Australian Government
Bureau of Meteorology

IMOS Integrated Marine Observing System

ABoM SSES

Applying *in situ* regressed SSES to *in situ* regressed SST Retrievals over the Australian Region

http://imos.org.au/sstproducts.html

Christopher Griffin[2], Helen Beggs[1] and Leon Majewski[2]

[1]Centre for Australian Weather and Climate Research, Bureau of Meteorology, Australia

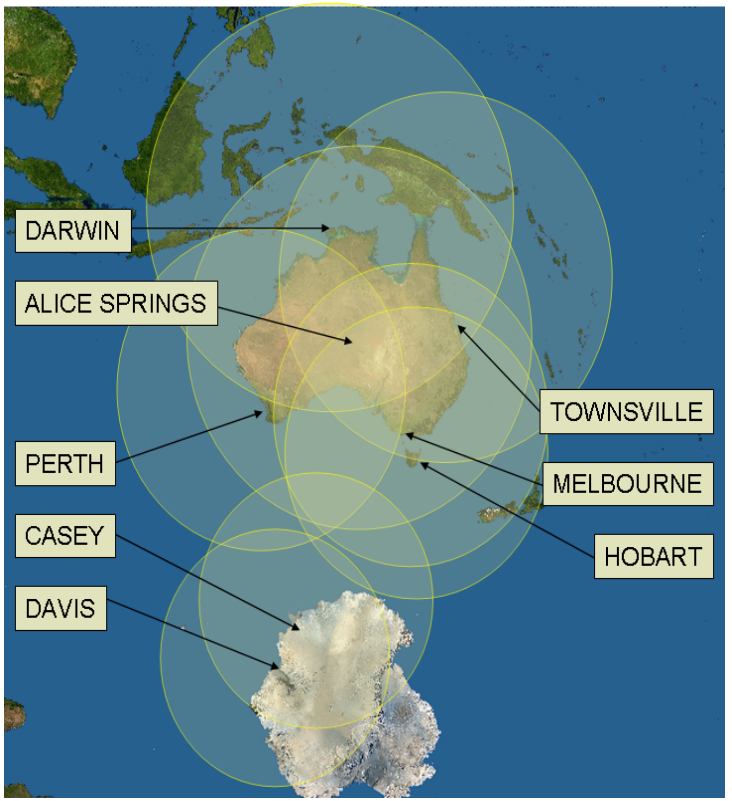
[2]Observations Infrastructure Branch, Bureau of Meteorology, Australia

Presented at the GHRSST15 ST-VAL Breakout Session, Cape Town, 3 June 2014

Australian Government
Bureau of Meteorology

Background

- ABOM provides High resolution SST from NOAA AVHRR missions.
- Current archives give good time coverage from April 1992.
  NOAA-11,12,14,15,16,17,18,19
- Retrievals are performed based on regression to *in situ* measurements over a *long* time span.
- Error Statistics reflect the residuals of this regression based on possible sources of systematic bias over a *short* time span.
- The quality and quantity of *in situ* measurements varies over time



Australian Government
Bureau of Meteorology

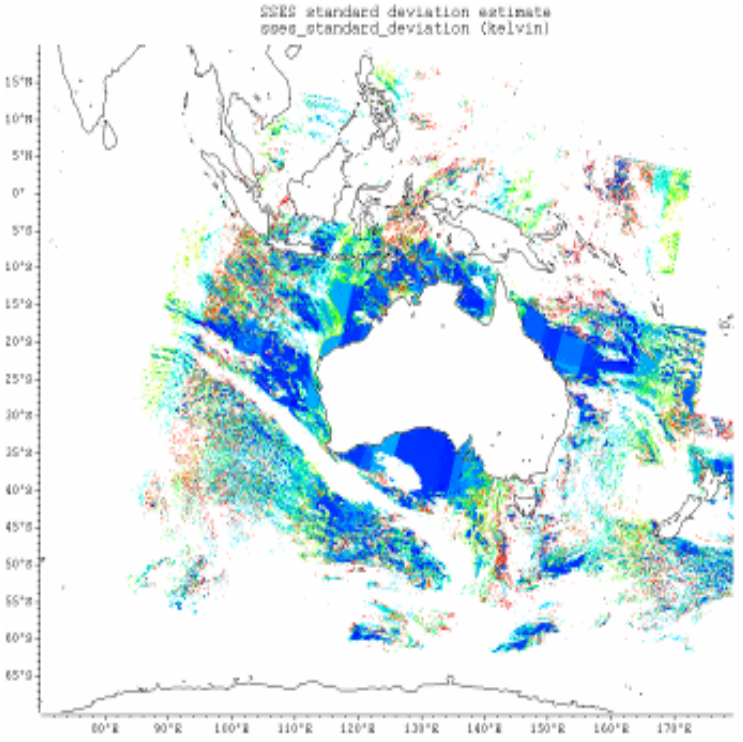
Context / Features

- Field of View (Swath) and Geographic variation, decoupled and smooth.
- Sensitive to *short* term variation implies:
  - Adaptive, updated frequently
  - Time based tracking of Error statistics
  - Time based weighting of measurements
- Great variation in quality and number of measurements:
  - Favour robust measures
  - Use as many measurements as possible

Australian Government
Bureau of Meteorology

Adaptive Error Statistics

- Per platform basis
- Rolling 1 year window adjusted frequently (every 1 to 6 days)
- Measurements are weighted by time (120 day time constant)
- Attributes considered (6-dimensions)
  - time of day,
  - satellite zenith angle,
  - quality level,
  - latitude, longitude, age



Australian Government
Bureau of Meteorology

Adaptive Error Statistics

- Includes "degrees of freedom" model
- Model for bias as a median
- Model for standard deviation

Empirical Equation

Geographic component

Swath component

$$n = n_{\text{swath}} g_n$$

$$\mu = \mu_{\text{swath}} + g_\mu$$

$$\sigma = \sigma_{\text{swath}} g_\sigma$$

- Least squares regression to

  highly correlated components

- Continuous

Australian Government
Bureau of Meteorology

Adaptive Error Statistics

- Resulting model has fewer degrees of freedom than "binning" method (66 vs. 144)

Empirical Equation

$$n = n_{\text{swath}} g_n$$

$$\mu = \mu_{\text{swath}} + g_\mu$$

$$\sigma = \sigma_{\text{swath}} g_\sigma$$

Swath Component:

