Implementation of IAU in the FV3GFS

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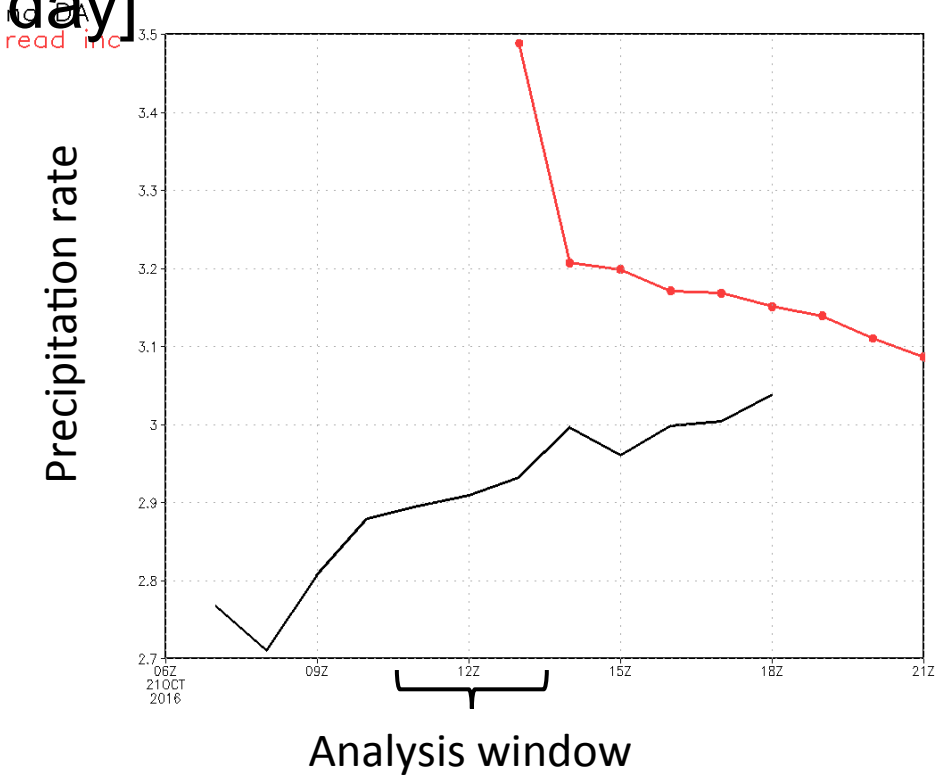
Current DA cycling strategy

- Data assimilation creates an analysis increment on the model's levels and Gaussian grid based on the history files.
- When model starts back up, it reads in the restart valid at the analysis time (6-hr forecast from previous cycle) and interpolates this increment to the model's state.

