

Use and Requirements for XBT Surface Temperature Observations by the Group for High Resolution SST (GHRSSST)



Helen Beggs¹ and David Meldrum²

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

²Scottish Association for Marine Science, Oban, Scotland

Presented at the 1st XBT Workshop, Melbourne, 7 – 8 July 2011.

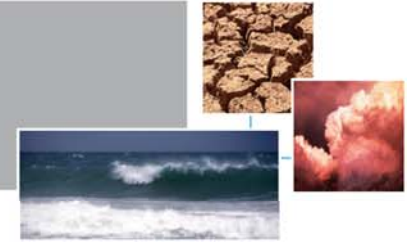


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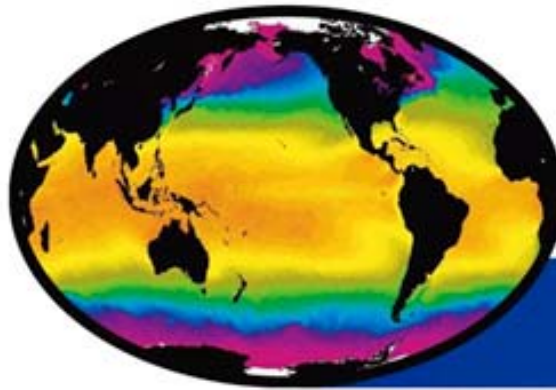
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Introduction



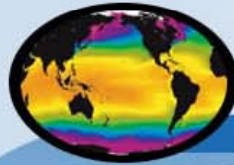
- What is GHRSSST?
- GHRSSST requirements from drifting buoys
- New eSURFMAR proposal for ship observation formats
- GHRSSST requirements from ship underway observations
- Use of Argo data in GHRSSST
- Use of XBT data in GHRSSST
- Future GHRSSST XBT SST requirements?



GHR SST

*Group for High Resolution
Sea Surface Temperature*

- Started in 2002 as GODAE pilot project
- Now main expert group of users and providers of satellite SST data
- Aim: to provide the best quality sea surface temperature data for applications in short, medium and decadal/climate time scales in the most cost effective and efficient manner through international collaboration and scientific innovation
- Set standards for satellite SST processing and formats (CF-compliant [netCDF](#))
- Share satellite SST level 2 (“[L2P](#)”) and level 3 (“[L3](#)”) data products
 - For each pixel: Time, lat, lon, SST(depth), error estimates (bias, standard deviation), quality level, wind speed, sea-ice fraction, land/ice/water flag, difference from SST climatology, etc
- Share global and regional SST analysis products (“[L4](#)”)
- See web page at: <http://www.ghrsst.org>



GHRSSST

Group for High Resolution Sea Surface Temperature

Search:

Location: Home /

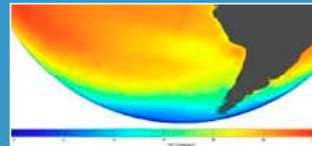
Integrated SST Data Products

The Group for High-Resolution Sea Surface Temperature (SST) (GHRSSST) provides a new generation of global high-resolution (<10km) SST products to the operational oceanographic, meteorological, climate and general scientific community.

Login

Email:
Password:

Data



- Latest SST map
- Real-time
- Historical data
- RDAC Data Servers
- Data Descriptions
- GHRSSST Data Tools
- Operational Announcements
- GHRSSST Metrics Dashboard

GHRSSST Science



- SST definitions
- What is GHRSSST?
- Organisation
- Science Team & Groups
- Product Validation
- GHRSSST Publications
- Documents

Users & Partners



- Applications
- User Requirements
- New Satellite Programs
- Input data streams
- Sponsors

News

New GHRSSST Science Team Chair

Added: 20-Jun-2011

Aquarius with NIRST launched

Added: 10-Jun-2011

GHRSSST Forum available

Added: 25-May-2011

GHRSSST XII update

Added: 17-May-2011

Public review for the AVHRR Pathfinder Version 5.2 SST

Added: 03-May-2011

Changes affecting data access at the GHRSSST GDAC

Added: 27-Apr-2011

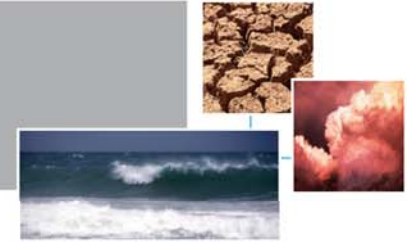
Meetings

Metrics Dashboard

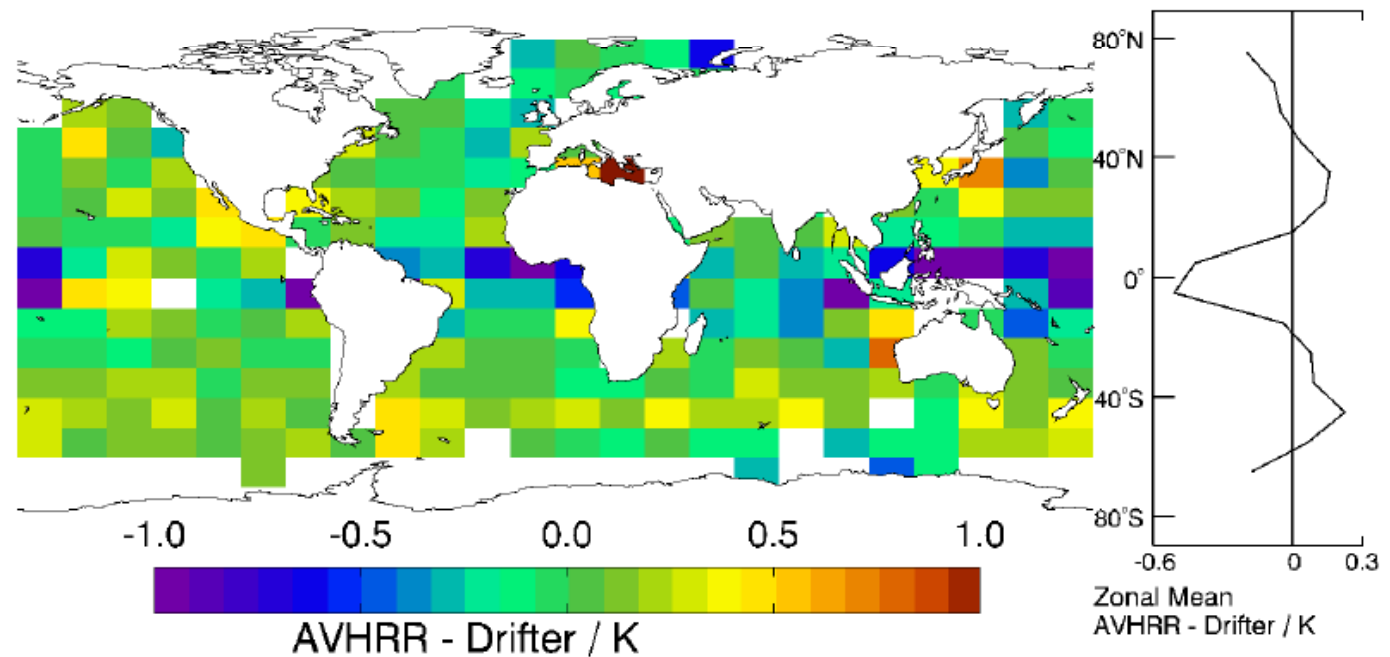
The GHRSSST Global Data Assembly (GDAC) center collects the data streams from the Regional Data Assembly Centers. The GHRSSST Long Term Stewardship and Reanalysis Facility (LTSRF) provides stewardship in perpetuity.

