In situ Quality Monitor: From *iQuam* version 1 to version 2

http://www.star.nesdis.noaa.gov/sod/sst/iquam/

Sasha Ignatov and Feng Xu
NOAA/NESDIS

Thanks to:
Prasanjit Dash, John Sapper, Yury Kihai

Content

iQuam v1 Refresher: Slides 3 – 7

- ✓ Use of *in situ* data at NOAA
- ✓ *i*Quam Objectives, QC, Data, SQUAM Example

Towards iQuam v2: Slides 9 – 14

- ✓ **Add ARGO Floats**
- ✓ Add CMS and OSTIA black lists as separate QFs
- ✓ Extend time series back to ~1980 (currently, starts at 1991)
- ✓ Regenerate full *i*Quam record off ICOADS (currently, GTS). Fully utilize ICOADS QFs, provide for graceful degradation into NRT GTS

Summary: Slide 15

Use of *in situ* SSTs at NESDIS

Generate Match-Ups

- ✓ L2 (LEO & GEO), L3, L4 SST data are matched with *in situ* data

Use Match-Ups for Cal/Val

- ✓ **CAL**: Derive regression coefficients/Adjust bias in RTM-based SSTs
- ✓ **VAL**: Monitor Accuracy/Precision of L2/3/4 SST products in SQUAM

In situ Near-Real Time: NCEP GTS

- ✓ Global Telecommunication System (GTS) data available in NRT
- ✓ Quality non-uniform & suboptimal; QC not available
- ✓ *Ad hoc/S*implistic/Non-uniform QC often used in satellite Cal/Val

In situ Historical: ICOADS

- ✓ Cover all satellite era; Come with Quality Control

iQuam Objectives

Near-real time online *in situ* Quality Monitor (*iQuam*) was set up in Sep 2009. It performs 3 major functions

- **Quality Control** – accurate, flexible, consistent with wider Meteorological/Oceanographic communities
- **Web Monitoring** – monitor statistical summaries of "*in situ* minus reference SST" on the web (stratified by platform type - ships, drifters, tropical & coastal moored, ARGO; also by individual platforms)
- **Qced Data** – serve online to satellite SST community, for the use in consistent and uniform Cal/Val

Quality Control – Consistent with UK MO

Category	Check	Type of error handled	Physical basis
Preprocessing	Duplicate Removal	Duplicates arise from multiple transmission or data set merging	Identical space/time/ID
Plausibility	Plausibility checks	Unreasonable field values	Range of single fields & Relationships among them
Internal consistency	Tracking	Points falling out of track	Travel speed exceeds limit
	Spike check	Discontinuities in SST time series along track	SST gradient exceeds limit
External consistency	Reference Check	Measurements deviating far away from reference	Bayesian approach (*) (Ref. SST: Daily OI SST v2)
Mutual consistency	Cross-platform Check	Mutual verification with nearby measurements (“buddies check”)	Bayesian approach (*) based on space/time correlation of SST field (Correlation model: 2-scale SOAR, Martin et al., 2002)

(*) Lorenc and Hammon, 1988; Ingleby and Haddleston, 2007

iQuam Data for Download

NOAA NESDIS STAR

iQuam

Quality Monitor for *in situ* Sea Surface Temperatures

NOAA / NESDIS / STAR

Home About **Data** Monitor Contact FAQ

HDF with Quality Flags

Data are in self-describing HDF 4.2 format. Refer to global and data layers attributes for more information.

Suggested usage of the 16-bit quality flags (QF) are:

- *for general applications, use data with the lowest bit cleared (QF AND 0x0001 == 0);*
- *for high-accuracy applications, use only data with the lowest two bits cleared (QF AND 0x0003 == 0);*
- *for advanced usage of individual QC checks, refer to the definition of individual QFs.*

