ESA Climate Change Initiative Phase-II

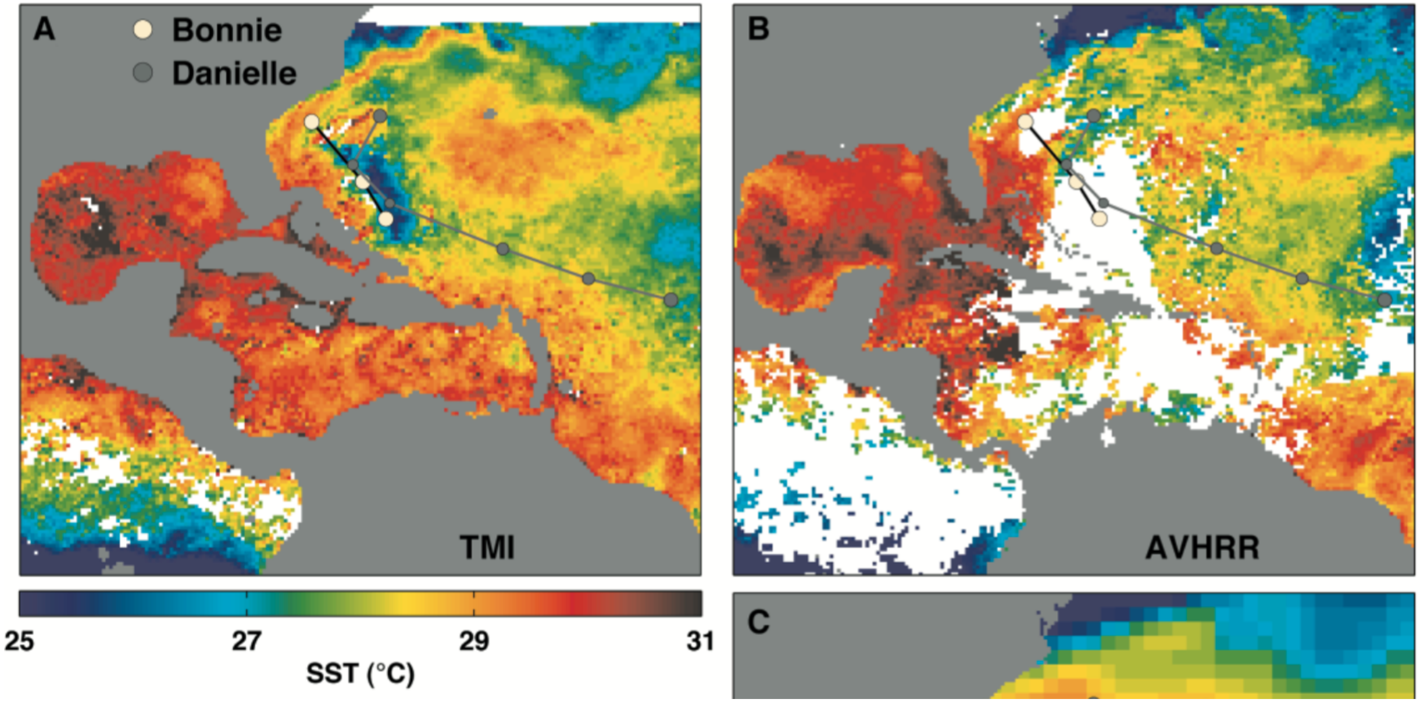
Sea Surface Temperature (SST)