- **Satellite Zenith Angle**
- **Time of day**
- **Quality Level**

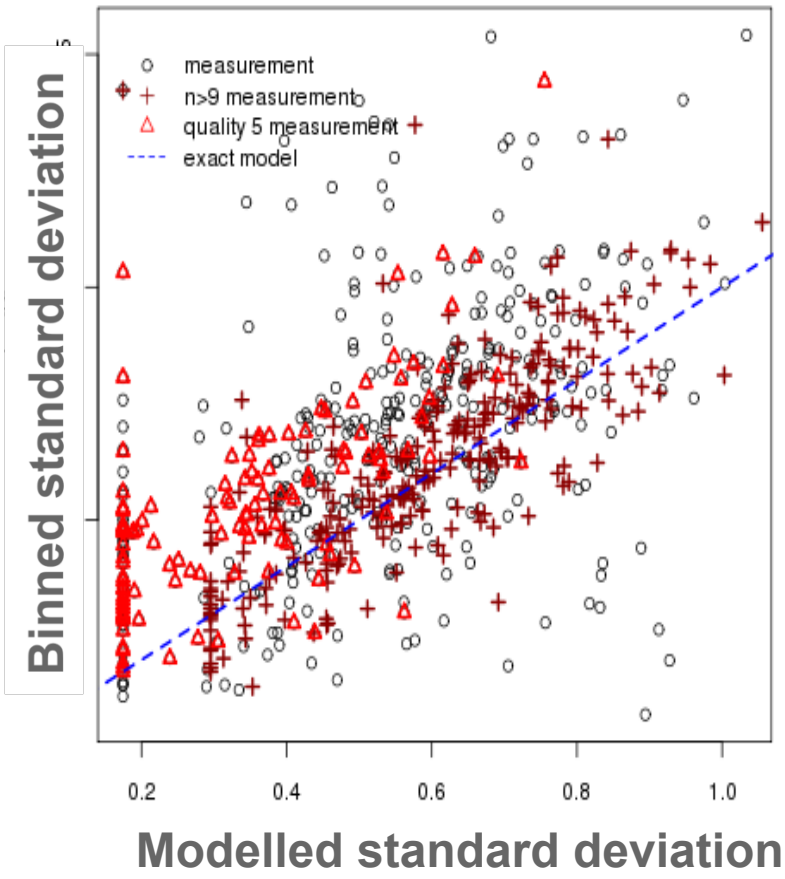
Geographic Component:

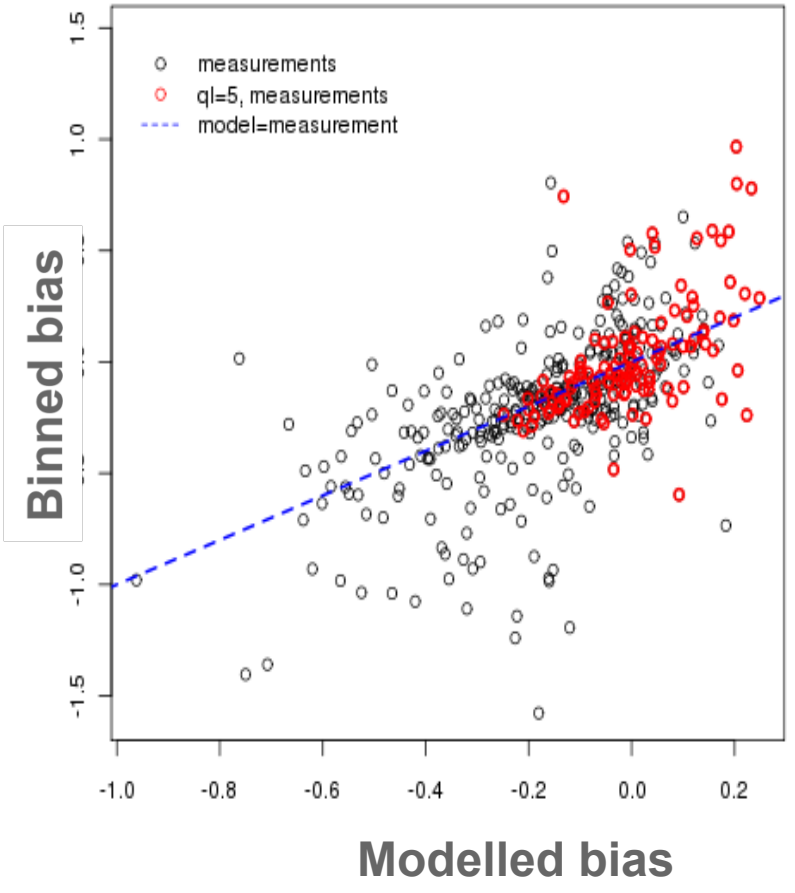
- **Latitude**
- **Longitude**
- **Time**
- **Quality Level**

