GHRSST-XIV

Inter-comparison Technical Advisory Group (IC-TAG)

Breakout session

Chaired by
Alexey Kaplan & Mike Chin

18 June 2013
8:00-10:00

- *8:00-8:10:* Introduction
- *8:10-8:50:* Analysis methods and development of L4 SST products

  Presentations (10 min each):

  Sea surface temperature by Barnes' interpolation: current stage (Franca Gutemberg)

  Recent updates to the near real time OSTIA system (Jonah Roberts-Jones)

  Brief update (5 min):

  NOAA Geo-Polar 5km Global SST Analysis for day&night, night-only, and diurnal correction plans (Eileen Maturi)

  Discussion (15 min)
- *8:50-9:35:* Inter-comparison of L4 SST products

  Presentations (10 min each):

  A comparison of SST gradients and the impact of going to higher resolution (Jorge Vazquez)

  L4 comparison using Reynolds/Chelton spectrum test (Michael Chin)

  Discussion (25 min), including:

  plans for the IC-TAG-wide inter-comparison based on Reynolds/Chelton approach
- *9:35-9:45:* GMPE plans discussion (lead by *Gary Corlett* and *Jonah Roberts-Jones*)
- *9:45-10:00:* General discussion and plans for the next year

Introduction

Terms of reference

1. To coordinate existing inter-comparison activities for L4 analyses within GHRSST, including the GHRSST Multi-Product Ensemble (**GMPE**), and the comparison of L4 analyses and lower level data including the SST Quality Monitor (**SQUAM**) and the High Resolution Diagnostic Data Set (**HRDDS**).
2. To coordinate the development of the existing inter-comparison systems, including the **development of links between those systems**.
3. To **develop standardised metrics** for use in routine inter-comparison of L4 analyses, and advise on the content and form of automatic reports from the inter-comparison systems.
4. To **improve the documentation** of the inter-comparison systems, and to provide high level information on the contributing L4 analysis systems.
5. To **promote the use of inter-comparison tools** for use by the other TAGs (e.g. Re-analysis TAG) where appropriate and make use of validation tools developed by other TAGs.
6. To **assess and improve the specification of error** in the L4 analyses.
7. To regularly review the IC-TAG chair/vice-chair and membership.

Introduction:

- The IC-TAG includes representatives from each of the L4 analysis producers which are contributing to GMPE, HRDDS and SQUAM, plus technical experts from the GMPE, HRDDS and SQUAM systems.
- On the IC-TAG GMPE is represented by Jonah Roberts-Jones. Gary Corlett and Jonah will lead a discussion here regarding the further development of GMPE.
- At G-13 HRDDS status was unclear, b/c of funding. Now Dave Poulter is back, funded by ESA, developing even more advanced system called Felyx, whose capabilities will include HRDDS. The project is lead by Jean-François Piollé. Craig Donlon talked about it yesterday, and Jean-François will lead a discussion on Felyx development today at the STVAL breakout (10:30-12:30).
- Since G-13 for logistical reasons SQUAM development only involved work with L2 and L3 products, not L4. Sasha Ignatov talked about it yesterday, Prasanjit Dash gave a poster and will discuss SQUAM at the STVAL breakout today. L4-SQUAM work will restart soon.

Current Membership

- Alexey Kaplan, Columbia University, USA (Chair)
- Mike Chin, NASA JPL, USA (Vice-Chair)
- Ed Armstrong, JPL, USA
- Viva Banzon, NOAA/NCDC, USA
- Ian Barton, Australia
- Helen Beggs, BoM, Australia
- Bruce Brasnett, Canada
- Dudley Chelton, OSU, USA
- Jim Cummings, NRL, USA
- Prasanjit Dash (SQUAM), NOAA/NESDIS, USA
- Chelle Gentemann, RSS, USA
- Robert Grumbine, NWS, USA
- Jacob Hoeyer, DMI, Denmark
- Alexander Ignatov (SQUAM), NOAA/NESDIS, USA
- Shiro Ishizaki, JMA, Japan
- Eileen Maturi, NOAA/OSPD, USA
- Bruce McKenzie, NAVOCEANO, USA
- Jean-François Piollé (Felyx), IFREMER, France
- Nick Rayner, Met Office, Hadley Centre, UK
- Jonah Roberts-Jones (GMPE), Met Office, UK
- Martin Rutherford, Australia
- Jorge Vazquez, JPL, USA

