Evaluation of HRSST drifters using Copernicus SLSTR
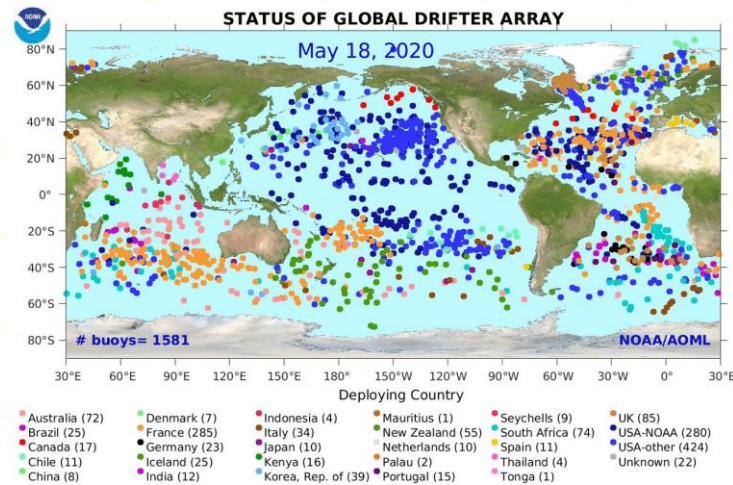
Gary Corlett, Anne O'Carroll, Igor Tomazic

Introduction

- Reference data, such as drifting buoys, are essential for satellite SST validation

https://www.aoml.noaa.gov/phod/gdp/

STATUS OF GLOBAL DRIFTER ARRAY
May 18, 2020
buoys= 1581
NOAA/AOML

Deploying Country
- Australia (72)
- Brazil (25)
- Canada (17)
- Chile (11)
- China (8)
- Denmark (7)
- France (285)
- Germany (23)
- Iceland (25)
- India (12)
- Indonesia (4)
- Italy (34)
- Japan (10)
- Kenya (16)
- Korea, Rep. of (39)
- Mauritius (1)
- New Zealand (55)
- Netherlands (10)
- Palau (2)
- Portugal (15)
- Seychells (9)
- South Africa (74)
- Spain (11)
- Thailand (4)
- Tonga (1)
- UK (85)
- USA-NOAA (280)
- USA-other (424)
- Unknown (22)

- Data mainly provided by the NOAA Global Drifter Program
- Coordinated by the JCOMM DBCP

- Estimated uncertainty of drifters was 0.1 K
  - However many studies suggested drifter uncertainty was closer to 0.2 K

GHRSST DBCP Pilot Project

- A number of drifters to be upgraded to a higher specification
  - Position accuracy and reporting to 0.01degrees (HRSST-1)
  - SST accuracy < 0.05K; reporting to 0.01K (HRSST-2)
    - Total standard uncertainty in measured SST to be < 0.05K
- Requirements
  - Hourly measurements
  - Report design depth in calm water to ±5cm
  - Report of geographical location to ±0.5km or better
  - Report of time of SST measurements to ±5 minutes
- Endorsed by GHRSST 2013

