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ICOADS drifting buoy data recovery from BUFR and its impact on OISST

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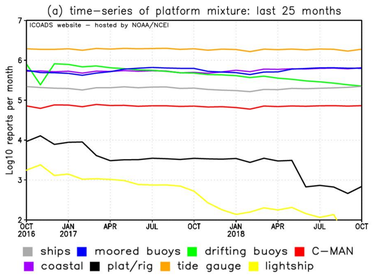
Introduction

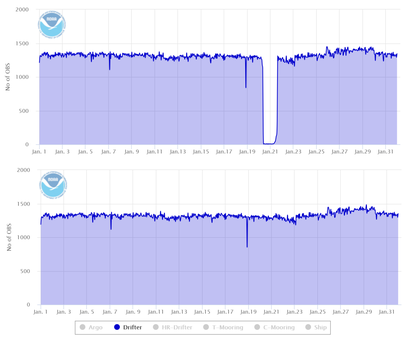
The International Comprehensive Ocean-Atmosphere Dataset (ICOADS) Release 3.0 contains large volumes of marine observation data and covers the time period from 1662 to present. Observations from ships, drifting buoys, and moored buoys are transmitted through the Global Telecommunication System (GTS) and collected by NCEI for near-real-time ICOADS monthly updates. The GTS data from ICOADS are the key component of many analysis products including the NOAA/NCEI Optimum Interpolation Sea Surface Temperature (OISST). Traditionally the GTS data for ICOADS are in the ASCII-based Traditional Alphanumeric Code (TAC) format. The number of TAC drifting buoy reports have dropped since November 2016 due to a format switch from TAC to the Binary Universal Form for the Representation (BUFR) of meteorological data format. The drop in TAC based data affects the operational OISST quality; for example, a cold bias in OISST was reported for certain regions and time periods.

This poster describes the BUFR decoding process for drifting buoys, moored buoys, and ship data at NCEI, and the enhancements gained from the format change. It will also be demonstrated that with the BUFR decoding, the majority of the lost drifting buoy reports in the TAC stream have been recovered. The impacts of adding the BUFR data on OISST are assessed on global and local scales since 2016.

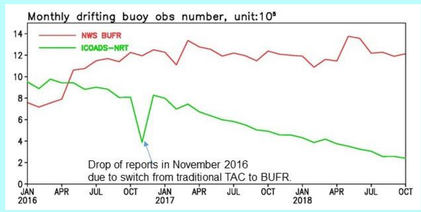


Recent numbers of preliminary ICOADS marine reports (combined NOAA/NCEI and NOAA/NCEP GTS data) by platform type. Notice the continuous decline in drifting buoy observations (green line) since November 2016 when distribution formats changed on the GTS.

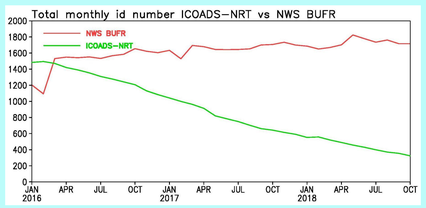
Source: https://icoads.noaa.gov



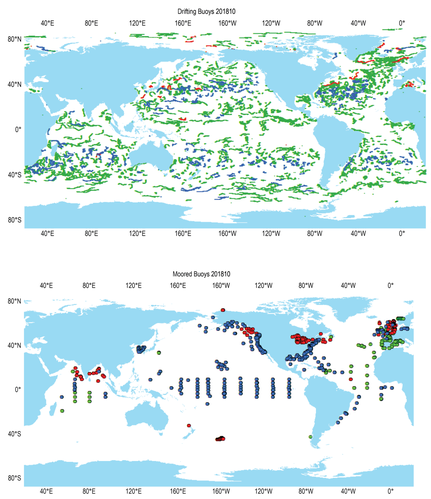
Drifting buoy reports gained from the ICOADS BUFR stream for January 2018.
Numbers of observations in the FNMOC data stream, before (top panel) and after (bottom panel) gaps on January 21 were filled by ICOADS data from the NCEI BUFR stream.
Figures are courtesy of the NOAA SST Quality Monitor(SQUAM).



Numbers of drifting buoy reports recovered from the NWS BUFR stream (in red) and received in TAC format (in green, used to produce ICOADS R3.0.1).



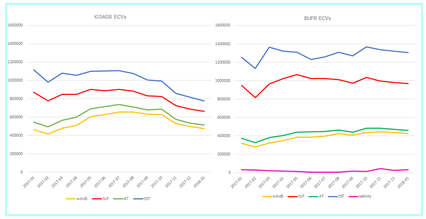
In Jan 2016, there are 400 drifting buoy IDs only in the ICOADS stream, 120 drifting buoy IDs only in the BUFR stream, and 1084 common IDs. By the end of October 2018, there are 8 drifting buoy IDs only in the ICOADS stream, 1404 BUFR drifting buoy IDs only in the BUFR stream, and only 312 common IDs.



Red dots represent unique observations in the TAC stream. Green dots represent unique observations in the BUFR stream. Blue dots represent observations in both TAC and BUFR streams. Few drifting buoys and ships remain to transition to BUFR.

