SST in Climate Research

Roger Saunders, Met Office

with inputs from Nick Rayner, John Kennedy, Rob Smith, Karsten Fennig, Sarah Millington, Owen Embury.

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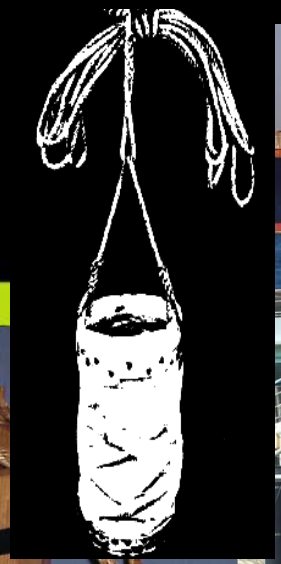
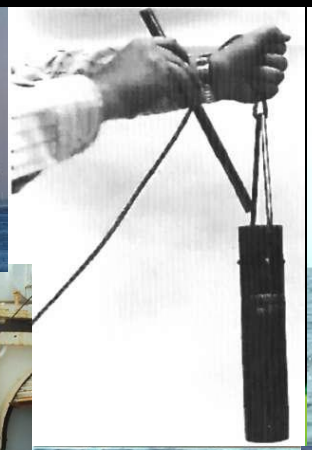
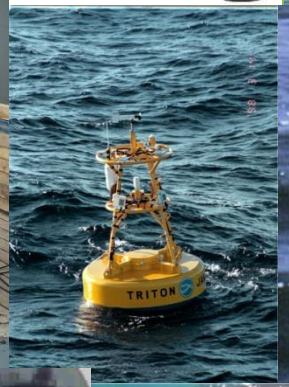
Diversity of measurements







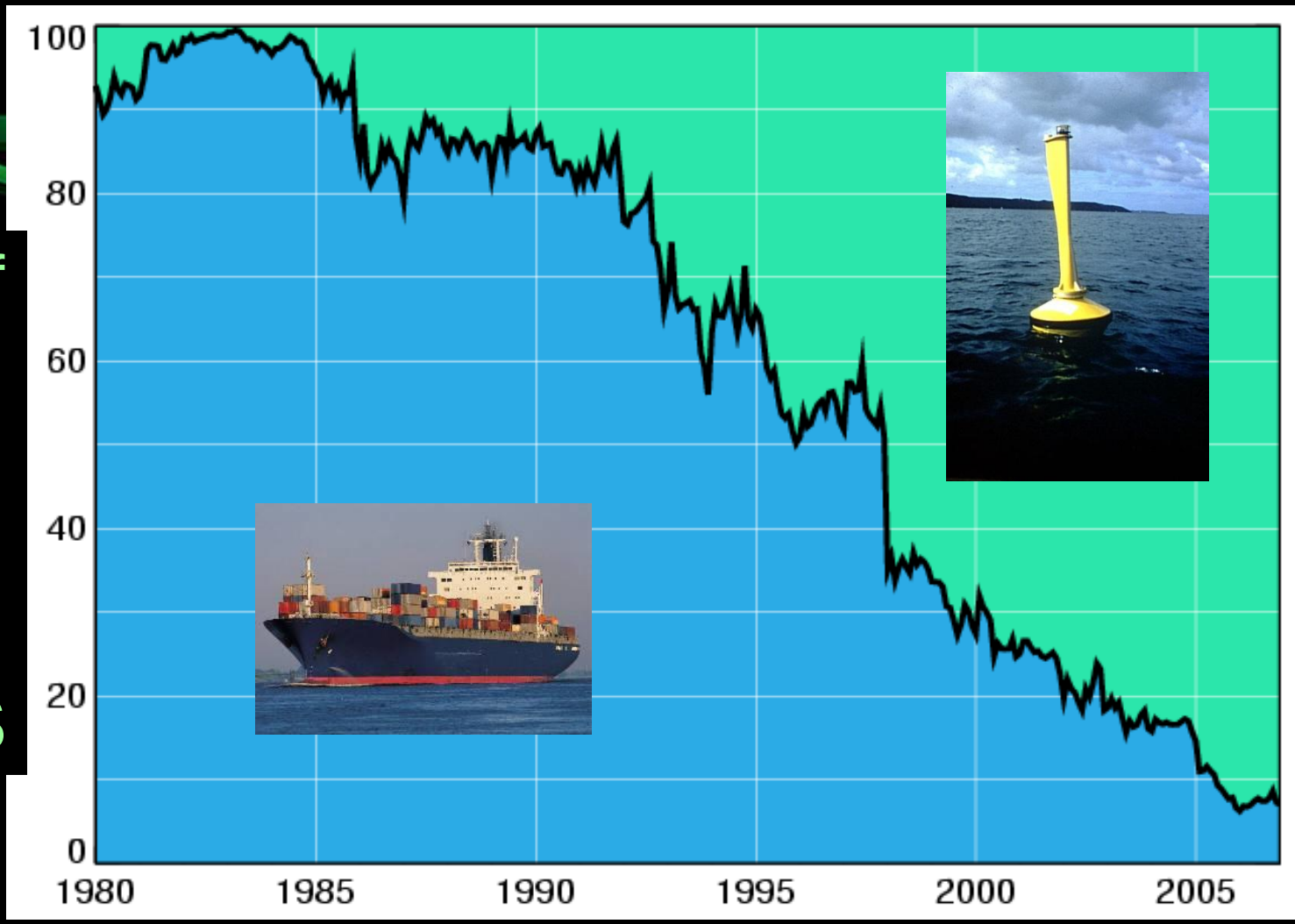
Not a stable observing system

Percentage of observations coming from

SHIPS

and

DRIFTERS



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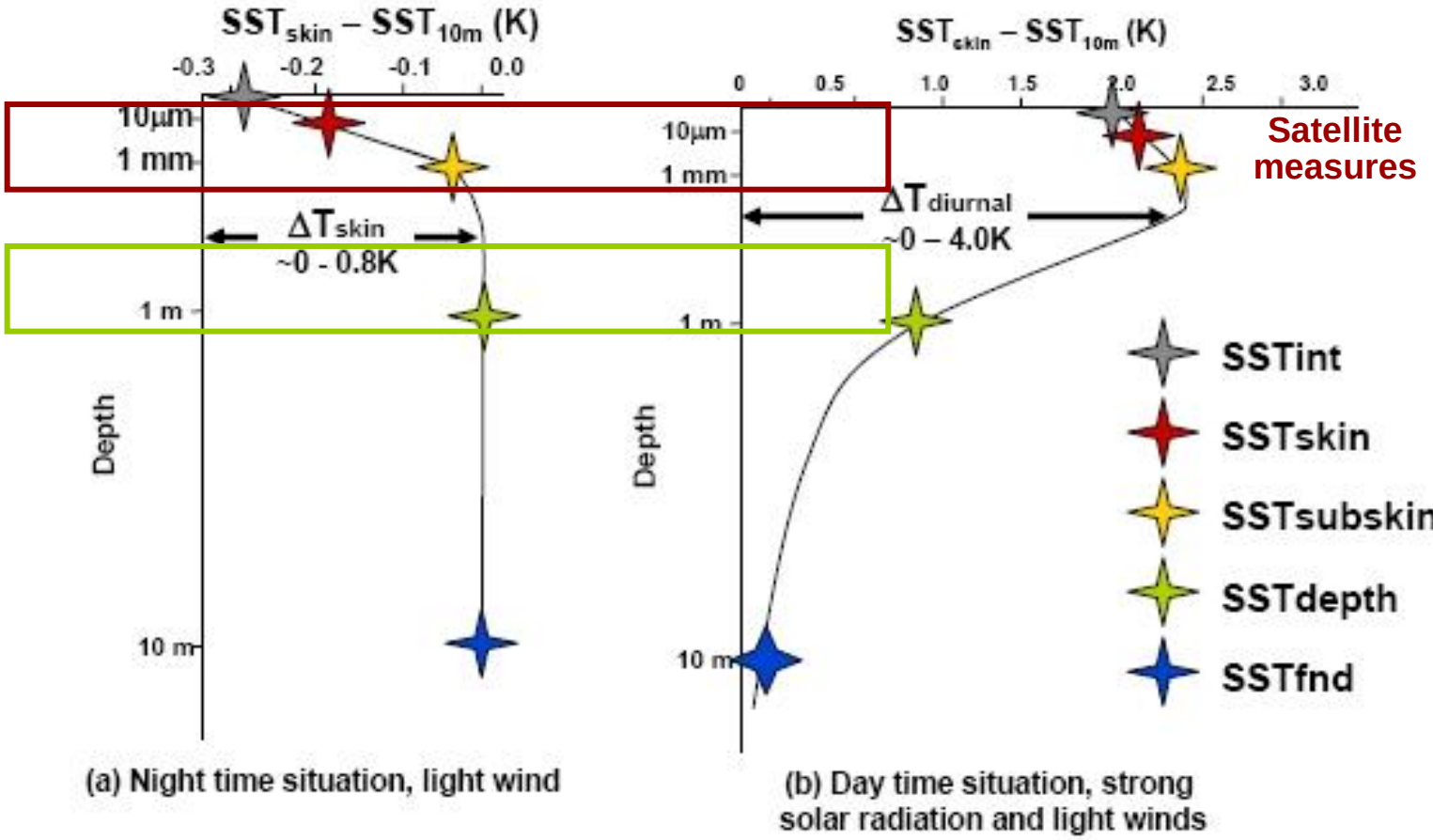
(A)ATSR - the solution!