- Most drifter data now HRSST-2

Copernicus Sentinel 3 SST

- The Sea and Land Surface Temperature Radiometer (SLSTR) is a dual-view self-calibrating IR radiometer following the ATSR class of sensors
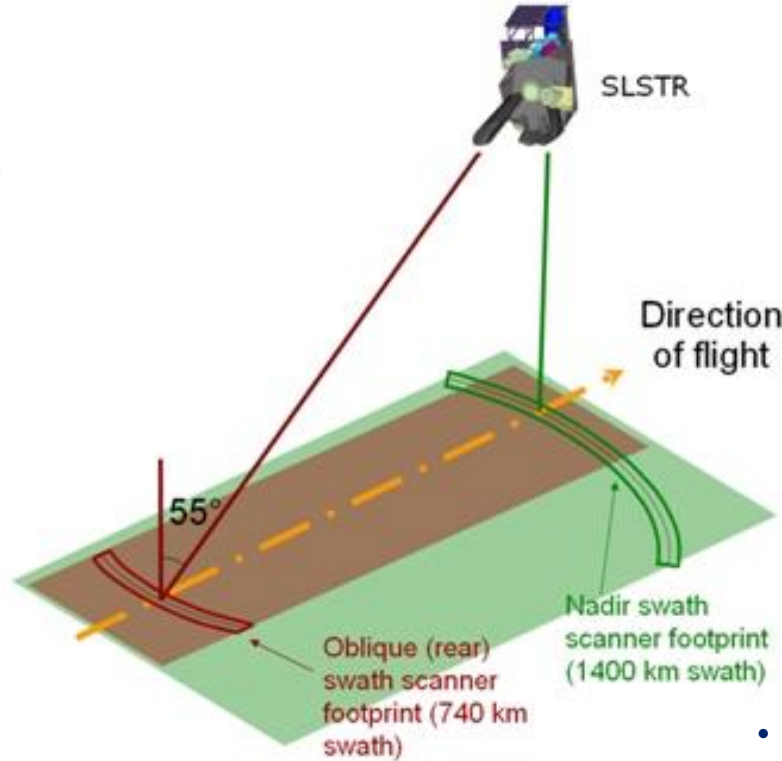
- SST Retrievals by radiative transfer modelling of the form:

$$a_0 + \sum_1^n a_n BT_n$$

  where n is the number of channels

- For SLSTR we use 2 channels during day and 3 during night
  - 3.7 μm not used during day owing to solar contamination
  - We have two views, so we have four SST retrievals in total

SLSTR provides SST$_{skin}$

SLSTR

Direction of flight

55°

Oblique (rear) swath scanner footprint (740 km swath)

Nadir swath scanner footprint (1400 km swath)

SLSTR-A
Operational since 05/07/2017
Reprocessed data from 19/04/2016 to 04/04/2018 available via CODA REP

SLSTR-B
Harmonized to SLSTR-A using SSES
Operational since 12/03/2019

Nominal Channel Centre	Primary Application
S7: 3.7 μm	SST Retrieval
S8: 11 μm	SST/LST Retrieval
S9: 12 μm	SST/LST Retrieval

Four Possible Retrievals:

Nadir 2-channel N2
Nadir 3-channel N3
Dual 2-channel   D2
Dual 3-channel   D3

http://eoportal.eumetsat.int/ (only simple registration is needed)

- WCT
  - This product provides sea surface temperature for all offered retrieval algorithms.
  - Only available to Cal/Val users via ODA (FTP) and Data Centre (Archive)

- **WST**
  - **This product provides the best SST at each SLSTR location in GHRSST L2P format.**
  - **Available to all via ODA (FTP), EUMETCAST (DVB), CODA(REP) (http) and Data Centre (Archive)**

European Commission   Copernicus Europe's eyes on Earth   EUMETSAT

TRUSTED

- EUMETSAT Copernicus funded project to deploy 150 new drifters
- Fiducial Reference Measurement (FRM) activity

- New type of drifter -> SVP-BRST
- Each drifter has two SST sensors
  - One conventional sampling (1 sample every 5 min)
  - One high-frequency sampling (300 samples every 5 min)

- Available via the GTS (low frequency data only)
  - Additional offline metadata and data available and provided with SLSTR MDB

- Further details available at:

http://www.eumetsat.int/website/home/Data/ScienceActivities/ScienceStudies/TowardsfiducialReferencemeasUrementsofSeaSurfaceTemperaturebyEuropeanDriftersTRUSTED/index.html

https://scienceblog.eumetsat.int/2019/11/sailors-drop-off-ocean-monitoring-buoys-during-trans-atlantic-race/

Aims of this work and methodology

- The aims of this work are to:
  1. Analyse SLSTR/drifter match-ups and identify issues that impact the validation results
  2. Use TRUSTED data to 'self-QC'
  3. Apply TRUSTED methods to all HRSST drifters
  4. To assess the overall accuracy of HRSST drifters

- Dataset used
  - SLSTR-A MDB (01/08/2016 to 12/05/2020)
  - 6106 unique drifters giving match-ups (drifter QL = 4 and 5)

- Initial approach is to investigate
  - Large sat/drifter SST differences
  - Variability of drifter SSTs