Unique and common ids and observations of drifting, moored buoys, and ships in Oct. 2018

	Total ids			Total observations		
	Unique ICOADS	Unique BUFR	common	Unique ICOADS	Unique BUFR	common
drifting	8	1404	312	239890	1213803	218947
moored	177	80	307	628816	449880	464649
ship	159	73	1768	222130	240770	178503



From Jan 2017 to Jan 2018:
BUFR stream has more observations of SST (Sea Surface Temperature) and SLP (Sea Level Pressure). TAC stream has more observations of wind speed and AT (Air Temperature). Only BUFR stream has salinity observations due to limitations in the WMO FM-13 and FM-18 TAC format.

Data Availability:
The Drifting Buoy data are available as an Auxiliary dataset in archive **ds539.5** at NCAR (https://rda.ucar.edu/datasets/ds539.5/#!access) until they can be incorporated into a new NRT product. Moored buoys, ships and coastal stations from BUFR are also becoming available. Please continue to check the ICOADS website for updates and data availability (https://icoads.noaa.gov).

Future work:
Merging the TAC and BUFR streams is a high priority in order to make these data available in an official ICOADS NRT product

Acknowledgements: : ICOADS would like to thank its International Partners and NOAA/STAR for BUFR-related development and validation assistance.

Drifting buoy data impact on OISST

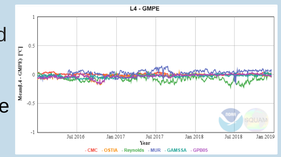
A cold bias in the operational preliminary OISST was reported by users. Here we look at the impact of adding BUFR drifting buoy data to the OISST run.

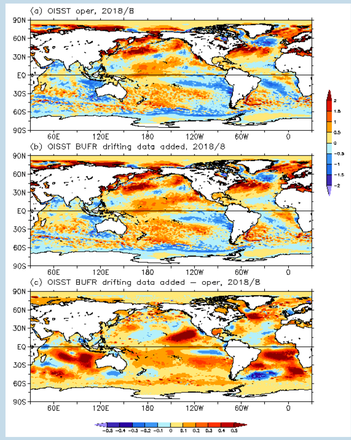
Two experiments: (1) NOAA19, METOPA, ICE, NCEP-TAC in situ; (2) NOAA19, METOPA, ICE, NCEP-TAC in situ + NWS-BUFR drifting buoy data

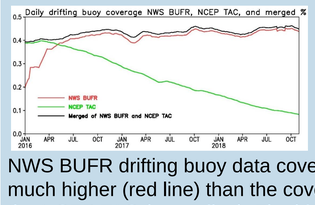
Conclusion: Adding more drifting buoy data to the OISST run eliminated most of the cold bias.

OISST and other L4 SST compared with the GHRSST Multi-Product Ensemble (GMPE). The Reynolds OISST (green line) has a cold bias, especially between June and September 2018.

Data courtesy of the NOAA SST Quality Monitor (SQUAM).



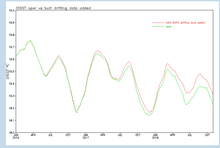


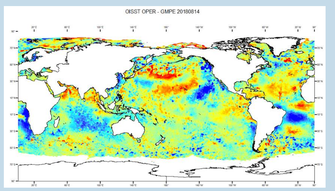


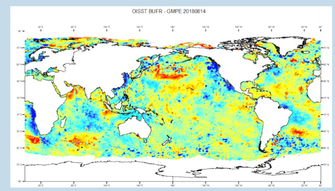
NWS BUFR drifting buoy data coverage is much higher (red line) than the coverage of the NCEP TAC (green line). The black line shows the drifting buoy data coverage from merging the two data steams.

OISST anomaly of August 2018:
Top panel – OISST run using drifting buoy data from NECP TAC only.
Middle panel – OISST run using drifting buoy data from both NECP TAC, and NWS BUFR.
Bottom panel – Difference between the two runs (b)–(a). The OISST produced with the extra drifting buoy data from BUFR eliminated most of the cold bias.

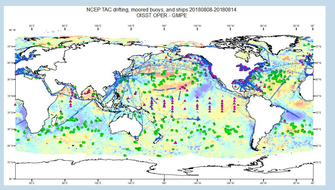
Time series of globally averaged SSTAs. The SSTA is higher in OISST run with the BUFR drifting buoy data.

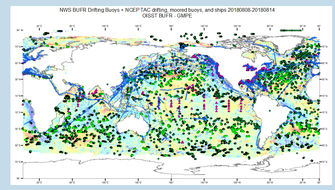






OISST anomaly relative to the GHRSST Median Product Ensemble (GMPE) for Aug. 14, 2018. The cold bias was very noticeable when OISST was run using in situ data from NCEP TAC only (left panel), and much smaller when run with data from both NCEP TAC and NWS BUFR (right panel)





Insufficient drifting buoy observations contribute to cold bias
The maps show drifting buoy, moored buoy, and ship observations from NCEP TAC (left panel) and NWS BUFR (right panel) overlaid on the OISST anomaly relative to the GMPE. Total observations are shown for the 7 days before an OISST produced using the same 7 days of data for satellite bias correction and the last day of data for interpolations. Cold biases (in blue in the maps) tend to occur where drifting buoy observations are sparse.