www.esa-sst-cci.org

SATELLITE-BASED SEA SURFACE TEMPERATURE CLIMATE DATA RECORDS

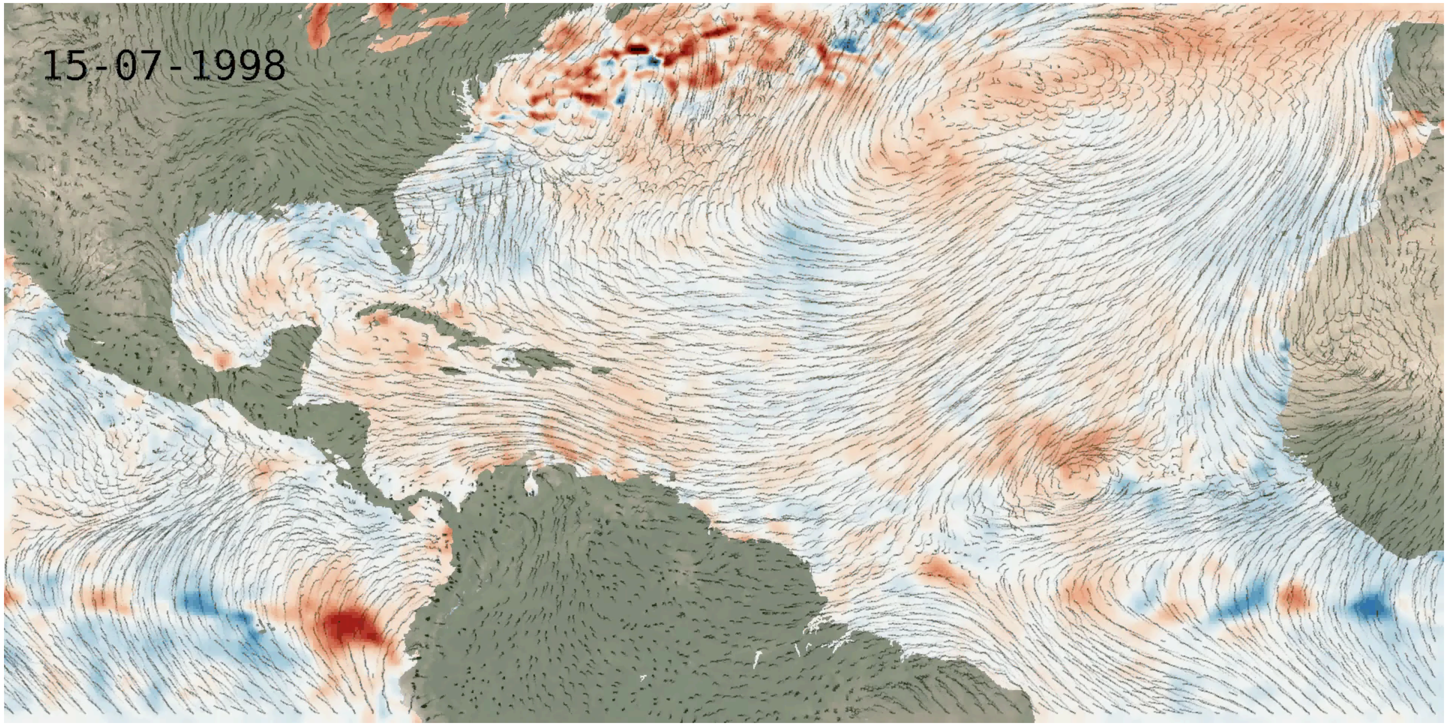
Chris Merchant

Hurricane wakes

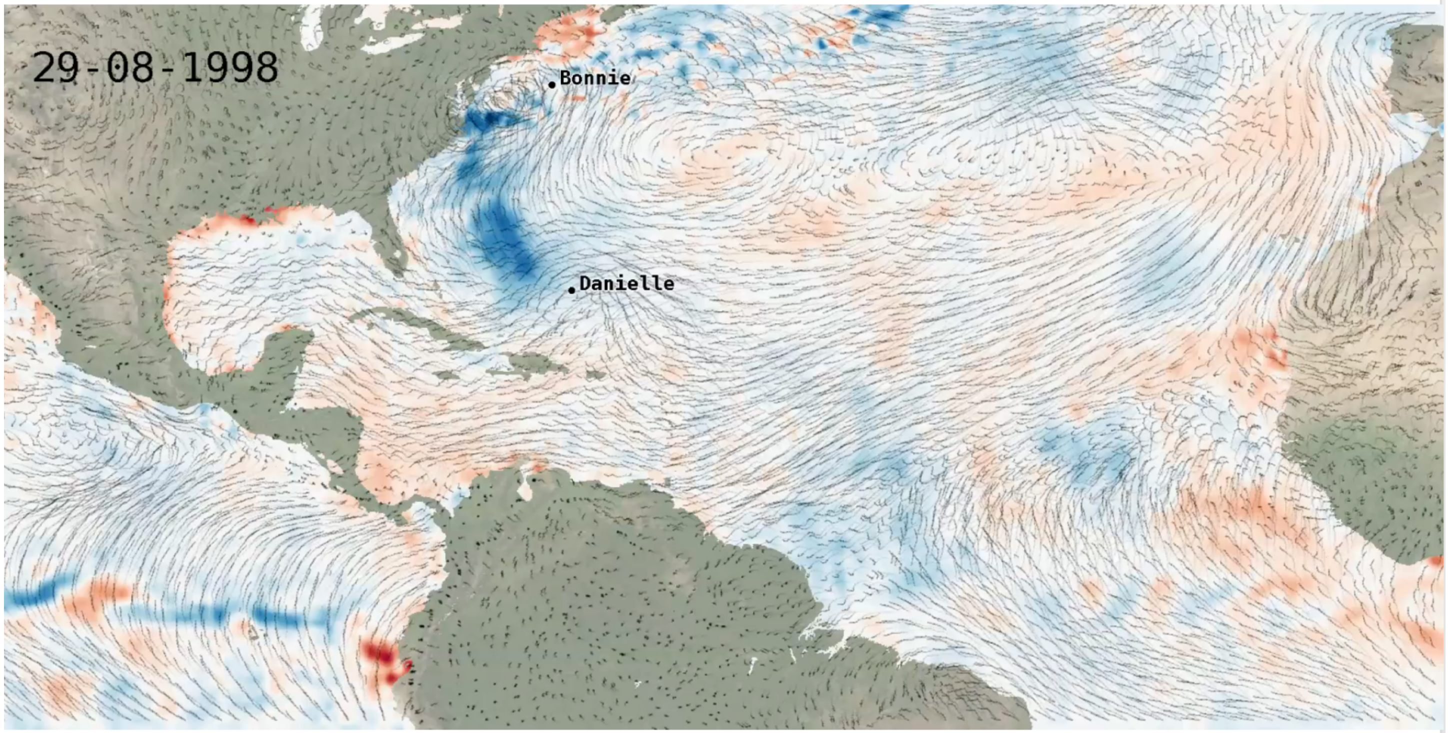


- Wentz et al, Science, 2000

SST CCI v1.1 L4 analysis



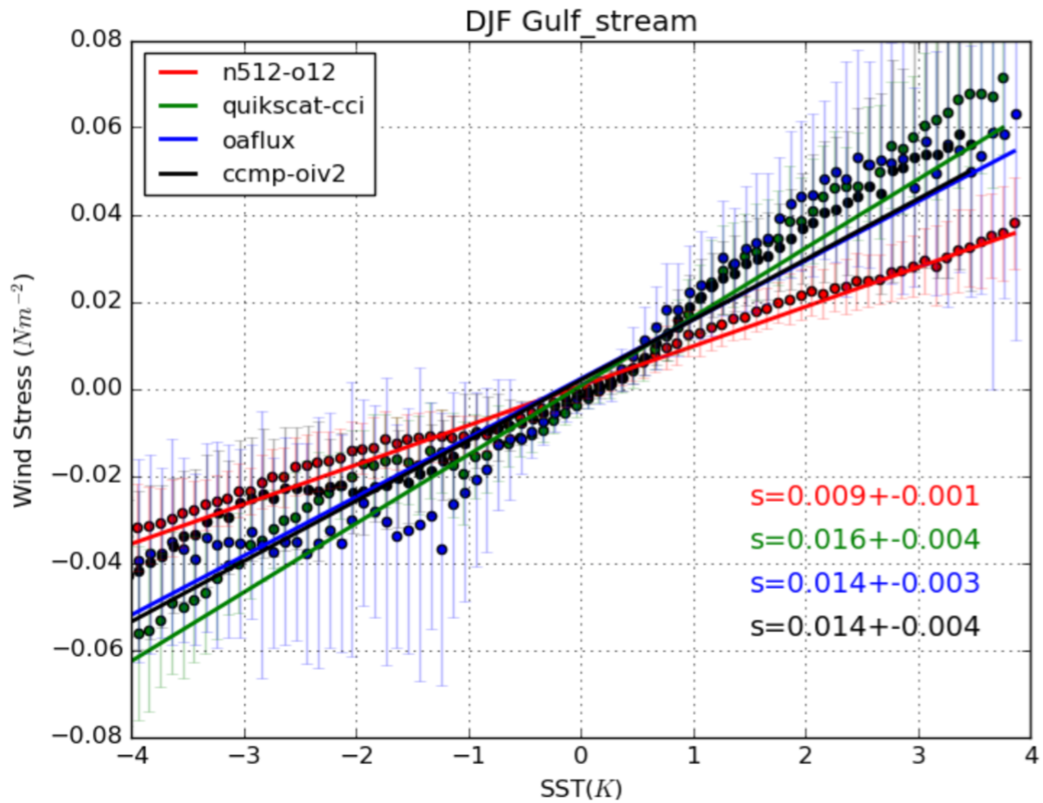
SST CCI v1.1 L4 analysis



Analysis of IR SSTs was capable of representing the cold wake ahead of Danielle

Air-sea coupling strength

3 different pairs of observational data



change in wind-stress resulting

change in SST across a front

Clearest relationship, strongest coupling with SST CCI analysis

Malcolm Roberts

UKMO

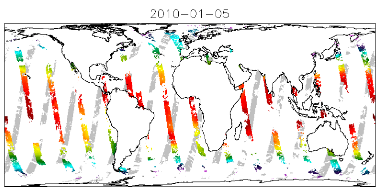
Ambitions for SST CCI

An independent timeseries of SST that has sufficient length, uncertainty and stability to provide improved quantification of SST variability and change

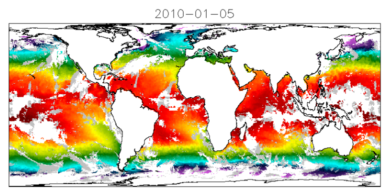
Target characteristics

- **Independence**
  - based on physics of radiative transfer and harmonisation, not dependent empirical tuning to other SST measurements
- Early 1980s to present
  - includes the particular challenge of the El Chichon and Pinatubo/Hudson periods
- **High stability, high SST sensitivity, and low bias**
- Integrated processing across levels 2 to 4 (swath, gridded and analysis)
- **Uncertainty-quantified** at all levels
- **Skin SST** (core retrieval) and **20-cm daily average estimates** (model)

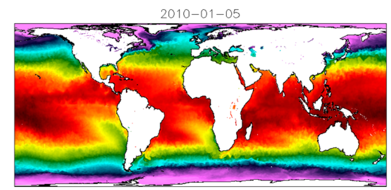
Sea Surface Temperature CCI



ATSRs: dual view, **stable** & **accurate**.
Use as SST calibration reference.