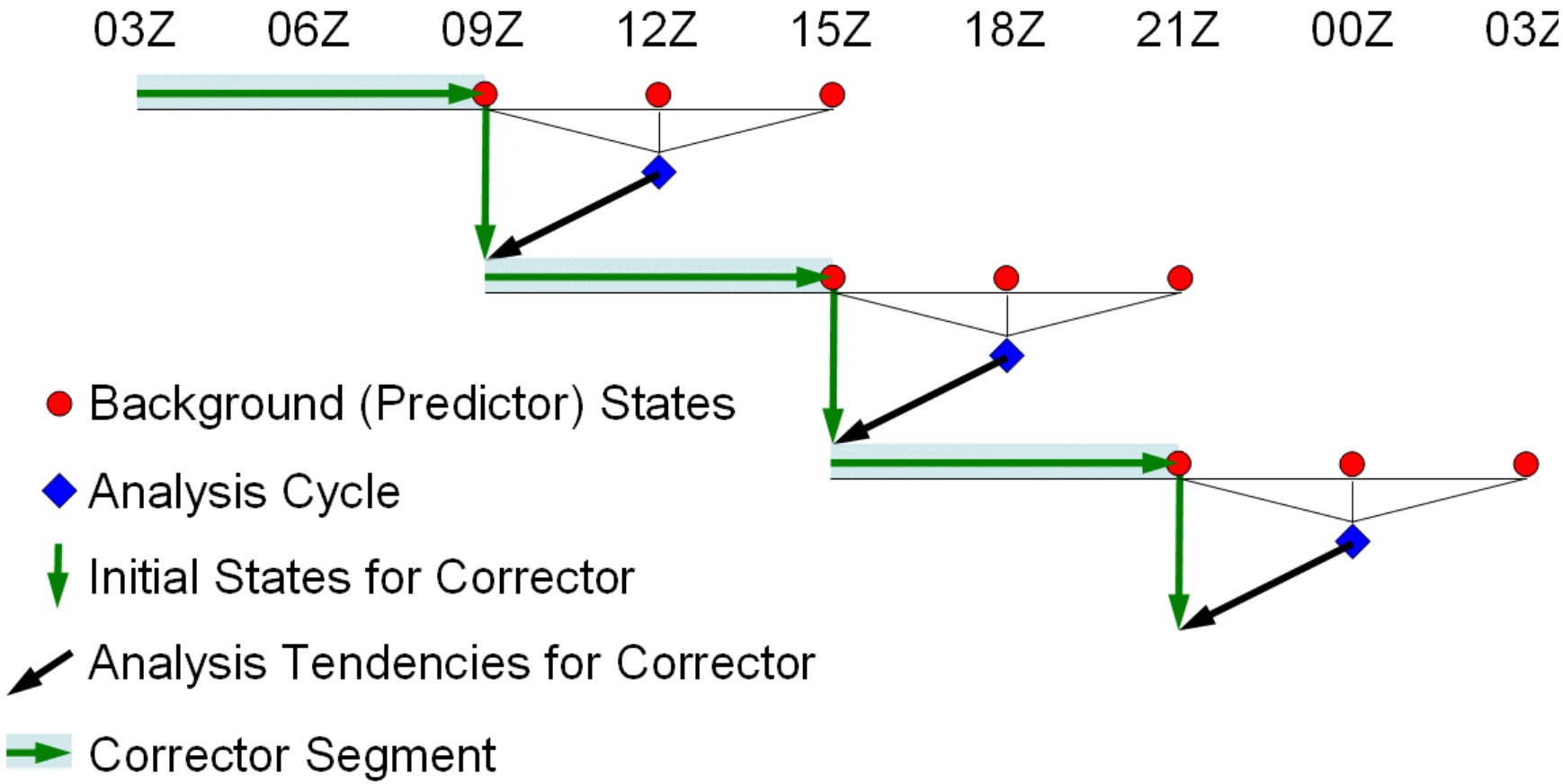
Global Mean precipitation [mm/day]



Incremental Analysis update (**IAU**)

- The analysis increments get added to the model state over a period of time (a little each time-step).
- When model starts back up, it reads in the restart valid at the beginning of the analysis window (3-hr forecast from previous cycle) and slowly adds in the analysis increment over the analysis window (normally 6-hours, defined by **iau_delthrs**).
- There is also the ability to read in multiple increment files (beginning, middle, and end of window) and interpolate across them. The valid forecast times for each increment file is defined by **iaufhrs** (6 for a single increment files; 3,6,9 for 3-hourly increment files.

Incremental Analysis Update (**IAU**)



