In situ SST Quality Monitor Version 2 (*i*Quam2)

www.star.nesdis.noaa.gov/sod/sst/iquam/v2

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Motivation and Objective

- NOAA is responsible for a wide range of satellite SST products from polar and geostat… …ed(L4) SSTs. "*In situ* …
  - Cov…
  - Incl… …r satellite Cal/Val (dri…
  - Uni… …n wider com…
  - Pro… …e with minimal late…
- The *i*Qu… …pplications, but has … …Cal/Val of SST product…
  - ✓ Eur…
  - ✓ NA…
  - ✓ Uni…
  - ✓ Cer…
  - ✓ Jap…
  - ✓ Chinese Ocean University Haiyang and Fengyun satellites

Enhancements in *i*Quam2

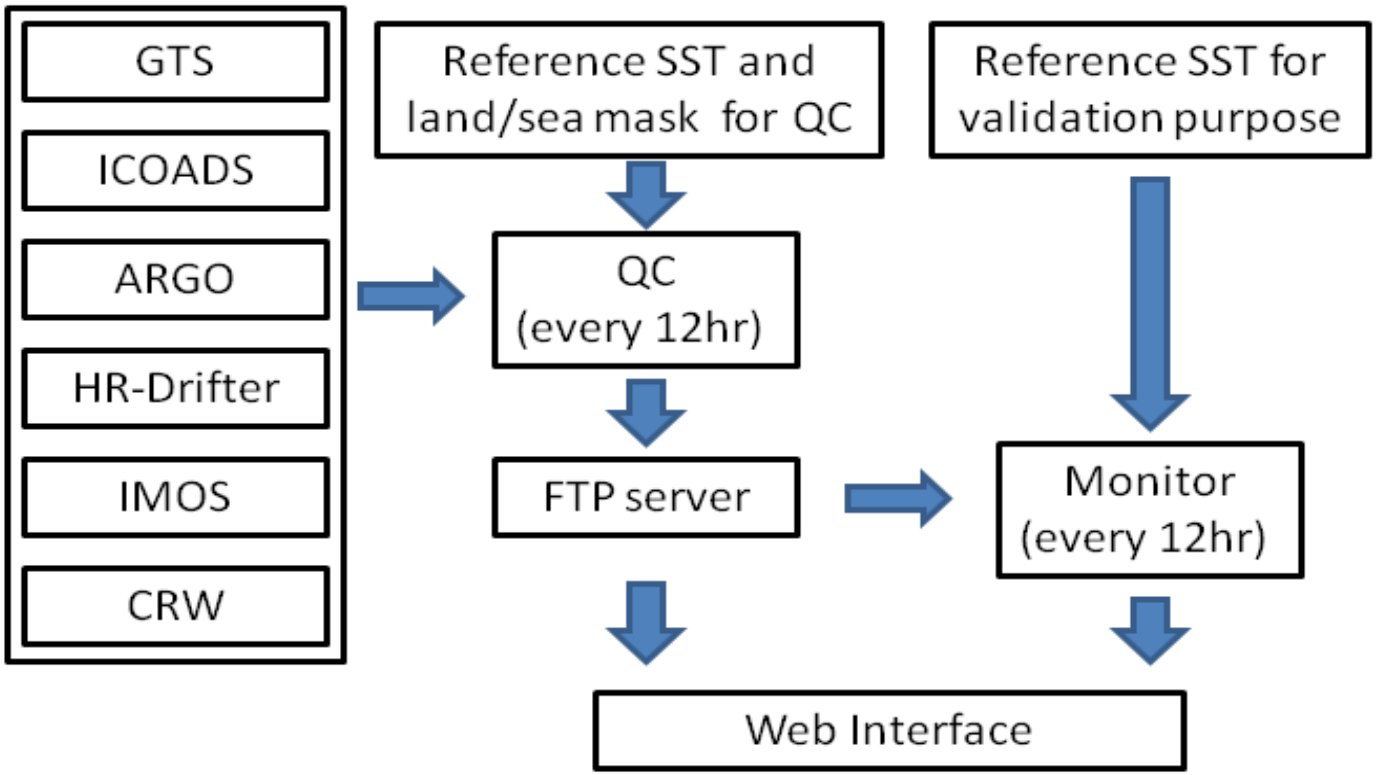
As *i*Quam user community grows, it requested several enhancements:

- ❑ Extend time series to full satellite era (Sep 1981 – on)
- ❑ Improve QC
  - The 2nd reference SST (CMC)
  - Performance history check (*i*Quam check similar to the UKMO/CMS "black lists")
  - CMS black list; and individual QFs from data producers (ICOADS, ARGO, IMOS)
- ❑ Improve web interface
  - Redesign web engine (from flash player to High Charts)
  - Add daily statistics
  - Enhance graphics (interactive display, and print/save functions)
- ❑ Add new *in situ* data
  - ARGO Floats (in NRT and post-processing modes)
  - High-Resolution Drifters
  - IMOS Ships
  - Coral Reef Watch buoys
- ❑ Change output data files to NetCDF4, maximally reconcile with GHRSST GDS2

Functionality and Data Flow

The *i*Quam is a web-based near-real time system. It performs 3 major functions

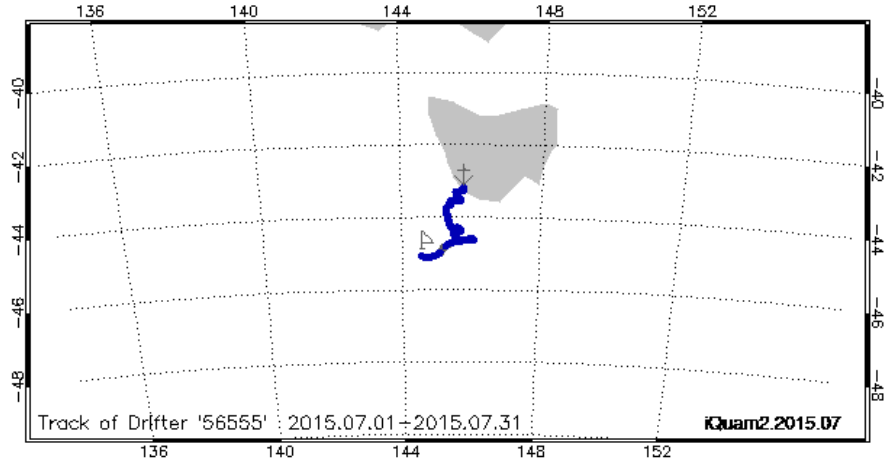
- Ingests various *in situ* SSTs, and performs a uniform Quality Control (QC)
- Monitors QCed *in situ* SSTs online
- Serves reformatted *in situ* SST data with quality flags appended

