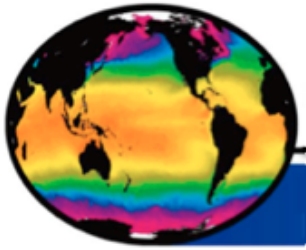
CDR-TAG session 2013

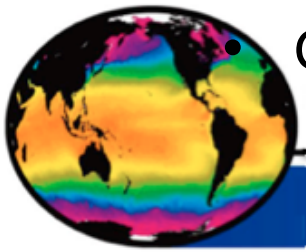
GHRSST XIV

Woods Hole



CDR-TAG membership

- Chris Merchant, Chair
- Jon Mittaz, VC
- Kenneth S. Casey
- Peter Minnett
- Edward Armstrong
- Jorge Vazquez
- Craig Donlon
- Hiroshi Kawamura
- Gilles Larnicol
- David Llewellyn-Jones
- Nick Rayner
- Gary Wick
- Richard W. Reynolds
- Bill Emery
- Helen Beggs
- Gary Corlett
- Jonah Roberts-Jones
- Mike Chin
- Eileen Maturi
- Matthew Martin
- Alexey Kaplan
- Steinar Eastwood
- Bruno Buongiorno Nardelli
- Viva Banzon



CDR-TAG ToR

CDR-TAG Responsibilities

Within the Group for High Resolution Sea Surface Temperature (GHRSST), the Climate Data Record Technical Advisory Group (CDR-TAG) accepts responsibilities addressing the need for long-term, stable and accurate SST data sets. The primary responsibilities are to:

1. Develop, regularly review and revise the GHRSST community consensus on the requirements that must be met by products intended to be Climate Data Records (CDRs).

2. Define, document, maintain and improve the Climate Data Assessment Framework (CDAF) in conjunction with relevant international bodies.

3. Review, revise and approve assessment information for GHRSST data sets that may be considered as CDRs. Maintain the authoritative list of assessment information, indicating which assessments have CDR-TAG approval.

4. Provide advice and guidance to the US NODC for operations of the LTSRF and GHRSST/GCOS SST Inter-comparison Facility.

5. Work in accordance with the current
    - GHRSST Data Specification (GDS 2.0, https://www.ghrsst.org/documents/q/category/gds-documents/operational/) and
    - GHRSST Development and Implementation Plan (GDIP, https://www.ghrsst.org/documents/q/category/ghrsst-strategy/),

   making recommendations for improvements to those documents as necessary.

6. Work with specific applications and users of CDRs to solicit and respond to feedback.

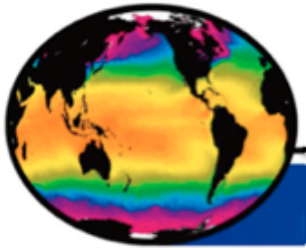
7. Provide regular reports on CDR-TAG activities and LTSRF operations at annual GHRSST meetings.

8. Provide scientific guidance to, and as appropriate, receive advice from, the GHRSST Science Team, RDACs, and GDAC on the scientific and technical issues associated with the implementation and operation of the CDR DPF.

9. Maintain CDR-TAG documents and information on the GHRSST web site (http://www.ghrsst.org), including at a minimum the:
    - Terms of Reference and Vision (this document)
    - membership list
    - name and contact information of the Chair
    - community consensus climate product requirements
    - climate data evaluation framework
    - authoritative source of CDAF outcomes

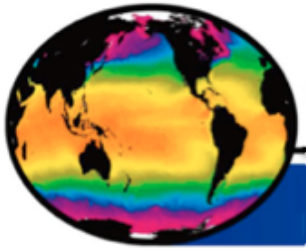
Agenda

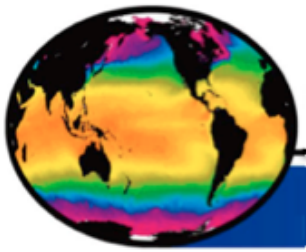
- Presentations
  - *The generation of SST climate data records using shipboard radiometers (Peter Minnett)*
  - *A long term satellite based data record of sea surface temperature from ESA's climate change initiative (Chris Merchant for Nick Rayner)*
- Review International Status Report
- Presentation of Climate Data Assessment Framework for formal recommendation to ST
- Preservation of sensor calibration information



INSERT

- The generation of SST climate data records using shipboard radiometers (Peter Minnett)





ESA Climate Change Initiative Phase 1

Sea Surface Temperature (SST)

A stable, low bias, long-term, satellite based data record of sea surface temperature from ESA's Climate Change Initiative

Nick Rayner[1], Simon Good[1] and Chris Merchant[2]

[1]Met Office Hadley Centre, UK

[2]University of Reading, UK

www.esa-sst-cci.org

Overview

- ESA Climate Change Initiative programme and SST CCI project
- SST CCI long-term products
- Methodological improvements compared to existing products
- Plans for validation and comparisons to other things over the next six months
- SST CCI next phase
- How to **take part** in the assessment

The ESA Climate Change Initiative: satellite data records for essential climate

cmug cci

sst cci

noisture

www.esa-sst-cci.org

University of Leicester

Met Office

METEO FRANCE

Norwegian Meteorological Institute

BROCKMANN CONSULT

Space ConneXions

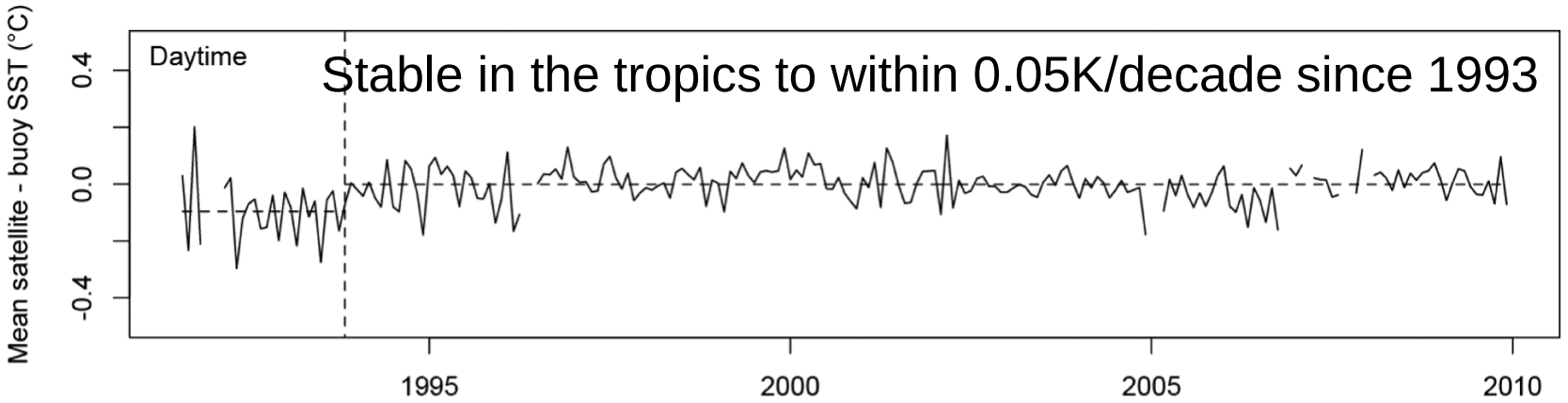
University of Reading

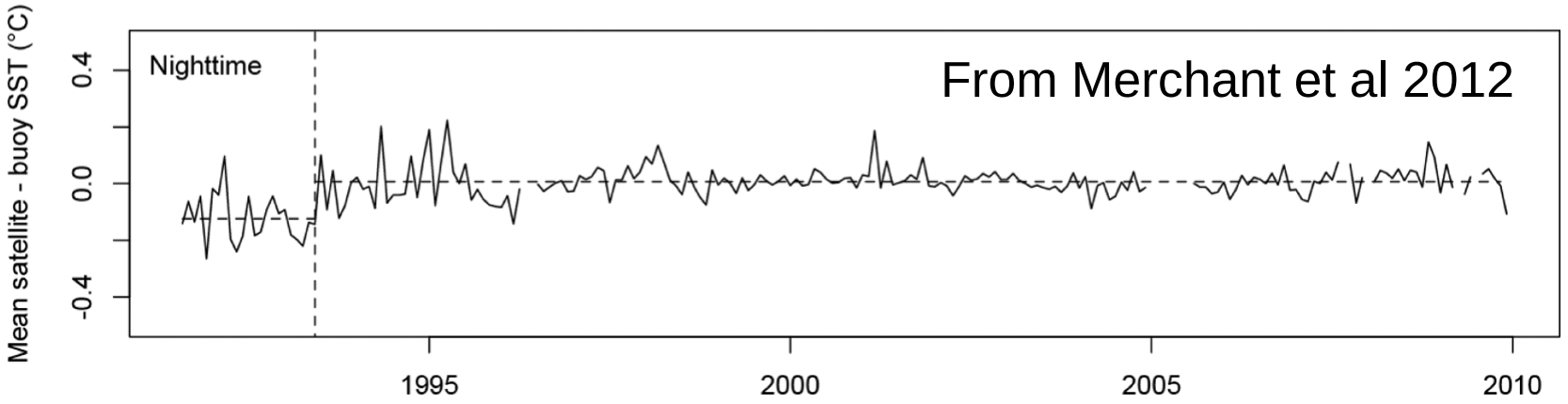
esa

SST CCI Long-term Products

- Satellite only – independent of measurements made *in situ*
- Period: 1991-2010
- Different levels: level 2 (AVHRR), level 3 (ATSR) and level 4 (combined)
- Depths: SST_{skin}, $SST_{0.2m}$
- CF-compliant NetCDF in GHRSST compatible format
- Documentation, including a Product User Guide with quick start guide and also more detailed information
- Tools

Long term products: combine the favourable stability and bias characteristics of the ATSR





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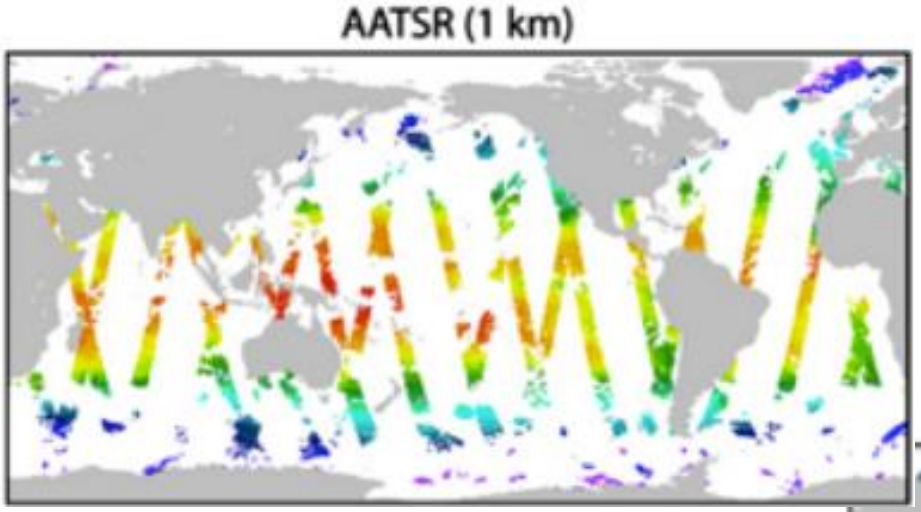
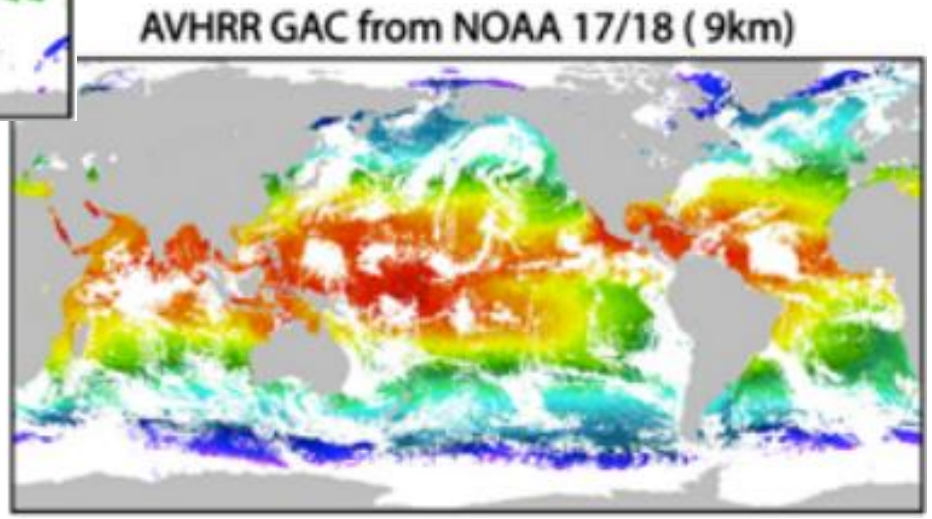
... with the favourable geographical coverage of the AVHRRs

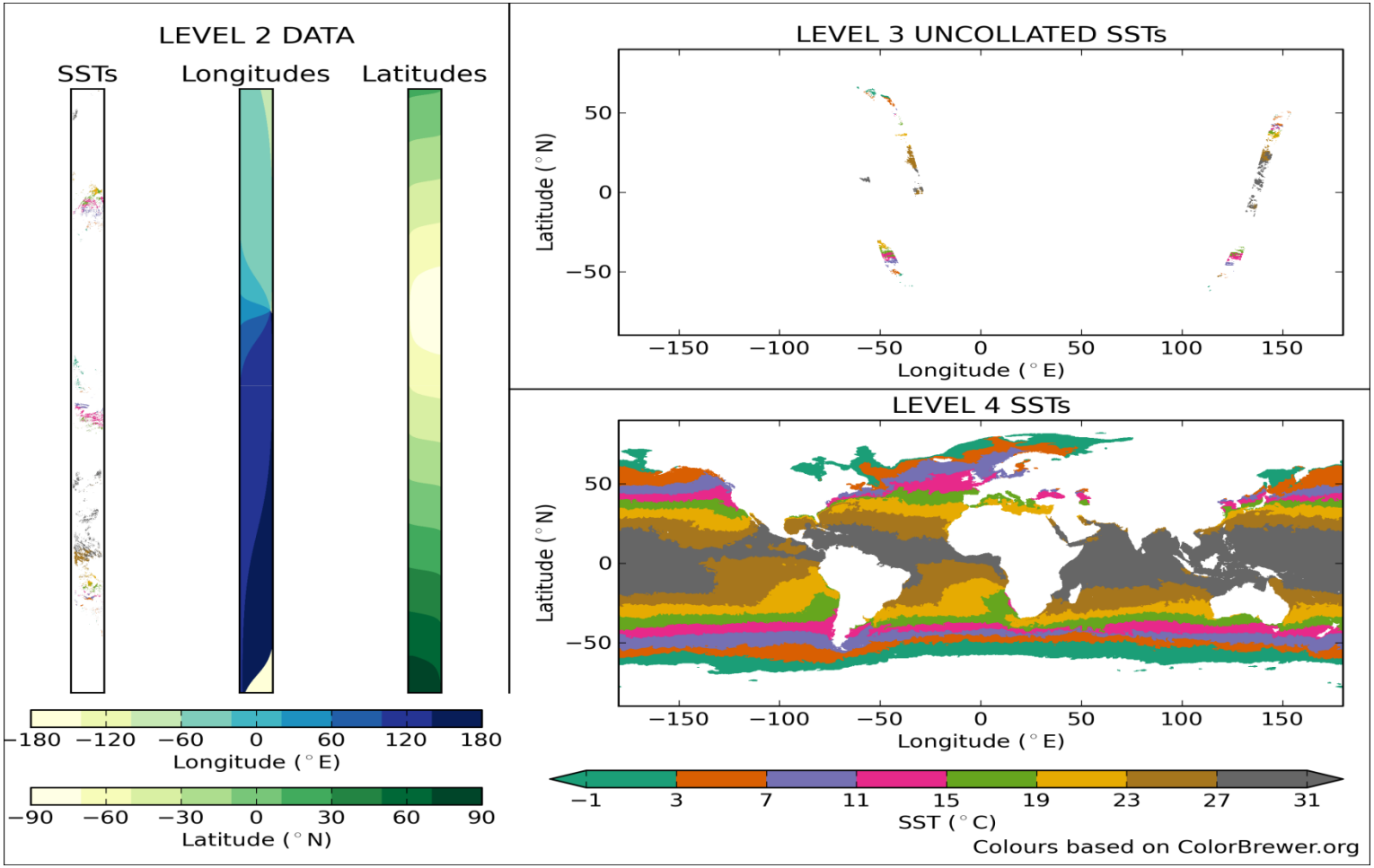


Through referencing of AVHRR brightness temperatures to ATSR brightness temperatures