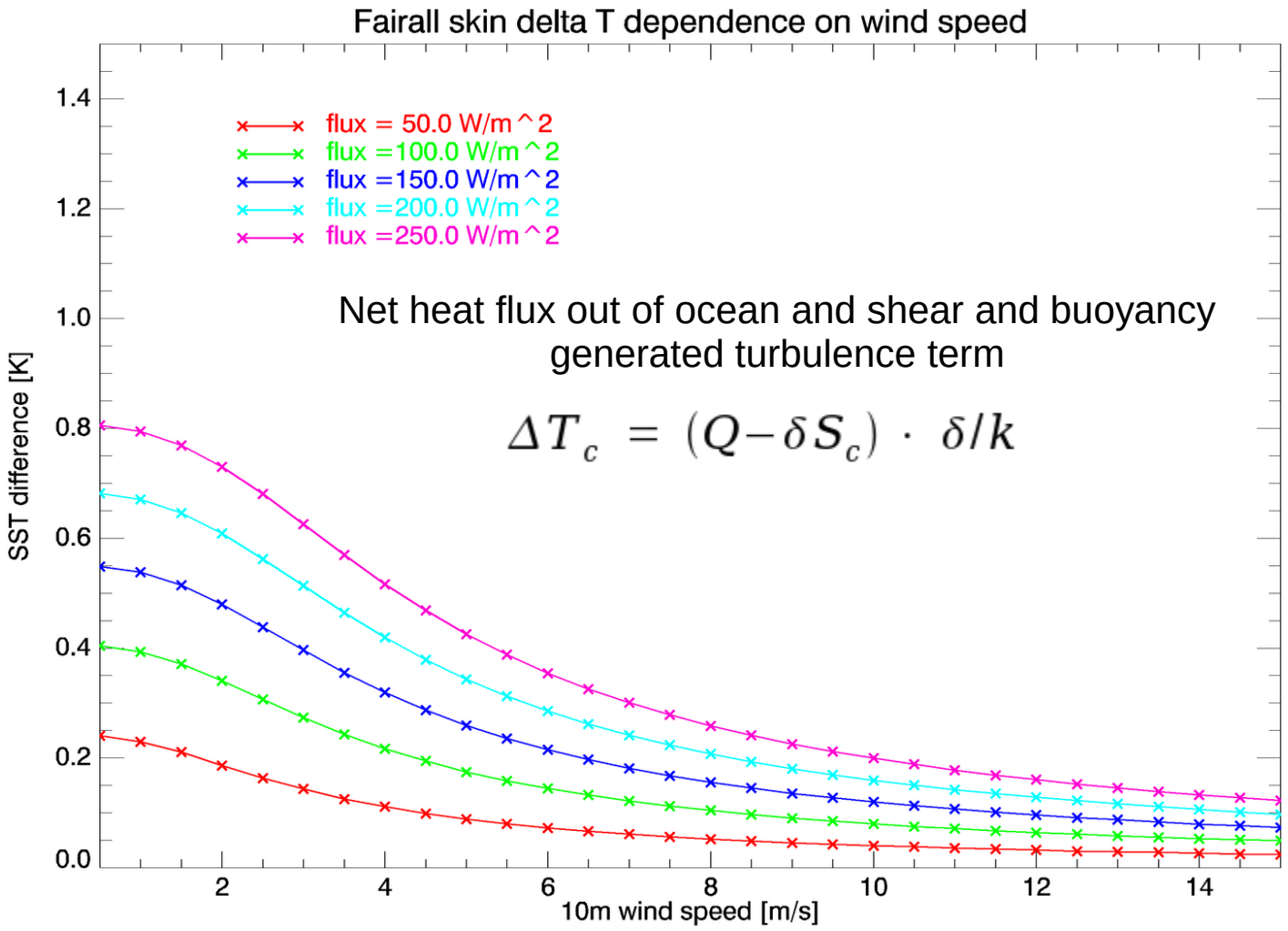
- **Single Platform**
- **Low measurement errors**
- **Low bias drift**

SST definitions

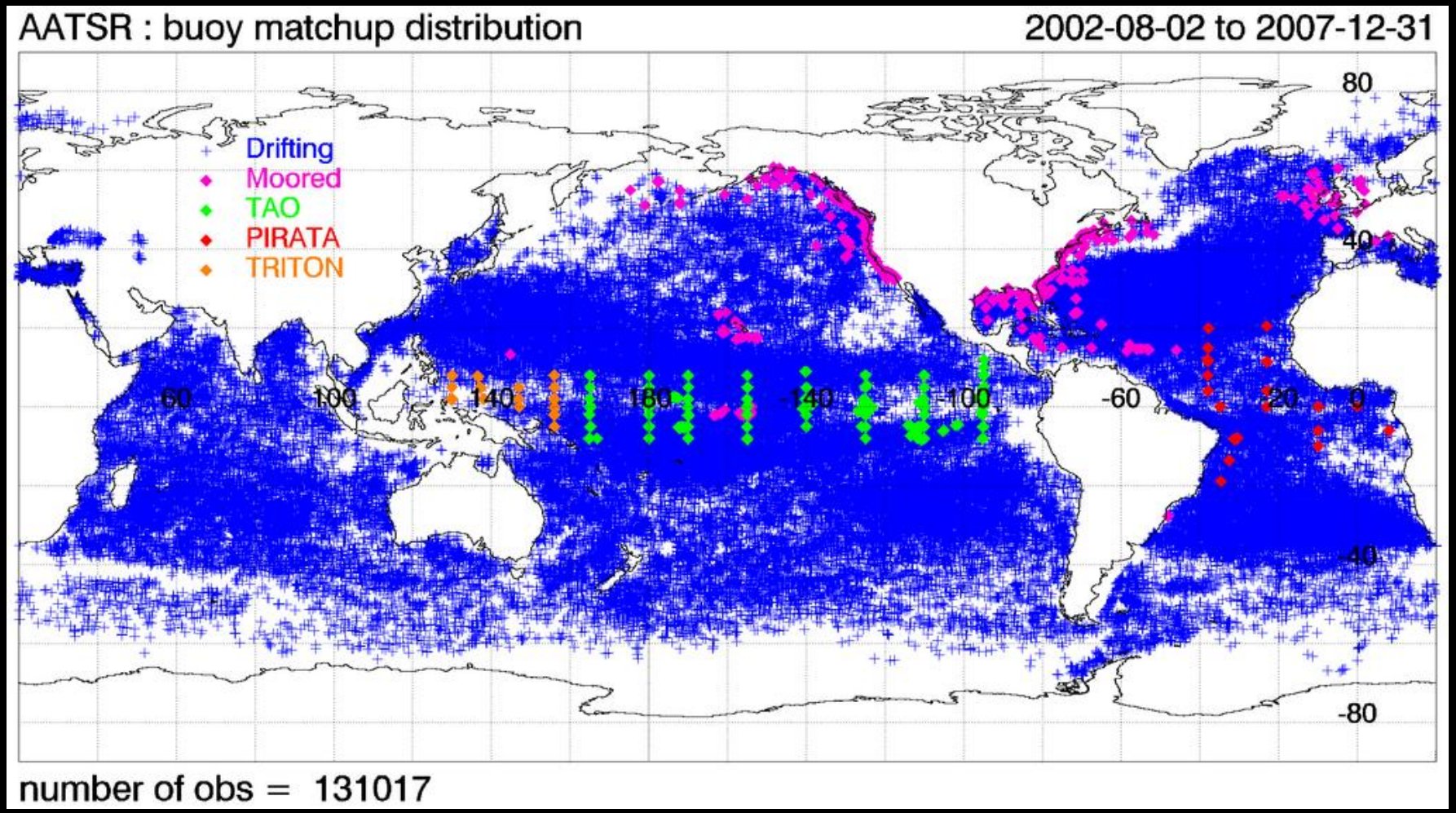
Buoys measure at Depths ~0.6m



Skin effect model



Buoy matchup database



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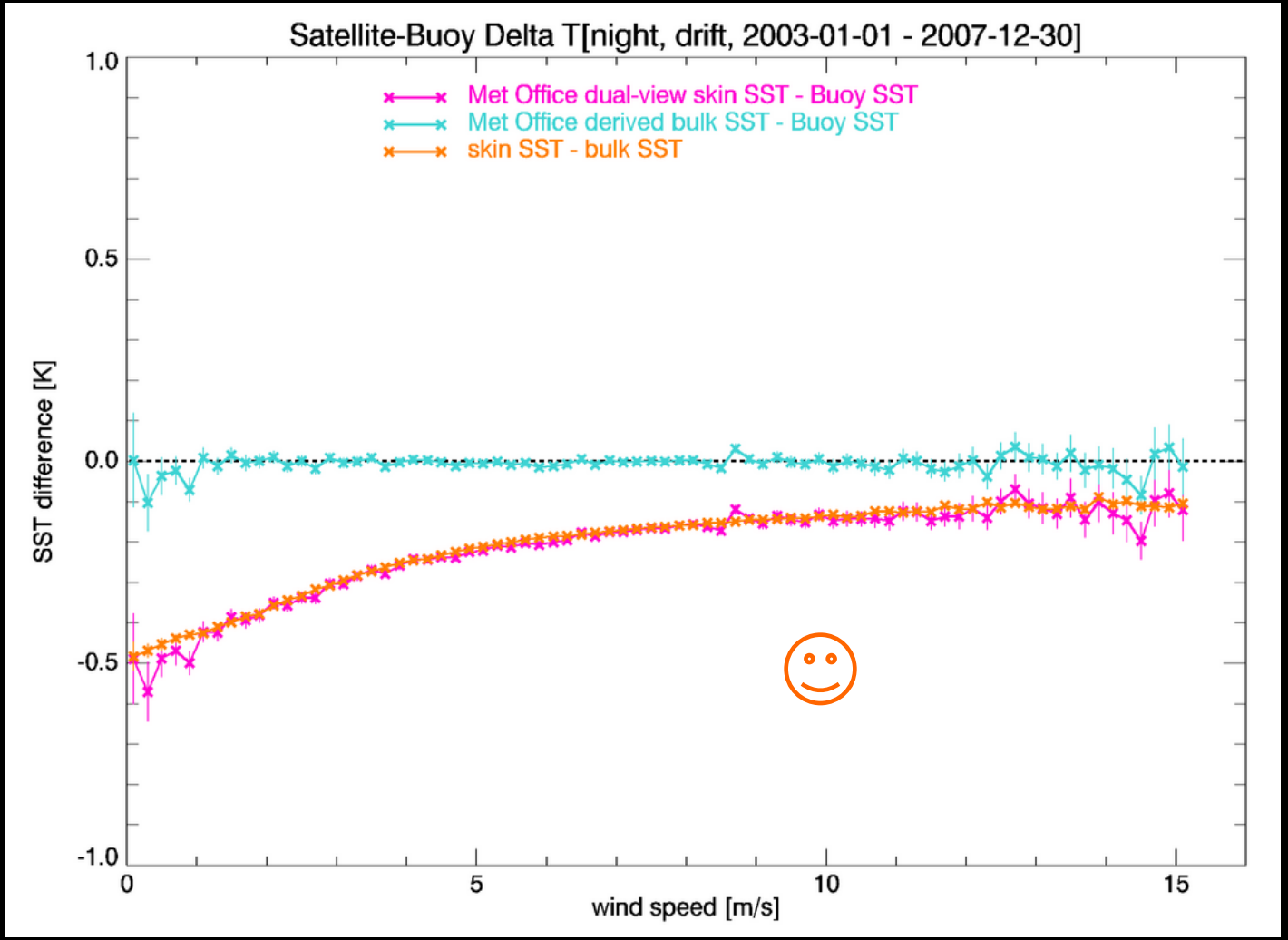
Validation of skin effect model