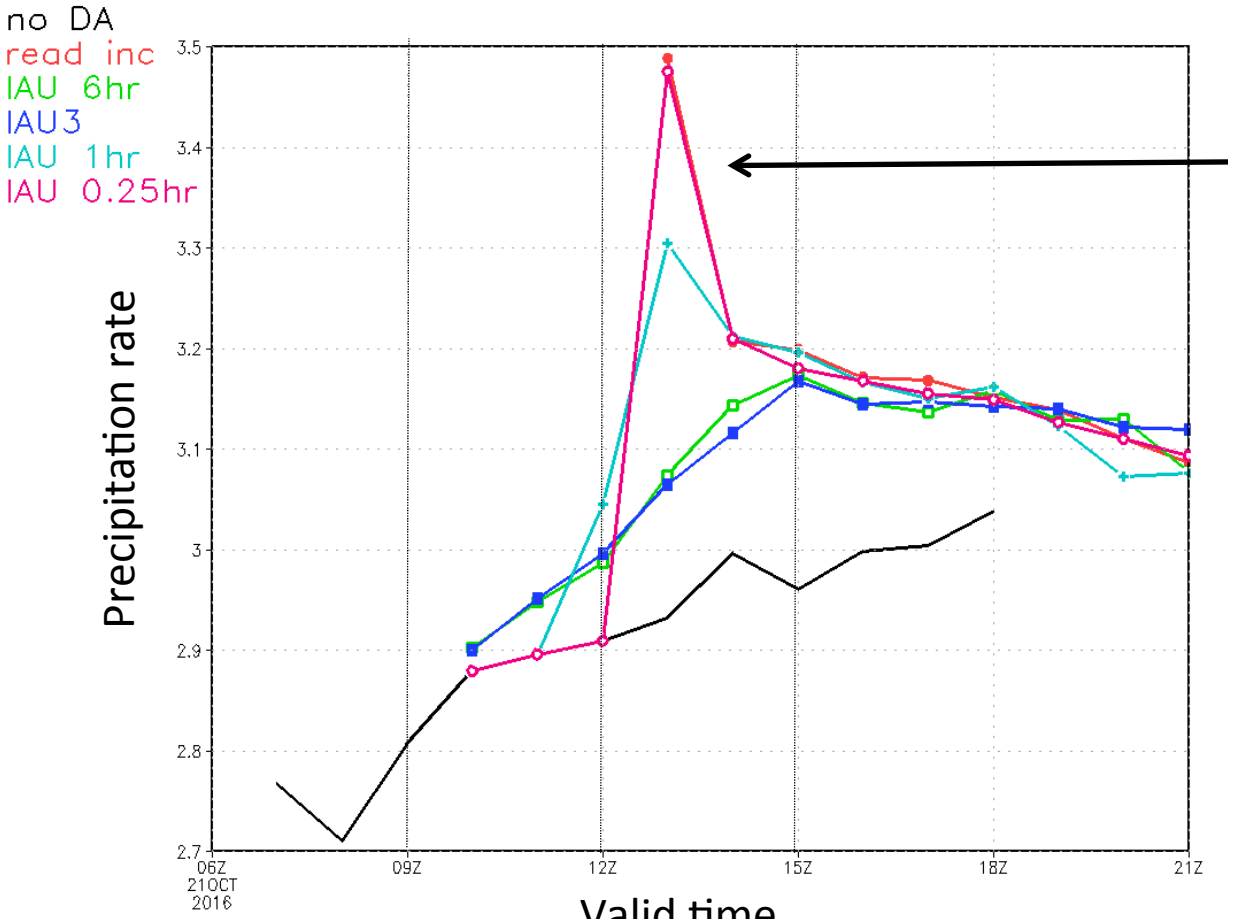
Courtesy GMAO/GFSC

Experiments

- C96 hydrostatic
- Start at 6z21AUG2016 with a restart and increment that is read at startup
- Data assimilation runs for 12z cycle, producing increment files valid at 9,12,and 15z.

