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Reprocessing of Fundamental Climate Data Records From Microwave Sounders

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FIDelity and Uncertainty in Climate data records from Earth Observation (FIDUCEO) - What Is It About?

- **Need**: trustworthy information about climatic variability and change over decades
- – rigorous science, including improving prediction
- – decision making, e.g. putting the future in context
- – climate services, meeting information needs
- **Problem**: proving the "trustworthy" part is hard. Often hasn't been done well even for prominent, much-used data sets
- **FIDUCEO answer**: demonstrate "trustworthiness" across several FCDRs and CDRs and promote the methodologies across the EO-climate community
- – **methods, guidance and tools**

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Fiduceo Aims: Uncertainty-quantified FCDR

DATASET	NATURE	POSSIBLE USES
AVHRR FCDR	Harmonised infra-red radiances and best available reflectance radiances, 1982 - 2016	**SST, LSWT, aerosol,** LST, phenology, cloud properties, surface reflectance …
HIRS FCDR	Harmonised infra-red radiances, 1982 - 2016	**Atmospheric humidity,** NWP re-analysis, stratospheric aerosol …
MW Sounder FCDR	Harmonised µwave BTs for AMSU-B and equivalent channels, 1992 – 2016	**Atmospheric humidity,** NWP re-analysis …
Meteosat VIS FCDR	Improved visible spectral response functions and radiance 1982 to 2016	**Albedo, aerosol,** NWP re-analysis, cloud, wind motion vectors …

At all data set scales there is adequate quantification of error distributions to propagate uncertainty across all data transformations accounting for error correlation structures