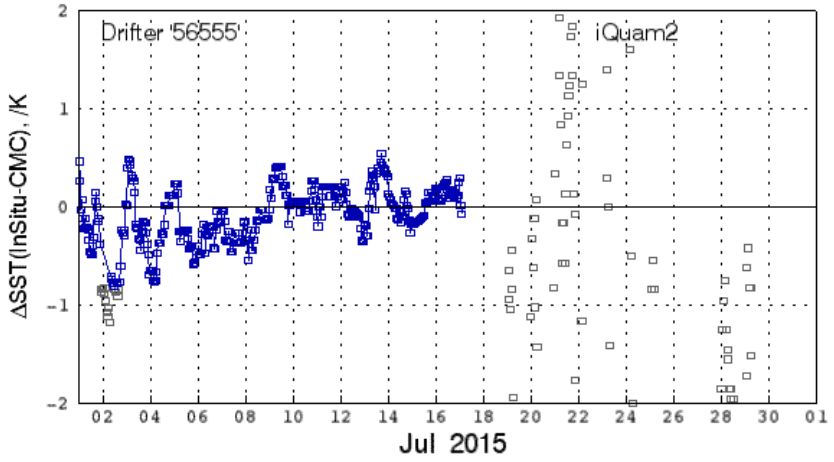


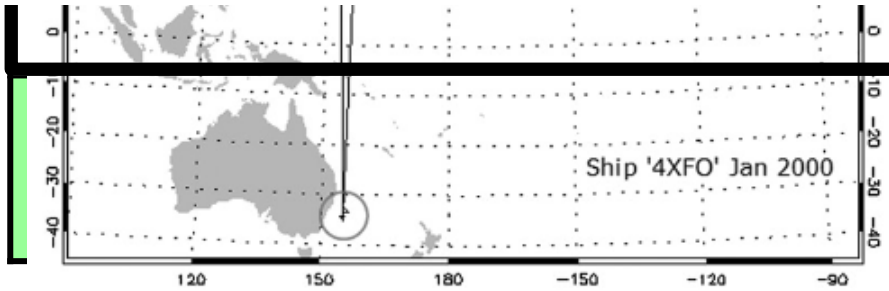
Quality Control

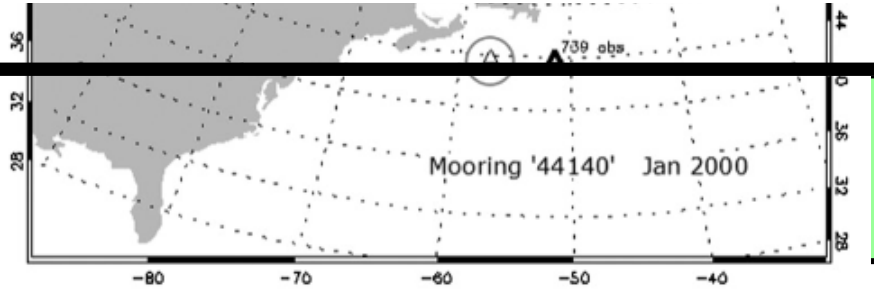
Category	Check	Type of error handled	Physical basis
Preprocessing	Duplicate Removal	Duplicates arise from multiple transmission or data set merging	Identical space/time/ID
P[illegible]	[illegible]	[illegible]	[illegible]

$$REF_probability = \frac{0.1 * Apriori_possibility}{0.1 * Apriori_possibility + QP[ind] * (1 - Apriori_possibility)}$$









Monitor Interface

NOAA NESDIS STAR

iQUAM *in situ* SST quality monitor v2.0

NOAA / NESDIS / STAR

Monitor Data About

Maps
Statistics
Time Series
Platforms

2015 08
<< < > >>

Monthly Daily

Ref SST Used in QC
Reyn CMC Both

QCed Outlier

- *Argo - Argo Floats*
- *Drifter - Conventional drifters*
- *HR-Drifter - High-Resolution Drifters*
- *T-Mooring - Tropical Moorings*
- *C-Mooring - Coastal Moorings*
- *CRW - Coral Reef Watch Buoys*
- *Ship - Conventional ships*
- *IMOS - IMOS Ships*

Symbol = one observation.

All Platforms | Argo | Drifter | HR-Drifter | T-Mooring | C-Mooring | CRW | Ship | IMOS

