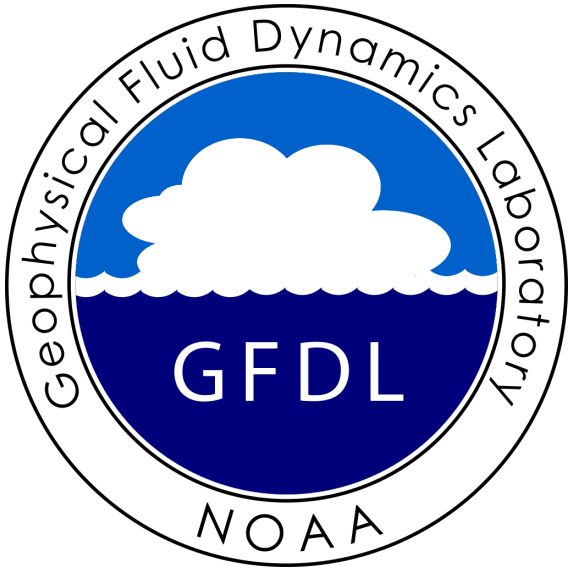
GFDL
Toolsets and Diagnostics



NEMSfv3gfs Forecast System Training and Tutorial
12-14 June, 2018

Toolsets

grid generation

mosaics

topography filter

re-gridding / re-mapping

distributed file combiner

Horizontal Grid Generation

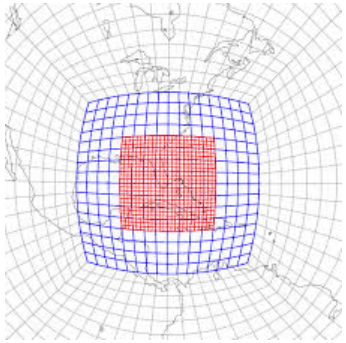
make_hgrid

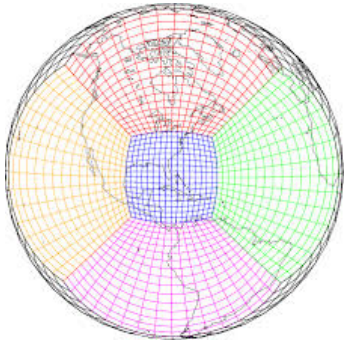
Generate different types of horizontal grids

cubed-sphere *regular lat-lon* *tripolar*

Can create stretched grids and nests for cubed-sphere

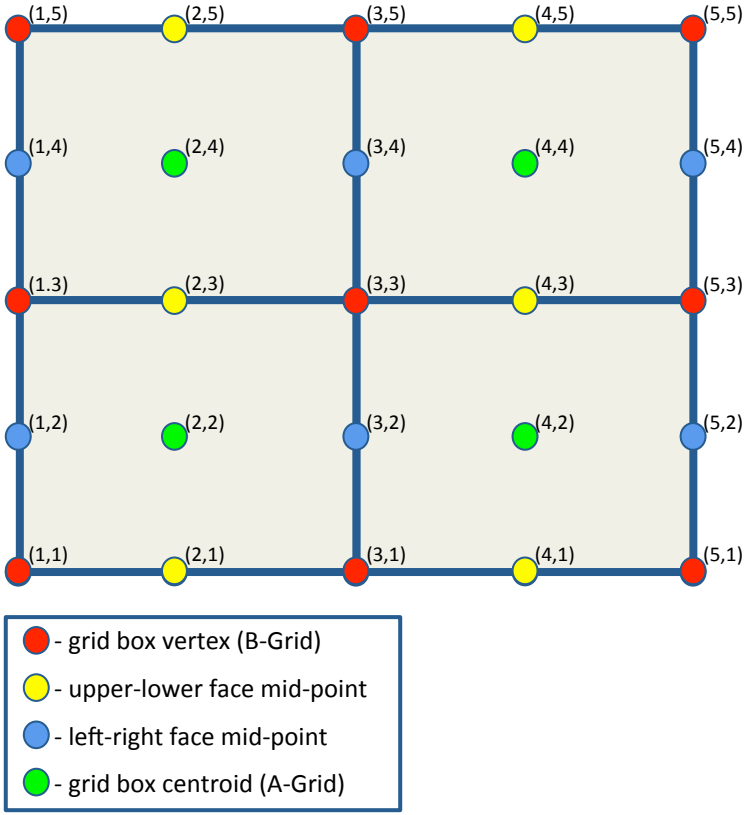
Grid orientation is variable





Result is expressed as a *supergrid*

Supergrid Representation



Supergrid vs Model Grid

Supergrid is defined by the vertices, centroids, and face mid-points

- 4 vertices
- 1 centroid
- 4 face mid-points

Grid boxes are bounded by the vertices

Model grid is defined by the centroids only

For a model grid size (ni, nj), the supergrid size is (2*ni+1, 2*nj+1)

