RESEARCH DEPARTMENT MEMORANDUM

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:	November 5, 2007 — File: R48.3/MH/0775
Subject:	**IFS Memorandum Cycle CY32R3**

Cycle 32r3 was created in September 2007. It will become operational on the 6th of November 2007. Cycle 32r3 is not a common cycle with Meteo France.

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

Contributors: G.Balsamo, P.Bauer, P.Bechtold, A.Beljaars, C.O'Dell, M.Drusch, R.Engelen et al., A.Geer, ,M.Hamrud, S.Healy, H.Hersbach, E.Holm, J.Haseler, M.Janiskova, M.Koehler, M.Leutbecher, P.Lopez, J.-J.Morcrette, G.Mozdzynski, Satellite Section, D.Salmond, D.Tan, A.Tomkins, N.Wedi

Jan Haseler

Write gridpoint cloud fields to trajectory structure. Preset IFS defaults for reading and writing gridpoint fields to consistent values.

Files modified(IFS):

`control/scan2mdm.F90`

`module/traj_main.F90`

`setup/sudim1.F90 sugfl.F90 sugridug.F90 suinif.F90 suspecg.F90`

Files modified(SCRIPTS):

`gen/fetcherr ifsmin ifstraj vardata`

Martin Leutbecher

The singular vector computation for the tropical cyclones will use the "new" moist physics (Janiskova-Tompkins large-scale condensation and Lopez convection) in the EPS.

Auxiliary programs in prepdata/mc_tools have been updated to permit EPS experiments with 91 levels and to permit to set the standard deviation in the Gaussian sampling without using analysis error variance norms.

The deletion of initial condition perturbation data (type=icp) has been added to task cleanmc. An additional task cleanvarfc has been added. It looks after the cleaning of the working directories WDIR.

Files created(SCRIPTS):

`sms/cleanvarfc.sms`

Files modified(SCRIPTS):

`def/eps_varfc.def`

`gen/modelsv`

`sms/cleanmc.sms`

Files modified(PREPDATA):

`mc_tools/gen_sv_coeff.F90 svgp2sp.F90 svsp2gp.F90`

Matthias Drusch

Extended Kalman Filter / Surface Analysis

The EKF is included in the IFS and runs under configuration nconf=302. The work is incomplete and the contributions to CY32R3 are passive; they represent the first step towards full implementation.

Changes to the FORTRAN code can be divided in three parts:

1. Introduce nconf=302 and enable the IFS to run multiple short-range forecasts with perturbed initial conditions.

Files modified(IFS):

`adiab/fspglh.F90 larmes.F90 spchor.F90 spchorad.F90 spcmascor.F90 spcsi.F90 spcsiad.F90 spnhsi.F90` control/cmac.F90 cmacad.F90 cmactl.F90 cnt0.F90 cnt3.F90 cnt4.F90 csta.F90 gp_model.F90 scan2h.F90 scan2mdm.F90 stepo.F90

dfi/suedfi.F90 sueini.F90

dia/spnorm.F90

nmi/nnmi3.F90 sunmi.F90

obs_preproc/mkglobstab.F90 obadat.F90

parallel/gpnorm1.F90

p_obs/hdepart.F90

setup/su0phy.F90 su0yomb.F90 suct0.F90 sudim1.F90 sudim2.F90 sudyn.F90 sugem1a.F90 sulap.F90 sumpini.F90 suoph.F90 surfpbuf.F90 suspec.F90

transform/transinvh.F90

utility/dealsc2.F90 gpnorm3.F90 gstats_output_ifs.F90 save_test4dinc.F90 sualspa1.F90

var/suvar.F90

2. Save (atmospheric) tendencies from the unperturbed run and use them in the perturbed runs. Save model output in local arrays.

Files modified(IFS):

phys_ec/callpar.F90 ec_phys.F90

3. Perform a very preliminary 'observation' - fg matching and Compute the Kalman Gain.

Files modified(IFS):

control/csekf1.F90 csekf2.F90

module/yomsekf.F90

obs_preproc/obsgen.F90

sekf/pertsekf_v2.F90 sekf_backgerr.F90 sekf_gain.F90 sekf_magn_rh.F90 sekf_matinv.F90 sekf_write.F90 sm_ekf_main.F90 store_sekf_cv.F90 susekf.F90

utility/dealsekf.F90

Sean Healy

A modification of the bufr to ODB routine was introduced to enable processing of GRAS measurements from METOP-A.

Files modified(ODB):

bufr2odb/bufr2odb_radio.F90

David Tan

Doppler wind lidar assimilation.

Infrastructure (no meteorological impact) for assimilation of ADM-Aeolus observations. Added functions needed to modify datum flags in Aeolus wind-component retrievals. Prototype module for Aeolus processing, to be called from HRETR. Height to geopotential conversion in observation pre-processing. Inclusion of Aeolus data in lag-family tasks.

