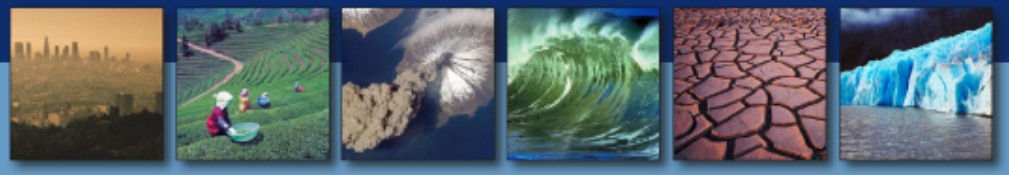
# CEOS SST-VC- Status and Issues

Craig Donlon and Kenneth S. Casey on behalf of the SST-VC members

GHRSST XV, Cape Town, South Africa,
2nd – 5th June 2014.



CSIRO

JAXA Explore to Realize

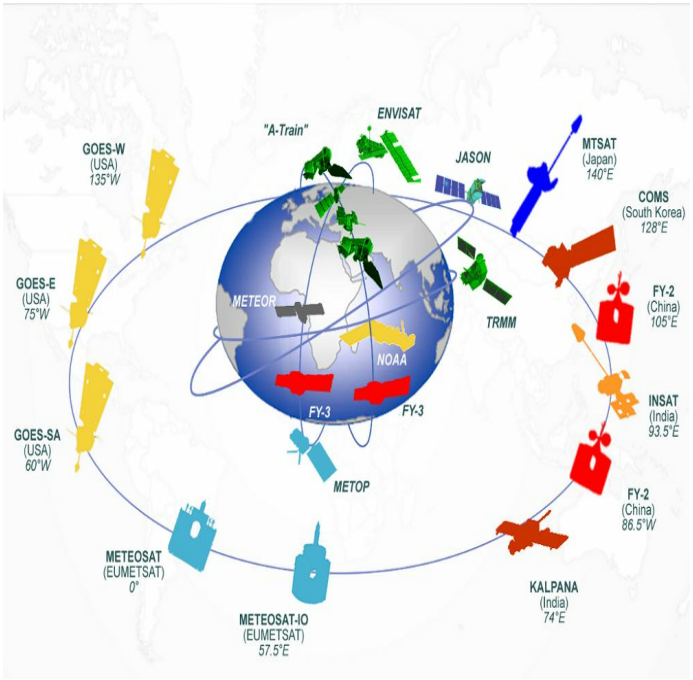
EUMETSAT

GHRSST Group for High Resolution Sea Surface Temperature

UK SPACE AGENCY

# Overview

- Progress 2013/14
  - ToR and Implementation
- CEOS SST Radiometer inter-calibration
- SST-VC Constellation Paper
- IDN/CWIC



# Membership, composition and leadership

| Working Groups | Chair | Vice-Chair | |
|---|---|---|---|
| WGCV | Srivastava (CSA) | Von Bargen (DLR) | |
| WGISS | Moreno (CNES) | Mitchell (NASA) | |
| WDCapD | Wood (USGS) | Olwoch (SANSA) | |
| WGDisasters | Petiteville (ESA) | Chalifoux (CSA) | |
| WGClimate | Bates (NOAA-CGMS) | Lecomte (ESA-CEOS) | |
| **Virtual Constellations** | **Co-Leads** | | |
| ACC-VC | Eckman (NASA) | Zehner (ESA) | |
| SST-VC | Donlon (ESA) | Casey (NOAA) | |
| OST-VC | Lambin (CNES) | Bonekamp (Eumetsat) | |
| OSVW-VC | Figa (Eumetsat) | Chang (NOAA) | Gohil (ISRO) |
| OCR-VC | DiGiacomo (NOAA) | Bontempi (NASA) | Regner (ESA) |
| P-VC | Neeck (NASA) | Oki (JAXA) | |
| *LSI-VC* | *Dalge (INPE)* | *Faundeen (USGS)* | *Diwakar (ISRO)* |