The graph on the left has 4 model grid boxes (2x2) and the supergrid size is (5x5)

The (i,j) index representation in the image corresponds to the points defined in the supergrid

Solo Mosaic

make_solo_mosaic

Generates mosaic information about component grid

tripolar, *cubed-sphere*, and *torus* support

Includes:

- list of tile files
- list of contact region by index and contact type

Renamed to *grid_spec.nc* when running component models (i.e. solo ocean, atmos-only, land-only, etc.)

Solo Mosaic

cubed-sphere contact information

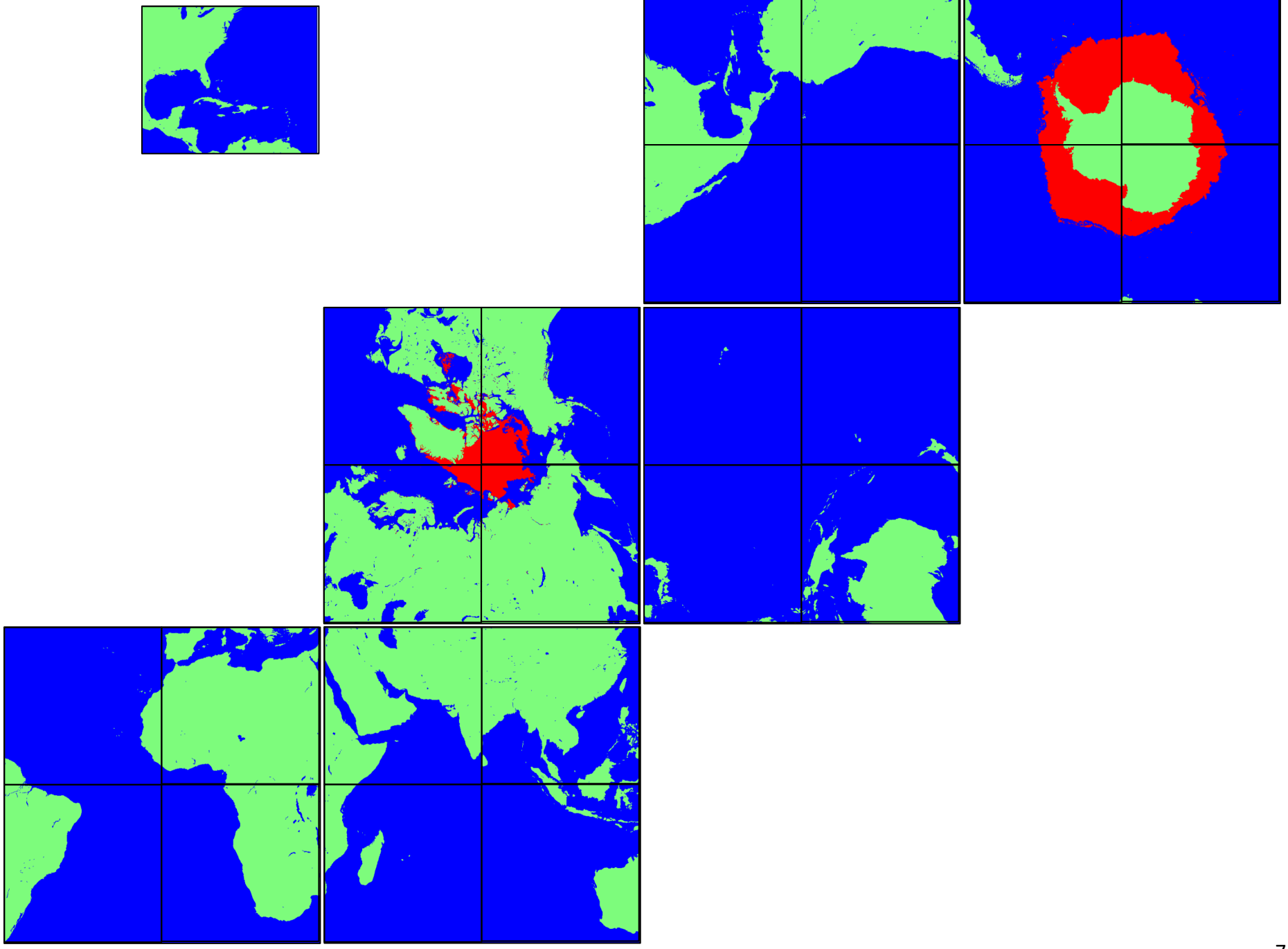
```
contacts =
  "C192_mosaic:tile1::C192_mosaic:tile2",
  "C192_mosaic:tile1::C192_mosaic:tile3",
  "C192_mosaic:tile1::C192_mosaic:tile5",
  "C192_mosaic:tile1::C192_mosaic:tile6",
  "C192_mosaic:tile2::C192_mosaic:tile3",
  "C192_mosaic:tile2::C192_mosaic:tile4",
  "C192_mosaic:tile2::C192_mosaic:tile6",
  "C192_mosaic:tile3::C192_mosaic:tile4",
  "C192_mosaic:tile3::C192_mosaic:tile5",
  "C192_mosaic:tile4::C192_mosaic:tile5",
  "C192_mosaic:tile4::C192_mosaic:tile6",
  "C192_mosaic:tile5::C192_mosaic:tile6" ;
```

```
contact_index =
  "384:384,1:384::1:1,1:384",
  "1:384,384:384::1:1,384:1",
  "1:1,1:384::384:1,384:384",
  "1:384,1:1::1:384,384:384",
  "1:384,384:384::1:384,1:1",
  "384:384,1:384::384:1,1:1",
  "1:384,1:1::384:384,384:1",
  "384:384,1:384::1:1,1:384",
  "1:384,384:384::1:1,384:1",
  "1:384,384:384::1:384,1:1",
  "384:384,1:384::384:1,1:1",
  "384:384,1:384::1:1,1:384" ;
```