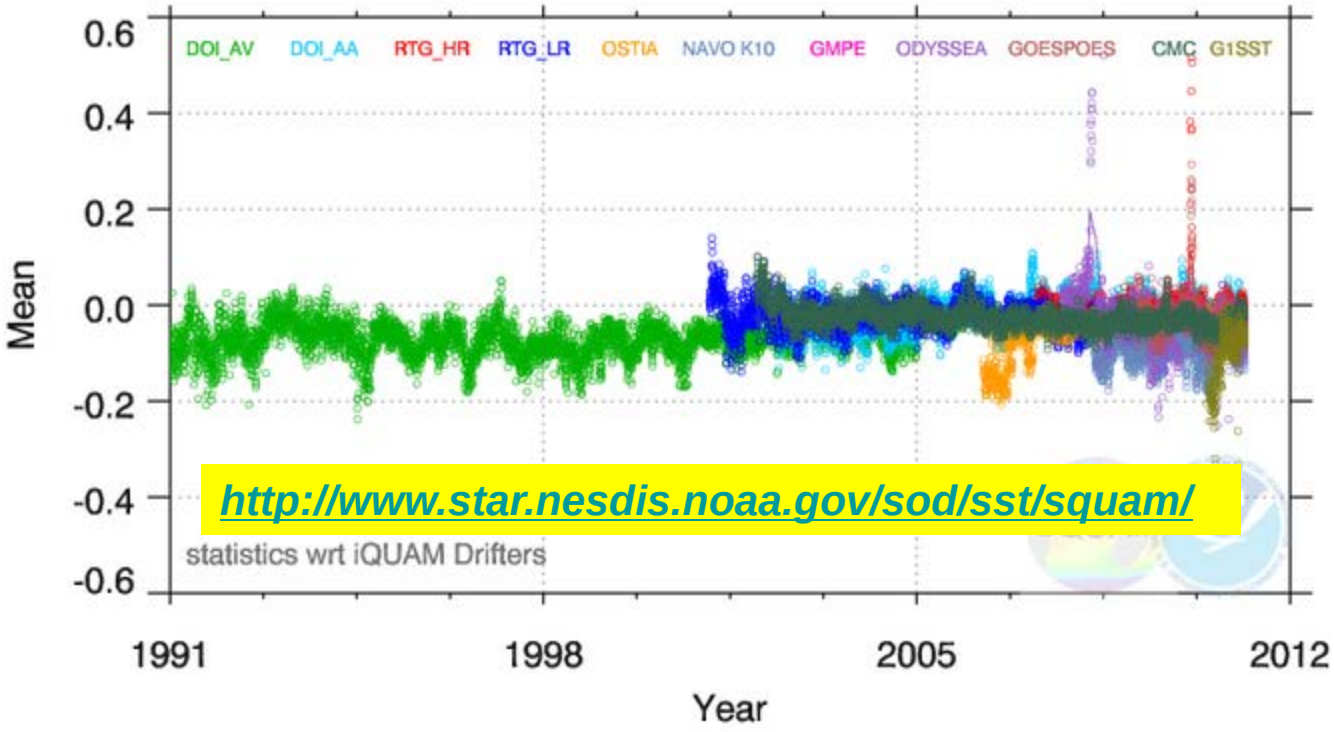
All data can be directly accessed at here.

NAME	HDF
IQUAM.NCEP.1991.01.HDF	Download
IQUAM.NCEP.1991.02.HDF	Download
IQUAM.NCEP.1991.03.HDF	Download
IQUAM.NCEP.1991.04.HDF	Download
IQUAM.NCEP.1991.05.HDF	Download
IQUAM.NCEP.1991.06.HDF	Download
IQUAM.NCEP.1991.07.HDF	Download
IQUAM.NCEP.1991.08.HDF	Download
IQUAM.NCEP.1991.09.HDF	Download
IQUAM.NCEP.1991.10.HDF	Download
IQUAM.NCEP.1991.11.HDF	Download
IQUAM.NCEP.1991.12.HDF	Download
IQUAM.NCEP.1992.01.HDF	Download
IQUAM.NCEP.1992.02.HDF	Download
IQUAM.NCEP.1992.03.HDF	Download
IQUAM.NCEP.1992.04.HDF	Download
IQUAM.NCEP.1992.05.HDF	Download
IQUAM.NCEP.1992.06.HDF	Download
IQUAM.NCEP.1992.07.HDF	Download
IQUAM.NCEP.1992.08.HDF	Download
IQUAM.NCEP.1992.09.HDF	Download

QC'ed data in HDF format available for download (1991-pr)

Last monthly file updated in NRT every 6hrs. Initial QC performed in NRT. Final QC requires ~7 days.