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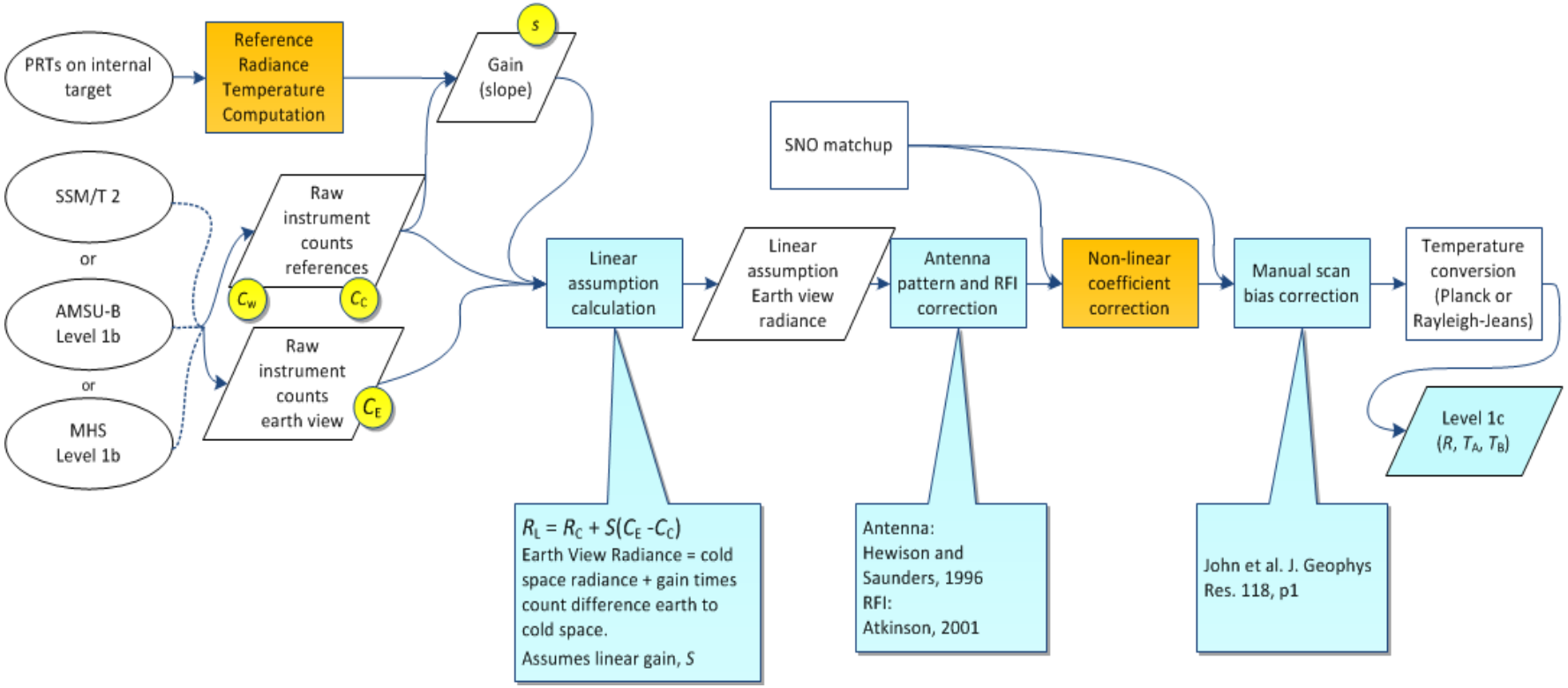
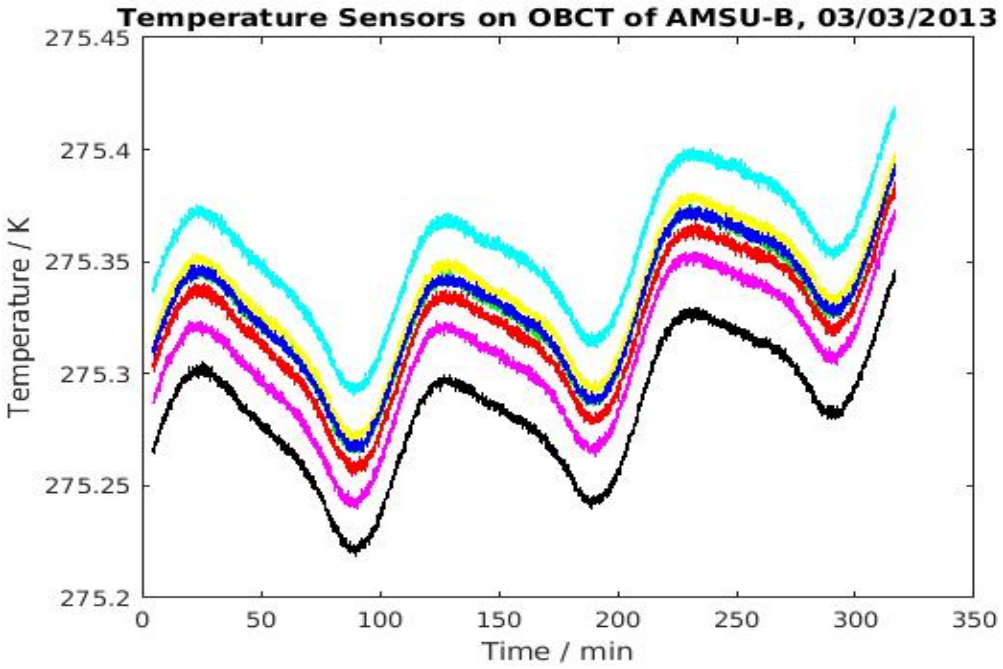
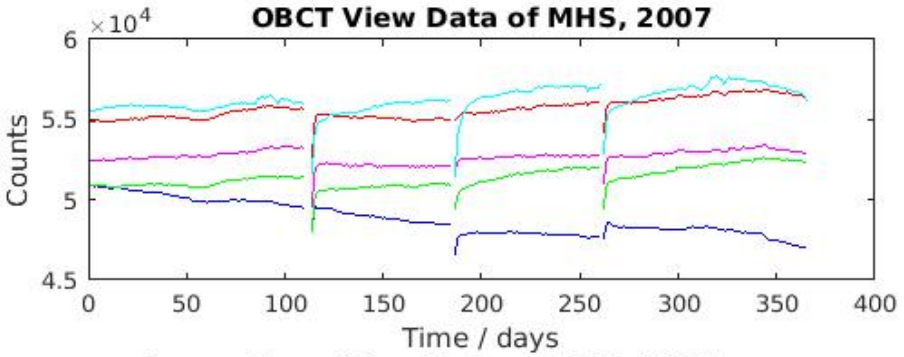
Main Processing Chain for Microwave Humidity Sounders

