RESEARCH DEPARTMENT MEMORANDUM

To:	RD Scientific Staff and Consultants	
Copy:	HR, HO, HMD, HMAS, HMOS, John Hodkinson, François Bouttier, Claude Fischer, Ryad El Khatib, Karim Yessad, John Hague	
From:	Deborah Salmond et al.	
Date:	August 18, 2010	File: R48.3/DS/1052
Subject:	**IFS Memorandum Cycle CY36R4**	

Cycle 36r4 was created in May-June 2010.

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

Contributors:

Saleh Abdalla, Anna Augusti-Panareda, Gianpaolo Balsamo, Peter Bechtold, Bill Bell, Angela Benedetti, Jean Bidlot, Massimo Bonavita, Paul Burton, Carla Cardinali, Mohamed Dahoui, Patrical De Rosnay, Richard Engelen, Reima Eresmaa, Mike Fisher, Johannes Flemming, Richard Forbes, Anne Fouilloux, Alan Geer, John Hague, Mats Hamrud, Jan Hasler, Sean Healy, Hans Hersbach, Antje Inness, Marta Janiskova, Johannes Kaiser, Martin Koehler, Tomas Kral, Blazej Krzeminski, Martin Leutbecher, Dingmin Li, Philippe Lopez, Qifeng Lu, Tony McNally, Martin Miller, Jean-Jacques Morcrette, George Mozdzynski, Joaquin Munoz Sabater, Gabor Radnoti, Iain Russell, Deborah Salmond, Glenn Shutts, Martin Steinheimer, Tim Stockdale, Yuhei Takaya, David Tan, Adrian Tomkins, Drasko Vasiljevic, Frederic Vitart, Tomas Wilhelmsson, Karim Yessad

SCIENTIFIC CHANGES

PHYSICS

Peter Bechtold - pae_CY36R3_for36r4phys

Gianpaolo Balsamo - pad_CY36R3_surf_for_36R4

- Fix surface runoff overshoot in super-saturated soil moisture conditions (rare event) and cleaning of srfwexc_vg_mod.F90.
- Bare-ground evaporation revision (stress function for soil evaporation limited to residual soil moisture instead of wilting point). Initial soil moisture rescaling for backwards compatibility (alike TESSEL-HTESSEL).

Files modified(SURF
`module/srfwexc_vg_mod.F90 surfexcdriver_ctl_mod.F90 sussoil_mod.F90 vsurf_mod.F90 yos_soil.F90`

Files modified(SCRIPTS
`gen/ smrescale`

Peter Bechtold

- Retuning and simplification of the convective entrainment/detrainment. The entrainment now only contains one RH humidity dependent term instead of an organized and turbulent term before, and is identical for deep and shallow convection apart form a factor of 2. The detrainment for deep convection can now be simply set in sucumf.F90, whereas for shallow convection it is equal to the entrainment rate. Summary: there are only 2 adjustable parameters for entrainment and detrainment
- Introduction of land/sea dependent precipitation threshold for precipitation.
- Fix potential error in cubasen.F90 when surface geopotential non-zero (reported by DWD).

The impact on the middle-latitude forecasts is neutral for winter season and slightly positive for summer, and positive for all levels in the Tropics. Globally the upper troposphere/lower stratosphere cold bias is reduced (especially around 100 hPa by 0.5 K).

- The convective gust computation now use the CAPE of the convection scheme and not the diagnostic CAPE as this is only computed every hour, correcting therefore a time step dependence of results.
- Correction in output of detrainment rates as used by Reanalysis (some values have not been correctly reset to zero as function of change in convective mask)- this causes error in accumulated output fields on Mars as mentioned by Norwegian colleagues.
- some code cleaning in callpar.F90 and ec_phys_tl.F90

Files modified(IFS):
`phys_ec/callpar.F90 cuascn.F90 cuascntl.F90 cuascnad.F90 cubasen.F90 cubasentl.F90 cubasenad.F90 cuentr.F90 cuentrtl.F90 cuentrad.F90 ec_phys_tl.F90 sucumf.F90 module/yoecumf.F90`

Peter Bechtold and Jean-Jacques Morcrette

Additional cloud diagnostics including cloud base height and zero degree level, as asked for by Member States. Verification of the products has been done against synop observations

The new parameters in the MARS Table 228 are:

Table	Code	Acronym	Unit	Long name
228	023	CBH	m	Cloud base height
228	024	DEG0L	m	Zero degree level

Nota: The horizontal visibility field is also already set but no values are provided yet, these should be provided later in the context of MACC aerosols.

228	025	HVIS	m	Horizontal visibility

Files created(IFS):
`phys_ec/ diag_clouds.F90`

Files modified(IFS):
`adiab/cpedia.F90, postphy.F90 dia/sunddh.F90 fullpos/hpos.F90 module/parfpos.F90 surface_fields_mix.F90 yomafn.F90 yomgrb.F90 namelist/namafn.F90 phys_ec/callpar.F90 cuascn.F90 cuentr.F90 ec_phys.F90 sucumf.F90 setup/suafn1.F90 suafn2.F90 suafn3.F90 supp.F90 su_surf_flds.F90`

Richard Forbes and Adrian Tompkins - pas_CY36R3_xmicroAA

Development of the new 5-species prognostic microphysics scheme:

- prognostic split between ice and liquid (mixed phase)
- prognostic precipitation (advected rain and snow)
- modifications and additions to microphysical processes
- new numerical implicit solver in cloud scheme
- Further modifications of microphysics scheme, coupling with general IFS physics, and consistency with convection scheme (R. Forbes)
- Correction to ice supersaturation scheme

- Autoconversion dependence on land/sea CCN contrast consistent with changes to convection
- Reduced version of cloud scheme called prior to convection
- Add total column rain water and snow as 2D output and 3D rain/snow fields also available

The relevant GRIB parameters are:

Table	Code	Acronym	Unit	Long name
128	075	CRWC	kg/kg	Stratiform precipitating rain water content
128	076	CSWC	kg/kg	Stratiform precipitating snow water content
228	089	TCRW	m	Total Column Rain Water
228	090	TCSW	m	Total Column Snow Water

Meteorological impact: The new microphysics scheme improves in particular the tropical climate (see also radiation changes below), the mid-latitudinal deterministic scores are fairly neutral. Computing time for forecast step is up by 10%. Memory usage is up by 7%.

Initialising the new prognostic variables:
prepIFS variable INIRAINSNOW (in the config.h file) controls whether the model reads in the 3D rain and snow fields in the initial data. INIRAINSNOW should be off (=false) if initialising a model from data that does not have 3D rain and snow fields archived, in which case the rain and snow fields are set to zero. INIRAINSNOW should be on (=true) if initialising a model from previous data that does contains archived rain and snow fields. If INIRAINSNOW is not set in config.h it defaults to false and initialises the rain and snow to zero.

Files created(IFS):
`phys_ec/lubksb.F90 ludcmp.F90`

Files modified(IFS):
`adiab/cpedia.F90 gpaddslphy.F90 gpmktend.F90 postphy.F90 control/cva1.F90 tesadj.F90 testli.F90 testlievol.F90 fullpos/hpos.F90 wrmlfp.F90 wrmlfpl.F90 module/yoecldp.F90 yomafn.F90 yom_grib_codes.F90 surface_fields_mix.F90 namelist/namafn.h phys_ec/callpar.F90 cloudsc.F90 ec_phys.F90 ec_phys_drv.F90 ec_phys_tl.F90 sltend.F90 sucldp.F90 vdfmain.F90 setup/suafn1.F90 suafn2.F90 suafn3.F90 sudefo_gflattr.F90 sugfl.F90 supp.F90 su_surf_flds.F90 sinvect/cun2.F90 cun3.F90`

Files modified(SCRIPTS):
`gen/ anml getgrb getini getmars grib_def.h ifsmin ifstraj mknam_fp model`

Richard Forbes, Peter Bechtold and Iain Russell

Climplot package: scripts changed include updates for GRIB_API, bug correction for cloud radiative forcing, and addition of rain and snow precipitation fields.

Files modified(SCRIPTS):
`metview/climate_obs.met monmeans_clim.met plot_amp_phase_clim.met save_mean_diurnal_flux.met zondia_seas_icon_batch.met`

Marta Janiskova and Peter Bechtold - pan_CY36R1_nonorog_gwd_TLAD_m2

Active use of TL/AD of non-orographic gravity wave scheme and removal of NCONF configuration test in dynamics (fspglh.F90) so that non-linear trajectory and trajectory in inner loop are run with same code. In order to reduce noise in TL computations regularisations had to be applied, including also the rewrite of buoyancy frequency computations in the non-linear nono-orographic gravity wave scheme in height coordinates instead of pressure coordinates. Impact on non-linear forecast model is neutral.

Files modified(IFS):
`phys_ec/callpar.F90 callparad.F90 callpartl.F90 gwdrag_wms.F90 gwdrag_wmss.F90 gwdrag_wmssad.F90 gwdrag_wmsstl.F90 sugwwms.F90 adiab/fspglh.F90`

Files modified(SCRIPTS):
`scripts/gen/ifsmin`

Martin Koehler

Ammendment of Stratocumulus criterium following Wood and Bretherton.

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

Martin Miller

Retuning of orographic gravity wave drag with reduced wave drag in upper troposphere and stratosphere and increased low-level blocking drag. This is a retuning for T1279 particularly and gives significant improvements in upper air height and wind scores at all levels in N.H. winter/spring. Largest positive impact in E.Asia and downstream over the N.Pacific.The impact is mostly neutral in N.H. summer and in the S.H., and the overall impact is smaller at lower resolutions.

Files modified(IFS):
`sugwd.F90`

Tomas Kral and Tomas Wilhelmsson - pa8_CY36R3_fixddhtiles

- Fixed initialization of FDIR and CDIR in sucddh.F90
- Fixed computation of DDH tiles fractions in vdfouter.F90

Files modified(IFS):
`phys_ec/vdfouter.F90 dia/sucddh.F90`

Jean-Jacques Morcrette and Richard Forbes

Reducing the shortwave bias over the oceans (model too reflective) by 2 W/m2, and providing a more complete description of the cloud/radiation interaction.

- Snow active in radiation scheme - New parametrization of liquid water droplet effective radius for raining cloud - Latitudinal varying decorrelation length for cloud overlap - Latitudinal varying ice particle effective radius

Files modified(IFS):

`module/yoerad.F90 namelist/naerad.h phys_ec/cldpp.F90 raddrv.F90 radint.F90 radintg.F90 radlswr.F90 phys_radi/mcica_cld_gen.F90 mcica_cld_generator.F90 suecrad.F90`

EPS

Martin Leutbecher - nel_CY36R3_for36r4

Revision of stochastic physics

The namelist in modeleps has been modified to activate a revision of Stochastically Perturbed Parameterization Tendency scheme (SPPT) uses in the EPS. The required changes in the source code (projects ifs and algor) are already in cycle 36r3. The revision comprises a revised treatment of supersaturation (NQSAT_SDT=3) and a multi-scale random pattern with three time and space scales (NSCALES_SDT=3). Results of the scientific evaluation will be described in a RD Memorandum. In addition, a bug in geticp.sms has been fixed.

Files modified(SCRIPTS):

`def/eps_varfc.def`

`gen/modeleps`

`sms/geticp.sms save.sms`

Martin Leutbecher - nel_CY36R3_for36r4

Changed default for stochastic physics: Tighter clipping of the random pattern.

Files modified(IFS):

`setup/suspsdt.F90`

Martin Steinheimer and Glenn Shutts - nea_CY36R3_nextCY

Update to spectral stochastic backscatter scheme (SPBS)

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

- Changed pressure dependency of RVP vertical correlation scale. The new implementation computes correlation scales dependent on the model layer thickness (in terms of LOG(p)) to avoid the need for tuning when the vertical resolution is changed. The old implementation can still be used by setting `LSTOPH_RVPOLD=TRUE`)
- Option to apply SPBS forcing only to a subrange of wavenumber space (n=1 to `NSMAXSPBS`; `NSMAXSPBS`=159 by default for EPS runs).

- The convective dissipation used in SPBS was changed to avoid model blowups related to a feedback found in cases with very strong convection. The convective dissipation is now limited to values consistent with CRM studies and in contrast to before $(\sin(\varphi))^2$ is used for scaling instead of the absolute vorticity factor $(\sin(\varphi)+\zeta/\Omega)^2$.

along with several minor bug fixes.

SPBS is controlled by namelist `NAMSTOPH`. The main switches are `LSTOPH_SPBS` to activate stochastic backscatter. SPBS is not used by default, i.e. `LSTOPH_SPBS` is set to `FALSE` by default.

Files modified(IFS):
`adiab/spchor.F90`
`module/stoph_mix.F90`
`namelist/namstoph.h`
`phys_ec/callpar.F90`
`setup/surand1.F90 surand2.F90`

Files modified(SCRIPTS):
`gen/modeleps`

Martin Steinheimer and Peter Bechtold - nea_CY36R3_CA_nextCY_fixed

Cellular Automaton (CA)

A Cellular Automaton was introduced to generate stochastic patterns with spacial and temporal correlation.

Possible applications are:

- Global pattern (`LCA_GLOBAL=TRUE`): This can be used in the stochastic backscatter context instead of the old CA which was implemented on a Lat/Long grid.
- Tropical convection: For this application the maximum number of lives is a function of CAPE, to restrict the CA to the tropics. The idea is to simulate convective cell organisation by using the CA to *communicate* between grid columns. The intention is to improve tropical waves.
- Convective rain advection: As seen this winter, there are cases where the IFS has problems with simulating rainfall from convective systems developing over the Channel which are then advected over land. While the convection stops over land in the model there were considerable precipitation amounts recorded in reality. The idea is to intitalize the CA at gridpoints with deep convection and then use the advected and propagated pattern to force convection.

The CA is controlled by namelist `NAMCA`. The main switch is `LCUCONV_CA` to activate the CA. The CA is not used by default, i.e. `LCUCONV_CA` is set to `FALSE` by default.

Files created(IFS):
`module/yoe_cuconvca.F90`
`namelist/namca.h`

phys_ec/ca_profpert.F90

setup/sucuconv_ca.F90

Files modified(IFS):

adiab/call_sl.F90

control/gp_model.F90

phys_ec/callpar.F90 ec_phys.F90 ec_phys_drv.F90 ec_physg.F90

setup/su0yomb.F90 surand1.F90 surand2.F90 updcelaut.F90

Files modified(SCRIPTS):

gen/mknam_fp modeleps

SATELLITE

Tony McNally et al - dam_CY36R3_test_sat_sean_alan_richard_reima_modebugfix

Alan Geer - stg_CY36R3_merge_final

All-sky improvements

These affect the all-sky assimilation of SSM/I and AMSR-E microwave radiances:

1. Cloud and precipitation overlap in the observation operator (RTTOV-SCATT) is now consistent with the cloud and precipitation overlap in the model moist physics operators. See EUMETSAT/ECMWF Fellowship Report no. 18: "Cloud and precipitation overlap in simplified scattering radiative transfer", September 2009
2. Revised snow screening. In the higher frequency channels, scenes affected by excess frozen precipitation are screened out. The new approach uses a threshold based on min(P37) ¡ 0.8, as described in section 2.6 of ECMWF tech memo 620: "Enhanced use of all-sky microwave observations sensitive to water vapour, cloud and precipitation", April 2010
3. Performance enhancements (both scientific and technical) giving a 30% decrease in computational cost for RTTOV-SCATT, with 4D-Var being about 2% faster overall. There are minor changes to simulated brightness temperatures (order 0.01K).

All changes have scientific impact, most noticeably in the monitoring statistics, where there is an increase in the numbers of higher-channel all-sky observations, coupled with a reduction in the FG departure standard deviations.