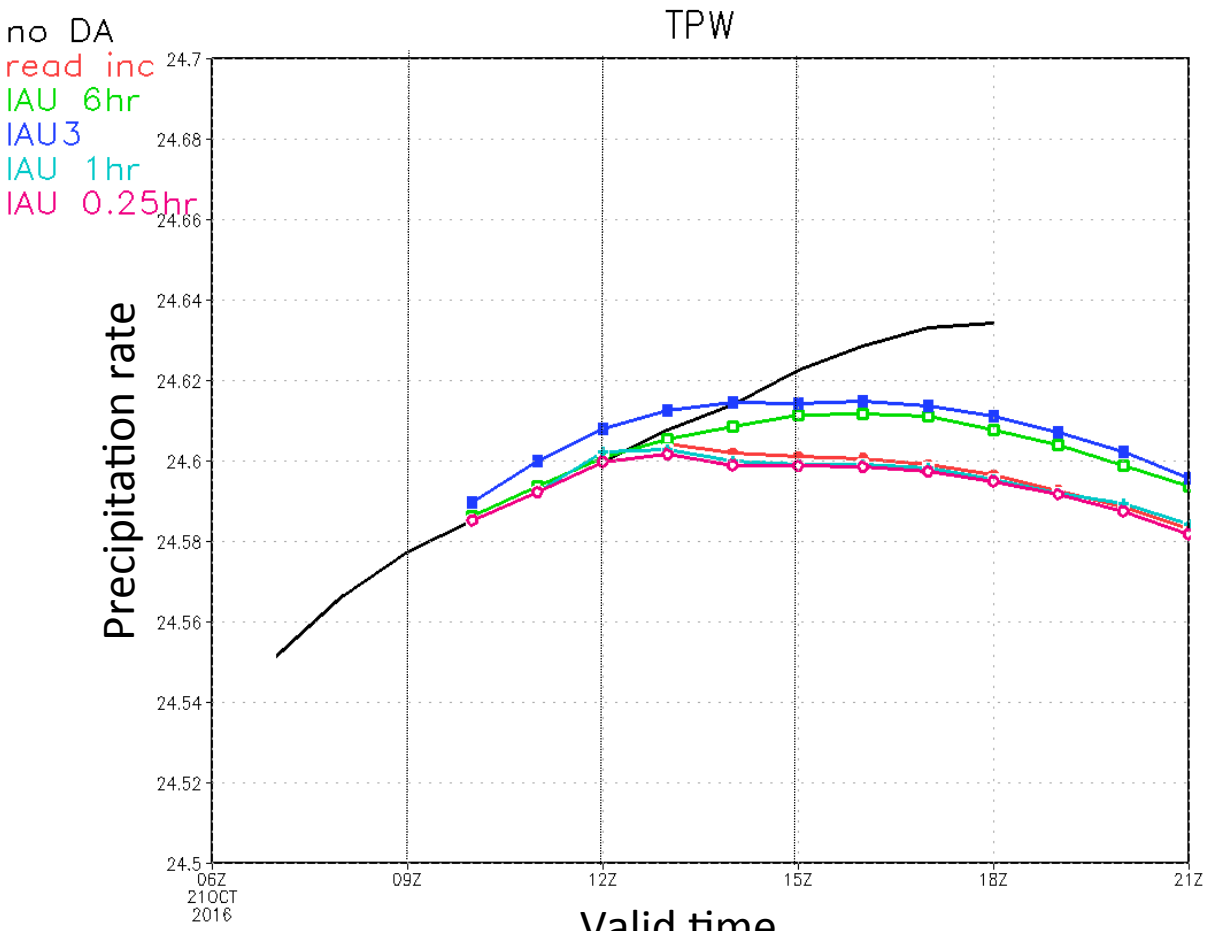
Expt. Name	Description
no DA	12-hour forecast initialized at 6z
read inc	Increment file valid at 12z is read at initialization (current configuration in trunk)
IAU 6hr	Single increment file is read and applied over the 6-hour window
IAU3	Increment valid at 9,12,and 15z are interpolated over the 6-hour window
IAU 1hr	Single increment file, increments are applied over a 1-hour window centered at 12z
IAU 0.25 hr	Single increment file, increments are applied in 1-time step at 12z

Global Mean precipitation [mm/day]



