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Quality issues, ECVs and climate data: A personal perspective for satellite datasets

John Remedios

Space Research Centre
Department of Physics & Astronomy
University of Leicester

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Background

My perspectives come from:

- ATSR SST time series and verification of errors.

  Remote Sensing of Environment Special Issue on ATSR: 18 papers + Preface.

- New improved LST from ATSR and SEVIRI (and MODIS).
- Atmospheric water vapour (Tim Trent)
- Atmosphere trace gases: stratosphere and troposphere

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What makes a climate data set?

GCOS principles but in reality:

- A long time series
- A unique measurement or one that can "independently" confirm existing systems. Both are very important.

  e.g. Satellite LST; SST for ATSR and from buoys.

  GCOS has some confused views on this – it thinks for LST that this is only useful if it can be related to 0.2 m T(air)
- A data set which has uncertainties "small"(er?) compared to the expected change.
- Inter-relation of series of sensors (calibration; performance; retrieval)

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Climate data status

- ATSR SST mature. Quality good enough for climate
- LST not an ECV (so far) – it's 0.2 m T(air).

  Improve data quality; quantify accuracy – internal; demonstrate utility, understand influences.
- Atmospheric water vapour (Tim Trent)

  Lots of satellite data but profile data only since 2000.

  Not huge amounts of quality assessment for climate.
- Strat. ozone, CFCs mature. Trop. Ozone, CO, GHG coming along. Data quality is key here. Do we believe variations we see?

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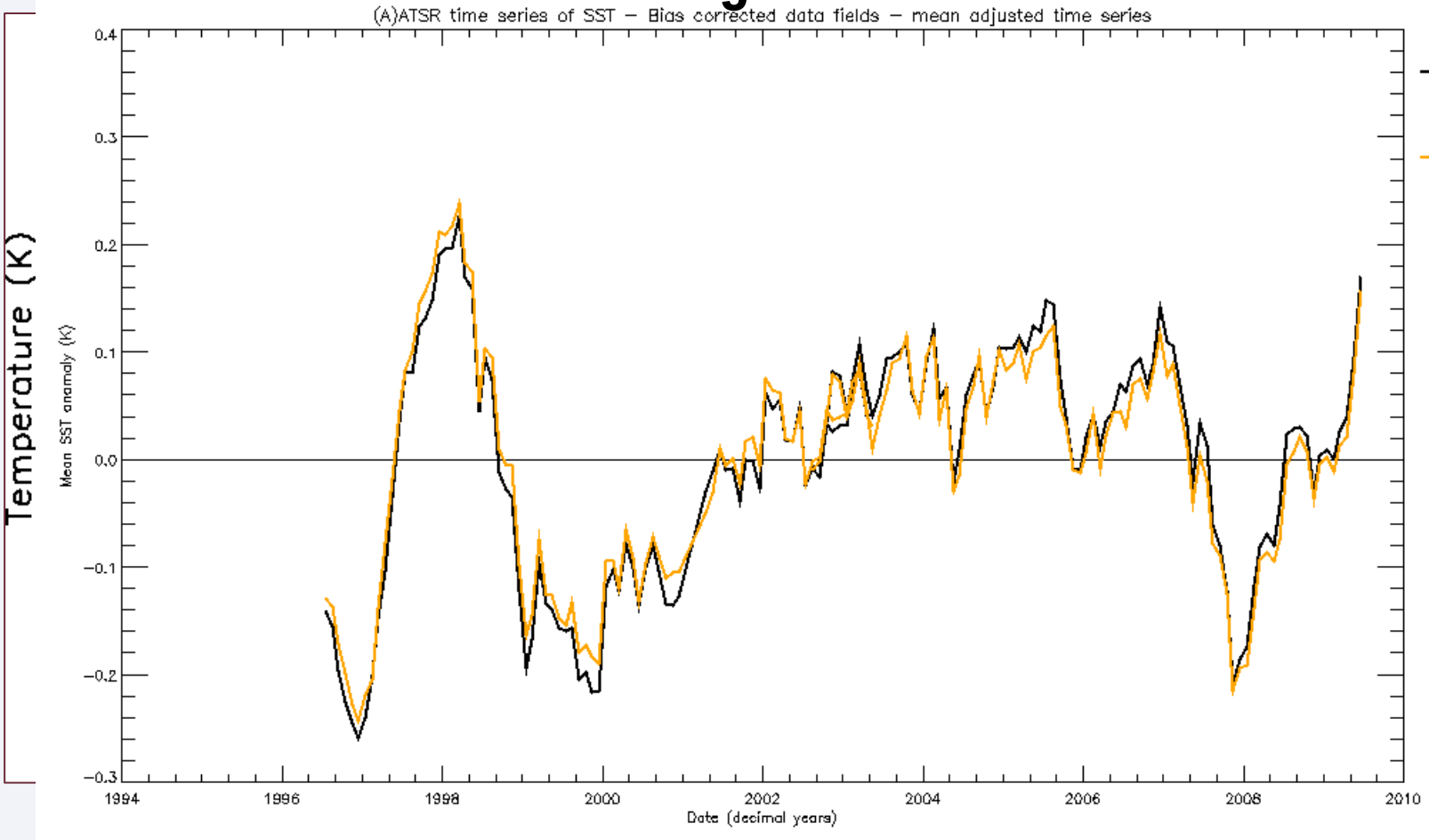
ATSR Time Series:

V2 global time series: mean-adjusted bias correction

Most accurate: Dual-3 nighttime. K. Veal



What is the error?

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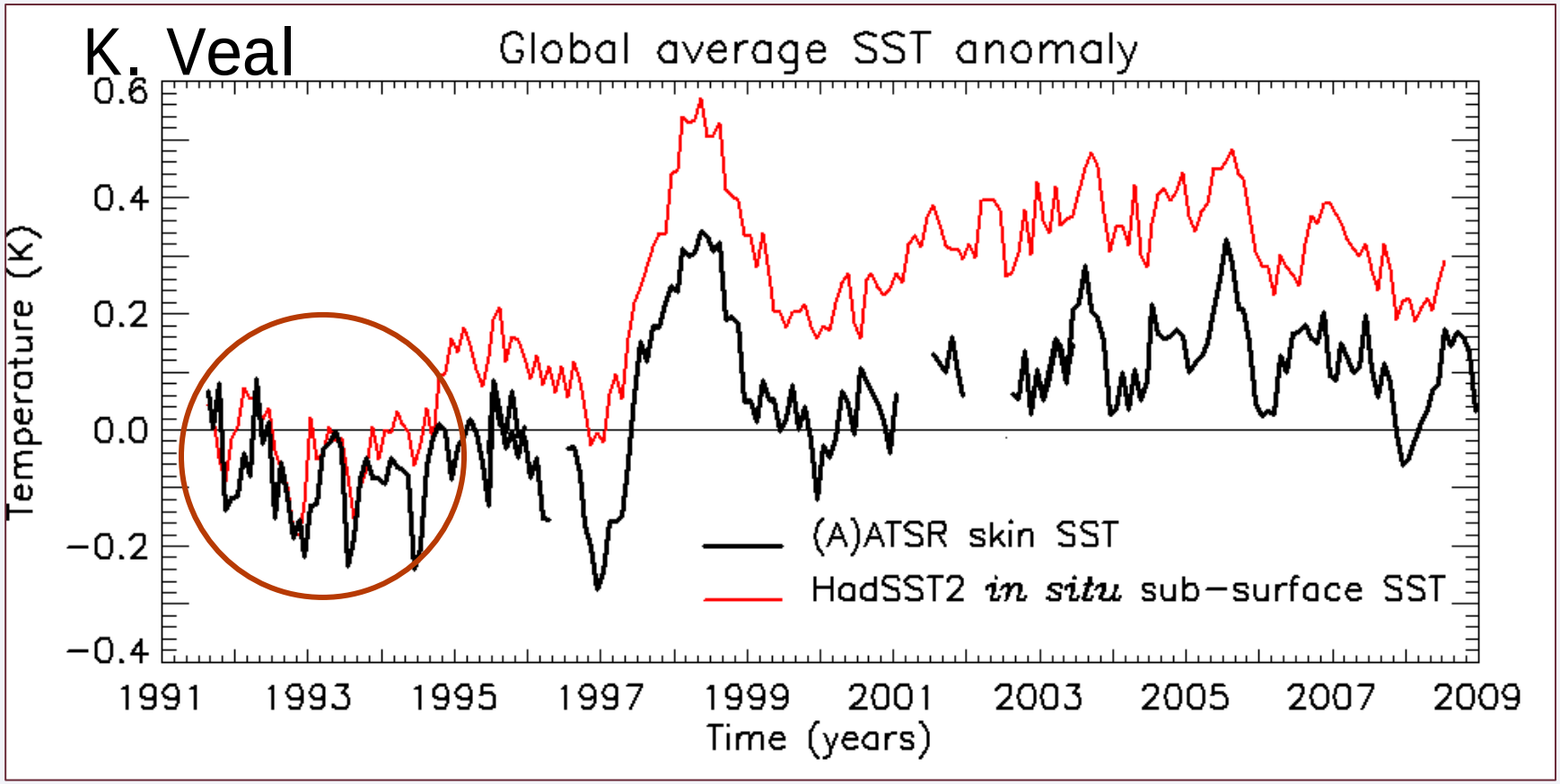
The errors/uncertainties can vary.



