ESA Activities Relevant to GHRSST

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➔ESA and GHRSST

GHRSST was initiated at the GODAE High-resolution Sea Surface Temperature Workshop, JRC, Ispra, 30th Oct.–1st Nov., 2000 where a small team of international experts noted that immediate action, in the form of a GODAE Pilot Project similar to ARGO, was required to develop a new approach to merging SST measurements from multiple satellites in support of operational oceanography (that was emerging at this time). Since then, ESA has been supporting GHRSST using a series of activities including the GHRSST Project Office, the ESA Medspiration Project, and most recently support to develop Fiducial Reference Measurements (FRM) for SST. Oh, and of course, ESA has provided SST data from the ERS-1, ERS-2, ENVISAT and most recently the Copernicus Sentinel-3 missions.

At this time, as Copernicus drives new European operational services and European GHRSST activities are intimately linked. They are now in transition to a sustained capability for the next 20 years. GHRSST and ESA have played a significant role in achieving this success.

➔GHRSST Project Office (GPO)

ESA has supported the GHRSST since 2009 by maintaining in partnership with the MetOffice (UK) and the University of Reading (UK) an International Project Office. The office provides an essential focus for GHRSST maintaining coordination across the International community.

Staffed by G. Corlett and S. Bragaglia-Pike, the GPO looks after the GHRSST Science Team, a professional web presence, prepares and implements GHRSST Science Team meetings, maintains of critical documentation (eg GSD, User Requirements) and interfaces to Space Agencies. The Office has been very successful in developing close relationships with User Producer organisations that lie at the heart of GHRSST.

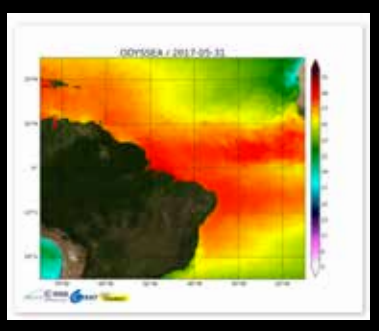
As Operational Oceanography matures in Europe, the GHRSST project Office activity has been successfully transitioned from ESA's R&D environment into EUMATSAT's operational structures with a long-term outlook.

https://www.ghrsst.org/

➔ESA Medspiration

The ESA Medspiration project started in 2004 as a direct response to the call for cross Space-Agency support to implement the GHRSST Pilot Project. The project was instrumental to GHRSST and developed and implemented the first version of the GHRSST Data Product specification (GDS) that was subsequently evolved by the internatioanl science team.

Medspiration was the first operational node of GHRSST and has been delivering a full range of innovative SST products and services for sea surface temperature since then. Some of the products are now natively produced under the umbrella of other agencies (ESA, EUMETSAT,...) or projects (MyOcean) but Medspiration is still improving and delivering new products focusing on the development of high resolution gap-free maps of SST.



At ESA, GHRSST Medspiration was fundamental to promoting and improving the quality of ENVISAT (A)ATSR SST data, developing new approaches for calibration and validation, and the development of the Sentinel-3 SLSTR instrument. Through GHRSST and Medspiration the (A)ATSR series of satellite radiometers became the reference sensor dor SST – to be continued with Copernicus Sentinel-3 SLSTR. Today much of the work of ESA Medspiration nas been passed to the Copernicus Marine Environmental Monitoring Service (CMEMS) demonstrating a successful transition form research to Operations.

http://cersat.ifremer.fr/thematic-portals/projects/medspiration

➔ Copernicus Sentinel-3

There is now a large variety of Sentinel data over ocean available through ESA's and EUMETSAT's data dissemination systems – see for example

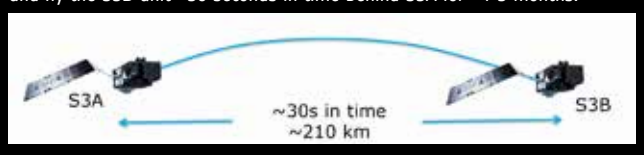
https://scihub.copernicus.eu

Sentinel-3A is concluding its ramp-up phase with Level 2 data to be officially released in June 2017. Level 1 already available from ESA and EUMETSAT since October 2016.

