Dataset History
The MSU Experience

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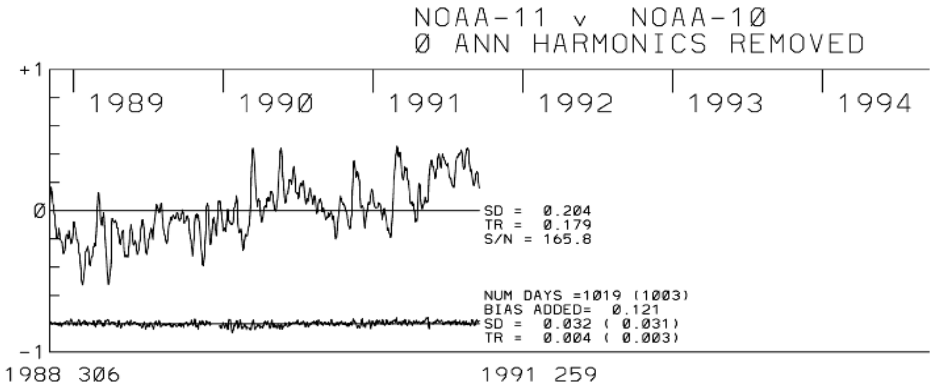
1989 Events

- 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

Remote Sensing Systems
Wentz and Mears

- **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)

- Prabhakara (1995, 1998, 2000)
  - 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**

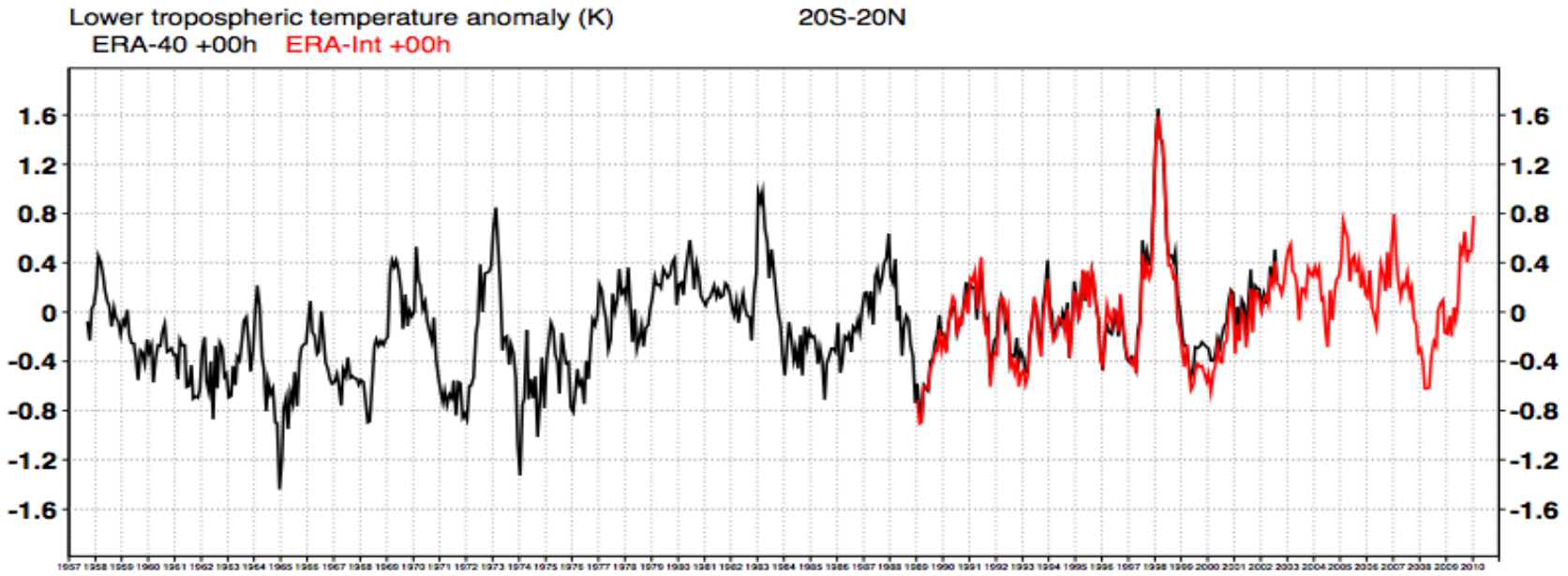
STAR (NOAA)

