CHGRES Program

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Introduction

- Provides a “cold start” capability for forecast model.
- Interpolates GFS atmospheric, surface and Near-Surface Sea Temperature (NSST) data to the FV3 cubed-sphere grid and any nests.
- Ingests files from current OPS or from the previous version of GFS (prior to July 19, 2017).
  - Current OPS: NEMSIO format. Atmospheric, surface and NSST data in separate files.
  - Previous OPS: Atmospheric fields (spectral coeffs) in ‘sigio’ format. Surface fields in ‘sfcio’ format. No NSST.
- Outputs fields in NetCDF (each tile in its own file).

Building

- Code is available here: https://github.com/NOAA-EMC/fv3gfs
- Source code located under the *./sorc/global_chgres.fd* subdirectory.
- Build script: *./sorc/build_chgres.sh*.
  - Invoke with no arguments.
  - Builds on the following machines:
    - WCOSS Phase 1/2/Cray, Theia, Jet, Gaea.

Inputs

- GFS Data
  - Current OPS
  - Previous implementation
- Fixed Data
  - Location
    - */gpfs/hps3/emc/global/noscrub/emc.glopara/git/fv3gfs/fix* (WCOSS Cray)
    - */scratch4/NCEPDEV/global/save/glopara/git/fv3gfs/fix* (Theia)
  - Grid and orography files
    - Located under *./fix_fv3_gmted2010*
    - Grid files (CRES_grid.tileX.nc) contain lat/lon and other information about tile points.
    - Orography files (CRES_oro_data.tileX.nc) contain land-mask, terrain and gravity wave drag fields.
  - Surface fixed files (Ex: soil type) located under *./fix_am*
    - Grib 1 data on Gaussian or lat/lon grid
  - Definition of vertical coordinate (under *./fix_am*)
    - Ex: global_hyblev.l65.txt (65 levels)

Run Scripts

- Scripts located under the *./ush* directory.
  - global_chgres_driver.sh (driver script)
  - global_chgres.sh (called from driver)
- Some important script variables
  - CASE – resolution of tile (default 'C96')
  - CDATE – yyyymmddhh of run. CYC – hh.
  - CDUMP – Is GFS data from 'gdas' or 'gfs' cycle?
  - LEVS – number of vertical levels (default 65)
  - HOMEgfs – location of your code baseline
  - FIXfv3 – location of grid and orography files
  - FIXam – location of surface fixed data and vertical coordinate definition files.

Run Scripts

- Some important script variables (continued)
  - INIDIR – location of input GFS data
  - OUTDIR – location of output FV3 NetCDF files
  - gtype – grid type; 'uniform', 'stretched', or 'nest'
- Scripts determine if input GFS data is current or previous OPS based on file names:
  - Current OPS:
    - NSST: nsnanl.$CDUMP.$CDATE or $CDUMP.t${cyc}z.nstanl.nemsio
    - SFC: sfnanl.$CDUMP.$CDATE or $CDUMP.t${cyc}z.sfcanl.nemsio
    - ATM: gfnanl.$CDUMP.$CDATE or $CDUMP.t${cyc}z.atmanl.nemsio
  - Previous OPS:
    - SFC: sfcanl.${CDUMP}.$CDATE or $CDUMP.t${cyc}z.sfcanl
    - ATM: siganl.${CDUMP}.$CDATE or $CDUMP.t${cyc}z.sanl
- CHGRES invoked separately for atmospheric and surface fields. All atmospheric tiles created with one invocation. For surface, CHGRES processes one tile per invocation.

Interpolation Method – Atmosphere (brief overview)

- If previous OPS data, convert from spectral to Gaussian grid point space.
- Compute mid-layer pressure.
- Vertically interpolate to user-specified vertical levels.
- Compute vertical layer heights.
- Horizontally interpolate to FV3 tiles.
- Model performs additional initialization steps.

Atmospheric file contents

```
netcdf gfs_data.tile1 {
dimensions:
        lon = 96 ;
        lat = 96 ;
        lonp = 97 ;
        latp = 97 ;
        lev = 65 ;
        levp = 66 ;
        ntracer = 3 ;
variables:
        float lon(lon) ;
                lon:cartesian_axis = "X" ;
        float lat(lat) ;
                lat:cartesian_axis = "Y" ;
        float ps(lat, lon) ;
        float w(lev, lat, lon) ;
        float zh(levp, lat, lon) ;
        float sphum(lev, lat, lon) ;
        float o3mr(lev, lat, lon) ;
        float liq_wat(lev, lat, lon) ;
        float u_w(lev, lat, lonp) ;
        float v_w(lev, lat, lonp) ;
        float u_s(lev, latp, lon) ;
        float v_s(lev, latp, lon) ;
```

lon – ‘x’ dimension of tile
lat – ‘y’ dimension of tile
lonp – ‘x’ dimension of “w” winds
latp – ‘y’ dimension of “s” winds
lev – number vert levels
levp – number vert level interfaces
ntracer – number of tracers

lon – longitude first row of points.
lat – latitude first column of points.
ps – surface pressure
w – vert. velocity. Zero when using OPS GFS.
zh – height of layer interfaces
sphum – specific humidity
liq_wat – cloud liquid water
u/v_w – winds at ‘west’ face
u/w_s – winds at ‘south’ face