Figs from Robinson et al., 2012, Rem Sens Env, 116

Levels of data available



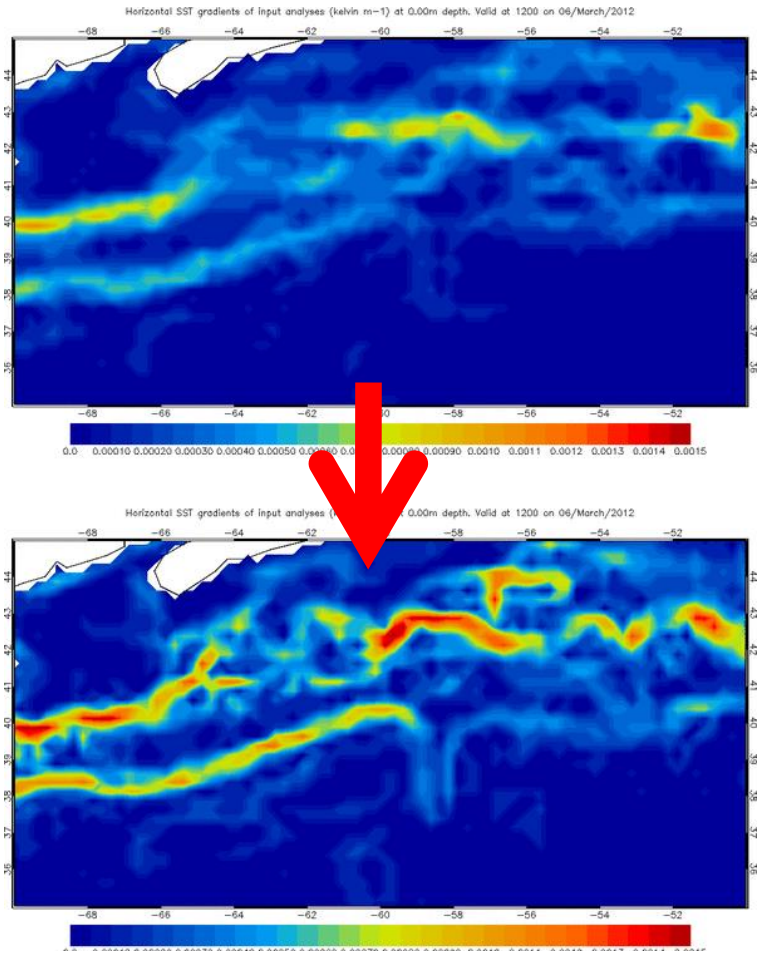
Estimating uncertainty

- Uncertainty is estimated from contributions to the retrieval process, not through comparison to *in situ* measurements
- Uncertainty in each value in the L2 and L3 products is split into three components due to:
  - Uncorrelated effects, e.g. Radiometric noise
  - Synoptically correlated effects (1 day and 100km), e.g. Retrieval or depth adjustment error due to imperfect knowledge of atmospheric conditions
  - Large-scale correlated effects, e.g. Residual errors in sensor calibration after cross referencing
- SST CCI tools aim to propagate uncertainties in the retrievals appropriately through averaging
- Nomenclature used in project documents has been refined in discussion with the metrology community

Producing the L4 analysis

- Developed from the Met Office OSTIA analysis system
- Uses a multi-scale OI scheme with persisted background and background error estimates split between two spatial scales
  - Sizes and correlation lengths of background errors have been improved for the SST CCI analysis and their seasonal cycle included
- Includes only satellite data from both day and night (10.30 am and pm) adjusted to 0.2m depth for the long-term product
  - Approximates to the daily mean SST

Example improvement in Level 4 analysis



Sharper, more realistic SST gradients in Gulf Stream

- First independent satellite-only analysis (spatially complete SST)
- Accuracy and feature resolution improved
  - expect between 20% and 50% reduction in variance of SST error cf. precursor
  - gradients of major ocean features more realistic
- Achieved by:
  - improved parameters
  - better numerical approach

Other expected improvements compared to current products

- For ATSR SSTs compared to precursor ATSR Reprocessing for Climate
  - Lower noise SST
  - More stable and consistent cloud detection
  - Longer record (20 years)
  - Improved uncertainty information
- For AVHRRs cf. US Pathfinder SST from AVHRR
  - Independence from in situ observations
  - Skin and depth SST estimates
  - Maximum regional biases reduced from ~0.5 K to ~0.1 K
  - Lower noise SST from optimal estimation retrieval
  - 100% sensitivity to SST variations (diurnal variations, fronts)
  - Compensated for drift of overpass times relative to diurnal cycle in SST
  - Stable SST observation (0.05 K/decade) by being tied to ATSR

Comparison to *in situ* measurements and climate assessment

- Validation:
  - Using multi-sensor and reference data match ups within the MMS
  - Uses independent and pseudo-independent reference measurements made *in situ*
  - Uncertainty estimates will be validated and results presented in “degree of confirmation” maps
- Climate assessment:
  - Comparison to other existing century-scale and satellite-era products
  - Impact of use of SST CCI products in model assessment
  - Exploration of fronts in SST CCI and OC CCI products
  - **Feedback from trail-blazer users – please email me (nick.rayner@metoffice.gov.uk) if you would like to take part**

Phase 2 of the CCI

- Three year prototyping phase is almost over
- The next three year phase of the programme will:
  - Revise the products following user feedback
  - Create a system that can be used to reprocess and update the products easily in the future
  - Hopefully extend the SST CCI products back to 1978

How to find out more and provide feedback

- Products will be available to download by the end of April
  - **Email me now** if you are interested in being a trail-blazer user at nick.rayner@metoffice.gov.uk
- **Please download them** and test them in your work, visit
  - http://www.esa-sst-cci.org/PUG/home.htm
- Then **please provide feedback** on your experience so that we can further improve them:
  - Email nick.rayner@metoffice.gov.uk

EXTRAS FOLLOW

User requirements gathering → product specification

- 800+ climate users of SST products contacted from different specialisms
- 100+ responded with detailed answers to a wide-ranging questionnaire
- Provided invaluable data from which we were able to design products and tools to allow us to meet the needs of the majority
- Has helped us to decide what to focus on as we go through the project and plan for the future

Input data/time periods of SST CCI prototype long-term products

Input	Period
ATSR-1, ATSR-2, AATSR full res.	**1991 – 2010,** JFM 2012 (demo. sample)
NOAA AVHRR GAC	**1991 – 2010**
Metop AVHRR GAC	**2006 – 2010**
AMSR-E	JJA 2007 (demonstration sample)
TMI	JJA 2007 (demonstration sample)
Metop AVHRR full resolution	JFM 2012 (demonstration sample)
SEVIRI	JFM 2012 (demonstration sample)
ERA-Interim (auxiliary fields)	**1991 – 2010,** JFM 2012 (demo. sample)

Input data/time periods of SST CCI prototype products

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AMSR-E	JJA 2007 (demonstration sample)
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Metop AVHRR full resolution	JFM 2012 (demonstration sample)
SEVIRI	JFM 2012 (demonstration sample)
ERA-Interim (auxiliary fields)	**1991 – 2010,** JFM 2012 (demo. sample)

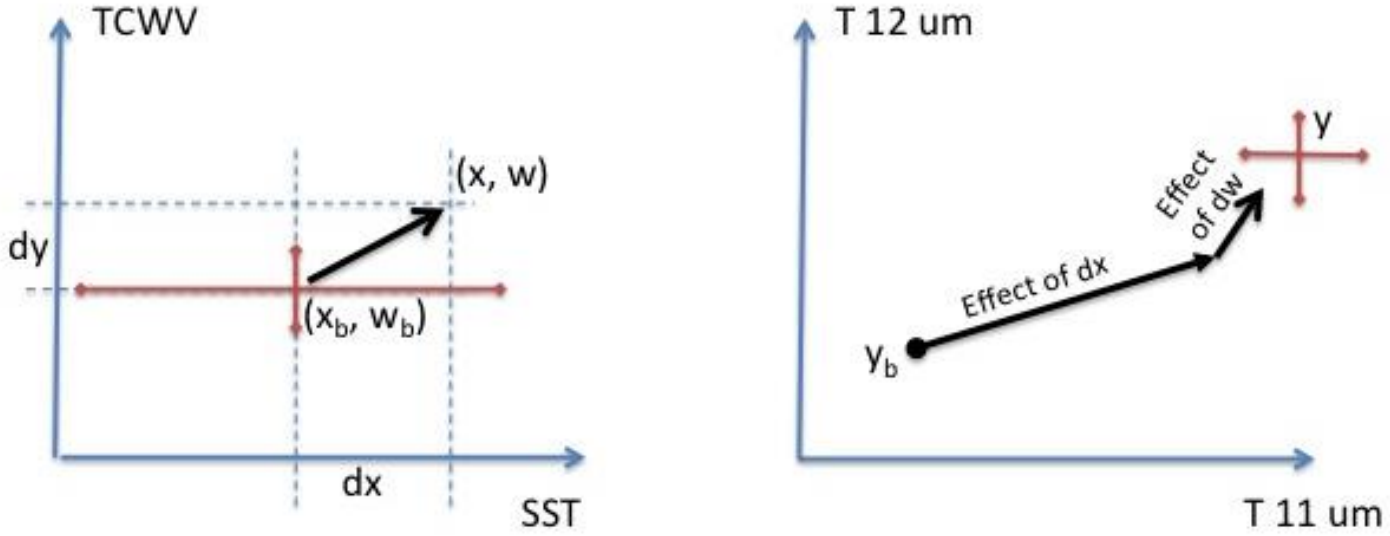
Examples of algorithm selection metrics

Table A3.2-4: Comparison of metrics related to SST estimation for day-time AVHRR onboard NOAA-19 with and without solar zenith angle filtering applied ("with SZA filter" indicates match-ups with solar zenith angle < 20° are excluded).

Table A3.2-4 NOAA-19 Day (SZA filtering)	Optimal Estimation v2	Optimal Estimation v2 (with SZA filter)	Incremental Regression	Incremental Regression (with SZA filter)	Weight
Bias (mean discrepancy)	-0.161 K	-0.144 K	-0.295 K	-0.288 K	Very High
Bias (median discrepancy)	-0.076 K	-0.067 K	-0.206 K	-0.201 K	Very High
Bias (mean discrepancy map)					Very High
Bias (median discrepancy map)					Very High
Precision map (SD of discrepancy)					Medium
Precision map (RSD of discrepancy)					Medium
Precision (mean of cell SDs)	0.658 K	0.629 K	0.588 K	0.579 K	Medium
Precision (median of cell RSDs)	0.462 K	0.446 K	0.415 K	0.409 K	Medium
Number of Matches	18381	16947	24948	23056	

Optimal estimation of sea surface temperature

- Simultaneous estimates of SST (x) and total column water vapour (w)
- Retrieval nudges the prior estimates: $x = x_b + dx$; $w = w_b + dw$
- dx and dw reconcile simulated (y_b) & observed (y) IR temperatures within uncertainties



- Magnitudes of dx and dw optimally balance the various uncertainties
- Assumed uncertainty for prior SST is exaggerated (5 K) …
  … this means SST is mainly determined by IR temperatures, not prior SST
- Generalizes to more wavelengths and/or views of surface
- Key to SST accuracy is low bias in simulation step

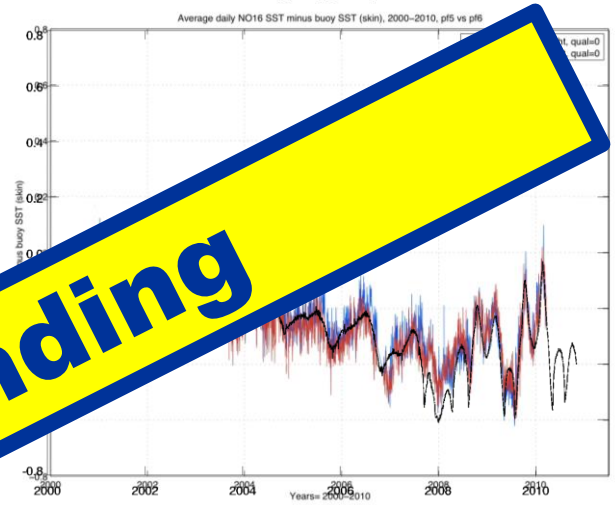
Historical and In situ Activities

An FCDR for the AVHRR

GHRSST Climate Data Record Technical Advisory Group

Project Goals

1. To recalibrate the AVHRR Level 1B radiances for the historic data back to 1981
2. To provide the data to the community through the NOAA CDR Program



Update pending

Current Status

1. Detailed an… completed showi… vements to the lo… moving a +/- 0.5K … the this AVHRR is …08K/decade (estimated)
2. U… instrument parameters (particularly the instrument temperature) to fix large time variable biases for NOAA-16
3. Work beginning on systematic comparison of AVHRRs with (A)ATSR from 1991 with new hire

Looking Forward

1. Analyze pre-launch data for AVHRR/1 and AVHRR/2s
2. Use multiple techniques to determine calibration for pre-1991 data
3. Use targeted SST retrieval studies as part of the validation scheme

John Mittaz, NOAA/CICS

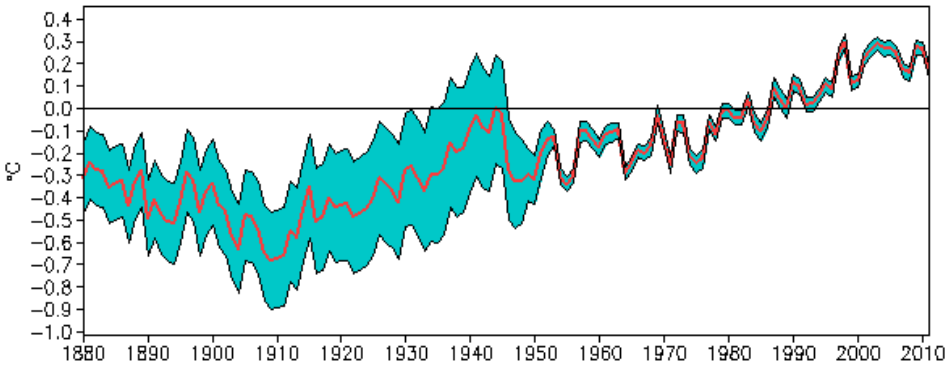
ERSST Version 3b

GHRSST Climate Data Record Technical Advisory Group

Project Goals

1. Provide monthly SST analyses from 1880 to present on a 2^ox2^o spatial grids
2. Merge SST and land surface air temperatures to produce global surface temperature

SST annual anomaly (red) and
its uncertainty (shade) at 95% confidence level



Current Status

1. Maintaining operational ERSST v3b with revised uncertainty estimation
2. Upgrades towards ERSST.v4
   - ICOADS Release 2.5 SST observations
   - SST bias adjustment using HadMAT2
   - SSTA relative to SST climatology at *in situ* location
   - QC using OISST (1982-2011) STD
   - EOTs based on OISST 1982-2011
   - EOT weighting of $N/(N+e^2)$
   - Sea ice from HadISST and NCEP

Looking Forward

1. Release ERSST.v4
2. Assessment of parametric uncertainty
3. Assessment of gridded sampling uncertainty
4. Assessment of difference between ERSST.v4 and other available products.

