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Continued Monitoring of Atmospheric Temperature Using Data from Microwave Sounding Instruments

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Outline

- Project Overview and Summary
- Approach
- Algorithm/Product Maturity
- Results
- Recommendations

Project Overview and Summary

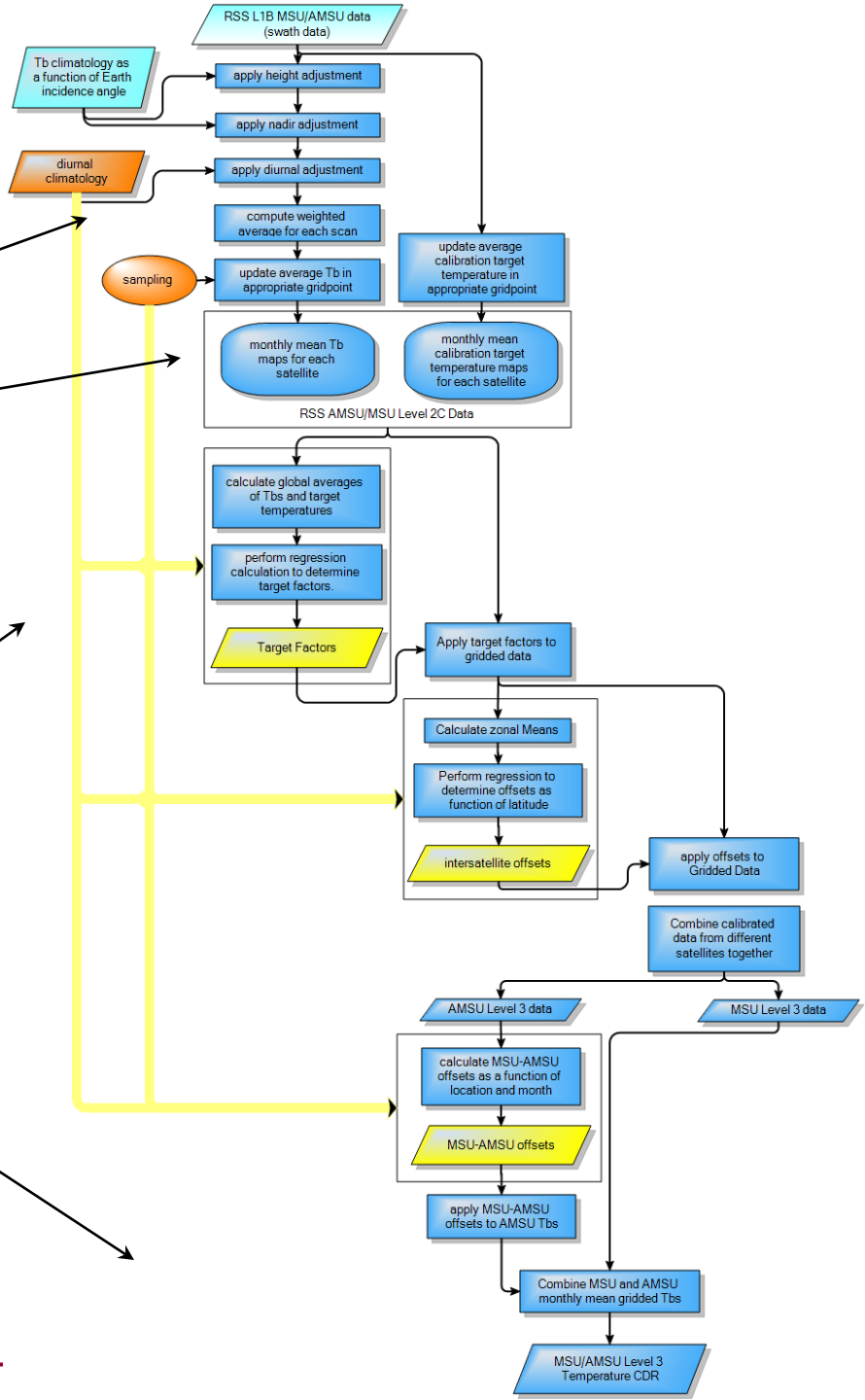
- Produce a gridded, monthly, deep-layer atmospheric temperature measurements from MSU and AMSU radiances
- 4 Channels
  - TLT, TMT, TTS, TLS
- Performance baseline (target versus actual)
  - ??
- Deliverables (as applicable)
  - Monthly Updates to Gridded Dataset
  - Simplified Versions of Code and Monitoring Tools
- ECVs addressed (as applicable)
  - Temperature
- Current/expected user communities
  - Climate Research
  - Model Evaluation
  - Policy Makers (Energy, CO2 emissions)

