GHRSST Project Office

Annual Report 2020

GHRSST   To provide operational users and the science community with accurate SST's derived from the satellite constellation

The Group for High Resolution Sea Surface Temperature (GHRSST) provides a framework for SST knowledge and data sharing, best practices for data processing, assessing uncertainties in the satellite SSTs, and a forum for scientific dialog including how best to provide SSTs for climate studies, bringing SST to the operational users and scientific researchers.

GHRSST is:

- Composed of a Science Team of researchers and operational practitioners.
- Coordinates research and operational developments in satellite-derived SST.
- The science team of the CEOS Virtual Constellation for SST
- Organised into Technical Advisory Groups and Task Teams focused on particular problems or activities

GHRSST services offer:

- Data processing through Regional and Global Data Assembly Centers, combining satellite and NWP fields in common data formats for ease of access and analysis.
- A variety of tailored methods for downloading and access full products or subsets.
- Online visualisation of data quality through diagnostic comparisons

International collaboration

GHRSST comprises researchers and operational practitioners of SST from a number of worldwide institutes and agencies. These bodies are represented by the set of logos shown below. Participation in GHRSST is always increasing as new groups join the project.

CEOS SST Virtual Constellation

A key development in recent years is the formation of the CEOS SST Virtual Constellation (SST-VC). The CEOS Virtual Constellations coordinate space-based, ground-based, and/or data delivery systems to meet a common set of requirements within a specific domain. They leverage inter-Agency collaboration and partnerships to address observation gaps, sustain the routine collection of critical observations, and minimize duplication/overlaps, while maintaining the independence of individual CEOS Agency contributions. GHRSST acts as the science team for the CEOS SST-VC.

GHRSST Project Office

The GHRSST Project Office (GPO) provides the secretariat for the GHRSST Project. The GPO is funded by the European Union as part of the Copernicus Programme. The office is comprised of the GHRSST Project Coordinator (GPC), Karen Veal, and the GHRSST Project Administrator (GPA), Silvia Bragaglia-Pike, from the University of Leicester. Contact details are provided later on page 7.

The aim of the GHRSST Project Office is to:

· Coordinate, at the international level, the Group for High Resolution Sea Surface Temperature and its scientific teams to foster effective scientific and operational progress in the subject area of sea surface temperature.

The Objectives of the project office are:

· Together with the GHRSST Science Team Chair, coordinate, enable and facilitate, on behalf of the GHRSST Science Team, the open exchange of relevant satellite and in situ data streams for use within GHRSST.

· Provide direct logistical co-ordination and technical support to the, GHRSST Advisory Council.

· Together with the GHRSST Science Team Chair, provide direct logistical co-ordination and technical support to coordinate, enable and facilitate the GHRSST Science Team and all subsidiary TAG and TT and the GHRSST Advisory Council.

· Manage GHRSST activities in cooperation with international, national and regional institutions, committees, and offices as well as related global programs.

· Ensure good information flow among GHRSST participants and work effectively with the GHRSST Science Team Chair.

· Act as an interface to, and integrate GHRSST with, other global systems and projects as appropriate.

· Manage GHRSST documentation.

· Promote the activities of GHRSST on the International stage.

In support of these objectives, the GHRSST Project Office will:

· Maintain the GHRSST website (http://www.ghrsst.org)

· Maintain the GHRSST Twitter feed

· Maintain the primary GHRSST documentation, comprising:

   o GHRSST Strategy and Implementation Plan (GDIP)

   o User Requirements Document (URD)

   o GHRSST Data Specification (GDS)

   o Climate Data Assessment Framework (CDAF)

   o Validation Protocol Document (VPD)

· Organise the annual Science Team meeting

· Provide secretarial support to the GHRSST Science Team Chair and the GHRSST Science Team

· Provide an interface to the CEOS SST-VC

· Publish GHRSST newsletters

· Maintain the GHRSST brochure

· Promote GHRSST at international conferences and meetings.

