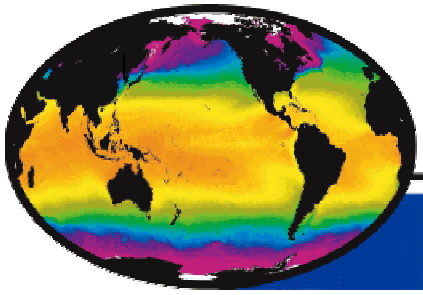

GHRSST-PP

GODAE High Resolution Sea Surface Temperature Pilot Project

Summary Report of the Fifth GODAE High Resolution SST Pilot Project Workshop

Southbank Hotel and Convention Centre, Townsville, Queensland Australia, July 26th -30th 2004.

GHRSST-PP Report: GHRSST/20, 2004

Sponsored by:

Summary Report of the Fifth GODAE High Resolution SST Pilot Project Workshop

Southbank Hotel and Convention Centre, Townsville, Queensland Australia, July 26th -30th 2004.

Compiled by C Donlon and the GHRSST-PP International Science Team

Published by the International GHRSST-PP Project Office
Hadley Centre for Climate Prediction and Research, Met Office
Fitzroy Road, Exeter, EX3 1PB
United Kingdom

E-mail: craig.donlon@ghrsst-pp.org
Tel: +44 (0)1392 886622
Fax: +44 (0)1392 885681

The GHRSST-PP International Science Team (2004/05):

Craig Donlon	Chair; Hadley Centre, Met Office, United Kingdom
Andrew Bingham	JPL, PO.DAAC, USA
Andrew Harris	NOAA/NESDIS ORA, USA
Bill Emery	University of Colorado, USA
Bob Evans	University of Miami, USA
Chelle Gentemann	Remote Sensing Systems, USA
Chris Merchant	University of Edinburgh, UK
Chris Mutlow	Rutherford Appleton Laboratory, United Kingdom
David Llewellyn-Jones	University of Leicester, United Kingdom
Doug May	Naval Oceanographic Office, USA
Ed Armstrong	JPL PO.DAAC, USA
Gary Wick	NOAA ETL, USA
Hiroshi Kawamura	Tohoku University/JAXA, Japan
Ian Barton	CSIRO Marine, Australia
Ian Robinson	Southampton Oceanography Centre, United Kingdom
Jean François Piollé	IFREMER, Brest, France
Jim Cummings	Naval Research Laboratory, Monterrey (Ca), USA
Jorge Vasquez	JPL PO.DAAC, USA
Ken Casey	NOAA/NESDIS NODC, USA
Nick Rayner	Hadley Centre, Met Office, United Kingdom
Peter Minnett	University of Miami, USA
Pierre LeBorgne	Meteo France/O&SI SAF, France
Richard Reynolds	NOAA NCDC, USA

Printed in England, 2004.

Document change record

Author	Modification	Issue	Ref.	Date
C J Donlon	Original	0.1	DRAFT	August 10th 2004
C J Donlon	Revised and updated	0.5	DRAFT	August 17th 2004
C J Donlon	Revised and completed version 1.0 for review by Workshop delegates	1.0	DRAFT	August 21st 2004
C J Donlon	Integrated Science Team comments on version 1.0	1.1	Released	September 20th 2004
C J Donlon	Further revisions based on feedback	1.2	Released	September 24th 2004

Table of Contents

1 Introduction

In the relatively short time (4 years) since inception, the Global Ocean Data Assimilation Experiment, (GODAE) High Resolution Sea Surface Temperature Pilot Project (GHRSST-PP) has achieved enormous progress. It has matured significantly, attracting nearly €10M (~$10M US) of investment by the participating nations and space agencies, following a remit to ensure that a new generation of high quality, high resolution SST data products are made available to the scientific community in real time. Today, several Regional Data Assembly Centres (RDAC) are now actively building operational GHRSST-PP data production and dissemination systems according to the specifications laid out in the GHRSST-PP Data Processing Specification (GDS v1.0 rev1.5) which has been developed over the last 3 years as a baseline for the GHRSST-PP system. GHRSST-PP has two distinct components:

1. the development and implementation of a regional/global task sharing framework that facilitates the international exchange and utility of satellite and in situ SST data sets and
2. the development of new analysis systems to provide a new generation of bias free high resolution SST data products.

Part one is clearly a pre-requisite if part two is to be a success. This workshop provided a unique and timely opportunity for RDAC and Global Data Analysis Centre (GDAC) project teams to exchange knowledge and plans for developing the necessary data analysis and management systems required by the GHRSST-PP. Over 35 people attended the workshop representing the international SST community many working at the forefront of SST research, some from operational centres and space agencies providing operational SST data feeds, others representing donors and funding agencies and several planning to spin up new activities within the GHRSST-PP program.

The workshop theme was focussed on ***Global Integration and Application of GHRSST-PP Sea Surface Temperature Data Products***. A series of project reports that were prepared by several GHRSST-PP working groups as input documentation for the workshop (see section 5 or http://www.ghrsst-pp.org) to stimulate discussion. During the workshop, RDAC/GDAC data management and data exchange, the GHRSST-PP High Resolution Diagnostic Data Set (HR-DDS), the GHRSST-PP Reanalysis Project (RAN) and the implementation of a GHRSST-PP GDAC system were discussed in some detail. The specific target outputs of the workshop were to obtain:

- A consensus agreement for the specification of the main data analysis techniques required to produce global coverage GHRSST-PP L4SSTfnd data products based on GHRSST-PP L2P data products,
- Inputs for a revised version of the GHRSST-PP Data Processing specification (GDS),
- Inputs for a revised version of the GHRSST-PP Development and Implementation Plan (GDIP),
- Coordination of activities within the GHRSST-PP regionally funded RDAC and GDAC projects
- An initial implementation plan for the GHRSST-PP reanalysis project.

This document provides a summary of the main points raised during the workshop, the conclusions and recommendations of the GHRSST-PP Science Team and the action list raised to address significant issues. In addition, it provides a contact list for each participant. It has been developed to assist in the follow up of the Workshop and in particular, the integration of the GHRSST-PP services that are currently being implemented within several national projects. During the coming months a full workshop proceedings will be developed by the GHRSST-PP International project Office and published as a hard-copy document.

I would like to take this opportunity, on behalf of the GHRSST-PP Science Team, to thank all of the participants who contributed to the workshop, the session chairs and in particular the rapporteurs for their summary reports. Ian Barton and the CSIRO team deserve a special thank you for all of their help and support in preparing the workshop, to the GODAE project Office, BLUElink> – Ocean Forecasting Australia, and CSIRO Marine Research for sponsoring the workshop and to the European Space Agency and Met Office, UK, for support to the International GHRSST-PP project Office.

Finally, it is with a warm heart that I thank each of you for your contributions, support and dedication to the GHRSST-PP. I look forward to meeting you all once again in May 2005 at the Met Office, Exeter to continue the quest for a new generation of SST data products and services.

Craig Donlon
(Director of the GHRSST-PP International Project Office,
August 20th, 2004, Met Office, Exeter United Kingdom)

2 Main Conclusions of the Meeting

The main conclusions and recommendations of the 5th GHRSST-PP workshop are presented as components or services within the GHRSST-PP Regional/Global task sharing framework.

2.1 Status of GHRSST-PP Implementation

1. **GHRSST-PP International project office (GHRSST-PO).** The GHRSST-PP international project office, funded by the European Space Agency (ESA) and the Hadley Centre for Climate Prediction and Research, Met Office, UK, has operated over the past 12 months providing day-to-day support, administration and focus for the GHRSST-PP project, the Science Team and associated working groups. The GHRSST-PO supports ESA directly in managing the Data User Element (DUE) Medspiration project that forms the European RDAC node of the GHRSST-PP. Considerable effort has been invested in the development of project documentation and especially the preparation of Workshop proceedings and the GDS-v1.5 which was published in April 2004. A GHRSST-PP test data set has been developed as a 3-DVD-ROM set (available on request) containing 2-days of satellite and in situ data. Publication and promotion of the GHRSST-PP has been a major part of the day-to-day project office workload. Following the discussions at the workshop, the GHRSST-PO will focus on the development of an international user requirements document, revising and simplifying the GHRSST-PP web site, providing support to the GHRSST-PP working groups and the development of a GDS-v2.0 together with the GDS-TAG.

2. **The GHRSST-PP regional/global task sharing (R/GTS) framework.** Presentations given by RDAC and GDAC team leaders demonstrated that the GHRSST-PP R/GTS framework is now being implemented by several regionally funded projects. Regional Data Assembly Centres (RDAC) in the USA (funded under the National Oceanographic Partnership Program, NOPP), Europe (funded by the European Space Agency) and Australia (funded by CSIRO and the Royal Australian Navy), and the SEASnet (Tropical regions, especially the Indian Ocean) are at various stages of development. An initial suite of global and regional coverage L2P data products are expected in late 2004 based on AVHRR GAC, AMSR-E and TRMM TMI microwave radiometers, ENVISAT AATSR, MSG SEVIRI and AVHRR LAC SST data sets. A GDAC is now being implemented in the USA at the JPL PO.DAAC with components at the US-GODAE server system, NRL Monterrey and the NOAA National Oceanographic Data Centre.
   It is expected that the R/GTS will itself evolve as the GHRSST-PP gains more experience. Consequently, a version 2.0 of the GDS system documentation is now in preparation.

3. **Medspiration Project (EU-RDAC)**. The Medspiration project commenced activities in January 2004 and has worked on the functional design of a system that will implement the GHRSST-PP GDS-v1.5 as a demonstration operational service. The system will provide a European RDAC covering the Atlantic Ocean and all European shelf seas. L2P data sets from AVHRR, MSG-SEVIRI, AMSR-E, AATSR and TMI will be generated and delivered to the GHRSST-PP GDAC OCEANIDS system, together with MMR metadata records. MDB data records will be generated and delivered to the GDAC MDB system via the OCEANIDS system. Medspiration will generate Ultra-High Resolution L4 SSTfnd products for the Mediterranean Sea. This limitation has been chosen for the initial baseline system as the Mediterranean Sea is particularly challenging in terms of SST dynamical patterns and diurnal warming events in summer. In addition, significant outbreaks of Saharan aerosol complicate the merging of satellite IR data in this region. As part of the project, a HR-DDS system has been designed and implemented for the EU area which could be provided to other RDAC systems as an installable package. L2P (Atlantic Ocean and European Seas) and Ultra-High Resolution (UHR) L4 SST_{fnd} (Mediterranean Sea@2km) data products are expected towards the end of 2004 and in a demonstration operational delivery mode by April 2005.
   The Medspiration team has worked closely with the GHRSST-PO to develop the Regional/Global Task sharing framework and a stable version of the GDS-v1.5 which can be successfully implemented. The challenging project schedule and reporting procedures have resulted in several revisions of the GDS documentation which is now 'workable' and complete. The project is now implementing the GDS-v1.5 system ready for acceptance testing later this year.

   The Science Team noted that the Medspiration project is unlike a conventional research project (i.e., a project having a broad R&D remit) as it is closely tied to the implementation of the GDS-v1.5 under contract to the European Space Agency. Medspiration has been tasked to implement the GHRSST-PP system as specified by the GHRSST-PP Science Team in the GDS

documentation. The strength of this approach is that a demonstration baseline system will be operational by 2005 which can be reviewed and developed based on experience and user interaction. The Medspiration team were disappointed that some RDAC projects were reluctant to work with the GDS-v1.5 which had been extensively reviewed and accepted by all teams at the 4th GHRSST-PP workshop, Pasadena, USA in 2003. It is expected that the Medspiration RDAC services will transition into a European GDAC following the successful demonstration of the Medspiration project and acceptable user feedback from European SST operational users.

4. **BLUELink> project (Australian RDAC).** BLUELink> is a new Australian initiative that aims to develop ocean model and analysis and assimilation systems and provide timely information and forecasts on oceans around Australia. BLUELink> will produce both hind- and now cast surface and subsurface fields. The project started in 2003 and will run until 2006 although continuation is expected subject to funding. The main BLUElink> contribution to the GHRSST-PP will be as an Australian RDAC system delivering AVHRR LAC SST data sets for the region 20°N – 65°S, 50°E-160°W and L4 SST regional analysis based on an improved version of the Australian Bureau of Meteorology operational SST analysis system. The current Bureau system provides a 1° weekly global SST analysis and 0.25° daily regional SST analysis based on a univariate statistical (optimal) interpolation system in which in situ SST data are used to provide an initial (unbiased) estimate of SST. A broad-scale (750 km) in situ analysis is compared with a similar broad-scale analysis of AVHRR data, and the difference is used to bias correct all the AVHRR data. A fine-scale (100-200 km) analysis is performed using all available SST data. For a regional analysis, the scales are 30-50 km in which the 1° analysis is used to correct possible bias in the local retrievals.

   An improved version of the Australian Bureau of Meteorology analysis system will be developed by BLUELink> to produce high resolution SST analysis combining all types of satellite SST data (AVHRR, MT-SAT1,AMSR-E, and AATSR) with *in situ* measurements (ARGO profiling floats, drifting buoys, ships and XBT's) to produce improved estimates of SST. Two innovative bias adjustment methods are planned:
   - Method A: Merge AATSR "pseudo-bulk" SST with AVHRR "bulk" SST data
   - Method B: Retrieve AVHRR "skin" SST by calibrating against collocated AATSR skin SSTs

   The system will consider the Australian region 20°N-65°S, 50°E-160°W and will blend all data sources into SST(skin) and SST(1m) estimates and output real-time SST analyses at around 5 km resolution within 6 hours of data reception. In consultation with CSIRO Marine Research BLUELink> plans to produce and use HR-DDS and in situ observations from ships and buoys as a routine validation source. The system aims to be operational at the end of 2006. Helen Beggs noted that the BLUELink> team are currently investigating the resources required to provide L2P data sets to the GHRSST-PP.

   The GHRSST-PP Science team welcomed the development of an Australian RDAC system and noted that BLUELink> will provide an integrated system that will both generate and apply new SST data sets within the framework of GHRSST-PP. In particular, the Science Team requested that BLUELink> provide L2P data for LAC AVHRR for the Australian region as a contribution to the R/GTS GHRSST-PP framework.

