Clear Sky OLR and Surface Skin Temperature from GMAO-GEOS4 and ECMWF Analyses

Man Li C. Wu

Global Modeling and Assimilation Office
Earth Sciences Directorate, NASA/Goddard Space Flight Center, Greenbelt MD 20771 USA
Outline

• CERES concerns on earlier GEOS4 Tskin analyses.
• Improvements in latest GMAO system.
  New LSM, Tskin Analysis, etc.
• New Results:
  GMAO Tskin is comparable to that of the ECMWF.
Warm colors => ECMWF better
Cold colors => GEOS4 better

CLR MAY 2001
OLD GEOS4 minus CERES Observed

BIAS = -1.9
RMS = 8

ECMWF minus CERES Observed

BIAS = -2
RMS = 7

OLD GEOS4 Error minus ECMWF Error

W/m²
Western U.S.

North Africa

Australia

Saudi Arabia

CERES Retrieved

CERES Retrieved

Tskin – OLD GEOS4 vs CERES

corr = 0.5111
slope = 0.3183
yint = 198.86
count = 3714
bias = 5.1417
std diff = 7.02428

corr = 0.7373
slope = 0.14098
yint = 179.39
count = 18679
bias = 1.47986
std diff = 7.88464

corr = 0.9314
slope = 0.8884
yint = 94.476
count = 25588
bias = 3.46949
std diff = 7.91351

corr = 0.8521
slope = 0.7732
yint = 87.788
count = 10708
bias = -2.60902
std diff = 4.49988
Tskill April 2001

NEW GEOS4 minus CERES Observed

BIAS = 1.5
RMS = 3.4

ECMWF minus CERES Observed

BIAS = 1.4
RMS = 4.0

NEW GEOS4 Error minus ECMWF Error

Warm colors => ECMWF better
Cold colors => GEOS4 better
Tskin July 2001

NEW GEOS4 minus CERES Observed

BIAS = 0.7
RMS = 3.6

ECMWF minus CERES Observed

BIAS = 0.2
RMS = 3.9

NEW GEOS4 Error minus ECMWF Error

Warm colors=> ECMWF better
Cold colors=> GEOS4 better
Warm colors=> ECMWF better
Cold colors=> GEOS4 better

Tskin October 2001
NEW GEOS4 minus CERES Observed

BIAS = 1.0
RMS = 3.4

ECMWF minus CERES Observed

BIAS = 1.7
RMS = 3.6

NEW GEOS4 Error minus ECMWF Error

OK
Warm colors => ECMWF better
Cold colors => GEOS4 better

BIAS = 2.2
RMS = 3.4

BIAS = 3.2
RMS = 3.4

Tskin January 2001
NEW GEOS4 minus CERES Observed

ECMWF minus CERES Observed

NEW GEOS4 Error minus ECMWF Error
Tskin and Clouds for 300E_330E; 70S_60S
Jan 2001
Tskin and Clouds for Central Eurasia – Jan 2001

ECMWF
NEW GEOS4
CERES
CLOUD TOP TEMPERATURE
Summary

• **Problems:**
  CERES was concerned about earlier GEOS4 surface skin temperature (Tskin).

• **Tskin improvement:**
  GMAO Tskin is now comparable with ECMWF.
  – New LSM, improved surface albedos.
  – Tskin analysis at 3hr intervals.
  – Smaller data window for surface TOVS.

• **Clear-sky OLR Comparisons:**
  CLR also comparable to ECMWF
  – ECMWF is better over ocean due to GEOS4 UTH problems
  – Over land statistics (bias, rms) are indistinguishable

• **Common biases in ECMWF and GMAO suggest cloud clearing problems in retrievals.**

  **GMAO HAS FROZEN GEOS4 FOR CERES REPROCESSING**
Next GMAO Assimilation system (GEOS5)

Joint Analysis System with NCEP - Accelerate the utilization and operational implementation of new satellite data types

- Flexible background error formulation in grid-space
- Advanced observation operators (radiances, winds)
- Increased observation count (~10^6/6-hr cycle)
- Run-time choices for NASA/NOAA applications

Input Observations
- Common Data Processing/QC

Input Model State
- NCEP AGCM
- GMAO AGCM

Interchangeable

Model→Analysis Interface (ESMF)

Analysis Algorithm
- Flexible background error formulation in grid-space
- Advanced observation operators (radiances, winds)
- Increased observation count (~10^6/6-hr cycle)
- Run-time choices for NASA/NOAA applications

NASA Development
- ESE Science Interests with NWP constraints on quality & performance

NOAA Development
- Primarily driven by operational NWP

Analysis→Model Interface (ESMF)

NASA metrics

NOAA metrics
- Partnerships: developing a unified model for NASA
- Enabling Technology:
  Earth System Modeling Framework (ESMF) ⇒ interchangeability

- Dynamical Core: fvGCM
- Radiation: Chou
- Convection: RAS
- Clouds (prognostic): McRAS (Sud et al)
  NSIPP-2
  NCAR (CAM2)
- Boundary Layer:
  NSIPP-2
  NCAR non-local
  Lock 2000
  Moist 2\textsuperscript{nd} Order (Helfand)

ESMF

Unified Model Running by Winter 2003