Spin-down of precipitation when dumping In increment to quickly

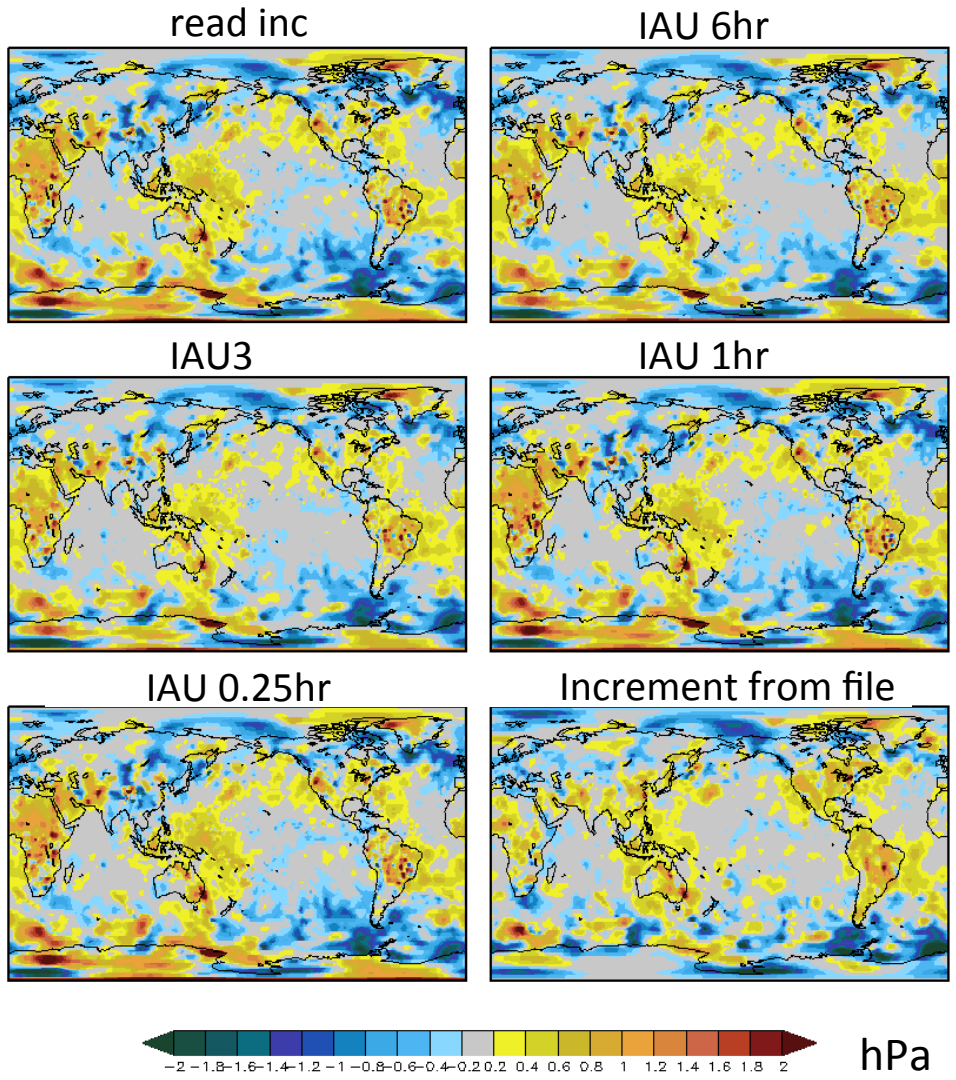
Global Mean Integrated water vapor [mm]



Lack of precipitation shock is seen as increased TPW

SLP valid 15z (end of IAU window)

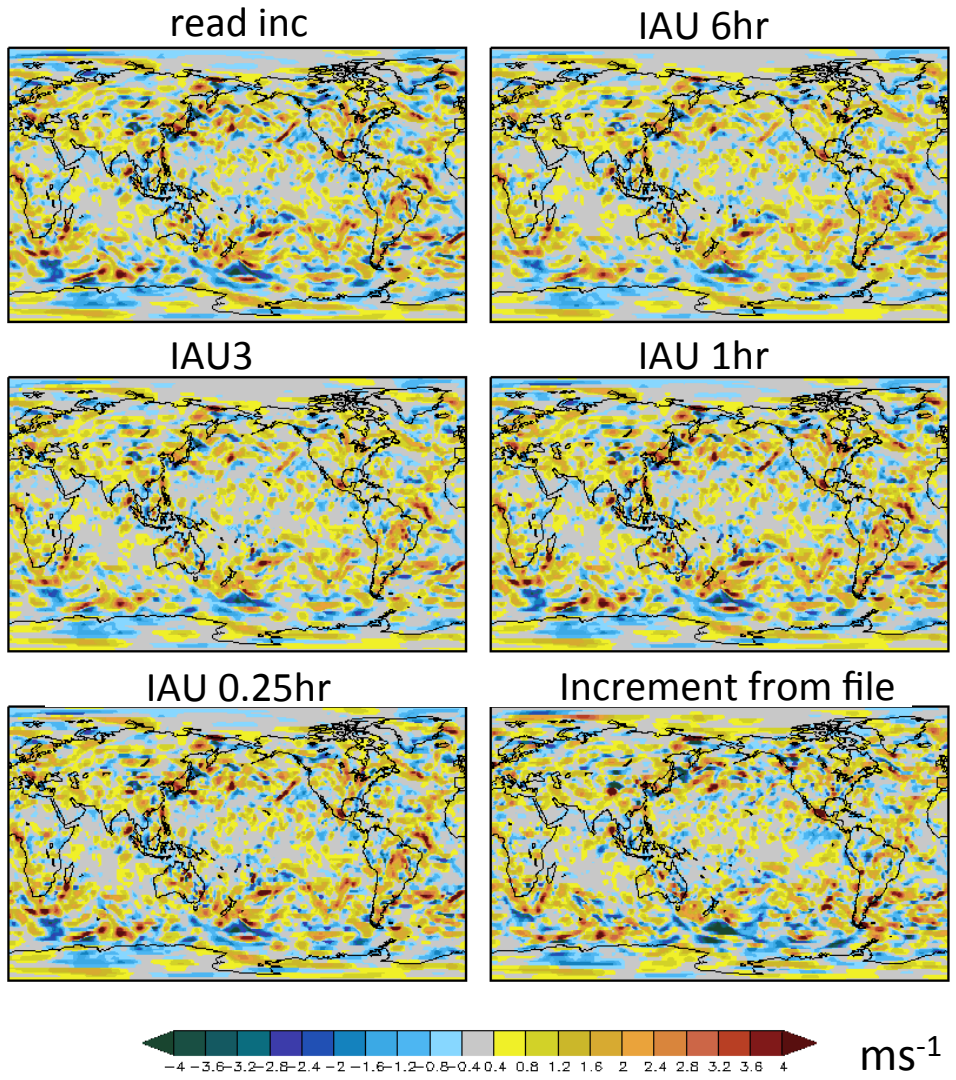
differences of experiments to no DA forecast



