RESEARCH DEPARTMENT MEMORANDUM

ECMWF

To:	RD Scientific Staff and Consultants
Copy:	HR, HO, HMD, HMAS, HMOS, J.Hodkinson Jean Pailleux, François Bouttier, Claude Fischer
From:	Mats Hamrud et al.
Date:	July 7, 2008 File: R48.3/MH/0869
Subject:	**IFS Memorandum Cycle CY33R2**

Cycle 33r2 was created in May 2008. It is the contibution from ECMWF to the joint cycle 34. It is not intended for operational implementation.

Modified libraries: ifs ifsaux trans scripts prepdata satrad odb surf scat obstat wam

Contributors: P.Bauer, J.Bidlot, N.Bormann, C.Cardinali, D.Cariolle, M.Dahoui, C.Delsol, R.Dragani, M.Drusch, R.Engelen, M.Fisher, J.Fleming, R.Forbes, A.Geer, ,M.Hamrud, H.Hersbach, J.Haseler, L.Isaksen, M.Leutbecher, A.McNally, M.Matricardi, K.Mogensen, J.-J.Morcrette, G.Mozdzynski, C.Peubey, G.Radnoti, D.Salmond, K. Scipal, S.Serrar, T.Stockdale, D.Tan, C.Tavolato, Y.Tremolet, N.Wedi, K.Yessad

Niels Bormann, Alan Geer, Carole Peubey, Marco Matricardi, Deborah Salmond

Implementation of RTTOV-9

RTTOV-9 has been implemented technically in the IFS, while the use of scientifically new features of RTTOV-9 is minimised in the assimilation for this cycle. The RTTOV-9 code is the official RTTOV-91 release from 18 March 2008, with updates from Roger Saunders from 29 April 2008. For cycle 34, RTTOV-9 is used in RTTOV-8 mode for clear-sky radiances by default (see switch rt8_mode in the module RTTOV_CONST), ie new RTTOV-9 features are switched off. The new RTTOV-internal interpolation is also not used in this cycle for the clear-sky assimilation. However, for the rainy radiance assimilation, the same approach is not entirely possible, so some new features are used. Documentation for RTTOV-9 can be found under http://www.metoffice.gov.uk/research/interproj/nwpsaf/rtm/rtm_rttov9.html

The interface between the IFS and RTTOV for the clear-sky assimilation has been revised, while maintaining the general structure (and some of the limitations it imposes, e.g., use of 43 level RTTOV coefficients); a more general revision of the interface is planned for later. On the IFS-side, the two routines RADTR and RADTR_ML (and their TL and AD) are the start of the route into RTTOV. RADTR is used if the interpolation of atmospheric profiles is performed on the IFS side; RADTR_ML is used if the interpolation is left to RTTOV, and model level data is given to RTTOV. The RTTOV-interpolation can be switched on through the variable LRTTOV_INTERPOL in YOMTVRAD, available through the namelist NAMSATS. The new RTTOV-internal interpolation avoids the spiky structure of gradients experienced so far with the log-linear interpolation used in the IFS. Checks against coefficient limit profiles, previously performed in RADTR, have now been moved to the main RTTOV (see RTTOV_CHECKINPUT).

Radiative transfer computations for clouds ("RTTOV_CLD") have been incorporated in the main RTTOV and completely redesigned in RTTOV-9, based on a multi-stream scattering parameterisation. Consequently, RADTRCLD has been incorporated in RADTR/RADTR_ML. In early tests, these cloud computations have appeared fairly memory-intensive, and they should therefore be used with caution. Cloudy computations can be performed for diagnostic purposes under HRETR which also uses the clear-sky output of these cloudy computations, for instance in the cloud screening for AIRS and IASI. This has so far been controlled by the switch LCLD_RTCALC (by sensor). To decouple the need for cloudy and clear-sky calculations, this switch has been replaced by the following switches:
LRTCALC_HRETR: switches on RT calculations (clear or cloudy) in HRETR by sensor
LCLD_RTCALC_SCREEN: determines that RT calculation in HRETR include cloud-effects
LCLD_RTCALC_ASSIM: switches on cloudy RT calculations under HOP and its TL and AD as well. This is not working yet, most likely due to problems on the IFS side.
The three switches are also available through the namelist NAMSATS. By default, cloudy RT calculations under HRETR are now switched off.

The software to simulate geostationary satellite images with RTTOV (satimsim) has been adapted to the new structure.

The implementation of RTTOV-9 also required a change to the way VARBC-predictors are calculated. Previously, these were tied to the interpolation to RTTOV levels, with the boundaries of some geopotential layer predictors determined by RTTOV-levels. This has now been altered to calculate VARBC predictors directly from model levels. This also means that the layer predictors are now calculated for the layers originally published in Harris and Kelly (2001). This considerably alters the statistical characteristics of the predictors. However, final bias corrections have been found to be very similar in longer-term experiments.

Code to dynamically retrieve emissivities or skin temperature over land for microwave instruments previously introduced by Meteo France has been considerably revised with the implementation of RTTOV-9 (this code is switched off by default). The main elements of this were a reduction of code-duplication in HRETR, the move of the emissivity retrieval to outside the main RTTOV (now performed in RTTOV_EC), and the generalisation of the switches that control the use of the dynamic emissivity/skin temperature retrieval (see YOMEMIS). Note that some files under the satrad and odb projects were not included in the last ECMWF/Meteo France exchange (they are included now), so the emissivity/skin temperature retrieval feature is not working for ECMWF cycles pre-CY34.

Some further points are worth mentioning, too:
- To make the current implementation of RTTOV-9 to be as close as possible to the previous IFS-implementation of RTTOV-8, the salinity term in rttov_calcemis_mw.F90 (and TL/AD) has been excluded. It will be introduced with the scientific use of RTTOV-9 in a later cycle.
- The use of new variable gases with RTTOV in the IFS has not been tested yet.
- Cloudy RT calculations do not allow mixed phase layers (limitation in RTTOV-9).
- RT calculations in BGOBS use the IFS-internal interpolation regardless of the switch LRTTOV_INTERPOL.
- Some aspects of RTTOV are now controlled through compiler switches, e.g., whether or not coefficients are distributed between processors.

Files created(IFS):

`pp_obs/emis_atlas.F90 hradp_ml.F90 hradp_ml_ad.F90 hradp_ml_tl.F90 radtr_ml.F90 radtr_ml_ad.F90 radtr_ml_tl.F90`

Files created(ODB):

`ddl.ECMA/satbody_screen_atovs.sql update_hdr_4.sql`

`ddl.ECMASCR/update_hdr_4.sql`

`ddl/satbody_screen_atovs.sql update_hdr_4.sql`

Files created(SATRAD):

`emiss/land_amsua_an1.F90 land_amsua_an2.F90 land_amsub_an1.F90 land_amsub_an2.F90 land_ssmi.F90 land_ssmis.F90 land_surf_type.F90`

`interface/deallocate_blob.h nullify_blob.h rttov.h rttov_alloc_ircld.h rttov_alloc_opdp_path.h rttov_alloc_predictor.h rttov_alloc_prof.h rttov_alloc_rad.h rttov_alloc_raytracing.h rttov_alloc_temp.h rttov_alloc_trans_scatt_ir.h rttov_alloc_transmission.h rttov_calcbt_basic.h rttov_calcrad_basic.h rttov_check_temp.h rttov_checkinput_ad.h rttov_checkinput_k.h rttov_checkinput_tl.h rttov_cldstr.h rttov_cldstr_ad.h rttov_cldstr_k.h rttov_cldstr_tl.h rttov_distribcoef_scatt_ir.h rttov_ec.h rttov_ec_ad.h rttov_ec_k.h rttov_ec_tl.h rttov_erfcx.h rttov_fresnel.h rttov_fresnel_ad.h rttov_fresnel_k.h rttov_fresnel_tl.h rttov_init_predictor.h rttov_init_profiles.h rttov_init_raytracing.h rttov_intavg_chan.h rttov_intavg_chan_ad.h rttov_intavg_chan_k.h rttov_intavg_chan_tl.h rttov_intavg_prof.h rttov_intavg_prof_ad.h rttov_intavg_prof_k.h rttov_intavg_prof_tl.h rttov_layeravg.h rttov_layeravg_ad.h rttov_layeravg_k.h rttov_layeravg_tl.h rttov_locpat.h rttov_locpat_ad.h rttov_locpat_k.h rttov_locpat_tl.h rttov_opdep.h rttov_opdep_9.h rttov_opdep_9_ad.h rttov_opdep_9_k.h rttov_opdep_9_solar.h rttov_opdep_9_solar_ad.h rttov_opdep_9_solar_k.h rttov_opdep_9_solar_tl.h rttov_opdep_9_tl.h rttov_opdep_ad.h rttov_opdep_k.h rttov_opdep_tl.h rttov_opdpscattir.h rttov_opdpscattir_ad.h rttov_opdpscattir_k.h rttov_opdpscattir_tl.h rttov_polcoe.h rttov_profaux_k.h rttov_refsun.h rttov_refsun_ad.h rttov_refsun_k.h rttov_refsun_tl.h rttov_scatt_setupindex.h rttov_setgeometry_ad.h rttov_setgeometry_k.h rttov_setgeometry_tl.h rttov_setpredictors_7.h rttov_setpredictors_7_ad.h rttov_setpredictors_7_k.h rttov_setpredictors_7_tl.h rttov_setpredictors_8_k.h rttov_setpredictors_9.h`