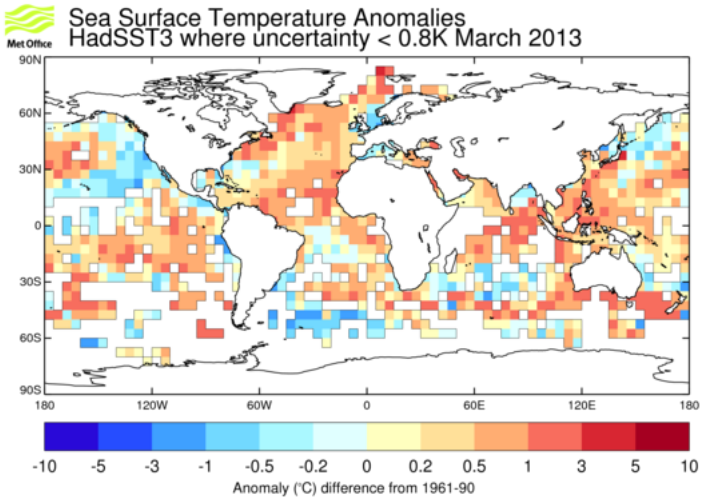
Boyin Huang, NOAA NCDC, http://www.ncdc.noaa.gov/ersst

HadSST3

GHRSST Climate Data Record Technical Advisory Group

Project Goals

1. A global, gridded data set of *in situ* SST measurements since 1850 with reduced biases and quantified uncertainties, including an assessment of their covariance structure



Current Status

1. Paper published in JGR atmospheres: Kennedy et al. (2011a and 2011b).
2. Monthly updates
3. Data available from http://www.metoffice.gov.uk/hadobs

Looking Forward

1. Continuing monthly updates
2. Greater exploration of structural uncertainty using Smith and Reynolds bucket 'corrections'
3. Using independent data to refine ensemble

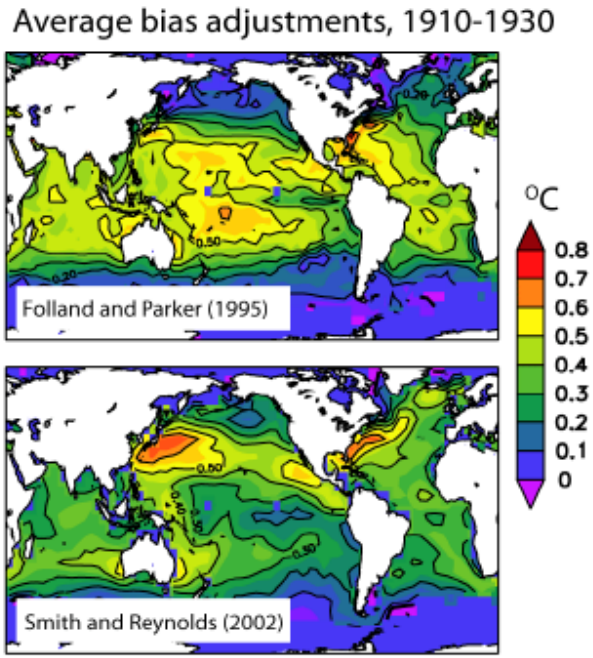
John Kennedy, UKMO

HOSTACE

GHRSST Climate Data Record Technical Advisory Group

Project Goals

1. Historical Ocean Surface Temperature – Adjustment, Characterisation and Evaluation (NERC funded)
2. Exploit new historical data and ARC / SST CCI satellite record in reconstructing 1850 – present
3. Explore uncertainty components more fully



Current Status

1. Just started, PDRAs recruited
2. ADVERTISING FOR PHD STUDENT (BRITISH) to do IRIS-SST comparison with historical reconstruction

Looking Forward

1. ARC vs in situ uncertainty budgets (ships and drifters)
2. Project duration 4 years

Liz Kent and Chris Merchant

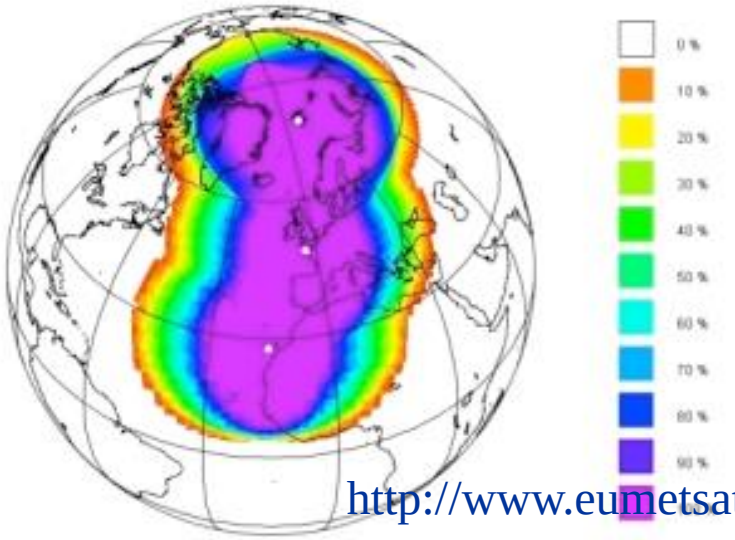
Level 1 Activities

AVHRR HRPT/LAC Reprocessing

GHRSST Climate Data Record Technical Advisory Group

Project Goals

1. To collect AVHRR HRPT data from receiving stations around the world with special focus on the pre-MODIS period.
2. To reformat and stitch together the collected Level 0 data, generate L1b data from that stitched data, and then produce L2 and L3 SSTs.
3. To serve as a fundamental input to high-resolution GHRSST CDRs



http://www.eumetsat.int

Current Status

1. R2HA2 Working Group formed in GHRSST.
2. Collected all CMS Level 0/1 data at URI.
3. SeaDAS configured to handle NOAA-archived LAC/HRPT data.
4. Formulation of L1P, a GHRSST version of L1a/L1b, near completion.

Looking Forward

1. Continue collection of Level 0-1 data at URI.
2. Seek commitments from other potential partners.
3. Complete L1p formulation.
4. Develop code to rewrite data contributions to L1P.

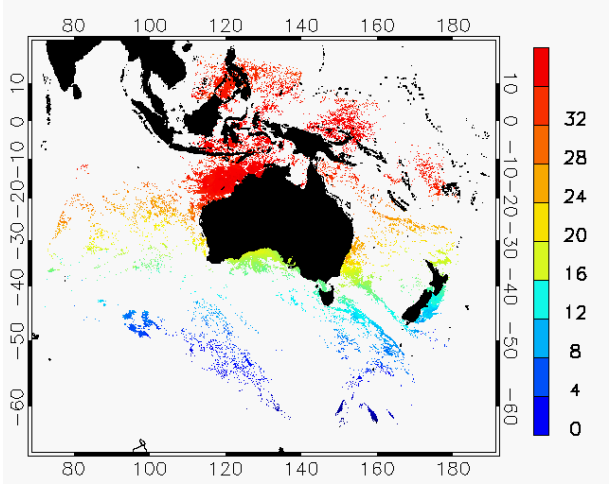
Peter Cornillon, University of Rhode Island/Hervé Roquet, Centre de Météorologie Spatiale

IMOS HRPT AVHRR SST Reprocessing

Project Goals

1. To reprocess HRPT AVHRR data back to 1992 from Australian and Antarctic ground stations to GDS2 L2P, L3U, L3C and L3S SSTskin files
2. Aim to reduce errors by using:
   - Regional drifting buoys to produce regression coefficients
   - Recalculating BT to SST regression coefficients monthly on 12 months of buoy match-ups
   - Improved CLAVR-based cloud clearing

Nighttime NOAA-18 L3C



Current Status

1. Transitioning from BoM 2011 regression algorithms with additional day-time terms for latitude and higher order to standard NLSST algorithm
2. Adding experimental SSTs using same day/night algorithm with day-time proxy Ch 3 BT field to reduce day/night SST bias

Looking Forward

1. L2P, L3U, L3C and L3S files from NOAA-11 to 19 data back to 1992 available from GHRSST GDAC by Dec 2013
2. Include real time Casey and Davis data
3. Routinely validate AVHRR SST against IMOS in situ SST (eg. ships, Argo, seals)

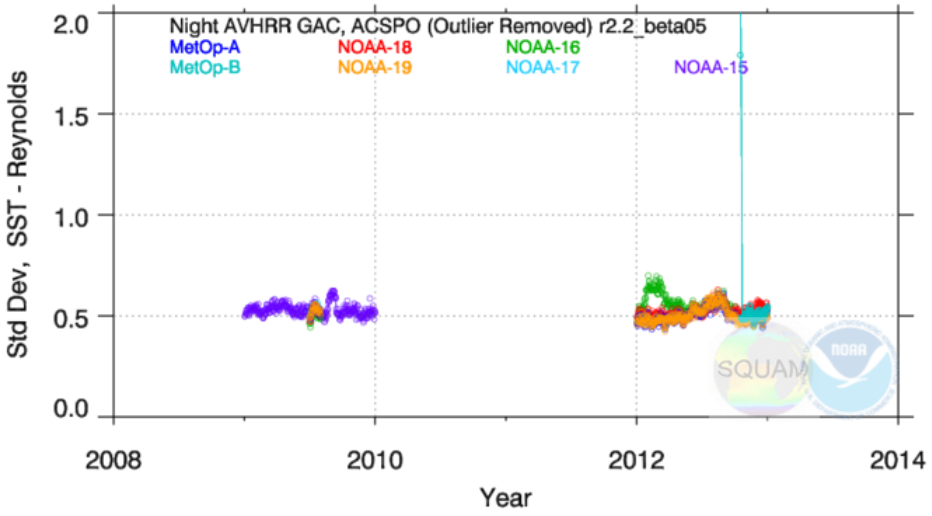
Level 2 and Level 3 Activities

Advanced Clear-Sky Processor for Oceans Reanalysis (ACSPO-RAN)

GHRSST Climate Data Record Technical Advisory Group

Project Goals

Generate/Maintain consistent AVHRR GAC L2 SST record based on NOAA ACSPO system. Process all NOAA & Metop platforms, consistently validate and monitor online SSTs, monitor Radiances



Current Status

1. Two years (2009 & 2012) of data processed from NOAA-15, -16, -17, -18, -19, and Metop-A and -B
2. Displayed in SQUAM & MICROS
3. Tweaking ACSPO system and display in SQUAM & MICROS

Looking Forward

1. iQuam v2 development underway
   - Initially go back to 2004
   - Subsequently extend to 1994
   - Eventually cover full AVHRR era 1981-present

Sasha Ignatov, NOAA

NOAA NESDIS GOES EAST/WEST SSTs

GHRSST Climate Data Record Technical Advisory Group

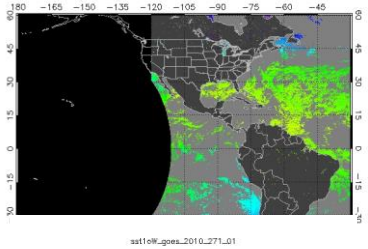
Project Goals

Generate geostationary climate quality sea surface temperature retrievals 1994 to present (GOES-8, 9, 10, 11, 12, 13, 14, 15)

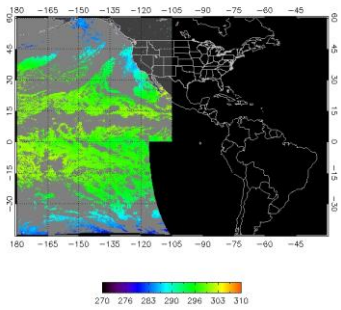
(Initiated reprocessing climate quality GOES E/W SST retrievals 1994 to present)

Current Operational

GOES-13 (GOES-E)



GOES-11(15) (GOES-W)



Current Status

Improve Algorithm retrieval methodology to reprocess with improved accuracy

- « Implementing Physical retrieval Algorithm with aerosol correction
- « Improving Bayesian Cloud Mask
- « Calibration Correction Applied

Looking Forward

Seeking funding to reprocess (funding approved)

1.Physical Retrieval Algorithm implemented to generate GOES-E/W SSTs

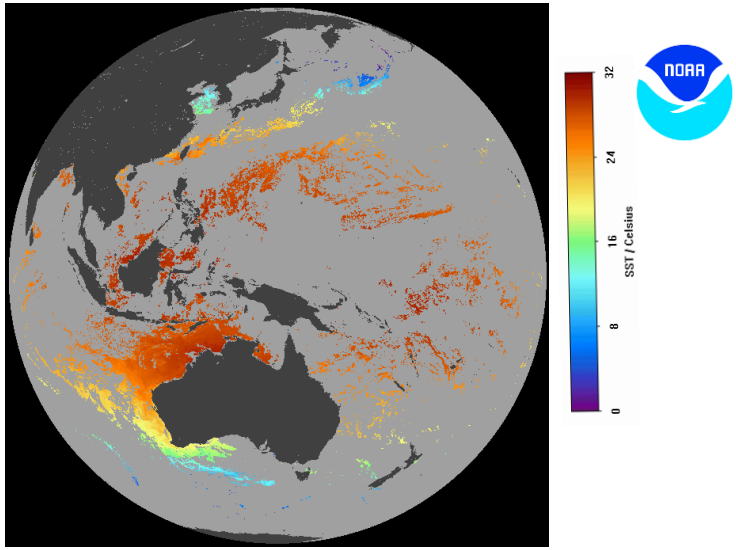
2. Satellite specific PDFs are being generated to improve Bayesian Cloud Mask

NOAA NESDIS MT-SAT SSTs

GHRSST Climate Data Record Technical Advisory Group

Project Goals

Generate geostationary climate quality sea surface temperature retrievals for
MTSAT-1 (2005-2010)
MTSAT-2 (2010-present)
(Initiated reprocessing climate quality MTSAT SST retrievals 2005 to present)



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Improve Algorithm retrieval methodology to reprocess with improved accuracy

- « Implementing Physical retrieval Algorithm with aerosol correction
- « Improving Bayesian Cloud Mask
- « Calibration Correction Applied

Looking Forward

Seeking funding to reprocess
(funding approved)

1. Physical Retrieval Algorithm implemented to generate MTSAT SSTs
2. Satellite specific PDFs are being generated to improve Bayesian Cloud Mask
3. Software set up to input 3D aerosol into CRTM (awaiting NCEP operational product)

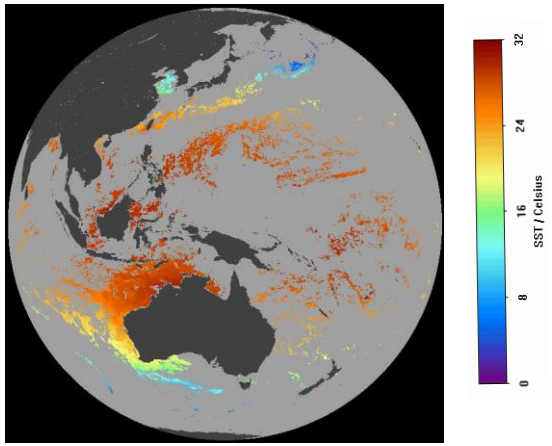
NOAA NESDIS MSG SSTs

GHRSST Climate Data Record Technical Advisory Group

Project Goals

Generate geostationary climate quality sea surface temperature retrievals from MSG-1 and MSG-2 and beyond