Analysis increment from DA valid 15z

U300 valid 15z (end of IAU window)

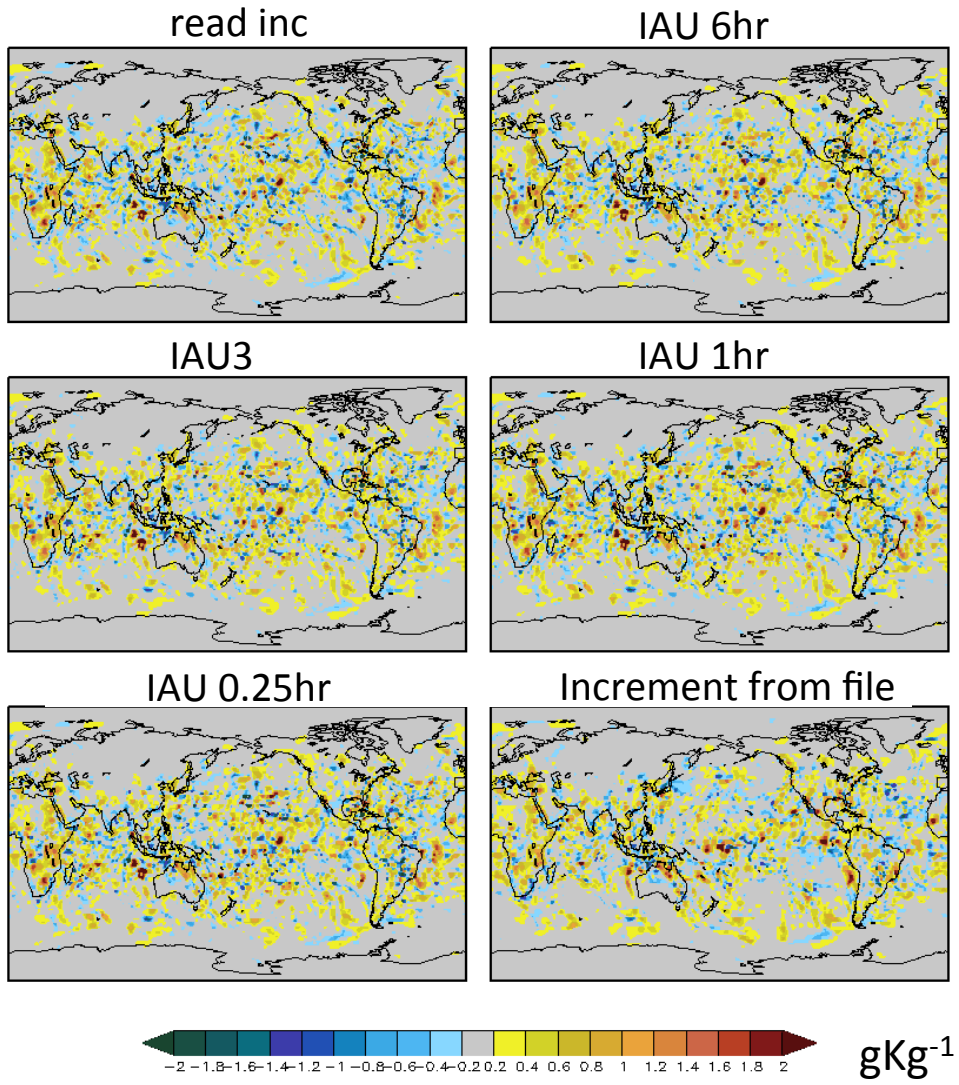
differences of experiments to no DA forecast