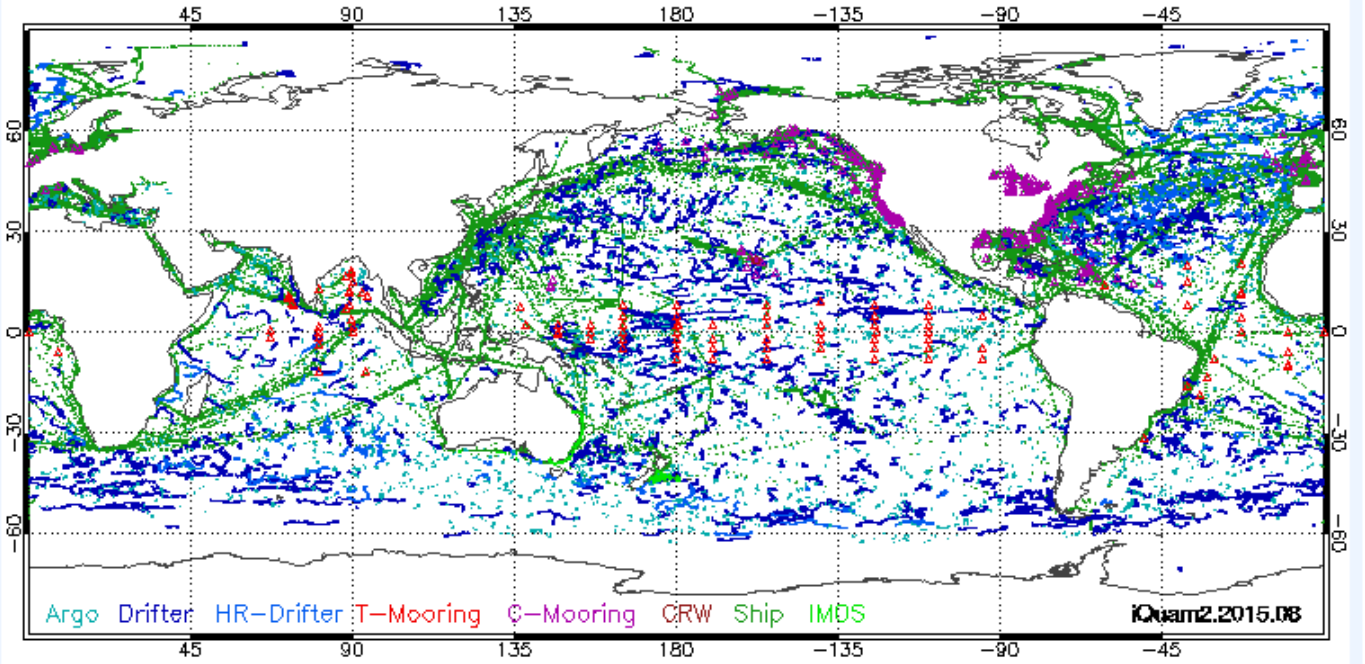


Fig. 1: *Global distribution of in situ data*

Monitor Interface

Maps | Statistics | Time Series | Platforms

2015 08 << < > >>

Monthly Daily

Ref SST Used in QC: Reyn CMC Both

Ref SST Used in Monitoring: Reyn CMC

N_Obs - number of obs;
N_QC - number of obs passed QC;
DR,GL,TS,SG,RS,XP,PH,XQ - nobs detected by each check:

- *AL - All checks combined.*
- *DR - Duplicate Removal*
- *GL - Geo-Location*
- *TS - Travel-Speed (aka. Tracking)*
- *SG - SST-Gradient (aka. Spike)*
- *RS - Ref SST (aka. background); 1 - Reynolds, 2 - CMC*
- *XP - Cross-Platform (aka. buddy). Performed on top of RS. 1- Reynolds, 2 - CMC*
- *PH - Performance History (aka. iQuam blacklist)*
- *XQ - External QC (from input data)*

Statistics are calculated over (In situ - Ref SST).
In situ: obs that passed iQuam QC
Ref1 = Reynolds; Ref2 = CMC

Note: N_Mtchp - number of (in situ - Ref) match ups. (Smaller than N_QC due to missing Ref SST in some points.)

For more information, see About.

QC Statistics - NOBS | QC Statistics - Percent

Platform	N_Obs	N_QC%	AL %	DR %	GL %	TS %	SG %	RS %	XP %	PH %	XQ %
Argo	7,925	88.26	11.74	0	0	0	0.04	4.56	4.83	0	6.86
Drifter	1,069,007	90.50	9.50	0.16	1.08	0.17	0.17	5.97	6.58	0.05	1.29
HR-Drifter	182,021	87.86	12.14	0	4.15	0.01	0.34	7.50	7.56	0.08	0
T-Mooring	44,589	96.60	3.40	0.70	0	1.33	0.03	1.28	1.35	0	0
C-Mooring	348,897	82.24	17.76	0.07	0.00	1.46	0.54	15.53	15.64	0.05	0
CRW	50,393	76.68	23.32	0	0	0	0.41	22.90	22.90	0	0
Ship	115,582	75.06	24.94	0.03	0.23	0.45	0.50	23.78	23.63	0.10	0
IMOS	41,804	98.27	1.73	0	0	0.14	0.06	0.48	0.53	0.01	0.99

In situ - Ref SST Statistics

Platform	N_Mtchp	MEAN	MED	SD	RSD	MIN	MAX	SKEW	KURT
Argo	6,995	0.05	0.06	0.30	0.23	-3.21	1.40	-0.39	4.27
Drifter	967,469	0.04	0.04	0.26	0.21	-2.77	2.49	-0.25	3.62
HR-Drifter	159,925	0.06	0.06	0.28	0.22	-2.87	2.35	-0.51	5.02
T-Mooring	43,074	0.04	0.03	0.20	0.16	-1.37	1.44	0.31	2.93
C-Mooring	286,928	0.08	0.07	0.47	0.35	-3.80	3.31	-0.32	3.26
CRW	38,643	0.29	0.32	0.46	0.51	-1.20	1.25	-0.36	-0.54
Ship	86,756	0.23	0.25	0.80	0.70	-3.95	3.57	-0.28	0.42
IMOS	41,079	-0.01	0.09	0.47	0.23	-2.05	1.45	-1.39	2.40

Histograms (Normalized at NOBS) | Histograms (Normalized at MAX)