5. **MISST project (USA RDAC).** The MISST project aims to provide a RDAC service providing global coverage SST data as a USA contribution to GHRSST-PP. The project is funded by the National Ocean Partnership Program (NOPP) and commenced in mid 2004. MISST aims to support all of the major components of the GHRSST-PP baseline system (as specified in the GDS-v1.5) and will importantly, conduct sufficient R&D to progress the GHRSST-PP system to GDS-v2.0. It was reported that there were financial difficulties for the MISST project to fully support the current GDS-1.5 baseline within the GHRSST-PP R/GTS framework.

   There are 2 phases to the project: Phase 1 (0-18 months) is dedicated to the production of an improved SST through the combination of observations from complementary IR and MW sensors. Phase 2 aims to demonstrate the impact of these improved SST products on operational ocean models, NWP, and tropical cyclone intensity forecasting. There are 5 major objectives for Phase 1 which will focus on the use of global coverage AMSR-E, TMI, NAVOCEANO LAC and GAC L2 SST data products:

   1. Computation of sensor-specific observational error characteristics required for optimal application and data fusion techniques

2. Parameterization of IR and MW retrieval differences, with consideration of diurnal warming and cool-skin effects required for multi-sensor blending.
3. Production and dissemination of sensor-specific SST products with associated retrieval confidence, standard deviation (STD), and diurnal warming estimates to the application user community.
4. Production and dissemination of improved multi-sensor high-resolution skin and bulk SST analyses to demonstrate and optimize utility in operational applications.
5. Targeted impact assessment of the SST analyses on hurricane intensity forecasting, numerical data assimilation by ocean models (both national and within GODAE), numerical weather prediction, and operational ocean forecast models

As a continued effort MISST will also consider the following L2 SST data products: NAVOCEANO GOES-10 & GOES-12, RSS WindSAT & historical AMSR, JPL PODAAC MODIS (Terra & Aqua) and ESA AATSR. The MISST project also aims to purchase, install and operate a Data Product Computational Facility (DPCF) that will allow multiple analysis systems to be operated simultaneously. The DPCF may be accessible to the international GHRSST-PP Science Team in the future but at present this is not foreseen.

The GHRSST-PP Science Team welcomed the MISST project as a major step towards implementing the GHRSST-PP. It was noted that the 4th GHRSST-PP Science Team Meeting (Pasadena, 2003) devoted considerable time to the exact specification of GHRSST-PP data product format and contents to ensure that MISST and Medspiration were in full agreement prior to Medspiration committing funds to implementation. In order for GHRSST-PP R/GTS framework to be successful, MISST and Medspiration must share a common interface and data product specification – and most importantly the inclusion of IPCV and MPCV flags within L2P data files. There is significant complementarity with the Medspiration project as MISST provides a mechanism to conduct significant R&D activities and the transition to a mature GHRSST-PP system. This means that the MISST project has a limited capacity to support the GDS-v1.5. Some MISST activities will contribute to the development of a GDS-v2.0 RDAC processing definition which can be compared to the baseline system implemented by the EU RDAC.

6. **The Japanese RDAC system** funded by JAXA is currently inactive following the failure of the ADEOS-II satellite. At this stage it is unclear what the future status of R&D SST activities will be in Japan and the GHRSST-PP Science Team hope that the New Generation SST (NGSST) project will be reactivated following a successful commissioning of MT-SAT-1 (expected in early 2005). Following discussion, it is unlikely that the Japanese Meteorological Agency (JMA) would be willing to participate within the GHRSST-PP with full RDAC status (i.e., L2P data production). However JMA SST analyses will be available to the GHRSST-PP.

   The Science Team thanked JAXA for the contributions to the GHRSST-PP and urged the agency to consider continued funding to the NGSST project which has pioneered the GHRSST-PP R/GTS framework. In particular, the Science Team requested that JAXA consider support for a dedicated RDAC based on MT-SAT1 SST data products and AMSR-E data sets, leveraging the considerable scientific expertise of Japanese SST experts.

7. **Proposed Indian Ocean GHRSST-PP RDAC system.** Discussions indicated a requirement for an Indian Ocean GHRSST-PP RDAC system and the SEASnet project (Funded by the IRD, Montpellier France) .provides an ideal baseline system serving LAC AVHRR data for this area. Further discussions between the Intergovernmental Oceanographic Commission (IOC), Indian Ocean Global Ocean Observing System (IO-GOOS), GHRSST-PP and SEASnet program will explore the user requirements and potential for an Indian Ocean GHRSST-PP RDAC in the coming months.

8. **The GHRSST-PP Global Data Analysis Centre (GDAC)**. A Global Data Analysis Centre system is currently being implemented in the USA as a tripartite system/agreement between the Physical Oceanography Data Active Archive Centre (PO.DAAC), US-GODAE server and the National Oceanographic Data Centre (NODC). The GHRSST-PP MMR system is nearly complete at the PO.DAAC although the MDB system is yet to be implemented. The PO.DAAC will clear all GHRSST-PP data sets (L2P, L4, Master Metadata Repository (MMR) records, Matchup Database (MDB) records and High Resolution Diagnostic Data Set (HR-DDS) records using the OCEANIDS system. A rolling archive of 1Tb is expected at the GDAC which will provide approximately 20 days of archive space for use by GHRSST-PP RDAC. The US National Ocean Data Centre (NODC) have indicated that they are planning to provide a long term stewardship archive for all

GHRSST-PP data but were unable to commit to this until final RDAC data volumes had been analysed in some detail. This activity is now in progress following a general discussion of data volumes at the workshop and will be concluded in September 2004. L4 data sets will be archived and served at the US-GODAE server facilitating their direct use by GODAE. GHRSST-PP GDAC services (OCEANIDS, metadata repository (MMR) and User support services) will be available and operational at the PO.DAAC, USA by 15th December 2004 in order to support Medspiration and MISST activities. Funding has been assured for this work.

9. **European GDAC system.** Plans are now in preparation for a second GDAC system located in Europe to provide operational redundancy and backup fro the USA GDAC within the GHRSST-PP system. It is intended that the EU-GDAC will be developed together with several emerging operational oceanography systems within the European area (e.g., the MERSEA project and upcoming Global Monitoring for Environment and Security (GMES) initiatives of the European Commission). A major part of this effort relies on the proposal to generate global coverage GHRSST-PP L2P SST data records from the MSG-SEVIRI and METOP-3 system at the EUMETSAT O&SI SAF. METOP will provide global coverage high resolution IR data sets once per day and the SEVIRI will provide 5km split-window geostationary IR observations every 15 minutes as required.

10. **GHRSST-PP User Requirements Documentation (URD)**. The workshop concluded that a URD should be developed by the GHRSST-PO in collaboration with RDAC teams that includes a summary of the collective international (rather than regional) user requirements for GHRSST-PP. This will be used as the basis for user application development and to convene a GHRSST-PP user applications symposium in 2005/6. In addition, a separate (but related) URD will be developed by the RAN-TAG reflecting the GHRSST-PP reanalysis data product user requirements providing justification for the RAN implementation plan.

11. **GHRSST-PP Data management Technical Advisory Group (DM-TAG).** The GHRSST-PP DM-TAG working group has progressed steadily throughout the inter-sessional period since the 4th GHRSST-PP workshop. Focus has been toward the configuration and operation of the GHRSST-PP GDAC system and a working group report was submitted to the Science Team for consideration. The Science Team has requested that a re-assessment of data volume within the RDAC projects is provided based on the changes agreed at the 5th workshop. These were a recommendation to reduce the spatial resolution of 1km MODIS data sets to a sub-sampled 4km global data product, a request to EUMETSAT to provide 5km hourly SEVIRI data (rather than 10km 3hoiurly data), a request to BLUELink> to provide systematic AVHRR LAC regional coverage data over the Australian region and proposed Indian Ocean SEASnet RDAC system L2P AVHRR LAC data. The DM-TAG was asked to focus on the development of an appropriate archive system for GHRSST-PP L2P data sets (potentially to be based at the NOAA National Oceanographic Data Centre, USA) in order to secure the proper data stewardship of GHRSST-PP products and to facilitate their use within the GHRSST-PP reanalysis project.

    The Science Team thanked the DM-TAG for their contributions and noted that it was considered an extremely useful working group especially as the GHRSST-PP moves more towards application of data products and services. The role of the group in terms of user support will be vital to the successful application of GHRSST-PP data products.

12. **GHRSST-PP Data Processing Specification Technical Advisory Group (GDS-TAG).** The GDS-TAG (formerly the ISDI-TAG) has been relatively inactive throughout the inter-sessional period since the last science team meeting. Following the development of the GDS-v1.5 which was considered a complex and detailed document by the workshop, the GDS-TAG have been asked to provide a simplified summary digest of the document in a FAQ format and as a series of WWW pages. This will greatly assist the user community in assessing the data processing and quality control methods used during the production of L2P and of L4 data products. In addition, the GDS-TAG have been requested to treat the GDS-v1.5 as a baseline for the GHSST-PP which must be upgraded based on new science and the initial experience of the Medspiration and MISST RDAC teams as they implement the processing system. A GDS-v2.0 document should be prepared for review at the 6th GHRSST-PP Science team meeting (May 2005) taking into consideration the requirements and experience of the user community working with GDS-v1.5 data products together with inputs from the RDAC/GDAC teams. The GDS-v2.0 will then undertake a full Critical Design Review in June/July 2005 before final acceptance by the GHRSST-PP Science Team and implementation during the middle/latter part of 2005.

Following some discussion it was agreed that the GDS-TAG will be reconvened with revised membership including representatives from SEASnet and BLUELink>. Dr. Gary Wick will remain Chairman of the group and will develop a revised 'Terms of Reference' (ToR) in collaboration with the GHRSST-PO. It was agreed that the ToR will include as a minimum, the following remit:

(a) Prepare a digest of the GDS 1.5 as a FAQ to make the document simple to understand
(b) Review the GDS 1.5 from a critical scientific, technical and operational standpoint
(c) Prepare a v2.0 prototype GDS based on developments within GHRSST-PP and user community
(d) Convene a critical design review meeting of the proposed GDS-2.0 in June/July 2005.

13. **GHRSST-PP Diurnal Variation Working Group (DV-WG).** The GHRSST-PP Diurnal Variability Working Group (DV-WG) was unable to report to the GHRSST-PP Science Team as this group did not meet as planned prior to the 5th Workshop. The Science Team considered the DV-WG essential to the successful development of L4 analysis systems and it was noted that SST_{fnd} depended on the ability of the GHRSST-PP to successfully account for diurnal variability as well as the SST_{skin} temperature deviation. There are many approaches to the problem beyond the parameterisation schemes specified in the GDS-v1.5 that require further investigation that should be co-ordinated by the DV-WG. The chair of the DV-WG (H. Kawamura) had indicated to the GHRSST-PO prior to the workshop that he was keen for an alternative chairperson due to the current uncertainty within the Japanese RDAC although he wished to remain a member of the group itself.
The Science Team thanked Prof Kawamura for his work and Dr Chris Merchant was nominated as the new chairman of the DV-WG to take up immediate responsibility. Together with the GHRSST-PO, Merchant will develop a new membership and terms of reference for the DV-WG and report recommendations for diurnal variability parameterisation schemes at the 6th GHRSST-PP Science Team Meeting in 2005.

14. **GHRSST-PP web site.** The Science Team agreed that the current implementation of the GHRSST-PO web site was too complicated and out of date in several places. The site should be completely overhauled and contain a separate section for the GHRSST-PP Science Team/project management ('Experts') and a distinct section for user interactions ('Users'). In addition, the use of simple FAQ type 'live' documentation should be promoted to simplify the task of reviewing the GHRSST-PP and retrieving important information. Furthermore, more emphasis should be given to the application of GHRSST-PP data products and services rather than to the project management. It was agreed that a summary document is prepared to clearly identify how and from where a typical user might obtain GHRSST-PP data, indicating any restrictions on the application and publication of GHRSST-PP data sets. Separate pages should be developed for each RDAC and for GDAC systems that provide a basic summary of activities but link back to the actual project web sites (where available). Pages should be developed for each of the GHRSST-PP working groups providing a summary of their activities and documentation. Most importantly, the site should be kept current. The pages should act eventually as a portal system for the GHRSST-PP and a content management system was recommended for managing the site.

    The GHRSST-PO Director acknowledged the Science Team comments and requests and agreed to implement the changes immediately. The GHRSST-PO Director requested that RDAC and GDAC teams work closely with the GHRSST-PO and prepare appropriate pages for each project as part of the new web site.

15. **GHRSST-PP Development and Implementation Plan (GDIP).** The Science Team requested that the GHRSST-PP Development and Implementation Plan (GDIP) should be revised by the GHRSST-PO and updated to reflect the recent and rapid developments within the GHRSST-PP since the 4th Science Team meeting. It was noted by the Science Team that the GDIP is the first document that is typically consulted following a review of the GHRSST-PP web site and this should be an accurate representation of all activities within the project. The Science Team requested that the implementation plan be kept as a simple document that refers out to technical documentation where appropriate and that a WWW hyper-link version of the document is made available on the GHRSST-PP web site.

    The GHRSST-PP Project Office will coordinate the development of an updated version of the GHRSST-PP GDIP in readiness for the GODAE Symposium St Petersburg, Florida, USA, 1-6th November, 2004. The GHRSST-PO Director requested that inputs from RDAC and GDAC teams

together with inputs from all of the GHRSST-PP working groups are made available for integration within the GDIP as soon as possible.

16. **Science Team appointments.** Jean-Françios Piollé (IFREMER, France), Andrew Bingham (JPL, USA) and Chris Merchant (University of Edinburgh, UK) were appointed to the GHRSST-PP Science Team. Piollé will represent the Medspiration project as of 2005, Bingham is the Team leader of the OCEANIDS project (GDAC ingestion system) and Merchant will take up responsibility for the GHRSST-PP DV-WG based on his R&D experience.