# SST-VC Targets with GHRSST

## SST-VC Implementation Targets:

1. **Wider participation of CEOS Agencies** in SST related activities
2. Continued **support to an extensive user community** with established and functional systems and services
3. **Stronger CEOS Agency SST activities** through better synergy and communication
4. **Better SST product and service interoperability** building on the strengths of CEOS Agencies
5. **Better data access and product applications** by CEOS Agencies
6. **Value for money to CEOS Agencies** by capitalising on the already committed investments made to GHRSST
7. **Reduce duplication of coordinating activities**

# Objective #4: linking VCs & Science

- Two lines of action aim at establishing and/or improving the linkages between VCs and existing relevant scientific such as GRSST, IOCCG, OSTST, IPWG (Precipitation), etc.
  - Identify gaps and/or hurdles in these linkages
  - Work with the sponsors of the relevant scientific groups with a view to build on complementarity, commonalities, and to improve overall coordination and efficiency
    - We'll hear more about this under agenda item 9
    - This topic will be open for discussion under item 12

# SST-VC Status and Issues

- **Relatively healthy space segment but:**
  - Currently no dual-view IR SST reference capability
  - Future of passive microwave SST capability is not secure
  - Ground-based Fiducial Reference Measurements (FRM) remain a challenge
- **International collaboration remains strong** within the framework of GHRSST and the CEOS SST-VC
- **SST-VC requests participation from CEOS member states** having an SST capability (ISRO, CONAE, NRSCC, NSMC/CMA, Roskomos, KARI and others).
- **Collaboration** with WGCV, WG-Climate and WGISS proceeds well
- **SST-VC will meet** during the Group for High Resolution SST (GHRSST) Annual Science Team Meeting, Cape Town, South Africa June 2-5th 2014. Sponsored by SANSA, ESA and EUMETSAT.

| Advancement of the CEOS Virtual Constellations: 2014-2016 | | | |
|---|---|---|---|
| **Objective/Deliverable** | **Projected Completion Date** | **Background Information** | **Responsible CEOS Entity** |
| VC-1: List of Relevant Datasets from VCs | | Results of study will be fed into WGISS IDN to ensure coverage of all VC data | VCs with support from WGISS |
| VC-17: Documented plan for the SST Virtual Constellation | Q3 2015 | Develop a White Paper describing and justifying the SST- Virtual Constellation | SST-VC |

## For Information:

- **VC-1 is maintained using the GHRSST Regional/Global Task Sharing (R/GTS) Framework documented within a master metadata repository (Lead: NASA/NOAA)**
- **VC-17: White paper is in draft form and will be consolidated by 2015. It will take a justified requirements-based approach (as was done for the The CEOS Next 15 Years of Satellite Altimetry document) Lead: ESA**

# GHRSST dataset testing report (2014-04-03 01:30:00)

Get as Excel (Dataset with granules) | Get as Excel (Dataset with 0 granule) | Get as Excel (Dataset with exception)