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Presentations (10 min each):

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Recent updates to the near real time OSTIA system (Jonah Roberts-Jones)

Brief update (5 min):

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Discussion (25 min), including:

plans for the IC-TAG-wide inter-comparison based on Reynolds/Chelton approach (lead by Michael Chin)

9:35-9:45: **GMPE plans discussion**
(lead by *Gary Corlett* and *Jonah Roberts-Jones*)

9:45-10:00: **General discussion and plans for the next year**

[including *Action Items*]

G13-60	Dudley Chelton	IC-TAG	Write proposal to producers and provide a synthetic dataset
G13-61	Alexey Kaplan	IC-TAG	Run analysis for Chelton's synthetic dataset
G13-62	Alexey Kaplan	IC-TAG	Evaluation of feature resolution, possibly a joint paper. If successful, similar approach 'common data input' could be used for formal evaluation of the actual impact of various satellite missions the L4 products (if a subset of real input data sets rather than synthetic data is used). PO.DAAC will consider participating in collecting and processing the results.

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G12-68	Alexy Kaplan	IC-TAG	Alexey and Matt Martin to produce a white paper summary of discussions on how to standardise error reporting for L4.

APPENDIX

Two seminal papers published, documenting the utility of **GMPE** and **SQUAM:**

Martin, M., P. Dash, A. Ignatov, V. Banzon, H. Beggs, B. Brasnett, J.-F. Cayula**, J. Cummings**, C. Donlon**, C. Gentemann, R. Grumbine, S. Ishizaki, E. Maturi, R. W. Reynolds, J. Roberts-Jones,** Group for High Resolution Sea Surface temperature (**GHRSST**) analysis fields inter-comparisons. Part 1: A GHRSST multi-product ensemble (**GMPE**), *Deep Sea Research Part II: Topical Studies in Oceanography*, Available online 2 May 2012, ISSN 0967-0645, 10.1016/j.dsr2.2012.04.013.

Dash, P., A. Ignatov, M. Martin, C. Donlon, B. Brasnett, R. W. Reynolds, V. Banzon, H. Beggs, J.-F. Cayula, Y. Chao, **R. Grumbine, E. Maturi,** A. Harris, J. Mittaz, J. Sapper**, T. M. Chin, J. Vazquez-Cuervo, E. M. Armstrong, C. Gentemann, J. Cummings, J.-F. Piollé, E. Autret, J. Roberts-Jones, S. Ishizaki, J. L. Høyer, D. Poulter,** Group for High Resolution Sea Surface Temperature (**GHRSST**) analysis fields inter-comparisons—Part 2: Near real time web-based level 4 SST Quality Monitor (**L4-SQUAM**), *Deep Sea Research Part II: Topical Studies in Oceanography*, Available online 17 April 2012, ISSN 0967-0645, 10.1016/j.dsr2.2012.04.002.

Special Thanks to Jorge Vazquez, a Special Editor of this DSR-II Special Issue!

Table 1
Summary of the various L4 SST analysis systems.