Files created(IFS):

mwave/mwave_cpfrac.F90 mwave_diags.F90

Files modified(IFS):

control/gp_model.F90 gp_model_tl.F90

module/parmwave.F90 yommwave.F90

mwave/mwave_emis.F90 mwave_get_tl.F90 mwave_obsop.F90 mwave_obsop_ad.F90
mwave_obsop_test.F90 mwave_obsop_tl.F90 mwave_put.F90 mwave_put_tl.F90
mwave_setup.F90

namelist/nammwave.h

phys_ec/callpar.F90 callparad.F90 callpartl.F90 cloudsc.F90 cloudst.F90 cloudstad.F90 cloudsttl.F90 ec_phys.F90 ec_phys_ad.F90 ec_phys_drv.F90 ec_phys_tl.F90 ec_physg.F90 phys_ad.F90 phys_nl.F90 phys_tl.F90

Files modified(ODB):

ddl/robhdr_mwave_get_ssmi.sql

Files modified(SATRAD):

interface/rttov_iniscatt.h rttov_iniscatt_ad.h rttov_iniscatt_tl.h rttov_scatt.h rttov_scatt_ad.h rttov_scatt_tl.h

module/rttov_const.F90 rttov_types.F90

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

rttov/rttov_boundaryconditions.F90 rttov_boundaryconditions_ad.F90 rttov_boundaryconditions_tl.F90 rttov_eddington.F90 rttov_eddington_ad.F90 rttov_eddington_tl.F90 rttov_iniedd.F90 rttov_iniedd_ad.F90 rttov_iniedd_tl.F90 rttov_iniscatt.F90 rttov_iniscatt_ad.F90 rttov_iniscatt_tl.F90 rttov_integratesource.F90 rttov_integratesource_ad.F90 rttov_integratesource_tl.F90 rttov_mieproc.F90 rttov_mieproc_ad.F90 rttov_mieproc_tl.F90 rttov_readscattcoeffs.F90 rttov_scatt.F90 rttov_scatt_ad.F90 rttov_scatt_tl.F90

Files modified(SCRIPTS):

gen/ifsmin ifstraj

Files deleted(IFS):

mwave/mwave_diags_errors.F90

Sean Healy - sti_CY36R3_test1

Changes to RO code

Files created(IFS):

op_obs/gpscalc_compress.F90 gpscalc_compressad.F90 gpscalc_compresstl.F90

Files modified(IFS):

op_obs/gpscalc_alpha.F90 gpscalc_alphaad.F90 gpscalc_alphatl.F90 gpscalc_nr.F90 gpscalc_nrad.F90 gpscalc_nrtl.F90 gpscalc_refrac.F90 gpscalc_refracad.F90 gpscalc_refractl.F90 gpsro_ad.F90 gpsro_op.F90 gpsro_tl.F90

Richard Engelen - stj_CY36R3_for_Tony

Bugfixes in hretr

Files modified(IFS):

op_obs/hretr.F90

Dingmin Li - stl_CY36R3_amvcntl

Bugfix to correctly initialize the LMODE logical variable for ALLSKY data

Files modified(IFS):

`module/varbc_setup.F90`

Files modified(SCRIPTS):

`gen/ifsmin ifstraj`

Reima Eresmaa - ste_CY36R3_may2010_tech

Allows the saving of the aerosol contamination flag

Also cleanup of some other bad ODB variable names

Files modified(IFS):

`obs_preproc/cloud_detect_setup.F90`

`op_obs/hretr.F90`

Files modified(SCRIPTS):

`gen/mklinks`

Reima Eresmaa and Tony McNally - ste_CY36R3_airs_channel_selection_bugfix

Bugfix for AIRS cloud detection

Files modified(IFS):

`obs_preproc/cloud_detect_setup.F90`

Qifeng Lu - stu_CY36R3_fy3b

Monitoring/Assimilation of FY-3B data

FY-3B is the second in the Chinese FY-3 series of polar orbiting satellites, and is due to be launched later in 2010. The satellite payload will be very similar to that of FY-3A, data from which has already been evaluated in IFS during 2009.

The changes required are :

- ifs/var/getsatid.F90 to define the satellite id for FY-3B, (521);
- satrad/programs/screen_1c.F90 to switch on screening of FY-3B data;
- scripts/gen/fetchobs to define the data fetch path.

Testing of these changes involved encoding FY-3A data as FY-3B data, processing in IFS then inspecting differences in the JO-table. Observation counts and cost are identical for all observation types.

For testing purposes the FY-3B RTTOV coefficient files were copied from FY-3A and set up from a local ecfs directory in *mklinks*. **For pre-operational testing these coefficient files should be lodged in the /home/rd/rdx/data/36R4/sat/rttov9 directory**. When finalised RTTOV coefficient files are available (post-launch) these temporary files should be replaced.

Files modified(IFS):

`var/getsatid.F90`

Files modified(SATRAD):

`programs/screen_1c.F90`

Files modified(SCRIPTS):

`gen/fetchobs`

Hans Hersbach - dal_CY36R3_oceansat2

Preparations for Oceansat-2 scatterometer data

In CY36R3 the incorporation of Oceansat-2 scatt data had already been prepared. However, data format was unknown at that stage.

That point has now been resolved, and the assimilation system (mainly the preprocessing in the obs/prepare_obs/prescat job) has been adapted accordingly. Once Oceansat-2 data arrives in NRT, it should be possible to processs and monitor the data directly (by an appropriate change in the fetchobs script). Active assimilation could be achieved by a blacklist change.

Files created(IFS):

`obs_preproc/oscatin.F90`

Files created(ODB):

`bufr2odb/bufr2odb_oscat.F90`

Files created(SCAT):

`module/datstat.F oinvert.F oscat_bufr.F oscat_flag.F oscat_wind.F`
`oretrieve/invert_owind.F obeam_check.F oscat_invert50.F oscat_read_bufr.F`
`oscat_write_bufr.F read_os2_table.F read_sigma0_bias.F`

`programs/oscat_filter.F`

Files modified(IFS):

`module/parersca.F90 yomcosjo.F90 yomscc.F90 yomthlim.F90`
`namelist/namjo.h namscc.h`

`obs_preproc/decis.F90 defrun.F90 scaqc.F90 scat_ob.F90 scatsin.F90 sufglim.F90`

Files modified(ODB):

`tools/Bufr2odb.F90`

Files modified(SCAT):

`module/qtabdata.F`

Files modified(SCRIPTS):

`gen/fetchobs ifstraj mkabs_scat prescat`

Files deleted(IFS):

`obs_preproc/iscatin.F90`

Files deleted(ODB):

`bufr2odb/bufr2odb_iscat.F90`

Bill Bell - stw_CY36R3_F18

Monitoring F18 SSMIS

These code changes allow the processing and monitoring of F18 SSMIS (WMO satid = 286), launched 18th October 2009. These changes are small incremental additions to the code already lodged at CY36R3. F18 SSMIS is not yet being received at ECMWF, but should be available sometime in early June 2010. The sensor will provide data of higher quality than the first two SSMIS instruments (F16 and F17) and will be a significant addition to the constellation of microwave imagers available for the *all-sky* assimilation scheme. The code has been tested by processing *dummy* F18 data (F17 data encoded and archived as F18 data). F18 data will be passively monitored initially (*i.e.* blacklist entry set to fail(EXPERIMENTAL)).

Files modified(OBSTAT):

`module/mod_sat_monitor.F90`

Files modified(SCRIPTS):

`gen/fetchobs premwimg`

WAVE

Jean Bidlot and Saleh Abdalla - wab_CY36R3_for_CY36R4

Change to the altimeter data assimilation in shallow waters and revised subgrid parametrisation is coastal areas

With increased horizontal resolution, some fine details of what is happening in coastal areas became more apparent. Until now the formulation used to update the wave spectrum following altimeter wave height assimilation was based on deep water consideration only. The updating scheme has been modified to account for basic shallow water physics, namely the maximum wave energy is controlled by the water depth as well as the frequency down shifting. We have also revised the subgrid parametrisation which accounts for unresolved bathymetric features in the advection scheme. It was found that the scheme is actually too active in shallow coastal waters. The current scheme has been relaxed in such conditions.

A few minor technical changes worth noting:

- model numbers are now 107 for the global models and 207 for the limited area one.
- archiving of wave spectra can be done in chunks of 3 days rather that every 6 hours (this is relevant for long wave model hindcast runs).
- retrieval of wave spectra will be done in one go rather than a first attempt at the first frequency and direction followed by the full request.

- Corrected bias corrections file for re-analysis.
- A few land depressions removed from being seen as sea points

Files created(SCRIPTS):

`wav/biascorrection_as_used_in_era_int.swh`

Files modified(SCRIPTS):

`def/wam.def`

`sms/wamarchive.sms`

`wav/archive_wave biascorrection_era.swh wam_reference_levels_global wave_getrst wave_getwind wave_setup wave_setup_an`

Files modified(WAM):

`Wam_oper/create_wam_bathymetry.F fdur.F fkmean.F fustar.F fwsea.F update.F upwspec.F wavemdl.F wsmfen.F`

`module/yowgribhd.F yowpcons.F`

SEKF

Patricia De Rosnay - dap_CY36R3_SEKF

SEKF surface analysis updates and use of satellite soil moisture data from ASCAT

Files modified(IFS):

`module/yomsekf.F90`

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

`sekf/susekf.F90`

Files modified(SCRIPTS):

`def/an.def`

`gen/sekf_sm soilana ssaana`

Files modified(WAM):

`Wam_oper/wavemdl.F`

EDA

Massimo Bonavita - dav_CY36R3_EDA1

Use of EDA sample variances in 4D-Var

Scripts and routines have been provided to make it possible to use EDA sample variances in the deterministic analysis. When the IFS is run EDA configuration ($ENDANENS -gt 0) a new family (enda_pp) is created in the lag family and tasks ens_stats, ens_cal and ens_errors are run. These successively compute mean and standard deviations of short range ensemble forecasts, adaptive state-dependent calibration of ensemble variances,

objective filtering of calibrated variances. Post-processed EDA standard deviations are finally saved in MARS (STREAM=ENDA, TYPE=SES). When the IFS is run in deterministic mode ($ENDANENS -eq 0) the fetcherr script retrieves the first guess errors estimates from the post-processed EDA standard deviations instead of the randomization fields.

Files created(PREPDATA):

`programs/Ens_Spread_Cal.F90 Ensemble_Stats.F90 Fieldset_Diff.F90 GH_RH.F90 Spectral_Filter.F90 Spread_Skill_Time_Avg.F90 gptosp_api.F90 sptogp_api.F90 sqrt_api.F90`

Files created(SCRIPTS):

`gen/ens_cal ens_errors ens_stats`

`sms_an/ens_cal.sms ens_errors.sms ens_stats.sms`

Files modified(SCRIPTS):

`def/an.def`

`gen/fetcherr mkabs_prepdata`

Gabor Radnoti and Carla Cardinali - dag_CY36R3_eda_bgpert

Optimally perturb background for EDA

Controlled by preIFS switch LBGPERT

Files created(SCRIPTS):

`sms_an/ifsmsave.sms`

Files modified(IFS):

`dia/wroutgpgb.F90`
`module/iostream_mix.F90 yomvar.F90`
`namelist/namvar.h`
`var/rdfpinc.F90 suinfce.F90 suvar.F90 upspec.F90`

Files modified(SCRIPTS):

`def/an.def`

`gen/ifsmin ifstraj vardata`

SNOW

Patricia De Rosnay and Gianpaolo Balsamo - dap_CY36R3_SNOW_OI_NESDIS4km

Revision of the snow analysis: OI, Nesdis 4km data, SYNOP snow depth data Quality check

Detailed investigation of the snow analysis this winter pointed out some major conceptual issues in the Cressman snow analysis used in operation, as well as a lack of satellite data in coastal areas and lack of SYNOP data quality control. In cycle 36r4 the proposed snow analysis is based the Optimum Interpolation surface analysis, revised following the snow OI of Brasnett, J. Appl. Meteo. (1999) to compute the horizontal and vertical weighting functions. In addition, acquisition of the NOAA/NESDIS 4km snow cover product has been set up

and pre-processing of this new data has been developed. The surface analysis has been revised to use this new high resolution snow cover data set, which ensures satellite data coverage in coastal areas. A switch in prepIFS enables to choose between the 24km and the 4km snow cover products. Due to the high volume of the NESDIS 4km snow cover data, a thinning coefficient have been included (and put in the namelist). Use of NESDIS data has been revised and the subroutine cres_fill1 is renamed nesdis_fill.F90. Modifications include corrected distance computation. Possibilities to modify the snow free relaxation depth from the namelist is included. SYNOP snow depth data quality control is also proposed based on (i) detailed output of the snow analysis for each used and rejected stations and (ii) reading SYNOP snow depth stations blacklist. Detailed information in the log file concerning each SYNOP snow depth data used and rejected (and the reason of rejection) will also be useful to address member states comments on our use of SYNOP snow depth data. The Quality control will allow to maintain up to date the blacklist_snow ascii file (which is short at the moment) which in turn will be used to reject wrong observations.

Files created(SSA):

`sub/nesdis_fill.F90`

Files modified(SCRIPTS):

`def/an.def`

`gen/fetchobs mkabs_ssa ssaana`

Files modified(SSA):

`interface/calc_distance.h oiinc.h oiset.h`

`module/comobs.F90 yomiodssa.F90 yomssa.F90`

`namelist/namssa.h`

`plot/print_nml.F90 print_summary.F90`

`sub/control_ssa.F90 fg2obs.F90 inisnw.F90 oiinc.F90 oiupd.F90 redundant_obs.F90 scan_cma_odb.F90 snow_analysis.F90 sub_prep_nes.F90 sucsnw.F90 t2m_analysis.F90`

`util/alloc_mem.F90 calc_distance.F90 equsolve.F90 oiset.F90 setcomssa.F90`

Files deleted(SSA):

`sub/cres_fill1.F90 lsm_check.F90`

PASSIVE AND TECHNICAL CHANGES

ODB

Anne Fouilloux - stf_CY36R3_copie_MARS_for36r4_v5

Extensive cleaning of ODB

The very first phase of the ODB cleaning was achieved. The aim of this cleaning is to be able to archive ODB in MARS and prepare ODB for the OOPS project.

This branch was supposed to be bit-reproducible but it was not possible because of a bug-fix (see section IV). Changes are not significant.

I. Changes in the ODB schema files.

I.1 Renaming columns moved from one table to another

Usually the corresponding MDB pointers were not changed (or if changed they are supposed to be more meaningful...).

All flags have a prefix report_ (if part of an hdr-like table) or datum_ (if part of a body-like table). Examples:

```
status@hdr  --> report_status@hdr
status@body --> datum_status@body
```

satid was renamed to satellite_identifier and corresponds to the WMO satellite platform (ident@hdr was removed)

satinst was renamed to satellite_instrument and corresponds to the WMO satellite instrument. Please note that for now satellite_instrument is both available in hdr and sat tables. It will be removed from the hdr table in a future cycle.

insttype was renamed to instrument_type and correspond to the observation instrument type

press@body was renamed to vertco_reference_1 press_rl@body was renamed to vertco_reference_2

retrsource@hdr moved to resat tables i.e. retrsource@reo3

fov is now called scanpos for all observation groups (reo3, all atmospheric radiances).

Thanks to Alan Geer, the following arrays were removed from ODB:
tbdiag[$NUMRAINTBDIAG] is now:

```
fg_rain_rate             pk9real,  // Surface rain @ FG [mm h-1]
fg_snow_rate             pk9real,  // Surface frozen precipitation @ FG [ mm h-1]
fg_tcwv                  pk9real,  // Total column water vapour @ FG [ kg m-2]
fg_cwp                   pk9real,  // Cloud liquid water path @ FG [ kg m-2 ]
fg_iwp                   pk9real,  // Cloud ice water path @ FG [ kg m-2 ]
fg_rwp                   pk9real,  // Rain water path @ FG [ kg m-2 ]
fg_swp                   pk9real,  // Snow water path @ FG [ kg m-2 ]
fg_rttov_cld_fraction    pk9real,  // Cloud fraction used in RTTOV_SCATT [0-1]
```

```
an_rain_rate             pk9real,  // Surface rain @ FG [mm h-1]
an_snow_rate             pk9real,  // Surface frozen precipitation @ FG [ mm h-1]
an_tcwv                  pk9real,  // Total column water vapour @ FG [ kg m-2]
an_cwp                   pk9real,  // Cloud liquid water path @ FG [ kg m-2 ]
an_iwp                   pk9real,  // Cloud ice water path @ FG [ kg m-2 ]
an_rwp                   pk9real,  // Rain water path @ FG [ kg m-2 ]
an_swp                   pk9real,  // Snow water path @ FG [ kg m-2 ]
an_rttov_cld_fraction    pk9real,  // Cloud fraction used in RTTOV_SCATT [0-1]
```

tbgnorm[$NUMRAINTBGNRM] is now

```
fg_rain_rate     pk9real, // Surface rain @ FG [mm h-1]
gnorm_10mwind    pk9real, // Norm of gradient against 10m wind
gnorm_skintemp   pk9real, // Norm of gradient against skin temperature
gnorm_temp       pk9real, // Norm of gradient against temperature
gnorm_q          pk9real, // Norm of gradient against specific humidity
gnorm_rainflux   pk9real, // Norm of gradient against rain flux
gnorm_snowflux   pk9real, // Norm of gradient against snow flux
gnorm_clw        pk9real, // Norm of gradient against cloud water
gnorm_ciw        pk9real, // Norm of gradient against cloud ice
gnorm_cc         pk9real, // Norm of gradient against cloud cover
```

tbp19 [$NUMRAINTBP] is now

```
ob_p19           pk9real, // 19 GHz normalised polarisation difference observed
fg_p19           pk9real, // 19 GHz normalised polarisation difference first guess
an_p19           pk9real, // 19 GHz normalised polarisation difference analysis
```

tbp37 [$NUMRAINTBP] is now

```
ob_p37           pk9real, // 19 GHz normalised polarisation difference observed
fg_p37           pk9real, // 19 GHz normalised polarisation difference first guess
an_p37           pk9real, // 19 GHz normalised polarisation difference analysis
```

fg_check[2]:

```
qc_a             pk9real, // VAR QC prior probability of gross error by variable and
qc_l             pk9real, // VAR QC width of the distribution
qc_pge           pk9real, // VAR QC a posteriori probability of gross error
```

These new entries are not fully used yet and some more cleaning will have to be done (may removed qc_a and qc_l from ODB because these values are hard-coded in defrun.F90).

tbvalue, tbvaluead and tbvaluetl are moved from the body table to allsky_body table. tbvalue@allsky_body, tbvaluetl@allsky_body and tbvaluead@allsky_body are now initialized to 0 because some problems (with the last timeslot) are highlighted when initialized to NULL. This problem will be investigated and may require some changes in a future cycle (thanks to Alan Geer).