## Datasets with granules:

| EntryId | Testing request | Testing response | Number of Granule | CWIC response time (millisecond) |
|---|---|---|---|---|
| ABOM-L4HRfnd-AUS-RAMSSA_09km | request link | response link | 1816 | 1610 |
| OSDPD-L2P-GOES15 | request link | response link | 13656 | 2316 |
| JPL_OUROCEAN-L4UHfnd-GLOB-G1SST | request link | response link | 1264 | 2016 |
| DMI-L4UHfnd-NSEABALTIC-DMI_OI | request link | response link | 2212 | 1430 |
| NCDC-L4LRblend-GLOB-AVHRR_AMSR_OI | request link | response link | 4090 | 2025 |
| EUR-L4UHRfnd-NWE-ODYSSEA | request link | response link | 501 | 1804 |
| NEODAAS-L2P-AVHRR17_L | request link | response link | 3328 | 2154 |
| EUR-L2P-AVHRR17_L | request link | response link | 3124 | 1593 |
| OSDPD-L2P-MTSAT2 | request link | response link | 9058 | 2607 |
| REMSS-L4HRfnd-GLOB-mw_ir_rt_OI | request link | response link | 2414 | 2548 |
| NAVO-L2P-AVHRR18_L | request link | response link | 58140 | 2005 |
| OSDPD-L2P-GOES12 | request link | response link | 36367 | 2437 |
| EUR-L2P-AMSRE | request link | response link | 8973 | 1421 |
| EUR-L2P-AVHRR_METOP_A | request link | response link | 18397 | 1522 |
| JPL-L4UHblend-NCAMERICA-RTO_SST_Tn | request link | response link | 299 | 1621 |
| REMSS-L2P-AMSRE | request link | response link | 80074 | 2379 |
| NAVO-L2P-AVHRR19_G | request link | response link | 13610 | 2079 |
| NEODAAS-L2P-AVHRR19_L | request link | response link | 9229 | 2306 |
| REMSS-L4HRfnd-GLOB-mw_ir_OI | request link | response link | 5560 | 2417 |
| REMSS-L2P_GRIDDED_25-WSAT | request link | response link | 3155 | 2452 |
| EUR-L3P-NAR_AVHRR_METOP_A | request link | response link | 374 | 1813 |
| REMSS-L2P_GRIDDED_25-AMSRE | request link | response link | 4851 | 2356 |
| JPL-L4UHblend-NCAMERICA-RTO_SST_Td | request link | response link | 271 | 1548 |
| NEODAAS-L2P-AVHRR18_L | request link | response link | 2611 | 2290 |
| NAVO-L2P-AVHRR18_G | request link | response link | 34943 | 1868 |
| EUR-L4UHFnd-MED-v01 | request link | response link | 981 | 1573 |
| UKMO-L4HRfnd-GLOB-OSTIA | request link | response link | 2251 | 2622 |
| EUR-L2P-AVHRR16_G | request link | response link | 7519 | 1432 |
| EUR-L2P-NAR17_SST | request link | response link | 2344 | 1519 |
| OSDPD-L2P-MSG02 | request link | response link | 6861 | 2487 |
| NAVO-L2P-AVHRR19_L | request link | response link | 55180 | 2048 |
| NAVO-L2P-AVHRR17_G | request link | response link | 14704 | 1790 |
| EUR-L2P-AVHRR17_G | request link | response link | 9734 | 1689 |
| EUR-L2P-AVHRR16_L | request link | response link | 1018 | 1453 |
| JPL-L4UHfnd-GLOB-MUR | request link | response link | 4111 | 1759 |
| JPL-L4UHblend-NCAMERICA-RTO_SST_An | request link | response link | 298 | 1617 |
| EUR-L2P-NAR16_SST | request link | response link | 581 | 1552 |
| REMSS-L2P_GRIDDED_25-TMI | request link | response link | 7292 | 2379 |
| JPL-L2P-MODIS_A | request link | response link | 79317 | 1889 |
| OSDPD-L2P-GOES13 | request link | response link | 62643 | 2199 |
| EUR-L3P-GLOB_AVHRR_METOP_A | request link | response link | 2125 | 1533 |
| EUR-L4UHRfnd-MED-ODYSSEA | request link | response link | 506 | 1801 |