Example Use of *iQuam* Data in SQUAM



http://www.star.nesdis.noaa.gov/sod/sst/squam/

VAL against *i*Quam now available in SQUAM

Content

iQuam Basics: Slides 3 – 7

- ✓ Use of in situ data at NOAA
- ✓ iQuam Objectives, QC, Data, SQUAM Example

Towards iQuam v2: Slides 9 – 14

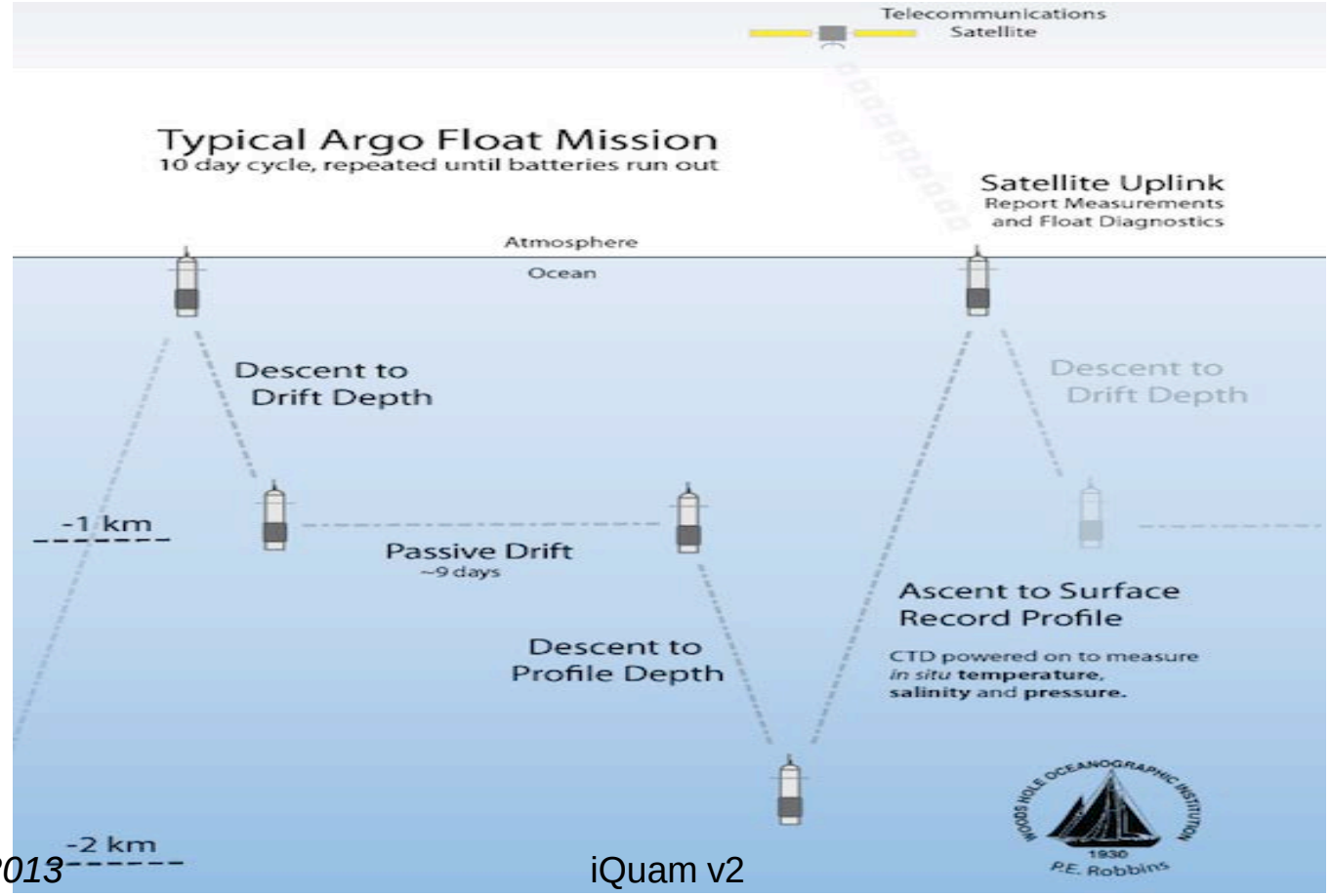
- ✓ **Add ARGO Floats**
- ✓ Add CMS and OSTIA black lists as separate QFs
- ✓ Extend time series back to ~1980 (currently, starts at 1991)
- ✓ Regenerate full *i*Quam record off ICOADS (currently, GTS). Fully utilize QC information available in ICOADS, with graceful / seamless degradation into NRT GTS