Highlights in 2020

## GHRSST XXI Online meeting

The 21st International GHRSST Science Team Meeting was held on 1st—4th June 2020 and online due to travel restrictions caused by the COVID-19 pandemic.

The meeting was hosted on the EUMETSAT Moodle. The meeting consisted of a mixture of pre-recorded presentations and poster presentations available on Padlets with online forums for discussions and Q and A sessions. The GHRSST Project Office is grateful to the EUMETSAT Training Team for help in setting up the Moodle.

The meeting included sessions for reporting from the GHRSST Task Teams. A separate EUMETSAT Moodle has also been set up to facilitate the ongoing work of the Task Teams and aid collaboration into the future.

The meeting was well received with participants enjoying the online format. We plan to hold next year's meeting online again with the hope that face to face meetings can be resumed subsequently.
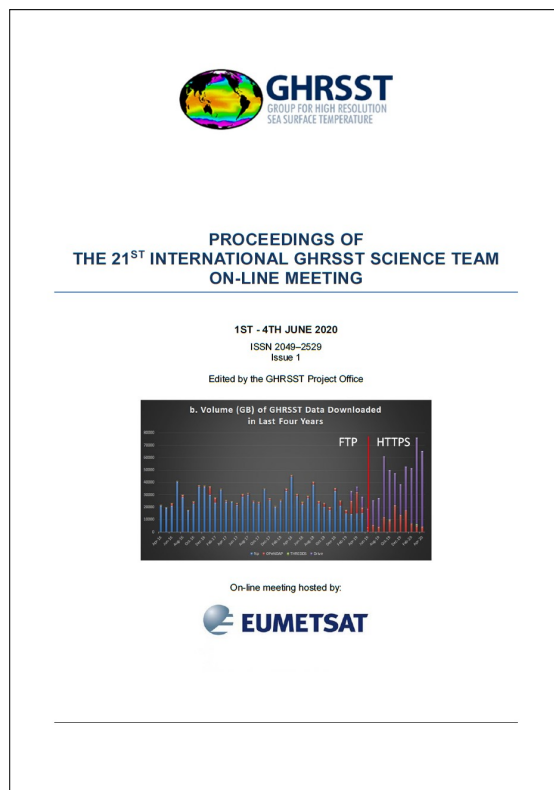

Coral Heat Stress SST User Requirements Report

The GHRSST Task Team on Coral Heat Stress User SST Requirements was set up at GHRSST XX. The team published their first report this year. The report includes recommendations to SST data providers and is available online at

https://www.ghrsst.org/resources/ghrsst-project-documents/

The team is currently working on an update to the report which will take into account evolving coral knowledge (e.g. the need for an understanding of the entire diurnal cycle in and around a coral reef) and broaden the context to include other uses of SST regarding coral reef science and management beyond the quantification of heat stress.

EVALUATION OF HRSST DRIFTERS USING COPERNICUS SLSTR by Gary Corlett, Anne O'Carroll, and Igor Tomazic