## Capacity Building, Data Access, Availability and Quality Objectives/Deliverables: 2014-2016

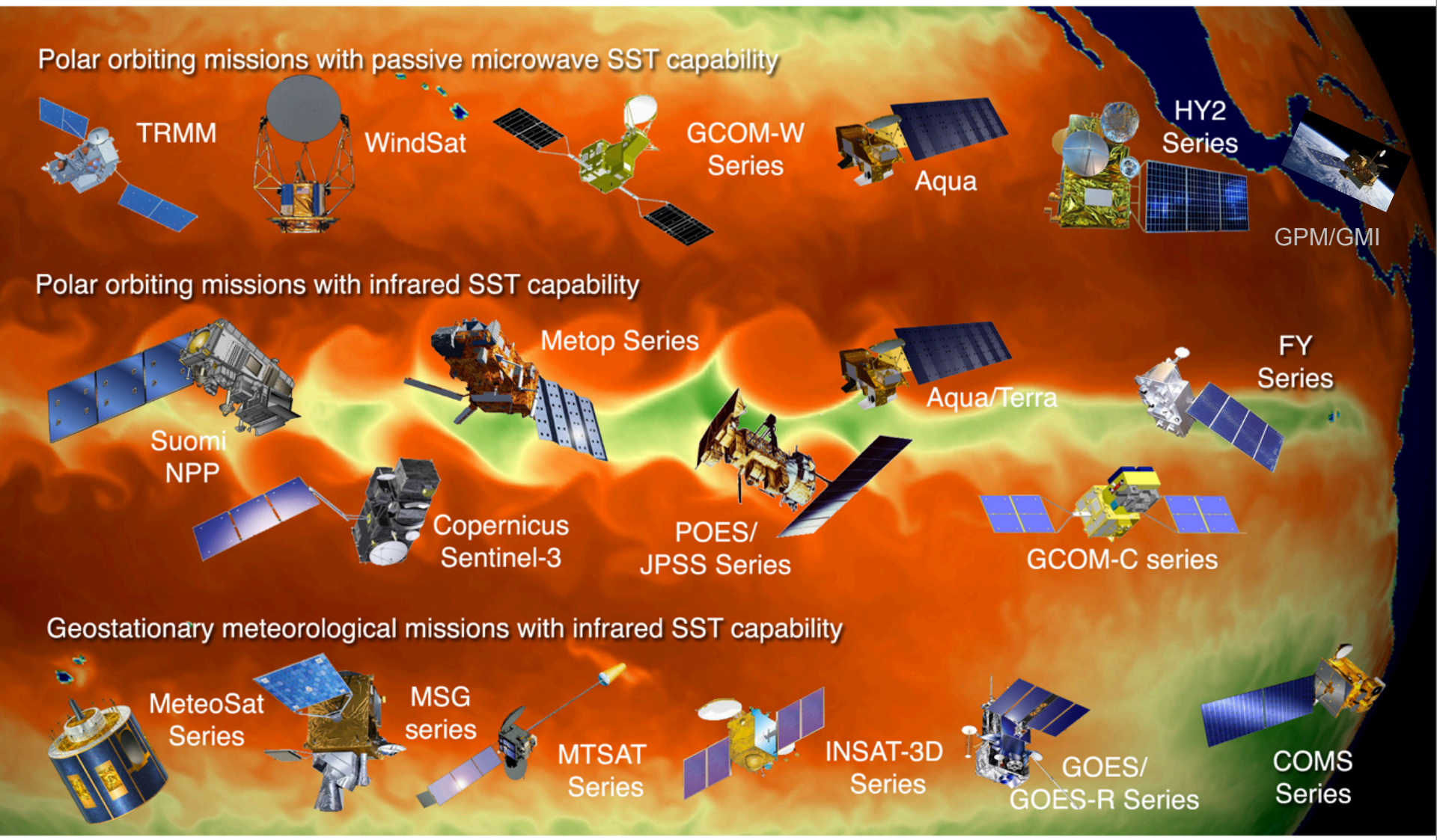
| Objective/Deliverable | Projected Completion Date | Background Information | Responsible CEOS Entity |
|---|---|---|---|
| CV-1: SST Comparison Campaign Plan | Q2 2014 | Set up a multi-agency comparison project to ensure international consistency in post-launch Cal/Val of satellite derived Earth surface temperatures for climate data records. The proposal will encompass two projects: **Phase 1** – Laboratory 'radiometric comparison'; **Phase 2** – Field comparison of validation parameter, with two independent activities: **Phase 2A** – Ocean, and **Phase 2B** – Land. ESA has agreed to provide funding for an SST calibration campaign, to be held end 2014 and in 2015. | WGCV with support from SST-VC |
| CV-2: SST Comparison Campaign Implementation | Q4 2015 | ESA has already providing funding for the implementation of the SST comparison campaign but funding is required from additional agencies. | WGCV with support from SST-VC |
| CV-3: SST Operational Validation White Paper | | The White Paper is being developed now which includes the plan for the project and costing. | WGCV |

## For Information:

- **Requirements fed to WGCV. ESA provides funding to coordinate project**

# CEOS Virtual Constellation for Sea Surface Temperature (SST-VC)

*Providing best quality SST data for wide application through international collaboration, scientific innovation, and rigor*

