The GEOS-5 System & Future Plans

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&
GMAO

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GEOS-5 Atmospheric DAS

(Supported by NASA MAP Program)

AGCM

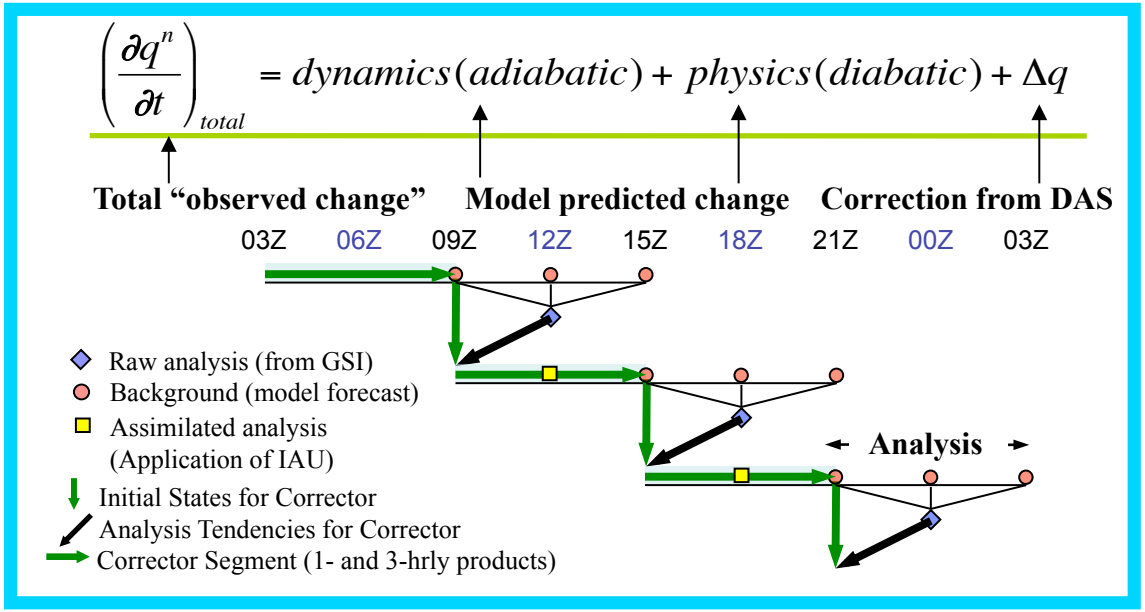
- Finite-volume dynamical core (S.J. Lin)
- Moist physics (J. Bacmeister, S. Moorthi and M. Suarez)
- Physics integrated under the Earth System Modeling Framework (ESMF)
- Generalized vertical coord to 0.01 hPa
- Catchment land surface model (R. Koster)
- Prescribed aerosols (P. Colarco)
- Interactive ozone
- Prescribed SST, sea-ice

Analysis

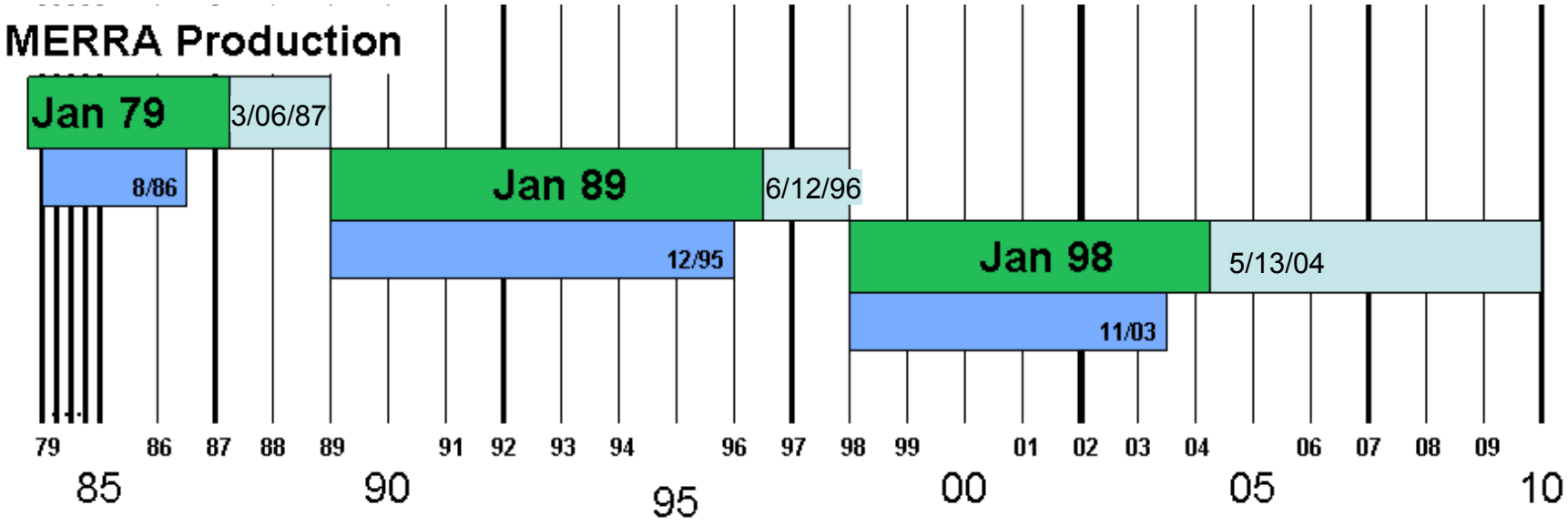
- Grid Point Statistical Interpolation (GSI from NCEP)
- Direct assimilation of satellite radiance data using JCSDA Community Radiative Transfer Model (CRTM)
- Variational bias correction for radiances
- Met analysis and ozone analysis

