



# Data Assimilation

## MDAB-DA Team

Presented by Russ Treadon

(special thanks to Daryl Kleist, Andrew Collard, and Jacob Carley)

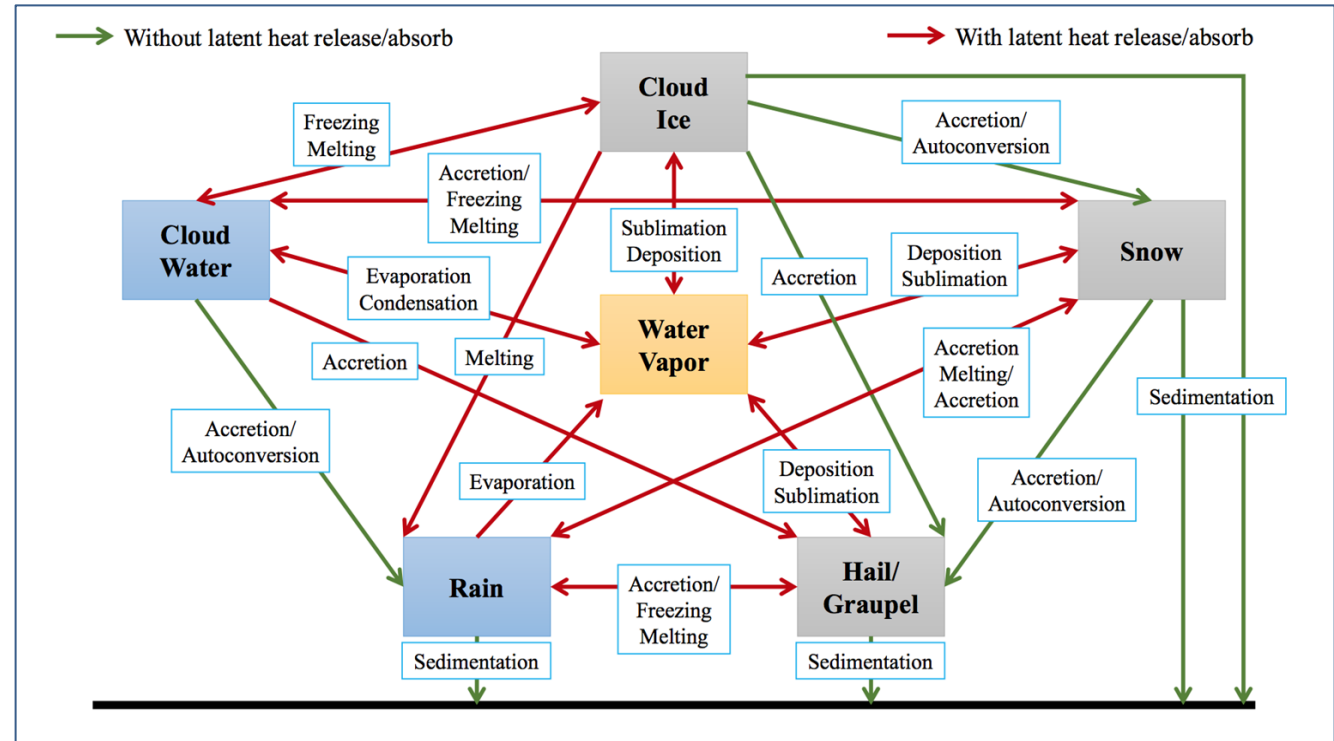
# **Data assimilation upgrades in the Q2FY19 FV3GFS Implementation**

# DA Infrastructure Changes

- Adaptation to current GSI-based hybrid 4DEnVar (regular grid/regridding)
  - *While control remains ~13km, ensemble and increment resolution have been increased to ~25 km (currently ~39km)*
- Initialization
  - Current GFS uses digital filter, *FV3GFS not yet using initialization*
    - Both use Tangent Linear Normal Mode Constraint
  - No TC Relocation. Assimilate single central SLP observation
- Treatment of system error
  - GFS uses SKEB+SPPT+SHUM, *FV3GFS utilizes SPPT+SHUM only*

# DA Infrastructure Changes contd.

- New microphysics
  - GFS analyzes total cloud increment and passes back to model
  - FV3GFS engineered to make this work with new MP scheme (5 species), **but does not pass cloud increment back to model**



- This approach (treating the cloud as a “sink variable”) updates other model fields to be consistent with the cloud increment through the multivariate error correlation in the background error specification while also mitigating “spin-down” issues seen in current operations.