(Initiated reprocessing climate quality MSG SST retrievals 2005 to present)



Current Status

Improve Algorithm retrieval methodology to reprocess with improved accuracy

- « Implementing Physical retrieval Algorithm with aerosol correction
- « Improving Bayesian Cloud Mask

Looking Forward

Seeking funding to reprocess

(funding approved)

1.Physical Retrieval Algorithm implemented to generate MSG SSTs

2. Satellite specific PDFs are being generated to improve Bayesian Cloud Mask

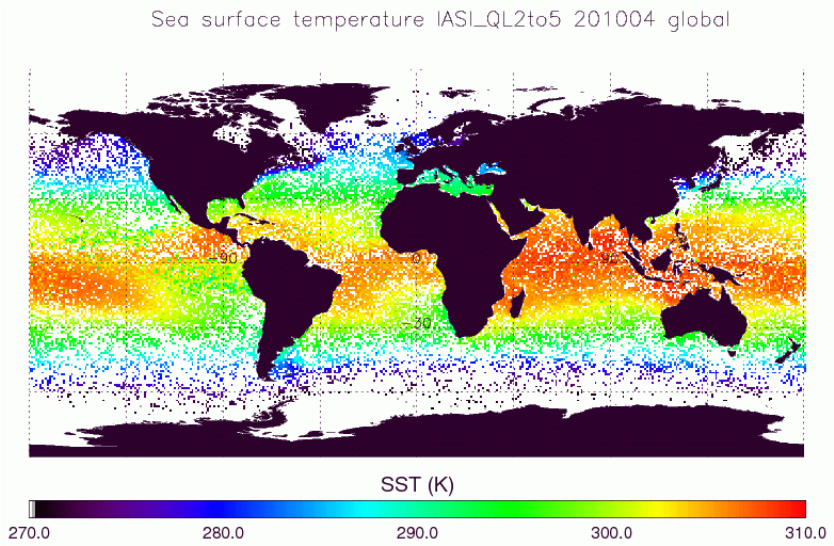
3. Software set up to input 3D aerosol into CRTM (awaiting NCEP operational product)

IASI L2P SST

GHRSST Climate Data Record Technical Advisory Group

Project Goals

1. IASI L2P SST.
2. Full IASI L2P products from the OSI-SAF CDOP-2 phase late 2013.



Current Status

1. IASI L2 products available from April 2008, L2Pcore from March 2010.
2. Currently IASI L2 PPF v5.
3. Metop-B launched September 2012.

Looking Forward

1. IASI L2 PPF v6 late 2013 to include new cloud scheme.
2. No date yet known for re-processing plans.

Anne O'Carroll, EUMETSAT

MODIS SST Improvements

GHRSST Climate Data Record Technical Advisory Group

Project Goals -

All Goals Achi

1. Add LATBAND SST retrievals to MODIS Aqua and Terra
2. Implement new MODIS Collection 6 calibration
3. Minimize seasonal, latitudinal differences with respect to refere observations

Update pending

Current Statu

1. Update to ... 6 calib...
2. ...atchup databases -
3. ...SST retrieval equation calculated - DONE
4. New Hypercube tables being computed (discrete values) – DONE

Looking Forward

1. Proposal submitted to NASA to support implementation of Hypercube with continuous functions - FUNDED
2. LATBAND and Hypercube being implemented in Pathfinder for all 5-channel AVHRRs – PENDING NOAA FUNDING?

Bob Evans, UMiami/RSMAS

AVHRR Pathfinder SST

GHRSST Climate Data Record Technical Advisory Group

Project Goals

1. To provide the longest, most accurate, and highest resolution consistently-reprocessed SST climate data record (CDR) from the AVHRR sensor series
2. To serve as a fundamental input to GHRSST Reanalysis CDRs

Current Status

1. Version 5.2 GDS2 L3C available for 1981-2012. Still no errors or times.
2. TDS, FTP, HTTP, LAS, OPeNDAP, WCS, WMS, and Geoportal Server
3. 7-day climatology and gap-filled time series in Coral Reef Temperature Anomaly Database (CoRTAD v4)

Looking Forward

1. Summer 2013: Daily, 5-day, 7-day, and monthly V5.2 averages and climatologies in GDS2 L3C/L4
2. End of 2013: V5.3 GDS2 L2P, L3U, L3C (many improvements, see notes)
3. 2014-2015: Version 6 GDS2 L2P, L3U, and L3C, with uncertainties and times, 2000-present

Bob Evans, RSMAS; Gregg Foti and Ken Casey, NOAA NODC

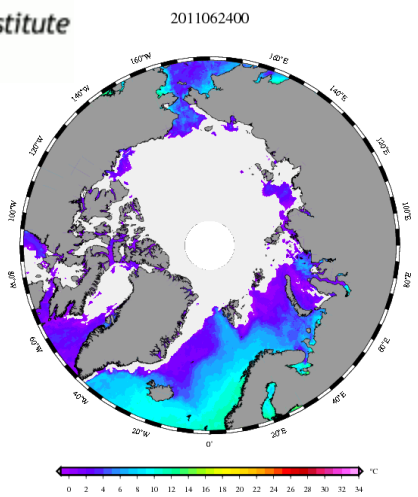
NORMAP – High Latitude SST

GHRSST Climate Data Record Technical Advisory Group

Project Goals

- Norwegian project for time series of satellite derived data
- Reprocess SST, IST and radiative fluxes from AVHRR GAC at high latitudes (>40N)
- Use Climate SAF AVHRR GAC FCDR
- Base processing on OSI SAF

Norwegian Meteorological Institute
met.no



Current Status

- Cooperating with DMI to set up reprocessing chain
- Input data ready: GAC, angle files and PPS cloud mask data (1989-2009 = 23Tb globally), as well as NWP from ECMWF

Looking Forward

- Start with 1989-2009 (currently available from CM SAF), extend with 1982-1988)
- Main activity autumn 2012 and 2013
- Expect data set ready end 2013

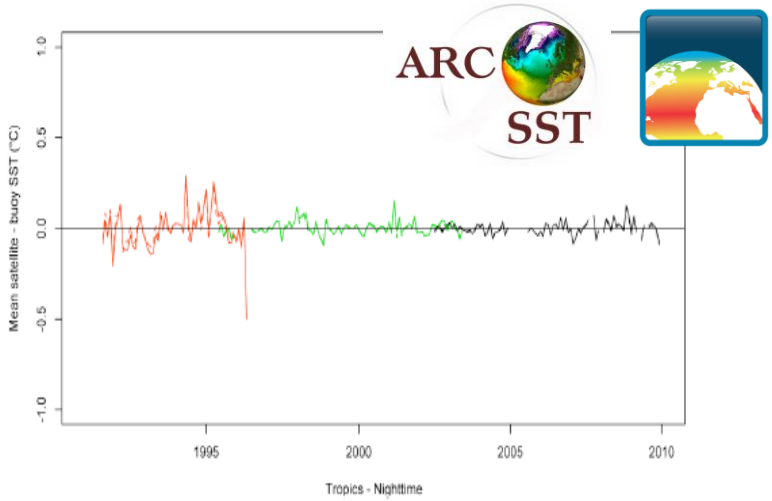
Steinar Eastwood, met.no

ATSR Reprocessing for Climate (ARC)

GHRSST Climate Data Record Technical Advisory Group

Project Goals

1. ARC v1.1.1 1991 to 2012 (v1.1 extended under SST CCI)
2. 0.1 K accuracy; <0.05 K/dec stability; 0.1 deg resolution; homogenised over 3 sensors
3. Based on physics: independent of in situ data



Current Status

1. Stability assessment suggests 0.05 K / dec achieved, at least for 1993 – 2009 in tropics
2. Accuracy assessment suggests 0.1 K bias target achieved globally
3. Overview JGR paper end 2012; and RSE submitted on harmonisation

Looking Forward

1. DECC-funded project with ESA will generate ARC-based ATSR L2P (full resolution)

Chris Merchant, University of Reading

SEVIRI

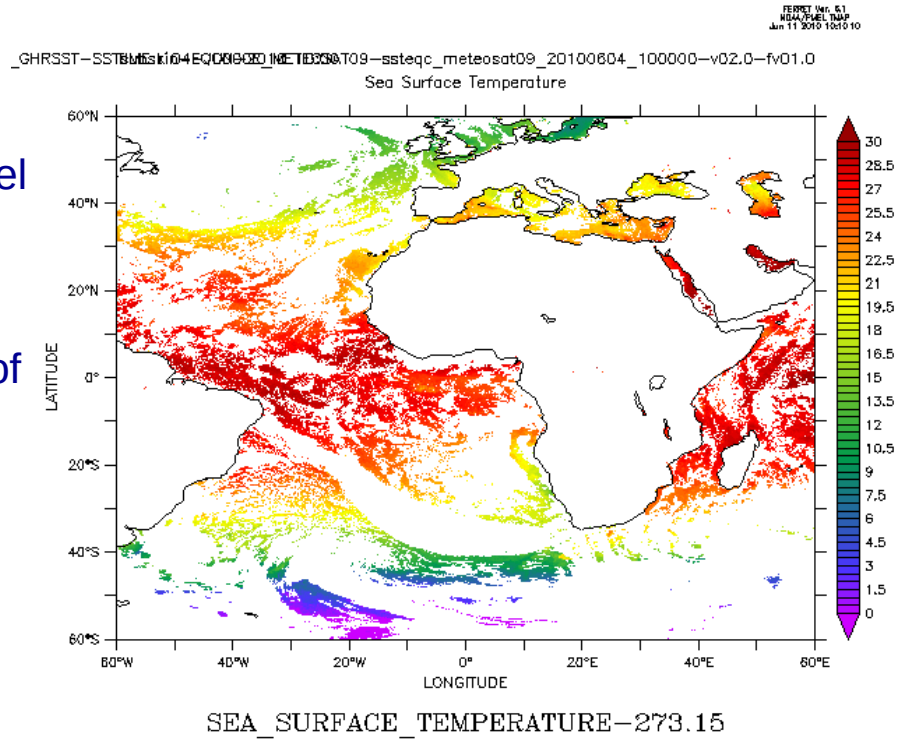
GHRSST Climate Data Record Technical Advisory Group

Project Goals

1. To reprocess SEVIRI data back to beginning of reliable reprocessed level 1 MSG-1 data, January 2004
2. The SST re-processing will be performed in the framework of (and funded through) the CDOP-2 phase of the EUMETSAT Ocean and Sea Ice SAF.

Current Status

1. Will use new processing chain and algorithms (smoothed optimal estimation, Merchant et al., 2013)
2. SST reprocessing is scheduled for 2014/2015
3. Cloud mask reprocessing by EUMETSAT Climate Monitoring SAF on-going
4. SST files will be produced a hourly GDS v2.0 L3C, collating data from 15 minutes slots in 1 file



Looking Forward

1. Data will be ready for delivery after 2015

Hervé Roquet, Meteo France

ESA SST Climate Change Initiative

GHRSST Climate Data Record Technical Advisory Group

Project Goals

1. Generate an SST CDR for 1991 to 2010 using ATSR + AVHRR
2. CDR features: independent of in situ; homogenized and corrected for diurnal cycle; 0.05 deg resolution; 0.05 K / dec stability goal; GHRSST formats; skin and drifter-depth estimates; uncertainties modelled
3. Prototype, demonstrate & specify a system for ongoing CDR in future

www.esa-sst-cci.org

Current Status

1. Prototyped products at L2P / L3 and L4 generated
2. Climate Research Data Package freely available via www.neodc.rl.ac.uk
3. Validation and assessment of utility in climate research now underway (Leicester and Hadley Centre)

Looking Forward

1. Second phase due to start 2014
2. Will address pre-ATSR period and post-AATSR period, and residual problems with Pinatubo etc

Chris Merchant

Level 4 Activities

OSTIA Reanalysis

GHRSST Climate Data Record Technical Advisory Group

Project Goals

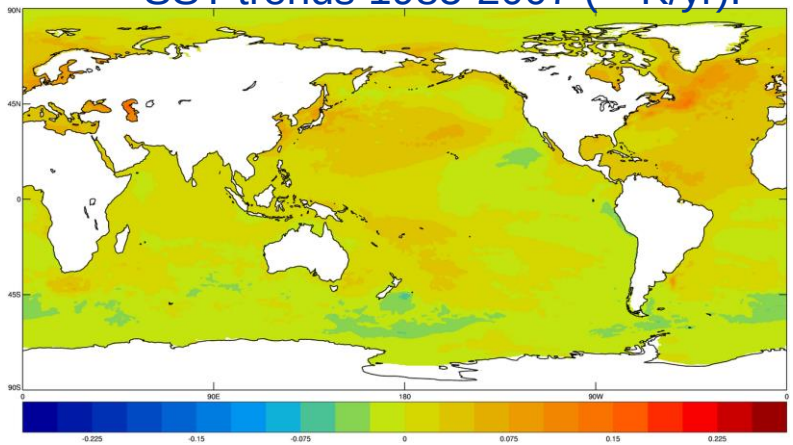
- OSTIA reanalysis produces global, daily SST and sea-ice reanalysis at high resolution (1/20˚).
- Reanalysis runs from 1985-2007.
- AVHRR Pathfinder and ATSR-1 data are bias corrected. The in-situ ICOADS and ATSR-2/AATSR data used as reference data set.
- OSI-SAF sea-ice concentration reprocessing used.

Current Status

- OSTIA reanalysis completed.
- Data freely available through MyOcean project

  http://www.myocean.eu.org/
- OSTIA reanalysis been assessed and validated in Technical Report and paper.

SST trends 1985-2007 (˚ K/yr).



-0.25 0.25

Roberts-Jones, Jonah, Emma Fiedler, Matthew Martin, 2012: Daily, Global, High-Resolution SST and Sea Ice Reanalysis for 1985-2007 Using the OSTIA System. J. Climate, 25, 6215-6232. doi: http://dx.doi.org/10.1175/JCLI-D-11-00648.1

In the process of being superseded by the ESA SST CCI L4 analysis.

