Consistent Radiance FCDR and Upper-Air Temperature TCDR from MSU/AMSU/SSU

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Outline

- Project Description
- Production and QA Approach
- Applications
- Schedule & Issues

Project Description (2-1)

- Develop MSU/AMSU/SSU radiance FCDR to support consistent modeling reanalysis activities and consistent satellite retrievals

CDR(s) (Validated Outputs)	Period of Record	Spatial Resolution; Projection information	Time Step	Data format	Inputs	Uncertainty Estimates (in percent or error)	Collateral Products (unofficial and/or unvalidated)
MSU FCDR (3 chs)	1979-2006	110 km	25.6 sec (scan-line)	netCDF	Raw Counts SNO Cal. Coefficients	Abs. Bias: 0.5-1 K Rel. bias 0.05-0.1 K	Limb, diurnal, corrected L1C
AMSU-A FCDR (11 chs)	1998-present	45 km	8 sec. (scan-line)	netCDF	Raw Counts SNO Cal. Coefficients	Abs. Bias: 0.5-1 K Rel. bias 0.05-0.1 K	Limb, diurnal, freq. corrected-L1C
SSU FCDR (3 chs) (Cell pres. CO2 corrected)	1979-2006	147 km	32 sec. (scanline)	netCDF	SSU L1B MERRA	~ 0.5 K	Limb, Dirunal, Atmo. CO2 corrected L1C

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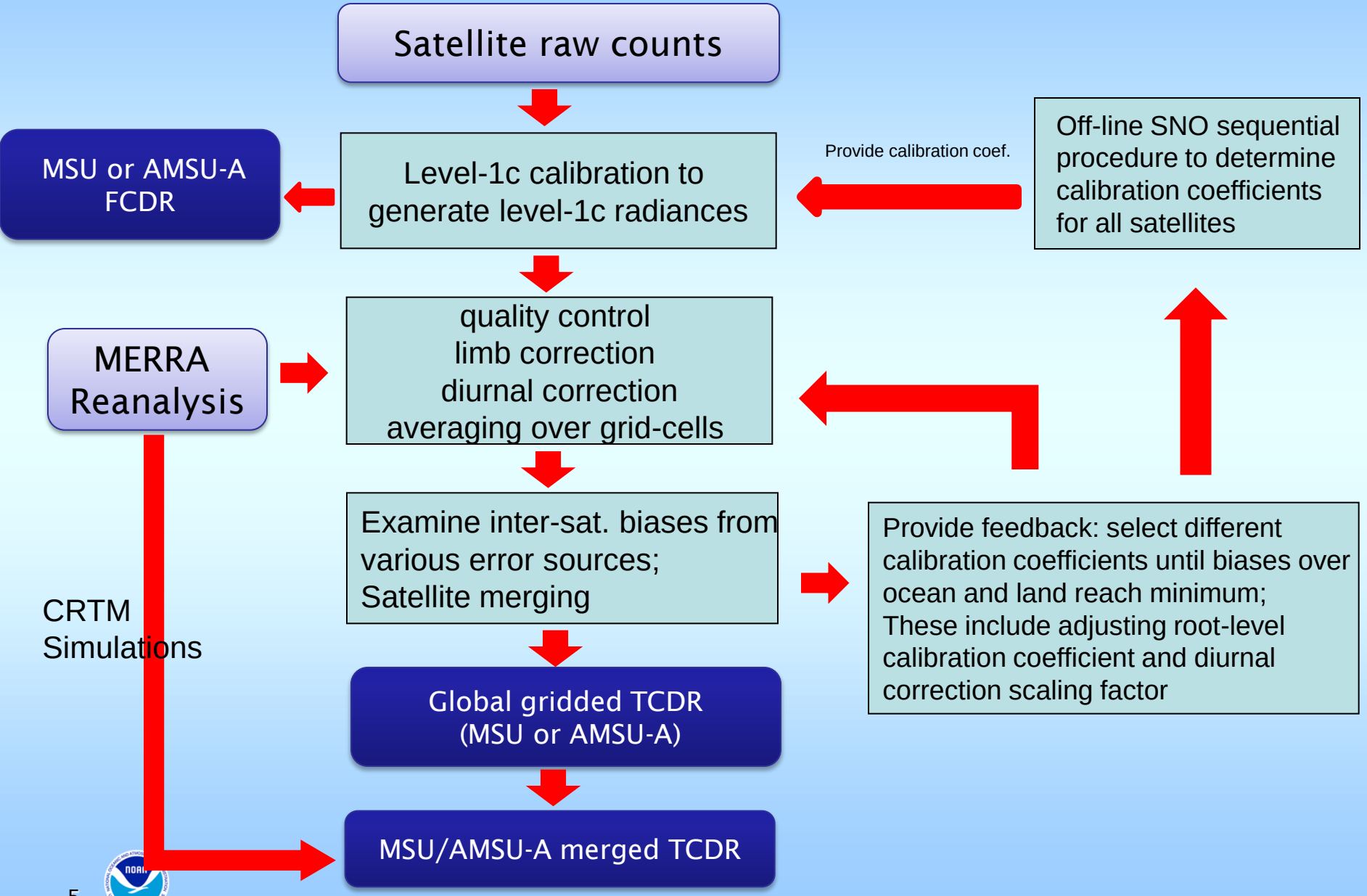
Project Description (2-2)