2.2 The GHRSST-PP Data Processing Specification (GDS)

1. **L2P data products.** It was clear that several key members of the Science Team were unfamiliar with the content of the GHRST-PP Data processing Specification v1.5 (GDS-v1.5) documentation which hampered and confused much of the discussion. However, the workshop spent some time reviewing the content of GDS-v1.5 L2P data sets (specified in detail at the 4th GHRSST-PP Workshop, Pasadena, USA 2003). Some members of the Science Team initially noted that L2P data products were over-specified. However, as the meeting progressed, the benefit of the L2P data product was clarified and the majority of the Science Team was satisfied that the L2P scope and content was appropriate for the development of the GHRSST-PP at this time. It was noted that there was considerable work required to derive infrared/microwave proximity confidence values (IPCF and MPCF) but that these fields are essential if GHRSST-PP was to be able to continue in the regional/global task sharing framework. Without a common bias adjustment scheme and a standards-based common data product format, the GHRSST-PP would become a collection of loosely defined national research projects rather than a global collaboration working together.

   Concern was raised about the content of ancillary fields attached to the L2P data sets which had been changed from flag indicators to data fields at the 4th GHRSST-PP Science Team workshop. The validity of using satellite wind speeds together with NWP model analysis was questioned. Discussions suggested that the benefit of satellite wind speeds is marginal as these are instantaneous whereas model data are only approximations to the true wind field. It was noted that the original basis for the inclusion of wind data within L2P was to provide an indicator flag for high/low wind speed conditions that can be used to stratify a data set in terms of data likely to be influenced by diurnal warming. At the 4th GHRSST-PP Science Team workshop, it was agreed that a wind field would be used instead. However, as diurnal variability is defined to a certain extent buy the historical wind field, a time-averaged (NWP model) estimate is probably a more meaningful quantity. The Science Team discussed the potential for a simplification of the L2P data products but discussion was hampered due to several key Science Team members being unfamiliar with the GDS documentation. In order to progress, it was agreed that the GDS-TAG, including representation from all RDAC, will provide a critical review of the GDS-v1.5 and a proposed revision to GDS-v2.0 (including the L2P data format) for consideration at the 6th GHRSST-PP Science Team meeting. As part of this effort, the GDS-TAG agreed to summarise the GDS-v1.5 as a FAQ document that can be published on the GHRSST-PP web site.

   A summary document describing the MISST schedule and deliverables was circulated by the MISST PI which indicated that the GHRSST-PP Medspiration (EU project) and Multi Instrument SST (MISST, USA project) were in general agreement for L2P, MMR and MDB data product content, format and output schedule. As part of the MISST development process, it was agreed that L2P data products could be extended to include additional error fields to hold additional 'MISST-specific' error fields as the netCDF format was extensible. To ensure compatibility across the GHRSST-PP and to provide accurate user documentation, all MISST GDS data format field extensions must be agreed by the GHRSST-PP Science Team and fully documented by the GHRSST-PO. Both RDAC teams have agreed to provide initial test L2P data for the AATSR, MSG SEVIRI, AMSRE, TMI and AVHRR GAC by 15th December 2004. A sustained production of L2P data products will commence in April 2005 with Ultra-high resolution (UHR) L4 data products expected from the Medspiration project for the Mediterranean Sea shortly after. L4 global coverage data products are expected toward the end of 2005 from the MISST system following successful commissioning of the GDAC.

2. **L4 analysis systems.** It was noted that the GDS-v1.5 is poorly defined in terms of the L4 analysis procedures to be implemented by RDAC and GDAC systems. This is because there is poor consensus across the wider community on the most appropriate 'universal' analysis

procedure to adopt for SST data production. In practice, several presentations demonstrated that operational analysis systems are typically large, expensive installations that are relatively inflexible in their configuration due to operational constraints. However, progress is being made within the GHRSST-PP. The Medspiration team have developed an extremely flexible L4 analysis system for the Mediterranean Sea which will provide 2km Ultra-high resolution SSTfnd data products. The system has been designed for easy expansion to global coverage and to allow simple but comprehensive control configuration of all parameters and will be an exceptionally useful tool for the GHRSST-PP. Within the MISST project, several different global analysis systems/configurations will be used according to the specific application scenario. Inter-comparison of these data products will enable the GHRSST-PP Science Team to reach an informed consensus on the best practices to implement for the GHRSST-PP RAN project which will develop the legacy data set for the GHRSST-PP.

Richard Reynolds presented ideas for a multiple time-space scale OI system that would be capable of balancing the high resolution infrared scale data with lower resolution microwave data without losing independence of each data type. Reynolds suggested that two analyses should be performed; a High Resolution Analysis (HR, ~ 10km) using high resolution infrared data as input and a Low Resolution Analysis (LR, ~ 50km) based on low resolution infrared & microwave data. The method would use the previous HR analysis as the First Guess (FG). The FG would be smoothed to the lower resolution data set (LR FG) and the LR analysis computed using the native LR data. The increments produced would be added into the high resolution first guess (HR FG) and the HR analysis computed using the adjusted HR FG and HR data.

Tsurane Kuragano presented the Japanese Meteorological Agency (JMA) multiple time-space scale OI system that already implements the earlier suggestions of Reynolds. This system, called the Merged Global Daily SST (MGDSST) decomposes the time space scales of AVHRR-GAC and AMSR-E gridded data using a Gaussian filter into 3 distinct regimes (low, medium and high). Kuragano noted that in particular, the dynamic structure of the analyzed SST fields is much more realistic when the multiple time/space scale OI scheme is applied when compared to a single scale system. This is due to the fact that the random noise error in satellites' SST is effectively removed by the Scale-decomposition OI scheme. MGDSST data products can be obtained from the Japan-GODAE LAS (http://godae.kishou.go.jp) and NEARGOOS RRTDB (http://goos.kishou.go.jp).

The Science Team agreed that there is still no consensus on the 'optimal' SST analysis system for the GHRSST-PP but noted that the scale-decomposition approach was the most promising approach. There is still benefit in the development of multiple analysis systems in which RDAC teams will work towards regional (and in some cases, global) coverage L4 data products that can be compared and assessed. The workshop concluded that the GODAE data inter-comparison project/framework should be used to compare L4 analysis as this was well established in terms of methodology and protocol. In addition, there are several relatively simple statistical schemes that can be used to assess the uncertainty of L4 analysis products in addition to the use of observed-analysis/forecast/climatology approaches. In the short term, it was agreed that the NRL Sea Ice and SST analysis system currently being configured for the MISST RDAC would provide the GHRSST-PP baseline global coverage L4 data products.

3. **SST errors and error statistics.** There was some confusion concerning the definition of SSES. SSES, in the GHRSST-PP GDS context, refers to the statistical derivation of a mean bias error and standard deviation associated with a given sensor for a specific confidence value (defined by either the infrared proximity confidence value (IPCV) or the microwave proximity confidence value (MPCV)) over a defined time period. SSES are designed to assess L2 data provided by an L2 SST data provider and it is assumed that the L2 data provider will take all steps to provide the best possible data product to the GHRSST-PP. SSES are derived solely from analysis of GHRSST-PP Matchup Database (MDB) records and are fully documented in the GDS-v1.5 documentation. The concept of SSES is essential to the GHRSST-PP R/GTS framework as this allows any RDAC/GDAC system to provide a statistical bias error estimate for a given satellite sensor and pixel. It allows RDAC and GDAC to inter-compare error statistics in a real time environment. The GHRSST-PP SSES methodology has a demonstrated operational heritage as it builds on the operational methodology that is implemented at NAVOCEANO and EUMETSAT Ocean sand Sea Ice Satellite Application Facility.

Some groups are actively working with data providers to generate better L2/3 SST data products that can be used within the GHRSST-PP framework. For example, Anthony Rea presented

significant improvements in LAC AVHRR data that have been achieved through improved image navigation which is critical if a high-resolution product is to be generated. Chris Merchant noted that significant bias errors are present in data due to clouds in infrared data sets noting that a Bayesian cloud clearing approach may provide a more optimal solution. Within the MISST project, a program of research will focus on the analysis of sensor dependent errors that may lead to improved L2 input data sets by accounting for errors during the creation of L2 data sets. However, unless a common reference is used to define errors that is then applied consistently to all input SST data sets, there is an ambiguity across the GHRSST-PP L2P data set. Following discussion, the workshop concluded that it may be better to make use of the improved sensor dependent error estimates where these are available using the appropriate flags provided in the L2P data product format in preference to SSES.

However, the maintenance of the GHRSST-PP MDB system and the derivation of SSES from collocated buoys and satellite data provide the GHRSST-PP baseline. Systematic errors can then be identified by the GHRSST-PP which will be fed back to SST data providers who are responsible for the implementation of appropriate corrections. From the MISST R&D program, it is anticipated that improved IPCF and/or MPCF confidence value methodology/specifications for SSES generation will be developed. All improvements and recommendations will be incorporated into the GDS-v2.0.

The EU RDAC team raised an issue with NAVOCEANO MCSST GAC data products which are provided as individual SST records rather than a geo-located raster. In this case, there is no spatial context information available in the data set which is required to calculate the distance to the nearest cloudy pixel – a fundamental parameter used in the derivation of an infrared proximity confidence value. NAVOCEANO indicated that they has considered modifications to the operational code used to produce MCSST GAC data and provide a distance to cloud estimate, but that this would be challenging to implement without significant modifications to the present system. However, it was noted that NAVOCEANO already provide a confidence value derived from similar principles to that proposed in the GDS-v1.5 and that the most favourable solution will be to establish a mapping between NAVOCEANO confidence values and GHRSST-PP IPCF values. The Science Team accepted that this was a viable solution that can be investigated using the GDS-v1.5 baseline system currently being implemented at the EU GDAC. The EU-GDAC, NAVOCEANO and GHRSST-PO will establish a mapping between IPCV and NAVOCEANO confidence values and present this to the Science Team for approval prior to the production of L2P data sets in December 2004.

The workshop noted that the implementation of the GDAC Matchup Database (MDB) system was far from complete. It is unlikely that a GDAC MDB system will be ready for the 15th December 2004 deadline imposed by the EU RDAC due to uncertainty in funding and resource limitations (more effort has been invested at the GDAC to develop the Metadata repository system which is a priority for the GDAC data management strategy). The Science Team concluded that until MDB-derived SSES error estimates are available, SSES may be specified using the best available information for a given sensor (which may in some cases be a simple static estimate based on limited coverage in situ-satellite comparisons). The Science Team noted that the implementation of the GHRSST-PP MDB system is on the critical path fore the project as a whole and urged the GHRSST-PO to work towards a solution to rectify this situation. In conclusion, it was agreed that Southampton Oceanography Centre, the GHRSST-PO and JPL PO.DAAC would work together to implement a MDB system as a matter of urgency.

Sandra Castro presented an interesting analysis of error characterisation in infrared and microwave SST data sets based on the use of atmospheric and oceanographic in situ observations. Complex relationships could be seen between various parameters (sea level pressure, air-sea temperature difference and wind speed) highlighting the need for a concerted investigation of error sources and their propagation. In particular, the ability of MW SST to provide a clear estimate of the SSTsub-skin was called into question as contemporaneous TMI and buoy data suggested that in the case of TMI SST, a cool skin effect is present in the data. The Science Team endorsed this type of approach to error characterisation and encouraged continued research to ensure that any systematic error corrections that can be implemented by L2 SST data providers are implemented at source and that improvements to the derivation of SSES confidence value specification are included in the GDS-v2.0.

4. **Diurnal variability parameterisations.** Considerable discussion focussed on the application of diurnal SST variability parameterisation schemes within the GHRSST-PP. While advances have

been made it is clear that more work is required to develop an operational methodology that reliably accounts for diurnal variability in all areas. Presentations by Bruno Buongiorno-Nardelli and Pierre LeBorgne reviewed the application of the Stuart-Menteth diurnal variation parameterisation (ACSM, proposed in the GDS-v1.5 following endorsement at the 4th Science Team meeting) which was found useful as a means to control L2P data prior to their use in L4 analysis schemes if tight environmental constraints (so called 'BEST' limits) were imposed on its use. The wind speed data used to drive the parameterisation was critical to the ability of ACSM to obtain a useful output and typically, the use of ECMWF wind speed forecast data let to an overestimate of diurnal signal. It was recommended that wind speeds <2.5 m/s should not be used with the present formulation of the ACSM scheme. The parameterisation was less robust when used to provide an estimate of the $SST_{sub\text{-}skin}$ when applied to SST_{fnd} analysis. The Science Team concluded that more work was urgently required to derive new schemes (including a new formulation for the ACSM scheme) that were more robust. It was acknowledged that the principle limitation to any scheme is the lack of high resolution wind speed observations.

It was agreed that where an estimate of SST_{skin} is required (e.g., within the L4 SST_{fnd} data product), an infrared SST data derived from a geostationary sensor (e.g., SEVIRI, MT-SAT or GOES) would provide a more robust estimate than any model/parameterisation and should therefore be used in lieu of any model derived estimate. Where no data are available (e.g., due to clouds), then a parameterised estimate is the only available option. In this case, data should be clearly labelled as a parameterised estimate in L4 data products. Ian Barton presented an analysis of GOES-9 data which highlighted the need to exercise stringent quality control on some geostationary data; in the case of GOES-9, the problem of diurnal cycling of the sensor on board the satellite requires a midnight blackbody correction which complicates their use for diurnal SST studies. It was noted that the GHRSST-PP Diurnal Variation Working Group had a significant responsibility to establish the best practice methodology accounting for diurnal variation the GHRSST-PP by the 6th workshop.

5. **Availability of MSG-SEVIRI data**. The EUMETSAT Ocean and Sea Ice Satellite Application Facility (O&SI SAF) have now operationally released MSG-SEVIRI SSTsub-skin data. Pre-operational validation analysis, based on in situ satellite match up data show a mean bias of -0.06 K (SD=0.48) for night time data and a bias of -0.13K (SD=0.53K) during the day. Data are provided at a resolution of 10 km every 3 hours and are available via ftp from the EUMETSAF SAF (anonymous ftp, ftp.ifremer.fr, cd ifremer/cersat/SAFOSI). The Medspiration project will provide a full L2P version of these data for use within the GHRSST-PP in April 2005. The Science Team noted that the EUMETSAT products degraded the spatial and temporal resolution of MSG SEVIRI data.