rttov_setpredictors_9_ad.h rttov_setpredictors_9_k.h
rttov_setpredictors_9_solar.h rttov_setpredictors_9_solar_ad.h
rttov_setpredictors_9_solar_k.h rttov_setpredictors_9_solar_tl.h
rttov_setpredictors_9_tl.h rttov_setpressure.h rttov_sublayer.h
rttov_sublayer_ad.h rttov_sublayer_k.h rttov_sublayer_tl.h
rttov_transmit_9_solar.h rttov_transmit_9_solar_ad.h rttov_transmit_9_solar_k.h
rttov_transmit_9_solar_tl.h rttovscatt_test_one.h

module/mod_rttovscatt_test.F90

rttov/aer_clim_prof.F90 rttov_alloc_ircld.F90 rttov_alloc_opdp_path.F90 rttov_alloc_-predictor.F90 rttov_alloc_prof.F90 rttov_alloc_rad.F90 rttov_alloc_raytracing.F90 rttov_alloc_temp.F90 rttov_alloc_trans_scatt_ir.F90 rttov_alloc_transmission.F90 rttov_-calcbt_basic.F90 rttov_calcrad_basic.F90 rttov_check_temp.F90 rttov_checkinput_ad.F90 rttov_checkinput_k.F90 rttov_checkinput_tl.F90 rttov_cldstr.F90 rttov_cldstr_ad.F90 rttov_cldstr_k.F90 rttov_cldstr_tl.F90 rttov_distribcoef_scatt_ir.F90 rttov_ec_ad.F90 rttov_ec_k.F90 rttov_ec_tl.F90 rttov_erfcx.F90 rttov_fresnel.F90 rttov_fresnel_ad.F90 rttov_fresnel_k.F90 rttov_fresnel_tl.F90 rttov_init_predictor.F90 rttov_init_profiles.F90 rttov_init_raytracing.F90 rttov_intavg_chan.F90 rttov_intavg_chan_ad.F90 rttov_intavg_-chan_k.F90 rttov_intavg_chan_tl.F90 rttov_intavg_prof.F90 rttov_intavg_prof_ad.F90 rttov_intavg_prof_k.F90 rttov_intavg_prof_tl.F90 rttov_integrate_polar.F90 rttov_-integrate_polar_ad.F90 rttov_integrate_polar_k.F90 rttov_integrate_polar_tl.F90 rttov_-layeravg.F90 rttov_layeravg_ad.F90 rttov_layeravg_k.F90 rttov_layeravg_tl.F90 rttov_-locpat.F90 rttov_locpat_ad.F90 rttov_locpat_k.F90 rttov_locpat_tl.F90 rttov_opdep.F90 rttov_opdep_9.F90 rttov_opdep_9_ad.F90 rttov_opdep_9_k.F90 rttov_opdep_9_solar.F90 rttov_opdep_9_solar_ad.F90 rttov_opdep_9_solar_k.F90 rttov_opdep_9_solar_tl.F90 rttov_-opdep_9_tl.F90 rttov_opdep_ad.F90 rttov_opdep_k.F90 rttov_opdep_tl.F90 rttov_opdpscattir.F90 rttov_opdpscattir_ad.F90 rttov_opdpscattir_k.F90 rttov_opdpscattir_tl.F90 rttov_-polcoe.F90 rttov_profaux_k.F90 rttov_refsun.F90 rttov_refsun_ad.F90 rttov_refsun_-k.F90 rttov_refsun_tl.F90 rttov_setgeometry_ad.F90 rttov_setgeometry_k.F90 rttov_-setgeometry_tl.F90 rttov_setpredictors_7.F90 rttov_setpredictors_7_ad.F90 rttov_-setpredictors_7_k.F90 rttov_setpredictors_7_tl.F90 rttov_setpredictors_8_k.F90 rttov_-setpredictors_9.F90 rttov_setpredictors_9_ad.F90 rttov_setpredictors_9_k.F90 rttov_-setpredictors_9_solar.F90 rttov_setpredictors_9_solar_ad.F90 rttov_setpredictors_-9_solar_k.F90 rttov_setpredictors_9_solar_tl.F90 rttov_setpredictors_9_tl.F90 rttov_-setpressure.F90 rttov_sublayer.F90 rttov_sublayer_ad.F90 rttov_sublayer_k.F90 rttov_-sublayer_tl.F90 rttov_transmit_9_solar.F90 rttov_transmit_9_solar_ad.F90 rttov_transmit_-9_solar_k.F90 rttov_transmit_9_solar_tl.F90 rttovscatt_test_one.F90

Files modified(IFS):

control/cnt1.F90 scan2mtl.F90

module/yomemis.F90 yomtvrad.F90 yomvarbc.F90

mwave/mwave_obsop.F90 mwave_obsop_ad.F90 mwave_obsop_tl.F90

namelist/namemis_conf.h namsats.h

obs_preproc/defrun.F90

onedvar/onedvar_adjoint_test.F90 onedvar_obsop.F90 onedvar_obsop_grad.F90
onedvar_obsop_tl.F90 onedvar_raintb.F90 onedvar_screen.F90

phys_dmn/mts_phys.F90

pp_obs/bgobs.F90 biaspred.F90 hop.F90 hopad.F90 hoptl.F90 hradp.F90 hretr.F90
rad1cemis.F90 rad1cnne.F90 rad1cobe.F90 radtr.F90 radtrad.F90 radtrb.F90
radtrbad.F90 radtrbtl.F90 radtrk.F90 radtrtl.F90

setup/suemis_conf.F90

utility/deallo.F90

var/getsatid.F90 rtsetup.F90 surad.F90 vec2gp.F90

Files modified(ODB):

bufr2odb/bufr2odb_airs.F90 bufr2odb_atovs.F90 bufr2odb_ssmis.F90 bufr2odb_tmi.F90

cma2odb/ctxinitdb.F90 getdb.F90 update_obsdb.F90

ddl/cma.h robody_screen.sql sat_atovs.sql sathdr_screen_atovs.sql

Files modified(SATRAD):

interface/rttov_ad.h rttov_boundaryconditions.h rttov_boundaryconditions_ad.h rttov_boundaryconditions_tl.h rttov_calcbt.h rttov_calcbt_ad.h rttov_calcbt_tl.h rttov_calcemis_ir.h rttov_calcemis_mw.h rttov_calcemis_mw_ad.h rttov_calcemis_mw_k.h rttov_calcemis_mw_tl.h rttov_calcrad.h rttov_calcrad_ad.h rttov_calcrad_k.h rttov_calcrad_tl.h rttov_checkinput.h rttov_cmpuc.h rttov_coeffname.h rttov_dealloc_coef.h rttov_deletecomment.h rttov_direct.h rttov_distribcoeffs.h rttov_eddington.h rttov_eddington_ad.h rttov_eddington_tl.h rttov_errorhandling.h rttov_errorreport.h rttov_findnextsection.h rttov_iniedd.h rttov_iniedd_ad.h rttov_iniedd_tl.h rttov_iniscatt.h rttov_iniscatt_ad.h rttov_iniscatt_tl.h rttov_initcoeffs.h rttov_integrate.h rttov_integrate_ad.h rttov_integrate_k.h rttov_integrate_tl.h rttov_integratesource.h rttov_integratesource_ad.h rttov_integratesource_tl.h rttov_intex.h rttov_intex_ad.h rttov_intex_tl.h rttov_intext_prof.h rttov_k.h rttov_mieproc.h rttov_mieproc_ad.h rttov_mieproc_tl.h rttov_opencoeff.h rttov_profaux.h rttov_profaux_ad.h rttov_profaux_tl.h rttov_q2v.h rttov_readcoeffs.h rttov_readcoeffs_ascii.h rttov_readcoeffs_binary.h rttov_readscattcoeffs.h rttov_scatt.h rttov_scatt_ad.h rttov_scatt_tl.h rttov_setgeometry.h rttov_setpredictors_8.h rttov_setpredictors_8_ad.h rttov_setpredictors_8_tl.h rttov_setup.h rttov_skipcommentline.h rttov_tl.h rttov_transmit.h rttov_transmit_ad.h rttov_transmit_k.h rttov_transmit_tl.h rttov_v2q.h rttov_writecoef.h

module/mod_cparam.F90 rttov_const.F90 rttov_global.F90 rttov_types.F90

mwave/mwave_get_rtcoeff.F90 mwave_obsop_rttov.F90 mwave_obsop_rttov_ad.F90 mwave_obsop_rttov_adtest.F90 mwave_obsop_rttov_tl.F90

onedvar/onedvar_get_rtcoeff.F90 onedvar_obsop_grad_rttov.F90 onedvar_obsop_rttov.F90 onedvar_obsop_tl_rttov.F90