SLSTR–A versus drifter: Time series of D3 match-ups
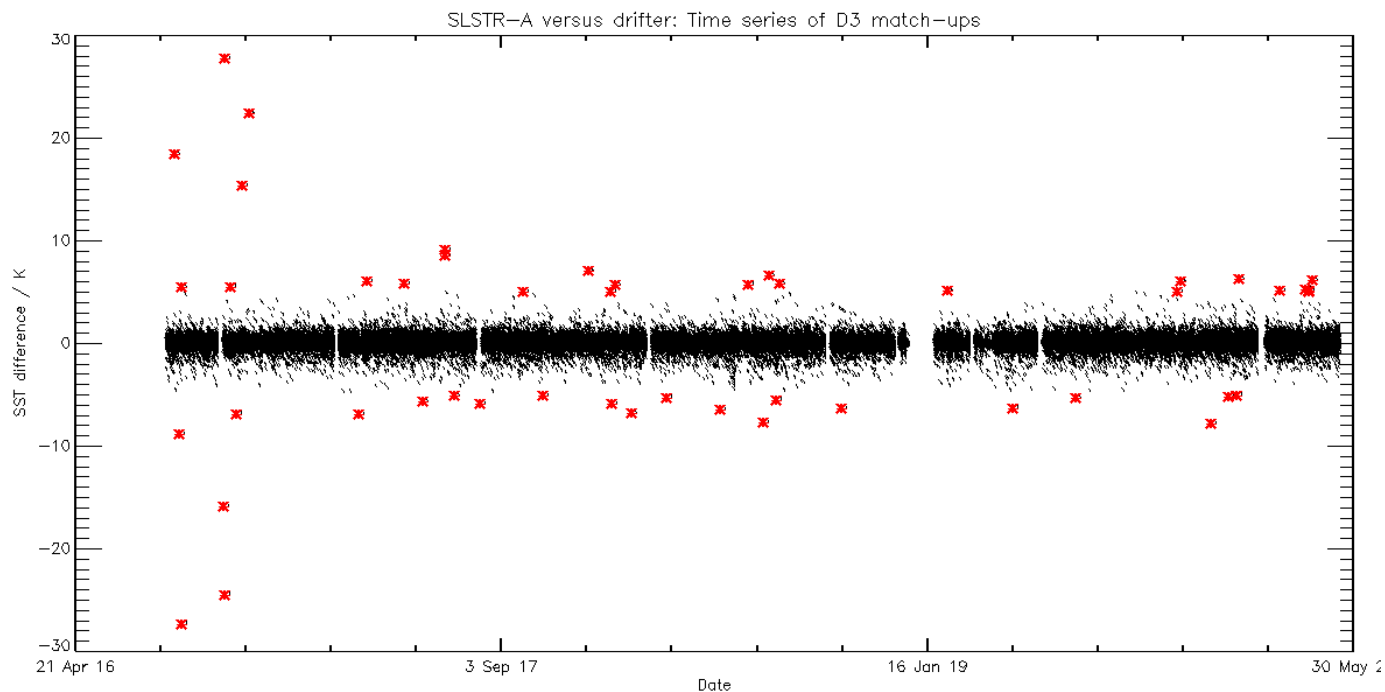
In situ data for satellite SST validation are required to be of high quality. Sentinel 3 SLSTR data are being used to evaluate drifter data. The Figure shows a time series of all match-ups between Sentinel 3A SLSTR D3 and drifters from the start of the mission to date. Each match-up is shown as a black dot and all match-ups where the SST difference is > 5 K are shown by red asterisks.

SENTINEL-3 SLSTR SST VALIDATION USING A FIDUCIAL REFERENCE MEASUREMENTS (FRM) SERVICE by W. Wimmer, T. Nightingale, J. Høyer, H. Kelliher, R. Wilson, and J-F. Piollé
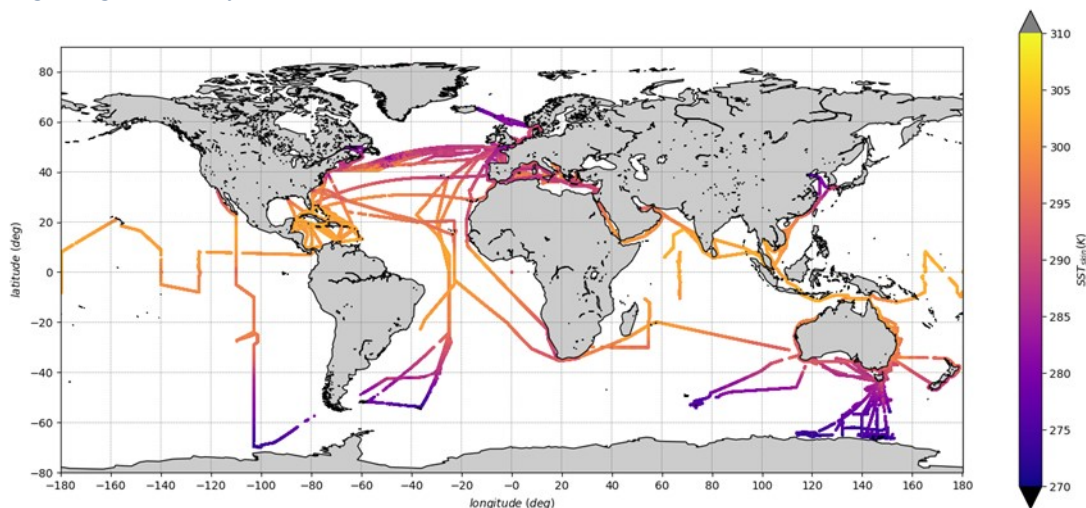
The fiducial reference measurement (FRM) data used to validate SLSTR products comes from the ships4sst project. The Figure shows the SST$_{skin}$ data held in the ships4sst archive. The International SST FRM Radiometer Network (ships4sst), building on almost 18 years of continuous FRMs from UK-funded shipborne radiometers, was established by ESA as a service to provide historic and ongoing FRM measurements to the wider SST community.