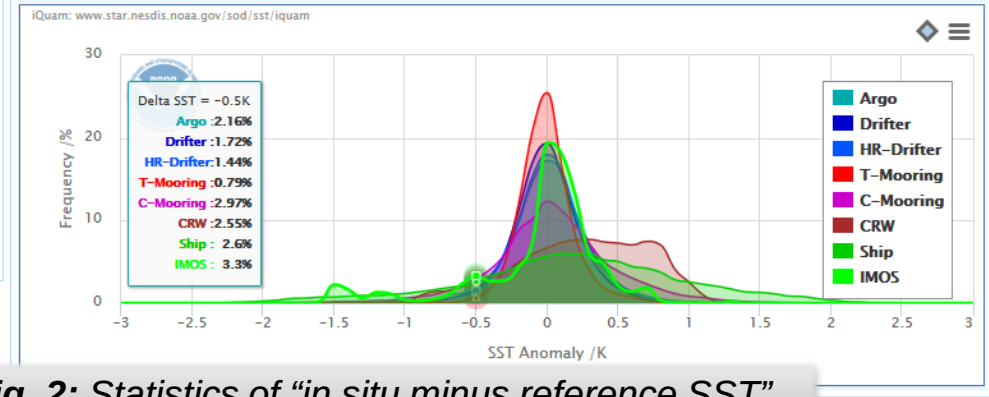


Fig. 2: *Statistics of "in situ minus reference SST"*

Monitor Interface

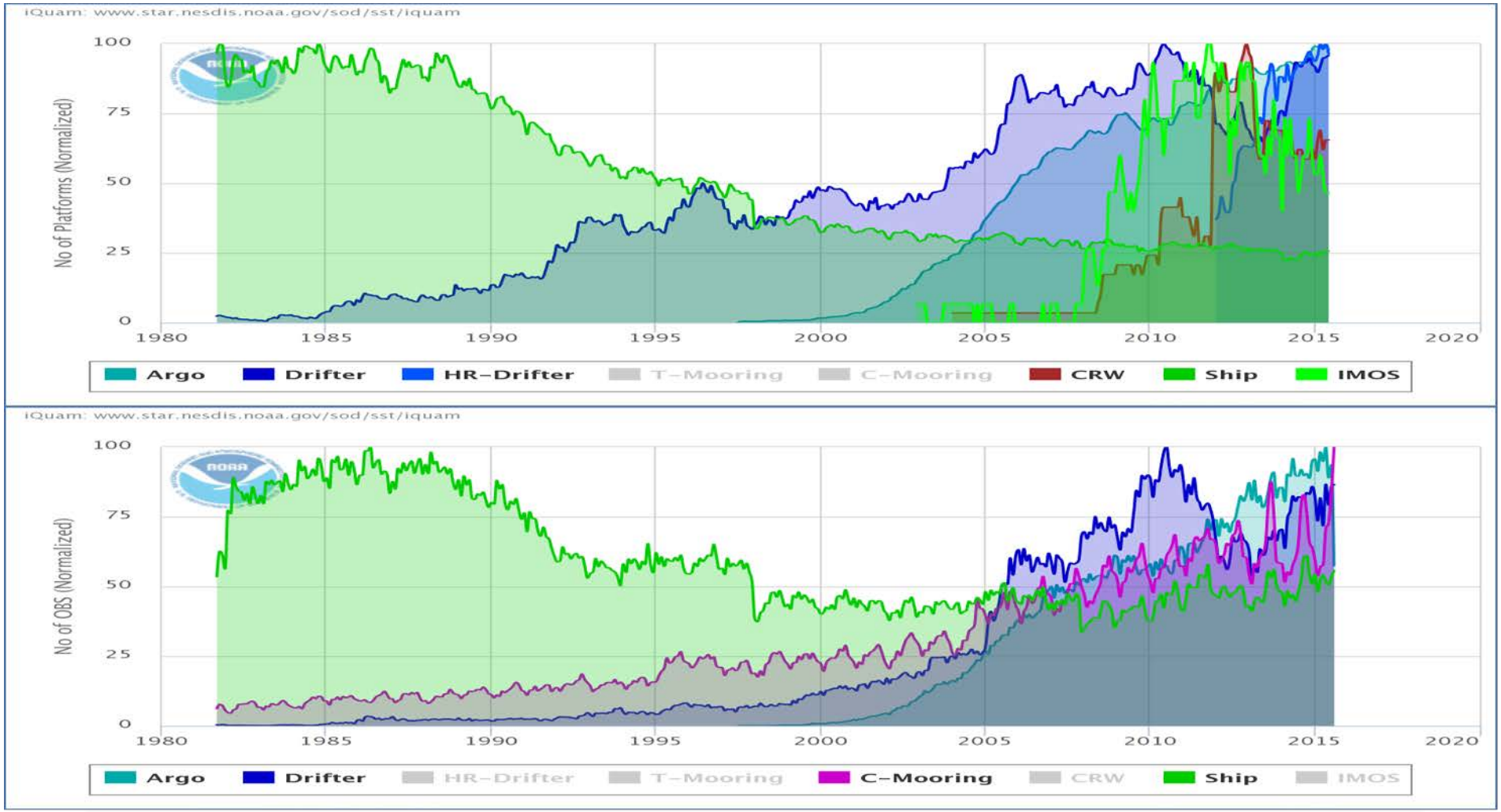


Fig. 3: Monthly *in situ* number of **unique platform IDs** (upper) and **observations**(lower), normalized at Max = 100%

Monitor Interface

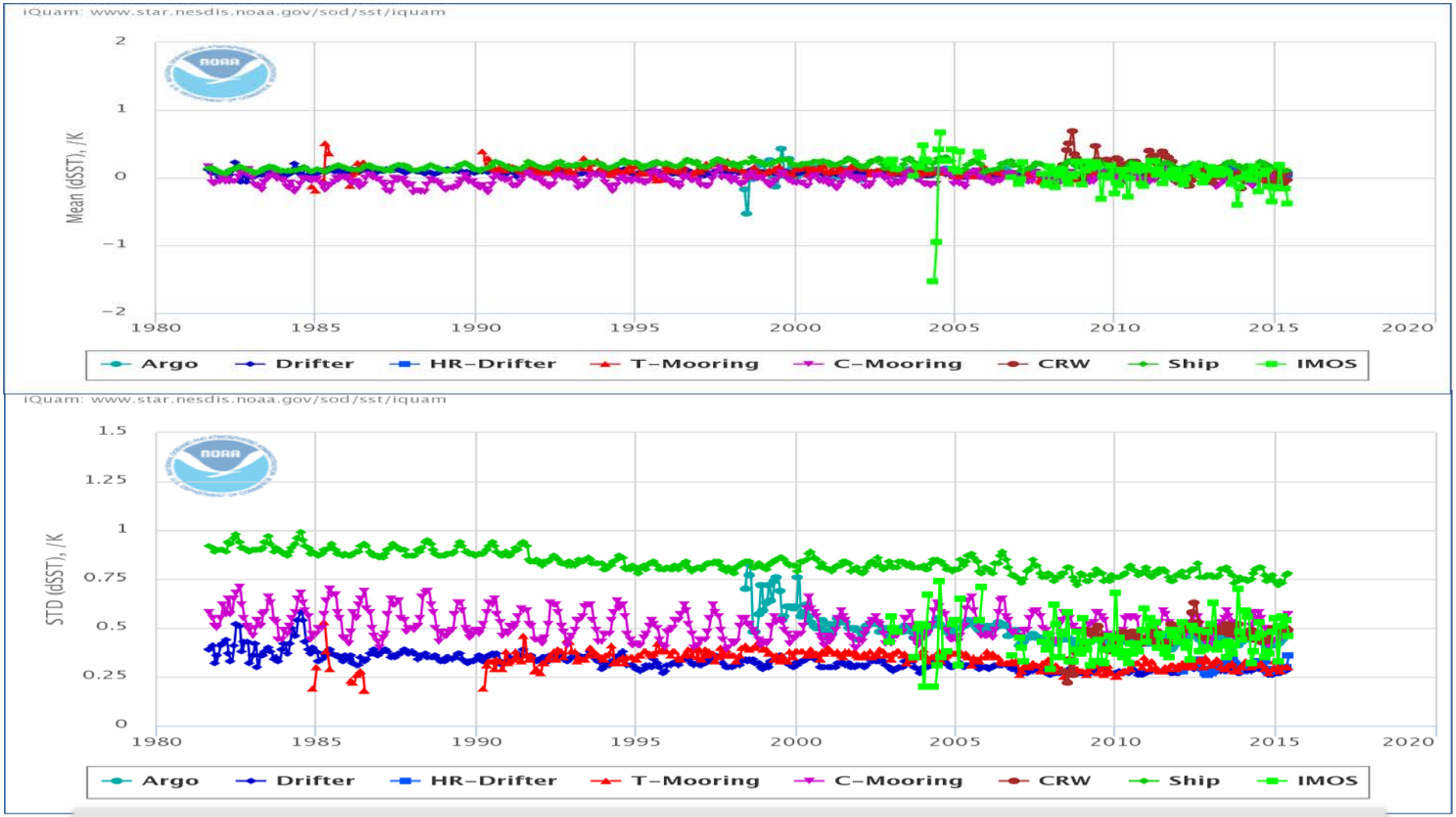


Fig. 4: Monthly *in situ time series* of **Mean Biases** (upper) and **Standard Deviations** (lower)