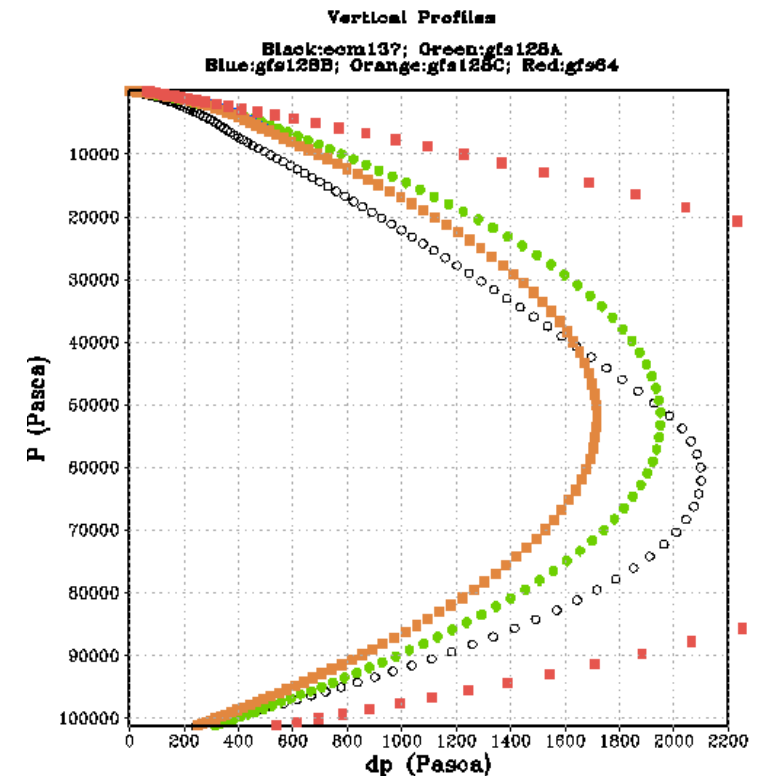
# Observation Changes

- Upgrades
  - All-sky ATMS assimilation – consistent with the AMSU-A sensors
  - Assimilate S-NPP CrIS full spectral resolution (FSR) – consistent with NOAA-20 CrIS
- Assimilate
  - NOAA-20 CrIS & ATMS and GOES-16 AMVs added to operations in 2018. Include in FV3GFS package with slight modification to CrIS AMV observation error & thinning
  - Turn on assimilation of 10 water vapor channels for IASI.
  - Assimilate Megha-Tropiques Saphir and Metop-B ASCAT
- Monitor S-NPP OMPS retrievals and Meteosat-11 SEVIRI radiances

# **Potential data assimilation upgrades in (or before) the Q1FY21 FV3GFS Implementation**

# DA Methodology Changes

- Vertical Resolution: **127L with 80km top** (currently **64L with 50km top**). Adaptation for “advanced physics” (suites currently being tested).
- Ensemble Perturbation Update: LETKF (replace EnSRF), Early Cycle (instead of late, GDAS cycle)
- 4D Incremental Analysis Update
- Review hydrometeor control variables; potentially pass increments to the model again
- Shifting-Lagging of ensemble members
- JEDI-UFO (as available)



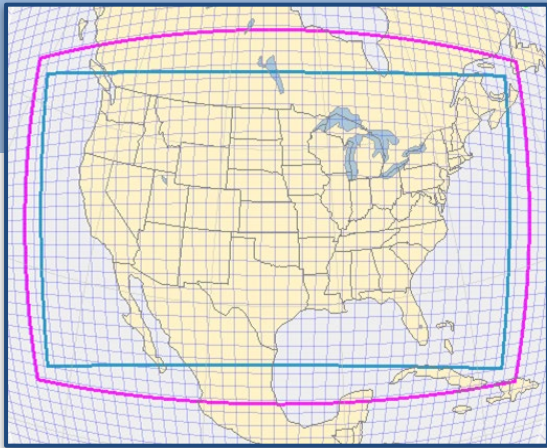
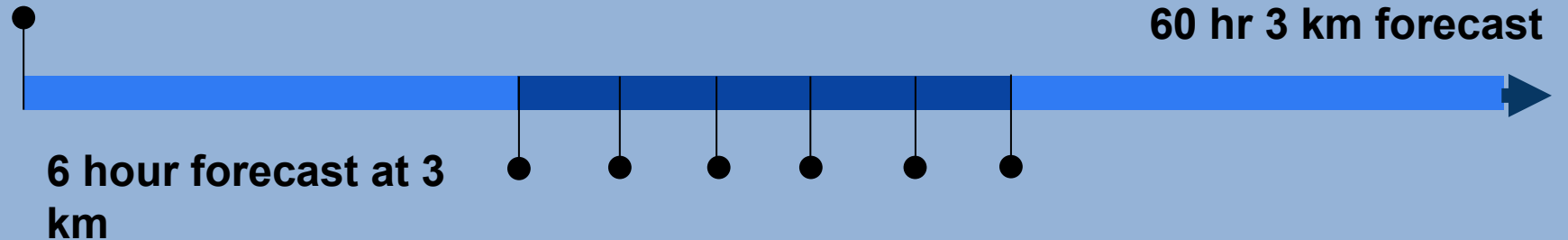
# Observation Changes