pre_screen/bufr_screen_ssmi.F90

rttov/phrtsetup.F90 rttov_ad.F90 rttov_ascii2bin_coef.F90 rttov_boundaryconditions.F90 rttov_boundaryconditions_ad.F90 rttov_boundaryconditions_tl.F90 rttov_calcbt.F90 rttov_calcbt_ad.F90 rttov_calcbt_tl.F90 rttov_calcemis_ir.F90 rttov_calcemis_mw.F90 rttov_calcemis_mw_ad.F90 rttov_calcemis_mw_k.F90 rttov_calcemis_mw_tl.F90 rttov_calcrad.F90 rttov_calcrad_ad.F90 rttov_calcrad_k.F90 rttov_calcrad_tl.F90 rttov_checkinput.F90 rttov_cmpuc.F90 rttov_coeffname.F90 rttov_dealloc_allcoef.F90 rttov_dealloc_coef.F90 rttov_deletecomment.F90 rttov_direct.F90 rttov_distribcoeffs.F90 rttov_ec.F90 rttov_eddington.F90 rttov_eddington_ad.F90 rttov_eddington_tl.F90 rttov_errorhandling.F90 rttov_errorreport.F90 rttov_findnextsection.F90 rttov_iniedd.F90 rttov_iniedd_ad.F90 rttov_iniedd_tl.F90 rttov_iniscatt.F90 rttov_iniscatt_ad.F90 rttov_iniscatt_tl.F90 rttov_initcoeffs.F90 rttov_integrate.F90 rttov_integrate_ad.F90 rttov_integrate_k.F90 rttov_integrate_tl.F90 rttov_integratesource.F90 rttov_integratesource_ad.F90

rttov_integratesource_tl.F90 rttov_intex.F90 rttov_intex_ad.F90
rttov_intex_tl.F90 rttov_intext_prof.F90 rttov_k.F90 rttov_mieproc.F90
rttov_mieproc_ad.F90 rttov_mieproc_tl.F90 rttov_opencoeff.F90 rttov_profaux.F90
rttov_profaux_ad.F90 rttov_profaux_tl.F90 rttov_q2v.F90 rttov_readcoeffs.F90
rttov_readcoeffs_ascii.F90 rttov_readcoeffs_binary.F90 rttov_readscattcoeffs.F90
rttov_scatt.F90 rttov_scatt_ad.F90 rttov_scatt_setupindex.F90 rttov_scatt_tl.F90
rttov_setgeometry.F90 rttov_setpredictors_8.F90 rttov_setpredictors_8_ad.F90
rttov_setpredictors_8_tl.F90 rttov_setup.F90 rttov_skipcommentline.F90
rttov_tl.F90 rttov_transmit.F90 rttov_transmit_ad.F90 rttov_transmit_k.F90
rttov_transmit_tl.F90 rttov_v2q.F90 rttov_writecoef.F90 rttovscatt_test.F90
rttvi.F90 test_2_coef.F90 test_coef.F90 test_errorhandling.F90 test_q2v.F90

satim/gensatim.F90

Files modified(SCRIPTS):

build/arch/Makefile.in.ibm_power5

gen/create_ioassign ifsmin ifstraj mklinks satimsim varconsts

sms/libs.sms

sms_an/satimsim.sms

Files deleted(IFS):

pp_obs/emis_mw_atlas.F90 radtrcld.F90 radtrskin.F90

Files deleted(SATRAD):

interface/mwave_rttov_ind.h rttov_aitosu.h rttov_aitosu_ad.h rttov_aitosu_tl.h
rttov_calcpolarisation.h rttov_calcpolarisation_ad.h rttov_calcpolarisation_tl.h
rttov_cld.h rttov_cld_ad.h rttov_cld_k.h rttov_cld_tl.h rttov_emiscld.h
rttov_emiscld_ad.h rttov_emiscld_tl.h rttov_interpcubic.h rttov_interpcubic_ad.h
rttov_interpcubic_tl.h rttov_onedvar_setupindex.h rttov_profout_k.h
rttov_readcoeffs_new.h rttov_scattad_test.h rttov_setpredictors.h
rttov_setpredictors_ad.h rttov_setpredictors_tl.h rttov_setupchan.h
rttov_setupchan_scatt.h rttov_setupindex.h rttov_setupindex_ec.h rttovcld.h

mwave/mwave_rttov_dim.F90 mwave_rttov_ind.F90

rttov/rttov.F90 rttov_aitosu.F90 rttov_aitosu_ad.F90 rttov_aitosu_tl.F90 rttov_calcpolarisati
rttov_calcpolarisation_ad.F90 rttov_calcpolarisation_tl.F90 rttov_cld.F90 rttov_-
cld_ad.F90 rttov_cld_k.F90 rttov_cld_tl.F90 rttov_emiscld.F90 rttov_emiscld_ad.F90
rttov_emiscld_tl.F90 rttov_interpcubic.F90 rttov_interpcubic_ad.F90 rttov_interpcubic_-
tl.F90 rttov_onedvar_setupindex.F90 rttov_parm.F90 rttov_parm_ec.F90 rttov_scatt_-
k.F90 rttov_scattad_test.F90 rttov_setpredictors.F90 rttov_setpredictors_ad.F90 rttov_-
setpredictors_tl.F90 rttov_setupchan.F90 rttov_setupchan_ec.F90 rttov_setupchan_-
scatt.F90 rttov_setupindex.F90 rttov_setupindex_ec.F90 rttovad.F90 rttovcld.F90 rttovcld_-
direct.F90 rttovcld_test.F90 rttovk.F90 rttovtl.F90 tstrad.F90 tstrad_ad.F90 tstrad_-
k.F90 tstrad_tl.F90

Martin Leutbecher

Avoid failure of task targets when tropical cylones are reported with no name.

Files modified(PREPDATA):

mc_tools/epsrdbufr.F

David Tan

Doppler wind lidar assimilation.

Infrastructure (no meteorological impact) for assimilation of ADM-Aeolus observations.

IFS: facilitate Aeolus Level-2B wind retrievals via additional OMP loop in ifs/var/taskob.F90 and optional logical parameter passed to ifs/pp_obs/hretr.F90;

modify the dummy retrieval values used for development work and rationalize transfers between ODB tables.

ODB: upgrade bufr2odb_aeolus to process bufr data from MDA's Level-1B Processor V1.06 and extend ODB table aeolus-2b.

Upgrade aeolus project to "Release 1.33".

Files created(IFS):

`pp_obs/aeolus_l2b_to_body.F90`

Files created(ODB):

`ddl.ECMA/sathdr_screen_aeolus_sat.sql`

`ddl/sathdr_screen_aeolus_sat.sql`

Files modified(IFS):

`common/yomdb_defs.h yomdb_vars.h`

`module/aeolus_getamd_mod.F90 aeolus_l2bp_wrapper_mod.F90`

`pp_obs/hopad.F90 hretr.F90`

`var/taskob.F90`

Files modified(ODB):

`bufr2odb/bufr2odb_aeolus.F90 get_varindex.F90`

`cma2odb/ctxgetdb.F90 ctxinitdb.F90 getdb.F90 initmdb.F90`

```
ddl/cma.h robhdr_screen.sql sathdr_screen_aeolus_1b.sql
sathdr_screen_aeolus_2b.sql sathdr_screen_aeolus_auxmet.sql
sathdr_screen_aeolus_hdr.sql
```

`interface/ctxgetdb.h getdb.h`

`module/varindex_module.F90`

Files modified(SCRIPTS):

`build/Makefile.root.aeolus`

Files created/modified/deleted(AEOLUS):

`Almost the entire project.`

Karim Yessad and Nils Wedi

NH model

- Coding of a Phi-gw NH model (prototype, which does not work; VFE only).
- Possibility to use VFE in the current Qhat-d4 NH model, at least partially (in the explicit model only); continuation of what is already present in CY33; additional options, like LVFE_GW, LVFE_DELNHPRE.
- Some default values have been modified for NH model.

- LGWADV with LSETTLS=T (but it is unfortunately unstable).
- Correction of several bugs for LGWADV=T.
- Deep layer version of NH model, for LGWADV=T only.

Other topics

- Cheap version of PC scheme (LPC_CHEAP=T).
- Optimise the interface (list of dummy arguments) of some routines in the dynamics.
- Proper use of variables NFLSUL,NFLSA,NFLEN, and correction of some potential bugs about these variables (SL scheme). - New operator (RDERB) for VFE derivatives.
- Cleanings and bug corrections in GPINISLB+GPINISLBAD.
- Split LSETTLS into LSETTLS (equations RHS) and LSETTLST (SL trajectory); split LPC_NESC into LPC_-NESC (equations RHS) and LPC_NESCT (SL trajectory).
- Possibility to use BETADT different from 1 in the SL2TL (for validation).
- Delete some obsolete decks.
- Merge YOMOZODM+YOMOZOSM into YOMOZO, with some variables renamimg.
- GPNHBUF renamed into GPPCBUF (and renaming also pointers in PTRGPNH).
- Add missing comments in some modules.
- Some cleanings in POS.
- LVERCOR=T with LVERTFE=T in the hydrostatic model: add missing pieces of code. The code should now work, but it has not been tested in this configuration.