Files created(IFS):

```
module/aeolus_processing.F90
```

Files created(SCRIPTS):

```
sms_an/odbcmp_aeolus.sms
sms_era/obtime_aeolus.sms
```

Files modified(IFS):

```
function/fcobs.h
obs_preproc/dwlin.F90
```

Files modified(SCRIPTS):

```
gen/fdbksave obstat_init
```

Satellite Section

* Changes to COSMIC RO usage in DS blacklists - Sean Healy

* Changes to 1D+4D-Var with new passive imagers TMI/AMSR-E/SSMIS and code for 4D-Var rain-affected radiances - Alan Geer and Peter Bauer

* Changes to GEO CSR usage QC and bias correction - Carole Peubey

* Clear sky assimilation of new MW-imagers - Niels Bormann, http://intra.ecmwf.int/publications/library/do/references/show?id

* Var-BC code clean up - Thomas Auligne

* AMSUA-14 bias correction frozen at zero - Tony Mc Nally, http://intra.ecmwf.int/publications/library/do/references/show?id=

* New AMSU-A RT coefficients with Zeeman-effect removed and improved layer averaging - Shinya Kobayashi and Marco Matricardi

* Passive monitoring of OMI data and assimilation of SBUV data from NOAA-17 and 18 - Rossana Dragani

Files created(IFS):

```
module/ptrgp0.F90 ptrgp1.F90 ptrgp5.F90 ptrgp9.F90 ptrgpd.F90
onedvar/onedvar_adjoint_test.F90 onedvar_cloudtest.F90 onedvar_diagnostics.F90
onedvar_find_satsens.F90 onedvar_passive_ok.F90 onedvar_read_sat_bias.F90
onedvar_read_sat_error.F90
phys_ec/satur_1d.F90
```

Files created(ODB):

```
bufr2odb/bufr2odb_amsre_1d.F90 bufr2odb_ssmis_1d.F90 bufr2odb_tmi_1d.F90
compiler/yacc.not_implemented_yet
scripts/odb_compress.pl
```

Files created(SATRAD):

```
interface/rttov_onedvar_setupindex.h rttov_setupchan_scatt.h
module/onedvar_variables.F90
onedvar/onedvar_get_file_name.F90 onedvar_rain_coeffs.F90
pre_screen/bufr_screen_amsre_1d.F90 bufr_screen_ssmis_1d.F90
bufr_screen_tmi_1d.F90
rttov/rttov_onedvar_setupindex.F90
```

Files created(SCRIPTS):

era/plotIncrements plot_obstat_time plot_obstat_usage screening_stats seismograms synoptic_maps web_monitor

sms_era/biasTable.sms datacoverage.sms obstat_calc.sms obstat_usage.sms plotsynmaps.sms seismograms.sms web_bias_noaa.sms web_monitor.sms web_monitor_increments.sms web_obtime.sms web_obtime_conv.sms web_obtime_sat.sms web_obtime_usage.sms web_plotFlux.sms web_plotPlev.sms web_plotSurf.sms web_rsbias.sms web_rstime.sms

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 paronedvar.F90 yom_ptr_ssmi.F90 yom_ssmi.F90 yommwave.F90 yomonedvar.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 namonedvar.h

obs_preproc/defrun.F90 first.F90 new_thinn.F90 new_thinner.F90 new_thinner_no_sq.F90 post_thinner.F90 pre_thinner.F90

onedvar/onedvar_fstscrn.F90 onedvar_get_bias.F90 onedvar_lintest.F90 onedvar_obsop.F90 onedvar_obsop_grad.F90 onedvar_obsop_tl.F90 onedvar_raintb.F90 onedvar_raintb_hlp.F90 onedvar_raintb_rcv.F90 onedvar_raintb_set.F90 onedvar_raintb_snd.F90 onedvar_screen.F90 onedvar_setup.F90 onedvar_simul.F90

phys_ec/callpar.F90 callparad.F90 callpartl.F90 cloudst.F90 cloudsttl.F90 cubasen2.F90 cubasen2ad.F90 cucalln2.F90 cucalln2ad.F90 cucalln2tl.F90 cuddrafn2.F90 cuddrafn2ad.F90 cuddrafn2tl.F90 cudtdqn2.F90 cudtdqn2ad.F90 cudtdqn2tl.F90 cuflx2.F90 cuflx2ad.F90 cuflx2tl.F90 cuinin2.F90 cumastrn2.F90 cumastrn2ad.F90 cumastrn2tl.F90 cupdra.F90 ec_phys.F90 ec_phys_ad.F90 ec_phys_tl.F90 phys_nl.F90 suphli.F90 vdfmainsad.F90 vdfmainstl.F90

pp_obs/gpscalc_alpha.F90 gpscalc_alphaad.F90 gpscalc_alphatl.F90 hdepart.F90 hjo.F90 hop.F90 hopad.F90 hoptl.F90 rad1cemis.F90

var/adtest.F90 getsatid.F90 gp_nearest.F90 gp_ptr_ssmi.F90 gp_ssmi.F90 gp_ssmi_gp2obs.F90 gp_ssmi_igp2obs.F90 gp_ssmi_inv.F90 gp_ssmi_iobs2gp.F90 gp_ssmi_obs2gp.F90 rtsetup.F90 suvarbc.F90

