamfunction forcing so that all wavenumbers are forced with a functional dependence given by $(1+n)^{-1.27}$ where n is the spherical harmonic degree
- introduction of the parameter `RATIO_BACKSCAT_CON2NUM` to adjust the relative amounts of energy backscattered from convective and numerical dissipation
- new option RVP for the vertical correlation of the stream function forcing. A different random vertical profile for each wave-mode is used for updating the Markov chain of the SPBS pattern. The profile is generated by a random phase shift of the complex spherical cooefficient between model levels.

along with several minor bug fixes.

SPBS is controlled by namelist `NAMSTOPH`. The main switches are `LSTOPH_SPBS` to activate stochastic backscatter and `LSTOPH_RVP` to activate the new vertical correlation option. Both are set to `FALSE` by default.

Files modified(IFS):
`adiab/spchor.F90`
`control/cnt4.F90 reresf.F90`
`module/stoph_mix.F90 yomrandom_streams.F90`
`namelist/namstoph.h`
`phys_ec/callpar.F90 ec_phys.F90 ec_phys_drv.F90 ec_physg.F90`
`setup/surand1.F90 surand2.F90`

Mats Hamrud

Optimisation of IOSTREAM

Files modified(IFS):
`module/iostream_mix.F90 traj_main_mod.F90 traj_surface_mod.F90`
`trajectory_mod.F90 yomtraj.F90`
`utility/gstats_label_ifs.F90 read_grid_traj.F90 write_grid_traj.F90`
`var/getmini.F90 savmini.F90`

Files modified(IFSAUX):
`module/mpl_data_module.F90 mpl_init_mod.F90`

Files modified(SCRIPTS):
`gen/ifsmin ifstraj`
`sms_an/obstat_iasi.sms obstat_meris.sms odbcmp_iasi.sms odbcmp_meris.sms`

Files modified(TRANS):
`module/gath_grid_ctl_mod.F90`

Files modified(SCRIPTS):
`gen/model modeleps`

Marta Janiskova

Modifications in the routines for TL and AD tests (NCONF=401,501)

The modifications do not have any impact on any operational configuration. They concern configurations NCONF=401 (test of TL) and NCONF=501 (test of AD). For those configuration, switch for grid-point cloud diagnostics is initialized in order to write the grid-point norms of cloud characteristics (cloud fraction, liquid and ice water) when cloud scheme is used. The results of TL/AD tests are not changed, only more information for diagnostic purposes is written down.

Test of TL was updated including option for using new radiation and cloud schemes. A fix in callpar.F90 was introduced to prevent calling routine updating surface values of temperature, moisture and snow in the case of using the simplified physics in nonlinear computations (that is only case for some diagnostics/debugging computations).

Files modified(IFS):

`control/testli.F90 testlievol.F90 tesadj.F90`
`phys_ec/callpar.F90`

Angela Benedetti

Routines for calculation of aerosol reflectance

A number of routines have been added in op_obs (mainly) for the calculation of aerosol reflectance. Modifications to hop.F90, hoptl.F90, hopad.F90, reo3sin.F9op_obs, hvnmtlt.F90, and suvnmb.F90 are all related to the call to the new observation operator AER_REFL_OP(with adjoint AER_REFL_AD and tangent linear AER_REFL_TL) under variable "RFA".

Files created(IFS):

`module/yoeadbuffer.F90`
`op_obs/aer_opt_prop.F90 aer_opt_prop_ad.F90 aer_opt_prop_tl.F90 aer_refl_ad.F90 aer_refl_op.F90 aer_refl_tl.F90 atmref_gems.F90 atmref_gems_ad.F90 atmref_gems_tl.F90 csalbr_gems.F90 discom_gems.F90 discom_gems_ad.F90 discom_gems_tl.F90 gauss_gems.F90 iso_gems.F90 iso_gems_ad.F90 iso_gems_tl.F90 kernel_pbp.F90 kernel_pbp_ad.F90 kernel_pbp_tl.F90 kernel_ppsl.F90 os_gems.F90 os_gems_ad.F90 os_gems_tl.F90 popboolean.F90 popinteger4.F90 popreal8.F90 pre_calc.F90 pushboolean.F90 pushinteger4.F90 pushreal8.F90 rt6s_gems.F90 rt6s_gems_ad.F90 rt6s_gems_tl.F90 rt6svalues.F90 scatra_gems.F90 scatra_gems_ad.F90 scatra_gems_tl.F90 trunca_gems.F90 trunca_gems_ad.F90 trunca_gems_tl.F90 vertdisc.F90 vertdisc_ad.F90 vertdisc_tl.F90`
`setup/suadbuffer.F90`

Files created(IFSAUX):

`support/adStack.c`

Files modified(IFS):

`obs_preproc/reo3sin.F90`
`op_obs/hop.F90 hopad.F90 hoptl.F90 hvnmtlt.F90`
`setup/suvnmb.F90`

Carla Cardinali

Forecast sensitivity to observation

Pre-operational suite computing Sensitivity Gradient and sensitivity to observation in one sms. Results are saved to odb.

Files created(SCRIPTS):

`sens/J1back.sms`

Files modified(IFS):

`control/cfcsens2obs.F90 cnt4ad.F90 cnt4tl.F90 sim4d.F90`
`module/varbc_setup.F90 yomvar.F90`
`namelist/namvar.h`
`op_obs/hoptl.F90`
`utility/mod_ini.F90 prtgom.F90 state2spec.F90 state2specad.F90`
`var/cosjr.F90 grtest.F90 sualcos.F90 sujr.F90 suvar.F90`

Files modified(SCRIPTS):

`def/fsobs.def`
`gen/fdbksave getini getmars ifsmin mkidta_sens vardata`
`sens/J1.sms m1.sms sg.sms`
`sms/getini.sms inidata.sms logfiles.sms`

Mohamed Dahoui

Satmon changes

The main change is the use, for microwave imaging observations, of the cloudiness status computed inside the IFS. This will ensure more consistency of statistics.