A GEOMETRICAL APPROACH FOR LEVEL 3 (SUPER) COLLATED AND LEVEL 4 SST ANALYSIS by Marouan Bouali, Paulo Polito and Olga Sato
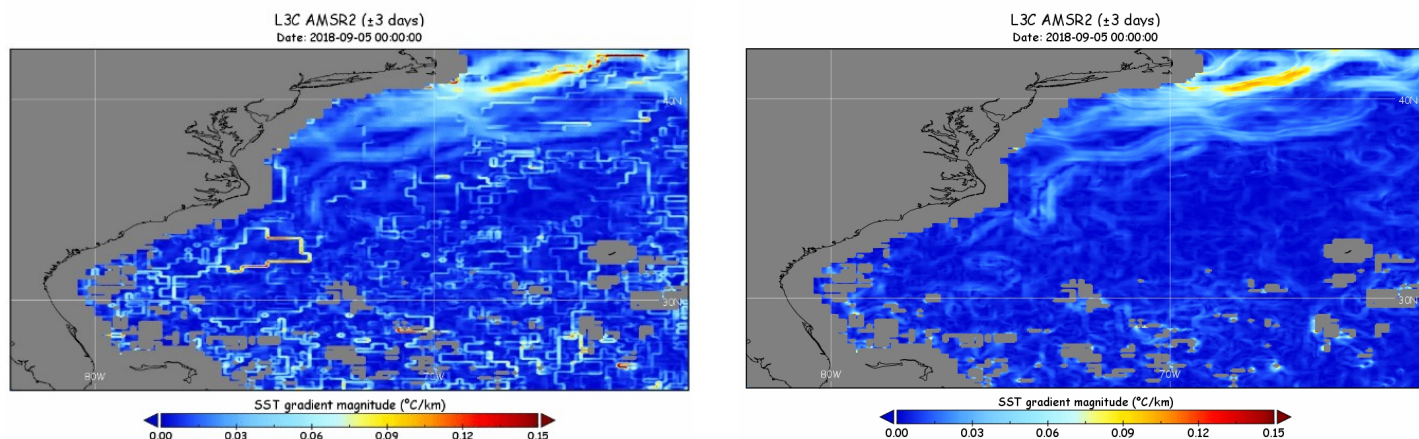

Standard compositing based on (weighted) averaging introduces strong artefacts that affect the spatial distribution, magnitude and temporal variability of SST gradients. A novel method for gradient-based (super) collation reduces these artefacts while bias and standard deviation, with respect to in situ, are almost identical. The Figure shows SST gradient magnitude for the period from Sep 2-8 2018 in the Gulf Stream region derived from standard compositing L3C (left) and the gradient-domain approach L3C*G (right).