Mean differences, night D3, drifter



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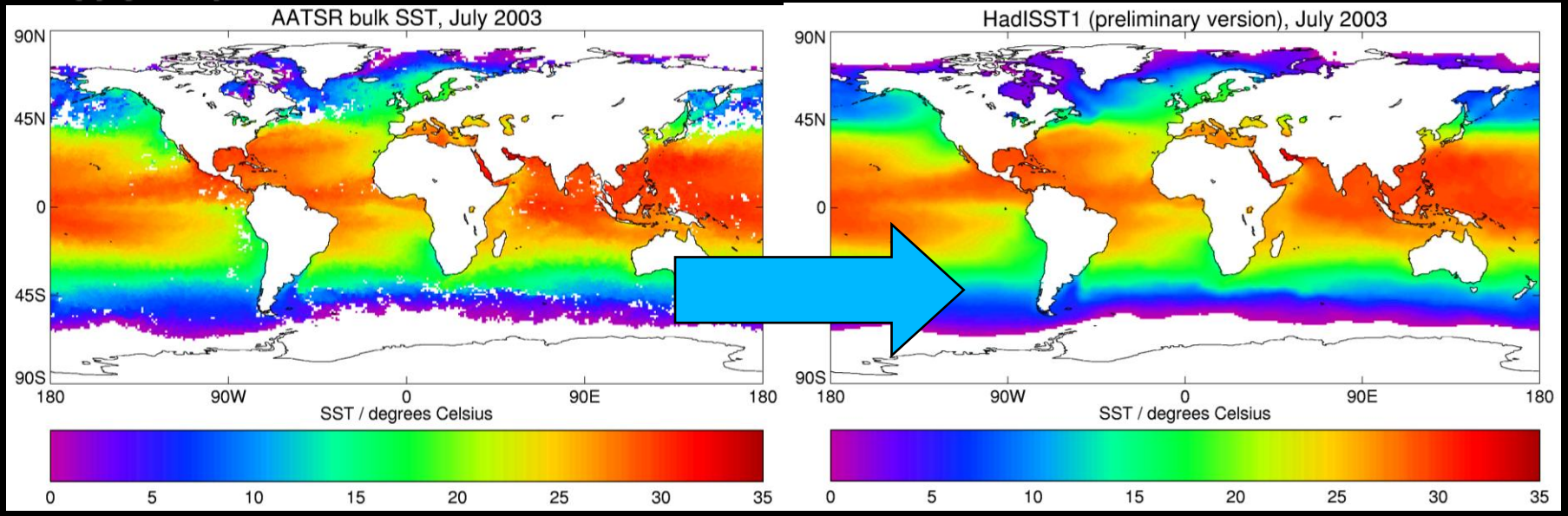
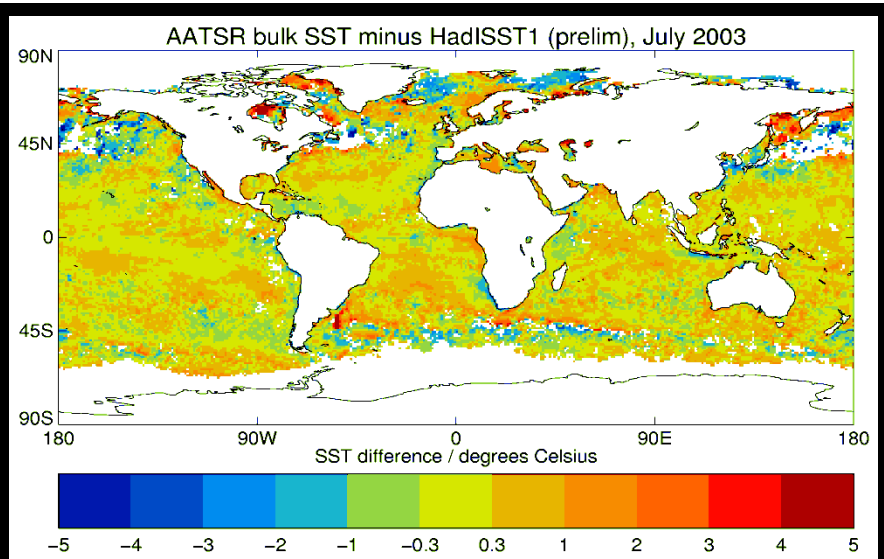
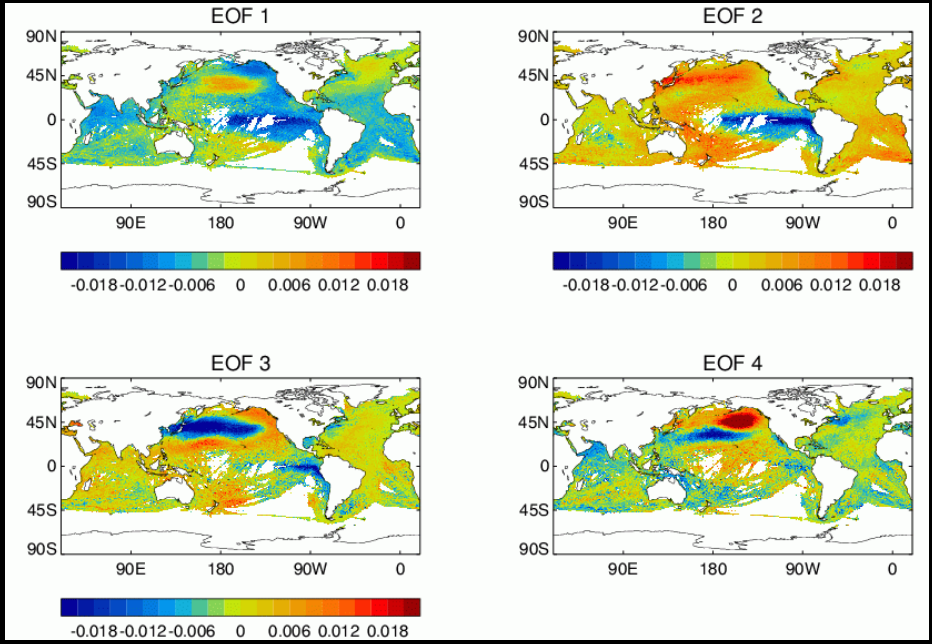
Good global coverage



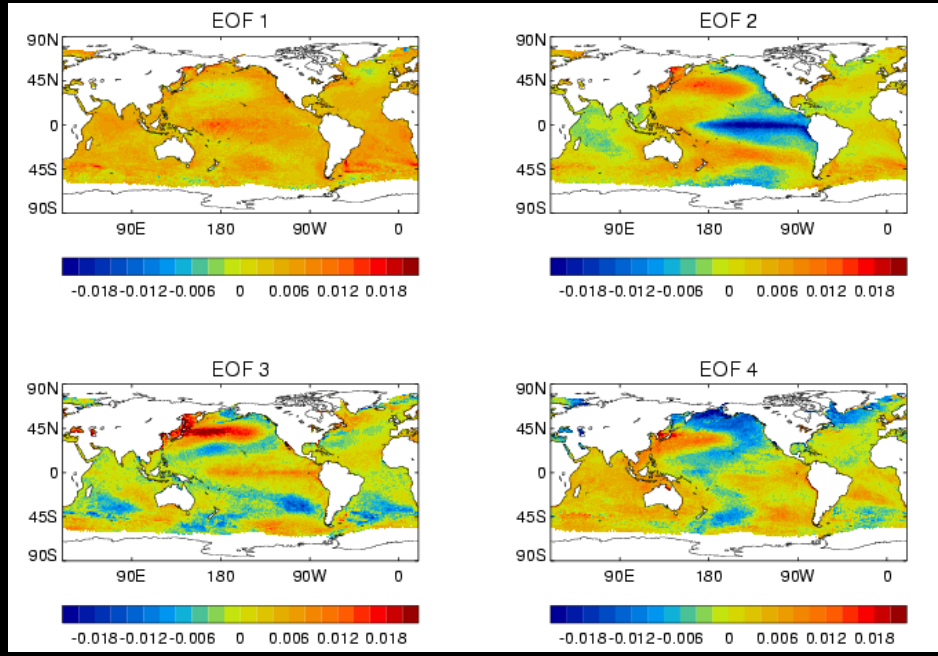


- To deliver high quality bulk (A)ATSR SST product to Hadley Centre from 1991-2013 for assimilation into HADiSST
- Provide *the* reference SST climate data record for this period and understand biases with in-situ and other satellite datasets