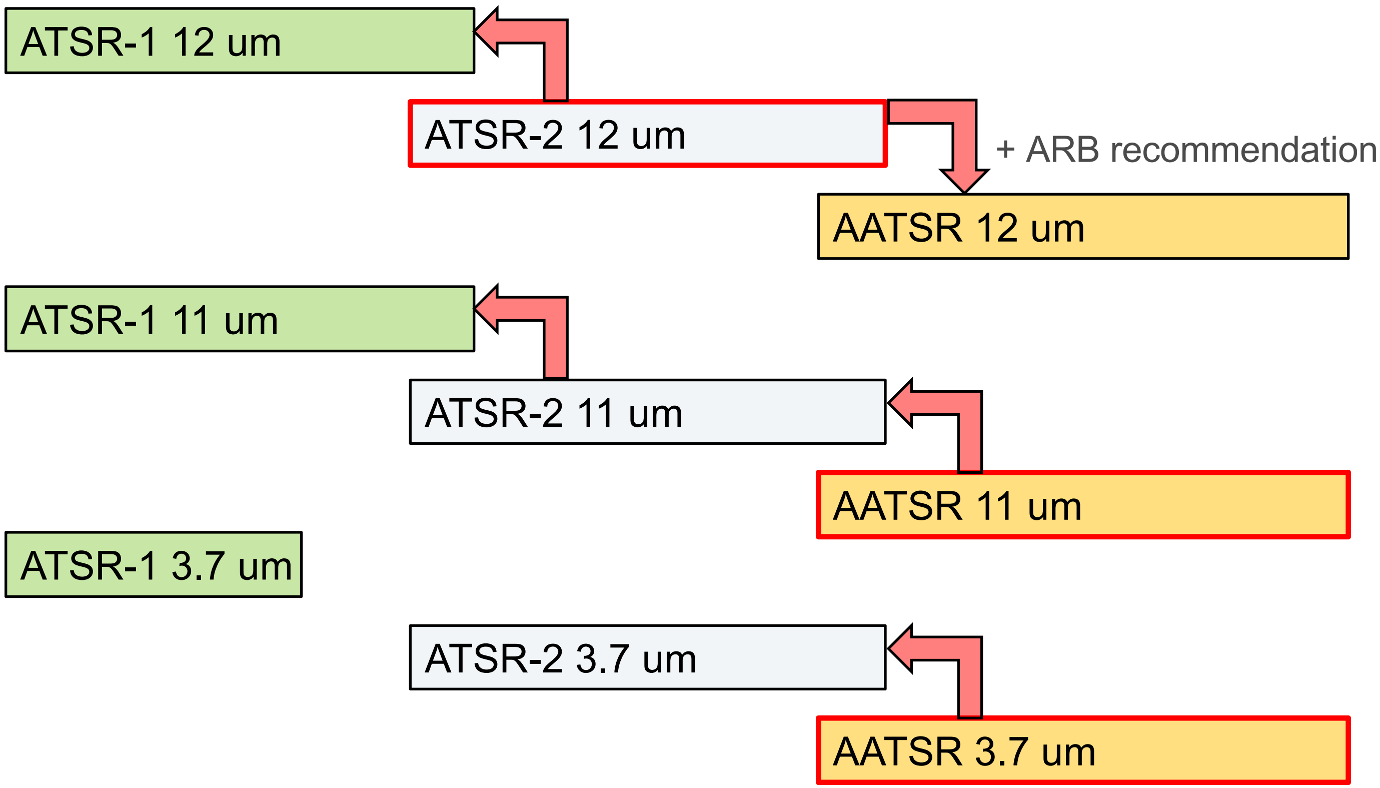


AVHRRs: single view, not designed for climate, **good coverage** and a **longer history**.



ATSRs & AVHRRs are blended.
Using an improved version of Met Office “OSTIA”.

ATSR-series BT harmonisation concept

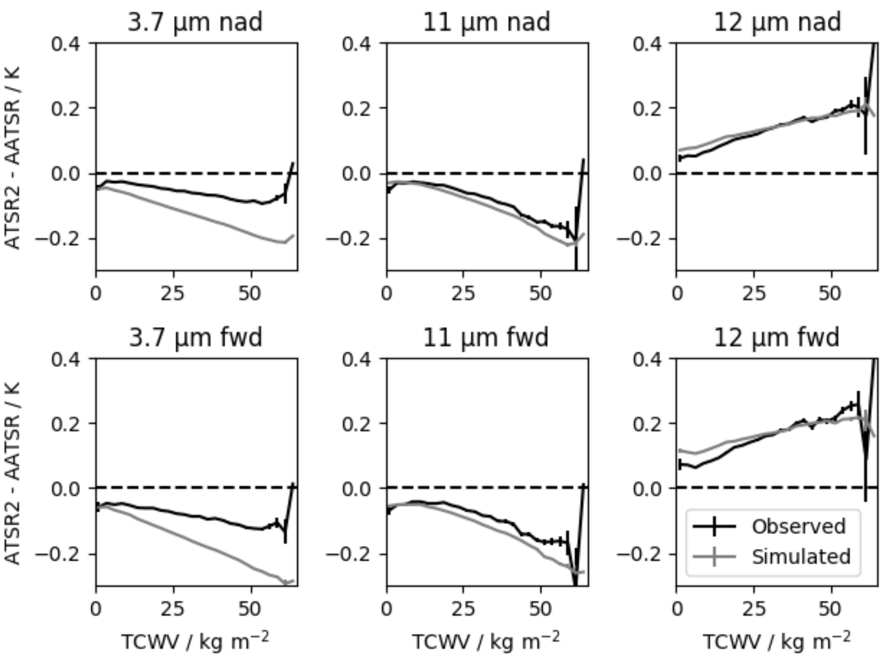


Examples of the BT adjustments

Some inter-sensor differences are expected because of known spectral response function differences

The residuals (S – O) are calibration differences that are parameterised in terms of TCWV