Australian Government
Bureau of Meteorology

Comparison with binned data

- Modelled parameters considered against binned *in situ* measurements

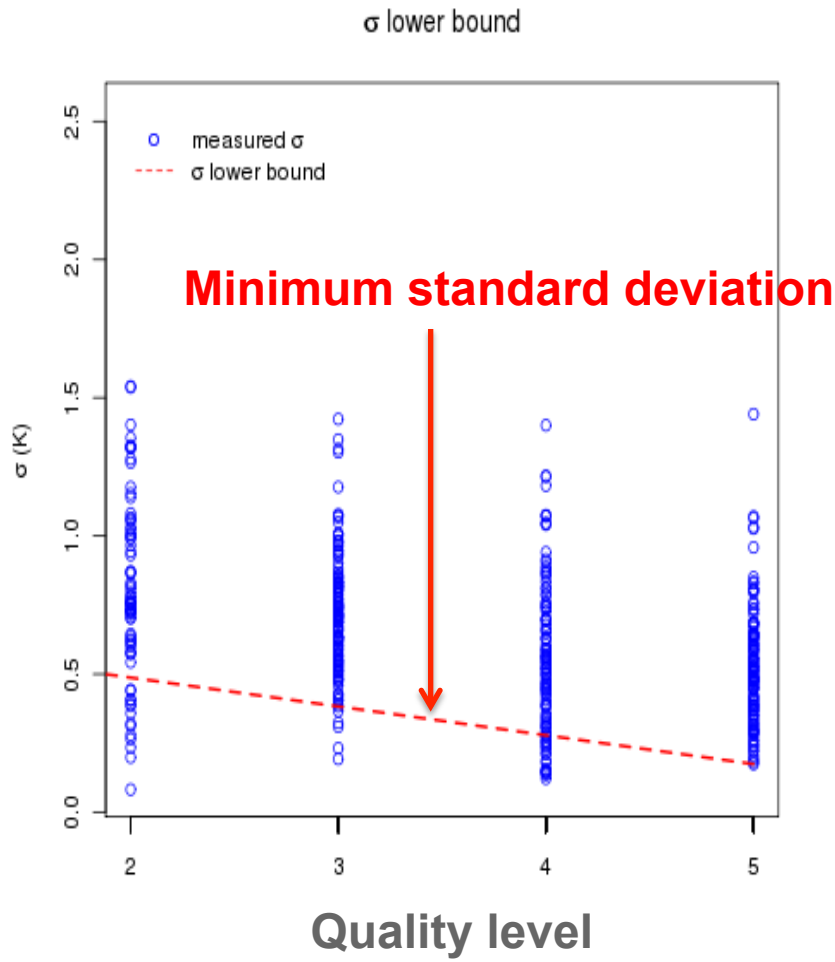




Australian Government
Bureau of Meteorology

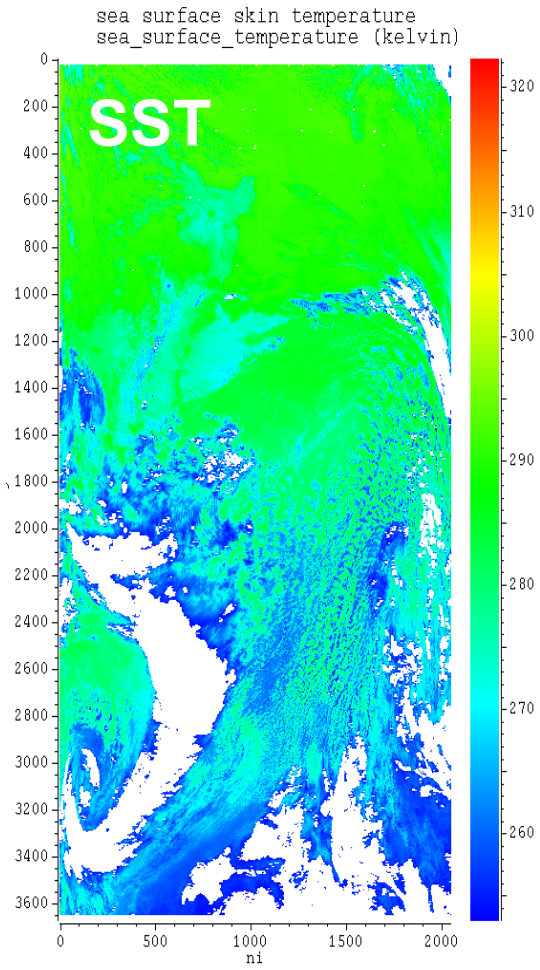
Keeping small variations in check

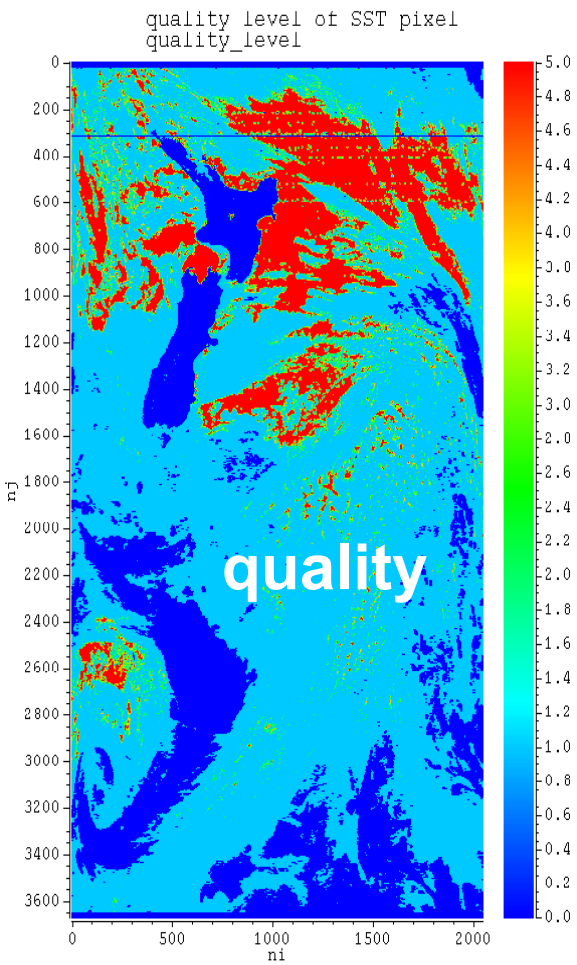
- Data is binned so that medians and standard deviations can be determined.
- Ensure that the range of a computed standard deviation is *reasonable* by computing the minimum acceptable value
- Limit is based on view model, but is applied separately for view model and overall standard deviation.