Algorithm

Diurnal and Orbital Height Adjustments

Averaging

Calibration Adjustments



v. June 2010

CDR Maturity Matrix

Level	Sensor Use	Code Stability	Metadata & QA	Documentation	Validation	Public Release	Science & Applications	IV&V
1	Research Mission	Significant changes likely	Incomplete	Draft ATBD	Minimal	Limited data availability to develop familiarity	Little or none	
2	Research Mission	Some changes expected	Research grade (extensive)	ATBD Version 1+	Uncertainty estimated for select locations/times	Data available but of unknown accuracy; caveats required for use.	Limited or ongoing	ATBD Review
3	Research Missions	Minimal changes expected	Research grade (extensive); Meets international standards (CF compliant)	Public ATBD; Peer-reviewed algorithm and product descriptions	Uncertainty estimated over widely distribute times/location by multiple investigators; Differences understood.	Data available but of unknown accuracy; caveats required for use.	Provisionally used in applications and assessments demonstrating positive value.	NOAA Operations Review
4	Operational Missions And Research Missions (POES + AQUA)	Minimal changes expected	Stable, Allows provenance tracking and reproducibility ; Meets international standards	Public ATBD; Draft Operational Algorithm Description (OAD); Peer-reviewed algorithm and product descriptions	Uncertainty estimated over widely distribute times/location/time scales by **one** investigator; Differences understood.	Source code released; Data available but of unknown accuracy; caveats required for use.	Provisionally used in applications and assessments demonstrating positive value.	
5	All relevant research and operational missions; unified and coherent record demonstrated across different sensors	Stable and reproducible	Stable, Allows provenance tracking and reproducibility ; Meeting international standards	Public ATBD, Operational Algorithm Description (OAD) and Validation Plan; Peer-reviewed algorithm, product and validation articles	Consistent uncertainties estimated over most environmental conditions by multiple investigators	Source code portable and released; Multi-mission record is publicly available with associated uncertainty estimate	Used in various published applications and assessments by different investigators	CDR Certification Review
	All relevant research and operational missions; unified	Stable and reproducibl	Stable, Allows	Product, algorithm	Observation strategy designed to reveal	Source code portable and	Used in various	

Research- to- Operations Results

- What is the deliverable?
  - Simplified version of QA, calibration and merging code. (Fixed parameters)
  - Ideal world -- everything ported to python
- What are your post-award plans with continuing this work, or not?
  - Transfer Fixed Version of Algorithm to NOAA
  - Continue Development Work to Improve Future Versions of Product (via CDR team)
- NOAA points-of-contact or collaborators, as applicable
  - ????

Uncertainty Estimates

- Main progress in last year is in area of uncertainty estimation and representation
- Uncertainty most critical part of EDR to CDR
- For MSU/AMSU, uncertainty difficult to represent due to correlations in errors across time and space
- Our approach -- use Monte-Carlo to produce a large number (currently 400) of realizations of the possible error that contain all known sources of error, and their effect on the merging process
- These results will be available to users
- (#lons x #lats x #months x 400) array of possible errors.
- Paper submitted to JGR

Flow of Uncertainty

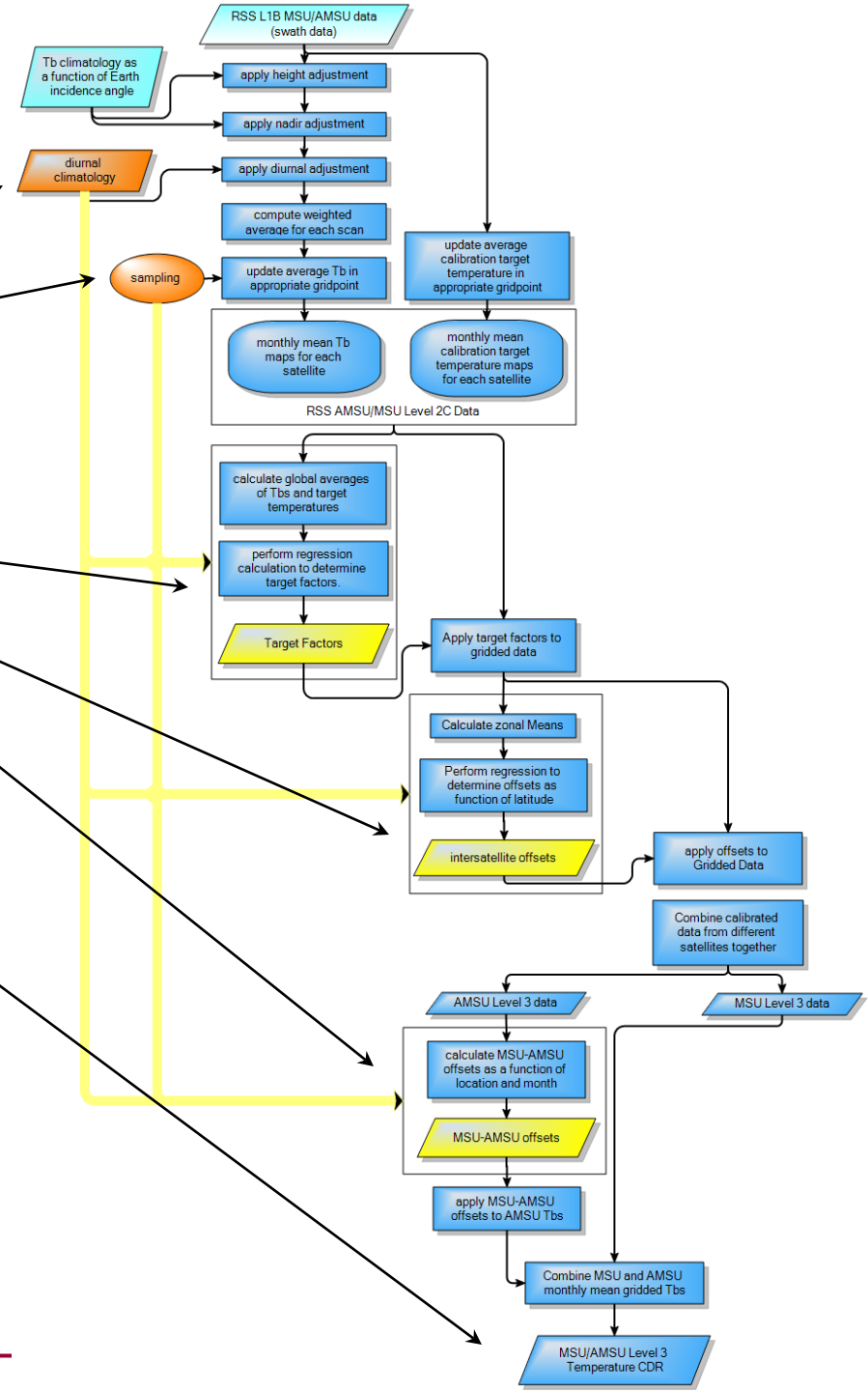
Uncertainty caused by diurnal adjustments and temporal averaging

