Current analysis development at NCEP/EMC

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History

• Historically reanalysis has used a version of an operational NWP data assimilation system
  – Allows use of state-of-the-art data assimilation system
  – Tested over many different situations
  – Allows use of operational data handling infrastructure
  – Development costs greatly reduced

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CFSv3.0
GFS GSI

- Current version has evolved from CFSv2.0
  - Infrastructure allows analysis of other variables
  - Inclusion of additional instruments
  - Many smaller enhancements
- Major upgrade being finalized for implementation (Spring 2012)
  - Uses hybrid EnKF/variational assimilation system
  - GPS RO bending angle rather than refractivity
500mb Anomaly Correlation
1000mb Anomaly Correlation
200mb Tropical winds
850mb Tropical winds
GFS GSI

• Under development
  – NSST analysis and inclusion of NSST model in forecast model
  – Climatological variation in CO$_2$, CH$_4$, CO, N$_2$O
    • Important for radiative transfer and use of radiance data
  – Cloud and precipitation analysis
  – Aerosol and trace gas analysis
What is NSST?

NSST is a T-Profile just below the sea surface. Here, only the vertical thermal structure due to diurnal thermocline layer warming and thermal skin layer cooling is resolved.

Assuming the linear profiles, then, 5 parameters are enough to represent NSST: $T_r, T'_w(0), z_w, T'_c(0), \delta_c$

Diurnal Warming Profile

\[ T'_w(z, t) = [1 - z / z_w(t)]T'_w(0, t) \]
\[ T'_w(0, t) = T(0, t) - T(z_w, t) > 0 \]

Skin Layer Cooling Profile

\[ T'_c(z, t) = [1 - z / \delta_c(t)]T'_c(0, t) \]
\[ T'_c(0) = T(\delta_c) - T(0) > 0 \]

$T'_w(0) < 5K, z_w \sim O(5m)$

$T'_c(0) < 1.0K, \delta_c \sim O(1mm)$
SST: \( T_s = T_r + T_w'(0) - T_c'(0) \)

Diurnal Variability of NSST at \( z=0 \) (05/17/2010 – 06/24/2010)
Diurnal Variability of Air temperature (05/17/2010 – 06/24/2010) $T_{2m}$
Validation of analysis: Histogram of O-B. 05/12/2010 – 06/24/2010

AVHRR_N18
Ch-4

Surface Air T

Sea T

Drifting Buoy Trajectory during these 44 days

- OLD (Used)
- OLD (All)
- NEW (Used)
- NEW (All)
Time series at drifting buoy locations.
Northern Mid-Latitude Atlantic, 05/12/2010 – 06/24/2010

- OLD (Used)
- OLD (All)
- NEW (Used)
- NEW (All)

Time Series: OB/BG
- 297.86
- 297.75
- 297.85
- 297.44
- 297.41
- 297.84
- 297.85

- All OB
- Used OB (OLD)
- Used OB (NEW)

Time Series: Num
- 116.04
- 134.40
- 136.23
- 136.23
- 18.369

NEW - OLD

Time Series: Bias (OB - BG)

Time Series: RMS (OB - BG)
CO2 sensitivity for AIRS
Methane sensitivity for AIRS

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Final Comments

• Data Mining – should be ongoing – expertise is going away
• Data Handling – messiest part of reanalysis. Who will do this work?
• Data Quality control of data also very important
• Needs ongoing development – NWP-Reanalysis feedback
• Mass-wind-moisture balance very important to get right
• How will you handle model biases?