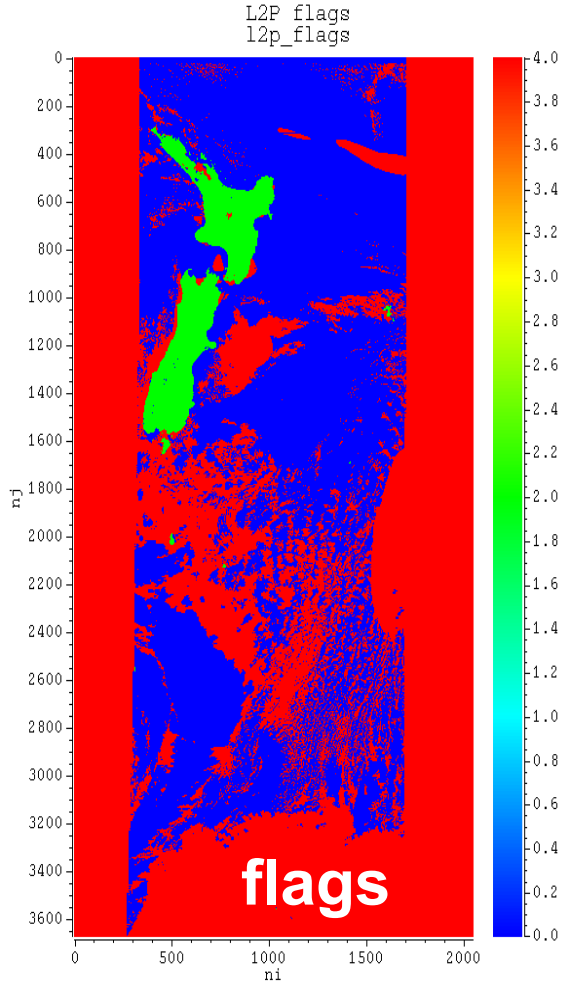


Australian Government
Bureau of Meteorology

Applied to a swath



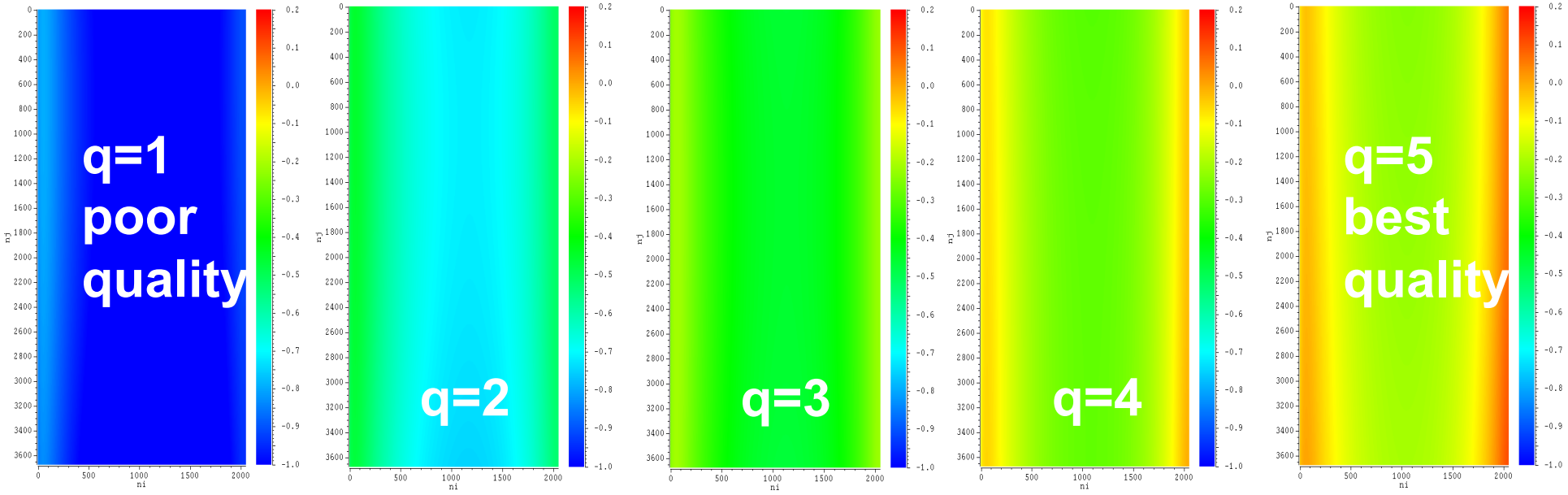




Australian Government
Bureau of Meteorology

Smoothly varying bias

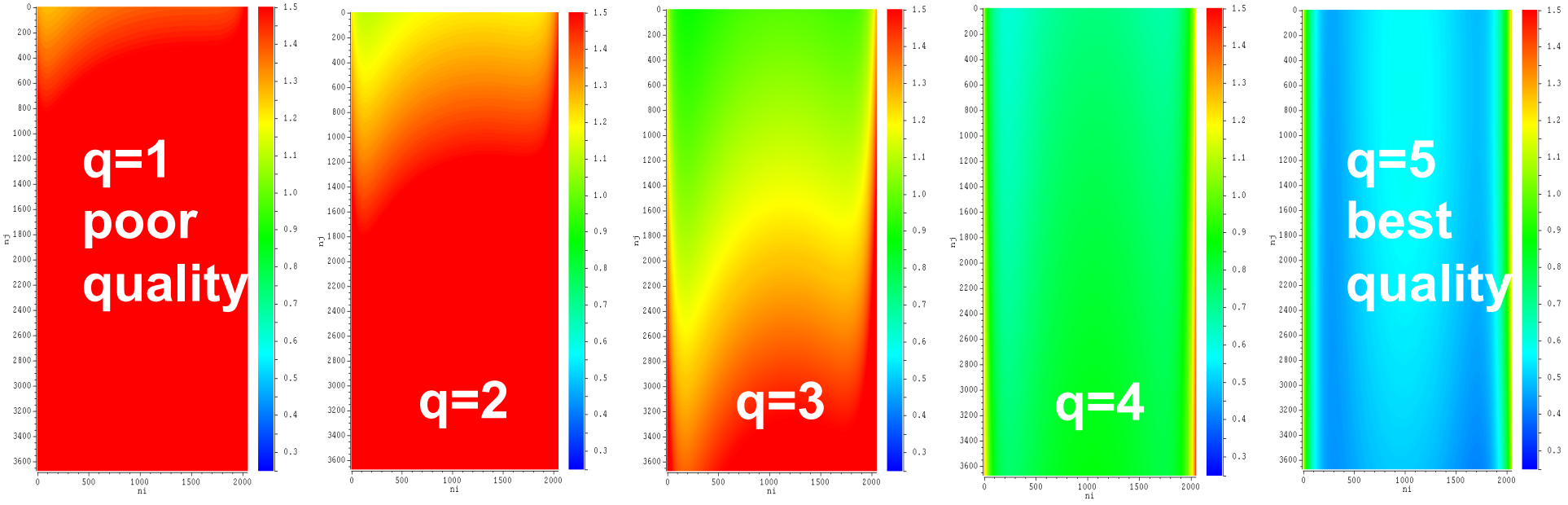
- Smoothly takes care of edge of swath
- Asymmetry from geographical factors