LTSRF ●					

DBCP – GHRSSST Pilot Project

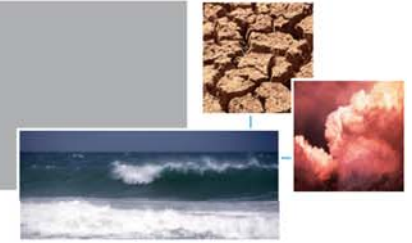


- Drifting buoys are currently main reference dataset for GHRSSST
- Used for common reference for GHRSSST satellite SST product error statistics
- DBCP and GHRSSST established a [joint Pilot Project](#) in 2010 to upgrade elements of the GDP buoy fleet to allow the reporting of higher resolution SST and position
- Aim: Driving down regional biases in satellite SST



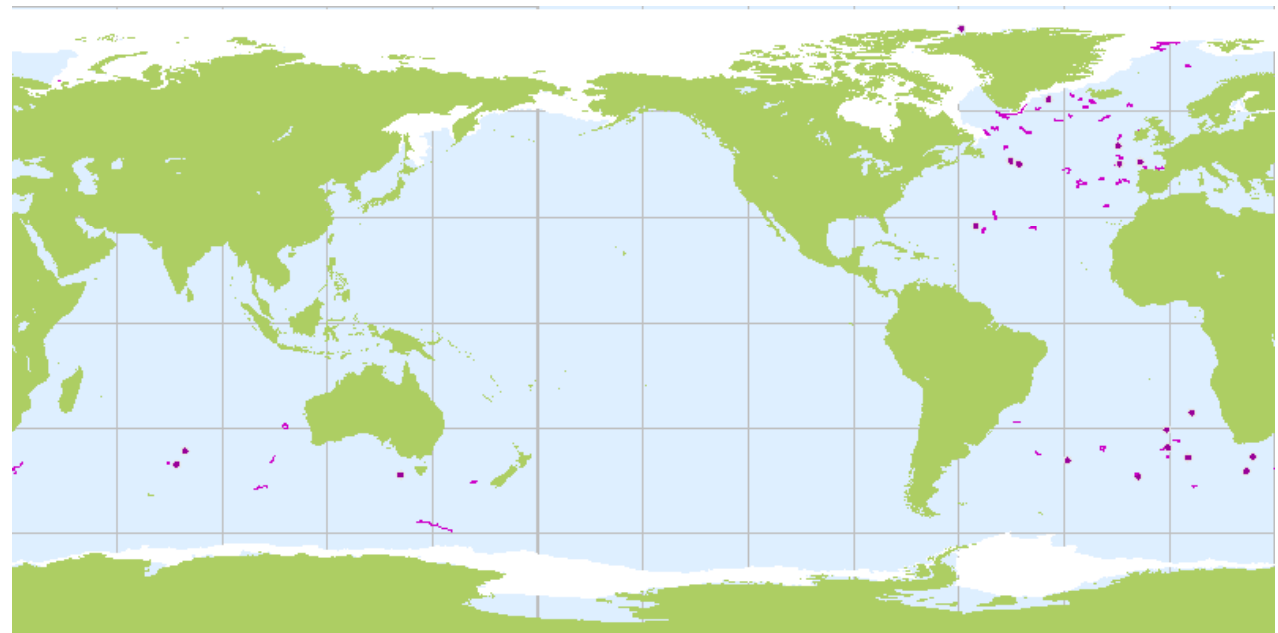
DBCP-GHRSST Pilot Project Proposal

Craig Donlon and David Meldrum, 11 July 2010



Data Buoy Element	Resolution	Accuracy
Time	5 minutes	5 minutes
Latitude/Longitude	0.005°	0.005°
SST	0.01°C	0.05°C

- Data buoys report in binary BUFR format to GTS at hourly intervals
- So far ~100 upgraded drifting buoys deployed that report to 0.01°C
- see <http://www.jcommops.org/dbcp/iridium-pp/index.html>



Proposed E-SURFMAR Data Resolution from Ships

Pierre Blouch, Meteo-France, 26 Apr 2011



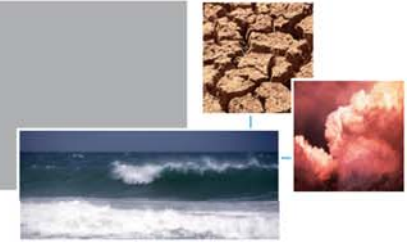
Element	Ship Observations	Ship-AWS
Time	1 minute	1 second
Ship's mean SOG	1 m/s	0.1 m/s
Ship's True Heading	5°	1°
Latitude/Longitude	0.01°	0.001°
Pressure	0.1 hPa	0.1 hPa
Wind Direction	1°	1°
Wind Speed	0.5 m/s	0.1 m/s
Air Temperature	0.1°C	0.1°C
Relative Humidity	1%	1%
SST	0.01°C	0.01°C
Departure of summer load line from sea level	1 m	
Total Cloud Cover	10%	
Global solar radiation	1000 J.m-2	
Long wave radiation	1000 J.m-2	