Copernicus Sentinel-3A was successfully launched on February 9th 2016 from the Plesetsk Cosmodrome in Russia. The mission brings continuity to the ENVISAT (A)ATSR series. Sentinel-3A will be joined by Sentinel-3B in early 2018 and the two-satellite constellation will provide daily coverage SST. The photo below shows Sentinel-3B entering thermal vacuum tank tests at Thales Alenia, France earlier this year

➔Sentinel-3 Tandem Mission

Following consultation between the user community, ESA, EUMETSAT and the European Commission, A Tandem phase will be introduced following the launch of Sentinel-3B. This will be implemented in the first ~7 months of the S3B mission. The tandem will maintain S3A in an operational status and fly the S3B unit ~30 seconds in time behind S3A for ~4-5 months.

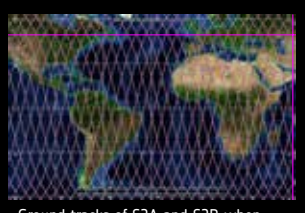


The tandem will be implemented by launching S3B into a higher injection altitude and drifting towards a tandem configuration with S3A over ~1.5 months. S3B will fly on the same ground track as S3A. During this time the satellite and payload will be commissioned as much as possible. Once in the tandem configuration, tandem operations will commence for 4-5 months (depending in the initial injection and drift operations).

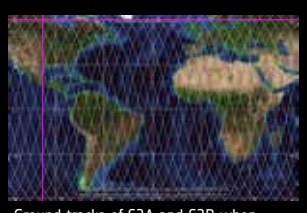
- At ~30s separation, the atmospheric and oceanic variability will be reduced to negligible levels → reduced uncertainty when comparing data.
- At ~30s separation, more dynamic targets such as convective cloud tops and hot deserts can be included in verification work.
- Multiple coincidences extracted across a full range of atmospheric conditions at all latitudes will give the statistical power to characterise relative calibration to the precision required.
- We can run S3A and S3B instruments in different modes (important for the altimeter)
- We are interested in new science aspects of the Tandem phase.

Finally the S3B will be maneuvered into an operational configuration with 140 degree separation between the two satellites on the same ground track.

➔S3 Constellation Orbit Phase



Ground tracks of S3A and S3B when separated by 180°

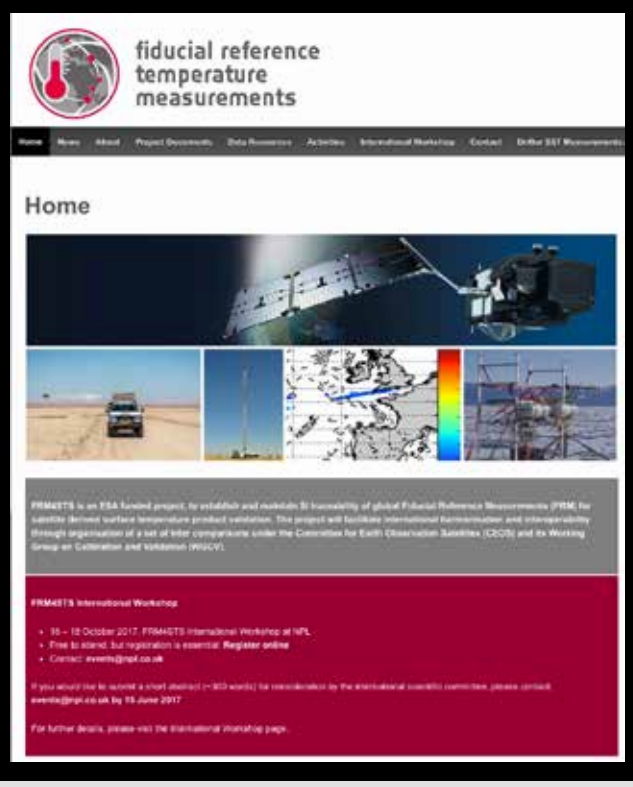


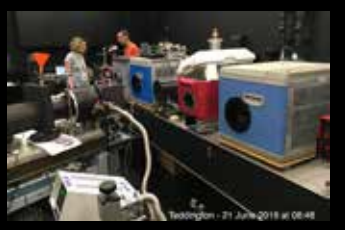
Ground tracks of S3A and S3B when separated by 140°