Australian Government
Bureau of Meteorology

Smoothly varying standard deviation

- Smoothly takes care of edge of swath
- Asymmetry from geographical factors

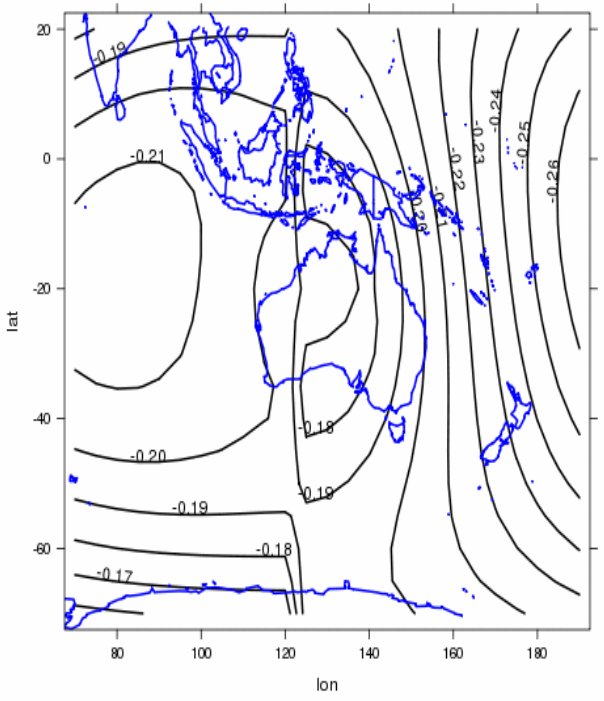


Australian Government
Bureau of Meteorology

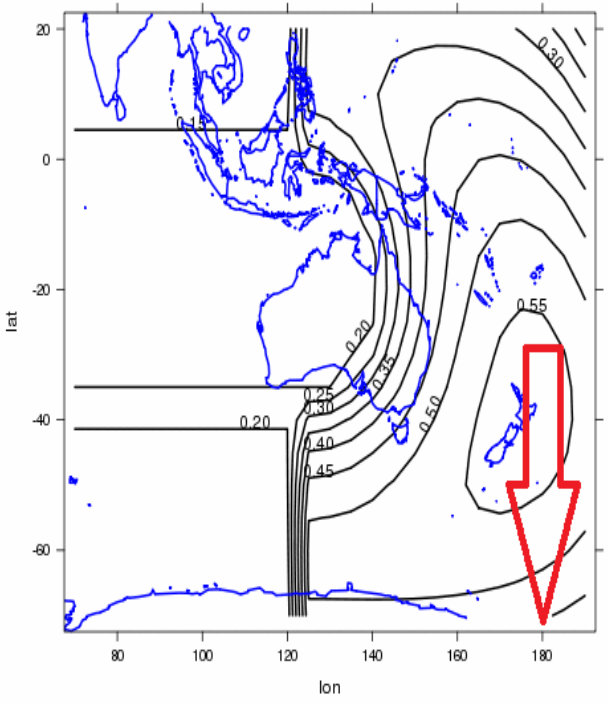
Applied Geographically

q=5, nadir

Bias



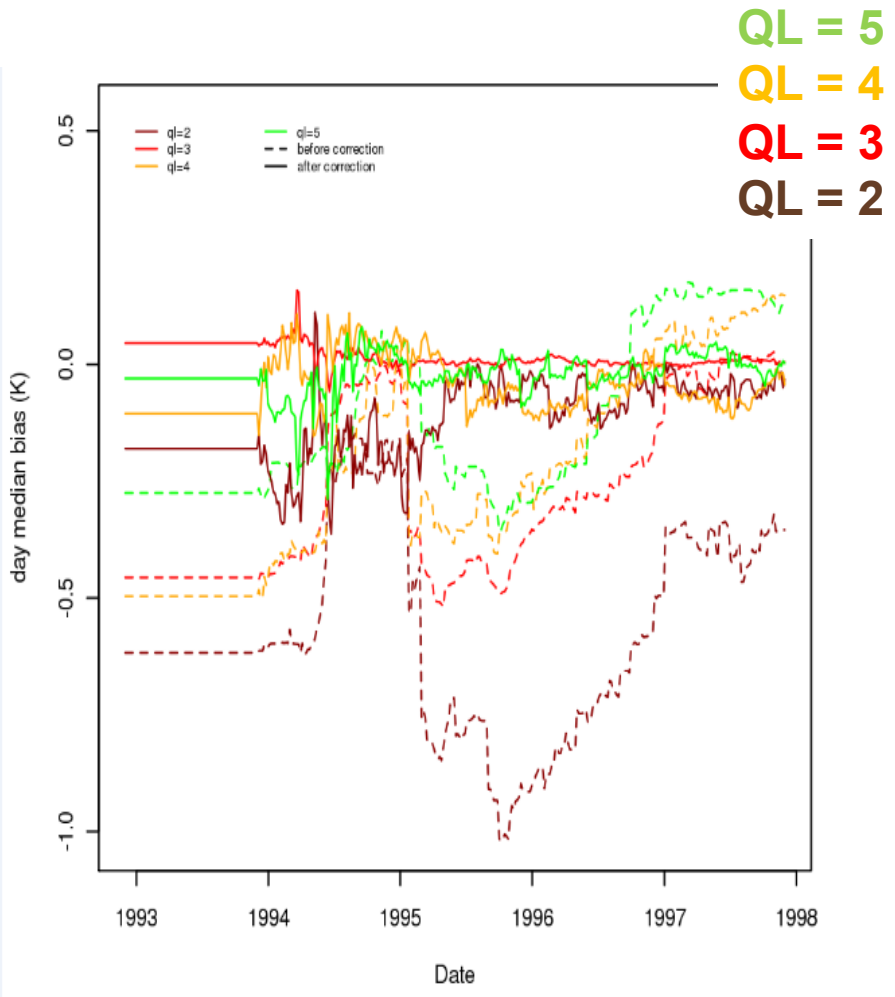
Standard deviation



Australian Government
Bureau of Meteorology

Bias estimate performance

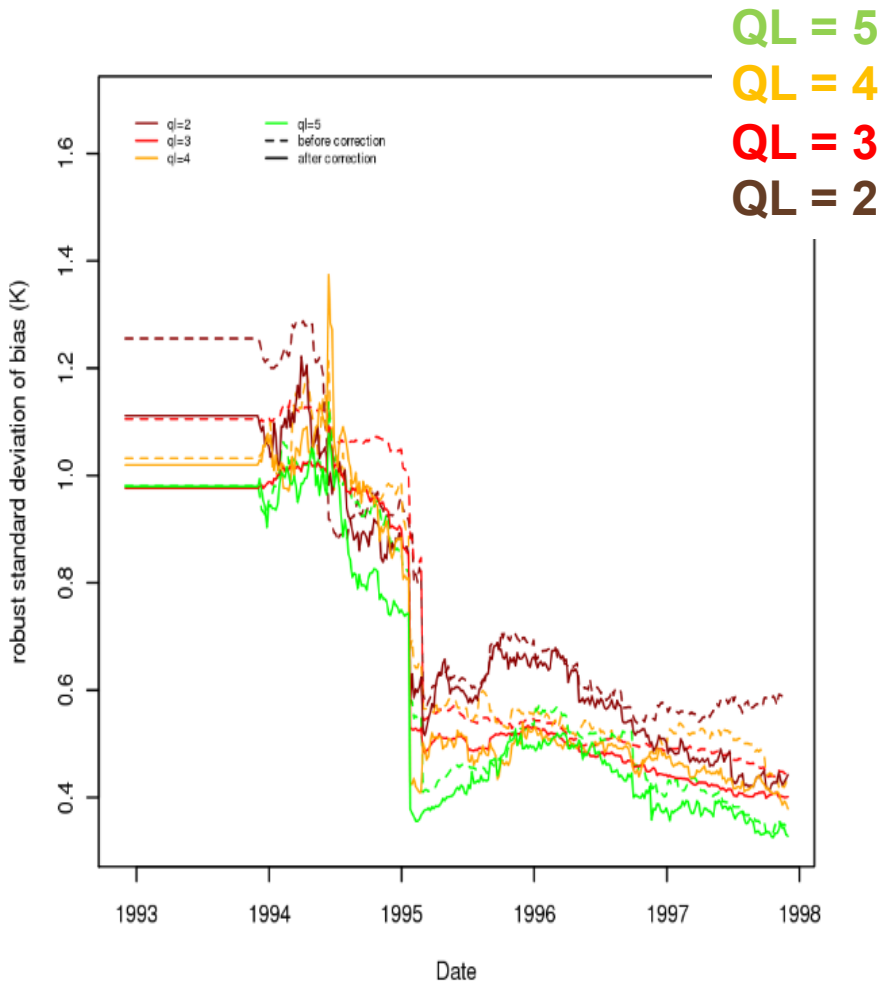
- Applying the bias correction improves the bias compared with *in situ* SST at all quality levels
- Dashed lines show before bias correction
- Annual performance is shown to the right. 60 day performance also shows an improvement (although the fluctuations are more erratic)