Name of system	*Institute, country*	*Reference*	*Date of availability of NRT data*	*Reanalysis period*
CMC	Canadian Meteorological Center, Canada	Brasnett (2008), Brasnett (1997)	April 2008	September 1991
FNMOC	Fleet Numerical Meteorology and Oceanography Center, USA	Cummings (2005), Cummings (2011)	2005	N/A
GAMSSA	Bureau of Meteorology, Australia	Beggs et al. (2011), Zhong and Beggs (2008)	October 2008	N/A
MGDSST	Japan Meteorological Agency, Japan	Kurihara et al. (2006)	September 2002	September 1981
NAVO K10	Naval Oceanographic Office, USA	–	July 2004	N/A
OISST.v2:AVHRR, AVHRR+AMSR	NCDC/NOAA, USA	Reynolds et al. (2007)	November 2008 (V1 started 2006 and was discontinued in 2009)	September 1981 (AVHRR), June 2002 (AVHRR+AMSR)
OSTIA	Met Office, UK	Donlon et al. (2011)	November 2006	January 1985
POES/GOES	NESDIS/NOAA, USA	Maturi et al. (2008)	June 2007	N/A
RSS MW, MW/IR	Remote Sensing Systems, USA	Gentemann et al. (2006)	2007	June 2002, January 2002
RTG	NWS/NCEP/NOAA, USA	Gemmill et al. (2007)	September 2005	N/A

Table 2
Summary of the data types used by the various L4 SST analyses in NRT. Note that AMSR-E data are not available since 5th October 2011.

Name of system	*In situ*	*AATSR/Envisat*	*AVHRR/NOAA*	*AVHRR/MetOp*	*MODIS/Aqua,Terra*	*AMSR-E/Aqua*	*TMI/TRMM*	*SEVIRI/MSG*	*GOES*	*MTSAT-2*
CMC	X	X	X	X		X				
FNMOC	X		X	X					X	
GAMSSA	X	X	X	X		X				
MGDSST	X		X	X		X				
NAVO K10			X	X		X			X	
OSTIA	X	X	X	X		X	X	X		
POES/GOES		X	X	X		X		X	X	X
OISST.v2:AVHRR	X		X	X						
OISST.v2:AVHRR+AMSR	X		X	X		X				
RSS-MW						X	X			
RSS-MW/IR					X	X	X			
RTG	X		X	X						

Table 3
Summary of the characteristics contributing to the horizontal and temporal scales resolved by each L4 analysis.

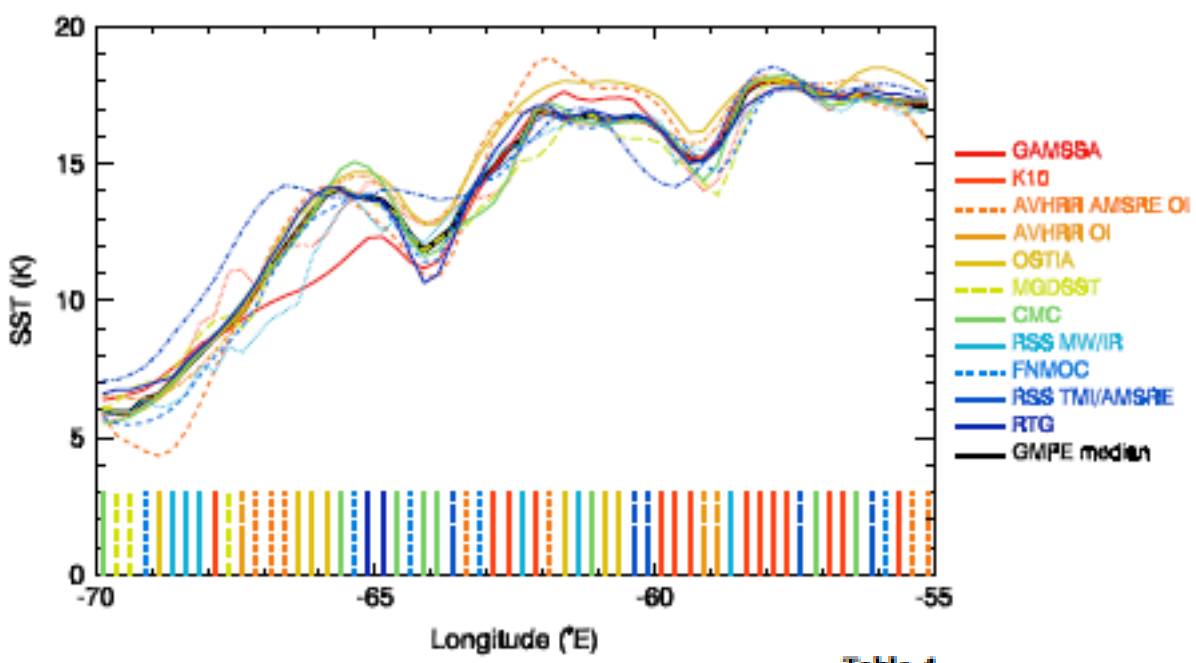
Name of system	*Horizontal grid resolution*	*Minimum horizontal correlation scale*	*Highest input data resolution (after thinning)*	*Temporal correlation scale*	*Update cycle*
CMC	0.2° lat/lon	43 km	44 km	None	Daily by 09:15 UTC for analysis of previous day
FNMOC	~9 km	~10 km	~9 km	None	6 hourly with 7 h delay on each analysis
GAMSSA	0.25° lat/lon	50 km	17 km	0.5 days	Daily by 03:30 UTC for analysis of previous day
MGDSST	0.25° lat/lon	50 km	25 km	5 days	Daily by 00:30 UTC for analysis of previous day
NAVO K10	10 km	10 km	2 km	4 days	Daily by 03:00 UTC for analysis of previous day
OISST.v2: AVHRR, AVHRR+AMSR	0.25° lat/lon	50 km	25 km	3 days	Daily by 12:30 UTC for analysis of previous day
OSTIA	0.05° lat/lon	10 km	~3.5 km	5 days	Daily by 06:30 UTC for analysis of previous day
POES/GOES	0.1° lat/lon	11 km	4 km	None	Daily
RSS MW, MW/IR	25 km, 9.76 km	1°, 1.5°	25 km, ~10 km	4 days, 3 days	Daily
RTG	1/12° lat/lon	50 km	8 km	None	Daily by 21:30 UTC for analysis of day