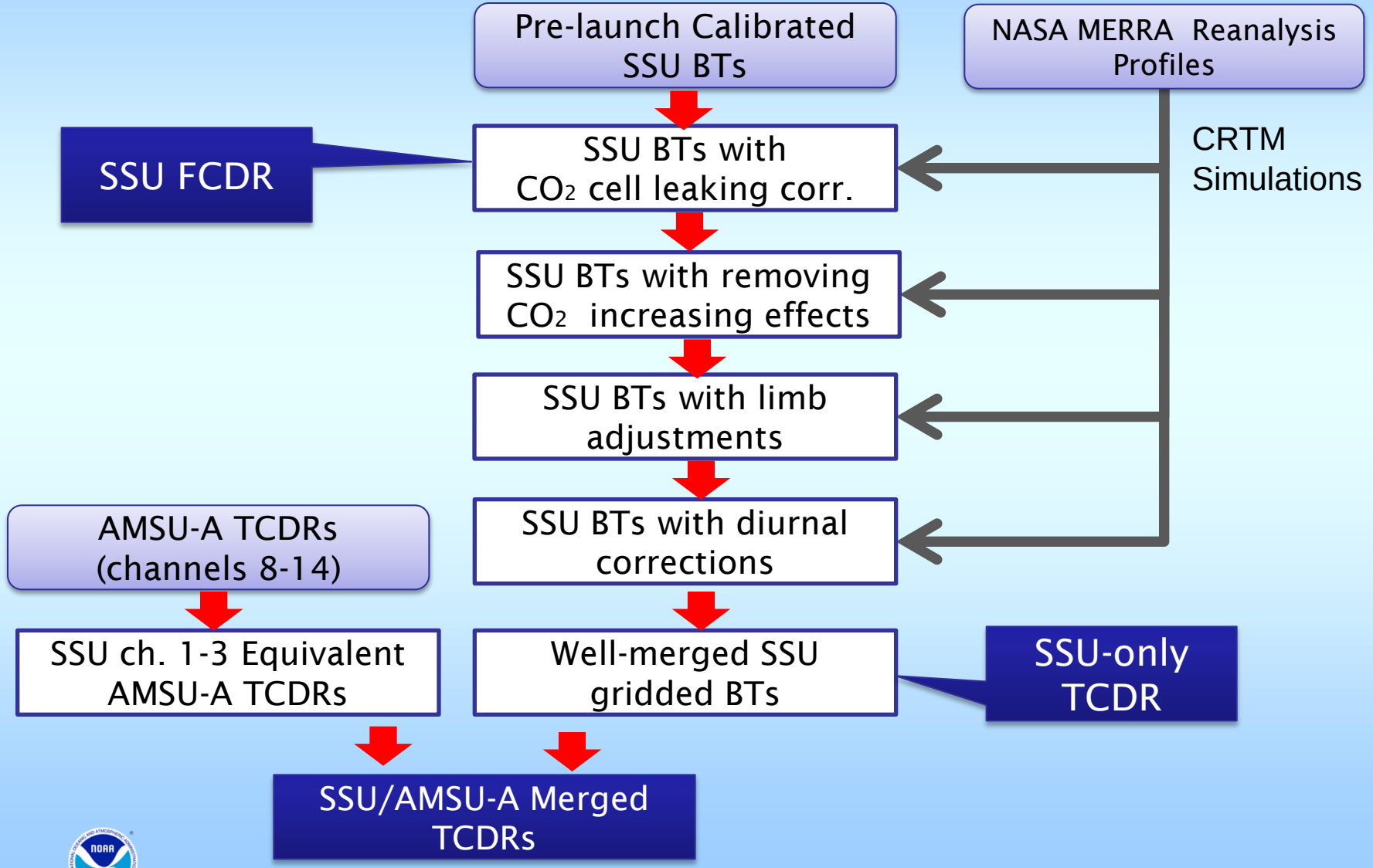
- Develop consistent atmospheric layer temperature TCDR for climate service support – climate change research, climate change monitoring, validating climate model simulation…