Assimilation

- Apply Incremental Analysis Updates (IAU) to reduce shock of data insertion (Bloom et al.)
- IAU gradually forces the model integration throughout the 6 hour analysis period
- Allows for 1 hourly diagnostic output



MERRA Production Status 4/27/2009



Length of Experiment

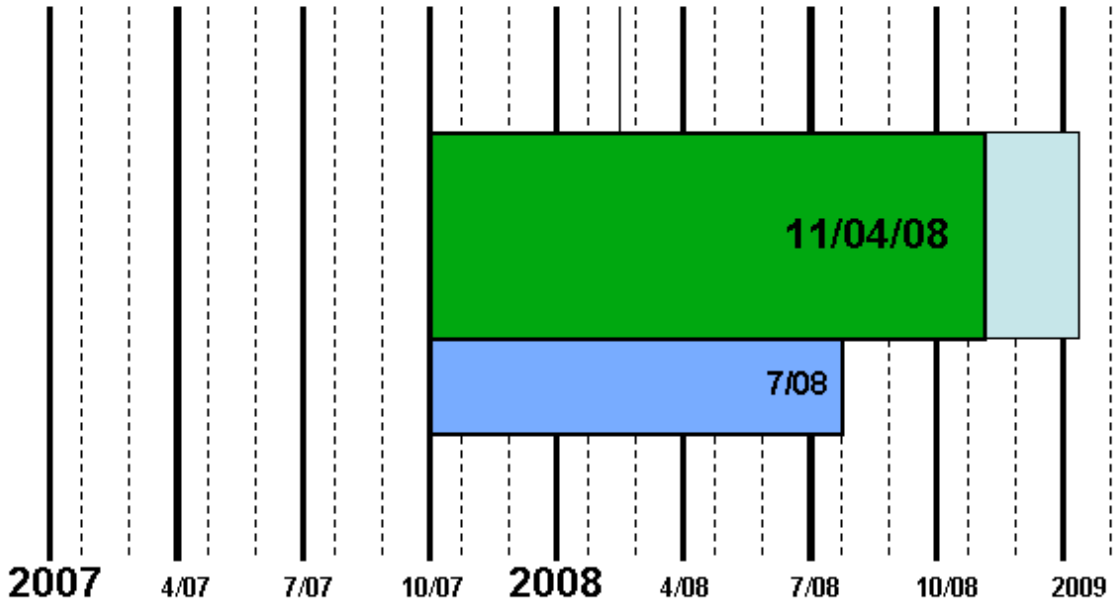
HALTED | RUNNING | Complete

DATA DELIVERED Thru Data Date

~~DATA RELEASED~~ FOR DELIVERY ~~Thru Data Date~~

NOTE:*
Scout 92 – S/W upgraded on 12/15/95
Scout 99 – S/W upgraded on 9/15/01

G5-CERES Production Status 4/24/2009



Length of Experiment | Halted | Running | DATA RELEASED | DATA DELIVERED Thru Data Date | DATA RELEASED FOR DELIVERY Thru Data Date

