



GMAO Updates – FP Systems and Validation

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- **GEOS FP Releases since IGC8**
- **FP Coming Attractions**
- **GMAO Constituent Transport Evaluation during Development**



GEOS Near Real Time Systems (Continuous Upgrades, Highest Resolution)

GEOS Product Identifier	Product Description	GEOS Version Used	Periods Covered	Data Access	Documentation
GEOS FP	NRT assimilation (DAS), 10-d fcst at 00z, and 5-d fcst at 12z (See schedule above.) See details (spatial resolution, frequency, input data, known problems,...) [Processing Timeline]	5.22	3/13/2019 - on-going	Latest version of forecasts (recent 6 months) and DAS available on NCCS data portal**	File Specifications: GEOS FP (v1.2) [Current] GEOS FP (v1.1) GEOS FP (v1.0)
	Archived forecast and DAS data See details	5.21	7/11/2018 - 3/13/19		GEOS File Specification Variable Definition Glossary
	Archived forecast and DAS data See details	5.17	11/01/2017 - 7/11/018		Technical Report: The GEOS Data Assimilation System - Documentation of Versions 5.0.1, 5.1.0, and 5.2.0
	Archived forecast and DAS data See details	5.16	1/24/2017 - 11/01/2017		GEOS ADAS System Changes: From GEOS-5.2.0 (MERRA) to GEOS-5.11.0

https://gmao.gsfc.nasa.gov/GMAO_products/NRT_products.php



GEOS Reanalysis Systems (Unchanging GEOS System, Moderate Resolution)

(MERRA-2 Runs ~2 weeks behind real time)

GEOS Product Identifier	Product Description	Product Information	Periods Covered	Data Access	Documentation
MERRA-2	Atmospheric reanalysis for the satellite era, including coupled aerosols	MERRA-2 Project Page	1/1/1980 - ongoing	Data available at MDISC, managed by GES DISC MERRA-2 User Metrics	MERRA-2 File Specifications MERRA-2 Technical Memorandum
M2AMIP	MERRA-2 AGCM (10 members, plus ensemble mean and variance) with the same SST's and other climate forcing	MERRA-2 AMIP Page	1980-2017 (to be updated)	NCCS Portal	MERRA-2 AMIP File Specification MERRA-2 AMIP Technical Memorandum
Downscaled MERRA-2	MERRA-2 dataset downscaled to 12.8km resolution		1/1/2002-1/12/2016		

https://gmao.gsfc.nasa.gov/GMAO_products/reanalysis_products.php



GMAO GEOS FP System upgrades since IGC8

FP Version	Date Implemented	Details of Change	Impact on Results
5.17	Nov 1, 2017	<ul style="list-style-type: none"> Updated topography data set Assimilating AERONET data 	<ul style="list-style-type: none"> Improved Forecast Skill Better representation of precipitation over topography
5.21	July 18, 2018	<ul style="list-style-type: none"> GCM: RRTMG longwave radiation, moist physics tuning GCM: higher order divergence damping Analysis: All-sky GPM Assimilation: Upgraded IAU for stability 	<ul style="list-style-type: none"> Improved agreement of OLR with CERES-EBAF reduced temperature biases in some locations between 850 and 150mb
5.22	Mar 13, 2019	<ul style="list-style-type: none"> GCM: More effective sponge layer near lid Analysis: Assimilate CrIS and ATMS on NOAA-20 Analysis: Improved observation error statistics 	<ul style="list-style-type: none"> More accurate short-range forecasts (reduced bias) wrt radiosondes

Note: present GEOS FP file specification is unchanged from previous system. Upcoming system changes will include output on the cubed sphere grid at a horizontal resolution to be determined