I.2 ODB columns removed.

This list is not an exhaustive list of all ODB columns removed from IFS

```
instspec
ifovnumb
retrsource
country_code
varno_presence
tcwv_fg
ifovnumb
ident
instspec
sun_zenith
sun_azimuth
sat_zenith
sat_azimuth
rank_an              // rank_cld@body is still in body table
csr_pclear           // should be used by geos data instead of press_rl
csr_pcloudy
limb_azimuth         // azimuth@sat used instead
mwemis_sat4d[4]      // entries in surfemiss_body table should be used instead
mwskin4d[4]          // entries in surfemiss_body table should be used instead
mwatmo_trans4d[2]    // entries in surfemiss_body table should be used instead

predictor_1@atovs_pred
predictor_2@atovs_pred
```

Some other predictors were moved to modsurf table.

```
station_height@atovs
zenith@atovs            // moved to sat table
bearing_azimuth@atovs   // removed and added azimuth@sat
solar_zenith@atovs      // moved to sat table
solar_azimuth           // moved to sat table

vertsign[3:4]@atovs
landsea@atovs
landsurf_height@atovs
scanline_status@atovs
water_fraction@atovs
land_type@atovs
land_fraction@atovs
skintemp@atovs
press[2:2]@atovs
iterno_1dvar@atovs
error_1dvar@atovs
channel_1dvar[0:1]@atovs
```

```
presat_flags@atovs
iterno_conv_1dvar@atovs
failure_1dvar@atovs
landsea_obs@atovs
```

Table ddrs was completly removed and the following new entries were created:

```
numtsl@desc             // total number of timeslots
enddate@timeslot_index // End date of the timeslot
endtime@timeslot_index // End time of the timeslot
```

Table atovs_body has been removed (surface emissivity entries are now in surfemiss_body table).

I.3 Reorganisation of the ODB schema file

The schema file cma.h was re-organised and split in several files:

type_definitions.h contains all the type definitions (CREATE TYPE)

aeolus.h contains all aeolus tables (not cleaned yet)

allsky.h contains allsky/mwave specific tables

auxiliary.h contains two tables (one hdr-like and one body-like table) intented to replace aux[1:$NUMAUX]@body ODB columns. Please do not use aux[1:$NUMAUX]@body as these columns will be removed in a future cycle. These auxiliary tables are not created by default. You can use any columns in auxiliary and auxiliary_body for your own developments by setting the environment variable ODB_AUXILIARY=1 (these tables are then created in the first trajectory). ODB_AUXILIARY is always set to 0 in operation and in all default research experiments.

body.h contains all body entries common to all instruments. Still not fully cleaned; I added some comments to show what will happen later (for conventional only, for resat or gnssro only, etc.).

cloud_sink.h contains ODB attributes used when LCLDSINK is TRUE. This table is created if LCLDSINK is TRUE only.

cma.h contains ODB tables (to be cleaned too...) and other tables I did not clean yet.

co2_sink.h contains some attributes valid if LCO2 is TRUE. This table is obsolete and will be removed (by Richard Engelen) and the IFS code will be cleaned accordingly in a next cycle. (it was created because we did not have time to remove the usage of these ODB columns in IFS...).

gnssro.h contains two tables (one hdr-like and one body-like table) to be used in a later cycle for GNSSRO data. When used columns in hdr and body will be removed (some columns were added for Meteo-France and their misusage of existing body-entries).

hdr.h some columns were removed but some more cleaning will be done in a next cycle (see comments in hdr.h). We added columns for the MARS archiving: groupid, reportype. These new columns are set in our bufr2odb software using map_reportype.F90 (this file is created automatically from a MYSQL database which contains all existing MARS observation groups and reportype).

iasi.h contains iasi specific entries (set in our bufr2odb software).

modsurf.h is a hdr-like table containing physical quantities from the model interpolated at the observation location. lsm@modsurf replaces modlm@hdr orography@modsurf replaces modoro@hdr snow_depth@modsurf

replaces predictor_4@atovs_pred and is only set for codetype=210 (radiances). t2m@modsurf replaces predictor_6@atovs_pred albedo@modsurf replaces predictor_7@atovs_pred windspeed10m@modsurf replaces predictor_8@atovs_pred

radar.h not cleaned; not used at ECMWF.

radiance.h contains ODB attributes common to all atmospheric radiances. Currently used at ECMWF for codetype=210 and codetype=215.

resat.h not cleaned yet. It contains tables for all retrieval of satellite data (ozone, aerosols, and some chemical quantities). Tables are still named reo3 but may be renamed to resat in a future cycle.

sat.h contains ODB attributes that are usually common to all satellite.

satob.h not cleaned yet. It contains an hdr-tlike table for satob specific information.

scatt.h not cleaned yet. It contains an hdr-like table (scatt) and a body-like table (scatt_body) for scatterometer specific information.

smos.h contains smos specific ODB entries.

ssmi1d.h contains obsolete SSMI-1DVAR entries. These tables are not used at ECMWF anymore. They will be removed in a future cycle and the IFS code will be cleaned accordingly.

surfemiss.h contains an hdr-like (surfemiss) and a body-like (surfemiss_body) table for the surface emissivity processing in IFS. It requires some cleaning (remove the usage of arrays, give more meaningful names, ...). These tables are now used both by codetype=210 and codetype=215.

Please note that it is now forbidden to add a new column or a new table without the aggreement of the ECMWF governance group.

Some new MARS entries were added in the desc table (see cma.h):

```
class  string,     // MARS key - ECMWF classification for data
stream string,     // MARS key - forecasting system used to generate data
type   string,     // MARS key - type of field used to retrieve data
```

They are not filled yet.

All Meteo-France tools (mandalay/bator) will need to be fixed.

II. Add a new codetype for MERIS.

A new codetype (214) was added for MERIS (previously used with codetype=215 i.e. with allsky/mwave). This would allow to simplify many existing SQL requests (not done yet).

III. bufr2odb changes

obstype,codetype,reportype, etc. are now set in bufr2odb (at ECMWF they were set in the first trajectory in IFS vi a call to buf2cmat4odb). They are now set in bufr2odb via a call to buf2cmat_new and map_reportype (it will be improved in the framework of the OOPS project...).

IV. Bug fix

Files modified hretr.F90 and prech.F90

Option L_OBS_ERR_INCREASE_Hretr (see hretr.F90) is now removed. addoer was called from hretr if L_OBS_ERR_INCREASE_Hretr. L_OBS_ERR_INCREASE_Hretr was set to TRUE at ECMWF for the first tra-

jectory) while the orography (orography@modsurf / MDB_OROGRAPHY) was not set yet. This bug was highlighted when initializing orography@modsurf to NULL (was previously initialised to 0). addoer is now called from prech.F90.

V. MARS archiving

To further prepare the archiving of ODB in our MARS archive, we made a number of changes in the scripts:

MONDB (MONitoring Database) is created by default and in research mode an attempt to archive it in MARS is performed. MONDB is always saved in ECFS.

Creation of ODBCMPs are now removed (./scripts/gen/ODBCMP.ddl has been removed). They have been replaced by dedicated databases for each MARS observation group (./scripts/gen/SATOB.ddl, ./scripts/gen/MERIS.ddl, etc.). When ODBSAVE_ODBCMP is "on" in prepIFS, these new dedicated databases are created and an attempt to archive them in MARS is performed (conversion to ODB-2.0 format and MARS archiving). Note: we should always have ODBSAVE_ODBCMP=false (because now we use ODBSAVE_ODBCMP to create dedicated ODB databases; these databases are meaningful for the archiving of ODBs in MARS only and we do not want to test MARS archiving in operations).

This is the same for MONDB: the task archive_mondb should not exist in operations.

Files created(ODB):

```
cma2odb/init_odb_tables.F90 map_reportype.F90
ddl.CCMA/aeolus.h allsky.h auxiliary.h body.h cloud_sink.h co2_sink.h
ecmwf_matchup_allsky_body.sql gnssro.h hdr.h iasi.h matchup_allsky_body.sql
mkglobstab_cloud_sink.sql mkglobstab_co2_sink.sql modsurf.h obsdist_allsky.sql
obsdist_allsky_body.sql obsdist_auxiliary.sql obsdist_auxiliary_body.sql
obsdist_hdr2allsky_body.sql obsdist_hdr2auxiliary_body.sql
obsdist_hdr2surfemiss_body.sql obsdist_modsurf.sql obsdist_radiance.sql
obsdist_surfemiss.sql obsdist_surfemiss_body.sql obsort_hdr2allsky_body.sql
obsort_hdr2auxiliary_body.sql obsort_hdr2surfemiss_body.sql radar.h radiance.h
resat.h sat.h satbody_allsky.sql sathdr_cloud_sink.sql sathdr_co2_sink.sql
satob.h scatt.h smos.h ssmi1d.h stat_obs_1.sql surfemiss.h time_info.sql
type_definitions.h
ddl.ECMA/aeolus.h allsky.h auxiliary.h body.h cloud_sink.h co2_sink.h
ecmwf_matchup_allsky_body.sql gnssro.h hdr.h iasi.h links_auxiliary.sql
links_body.sql links_modsurf.sql links_sat.sql matchup_allsky_body.sql
mkglobstab_cloud_sink.sql mkglobstab_co2_sink.sql modsurf.h obsdist_allsky.sql
obsdist_allsky_body.sql obsdist_auxiliary.sql obsdist_auxiliary_body.sql
obsdist_hdr2allsky_body.sql obsdist_hdr2auxiliary_body.sql
obsdist_hdr2surfemiss_body.sql obsdist_modsurf.sql obsdist_radiance.sql
obsdist_surfemiss.sql obsdist_surfemiss_body.sql obsort_allsky.sql
obsort_allsky_body.sql obsort_auxiliary.sql obsort_cloud_sink.sql
obsort_co2_sink.sql obsort_hdr2allsky_body.sql obsort_hdr2auxiliary_body.sql
obsort_hdr2surfemiss_body.sql obsort_iasi.sql obsort_modsurf.sql
obsort_radiance.sql obsort_surfemiss.sql obsort_surfemiss_body.sql radar.h
radiance.h resat.h sat.h satbody_allsky.sql sathdr_cloud_sink.sql
sathdr_co2_sink.sql sathdr_screen_cloud_sink.sql sathdr_screen_co2_sink.sql
satob.h scatt.h smos.h ssmi1d.h stat_obs_1.sql stat_obs_2.sql surfemiss.h
time_info.sql type_definitions.h update_links_allsky.sql
update_links_auxiliary.sql update_links_radiance.sql update_links_surfemiss.sql
ddl.ECMASCR/aeolus.h body.h hdr.h radar.h resat.h satob.h scatt.h smos.h
ssmi1d.h type_definitions.h
ddl/aeolus.h allsky.h auxiliary.h body.h cloud_sink.h co2_sink.h
```

ecmwf_matchup_allsky_body.sql gnssro.h hdr.h iasi.h links_auxiliary.sql
links_body.sql links_modsurf.sql links_sat.sql matchup_allsky_body.sql
mkglobstab_cloud_sink.sql mkglobstab_co2_sink.sql modsurf.h obsdist_allsky.sql
obsdist_allsky_body.sql obsdist_auxiliary.sql obsdist_auxiliary_body.sql
obsdist_hdr2allsky_body.sql obsdist_hdr2auxiliary_body.sql
obsdist_hdr2surfemiss_body.sql obsdist_modsurf.sql obsdist_radiance.sql
obsdist_surfemiss.sql obsdist_surfemiss_body.sql obsort_allsky.sql
obsort_allsky_body.sql obsort_auxiliary.sql obsort_cloud_sink.sql
obsort_co2_sink.sql obsort_hdr2allsky_body.sql obsort_hdr2auxiliary_body.sql
obsort_hdr2surfemiss_body.sql obsort_iasi.sql obsort_modsurf.sql
obsort_radiance.sql obsort_surfemiss.sql obsort_surfemiss_body.sql radar.h
radiance.h resat.h sat.h satbody_allsky.sql sathdr_cloud_sink.sql
sathdr_co2_sink.sql sathdr_screen_cloud_sink.sql sathdr_screen_co2_sink.sql
satob.h scatt.h smos.h ssmi1d.h stat_obs_1.sql stat_obs_2.sql surfemiss.h
time_info.sql type_definitions.h update_links_allsky.sql
update_links_auxiliary.sql update_links_radiance.sql update_links_surfemiss.sql
interface/init_odb_tables.h

scripts/make_tarball.small makefile.small

Files created(SCRIPTS):

gen/AIRS.ddl ALLSKY.ddl AMSRE.ddl AMSUA.ddl AMSUB.ddl CONV.ddl GEOS.ddl
GPSRO.ddl HIRS.ddl IASI.ddl MERIS.ddl MHS.ddl REO3.ddl SATOB.ddl SCATT.ddl
SSMI.ddl SSMIS.ddl SURFCONV.ddl TMI.ddl TOVS.ddl WINDSAT.ddl archive_mondb
archive_obsgroup

sms_an/archive_airs.sms archive_amsre.sms archive_amsua.sms archive_amsub.sms archive_-
conv.sms archive_geos.sms archive_gpsro.sms archive_hirs.sms archive_iasi.sms archive_-
meris.sms archive_mhs.sms archive_mondb.sms archive_msu.sms archive_mwhs.sms archive_-
mwri.sms archive_mwts.sms archive_obsgroup.sms archive_reo3.sms archive_reo3ak.sms
archive_satob.sms archive_scatt.sms archive_smos.sms archive_ssmi.sms archive_ssmis.sms
archive_ssu.sms archive_surf_conv.sms archive_tmi.sms archive_vtpr1.sms archive_-
vtpr2.sms archive_windsat.sms odb_prepare.sms