Summary: Slide 15

ARGO

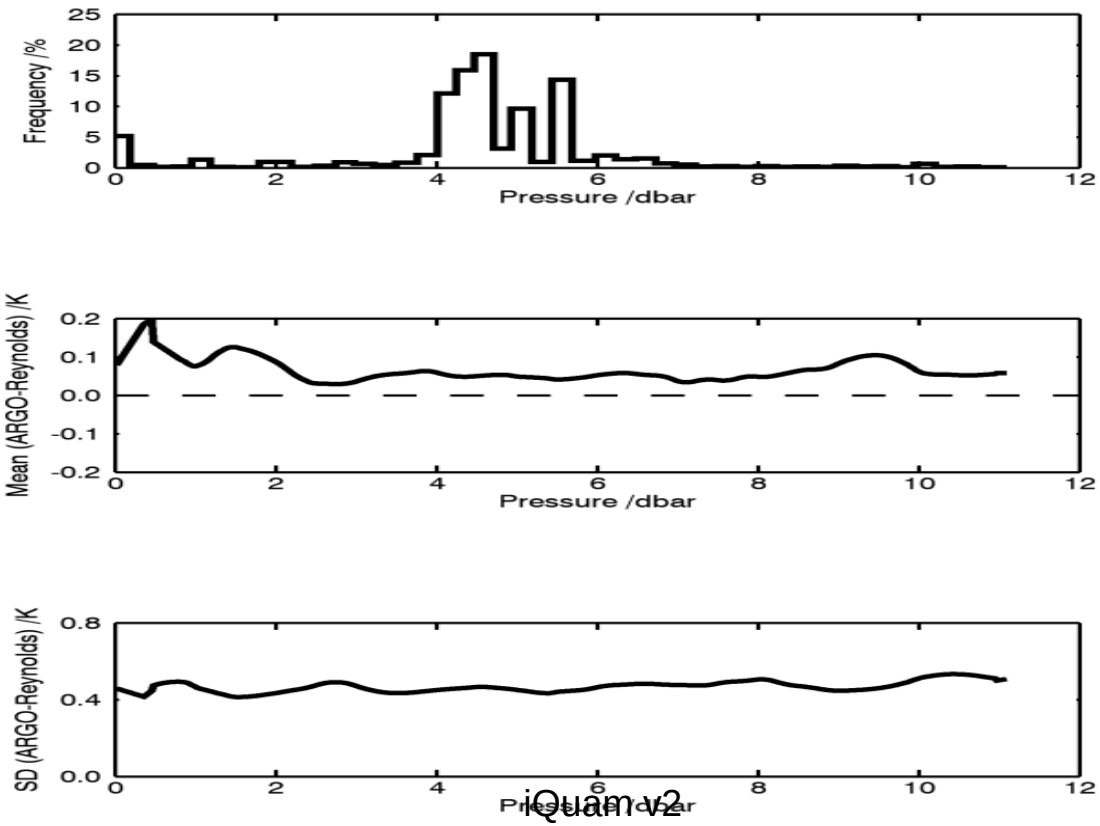
- 3,600+ profiles/month; Good global coverage
- 10-day cycle (~3 SST/month)

How to extract SST from Argo Profiles?



ARGO: Depth considerations

- [Martin et al., 2012]: the shallowest valid data point between 3-5m depth
- *i*Quam: The shallowest valid data point between 3-8m



ARGO QC in iQuam

1. Use heritage ARGO QC
   - Time/Lat/Lon pass ARGO QC
   - Temperature/pressure pass ARGO QC
2. Perform Additional pre-processing in iQuam
   - Check vertical smoothness: Temperature vs. pressure gradient – remove upper point(s) if outlier(s)
   - Keep good upper point in range: 3dbar < pressure < 8dbar (discard profile if no good data in this range)
3. Process ARGO SSTs selected at steps (1)-(2) with the routine *i*Quam QC (same algorithms as for other *in situ* platforms – ships, drifters, moorings)