CDR(s) (Validated Outputs)	Period of Record	Spatial Resolution; Projection information	Time Step	Data format	Inputs	Uncerainty Estimates (in percent or error)	Collateral Products (unofficial and/or unvalidated)
MSU-only TCDR (3 chs)	1979-2006	2.5° x 2.5°	5-Day Monthly	netCDF ASCII	MSU FCDR	Inter-sat bias: 0.05-0.1 K Inter-sat □: 0.03-0.05K	
SSU-only TCDR (3 chs)	1979-2006	2.5° x 2.5°	5-Day Monthly	netCDF ASCII	SSU FCDR	0.5 K	
AMSU-A-only TCDR (11 chs)	1998-presen	2.5° x 2.5°	5-Day Monthly	netCDF ASCII	AMSU-A FCDR MERRA	Inter-sat ias: 0.05-0.1 K Inter-Sat □: 0.03-0.05K	
MSU/AMSU-A Merged TCDR (3 chs)	1979-present	2.5° x 2.5°	5-Day Monthly	netCDF ASCII	MSU FCDR AMSU-A TCDR MERRA	0.03 – 0.05 K	
SSU/AMSU-A Merged TCDR (3 chs)	1979-present	2.5° x 2.5°	5-Day Monthly	netCDF ASCII	SSU TCDR AMSU-A TCDR MERRA	0.5 K	