GEOS FP System Upgrades Under Evaluation

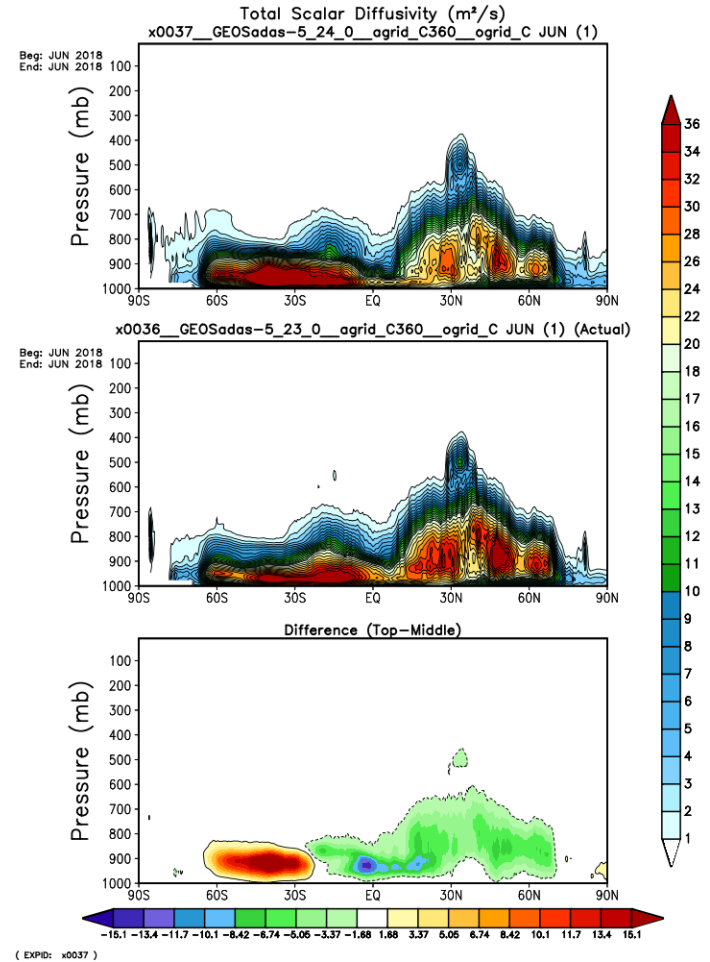
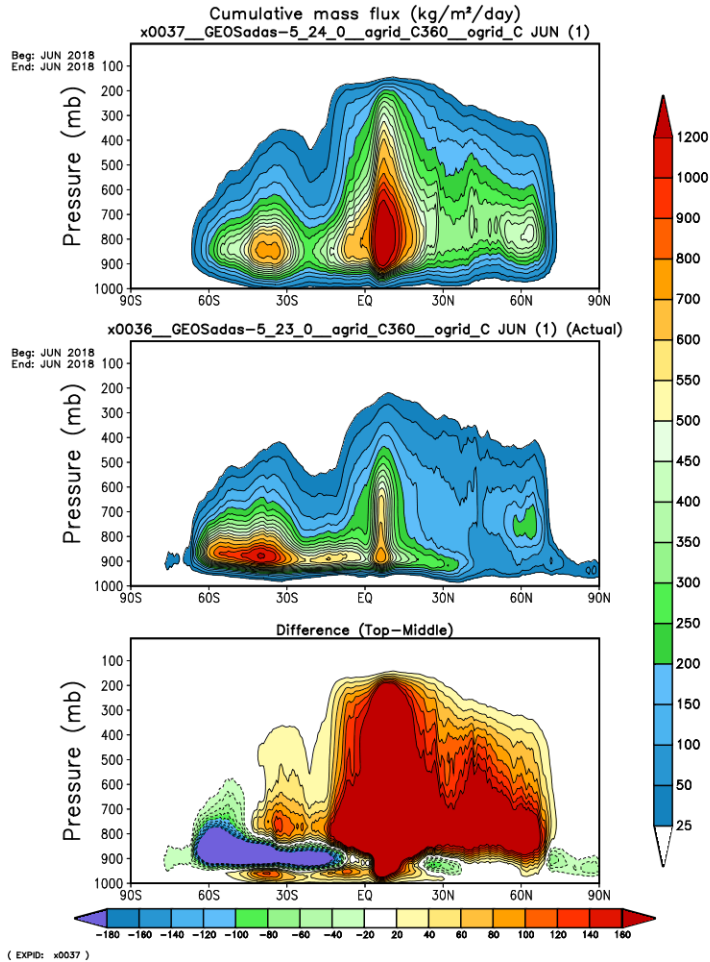
- **Analysis System Data and Ensemble Upgrades**
- **Model: Replacement of RAS with Grell-Freitas cumulus parameterization**
- **Model: Implementation of Bretherton Shallow Convection Parameterization**