CONNECTING USERS AND APPLICATIONS WITH PO.DAAC HOSTED GHRSST DATA by Edward M. Armstrong, Wen-Hao Li, Yibo Jiang, and Chelle Gentemann
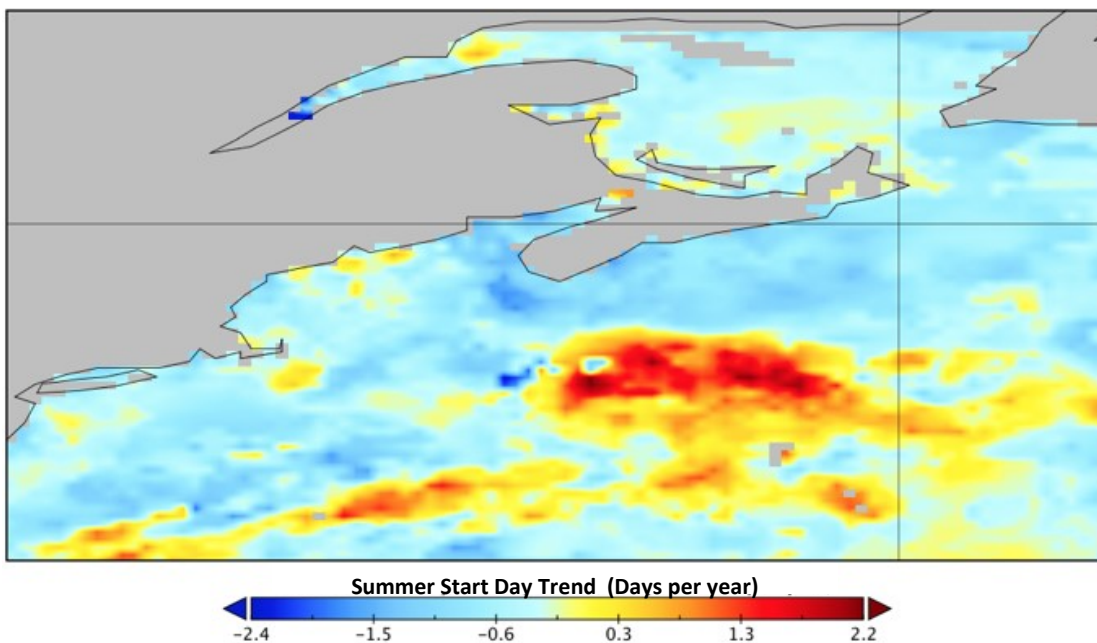
The 80+ GHRSST public datasets represent a rich resource for sea surface temperature research and applications given their time series length, resolution, spatial coverage, varying measurement types and processing levels, and availability in the full spectrum of PO.DAAC tools and services ecosystem. The PO.DAAC has created a publicly accessible recipe suite for the user community to perform straightforward yet powerful computations on GHRSST data using python recipes, Jupyter note-books, R, Matlab, and the NCO programming language.

COMPARISON OF MULTIPLE SST PRODUCTS USING THE MARINE HEATWAVE TRACKER by Robert W Schlegel
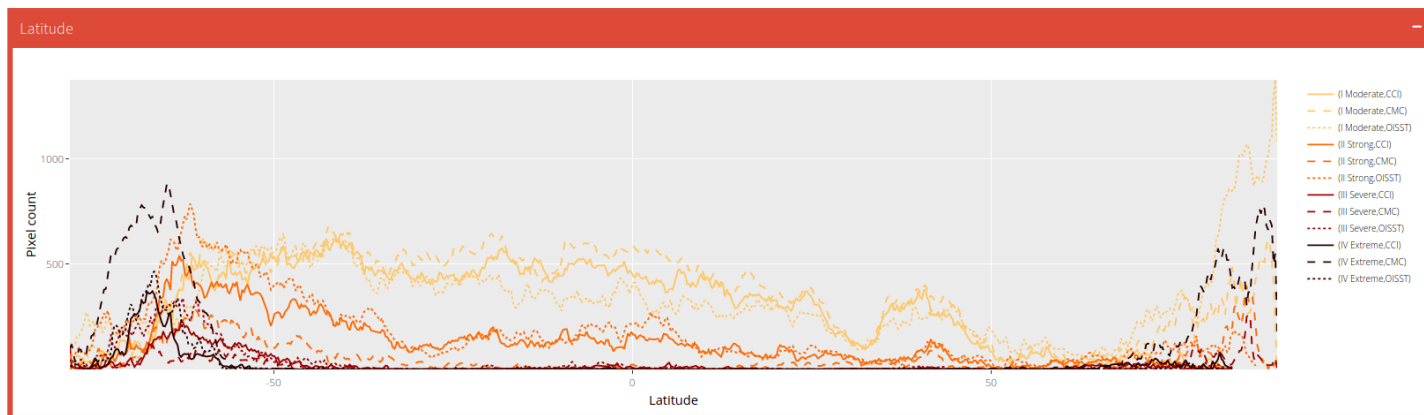
The Figure shows counts of recorded Marine Heat Waves (MHWs) in different categories (colours) for three different SST products (line type) at different latitudes during 1992. SST products are NOAA Optimum Interpolation SST (dotted), ESA Climate Change Initiative SST (solid), and the Canadian Meteorological Center SST (dashed). Heatwave categories are Moderate (yellow), Strong (orange), and Extreme (black).