Approaches: MSU/AMSU CDR

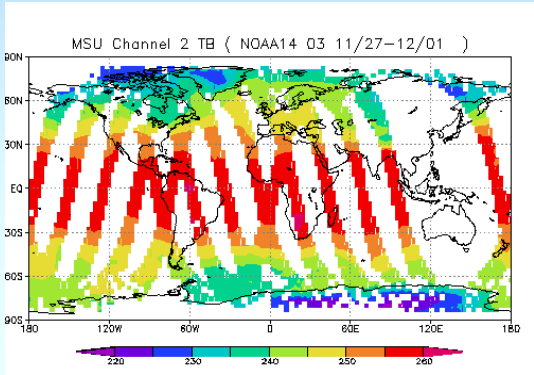


Approaches
SSU-only & SSU/AMSU Merged CDRs

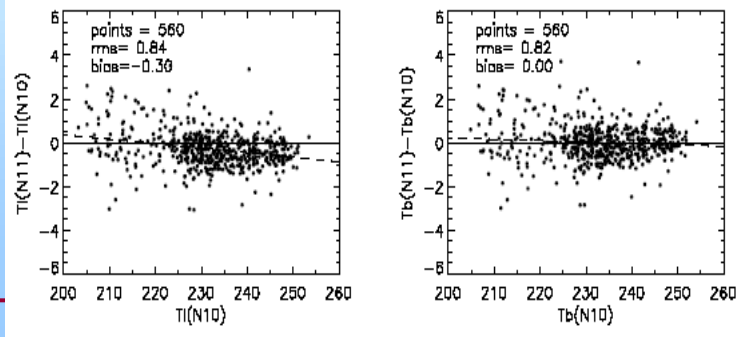


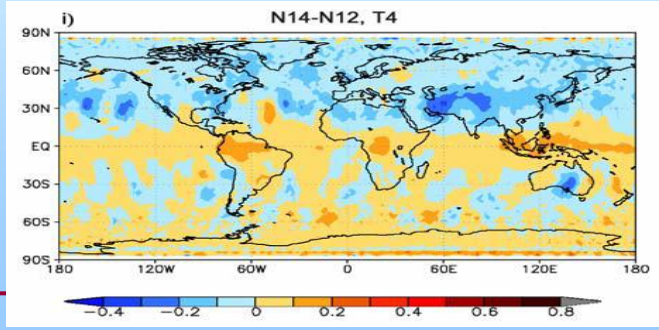
Quality Assurance Approach

- FCDR: L1B QC flag + additional Tb/raw counts thresholds
- Manual/visual image evaluation:



- Statistical analysis:
  1. SNO calibration → SNO bias/scene temperature-dependent biases close to zero
  2. Inter-satellite bias minimized everywhere, global mean inter-sat. diff time series stable, bias/stddev close to zero





Quality Assurance Approach

- CDR Consistency Test
  1. Ocean-mean trend should be most reliable, diurnal drift errors are negligible over ocean in most channels
  2. Trends over land should be compatible with ocean
  3. Average of the spatial trend consistent with global-mean merging trend
  4. Adding more satellites not affecting the trend
     1998-2006 trend consistent with/without AMSU-A data
  5. Robust scheme for instrument signal removal – double correction
- Comparison with similar dataset products
  UAH - RSS - STAR
- Comparison with GPSRO, radiosonde, Lidar, reanalysis, climate model observations
- Comparisons with observation of other climate variables
  MSU/AMSU TMT trend versus sea ice trend

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Applications

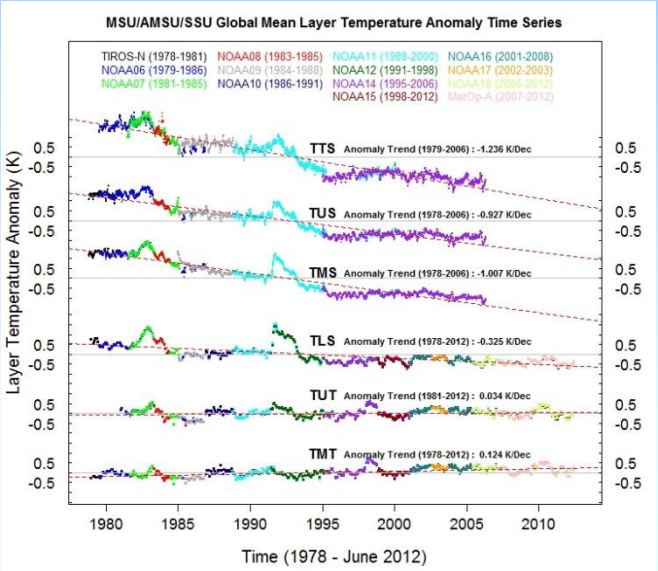
1. Operational monitoring climate change (Climate Service)