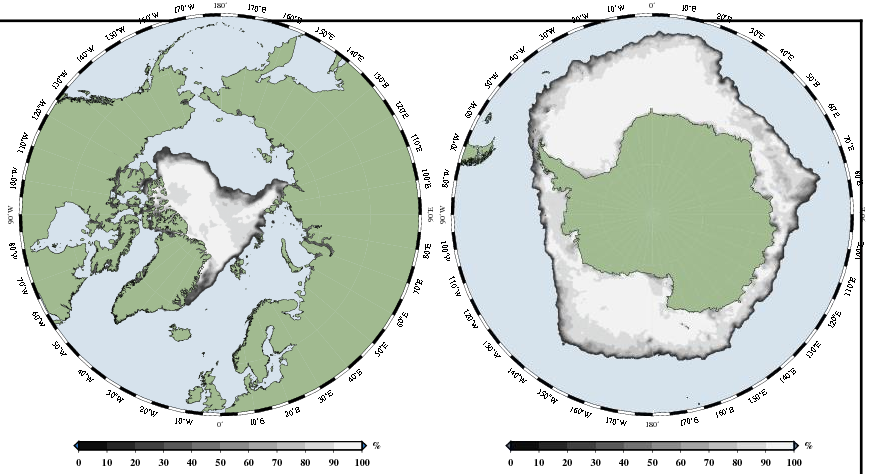
Jonah Roberts-Jones, Met Office

OSI SAF Sea Ice Concentration

GHRSST Climate Data Record Technical Advisory Group

Project Goals

- reprocess all available PMW data (SMMR, SSM/I)
- provide daily sea ice concentration back to 1978



Current Status

- version 1.0 was released spring 2010 (1978-2007)
- version 1.1 was released autumn 2011 (1978-2009), with improved uncertainties

Looking Forward

- continuous updates from end 2013, including SSMIS
- more information on http://osisaf.met.no

Steinar Eastwood, met.no

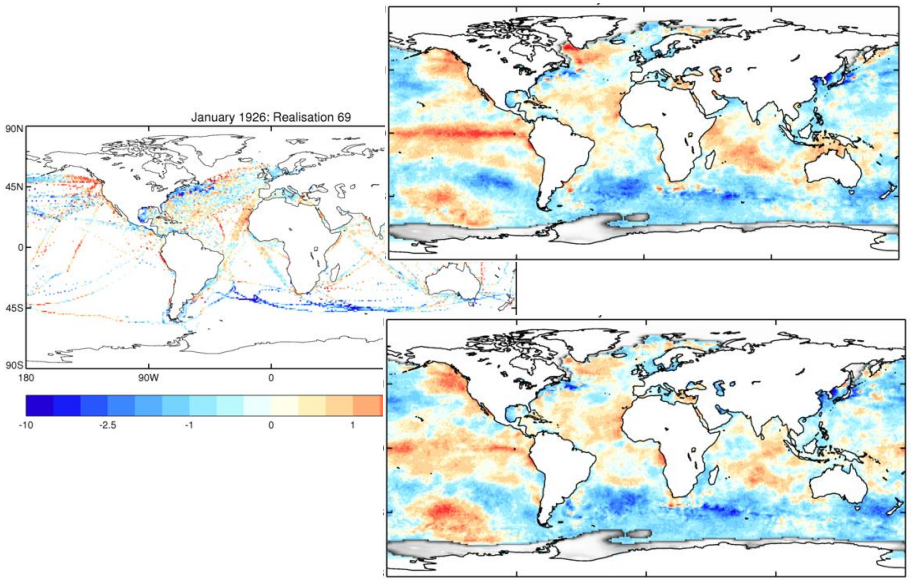
HadISST2

GHRSST Climate Data Record Technical Advisory Group

Project Goals

1. An ensemble of global, gridded, reconstructed data sets of *in situ* / AVHRR / ARC ATSR SST and sea ice measurements since 1850 with reduced biases and realistic covariance structure

Relevant Graphic



Current Status

1. Prototype v.2.1.0.0 ensemble of ten now created (for details nick.rayner@metoffice.gov.uk)
2. 1˚ x1˚ Monthly 1850-2009, Pentad 1961-2009 with Daily 0.25˚ interpolated versions of same

Looking Forward

1. Paper about to be submitted
2. Exploring options for updating satellite SST and sea ice
3. Planned near-real time updates

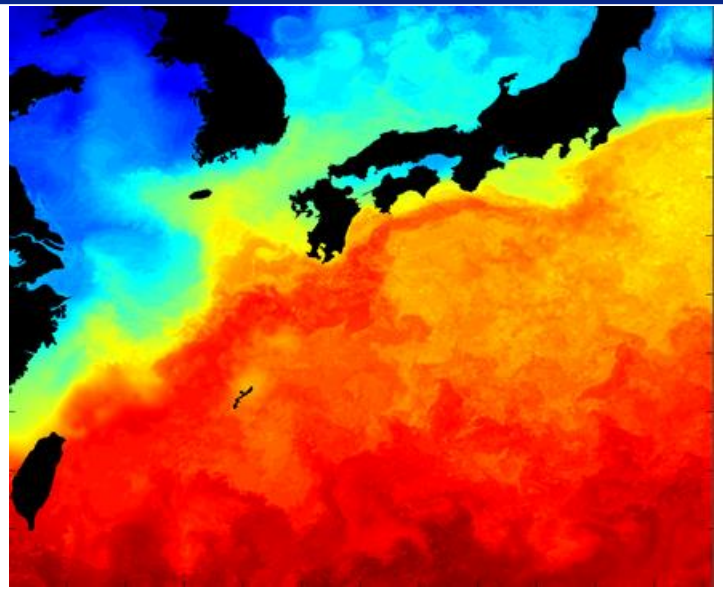
Nick Rayner, UKMO

MUR Global SST

GHRSST Climate Data Record Technical Advisory Group

Project Goals

- Global and decadal SST analysis at ultra-high (1 km) resolution.
- Optimize sensor contributions to spatial resolution using *Multi-Resolution Analysis* technique.



Current Status

- Version 4 covers from *mid-2002* to *present* (4-day latency).
- Input sensors: MODIS, AMSR-E, WindSAT, AVHRR-GAC, in-situ.

Looking Forward

- Near real-time production (reduce latency from 4 to 1 day).
- Pre-2002 retrospective extension.

Mike Chin, JPL

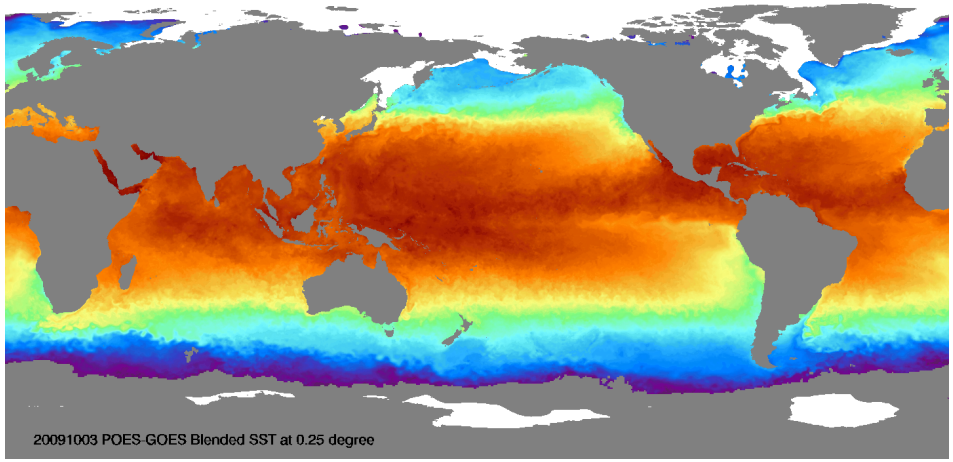
NOAA NESDIS Blended SST Analysis

GHRSST Climate Data Record Technical Advisory Group

Project Goals

- Improve the analysis by implementing changes that will improve the accuracy of the analysis
- Reprocess 0.25 Degree Geo-Polar Blended Analysis

(Initiated reprocessing climate quality Geo-Polar Blended SST Analysis)



Current Status

Improved error catagerization
Inclusion of microwave SST
AATSR SST for reference field

Looking Forward

Submitted a proposal to reprocess

(funding approved)
1. Improved error catagerization
2. AMSRE- failed- no SST-awaiting AMSR-2 SST operational product in the Fall
3. ENVISAT Satellite failed- no AATSR SST will use OSTIA for the reference field

DMI L4 Reanalysis, within Greenland Research Climate Centre

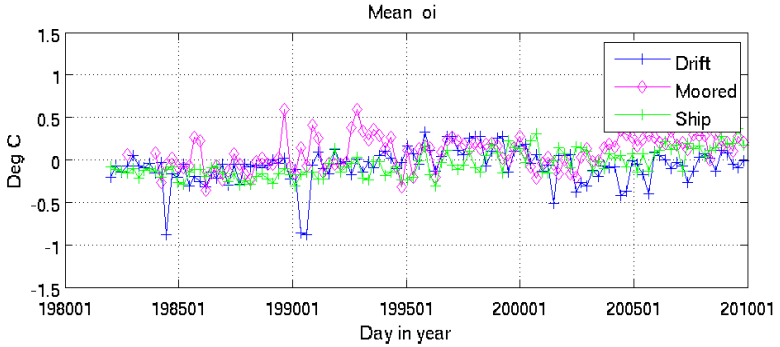
GHRSST Climate Data Record Technical Advisory Group

Project Goals

- An Arctic L4 SST reanalysis in 5 km
- 1982 to present, based upon Pathfinder and ARC data
- Using validation results and Arctic bias correction method (Høyer et al., 2011, & 2013).
- OSI SAF reanalysis ice mask.
- Including ICOADS2.5 + in situ observations from Greenland

Validation

Validated against in situ observations not included in the analysis: Bias < 0.1, Stddev



Current Status

- Reanalysis done + validated
- Contact Jacob (jlh@dmi.dk), for access to data set.

- References:
- Høyer et al.. Multi sensor validation and error characteristics of Arctic satellite sea surface temperature observations. Rem. Sens Env, 2012.
- Høyer et al. A bias correction method for Arctic satellite sea surface temperature observations. Rem. Sens Env., 2013 *In Press.*

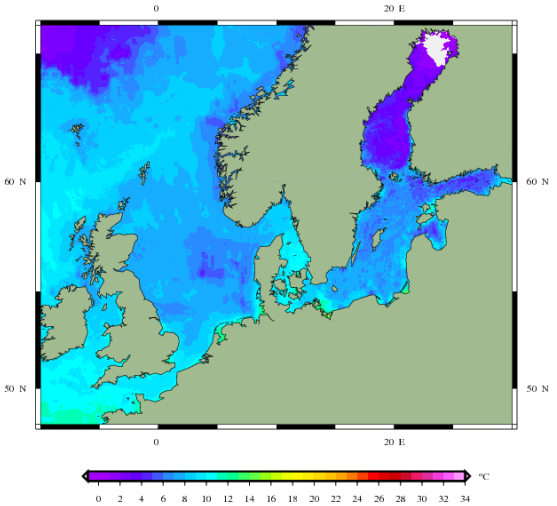
Jacob Høyer, DMI

MyOcean 2 reanalysis for Baltic Sea

Project Goals

- Produce North Sea-Baltic Sea L4 SST reanalysis
- 1982 to present, based upon Pathfinder and ARC data
- Using high latitude bias correction method (Høyer et al., 2013).
- Include high resolution ice mask from SMHI.
- Including ICOADS2.5 + in situ observations Marnet buoy network + lightship observations

Area



Current Status

- Reanalysis in progress
- Finished, end of June, 2013

Looking forward:

- Reanalysis will be available within MyOcean 2 access conditions.
- Also available: Product User Manual (PUM) + Quality Information Document (QUID)
- Included in Baltic Sea model reanalysis run.

Jacob Høyer, DMI

ESA SST CCI L4 analysis

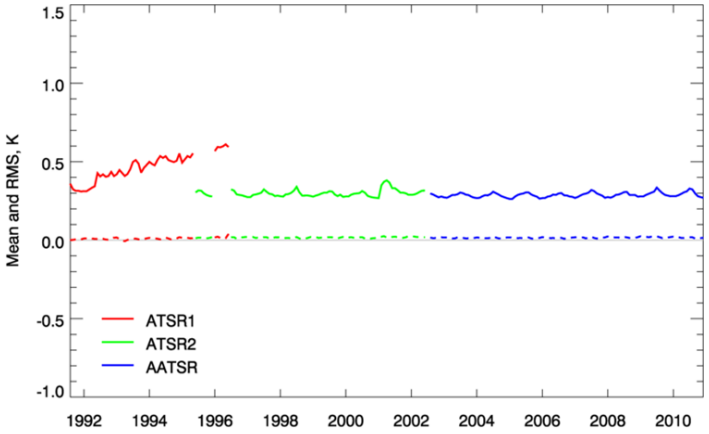
GHRSST Climate Data Record Technical Advisory Group

Project Goals

- Reanalysis carried out using the updated OSTIA system as part of the ESA SST CCI project.
- Reanalysis runs from Sep 1991-Dec 2010.
- Uses satellite data produced as part of the project
- In situ data is not assimilated.
- Reanalysis of SST depth (@20cm) and provides average daily SST.
- OSI-SAF sea-ice concentration data used.

Current Status

- SST CCI L4 completed and verified.
- Technical report on the updates to the OSTIA system written



SST CCI L4 ATSR o-b RMSE and bias.

Looking forward

- Reanalysis will be validated against independent in situ data.
- Comparison with other reanalyses will be carried out in a GMPE reanalysis system.

Jonah Roberts-Jones, Met Office

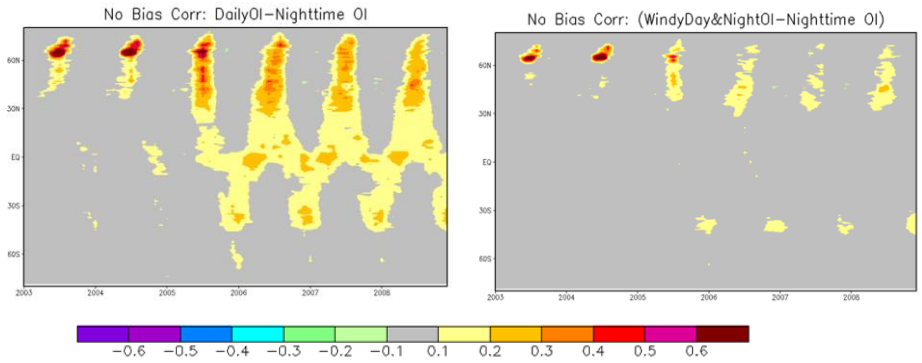
Night-like OISST

GHRSST Climate Data Record Technical Advisory Group

Project Goals

1. To make optimally interpolated SST fields that have reduced diurnal variability compared to daily OI
2. Instead of nighttime-only, redefined goal to night-like SST (closer to pre-dawn or foundation SST concept)

Relevant Graphic



Current Status

1. Pathfinder SST v.5.2 used for test period (2000-2008)
2. Implemented use of CFSR winds for screening of daytime SSTs
3. Demonstrated that the combining night+wind-screened day is very similar to night-only

Looking Forward

1. Process 1981-1999 but need missing Pathfinder data (for 2 months between N11 and 14; Sep-Oct 1981)
2. Code modernization

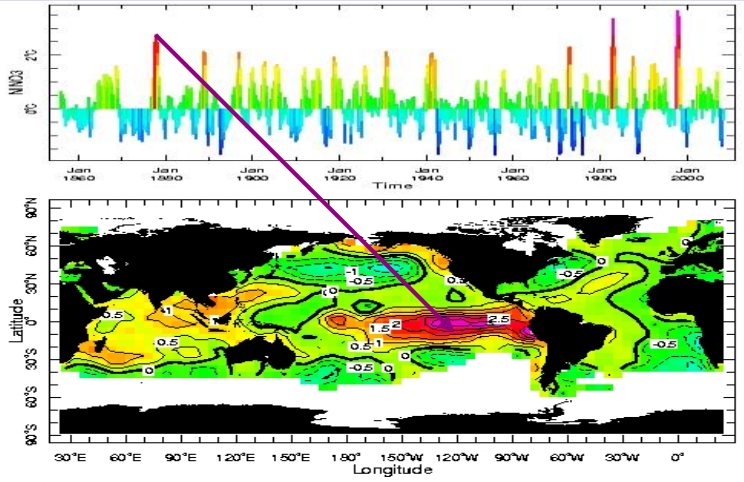
Viva Banzon, NOAA NCDC

LDEO [*Kaplan et al.*, 1998, 2003] SST

GHRSST Climate Data Record Technical Advisory Group

Project Goals

- To provide a statistically homogenous analysis of the full historical data set of in situ observations, with verified uncertainty estimates, using realistic covariances of the “true” field and data error, with the minimum of other assumptions.
- To support studies of climate variability and paleoreconstruction verification; serve as a benchmark for other century-scale analyses.