The original baseline orbit phasing between S3A and S3B was a 180° angle phase separation on the same orbital plane. This minimised the optical mission revisit time for global coverage. But, for the Topography mission, S3B essentially duplicates the information acquired by S3A at the mesoscale (25-50 km): measurements are separated by 2 days and 50 km and are highly correlated and significant areas remain poorly sampled after 4 days. Because of this, in terms of ocean model data assimilation systems, in the baseline orbit configuration S3B would be of marginal value for ocean topography applications.

Therefore a **new orbit phasing of S3A and S3B with 140° phase separation will now be implemented to optimise altimeter ground tracks with limited impact on the optical mission.**

➔ FRM for SST





← FRM4STS blackbody inter-comparison conducted at the National Physics Laboratory, Teddington, London in 2016. Details of the intercomparison and the results can be found at: http://www.frm4sts.org/project-documents/

→ FRM4STS radiometer inter-comparison conducted at the National Physics Laboratory, Teddington, London in 2016. Details of the intercomparison and the results can be found at: http://www.frm4sts.org/project-documents/

The AMT4SentinelFRM project focuses on providing high quality Fiducial Reference Measurements (FRM) to validate satellite data during the Atlantic Meridional Transect (AMT) annual research voyage between the UK and destinations in the South Atlantic.

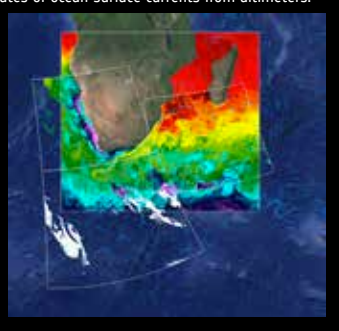
AMT4SentinelFRM is implementing FRM methods and practices to provide a validation data set for Sentinel-1, Sentinel-2 and Sentinel-3 ocean measurements. The SST validation component is focused on an ISAR radiometer supported by underway SST data depth and meteorological information.

➔ Example SST Applications

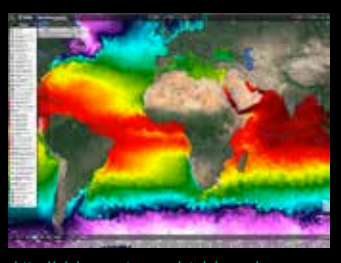
The ESA GlobCurrent project is now making use of SST data to perform frontal sharpening to help derive better estimates of ocean surface currents from altimeters.

The Globcurrent data repository now includes surface geostrophic current, the Ekman current at the surface and at 15 m depth, and the combined geostrophic and Ekman currents. The data are interpolated and collocated to a common grid with a spatial resolution of 25 km and a temporal resolution of 1 day for the geostrophic current and three hours for the Ekman currents and the combined currents. It covers the 23-year period from January 1993 to May 2016. A regional product for the Mediterranean Sea interpolated to a spatial resolution of 1/8 degree and a temporal resolution of 3 hours is also available.

http://www.globcurrent.org/



Access and data download: http://globcurrent.ifremer.fr/products-data/data-catalogue



The data can be visualized at Ocean Data Laboratory the Syntool visualization website. A wide range of satellite and in-situ data are visualized at global and regional levels. Syntool clearly highlights and demonstrates the ability of sensor synergy for studies of upper ocean dynamics at basin scale (~ 1000 km), at mesoscale (~ 30 to 100 km) and at sub-mesoscale (< 10 km).

http://globcurrent.oceandatalab.com/

The ESA Climate Change Initiative SST project is designed to address the requirements of GCOS in support of UNFCC and climate science applications. The project team has a focus on the following issues:

- Analysis of scientific requirements relating to climate
- Development of improved scientific algorithms
- Inter-comparison and selection of algorithms
- System prototyping and production of SST datasets
- Product validation and end-user assessment

Full details are available at http://www.esa-sst-cci.org/?q=overview with data access at http://cci.esa.int/data