tri-polar contact information

```
contacts =
  "ocean_mosaic:tile1::ocean_mosaic:tile1",
  "ocean_mosaic:tile1::ocean_mosaic:tile1" ;
```

```
contact_index =
  "2880:2880,1:2160::1:1,1:2160",
  "1:1440,2160:2160::2880:1441,2160:2160" ;
```



Coupled Mosaic

make_coupler_mosaic

Generates three(3) exchange grids for the FMS coupler

- fluxes between atmosphere and surface (sea ice and land)
- runoff between land and sea ice

Exchange grid is between model grids on T-cell

Generates the coupler mosaic containing references to:

- atmos, land and ocean solo mosaic files
- ocean topography files
- exchange grid files

Renamed to *grid_spec.nc* when running a coupled model

Coupled Mosaic

```
atm_mosaic_file = "C96_mosaic.nc" ;

lnd_mosaic_file = "C96_mosaic.nc" ;

ocn_mosaic_file = "ocean_mosaic.nc" ;

ocn_topog_file = "ocean_topog.nc" ;

aXo_file =
 "C96_mosaic_tile1Xocean_mosaic_tile1.nc",
 "C96_mosaic_tile2Xocean_mosaic_tile1.nc",
 "C96_mosaic_tile3Xocean_mosaic_tile1.nc",
 "C96_mosaic_tile4Xocean_mosaic_tile1.nc",
 "C96_mosaic_tile5Xocean_mosaic_tile1.nc",
 "C96_mosaic_tile6Xocean_mosaic_tile1.nc" ;

aXl_file =
 "C96_mosaic_tile1XC96_mosaic_tile1.nc",
 "C96_mosaic_tile2XC96_mosaic_tile2.nc",
 "C96_mosaic_tile3XC96_mosaic_tile3.nc",
 "C96_mosaic_tile4XC96_mosaic_tile4.nc",
 "C96_mosaic_tile5XC96_mosaic_tile5.nc",
 "C96_mosaic_tile6XC96_mosaic_tile6.nc" ;

lXo_file =
 "C96_mosaic_tile1Xocean_mosaic_tile1.nc",
 "C96_mosaic_tile2Xocean_mosaic_tile1.nc",
 "C96_mosaic_tile3Xocean_mosaic_tile1.nc",
 "C96_mosaic_tile4Xocean_mosaic_tile1.nc",
 "C96_mosaic_tile5Xocean_mosaic_tile1.nc",
 "C96_mosaic_tile6Xocean_mosaic_tile1.nc" ;
```