Suggests SRF errors are underlying source of residuals



SST harmonisation

$$\hat{x} = a_0 + \sum_{channels,i} a_i T_i$$

BT harmonisation removes a large portion of inter-sensor SST inconsistency, but not all

therefore we also harmonise SST retrievals during sensor overlaps

The reference SST retrieval is the dual-view 3-channel (D3) of AATSR

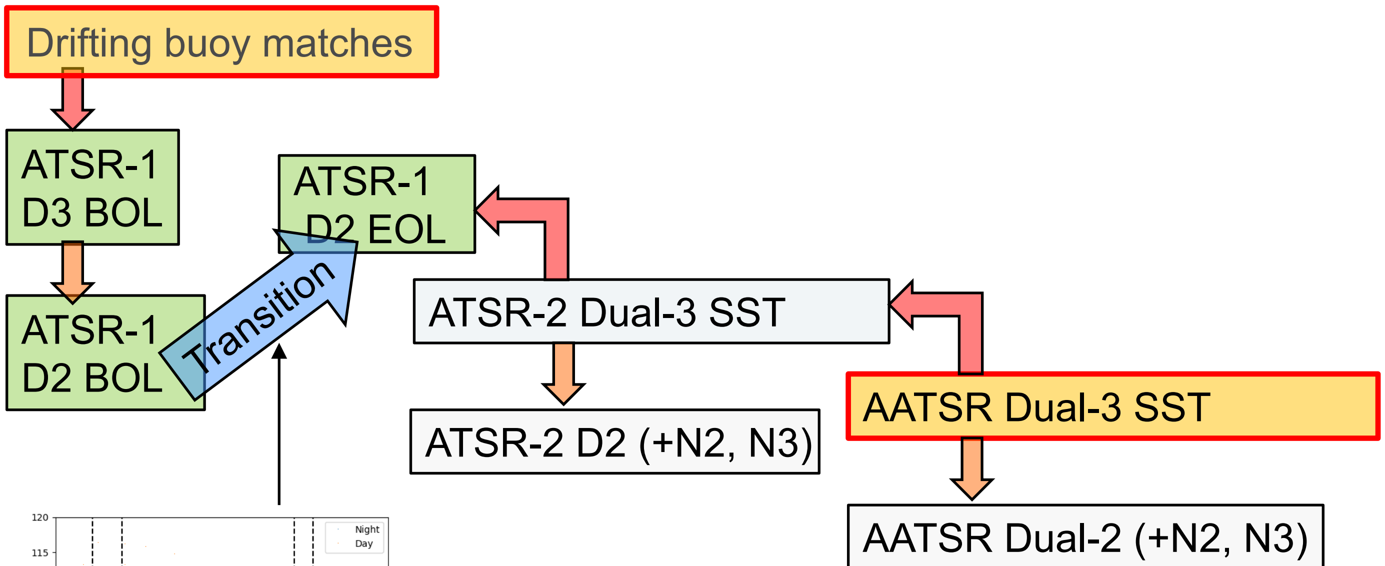
In each case of an "SST harmonisation" step the following is done:

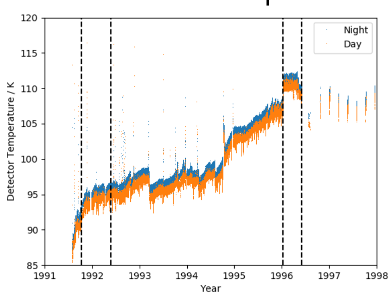
matched retrievals of different types/sensors are obtained

for each band of coefficients for TCWV, the offset coefficient is adjusted to match the SSTs of the reference retrieval on average