SLSTR-A versus drifter: Time series of D3 match-ups
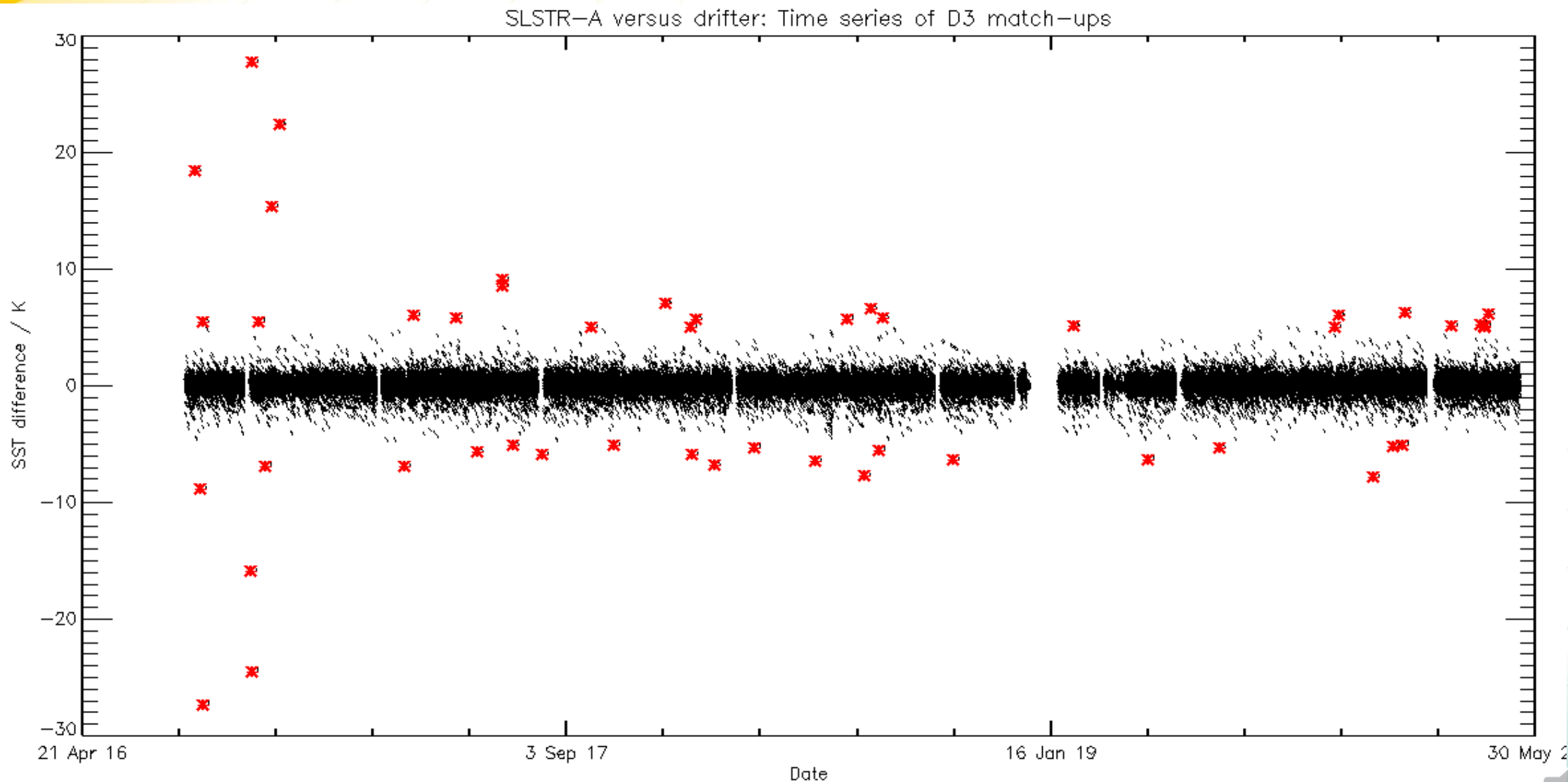
43 match-ups out of 107125 Have an SST difference > 5 K