Files modified(IFSAUX):

minim/m1qn3_1dv.F m1qn3a_1dv.F mlis0_1dv.F

Files modified(OBSTAT):

module/mod_sat_monitor.F90

satmon/sat_monitor.F90

Files modified(ODB):

bufr2odb/bufr2odb_amsre.F90 bufr2odb_ssmi.F90 bufr2odb_ssmis.F90 get_varindex.F90

cma2odb/buf2cmat_new.F90 initmdb.F90

ddl/cma.h map_ssmi_rain_body.sql map_ssmi_rain_ssmi.sql new_thinn_robhdr_2.sql post_thinn_robhdr_2.sql post_thinn_robody_2.sql pre_thinn_robhdr_2.sql pre_thinn_robody_2.sql robhdr_gp_get_ssmi.sql robhdr_gp_put_ssmi.sql robhdr_mwave_get_screen_ssmi.sql robhdr_mwave_get_ssmi.sql robhdr_mwave_put_screen_ssmi.sql robhdr_mwave_put_ssmi.sql

robody_gp_get_ssmi.sql robody_gp_put_ssmi.sql
module/varindex_module.F90
tools/Bufr2odb.F90

Files modified(SATRAD):
bias/suadvar.F90
interface/rttov_iniscatt.h rttov_iniscatt_ad.h rttov_iniscatt_tl.h rttov_scattad_test.h
module/mod_cparam.F90 mwave_const.F90 onedvar_const.F90
mwave/mwave_obsop_rttov.F90 mwave_obsop_rttov_ad.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 bufr_screen_ssmi_1d.F90 bufr_screen_ssmis.F90 reo3_prescreen.F90
rttov/rttov_calcemis_mw_ad.F90 rttov_calcpolarisation.F90 rttov_calcpolarisation_ad.F90 rttov_calcpolarisation_tl.F90 rttov_iniscatt.F90 rttov_iniscatt_ad.F90 rttov_iniscatt_tl.F90 rttov_readscattcoeffs.F90 rttov_scatt.F90 rttov_scatt_ad.F90 rttov_scatt_tl.F90 rttov_scattad_test.F90 rttov_setupchan_scatt.F90 rttov_setupindex.F90

Files modified(SCRIPTS):
def/an.def
gen/fetchobs getpersSST ifsmin ifstraj mkabs_odbtools mkabs_satrad mklinks preobs prereo3 varconsts
sms_an/prereo3.sms smon.sms

Files modified(SURF):
module/sppcflsad_mod.F90 sppcflstl_mod.F90

Files deleted(SATRAD):
interface/rttov_calc_polarisation.h rttov_calc_polarisation_ad.h rttov_calc_polarisation_tl.h
onedvar/onedvar_bias.F90 onedvar_set_rtindex.F90

Elias Valur Holm

Remove temporary reduction of increments at model top

The tapering off towards zero of analysis increments at the model top was introduced as a temporary feature during the transition from 60 to 91 levels to combat instabilities. Subsequent developments have made this feature redundant, and it has been removed.

Files modified(IFS):
module/yomjg.F90
namelist/namjg.h
utility/deallo.F90
var/rdfpinc.F90 sujb.F90

"Univariate" tracer assimilation in 4D-VAR: on for ozone

These changes allow a simpler semi-Lagrangian advection of GFL fields in the TL/AD models, where only the trajectory wind is used for the advection/interpolation, instead of including the wind increments. The switch is introduced as an additional property of the GFL fields, YGFLC(JGFL)%LADV5 = .TRUE. will turn the option on for GFL field JGFL. By default the switch is false, but for each GFL field it can be turned on in a namelist. The activation is done in the script ifsmin, by adding a line to the namelist NAMGFL, e. g. for ozone

```
ifsmin:
&NAMGFL
YO3_NL%%LADV5=true,
/
```

The effect of this change is to make the analysis of GFL fields univariate even in 4D-VAR (apart from the observation operator), since the adjoint wind increments do not receive contribution from the GFL field. It is particularly useful for tracer fields where model and observations have biases or are less accurate than the rest of the model. With this switch, inaccuracies in the tracer field are stopped from creating fictive wind and temperature increments to compensate for the tracer deficiencies.

Affected routines are the following.

In module/type_gfls.F90 we define LADV5 and in module/gfl_subs.F90 it is added in the call to set_gfl_attr (LDADV5) which assigns it to YDGFLC%LADV5. If true for a particular GFL field, only the trajectory fields are used in the SL TL/AD advection of that field.