Files created(SSA):

interface/scan_odb.h

sub/scan_odb.F90

Files modified(IFS):

canari/cancer.F90 caviso.F90 cavodk.F90

common/yomdb_defs.h yomdb_vars.h

module/varbc_tcwv.F90 yomcoctp.F90 yomdb.F90

mwave/mwave_get.F90 mwave_get_ad.F90 mwave_get_tl.F90 mwave_put.F90
mwave_put_tl.F90

obs_preproc/addoer.F90 airepin.F90 black.F90 blackhat.F90 blacksat.F90
filfbde.F90 gefger.F90 mertsin.F90 mkglobstab.F90 new_thinn.F90 new_thinner.F90
new_thinner_no_sq.F90 obadat.F90 obatabs.F90 obinssp.F90 post_thinner.F90
pre_thinner.F90 prech.F90 rad1cin.F90 readoba.F90 reo3sin.F90 settc.F90
suobarea.F90 synopbe.F90 thin_red_presort.F90

op_obs/amv_reassign.F90 gpsro_op.F90 hjo.F90 hop.F90 hopad.F90 hoptl.F90
hradp.F90 hradp_ml.F90 hradp_ml_tl.F90 hradptl.F90 hretr.F90 hsatang.F90
radtrk.F90

setup/cmoctmap.F90 sucmoctp.F90

var/gp_ssmi.F90 setqccma.F90 surad.F90 writeoba.F90

Files modified(OBSTAT):

```
data/bufrodbcodes.cfg
```

Files modified(ODB):

```
bufr2odb/bufr2odb_205.F90 bufr2odb_aeolus.F90 bufr2odb_aircraft.F90
bufr2odb_airs.F90 bufr2odb_amsre_1d.F90 bufr2odb_ascat.F90 bufr2odb_atovs.F90
bufr2odb_fy3.F90 bufr2odb_gch1.F90 bufr2odb_gch2.F90 bufr2odb_gch3.F90
bufr2odb_gch4.F90 bufr2odb_grad.F90 bufr2odb_iasi.F90 bufr2odb_iscat.F90
bufr2odb_meris.F90 bufr2odb_metar.F90 bufr2odb_modisaer.F90 bufr2odb_msg.F90
bufr2odb_mwri_1d.F90 bufr2odb_paob.F90 bufr2odb_pgps.F90 bufr2odb_qscat.F90
bufr2odb_radio.F90 bufr2odb_reo3.F90 bufr2odb_satem.F90 bufr2odb_satob.F90
bufr2odb_scat.F90 bufr2odb_smos.F90 bufr2odb_ssmi.F90 bufr2odb_ssmis_1d.F90
bufr2odb_synop.F90 bufr2odb_temp.F90 bufr2odb_tmi_1d.F90
bufr2odb_windprofiler.F90 bufr2odb_windsat.F90 get_odb2bufr_varindex.F90
get_varindex.F90
cma2odb/buf2cmat_new.F90 ctxinitdb.F90 distribute_odb.F90 distributedb.F90
dotransf.F90 getatdb.F90 getdb.F90 initmdb.F90 makedesc.F90
maketimeslot_index.F90 matchupdb.F90 putatdb.F90 revmatchupdb.F90
shuffle_odb.F90 shuffle_rest.F90 shuffledb.F90 update_ddr_odb.F90
update_obsdb.F90 xchangedatadb.F90 xchangedatadistdb.F90
compiler/odb98.c
ddl/PSBIAS.ddl adjust_distribid.sql airs.sql airs_flag.sql ak_reo3_body.sql
amv.sql amv2.sql amv_flag.sql amv_flag2.sql ascatsm_robhdr_1.sql
ascatsm_robody_1.sql black_atovs.sql black_robhdr_1.sql black_robhdr_2.sql
black_robhdr_3.sql black_robhdr_4.sql black_robhdr_6.sql black_robhdr_7.sql
black_robhdr_8.sql black_robhdr_9.sql black_robody_1.sql black_robody_2.sql
black_robody_3.sql black_robody_4.sql black_robody_5.sql black_robody_6.sql
black_robody_7.sql black_robody_8.sql black_robody_9.sql black_satob.sql
black_scatt.sql camelo_robhdr.sql camelo_robody.sql canaco_robhdr.sql
canaco_robody.sql cancer_robody.sql cantik_robody.sql carcfo.sql
caviso_robhdr.sql caviso_robody.sql cavodk_robody.sql cma.h
conventional_robhdr_1.sql conventional_robody_1.sql cycle_biasprep_robhdr.sql
cycle_biasprep_robody.sql cycle_biasprep_sathdr.sql cycle_biasprep_satpred.sql
decis_robhdr_1.sql decis_robhdr_2.sql decis_robhdr_3.sql decis_robhdr_4.sql
decis_robody_1.sql decis_robody_2.sql decis_robody_3.sql decis_robody_4.sql
discard_dep_1.sql discard_dep_2.sql dmsprainy.sql ecma_body_4_psbias.sql
ecma_body_4_rstrhbias.sql ecma_hdr_4_psbias.sql ecma_hdr_4_rstrhbias.sql
ecmwf_matchup_body.sql ecmwf_matchup_hdr.sql ecmwf_matchup_update_1.sql
ecmwf_matchup_update_2.sql ecmwf_matchup_update_3.sql ecmwf_matchupsink.sql
ecset.sql emiskf_amsua.sql emiskf_amsub.sql emiskf_mhs.sql fb_getatovs_pred.sql
fb_getbody.sql fb_getbufr.sql fb_geterrstat.sql fb_gethdr.sql fb_getreo3.sql
fb_getsatob.sql fb_getscatt.sql fb_getscatt_body.sql fb_gettypes.sql
fb_getupdate_1.sql fb_getupdate_10.sql fb_getupdate_2.sql fb_getupdate_3.sql
fb_getupdate_4.sql fb_getupdate_5.sql fb_getupdate_6.sql fb_getupdate_7.sql
fb_getupdate_8.sql fb_getupdate_9.sql fcq_robody_0.sql fcq_robody_1.sql
fcq_robody_2.sql flago_mobhdr.sql flago_mobody.sql gather4poolmask.sql
gather4poolmask_counts.sql get_soe_reo3.sql getlimbid.sql getsatid.sql
getsatid_reo3.sql getsatobid.sql gpsro.sql gpsro_2.sql gpsro_flag.sql
hop_canari_robody.sql hretr_canari_robody.sql level1cgeos_robhdr_1.sql
level1cgeos_robody_1.sql manda_gene_body.sql manda_gene_hdr.sql
matchup_atovs_pred.sql matchup_body.sql matchup_hdr.sql matchup_sensorlist.sql
matchup_update_1.sql matchup_update_10.sql matchup_update_2.sql
matchup_update_3.sql matchup_update_4.sql matchup_update_5.sql
matchup_update_6.sql matchup_update_7.sql matchup_update_8.sql
```

matchup_update_9.sql matchupsink.sql mkglobstab.sql mkglobstab_atovs.sql
mobhdr_obsort.sql mobhdrca_obsort.sql nak_reo3_body.sql new_thinn_robhdr_10.sql
new_thinn_robhdr_2.sql new_thinn_robhdr_3.sql new_thinn_robhdr_4.sql
new_thinn_robhdr_5.sql new_thinn_robhdr_6.sql new_thinn_robhdr_7.sql
new_thinn_robhdr_8.sql new_thinn_robhdr_9.sql new_thinn_robody_10.sql
new_thinn_robody_3.sql new_thinn_robody_4.sql new_thinn_robody_5.sql
new_thinn_robody_8.sql new_thinn_robody_9.sql obatabs_robhdr.sql obs_boxes.sql
obscount_1.sql obsdist_ssmi_body.sql obshor.sql obsort_atovs.sql
obsort_atovs_pred.sql obsort_body.sql obsort_errstat.sql obsort_hdr.sql
obsort_hdr2body.sql obsort_hdr2radar_body.sql obsort_hdr2reo3_body.sql
obsort_index.sql obsort_limb.sql obsort_radar.sql obsort_radar_body.sql
obsort_radar_station.sql obsort_reo3.sql obsort_reo3_body.sql obsort_sat.sql
obsort_satob.sql obsort_scatt.sql obsort_scatt_body.sql obsort_ssmi.sql
obsort_ssmi_body.sql obsort_update.sql obsort_update_1.sql obsort_update_10.sql
obsort_update_2.sql obsort_update_3.sql obsort_update_4.sql obsort_update_5.sql
obsort_update_6.sql obsort_update_7.sql obsort_update_8.sql obsort_update_9.sql
obsortca_body.sql obsortca_errstat.sql obsortca_hdr.sql obsortca_hdr2body.sql
obsortca_index.sql obsortca_update_1.sql obsortca_update_2.sql
obsortca_update_3.sql obstat.sql obstat_gpsro.sql obstat_radwd.sql
obstat_reo3.sql obstat_scatt.sql obstat_tovs.sql obstype.h
odb2ee_aeolus_auxmet.sql odb98.flags out_body.sql ozone_robhdr_1.sql
ozone_robody_1.sql pertobs_corr_robhdr.sql pertobs_corr_robody.sql
pertobs_uncorr_robhdr.sql pertobs_uncorr_robody.sql poolmask_2.sql
poolmask_3.sql post_thinn_robhdr_2.sql post_thinn_robhdr_3.sql
post_thinn_robhdr_4.sql post_thinn_robhdr_5.sql post_thinn_robhdr_6.sql
post_thinn_robhdr_7.sql post_thinn_robhdr_8.sql post_thinn_robhdr_9.sql
post_thinn_robody_2.sql post_thinn_robody_3.sql post_thinn_robody_4.sql
post_thinn_robody_5.sql post_thinn_robody_6.sql post_thinn_robody_7.sql
post_thinn_robody_8.sql post_thinn_robody_9.sql pre_thinn_robhdr_10.sql
pre_thinn_robhdr_2.sql pre_thinn_robhdr_3.sql pre_thinn_robhdr_4.sql
pre_thinn_robhdr_5.sql pre_thinn_robhdr_6.sql pre_thinn_robhdr_7.sql
pre_thinn_robhdr_8.sql pre_thinn_robhdr_9.sql pre_thinn_robody_10.sql
pre_thinn_robody_2.sql pre_thinn_robody_3.sql pre_thinn_robody_4.sql
pre_thinn_robody_5.sql pre_thinn_robody_6.sql pre_thinn_robody_7.sql
pre_thinn_robody_8.sql pre_thinn_robody_9.sql prtdpst_robhdr.sql
prtdpst_robody.sql psbiashdr.sql psbiashdr_maintenance.sql redun_robhdr_1.sql
redun_robhdr_2.sql redun_robhdr_3.sql redun_robhdr_4.sql redun_robhdr_5.sql
redun_robhdr_6.sql redun_robhdr_7.sql redun_robody_1.sql redun_robody_2.sql
redun_robody_3.sql redun_robody_4.sql redun_robody_5.sql redun_robody_6.sql
redun_robody_7.sql reini_body.sql reini_hdr.sql reprod_seqno_1.sql
reprod_seqno_2.sql reprod_seqno_3.sql reprod_seqno_4.sql revmatchup_body.sql
revmatchup_hdr.sql robhdr.sql robhdr_gp_get_ssmi.sql robhdr_gp_put_ssmi.sql
robhdr_grid_distribute.sql robhdr_mwave_count_smos.sql robhdr_mwave_get_ssmi.sql
robhdr_mwave_process_smos.sql robhdr_mwave_put_ssmi.sql
robhdr_mwave_update_smos.sql robhdr_obsort.sql robhdr_screen.sql robhdr_tc.sql
robhdrca_obsort.sql robody.sql robody_gp_get_ssmi.sql robody_gp_put_ssmi.sql
robody_mwave_get_ssmi.sql robody_mwave_process_smos.sql
robody_mwave_put_ssmi.sql robody_mwave_update_smos.sql robody_screen.sql
robody_tc.sql robody_traj.sql sat_atovs.sql sat_lrad.sql sat_satob.sql
sat_ssmi.sql satbody_radar.sql satbody_scat.sql satbody_screen_atovs.sql
satem_robhdr_1.sql satem_robody_1.sql sathdr_limb.sql sathdr_ozone.sql
sathdr_radar.sql sathdr_satem.sql sathdr_satob.sql sathdr_scat.sql
sathdr_screen_aeolus_1b.sql sathdr_screen_aeolus_2b.sql sathdr_screen_atovs.sql
sathdr_screen_lrad.sql sathdr_screen_satob.sql satob_robhdr_1.sql

satob_robody_1.sql scat_robhdr_1.sql scat_robody_1.sql scatt.sql scatt_flag.sql
screen_robhdr_1.sql screen_robhdr_2.sql screen_robhdr_3.sql screen_robody_1.sql
screen_robody_2.sql screen_robody_3.sql sensor.h smon_hsris.sql
smon_hsris_flag.sql smon_mwimg_allsky.sql smon_slmoist.sql ssa_robhdr_2m.sql
ssa_robhdr_snow.sql ssa_robody_2m.sql ssa_robody_snow.sql sufger_robhdr_1.sql
sufger_robody_1.sql suobarea.sql suobarea_limb.sql suobarea_sat.sql
suobarea_satob.sql suobsaddr.sql suobscor_robhdr.sql suobscor_robody.sql
suvarbc_robhdr_0.sql suvarbc_robody_0.sql thinn_robhdr_2.sql thinn_robhdr_3.sql
thinn_robhdr_4.sql thinn_robhdr_5.sql thinn_robhdr_6.sql thinn_robhdr_7.sql
thinn_robhdr_8.sql thinn_robody_2.sql thinn_robody_3.sql thinn_robody_4.sql
thinn_robody_5.sql thinn_robody_6.sql thinn_robody_7.sql thinn_robody_8.sql
tovsrtovs_robody_1.sql tslot.sql update_body_3.sql update_hdr_1.sql
update_hdr_2.sql v_o3.sql varbc_allsky_robhdr.sql varbc_allsky_robody.sql
varbc_rad_robhdr.sql varbc_rad_robody.sql varbc_tcwv_robhdr.sql
varbc_tcwv_robody.sql varbc_to3_robhdr.sql windaux.sql

interface/shuffle_rest.h

module/odb2bufr_varindex_module.F90 varindex_module.F90

pandor/extrtovs/extr_init_1c.F90 extrtovs/extr_lecdata_1c.F90
mandalay/mandalay.F90 module/bator_decodgrib_mod.F90
module/bator_ecritures_mod.F90

perl/skeleton.pl

scripts/bufrodbcodes.cfg create_ioassign

tools/Bufr2odb.F90 Controdb.F90 Mandalay.F90 Odb2bufr.F90

Files modified(SCRIPTS):

def/an.def

gen/MONDB.ddl ODBCMP.ddl create_ioassign fdbksave ifstraj obstat odb2bufr

sms_an/odb_compress.sms odbcmp_prepare.sms

Files modified(SSA):

sub/feedback_odb.F90 inisnw.F90 inisst.F90 init2m.F90

Files deleted(BL): Makefile.not_used

Files deleted(IFS):

obs_preproc/crsybode.F90

Files deleted(ODB):

aux/_pcma_255.c.not_used addrdiff.c.not_used getcwd.c.not_used gethwm.c.not_used
getstackusage.c.not_used n_precision.c.not_used rsort32.c.not_used
svipc.c.not_used

cma2odb/Bigdiff.F90.obsolete Cmadiff.F90.obsolete buf2cmat4odb.F90
cma2odb_rest.F90.obsolete initddrs.F90 makeddrs.F90 odb2ecma_info.F90
odb2ecma_len.F90 odb2ecma_rest.F90 odbddr1.F90 odbddr2.F90 to_ecma.F90.obsolete
to_odb.F90.obsolete

ddl.CCMA/ddrdata.sql obsdist_atovs_body.sql obsdist_ddrs.sql
obsdist_hdr2atovs_body.sql obsdist_ssmi.sql obsort_ddrs.sql update_ddrs.sql

ddl.ECMA/ddrdata.sql obsdist_atovs_body.sql obsdist_ddrs.sql
obsdist_hdr2atovs_body.sql obsort_atovs_body.sql obsort_ddrs.sql
obsort_hdr2atovs_body.sql sathdr_level1cgeos.sql satpred_level1cgeos.sql
smon_mwimg.sql tcwv.sql update_ddrs.sql update_hdr_4.sql

ddl.ECMASCR/ddrdata.sql obsort_ddrs.sql update_ddrs.sql update_hdr_4.sql

ddl.PRESCREEN/alloc.h odb.h odb98.flags privpub.h

ddl/ddrdata.sql duplchk_ps_1.sql duplchk_ps_2.sql in_desc.sql.not_used
in_plev_body.sql.not_used in_plev_hdr.sql.not_used in_sat_body.sql.not_used
in_sat_hdr.sql.not_used in_sbuv_body.sql.not_used in_sbuv_hdr.sql.not_used
in_scatt_body.sql.not_used in_scatt_hdr.sql.not_used in_ssmi_body.sql.not_used
in_ssmi_hdr.sql.not_used in_ssmiretr_body.sql.not_used
in_ssmiretr_hdr.sql.not_used in_surf_body.sql.not_used in_surf_hdr.sql.not_used
in_surface_body.sql.not_used in_surface_hdr.sql.not_used
in_toms_body.sql.not_used in_toms_hdr.sql.not_used obsdist_atovs_body.sql
obsdist_ddrs.sql obsdist_hdr2atovs_body.sql obsort_atovs_body.sql
obsort_ddrs.sql obsort_hdr2atovs_body.sql obsort_ssmi_mlev.sql.obsolete
obsort_ssmi_slev.sql.obsolete robody_0.sql.obsolete robody_1.sql.obsolete
robody_traj_0.sql.obsolete robody_traj_1.sql.obsolete robody_traj_2.sql.obsolete
satbody_screen_ssmi.sql.obsolete satbody_ssmitrmm.sql.obsolete
sathdr_level1cgeos.sql sathdr_screen_ssmi.sql.obsolete
sathdr_ssmitrmm.sql.obsolete satmlev_screen_ssmi.sql.obsolete
satmlev_ssmitrmm.sql.obsolete satpred_level1cgeos.sql
satslev_ssmitrmm.sql.obsolete smon_mwimg.sql ssmitrmm_robhdr_1.sql.obsolete
ssmitrmm_robody_1.sql.obsolete tcwv.sql update_ddrs.sql update_hdr_4.sql
lib/Iusrcl.F90.not_used Mpesim.F90.not_used
preodb/cmabufr2preodb.F90.obsolete
prescreen/bufr2prescreen bufr2prescreen.F90 duplchk_ps.F90 to_prescreen.F90
tools/b3.c.not_used
y2k.obsolete/datediff.c.not_used dateincr.c.notused eclib_c.c eclib_f.c error.c
julian.c.not_used julian_lib.c

Files deleted(SSA):

interface/scan_ddr.h scan_ddr_odb.h
sub/scan_ddr_odb.F90

SEASONAL FORECAST

Tim Stockdale - net_CY36R3_s4

New option for solar variation, and revisions to treatment of specified volcanic aerosol under LHVOLC switch

A new option for time-varying solar constant is added (NHINCSOL=3). This gives annual mean data taken from CMIP5 recommended values. As recommended by CMIP5, the data are adjusted to the ”TIM” scale, which is about 4.8W/m2 lower than the PMOD scale, ie the mean is about 1361.2 instead of 1366. Data are from 1851-2008, with a repeated solar cycle thereafter, as per CMIP5 specification.

