GEOS-5 Data Assimilation System Updates

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GEOS-5 Data Assimilation Streams

2013 REAL TIME PROCESSING

GEOS 5.7.2 ¼°
FP-IT GEOS 5.9.1 ½°
GEOS 5.2.0 (IT) ½°

GEOS 5.10.1 ¼°

2000  2005  2010
FROM 1979 >
MERRA - GEOS 5.2.1 ½°
RP_IT 5.9.1 ½°

REANALYSIS/REPROCESSING

MERRA 2 - GEOS 5.10.1 ¼°
NCA 5.10.1 ¼°

FROM 1979 >

Run continues into future  Length of Experiment  Experiment Complete thru

4/23/2013
MERRA (5.2.1) → MERRA2 (5.10.1)

MERRA DAS ingests data types that are dwindling and soon disappearing, new data types/instruments available

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<th>MERRA (5.2.1)</th>
<th>MERRA2 (5.10.1)</th>
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| Radiance       | NOAA-17 HIRS
NOAA-15 AMSUA
NOAA-18 AMSUA
Aqua AMSUA
Aqua AIRS *
NOAA-18 MHS    | NOAA-17 HIRS
NOAA-19 HIRS
MetOp-A,B HIRS
NOAA-15 AMSUA
NOAA-18 AMSUA
NOAA-19 AMSUA
MetOp-A,B AMSUA
Aqua AMSUA
Aqua AIRS *
MetOp-A,B IASI *
NOAA-18 MHS
MetOp-A,B MHS
GOES SNDR
NPP ATMS
MeteoSat-9 SEVIRI
MeteoSat-10 SEVIRI
NPP CrIS *
DMSP SSMI/S    |
| (*hyper-spectral) (Beyond end of predicted lifespan) |                                                                            |                                                                              |
| Total          | ~1.7 million/6h                                                               | ~5.0 million/6h                                                               |
AIRS and AMSUA (ATOVs) represent a large fraction of observations in MERRA.
MERRA (5.2.1) $\rightarrow$ MERRA2 (5.10.1)

**GSI:**
- Observations able to be assimilated
- New background error covariance formulation (incl. mass-wind balance)
- Change in moisture variable: Q1 (like q) to Q2 (like RH)
- Aerosol assimilation

**GCM:**
- Fundamental changes in physical parameterizations affecting chemistry and transport:
  1. Repressed deep convection at $\frac{1}{2}$ and particular at $\frac{1}{4}$ deg
  2. Increased near-surface turbulence over most surfaces
  3. Generally higher specific and relative humidity
  4. New PBL Height diagnostic
- Cubed Sphere Grid
- Horizontal-resolution aware moist physics
Cumulus mass flux in all current GEOS-5 systems (5.7, 5.9, 5.10) is suppressed at \( \frac{1}{2} \) and \( \frac{1}{4} \) deg resolutions relative to MERRA.
Combination of AGCM changes in moist parameterizations and GSI change from Q1 to Q2 results in an assimilated moisture field that is wetter than MERRA
MERRA (5.2.1) → MERRA2 (5.10.1)
MERRA (5.2.1) ⇒ MERRA2 (5.10.1)

Summer PBL Depth for arid, hot deserts

From E. McGrath Spangler

July PBL Depth for ARM SGP

January PBL Depth for ARM SGP

NASA Goddard Space Flight Center
GLOBAL MODELING AND ASSIMILATION OFFICE
“Replay” in GEOS-5: Basic Idea and Uses

“Replay” → Essentially reproduce data assimilation meteorological fields during a simulation. Follow atmospheric synoptic scale events.

Current uses in GMAO:

• Coupled atmosphere-chemistry - fully coupled alternative to offline Chemistry Transport Model experiments
• Coupled atmosphere-ocean (for Ocean Data Assimilation, e.g.)
• Testbed for impact of model changes on data assimilation experiments (examine “analysis increments”)

Replay options:

• “Replay” any and all meteorological fields individually/together
• Use (almost) any data assimilation system (MERRA, ERA Interim, NCEP...)
• Use any convective mass fluxes or turbulent diffusion coefficients as an alternative to GEOS-5 AGCM parameterized fields
"Replay" in GEOS-5: Flow Diagram

- **3z**
  - Forecast
  - Read analysis: increment = analysis - forecast
  - Replay with increments/6hr

- **6z**
  - Forecast
  - Read analysis: increment = analysis - forecast
  - Replay with increments/6hr

- **9z**
  - Forecast

- **12z**
  - Forecast

- **15z**
GEOS-5 Systems Information

WIKI page - General user information and links:  geos5.org

MERRA References:


Special Issue in J. Climate, 2012

AGCM development since MERRA:


More questions?

GEOS-5 part of the Q&A this evening at 5PM

Steven Pawson (steven.pawson@nasa.gov), Andrea Molod (andrea.molod@nasa.gov) from GMAO are here today and tomorrow, and available by email