2. Policy Support:

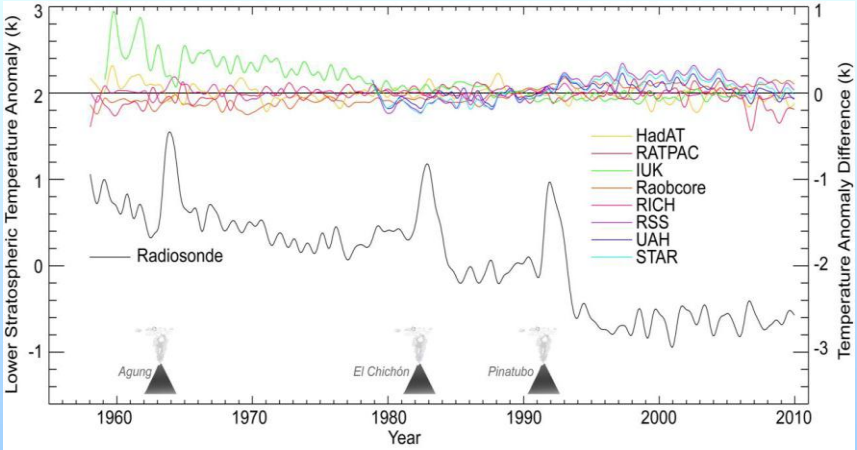
IPCC report

BAMS Climate Assessment Report: State of the Climate

NCDC Climate Report



http://www.star.nesdis.noaa.gov/smcd/emb/mscat/index.php



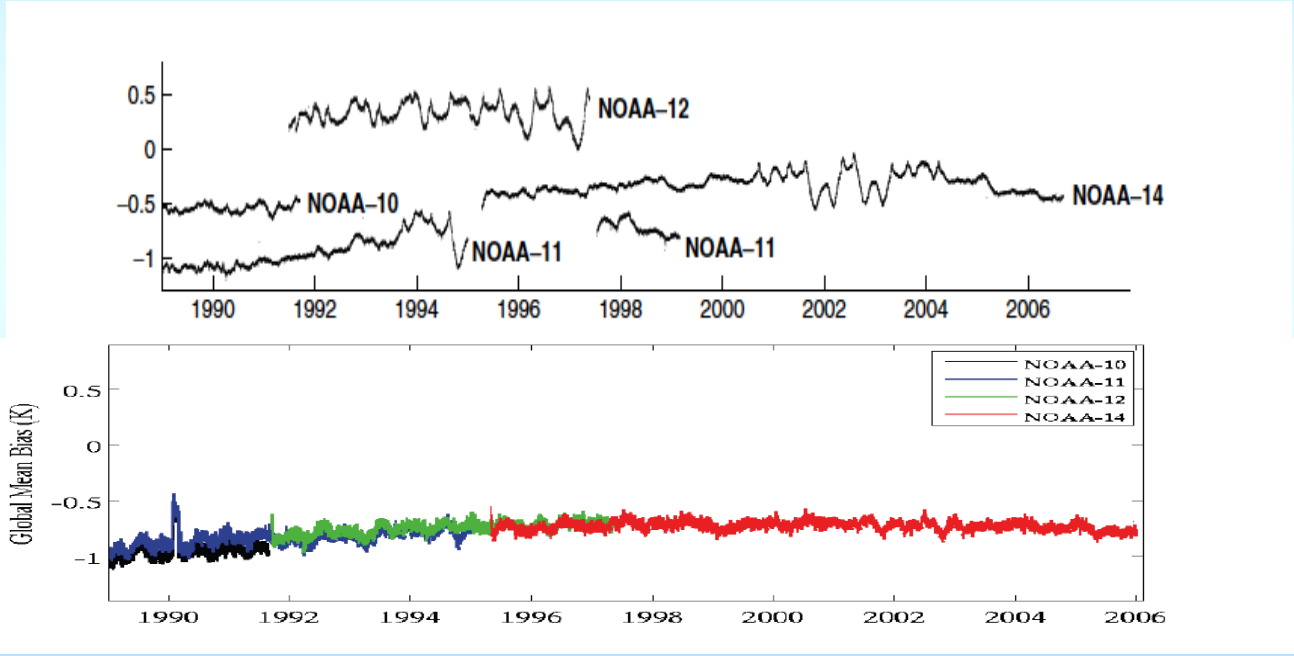
Applications

3. Support Climate Forecast System Reanalysis

Saha et al., 2010: The NCEP climate forcast system reanalysis, BAMS

Rienecker, et. al. 2011: MERRA - NASA's Modern-Era Retrospective Analysis for Research and Applications, J. Climate