Offset adjustments are typically of order 0.1 K

SST harmonisation logic

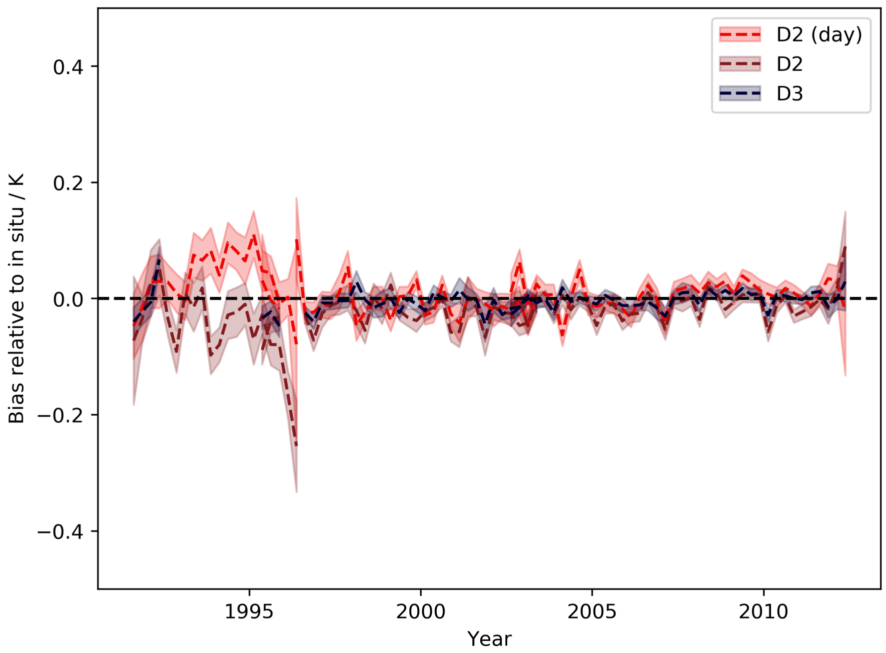




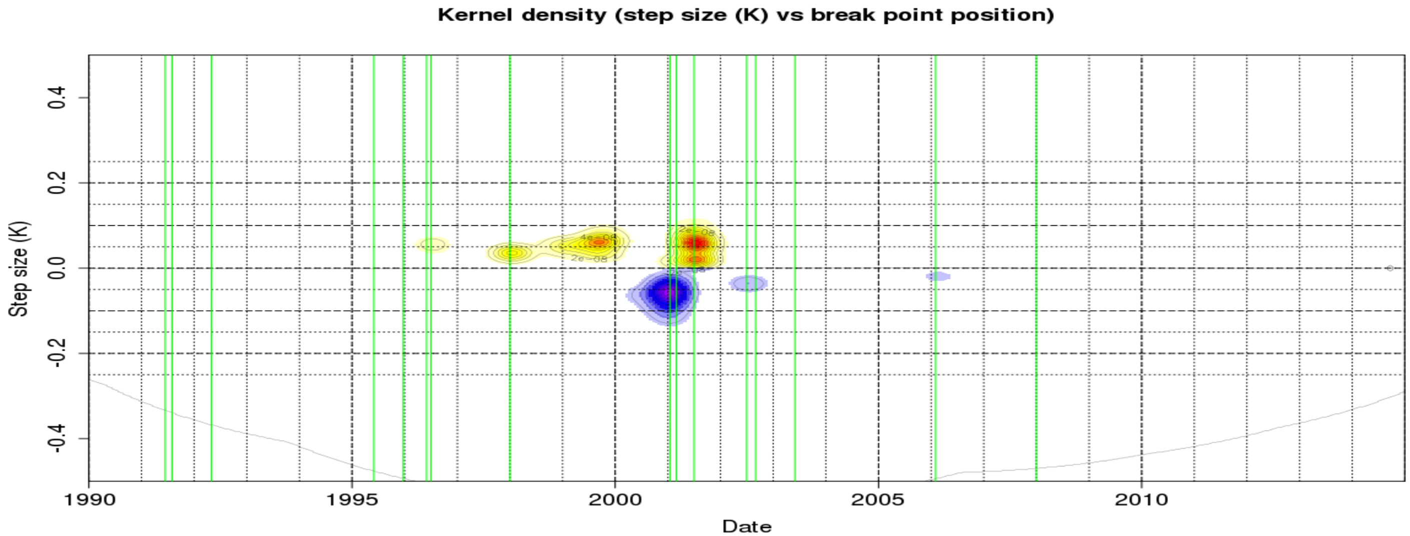
ATSR-1 Detector temperature trend

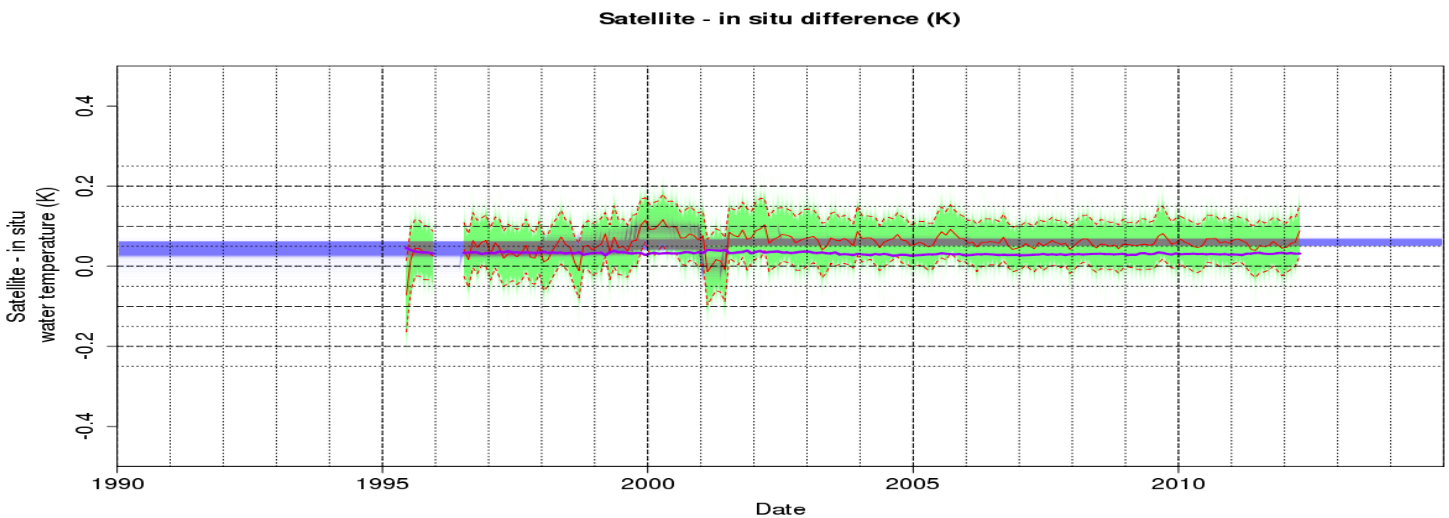
ATSR-series harmonisation outcome

- Use GTMBA as pre- and post-calibrated reference for long-term comparison
- Deviations within target 0.1 K except last few months of ATSR-1 lifetime



Step change detection against drifters (ATSR 2+AATSR)