Files created(IFS):

```
adiab/cpg_gpb_nhgeogw.F90 gnh_conv_nhvar_geogw.F90 gnh_conv_prhs.F90 gnhdlr.F90
gnhdlra.F90 gnhdlrb.F90 gnhgrdlr.F90 lanhsi_geogw.F90 sivderi.F90
spnh_conv_prhs.F90 spnhsi_geogw.F90
module/par_rdlr.F90 yomozo.F90
phys_dmn/mf_phys_prep.F90
setup/sunh_vertfe3dbc.F90 sunhbmat_geogw.F90 susta_conv_prhs.F90 sustadlr.F90
suvertfe99.F90
transform/transdir_nhconvprhs.F90 transinv_nhconvprhs.F90
```

Files modified(IFS):

```
adiab/call_sl.F90 call_sl_ad.F90 call_sl_tl.F90 cpeuldyn.F90 cpeuldynad.F90
cpeuldyntl.F90 cpg.F90 cpg5_gp.F90 cpg_dia.F90 cpg_dyn.F90 cpg_dyn_ad.F90
cpg_dyn_tl.F90 cpg_end.F90 cpg_end_ad.F90 cpg_end_tl.F90 cpg_gp.F90
cpg_gp_ad.F90 cpg_gp_tl.F90 cpg_pt.F90 cpg_zero_ad.F90 cpgad.F90 cpglag.F90
cpgtl.F90 cputqy_arome.F90 estrcpl.F90 gnh_conv_nhvar.F90 gnh_tndlagadiab_gw.F90
gnh_tndlagadiab_spd.F90 gnh_tndlagadiab_svd.F90 gnh_tndlagadiab_uvs.F90
gnhd3.F90 gnhgrpre.F90 gnhgw2svd.F90 gnhpre.F90 gnhpreh.F90 gnhsim.F90
gnhsvd2gw.F90 gnhx.F90 gpaddslphy.F90 gpcty.F90 gpgrp.F90 gpgw.F90 gphluv.F90
gpinislb.F90 gpinislbad.F90 gpino3ch.F90 gpinozstdm.F90 gppvo.F90 gptf1.F90
gptf1ad.F90 gptf2.F90 gptf2ad.F90 gpuvs.F90 gpuvsad.F90 gpxx.F90 lacdyn.F90
lacdynad.F90 lacdynshw.F90 lacdynshwad.F90 lacdynshwtl.F90 lacdyntl.F90
ladine.F90 ladinead.F90 ladinetl.F90 lanhsi.F90 lanhsib.F90 lapinea.F90
lapinea5.F90 lapineaad.F90 lapineatl.F90 lapineb.F90 lapinebad.F90 lapinebtl.F90
larcinb.F90 larcinha.F90 larcinhb.F90 larmes.F90 latte_bbc.F90 lattes.F90
lattex.F90 lattex_dnt.F90 lavabo.F90 lavent.F90 postphy.F90 spcsi.F90
spcsiad.F90 spnh_conv_nhvar.F90 spnhsi.F90
c9xx/apache.F90
climate/updclidm.F90 updo3ch.F90
```

control/cnt4.F90 gp_model.F90 spcm.F90

dia/cpdyddh.F90 cpphddh.F90 cpphddhe.F90 spnorm.F90 wrmlppadm.F90 wrspeca.F90

module/gmv_subs.F90 par_clim.F90 parrint.F90 ptrgpnh.F90 ptrslb1.F90 ptrslb2.F90 type_gmvs.F90 yomct0.F90 yomcver.F90 yomdim.F90 yomdyn.F90 yomdyna.F90 yomfpg.F90 yomgnhb.F90 yomobset_thsafe.F90 yomozodm.F90 yomozosm.F90 yompldsw.F90 yomsig.F90 yomts.F90 yomvodcst.F90

namelist/namancs.h namct0.h namdyn.h namdyna.h

phys_dmn/mf_phys.F90

phys_ec/ec_phys.F90 ec_phys_drv.F90 ec_phys_lslphy.F90 o3chem.F90 radcfg.F90 raddrv.F90

pp_obs/endpos.F90 fpachmt.F90 fpps.F90 phymfpos.F90 pos.F90 ppvvel.F90 spaconvert.F90 vpos.F90

setup/sualdynb.F90 suallo.F90 suct0.F90 sudim2.F90 sudyn.F90 sudyn_setgflattr.F90 sudyna.F90 sufpg1.F90 sugridadm.F90 suheg.F90 suinif.F90 sump.F90 sumpini.F90 sunh_vertfe3d.F90 sunhbmat.F90 sunhheg.F90 sunhsi.F90 suorog.F90 supong.F90 supp.F90 suptrgpnh.F90 susc2b.F90 suslb.F90 suspecg.F90 sutric.F90 suvertfe.F90

transform/transinv_nhconv.F90

utility/deallo.F90 simplico.F90 verder.F90

Rossana Dragani

Update of the MLS ozone profile implementation to be WMO compliant.

Files modified(IFS):

var/surad.F90

Files modified(OBSTAT):

module/mod_sat_monitor.F90

satmon/sat_add_geo.F90

Files modified(SATRAD):

pre_screen/reo3_prescreen.F90

Files modified(SCRIPTS):

gen/fetchobs prereo3 smon_def

Soumia Serrar

Correction of the threshold set to meaningful values in the interpolated fields. The error was introduced in cycle CY31R1 and was exclusively affecting accumulated fluxes with values less than -999999.

Files modified(PREPDATA):

programs/interpo.F90

Some cleaning has been done to allow for the use of GFL extra fields for any prognostic or diagnostic field. The use of GFL extra fields was previously restricted to tracers.

Files modified(IFS):

phys_ec/callpar.F90 callpartl.F90callparad.F90 module/traj_physics.F90

setup/suctrl_gflattr.F90

The post-processing of some diagnostic physical tendencies is no more restricted to ERA40-type experiments.

Files modified(IFS):

phys_ec/callpar.F90

set_up/sudim1.F90 sudefo_gflattr.F90 suafn1.F90

control/ scan2mdm.F90

pp_obs/pos.F90

Alan Geer and Peter Bauer

Updates to the 4D-Var of rainy and cloudy microwave imager observations, which is still in development and not yet operational. The main part of this change enables the assimilation of a variety of microwave imagers (e.g. AMSR-E, TMI) rather than just SSM/I. Other minor additions are an adjoint sensitivity check, minor updates for RTTOV-9, and additional diagnostics stored to the ODB.

Files created(IFS):

mwave/mwave_read_sat_error.F90

Files created(SATRAD):

mwave/mwave_get_filename.F90 mwave_share_rtcoeff.F90

Files modified(IFS):

common/yomdb_defs.h yomdb_vars.h

control/gp_model.F90 gp_model_ad.F90 gp_model_tl.F90

module/parmwave.F90 yomdb.F90 yommwave.F90

mwave/mwave_get.F90 mwave_get_ad.F90 mwave_get_tl.F90 mwave_gp2obs.F90 mwave_igp2obs.F90 mwave_iobs2gp.F90 mwave_nearest.F90 mwave_obs2gp.F90 mwave_obsop.F90 mwave_obsop_ad.F90 mwave_obsop_test.F90 mwave_obsop_tl.F90 mwave_put.F90 mwave_put_tl.F90 mwave_screen.F90 mwave_setup.F90

namelist/nammwave.h

phys_ec/callpar.F90 callparad.F90 callpartl.F90 ec_phys.F90 ec_phys_ad.F90 ec_phys_drv.F90 ec_phys_tl.F90 ec_physg.F90

pp_obs/hop.F90 hopad.F90 hoptl.F90 hsatang.F90

var/rtsetup.F90

Files modified(ODB):

cma2odb/ctxinitdb.F90 initmdb.F90

ddl/cma.h robhdr.sql robhdr_mwave_get_screen_ssmi.sql robhdr_mwave_get_ssmi.sql robhdr_-mwave_put_screen_ssmi.sql robhdr_mwave_put_ssmi.sql robody_mwave_get_screen_ssmi.sql robody_mwave_get_ssmi.sql robody_mwave_put_screen_ssmi.sql robody_mwave_put_ssmi.sql robody_screen.sql sat_ssmi.sql

Files modified(SATRAD):

module/mwave_const.F90

mwave/mwave_get_rtcoeff.F90 mwave_obsop_rttov.F90 mwave_obsop_rttov_ad.F90 mwave_obsop_rttov_adtest.F90 mwave_obsop_rttov_tl.F90

Files modified(SCRIPTS):

gen/ifsmin ifstraj mklinks premwimg varconsts

Files deleted(IFS):

mwave/mwave_get_bias.F90

Files deleted(SATRAD):

interface/mwave_rttov_ind.h

mwave/mwave_rttov_dim.F90 mwave_rttov_ind.F90

Christina Tavolato and Lars Isaksen

Code for Huber norm variational quality control and retuning of observations errors. When the Huber norm is active it is safe to relax the first guess rejection limits for conventional data. The new limits have been determined from observation departure statistics for the T799L91 assimilation system during the period February 2006 to September 2007. The Huber norm is controlled by a set of variables that to some extent mirrors the VARQC variables. Default values are set in defrun.F90 and most Huber norm variables are available in namelist NAMJO. The most important are

```
 Variational Quality Control with Huber
  RHUBERLEFT            R    LEFT HUBER CUTOFF VALUES
  RHUBERRIGHT           R    RIGHT HUBER CUTOFF VALUES
  RHUBERBGQC            R    BACKGROUND CHECK LIMITS FOR HUBER VARQC
  RHUBERBGQC_SONDEGOOD  R    BACKGROUND CHECK LIMITS FOR HUBER VARQC FOR GOOD SONDES AND PILOTS
  RHUBERBGQC_SONDEOK    R    BACKGROUND CHECK LIMITS FOR HUBER VARQC FOR OK SONDES AND PILOTS
  RHUBEROETUNING        R    FACTOR TO REDUCE THE OBSERVATION ERROR WHEN USING HUBER VARQC
  LHUBERMINQCG          L    SWITCH HUBER VARIATIONAL QC WEIGHTS ON/OFF GLOBALLY
  LHUBERBGQCG           L    SWITCH CHANGE IN BGQC LIMITS FOR HUBER VARIATIONAL QC ON/OFF GLOBALLY
  LHUBERMINQC           L    SWITCH HUBER VARIATIONAL QC WEIGHTS ON/OFF BY VAR. AND OBS-TYPE
  LHUBERBGQC            L    SWITCH CAHNGE IN BGQC LIMITS FOR HUBER VARIATIONAL QC ON/OFF BY VAR. AND OBS-TYPE
```

Further details will be described in a memorandum.