Flows to estimates of the needed Calibration adjustments……

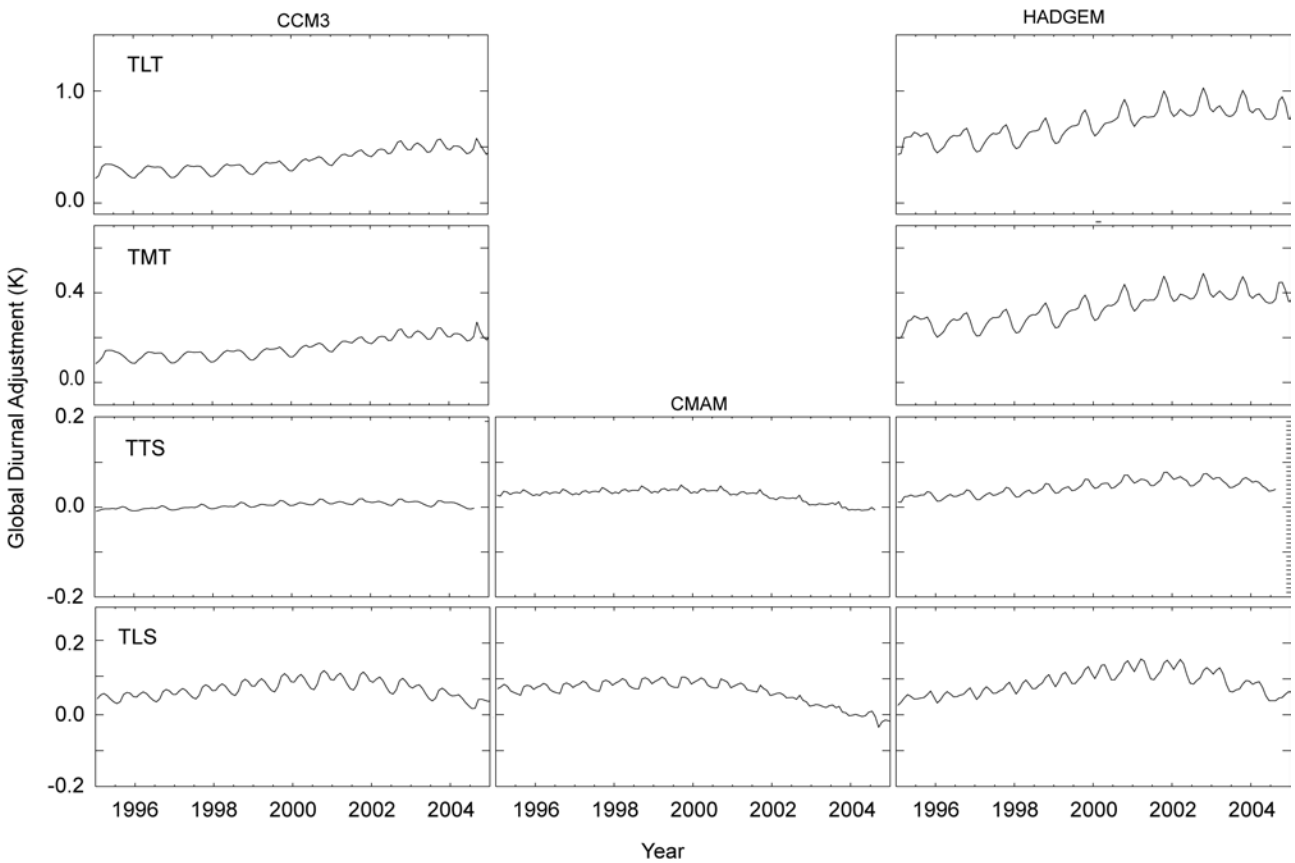
And causes uncertainty in final results.

Quantitatively estimated via Monte Carlo approach:

400 Realizations of gridded monthly error estimates.

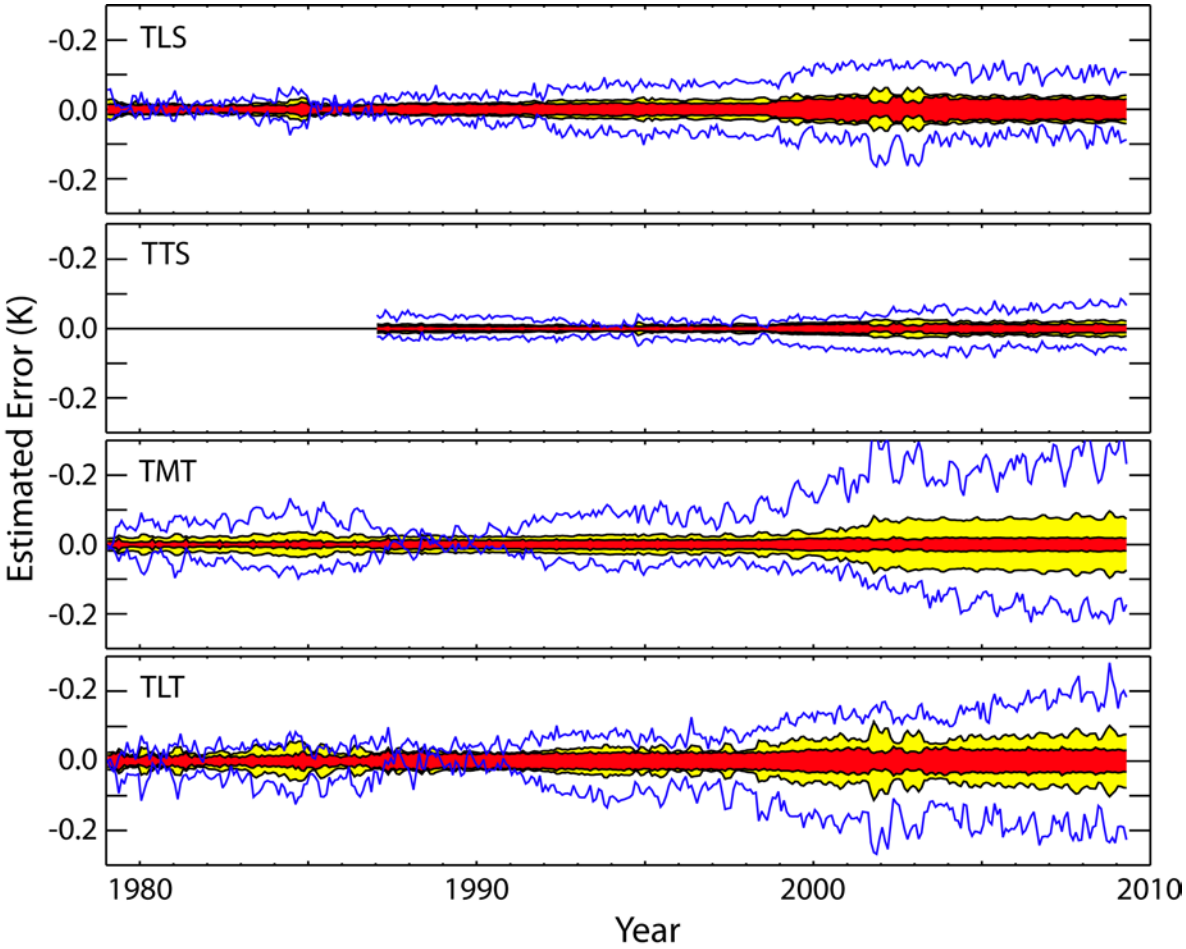


Global Diurnal Adjustment from Different Models

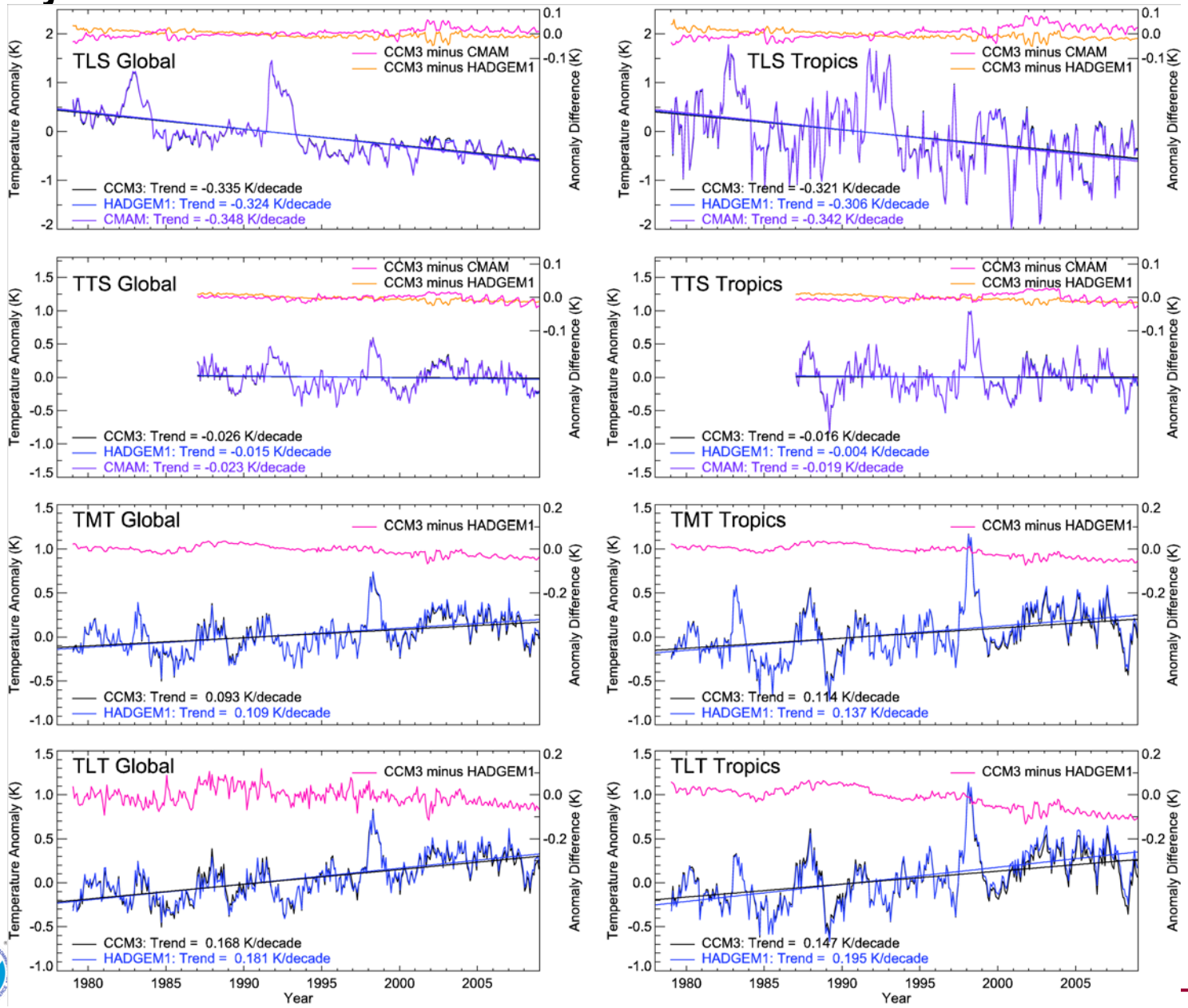