Scale dependence of Parameterized Precipitation in GEOS GCM

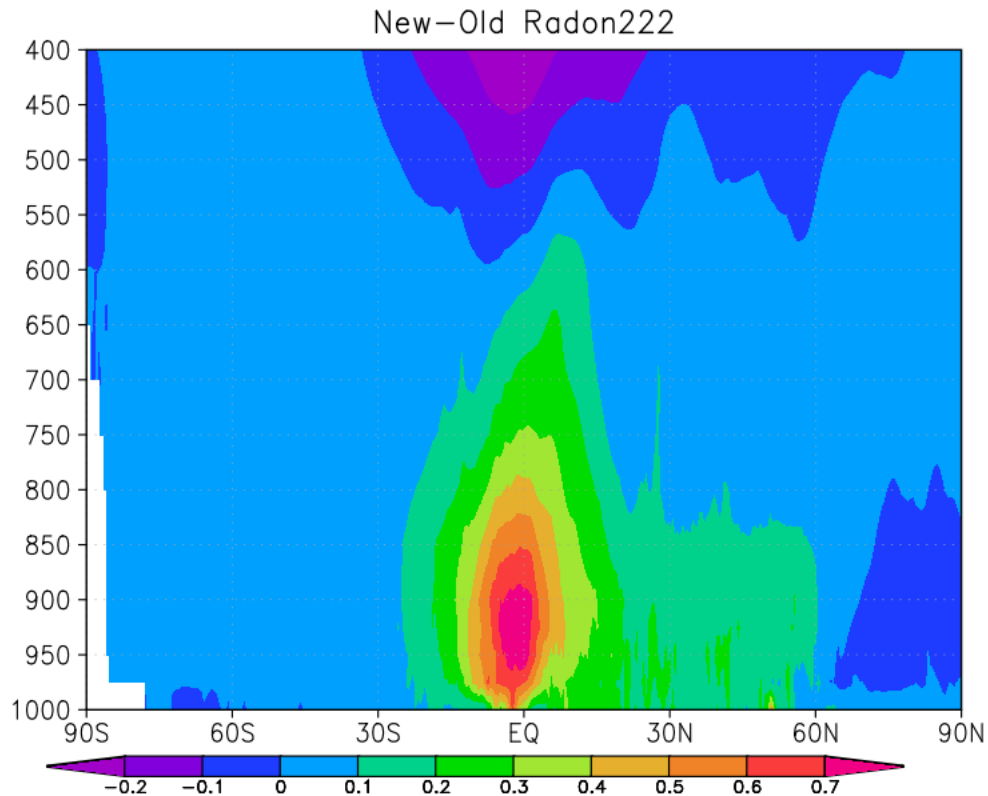
Horizontal Resolution	Grid Size	GF Conv/Total (mm/day)	RAS Conv/Total (mm/day)
C0090	~100km	2.03/3.09 – 66%	1.74/2.9 – 60%
C0180	~ 050km	2.00/3.07 – 65%	1.2/2.8 – 42%
C0360	~ 025km	1.91/3.10 – 62%	0.7/3.10 – 22%
C0720	~ 012km	1.40/3.10 – 45%	0.42/2.9 – 14%
C1440	~ 006km	1.12/3.09 - 36%	
C2880	~ 003km	1.02/3.07 – 33%	



Implications of Changes in Atmospheric Physics



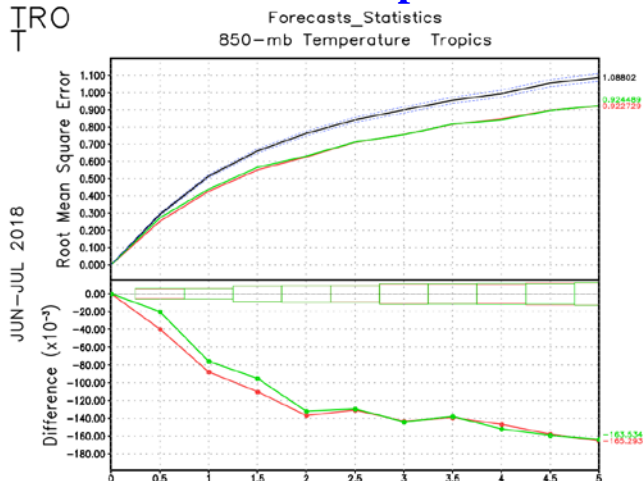
Implications of Changes in Atmospheric Physics