The treatment of specified volcanic aerosol (data from GISS) is bug-fixed and then upgraded. The GISS-specified time varying optical depths are applied to the sulphate aerosol (not the ash). An option for controlling the vertical distribution of specified stratospheric aerosol is introduced (NVOLCVERT). Default is as before (mass-weighted distribution over the whole stratosphere as diagnosed by a temperature function), but there are options to cut off aerosol above 10hPa (NVOLCVERT=1), or to use ozone concentrations to diagnose the lower boundary of the stratosphere together with a 10hPa cutoff (NVOLCVERT=2). The GISS data has a clean stratosphere for years after 2005. It is possible to override the GISS data and specify an arbitrary optical depth for volcanic aerosol using LVOLCSPEC and RVOLCSPEC. Values can be specified for NH, tropics and SH

separately.

These changes do not interact with other treatments of aerosol in the code, and have no impact for default IFS settings (binary identical results).

Script changes are minor fixes for the seasonal forecasting system, and new default values for volcanic aerosol and non-orographic GWD for the seasonal system.

Files modified(IFS):
`climate/updrgas.F90`
`module/yoerad.F90`
`namelist/naerad.h`
`phys_dmn/apl_arome.F90`
`phys_ec/aer_clcld.F90 aer_climg.F90 aer_clist.F90 aer_stratcl.F90 radaca.F90 radact.F90 radint.F90 radintg.F90 suecaec.F90`
`phys_radi/suecrad.F90`

Files modified(SCRIPTS):
`def/an.def`
`gen/mkabs_fc`
`oce/model_nemoIFS storm`
`wav/wave_setup`

Frederic Vitart - ney_CY36R3_module_access_KPP

Enables ocean mixed-layer model

Files modified(IFS):
`dia/preset_grib_template.F90`
`module/control_vectors_comm_mod.F90 iostream_mix.F90`
`obs_preproc/mkglobstab.F90`
`setup/sugrib.F90 sugrido.F90`

Files modified(SURF):
`external/surf_inq.F90`
`interface/surf_inq.h`

ADM-Aeolus

David Tan, Blazej Krzeminski and Paul Burton - dat_CY36R3_for_CY36R4

Further technical development (no meteorological impact) for ADM-Aeolus processing tasks

- ODB: minor upgrades to bufr2odb_aeolus and aeolus_1b sql.
- SCRIPTS: upgrade generation/dissemination of Aeolus products as validated during Ground Segment Overall Validation Phase 1 (Interface Test 06, GSOV-1/IT-06). Prototype scripts (not yet activated) for

the new ESA Ground Track Tool (BK). New tasks to make some Python scripts available from the Aeolus project (PB).

- AEOLUS: upgrade to "pre-Release 1.50", which includes interfacing to the Version 5.05 Level-1B data format and enhanced hlos retrievals (use of internal reference and nonlinearity corrections).

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

Files created(SCRIPTS):
`gen/fetchorbpre gtt gtt2simulobs gtt2simulobs_preproc`
`sms/get_aeolus.sms libaeolus.sms`
`sms_an/fetchorbpre.sms orbpre2simulobs.sms`

Files modified(ODB):
`bufr2odb/bufr2odb_aeolus.F90`
`ddl/sathdr_screen_aeolus_1b.sql`

Files modified(SCRIPTS):
`build/Makefile.root.aeolus`
`def/an.def gen.def`
`gen/aeolus_auxmet aeolus_l2b aeolus_orbpre mkabs_aeolus mklinks varconsts`

MACC

Richard Engelen, Anna Augusti-Panareda, Angela Benedetti, Johannes Flemming, Antje Inness, Johannes Kaiser, Jean-Jacques Morcrette - stj_CY36R3_MACC

Improvements to MACC

Updates to MACC atmospheric constituent variables including new observation operators, improvements to the aerosol model, improvements to the coupling of the chemical model, general clean-up of the scripts related to MACC

Introduction of generalized varbc for reo3 data, to include MACC GRG and AER data. This required to change the varbc key for reo3 data by adding varno to the key. The new key allows us to distinguish the different variables, e.g. operational ozone and MACC ozone, and it ensures that the operational ozone bias correction is not applied to MACC data and vice versa.

The code works for operational ozone data, but if Varbc is initialized with information from an experiment that used the old key, a cold start will be performed for ozone data, as varbc sees them as 'new' data with a different key.

Files created(IFS):
`module/yoeaerlid.F90`
`op_obs/mopitt_ak_ad.F90 mopitt_ak_op.F90 mopitt_ak_tl.F90`
`phys_ec/su_clop550.F90`

Files created(ODB):
`bufr2odb/bufr2odb_gch5.F90`

Files created(SCRIPTS):

era/ContPlot_tz.py PlotUtil.py ainc_tz_calc.py ainc_tz_plot.py

gen/aod_pp ctm_files get_fire_emis get_gems_surface monthlyMean_macc

sms_an/ctm_files.sms monthlyMean_macc.sms monthlyMean_macc_pl.sms monthlyMean_macc_sfc.sms pytools.sms

sms_era/ainc_plots.sms ainc_plots_long.sms ainc_stats.sms

Files modified(IFS):

adiab/gpnox.F90 postphy.F90

dia/sucddh.F90 sunddh.F90

fullpos/specfitg.F90

module/couplo4_mix.F90 traj_physics_mod.F90 varbc_setup.F90 varbc_to3.F90 yoeaeratm.F90 yoeaermap.F90 yoeaerop.F90 yoeaersrc.F90 yom_ygfl.F90 yomcouplo4.F90 yomgems.F90 yomtvrad.F90 yomvnmb.F90

namelist/naeaer.h namcouplo4.h namgfl.h

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

op_obs/aod_ad.F90 aod_op.F90 aod_tl.F90 cod_op.F90 cod_opad.F90 cod_optl.F90 grg_ak_ad.F90 grg_ak_op.F90 grg_ak_tl.F90 grg_jno2_cloud.F90 grg_jno2_cloudad.F90 grg_jno2_cloudtl.F90 grg_jno2ad.F90 grg_jno2tl.F90 hdepart.F90 hop.F90 hopad.F90 hoptl.F90 hretr.F90 nox2no2.F90 nox2no2ad.F90 nox2no2tl.F90

phys_ec/aer_bdgtmss.F90 aer_drydep.F90 aer_negat.F90 aer_phy1.F90 aer_phy2.F90 aer_phy3.F90 aer_rad.F90 aer_scavbc.F90 aer_scavin.F90 aer_so2so4.F90 aer_src.F90 aer_ssalt.F90 aer_ssalt_ms.F90 callpar.F90 callparad.F90 callpartl.F90 gems_init.F90 grg_nox2no2.F90 radact.F90 radlswr.F90 su_aerop.F90 su_aerp.F90 su_aerw.F90

phys_radi/suecrad.F90 uvradi.F90

pp_obs/ppobsa.F90 ppobsaad.F90 ppobsatl.F90

prism/couplo4_definitions.F90 couplo4_endmpi.F90 couplo4_exchange.F90 couplo4_grg_input.F90 couplo4_inimpi.F90

setup/su0yomb.F90 su_surf_flds.F90 sudefo_gflattr.F90 sudim1.F90 sudyn_setgflattr.F90 sugfl.F90 sugridug.F90

var/sujb.F90 sujbwavelet.F90 surad.F90 sureo3.F90

Files modified(ODB):

bufr2odb/bufr2odb_205.F90 bufr2odb_gch1.F90 bufr2odb_gch2.F90 bufr2odb_gch3.F90 bufr2odb_gch4.F90

cma2odb/buf2cmat_new.F90 subuoctp.F90

ddl/get_soe_reo3.sql getsatid_reo3.sql varbc_to3_robody.sql

module/yomboctp.F90

tools/Bufr2odb.F90

Files modified(SCRIPTS):

build/Makefile.root.ifs arch/Makefile.in.ibm_power5 arch/Makefile.in.ibm_power6 arch/Makefile.in.p690

def/an.def

era/increments_vmr.pl

gen/anml anpl ansfc fast_sgint fetchobs gems_setup getghgsfc getgrb getini getinigems ifsmin ifstraj ifsverify inter_fp mkabs_an mkabs_fc mklinks mknam_fp model obstat obstat_init prep_couplo4 prereo3 run_parallel

sms/archivectm.sms getfcdata.sms libmozart.sms ml.sms pl.sms pt.sms pv.sms
sms_an/ifstsave.sms lowres.sms vardata.sms
sms_era/obtime.sms

Jean-Jacques Morcrette - pam_CY36R3_M7_basic

Initial introduction of the M7 modal aerosol model

Files created(IFS):
module/yo_aero_m7.F90 yo_aero_trac.F90
namelist/naeaem7.h
phys_ec/m7.F90 m7_aero_prop.F90 m7_averageproperties.F90 m7_coaset.F90
m7_coat.F90
m7_concoag.F90 m7_cumnor.F90 m7_dconc.F90 m7_delcoa.F90 m7_dgas.F90 m7_dnum.F90
m7_drydep.F90 m7_emi.F90 m7_emi_car.F90 m7_emi_dms.F90 m7_emi_du.F90
m7_emi_so2.F90
m7_emi_ss_lsce.F90 m7_emi_ss_mon.F90 m7_equil.F90 m7_equimix.F90 m7_equiz.F90
m7_interface.F90 m7_logtail.F90 m7_negat.F90 m7_nuck.F90 m7_nucl_ku.F90
m7_nucl_ve.F90
m7_sedimentation.F90 m7_wetdep.F90 su_aerm7.F90

SMOS

Joaquin Munoz Sabater - daq_CY36R3_SMOS_monitor_to_CY36R4

Introduction of the observation operator for passive microwaves in low frequencies and the interface with the IFS

Other changes complete the passive monitoring for SMOS observations started in CY36R3.

- Project ODB: New definition of columns in smos table, new SQLs and modifications of some routines.
- Project SATRAD: introduction of observation operator and interface with IFS,
- Project IFS: first-guess departures stored in ODB and modifications of the SMOS administration routines.
- Project SCRIPTS: few changes.

This is a passive contribution, then this should have no meteorological impact.

It is not intended to make SMOS data operational for this cycle as some operational issues have been detected. Then SMOS data shouldn't interfere with pre-processing or analysis tasks.

Files created(IFS):
module/yomcmempar.F90 yomcmemtypes.F90

Files created(ODB):
ddl.ECMA/sat_smos.sql

ddl/sat_smos.sql

Files created(SATRAD):

cmem/abor_cmem.F90 atm_sub.F90 cmem_alloc_types.F90 cmem_atm.F90
cmem_dealloc_types.F90 cmem_init.F90 cmem_main.F90 cmem_rtm.F90 cmem_setup.F90
cmem_snow.F90 cmem_soil.F90 cmem_veg.F90 dielice_sub.F90 dielsoil_sub.F90
dielwat_sub.F90 fresnel_sub.F90 rdcmemifs.F90 rghref_sub.F90 teff_sub.F90
veg_sub.F90 vegtable.F90 wilheit_sub.F90

interface/abor_cmem.h atm_sub.h cmem_alloc_types.h cmem_atm.h
cmem_dealloc_types.h cmem_init.h cmem_rtm.h cmem_setup.h cmem_snow.h cmem_soil.h
cmem_veg.h dielice_sub.h dielsoil_sub.h dielwat_sub.h fresnel_sub.h rdcmemifs.h
rghref_sub.h teff_sub.h

veg_sub.h vegtable.h wilheit_sub.h

Files modified(IFS):

common/yomdb_defs.h yomdb_vars.h

control/gp_model.F90

module/pardimo.F90 yomcosjo.F90 yomvnmb.F90

op_obs/hop.F90 hvnmtlt.F90

phys_ec/callpar.F90

smos/smos_nearest.F90 smos_obsop.F90 smos_screen.F90 smos_update.F90

Files modified(ODB):

cma2odb/ctxinitdb.F90 getdb.F90 initmdb.F90

ddl/cma.h robhdr_mwave_update_smos.sql robody_mwave_update_smos.sql

Files modified(SCRIPTS):

def/an.def

gen/fetchobs presmos

Patrica De Rosnay and Yuhei Takaya - dap_CY36R3_SSS_Yuhei

Sea Surface Salinity Fields for SMOS monitoring

Defines grib API SSS field to be passed to IFS for SMOS monitoring.