Time Series of Errors from Monte-Carlo

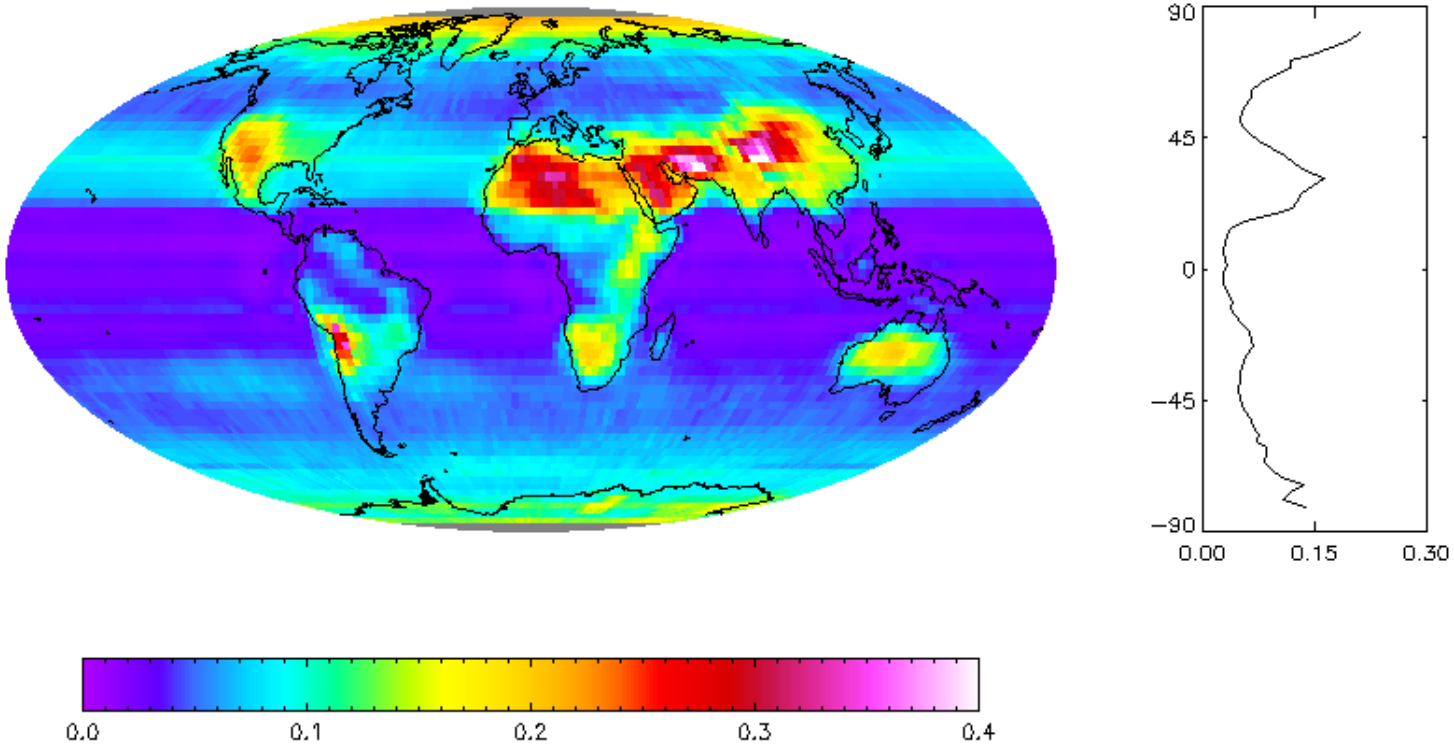
Yellow - 2-sigma range without errors in diurnal adjustment
Red - 2-sigma range including diurnal errors