GHRSSST requirements from underway ship observations on GTS



- SOT requested advice on future data transmission resolution for ship measurements
- 0.01°C resolution in SST is endorsed by GHRSSST
- Liz Kent noted 10% resolution for cloud cover contradicts existing Octal climate record
- GHRSSST has little knowledge or use of Trackob records apart from BoM operational SST analyses

GHRSSST Use of Argo Data



- GHRSSST has need for independent global validation measurements for retrievals, skin to depth models (including diurnal variability)
- High accuracy Argo data offers such capability
- GHRSSST currently uses closest to surface measurement (3-5 m) for validation
- Investigating using near surface profiles (un-pumped and second sensor)
- The near-surface measurements from Argo profiling floats provide a valuable, very accurate new data set that has yet to be fully exploited within GHRSSST

GHRSSST use of XBT data



- XBTs on the GTS report to 0.1°C resolution in BATHY code, 0.01°C if in TESAC
- Absolute accuracy: quoted as $\pm 0.1^\circ\text{C}$ to 0.15°C (standard drifting buoys are $\pm 0.2^\circ\text{C}$)
- Problems for satellite validation:
 - response time of the thermistor is 0.16 s, meaning that the probe has to descend several metres before the sensor has equilibrated. Values of up to 5 m are quoted
 - T spikes at surface which must be QC'd out of record
- ICOADS and HadSST long-term in situ SST analyses use QC'd XBT SST
- To the GHRSSST Science Team's knowledge only one GHRSSST product uses XBT data – BoM RAMSSA SST analysis

BoM Regional Australian Multi-Sensor SST Analysis System



Optimal Interpolation analysis of observations

Depth: Foundation (pre-dawn SST)

Resolution: Daily, 1/12°

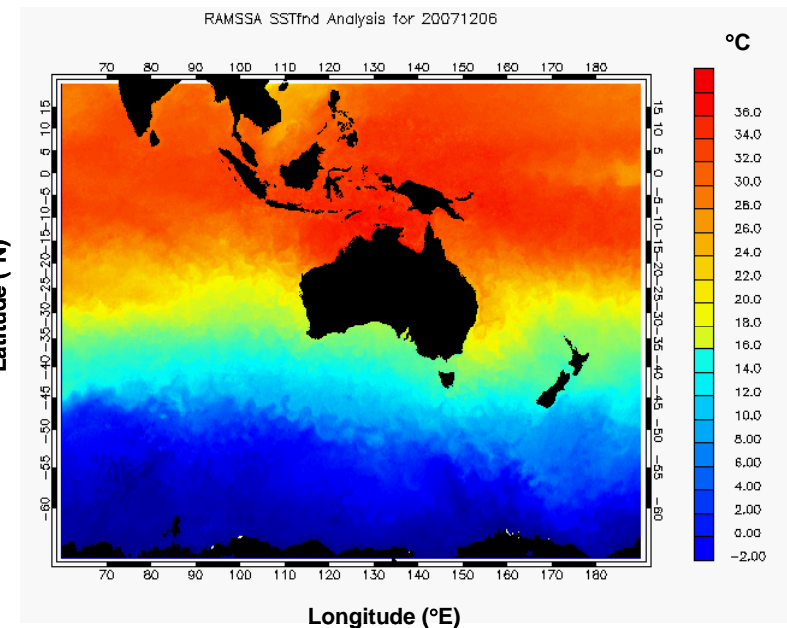
Domain: 60°E - 170°W , 20°N - 70°S

Data Inputs:

- 1 km HRPT AVHRR (NOAA-18, 19)
- 9 km NAVOCEANO GAC AVHRR (NOAA-18, METOP-A) L2P
- 25 km AMSR-E (Aqua) L2P
- 1/6° AATSR (EnviSat)
- Buoy, ship, Argo, CTD, **XBT** obs (GTS)
- 1/12° NCEP ice edge analyses
- NAVOCEANO 1/120° land/sea mask

Uses:

- Boundary condition for BoM regional NWP models
- Validating BoM's ocean model SST5m analyses/forecasts



Daily foundation SST analyses available as netCDF GDS v1.7 L4 files from

<http://godaie.bom.gov.au> and
<http://podaac.jpl.nasa.gov>



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Future GHRSSST Requirements for XBT data?



- Near real-time access to QC'd XBT SSTs (with any spikes removed)

XBT Element	Resolution	Accuracy
Time	5 minutes	5 minutes
Latitude/Longitude	0.005°	0.005°
Depth (in top 10 m)	0.1 m	0.5 m?
SST	0.01°C	0.05°C