http://iridl.ldeo.columbia.edu/expert/SOURCES/.KAPLAN/.EXTENDED/.v2/.ssta/

Current Status

- The original 5ºx5º analysis version of in situ data only (1856-) extended to the present using monthly NCEP OI v.2. It is updated monthly by IRI Data Library.
- Recent methodological developments: adding smaller scales to the reduced space solution, Bayesian ensemble representation of uncertainty [*Karspeck et al.*, 2012], results are avilable here:

http://rainbow.ldeo.columbia.edu/~alexeyk/KKS2011supp/

Looking Forward

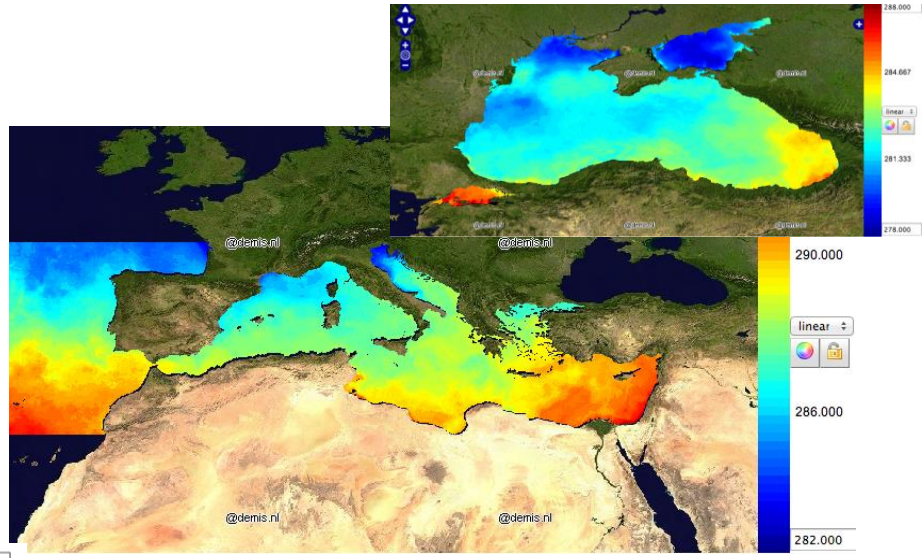
- Using SST variability estimates from satellite data to model in situ data error and use it in the reduced space analysis of historical data;
- Implementation of *Karspeck et al*. [2012] approach in the global analysis of historical SST data: combining estimated variability at different scales with the non-stationary covariance representation and describing the uncertainty of the results by an ensemble of equiprobable SST fields

Mediterranean/Black Sea L4 re-analyses

GHRSST Climate Data Record Technical Advisory Group

Project Goals

1. Provide consistent long L4 SST daily timeseries for regional (MED/BS) climate modelling, and climatologies to be used as background (first guess) field for operational real-time L4 processing. (MyOCEAN2)
2. Assess the system variability and trends via statistical analyses (EU-MFSD)
3. Build robust climatologies for comparison and validation of in-sit climatologies (SeaDataNet2)



http://gos.ifa.rm.cnr.it/index.php?id=407

Current Status

1. Version 1 Available: HR (1/16°) Daily 1985-2005, and climatologies
2. Available via FTP, HTTP
3. Climatologies are used as first guess for the L4 operational production within MyOCEAN2 OSI-Tematic Assembly Center

Looking Forward

1. MYO HR/UHR L4 re-processing from multisensor data (new covariance model)→September 2013
2. HR/UHR L4 re-analysis from PFV5.2 →end 2013

Bruno Buongiorno Nardelli, GOS/CNR

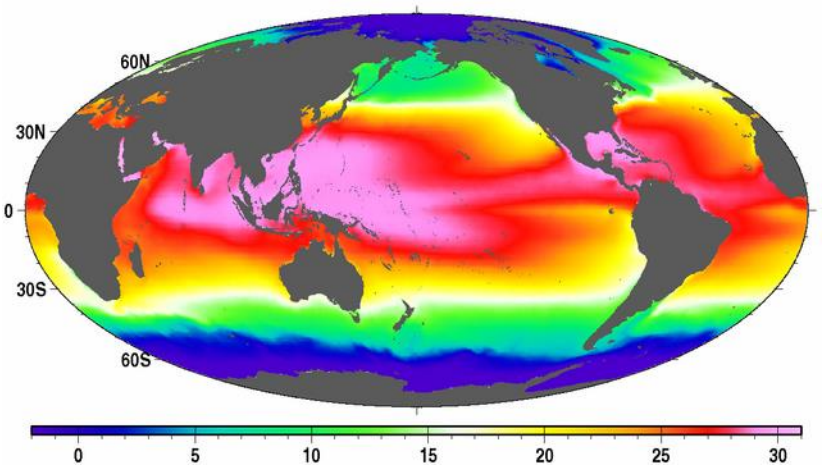
MGDSST Reanalysis

GHRSST Climate Data Record Technical Advisory Group

Project Goals

1. Provide consistent time series of global daily SST analysis during the satellite era
2. Used for ocean reanalysis with a ocean data assimilation system for the western North Pacific (MOVE/MRI.COM-WNP)

Climatology for July



Current Status

1. Complete reprocessing using Pathfinder SST v.5.0/5.1 (1982-2006)
2. Data will be available through NEAR-GOOS Database (not GDS2.0) http://goos.kishou.go.jp/
3. Sent to UKMO for 'reanalysis' GMPE system

Looking Forward

1. Using AMSR-E/AMSR2 SST for reanalysis
2. Hindcast experiment of monthly weather prediction model using the reanalysis will be implemented

Shiro Ishizaki, JMA

Data Tools/Intercomparison Activities & other

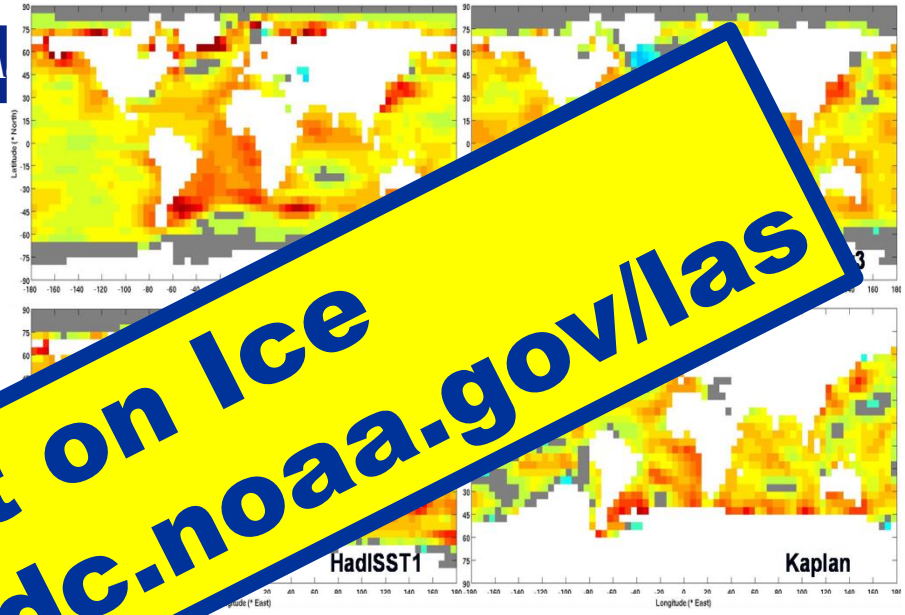
GCOS SST Intercomparison Framework

GHRSST Climate Data Record Technical A

Project Goals

1. To understand differences between global and near-global SST analyses with the aim of producing better, long-term SST climate data records
2. To use this understanding to link the modern satellite-based records wit… historical, primarily in situ-b…

http://ghrsst.nodc.noaa.gov/i…



Project on Ice
http://data.nodc.noaa.gov/las

Current Status

1. 11 uni… …se
2. …ailable via NODC
3. As… …pilot study to determine the origins of observed differences, common input data and two historical analyses (ERSST and COBE) based on that input received

…ooking Forward

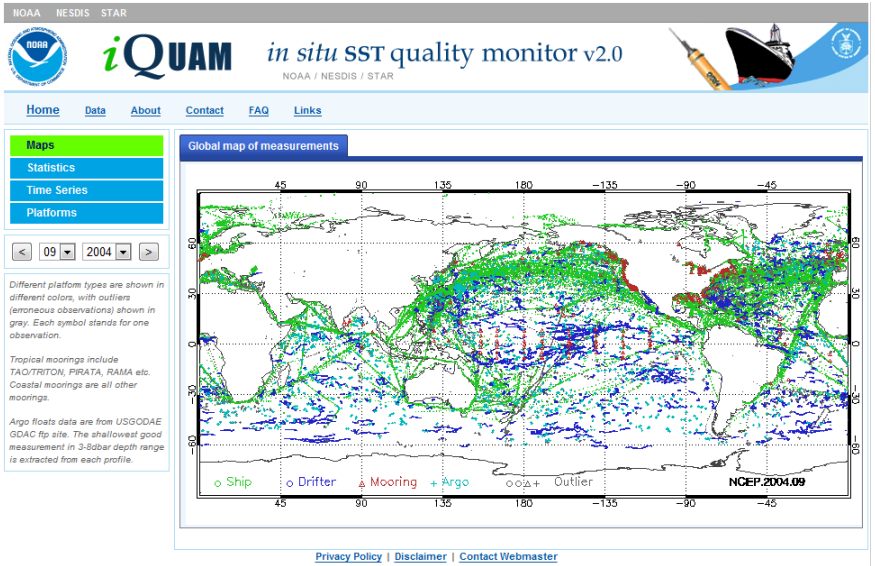
1. Receive rest of common-input analyses for pilot study
2. Update products with new versions (e.g. ERSSTv3b) and new data (e.g. PFV5.2 through 2010)
3. Summarize differences as a set of strengths and weaknesses for each product to provide guidance to users of SST analysis products

In situ SST Quality Monitor (*i*Quam)

GHRSST Climate Data Record Technical Advisory Group

Project Goals

1. Generate & maintain global near-real time community consensus *in situ* SSTs for satellite Cal/Val
   - Perform uniform QC
   - Monitor on the web
   - Serve QCed data to users



Current Status

1. *i*Quam v1 sustained operations
   www.star.nesdis.noaa.gov/sod/sst/iquam
2. Manuscript submitted to JTECH
3. *i*Quam SSTs used in SQUAM
   www.star.nesdis.noaa.gov/sod/sst/squam/

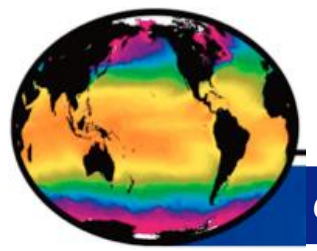
Looking Forward

1. iQuam v2 development underway
   - Add ARGO Floats (Fig. above)
   - Add OSI SAF & UKMO black lists
   - Extend back to 1980
   - Regenerate based on ICOADS

Sasha Ignatov, NOAA

2013 Reprocessed GHRSST Status

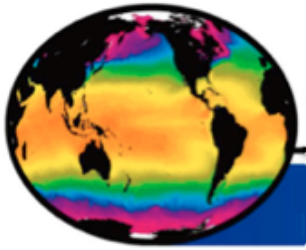
GHRSST Climate Data Record Technical Advisory Group



Sensor not in operation or capable of SST observations	
No plans yet for reprocessed GHRSST L2P/L3U	
Efforts underway or proposed for reprocessed GHRSST L2P/L3U	
Consistent reprocessed data available in GHRSST L2P/L3U	

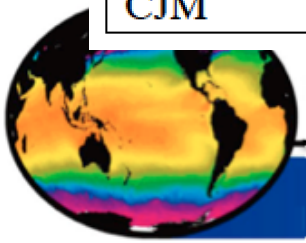
Climate Data Assessment Framework

- Present v1.0.2 document
- CDR-TAG recommends adoption to ST?
- Follow-up actions and questions
  - Dissemination beyond GHRSST
  - Potential use of Felyx
  - Trial submissions and review at GHRSST XV
  - Need to improve guidance on “traceability”



Consultation

Author	Modification	Issue	Rev	Date
CJM	Original draft	0.1	1	6 February 2013
JM & GKC	Comments on draft implemented	0.2	1	Feb 2013
CJM	Inclusion of Argo and possible extensions	0.3	1	Feb 2013
CJM	Update to make language consistent with language of "system maturity metrics" and "climate data assessments" adopted by CEOS WG Climate. Also Bates matrix removed, to preserve the above distinction.	0.4	1	22 Feb 2013
JM & GKC	Final comments prior to TAG consultation	0.5	1	23 Feb 2013
CJM	Updates in response to comments received during TAG consultation at http://podaac.jpl.nasa.gov/forum/node/54	1.0	1	6 June 2013
CJM	Further comments received directly	1.0	2	16 June 2013



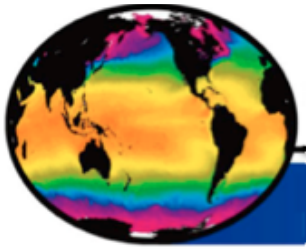
Purpose and scope

A CDR is "a time series of measurements of sufficient length, consistency and continuity to determine climate variability and change" (NRC, 2004), ideally traceable to SI standards.

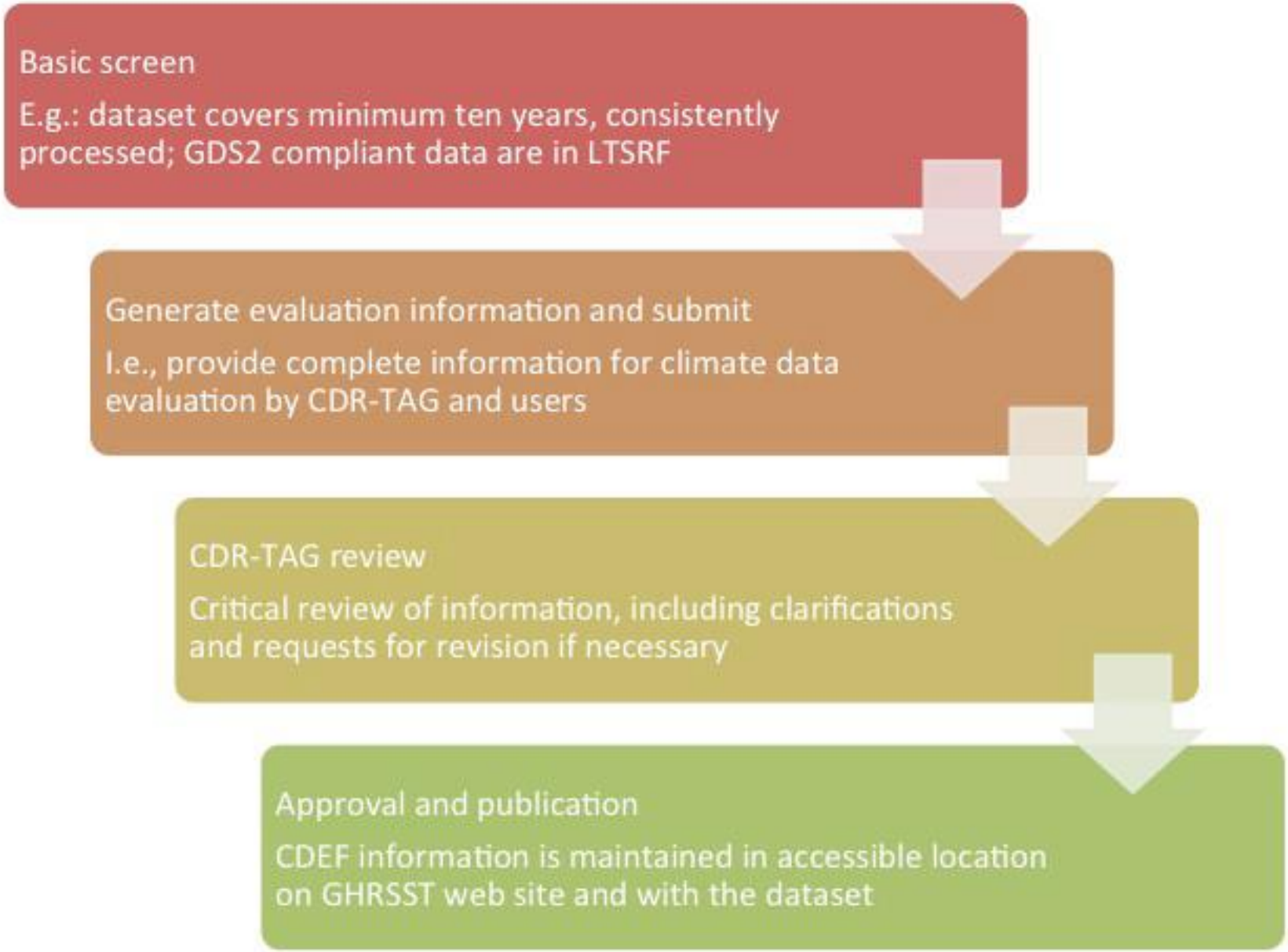
The CDR-TAG is tasked to support users of sea surface temperature (SST) datasets to understand the suitability of GHRSST datasets for use as Climate Data Records (CDRs).