6. **Recommendation for hourly 5km SST data sets from MSG-SEVIRI.** Given the recommendation for the direct use of geostationary SST observations, the GHRSST-PP Science Team requested that hourly full resolution MSG SEVIRI data are made available to the GHRSST-PP for a significant (3-6 month period) so that diurnal variation studies can be conducted to establish the best way forward. This is especially relevant to the Mediterranean Sea (and thus the EU-RDAC Medspiration project) where significant diurnal variability was clearly visible in several data sets. The Science Team asked the GHRSST-PO to formerly request the EUMETSAT O&SI SAF to provide hourly 5km SEVIRI data to the GHRSST-PP and for general use.

7. **Availability and access to 1km global coverage AATSR data.** AATSR data served by the ESA Cat-1 'GHRSST-PP' project will be served via ESA accessed via the EU-RDAC. The GHRSST-PP Science Team requested that ESA consider providing global coverage L2P AATSR data products rather than regional coverage L2P data sets to complement the activities of the USA RDAC system providing global coverage AMSRE, TMI and AVHRR GAC L2P products. The rational for this approach is that the AATSR is a particular sensor that is best administered by the European groups most familiar with the data. The ESA representative agreed to consider a viable route forward to the provision of global coverage 1km L2P data for the AATSR sensor noting that this was a considerable undertaking as compared to low-volume SST data sets which are considerably less demanding. The likely implementation scenario will be at the re-negotiation of the Medspiration contract prior to Phase 2 of the project (sustained operation of the service) due to commence in April 2005. This decision is based on the need to avoid introducing incomplete data formats (so called L2P-lite) that may compromise the integrity of the Medspiration project. It was noted by the ESA delegate that the Regional Global Task sharing framework agreed at the 4th GHRSST-PP workshop was evolving into an RDAC system in which each RDAC provided a specific set of L2P data products for a given sensor. This was in part due to the composition of

partners working within the RDAC where data providers are working together with the R&D community.

8. **Request to ESA for a follow on AATSR system.** Dr. Olivier Arino informed the delegates that within the European Space Agency GMES Earth Observation Component Definition of Preparatory Activities (ESA/PB-EO(2004)48), there is no intention to continue the ATSR class of sensor aboard the Sentinel-3 Ocean missions. The Science Team noted that continuity of AATSR data is essential to monitor the SST for the GHRSST-PP reanalysis effort as it is a unique satellite sensor capable of systematically delivering the accuracy required for climate detection (as demonstrated by the presentation of Gary Corlett). Following extensive plenary discussion of the future prospects for GHRSST-PP with and without the input of a post-ENVISAT AATSR operational capability, the International GHRSST-PP Science Team requested that the GHRSST-PO Director should write to the director of ESA. The content of the following recommendation to ESA for the proposed Sentinel-3 (Oceans) mission was agreed.

   "The International GHRSST-PP Science Team[1] recognizes the unique capability of the Along Track Scanning Radiometer class of satellite imaging radiometers as an essential contribution to the development of accurate global coverage sea surface temperature data sets in an operational framework. The exceptional on-board calibration system and the ability of (A)ATSR to account for atmospheric aerosol contamination delivers a SST data set that is sufficiently accurate and consistent to act as a reference data set to which other satellite sensors can be compared. The ATSR has a proven history and over 12 years of measurements are available (with suitable overlap periods in adherence to the GCOS climate monitoring principles) which will form a critical component of the GHRSST-PP reanalysis effort. The GHRSST-PP Science Team also recognizes the major contribution that the European Space Agency is making towards the integration of international SST research community. In particular, the successful ESA investment in a real time data service providing global coverage AATSR 1km data products for application development within the GHRSST-PP. The loss of an AATSR class SST data stream post-ENVISAT will have considerable impact on the ability of the GHRSST-PP to meet its goal and objectives and the expected outcomes of investment already committed to GHRSST-PP by the international community.

   The GHRSST-PP Science Team therefore request that:

   1. The European Space Agency consider flying an AATSR-like follow on mission with a view to provide an operational sustained service on board Sentinel-3 mission in order to extend the 12 year AATSR reference SST data set beyond the ENVISAT lifetime.
   2. The Instrument should provide a 1km or better spatial resolution to satisfy the requirement for detailed information in the coastal zone.
   3. Ideally, the current AATSR instrument should be extended to provide a wide area coverage of at least 1000km.
   4. The Instrument should aim to deliver SST data sets to an accuracy of better than 0.3K (sd of ±0.3K, 1σ) for 1/12° latitude x longitude grid cells and a daily repeat coverage.
   5. A zero bias and an uncertainty of ±0.3K (1σ) for a 5° latitude x longitude area and 1 month time scale are required to monitor SST for climate change research.
   6. A long term SST stability requirement is based on SST monitoring of global climate change and is set at 0.1K/decade.
   7. A polar orbit platform should be flown in a configuration that avoids sampling during the afternoon period local solar time."

9. **Availability of AIRS data**. It is expected that 45 km spatial resolution AIRS SST_{skin} data in native L2 granule form will be available at the JPL DAAC by January 2005. There are no immediate plans to generate a L2P data product for AIRS SST data products although it is possible that this could be produced. It was noted that the best use of AIRS data at this stage within the GHRSST-PP would be within the HR-DDS system. In addition to SSTskin products, AIRS provides a suite of other atmospheric parameters including surface emissivity, atmospheric humidity temperature profiles, various cloud products, flags for cirrus and atmospheric aerosol and air surface temperature all with accompanying error estimates.

   It was noted that the AIRS data set is extremely large and it was unclear to the Science Team how all of these data could be used within the GHRSST-PP. The GHRSST-PP Science Team requested that the AIRS team that L2P SST data products be prepared for at least the GHRSST-

[1] Membership and affiliation of the International GHRSST-PP Science Team is enclosed with this letter.

PP HR-DDS sites and preferably for global coverage data sets. In conclusion, D. Hagan agreed to liaise with RDAC and GDAC team members and define an optimised strategy for the operational inclusion of a specific set of AIRS data products within the GHRSST-PP activities.

10. **Tropical Rainfall Mapping Mission (TRMM) satellite switch-off plans.** The GHRSST-PP Science Team request that NASA maintain the operational status of the TRMM system in order to continue the unique provision of TMI and VIRS SST data products. TRMM provides the only satellite system that has a truly contemporaneous infrared and microwave radiometer system and is extremely important for the correct interpretation of microwave SST retrievals. The GHRSST-PO has written, on behalf of the GHRSST-PP Science Team, a letter of support to the TRMM project office urging NASA to maintain the TRMM satellite and SST data products.

11. **Availability of MODIS data**. A proposal has been submitted to NASA by the JPL PO.DAAC to create a level 2 pre-processed (L2P) MODIS SST product in near real time in support of the GHRSST-PP project. PO.DAAC intends to use the Goddard GES DAAC and NOAA MODIS real time system that distributes 5 minutes of observational data, equivalent to one MODIS granule. One hour of compressed SST data amounts to 120 megabytes. PO.DAAC will then collocate and merge necessary ancillary data and compute confidence and error statistic data required to generate a L2P data file. An approximation for the amount of L2P delivered for one hour of the NOAA MODIS SST data would be ~500 megabytes at a 1 km resolution.

    The GHRSST-PP Science Team commended the PO.DAAC for their efforts to alleviate this problem and noted that without such an effort, MODIS SST data were unlikely to form a core component of the GHRSST-PP. However, considerable discussion of the large data volume generated by the MODIS sensor concluded that the PO.DAAC should revise the proposal to consider a 4km MODIS data product that would significantly reduce the data volume and provide an optimised solution for the GHRSST-PP (which is targeting a 10km data product). The Science Team requested that the GHRSST-PO prepare a letter of support for the PO.DAAC proposal that clearly states the need for a reduced resolution 4km L2P data product by the GHRSST-PP.

12. **Problems with Microwave SST retrievals in the EU area**. Two problems were raised for MW SST retrievals in the EU area. The first was raised by the Medspiration team who noted that there has inconsistent coverage of the eastern Mediterranean Sea when using Remote Sensing Systems data products. Gentemann and Ruiz agreed to investigate the sparse MW data availability in the Mediterranean and report back to the GHRSST-PP Science Team.

    The second problem is related to interference by European television satellite broadcasts which effectively prevent AMSR SST and wind speed retrievals in certain view geometry situations. Gentemann noted that the UK/western France area was is the only place that the effect has been noticed but other areas may suffer from the same interference. The Science Team noted that there is a clear need to ensure future satellite missions are not corrupted by satellite television broadcasts. In conclusion, the GHRSST-PO will inform Guy Rochard explaining the derogatory impact of European geostationary Television satellite broadcasts on the quality of MW SST data sets in the European area. Further work will be undertaken using AMSR-E data in Russia/Japan, and within the MISST and Medspiration projects to flag erroneous data due to these effects.

13. **Master Metadata Repository (MMR) system.** The GHRSST-PP metadata repository system has been implemented at the JPL GDAC based on the agreed MMR structure reviewed by the GHRSST-PO, PO.DAAC and Medspiration RDAC teams in February 2004. The MMR adheres to the NASA DIF format using a streamlined set of attributes. MMR records will be generated and delivered to the system in XML format according to the GDS-v1.5 Document Type Definition (DTD) specifically developed for the GHRSST-PP by Jean-François Piollé. The format of MMR records, XML wrapped example records and XML DTD is fully documented in the GDS-v1.5. Two types of metadata records are required: a Data Set Description (MMR_DSD) record containing static metadata common to all files (i.e., same sensor) which will be prepared in collaboration with the GHRST-PO. Dynamic metadata (e.g., parameter, location etc.) will be contained in a separate MMR File Record (MMR_FR) which is attached to an appropriate MMR_DSD and linked by a common field (Entry_ID). MMR_FR will be prepared by RDAC/GDAC systems on a file-by-file basis.

    The current MMR implementation is based at JPL and has been built using a MySQL database (version 4.0.17) installed on a dedicated MMR system server (coda.jpl.nasa.gov). A complete set of MMR_FR test metadata has been created for MODIS L2 data as an end-to-end test. >400 FR

metadata files were ingested by the system without error or user intervention over 3 days using an e-mail based delivery (i.e., not through the OCEANIDS system). A user interface is currently being developed for the MMR system based on PHP which should be available at the end of 2004.

The Science Team commended Ed Armstrong for his work to develop the MMR and noted that this system was the cornerstone of the GHRSST-PP data management strategy. Several issues must be resolved including the mode of operations for updating GHRSST-PP data sets at the MMR and the relationship with the GHRSST-PP RAN and data archive. The Science Team requested that the DM-TAG review these issues. In addition, the Science Team requested Armstrong to circulate his ideas for a graphical user interface for comments and discussion prior to implementation. In particular, the mechanism for delivery of multiple records should be considered carefully so that delivery can remain flexible toward the users preferences (i.e., globbing, standard web browsing etc).

14. **Matchup Database (MDB) system**. The implementation of the MDB system is still in a conceptual design phase. The content and structure for MDB records has been defined in the GDS-v1.5 and it is proposed to deliver data in an XML format according to the DTD specified in the GDS-v1.5. MDB records have been designed to accept a 5 x 5 array of L2P data centred on an in situ measurement. This can be revised to provide a 7 x 7 or greater array extraction as required. The MDB allows multiple in situ parameters and an option to include profile data to a depth of 100m specifically to capture ARGO (and other) profile data. The Science Team noted that once the MDB system was operational there would be some latency in the system before SSES could be generated as this required significant data for each sensor that included proximity confidence values. In order to build rapidly the population and for testing of the MDB system, it was agreed that existing MDB data records from other institutions could be ingested into the GHRSST-PP MDB system to initiate the database and provide a means to compute basic SSES. In order to expedite this process, the Science Team requested that code is provided to generate an initial MDB population based on example records provided by RSS, the University of Miami, CMS and NAVOCEANO.

    Following discussion, the Science Team noted with concern that the implementation of the MDB service is on the critical path for the successful implementation of the GHRSST-PP and remains a priority issue for the project. It was agreed that a joint effort between the GHRSST-PO, Southampton Oceanography Centre and PO.DAAC engineers will try to provide a viable system by the 15th December 2004 in order to test the Medspiration RDAC system functionality.

15. **GHRSST-PP XML advisory Group.** Several Science Team members were concerned by the use of XML within the GHRSST-PP and requested that a working group be convened to act as a central information source for questions and issues relating to the implementation of XML data systems within the project. It was agreed that while this could be a sub-group of the Data Management TAG, the development of the GHRSST-PP may require further implementation of XML and variants across the project. In conclusion, A GHRSST-PP subgroup will be convened to advise RDAC teams on the appropriate use of XML and to evaluate the GHRSST-PP XML DTD definitions for MMR and MDB systems. Ed Armstrong has been appointed Chair of the group with members: Piollé, Casey, Poulter and Donlon. The group will be open to all other Science Team members and will report at the 6th GHRSST-PP workshop through the DM-TAG.

16. **Development of a GDS-v2.0.** Considerable discussion was invested in defining the procedure and methodology for upgrading the GDS-v1.5. The Science Team acknowledged the need for a baseline processing system description and the benefits of the European Medspiration project implementing the system within an operational context. Nevertheless, it was agreed that the GDS-v1.5 must now be developed based on new scientific knowledge and operational experience in order to innovate the GHRSST-PP. A version 2.0 GDS document will be developed in parallel to the current GHRSST-PP activities base lined against GDS v1.5. This will be coordinated by G. Wick and the GDS-TAG group and will be reviewed at the next GHRSST-PP Science Team Meeting (Exeter, UK, May 2004). The GDS-v2.0 will then undertake a full Critical Design Review in June/July 2005 before final acceptance and implementation during the middle/latter part of 2005. The process of iterating the GDS documentation to v2.0 was considered a critical development for the international consortium implementing the GHRSST-PP and was welcomed by the Science Team as a first step to providing a robust and sustainable GHRSST-PP system. The upgrade process demonstrates the GHRSST-PP to be responsive to new developments in

the field and allows the RDAC teams to confidently innovate the GHRSST-PP methods and algorithms against a baseline system.

