Data Assimilation Experiments with FV3

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What is missing

- GSI requires a rectangular grid – cannot work with native cubed-sphere 6 tile FV3 grid.
- FV3 does not yet have stochastic physics or IAU capability.
- Static background-error covariance matrix not yet developed for FV3.
- No ‘global_cycle’ external utility to update surface fields.

What is missing

- GSI requires a rectangular grid – cannot work with native cubed-sphere 6 tile FV3 grid.
  - ***External utility regrids native grid history files to gaussian grid nemsio ('GFS look-alike') files.***
  - ***GSI thinks background forecast is from GFS.***
  - ***FV3 model ingests gaussian-grid increments, interpolates to native grid and adds to restart fields on the fly.***
- FV3 does not yet have stochastic physics or IAU capability.
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- FV3 does not yet have stochastic physics or IAU capability.
  - ***Increase multiplicative (relaxation to prior spread) inflation coefficient from 0.85 to 1.1.***
- Static background-error covariance matrix not yet developed for FV3.
- No 'global_cycle' external utility to update surface fields.

What is missing

- GSI requires a rectangular grid – cannot work with native cubed-sphere 6 tile FV3 grid.
- FV3 does not yet have stochastic physics or IAU capability.
- Static background-error covariance matrix not yet developed for FV3.
  - ***Use GFS version, but with top level removed (FV3 has only 63 levels, same as 1st 63 GFS levels).***
- No 'global_cycle' external utility to update surface fields.

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- FV3 does not yet have stochastic physics or IAU capability.
- Static background-error covariance matrix not yet developed for FV3.
- No 'global_cycle' external utility to update surface fields.
  - ***Set FHCYC=24 in FV3 namelist, gcycle subroutine updates boundary conditions as model runs.***

Code and scripts

- 'jwhitaker' branch in fv3gfs project.
- **sorc/regrid_nemsio.fd**: *utility to regrid native grid output to gaussian grid nemsio.*
- **sorc/calc_increment.fd**: *utility to calculate gaussian grid increments from nemsio background and analysis files, write to netCDF.*
- **sorc/fv3gfs.fd**: *patched version of FV3 model that reads gaussian grid increments and interpolates to cubed-sphere grid on the fly*.
- **da_scripts**: *shell scripts to run cycled DA on theia and wcoss.*

Code and scripts

- 'jwhitaker' branch in fv3gfs project.
- **sorc/regrid_nemsio.fd**: *utility to regrid native grid output to gaussian grid nemsio.*
  - *Runs with LEVS+1 mpi tasks, interpolates one level of data on each task (surface data and IO on root task).*
  - *Text table defines mapping of netCDF to nemsio variable names, type of interpolation to be done for each variable (nearest neighbor or bilinear).*
  - *ESMF regridding weights (generated offline) are used for interpolation.*
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  - *Computes 3D increments for delp,T,u,v,spfh,o3mr,clwmr.*
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- **sorc/fv3gfs.fd**: *patched version of FV3 model that reads gaussian grid increments and interpolates to cubed-sphere grid on the fly*.
  - *Extra namelist variable* `read_increment` *added to* `fv_core.nml`. `res_latlon_dynamics` *namelist variable holds name of increment file.*
- **da_scripts**: *shell scripts to run cycled DA on theia and wcoss.*