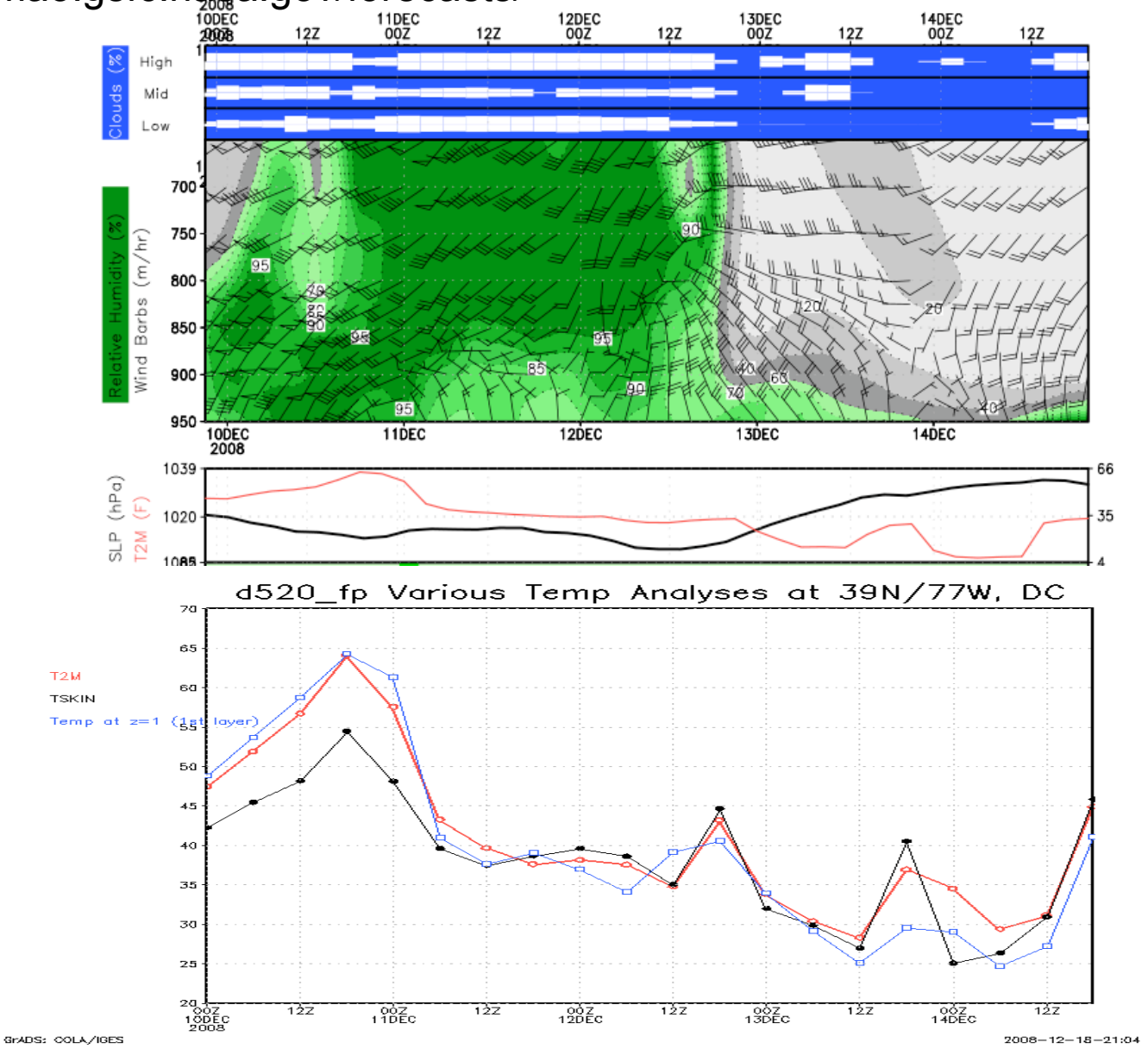
G5-CERES: restricted input data streams

DATA SOURCE/TYPE	PERIOD	DATA SUPPLIER
Conventional Dat a		
Radiosondes	1970 - present	NOAA/NCEP
PIBAL winds	1970 - present	NOAA/NCEP
Wind profiles	1992/5/14 - present	UCAR CDAS
Conventional, ASDAR, and MDCRS aircraft reports	1970 - present	NOAA/NCEP
Dropsondes	1970 - present	NOAA/NCEP
PAOB	1978 - present	NCEP CDAS
GMS, METEOSAT, cloud drift IR and visible winds	1977 – present	NOAA/NCEP
GOES cloud drift winds	1997 – present	NOAA/NCEP
~~EOS/Terra/MODIS winds~~	~~2002/7/01 – present~~	~~NOAA/NCEP~~
~~EOS/Aqua/MODIS winds~~	~~2003/9/01 – present~~	~~NOAA/NCEP~~
Surface land observations	1970 - present	NOAA/NCEP
Surface ship and buoy observations	1977 - present	NOAA/NCEP
SSM/I rain rate	1987/7 - present	NASA/GSFC/DAAC
SSM/I V6 wind speed	1987/7 - present	RSS
TMI rain rate	1997/12 - present	NASA/GSFC/DAAC
QuikSCAT surface winds	1999/7 - present	JPL
~~ERS-1 surface winds~~	~~1991/8/5 – 1996/5/21~~	~~CERSAT~~
~~ERS-2 surface winds~~	~~1996/3/19 – 2001/1/17~~	~~CERSAT~~

Satellite Dat a		
TOVS (TIROS N, N-6, N-7, N-8)	1978/10/30 – 1985/01/01	NCAR
(A)TOVS (N-9; N-10 ; N-11; N-12)	1985/01/01 - 1997/07/14	NOAA/NESDIS & NCAR
ATOVS (N-14; N-15; N-16; N-18; N-18)	1995/01/19 - present	NOAA/NESDIS
~~EOS/Aqua~~	~~2002/10 - present~~	~~NOAA/NESDIS~~
SSM/I V6 (F08, F10, F11, F13, F14, F15)	1987/7 - present	RSS
~~GOES sounder T_B~~	~~2001/01 - present~~	~~NOAA/NCEP~~
SBUV2 ozone (Version 8 retrievals)	1978/10 - present	NASA/GSFC/Code 613.3

Problem! Very cold forecast surface temperatures in Dec 2009 for DC!

http://gmao.gsfc.nasa.gov/forecasts/



Cold temperature problem most apparent in forecasts, "controlled" in analyses by assimilation.