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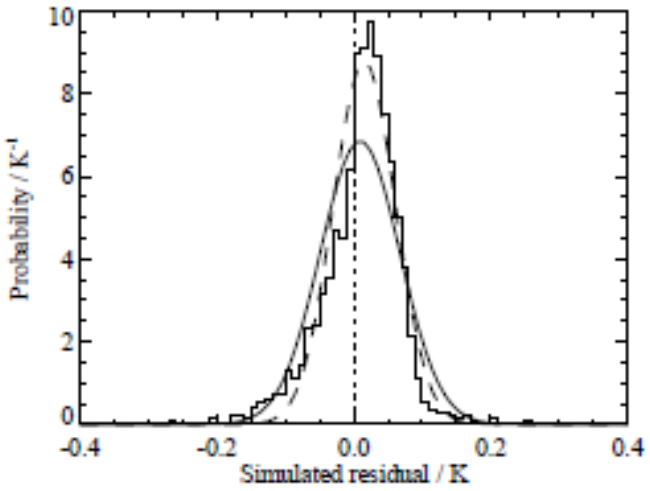
Internal knowledge of retrieval characteristics



ARC D2 retrieval

Figure 1: Probability distribution of simulated D2 retrieval error. Thin solid line shows Gaussian distribution using standard statistics, the standard deviation (SD) being 0.058 K; thin dashed line shows Gaussian distribution using robust statistics, the robust SD being 0.045 K. There are 2100 simulated cases, as described in Embury and Merchant (this issue), and those shown are for the AATSR instrument. Results for other ATSRs are similar.