Files modified(IFS):

module/surface_fields_mix.F90 yoephy.F90 yom_grib_codes.F90 yomgrb.F90

namelist/naephy.h

setup/su0phy.F90 su_surf_flds.F90

Files modified(SCRIPTS):

gen/ssaana

ENKF

Mats Hamrud - nar_CY36R3_enkf_first

Introduction of ENKF

Files created(ODB):

```
ddl.CCMA/global_enkf_1.sql global_enkf_10.sql global_enkf_100.sql
global_enkf_15.sql global_enkf_2.sql global_enkf_20.sql global_enkf_25.sql
global_enkf_3.sql global_enkf_30.sql global_enkf_35.sql global_enkf_4.sql
global_enkf_40.sql global_enkf_45.sql global_enkf_5.sql global_enkf_50.sql
global_enkf_55.sql global_enkf_60.sql global_enkf_65.sql global_enkf_70.sql
global_enkf_75.sql global_enkf_80.sql global_enkf_85.sql global_enkf_90.sql
global_enkf_95.sql update_enkf_links.sql update_hprior_1.sql
update_hprior_10.sql update_hprior_100.sql update_hprior_11.sql
update_hprior_12.sql update_hprior_13.sql update_hprior_14.sql
update_hprior_15.sql update_hprior_16.sql update_hprior_17.sql
update_hprior_18.sql update_hprior_19.sql update_hprior_2.sql
update_hprior_20.sql update_hprior_21.sql update_hprior_22.sql
update_hprior_23.sql update_hprior_24.sql update_hprior_25.sql
update_hprior_26.sql update_hprior_27.sql update_hprior_28.sql
update_hprior_29.sql update_hprior_3.sql update_hprior_30.sql
update_hprior_31.sql update_hprior_32.sql update_hprior_33.sql
update_hprior_34.sql update_hprior_35.sql update_hprior_36.sql
update_hprior_37.sql update_hprior_38.sql update_hprior_39.sql
update_hprior_4.sql update_hprior_40.sql update_hprior_41.sql
update_hprior_42.sql update_hprior_43.sql update_hprior_44.sql
update_hprior_45.sql update_hprior_46.sql update_hprior_47.sql
update_hprior_48.sql update_hprior_49.sql update_hprior_5.sql
update_hprior_50.sql update_hprior_51.sql update_hprior_52.sql
update_hprior_53.sql update_hprior_54.sql update_hprior_55.sql
update_hprior_56.sql update_hprior_57.sql update_hprior_58.sql
update_hprior_59.sql update_hprior_6.sql update_hprior_60.sql
update_hprior_61.sql update_hprior_62.sql update_hprior_63.sql
update_hprior_64.sql update_hprior_65.sql update_hprior_66.sql
update_hprior_67.sql update_hprior_68.sql update_hprior_69.sql
update_hprior_7.sql update_hprior_70.sql update_hprior_71.sql
update_hprior_72.sql update_hprior_73.sql update_hprior_74.sql
update_hprior_75.sql update_hprior_76.sql update_hprior_77.sql
update_hprior_78.sql update_hprior_79.sql update_hprior_8.sql
update_hprior_80.sql update_hprior_81.sql update_hprior_82.sql
update_hprior_83.sql update_hprior_84.sql update_hprior_85.sql
update_hprior_86.sql update_hprior_87.sql update_hprior_88.sql
update_hprior_89.sql update_hprior_9.sql update_hprior_90.sql
update_hprior_91.sql update_hprior_92.sql update_hprior_93.sql
update_hprior_94.sql update_hprior_95.sql update_hprior_96.sql
update_hprior_97.sql update_hprior_98.sql update_hprior_99.sql
ddl/global_enkf_1.sql global_enkf_10.sql global_enkf_100.sql global_enkf_15.sql
global_enkf_2.sql global_enkf_20.sql global_enkf_25.sql global_enkf_3.sql
global_enkf_30.sql global_enkf_35.sql global_enkf_4.sql global_enkf_40.sql
global_enkf_45.sql global_enkf_5.sql global_enkf_50.sql global_enkf_55.sql
global_enkf_60.sql global_enkf_65.sql global_enkf_70.sql global_enkf_75.sql
global_enkf_80.sql global_enkf_85.sql global_enkf_90.sql global_enkf_95.sql
update_enkf_links.sql update_hprior_1.sql update_hprior_10.sql
update_hprior_100.sql update_hprior_11.sql update_hprior_12.sql
update_hprior_13.sql update_hprior_14.sql update_hprior_15.sql
update_hprior_16.sql update_hprior_17.sql update_hprior_18.sql
update_hprior_19.sql update_hprior_2.sql update_hprior_20.sql
update_hprior_21.sql update_hprior_22.sql update_hprior_23.sql
update_hprior_24.sql update_hprior_25.sql update_hprior_26.sql
```

update_hprior_27.sql update_hprior_28.sql update_hprior_29.sql
update_hprior_3.sql update_hprior_30.sql update_hprior_31.sql
update_hprior_32.sql update_hprior_33.sql update_hprior_34.sql
update_hprior_35.sql update_hprior_36.sql update_hprior_37.sql
update_hprior_38.sql update_hprior_39.sql update_hprior_4.sql
update_hprior_40.sql update_hprior_41.sql update_hprior_42.sql
update_hprior_43.sql update_hprior_44.sql update_hprior_45.sql
update_hprior_46.sql update_hprior_47.sql update_hprior_48.sql
update_hprior_49.sql update_hprior_5.sql update_hprior_50.sql
update_hprior_51.sql update_hprior_52.sql update_hprior_53.sql
update_hprior_54.sql update_hprior_55.sql update_hprior_56.sql
update_hprior_57.sql update_hprior_58.sql update_hprior_59.sql
update_hprior_6.sql update_hprior_60.sql update_hprior_61.sql
update_hprior_62.sql update_hprior_63.sql update_hprior_64.sql
update_hprior_65.sql update_hprior_66.sql update_hprior_67.sql
update_hprior_68.sql update_hprior_69.sql update_hprior_7.sql
update_hprior_70.sql update_hprior_71.sql update_hprior_72.sql
update_hprior_73.sql update_hprior_74.sql update_hprior_75.sql
update_hprior_76.sql update_hprior_77.sql update_hprior_78.sql
update_hprior_79.sql update_hprior_8.sql update_hprior_80.sql
update_hprior_81.sql update_hprior_82.sql update_hprior_83.sql
update_hprior_84.sql update_hprior_85.sql update_hprior_86.sql
update_hprior_87.sql update_hprior_88.sql update_hprior_89.sql
update_hprior_9.sql update_hprior_90.sql update_hprior_91.sql
update_hprior_92.sql update_hprior_93.sql update_hprior_94.sql
update_hprior_95.sql update_hprior_96.sql update_hprior_97.sql
update_hprior_98.sql update_hprior_99.sql

scripts/create_global_enkf_sql.ksh create_hprior_links.ksh create_hprior_sql.ksh
create_links.ksh

tools/Create_enkf.F90 Myprog.F90

Files modified(IFS):

common/yomdb_defs.h yomdb_vars.h

module/parcma.F90 yomdb.F90

op_obs/hop.F90

Files modified(ODB):

cma2odb/ctxinitdb.F90 distribute_odb.F90 getatdb.F90 getdb.F90 initmdb.F90
opendb.F90 putatdb.F90 shuffle_odb.F90 xchangedatadb.F90 xchangedatadistdb.F90

compiler/odb98.c

ddl/cma.h v_o3.sql

include/odb.h

interface/ctxinitdb.h initmdb.h

lib/codb.c msgpass_obsdata.F90

module/context.F90 odb.F90

scripts/create_ioassign

Files modified(TRANS):

external/trans_inq.F90

interface/trans_inq.h

SINGLE COLUMN MODEL

Martin Koehler - pao_CY36R1_scm

Upgrade of the ECMWF single column model (SCM) from cycle 31r1 to 36r1

Files created(SCMEC):

`dummy/disgrid.F90 disspec0.F90 dpotrf.F90 facies.F90 facile.F90 fadies.F90 fairme.F90 faitou.F90 falimu.F90 ircvgpf.F90 isndgpf.F90 mwave_obsop.F90 mwave_screen.F90 my_sync.F90 parrrtm.F90 parsrtm.F90 set2pe.F90 spectral_arp_mod.F90`

`spotrf.F90 trajectory_mod.F90 vpow.F90 yomlcz.F90 yomskf.F90`

Files created(SCRIPTS):

`build/Makefile.root.scmec`

Files modified(SCMEC):

`module/pardim1c.F90 yomgp1c0.F90 yomgp1c1.F90 yomgp1c9.F90 yomgpd1c.F90`

`scripts/build/Makefile.root.scmall compile.p gen/p4_mklib`

`source/cpg1c.F90 master1c.F90 su0yom1c.F90 su1c.F90 suallo1c.F90 sud1c_nc.F90 sudim1c.F90 sudyn1c.F90 suecrad1c.F90 sugfl1c.F90 suinif1c_nc.F90 sup1c_nc.F90 suphec1c.F90 suphyds1c.F90 surip1c.F90 suvert1c.F90 wrtd1c.F90 wrtd1c_nc.F90 wrtp1c.F90 wrtp1c_nc.F90`

Files modified(SCRIPTS):

`build/Makefile arch/Makefile.in.linux findbin_mk.ksh perl/depend.pl`

`gen/p4_mklib`

Files deleted(SCMEC):

`dummy/updclidm.F90 updnuddm.F90`

`module/pardim.F90 parrrtm.F90 parsrtm.F90`

OBSTAT

Mohamed Dahoui - mo3_CY36R3_OBSTAT_for36r4

Improvements to OBSTAT

This updated version of OBSTAT is intended to replace the current satellite data monitoring software SATMON without alterating the original OBSTAT functionalities.

The main introduced improvements are:

- Production of gridded statistics in GRIB2 format. For each data set OBSTAT produces optionally gridded statistics with two different and user defined resolutions (Low and high). By default monthly files are produced.
- Production of statistics for large and extendible number of data selection criteria
- Production of statistics for large and extendible number of diagnostics

- Production of statistics according to the land sea mask
- Production of statistics according to the Field of View, the satellite phase (ascending/descending) or the observation angle.
- Production of statistics according to UTC and solar time. The time binning is flexible (from 1 hour).
- Flexible pressure binning for data with the pressure as the vertical coordinate.
- Flexible production and plotting of scatter statistics
- Compact way of requesting statistics
- Possibility to produce statistics for all data present in the feedback file.
- Robustness of the code regarding the order and content of SQL queries
- Possibility to ingest feedback data from user defined ASCII/BINARY files
- Large possibilities for the plotting of statistics: large area time series, geographical maps of statistics, Hovmoeller diagrams, scatter plots, histograms and vertical profiles of statistics.

Files created(OBSTAT):

```
data/config.linux iasi_channels obstatgrib2 rtablel_2031 rtablel_2047
rtablel_2063 rtablel_2095 rtablel_21023 rtablel_21151 rtablel_2127 rtablel_21279
rtablel_2159 rtablel_22047 rtablel_2215 rtablel_2255 rtablel_2319 rtablel_2399
rtablel_2511 rtablel_2639 rtablel_2799
module/dataqc.F90 funcs.F90 mod_obstat_plot.F90
src/addstat.F90 bsslzr.F90 defsensor.F90 enlstatarray.F90 flags_check.F90 gauaw.F90
genopt.F90 gridpos.F90 iniscat.F90 inisoftflag.F90 inisoftinstr.F90 inisoftstream.F90
obstat_add_grib.F90 obstat_geo_plot.F90 obstat_grib_tools.F90 obstat_hist_plot.F90
obstat_hov_plot.F90 obstat_normalize_grib.F90 obstat_normalize_scat.F90 obstat_overview_-
hist_plot.F90 obstat_scat_plot.F90 outcoverage.F90 param_val.F90 sucalcgauw.F90 user_-
data_read.F90 writealarm.F90 writegribs.F90 writescat.F90
```

Files created(ODB):

```
ddl.ECMA/obstat_geos.sql obstat_mwimg.sql obstat_satob.sql
ddl/obstat_geos.sql obstat_mwimg.sql obstat_satob.sql
```

Files modified(OBSTAT):

```
data/airs_channels bufrodbcodes.cfg general.cfg
module/general.F90 globvar.F90 mod_sat_monitor.F90 obsdata.F90 statsoft.F90
satmon/sat_monitor.F90
src/allocsoft.F90 buxtract.F90 calcairspop.F90 inigene.F90 iniglob.F90 iniitemloc.F90
inisoft.F90 inisoftarea.F90 inisoftdef.F90 inisoftest.F90 inisoftstat.F90 mergesoft.F90
mpsoft.F90 obstat.F90 odbread.F90 odbscaling.F90 odbscatamb.F90 plotrms.F90 plotrmsbias.F90
plotsoft.F90 updhard.F90 updsoft.F90 winditem.F90 writesoft.F90 wrsoftdef.F90
```

Files modified(ODB):

```
ddl.CCMA/obstat.sql
ddl/obstat.sql obstat_gpsro.sql obstat_radwd.sql obstat_reo3.sql obstat_scatt.sql
obstat_tovs.sql smon_hsris.sql smon_hsris_flag.sql smon_mwimg.sql smon_mwimg_allsky.sql
smon_slmoist.sql
```

Files modified(SCRIPTS):
`build/Makefile.root.obstat`
`def/an.def`
`gen/mkabs_obstat obstat obstat_init`
`sms_an/pobstat.sms`

BUG FIXES

Philippe Lopez

Bugfix for TL Evolution test

Files modified(IFS):
`module/gfl_subs_mod.F90`

Adrian Tomkins - cpa_CY36R3_climplot

Bugfix for climplot

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

Deborah Salmond - das_CY36R3_NEW

Bugfix for CAPE

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

Deborah Salmond and Anne Fouilloux - das_CY36R3_NEW

Fix for potential failure in SUFGER

Files modified(ODB):
`cma2odb/ctxinitdb.F90 getdb.F90 ddl/sufger_allsky.sql sufger_robhdr_1.sql sufger_robody_1.sql sufget_sat.sql`

Files modified(IFS):
`obs_preproc/gefger.F90 sufger.F90`

Tomas Wilhelmsson - nat_CY36R3_test_of_adjoint

Bugfix for test of adjoint

Files modified(IFS):

setup/su_surf_flds.F90
var/suvar.F90

Saleh Abdalla - waa_CY36R1_pda

IPR changes

Files created(WAM):

gpl/dcfftf.F dcffti.F dcftf1.F dcfti1.F dnfftf.F dpssf.F dpssf2.F dpssf3.F dpssf4.F dpssf5.F

Files modified(WAM):

Alt/moment.F

Files deleted(WAM):

Sar/dcfftf.F dcffti.F dcftf1.F dcfti1.F dnfftf.F dpssf.F dpssf2.F dpssf3.F dpssf4.F dpssf5.F

Mike Fisher - dai_CY36R3_bugifx_NLEVBAL01

Bug-fix for SUJB

Corrects a bug in SUJB whereby NLEVBAL0 and NLEVBAL1 were reset to default values after NAMJG was read, resulting in the values set by the user in the namelist being ignored.

Effect: Bit identical in standard configurations.

Files modified(IFS):

var/sujb.F90

Drasko Vasiljevic - dad_CY36R3_AIREP_BIAS_05

AIREP temperature bias (VarBC) correction

Files created(IFS):

module/varbc_airep.F90

Files created(ODB):

ddl.ECMA/getairepid.sql varbc_airep_robhdr.sql varbc_airep_robody.sql
ddl/getairepid.sql varbc_airep_robhdr.sql varbc_airep_robody.sql

Files modified(IFS):

common/yomdb_defs.h yomdb_vars.h
module/varbc_eval.F90 varbc_pred.F90 varbc_setup.F90 varbc_table.F90
op_obs/hdepart.F90 hop.F90 hopad.F90 hoptl.F90 hretr.F90

Files modified(ODB):

bufr2odb/bufr2odb_aircraft.F90 get_varindex.F90
cma2odb/ctxinitdb.F90 initmdb.F90

ddl/cma.h

module/varindex_module.F90

Files modified(SCRIPTS):

gen/ifsmin ifstraj

SCRIPTS

Jan Haseler - dah_CY36R3_for36r4

Surface analysis - introduce prepIFS job parameters

Files modified(SCRIPTS):

def/an.def

Different number of updates to trajectory in early delivery and delayed cut-off

Files modified(SCRIPTS):

def/an.def gen/eda_err_save ens_cal ens_errors ens_stats sms_an/4dvar.sms create_ccma.sms feedback.sms ifstmerge.sms ifstsave.sms lowres.sms makecma.sms makeodb.sms matchup.sms mergeodb.sms odb2bufr.sms revmatchup.sms sekf.sms

Specify observation cut-off in hours and minutes

Files modified(SCRIPTS):

gen/fetchobs

Ensemble data assimilation errors - split between main and lag families,pass between experiments

Files modified(SCRIPTS):

def/an.def gen/eda_err_save ens_cal ens_errors ens_stats fetcherr sms_an/eda_err_save.sms

Ensemble data assimilation - archiving, start one EDA from another, etc

Files modified(SCRIPTS):

def/an.def gen/anil fdbksave getmars mkabs_b2otools mkidta rebuild_ifs restart_999 sekf_sm sstana vardata wav/archive_wave prep_wave wave_getrst

Always run task getpersSST before forecast (to reflect changed practice in operational delayed cut-off forecast)

Files modified(SCRIPTS):

def/an.def gen/model

Satellite image simulation - split into smaller tasks to mirror operational suite behaviour

Files modified(SCRIPTS):

def/an.def gen/satimsim sms_an/satimsim.sms

Forecast sensitivity to observations

Files modified(SCRIPTS):

def/fsobs.def gen/ifsmin ifstraj mergeodb mkabs_odbtools mkidta_sens sms/fc_sens_prepare.sms fc_sens_save.sms getini.sms

MACC - change LGEMS to LMACC

Files modified(SCRIPTS):

`def/an.def fsobs.def gen/anpl fast_sgint getmars mklinks model obstat obstat_init prereo3`

From MetApps

Files modified(SCRIPTS):

`gen/biassave get_exe ma_get_ana model modeleps pre1crad_screen preobs oce/reord_create_veps wm_create_veps_sfc wm_create_veps_ua sms/getiniLeg.sms getpersSST.sms getvarepsdata.sms svsave.sms targets.sms wavini.sms sms_oc/cleantc.sms wmanom.sms`

OPTIMISATION

John Hague - ibj_CY36R3_UPDTIM

Optimisation of UPDTIM

1. Routines su_*clim (except su_ghgclim) allocate and fill arrays (defined in yomclim_mod) instead of using automatic allocation. It should be possible to deallocate these arrays at some point, but I am not sure when, so have not done this.
2. Routine su_ghgclim accesses arrays directly via yomclim_mod so other su_*clim routines do not have to copy the data back to su_ghgclim.
3. Routine su_ghgclim sets LHOOK=.false. for calls to other su_* routines (which each call 24 part* routines)

Time spent in UPDTIM (which calls su_ghgclim) appears to be halved (e.g. 3 to 1.5 sec in each of the 4dvar jobs) - but there is a curious effect where time depends on the node - and each task on the same node takes the same time.