In setup/sudim1.F90 we set default values YGFLC(:)%LADV5 =.FALSE. for all cases, except for ozone, and in setup/sudyn.F90 the call to set_gfl_attr is modified to include LADV5.

In adiab/larcinbtl.F90 and larcinbad.F90 we introduce a logical LLADV5 in the calls to the semi-Lagrangian TL/AD interpolation routines laitritl.F90 and, laitritlad.F90, which take on the value of LADV5 for GFL fields, and is set to .FALSE. otherwise (wind, temperature, and continuity equation). In adiab/laitritl.F90 and laitritlad.F90 a logical is introduced in the call to these routines to turn off the wind increments in the advection, which is equivalent to putting the increments of latitude, longitude, and in the vertical to zero in the TL interpolation, and corresponding changes in the AD routine. The local logical is called LADV55.

Files modified(IFS):

```
adiab/laitritl.F90 laitritlad.F90 larcinbad.F90 larcinbtl.F90
module/gfl_subs.F90 type_gfls.F90
setup/sudim1.F90 sudyn.F90
```

Richard Engelen et al.

GEMS contribution

The GEMS contribution consists of various updates to the existing code. The main elements are adapting the improved code for vertical mass transport to the tracers, implementing observation operators for aerosol and reactive gases, improved handling of the trajectory fields for the GFL variables, and adding new aerosol model code.

Files created(IFS):

```
climate/updclie_aer.F90
module/yommvo.F90
phys_ec/aer_cgrowth.F90 aer_stratcl.F90
```

Files created(ODB):

bufr2odb/bufr2odb_modisaer.F90

Files modified(IFS):

adiab/cpedia.F90 postphy.F90

climate/updclie.F90 updclie_CO2.F90

control/scan2mdm.F90

dia/ppeddhec.F90 sucddh.F90 sunddh.F90 wrmlfp.F90 wrmlfpl.F90

module/goms.F90 pardimo.F90 parfpos.F90 surface_fields.F90 traj_main.F90 traj_physics.F90 yoeaeratm.F90 yoeaerop.F90 yoeaersnk.F90 yoeaersrc.F90 yoedbug.F90 yom_ygfl.F90 yomafn.F90 yomgrb.F90 yommcc.F90 yommddh.F90 yomvnmb.F90

namelist/naeaer.h namafn.h namgfl.h

obs_preproc/defrun.F90 fgchk.F90 first.F90 gefger.F90 reo3sin.F90

phys_ec/aer_bdgtmss.F90 aer_drydep.F90 aer_phy2.F90 aer_phy3.F90 aer_scavbc.F90 aer_scavin.F90 aer_sedimnt.F90 aer_src.F90 aer_unit_conv.F90 callpar.F90 callparad.F90 callpartl.F90 cuascn2.F90 cuascn2ad.F90 cuascn2tl.F90 cuctracerad.F90 cuctracertl.F90 cuddrafn2.F90 cuddrafn2ad.F90 cuddrafn2tl.F90 cuflx2.F90 cuflx2ad.F90 cuflx2tl.F90 cumastrn2.F90 cumastrn2ad.F90 cumastrn2tl.F90 cupdra.F90 cupdraad.F90 cupdratl.F90 ec_phys.F90 ec_phys_ad.F90 ec_phys_tl.F90 sltend.F90 su_aerop.F90 su_aerp.F90 su_aerw.F90 vdfdifc.F90 vdfdifcs.F90 vdfdifcsad.F90 vdfdifcstl.F90

pp_obs/aod_ad.F90 aod_op.F90 aod_tl.F90 bgobs.F90 hop.F90 hopad.F90 hoptl.F90 hpos.F90 hretr.F90 hvnmtlt.F90 ppobsa.F90 ppobsaad.F90 ppobsatl.F90 specfitg.F90

setup/su_surf_flds.F90 suafn1.F90 suafn2.F90 suafn3.F90 sudim1.F90 sudyn.F90 sugfl.F90 sugridug.F90 suinif.F90 sumcc.F90 suspecg.F90 suvnmb.F90

utility/state2spec.F90 state2specad.F90

var/cain.F90 cainad.F90 cainin.F90 caininad.F90 estsig.F90 rdfpinc.F90

Files modified(ODB):

bufr2odb/get_varindex.F90

cma2odb/buf2cmat_new.F90 subuoctp.F90

ddl/varno.h vertco_type.h

module/getval_module.F90 varindex_module.F90 yomboctp.F90

tools/Bufr2odb.F90

Jean-Jacques Morcrette

Bug-fix to reestablish the calculation of the diagnostic UV-B and PAR that had gone to zero with the implementation of McRad in 32R2

Files modified(IFS):

phys_ec/radintg.F90 radlswr.F90 srtm_spcvrt_mcica.F90 srtm_srtm_224gp.F90 srtm_srtm_224gp_mcica.F90

Anton Beljaars and Marta Janiskova

Clen-up of roughness length initialization in non-linear surface routines and corresponding simplified ones with their tangent-linear and adjoint versions.