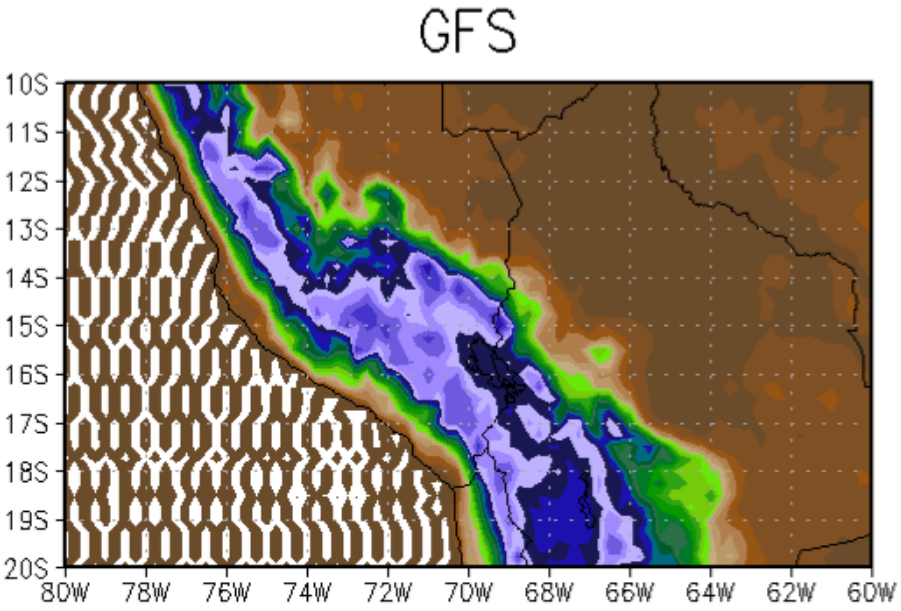
Topography Filter

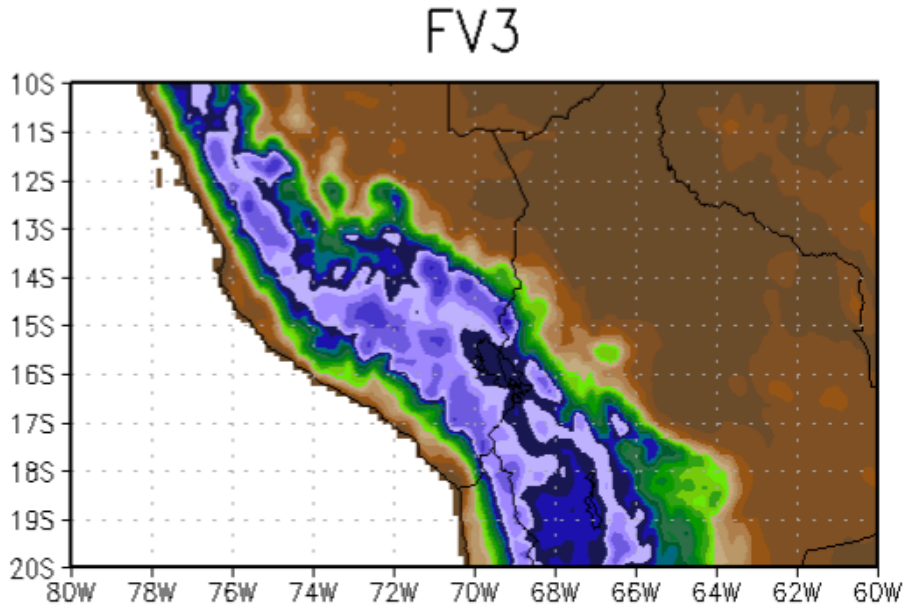
filter_topo

Multi-pass filtering algorithm to smooth topography

Replaces *filtered* orography variable in orography files

Filtering near intersections requires concurrent loading of all six cubed-sphere tiles