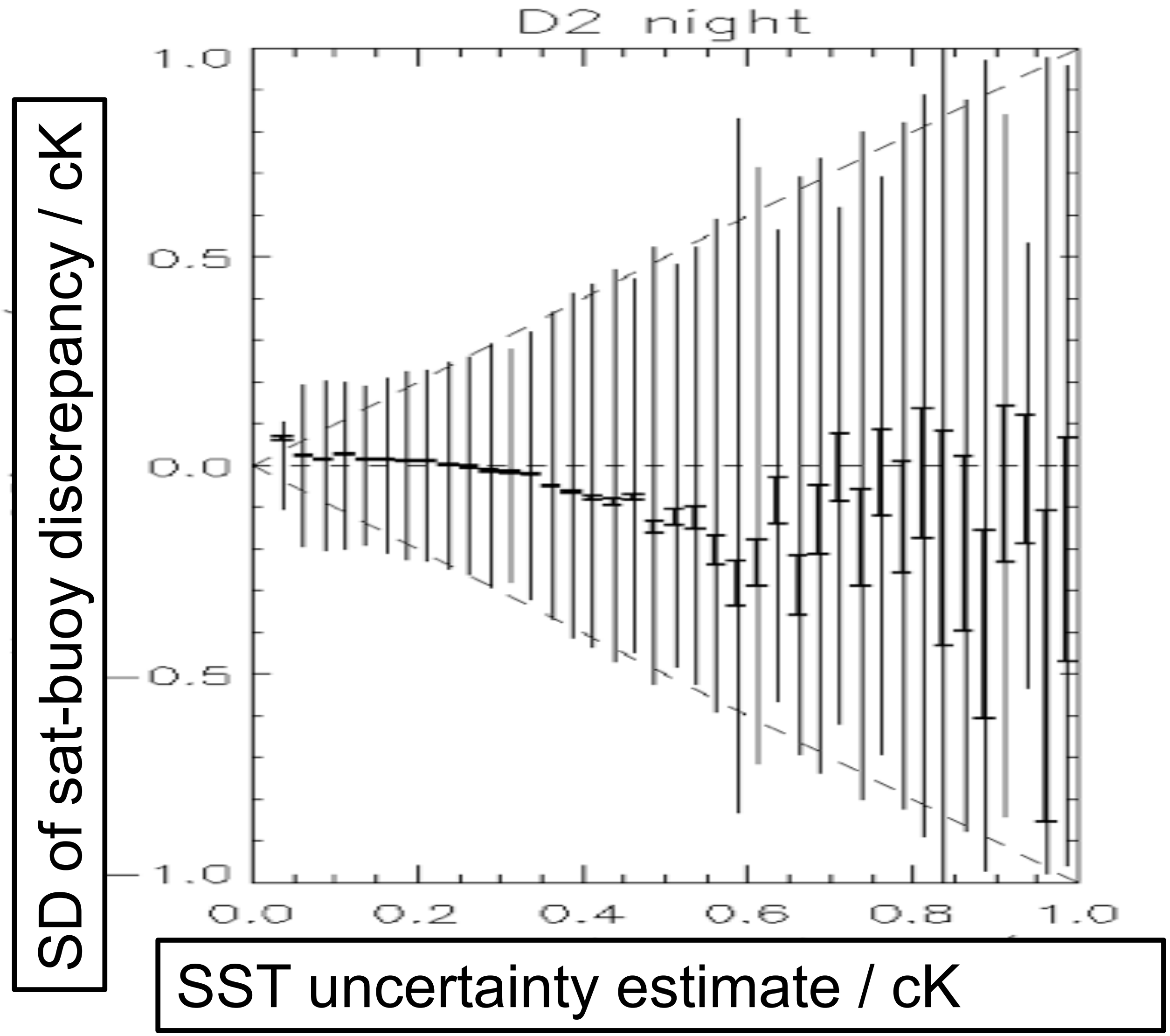
Dave Berry
(NOC)

AATSR validation at different depths

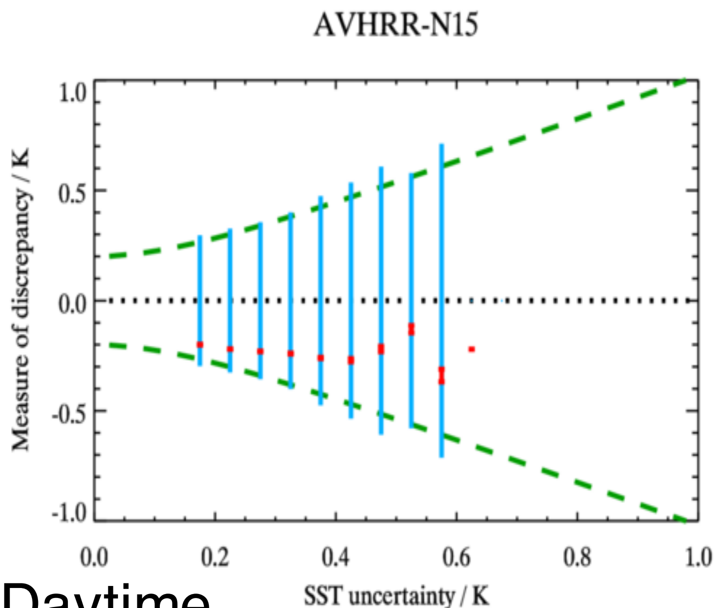
Day/ night	N	In situ	Depth	Dual 2-chan	Dual 3-chan
Night	302	Radiom.	**Skin**	0.013 (0.217)	**0.003 (0.187)**
Night	135129	Drifters	**20 cm**	-0.002 (0.182)	**0.001 (0.156)**
Night	12590	GTMBA	**1 m**	-0.011 (0.181)	**-0.001 (0.129)**
Day	273	Radiom.	**Skin**	**-0.000 (0.200)**	
Day	166218	Drifters	**20 cm**	**0.026 (0.178)**	
Day	10312	GTMBA	**1 m**	**0.007 (0.180)**	

Validating against in situ at skin, 20 cm and 1 m means we can assess the results of both the skin SST retrieval and the model used to adjust to SST-depth (user requirement to blend CDR with centennial SST data)