Extra Slides for discussion



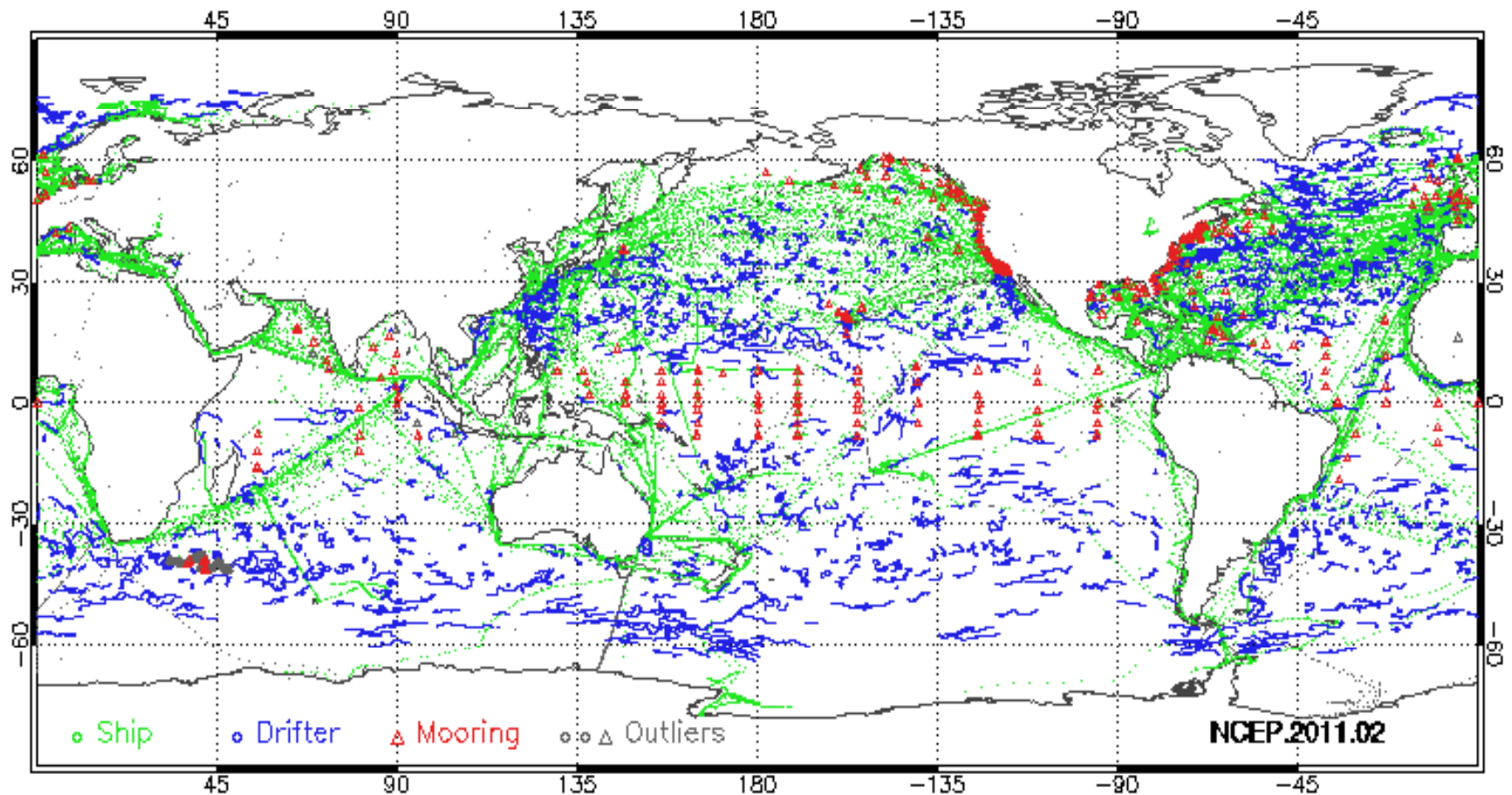
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How can we improve the validation of satellite SST products and ocean forecasts over regions sparse in buoy observations?

In Situ SST observations from GTS for Feb 2011



One solution: Improve the availability and accuracy of SSTdepth observations from ships reporting to the GTS

IMOS Ship of Opportunity SST

Goal

Significantly enhance quantity, quality and timeliness of ship SST data in the Australian region

Status June 2011

NRT QA'd SST data from 13 vessels (6 with hull-contact sensors) available from GTS and Ocean Portal

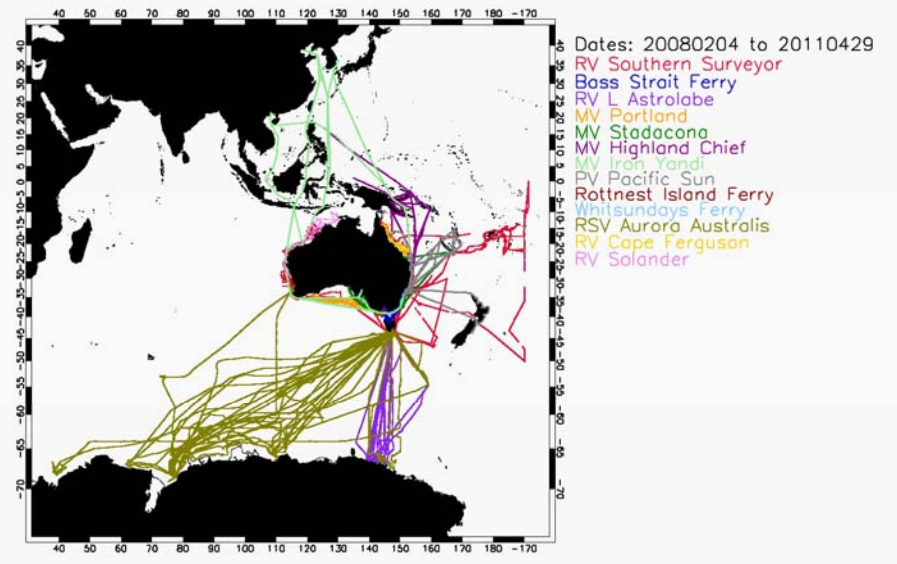
<http://imos.aodn.org.au/webportal>

- All except Rottnest and Whitsunday Ferries (engine intake SST from catamarans) have comparable errors to drifting buoys
- IMOS ship SST used for satellite SST and ocean model validation at BoM
- RV SST sent in Trackob format to GTS