Examples 1
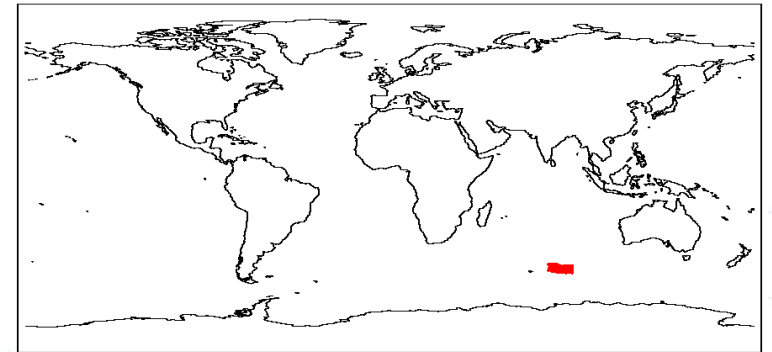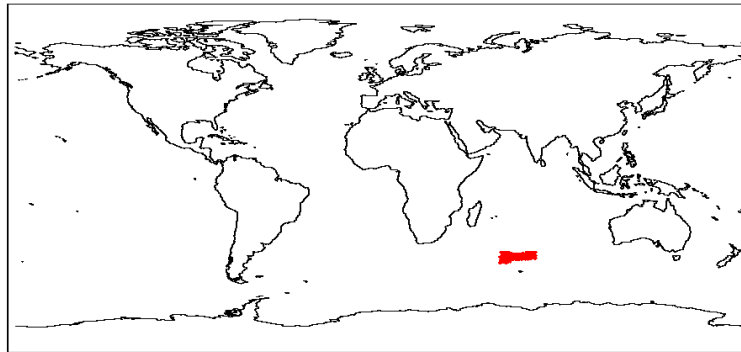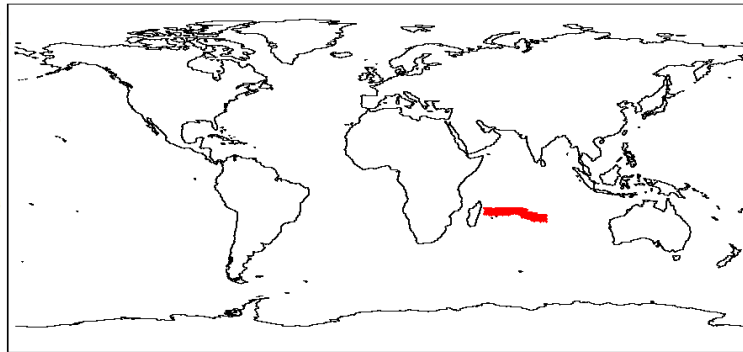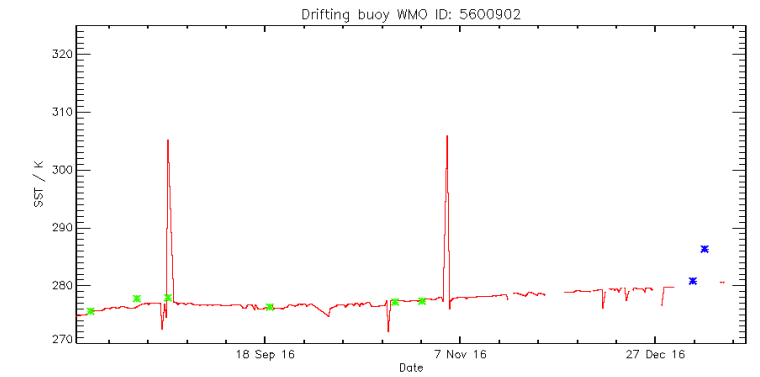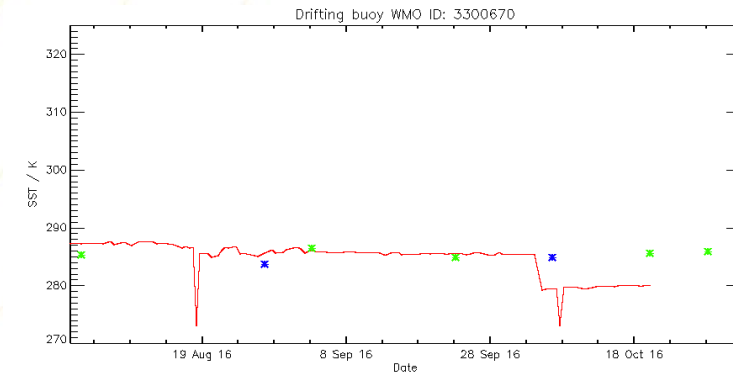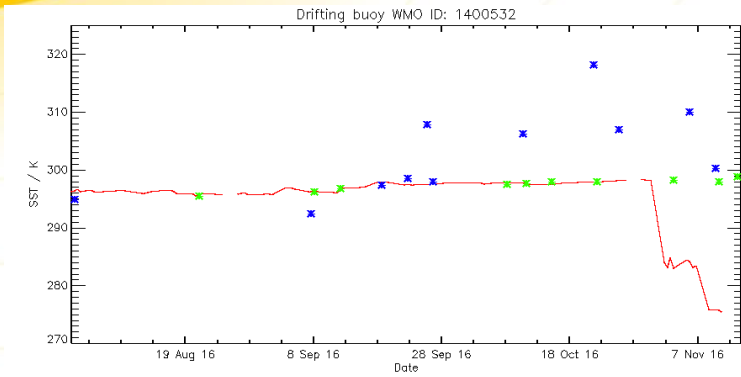