Files modified(SURF):

`/module/vupdz0_mod.F90 surfexcdriver_ctl_mod.F90 vupdz0s_mod.F90 vupdz0stl_mod.F90 vupdz0sad_mod.F90 surfexcdrivers_ctl_mod.F90 surfexcdriverstl_ctl_mod.F90 surfexcdriversad_-ctl_mod.F90`

Nils Wedi

Move the threshold for distribution of the parametrized wave stress to 0.1 hPa to have less influence on the model climate until a nonorographic scheme is in place.

Files modified(IFS):

`phys_ec/gwdrag.F90`

Bugfix for postprocessing pressure levels above 1hPa. *Files modified(IFS):*

`module/iostream.F90`

Hans Hersbach

Quality control on sea ice for scatterometer data moved to the blacklist formalism.

Files modified(IFS):

`obs_preproc/black.F90 blinit.F90 defrun.F90 fgwnd.F90`

Quickscat changes.

Files modified(IFS):

`obs_preproc/scaqc.F90`

Files modified(SCAT):

`dcone_qc/dcone_qc.F scan_bufr.F`

`module/qrain.F`

`qretrieve/qscat25to50km.F regroup.F write_50kmbufr.F`

Alan Geer, Chris O'Dell and Peter Bauer

Modifications to 1D+4D-Var of rain and cloud-affected SSM/I observations

Most of the following changes are passive in 32R3, but there are a few minor fixes to the 1D+4D-Var assimilation, though these have essentially no effect on forecast scores. In detail:

- passive monitoring of SSMIS, AMSR-E and TMI in all sky (clear, cloudy and rainy) conditions

- Additional diagnostics from 1D-Var are now stored in the ODB

- Minor improvements to the active SSMI assimilation:

+ Rejection of poorly converged 1D-Var retrievals, which leads to 20% fewer TCWV observations passed to 4D-Var. It prevents an erroneous situation in which the first guess TCWV was being fed back into 4D-Var as "new" information.

+ Better treatment of cases where the 1D-Var retrieval produces negative humidities. These were previously rejected from the system. They are now handled properly leading to 10% more TCWV observations for 4D-Var, primarily in subtropical dry areas.

These improvements are justified because they fix obvious errors in the 1D-Var. However, they have a generally neutral and insignificant impact on forecast scores. There is a very slight, but statistically insignificant, increase in RMS errors in the SH. This is thought to be due to the fact that these changes effectively put more weight towards the observational information from SSM/I.

Files created(IFS):

```
onedvar/onedvar_adjoint_test.F90 onedvar_cloudtest.F90 onedvar_diagnostics.F90
onedvar_find_satsens.F90 onedvar_passive_ok.F90 onedvar_read_sat_bias.F90
onedvar_read_sat_error.F90
```

Files created(ODB):

```
bufr2odb/bufr2odb_amsre_1d.F90 bufr2odb_ssmis_1d.F90 bufr2odb_tmi_1d.F90
```

Files created(SATRAD):

```
interface/rttov_onedvar_setupindex.h rttov_setupchan_scatt.h
module/onedvar_variables.F90
onedvar/onedvar_get_file_name.F90 onedvar_rain_coeffs.F90
pre_screen/bufr_screen_amsre_1d.F90 bufr_screen_ssmis_1d.F90
bufr_screen_tmi_1d.F90
rttov/rttov_onedvar_setupindex.F90
```

Files modified(IFS):

```
common/yomdb_defs.h yomdb_vars.h
control/gp_model.F90
module/paronedvar.F90 yom_ptr_ssmi.F90 yom_ssmi.F90 yomonedvar.F90
namelist/namonedvar.h
onedvar/onedvar_fstscrn.F90 onedvar_get_bias.F90 onedvar_lintest.F90
onedvar_obsop.F90 onedvar_obsop_grad.F90 onedvar_obsop_tl.F90 onedvar_raintb.F90
onedvar_raintb_hlp.F90 onedvar_raintb_rcv.F90 onedvar_raintb_set.F90
onedvar_raintb_snd.F90 onedvar_screen.F90 onedvar_setup.F90 onedvar_simul.F90
phys_ec/ec_phys.F90
var/csvarbc.F90 getsatid.F90 gp_nearest.F90 gp_ptr_ssmi.F90 gp_ssmi.F90 gp_ssmi_-
gp2obs.F90 gp_ssmi_igp2obs.F90 gp_ssmi_inv.F90 gp_ssmi_iobs2gp.F90 gp_ssmi_obs2gp.F90
rtsetup.F90
```