Analysis increment from DA valid 15z

Q850 valid 15z (end of IAU window)

differences of experiments to no DA forecast

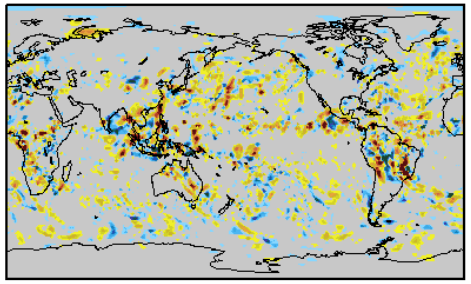


Analysis increment from DA valid 15z

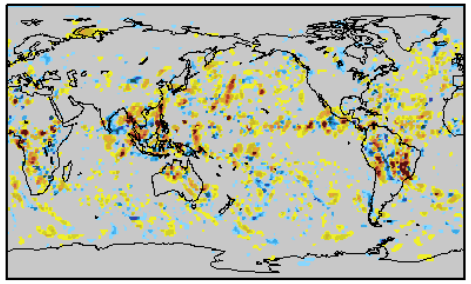
OLR valid 15z (end of IAU window)

differences of experiments to no DA forecast

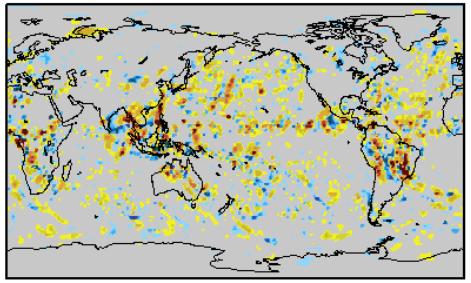
read inc



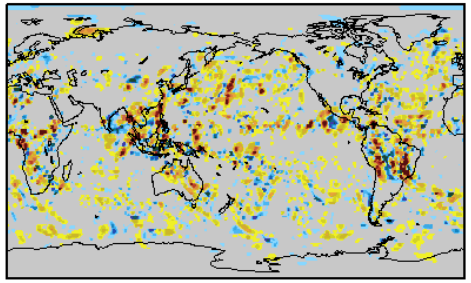
IAU 6hr



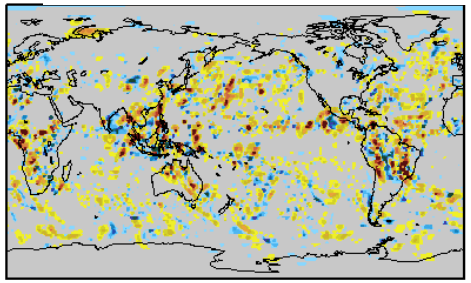
IAU3



IAU 1hr



IAU 0.25hr



Wm^{-2}

Summary

- IAU appears to be working in FV3GFS, available at https://svnemc.ncep.noaa.gov/projects/nems/apps/NEMSfv3gfs/branches/iau
- I also merged in IAU with stochastic physics on theia in /scratch3/BMC/gsienkf/Philip.Pegion/NEMS/NEMSfv3gfs/stochy_iau
- Namelist changes:
  - set read_increment=F in fv_core_nml
  - 3 namelist variables need to be added to gfs_physics_nml

  Single increment file:

  iau_delthrs = 6
  iaufhrs = 6
  iau_inc_files = 'fv3_increment.nc'

  Multiple increment files:

  iau_delthrs = 6
  iaufhrs = 3,6,9
  iau_inc_files = 'fv3_increment3.nc','fv3_increment6.nc','fv3_increment9.nc'

- All increment files need to reside in INPUT directory.
- Jeff Whitaker is working on the scripting changes to the DA cycling workflow at ESRL/PSD.