EOFs of SST field for reconstructing historical analyses



In-situ data only



In-situ + ATSR + AVHRR data

Data voids removed

Allows SST fields before the satellite era to be estimated

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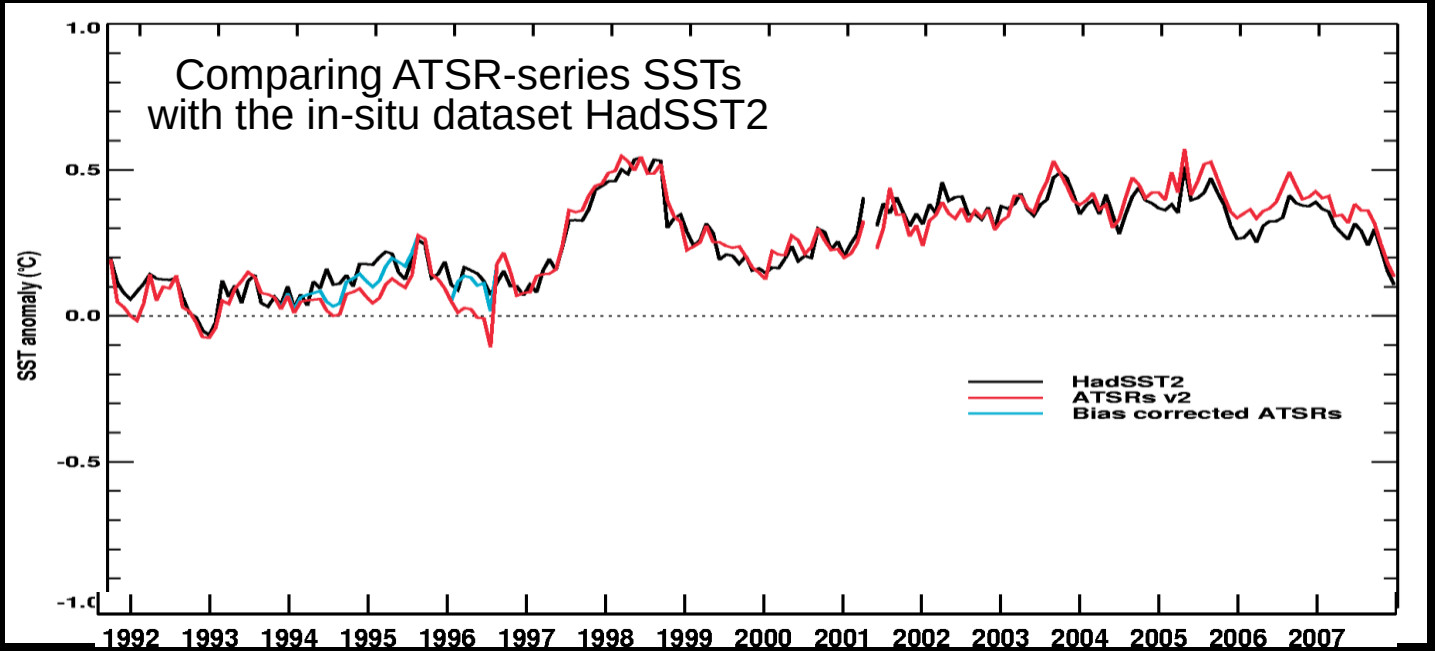
Time series of satellite SSTs

AVHRR bias correction:

- Uses ATSR as reference
- Uses TOMS to correct for aerosol effects

SST anomaly:

Observed SST vs. 1961-1990 climatology



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AVHRR bias correction:

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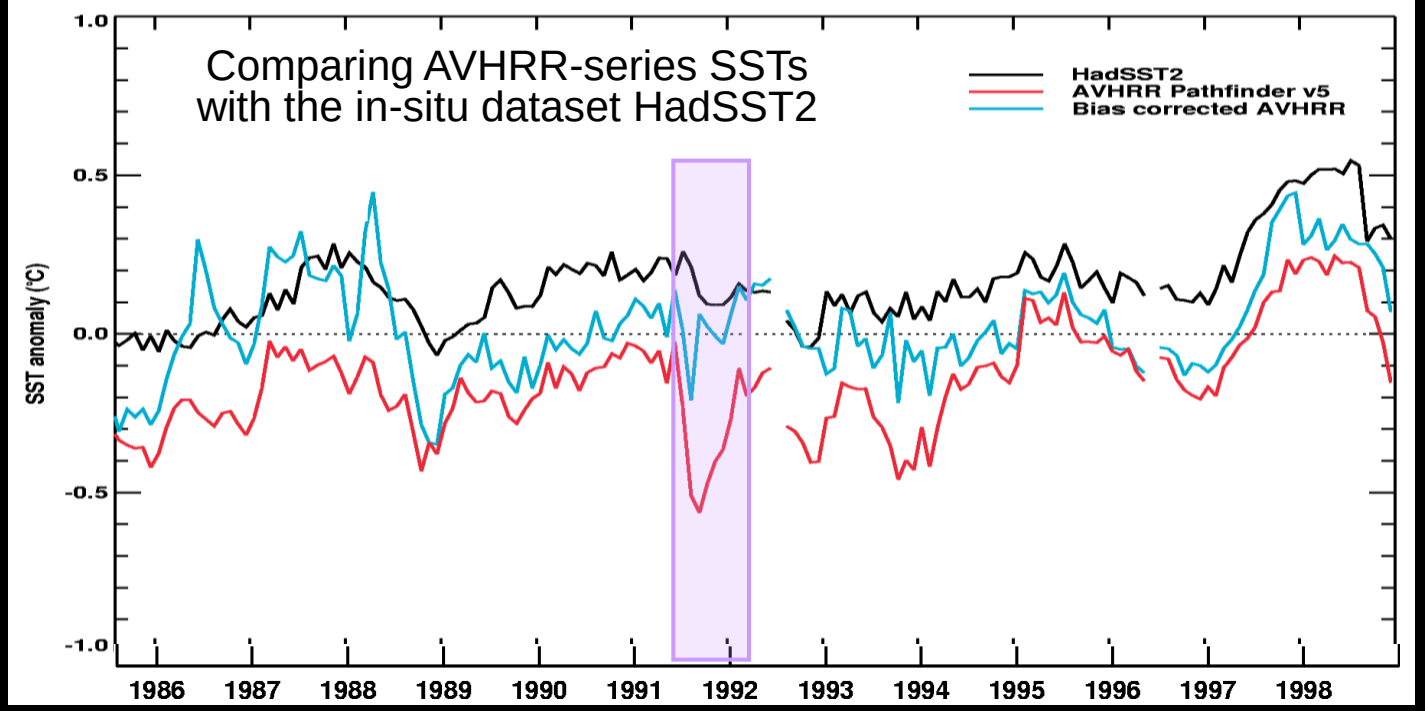
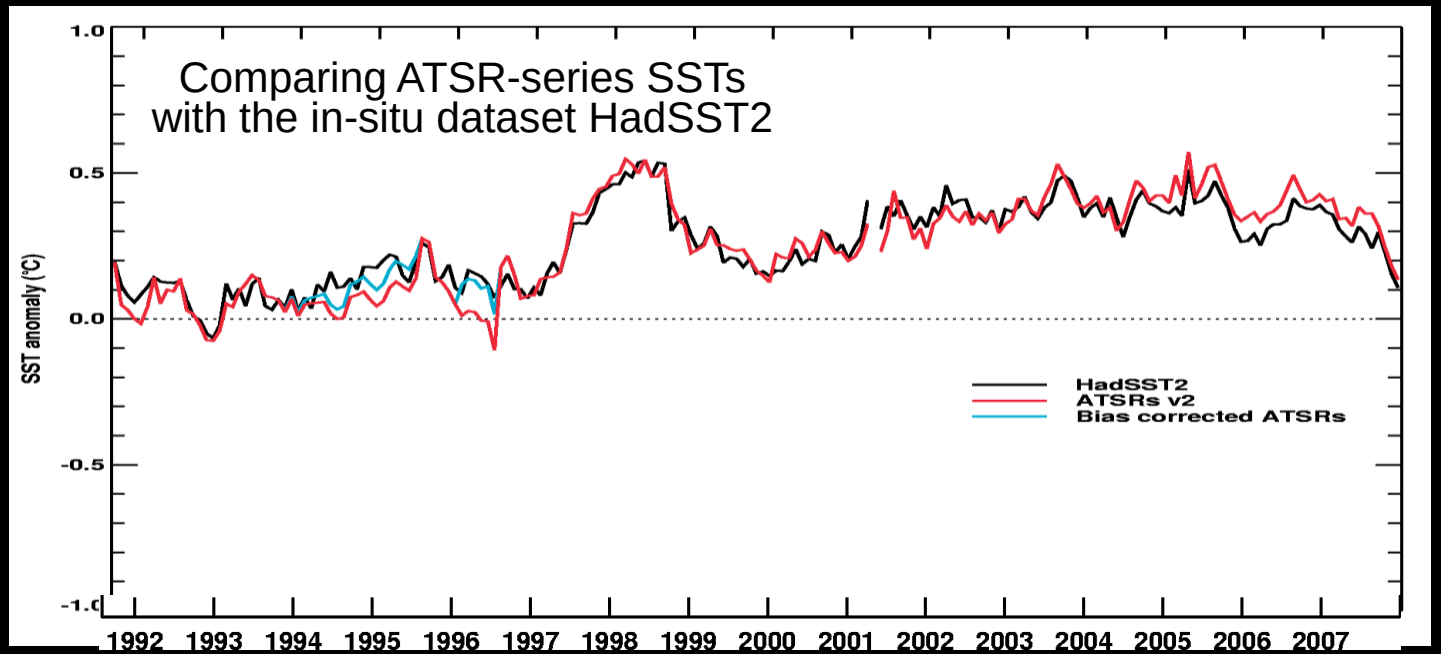


SST anomaly:

Observed SST vs. 1961-1990 climatology



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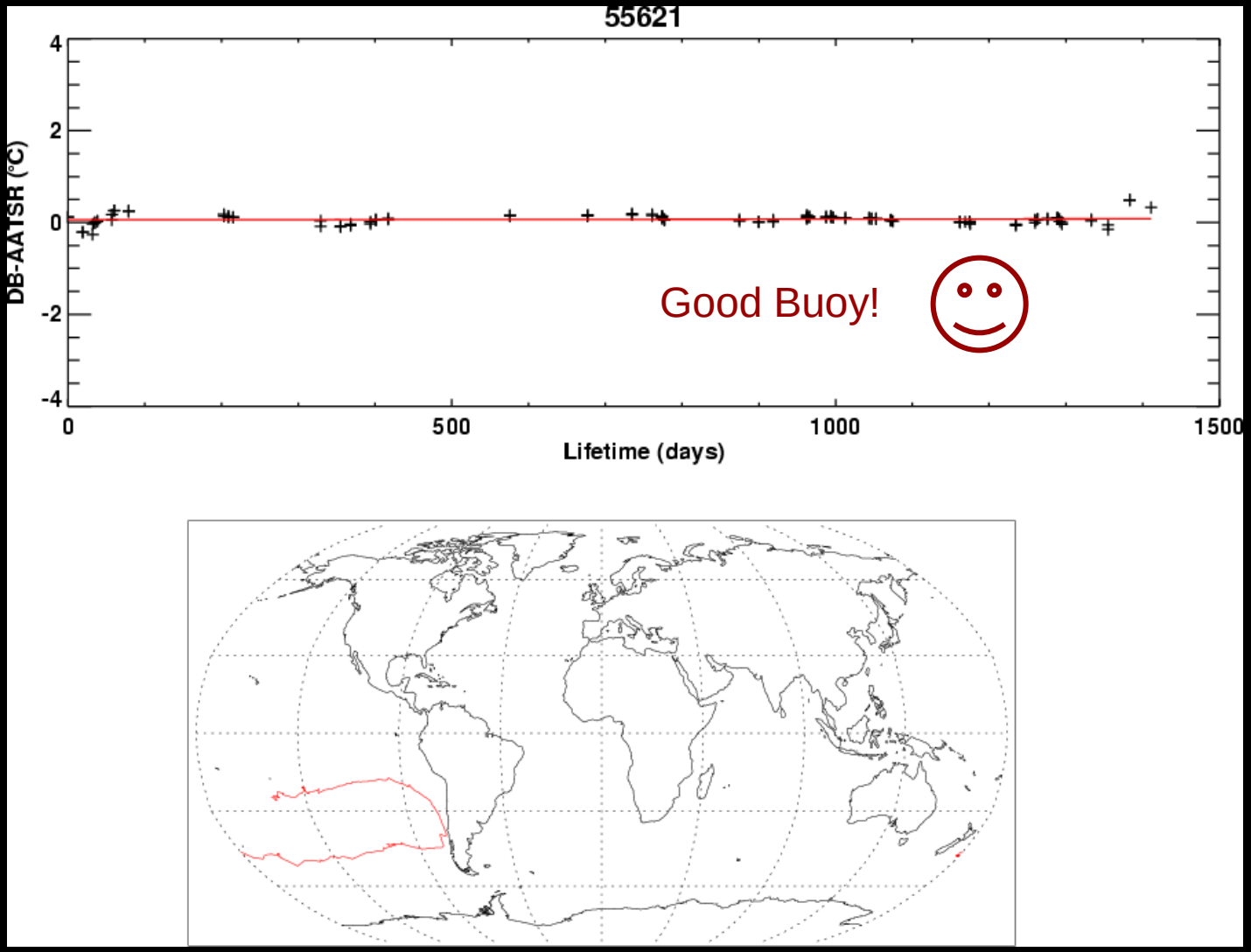
Monitoring the buoy network (1)



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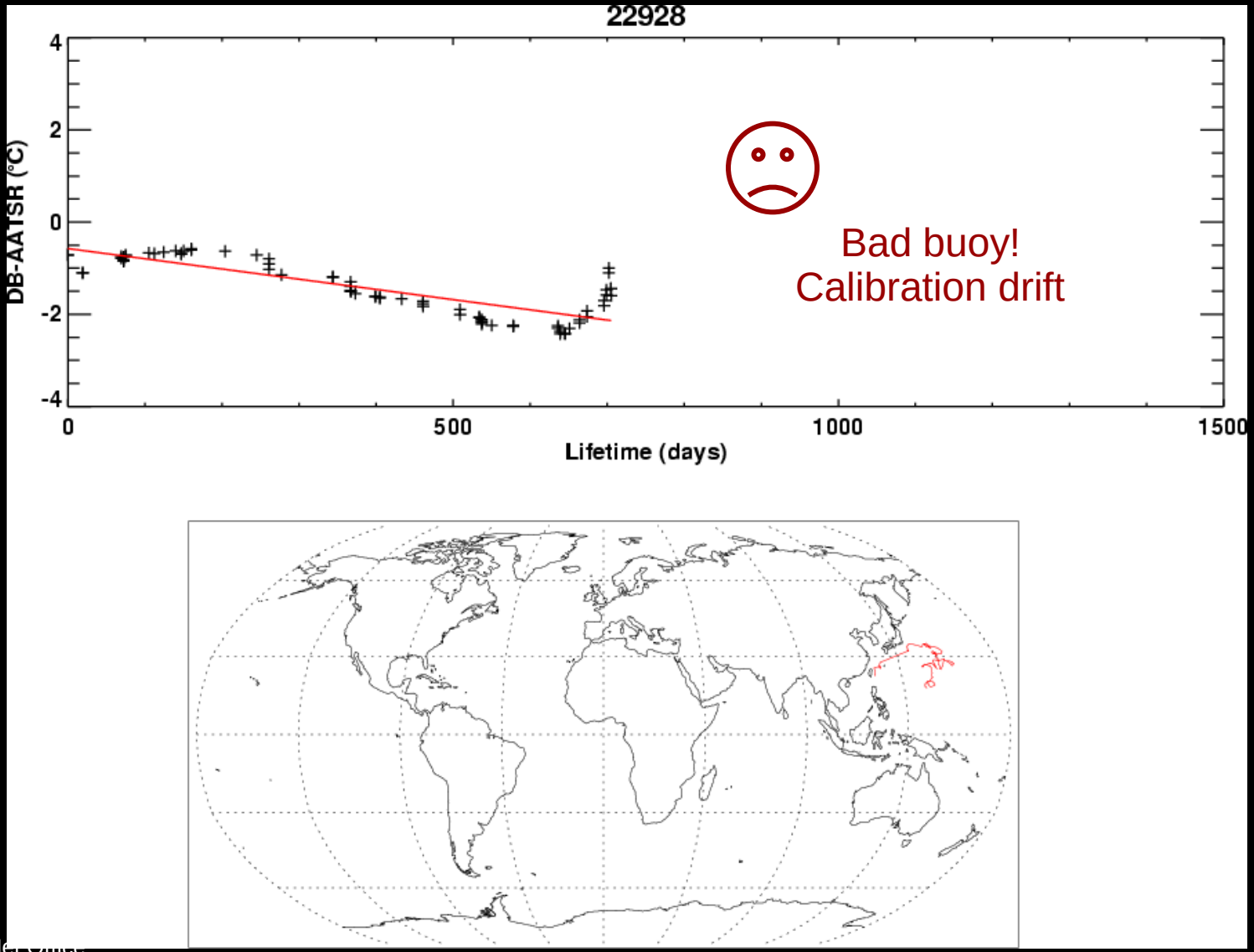
Monitoring the buoy network (2)



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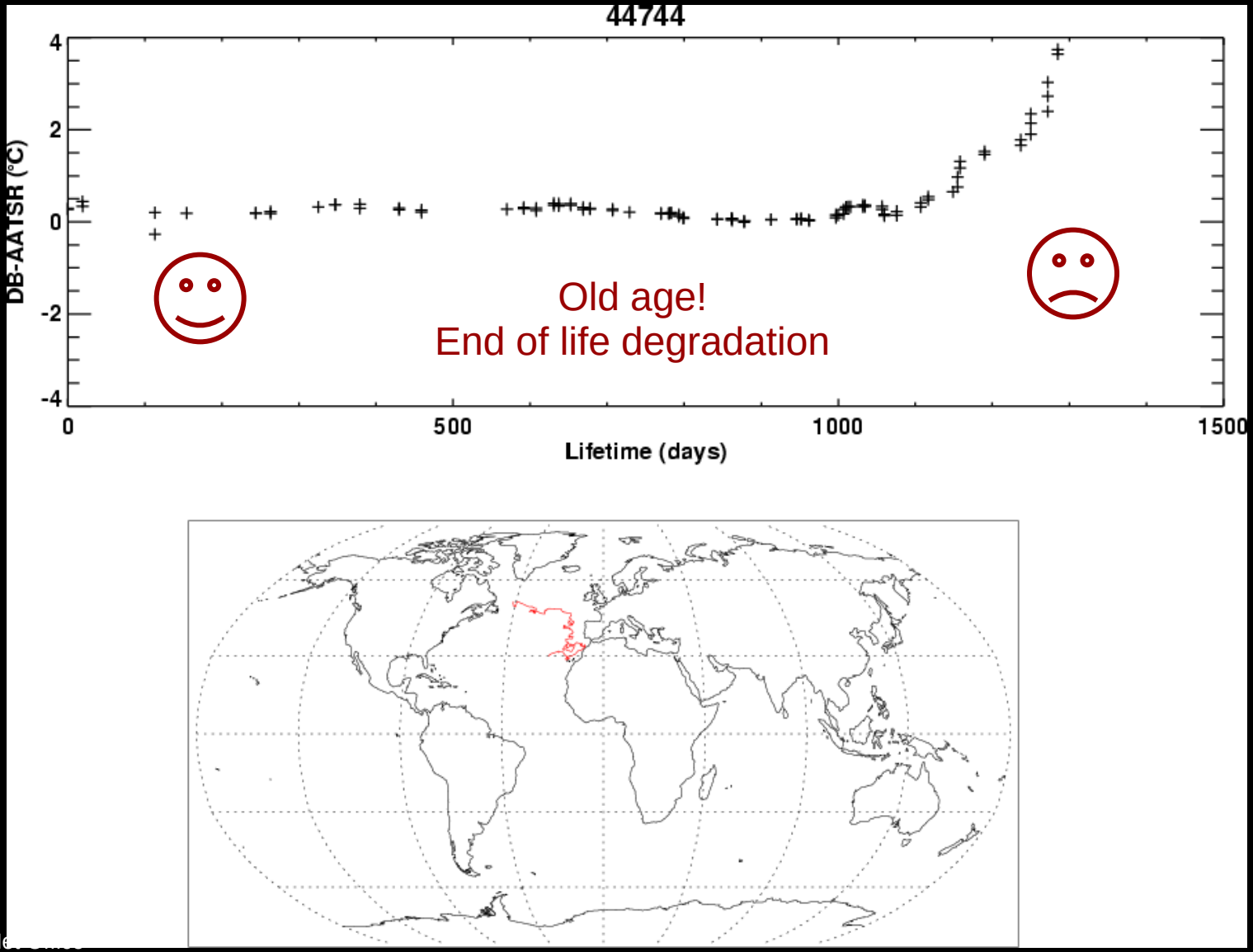
Monitoring the buoy network (3)