Updates to GEOS-5 to correct this problem:

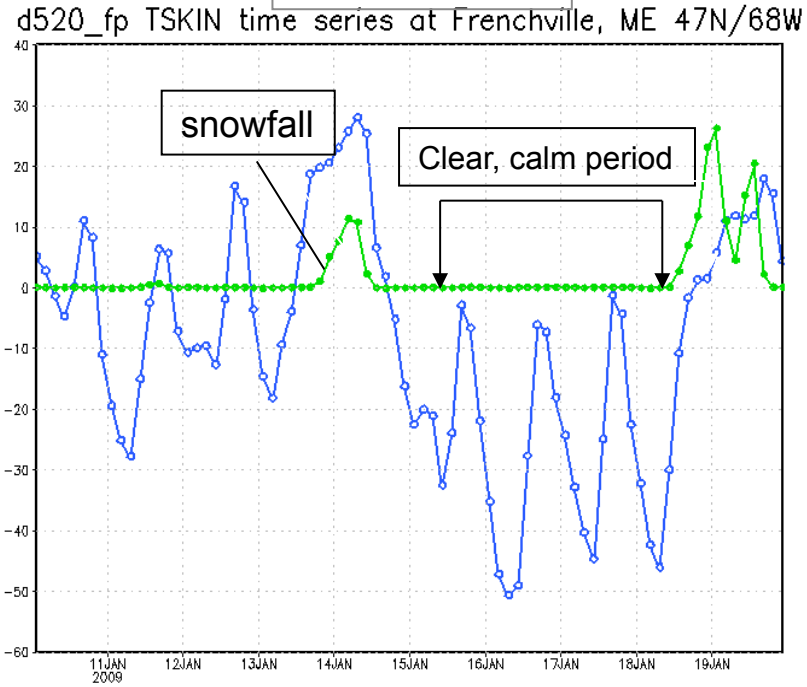
- increased the heat capacity in bare soil
- increased the minimum thickness of the snow layer to avoid very thin layers as snow is melting
- modified the viscous sublayer over ice so that it is treated the same as over other surfaces

Included in Year of Tropical Convection (YOTC) integrations

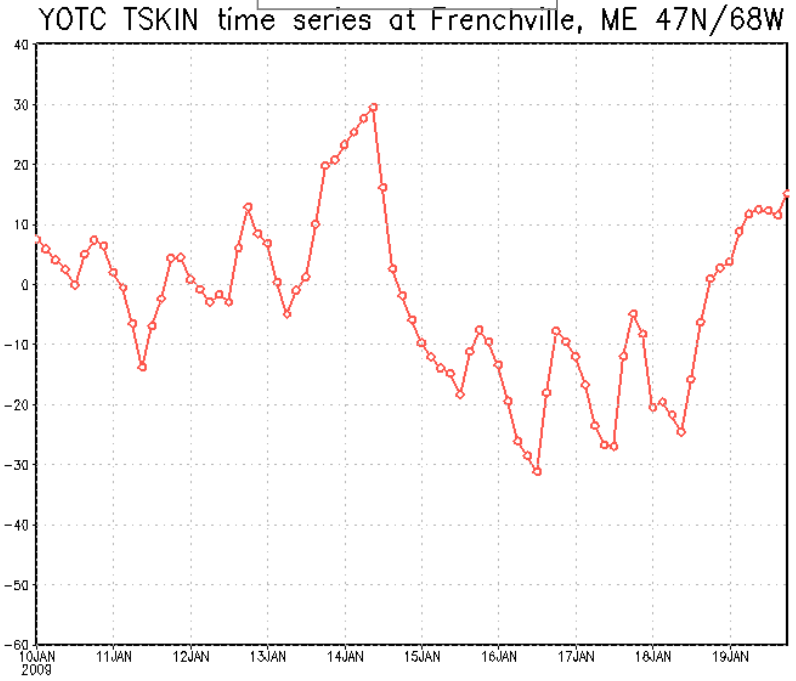
- GEOS-5.3.0
- model grid 0.25° × 0.33° × L72
- 3-hourly 3D and 1-hourly 2D products
- available soon on the NCCS data portal