Australian Government
Bureau of Meteorology

Bias estimate performance

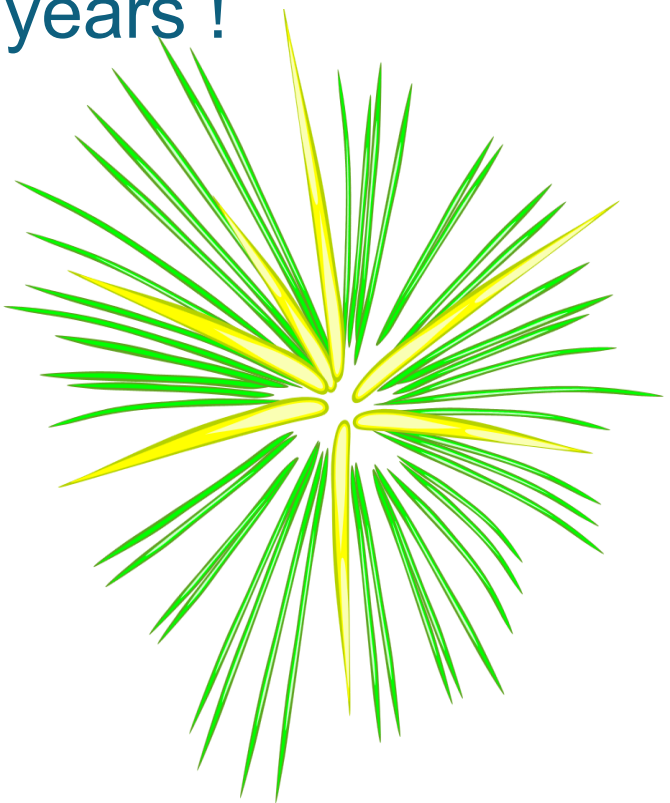
- Applying the bias correction improves the rsd compared with *in situ* SST at all quality levels
- Dashed lines show before bias correction
- Annual performance is shown to the right. 60 day performance also shows an improvement (although the fluctuations are more erratic)



Australian Government
Bureau of Meteorology

v2.0 long term data set

Available soon in v2.0 L2P/L3U/L3C/L3S
over all platforms, and 21 years !

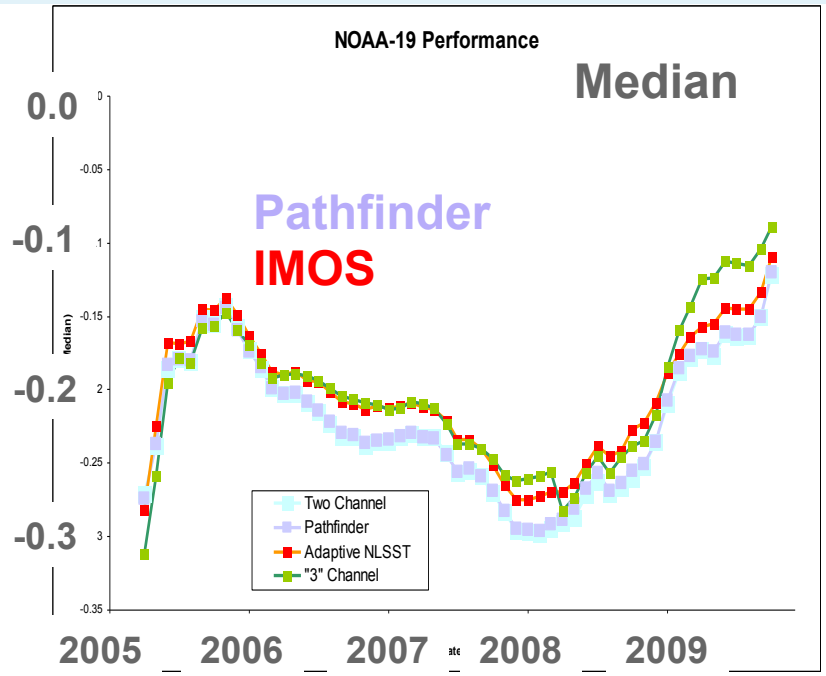


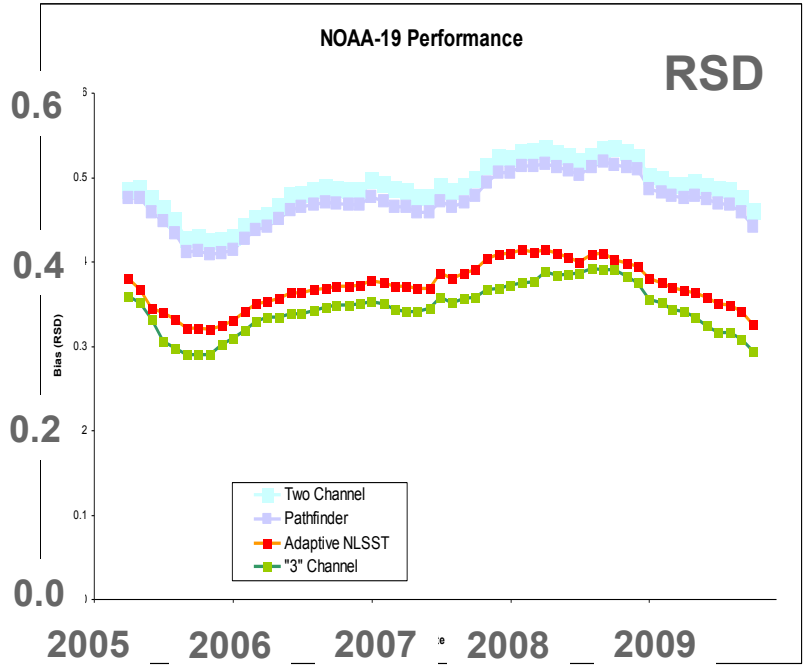
Thank you !