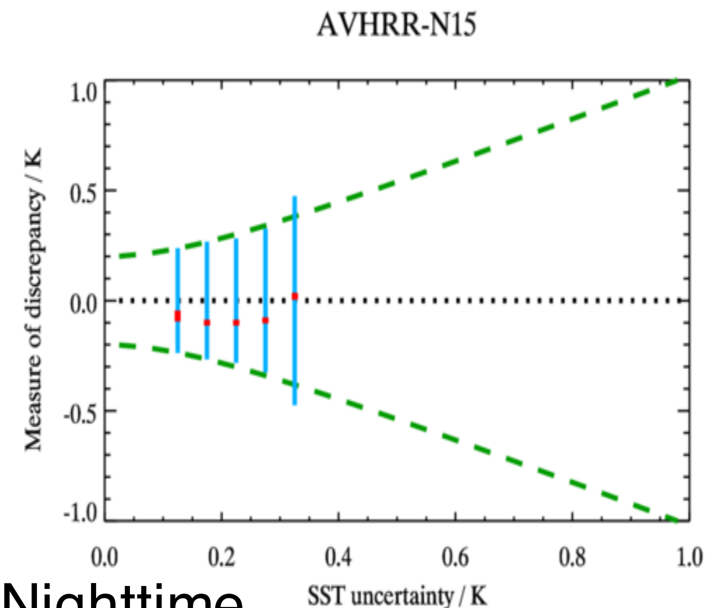
AATSR D2 SST
based on
coefficients
0.1 deg cells



DRIFTER VALIDATION OF U(SST)



Daytime

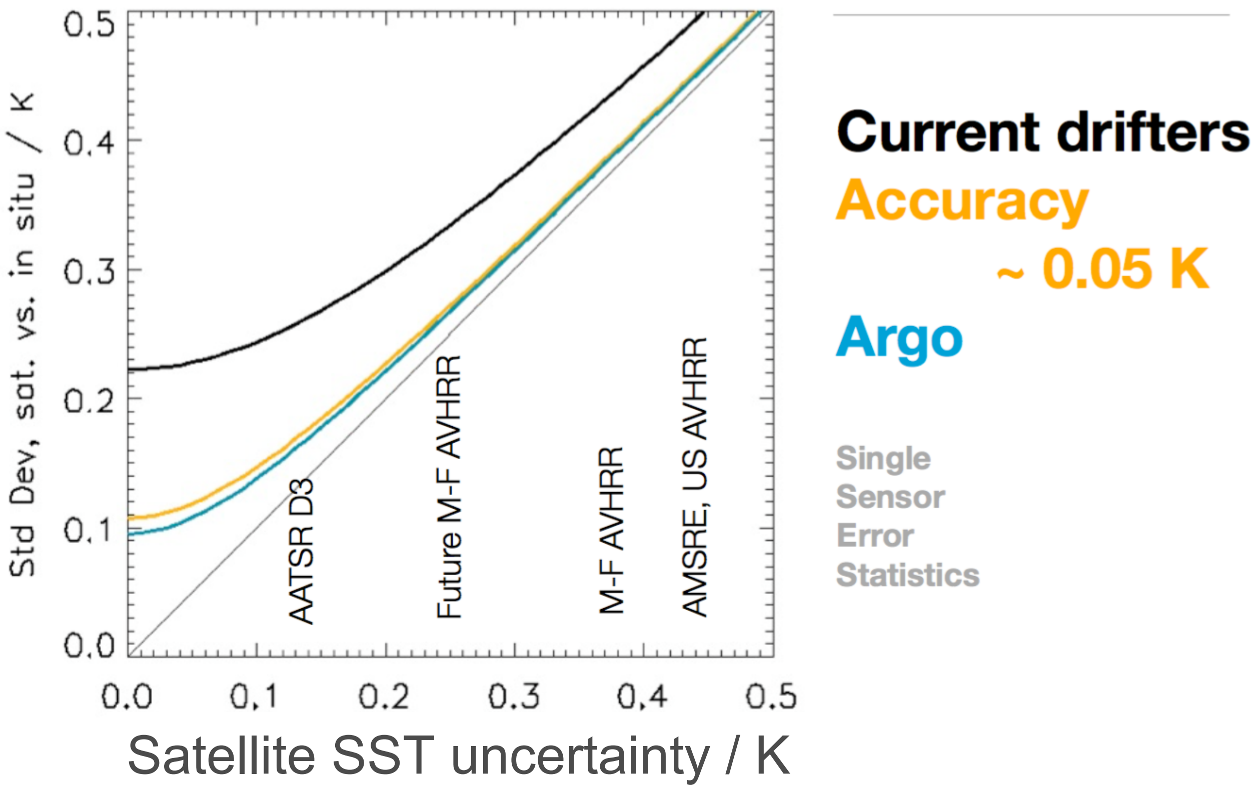


Nighttime

limiting: validation of uncertainty estimates below about 0.2 K is not very sensitive to true satellite uncertainty (buoys' u dominates)

Uncertainty validation

"Normal" drifting buoys are limiting for validating estimated uncertainties of 0.15 to 0.25 K



CONCLUSIONS

For recent satellite era (1996 onwards), harmonisation at BT and SST levels can support independent satellite CDR based on radiative transfer physics

Going further back, in situ observations become both sparser and less certain

- Stability of drifting buoy record in particular is poorly known

We want to validate skin, drifting buoy depth and mooring depth SST estimates

- skin retrieval + model-mediated depth estimates

Improved drifters not only will make us more confident about SSTs, but also about our estimates of uncertainty at finer scales