2.3 The GHRSST-PP Reanalysis project

1. **GHRSST-PP Reanalysis Technical Working Group Report (RAN-TAG).** The RAN-TAG has been working steadily throughout the inter-sessional period since the 4th GHRST-PP workshop and has submitted a report describing the RAN-TAG Terms of Reference and mode of operations to the Science Team in January 2004. The report carries a summary of the main conclusions resulting from the 4th GHRSST-PP workshop and scopes a definition of the main RAN product characteristics. RAN data products will be built from L2P data sets taking advantage of delayed mode L2P data sets that did not enter into the real-time analysis procedures, improved error statistics derived from multiple sources, the ability to make use of correlation scales derived from data prior to and following the analysis date, improved diurnal variability schemes and improved but consistent analysis schemes. SST_{fnd} data products, conforming to the GDS-v2.0 specification, will be generated by the RAN system with a delay on the order of 12 months. The report notes the importance of properly investigating overlap periods between different satellite missions (in accordance with the Global Climate Observing System [GCOS] monitoring principles) in order to reconcile biases within the long-term SST data record which requires the utilization of SST data prior to the GHRSST-PP operational period. This point was underscored during the presentation of David Llewellyn-Jones who demonstrated the combined use of (A)ATSR and AVHRR data to detect climate change signatures in global SST data sets. Given that GODAE has recently requested a long-term historical SST data set for its own purposes, this extension to the original scope of the RAN project was welcomed by the Science Team.

   The Science Team thanked the RAN-TAG for their efforts in preparing the report which was provided as a reference document prior to the workshop.

2. **RAN Implementation Plan (RAN-IP)**. Prior to the Workshop, the RAN-TAG had prepared a draft implementation plan (RAN-IP) and a RAN-TAG meeting was held during the workshop to consider the RAN-IP proposals prior to presentation in plenary. The essential components of the plan focus on the data flow and archive of L2P and other SST data sets within the GHRSST-PP. The GDAC system is a critical component of the RAN-IP as this is the system through which all data are ingested into the GHRSST-PP via the OCEANIDS interfaces. Furthermore, data catalogues are maintained via the MMR system, also part of the GDAC system. Current GDAC plans only foresee a 1Tb rolling archive system that will provide at best ~20-30 days of storage for GHRSST-PP data products. The RAN-TAG introduced the concept of a Long Term Stewardship Center (LTSC) that would interface directly with the GDAC system and sweep data from the GDAC rolling archive according to a predefined cut-off period (allowing spare capacity at the GDAC for system problems). The National Oceanographic Data Centre is provisionally eager to take up responsibility for the RAN LTSC subject to clarification of data volumes and funding by mid January 2005. This would allow sufficient time for testing of the RDAC systems as they spin up in December 2004 – April 2005. In summary, the function of the LTSC is:

   - Ingest: Receipt, verification, and proper cataloguing, via appropriate file-level and collection-level metadata, of the input data streams
   - Archive: Offsite backup, media migration, validation of stored data, etc
   - Access: Providing data and metadata to a both a diverse user community and the Reanalysis Computational Facility (RANCF)
   - Application: Use and testing data in a variety of applications with feedback on the data quality
   - User Services: Standard user assistance, but also serves as the vital feedback loop to receive user input on problems, new applications, and directions for future improvements.

   The LTSC intend to make all data online freely available via http, ftp, and OPeNDAP. It will formally archive the L2P and L4 data, MDB, HR-DDS, and MMR, according to NODC procedures (cost estimate approximately $70K) and provide access to the entire GHRSST-PP collection to enable multiple RAN reprocessing runs. In addition, it will provide the IT support staff to ingest these data into the NODC systems. In order to operate the system, the RAN-TAG intends to seek funds in association with the GHRSST Project Office (PO) to support User Services requests for these data. It is expected that approximately $70K would be required to handle requests for GHRSST-PP products. The Workshop noted that the USA National Ocean Partnership Program (NOPP) mechanism should be explored for initial funding.

The RAN-TAG introduced the RAN Computational Facility (RANCF) which will be used to host RAN analysis systems and produce RAN data products. The RAN-TAG noted that ideally, the RANCF and the LTSC should be hosted at the same location (NODC) to minimize data transfer latency within the system. This system must be funded and the RAN-TAG proposed to seek, in association with the GHRSST-PO, funds to develop the RANCF at NODC and to conduct periodic reprocessing of the L4 products and to extend those reprocessing to include periods prior to the GHRSST demonstration phase as feasible. The RAN-TAG Chair requested assistance from the Science Team to scope out an initial 'ball park' costing for the RNCF system.

3. **RAN User Requirements Document (URD)**. As part of the RAN-IP development process, the RAN-TAG has identified a preliminary user application community that will be consulted widely as input into a RAN User Requirements Document (URD). The applications, including medium and seasonal range forecasting, include:

    - Education
    - Research
    - Water Resources
    - Energy
    - Agriculture
    - Forestry
    - Transportation
    - Defence
    - Health
    - Insurance
    - Recreation and Tourism
    - Manufacturing
    - Retail

    The RAN-IP will develop a URD based on the Medspiration URD and will include the following fields (for each potential application)

    - **Point of Contact**
        - URL, Name and Address
    - **Description**
        - Text on institution providing requirements and their SST uses
    - **SST Requirements (table with both current SST usage and desired requirements)**
        - Domain (e.g., Baltic Sea, global, lat/lon ranges)
        - SST parameter type (e.g., L4 or L2P)
        - Spatial Resolution (e.g., 1/12 deg, 4 km)
        - Temporal Domain (e.g., L2P 6 hourly, L4 Daily)
        - Accuracy (e.g., 0.4 K)
        - Format (e.g., HDF, netCDF, GRIB, BUFR, ASCII)
        - Data Request Period (e.g., 2005-2009)
        - Data Delivery Method (e.g., ftp push/pull, OPeNDAP

    In addition the RAN-URD will request that applications and users provide an estimate of the temporal stability requirement for SST data sets which is not included in the existing GHRSST-PP URD documentation. This is a key data product characteristic for any reanalyzed data set. The Science Team endorsed the proposal of the RAN-TAG to generate a URD describing the user/application needs for SST data sets from an off line Climate Data record perspective.

4. **RAN CDR Requirements Review.** The proposed RAN-IP considers wide SST community consensus as a fundamental foundation for the development of RAN SST Climate Data Records (CDR). The RAN-IP notes two important ways of interfacing with the SST community:

    i. Through the interface between the RANCF and the community of scientists and developers which is the GHRSST-PP and RAN-TAG focal point
    ii. Through two-way exchanges with, and development of, user communities and the active solicitation of user/application feedback.

The workshop discussed the various definition of CDR based on the National Academy Report on Climate Data Records from NOAA Operation Satellites, the NOAA White Paper on CDR from Operational Satellites and the GCOS Climate Monitoring from Satellites Principles. The Workshop noted that most of the requirements are already incorporated within the RAN system plans but these need to be clearly stated in the RAN-URD and the RAN-IP documentation. In conclusion, the Science Team agreed that the proposed RAN system will satisfy statements on CDR, provide a useful contribution to GODAE and the wider scientific community and ensure that a legacy SST data set of high quality for the 'golden age' of satellite SST is archived for future use. As a distant deadline for the completion of RAN activities as currently planned, the Science Team considered the International Panel on Climate Change (IPCC) reporting period as a useful marker (2010).

5. In conclusion to the RAN session, the GHRSST-PP Science Team endorsed the proposed RAN-IP and sub documents (URD, CDR review) as a viable proposal that has been developed in the context of a pre-existing framework. The Science Team requested that the GHRSST-PP reanalysis group provide a completed implementation plan document for the RAN activities in readiness for the GODAE Symposium St Petersburg, Florida, USA, 1-6th November, 2004 and also for input to the CLIVAR Ocean reanalysis meeting, Boulder Colorado, USA 8-11th November, 2004). The RAN-TAG Chairman and the GHRSST-PO Director will both attend this meeting and represent the interests of GHRSST-PP.

2.4 The GHRSST-PP High Resolution Diagnostic Data Set (HR-DDS)

1. **Status of the HR-DDS system**. A session of the workshop reviewed and discussed the implementation of the GHRSST-PP HR-DDS system. David Poulter presented the approach adopted by the Medspiration project team which is pioneering the HR-DDS. The Medspiration HR-DDS design is fully GDS (v1.5) compliant, (i.e. the products and basic system components are described in the GDS) and is designed to use 1/100th degree re-sampled data as agreed at the 4th GHRSST-PP workshop. All data discovery within the HR-DDS system will be made via the GHRSST-PP MMR system. Almost all components of the EU-RDAC system have been alpha or pseudo coded, some are already at beta stage. AATSR L2 derived HR-DDS global coverage granules are imminently ready to be produced non-operationally. L4UHR derived HR-DDS granules require a few days work to be able to be produced. L2P derived HR-DDS granules will require a little more thought, but are almost ready. In summary, the HR-DDS system should be the first Medspiration component to be ready, and should start to granules for AATSR very soon. The HR-DDS will be able to serve remapped L2P data sets and will generate png graphics format quicklook images to assist in the rapid web visualisation of HR-DDS granules.

   The Medspiration HR-DDS system is a 'stand alone' system built from of Open Source (or free) software. There are very few components unique to SOC or Medspiration. It is written entirely in Python, and can easily be made into a stand-alone executable for Windows (exe + dll) or Linux (distributable .c, .h and make files) systems, Java executable (with a bit of work) or just a Python package. In addition to the developments within the Medspiration contract, Southampton Oceanography Centre (SOC) intends to develop a suite of user services/interfaces for the HR-DDS system. These are based around the concept of an HR-DDS web portal providing:

   - Real time data display
   - Analysis of stats (bias, STD, RMS) on demand with user selecting data by site / time / sensor
   - Automatic monitoring for changes in bias / STD for each SST sensor
   - Interoperability services to provide HR-DDS granules in other formats (HDF) or on other projections.

   The Science Team commended the Medspiration team on their efforts so far and welcomed the offer to develop the Medspiration HR-DDS system as an installable package for other RDAC/GDAC systems to use following operational testing. In order for the system to function, each RDAC must have an operational OPeNDAP and ftp server implemented.

   The workshop considered the directory structure required by the HR-DDS system under which HR-DDS data granules would be stored. This is not specified in the GDS-v1.5 and was implemented as a single directory for each day of data from all sensors within the Medspiration system. There are benefits and disadvantages to the basic single directory system; it is problematic for OPeNDAP but good for wildcard ftp retrieval. The workshop concluded that a single directory for each day offers a compromise solution and should be maintained until detailed testing by the user

community. It was noted that suitable documentation was required to implement the HR-DDS system and to document future upgrades and changes.

2. **HR-DDS re-sampling scheme**. The Science Team considered the HR-DDS re-sampling scheme chosen by the Medspiration to generate 1/100th degree HR-DDS granules from native resolution L2P data sets. The current scheme specified in the GDS-v1.5 suggests a non-weighted nearest neighbour approach but does not specify the search radius to use when mapping from the sensor to the output grid. The Science Team agreed that this would be roughly ~1.2 * the resolution of the sensor but that this should be developed and tested. In conclusion, the Science Team requested that the Medspiration team provide a short summary report on the chosen search radius at the 6th GHRSST-PP workshop.

3. **Links between the MDB and the HR-DDS.** The workshop noted that both the HR-DDS and the MDB provide datasets valuable to some of the scientific challenges facing the GHRSST-PP but, at present, there are no formal interactions specified between the two systems. The workshop considered mechanisms to link these two systems as this synergy benefits are potentially large. The following mechanisms were explored:

    - Link the MDB entries to an HR-DDS site. This could be achieved by placing an element pointing to the corresponding HR-DDS (or L2P / L4) MMR-FR file if available in the MDB XML files. This could be considered as part of the GDS-v2.0.
    - HR-DDS web services could be enabled with access to the MDB, allowing the user to plot a time series of for example, average SZA from AVHRR data for a set of match-ups (data that is not available in the MDB records). The Science Team agreed that this would be an extremely useful capability from a user perspective.

    In conclusion, the Science Team requested that the interfaces to the HR-DDS are developed in a flexible extensible manner as almost certainly, the requirements from the system will develop alongside the functionality provided by the initial system. A series of 'standard operators' should be provided as part of the user interface (e.g., multiple time series plots of the mean HR-DDS SST value, subtraction of 1 time series from another, standard deviation of samples etc).

4. **Definition of HR-DDS granules.** The workshop considered the location of HR-DDS sites as specified in the GDS-v1.5 and expressed concern that the network design of the HR-DDS distribution was not optimal. In particular, the large HR-DDS sites at the Antarctic ice edge were found to constitute nearly half of the HR-DDS volume alone. The Science Team concluded that the latitudinal scope of the Antarctic sites should be maintained but that their longitudinal dimension should be reduced to 0.75° (i.e. 3 Microwave SST pixels). In addition, the Science Team requested that the HR-DDS distribution include more sites in the following regions:

    - Atlantic Saharan dust outflow
    - Mediterranean Sea
    - Pacific Ocean ARM sites
    - Western Boundary currents (Gulf stream, Kuroshio, Falklands-Malvinas).
    - Indian Ocean CLIVAR areas of interest
    - Agulhas retro reflection
    - In support of the RAPID project

    Craig Donlon reminded the Workshop that there is now a mechanism for GHRSST-PO to update a list of HR-DDS sites every month, in the form of a web posted configuration file that is required by Medspiration. Any member of the GHRSST-PP Science Team can request the addition or removal of an HR-DDS site at any time without it effecting operations (subject to approval by the Science Team), but the HR-DDS systems must be designed to be flexible enough to take advantage of this. The Science Team agreed that David Poulter would coordinate the GHRSST-PO and the RDAC's to produce organised changes to the HR-DDS list once Medspiration is operation.

5. **HR-DDS documentation Reference document (GHRSST/14)**. The workshop noted that the GHRSST-PP HR-DDS implementation plan was no longer valid as the Medspiration team had significantly developed the concept and design of the system. A new version of the document is required that should include a technical section describing the installation and configuration of an HR-DDS node site but also, a section describing how the HR-DDS is used (user interactions,

capability, limitations, etc). The Workshop requested that the Medspiration consortium consider the development of their user documentation in the wider context of GHRSST-PP so that maximum benefit could be gained from Medspiration/SOC experience and knowledge at other RDAC/GDAC HR-DDS nodes. This was especially relevant if the Medspiration team are intending to provide an HR-DDS package for use at other GHRSST-PP centres. In conclusion, David Poulter volunteered to coordinate a revised version of GHRSST/14 to include an implementation plan for the HR-DDS, a technical section describing the installation of HR-DDS codes and a user section describing how to interact with the system.