Files created(IFS):

`module/yomclim_mod.F90`

Files modified(IFS):

`phys_ec/su_ghgclim.F90`

`phys_radi/su_c11clim.F90 su_c12clim.F90 su_c22clim.F90 su_ccl4clim.F90 su_ch4clim.F90 su_co2clim.F90 su_gch4clim.F90 su_gco2clim.F90 su_gozoclim.F90 su_n2oclim.F90 su_-no2clim.F90 su_ozoclim.F90`

John Hague - ibj_CY36R3_script_perf

Improved the asynchronous scheduling of ”here docements”

Files modified(SCRIPTS):

`sms_an/4dvar.sms`

John Hague - ibj_CY36R3_sgemmx

Optimisation of SGEMMX

Re-instates and fix the RS6K version and bypasses copying where possible

Files modified(ALGOR):

`internal/linalg/sgemmx.F`

John Hague - ibj_CY36R3_heapcheck

Print out HEAP usage from Dr.Hook

An aid to monitoring memory usage:

If "export DR_HOOK_HEAPCHECK=yes" is set in the run script, one line is printed out in stderr every time the heap increases (at the beginning and end of each drhook enabled routine) in the master thread for myproc=1.

Increases can be found in IFS output with:

```
grep HEAPCHECK stderr.lst
```

If "export DR_HOOK_HEAPCHECK=trb" is used, then an xl traceback will be printed after each HEAPCHECK.

For checking stack (as before) use:

```
export DR_HOOK_STACKCHECK=yes
```

and then

```
grep STACKCHECK stderr.lst
```

A fragment of heapcheck output from experiment fbcx (t1279 4dvar traj0 on 48 nodes) is:

```
0: HEAPCHECK Max heap at end of routine = 2454601504 IOSTREAM_MIX:ALLO_IGRIB
0: HEAPCHECK Max heap at beg of routine = 9869958384 IOSTREAM_MIX:INQUIRE_GRIB
0: HEAPCHECK Max heap at beg of routine = 9922746224 ECSORT_MIX:INT4_KEYSORT_1D
0: HEAPCHECK Max heap at end of routine = 10008534240  GRID_BICONSERV
```

Files created(IFSAUX):

`utilities/get_proc_id.F90`

Files modified(IFSAUX):

`support/dr_hook_util.F90`

`utilities/getcurheap.c`

John Hague - ibj_CY36R3_JIO

Profiler for I/O in IFS

A technique for profiling I/O in IFS has been developed.

jio.c intercepts calls to fopen, fread, fwrite, fclose, open, close, read, write, and fgets

master.F90 contains a call to jio_final to print out statistics

To profile the I/O, it is necessary to export the environment variable JIO_ENV at run time.

- JIO_ENV=JIO_SUMMARY produces a summary table (one line for each of the above calls).
- JIO_ENV=JIO_DETAIL produces a detailed table as well as a summary table (one or more lines for each file)
- JIO_ENV=JIO_TRACE produces one line for each I/O request as well as the summary tables.

Summary Tables from a T1279 4D-Var experiment (192 tasks, 16 threads, 48nodes)for traj0 and min 0 are included below. Summarising from the Summary tables:

```
          WALL    I/O
traj0     250s    12s
min0      125s    12s
traj1     166s    12s
min1      309s    22s
traj2     174s    19s
min2      302s    21s
traj3     257s    31s
-----     ----   ----
TOTAL    1583s   129s
```

Typically, task0 reads and/or writes a few hundred thousand records (many of them very short) and accesses a few hundred files.

The Summary Table for traj0 is:

```
 0:JIO Summary Routine   Calls          MB        MSEC       MB/s
 0:JIO Summary fopen:      228       0.000     918.609      0.000
 0:JIO Summary fclose:     232       0.000     562.509      0.000
 0:JIO Summary fread:    94194    3769.846    9621.006    391.835
 0:JIO Summary fwrite:   54068      13.581     136.970     99.154
 0:JIO Summary open:         2       0.000       0.210      0.000
 0:JIO Summary close:        4       0.000      25.238      0.000
 0:JIO Summary read:         2       0.003       0.032     90.667
 0:JIO Summary write:       18      93.298     465.516    200.419
 0:JIO Summary fgets:   123601     480.940     185.613   2591.096
```

The Summary Table for min0 is:

```
 0:JIO Summary Routine   Calls          MB        MSEC       MB/s
 0:JIO Summary fopen:      116       0.000    1311.177      0.000
 0:JIO Summary fclose:     128       0.000     109.723      0.000
 0:JIO Summary fread:   358797    2228.607    6760.183    329.667
 0:JIO Summary fwrite:   12316    1407.881    4036.034    348.828
 0:JIO Summary open:         2       0.000       0.165      0.000
 0:JIO Summary close:        6       0.000       0.184      0.000
 0:JIO Summary read:         2       0.003       0.042     68.722
 0:JIO Summary write:        6       3.760     109.824     34.233
 0:JIO Summary fgets:     9556      35.229     171.187    205.790
```

Files created(IFSAUX):

`support/jio.c`

Files modified(IFS):

`programs/master.F90`

Files modified(SCRIPTS):

`gen/run_parallel`

John Hague - ibj_CY36R3_CLOUDSC_36r4

Optimisation of CLOUDSC

Files modified(IFS):

`phys_ec/cloudsc.F90`

Marta Janiskova - pan_CY36R3_letrajpt_T

Optimisaion of TL/AD by storing trajectory

Files modified(IFS):

`dia/wrphtrajt.F90`
`phys_ec/callparad.F90 callpartl.F90`
`setup/sutrajp.F90`
`utility/rdphtrajt.F90`

George Mozdzynski - mpm_CY36R3_memoryscape

Support for TOTALVIEW memoryscape

This branch adds support for totalview's memoryscape which can be used to find memory leaks. As an example Enrico used it successfully for grib_api.

Also prepIFS (for 36r3 and 36r4) has already been updated by Joerg to provide two new options in the 'Compiler options, debugging' section, namely,

```
TOTALVIEW_VERSION (default=8.8.0-1) and
```

```
  MEMORY_DEBUGGING (default=off)
```

Files modified(SCRIPTS):

```
gen/mkabs_an mkabs_fc
```

George Mozdzynski - mpm_CY36R3_gstats

Improvements to GSTATS

For a T1279 model (task 1), a 36r2 control expt (task 1) reported,

```
  FRACTION OF TOTAL TIME ACCOUNTED FOR    96.52
  FRACTION OF TOTAL TIME ACCOUNTED FOR INCLUDING SUMB    97.53
```

with mpm_CY36R2_gstats this is now,

```
  FRACTION OF TOTAL TIME ACCOUNTED FOR    99.03
  FRACTION OF TOTAL TIME ACCOUNTED FOR INCLUDING SUMB   100.00
```

For a T799 4D-Var, traj0, a 36r2 control expt (task 1) reported,

```
  FRACTION OF TOTAL TIME ACCOUNTED FOR    88.63
  FRACTION OF TOTAL TIME ACCOUNTED FOR INCLUDING SUMB    99.56
```

with mpm_CY36R2_gstats this is now,

```
  FRACTION OF TOTAL TIME ACCOUNTED FOR    96.76
  FRACTION OF TOTAL TIME ACCOUNTED FOR INCLUDING SUMB   100.00
```

and for T799 4D-Var min2, mpm_CY36R2_gstats shows

```
  FRACTION OF TOTAL TIME ACCOUNTED FOR    98.05
  FRACTION OF TOTAL TIME ACCOUNTED FOR INCLUDING SUMB   100.00
```

This branch produces identical results to a 36R2 control. Cases tested: T159 model, T1279 model, T799 4D-Var.

New with this branch is a further mechanism to help find unaccounted SUMB times, which is located in dr_hook_util, and can be enabled with a local logical LLFINDSUMB in that routine, currently set to FALSE.

Also new with this branch are two internal counters for gstats, i.e.

```
NUM ROUTINE      CALLS  MEAN(ms)   MAX(ms)   FRAC(%)  UNBAL(%)
400 GSTATS       55773       0.0       0.0      0.01      0.00
401 GSTATS HOOK  51253       0.0       0.0      0.18      0.02
```

which show that the dr_hook calls in gstats.F90 account for the majority of the gstats overhead.

Files modified(IFS):

```
adiab/spcsi.F90 spcsiad.F90
dia/ppeddhec.F90 ppsydh.F90
fullpos/subfpos.F90 wrmlfp.F90
module/iostream_mix.F90 varbc_pred.F90 varbc_setup.F90
obs_preproc/interp_obs.F90 interp_obsad.F90 opk_obscor.F90 rd_obs_boxes.F90
readoba.F90 screen.F90 suobarea.F90 suobs.F90 suobscor.F90
op_obs/obscor_sumup_scalp.F90
parallel/dresddh.F90
setup/su0yomb.F90 su_grib_api.F90 sumpini.F90
utility/gstats_label_ifs.F90 updtim.F90
var/suamv.F90 suhifce.F90 suhifcead.F90 sujbwavallo.F90 sujqcor.F90 sulimb.F90 sureo3.F90
wavxform.F90 writeoba.F90
```

Files modified(IFSAUX):

```
module/yomgstats.F90
support/dr_hook_util.F90 gstats.F90 gstats_print.F90
```

Files modified(TRANS):

```
module/suleg_mod.F90 sutrle_mod.F90 trgtol_mod.F90 trltog_mod.F90
```

Files modified(WAM):

```
Wam_oper/closend.F current2wam.F getstress.F newwind.F notim.F prewind.F readwind.F
timin.F wvwaminit.F
```

George Mozdzynski - mpm_CY36R3_NPES_AN

Fix to NPES_AN

Fixes a problem in 4D-Var when we attempt to change NPES_AN (in family an) to a value different from that set at job submission (i.e. prepIFS setting for NPES_AN).

We need this capability when preparing a 4D-Var benchmark, where a 4D-Var benchmark job can be run for different values of NPES_AN (typically NPOOLS set to the same value).

Without this fix, changing NPES_AN to a value greater than that at job submission resulted in a hang in traj0 (msgpass_obsdata). If changed to a value less than that at job submission then this resulted in a SEGV in min0.

The change is simply adding NPES_AN=%NPES_AN% in script ifsvar.

This fix produces identical results to 36R3 controls.

Files modified(SCRIPTS):

```
def/an.def eps_varfc.def
gen/getini getmars grib_def.h ifsvar mkabs_b2otools mkidta preobs restart_999
ssaana
oce/wm_create_veps_sfc wm_create_veps_ua
sms/svsave.sms
sms_an/odb_mondb.sms
```

```
wav/prep_wave wave_getrst
```

George Mozdzynski - mpm_CY36R3_radint

Remove old RADINT interface

This branch removes the old radint interface and has been tested here on 36R2 (36R3) and also by Antoinette Alias at Meteo France.

This branch produces bit identical results to CY36R3 controls.

Files modified(IFS):

```
module/yoerad.F90 yomprad.F90 yomrad15.F90 yomtag.F90
namelist/naerad.h namrad15.h
parallel/sutag.F90
phys_dmn/acradin.F90 suecrad15.F90
phys_ec/raddrv.F90
phys_radi/suecrad.F90
utility/deallo.F90 gstats_label_ifs.F90
```

Files modified(SCRIPTS):

```
def/an.def
eps/ifsnam.eps_fc.h ifsnam.eps_sv.h
gen/modelsv
```

Files deleted(IFS):

```
phys_dmn/suecradi15.F90
phys_ec/lcubint.F90 radcbdy.F90 radclb.F90 radint.F90
phys_radi/suecradi.F90 suecradl.F90
```

George Mozdzynski - mpm_CY36R3_weighted_dist

New option for Weighted Distribution

New optional argument 'PWEIGHT' to SETUP_TRANS for Ensemble Kalman Filter development.

PWEIGHT is a real array which is NGPTOTG long and contains the weights per grid point which are used in the subsequent grid partitioning to produce partitions of equal weight. PWEIGHT is only supported for LEQ_REGIONS=T and LSPLIT=T grids.

This branch further removes the NAPSETS option which became obsolete with the development of EQ_REGIONS partitioning (this removal accounts for the rather large list of modified routines).

Finally, this branch produces bit identical results to 36R3 controls.

Files modified(IFS):

```
module/yommp.F90
namelist/nampar1.h
obs_preproc/suobscor_resol.F90
parallel/phcset.F90 rdcset.F90
```

phys_radi/suecrad.F90
setup/suecphypo.F90 sump0.F90 sutrans.F90
var/sujbwavtrans.F90

Files modified(PREPDATA):
mc_tools/svgp2sp.F90 svsp2gp.F90
module/svgg.F90
programs/gptosp.F90 orfit.F90 restbl.F90 sptogp.F90 uvtovod.F90

Files modified(TRANS):
external/setup_trans.F90 trans_end.F90
interface/setup_trans.h
module/sump_trans_mod.F90 sumplat_mod.F90 sumplatbeq_mod.F90 sustaonl_mod.F90 tpm_distr.F90
programs/aatestprog.F90 test_adjoint.F90

George Mozdzynski - mpm_CY36R3_savemem_all

Reduce 'Max heapsize' memory

This branch reduces 'Max heapsize' memory use per task by up to 270 Mbytes for IFS experiments. Using totalview's MemoryScape we can see that the data segment was reduced from 471 MB to 208 MB. Note however, as the IBM Power6 (and earlier Power systems) have a demand paged virtual memory architecture there is no reduction in resident (or real) memory use with this branch.

```
                Max heapsize reduction
FC model,           274 MB
4D-Var traj jobs    107 MB
4D-Var min  jobs    186 MB
```

These reductions do not depend on the model resolution.

The 'Max heapsize' reduction comes from some large statically (size known at compile time) dimensioned arrays, which have in this branch been changed to be allocatable arrays.

This branch produces bit identical results to controls.