Tskin Analyses at 47N, 68W

GEOS-5.2.0

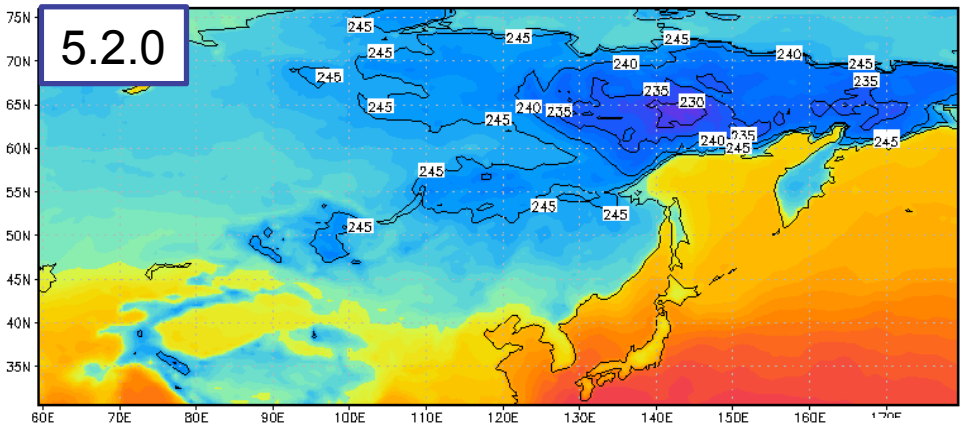


GEOS-5.3.0

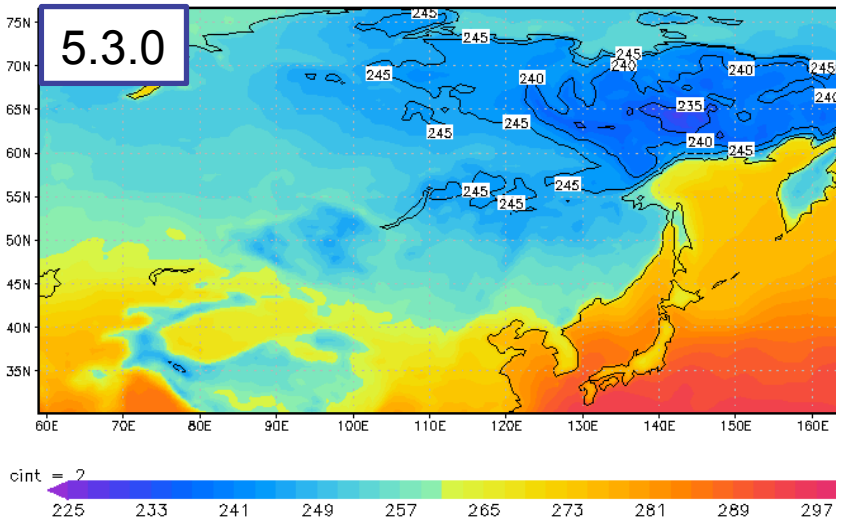


Tskin analyses, January 2009

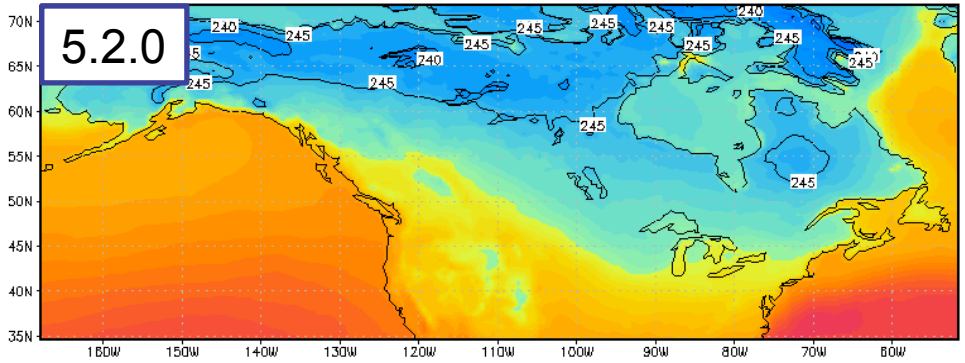
d520_fp Jan1–22 2009 TSKIN NE Asia



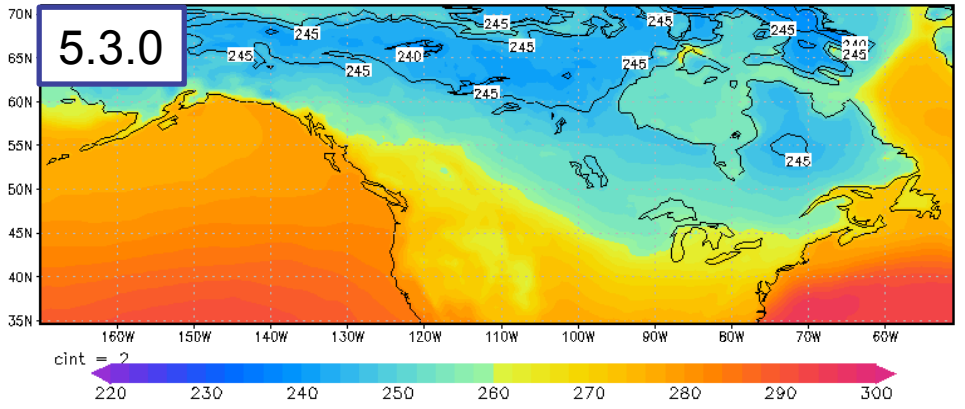
YOTC Jan1–22 2009 TSKIN NE Asia



d520_fp Jan1–22 2009 TSKIN NAMER



