Dataset History
The MSU Experience

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1989 Events

• Roy Spencer and I were skeptical of surface datasets at the time (both of us had been observers) - much extrapolation, areas dependent on single, error-prone stations, etc.

• Extracted MSU ch1-4 from NOAA-6, NOAA-7, merged together by removing annual cycle (latitude by latitude)

• Signal-to-noise was eye-popping (> 100 on daily global anomalies)
1989 Events

• Proposal to extract all archived MSU data from NOAA files was declined (cost ~$1.2 million) because the MSU stream was a tiny fraction of the total

• Contacted NCAR for all MSU data
  – Fortune had it that NCAR was just ready to transfer all TIROS-series data from TBM (Television) tape reels to new media (MSU about 1% of total)
  – During this operation, NCAR extracted the MSU orbit files for us - $25K, but we didn’t have to pay for the process of mounting, reading, archiving, etc.
  – Had this not happened, the dataset would have been years delayed
1989-90 Events

- Oct 1989 Presentation at NOAA Climate Diagnostic Workshop, La Jolla CA
- March 1990 Publication in Science
- Oct 1990 Publication in J. Climate
- Offered data to community via public ftp in ASCII files
Early Versions

- **UAH-A (Science 1990)**
  - Intersatellite Bias Removal
  - Annual cycle for a.m. and p.m. separately removed

- **UAH-B (IPCC SAR 1995)**
  - Simple diurnal correction applied to p.m. drifters when intersatellite divergence observed
  - -0.03 °C/decade (LT)

- **UAH-C (1998)**
  - Removal of residual annual cycle due to sensor (hot target) temperature variations
  - Define the “Backbone” satellites (a.m. orbiters)
  - +0.03 °C/decade (LT)
Early Versions

• Data better organized and placed on open internet accessible site with running commentary on issues and version updates (13 Jul 1999)

Update 15 Dec 2006 ************************************

Due to a dumb mistake, the values for MT were in error when loaded up for the period ending Nov 2006. Rather than eliminating NOAA-16 data (the bad satellite) I had eliminated NOAA-15 (the good satellite) after Sept 2005.

• **UAH-D** (2000, IPCC TAR 2001)
  – Orbital decay (LT only, Wentz and Schabel 1998)
    • +0.10 °C/decade
  – NOAA-12 recalibrated (still uncertainty in 2010)
    • -0.03 °C/decade
  – Transient sensor response to instrument heating/cooling
    • -0.04 °C/decade
Version 5

- **UAH 5.0**
  - MSU non-linear empirical diurnal correction
  - Add AMSU (NOAA-15) to time series
  - +0.01 °C/decade

- **UAH 5.1**
  - Data acceptance criteria tightened -0.004 °C/decade

- **UAH 5.2 (Lower Troposphere only - 2005, IPCC AR4)**
  - Mears and Wentz (2005) - artifact in LT diurnal correction
  - AMSU-based empirical diurnal correction for MSU data
  - +0.035 °C/decade

- **UAH 5.3 (Feb. 2010)**
  - Residual annual cycle improvement for AMSU period
  - +0.00 °C/decade
• Proposal to NOAA for independent construction of MSU dataset (1999?)
  – In line with NOAA emphasis on multiple organizations producing datasets independently

• Considerable experience on microwave sensors (MSU, SSM/I)

• Similar to UAH-D
  – Sensor correction based on hot-target temperature
  – Intersatellite bias correction (global)

• Different than UAH-D
  – Utilized more overlaps (shorter ones v. backbone)
  – diurnal correction based on Climate Model
Prabhakara (NASA)

  - Nadir footprint only (of 11)
  - Similar to UAH-A
  - Global values (no grids)
  - 1998 - Instrument heating effect
  - 2000 - Annual cycle variable

- Dataset not updated past 1998
  - TMT (channel 2) mentioned in IPCC TAR, but TMT was not displayed

- Dataset was difficult to acquire
Vinnikov/Grody (UMd/NOAA)