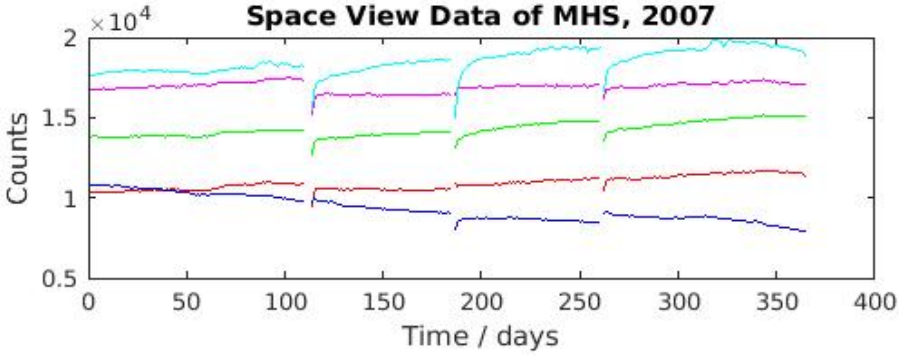


Analysis: Error Related to BB Temperatures

- Calibration target not thermally controlled, insulated from instrument
  - σ = 1.2 mK
  - changes < 0.1 mK/sec
  - gradients < 100 mK/°
  - accuracy < 100 mK
- No strong correlation between gain and temperature drifts
- Several days needed to reach stable conditions after data drop-out