Trend Differences with Different Diurnal Adjustments



Errors in Trends, TLT, 1979-2008

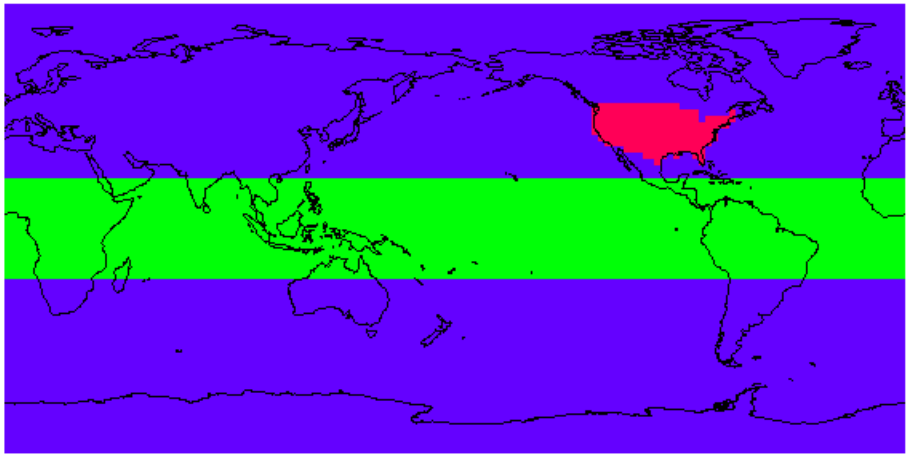


Example: Long Term Trends

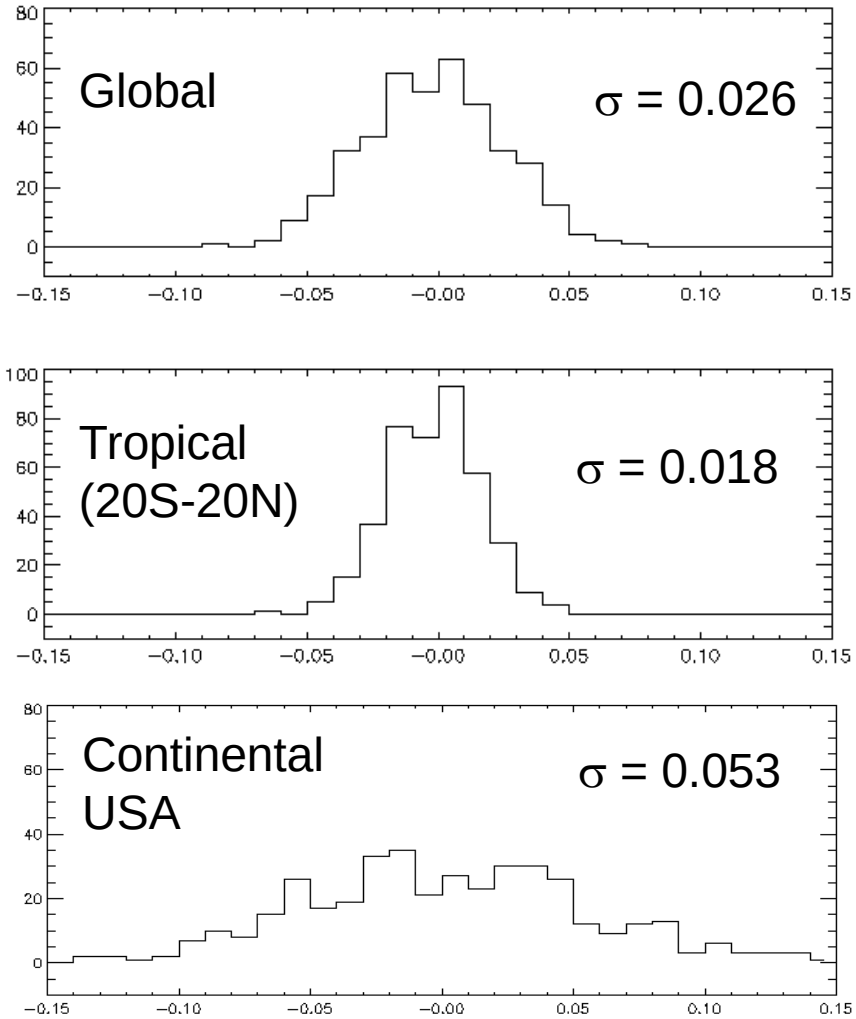
Compare trend uncertainty in 3 weightings

Global Average

Tropical (20S to 20N)