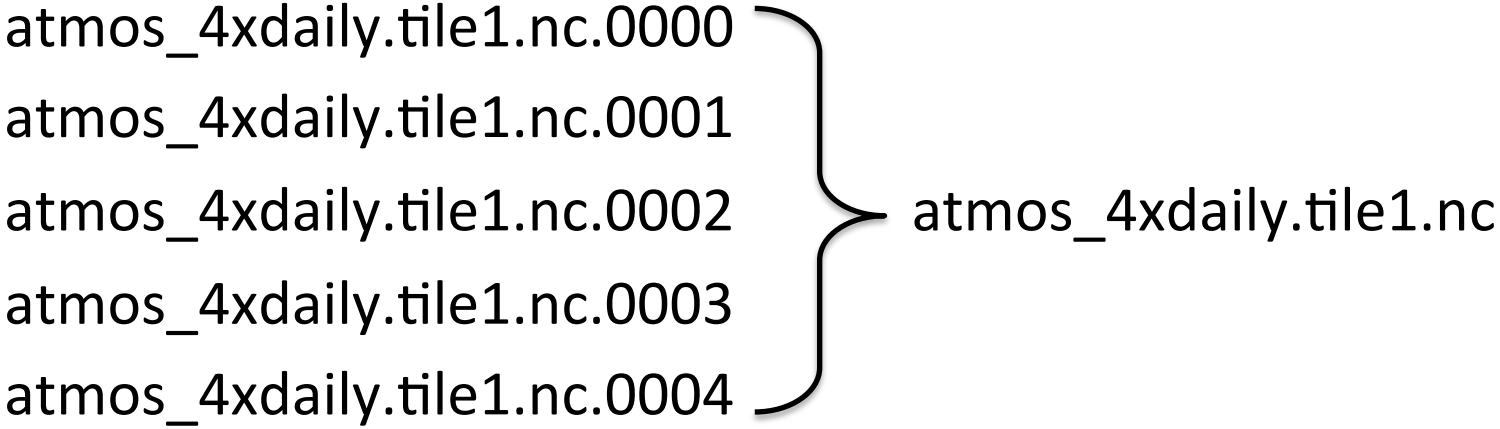




Combiner

mppnccombine

Coalesces a grouping from an I/O subset into a single tile file



Always use “-64” option to enable large file support

Re-gridding

fregrid

Remaps data from input mosaic to target mosaic or grid

scalar (T-cell) and vector (A-Grid, bilinear) available

Interpolation algorithms:

- conserve_order1[1] (default)
- conserve_order2[1,2]
- bilinear[3]

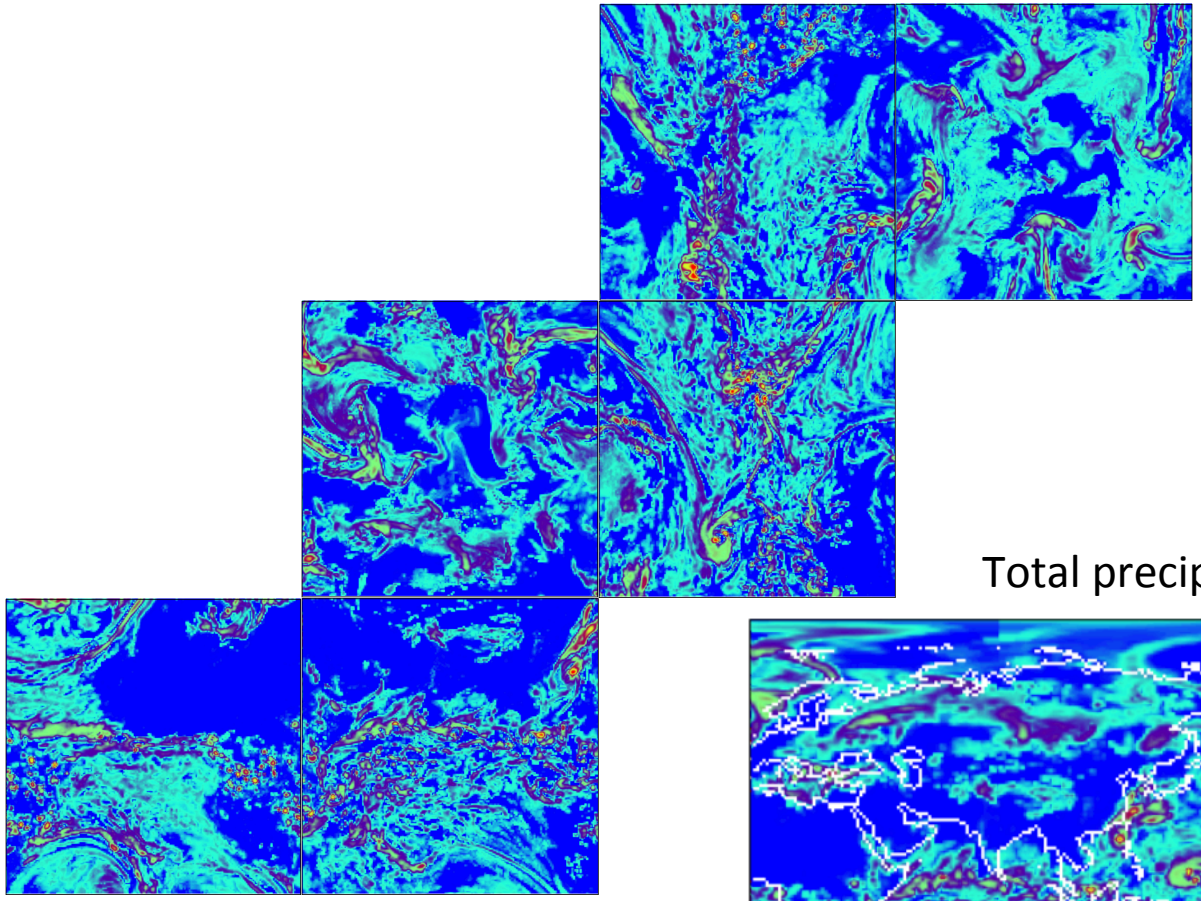
Reusable *weight* files for common re-mappings between two grid representations supported