The observation errors for METAR has been brought in line with the other conventional observations, by moving code from metarin.F90 to suobserr.F90. Based on departure statistics the observation errors for METAR has been reduced to make it similar to automatic SYNOP pressure observations.

The code is not active in this cycle and gives bit-identical results when switches off. It is controlled by the main switches LHUBERMINQCG=.false, and LHUBERBGQCG=.false..

Files modified(IFS):

module/pardimo.F90 yomcosjo.F90

namelist/namjo.h

obs_error/suobserr.F90

obs_preproc/defrun.F90 fgchk.F90 fgwnd.F90 metarin.F90 sulevlay.F90 tempin.F90

pp_obs/hjo.F90

setup/sucmoctp.F90

Gabor Radnoti

Developments to account for correlated observation errors in 4DVAR. The option is kept passive for the time being. To do experimentation with obs error correlations one has to increase the value NUMEV (e.g. NUMEV=100) in cma.h and recompile odb. I had to keep NUMEV=1 in order not to have any memory issue in passive mode. *Files created(IFS):*

obs_preproc/interp_obs.F90 interp_obsad.F90 obscor_lanczos.F90 opk_obscor.F90 opm_obscor.F90 suobscor.F90 suobscor_resol.F90

pp_obs/obscor_sumup_scalp.F90

var/suhifcead.F90

Files created(IFSAUX):

module/yomlcz.F90

Files created(ODB):

ddl.CCMA/suobscor_robhdr.sql suobscor_robody.sql

ddl/suobscor_robhdr.sql suobscor_robody.sql

Files modified(IFS):

common/yomdb_defs.h yomdb_vars.h
module/parcma.F90 yomcosjo.F90 yomdb.F90 yomlap.F90
namelist/namjo.h
obs_preproc/defrun.F90 gen_corr_pert.F90 pertobs.F90 suobs.F90
parallel/gathergpf.F90
pp_obs/hjo.F90 hop.F90 hoptl.F90 statpred.F90
sinvect/store.F90
utility/gstats_label_ifs.F90

var/suhifce.F90 taskob.F90 taskobtl.F90 xformev.F90

Files modified(IFSAUX):

lanczos/landr.F lanso.F purge.F startv.F stpone.F

Files modified(ODB):

cma2odb/ctxinitdb.F90 initmdb.F90

ddl/cma.h robody.sql

Files modified(SCRIPTS):

gen/fdbksave fetchobs ifsmin

Files deleted(IFS):

module/yomlcz.F90

Alan Geer

Minor bugfix which removes a dependency of the gaussian grid pre-screening code on core IFS routines. This was found to be unsafe during integration testing.

Files modified(SATRAD):

pre_screen/bufr_grid_screen.F90 distance_between.F90

A minor bugfix to the IFS interface to RTTOV-9 for the rainy/cloudy observations: contrary to the RTTOV-9 users' guide, "latitude" and "elevation" inputs were discovered to actually be compulsory for RTTOV-9. The RTTOV-9 users' guide will be changed.

Files modified(IFS):

onedvar/onedvar_raintb.F90 onedvar_screen.F90

Files modified(SATRAD):

`onedvar/onedvar_obsop_grad_rttov.F90 onedvar_obsop_rttov.F90 onedvar_obsop_tl_rttov.F90`

Peter Bauer

Monitoring of Envisat MERIS derived total column water vapour observations over land.

Files created(ODB):

`bufr2odb/bufr2odb_meris.F90`

Files created(SATRAD):

`pre_screen/bufr_screen_meris.F90`

Files created(SCRIPTS):

```
sms_an/b2o_meris.sms obstat_meris.sms odbcmp_meris.sms
sms_era/obtime_meris.sms
```

Files modified(IFS):

```
common/yomdb_defs.h yomdb_vars.h
module/yomtvrad.F90
obs_preproc/black.F90
pp_obs/hdepart.F90 hop.F90 hopad.F90 hoptl.F90 hretr.F90
var/getsatid.F90 surad.F90
```

Files modified(ODB):

```
bufr2odb/get_varindex.F90
cma2odb/buf2cmat_new.F90 initmdb.F90 subuoctp.F90
ddl/black_robhdr_6.sql cma.h robhdr.sql robody.sql robody_traj.sql
module/getval_module.F90 varindex_module.F90 yomboctp.F90
tools/Bufr2odb.F90
```

Files modified(SCRIPTS):

```
build/arch/Makefile.in.ibm_power5
def/an.def
gen/bufr2odb fdbksave fetchobs mkabs_satrad preobs
sms_era/obtime.sms
```

Tim Stockdale

Bugfix for coupled ocean-atmosphere runs (NFRCO /= 0). Previously, the arrays used to accumulate the fluxes to be passed to the ocean model were not initialized after they were allocated during the start-up of the IFS. The fix ensures that they are correctly initialized (generally to zero) immediately after creation.

Impact on coupled ocean-atmosphere runs: the fluxes passed to the ocean on the first timestep are guaranteed to be correct, instead of being possibly anything. Only the first timestep is affected. No impact on any other configurations.

Files modified(IFS):

setup/sugem2.F90

Hans Hersbach

Bugfix for monitoring of ASCAT soil moisture in HJO

Files modified(IFS):

pp_obs/hjo.F90

Tony McNally

The local extension of the control vector for satellite radiance observations (currently containing a surface skin temperature sink variable) has been extended to include sink variables for cloud top pressure and cloud fraction. The radiance observation operators have been similarly extended to allow cloudy computations using these variables and the 4DVAR now produces analysed values of the new cloud variables. The intention is to allow infrared radiance data to be used in cloud affected regions by estimating cloud parameters simultaneously with temperature and humidity. All the new code and ODB storage of new variables is activated by a switch LCLDSINK = .TRUE.

Files modified(IFS):

common/yomdb_defs.h yomdb_vars.h

module/yomvar.F90

namelist/namvar.h

obs_preproc/fgchk.F90 mkglobstab.F90 new_thinner_no_sq.F90 pre_thinner.F90 thinner_no_sq.F90

pp_obs/bgobs.F90 hop.F90 hopad.F90 hoptl.F90 hradp.F90 hradptlF90 hradpad.F90 hretr.F90 radtr.F90 radtrad.F90 radtrtl.F90

var/sualctv.F90 suvar.F90

Files modified(ODB):

cma2odb/initmdb.F90

ddl/cma.h matchup_atovs_pred.sql mkglobstab_atovs.sql sat_atovs.sql sathdr_screen_atovs.sql

Carla Cardinali

1. Correct definition of the cost function = 1/2 J 2. Modification of congrad to solve a linear equation system.

Files modified(IFS):

control/cva2.F90 forecast_error.F90 sim4d.F90

pp_obs/hjo.F90 hopad.F90

var/congrad.F90 evjcdfi.F90 fjvarbc.F90

Johannes Fleming

Introduce in the IFS code interfaces needed to run coupled runs with the coupler OASIS4.

The dummy modules prism_dummy_mod.F90 and prism_time_constant.F90 are needed for the compilation without linking the OAISIS4 libraries. Calling any routine of the dummy module with call for abort. For real OASIS4 coupled runs "USE PRISM_DUMMY_MOD" has to be replace with "USE PRISM" and OASIS4, xml and netcdf libraries have to be added to the compile and links scripts.

couplo4_inimpi and couplo4_endmpi are called at the start and the end of the IFS in master.F90. couplo4_-inimpi checks the environment variable OASIS4RUN. If "yes", it requests a local MPI communicator from the OASIS4 driver and assigns it to the communicator variable used in the ifsaux library. Libraries assuming the MPI communicators should not be MPI_COMM_WORLD can not be used in coupled runs. couplo4_endmpi finalises the MPI communication in the coupled runs.

couplo4_definitions, called in cnt4, defines the grids and the exchanged variables based on the namelist NAM-COUPLO4, which is read in at the start of the routine. The exchanged fields can be provided at the following grid types:

1) 3d reduced Gaussian grid for 3d grid point fields (3D GP)
2) 2d reduced Gaussian grid for surface grid point fields (2D GP)
3) 3d gridless field for 3d spectral field (3D SP)
4) 2d gridless field for surface spectral fields (2D SP)

Coordinates and shape and length of the data arrays communicating the grid structure to the coupler is first locally defined for each MPI task depending on the respective distribution in grid-point and spectral space. If data exchange via one task only is requested (LGLOBALGP and LOGLOBALSP) the grid information arrays are gathered on one MPI task before it is provided to the coupler. The fields subject to coupling are defined according to setting (LOUT_XX, LIN_XX) in the namelist NAMCOUPLO4.

Couplo4_exchange is included in the model time loop (gp_model), and it performs the data exchange at the described coupling intervals by looping over the defined exchange variables. The routine puts fields to the coupler after the data have been copied from the IFS data arrays, or gets the data and copies them to IFS arrays in a separate routine couplo4_grg_input.