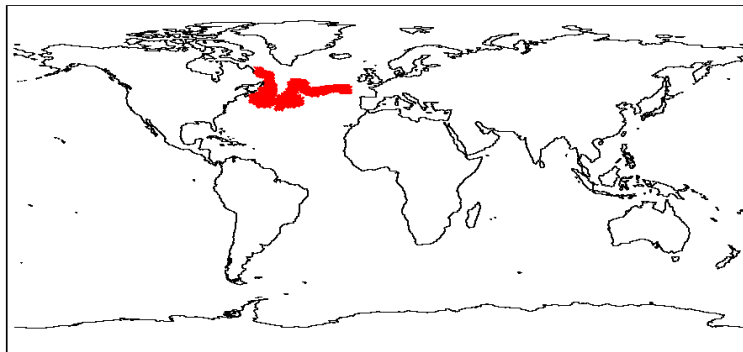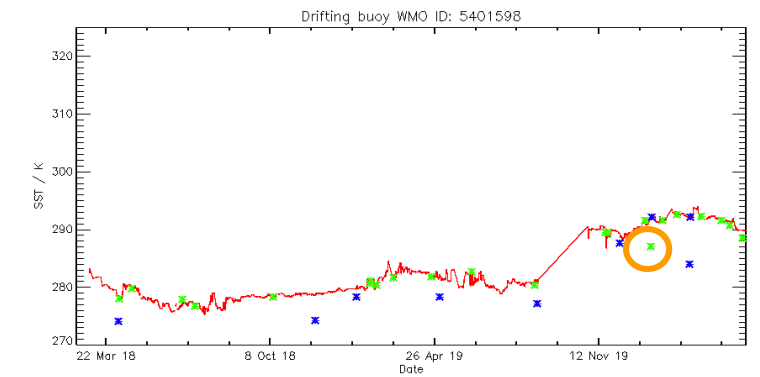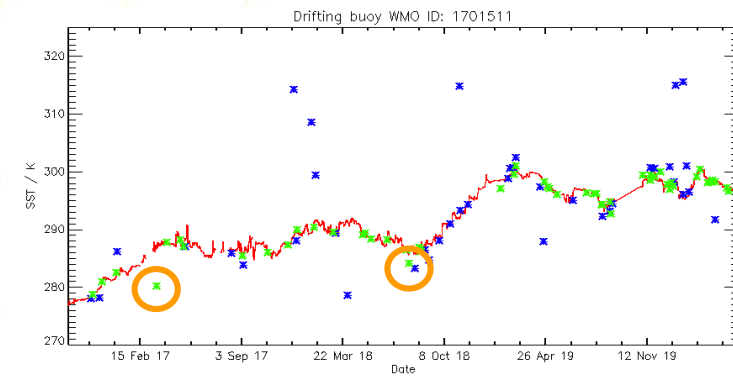Upper plot: Time series of in situ SST at match-up location in red; blue asterisk indicates match-up rejected by satellite QC; green asterisk is good match-up (QL=5)