- MetOp-C (IASI, MHS, AMSU-A, AVHRR, ASCAT, GRAS)
- GOES-17 AMVs
- GOES-16/17, Himawari and Meteosat-11 geostationary clear sky radiances
- GPM GMI, GCOM-W1 AMSR-2
- S-NPP/NOAA-20 OMPS (Ozone)
- COSMIC-2, KOMPSAT-5 (GPSRO)
- Extension of cloudy radiances to more microwave and infrared radiances
- Improvement of the treatment of radiances over land
- Introduction of spectrally correlated observation errors



# FV3 CAM Data Assimilation – Current Testing

Coldstart from FV3-GFS



## Hourly hybrid 3DEnVar assimilation

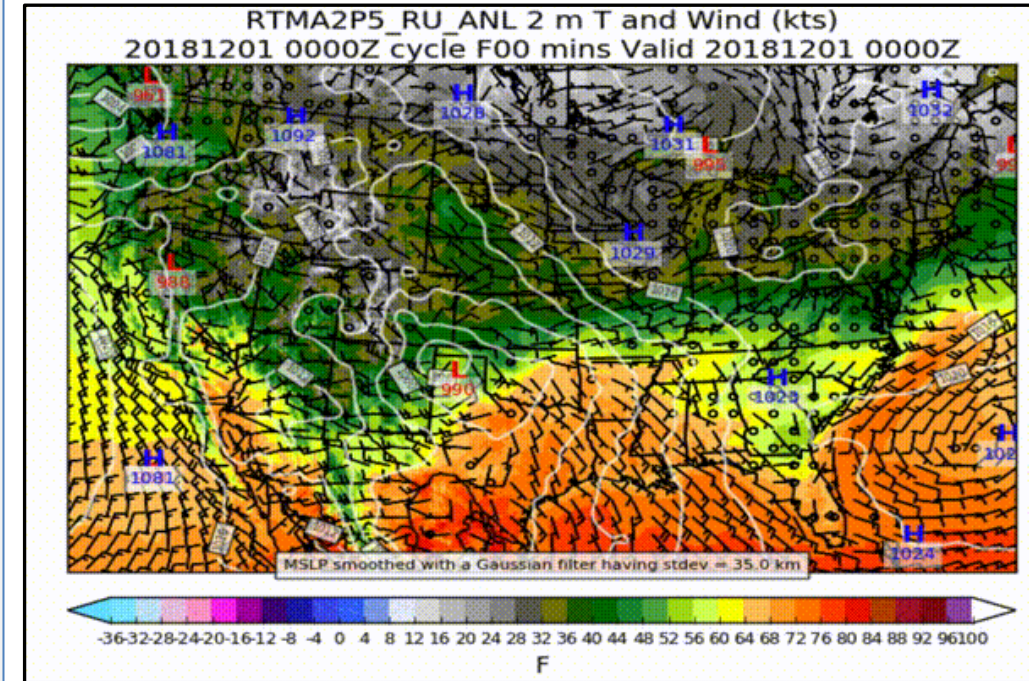
- Using global EnKF members
- Assimilates all data used in NAM CONUS nest
- \*NO\* cloud analysis and dBZ derived latent heating
- \*NO\* CAM ensemble *yet!*

- Very much in experimental/sandbox testing mode
- Construction of JEDI interface for FV3 CAM is simultaneously underway [recent development]
- *All collaborative with UFS/SIP CAM team → EMC/GSD/NSSL/AOML/GFDL/NCAR/DTC/Academia*
- FY22 → A single core (FV3) CAM ensemble-based DA and forecast system with rapid updates
- **CAM Plans Session tomorrow will have more details**

# 3D RTMA Status

## Joint EMC + GSD Development Effort

- To replace existing 2D RTMA/URMA
  - 15 min updates
  - Situational awareness, verification, and calibration
- Targeting FY21 for first version implementation
  - CONUS first then OCONUS thereafter
- EMC and GSD completed year 1 of 3 year project
  - Very early prototype running now at GSD!
- Highlights of ongoing work:
  - Introducing multigrid beta filter background error
    - More efficient and lower latency analyses!
    - Enhanced flexibility for introducing multiscale components
  - Begin integration of SPC Mesoanalysis product generation
  - Enhanced aviation products through full column analysis → C&V, icing, turbulence, etc.
  - Improved near surface analyses through 3D treatment in forward operators



v2.7 RTMA-RU 15 min analyses

\*v2.7 RTMA/URMA Implementation tomorrow,  
Dec. 4<sup>th</sup> @ 12Z\*

# Questions?



# SIP Data Assimilation Projects

- 6.1: Observations: Preparation for new observations, currently available but unused observations, new methods for further exploitation of data
- 6.2: Assimilation Algorithms: Compare Hybrid 4DEnVar (current) and Hybrid 4DVar, Multi-scale assimilation
- 6.3: Coupled Assimilation: Unification of assimilation schemes across components (including marine, land, etc.).
- 6.4: JEDI Framework: Transition to new DA infrastructure over next four years
- 6.5: Rapidly Updating Global: Develop and test global hourly updating FV3-based system