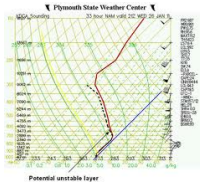



2015 status: With launch of Sentinel-3, many core elements will be operational and major requirements met

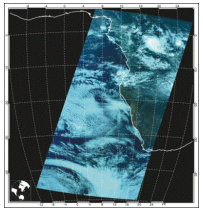
GHRSST XV
Cape Town, S. Africa
2nd – 5th June 2014

# Essential elements of the Future SST Satellite Constellation

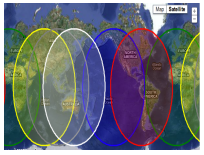
**Ocean in situ SST system**



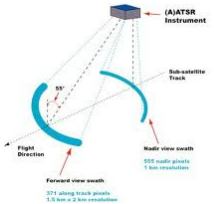

**Atmospheric parameters (satellite, model and in situ)**



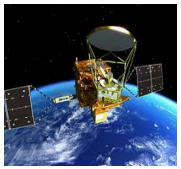
**2 wide-swath high polar orbit Infra red imagers (1km, <0.3K)**



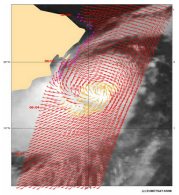
**Global constellation of geostationary infrared imagers (1-3 km, <0.3K)**




**Dual view polar orbit infrared high fidelity SST reference sensor**



**Wide swath polar orbit passive microwave imager**



**Wide swath ocean surface vector winds (<25 km, <0.2m/s)**

Donlon, et al, (2010). "Successes and Challenges for the Modern Sea Surface Temperature Observing System" in *Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society (Vol. 2),* Venice, Italy, 21-25 September 2009, Hall, J., Harrison, D.E. & Stammer, D., Eds., ESA Publication WPP-306, doi:10.5270/OceanObs09.cwp.24

# SST-VC scope: GHRSST White Paper

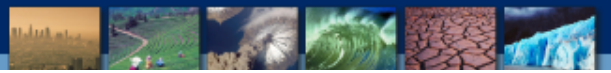
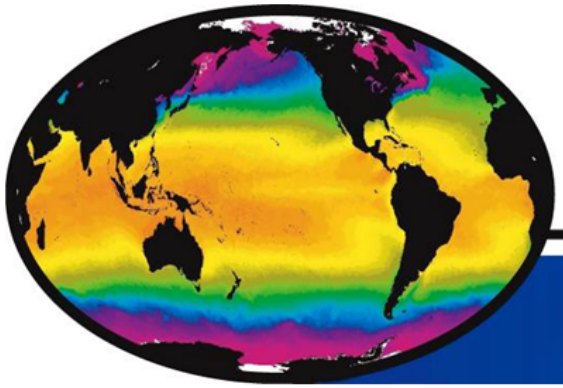