NOAA NESDIS STAR

iQUAM *in situ* SST quality monitor v2.0

NOAA / NESDIS / STAR

Home | Data | About | Contact | FAQ | Links

- Maps
- Statistics
- Time Series
- Platforms

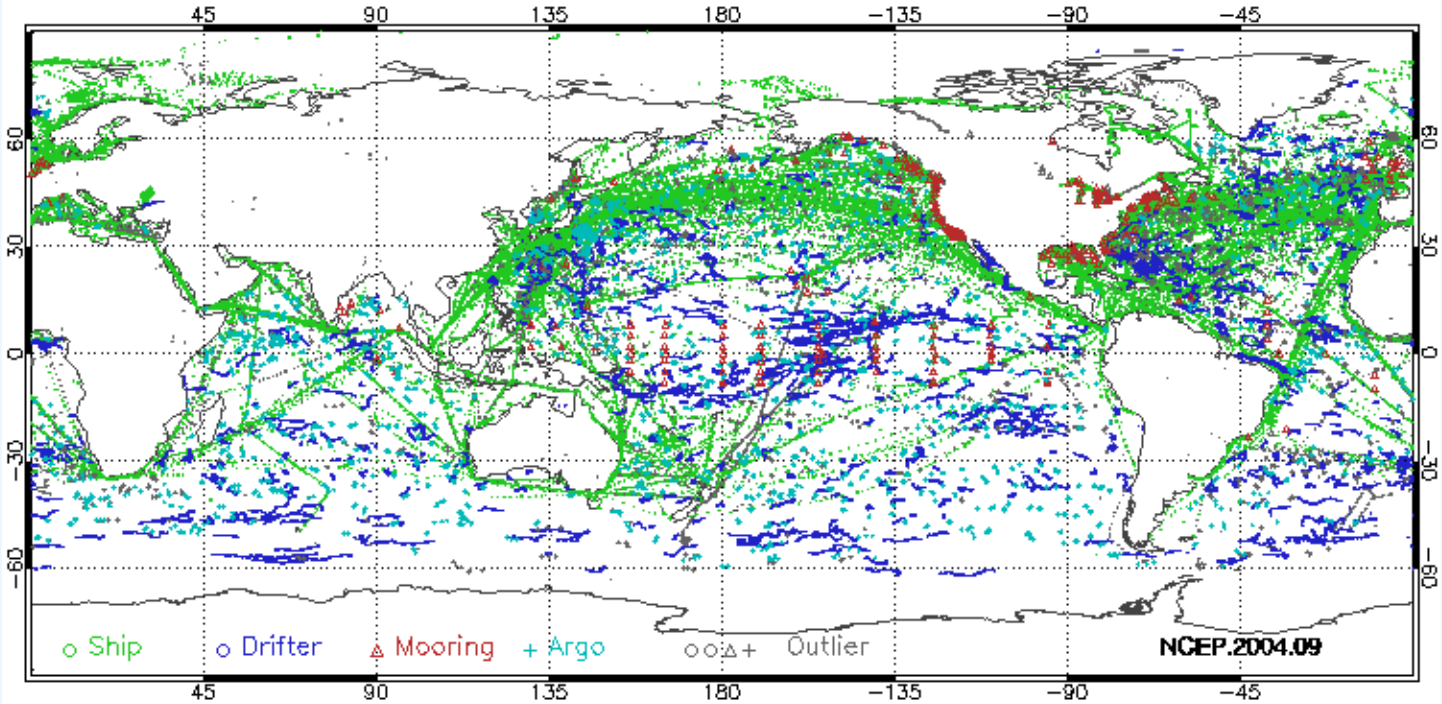
< 09 2004 >

Different platform types are shown in different colors, with outliers (erroneous observations) shown in gray. Each symbol stands for one observation.

Tropical moorings include TAO/TRITON, PIRATA, RAMA etc. Coastal moorings are all other moorings.

Argo floats data are from USGODAE GDAC ftp site. The shallowest good measurement in 3-8dbar depth range is extracted from each profile.

Global map of measurements



Privacy Policy | Disclaimer | Contact Webmaster

ARGO has the most uniform global coverage

Monthly Statistical Summaries

QC Statistics

Outliers detected by each QC check

Platform	N_Obs	N_QC	DR	GL	TS	SG	RS	XP	PH	XQ
Ship	62,651	49,811	0	3,839	506	41	4,345	4,527	3,927	0
Drifter	335,949	321,306	1,259	2,098	246	926	7,167	8,601	1,513	0
Tropical Mooring	11,080	10,503	425	0	1	1	100	150	0	0
Coastal Mooring	123,021	114,238	103	982	56	336	5,300	7,005	301	0
Argo	4,348	3,272	2	4	0	12	285	301	0	757