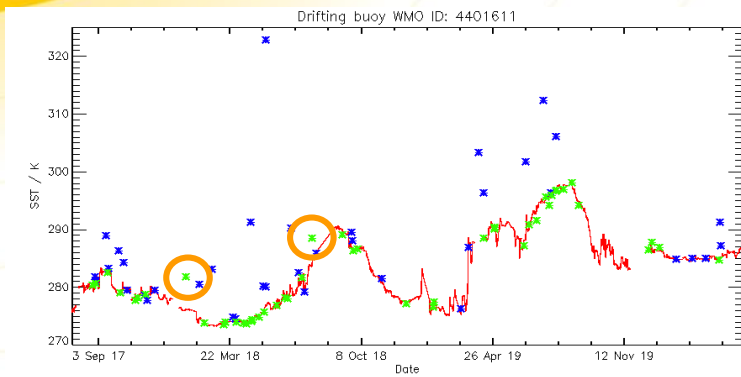Lower plot: Map of satellite / drifter match-up locations

Examples 2
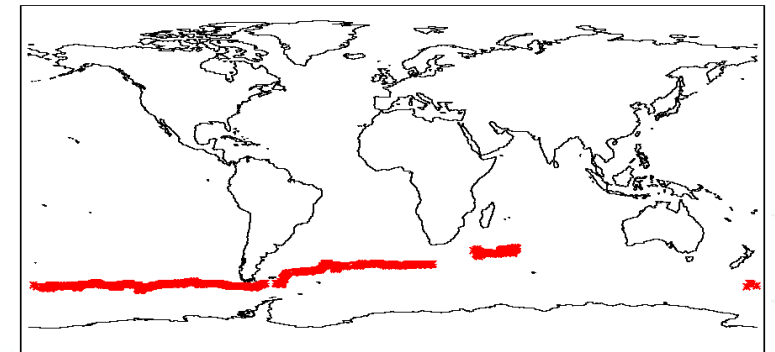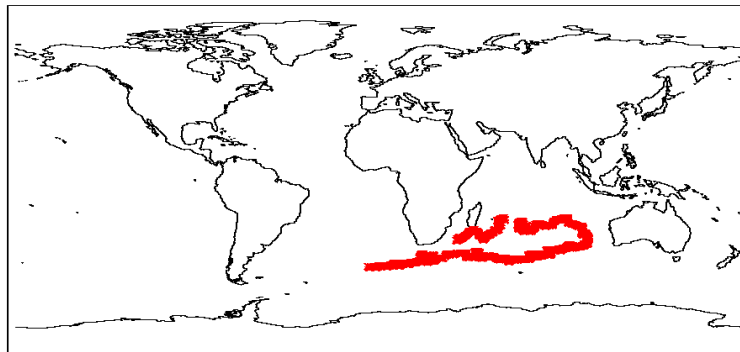
Upper plot: Time series of in situ SST at match-up location in red; blue asterisk indicates match-up rejected by satellite QC; green asterisk is good match-up (QL=5)

Lower plot: Map of satellite / drifter match-up locations

Summary

- Reference data from drifting buoys essential for satellite SST validation
  - A few issues limit the usefulness of current drifter data

- The satellite and in situ communities are coordinating their efforts to better understand these limitations through GHRSST and the DBCP
  - Most drifters are now HRSST-2 standard

- A new Copernicus funded FRM project, TRUSTED, is providing new data to facilitate self-QC of drifter data

- Initial results suggest the overall quality of the drifting buoy array has improved in recent years

- High-resolution sea surface temperature (HRSST) drifting buoys for satellite SST – review workshop

- To be held at Meteo-France, Saint Mandé, Paris, France, 2-4 March 2021
  - Video link available

- TRUSTED metadata and high frequency SSTs are available with the SLSTR MDB
  - See poster of Igor Tomazic (013)