Table 1
List of L4 SST products monitored or considered in L4-SQUAM. Note that AMSR-E data was an input to most of the L4 SSTs listed here but its production has been suspended on 04 October 2011.

Product	Space/time res. & type	Abbreviation & mode	Reference	Availability period, data format, and ftp source,	Input data				Ice mask
					Infrared	Microwave	*Insitu*	Other	
Products fully implemented in L4-SQUAM									
Optimal interpolation SST	0.25° Daily depth (bulk)	AVHRR_OI NRT; delayed reanalysis	Reynolds et al., 2007	1981 to present, netCDF ftp://eclipse.ncdc.noaa.gov/pub/OI – daily-v2/NetCDF	AVHRR (PF until 2005, then NAVO)	-NA-	√	NCEP ice	√
		AVHRR_AMSR_OI NRT; delayed reanalysis		01-Jun-2002 to 04-Oct-2011, netCDF ftp://eclipse.ncdc.noaa.gov/pub/OI – daily-v2/NetCDF	AVHRR	AMSR-E* (*suspended on 04-Oct-2011)	√	NCEP ice	√
Operational SST & Sea Ice analysis	0.05° Daily foundation	OSTIA NRT	Stark et al., 2007;2008; Donlon et al., 2011	Apr-2006 to present, netCDF ftp://podaac-ftp.jpl.nasa.gov/allData/ghrsst/data/L4/GLOB/UKMO/OSTIA	AVHRR, AATSR, SEVIRI	TMI, AMSR-E	√	O&SI SAF ice	√
		OSTIA_RAN reanalysis		1985-2007, netCDF ftp://data.ncof.co.uk/ostia_reanalysis/ (passwd)	AVHRR PF, (A)ATSR	-none-	√	O&SI SAF ice	√
Real time global SST	0.50° Daily depth (bulk)	RTG_LR NRT	Thiébaux et al., 2003	Dec-2000 to present, gridded binary (grib) ftp://polar.ncep.noaa.gov/pub/history/sst	AVHRR	-none-	√	NCEP ice	X
	1/12° Daily depth (bulk)	RTG_HR NRT	Gemmill, Katz, & Li, 2007	Feb-2007 to present, grib ftp://polar.ncep.noaa.gov/pub/history/sst/ophi (rotated for a year)	AVHRR physical retrievals	-none-	√	NCEP ice	X
NAVOCEANO K10 Analysis	0.10° Daily depth	K10 NRT	http://podaac.jpl.nasa.gov/dataset/NAVO-L4HR1m-GLOB-K10_SST	Apr-2008 to present, netCDF ftp://podaac-ftp.jpl.nasa.gov/allData/ghrsst/data/L4/GLOB/NAVO/K10_SST	AVHRR, GOES	AMSR-E	X	JPL climate	X
NESDIS multi-SST analysis *(formerly called POES-GOES)*	0.10° Daily depth	GOESPOES NRT	Maturi et al., 2008; http://www.nesdis.noaa.gov/mecb/blended_validation/	Feb-2009 to present, HDF ftp://dds.nesdis.noaa.gov/pull/ (passwd)	AVHRR, GOES, MTSAT, SEVIRI,	*Planned: AATSR, AMSR-2*	X	NCEP ice (since May 2010)	√
JPL ultra high resolution G1SST	0.01° Daily, ± 80°lat foundation	G1SST NRT	Chao et al., 2009	Jun-2010 to present, netCDF ftp://podaac-ftp.jpl.nasa.gov/allData/ghrsst/data/L4/GLOB/JPL_OUROCEAN/G1SST/	AVHRR, AATSR, MODIS, GOES, SEVIRI, MTSAT	TMI, AMSR-E	√	Some ice	√