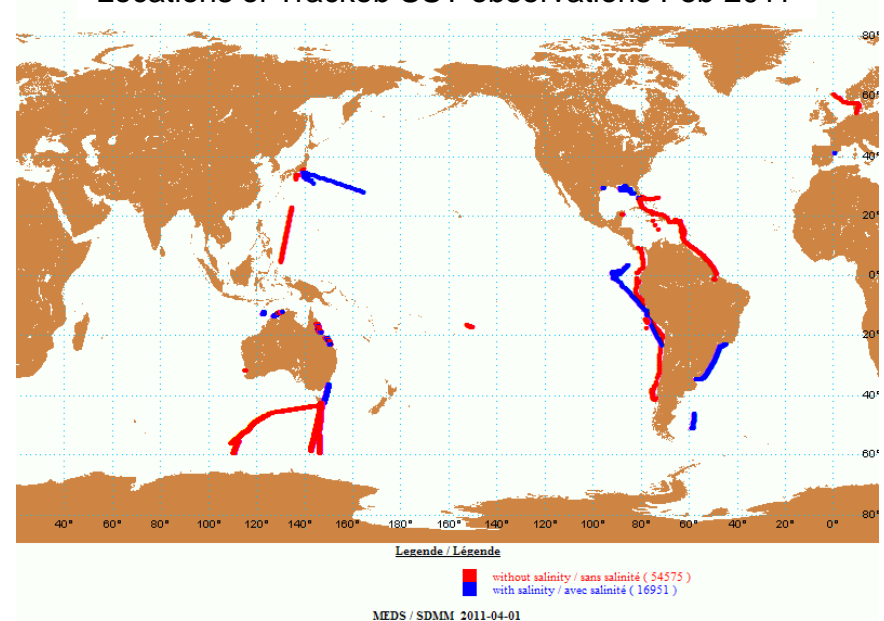
By June 2012

NRT QA'd SST from 2 more vessels – RV Tangaroa and RV Linnaeus

Locations of IMOS ship SST observations to 29 Apr 2011



Locations of Trackob SST observations Feb 2011



EIF 2c: Ship SST Sensors 2011/12 Plans



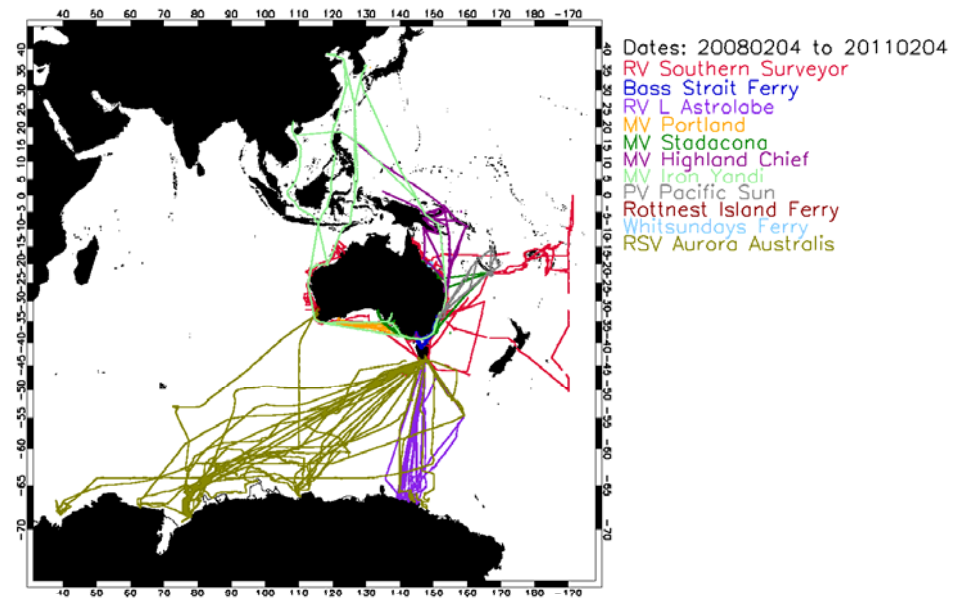
Locations of IMOS ship SST observations to 4 Feb 2011

By Dec 2011: Recalibrate hull-contact sensors deployed > 12 months

Supply QA'd bulk SST from RV Cape Ferguson, RV Solander and RV Tangaroa to Ocean Portal and GTS in near real-time

By Jun 2012: At least 13 QA'd IMOS ship SST data streams on GTS and Ocean Portal in near real-time

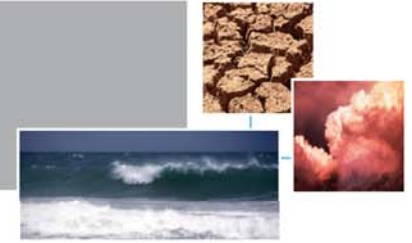
By Dec 2012: Instrument MV Whana Bhum and MV Xutra Bhum with hull-contact temperature sensors



Whana Bhum and Xutra Bhum cruise tracks



Operational System Satellite SST Requirements

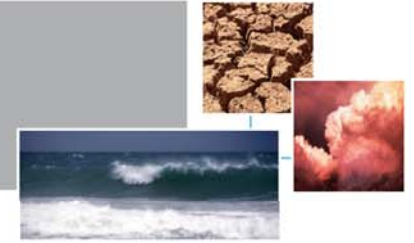


One SST product can not best suit every application

Operational systems need SST products in consistent, well-described formats (eg. CF-compliant netCDF) that are:

- Timely
- Reliable
- Accurate (with specified uncertainties)
- Stable over time
- With spatial and temporal scales appropriate for the application
 - Sea fog prediction requires small spatial scales (~1 km) and frequent updates during 24 hours
 - Higher resolution NWP models require higher resolution SST products
- At the appropriate and specified depth
 - skin, subskin, depth, “blend” or foundation

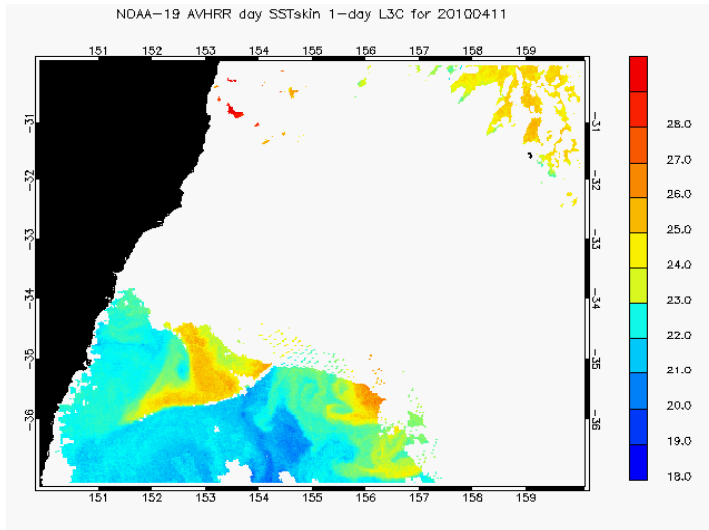
Applications of different depth SST products