Files modified(IFSAUX):

```
minim/m1qn3_1dv.F m1qn3a_1dv.F mlis0_1dv.F
```

Files modified(ODB):

```
bufr2odb/bufr2odb_amsre.F90 bufr2odb_ssmi.F90 bufr2odb_ssmis.F90
get_varindex.F90
cma2odb/buf2cmat_new.F90 initmdb.F90
ddl/cma.h map_ssmi_rain_body.sql map_ssmi_rain_ssmi.sql robhdr_gp_get_ssmi.sql
```

robhdr_gp_put_ssmi.sql robody_gp_get_ssmi.sql robody_gp_put_ssmi.sql
module/varindex_module.F90
tools/Bufr2odb.F90

Files modified(SATRAD):

interface/rttov_iniscatt.h rttov_iniscatt_ad.h rttov_iniscatt_tl.h
module/onedvar_const.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 bufr_screen_ssmi_1d.F90 bufr_screen_ssmis.F90
rttov/rttov_calcemis_mw_ad.F90 rttov_calcpolarisation.F90 rttov_calcpolarisation_ad.F90 rttov_calcpolarisation_tl.F90 rttov_iniscatt.F90 rttov_iniscatt_ad.F90 rttov_iniscatt_tl.F90 rttov_readscattcoeffs.F90 rttov_scatt.F90 rttov_scatt_ad.F90 rttov_scatt_tl.F90 rttov_setupchan_scatt.F90 rttov_setupindex.F90

Files modified(SCRIPTS):

def/an.def
gen/ifstraj mkabs_satrad mklinks preobs varconsts

Files deleted(SATRAD):

interface/rttov_calc_polarisation.h rttov_calc_polarisation_ad.h rttov_calc_polarisation_tl.h
onedvar/onedvar_bias.F90 onedvar_set_rtindex.F90
rttov/rttov_setupindex_ec.F90

Gianpaolo Balsamo

H-TESSEL is active by default (LEVGEN=.TRUE. and LESSRO=.TRUE.) in ifs/setup/su0phy.F90 and also in the scripts/gen/soilana (by the OI namelist which contains a flag L_HTESSEL=.true. in the OI namelist).

Peter Bechtold

(1) Convection revisions: New formulation of entrainment and deep convective adjustment time. No more an updraught iteration is performed, but only one single computation. Furthermore, the momentum transport has been rewritten (it is now concentrated in one single routine, i.e. cumastrn.F90) and several code optimisations are performed. The overall gain in computing time is around 1% for the deterministic forecast.

Files modified(IFS):

phys_ec/yoecumf.F90 cuascn.F90 cuascnad.F90 cuascntl.F90 cubasen.F90 cubasenad.F90 cubasentl.F90 cubasmcn.F90 cubasmcnad.F90 cubasmcntl.F90 cucalln.F90 cucallnad.F90 cucallntl.F90 cuctracer.F90 cuctracerad.F90 cuctracertl.F90 cuddrafn.F90 cuddrafnad.F90 cuddrafntl.F90 cudlfsn.F90 cudlfsnad.F90 cudlfsntl.F90 cudtdqn.F90 cudtdqnad.F90 cudtdqntl.F9 cuentr.F90 cuentrad.F90 ccuentrtl.F90 cumastrn.F90 cumastrnad.F90 cumastrntl.F90

(2) Apply rain freezing below 0C, and use different critical relative humidities for rain evaporation below cloud over land and water (0.7 and 0.9, respectively)

Files modified(IFS):

```
phys_ec/cuflxn.F90 cuflxnad.F90 cuflxntl.F90
```

(3) Adjustment to some microphysical parameters, in particular the melting time scale has been increased by a factor of 1.5, the autoconversion time scale for cloud droplets is reduced form 7200 to 6000 s, the diffusion coefficient for clouds is increased from 2.e-6 to 3.e-6 and the effective ice particle radius used in the radiation is reduced from 60 to a value of 45.

Files modified(IFS):

```
phys_ec/sucldp.F90 sucumf.F90 sucumf2.F90 suecrad.F90
```

(4) Together with Judith Berner provide revised formulation of convective contribution based on vertically integrated updraught kinetic energy (as also now used in convective closure) to total dissipation in experimental stochastic physics. Clean up again of budgets and units

Files modified(IFS):

```
phys_ec/callpar.F90 callparad.F90 vdfincr.F90
```

As pointed out by Metops and some member state users the archived CAPE is 0 at initial time and therefore useless. As explained to me by Mats this is due to a longstanding error during wrtiting of the Grib files (CAPE was put togetehr with the goup of fluxes=accumulated field and not with the instantanous fields). This is corrected now and has been tested

Files modified(IFS):

```
dia/wrmlfp.F90 wrmlfpl.F90
```

Anton Beljaars

Use an implicit factor of 1 in tracer diffusion (replaces the value of 1.5 in T/q diffusion)

Files modified(IFS):

```
phys_ec/vdfdifcs.F90 vdfdifcsad.F90 vdfdifcstl.F90
```

Martin Koehler

(1) PBL bug fixes: Various bugs related to the PBL updraught and cloud top entrainment were found and fixed. Climate tests showed insignificant impacts.