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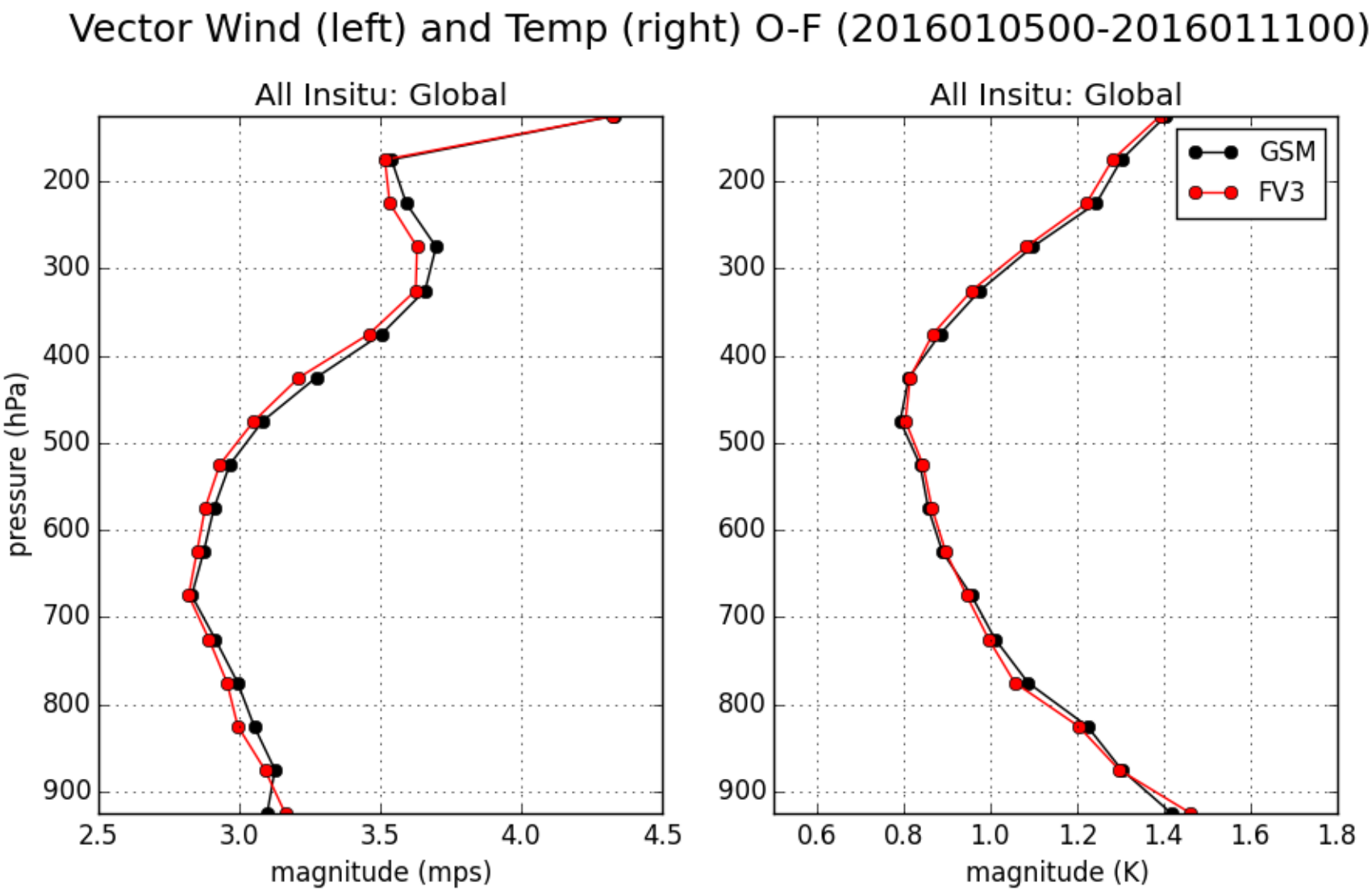
- **da_scripts**: *shell scripts to run cycled DA on theia and wcoss.*
  - *Uses EnKF code from EXP-enkfanavinfo branch.*
  - *63 level versions of fixed files (global_anavinfo.l63.txt, global_hybens_locinfo.l63.txt and global_berror.l63y386.f77) included.*