Files modified(OBSTAT):

`module/mod_sat_monitor.F90`
`satmon/get_mwimg_odb.F90 sat_monitor.F90`

Files modified(ODB):

`ddl/smon_mwimg_allsky.sql`

Additional changes for satmon (Scatterometer and Windsat data)

Changes are related to the introduction of new modes for scatterometer winds (from ERS-2, ASCAT and QuikSCAT) and Windsat data. For obstat there is a fix for ozone data (use of the appropriate sql request instead of the generic one to have access to reo3 product type).

Files created(OBSTAT):

`satmon/get_scatt_odb.F90`

Files modified(OBSTAT):

`satmon/sat_monitor.F90 sat_add_geo.F90 sat_geo_plot.F90 sat_hist_plot.F90`
`sat_hov_plot.F90 sat_overview_plot.F90 module/mod_sat_monitor.F90`
`mod_sat_create_netcdf.F90 src/iniitemloc.F90`

Files modified(ODB):

`ddl/scatt_flag.sql scatt.sql obstat_reo3.sql`

Files modified(SCRIPTS):

`gen/satmon_getdat satmon_monitor smon smon_clean smon_def smon_funcs getsmon obstat def/an.def`

John Hague and Anne Fouilloux

Safe OMP_EVENT logic, binding for P6 and hpm for P6 in Dr.Hook

Files modified(IFSAUX):

`module/oml_mod.F90 eclite/bindproc.c support/drhook.c`

Files created(IFSAUX):

`support/my_sync.c`

John Hague

Stack checking from Dr.Hook

If environment variable 'DR_HOOK_STACKCHECK=yes' is set - the size of the stack is checked from Dr.Hook.

Files modified(IFSAUX):

`support/dr_hook_util.F90 yomhookstack.F90`

Tomas Wilhelmsson

Modifications for 4D-Var bit-reproducibility

Files modified(IFS):

`module/varbc_setup.F90`

Files modified(SATRAD):

`rttov/rttov_eddington.F90 rttov_eddington_ad.F90 rttov_eddington_tl.F90`

Changed threshold for reducing the number of unpacked wavenumbers in spint

Files modified(PREPDATA):

`programs/spint.F90`

Jan Haseler

Archiving

Combine spectral and gaussian grid fields in the same archive request. Combine different hours in the same archive request. Add loadLeveler directive to identify archive jobs

Files modified(SCRIPTS):

gen/anml anpl ansfc anwave
sms/ml.sms pl.sms pt.sms pv.sms sfc.sms
sms_an/af.sms anil.sms anml.sms anpl.sms ansfc.sms anwave.sms

Monitor-only

Modify suite definition to make monitor-only mode work

Files modified(SCRIPTS):
def/an.def
gen/ifstraj

Linux-cluster - renaming of nodes

Remove references to linux_cluster bee.. host names. Add new tasks preCleanFDB and forceinv.

Files modified(SCRIPTS):
def/an.def
gen/forceinv2clim ifsvar mkabs_reanal p4_compile_setup p4_mklib preCleanFDB vardata
sms_an/forceinv.sms preCleanFDB.sms

Niels Bormann

Avoid abort if RTTOV returns a fatal error code

Altered the behaviour when RTTOV returns a fatal error code (for instance, when data is out of physically sensible limits): Previously, this led to an abort; now, by default, the First Guess is set to missing values for the observations in question (leading to rejection of the observation) and a warning is given in the standard error. If an abort is preferred (e.g., for reliable detection of problems) this can be switched on through the variable LABORT_RTTOV_FAILURE in the namelist NAMSATS. Also, the screening for bad zenith angles in the pre-screening has been revised to more adequate values for ATOVS data. In addition, error or warning messages relating to RTTOV problems now state more clearly what data has caused the problem.

Files modified(IFS):
module/yomtvrad.F90 namelist/namsats.h op_obs/radtr.F90 radtr_ml.F90 var/getsatid.F90 rtsetup.F90

Files modified(SATRAD):
programs/screen_1c.F90

George Mozdzynski

Incremental improvement to IFS OpenMP performance

This focus of this branch was to improve the performance of IFS by reducing the gstats reported SERIAL (ie. non comms, non OpenMP) and SUMB (i.e. unaccounted) time.

Files modified(ALGOR):
algor/module/control_vectors_oper_mod.F90

Files modified(IFS):

control/gp_model.F90 gp_model_ad.F90 gp_model_tl.F90 scan2mad.F90 scan2mtl.F90
module/iostream_mix.F90 traj_main_mod.F90 parallel/read_spec.F90 write_spec.F90
phys_ec/ec_phys_drv.F90 setup/sugridg.F90 sump.F90
transform/transdir_wavelet.F90 transdir_waveletad.F90 transinv_wavelet.F90
transinv_waveletad.F90 utility/grid_biconserv.F90 grid_bicubic.F90
grid_bilinear.F90 gstats_label_ifs.F90 interp_gp.F90 var/bgvecs.F90 congrad.F90
cvar2in.F90 cvar2inad.F90 cvarbcin.F90 cvarbcinad.F90 cvargpad.F90 cvargptl.F90
jbtomodel.F90 jbtomodelad.F90 jbvcor_waveletin.F90 jbvcor_waveletinad.F90
sujbwavgen.F90 taskob.F90 taskobad.F90 taskobtl.F90 wavxform.F90 wrevecs.F90
xformev.F90