Files created(IFS):

`module/couplo4_module.F90`

`prism/couplo4_cor_test.F90 couplo4_definitions.F90 couplo4_endmpi.F90 couplo4_exchange.F90 couplo4_grg_input.F90 couplo4_grg_stats.F90 couplo4_inimpi.F90`

Files created(IFSAUX):

`module/prism_dummy_mod.F90`

Files modified(IFS):

`control/cnt4.F90 gp_model.F90 master.F90`

Jan Haseler

Modifications to enable the data assimilation to run at t1279 resolution

Files modified(IFSAUX):

`include/grib_internal.h`

Files modified(PREPDATA):

`module/yomgrib_si.F90`

programs/forceinv.F90 gptosp.F90 intsst.F90 spint.F90

Files modified(SCRIPTS):

def/an.def

gen/fast_sgint ifsmin ifstraj lowres_fp model vardata

sms/verify.sms

sms_an/lowres.sms preobs.sms slwet.sms ssaana.sms vardata.sms

Files modified(SSA):

plot/coordinates.F90

Jan Haseler, Mohamed Dahoui et al.

Bugfixes for operational suite, including changes to satellite monitoring, reading BUFR data in EPS, errors in wave model detected by bounds checking.

Files created(OBSTAT):

satmon/sat_summary_plot.F90

Files modified(OBSTAT):

module/mod_sat_create_netcdf.F90 mod_sat_monitor.F90

satmon/get_dmsprainy_odb.F90 get_tcwv_odb.F90 sat_add_geo.F90 sat_geo_plot.F90 sat_-hist_plot.F90 sat_hist_profile_plot.F90 sat_hov_plot.F90 sat_monitor.F90 sat_overview_-hist_plot.F90

Files modified(ODB):

ddl/dmsprainy.sql

Files modified(PREPDATA):

mc_tools/epsrdbufr.F

Files modified(SCRIPTS):

def/an.def

gen/fetchobs getsmon model satmon_getdat satmon_monitor smon smon_clean smon_def smon_-funcs

Kristian Mogensen

Introduction of a user defined MPI communicator to facilitate running the IFS in multiple data multiple program (MPMD) mode with OASIS3 and OASIS4. The user defined communicator needs to be set before any MPL calls (including calls to Dr. Hook).

Files modified(IFSAUX):

module/mpl_allgatherv_mod.F90 mpl_arg_mod.F90 mpl_comm_create_mod.F90 mpl_data_module.F90 mpl_gatherv_mod.F90 mpl_init_mod.F90 mpl_ioinit_mod.F90 mpl_locomm_create_mod.F90

Yannick Tremolet and Gabor Radnoti

Weak-constraint 4DVAR

Fixes and developments related to different choices of the model error control variable. Additionally some developments towards the possibility of long, overlapping 4DVAR windows.

Files created(IFS):

```
utility/save4next.F90
```

Files modified(IFS):

```
control/cdsta.F90 cnt4.F90 cnt4ad.F90 cnt4tl.F90 sim4d.F90
module/model_error.F90
namelist/nammoderr.h
setup/sudim1.F90 suinimoderr.F90
utility/dealctv.F90 savmoderr.F90 subfgs.F90
var/add_moderr_ad.F90 add_moderr_tl.F90 rdfpinc.F90 sujqstd.F90 sumoderr.F90 suvazx.F90
upspec.F90 weak_constraint.F90
```

Files modified(SCRIPTS):

```
build/arch/Makefile.in.ibm_power5
gen/anml getgrbme getini ifsmin ifstraj var_include vardata
oce/saverestarts
sms_an/ssaana.sms
```

Richard Forbes

Removes small negative numbers in the precipitation fluxes and cloud variables due to numerical rounding errors. The changes affect prognostic fields at the bit-level and therefore results will not be bit-identical. The diagnostics LSP (grib code 142) and SF (grib code 144) are affected (as well as CIWC and CLWC) and these fields should no longer contain small negative numbers.

Files modified(IFS):

```
phys_ec/cloudsc.F90
```

Jean Bidlot

This cycle contains de few changes that were made to the operational version of 33R1 but were not backstiched in the research version of 33R1.

The value used to specify the minimum energy level in each spectral bin, FLMIN was reset to 0.0001 (from 0.000001).

A few minor array bound violations were removed.

Files modified(WAM):

```
Sar/accuwa.F chasar.F dnfftf.F fftsub.F fullmap.F getsarpar.F sarinv.F
sarinvert.F
Wam_oper/getwspec.F mpdecomp.F spec2fdb.F userin.F
```

`module/yowparam.F`

Claire Delsol

Introduce the FY-2C AMVs in passive mode.

Files modified(ODB):

`bufr2odb/bufr2odb_satob.F90`

Files modified(SCRIPTS):

`gen/fetchobs`

Mike Fisher

Modify the analysis change-of-variable to avoid an unnecessary transform of gridpoint fields to and from spectral space.

Files modified(IFS):

`utility/jbtomodel.F90 jbtomodelad.F90`

`var/cvar2in.F90 cvar2inad.F90 cvar3in.F90 cvar3inad.F90 cvargpad.F90 cvargptl.F90 evjq.F90 sqrtbin.F90 sqrtbinad.F90`

Deborah Salmond

Optimizations.

- Change of JDUP to 33 #ifdef NECSX - otherwise JDUP=1 in LASCAW..

- Reduction in the work of CLDPP (from Richard Forbes)

- Optimisations of physics routines based on those from the IBM benchmarking which initially was not putin as the code had changed between the benchmark and the current cycle

- Reduction of the message passing in setup of Jb - to go with the improvements to the I/O already introduced by Mike Fisher

- Optimisation of the random number generator (John Hague)

- Mod to make larche_hlp work if compiled with -O4:

- Fix problems for adjoint test caused by treatment of common expressions with compiler V11 and qhot_level0

- Loop splitting in LAITQM and LAITQMH inspired by visit to IBM comiler developers.

Files created(IFS):

`module/yomlascaw.F90`

Files modified(IFS):

`adiab/laitqm.F90 laitqmh.F90 larche_hlp.F90 lascaw.F90 lascawad.F90 lascawtl.F90`

`phys_ec/cldpp.F90 cuancape2.F90 cubasen.F90 rrtm_ecrt_140gp_mcica.F90 rrtm_rtrn1a_140gp_mcica.F90 srtm_reftra.F90 srtm_spcvrt_mcica.F90` srtm_srtm_224gp_mcica.F90 srtm_vrtqdr.F90 vdfdifhs.F90 vdfdifhsad.F90 vdfdifhstl.F90

var/sujbwavallo.F90

Files modified(IFSAUX):

module/random_numbers.F90

Klaus Scipal

Code for ASCAT soil moisture monitoring.

Files created(IFS):

module/yomascatsm.F90

obs_preproc/ascatsm_cdfmatch.F90 ascatsm_cdfpar.F90

Files modified(IFS):

common/yomdb_defs.h yomdb_vars.h

module/pardimo.F90 yomcosjo.F90 yommkodb.F90

namelist/nammkodb.h

obs_preproc/ascatin.F90 scat_ob.F90 suobs.F90

pp_obs/hjo.F90 hop.F90 hvnmtlt.F90 preints.F90

Files modified(ODB):

bufr2odb/bufr2odb_ascat.F90 get_odb2bufr_varindex.F90 get_varindex.F90

cma2odb/initmdb.F90

ddl/cma.h satbody_scat.sql scat_robhdr_1.sql scat_robody_1.sql

module/odb2bufr_varindex_module.F90 varindex_module.F90

Files modified(SCRIPTS):

build/arch/Makefile.in.ibm_power5

gen/ODBCMP.ddl ifstraj

Matthias Drusch

Additional code for the surface kalman filter.

Files created(IFS):

module/parsekf.F90

namelist/namsekf.h

obs_preproc/sekf_prep_ascat.F90

sekf/sekf_costf.F90 sekf_write.F90

Files created(SCRIPTS):

gen/sekf_sm

sms_an/sekf.sms

Files modified(IFS):

control/csekf2.F90

module/yomsekf.F90

```
obs_preproc/obsgen.F90
sekf/sekf_gain.F90 sekf_matinv.F90 sm_ekf_main.F90 susekf.F90
setup/suct0.F90
utility/dealsc2.F90 matrixin.F90
```

Files modified(PREPDATA):

```
programs/soilinc.F90
```

Files modified(SCRIPTS):

```
def/an.def
gen/soilana
wav/wave_setup_4v
```

George Mozdzynski

Provide a tuned NPROMA setting for model resolutions with 62 or less levels, i.e. targeting our current EPS resolution.