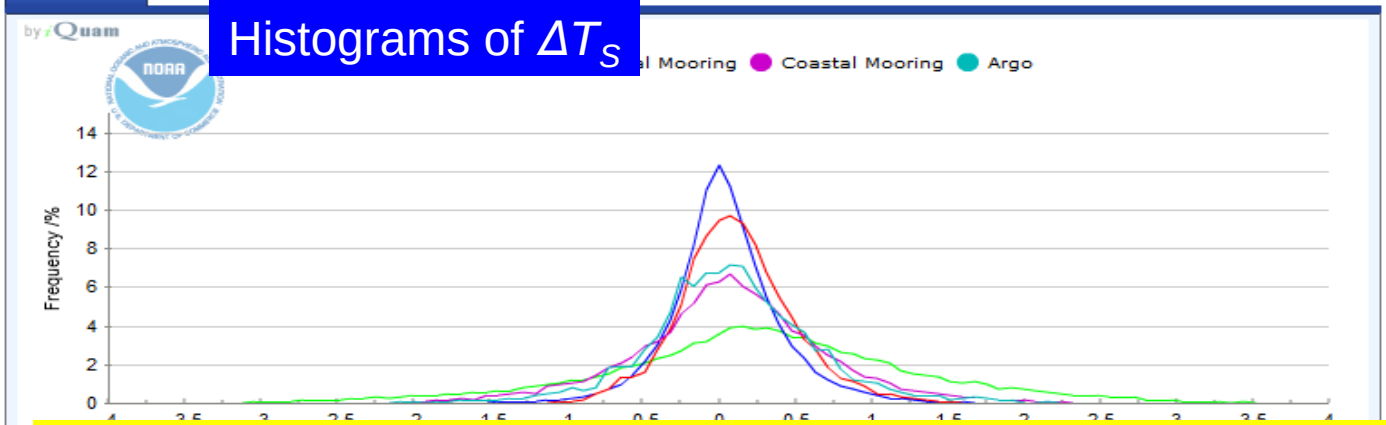
SST Statistics

Moments of $\Delta T_S = T_{in\ situ} - T_{Reynolds}$

Platform	BIAS	SD	SKEW	KURT	MED	RSD	N_Mtchp
Ship	0.3	1.04	-0.16	0.69	0.3	0.89	47,338
Drifter	0.08	0.36	0.09	3.23	0.07	0.28	320,404
Tropical Mooring	0.16	0.37	0.34	0.79	0.13	0.33	10,503
Coastal Mooring	0.11	0.66	-0.21	2.51	0.12	0.53	106,318
Argo	0.12	0.57	0.23	2.65	0.11	0.46	3,272