- **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**

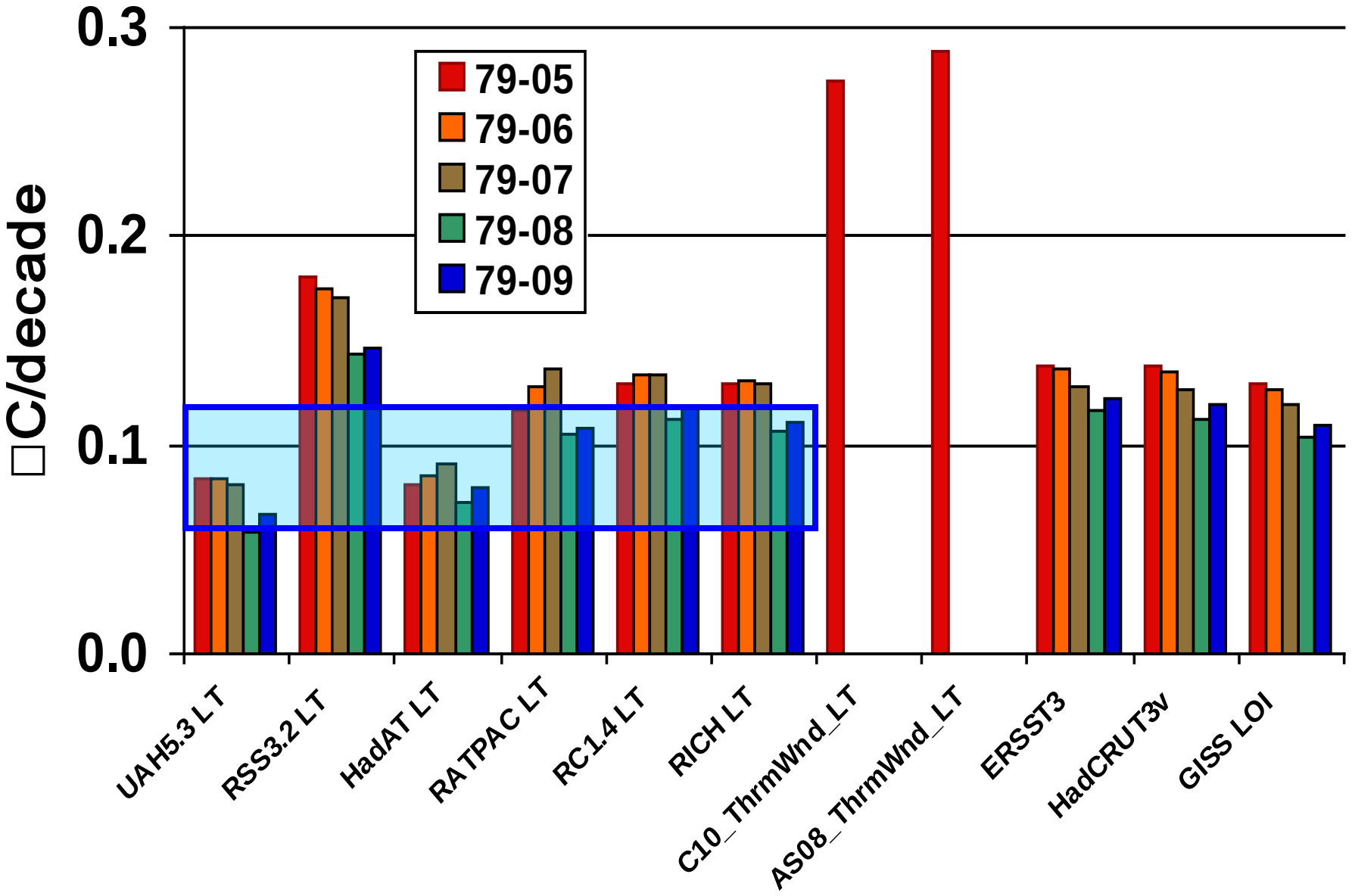
Radiosonde-Simulated and Reanalsyses-Simulated MSU

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

ERA 40/I


Lower tropospheric temperature anomaly (K)
20S-20N
ERA-40 +00h
ERA-Int +00h
1.6
1.2
0.8
0.4
0
-0.4
-0.8
-1.2
-1.6

Christy et al. 2010 Tropical Trends



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**