For T399/T255/L62 this gives the following improvement,

- RD/prepIFS 1.8% (defaults for this case are now NPROMA=-56, and NRPROMA=-8)

- operations 0.9% (NPROMA=-56, NRPROMA=-8 is already being used)

Files modified(IFS):

```
setup/sump.F90
```

Ensure reproducible results with different values of NRPROMA

Files modified(IFS):

```
phys_ec/srtm_reftra.F90 srtm_spcvrt_mcica.F90 srtm_vrtqdr.F90
```

Bring the gstats package up to date particularly for the detailed timing statistics. The accuracy of the gstats package is important for benchmarkers as it provides essential information needed for extrapolating performance on HPC systems.

```
e.g. for T799L91 4D-Var

"FRACTION OF TOTAL TIME ACCOUNTED FOR"
            was   now   now+sumb
   traj0     75    96     99.8
   min0      85    94     99.3
   traj1     88    92     99.5
   min1      90    97     99.6
   traj2     88    90     99.3
   min2      94    98     99.6
   traj3     69    93     98.9

and for a T799L91 model
        was   now   now+sumb
       99.3  98.3**   99.8
```

```
** reduction is due to use of overlapping counters (double counting) in
the control
```

Some specific details for this branch :-

- New local logical in gstats.F90 LLFINDSUMB (default is false) which when set to true detects overlapping counters and provides a stack of the most recent gstats calls when SUMB (total or increment) is greater than some nominal value

- the calculation of imbalance is corrected (yet more double counting!) e.g T799L91 model 64Tx8t (one day forecast) was TOTAL MEASURED IMBALANCE = 201.3 SECONDS, 25.0 PERCENT and is now, TOTAL MEASURED IMBALANCE = 122.9 SECONDS, 15.3 PERCENT

- ZLAST_PAR_TIME logic and references to counters 102 and 103 in gstats.F90 have been deleted; this code was a kludge (says George) to avoid resolving/finding some relatively large SUMB values

- New OpenMP directives added in jbvcor_waveletin.F90, jbvcor_waveinad.F90, wavxform.F90, xformev.F90 and wrevecs.F90 these result in a 1.4 percent improvement in min0 and less so in other minimisation steps

```
- additional line (i.e. INCLUDING SUMB) in detailed stats summary per
task which gives us confidence in the 'counting'
SUMMED TIME IN COMMUNICATIONS   =  99.7 SECONDS  12.39 PERCENT OF TOTAL
SUMMED TIME IN PARALLEL REGIONS = 675.2 SECONDS  83.87 PERCENT OF TOTAL
SUMMED TIME IN I/O SECTIONS     =   7.1 SECONDS   0.88 PERCENT OF TOTAL
SUMMED TIME IN SERIAL SECTIONS  =   8.1 SECONDS   1.01 PERCENT OF TOTAL
SUMMED TIME IN BARRIERS         =   1.1 SECONDS   0.14 PERCENT OF TOTAL
FRACTION OF TOTAL TIME ACCOUNTED FOR    98.28
FRACTION OF TOTAL TIME ACCOUNTED FOR INCLUDING SUMB    99.84
```

- support 'MXD' counter type (like BAR, OMP, etc.) in gstats package, useful for a new counter when you initially don't know where to charge the counter to; there are no 'MXD' counters at present

- tidy up of some prints

Files modified(IFS):

```
dia/ppflush.F90
obs_preproc/new_thinn.F90 obatabs.F90 readoba.F90 screen.F90 suobs.F90
phys_ec/radintg.F90 suecrad.F90 suphec.F90 wvcouple.F90
setup/su0yomb.F90
transform/transdir_wavelet.F90 transdir_waveletad.F90
utility/gstats_label_ifs.F90 subfgs.F90
var/gp_nearest.F90 gp_ssmi.F90 gp_ssmi_gp2obs.F90 gp_ssmi_igp2obs.F90 gp_ssmi_inv.F90
gp_ssmi_iobs2gp.F90 gp_ssmi_obs2gp.F90 jbvcor_waveletin.F90 jbvcor_waveletinad.F90
sujbwavelet.F90 surad.F90 wavxform.F90 wrevecs.F90 writeoba.F90 xformev.F90
```

Files modified(IFSAUX):

```
module/yomgstats.F90
support/broadcchar.F90 broadcint.F90 broadcreal.F90 gstats.F90 gstats_print.F90
```

Files modified(ODB):

cma2odb/shuffle_odb.F90

Files modified(SATRAD):

rtlimb/rtlimb_distribcoeffs.F90 rtlimb_readmws.F90

rttov/rttov_distribcoeffs.F90 rttov_readscattcoeffs.F90

Files modified(TRANS):

external/dir_trans.F90 dir_transad.F90 inv_trans.F90 inv_transad.F90

module/trgtol_mod.F90 trltog_mod.F90

Files modified(WAM):

Wam_oper/prewind.F

Changes in adjoint of Semi-Lagrangian:

1) Make OpenMP event lock assignments more dynamic and maintainable in the call_sl_ad call tree (see larcinbad.F90 and larcinaad.F90)

2) Reduce 'event stagger' of threads by recognising more independent variables (see use of old lock(7) in particular)

With the reduction of the 'event stagger' in the call_sl_ad call tree there is a small 0.3 percent (8 threads) to 0.5 percent (16 threads) performance improvement with this branch (for LVECADIN=F, the IBM default).

Files modified(IFS):

adiab/call_sl_ad.F90 lapineaad.F90 lapinebad.F90 larcinaad.F90 larcinbad.F90 larmesad.F90

Workarounds and fixes to permit IFS to be run with subscript checking (-C).

Files modified(IFS):

adiab/call_sl.F90 cpg_dia.F90 cpgad.F90 ladine.F90 ladinead.F90 ladinetl.F90 lapinea5.F90 lapineaad.F90 lapineatl.F90 lapinebad.F90 larcinb.F90 lascaw.F90

control/cnt4.F90 gp_model.F90 spcm.F90 spcmad.F90

module/goms.F90 iostream.F90 surface_fields.F90 yomafn.F90 yomgrb.F90 yomvareps.F90

obs_preproc/thin_red_presort.F90

parallel/commspnorm1.F90 slcomm2.F90 slcomm2a.F90

phys_ec/callpar.F90 cuancape2.F90 cumastrn.F90 cumastrnad.F90 cumastrntl.F90 ec_phys_drv.F90 sucumf.F90 vdfdpbl.F90 vdfexcu.F90 vdfexcus.F90 vdfexcusad.F90 vdfexcustl.F90 vdftofdc.F90 vdftofdcs.F90

pp_obs/pos.F90 ppvvel.F90 slint.F90 slintad.F90

setup/su0phy.F90 suafn1.F90 suafn2.F90 suafn3.F90 sudim1.F90 suhdfvareps.F90 sump.F90 suvareps.F90

utility/write_wavelet_initcv_grib.F90

var/cobslag.F90 gp_ssmi_inv.F90 jbvcor_waveletin.F90 jbvcor_waveletinad.F90 sualctv.F90 vec2gp.F90

Files modified(IFSAUX):

minim/ctcab_1dv.F ctonb_1dv.F dd_1dv.F euclide_1dv.F m1qn3a_1dv.F

module/control_vectors_data.F90 ecsort.F90 mpl_allgatherv_mod.F90 mpl_alltoallv_mod.F90 mpl_recv_mod.F90 mpl_send_mod.F90 spectral_fields.F90

Files modified(OBSTAT): mod_sat_monitor.F90 `src/odbread.F90 odbscaling.F90`

Files modified(ODB):

`bufr2odb/bufr2odb_satob.F90 bufr2odb_temp.F90`

`include/fodbmp2.h`

Files modified(PREPDATA):

`module/yomcons_si.F90`

`programs/soilinc.F90`

Files modified(SATRAD):

`rttov/rttov_ec.F90 rttovcld.F90`

Files modified(SURF):

`external/surfexcdrivers.F90`

Files modified(TRANS):

`module/ftdir_ctl_mod.F90 ltdir_ctl_mod.F90 ltdir_ctlad_mod.F90 ltinv_ctl_mod.F90 ltinv_-ctlad_mod.F90 trltom_mod.F90 trmtol_mod.F90`

Files modified(WAM):

`Wam_oper/initmdl.F mpdecomp.F spec2fdb.F upwspec.F userin.F wavemdl.F`

Mats Hamrud

Optimization of the message passing of observation equivalents.

The interpolation of observation equivalents (GOM arrays) from model space to observation locations has to be done at the appropriate time as the forecast progresses. The message passing of the observation equivalents can however be done in one go, just before the calculations on observation space thereby achieving longer messages and lower load imbalance. The same applies in reverse also in the adjoint computations.

This has been introduced as the default method but can be reverted to old way by setting the (hard-coded) switch LPREMPOBS to false.

Files created(IFS):

`pp_obs/mpobseq_pack.F90 mpobseqad_unpck.F90 post_obshor.F90 pre_obshorad.F90`

Files modified(IFS):

`control/cnt4.F90 cnt4ad.F90 cnt4tl.F90`
`module/yomglobs.F90`
`obs_preproc/mkglobstab.F90`
`pp_obs/laidliobsad.F90 mpobseq.F90 mpobseqad.F90 obshor.F90 obshorad.F90 slintad.F90`

Nils Wedi

Removed the old massfixer and introduced a new massfixer that allows to either fix only the dry total mass or the total mass. It is controlled via the switches (namdyn.h) LMASCOR=.TRUE. and to activate the fixing of the dry mass (which is the more accurate choice) LMASDRY=.TRUE.; optionally, the mass to be fixed can be specified with GMASSI. The frequency of mass fixing is specified via NFRMASSCON.

The restriction of the old massfixer needing to use NPRTRV=1 has been removed and the extra cost of the new massfixer is 0.5% in a T159L91 climate run when activated every time-step (NFRMASCON=1), hence could be considered for current operations, and should be considered for GEMS and climate runs in the physics.

Files created(IFS):

`climate/cormassdry.F90`

Files modified(IFS):

```
adiab/cpg.F90 cpg_gp.F90 spcmascor.F90
control/cnt4.F90 reresf.F90 spcm.F90
module/yommass.F90
namelist/namdyn.h namrcf.h
parallel/gpnorm1.F90
setup/sudyn.F90
utility/wrresf.F90
```

Allow to run IFS as a Held-Suarez climate simulation, or in aqua-planet mode, on a full or reduced-size planet (with/without acceleration of time/Coriolis), and various choices of initial conditions and orograpy for various test cases. This is important for the evaluation of both the hydrostatic and non-hydrostatic IFS model.