2.5 Validation and Metrics for the GHRSST-PP

1. **Development of Validation and Metrics for the GHRSST-PP**. The workshop considered the development of suitable performance metrics to monitor the performance of the GHRSST-PP system, data products and services at some length. Several metrics are already specified in the GDS-v1.5 documentation which relate to the production and delivery of L2P and L4 data sets. The discussion was focussed on the primary deliverables from the project which are:

    - L4 analysed SSTfnd (daily) and SSTskin (6 hourly) @ 10 km spatial resolution accurate to 0.4K or better every 6 hours
    - L2P SST in native sensor resolution and accuracy within 6 hours of reception at the satellite platform.
    - HR-DDS granules within 24 hours
    - MMR records within 1 hour
    - MDB records within 48 hours (but records will be accepted at any time)

    The discussion concluded that metrics should be specified in terms of a target value and a threshold value; e.g., a timeliness target could be 3 hours (ideal scenario) having a threshold of 12 hours (maximum acceptable delay).

2. **L4 product Timeliness metrics**. The GHRSST-PP needs to make sure a that L4 SSTfnd data sets are available within 12 hours of the Analysed Product Processing Window (APPW) and that they are current. The Science Team concluded that the delivery target would be 3 hours and the threshold would be 12 hours.

3. **L2P product timeliness metrics.** In the case of L2P data sets, timeliness metrics must be defined on a case by case basis. The following basic timeliness were agreed by data providers:

    - NAVOCEANO L2P AVHRR GAC: delivery target 6 hours and threshold 12 hours.
    - METOP L2P format provided by MERSEA in late 2006: delivery target 6 hours and threshold 12 hours.
    - NAVOCEANO L2P AVHRR LAC 1km coverage: delivery target 6 hours and threshold 12 hours.
    - For L2P geostationary data sets: delivery target 1 hours and threshold 5 hours.
    - Microwave SST: delivery target 6 hours and threshold 12 hours (TBC with Japanse Teams).

    In conclusion, following some discussion, broad metrics were agreed as a measure of the delay between satellite acquisition and production of Level 2P and delivery to the GDAC system as follows:

    - For polar/low-earth orbit platforms: target of 6 hours and a threshold of 12 hours
    - For geostationary platforms: target of 3 hours and a threshold of 6 hours

4. **Data coverage and data content metric**. A metric that allows a measure of missing data and missing orbits was discussed. In practice there are many reasons why data are unavailable including sensor problems/operations e.g., out-gassing or solar flare shutoffs, communication issues, processing issues, errors etc. The discussion reviewed the option to establish a metric based on the qualitative status of the satellite instrument and processing system/data provider in question using a log stating the reason why data are missing. A more favourable solution requested that RDAC systems could develop metrics to track missing orbits, missing data and ftp issues in statistical terms (e.g., percentage missing data). This has been done within the Medspiration project to some extent in order to demonstrate the functionality of the implemented

system. For example, various acceptable limits have been defined and the number of rejected values for a given data set are recorded. If the rejection rate for a given parameter within an L2P data file is too high then the entire file is rejected. The Science Team agreed that such metrics are useful and suggested that the Medspiration approach is explored further by other RDAC and GDAC. However, it was clear that some convergence is required to establish common metrics for data coverage based on experience. The issue was deferred until the 6th Science Team meeting.

5. **Data access, availably and transfer**. It was agreed that metrics associated with data provision, access and availability will be defined based on routine statistics (e.g., number of data files served, number of failed data transfers etc.) collected at data server sites (US-GODAE, PO.DAAC, Medspiration) for the major data providers (e.g., ESA, JAXA, PO.DAAC, Remote Sensing Systems). It was agreed that a metric should be defined to measure data transfer rates and timeliness of data. However, it was noted that harmonisation of the results would be difficult as each centre tended to use a different measure. In conclusion, the Science Team agreed that a review should be conducted by the DM-TAG of data access, availability and transfer following the operation of the GHRSST-PP user information services in 2005.

6. **Data quality metrics**. A series of metrics were discussed to measure the quality of GHRSST-PP data products which were based on the quality control tests as defined in the GDS-v1.5 documentation. Following some discussion, it was concluded that suitable limits for acceptable errors were wide ranging and user interaction/feedback is required at RDAC and GDAC centres before a final set of meaningful metrics can be established. Nevertheless, statistical measures capturing the percentage of missing data, percentage of out of range data, comparison with climatology and/or previous analysis fields used to define RMS and mean bias deviations, latitudinal averages, and the patterns associated with these statistics would provide the basis for meaningful measures. In addition, Innovation Vector Files can be used to measure observation-minus-forecast (OmF) differences and the forecast skill at each model innovation. Statistical parameters needed in OI analysis schemes can be derived (correlation length scales, observation errors) and used as the basis for metrics. Observation-minus-analysis (OmA) residuals can be used to monitor analysis system performance and to determine the fit of the analysis to observations and observing systems. Some of these measures are used operationally in analysis systems and the Science Team agreed to work closely with the GHRSST-PP analysis systems to define a set of standard metrics that will allow a meaningful assessment of data product quality as each new system becomes operational.

7. **L2P and L4 data product validation**. The workshop considered several options for the systematic validation of data products. The presentation of Merchant had noted that there is a real need to consider the systematic bias errors related to the errors within the retrieval system itself. The Science Team agreed that more work must be focussed to understanding regional satellite retrieval system biases as an integral component of routine comparison with in situ observations. Validation and consistency checks should be performed by routine HR-DDS analysis as a baseline effort and validation of ancillary L2P fields must also be considered. It was agreed that the use Reynold's SST, while not an independent data source, has proven extremely reliable as a tool for diagnostic studies within the HR-DDS. A particular issue with regard to the validation of L4 analysis products was the need to with hold data from the analysis itself in order to maintain independence. This is not always acceptable by operational; agencies who require the best analysis to be derived from all available data.

   In conclusion, it was clear that the validation of GHRSST-PP data products will be conducted as an initial scientific exercise using a combination of high quality in situ observations (radiometer, cruises, ARGO, moored and drifting buoys) and reference diagnostic tools (e.g., Reynolds OIv2.0, HR-DDS). The Science Team suggested that where semi-operational validation exercises are underway (e.g., Australian BoM, EUMETSAT SAF, Met Office, Medspiration/CORIOLIS data centre, US-NAVY etc), these should be used as a guide for the routine validation of GHRSST-PP data products. Finally, more focus should be given to validation of GHRSST-PP data products at the 6th Science Team meeting as GHRSST-PP data products will be available by this time.

8. **Time-space matchup criteria for validation of SST data products.** Anthony Rea presented an interesting study investigating the effect of navigation errors on validation results. Rea noted that most ships/buoys position is only reported to 0.1° Lat/Lon (~ 11km) via the GTS service introducing collocation errors into the validation data set. Within the Australian RDAC area, it was clear that bias errors approached zero at zero separation error and separation errors of just a few km had a significant impact on the final validation statistic (based on ~6000 matchups). The

Science Team recognized the importance of this result and recommended that all GHRSST-PP validation should be performed to the highest time and space criteria possible. Some time was spend reviewing the criteria agreed at the 4th GHRSST-PP Science Team meeting based on the time-space criteria used by the NAVOCEANO team (6 hours and 25 km). It was agreed that in the light of the results presented by Rea, these criteria were too broad. However, it was noted that GHRSST-PP MDB records include the time of in situ and satellite observation so that a more refined analysis based on more exact time-space match-up criteria would be possible.

2.6 Key events for 2004/05

1. The next GHRSST-PP Science Team meeting will be held at the Met Office, Exeter UK in May 16-20th 2005. This date was chosen as it is shortly after the Medspiration and MISST projects will have begun a sustained delivery of L2P data sets to the GDAC system. It will provide a forum for a critical assessment of the GHRSST-PP system, the user community and user feedback and the proposed upgrade to GDS-v2.0. The meeting should also consider a user symposium and dedicate time to consider the planning of the first GHRSST-PP User Symposium. Sponsorship for travel will be sought from ONR-GLOBAL (London), Met Office, GODAE, ESA, BNSC and other benefactors during the coming months.
2. A revised version of the GDIP will be available prior to the 2nd GODAE symposium, St. Petersburg, Florida USA, 1-3rd November 2005.
3. A full RAN-IP will be available for the CLIVAR Ocean Reanalysis meeting, to be held at NCAR, Boulder Colorado in November 2004.
4. Medspiration will begin trial data production of GHRSST-PP data streams on the 15th December 2004. An operational demonstration service will commence in April 2005. The MISST project has also agreed to work towards these dates. Thus a baseline GDAC system should be operational by the beginning of December 2004 that can be transitioned to operational demonstration status by April 2005.

3 Action list resulting from the 5th GHRSST-PP Science Team meeting

The following actions were reviewed and agreed in plenary by the GHRSST-PP Science Team which are based on the reports made by session Rapporteurs and the GHRSST-PO Director on the 30th July, 2004. Greyed text indicates a closed action.

No.	Action	Owner	Completion date	Status
1	GHRSST-PO and GODAE-PO to draft a letter on behalf of the GHRSST-PP science team to ESA director justifying a continuity of AATSR aboard the planned Sentinel missions.	Donlon	End of August 2004	closed
2	GHRSST-PO to explore with M Petit and M. Lynch how the SEASnet program could deliver L2P data in the Indian Ocean area in support of an Indian Ocean RDAC.	Donlon, Petit, Lynch	To report at the 6th GHRSST-PP Meeting, May 2005	Open
3	GHRSST-PO will inform Guy Rochard explaining the derogatory impact of European geostationary Television satellite broadcasts on the quality of MW SST data sets in the European area.	Donlon, Gentemann, Lynch	End of August 2004	Open
4	The chair of the GHRSST-PP data management technical advisory group will derive a new terms of reference document.	Vasquez	September 1st 2004	Open
5	A FAQ and summary document will be generated by the GDS-TAG describing the GDS v1.5 in a simple manner. The FAQ will be published on the GHRSST-PP web site.	Wick & GDS-TAG	October 30th 2004	Open
6	A template outlining the documentation requirements for the PO.DAAC to host a data set will be developed. The template will be sent by Vasquez to each RDAC describing a minimum set of requirements by end of August. The document will include the current PO.DAAC text for each sensor used within GHRSST-PP.	Vasquez & DM-TAG	End of September 2004	Open
7	The GHRSST-PO will coordinate with other RDAC systems and explore the most appropriate location and time for a GHRSST-PP user symposium for review at the 6th Science Team meeting.	Donlon	To report at the 6th GHRSST-PP Meeting, May 2005	Open
8	The GDS-TAG will be reconvened with revised membership and a revised ToR will be developed. The ToR will include the following remit: (a) to prepare a digest of the GDS 1.5 as a FAQ to make the document simple to understand (Action 5 of this action list) (b) to review the GDS 1.5 from a critical scientific, technical and operational standpoint (c) to prepare a v2.0 prototype GDS based on developments within GHRSST-PP and user community (d) convene a critical design review meeting of the proposed GDS-2.0.	Wick & GDS-TAG	April 2004	Open
9	A revised Table showing compressed and uncompressed data volumes within the GHRSST-PP will be included in the data management TAG report but made available as a matter of urgency to NCDC for assessment.	Casey	September 15th 2004	Open
10	The GHRSST-PO will draft a letter on behalf of the GHRSST-PP science team to explain the decision to request MODIS L2P SST data at 4km resolution. This will be send to Jack Kay (NASA).	Donlon & Vasquez	End of September 2004	Closed
11	A revised and complete ICD between PO.DAAC and groups interacting with the PO.DAAC OCEANIDS GDAC data management system will be generated including interfaces for: (a) MMR (b) MDB (c) HR-DDS (d) L2P and (e) L4 data products.	Bingham	November 2004	Open
12	Example computer code for MMR_DSD and MMR_FR record generation will be developed and provided to	Armstrong	October 1st, 2004	Open

	RDAC to assist in implementation of the GHRSST-PP MMR system.			
13	A summary of how a GHRSST-PP user will obtain data from the project will be prepared as a FAQ and published on the GHRSST-PP web site.	GHRSST-PO	April 2005	Open
14	The GHRSST-PP web site should be simplified and revised. A public and an internal 'expert' set of WWW pages will be developed as part of the GHRSST-PP web site restructuring.	GHRSST-PO	November 2004	Open
15	A first version document outlining the metrics to be used by the GHRSST-PP Science Team to assess the international project will be developed.	GHRSST-PO	1st January 2005	Open
16	A user requirements document will be developed specifying the collective international GHRSST-PP user requirements (RDAC and GDAC). Information will be solicited based on a pro forma template to be provided by the GHRSST-PO that includes temporal stability criteria.	GHRSST-PO	June/July 2005	Open
17	Translation code will be provided to generate an initial MDB population based on example records provided by Remote Sensing Systems, University of Miami, EUMETSAT O&SI SAF and NAVOCEANO.	Poulter, Armstrong, Donlon	December 2004	Open
18	The MDB must be implemented as a matter of urgency as this is on the critical path for Medspiration and MISST. Poulter, Donlon and Armstrong to generate a v1.0 system as soon as possible at SOC. The system will include a mechanism to relate updated MDB records within the database.	Poulter	By end of 2004	Open
19	A prioritised list of issues requiring action on the part of data providers relevant to GHRSST-PP operations will be developed and sent to E. Baylor, NOAA-NESDIS.	Emery	September 2004	Open
20	The GHRSST-PO will write to EUMETSAT to request that the O&SI SAF provide 5km hourly MSG-SEVIRI SST data rather than the current data products (3 hourly, 10km) which are poorly suited to resolving diurnal variability.	GHRSST-PO	End of August 2004	Open
21	David Poulter will coordinate a fully documented baseline v1.0 HR-DDS system. Documentation (which will replace the current HR-DDS implementation plan GHRSST/14) will include a revised list of HR-DDS locations for which the S Hemisphere ice locations will be smaller.	Poulter	April 2004	Open
22	Denise Hagan will explore the most appropriate method for using AIRS SST and other standard data products within the GHRSST-PP and report back to the GHRSST-PP Science Team.	Hagan	November 2004	Open
23	A revised version of the GHRSST-PP Development and Implementation Plan (GDIP) will be prepared in time for the GODAE Symposium.	GHRSST-PO and the GHRSST-PP ST	End of October 2004	Open
24	The availability and impact of NAAPS Aerosol forecast data for use within GHRSST-PP L2P Medspiration products will be investigated.	LeBorgne, Cummings, McKenzie	December 2004	Open
25	The sparse MW data availability over the Mediterranean region will be investigated. A short report to the GHRSST-PP Science Team will be prepared.	Gentemann, Ruiz	November 2004	Closed
26	M. Lynch to discuss the recommendations of the GHRSST-PP Science Team (develop a GHRSST-PP RDAC user requirements document for the Indian Ocean area) and explore further the potential for GHRSST-PP RDAC operations within the IOGOOS framework. Conclusions should be reported back to the GHRSST-PP Science Team.	Lynch	December 2004	Open
27	The RAN-TAG will develop a formal ICD between the GDAC and the RAN group.	Casey	December 2004	Open
28	Chris Merchant will discuss the AATSR RAN strategy with the RAN TAG chair and explore commonalities.	Merchant	By end of 2004	Open
29	David Llewellyn-Jones will pass on information/documentation describing CDR limits to the RAN-TAG for inclusion in the RAN implementation plan.	Llewellyn-Jones	September 2004	Open
30	The RAN-TAG will develop an implementation plan for the GHRSST-PP RAN prior to the second GODAE	Casey	End of October 2004	Open