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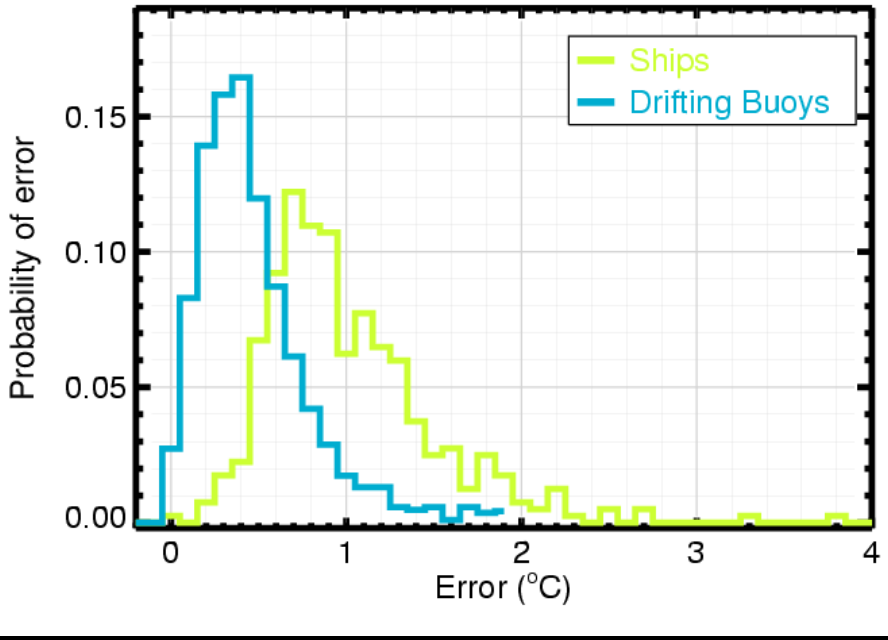
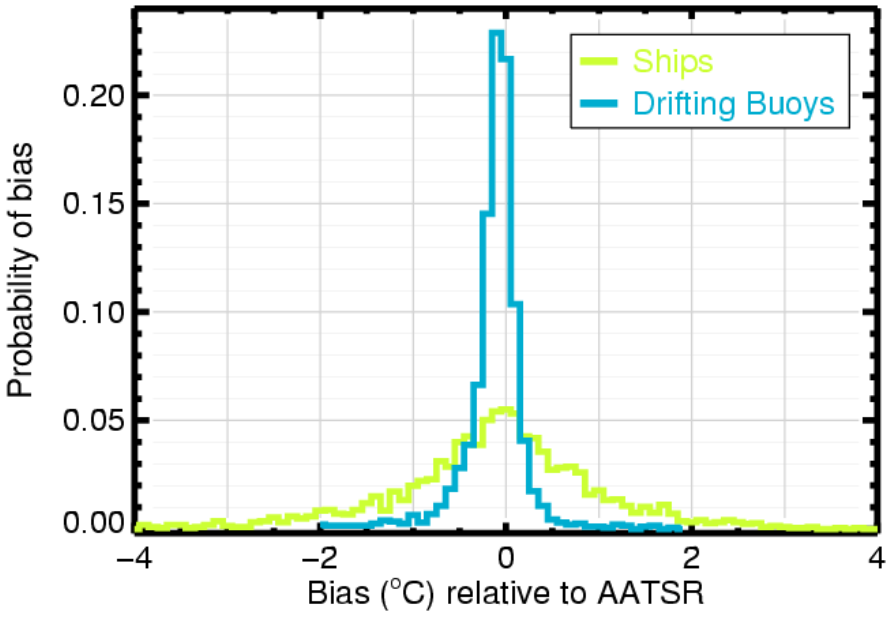
Measurement and bias errors distributions of in-situ data





Measurement error and bias error distributions.

Ships are more error prone than drifters although both can have large biases

Bias component implies errors are correlated

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Deriving a sea surface temperature record suitable for climate change research from the along-track scanning radiometers

(A)ATSR Re-analysis for Climate: ARC

http://arc.geos.ed.ac.uk

Chris Merchant, University of Edinburgh and many others

©

ARC Improvements

- **Cloud detection**
  - **Bayesian cloud detection makes use of NWP data**
  - **Reduces false alarm rate giving better coverage in important regions (Arctic, gulf stream, coastal)**
  - **Increases hit rate**
- **Aerosol**
  - **Detects Saharan dust over the Atlantic during summer**
- **Sea ice**
  - **Can distinguish sea-ice from open water**
- **SST algorithm**
  - **New technique using up-to-date spectroscopy**
  - **Reduces bias and noise and improved day/night consistency**
- **Skin to Bulk correction**
  - **Improved validated model**