INTEGRATING REGIONALLY OPTIMISED SEA SURFACE TEMPERATURE AND OCEAN COLOUR EARTH OBSERVATION PRODUCTS TO DETECT AND MONITOR HARMFUL ALGAL BLOOMS IN THE SOUTHERN BENGUELA UPWELLING SYSTEM (SBUS) by Christo Whittle, Marie Smith, Stewart Bernard, R. Molapo, and L. Vhengani.
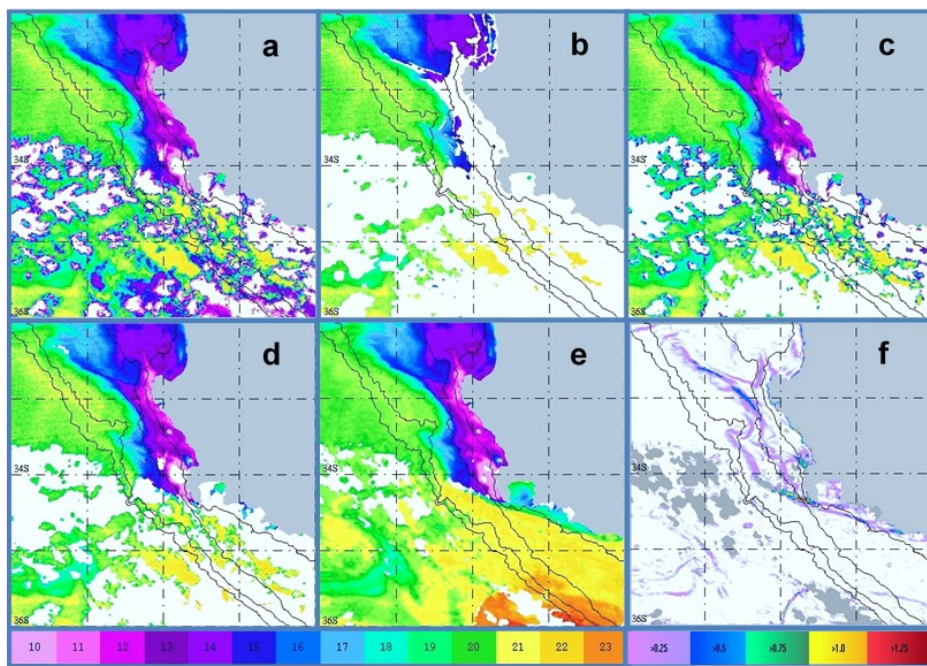
GHRSST SST data and ocean colour data are used as markers for harmful algal blooms in an environmental risk assessment and early warning service. The Figure shows the effect of different cloud flagging algorithms on MODIS Aqua daytime SST images (a, b, c, d), the daily average SST composite (e) of the SBUS for 28 January 2003 (colour bar on left, SST from 10 °C to 23 °C); and the SST gradients (f) for the same region (colour bar on the right, gradient strength from 0.25 to 1.25 °C km^{-1}.