Additional slides for discussion

Australian Government
Bureau of Meteorology

Adaptive Calibration



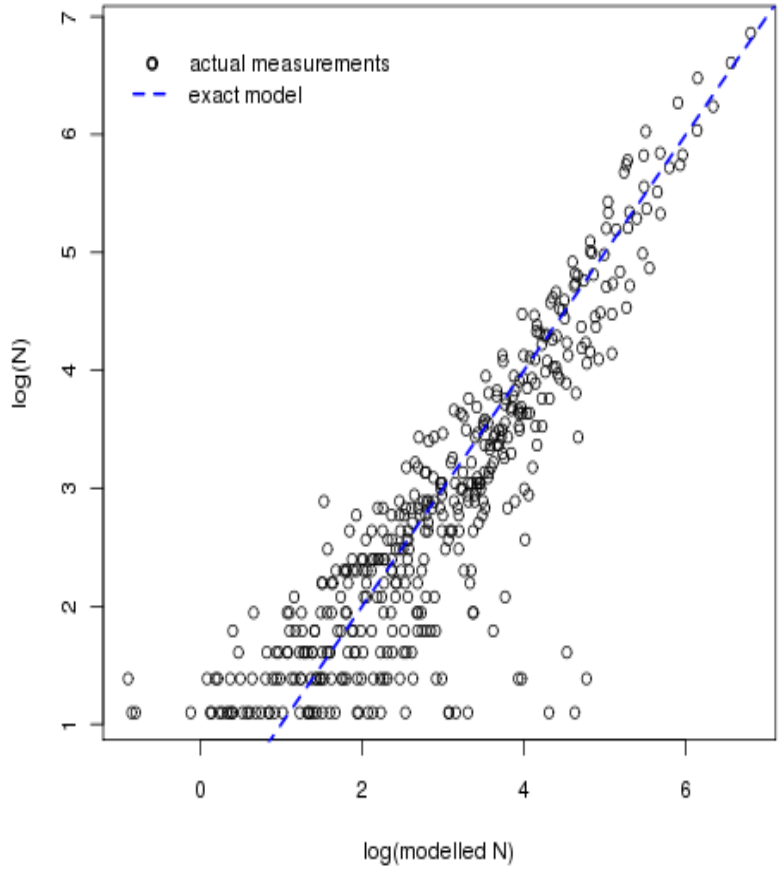


- Running 1 year calibration window, adjusted monthly
- Tuned on best matchups with in situ SST
- Performance measured on an expanded matchup data set

Australian Government
Bureau of Meteorology

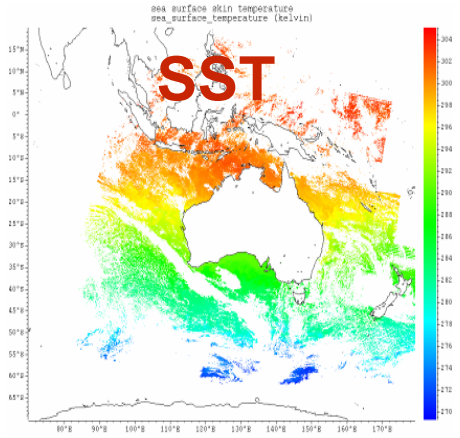
Adaptive Calibration

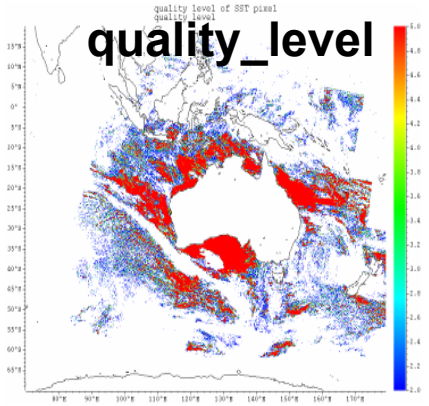
- Degrees of freedom modelling provides an estimate of the number of in situ measurements that went into the analysis as a function of the model degrees of freedom.

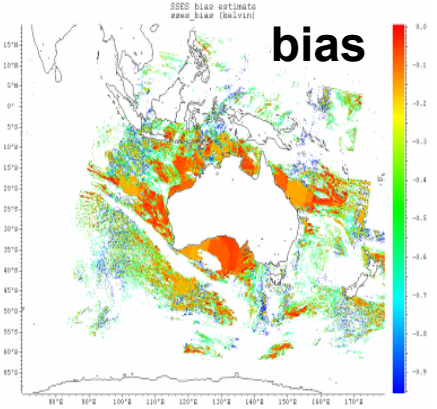


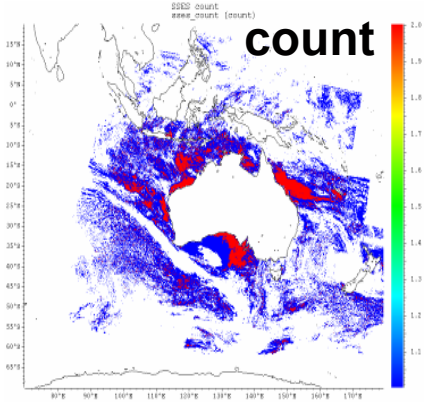
Australian Government
Bureau of Meteorology

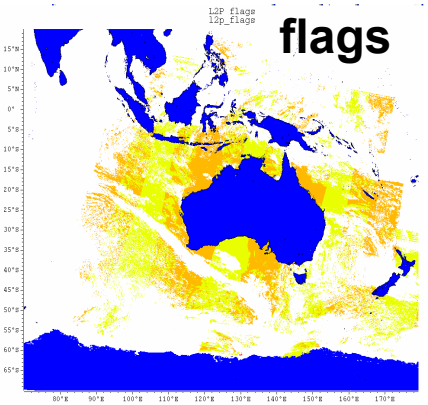
GHRSST 2.0 compliant format

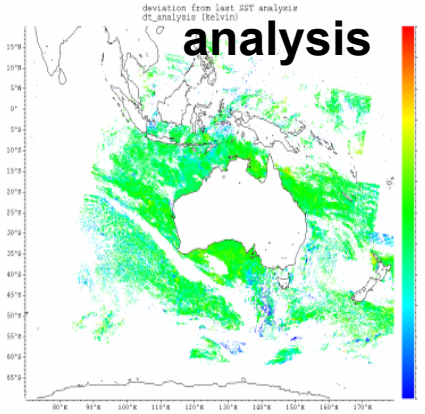


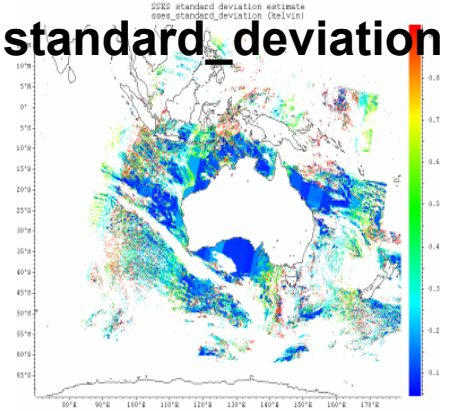












+ wind speed

+ aerosol

+ sea ice fraction

20131007 night composite from multiple satellites "L3S"