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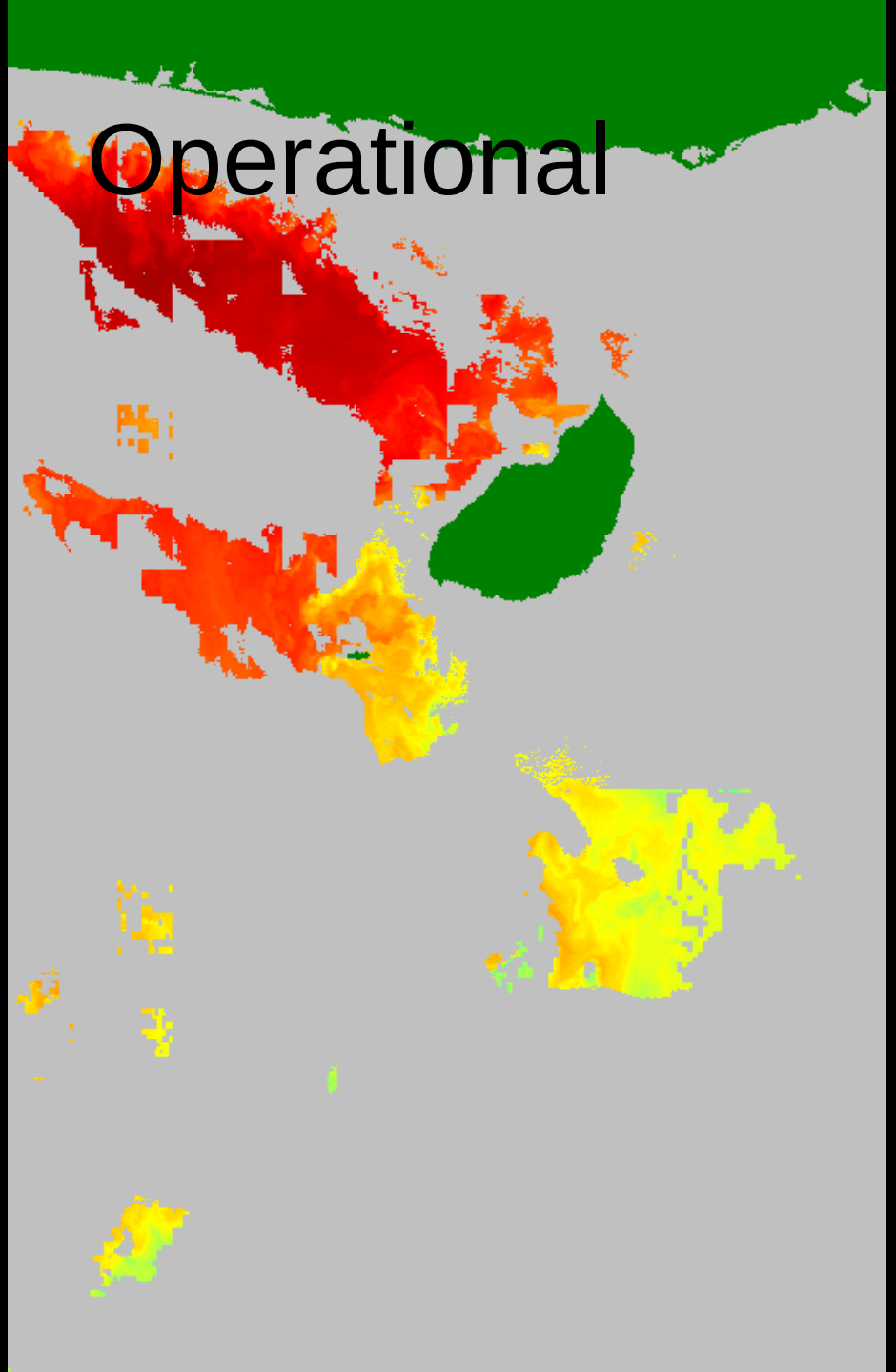
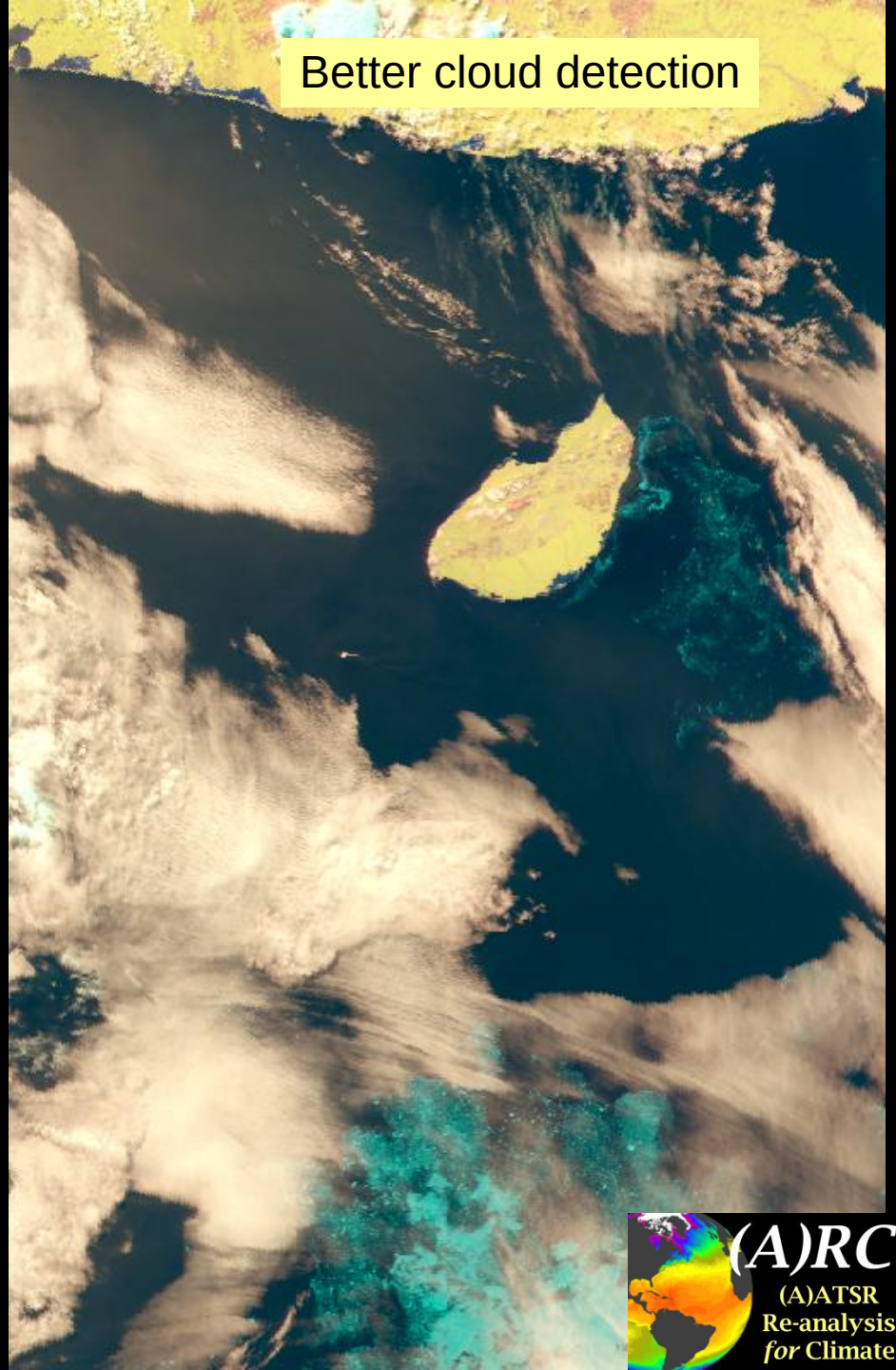
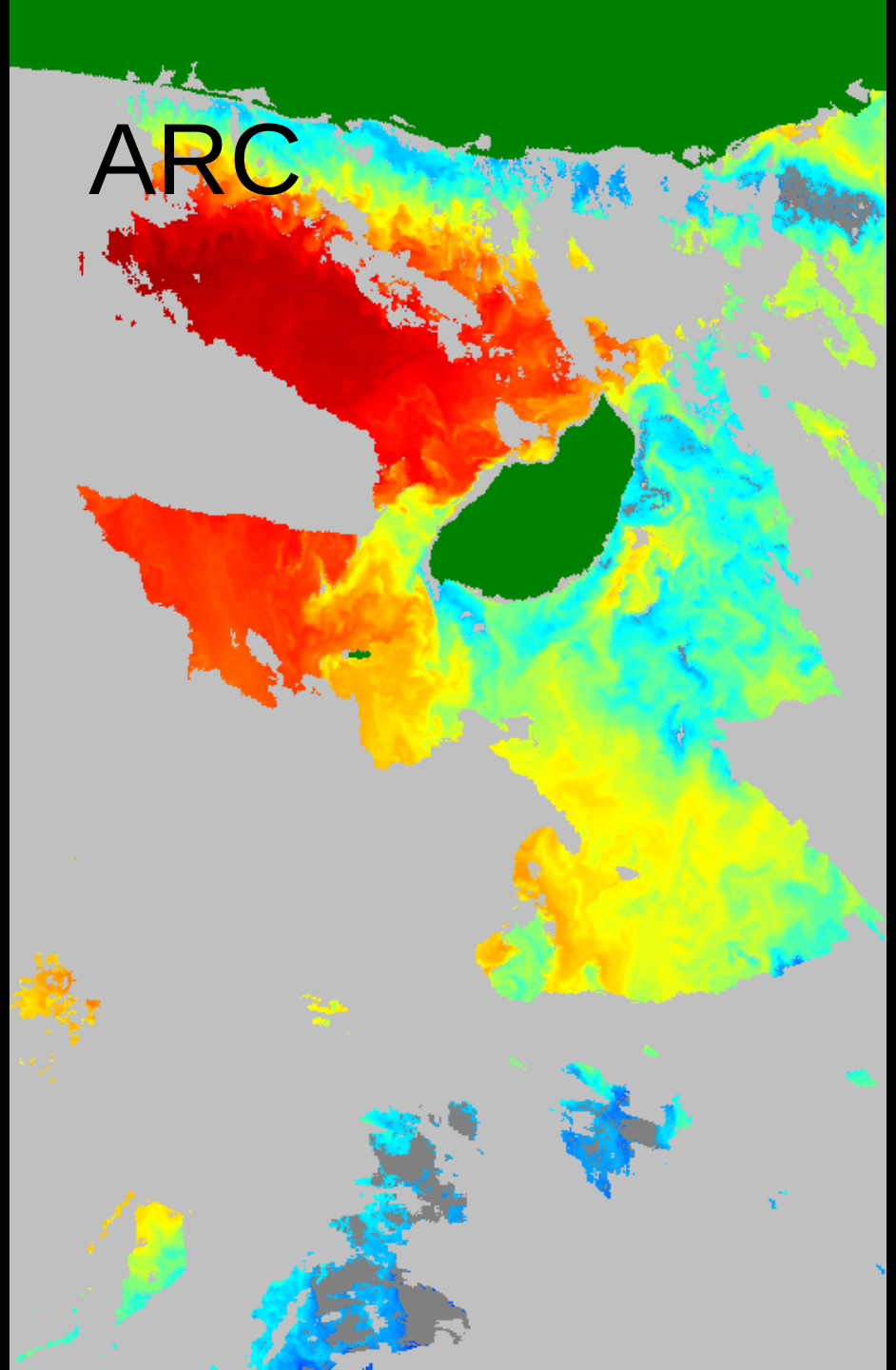
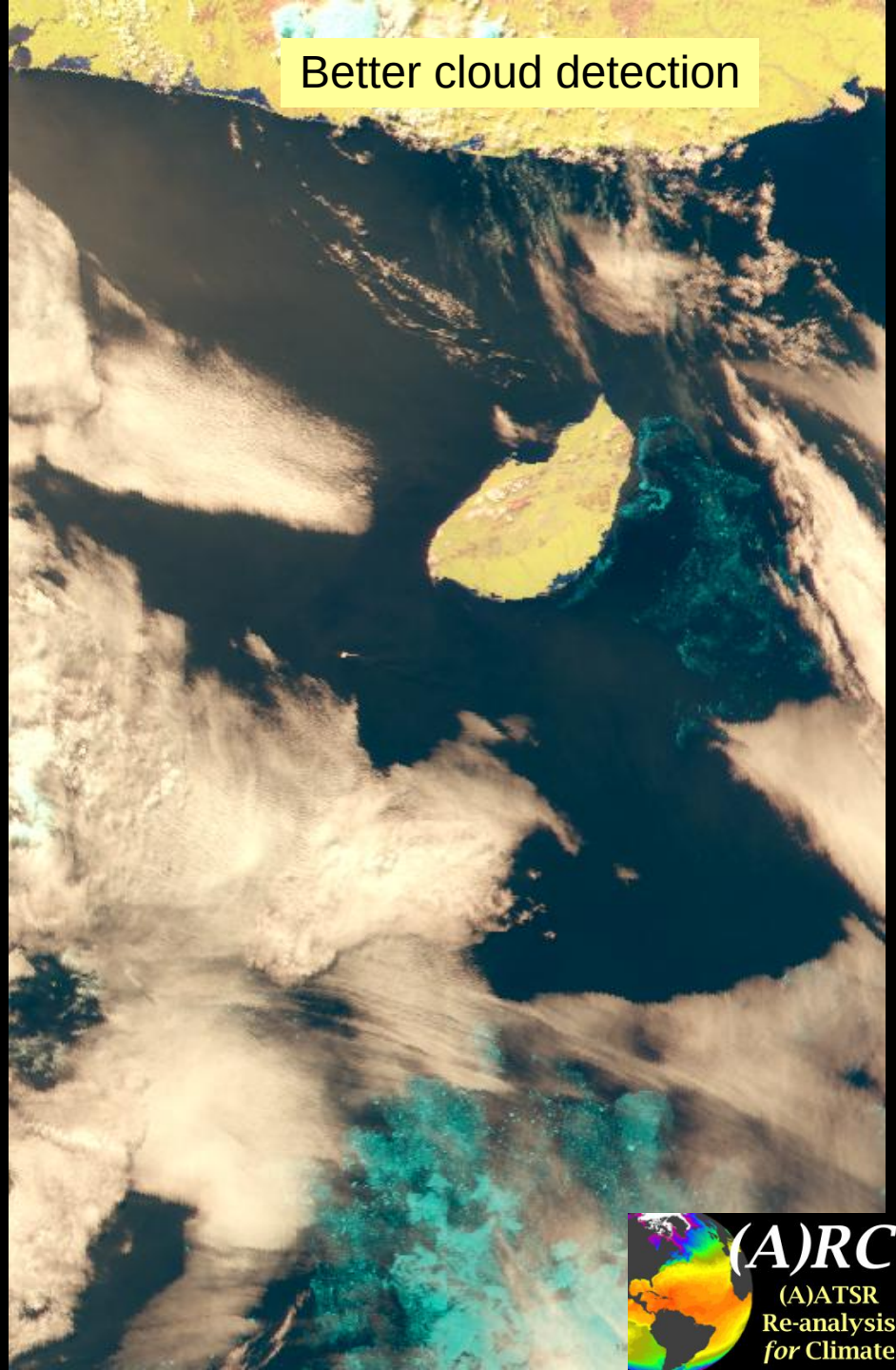