ERA-interim Bias Correction Pattern



NASA MERRA Bias Correction Pattern

4. Support consistent satellite level temperature retrievals

e.g. STAR level atmospheric temperature retrievals

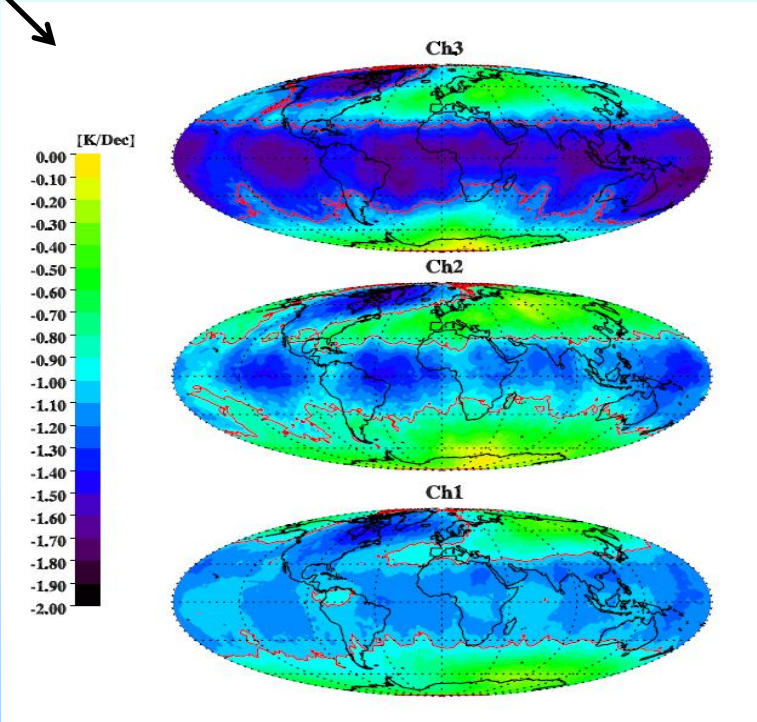
Applications

5. Support trend assessment by climate community

SSU CDRs provide key datasets for *WCRP Stratospheric Processes And their Role in Climate (SPARC) community for stratospheric temperature trend assessment Thompson et al., 2012: The Mystery of Stratospheric Temperature Trends, to be published in Nature*

MSU:

SPARC temperature trend reports



6. Validate other data products

STAR operational sounding product validation system

Schedule & Issues

- **Completed CDRs**
  - **MSU, AMSU-A, SSU radiance FCDRs,**
  - **MSU-1.2, MSU/AMSU-2.0, SSU-1.0 TCDRs**

Zou, C.-Z., W. Wang, 2012, MSU/AMSU Radiance FCDR ATBD

Zou, Cheng-Zhi and Wenhui Wang (2011), Inter-satellite calibration of AMSU-A, JGR, Vol. 116

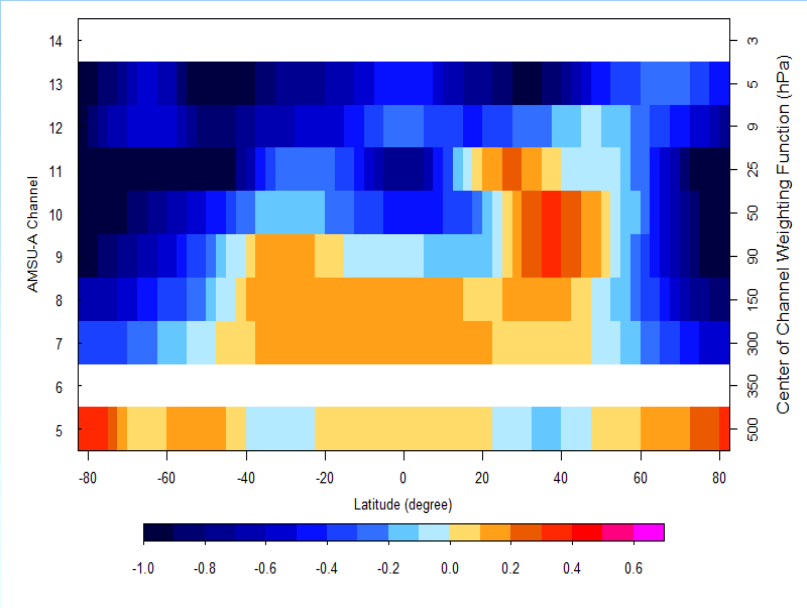
Wang, L., C.-Z. Zou, and H. Qian (2012), Construction of stratospheric temperature data records from SSU, J. Climate, Vol 25

