Sea surface temperature for climate from the ATSRs

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Climate requirements for SST

1. Independent record for \( \geq 15 \) year period
2. Biases <0.1 K, regionally
3. Target stability 0.05 K decade\(^{-1}\), regionally
   i. Discontinuities understood & removed
   ii. Consistency between sensors <=0.1 K
4. “Bulk” SSTs
5. Comprehensive error characterization:
   i. Retrieval errors (random and systematic)
   ii. Other errors (sampling, screening)
Elements of problem

- Channel availability
- Cloud detection
- SST retrieval (bias and stability)
- Bulk-skin relationship
- Practicalities
## Changing channel availability

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Chan 12</th>
<th>Chan 11</th>
<th>Chan 3.7</th>
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<tr>
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^  = absent latter part of mission  
*  = restricted availability

Availability affects cloud flagging and retrieval
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“Minimum channel set”
### Changing channel availability

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"All available"
See:

## Multiple “streams”

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<th>New cloud screen</th>
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<td>New cloud screen</td>
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<td>All available channels</td>
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- Reprocess all four
- Validate each thoroughly, choose “best”
- Differences informative about errors
Strategy for accuracy & stability

1. Using radiative transfer, refine SST retrievals independently of *in situ* measurements until
   - global bias < 0.1 K
   - minimize geographic variation in bias
SST estimators

- Usual form: \( a_0 + \sum a_{ch} BT_{ch} \)

- \( ch = 3.7, 11 \) and 12 \( \mu m \)
- But don’t use 3.7 \( \mu m \) if solar irradiance \( > 0 \)

- Therefore “dual-2” and “dual-3” estimators

  Two views; 11 & 12 \( \mu m \)  Two views; 3.7, 11 & 12 \( \mu m \)

  - Can calculate both of these on night data
  - Partial independence
  - Should be in agreement
Biases >1 K from Pinatubo aerosol in 1991/2

Made robust to stratospheric aerosol

+0.65 K
Improved modelling of water vapour absorption

Current “operational”
Improved model of surface emissivity (temperature dependent)

Simulated bias, dual-2 SST
Simulated dual-2 – dual 3 SST

(A) ATSR SST for climate: MERIS/AATSR Workshop Sep 05
Actual dual-2 – dual-3 SST


(A)ATSR SST for climate: MERIS/AATSR Workshop Sep 05
Expected performance with current understanding

Aim: correct these other errors

Dual-2 SST - Dual-3 SST / K

Latitude

60S 30S EQ 30N 60N

+0.65 K
Strategy for accuracy & stability

1. Using radiative transfer, refine SST retrievals independently of *in situ* measurements until
   - global bias < 0.1 K
   - minimize geographic variation in bias

2. Correct for residual global bias using subset of “best” *in situ* SSTs as reference
   - minimal loss of independence
   - basis for long-term stability
After bias correction against best *in situ* subset
Partners

- U of Edinburgh
- U of Leicester
- RAL SSTD
- NEODC
- MetO SAG
- NOCS
- MetO Hadley Centre

- NERC
- DEFRA
- MoD

(A)ATSR SST for climate: MERIS/AATSR Workshop Sep 05
Aim

- (A)ATSR SST time-series adequate to
  - Refine estimates of recent regional SST change globally
  - Give insight into evolution of errors in *in situ* observing system
MOHSST: number of months with any in situ SST in 2003
AATSR: number of months with retrieved SST in 2003
Global sample of conditions

Spectroscopy

Radiative transfer model

Model radiances

Estimator(s) for SST

Forward model

Observed in situ SSTs

(Bulk-to-skin)

SST estimates

Observations

Validation

See:
(A)ATSR SST for climate: MERIS/AATSR Workshop Sep 05