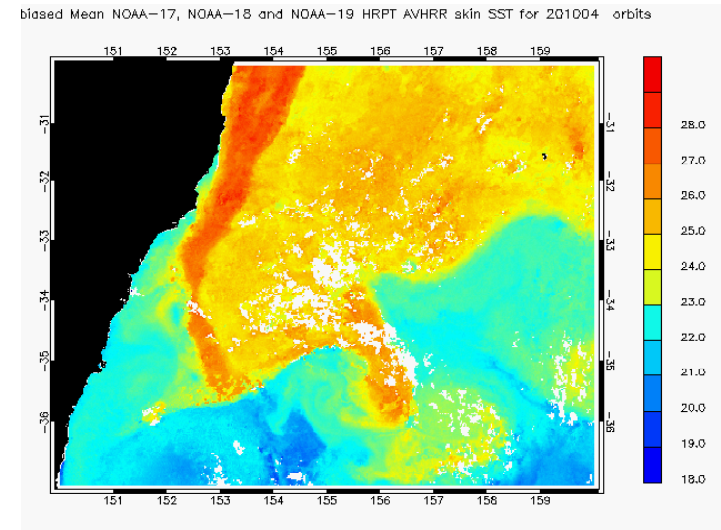
- Skin (infrared sensors)
 - measure air-sea heat/gas flux
 - measure diurnal variation (cool-skin and diurnal warming)
 - validate diurnal variation models
- Subskin (microwave sensors)
 - measure diurnal warming
 - fill in gaps in IR satellite SST
- Blend (0-20 m) (Satellites, Ships, buoys, Argo, XBT, etc)
 - climate change records (eg. HADSST, ICOADS)
 - SST climatology (eg. NCDC's Reynolds analyses)
- Foundation (Satellite and in situ SST adjusted using models or filtering)
 - input to ocean models
 - input to seasonal prediction coupled models
 - boundary condition for Numerical Weather Prediction models

Different BoM SST products using AVHRR L2P SST for 11 Apr 2010

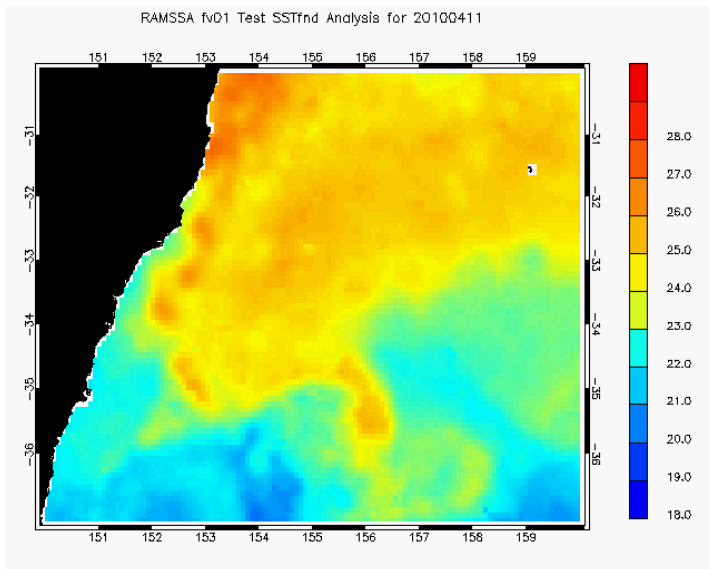
IMOS AVHRR 0.02° 1-day daytime **L3C** SSTskin from NOAA-19 (quality level > 2)



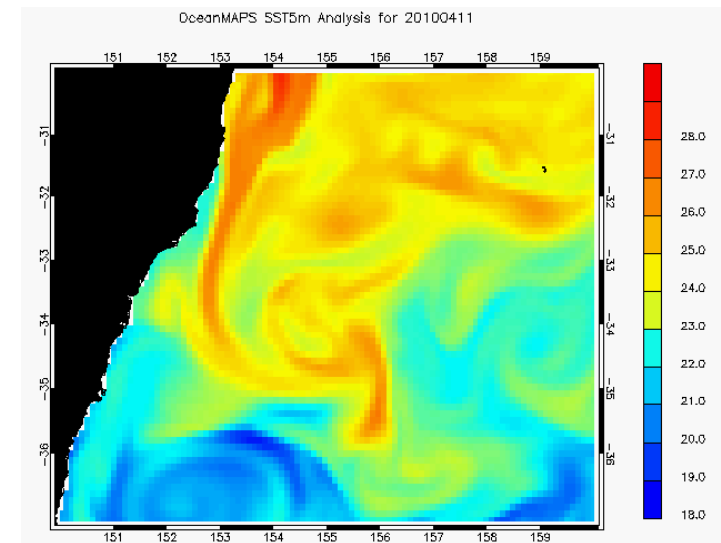
IMOS AVHRR 0.02° 5-day **L3S** SSTskin from NOAA-17, 18 and 19 for 7-11 Apr 2010 (QL > 2)