Interpolation Method – Surface/NSST

- Performs series of 'masked' interpolations from GFS Gaussian grid to FV3 tiles:
  - Land-to-land
  - Non-land to non-land
  - Sea ice to sea ice
  - Permanent land ice to permanent land ice
- State fields (Ex: soil temperature) are initialized from input GFS data.
- Static fields (Ex: vegetation type) are initialized from datasets in the *./fix_am* directory.
  - Grib 1 format.
  - Gaussian or global lat/lon grid – CHGRES interpolates to tile points.
- Also performs:
  - Re-scales soil moisture for soil type differences between GFS and FV3 grids.
  - Adjusts soil temperature for terrain height differences.
  - Computes liquid portion of total soil moisture.
- Unlike atmospheric interpolation, CHGRES can only process one tile at a time.

Surface/NSST file contents

```
netcdf sfc_data.tile1 {
dimensions:
        lon = 96 ;
        lat = 96 ;
        lsoil = 4 ;
variables:
        float lon(lon) ;
                lon:cartesian_axis = "X" ;
        float lat(lat) ;
                lat:cartesian_axis = "Y" ;
        float lsoil(lsoil) ;
                lsoil:cartesian_axis = "Z" ;
        float geolon(lat, lon) ;
        float geolat(lat, lon) ;
        float slmsk(lat, lon) ;
        float tsea(lat, lon) ;
        float sheleg(lat, lon) ;
        float tg3(lat, lon) ;
        float zorl(lat, lon) ;
        float alvsf(lat, lon) ;
        float alvwf(lat, lon) ;
        float alnsf(lat, lon) ;
        float alnwf(lat, lon) ;
        float vfrac(lat, lon) ;
        float canopy(lat, lon) ;
        float f10m(lat, lon) ;
        float t2m(lat, lon) ;
        float q2m(lat, lon) ;
        float vtype(lat, lon) ;
        float stype(lat, lon) ;
        float facsf(lat, lon) ;
        float facwf(lat, lon) ;
        float uustar(lat, lon) ;
        float ffmm(lat, lon) ;
        float ffhh(lat, lon) ;
        float hice(lat, lon) ;
        float fice(lat, lon) ;
        float tisfc(lat, lon) ;
        float tprcp(lat, lon) ;
        float srflag(lat, lon) ;
        float snwdph(lat, lon) ;
        float shdmin(lat, lon) ;
        float shdmax(lat, lon) ;
        float slope(lat, lon) ;
        float snoalb(lat, lon) ;
        float stc(lsoil, lat, lon) ;
        float smc(lsoil, lat, lon) ;
        float slc(lsoil, lat, lon) ;
        float tref(lat, lon) ;
        float z_c(lat, lon);
        float c_0(lat, lon) ;
        float c_d(lat, lon) ;
        float w_0(lat, lon) ;
        float w_d(lat, lon) ;
        float xt(lat, lon) ;
        float xs(lat, lon) ;
        float xu(lat, lon) ;
        float xv(lat, lon) ;
        float xz(lat, lon) ;
        float zm(lat, lon) ;
        float xtts(lat, lon) ;
        float xzts(lat, lon) ;
        float d_conv(lat, lon) ;
        float ifd(lat, lon) ;
        float dt_cool(lat, lon) ;
        float qrain(lat, lon) ;
        }
```

NSST Fields

SFC Fields

Extras

- Although not part of this release, CHGRES recently updated for regional stand-alone nests.
  - Nest not run within a global domain
  - Creates file of lateral boundary conditions for a user-specified halo region.
  - Removes halo region from atmospheric and surface/NSST files.
- New fully parallel version of CHGRES being developed.
  - Based on ESMF regridding.
  - Inputs FV3 tile history files (NetCDF).
  - Includes regional nest logic described above.
  - Has undergone limited testing.
  - Other inputs being considered: FV3 gaussian nemsio files, FV3 tiled restart files.
- Contact me if you would like to use these.

QUESTIONS?