[1] conservation requires cell areas in the presence of land-sea masked quantities

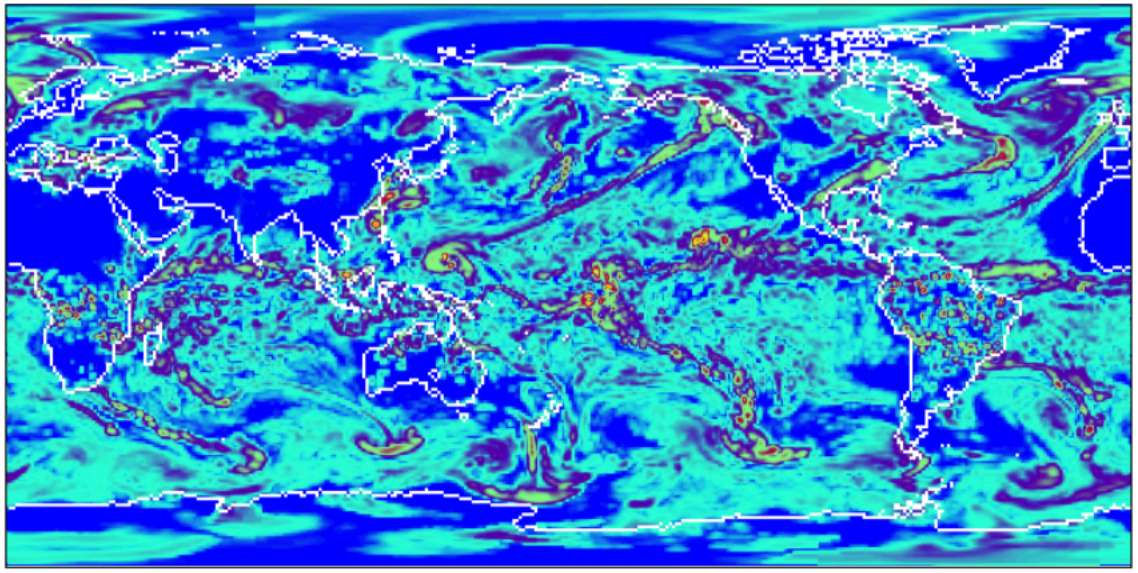
[2] smoother results, but overshoots may result in negatives in quantities with near-zero values

[3] cubic grid to lat-lon only (scalar and vector)

Re-gridding



Total precipitation rate (kg/m2/s)



Downloading

These tools and more are available on GitHub in the NOAA-GFDL domain:

https://github.com/NOAA-GFDL/FRE-NCtools