	symposium (1-3rd November 2004) and CLIVAR ocean reanalysis meeting (8-10th November 2004).			
31	Bill Emery and Ken Casey to explore the possibility of NOPP funding for the GHRSST-PP RAN effort.	Emery, Casey	October 2004	Open
32	GHRSST-PP RDAC team leaders to look at the GODAE inter-comparison project in preparation for GHRSST- VI discussion. GHRSST-PO to advise on the location of documentation.	GHRSST-PO and all Science Team	May 2005	Open
33	An initial list of data users for push and pull data transfers is required by the PO.DAAC team for configuration of the OCEANIDS system.	Bingham	September 2004	Open
34	PO.DAAC to investigate the implementation of LAS & OPeNDAP technology to serve GHRSST-PP L4 data products in addition to the POET system.	Vasquez	End of September 2004	Open
35	In Table A1.2.1 of the GDS-v1.5, the L2P filename date may be ambiguous in some cases. The filename date should be changes to represent the first observation time (initial scan) within a given data set. (For immediate action and as input to GDS-v2.0).	GDS-TAG & GHRSST-PO	End of September 2004	Open
36	In Table A1.2.2 of the GDS-v1.5, the L2P SSES_bias_error range restriction of +/- 1K should be dropped in preference to RDAC scaling using netCDF attributes. (For immediate action and as input to GDS-v2.0).	GHRSST-PO	End of September 2004	Open
37	A prioritisation of L2P data content (i.e., minimum contents to provide a valid L2P data file) and appropriate thresholds for rejection for L2P content will be prepared for the GDSv2.0.	Wick and GDS-TAG	May 2005	Open
38	A. Bingham and A. Rea will test the Aspera system for improved data transfer between PO.DAAC and Australia. The methodology of this study should be used as input to GHRSST-PP Metrics definitions.	Bingham, Rea	November 2004	Open
39	The functionality of the MMR update system when data is transferred between PO.DAAC and the NODC must be established and documented.	Casey, Bingham	December 2004	Open
40	User interaction procedures with the MMR and MDB must be documented and a user interface defined and implemented by the end of 2004. Ed Armstrong to explore options and circulate design baseline for a flexible interface to Science Team for comment prior to implementation.	Armstrong	December 2004	Open
41	A GHRSST-PP subgroup will be convened to advise RDAC teams on the appropriate use of XML and to evaluate the GHRSST-PP XML DTD definitions for MMR and MDB systems. Ed Armstrong has been appointed Chair of the group, members: Piollé, Donlon, Casey, Poulter. The group will report at the 6th GHRSST-PP workshop through the DM-TAG.	Armstrong	September 2004	Open
42	A GHRSST-PP RAN user requirements document will be developed and circulated to the Science Team.	Casey	October 2004	Open
43	An initial GHRSST-PP system (RDAC and GDAC) metrics document will be developed.	Barton, GHRSST-PO	January 2005	Open
44	The GHRSST-PP Science Team request that MSG SEVIRI hourly full resolution SST data sets are provided to Dave Poulter for diurnal variability studies. Poulter to report at the 6th GHRSST-PP Science Team meeting.	LeBorgne, Poulter	May 2005	Open
45	The GHRSST-PP SST Diurnal variability working group (DV-WG) will be reconvened. Chris Merchant has been appointed as chair. A new ToR will be established by the DV-WG fro review by the GHRSST-PP Science Team.	Merchant, GHRSST-PO	September 2004	Open
46	O. Arino will make available to the GHRSST-PO and Science Team documentation developed by ESA describing user feedback mechanisms and experience with user feedback.	Arino	September 2004	Open
47	Jim Cummings will document basic metrics and statistical assessment methodology and recommendations for inter-comparison of GHRSST-PP L4 data products.	Cummings	January 2005	Open
48	The proposed PO.DAAC rolling archive store must be	Vasquez,	September 2004	Open

	assessed to derive sweep latency from PO.DAAC to the proposed NODC data stewardship archive.	Casey		
49	Estimates of L4 operational processing costs will be provided to Ken Casey to help scope GHRSST-PP activities at NODC.	Gentemann, Ruiz, Kawamura, Beggs, Cummings	September 2004	Open
50	The GHRSST-PO will coordinate data flow diagrams between each RDAC and GDAC clearly showing the integration of the GHRSST-PP project.	GHRSST-PO	January 2005	Open
51	The GHRSST-PO to arrange the 6th GHRSST-PP Science Team Meeting at the Met Office, Exeter, UK during May 2005. A first announcement should be circulated in December 2004.	GHRSST-PO	December 2004	Open
52	The GHRSST-PO will invite representatives from all space agencies having an interest in SST to the next GHRSST-PP Science Team Meeting.	GHRSST-PO	December 2004	Open
53	Bruno Nardelli to provide a copy of his presentation given at the 5th workshop to the GHRSST-PO.	Nardelli	September 2004	Open
54	LeBogrne to provide a copy of the EU-GDAC presentation given at the GHRSST-PP 5th workshop to the GHRSST-PO.	LeBorgne	September 2004	Closed
55	The Medspiration team together with NAVOCEANO (McKenzie & May) will establish a mapping between GHRSST-PP IPCF values and NAVOCEANO confidence values.	Piollé, LeBorgne, McKenzie, GHRSST-PO	October 2004	Open
56	The GHRSST-PO will contact S. Briggs (ESA) to establish a high-level contact within the Indian remote sensing community and explore the potential for an Indian Ocean GHRSST-PP RDAC.	GHRSST-PO	End of August 2004	Open
57	The directory structure for HR-DDS data repositories needs to be specified in the GDS documentation. This will be coordinated with the GDS-TAG and the revision of the HR_DDS implementation plan (based on the experience of the Medspiration project).	Poulter, Wick	To report at the 6th GHRSST-PP Meeting, May 2005	Open
58	Dave Poulter to explore the possibility of preparing an HR-DDS package for installation by other RDAC systems.	Poulter	To report at the 6th GHRSST-PP Meeting, May 2005	Open

4 Participant contact details

Arino, Olivier
European Space Agency ESRIN
Via Galileo Galilei
CP 64 00044 Frascati
Italy
Phone: +39 06941 80564
Fax: +39 06941 80512
E-mail: olivier.arino@esa.int

Armstrong, Edward
Jet Propulsion Laboratory/California Institute of Technology
300/320 4800 Oak Grove Dr.
Pasadena, California 91109
United States
Phone: 818 393-6710
Fax: 818 393 2718
E-mail: ed@seastar.jpl.nasa.gov

Barton, Ian
CSIRO Marine Research
PO Box 1538,
Hobart, Tasmania 7001
Australia
Phone: +61 3 62325481
Fax:+61 3 62325123
E-mail: ian.barton@csiro.au

Bayler, Eric
NOAA/NESDIS/ORA/ORAD
NOAA Science Centre, Room 601
5200, auth Rd.,
Camp springs, MD 20746-4304
USA
Tel +01 301 763 8102
Fax: +01 301 763 8572
E-mail: eric.bayler@noaa.gov

Beggs, Helen
Ocean and Marine Forecasting Group,
BRMC, Bureau of Meteorology
PO Box 1289k,
Melbourne, Victoria,
Australia
Tel: +61 (0)3 9669 4394
Fax: +61 (0)3 9669 4660
E-mail: h.beggs@bom.gov.au

Bingham, Andrew W.
Jet Propulsion Laboratory/California Institute of Technology
300/323 4800 Oak Grove Drive
Pasadena, CA 91109,
USA
Tel: +1 818-354-1768 ,
Fax: +1 818-393-2718
E-mail: andrew.bingham@jpl.nasa.gov

Casey, Kenneth S.
NOAA/NESDIS
National Oceanographic Data Center, E/OC1,
1315 East-West Highway
Silver Spring, MD 20910,
USA
Phone: +01 301-713-3272 x133
Fax: +01 301-713-3300
E-mail: Kenneth.Casey@noaa.gov

Castro, Sandra
Univ. of Colorado,
CCAR – 431 UCB
Boulder, CO 89309,
USA
Phone: 303 492-1241
Fax: 303 492-2825
E-mail: sandrac@colorado.edu

Corlett, Gary
Univ. of Leicester
Space Research Centre
University Road
Leicester, LE17RH
UK
Tel:+44 116 252 5240
Fax: +44116 252 2464
Email: gkc1@le.ac.uk

Cummings, James
Marine Meteorology Division, Code 7533
Naval Research Laboratory
Monterey, California 93943
U.S.A.
Phone: (831) 656 5021
Fax: (831) 656 4769
Email: cummings@nrlmry.navy.mil

Donlon, Craig
Director of the GHRSST-PP Project Office
Hadley Centre for Climate Prediction and Research
Met Office,Fitzroy Road
Exeter,EX1 3PB
United Kingdom
Tel: +44 (0)1392 886622
Fax: +44 (0)1392 885681
E-mail: craig.donlon@metoffice.com

Emery, Bill
University of Colorado
CCAR, CB 431
Boulder, CO 80309-0431,
USA
Phone: +01 303-492-8591
Fax: +01 303-492-2825
E-mail: emery@colorado.edu

Erb, William
Intergovernmental Oceanographic Commission,
Perth Regional Program Office,
C/o Bureau of Meteorology
P.O. Box 1370, West Perth
WA 6872
Australia,
Tel: +61 8 9226 2899
Fax: +61 8 9226 0599
E-mail: w.erb@bom.gov.au

Evans, Robert,
Rosenstiel School of Marine Meteorology and Pysical OCeanogrpahy
University of Miami
4600 Rickenbacker Causeway
Miami, FL 33149-1098,
USA
Tel: +1 (305) 421-4799
Fax: +1 (305) 421-4622
E-mail: bob@rsmas.miami.edu

Gentemann, Chelle
Remote Sensing System
438 First St. Suite 200;
Santa Rosa, CA 95401
USA
Phone: +1 707-545-2904x14
Fax: +1 707-545-2906
E-mail: gentemann@remss.com

Hagan, Denise
Jet Propulsion Laboratory/California Institute of Technology
167/237 4800 Oak Grove Dr.
Pasadena, California, 91109,
United States
Phone: 818 354-7073
Fax: 818 393-4619
E-mail: dhagan@mailhost4.jpl.nasa.gov

Harris, Andy
NOAA/NESDIS ORA,
World Weather Building 5200 Auth Road
Camp Springs, MD 20746
USA
Phone: +1-301-763-8102 x169
Fax: +1-301-763-8108
E-mail: Andy.Harris@noaa.gov

Kuragano, Tsurane
Office of Marine Prediction,
Japan Meteorological Agency
1-3-4, Otemachi, Chiyodaku,
Tokyo, 100-8122,
JAPAN
Tel: +81-3-3212-8341 Ex.5127
FAX:+81-3-3211-3047
E-mail: kuragano@met.kishou.go.jp

Le Borgne, Pierre
Meteo-France/Centre de Meteorologie Spatiale
CMS, B.P. 147,22302
Lannion Cedex,
France
Phone: +33 2 96 05 67 52
Fax: +33 2 96 05 67 37
E-mail:Pierre.LeBorgne@meteo.fr

Llewellyn-Jones, David
Univ. of Leicester
Space Research Centre
University Road
Leicester, LE1 7RH
UK
Phone: 44 116 252 5238
Fax: 44 116 252 2464
E-mail: dlj1@le.ac.uk

Lynch, Mervyn
Remote sensing and satellite research
Department of Applied Physics
Building 301 room 146
Curtin University of Technology
PO Box U1982
Perth, WA 6001
Australia|
Tel: +618 9226 7540
Fax: +618 9328 7942
E-mail: m.lynch@curtin.edu.au

McKenzie, Bruce
NAVOCEANO Code N321
1002 Balch Boulevard
Stennis Space Center, MS 39522
USA
Tel : +01 228-688-4586
Fax: +01 228-688-5577
E-mail : mckenzieb@navo.navy.mil

Merchant, Chris
Institute for Atmospheric and Environmental Science
The University of Edinburgh
Mayfield Road
Edinburgh EH9 3JZ
United Kingdom
Fax +44 (0)131 650 5780
Tel +44 (0)131 650 5097
Chris.Merchant@ed.ac.uk

Buongiorno Nardelli, Bruno
Gruppo di Oceanografia da Satellite
Istituto di Scienze dell'Atmosfera e del Clima-Sezione di Roma-CNR
Area di ricerca di Tor Vergata
Via del fosso del cavaliere,10000133
Roma
Italy
Tel. +39-06-49934634
Fax +39-06-20660291
E-mail: bruno@gos.ifa.rm.cnr.it

PETIT, Michel
IRD-ESPACE Unit (S140), Earth Obs. Div.
Coord.Maison de la TELEDETECTION,
500, rue J.F. Breton,34093
MONTPELLIER CEDEX 05
FRANCE
Tel : 33 (0) 4 6754-87 67, Secr. -8708,
Fax. +33 (0)4 6754-8700
E-mail : Michel.Petit@ird.fr