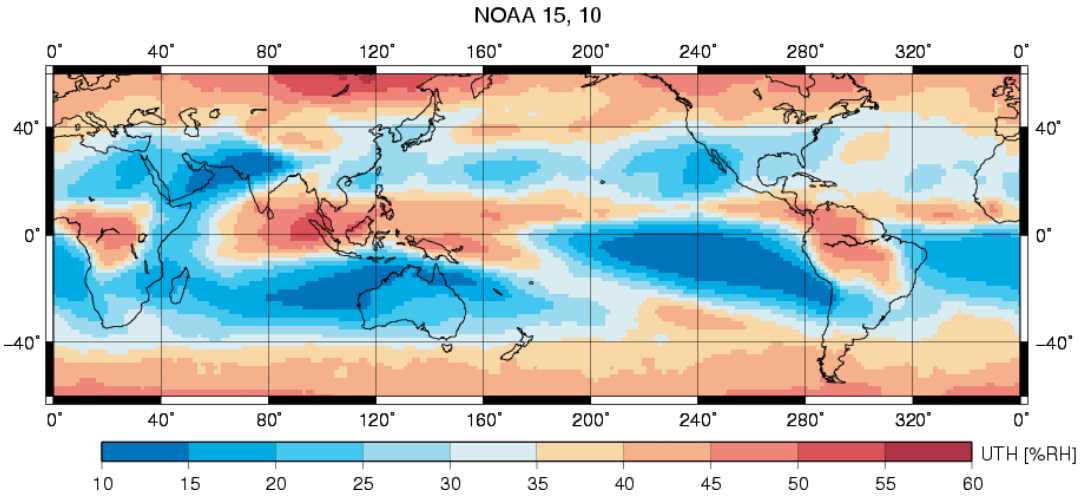


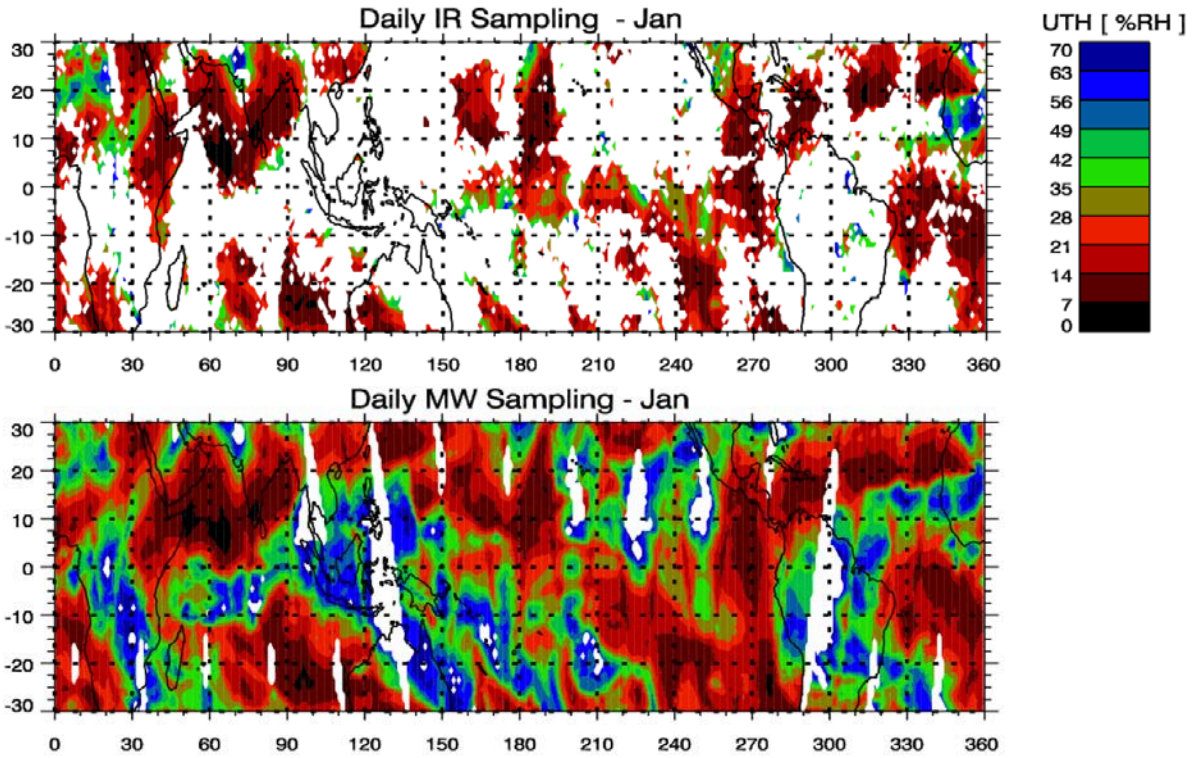




Cross-Comparison: SSM/T2, AMSU-B, MHS, and HIRS

- Problem: observations at different local times
- Solutions:
  - opportunities for SNOs from orbit drift
  - small diurnal variations in subsidence zones
- Problem: Clouds affect infrared more than microwave
- Solution: Optimize cloud detection algorithms





Fiduceo Aims: Uncertainty-quantified CDRs

DATASET	NATURE	USE
Surface Temperature CDRs	Ensemble SST and lake surface water temperature	Most of climate science … model evaluation, re-analysis, derived/synthesis products …
UTH CDR	From HIRS and MW, 1992 - 2016	Sensitive climate change metric, re-analysis …
Albedo and aerosol CDRs	From M5 - 7, 1995 – 2006	Climate forcing and change, health …
Aerosol CDR	2002 – 2012 aerosol for Europe and Africa from AVHRR	Climate forcing and change, health …

Uncertainty information that (i) discriminates more and less certain data, (ii) is validated as being realistic in magnitude, (iii) is traceable back to the FCDR uncertainty information

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FIDUCEO FCDR/CDR Improvements

Characteristic	Typical FCDR	FIDUCEO	Typical CDR	FIDUCEO
Ensemble spanning all forms of uncertainty	No	Yes	No	Yes
End-to-end traceability and propagation of uncertainty	No	Yes	No	Yes
Satellite-series harmonisation at radiance level based on rigorous physics	Some examples (e.g. MW); Others seem ad-hoc	Yes	Some examples	Yes
Uncertainty estimates for every pixel	No, usually generic values at best	Yes	Some examples	Yes
Uncertainty components support uncertainty propagation in aggregated data	No	Yes	One known example	Yes