YOTC Jan1–22 2009 TSKIN NAMER



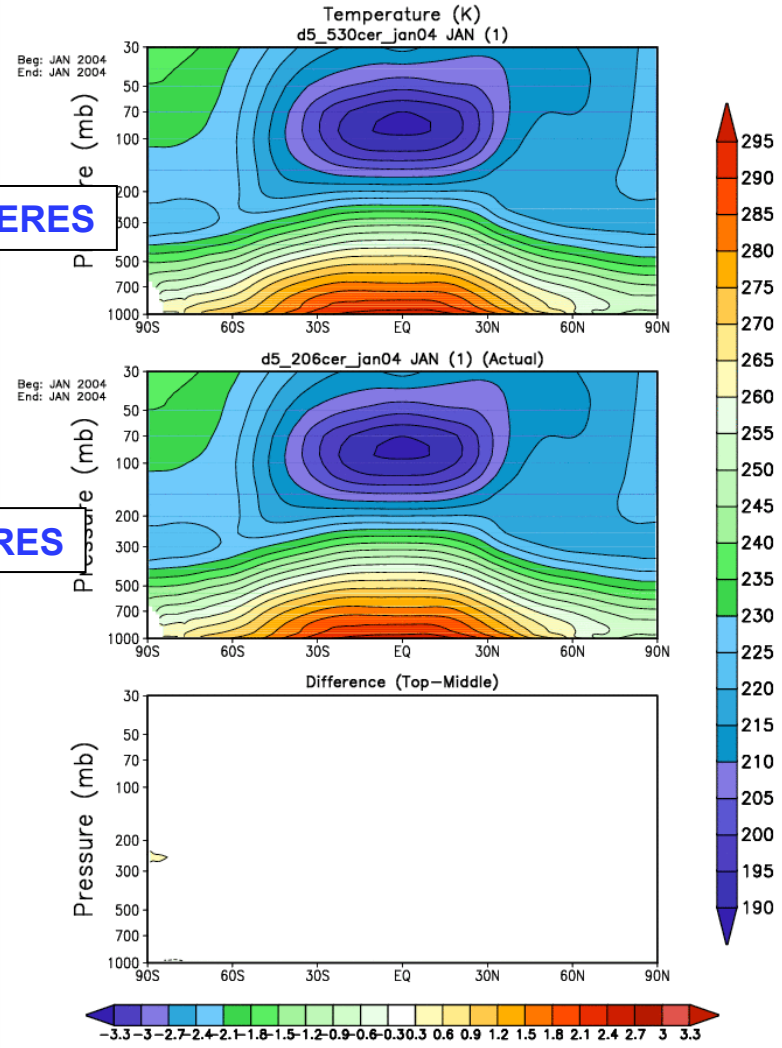
Temperature

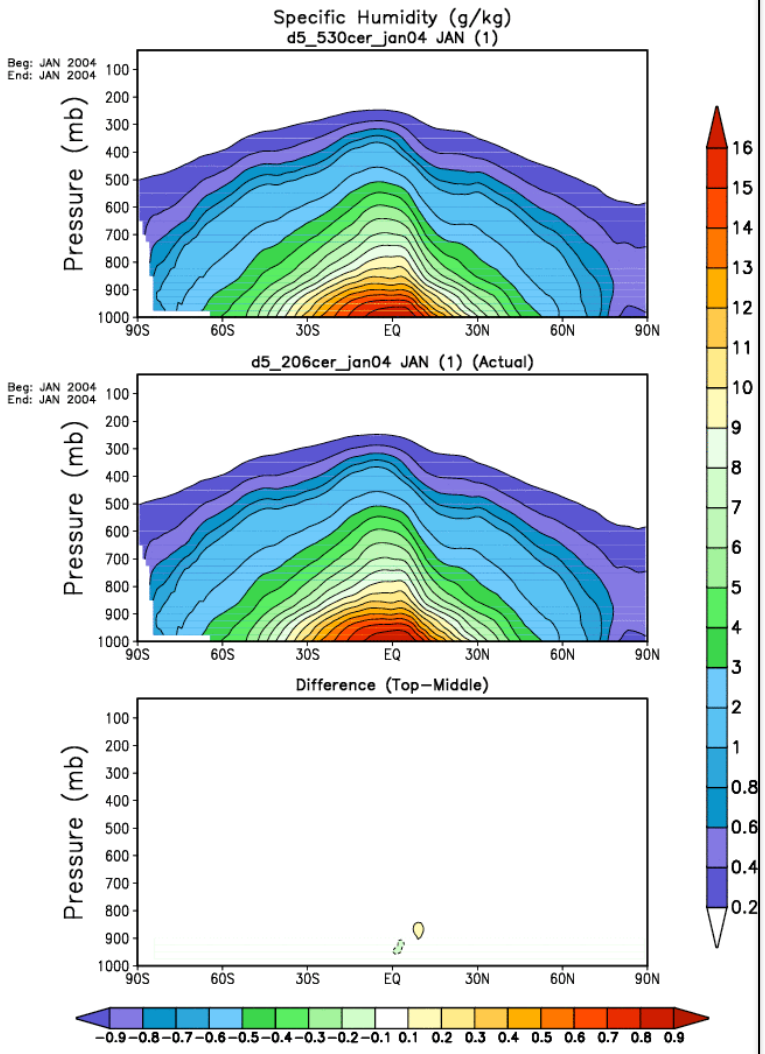
Specific Humidity

5.3.0 CERES

G5-CERES

Δ





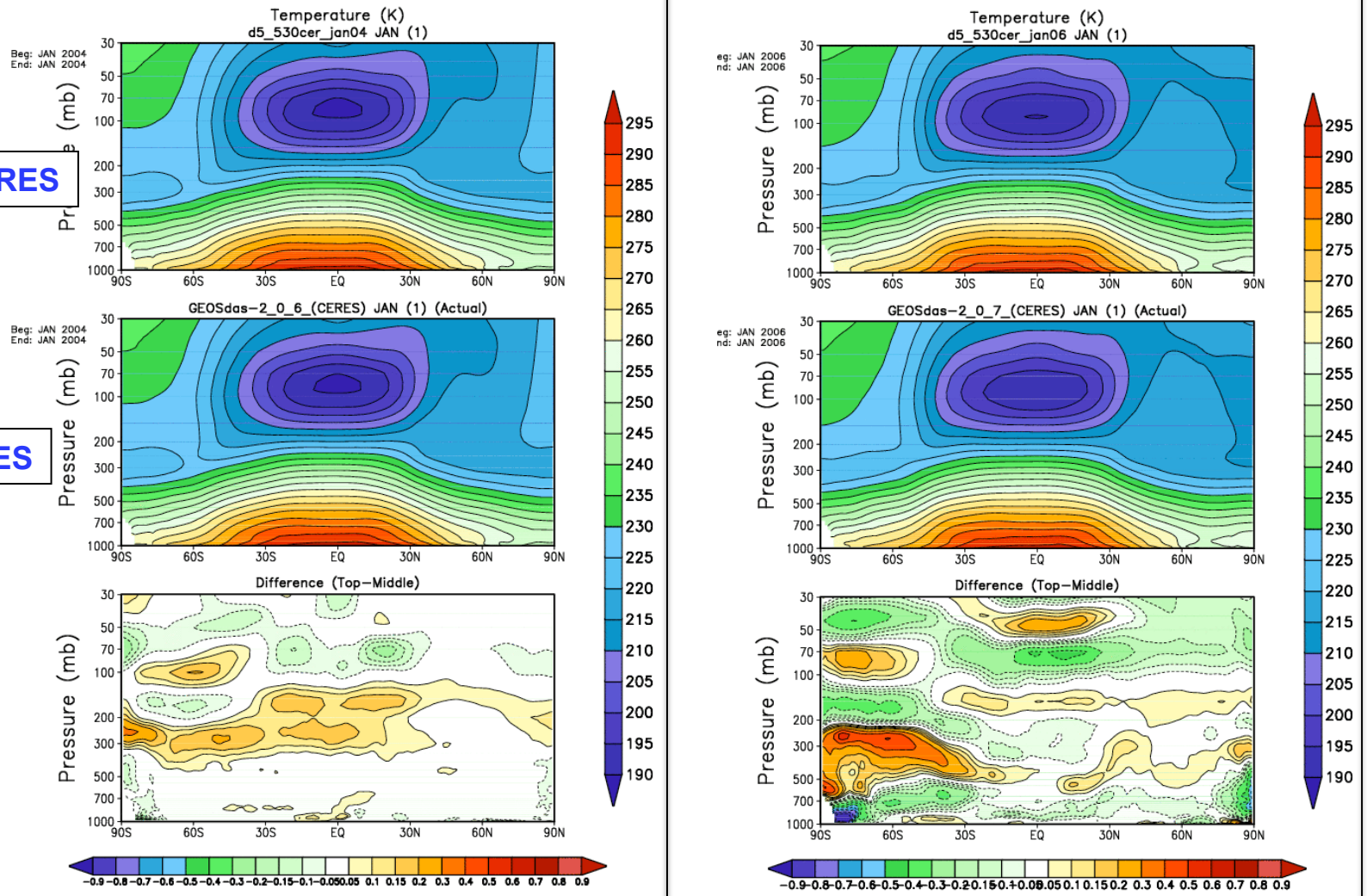
January 2004

January 2006

5.3.0 CERES

G5-CERES

Δ



Current update plans:

- GEOS-5.4.0
  - Finalizing latest merger with NCEP
  - Fv-cubed_sphere capable model
  - 4Dvar capable DAS
  - allows assimilation of IASI, COSMIC, Metop
  - better balance in analysis increment
- Parallel test mode scheduled for early June – will replace YOTC system
- NRT system now includes aerosol “analyses” and forecasts

- Next operational product will be 0.25° system, HDF5 – expect this ~August 2009 (working with NASA instrument teams on transition plans)