- **2003 (Science)**
  - Unique seasonal/diurnal harmonic determination
  - Unique instrument calibration
  - $T_{MT}, T_{LS}$ (Channel 2 and 4)
  - Zonal values (no grids)
  - Many versions in short period of time
- **Dataset not updated regularly**
  - $T_{MT}$ displayed in IPCC AR4, BAMS 2006
- **Dataset was available via internet but inconvenient format**
STAR (NOAA)

• **Zou (2009)**
  – Latest applies RSS diurnal correction
  – Unique satellite calibration adjustment
  – SNO (Simultaneous Nadir Overpass) for intersatellite bias adjustment
  – Easy web access to data
  – Versions change quickly
  – T2, T3, T4
  – Federally funded effort within agency

• **Dataset updated regularly**
  – Too late for IPCC AR4

• Trend values **UAH < RSS < STAR**
Radiosonde-Simulated and Reanalsyses-Simulated MSU

- Radiosonde/Reanlyses
  - HadRT, HadAT (Hadley Centre)
  - RATPAC (NOAA)
  - RICH, RAOBCORE (Haimberger)
  - ERA 40/I, JRA, NCEP Reanlyses

- 79-09 Trend values (Christy et al. 2010a,b)
- Tropical LT: +0.06 UAH < RICH ~ HadAT2 < RATPAC ~ RAOBCORE < RSS +0.15
- Global MT: +0.00 RATPAC < UAH < HadAT2 < RSS < STAR +0.13
Christy et al. 2010 Tropical Trends

The graph shows the trends in tropical temperatures from 1979 to 2005, represented by different datasets and time periods.

- **UAH53 LT** shows a slight increase in temperature.
- **RSS3.2 LT** and **HadAT LT** show a more pronounced increase, particularly from 1979 to 2006.
- **RATPAC LT** and **RC1.4 LT** also exhibit an increase, with **RATPAC LT** showing a notable rise from 1979 to 2008.
- **RICH LT** and **C10_ThrmWnd_LT** display similar trends, with a slight increase from 2005.
- **AS08_ThrmWnd_LT** and **ERSST3** show a significant increase, with **ERSST3** reaching its peak.
- **HadCRUT3v** and **GISS LOI** also show increases, with **GISS LOI** showing a slight increase from 2005.

The data is represented in C/decade, with time periods from 1979 to 2009.
What worked

• Updated at least monthly in a timely fashion
  – NCDC/CCDD requires by 10th of following Month

• Easy access of products
  – Derived products in ASCII
  – Users like simple time-series images and data
  – RSS has terrific analysis tools
  – Significant infrastructure based on other work

• Running documentation of updates/Versions
  – Continual attention to quality of product - “operational research”
  – Clear explanations of versioning
What worked

- Multiple, independent groups generating products
  - NCDC/CCDD requires by 10th of following Month
- Raw data archived by NOAA for everyone
- Willingness to cooperate with other producers, admit errors quickly, and announce broadly
- Funding
  - NOAA CCDD (~$20K/year) - operational funding
What didn’t work

• Uncertain update cycle for data release
• Obscure and changing path to access data
  – Unusual formatted data
• Numerous up-versioning events
  – Thoroughly test new version before uploading
  – Sometimes data altered without up-versioning
• Single point-of-failure
• Ad hoc, single scientist as producer
  – Marginal infrastructure and support
• Short-term Science Grant Funding Cycle
  – Agencies want “new work”
What would I have done differently

- Begin documentation (metadata) of the data set from the start
  - Descriptive flow chart of processes
- Involve certified software engineers to assure code is reliable and transferable
  - Not true today
  - Funds likely not available
- Prepare for up-versioning
  - Sometimes data altered without up-versioning
  - Retain earlier versions for appropriate length of time
- Identify and train back-up personnel
  - Potential to rely on centrally-run operations
- Be more cautious with statements of confidence
Plans

• MSU/AMSU temperature products workshop (March 2010) at NOAA (Zou)
  – Identify differences, offer explanations
• Exchange detailed descriptions of methodologies
• Goal is to standardize and certify our codes so as to be executable on federal infrastructure, but recognizing ownership of the algorithms
  – Code rewriting/certification by approved contractor