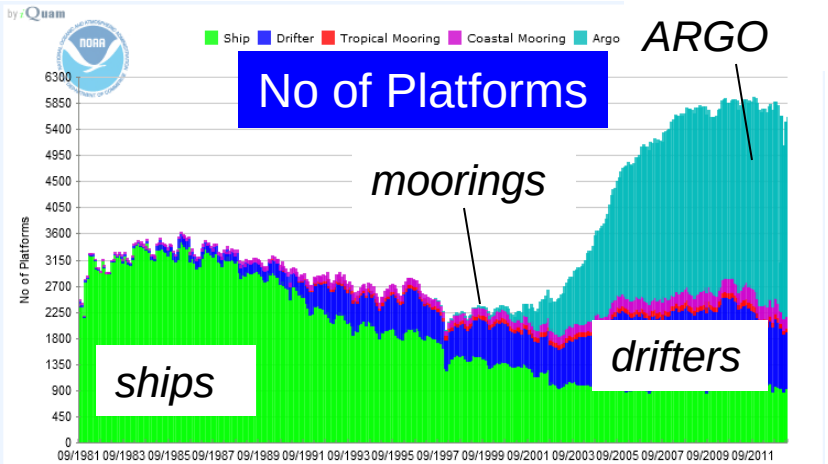
Histogram

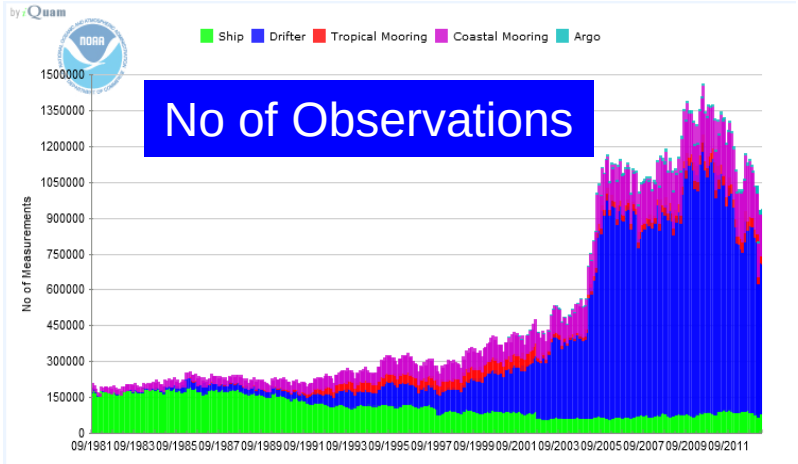
Histograms of ΔT_S



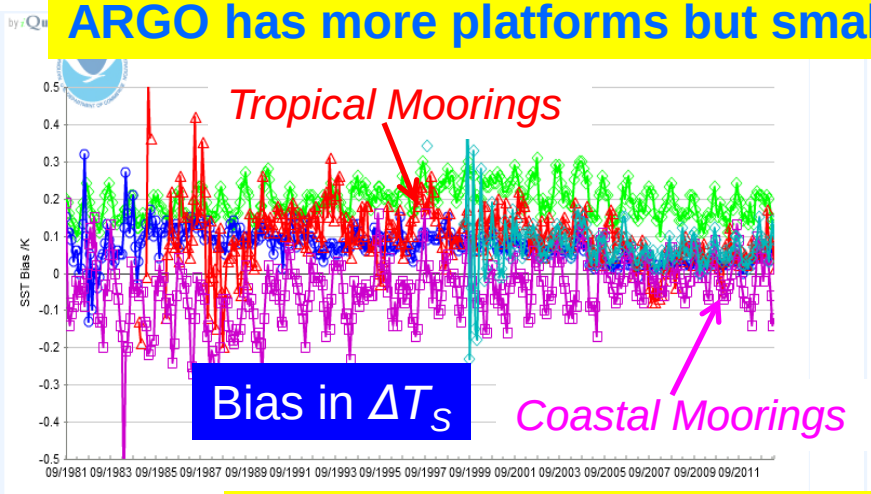
ARGO biases wrt. Reynolds comparable w/drifters & tropical moorings but SD larger – ARGO not assimilated in Reynolds?

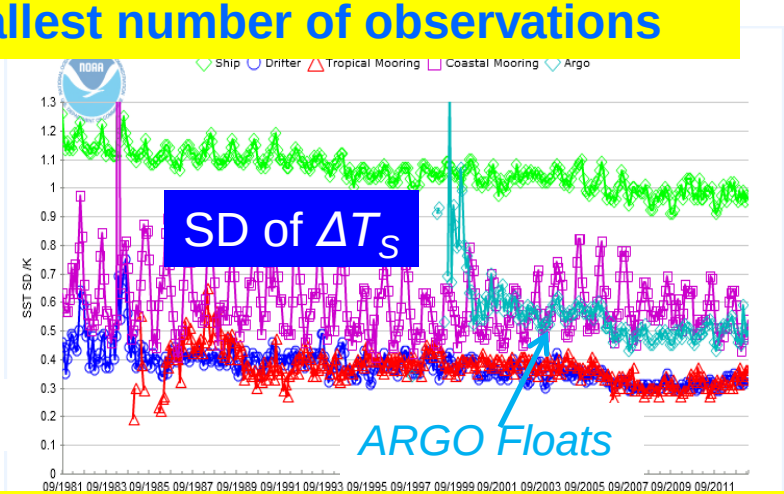
Monthly Stat "In situ – Reynolds" (1991-pr)





ARGO has more platforms but smallest number of observations





ARGO compare w/Reynolds less favorably than drifters or tropical moorings – Reynolds assimilated drifters but not ARGO floats?

iQuam Summary

- ***i*Quam v1: Remained Fully Functional**
  - ✓ Performing QC in NRT
  - ✓ Trending QCed data on the web
  - ✓ Serving data to users (used in SQUAM)
  - ✓ Manuscript submitted to JTech

- ***i*Quam v2: Under Development / Testing**
  - ✓ Add ARGO Floats
  - ✓ Add CMS & UK MO black lists as separate QFs
  - ✓ Extend time series back to ~1980
  - ✓ Regenerate full *i*Quam record off ICOADS