Files modified(IFS):
module/varbc_rad.F90 yomemis.F90
obs_preproc/biascor_era40.F90 defrun.F90
phys_radi/su_c11clim.F90 su_c12clim.F90 su_c22clim.F90 su_ccl4clim.F90 su_ch4clim.F90 su_co2clim.F90 su_gch4clim.F90 su_gco2clim.F90 su_gozoclim.F90 su_n2oclim.F90 su_ozoclim.F90 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 suecozc.F90
utility/deallo.F90

George Mozdzynski - mpm_CY36R3_trmtos

Cleaning of OpenMP directive

Files modified(IFS):

`parallel/trmtos.F90 trstom.F90`

Deborah Salmond - das_CY36R3_NANQ

Fixes to work with -qfltrap=EN:NANQ

Files modified(IFS):

`op_obs/amv_get_preds.F90 hop.F90 hoptl.F90`

Deborah Salmond - das_CY36R3_IPR

IPR related cleaning

Files modified(BL):

`compiler/compile.c`

Files modified(ODB):

`tools/pcma_main.c`

Files deleted(ODB):

`scripts/mpif.h.mpich-1.2.5.2 mpif.h.necsx.BoM mpif.h.necsx5.CSCS`

Deborah Salmond - das_CY36R3_OPT

Optimisation of TL/AD Physics

Files modified(IFS):

`parallel/slcset.F90`
`phys_ec/cloudst.F90 cloudstad.F90 cloudsttl.F90`
`phys_radi/lwvdrad.F90`

Deborah Salmond - das_CY36R3_V13

Work-around for xlf-V13

Files modified(ODB):

`module/bufr_module.F90`

Deborah Salmond - das_CY36R3_NEW

Remove unnecessary layer - BROADCREAL/INT/CHAR

Files modified(SATRAD):

`rttov/rttov_distrib_coef_scatt_ir.F90 rttov/rttov_readscattcoeffs.F90 rttov/rttov_distrib_coeffs.F90`

Files deleted(IFSAUX):

`parallel/broadcchar.F90 broadcint.F90 broadcreal.F90`

Deborah Salmond - das_CY36R3_NEW

Remove unnecessary READ

Files modified(IFS):

`phys_radi/sulwneur.F90`

Tomas Wilhelmsson - nat_CY36R3_derived_params

Extra derived parameters for OD

Files modified(IFS):

`adiab/cpedia.F90 postphy.F90`

`dia/grib_code_message.F90 pregrbenc.F90`

`fullpos/hpos.F90`

`module/parfpos.F90 surface_fields_mix.F90 yom_grib_codes.F90 yomafn.F90 yomct0.F90`

`phys_ec/ec_phys.F90`

`setup/su_surf_flds.F90 suafn1.F90 suafn2.F90 suafn3.F90 suct0.F90 supp.F90`

Files modified(SCRIPTS):

`def/an.def eps_varfc.def`

`gen/getini getmars grib_def.h mkabs_b2otools mkidta model preobs restart_999 ssaana`

`oce/wm_create_veps_sfc wm_create_veps_ua`

`sms/svsave.sms`

`sms_an/odb_mondb.sms`

`wav/prep_wave wave_getrst`

Tomas Wilhelmsson - nat_CY36R3_move_signi

Move building of mofctools to prepdata

Files created(PREPDATA):

`programs/ensms_veps.F90 invlap.F90 prob_perc.F90 prob_thr.F90 reord_veps.F90 signi.F90 wm.F90 wmem.F90`

Files modified(SCRIPTS):

```
def/an.def eps_varfc.def
gen/getini getmars grib_def.h mkabs_b2otools mkabs_prepdata mkidta preobs
restart_999 ssaana
oce/wm_create_veps_sfc wm_create_veps_ua
sms/svsave.sms
sms_an/odb_mondb.sms
wav/prep_wave wave_getrst
```

Files deleted(SCRIPTS):

```
sms_oc/mofc_tools.sms
```

Tomas Wilhelmsson - nat_CY36R3_reprod_optim

VarBC order independent sums in core

Files modified(IFS):

```
module/varbc_eval.F90 varbc_pred.F90 varbc_setup.F90 yomlun.F90
setup/sulun.F90
var/cvarbcad.F90 cvarbcinad.F90 taskob.F90 taskobad.F90
```

Files modified(IFSAUX):

```
module/order_independent_summation_mod.F90
```

Tomas Wilhelmsson - nat_CY36R3_reprod_scripts

Corrections to LREPRO4DVAR option

Files modified(SCRIPTS):

```
gen/get_exe ifsgmon mkabs_an
sms_an/b2o_meris.sms b2o_reo3ak.sms
```

Tomas Wilhelmsson - nat_CY36R3_rttov_readscattcoeffs

Add binary option to mietable_* files

Files created(SATRAD):

```
programs/rttov_ascii2bin_scattcoef.F90
```

Files modified(SATRAD):

```
rttov/rttov_readscattcoeffs.F90
```

Tomas Wilhelmsson - nat_CY36R3_suinfce

Fix GRIB_API buffer size problem

Files modified(IFS):

module/iostream_mix.F90

var/suinfce.F90

Tomas Wilhelmsson - nat_CY36R3_surf_depend

Correct use of surf model from ifs

Files modified(IFS):

phys_ec/aer_phy3.F90 aer_src.F90

setup/sugrido.F90

Files modified(SURF):

external/surf_inq.F90

interface/surf_inq.h

Files deleted(IFS):

phys_radi/susrtalb.F90

Tomas Wilhelmsson - nat_CY36R3_lascaw

Cleaning and optimisation of LASCAWTL/AD

Files modified(IFS):

adiab/lascaw.F90 lascaw_cla.F90 lascaw_cla_ad.F90 lascaw_cla_tl.F90 lascaw_clo.F90 lascaw_clo_ad.F90 lascaw_clo_tl.F90 lascaw_vintw_ad.F90 lascaw_vintw_tl.F90 lascawad.F90 lascawtl.F90

Tomas Wilhelmsson and Karim Yessad - nat_CY36R3_clean_yoe

Cleaning of ECMWF Physics

Files modified(IFS):

adiab/call_sl.F90 call_sl_ad.F90 call_sl_tl.F90 cpedia.F90 cpg.F90 cpg2.F90 cpg25.F90 cpg2tl.F90 cpg5_gp.F90 cpg_dia.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_gpb_nhgeogw.F90 cpgad.F90 cpglag.F90 cpgtl.F90 estrcpl.F90 gnh_conv_nhvar.F90 gnh_conv_nhvar_geogw.F90 gnhdlra.F90 gnhgw2svd.F90 gnhsvd2gw.F90 gnhx.F90 gppre.F90 gppread.F90 gppref.F90 gpprefad.F90 gppreftl.F90 gpprehad.F90 gpprehtl.F90 gppretl.F90 lapineb.F90 postphy.F90 pre_sladrep.F90

canari/caclsi.F90

control/ini1scan2m.F90 reresf.F90 restart_cnt3.F90 scan2m.F90 scan2mtl.F90 testli.F90 testlievol.F90

dfi/dfi2.F90 dfi2mod.F90 dfi3.F90

dia/aro_surf_diagh.F90 cpcfu.F90 cpxfu.F90 spnorm.F90 wrfu.F90 wrmlppa.F90 wrphtrajt.F90 wrradcoef.F90 wrsltraj2.F90 wrxfu.F90

fullpos/endpos.F90 fpachmt.F90 fpmodprec.F90 hpos.F90 phymfpos.F90 pregpfpos.F90 specfita.F90 vpos.F90 wrmlfpl.F90

module/trajectory_mod.F90 yoe_uvrad.F90 yoeaeratm.F90 yoeaerc.F90 yoeaermap.F90 yoeaersnk.F90 yoeaersrc.F90 yoecld.F90 yoecldp.F90 yoeclop.F90 yoecnd.F90 yoecumf.F90 yoecumf2.F90 yoegwd.F90 yoelw.F90 yoephy.F90 yoerad.F90 yoerdi.F90 yoerip.F90 yoerrtwn.F90 yoesrtcop.F90 yoesrtop.F90 yoesw.F90 yoevdf.F90 yoevdfs.F90 yoewcou.F90 yom_oas.F90 yomcst.F90 yomrip15.F90 yomtraj.F90 yomvar.F90 yophlc.F90

namelist/naeaer.h naephy.h naerad.h namvar.h naphlc.h

nmi/moprj.F90 moprjm.F90 vmodeenergy.F90

obs_error/fixerr.F90 obserr.F90 obsperr.F90 pererev.F90

obs_preproc/airepbe.F90 airepin.F90 ascatin.F90 awprfin.F90 biascor_era40.F90 dribube.F90 dribuin.F90 dwlin.F90 errstat.F90 ersin.F90 ewprfin.F90 filfbde.F90 flgdco.F90 flgdse.F90 flgtst.F90 geosrin.F90 hatbiasc.F90 iscatin.F90 level1cgeos_ob.F90 lndsyin.F90 mertsin.F90 metarin.F90 new_thinn.F90 nflgdse.F90 nscatin.F90 obatabs.F90 obinssp.F90 obinstp.F90 ozone_ob.F90 paobbe.F90 paobin.F90 pgpsin.F90 pilotbe.F90 pilotin.F90 qscatin.F90 rad1cbe.F90 rad1cin.F90 redun.F90 reo3be.F90 reo3sin.F90 satamin.F90 satemis.F90 satob_ob.F90 satobbe.F90 satobin.F90 scatbe.F90 shipin.F90 sufger.F90 suobarea.F90 synopbe.F90 tempbe.F90 tempin.F90 thin_red_presort.F90 tosabe.F90 tovshris.F90 tovslris.F90

op_obs/aer_opt_prop.F90 aer_opt_prop_ad.F90 aer_opt_prop_tl.F90 amv_get_preds.F90 amv_reassign.F90 aod_ad.F90 aod_op.F90 aod_tl.F90 bgobs.F90 cobslag.F90 cobslagad.F90 emis_mw.F90 emis_mw_n.F90 exchco.F90 exchcoad.F90 exchcotl.F90 ghg_ak_ad.F90 ghg_ak_op.F90 ghg_ak_tl.F90 grg_ak_ad.F90 grg_ak_op.F90 grg_ak_tl.F90 hop.F90 hopad.F90 hoptl.F90 hradp_ml_ad.F90 hradpad.F90 hradptl.F90 hretr.F90 hsatang.F90 laiddiobs.F90 meanuv_average.F90 meanuv_averagead.F90 meanuv_averagetl.F90 meanuv_weights.F90 meanuv_weightsad.F90 meanuv_weightstl.F90 mpobseq_pack.F90 nox2no2.F90 nox2no2ad.F90 nox2no2tl.F90 obshor.F90 obshorad.F90 preint.F90 preint2d.F90 preint2dad.F90 preint2dtl.F90 preintad.F90 preintr.F90 preintrad.F90 preintrtl.F90 preints.F90 preintsad.F90 preintstl.F90 preinttl.F90 qneg.F90 qnegad.F90 qnegtl.F90 rad1cemis.F90 rad1cnnead.F90 rad1cnnetl.F90 rad1cobe.F90 radtrk.F90 rousea.F90 rouseaad.F90 rouseatl.F90 rtl_hop_1d_ad.F90 rtl_hop_1d_tl.F90 rtl_hop_2d_ad.F90 rtl_hop_2d_tl.F90 slint.F90 slintad.F90 surbound.F90 surboundad.F90 surboundtl.F90

parallel/arowrgp_surf.F90 brptob.F90 casnd1.F90 casndr1.F90 commspnorm.F90 disfou.F90 diwrgrid.F90 diwrgrid_surf_ext.F90 dladdh.F90 dmaddh.F90 slcomm2.F90 slcomm2a.F90 trmtov.F90 trvtoh.F90 wrgp_surf.F90

phys_dmn/apl_arome.F90 aplpar.F90 aplparstl.F90 mf_phys.F90 mf_physad.F90 mf_phystl.F90 suphmse.F90 updtier15.F90 writephysio.F90

phys_ec/aer_clcld.F90 aer_src.F90 callpar.F90 callparad.F90 callpartl.F90 cldpp.F90 cldppad.F90 cldpptl.F90 cond.F90 condad.F90 condtl.F90 cover.F90 cpspe.F90 cuascntl.F90 cucalln2.F90 cucalln2ad.F90 cucalln2tl.F90 cuentrtl.F90 cuinin.F90 cumastrn2.F90 cumastrn2ad.F90 cumastrn2tl.F90 ec_phys.F90 ec_phys_ad.F90 ec_phys_tl.F90 ec_physg.F90 gwdrag.F90 gwdragad.F90 gwdrags.F90 gwdragtl.F90 gwprofil.F90 gwprofilad.F90 gwprofiltl.F90 heldsuarez.F90 phys_ad.F90 phys_nl.F90 phys_tl.F90 radaca.F90 radact.F90 radcfg.F90 raddiag.F90 raddrv.F90 radina.F90 radinaad.F90 radinatl.F90 radint.F90 radintg.F90 radlsw.F90 radlswad.F90 radlswr.F90 radlswtl.F90 radpar.F90 sppten.F90 su_aerop.F90 su_aerp.F90 su_aerw.F90 sucld.F90 sucldp.F90 suclop.F90 suclopn.F90 sucond.F90 sucumf.F90 sucumf2.F90 suecaec.F90 sugwd.F90 suphec.F90 suvdf.F90 suvdfs.F90 suwcou.F90 updtier.F90 vdfmain.F90 wvcouple.F90

phys_radi/lwinterf.F90 lwneur.F90 lwpad.F90 lwptl.F90 radghg.F90
rrtm_ecrt_140gp.F90 rrtm_gasabs1a_140gp.F90 rrtm_rrtm_140gp.F90
rrtm_rrtm_140gp_mcica.F90 rrtm_rtrn1a_140gp.F90 rrtm_rtrn1a_140gp_mcica.F90
rrtm_setcoef_140gp.F90 rrtm_taumol4.F90 rrtm_taumol5.F90 srtm_cldprop.F90
srtm_setcoef.F90 srtm_spcvrt.F90 srtm_spcvrt_mcica.F90 srtm_srtm_224gp.F90
srtm_srtm_224gp_mcica.F90 srtm_taumol20.F90 srtm_taumol23.F90 srtm_taumol25.F90
srtm_taumol26.F90 srtm_taumol27.F90 srtm_taumol29.F90 su_uvradi.F90 suecrad.F90
suecso4.F90 sulw.F90 sulwn.F90 surrtpk.F90 susrtalb.F90 susrtcop.F90 sw.F90
swad.F90 swniad.F90 swnitl.F90 swtl.F90 uvradi.F90

pp_obs/apache.F90 aval.F90 ctstarad.F90 ctstartl.F90 expbesuad.F90 poaero.F90
pos.F90 ppcc.F90 ppccad.F90 ppcctl.F90 ppclw.F90 ppclwad.F90 ppclwtl.F90
ppgeop.F90 ppgeop_old.F90 ppgeopad.F90 ppgeopad_old.F90 ppgeoptl.F90
ppgeoptl_old.F90 ppinitza.F90 ppinitztl.F90 ppleta.F90 ppobsa.F90 ppobsaad.F90
ppobsac.F90 ppobsacad.F90 ppobsactl.F90 ppobsap.F90 ppobsas.F90 ppobsasad.F90
ppobsastl.F90 ppobsatl.F90 ppobsaz.F90 ppobsaza.F90 ppobsaztl.F90 ppobsn.F90
pppsad.F90 pprh2m.F90 pprh2mad.F90 pprh2mtl.F90 ppsta.F90 ppstaad.F90
ppstatl.F90 ppt2m.F90 ppt2mad.F90 ppt2mtl.F90 pptad.F90 pptcc.F90 pptccad.F90
pptcctl.F90 ppttl.F90 ppuv10m.F90 ppuv10mad.F90 ppuv10mtl.F90 ppzhlev.F90

setup/su0phy.F90 su0yomb.F90 su1yom.F90 suallo.F90 sucma.F90 sucmaf.F90
sucst.F90 sudyna.F90 sugrcfu.F90 sugridf.F90 sugrxfu.F90 suinif.F90 sulfi.F90
sunhsi.F90 suoaf.F90 supong.F90 susi.F90 suspecg2.F90 suspgpg.F90 suspqlim.F90

sinvect/chsymeig.F90 jacdav.F90 nalan1.F90 nalan2.F90 opk.F90 sptrlcz.F90
vdiflczad.F90 vdiflcztl.F90

utility/deallo.F90 extgpf.F90 incgpf.F90 iopack.F90 matrixin.F90 pkgrida.F90
rdphtrajt.F90 rdradcoef.F90 rdsltraj2.F90 sc2rdg.F90 sc2wrg.F90 updtim.F90
wrgp2fa.F90 wrresf.F90

var/bgevecs.F90 bgvecs.F90 estsig.F90 estsiga.F90 fltbgerr.F90 jbvcoord_interpolate.F90
jbvcoord_interpolate_ad.F90 jgnr.F90 jgnrad.F90 jgnri.F90 jgnriad.F90 rdittrajm.F90
rdnhtrajm.F90 rdphtrajm.F90 rdphtrajtm.F90 rdphtrsf.F90 scaleae.F90 scalefe.F90 setqccma.F90
sqrtfe.F90 suecges.F90 suinfce.F90 sujbbal.F90 sujbcov.F90 sujbstd.F90 sujbvcoord.F90
sujbwavgen.F90 sumdfce.F90 suprffce.F90 susepfce.F90 sushfce.F90 suvar.F90 vec2gp.F90
vec2gpfe.F90 writesd.F90 writtrajm.F90 wrnhtrajm.F90 wrphtrajm.F90 wrphtrajtm.F90
wrphtrsf.F90 xformev.F90

Files modified(ODB):

cma2odb/init_common.F90 obsproc_init.F90 shuffle.F90

Files modified(SCMEC):

source/cpg1c.F90

Files modified(SSA):

util/setcomssa.F90

Files modified(SURF):

offline/setup/su0phy.F90

Files deleted(IFS):

module/yoeaersu.F90

obs_error/pwcoerr.F90 pwcperr.F90 thioerr.F90 thiperr.F90

obs_preproc/craibode.F90 crdrbode.F90 crpabode.F90 crpibode.F90 crsbbode.F90
crscbode.F90 crssbode.F90 crsybode.F90 crtebode.F90 crtsbode.F90 ssmibe.F90

phys_radi/susrtop.F90 sw2s.F90 swsurfs.F90 swsurfsad.F90 swsurfstl.F90

```
var/cuancape.F90 spa2cv.F90
```