This CDAF lays out how the CDR-TAG will discharge this responsibility by providing authoritative, comparable information about GHRSST datasets that will allow users to make their own judgment about use of the datasets as CDRs for their application.

The datasets to which the CDAF is applicable are those derived largely or wholly from satellite SST estimates. **This present version of the CDAF is intended to be applicable to L2P and L3 satellite SSTs.** Blended L4 products will be addressed in a future version of the CDAF after experience is gained with swath and gridded data.



Climate Data Evaluation Framework



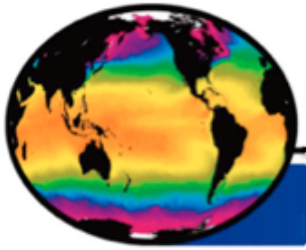
Basic Screen

A dataset here means a coherent collection of SST products, from one or multiple sensors.

Dataset producers identify whether their SST dataset passes some basic screening criteria. This requires affirmative answers to all of the following questions:

1. Is the dataset >10 years in length?
2. Is the dataset in its entirety freely available from the Long Term Stewardship and Re-analysis Facility (LTSRF) or from a sustained archive linked/discoverable from LTSRF pages?
3. Where multiple missions/sensors contribute to the dataset, have the data been harmonized? (This means: have relative SST biases between sensors been minimized, by exploiting overlap periods or by some other means?)

Datasets producers then inform the GHRSST Project Office (GPO) and CDR-TAG chair of the existence of a dataset appropriate for assessment as a climate data record, and proceed to the next self-assessment step.

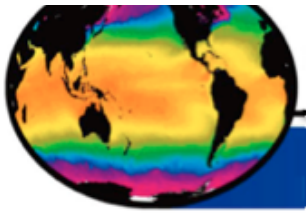


3.2 Generate assessment information and submit to CDR-TAG

The dataset must include the complete set of information specified in this CDAF, hereafter the "assessment information", which is defined in detail in §4. The information overlaps with, and in certain cases exploits, criteria and indices developed outside of GHRSST. This reduces the documentation burden on the dataset producer, since information can be reused. However, some of the assessment information may need to be developed specifically for consideration within the CDAF. Climate user requirements (e.g, Good and Rayner, 2011) justify the effort required to generate this information.

An important aspect for users will be confidence in the comparability of assessment information, particularly of quantitative measures of quality. The CDR-TAG has noted that a multi-sensor match-up system covering the GHRSST constellation as a whole would provide such comparability, since measures could then be calculated using identical approaches. At present, a community-wide multi-sensor match-up system does not exist. At present, only a certain level of comparability can be achieved, by specifying relatively detailed principles for calculation of quantitative information within this CDAF.

Creating a community multi-sensor match-up system is a GHRSST objective agreed at GHRSST 2012. Within such a system, the exact *in situ* datasets used as reference points for metrics in this document could be controlled between different assessments for minimum effort on the part of dataset providers.



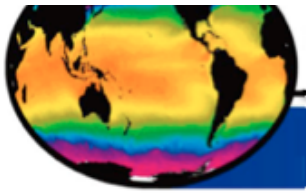
3.3 CDR-TAG review

The CDR-TAG will review the assessment information provided. The TAG will approve the assessment information as a fair and accurate representation to climate users of the nature of the dataset.

The CDR-TAG will consider:

1. Is the information complete?
2. Do we have confidence that quantitative measures are fair summaries of data quality? This may require technical review of the means of determination of these measures.
3. Is qualitative information given fair and accurate?
4. Is the information consistent and comparable with previously approved cases? This is arguably the paramount consideration, and perhaps the most difficult judgment required.

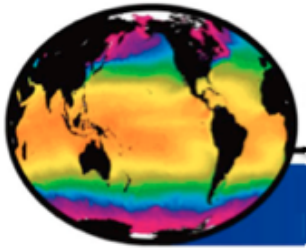
The CDR-TAG *will not* approve the dataset as an official GHRSST CDR. This is considered problematic. However, as experience with and confidence in the CDAF builds, the GHRSST Science Team may in future reconsider whether it wishes to task the CDR-TAG to identify some datasets as GHRSST CDRs using the assessment information in comparison to climate user requirements.



3.4 Approval and publication

After the CDR-TAG has approved the assessment information, the GHRSST web site will add the dataset to a maintained list of GHRSST datasets that have undergone climate data assessment. The list will link to the approved assessment information and to the data set.

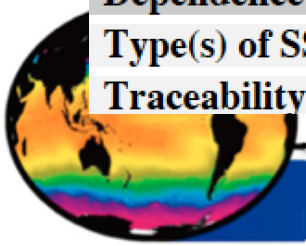
Since it may be useful to climate users, candidate datasets will also be listed and the assessment information linked. However, it will be made clear that the information has not yet been CDR-TAG approved, and that therefore the information is not verified as comparable with information for other datasets.



General assessment information

Status of assessment:
Dataset name and version:
Lead Investigator and/or Agency:
Principal strengths of data set:
Principal recommended applications:

KEY DESCRIPTIVE FEATURES	INFORMATION
Period covered	
Geographic range	
Spatial resolution	
Temporal resolution	
Timeliness of new data	
Dataset volume	
Valid data fraction	
Data level / grid	
Observation technology	
Dependence on other data	
Type(s) of SST	
Traceability	



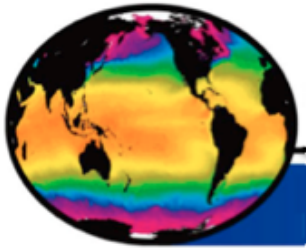
Contextual assessment info

AVAILABILITY, DOC'N, FEEDBACK	
Data URL / ftp / DOI	
Primary peer reviewed reference	
Source of technical documents	
Dataset restrictions	
Facility for user feedback	
Other documentation	

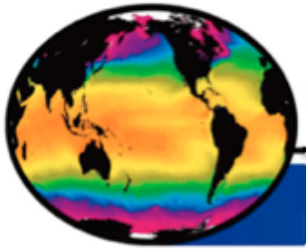
OTHER PRINCIPLES (GCOS)	COMMENTS
2. and 12. Overlaps between sensors exist and are exploited to harmonize the dataset	
3. Detailed history of methods/ algorithms is available	
11. Constant sampling within diurnal cycle	

Quantitative information

- Assessment against drifting buoys of
  - Systematic difference
  - Systematic uncertainty (geographically)
  - Non-systematic uncertainty
- Assessment against Argo measurements of
  - Systematic difference
  - Systematic uncertainty (latitudinally)
  - Non-systematic uncertainty
- Assessment of (deseasonalised) stability against GTMBA



QUANTITATIVE MEASURES	VALUE	COMMENTS
Systematic difference		*Global median difference of satellite minus drifting buoy SST, across full dataset. The satellite SSTs are SST_{skin} with no skin-effect adjustment, so a skin-effect difference of order -0.2 K is to be expected.*
		Global median difference of satellite minus upper Argo float SST, across full dataset. The satellite SSTs are SST_{skin} with no skin-effect adjustment, so a skin-effect difference of order -0.2 K is to be expected.
Systematic uncertainty		*Geographical variation in bias, as described by the standard deviation of median satellite minus drifting buoy SST differences on space scales of ~1000 km, across the full dataset.*
		Geographical variation in bias, as described by the standard deviation of median satellite minus upper Argo float SST differences on space scales of 20° latitude by 90° longitude, across the full dataset.



Consider adding or linking to further detail

- E.g., the underlying distribution of systematic differences cf. drifting buoys

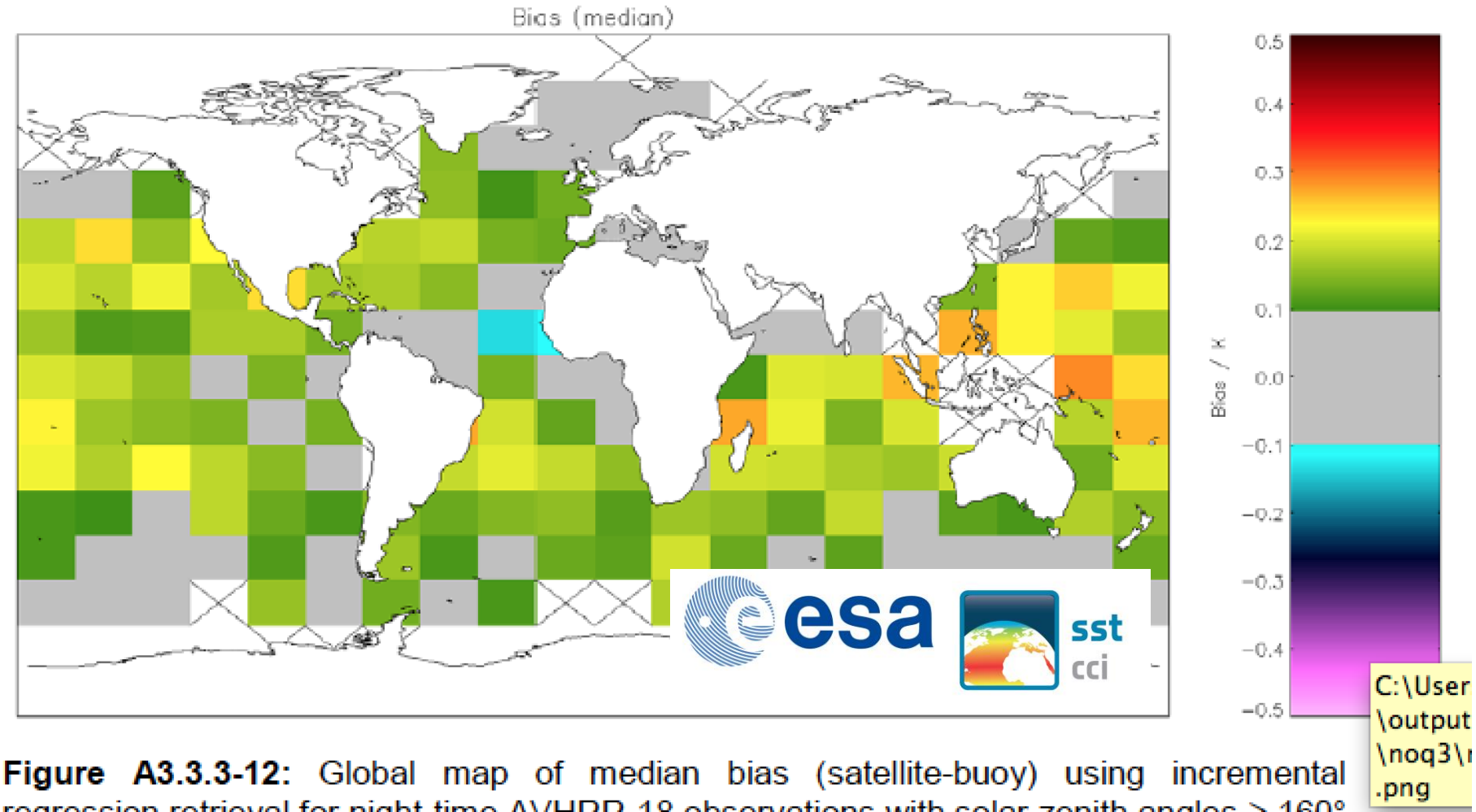
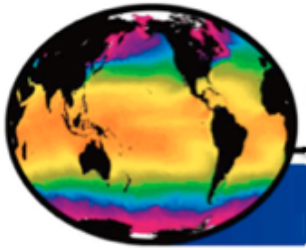


Figure A3.3.3-12: Global map of median bias (satellite-buoy) using incremental regression retrieval for night-time AVHRR-18 observations with solar zenith angles > 160° excluded. Crosses indicate grid cells excluded due to discrepancy of 0.1 K being insignificant for the cell. Global median bias = 0.152 K (**Table A3.2-5**).

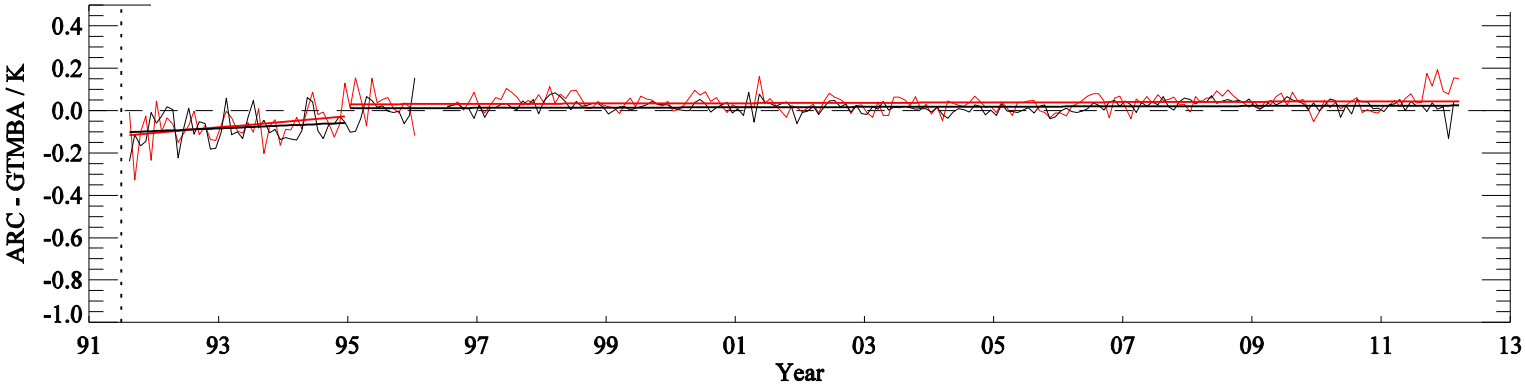
Non-systematic uncertainty

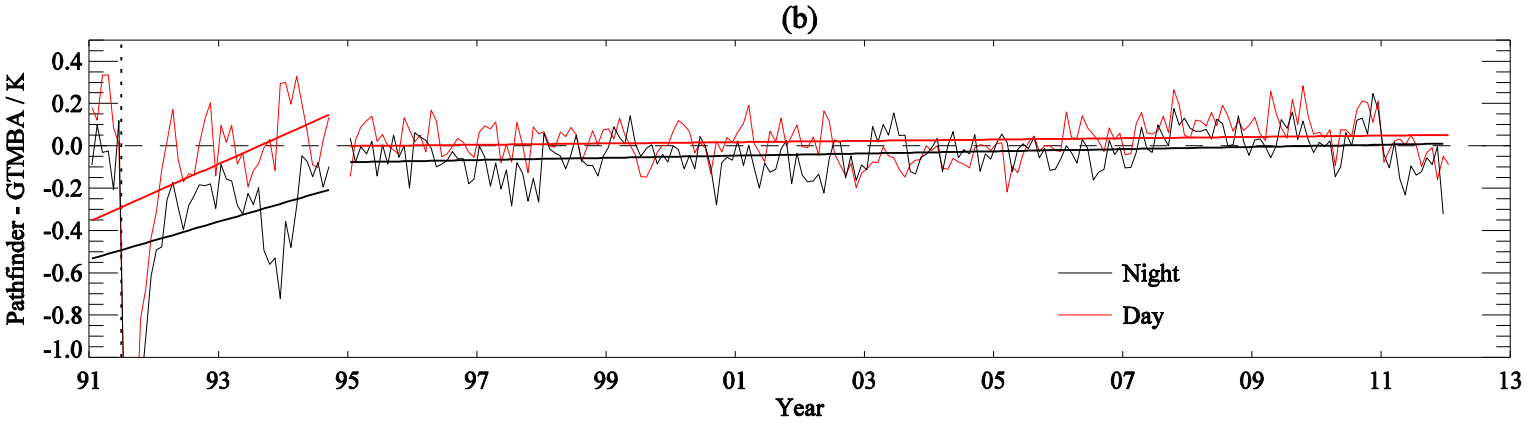
Quantitative measure	Value	Comments
Non-systematic uncertainty	0.55 K	*Uncertainty associated with all effects not included in systematic uncertainty, as quantified by a robust estimate of the standard deviation of residual differences of satellite and drifting buoy data*