GHRSST XXI Poster Presentations

A variety of posters were presented at GHRSST XXI on Padlets with an online forum for questions and discussions. The discussions are reported in the G-XXI Proceedings. The proceedings, oral presentations and posters are available from

https://www.ghrsst.org/meetings/21st-ghrsst-international-science-team-meeting-g-xxi/

Posters illustrated are: **Inter-comparison of Daily Sea Surface Temperature Data and In Situ Temperatures at Korean Coastal Regions** by Hye-Jin Woo, Kyung-Ae Park, and Hee-Young Kim; **EUMETSAT SLSTR Sea Surface Temperature Multi-Mission Matchup Database** by Igor Tomazic, Anne O'Carroll, Gary Corlett, and Jean-François Piollé; **Overview of AMSR-3 on The Global Observing Satellite for Greenhouse Gases and Water Cycle (GOSAT-GW)** by Misako Kachi, Naoto Ebuchi, Takashi Maeda, Nodoka Ono, Hideyuki Fujii, Kazuya Inaoka, Marehito Kasahara, and Yasushi Kojima; **NOAA's Ocean Heat Content Suite for The Indian Ocean** by Eileen Maturi, David R. Donahue, Lynn K, Shay, and Jodi Brewster.

A New Framework for GHRSST data provision

GHRSST pioneered a Regional/Global Task sharing Framework (R/GTS) which uses a scientifically sound and technically feasible strategy to acquire existing SST data products, add additional information and output a new generation of products in a common format. The first products were made available in 2005. Under the R/GTS, data produced by Regional Data Assembly Centres (RDACs) were ingested by a Global Data Assembly Centre (GDAC) and publically distributed via various services; final archiving and further distribution were performed by the Long-term Stewardship and Reanalysis Facility (LTSRF). The original system has grown more complex with the addition of more DACs and data producers.

A new system, with decentralisation of data ingestion and distribution, will better prepare GHRSST for future growth and facilitate the participation of new data producers. The new framework is illustrated below (and reported in "GHRSST R/G TS System Architecture", available from **http://www.ghrsst.org**). There are two entities: data producers (GDP) and distributing centres (DAC). Each DAC implements a minimum set of services for granule data access, search and discovery, production/distribution metrics and long-term archiving. The GHRSST-PO portal provides and maintains a central catalogue of all GHRSST datasets with collection level metadata, and federated search and discovery services. The portal allows the user to discover and search all GHRSST products and granules with no need to know the data producer or distributor.

Implementation of the new framework is underway. All DACs have agreed to provide metadata to the central catalogue and implementation of the catalogue, supported by EUMETSAT and Copernicus, will be completed in 2022. The DACs' level of readiness to provide data access (HTTP(S), FTP, THREDDS, and OpeNDAP) and granule search (OpenSearch) services has been established. Most are able to provide HTTP(S) and OpenSearch services. Mitigation for those that cannot will be in place by 2023. Implementation of the new framework will be completed by GHRSST XXIV (2023).

> GHRSST has been extremely successful in revolutionising the way satellite SST data sets are developed, shared, and applied in modern oceanography, meteorology, and climate centres. Success is achieved by solving scientific, operational, and technical problems and also by co-operation at an international level to agree data product definitions and standards that are acceptable to users, producers, and data managers. GHRSST coordinates and conducts research, establishes procedures and protocols, provides near real-time data access portals and user services, and implements near real-time quality control monitoring services. Large volumes of data and data services are harnessed together to deliver the new generation of global coverage high resolution SST data thereby meeting GHRSST User Requirements.