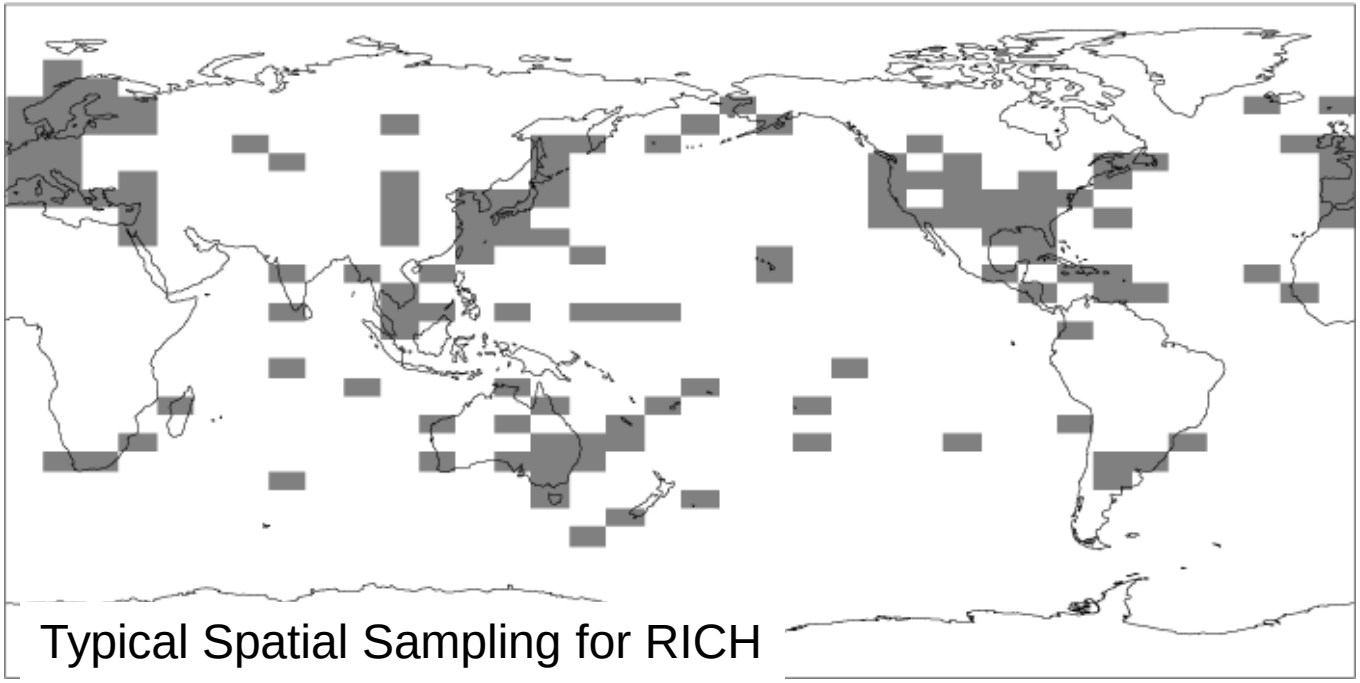


Trends in error realizations TMT, 1979-2008



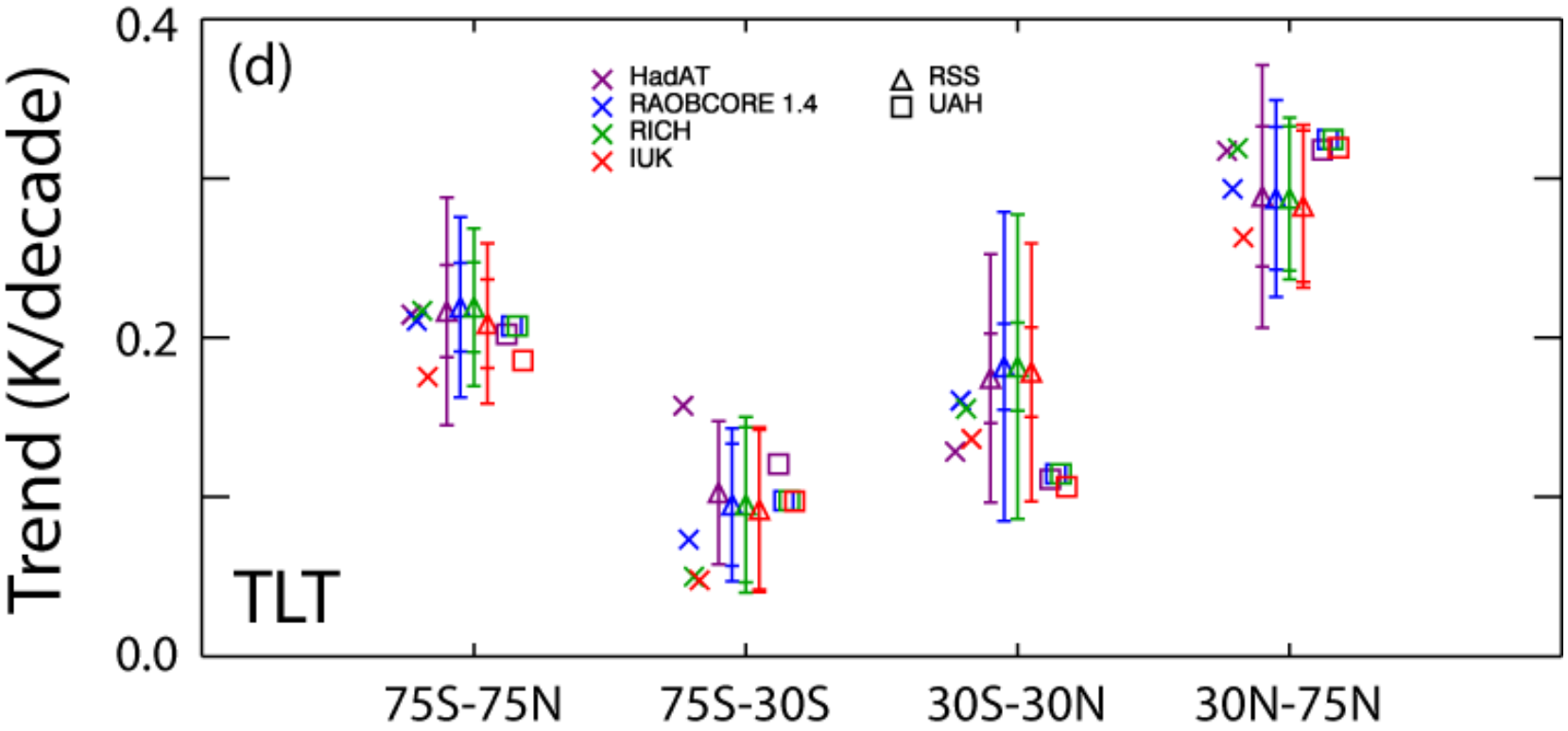
Example 2
Comparison with Homogenized Radiosondes

Sample both real data and error realizations at the radiosonde locations
Analyze Sampled Error Time Series to determine uncertainty estimate