**Table 1. Ideal plan for a global high resolution SST integrated observing system: 2009-2025.**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Dual view SST reference sensor** | Baseline global coverage high accuracy SST retrieval with long term stability <0.1K decade$^{-1}$ for the SST CDR. Maintaining accuracy of SST/climate observing system during periods of volcanic stratospheric aerosol. Used as a reference data source other satellite SST data | At least one LEO satellite with a dual view radiometer in an 10.00-10.30 LST orbit to continue the (A)ATSR CDR.<br><br>One LEO asynchronous satellite for use as a reference sensor for other satellite data streams. | Thermal IR channels within the ~3.7--12 μm waveband for SST measurement, near-IR and visible channels for cloud flagging, each with dual view along track scanning capability. | 0.1 K | 0.5-1 km (Target 0.25km) | >500 km | Global coverage. |
| **Wide swath passive microwave imager** | Baseline global coverage moderate resolution SST observing system. | Two satellites carrying microwave radiometers optimized for SST retrieval | For global coverage 7GHz is needed. Other channels are required for corrections for wind, precipitation etc. The AMSR2 channels should be considered minimum baseline. | <0.5 K (Target 0.3 K) | ~25km (target: 10km) | >1500 km | Earth coverage in 1 days |
| **Geostationary constellation of infrared imagers** | Baseline non-polar SST observing system providing high temporal resolution SST. | 6 spacecraft equi-spaced in longitude to ensure full coverage from ~70°S to ~70°N | Thermal IR channels within the ~3.7--12 μm waveband for SST measurement, near-IR and visible channels for cloud flagging. | <0.5 K | 1-5 km (target 1 km) | Earth disk from 36000 km altitude | Sample interval < 30 min |
| **Wide swath ocean surface winds** | Required to characterise the state of the ocean surface for emissivity and skin temperature deviation and diurnal heating and cooling parameterizations | Two satellites carrying passive and/or active microwave systems. | Various | <1 ms$^{-1}$ (Target: 0.25 ms$^{-1}$ between 2-10 ms$^{-1}$) | <25 km (target 10 km) | >2000 km | Several samples per day. Target: 4hirs? |
| **Sea Ice imaging** | Required to determine sea ice concentration and sea ice edge, | At least one LEO sun-synchronous satellite carrying microwave radiometers optimized for sea ice retrieval.<br><br>At least one LEO sun-synchronous satellite carrying Synthetic Aperture Radar (SAR).<br>At least one LEO sun-synchronous satellite carrying a visible imager | Passive Microwave:<br><br>SAR<br><br>High resolution scatterometer<br><br>Vis imager | | PM <10km<br><br>SAR: 10 m<br><br>Scatt: 2.5 km<br><br>Vis <1km | >1500 km | Polar region coverage in at least 1 day. (Target: 6 hours) |



GHRSST

Group for High Resolution Sea Surface Temperature

# Proposal for a GHRSST Technical Reference Series

Dr. Craig Donlon

Presented at the 13th GHRSST Science Team Meeting,
Tokyo, Japan
June 4-8, 2012


IOCC
Colou


IOCC
Consi


IOCC
Optic


IOCC
binne


IOCC
Fund
126. |


IOCC
Gregg


IOCC
Colou
Chris


Acco
Colou
[Portu

**IOCCG Report Number 1, 1998**

IOCCG
onal Ocean Colour
dinating Group

# Minimum Requirements for an Operational, Ocean-Colour Sensor for the Open Ocean

Report of an IOCCG working group held in Villefranche-sur-Mer, France, October 6-7, 1997. Chaired by Prof. André Morel.

*Published by the International Ocean-Colour Coordinating Group (IOCCG), an Affiliated Program of the Scientific Committee on Oceanic Research (SCOR).*

ISSN: 1098-6030

# Propose a GHRSST Publication


- IOCCG reports are extremely successful – GHRSST can do the same
- The SST-VC has an action to develop a Constellation Paper
- The achievements of GHRSST over the last 10 years
- Or
- Development of satellite SST: 10 years past and present through GHRSST
- Journal or separate volume (IOCCG like)?
- Scientific content complemented by users
- Cover each area of GHRSST
- Act as a “reference document” or a “Handbook”
- If interested please contact craig.donlon@esa.int
- Papers/contributions in next 12 months
- Publish in 2013/14

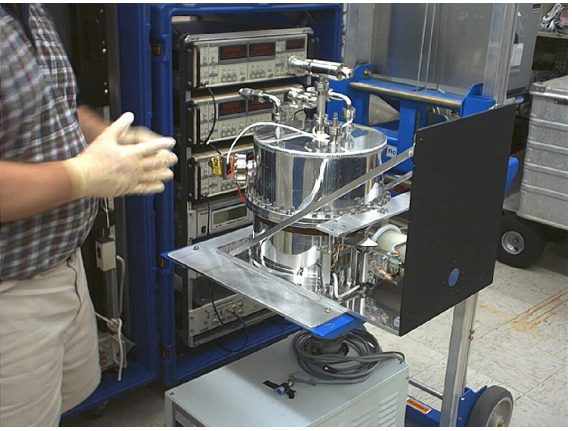
# SST-VC: SST ship borne radiometer Inter-comparison requirements