GDP : GHRSST Data Producer
DAC : Data Assembly Center
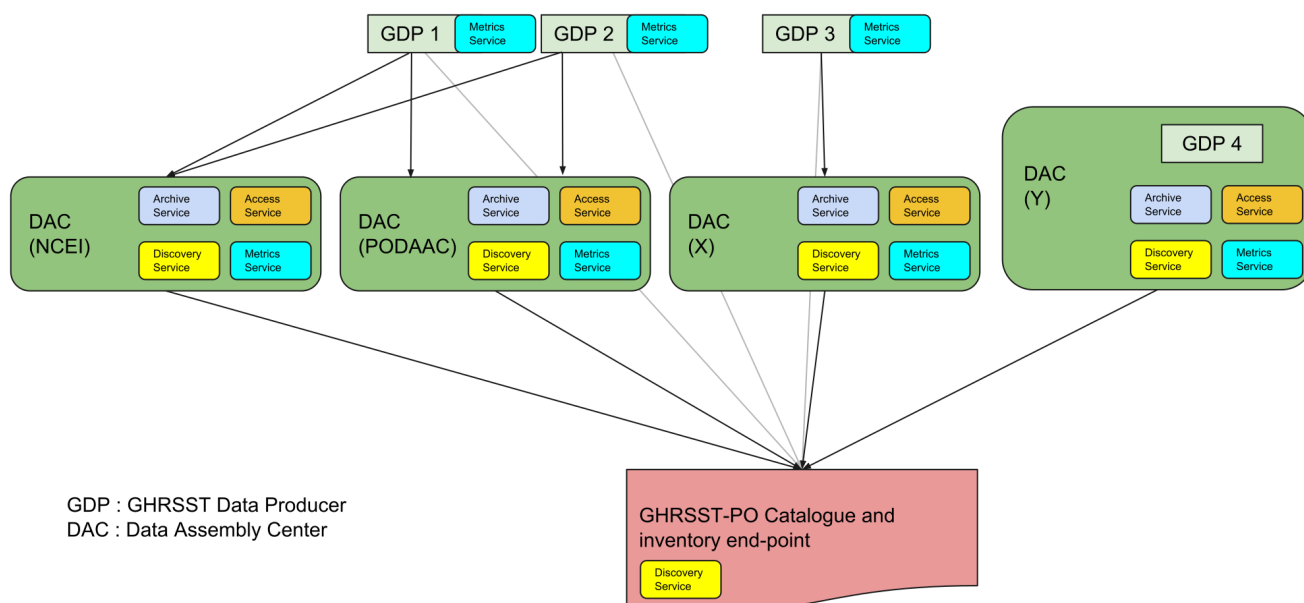
Contact details for the GHRSST Project Office and the major GHRSST components and services are given below.

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GDAC

You can download real-time data from the respective data producers (RDACs), or as collected by the GHRSST Global Data Archiving Centre (GDAC), which is provided and hosted by NASA at their Physical Oceanography Distributed Active Archive Center (PO.DACC). For further details of the GDAC and instructions on how to download data please go to the GDAC website at **http://podaac.jpl.nasa.gov/** .


LTSRF

Historical SST products (older than 30 days) are available from the GHRSST Long-Term Steward-ship and Reanalysis Facility, which is provided and hosted by NOAA at the National Oceanographic Data Center (NODC). For further details of the LTSRF and instructions on how to download data please go to the LTSRF website at **http://data.nodc.noaa.gov/ghrsst/**.

Felyx

The aim of the Felyx project is to provide an open-source, flexible and reusable software system that can be used to research and monitor the quality and performance of Earth observation (EO) data streams. Felyx is being developed by IFREMER, PML and Pelamis and funded by the European Space Agency. For further details please see **http://hrdds.ifremer.fr**.
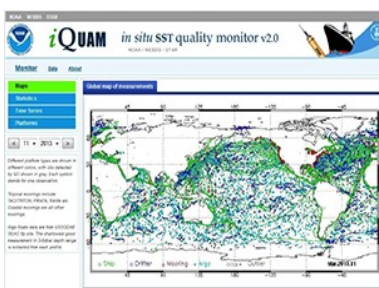
iQUAM and SQUAM

The in situ data quality monitor, iQUAM, and SST summary quality monitor, SQUAM, systems are provided and hosted by NOAA. For further details please see
http://www.star.nesdis.noaa.gov/sod/sst/iquam/ and
http://www.star.nesdis.noaa.gov/sod/sst/squam/, respectively.

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