Stability

Product	Time of Day	95 % confidence interval (mK year^{-1})
ARC v1.1.1	Day	-0.35 < trend < 2.03
ARC v1.1.1	Night	-0.13 < trend < 1.68
Pathfinder v5.2	Day	0.58 < trend < 5.59
Pathfinder v5.2	Night	2.59 < trend < 7.73





sst cci

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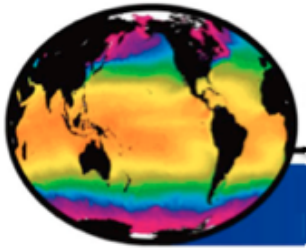
NATURAL ENVIRONMENT RESEARCH COUNCIL



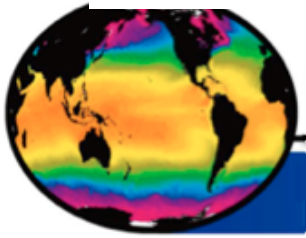
Sensitivity

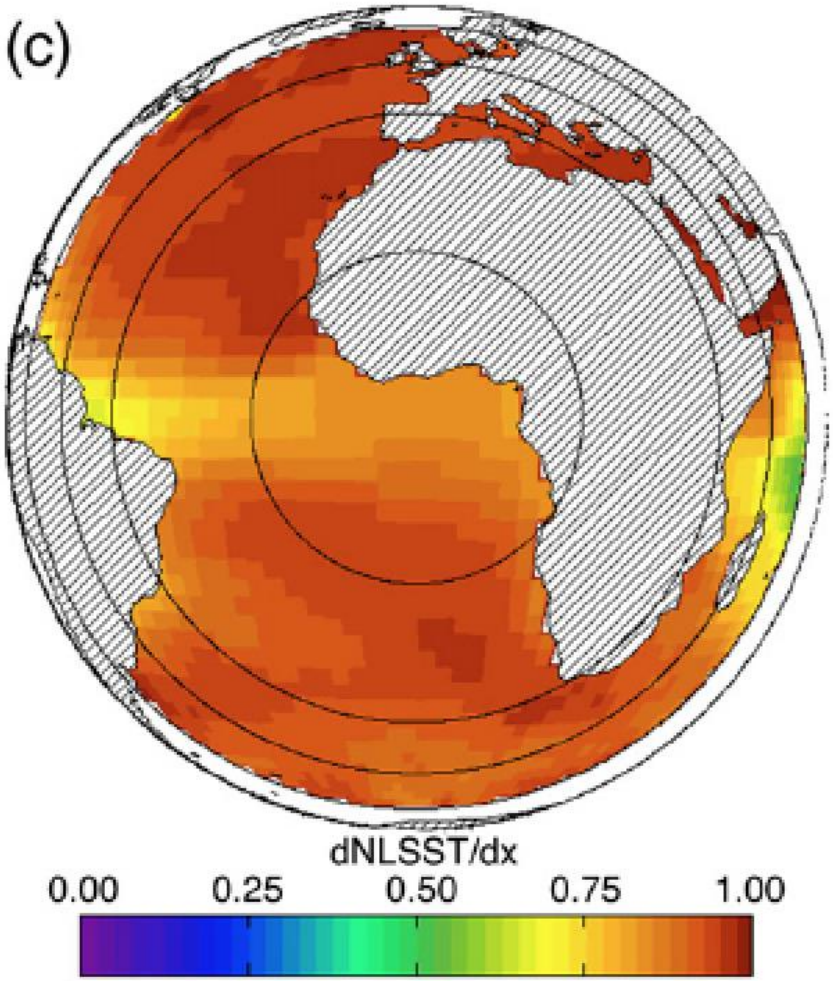
4.3.4 SST sensitivity

In general, remote sensing algorithms do not give results that are fully sensitive to true variations in the target geophysical variable, and SST retrieval is not exempt. The problem for a climate data record is that non-unity sensitivity indicates that part of the result actually derives from prior information and not from the satellite observations. Usually the degree of reliance on the prior information is variable across the product (as retrievals are more or less sensitive in different contexts) leading to complex and opaque prior error characteristics in the dataset.

SST sensitivity is calculable as:

$$\frac{d\hat{x}}{dx} = \sum_{c=1}^{n} \frac{\partial R}{\partial y_c} \frac{\partial y_c}{\partial x}$$





Remote Sensing of Environment 113 (2009) 445–457

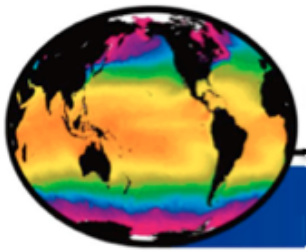
Contents lists available at ScienceDirect

Remote Sensing of Environment

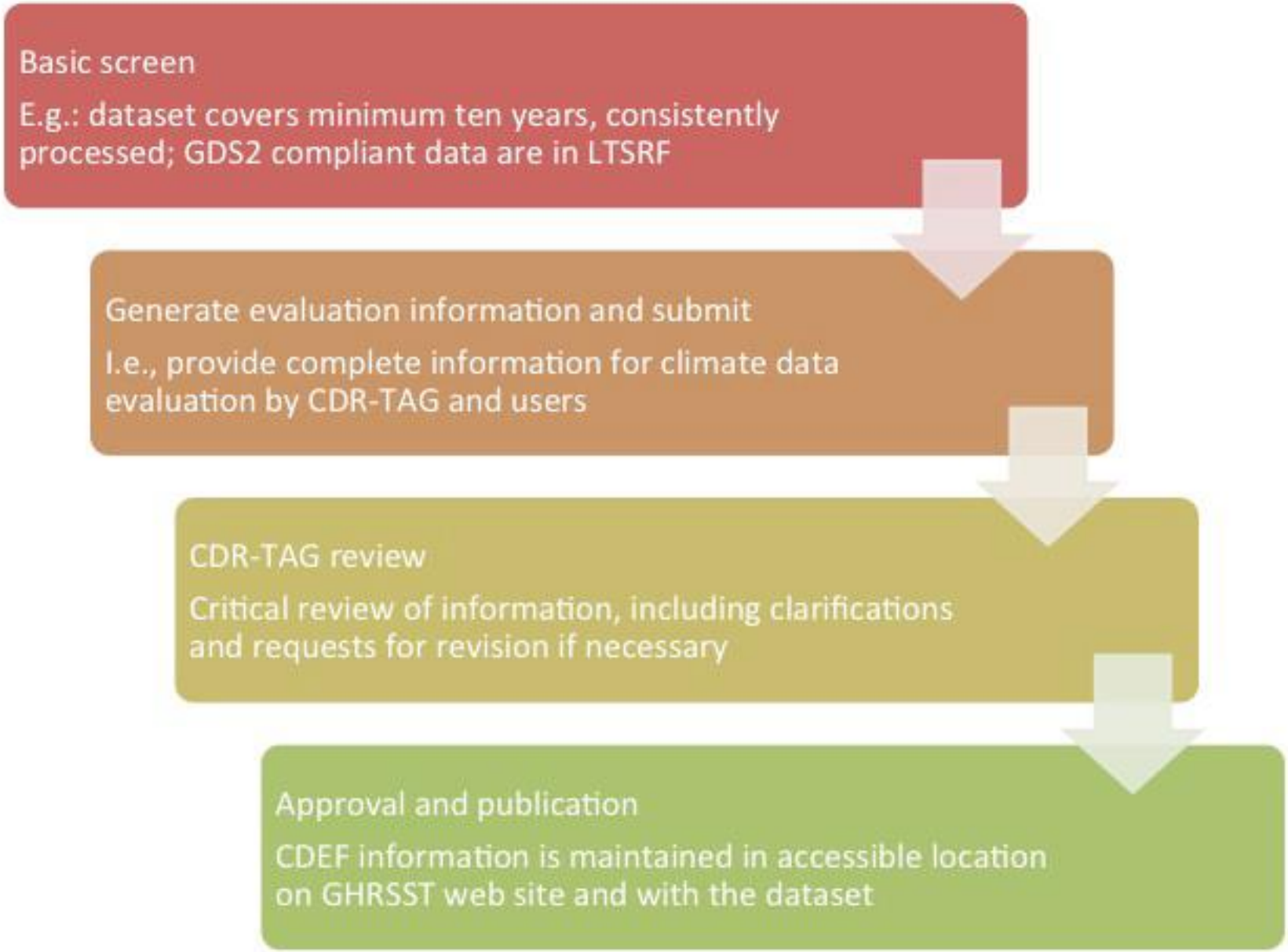
journal homepage: www.elsevier.com/locate/rse

Sea surface temperature from a geostationary satellite by optimal estimation

C.J. Merchant [a,*], P. Le Borgne [b], H. Roquet [b], A. Marsouin [b]

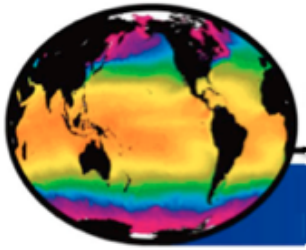


Climate Data Evaluation Framework



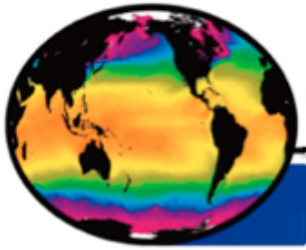
Questions and discussion

Any salient points on CDAF v1.0.2 text will be taken account of in v1.0.3



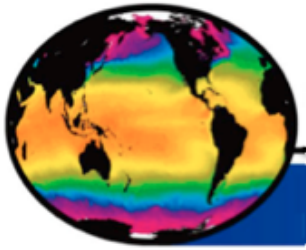
Decision

- The CDR-TAG recommends that the GHRSST Science Team adopts CDAF v1.0.3 as a framework for providing climate assessment information to users on GHRSST L2 and L3 products



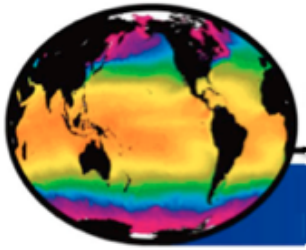
Distribution of CDAF beyond GHRSST

- Joerg Schluz and “CORE CLIMAX”
- CEOS WG Climate (inc. John Bates)
- IOCCG
- ESA CCI Climate Modellers’ User Group



Felyx

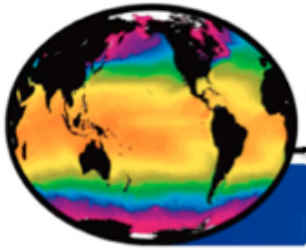
- Could be a means of standardising CDAF metrics?



CDAF trials

- Want to have review of 2 or 3 trail-blazer CDAF assessments at next GHRSST CDR-TAG

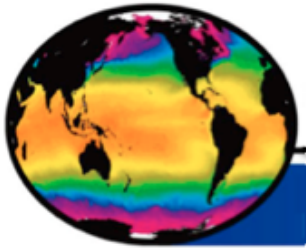
- SST CCI 1991 – 2010
- … volunteers … Pathfinder? REMSS?



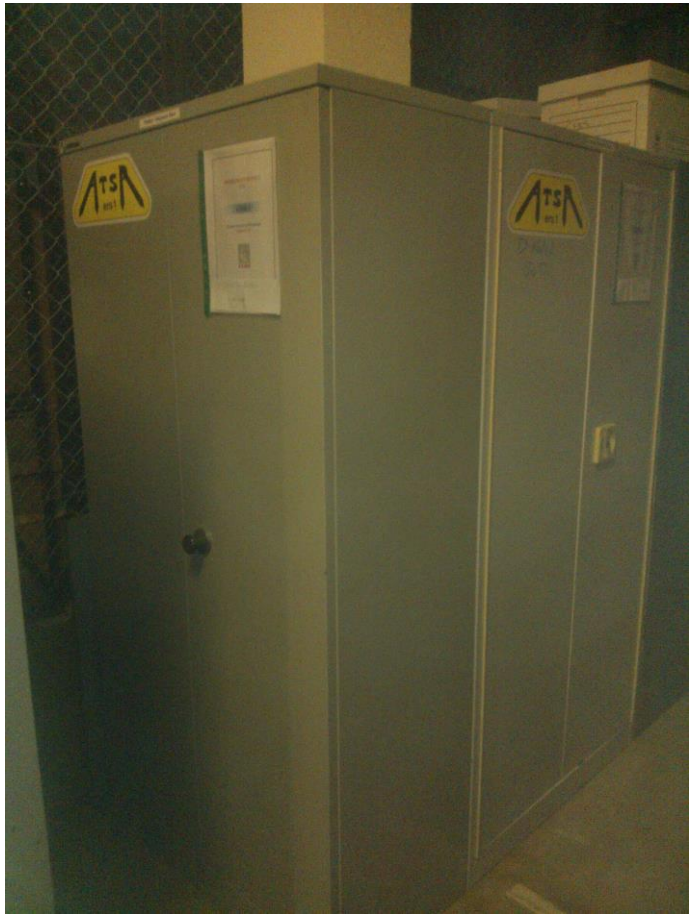
Traceability

- Need guidelines for dataset producers on how to describe/assess this

- Request to ST-VAL to provide?



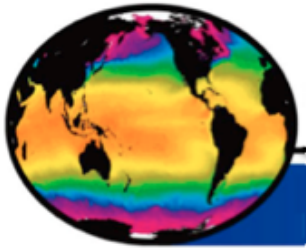
Historical documentation of sensors



Historical documentation of sensors

- Danger from loss of experts and their files

- Propose
  - raise in CEOS as a VC and ask CEOS to impress importance on their member agencies
  - open GHRSST letter on importance of this topic
  - send to agencies, CGMS



GCOS SST intercomparison site

- GCOS SST Intercomparison site
- Comment from Nick Rayner, in the light that there may at some point be scope in future to put effort into the site again:
  "building on what was done at NODC would be better than starting from scratch, so keeping everything where it is for now would be better than have it disappearing."