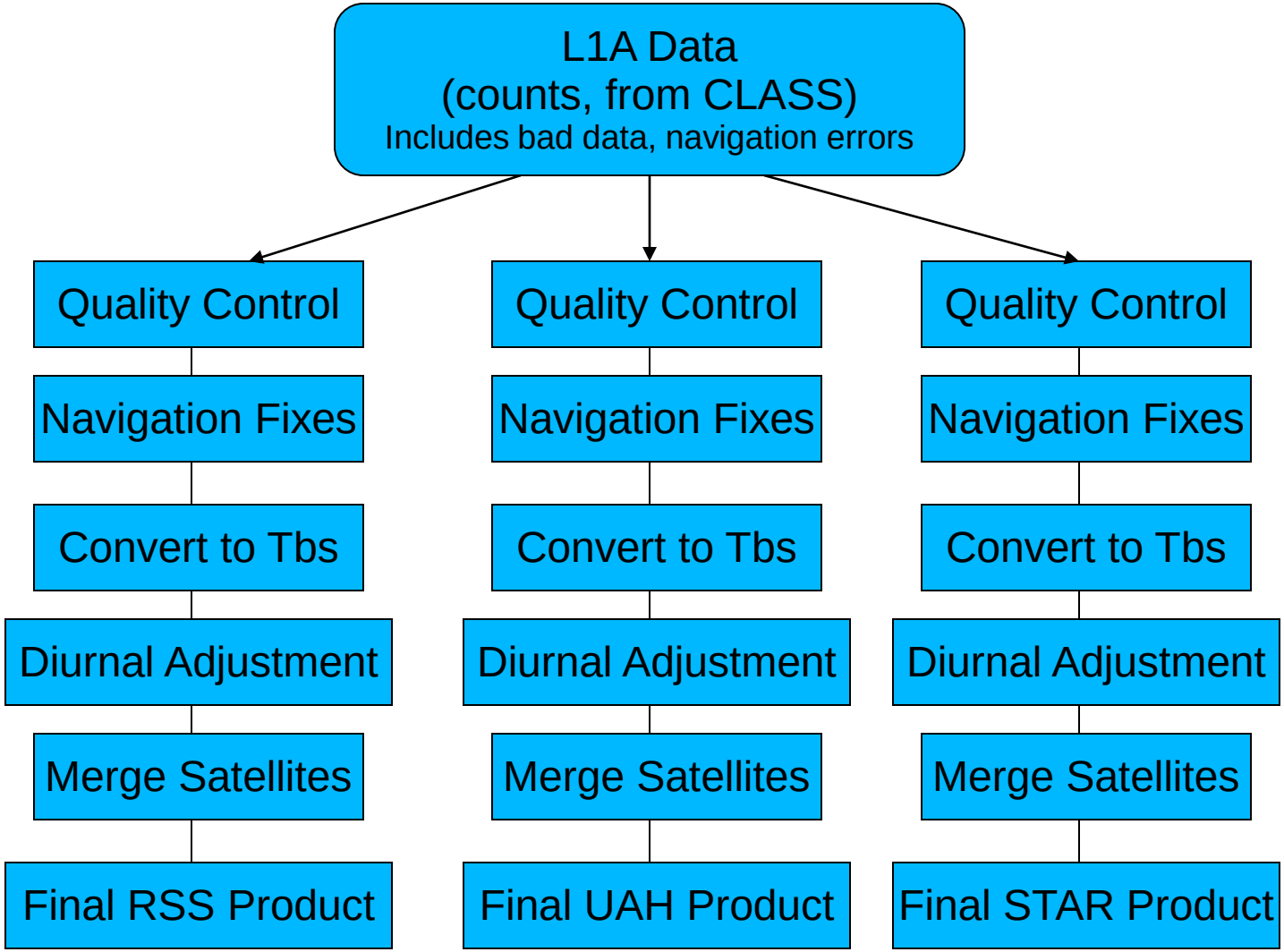
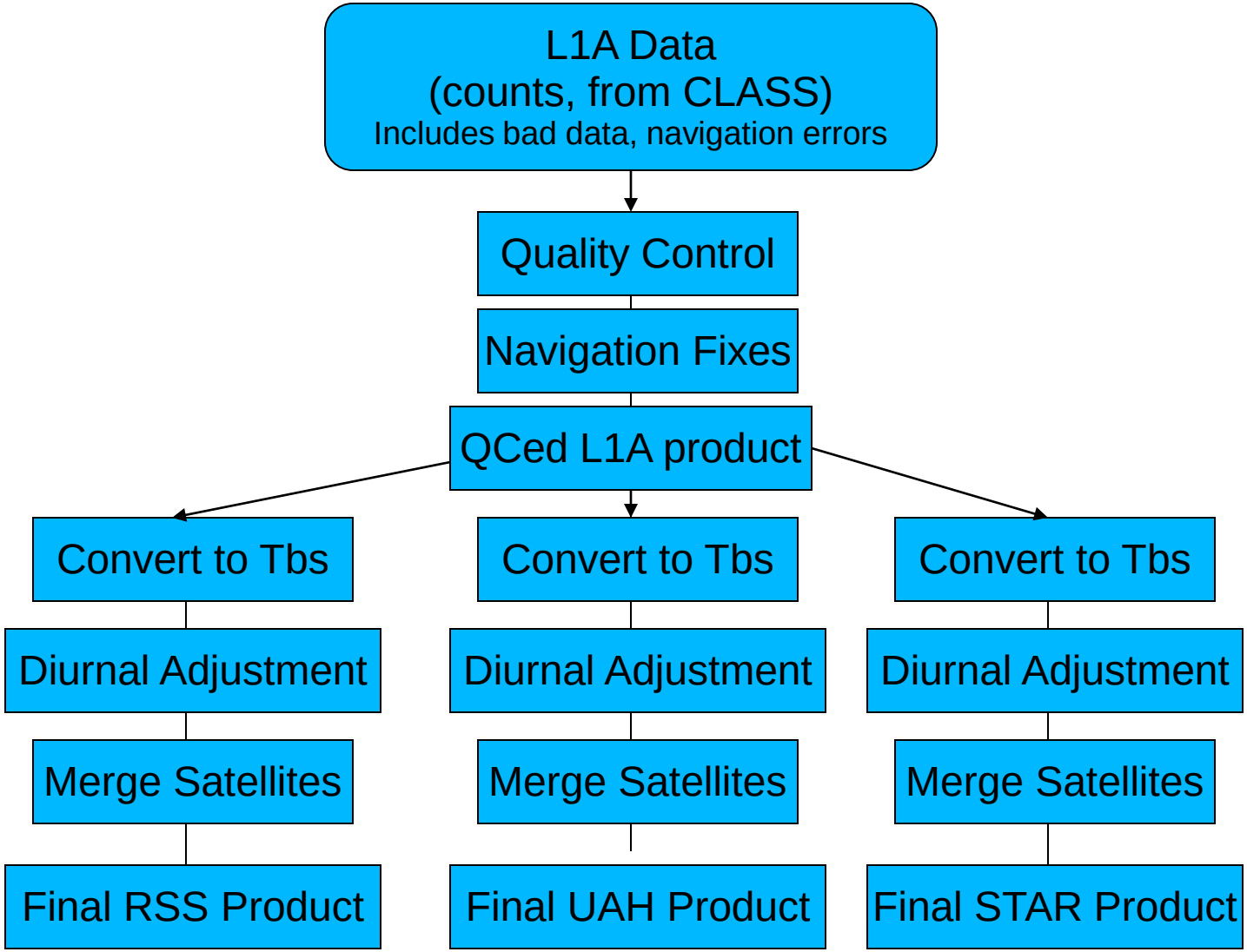


Typical Spatial Sampling for RICH

Radiosonde Comparison: TLT



Recommendations



Recommendations