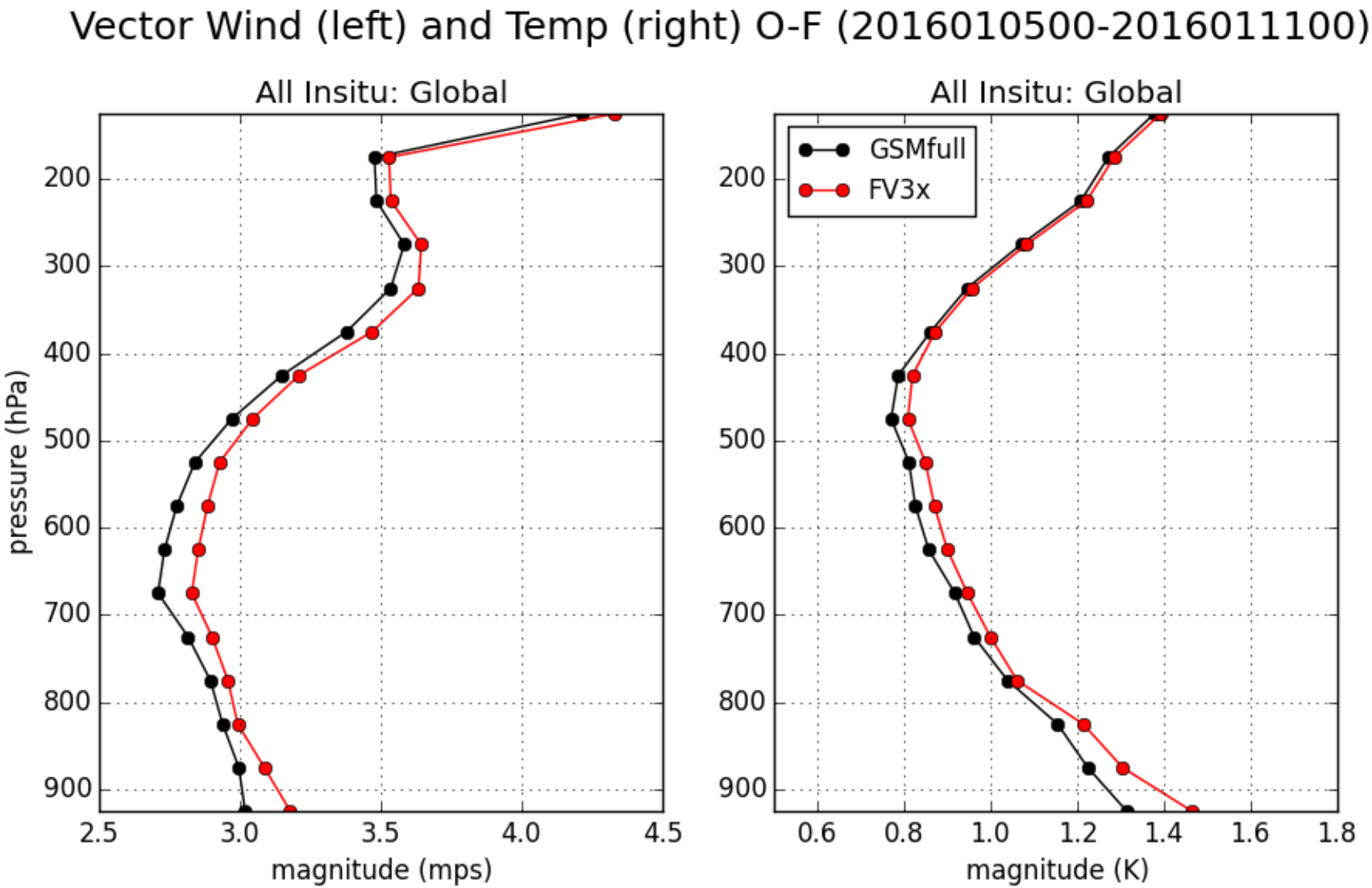
Test results (from theia)

- C192 (768 x 384 analysis grid) 80 member FV3 ensemble.
- No static B contribution, TLNMC disabled.
- No control forecast (GSI ingests ensemble mean background).
- EnKF analysis ensemble recentered around GSI analysis.
- Other parameter settings as in current ops.
- Start date 2016010100.
- Compared to T574 GSM ensemble, 1152 x 576 analysis grid.

RMS observation increments



RMS observation increments
(*comparing to full hybrid DA with stochastic physics, 4DIAU*)



Next Steps?

- Have EMC reproduce these results, port scripts to parallel workflow.
  - Run experiments at C384 (1536 x 768 analysis grid), chgres to C768 grid to run deterministic forecast?
  - Add dual-resolution capability?
- Add stochastic physics and IAU capability to NEMS-FV3.
- global_cycle utility?
- berror file (from cycled EnKF or 48-24 forecast differences?).
- Use regular lat/lon grid – create separate code path for FV3 in GSI that does not require spectral transforms?
- Add capability in EnKF to update native grid 6-tile restarts directly.