Files created(IFS):

```
module/yomdyncore.F90
namelist/namdyncore.h
phys_ec/gpsstaqua.F90 heldsuarez.F90 suecozcaqua.F90
setup/setinidyncore.F90 sugridug2.F90 suspecg2.F90
```

Files modified(IFS):

```
adiab/cppsolan.F90 gnh_conv_nhvar.F90 gnhx.F90 gprh.F90 spnh_conv_nhvar.F90
canari/cagade.F90 caohis.F90
climate/updclie.F90
control/gp_model.F90
dfi/ereast.F90
function/fctast.h fcttim.h
module/yoeozoc.F90 yoerad.F90
namelist/naerad.h namphy.h
phys_dmn/acdifoz.F90
phys_ec/callpar.F90 ec_phys.F90 ec_phys_drv.F90 radheatn.F90 radozc.F90
sucumf.F90 suecozc.F90 suecrad.F90 sugwd.F90 surdi.F90 updtier.F90
setup/dfltvv1.F90 modgrin.F90 su0phy.F90 suarg.F90 sucst.F90 sudyna.F90
sugridadm.F90 sugridf.F90 sugridu.F90 suphy.F90 surip.F90 suspec.F90 susta.F90
suvert.F90
utility/mod_ini.F90 openfa.F90 tsl.F90 updtim.F90
```

Files modified(SCRIPTS):

```
gen/getgrb getini inter_fp mknam_fp
oce/saverestarts
```

Files modified(SURF):

`module/srfwexc_mod.F90 suscst_mod.F90`

Files modified(TRANS):

`tpm_constants.F90`

Clean up post-processing of etadot.

Files modified(IFS):

`module/yomafn.F90 yomgrb.F90`

`pp_obs/pos.F90`

`setup/suafn1.F90 suafn3.F90`

Jean-Jacques Morcrette and Daniel Cariolle

New 2D-distributions from MOBIDIC can be used as climatologies for representing the trace gases (CO2, CH4, N2O, NO2, CFC11, CFC12, CFC22, CCl4, and O3 in the radiation schemes.

Files created(IFS):

`module/yoeradghg.F90`

`phys_ec/su_3dno2clim.F90 su_c11clim.F90 su_c12clim.F90 su_c22clim.F90 su_ccl4clim.F90 su_ch4clim.F90 su_co2clim.F90 su_ghgclim.F90 su_n2oclim.F90 su_no2clim.F90 su_ozoclim.F90`

Files modified(IFS):

`climate/updrgas.F90`

`module/yoerad.F90 yoerdi.F90`

`namelist/naerad.h`

`phys_ec/callpar.F90 radghg.F90 radint.F90 radintg.F90 radlsw.F90 radlswr.F90 rrtm_ecrt_140gp.F90 rrtm_ecrt_140gp_mcica.F90 rrtm_rrtm_140gp.F90 rrtm_rrtm_140gp_mcica.F90 srtm_srtm_224gp.F90 srtm_srtm_224gp_mcica.F90 suecrad.F90 surdi.F90`

`utility/updtim.F90`

Jean-Jacques Morcrette

Branch prepared for the ENSEMBLES project allowing a climatology of sulphate aerosols spanning 1920-2000, then IPCC scenario A1B to 2100.

Files created(IFS):

`module/yoeaersu.F90`

`phys_ec/su_so4_A1B2000.F90 su_so4_A1B2010.F90 su_so4_A1B2020.F90 su_so4_A1B2030.F90 su_so4_A1B2040.F90 su_so4_A1B2050.F90 su_so4_A1B2060.F90 su_so4_A1B2070.F90 su_so4_A1B2080.F90 su_so4_A1B2090.F90 su_so4_A1B2100.F90 su_so4_obs1920.F90 su_so4_obs1930.F90 su_so4_obs1940.F90 su_so4_obs1950.F90 su_so4_obs1960.F90 su_so4_obs1970.F90 su_so4_obs1980.F90 su_so4_obs1990.F90 suecso4.F90 suecso4his.F90`

Files modified(IFS):

`module/yoeaerc.F90 yoerad.F90`

`namelist/naerad.h`

`phys_dmn/apl_arome.F90`

`phys_ec/callpar.F90 radact.F90 radint.F90 radintg.F90 suecrad.F90`
`utility/updtim.F90`

Carole Peubey

Prevent the program from aborting in the case the number of data from one satellite exceeds a certain number. When this situation occurs, all the data from the satellite are rejected, so that no bad data enters the system.

Files modified(SATRAD):
`pre_screen/geos_prescreen.F90`

Richard Engelen et al.

GEMS contribution.

Files created(IFS):
`module/grg_photolysis.F90 yom_grgctm.F90 yomcouplo4.F90`
`namelist/namcouplo4.h`
`phys_ec/grg_nox2no2.F90 grg_tendctm.F90`
`pp_obs/ch4_tcmr.F90 ch4_tcmr_ad.F90 ch4_tcmr_tl.F90 ch4bcor.F90 co2_tcmr.F90 co2_-tcmr_ad.F90 co2_tcmr_tl.F90 gpnox.F90 gpnoxad.F90 gpnoxtl.F90 grg_ak_ad.F90 grg_-ak_op.F90 grg_ak_tl.F90 grg_fparam.F90 grg_fparamad.F90 grg_fparamtl.F90 grg_jno2.F90 grg_jno2_cloud.F90 grg_jno2_cloudad.F90 grg_jno2_cloudtl.F90 grg_jno2ad.F90 grg_-jno2tl.F90 intavg.F90 layeravg.F90 nox2no2.F90 nox2no2ad.F90 nox2no2tl.F90 ppak.F90 ppakad.F90 ppaktl.F90 ppnox.F90 ppnoxad.F90 ppnoxtl.F90 sublayer.F90`

Files modified(IFS):
`adiab/cpedia.F90 postphy.F90`
`climate/updclie_co2.F90`
`common/yomdb_defs.h yomdb_vars.h`
`control/gp_model.F90 scan2mdm.F90`
`dia/ppeddhec.F90 ppfidh.F90 pregrbenc.F90 sucddh.F90 sunddh.F90 wroutgpgb.F90`
`module/gfl_subs.F90 iostream.F90 parcma.F90 parfpos.F90 surface_fields.F90 traj_physics.F90 type_gfls.F90 yoephy.F90 yom_reo3_bcor.F90 yom_reo3_thin.F90 yom_ygfl.F90 yomafn.F90 yomcosjo.F90 yomct0.F90 yomgrb.F90 yommcc.F90 yomtvrad.F90 yomvar.F90`
`namelist/naeaer.h naephy.h namafn.h namgfl.h nampar0.h namvar.h`
`obs_preproc/black.F90 blinit.F90 defrun.F90 fgchk.F90 reo3sin.F90 suobarea.F90`
`phys_ec/aer_bdgtmss.F90 aer_drydep.F90 aer_phy1.F90 aer_phy2.F90 aer_phy3.F90 aer_src.F90 aer_unit_conv.F90 callpar.F90 callparad.F90 callpartl.F90 ec_phys.F90 ec_phys_ad.F90 ec_phys_drv.F90 ec_phys_tl.F90 su_aerop.F90 su_aerp.F90 su_aerw.F90`
`pp_obs/aod_ad.F90 aod_op.F90 aod_tl.F90 bgobs.F90 cod_op.F90 cod_opad.F90 cod_optl.F90 hdepart.F90 hop.F90 hopad.F90 hoptl.F90 hpos.F90 hretr.F90 hvnmtlt.F90 pos.F90 ppobsa.F90 ppobsaad.F90 ppobsatl.F90 preint.F90 specfitg.F90 vpos.F90`
`setup/su0phy.F90 su_surf_flds.F90 suafn1.F90 suafn2.F90 suafn3.F90 suctrl_gflattr.F90 sudefo_gflattr.F90 sudim1.F90 sudyn_setgflattr.F90 sugfl.F90`

sugridug.F90 sumpini.F90

utility/gstats_label_ifs.F90 prtgom.F90 sualspajb.F90

var/cain.F90 cainad.F90 cainin.F90 caininad.F90 estsig.F90 rdfpinc.F90 suinfce.F90 sujbwavelet.F90 surad.F90 sureo3.F90 suvar.F90

Files created(ODB):

bufr2odb/bufr2odb_205.F90 bufr2odb_gch1.F90 bufr2odb_gch2.F90 bufr2odb_gch3.F90

ddl.CCMA/ak_reo3_body.sql fixreo3len.sql get_soe_reo3.sql

ddl.ECMA/ak_reo3_body.sql fixreo3len.sql get_soe_reo3.sql nak_reo3_body.sql new_thinn_robody_8.sql

ddl/ak_reo3_body.sql fixreo3len.sql get_soe_reo3.sql nak_reo3_body.sql new_thinn_-robody_8.sql

Files modified(ODB):

bufr2odb/get_varindex.F90

cma2odb/buf2cmat_new.F90 ctxinitdb.F90 getatdb.F90 getdb.F90 initmdb.F90 subuoctp.F90 update_obsdb.F90

ddl/black_robhdr_4.sql black_robhdr_7.sql black_robody_4.sql cma.h getsatid.sql ozone_robhdr_1.sql ozone_robody_1.sql robhdr_screen.sql robody_screen.sql sathdr_ozone.sql varno.h

module/getval_module.F90 varindex_module.F90 yomboctp.F90

tools/Bufr2odb.F90

Files modified(SATRAD):

pre_screen/bufr_screen_ssmi.F90 reo3_prescreen.F90