Monitor Interface

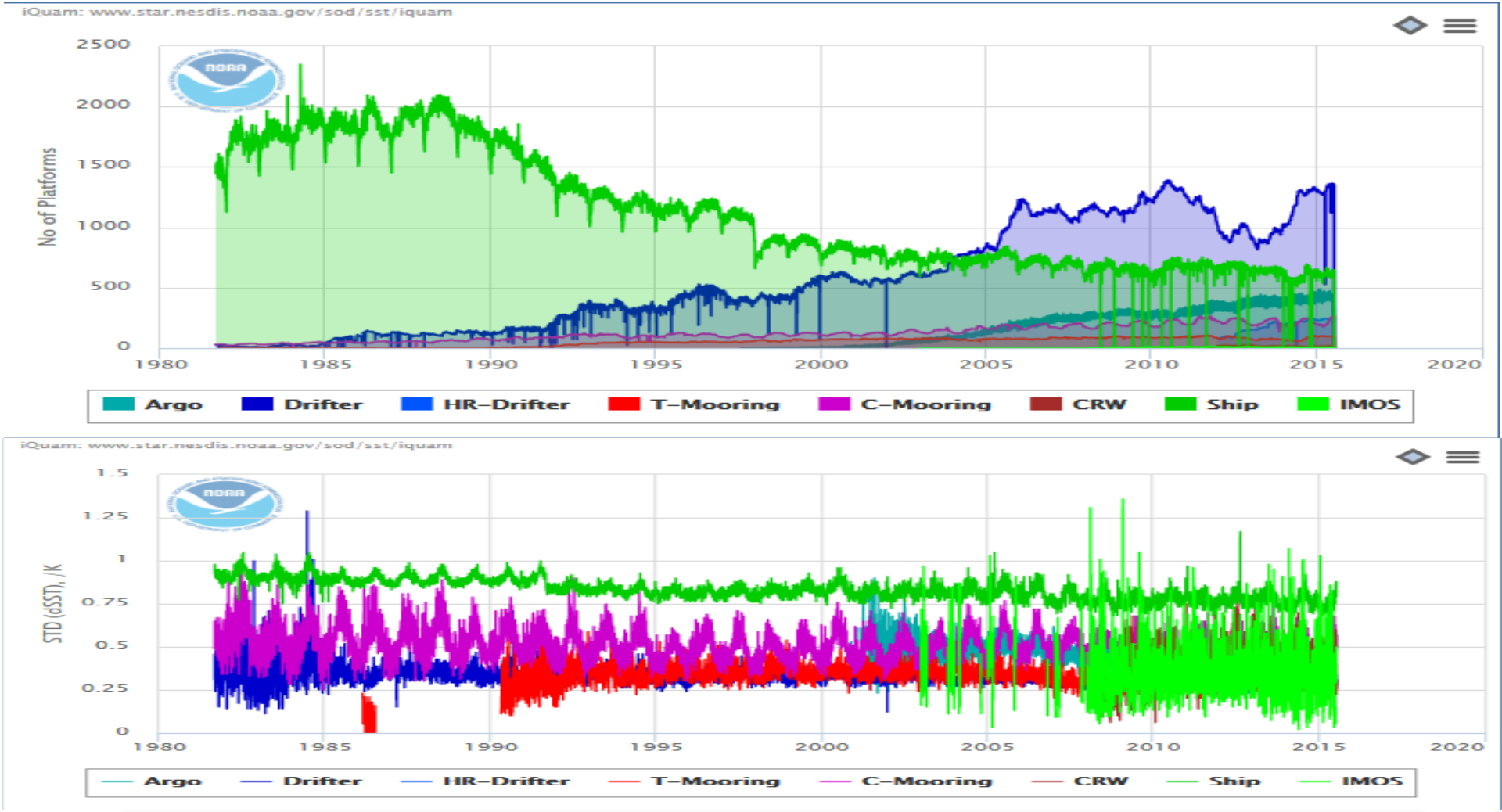


Fig. 5: Daily *in situ* Time series of **platform ID number** (upper) and **standard deviation** (lower)

FTP Interface

NOAA NESDIS STAR

iQUAM *in situ* SST quality monitor v2.0

NOAA / NESDIS / STAR

Monitor | Data | About

NetCDF with Quality Flags

(•) Data ( ) Log

Data are in self-documented NetCDF4 format. Refer to attributes for more information.