Canadian met. center analysis	0.2° Daily foundation	CMC 0.2° NRT	Brasnett, 1997; 2008	Jan-2002 to present, netCDF (contact CMC for data access)	AVHRR, AATSR	AMSR-E, WindSat	√	CMC ice	√ from Sep., 2011
Australian BoM GAMMSA	0.25° Daily foundation	GAMSSA NRT	Beggs et al., 2011; Zhong & Beggs, 2008	Oct-2008 to present, netCDF ftp://podaac-ftp.jpl.nasa.gov/allData/ghrsst/data/L4/GLOB/ABOM/GAMSSA_28km	AVHRR, AATSR	AMSR-E, WindSat	√	NCEP ice	√
Ocean data analysis, MyOcean/GMES	0.10° Daily foundation	ODYSSEA NRT	Autret & Piollé, 2011	Reinstated Sep-2010 to present, netCDF ftp://eftp.ifremer.fr/cersat-rt/project/myocean/sst-tac/l4/glob/odyssea/ (passwd)	AVHRR, AATSR, GOES, SEVIRI	TMI, AMSR-E	X	O&SI SAF ice	√
GHRSST multi prod. ensemble	0.25° Daily ensemble	GMPE NRT	Martin et al., this issue	Sep-2009 to present, netCDF ftp://data.ncof.co.uk/ (passwd *via* MyOcean)	-NA-	-NA-	-NA-	O&SI SAF ice	X
Products currently being tested									
JPL multi-scale ultra-high res. SST	0.01° Daily foundation	MUR being tested	http://mur.jpl.nasa.gov/multi_resolution_analysis.php	Jan-2009 to present, netCDF ftp://podaac-ftp.jpl.nasa.gov/allData/ghrsst/data/L4/GLOB/JPL/MUR/	MODIS (Terra, Aqua), AHVRR (GAC)	AMSR-E	X	O&SI SAF ice	√
RSS MW OI	0.25° Daily minimum	RSS MISST NRT	http://www.remss.com/	Jun-2002 to present, netCDF ftp://ftp.discover-earth.org/sst/misst/l4/tmi_amsre/nc	-NA-	TMI, AMSR-E	X	-	√
Products potentially being considered to be included									
RSS IR+MW	0.25° Daily foundation	mw_ir_oi NRT	http://www.remss.com/	netCDF ftp://ftp.discover-earth.org/sst/	MODIS	AMSR-E, TMI	X	-	√
JMA merged SST	0.25° Daily foundation	MGDSST NRT; delayed reanalysis	Kurihara et al., 2006	1985 to present, Plain binary http://goos.kishou.go.jp/rrtdb/usr/pub/JMA/mgdsst/ (passwd)	AVHRR (GAC, HRPT)	AMSR-E	√	JMA sea-ice	√
DMI OI SST analysis	0.05° Daily foundation	DMI_OI NRT	Høyer and She, 2007	Jan-2011 to present, netCDF ftp://ftpserver.dmi.dk/GBL005/ (passwd)	AVHRR (GAC, HRPT), SEVIRI, AATSR, MODIS	AMSR-E, TMI	X	O&SI SAF ice	√
Naval res. lab. NCODA analysis	~0.08° 6 hourly depth	NCODA NRT	Cummings, 2005	Jun-2009 to present, IEEE binary, direct access, http://www.usgodae.org/cgi-bin/datalist.pl?summary=Go&dset=fnmoc_ghrsst	AVHRR (GAC, LAC), SEVIRI, GOES, MTSAT-2	AMSR-E, Windsat (coming)	√	6-h SSM/I & SSMIS ice	X