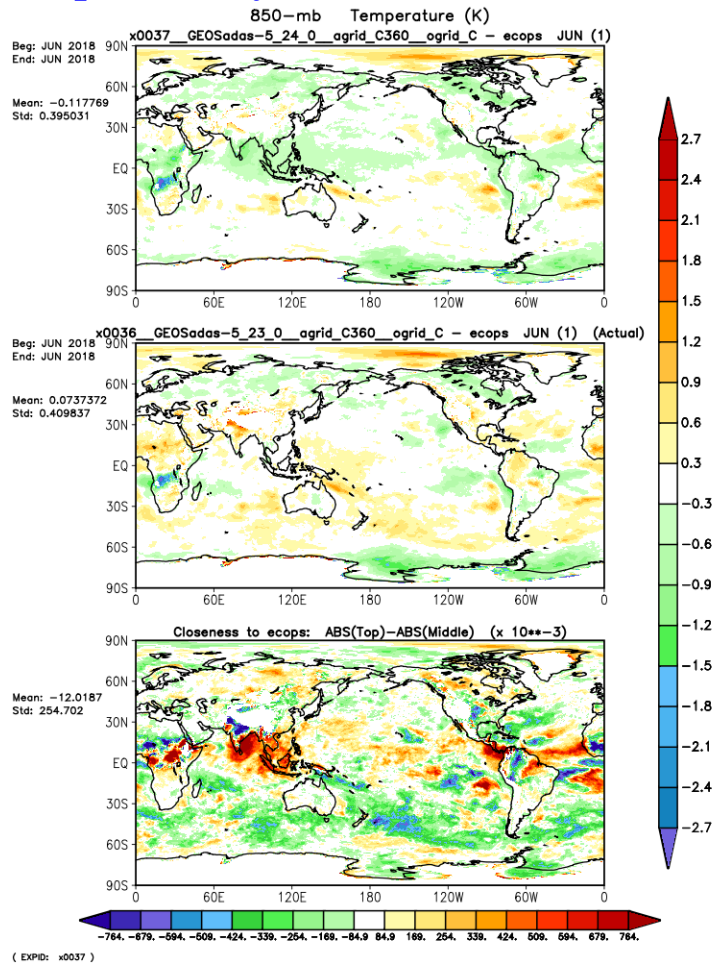
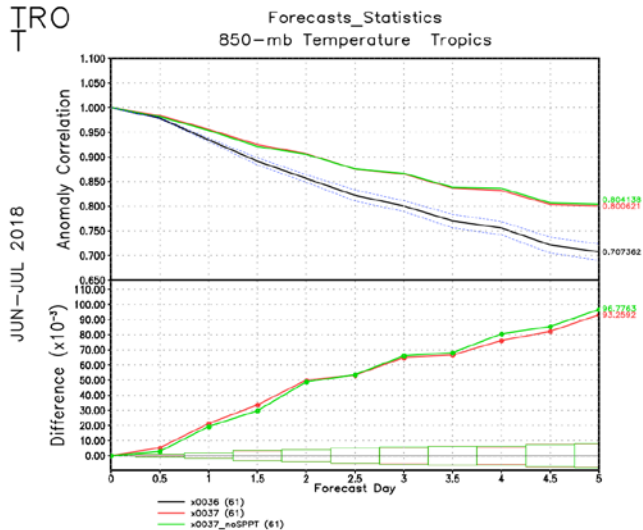


Implications of Changes in Atmospheric Physics

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GEOS FP System Constituent Transport Evaluation

- **Constituents and Idealized Tracers: CO, Rn222, SF6, AOA, AOA_NH**
- **Atmosphere-only simulations, ~30 years duration at ~50 km**
- **Year-long Data Assimilation experiments at ~25 km, run in several segments with output adequate for GEOS CTM simulations**
- **Evaluation of all experiments relative to observations (Rn222, CO), relative to observation-driven estimates of idealized tracers (AOA)**
- **Relevant metrics for decisions about candidate FP systems are under development**

Collaborative effort among GMAO, GSFC Chemistry and Dynamics Laboratory, GISS



GMAO at IGC9:

Steven Pawson (steven.pawson@nasa.gov):

GEOS-Chem and the GMAO: Reaction, replay, and reanalysis - Monday AM

Andrea Molod (andrea.molod@nasa.gov):

GMAO Update – Monday AM

Christoph Keller (christoph.a.keller@nasa.gov):

Machine Learning Emulator – Monday AM posters A3

Pamela Wales (pamela.a.wales@nasa.gov):

Stratospheric halogen loading in GEOS-Chem UCX and satellite-based retrievals of tropospheric BrO

Tuesday AM Posters B18

Emma Knowland (Katherine.knowland@nasa.gov):

Near real-time forecasts at 25km horizontal resolution - Wednesday AM

GSFC Atmospheric Chemistry and Dynamics Laboratory at IGC9:

Susan Strahan (susan.Strahan@nasa.gov) – Co-chair of new Stratospheric Chemistry Working Group