Suggested usage of quality_level:

- *high-accuracy applications: quality_level == 5*
- *general applications: quality_level == 4*
- *advanced users: refer to definitions of iquam_flags and original_flags.*

All statistics in iQuam page are for "high accuracy" data only, i.e (quality_level == 5).

Quality level and flags are only set for SST. Other measurements in iQuam have not been QCed.

Data are organized in monthly files. Latest file isrefreshed every 12hrs with a 2hr latency.

All data are available via ftp.

File Name	Last Update Time	Data Source
201507-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv00.0.nc	2015-07-14 08:02	GTS; ARGO_rt; HR; IMOS; CRW.
201506-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv01.0.nc	2015-07-06 13:09	GTS; ARGO; HR; IMOS; CRW.
201505-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv01.0.nc	2015-07-06 10:15	GTS; ARGO; HR; IMOS; CRW.
201504-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv01.0.nc	2015-07-06 10:19	GTS; ARGO; HR; IMOS; CRW.
201503-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv01.0.nc	2015-07-06 10:15	GTS; ARGO; HR; IMOS; CRW.
201502-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv01.0.nc	2015-07-08 08:13	GTS; ARGO; HR; IMOS; CRW.
201501-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv01.0.nc	2015-07-06 10:25	GTS; ARGO; HR; IMOS; CRW.
201412-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv01.0.nc	2015-07-06 10:17	GTS; ARGO; HR; IMOS; CRW.
201411-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv01.0.nc	2015-07-06 10:23	GTS; ICOADS; ARGO; HR; IMOS; CRW.
201410-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv01.0.nc	2015-07-06 10:28	GTS; ICOADS; ARGO; HR; IMOS; CRW.
201409-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv01.0.nc	2015-07-08 08:24	GTS; ARGO; HR; IMOS; CRW.
201408-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv01.0.nc	2015-07-06 10:17	GTS; ARGO; HR; IMOS; CRW.
201407-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv01.0.nc	2015-07-06 10:22	GTS; ARGO; HR; IMOS; CRW.
201406-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv01.0.nc	2015-07-06 10:27	GTS; ARGO; HR; IMOS; CRW.
201405-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv01.0.nc	2015-07-06 10:32	GTS; ARGO; HR; IMOS; CRW.
201404-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv01.0.nc	2015-07-07 10:01	GTS; ICOADS; ARGO; HR; IMOS; CRW.
201403-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv01.0.nc	2015-07-06 10:22	GTS; ICOADS; ARGO; HR; IMOS; CRW.
201402-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv01.0.nc	2015-07-06 10:26	GTS; ICOADS; ARGO; HR; IMOS; CRW.
201401-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv01.0.nc	2015-07-06 10:32	GTS; ICOADS; ARGO; HR; IMOS; CRW.
201312-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv01.0.nc	2015-07-06 10:21	GTS; ICOADS; ARGO; HR; IMOS; CRW.
201311-STAR-L2i_GHRSST-SST-iQuam-V2.00-v01.0-fv01.0.nc	2015-07-06 10:26	GTS; ARGO; HR; IMOS; CRW.

Fig. 6: *i*Quam2 file list for user download

Conclusion and Future Work

- ✓ Longer time series to cover full satellite era (Sep 1981 – on)
- ✓ Improved QC
- ✓ Improved web interface
- ✓ Add more *in situ* data
- ✓ Change output data files to NetCDF4

1. Collect users' feedback and implement iQuam2. Retire iQuam1.
2. Archive w/GHRSST (PO.DAAC/NODC). Document in literature.
3. Transition to *i*Quam2 in all NOAA Cal/Val applications including SQUAM.
4. Work towards *i*Quam3
   a) Add more *in-situ* data types from SAMOS Ships, Ocean Profilers et al.
   b) Test 3-way error analysis, to determine errors in individual *in situ* data

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Thank you
Questions, comments, remarks