Embury, Merchant, Corlett; RSE, 2011

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ARC SST(0.2 m) - drifters

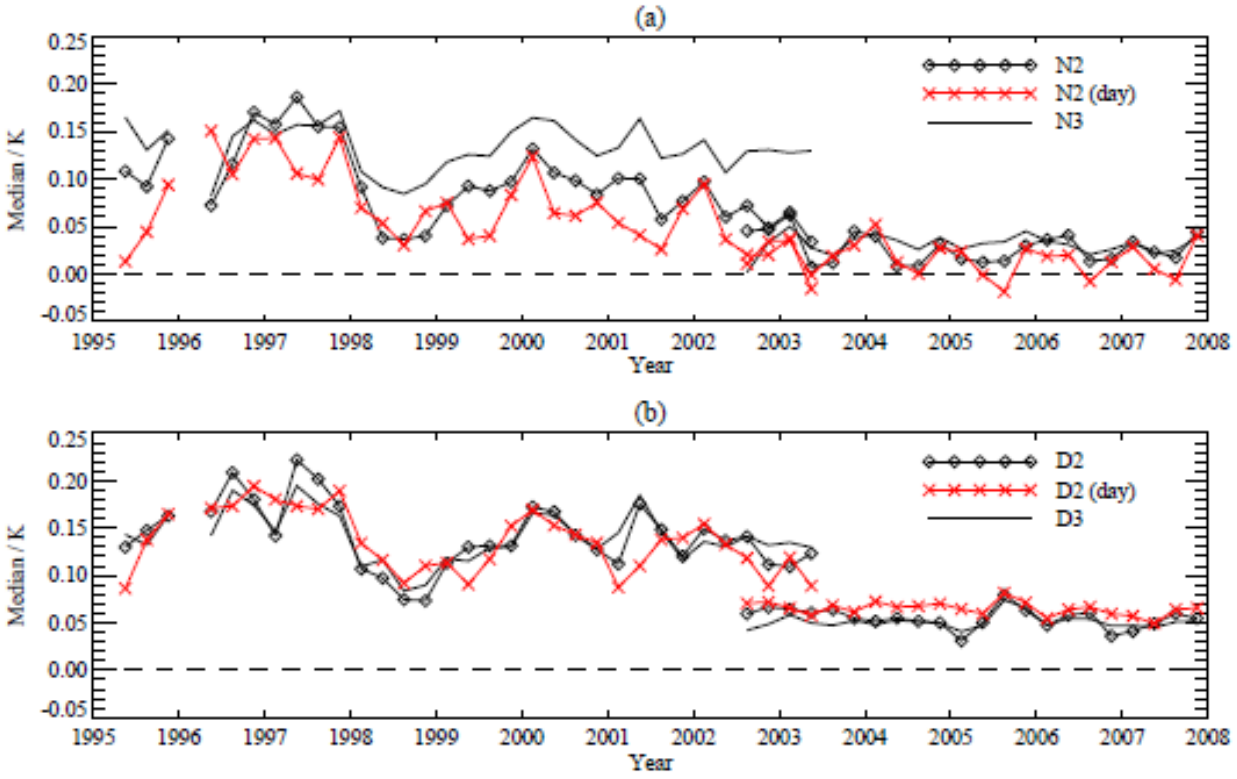

Figure 15: Time series of ATSR-2 (up to mid-2003) and AATSR (from mid-2002) estimated $SST_{0.2\,m}$-drifters. (a) Nadir-only retrievals: solid with symbol N2; solid N3. (b) Dual-view retrievals: solid with symbol D2; solid D3. Red lines (with X symbol) indicates day-time data.

Embury, Merchant, Corlett; RSE, 2011

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The quality problem for SST

Instrument calibration

- AATSR thermal channels well calibrated but 0.2 K anomaly at 12 microns
- Visible channels – less well calibrated but this affects cloud clouding which changes SSTs.

Validation

- Buoys give global coverage but "traceable" calibration.
- Radiometers give traceable calibration but only in specific regions of the globe.
- Should we try to get buoys to be traceable and why?
- Should we deploy more radiometers and where?
- Does traceability beat/complement statistical significance?
- What about historical in situ/satellite data which we need to use?

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The quality problem for some other things

To be dogmatic:

LST

- Instrument calibration, internal quality, lack of validation data

Water vapour

- Quality of validation data – which radiosondes etc.

Other gases

- Except for ozone, comparison methodology satellites and in situ?
- How sure are we about calibration and the time-varying components of error?

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Overall

- How do we know we have “enough” validation data to be statistically significant?
- Are our inter-comparison methods well enough established?
- Is satellite instrument in-orbit calibration or in situ traceability more important (accuracy, precision, stability)
- How do we show our measurement is good if other systems are not good enough – information better than none?
- Do we pay enough attention to traceability between satellite sensors on-ground?

Climate data series are a lot of hard work and need serious long-term efforts

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