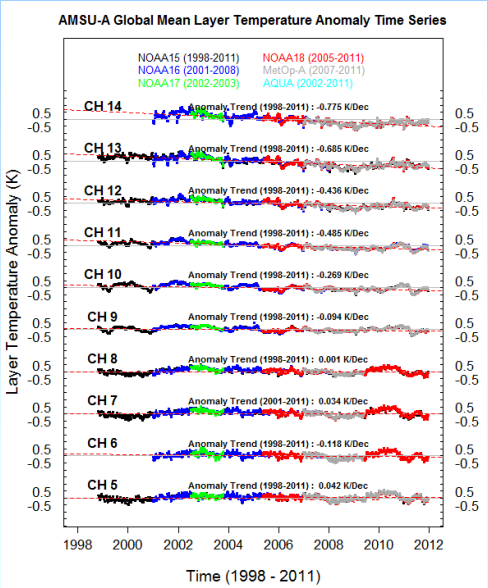
- **Ongoing CDRs**
  - **AMSU-A-only 1.0 TCDRs**
    → will release to public in a few months
  - **SSU/AMSU-A merged 2.0 TCDRs**
    → one year, depending on funding
  - **Version 3.0 MSU/AMSU-A TCDRs**
    → one year, depending on funding

    Major improvement/updates in merging algorithms
    Addition of new satellite observations
    Improved QC

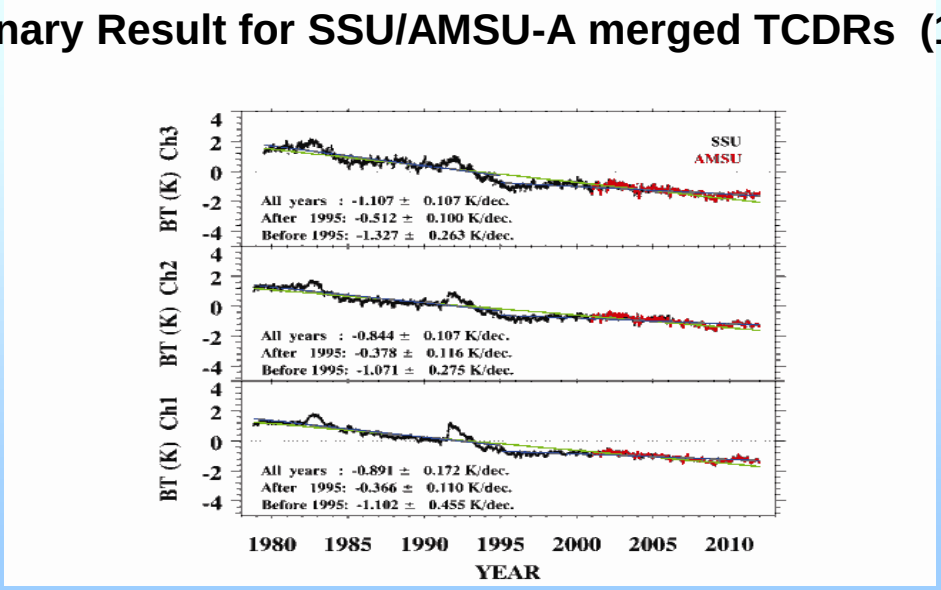
- **Future**
  - **R2O**
  - **Include NOAA-19/MetOp-B AMSU-A, ATMS**
  - **ATBDs for SSU, MSU/AMSU-A TCDRs**

Preliminary Result of AMSU-A-only 1.0 TCDR (1998-2011)





Preliminary Result for SSU/AMSU-A merged TCDRs (1979-2011)



Schedule & Issues

- Risks / Concerns
  - No microwave SI-traceable standards for absolute validation
  - Only two PRTs on MSU, thermal gradient problem may never be solved
  - Difficult to use SNO to resolve higher order nonlinearity than quadratic
  - Difficult to use SNO for SSU inter-calibration due to short/no overlap observations
  - Limited source for validation/comparison
  - Missing channels
  - Disk space limitation (IT constriction)

- How can the CDR Program better assist you?
  - Continue to fund the project

Thank You