Piolle, Jean-François
IFREMER/CERSAT
29280 Plouzane,
France
Phone: 33 2 98 224691
Fax: 33 2 98 224533
E-mail: jfpiolle@ifremer.fr

Poulter, David
School of Ocean and Earth Science
University of Southampton
Southampton Oceanography Centre
European Way, Southampton
SO14 3ZH,
United Kingdom
Tel +44 (0)2380 596107
Fax: +44 (0)2380 593059
E-mail djsp@soton.ac.uk

Ramos, Antonio
seaSNET Canarias – ULPGC
Campus Universitario de Tafira
35017-Las Palmas de Gran Canaria
Spain
Tel: +34 928452724
Fax:+34 928452922
E-mail: aramos@pesca.gi.ulpgc.es

Rea, Anthony
Satellite Applications and Software Space Based Observations Section
Australian Bureau of Meteorology
GPO Box 1289K
Melbourne 300
Australia
Tel: (613) 96694498
fax:(613) 96694736
E-mail: a.rea@bom.gov.au

Reynolds, Richard W.
NOAA/NESDIS
National Climatic Data Center
151 Patton Avenue
Asheville, NC 28801
USA
Phone: +01: (828) 271-4302
Fax: +01 (828) 271-4328
E-mail: Richard.W.Reynolds@noaa.gov

Ruiz, Simon
CLS Space Oceanography Division
8-10 rue Hermes
Parc Technologique du Canal
31526 Ramonville Saint-Agne
France
Tel:+33 5 6139 3737
Fax: +33 5 617 51014
Email: sruiz@cls.fr

Rutherford, Martin
Deputy Director Defence Oceanographic Data Centre,
Directorate of Oceanography and Meteorology
Maritime Headquarters
Wylde Street
Potts Point, NSW 2011
Australia
Tel: +61 02 3959 3139
Fax: +61 02 3959 3120
Email: martin.rutherford@defence.gov.au

Steinberg, Craig
AIMS
PMB No. 3
Townsville 4810
Australia
Tel: +61 7 47534444
Fax: +61 7 47725852
Email: c.steinberg@aims.gov.au

Turner, Peter
CSIRO Marine Research
PO Box 1538
Hobart 7001
Australia
Tel: + 61 3 62325094
Fax: +61 3 62325123
Email: peter.j.turner@csiro.au

Vazquez, Jorge
Jet Propulsion Laboratory/California Institute of Technology
300/323 4800 Oak Grove Drive
Pasadena, CA 91109,
USA
Phone: +01 818-354-6980
Fax: +01 818-393-6720
E-mail: jorge.vasquez@jpl.nasa.gov

Wick, Gary
NOAA Environmental Technology Laboratory
R/ET6 325 Broadway
Boulder, CO 80305,
USA
Phone: +01 303-497-6322
Fax: +01 303-497-6181
E-mail: Gary.A.Wick@noaa.gov

5 List of Reference Documents

The Reference documents described in Table 1 were provided prior to the workshop from the GHRSST-PP web site at http://www.ghrsst-pp.org.

Table 1 Document list for the fifth GHRSST-PP Science Team Workshop available from http://www.ghrsst-pp.org follow the link on the main page.

ID	Title	Link
RD-1	The GHRSST PP Data Processing Specification v1.0 (GDSv1.5)	http://www.ghrsst-pp.org/documents/GDS-v1.0-rev1.5.pdf
RD-2	Proceedings of the 4th GHRSST-PP Workshop	http://www.ghrsst-pp.org/documents/GHRSST-PP-FourthWorkshopReport-v1.8.pdf
RD-3	The GHRSST PP Development and Implementation Plan	http://www.ghrsst-pp.org/documents/GDIP-v0.4.pdf
RD-4	Draft GHRSST PP High Resolution Diagnostic Data Set Implementation Plan.	http://www.ghrsst-pp.org/documents/GHRSST-DDS-implementation-v1.4.pdf
RD-5	First report for the GHRSST-PP Reanalysis Technical Advisory Group (RAN-TAG)	http://www.ghrsst-pp.org/documents/RAN_1.0.doc
RD-6	First report of the GHRSST-PP Data Management Technical Advisory Group (DM-TAG)	http://www.ghrsst-pp.org/documents/dmtgv2.0.doc
RD-7	Medspiration project Reference Baseline	http://www.ghrsst-pp.org/documents/MED-SOC-RS-001_1-g.pdf
RD-8	MISST project proposal	http://www.ghrsst-pp.org/documents/MISST_NOPP_shortend.pdf
RD-9	Medspiration project User Requirements Document (URD).	http://www.ghrsst-pp.org/documents/Medspiration-URD-v2.6.pdf
RD-10	IDPS Operational agreement example document	http://www.ghrsst-pp.org/documents/GHRSST_ICD_Bingham_10Jun04.doc
RD-11	PO.DAAC proposal in support of GDAC and RDAC activities	http://www.ghrsst-pp.org/documents/Datamanagementghrsst.doc
RD-12	Draft 5th Workshop Meeting agenda v1.7	http://www.ghrsst-pp.org/documents/GHRSST-5-Agenda-v1.7-Draft.pdf
RD-13	5th Workshop Abstracts	http://www.ghrsst-pp.org/documents/GHRSST-5-Abstracts.pdf

6 Meeting Agenda

The following agenda was followed.

Sunday, 25th July 2004

Time	Agenda item	Session leaders	Ref
17:00	USA RDAC project Multi Sensor Integrated SST (MISST) project team meeting (SHCC board room)	C. Gentemann	
19:00	Close		
20:00	Icebreaker Location Southbank Hotel, Townsville.		

Monday, 26th July 2004

Time	Agenda item	Session leaders	Ref
08:00	Registration		
08:50	Welcome and logistics	I Barton	
09:00	Welcome address from the director of the Australian Institute of Marine Science (AIMS)	I Poiner	
09:20	Workshop aims and objectives	I Barton	
09:30	• Review of Agenda items. • Report from the GHRSST-PP International project Office: Overview of the GHRSST-PP project status, priorities and aims of the Workshop.	C Donlon	
10:00	Coffee		
Session 1. Reports to the GHRSST-PP Science Team		Chair: **B Emery** Rapporteur: **C Donlon**	RD-1, RD-2 and RD-3
10:30	**Australia**: Helen Beggs and Anthony Rea		
10:55	**Japan**: T. Kuragano		
11:20	**Seasnet**: M. Petit and A. Ramos		
11:45	**USA**: C. Gentemann and G. Wick		RD-8
12:10	**Europe**: Jean-Francois Piollé and O. Arino		RD-7
12:35	**Indian Ocean proposal for an IO-RDAC**: B. Erb		
13:00	Lunch		
14:00	**JPL GDAC report**: A Bingham		RD-11
14:30	**Report from the GHRSST-PP Reanalysis Technical Advisory Group (RAN-TAG):** K Casey		RD-5
15:00	Tea		
16:00	**Report from the Data Management Technical Advisory Group (DM-TAG):** J. Vasquez		RD-6
16:30	**Report from the GHRSST-PP Data Processing Specification Technical Advisory Group (formerly the ISDI-TAG):** G. Wick		
17:00	**D. Reynolds**: Report from the AOPC and OOPC		
17:20	**Plenary discussion:** • Identification of priority issues for the 5th workshop • Identification of splinter groups as required		
18:00	Close		
19:30	Workshop Social event-Informal, opportunity to meet everyone and to exchange ideas and plan. The Brewery, Denham and Flinders St East, Townsville.		

Tuesday, 27th July 2004

Time	Agenda item	Session leaders	Ref
Session 2. Data management		Chair: **J. Vasquez** Rapporteur: **A. Bingham**	
08:00	**J. Vasquez**: An overview and status of the data management strategy for GHRSST-PP: GDAC proposals Data volumes within the GHRSST-PP: How can we share data? **J. Cummings**: Status of the GODAE server and GHRSST-PP		RD-11
08:30	**A. Bingham**: OCEANIDS in support of the GHRSTT-PP – overview and practicalities (operational agreements)		RD-10
09:00	**E. Armstrong**: Updates to the GHRSST-PP Master Metadata Repository and Matchup Database		RD-1
09:20	**P. LeBorgne**: Developing a GHRSST-PP GDAC operational backup - an EU-GDAC.		
09:40	**C. Donlon**: User requirements for international GHRSST-PP		RD-7
10:00	Coffee		
10:20	**Plenary discussion**	Chair: **J. Vasquez** Rapporteur: **A. Bingham**	
13:00	Lunch		
Session 3. GHRSST-PP data processing systems #1: Science Issues, tools and techniques.		Chair: **J.F Piollé** Rapporteur: **A. Harris**	
14:00	**C Donlon:** Summary of the GDS-v1.0 revision 1.5		RD-1
14:20	**B Nardelli**: Diurnal variations in AVHRR SST fields: a strategy for removing warm layer effects from daily images.		
14:40	**P LeBorgne**: Testing of the Stuart Menteth diurnal warming parameterisation on MSG derived hourly SST fields		
15:00	Tea		
15:20	**Plenary discussion:** Diurnal warming and the GDS	Chair: **J.F Piollé** Rapporteur: **A. Harris**	RD-1
18:00	Close		

Wednesday, 28th July 2004

Time	Agenda item	Session leaders	Ref
Session 4. GHRSST-PP data processing systems #2: Science Issues, errors, SST_{skin}-SST_{depth}		Chair: **C. Gentemann** Rapporteur: **E Armstrong**	RD-2, RD-6 and RD-9
08:30	**C Gentemann**: Microwave SST error maps		
09:00	**Sandra Castro**: MW & IR SST errors		
09:30	**C. Merchant**: Bias and cloud-screening infrared imagery for SST		
10:00	Coffee		
10:30	**G. Corlett:** The accuracy of SST retrievals from AATSR: Comparisons with in situ data, AVHRR and MODIS.	Chair: **C. Gentemann** Rapporteur: **E Armstrong**	
11:00	**A. Rea**: Recent Improvements to the NOAA AVHRR SST Product at the Australian Bureau of Meteorology		
11:30	**Plenary discussion (cont.)**		
12:00	Lunch		
Session 5. The development and application of the GHRSST-PP High resolution Diagnostic Data set (HR-DDS).		Chair: **C. Donlon** Rapporteur: **D. Poulter**	RD-4 and RD-7
13:00	**D. Poulter**: Progress with the HR-DDS within the Medspiration project.		
13:30	**R. Reynolds**: Using diagnostic data sets		

13:50	**D. Hagan**: Satellite-Retrieved Surface and Atmospheric Parameters from the Atmospheric Infrared Sounder for GHRSST High Resolution Diagnostic Data Sets.		
14:10	**Plenary discussion**		
15:20	**Close**		
1530	Tour of The Museum of Tropical Queensland http://www.mtq.qld.gov.au/		
1630:	Visit ReefHQ http://www.reefhq.org.au/		

Thursday, 29th July 2004

Time	Agenda item	Session leaders	Ref
Session 6. GDAC data processing systems #2: Analysis tools and techniques, pre processing, integration, de-correlation length scales etc.		Chair: **D. Reynolds** Rapporteur: **J. Cummings**	RD-1
08:30	**J Cummings**: An overview of GODAE		
09:00	**Plenary discussion** • MISST (Cummings) • Medspiration (LeBorgne/Piollé) • BLUELink> (Smith) • JMA (Kuragano)		
10:00	Coffee		
10:20	**Plenary discussion (cont.)**		
13:00	Lunch		
Session 7. GHRSST-PP Reanalysis project: GHRSST-PP Climate Data Records		Chair: **K. Casey** Rapporteur: **C. Merchant**	
14:00	**K. Casey**: Overview of the GHRSST RAN project		RD-2 and RD-5
14:15	**Plenary discussion:** Review of RAN-TAG First Report and new draft RAN-TAG Implementation Plan- are we still on track? do we need any updates?		
15:00	Tea		
15:30	**D. Llewellyn-Jones**: SST Data from Satellites and Global Change Detection; Some Implications for the GHRSST Re-analysis Project		RD-2 and RD-5
16:00	**Plenary discussion:** User Requirements Discussion - review of relevant documents, what is missing, other sources?		
16:30	**Plenary discussion:** The Way Forward - formalizing Implementation Plan, funding opportunities, who can do what, etc.		
17:30	Close		
19:30	Workshop dinner Naked Eel, the Strand Townsville		

Friday, 30th July 2004

Time	Agenda item	Session leaders	Ref
Session 8. Validation and metrics for the GHRSST-PP: Towards operational sustainability		Chair: **I. Barton** Rapporteur: **G. Corlett**	RD-1 and RD-2
09:00	**Plenary Discussion**: Validation and metrics for the GHRSST-PP: Towards operational sustainability		
10:00	Coffee		
10:20	**Plenary Discussion**: Validation and metrics for the GHRSST-PP: Towards operational sustainability (cont.)	Chair: **I. Barton** Rapporteur: **G. Corlett**	RD-1 and RD-2
11:30	**Session 10. Plenary discussion I: Global Integration and Application of GHRSST-PP Sea Surface Temperature Data Products** Rapporteur reports • Session 1: C Donlon • Session 2: A Bingham		

	• Session 3: A Harris • Session 4: E. Armstrong • Session 5: D. Poulter • Session 6: J. Cummings • Session 7: C. Merchant • Session 8: G. Corlett		
13:00	Lunch		
14:00	**Session 10. Plenary discussion II: Global Integration and Application of GHRSST-PP Sea Surface Temperature Data Products (cont.)**	Chair: **C. Donlon**	
15:00	Summary of workshop and review of Action list arising from the workshop 1. Review action list 2. Assignment of Writing tasks: Preparation of proceedings 3. Science Team Membership 4. Next meeting 5. AOB	Chair: **C. Donlon**	
15:40	Close		
16:00	Visit to Billabong Sanctuary http://www.billabongsanctuary.com.au.		

Published by the International GHRSST-PP Project Office
Met Office
Beagle B2-042
Fitzroy Road
Exeter, EX3 1PB
United Kingdom

Tel: +44 (0)1392 886622
Fax: +44 (0)1393 885681
E-mail: craig.donlon@metoffice.com
http://www.ghrsst-pp.org

The GHRSST-PP International Project Office is sponsored by the European Space Agency and the MetOffice , United Kingdom.