RAMSSA 0.083° **L4** SSTfnd OI Analysis

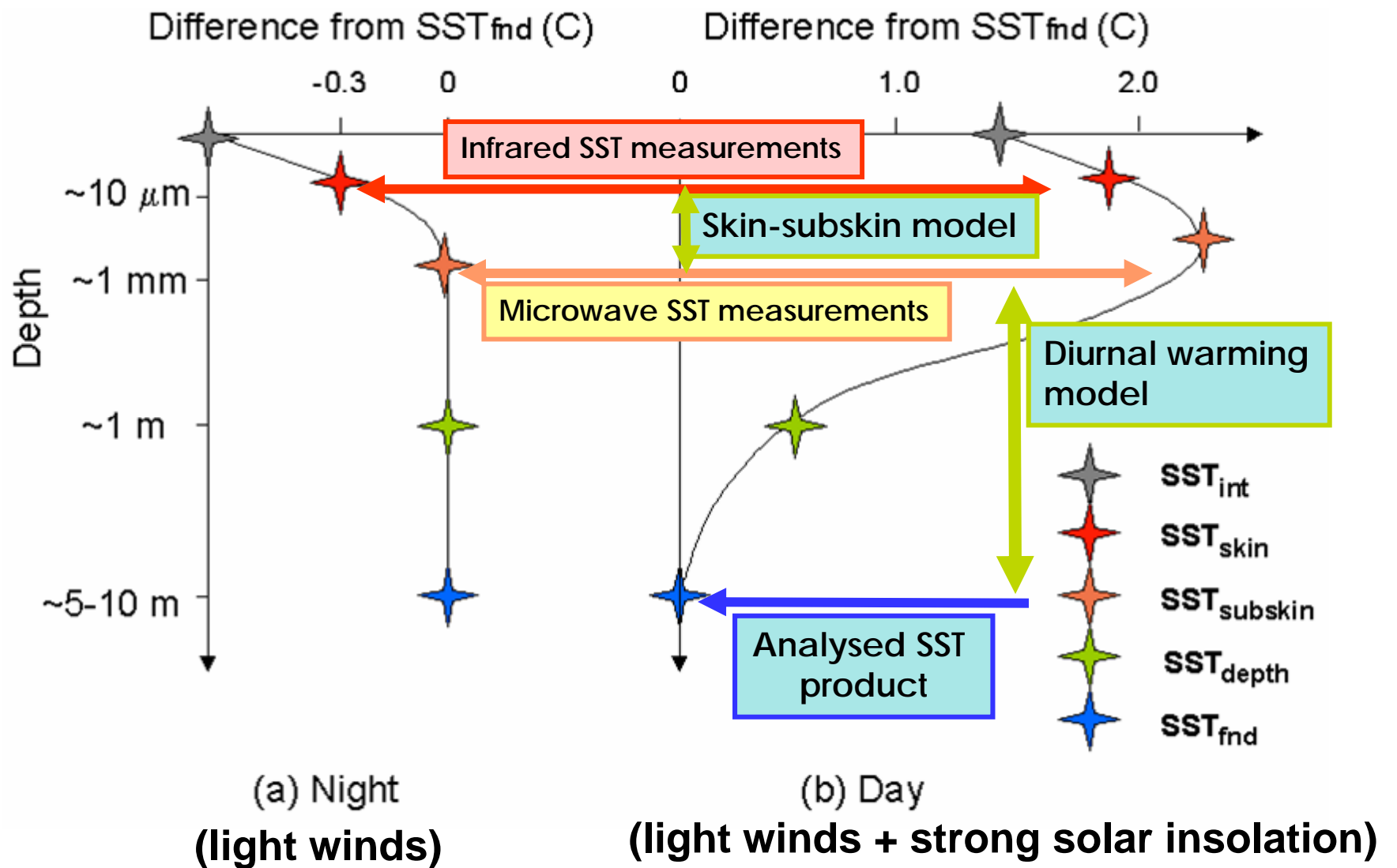


OceanMAPS 0.1° **OGCM** SST5m Analysis



SST at what depth?

skin, sub-skin, “blend” or “foundation”



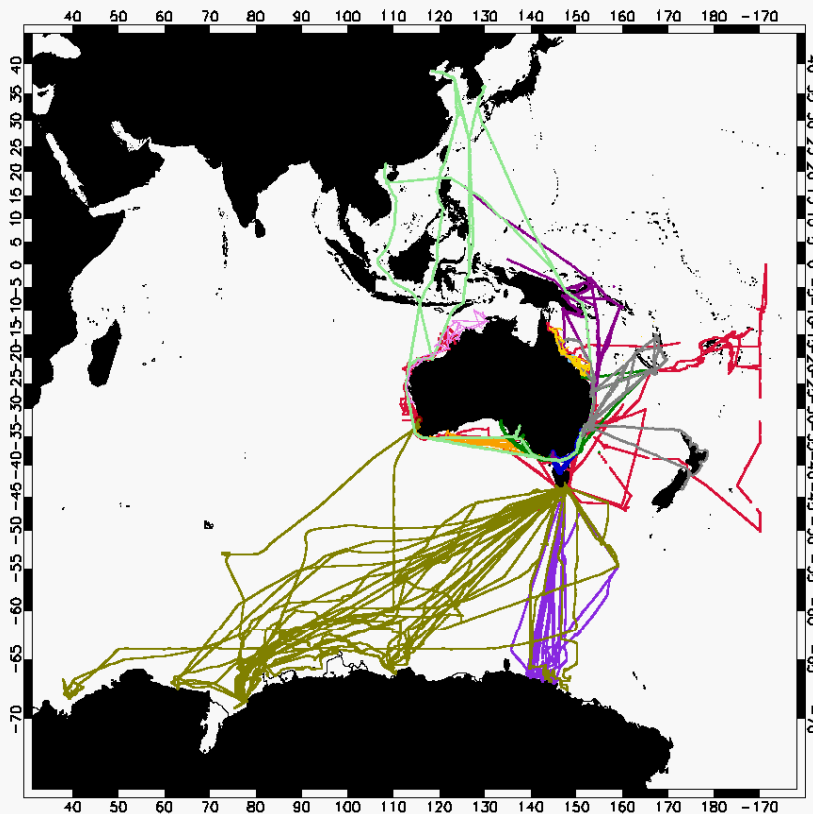
IMOS Ship of Opportunity SST sub-facility

(Contact: Helen Beggs)

Goal: Significantly enhance quantity, quality and timeliness of ship SST data in the Australian region

Current Status: NRT QA'd SST data from **13** vessels (6 with hull-contact temperature sensors) available from GTS and IMOS Ocean Portal

Locations of IMOS ship SST observations from 4 Feb 2008 to 29 Apr 2011



Dates: 20080204 to 20110429

RV Southern Surveyor
Bass Strait Ferry
RV L Astrolabe
MV Portland
MV Stadacona
MV Highland Chief
MV Iron Yandi
PV Pacific Sun
Rottneest Island Ferry
Whitsundays Ferry
RSV Aurora Australis
RV Cape Ferguson
RV Solander