Proposal for CERES

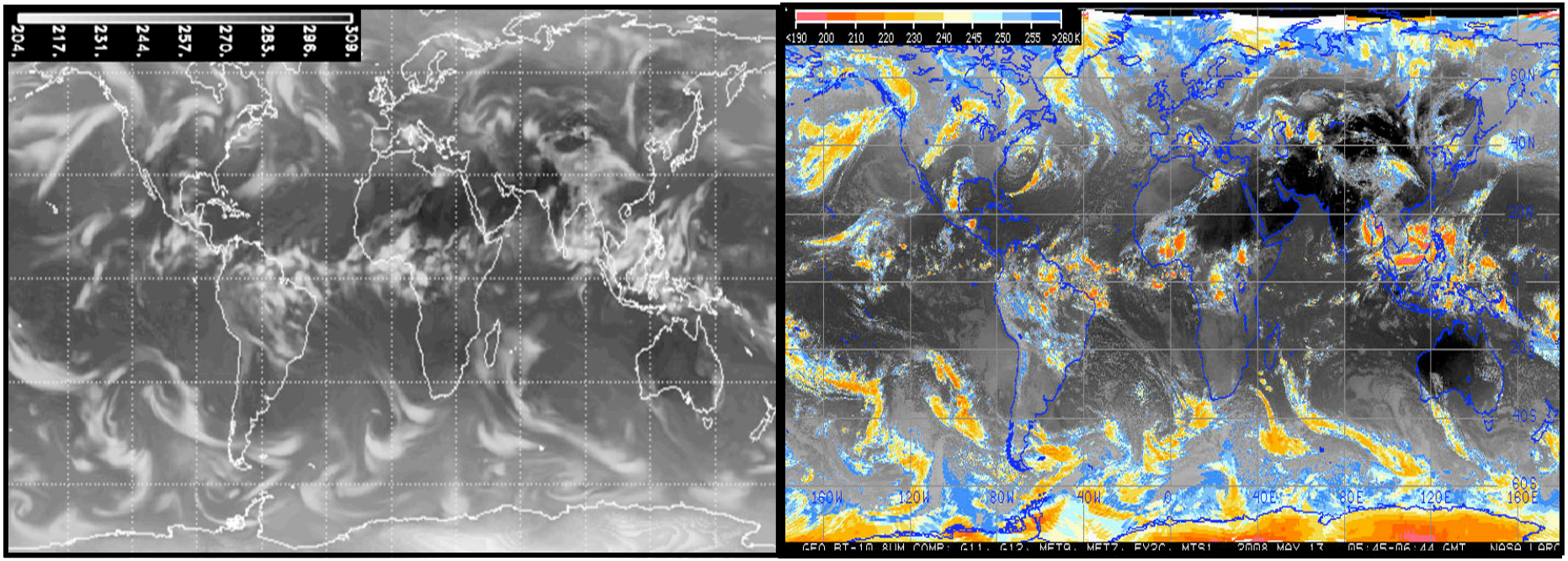
- Keep current G5-CERES integration for CERES Edition 2
- Implement 0.5° GEOS-5.4 configuration for reprocessing from 1997 onwards for Edition 3

New MAP project: ***"Use of Near-Real Time Satellite Retrieved Cloud and Surface Properties for Validating and Improving GEOS-5 Analyses and Forecasts"***

PI: Minnis

GEOS-5 simulated brightness temperature for GOES IR
6 UTC analysis 13 May 2008

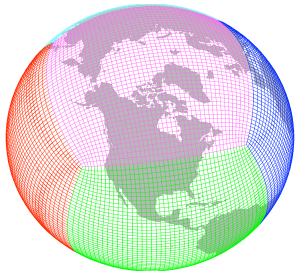
GEOsat IR observations
6 UTC analysis 13 May 2008



GEOS-5 cloud field (derived product, not assimilated) compares well with satellite data.

LaRC cloud products will be used to evaluate GEOS-5 cloud fields and eventually contribute to an assimilated product for Earth's energy budget analyses.

Minnis, LaRC; Da Silva, GSFC/GMAO



Finite Volume Cubed Sphere for GEOS-5/-6

S.J. Lin, W. Putman, M. Suarez

- ✓ Cubed-Sphere dynamical core
- ✓ Non-hydrostatic capability
- ✓ Coupled to GEOS-5 physics
- ✓ Climate models of the future; currently: dynamical downscaling of large-scale climate models
- ✓ Adjoint for 4D-var implementation of GEOS ADAS
- ✓ Performance targets:

  2009: 1/4 & 1/8° model with 1/2° 4DVar
  60 tracers with GMI chemistry

  2013: 1/8 & 1/16° non-hydro model with 1/4° 4DVar
  Chemistry at 1/4°

QuickTime™ and a MPEG-4 Video decompressor are needed to see this picture.

✓Interagency collaboration on infrastructure challenges: running on 10's of thousands of processors, I/O bottlenecks, etc.

- GEOS-5cs ported to NAS/Pleiades and ORNL/Jaguar
- Joint endeavor with NOAA/GFDL, DOE/ORNL/LLNL, NSF/NCAR
- GEOS-5 – WRF interactions to formulate GEOS-6 physics

Other plans:

- 4Dvar
  - Coarse resolution prototype run in NRT by end of 2009
  - FVcs adjoint ⟶ finer resolution implementation

- Tskin assimilation (LaRC product, with Pat Minnis)
- Nonhydrostatic global model development

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