Australian Government
Bureau of Meteorology

IMOS Integrated Marine Observing System

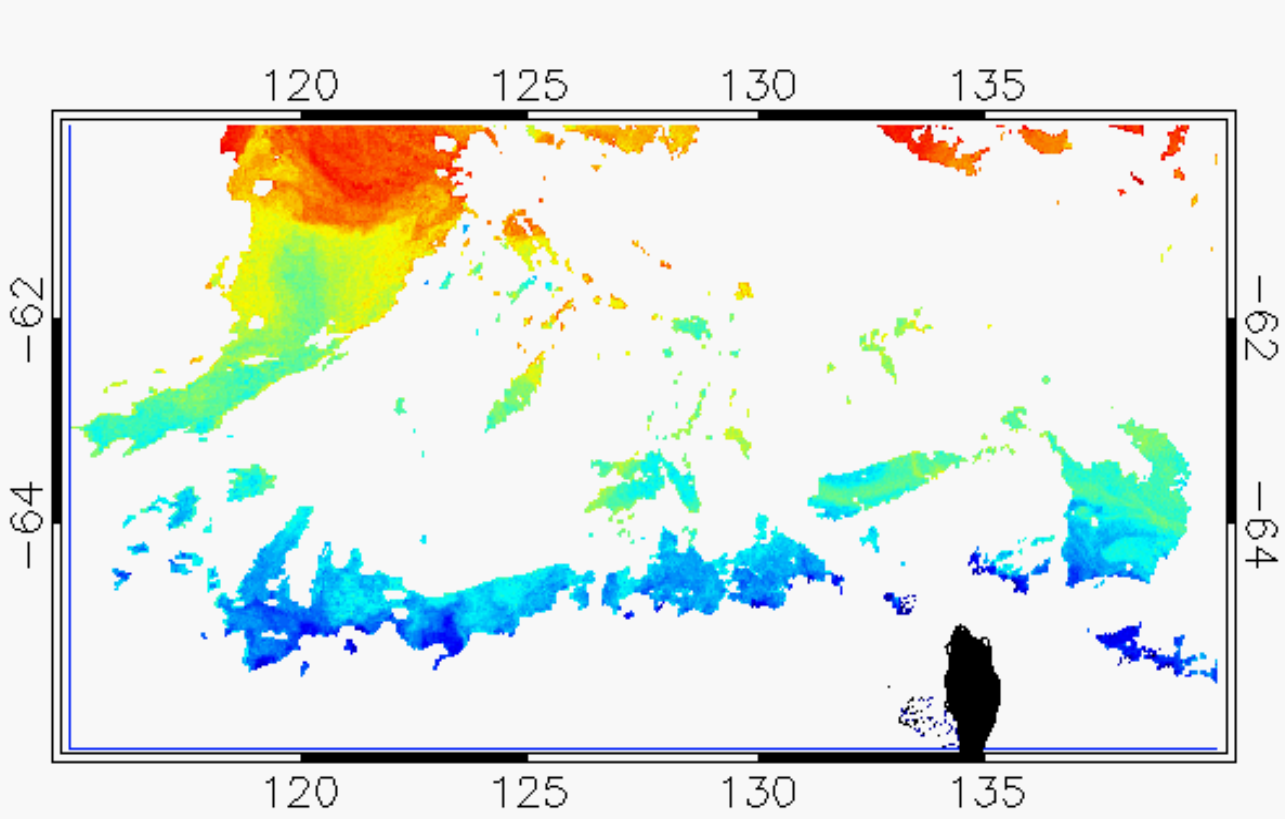
Access to Australian domain data:
ftp://aodaac2-cbr.act.csiro.au/imos/GHRSST

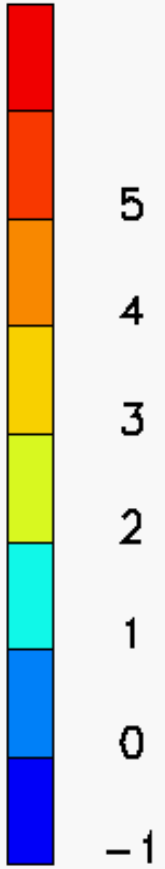
Access to pre-release Antarctic domain data:
Contact h.beggs@bom.gov.au or ghrsst@bom.gov.au

Happy to get Beta users and feedback!

Further information:
http://imos.org.au/sstproducts.html

Day+Night 1-day L3S
18 Feb 2014





Australian Government
Bureau of Meteorology

"open loop" retrieval

- No Analysis fields in calibration
  No Radiative Transfer Model
  No Background SST
  In situ measurements pre-selected
  Non-linear Retrieval (MCSST, NLSST like)

Night: $SSTskin = a_0 T_4 + a_1 T_3 (T_3 - T_5) + a_2 (\sec\theta - 1) + a_3$

Day: $SSTskin = b_0 T_4 + b_1 T_4 (T_4 - T_5) + b_2 (T_4 - T_5)(\sec\theta - 1) + b_3$

- Monitor:
  Performance compared with Analysis
  Residual error from fit
  Sensitivity (use *in situ* measurements)
  Propagation of sensor errors
  per **GHRSST** specifications

GHRSST
Group for High Resolution Sea Surface Temperature

Australian Government
Bureau of Meteorology

Composition which respects bias

Composition of different sensors

- Consider all sources of measurement weighted by the count
- Biases are adjusted before measurements are combined.
- The combined count is recorded.

Composition from the same sensor

- When combining, consider all sources of measurement weighted by $\left(\frac{n}{\sigma^2}\right)$
- Biases are estimated by weighting.
- The combined count is recorded.

Australian Government
Bureau of Meteorology

“3” channel Day/Night performance

		2 channel linear	2/3 channel linear	2/3 channel NLSST	“3” channel
Model complexity		3 terms Includes θ_z	Day / Night 2 equations	Day / Night 2 equations	“3” terms
μ	Day	0.09 K	**0 K**	**0 K**	0.10 K
	Night	-0.07 K	**0 K**	**0 K**	-0.08 K
	Both	0 K	0 K	0 K	0 K
σ	Day	0.56 K	0.56 K	0.56 K	0.54 K
	Night	**0.58 K**	0.44 K	0.42 K	0.43 K
	Both	**0.58 K**	0.50 K	0.48 K	0.49 K
median	Day	0.05 K	-0.05 K	-0.05 K	0.06 K
	Night	-0.11 K	**-0.05 K**	**-0.05 K**	-0.14 K
	Both	-0.04 K	-0.05 K	-0.05 K	-0.07 K
rsd	Day	0.30 K	0.30 K	0.29 K	0.28 K
	Night	**0.30 K**	0.21 K	0.20 K	0.20 K
	Both	**0.31 K**	0.24 K	0.23 K	0.25 K