IMOS Ship SST Plans

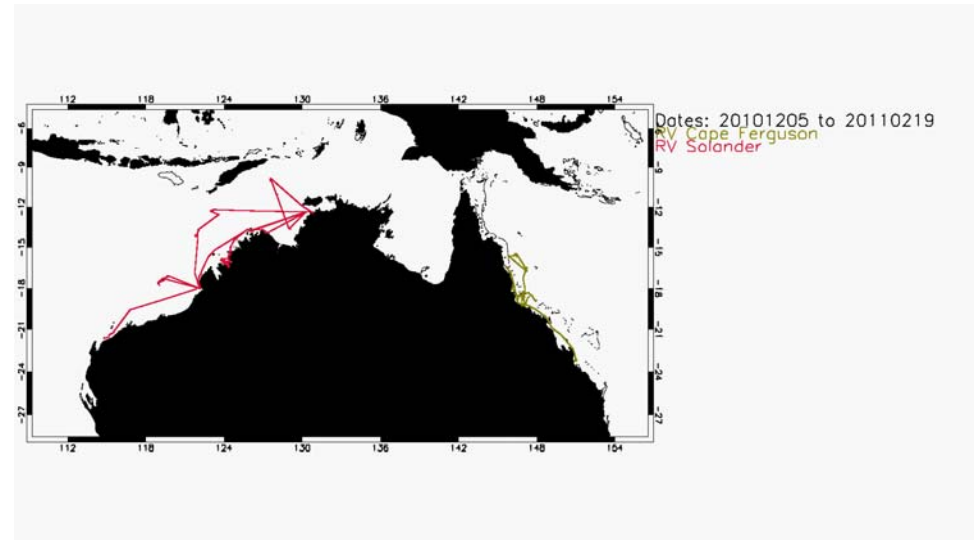


By Dec 2011: Supply QA'd SST from RV Cape Ferguson, RV Solander, RV Linnaeus and RV Tangaroa to IMOS Ocean Portal and GTS in near real-time

Develop stand-alone system to transmit hull-contact SST data in NRT from merchant vessels **not** instrumented with automatic weather stations

By Dec 2012: Instrument MV Whana Bhum and MV Xutra Bhum with hull-contact temperature sensors

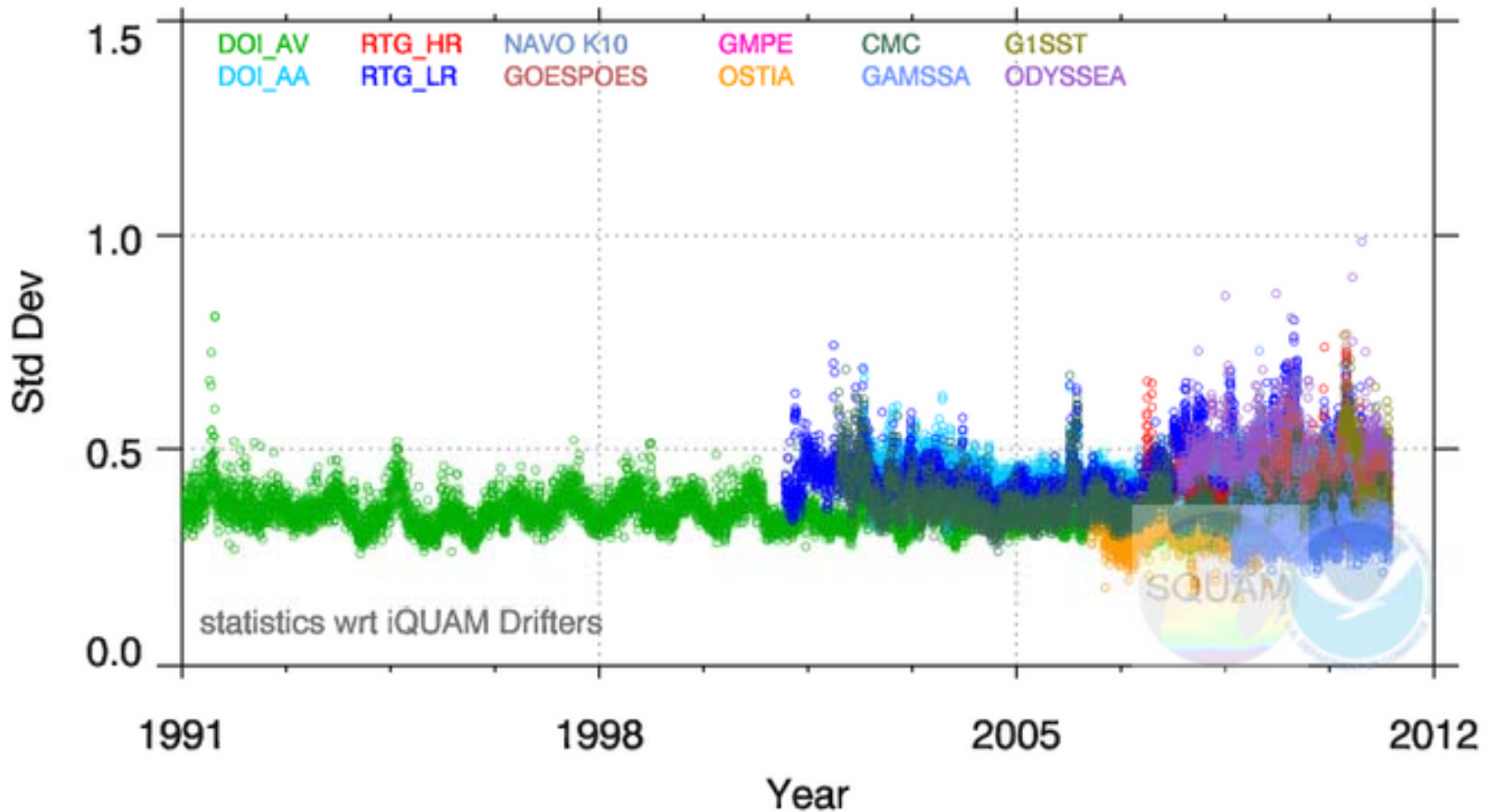
Locations of RV Cape Ferguson and RV Solander ship SST observations uploaded to GTS in delayed mode



Whana Bhum and Xutra Bhum cruise tracks



SST Analyses vs Drifting Buoy SST



<http://www.star.nesdis.noaa.gov/sod/sst/squam/index.html>