(2) PBL mass flux numerics: The mass-flux component in the PBL implicit solver is now treated with upwind finite differencing as opposed to centered previously. This improves the stability of the scheme by allowing about a factor 2 higher mass fluxes.

(3) Mass flux limiter: The mass-flux limited was set to 2*CFL instead of 1*CFL which was made possible by upgrade (2).

(4) Parcel entrainment: The parcel entrainment was decreased to get more realistic higher boundary layers including stratocumulus situations and to be in line with LES data. Parcel entrainment is now: eps=0.4/z(full layer) + 1/(500s*wup).

(5) Diffusion coefficient K: K was decreased because it was shown to destroy inversions above stratocumulus and introduce excessive diffusion in sheared situations. The Louis/Tiedtke/Geleyn increased K was kept near

the surface to keep stable boundary layers untouched. For higher layers (150m) K now moves assymptotically to a Monin-Obukov formulation, which is supported by multiple data.

Files modified(IFS):

```
phys_ec/vdfexcu.F90 vdfhghtn.F90 vdfmain.F90 vdfouter.F90
```

Adrian Tompkins

(1) Removed first-timestep iteration, where the convection and cloud schemes were looped over 3 times on the first timestep only, with the tendencies of each scheme reduced by an ad-hoc factor related to the iteration number. This iteration procedure was originally intended to reduce the rainfall "spin-up" but tests proved that it no longer performed this task at recent cycles. On the contrary, removing it and treating all timesteps identically (first guess cloud scheme call, followed by a single call to the convection and then the cloud scheme) actually slightly reduces the spin up and has a minimal impact on scores. Removing the iteration has the additional benefit of simplifying the structure of callpar and making the first timestep numerically cheaper.

(2) Freezing of rain below 0C for consistency with the microphysical changes to the convection scheme

Files modified(IFS):

```
phys_ec/callpar.F90 cloudsc.F90
```

Philippe Lopez

(1) The linearised version of the function for the partitioning of cloud liquid/ice has been made more consistent throughout the moist physics (three slightly different functions were used before).

Files modified(IFS):

```
phys_ec/cloud.F90 cloudad.F90 cloudst.F90 cloudstad.F90 cloudsttl.F90 cloudtl.F90
cond.F90 condad.F90 condtl.F90 cuascn.F90 cuascn2.F90 cuascn2ad.F90 cuascn2tl.F90
cuascnad.F90 cuascntl.F90 cucalln.F90 cucalln2.F90 cucalln2ad.F90 cucalln2tl.F90 cucallnad.F9
cucallntl.F90 cuddrafn2.F90 cuddrafn2ad.F90 cuddrafn2tl.F90 cudlfsn.F90 cudlfsnad.F90
cudlfsntl.F90 cudtdqn.F90 cudtdqn2.F90 cudtdqn2ad.F90 cudtdqn2tl.F90 cudtdqnad.F90
cudtdqntl.F90 cuflx2.F90 cuflx2ad.F90 cuflx2tl.F90 cuflxn.F90 cuflxnad.F90 cuflxntl.F90
```

(2) The regularization of the perturbations of convective updraught vertical velocity and cloud fraction has been enhanced to avoid some spurious growth found in singular vector experiments (Martin Leutbecher). Missing switch (LREGCV) for regularization of organized entrainment perturbation has been added.

Files modified(IFS):

```
phys_ec/cupdratl.F90 cupdraad.F90 cloudsttl.F90 cloudstad.F90 cuascn2tl.F90 cuascn2ad.F90
```

(3) The freezing of rain and its effect on temperature tendency is now included in the simplified moist physics.

Files modified(IFS):

```
phys_ec/cloudst.F90 cloudstad.F90 cloudsttl.F90 cuflx2.F90 cuflx2ad.F90
cuflx2tl.F90
```

(4) Rescaling of downdraught mass flux implemented in linearized convection to avoid reported instabilities in

TL calculations (e.g. CO2 transport).

Files modified(IFS):

`phys_ec/cumastrn2.F90 cumastrn2tl.F90 cumastrn2ad.F90`

(5) Fix for the adjoint test with the old moist physics (CUENTRTL and CUENTRAD). Also correction of a bug in the latent heat in the downdraught computations when LPHYLIN is on (CUDDRAFN2 and CUDLFSN), and a small change in CUASCNAD for consistency with TL and NL.