Operational


Better cloud detection
(A)RC
(A)ATSR
Re-analysis
for Climate


ARC


Better cloud detection
(A)RC
(A)ATSR
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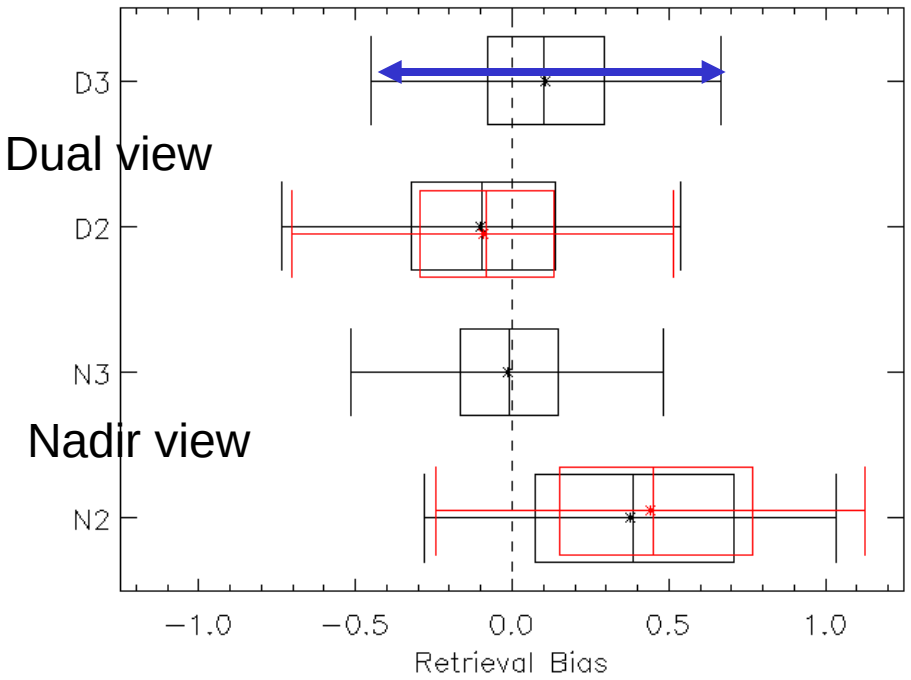
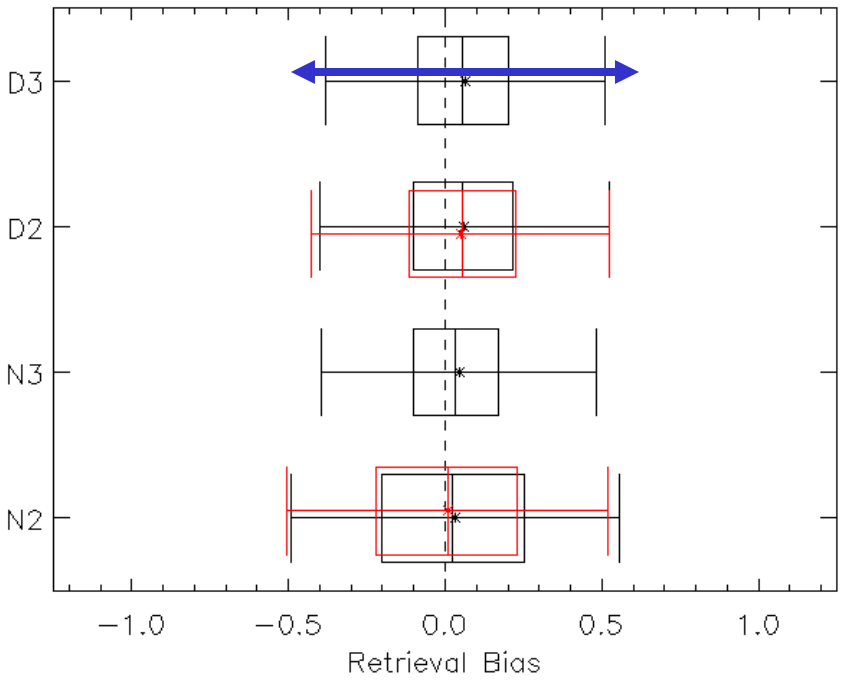
for Climate

SST retrieval error reduced

ESA Operational	ARC





Smaller errors

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Global Satellite Intercalibration Calibration System
Simultaneous Nadir Overpass (SNO) Method

POES intercalibration

- Useful for remote sensing scientists, climatologists, as well as calibration and instrument scientists
- Potential for (A)ATSR and geo or polar matches

- Has been applied to microwave, vis/nir, and infrared radiometers for on-orbit performance trending and climate calibration support
- Capabilities of 0.1 K for sounders and 1% for vis/nir have been demonstrated in pilot studies

GOES vs. POES

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Uses of ATSR data at the Hadley Centre

- ✔ To provide an independent climate data record of the SST ECV from 1991 to present day
- ✔ As input to the climate SST analysis HadISST along with ship, buoys and AVHRR SSTs
- ✔ To identify biases and drifts in current and past *in situ* measurements (e.g. buoys and ships)
- *Use of cloud and aerosol products for model validation*
- *For use in GSICS to "calibrate other satellite radiometers"*

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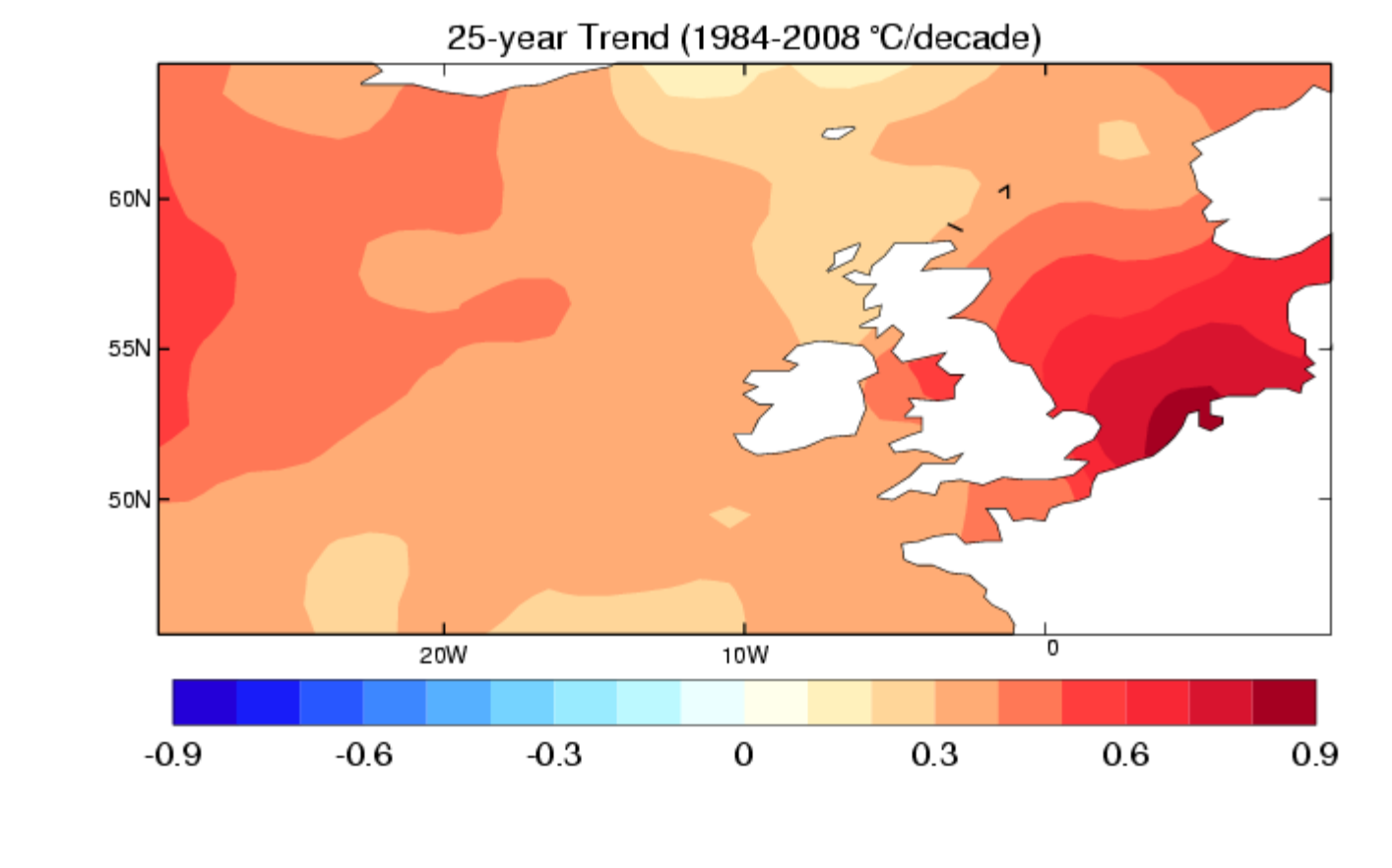
SST trends around UK



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Key messages

- (A)ATSR is now accepted as the “gold standard” for sea surface temperature
- AATSR SSTs are used operationally for NWP forecasts at several European Met Services
- ARC has been a success in reprocessing the complete 1991-2009 (A)ATSR dataset to provide an SST product fit for climate applications
- ARC SSTs will be a key data source for the new SST climate analysis being developed at the Hadley Centre - HadISST3.

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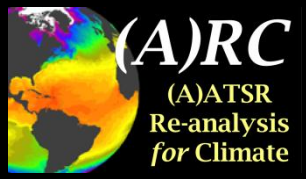

Questions and answers

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