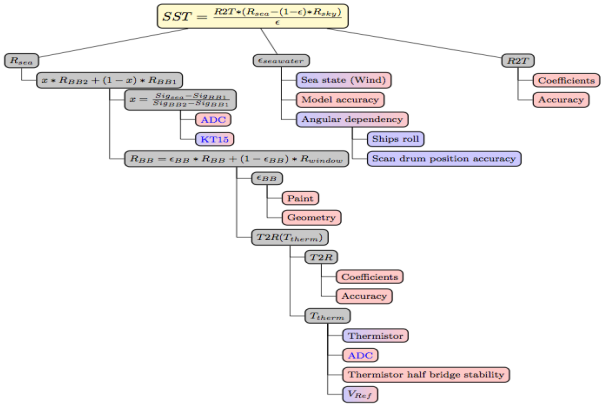
- **GHRSST/SST-VC Collaboration with WGCV**
- **Aim:**
  - ***Establish and maintain S.I. traceability for ship borne radiometers used as Fiducial Reference Measurements (FRM) for Satellite SST validation.***

- Passed Requirements to WGCV.
- Includes Land Surface Temperature (LST) radiometers
- Implementation building on previous CEOS Radiometer inter-calibration and validation activities (Miami Experiments)

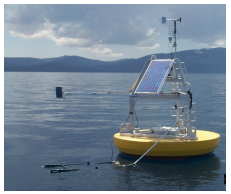
# FRM4-CEOS

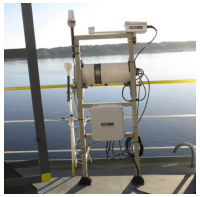
- **FRM4-CEOS: ESA ITT for FRM TIR radiometer validation and investigation of routes to SI traceability for other SST measurements**
- **~400K ITT in Summer 2014**

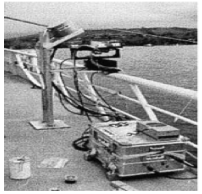












# SST-VC: SST calibration and validation requirements for other SST infrastructure

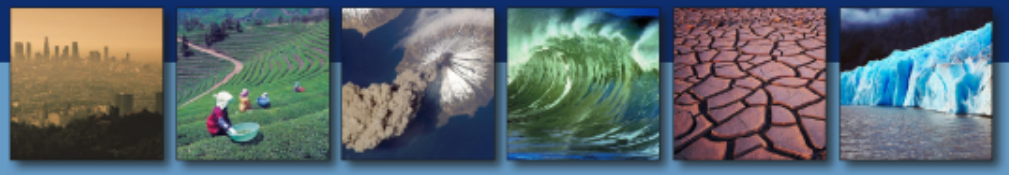
- **Aim:**
  - ***Establish and maintain S.I. traceability for infrastructure providing Fiducial Reference Measurements (FRM) for Satellite SST calibration and validation.***

- **REQ-1:** Define an approach and methodology to establish, as far as possible, a means to trace drifting buoy, ARGO and other in situ SST measurements to S.I standards accurate to 0.05K or better and of known stability (including time and space definition e.g. stable to <X> K per <time> over <Y>km on <region>).
- **REQ-2:** Maintain pre-deployment (and if possible) post-deployment calibration verification of drifting buoy, ARGO and other in situ SST measurements following the defined methodology and procedures set out under REQ-1.

# Summary

- CEOS SST-VC is in good shape with some solid and useful activities
- It has taken time to develop and mature
- Implementation of IDN/CWIC (evolution of the R/GTS for GHRSST?)
- Coming year will see writing of SST-VC White paper (Journal Article)
- Development and implementation of the CEOS-4FRM project and SI traceability of Ship-borne TIR FRM Radiometers prior to S3 SLSTR launch
  - Development of SBRN (Wimmer)
  - Development of standard format for SBRN (Nightingale)
- Start to tackle SI traceability for other SST measurements

# Thank you any Questions?



CSIRO

NOAA

esa

sansa
SOUTH AFRICAN NATIONAL
SPACE AGENCY

NASA

UK SPACE
AGENCY

JAXA
Explore to Realize

EUMETSAT

GHRSST
Group for High Resolution
Sea Surface Temperature