Files modified(IFS): `phys_ec/cuascnad.F90 cuddrafn2.F90 cuddrafn2ad.F90 cuddrafn2tl.F90 cudlfsn.F90 cudlfsnad.F90 cudlfsntl.F90 cuentrad.F90 cuentrtl.F90`

Deborah Salmond

Revised (and working) version of the capability to have coarser or finer resolution physics. It is now all contained inside ec_physg so should be easily more maintainable.

Files modified(IFS):

`climate/updo3ch.F90`

`module/parrrtm.F90 yoephy.F90 yom_phys_grid.F90 yomcoaphy.F90`

`namelist/naecoaphy.h`

`phys_ec/callpar.F90 ec_phys.F90 ec_phys_drv.F90 ec_physg.F90 radina.F90 suphec.F90 suwcou.F90 wvcouple.F90 wvrg2xf.F90 wvwg2rg.F90 wvxf2gb.F90`

`setup/sucoaphy.F90 suephypo.F90 sugridf.F90 susc2b.F90`

Files deleted(IFS):

`dia/pregrbphy.F90`

`parallel/gathergpfphys.F90`

Bugfixes.

Files modified(IFS):

`setup/sufa.F90`

`var/taskob.F90`

George Mozdzynski

1) Library (trans) support for grid-only resolutions

When additional resolutions are used only in grid-space (e.g. radiation grids) this new code allows us to skip the partitioning of fourier and spectral spaces. This allows IFS to run with a greater number of tasks than before that were previously constrained by the partitioning of fourier or spectral spaces.

For example, a T1279 model with a T511 radiation grid was restricted to run on a maximum of 341 tasks when NPRTRV=1 was specified (as used on a vector supercomputer to get the best vector performance in fourier space). With this branch this limit is now 1280 tasks for the same configuration. Note that scalar architectures can run with significantly more tasks by reducing NPRTRW and increasing NPRTRV, where NPROC = NPRTRW * NPRTRV.

2) Improved (NPRTRW,NPRTRV) partitioning for fourier and spectral spaces

For scalar architectures (e.g. IBM) this branch computes default values for (NPRTRW, NPRTRV) to give improved performance. For a T1279 model running on 80 nodes this results in a performance improvement of 3

The new values of NPRTRW and NRTRV also provide a useful reduction in total memory use on our IBM clusters, as shown for the deterministic forecast cases below,

MAX NODE MB nodes 32R2 NOW T1279L126 80 8063 7056 -14T799L91 30 7559 6944 - 9

For 4D-Var the same memory reduction is only 0.4

3) Improved latitude distribution of fourier space to take into account n*log(n) computational cost of fourier transforms

This improves performance by a further 0.5

This branch does NOT change the results of model forecasts or 4D-Var analyses.

Files modified(IFS):

`setup/sufa.F90` /bigtmp/nar/p4w/CY32R3_ifs_VIEW/ifs/module laufey:27 –¿ q2 find_files -m -b mpm_-CY32R2_fourier

Files modified(IFS):

`phys_ec/suecrad.F90`

`setup/sumpini.F90`

Files modified(SCRIPTS):

`gen/ifsmin ifstraj`

Files modified(TRANS):

`external/setup_trans.F90 trans_end.F90 trans_inq.F90`

`interface/setup_trans.h`

`module/ftdir_ctl_mod.F90 ftdir_ctlad_mod.F90 ftdir_mod.F90 ftinv_ctl_mod.F90 ftinv_-ctlad_mod.F90 setup_geom_mod.F90 sufft_mod.F90 suleg_mod.F90 sump_trans_mod.F90 sump_-trans_preleg_mod.F90 sumplat_mod.F90 sumplatb_mod.F90 sumplatf_mod.F90 tpm_distr.F90`

Optimisation to dot_product_ctlvec.F90 to improve OpenMP performance and reduce MPI communications when LREPRO4DVAR=F (the default) is used. Performance for a T799L91 4D-Var experiment is improved by approximately 1%. This branch results in small 'sum' differences over a control 32R2 experiment.

Files modified(IFS):

`parallel/dot_product_ctlvec.F90`

Fix a reproducibility problem in 4D-Var when changing the number of threads. *Files modified(IFS):*

`obs_preproc/mkglobstab.F90`

`var/evcost.F90 xformev.F90`

Workarounds for compiler problems in xlf_10104 and xlf_11100

Files modified(IFS):

`setup/suvertfe3.F90`

Files modified(ODB):

`interface/rlnkdb.h`

`lib/msgpass_obsdata.F90 rlnkdb.F90`

Improve the OpenMP performance of gather loops. For a T799L91 4D-Var experiment the improvement has been measured at 0.6%. This branch does not change results.

Files modified(IFS):

`parallel/gathergpf.F90 gathergpf_wavelet.F90`

Mats Hamrud

Optimizations.

Files modified(IFS):

`pp_obs/radtrb.F90 statpred.F90`

`var/taskob.F90`

Files modified(SATRAD):

`rttov/rttov_aitosu.F90`