Ice in L4 products

- Jacob: Not enough info on **when/if/how ice is incorporated into the SST fields** in L4 products (table update).
- HL-TAG would like to have a separate statistics for the **SST in the vicinity of ice**
- Prasanjit: GMPE outputs **no information regarding the presence of ice**.
- **Action item: for Jacob, Jonah, and Prasanjit to discuss and evaluate what realistically can be done here.**

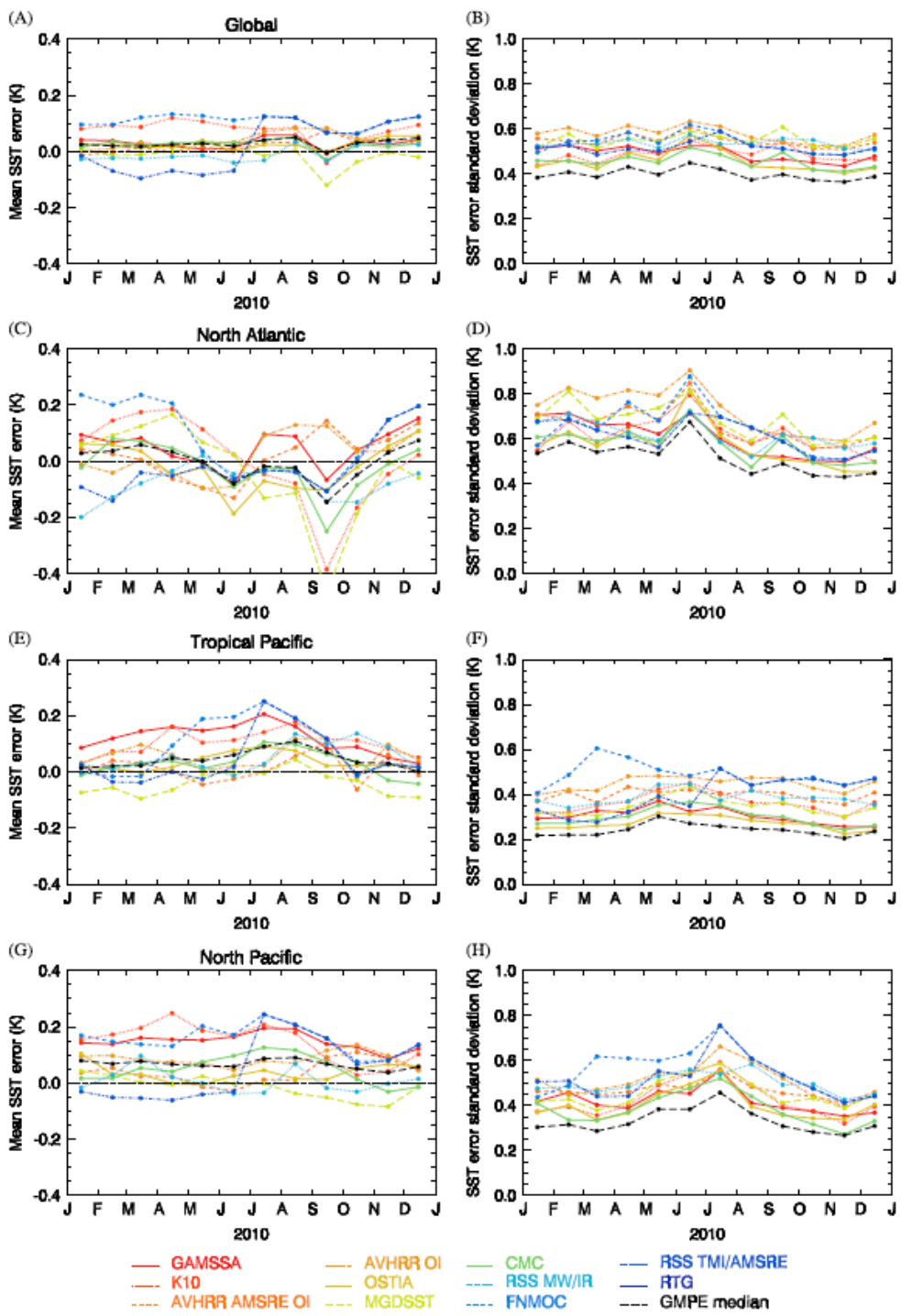


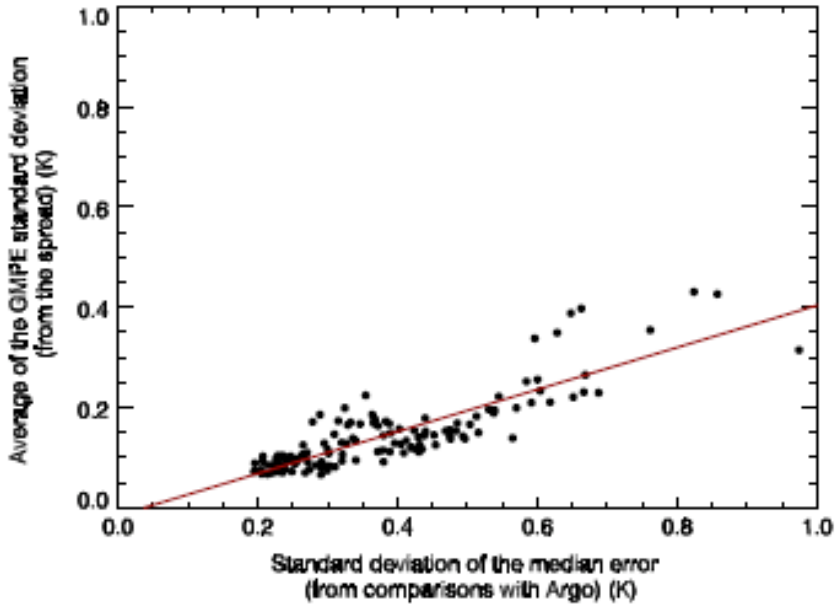
Helen proposed to have such stats routinely produced by GMPE, possibly carried by SQUAM; latency

Table 4
Percentage of grid points for which each analysis contributes to the median value in GMPE. This is calculated over the whole of 2010 globally and for various latitude bands.

Name of system	*Percentage of points contributing to the median over 2010*			
	Global	*90°S–30°S*	*30°S–30°N*	*30°N–90°N*
CMC	12.9	13.6	12.4	13.1
FNMOC	8.8	9.3	8.7	8.4
GAMSSA	10.3	9.0	11.2	10.2
MGDSST	8.5	8.9	8.3	8.2
NAVO K10	10.1	10.3	9.8	10.4
OISST.v2:AVHRR,	8.2	8.8	7.6	8.5
OISST.v2:AVHRR + AMSR	7.4	7.0	7.3	8.1
OSTIA	12.3	11.6	13.0	11.9
RSS MW	7.2	7.7	7.2	6.2
RSS MW/IR	7.3	7.5	7.0	7.7
RTG	7.1	6.3	7.5	7.3

Action:
Helen, Jonah, and Prasanjit will discuss and decide what can be done.

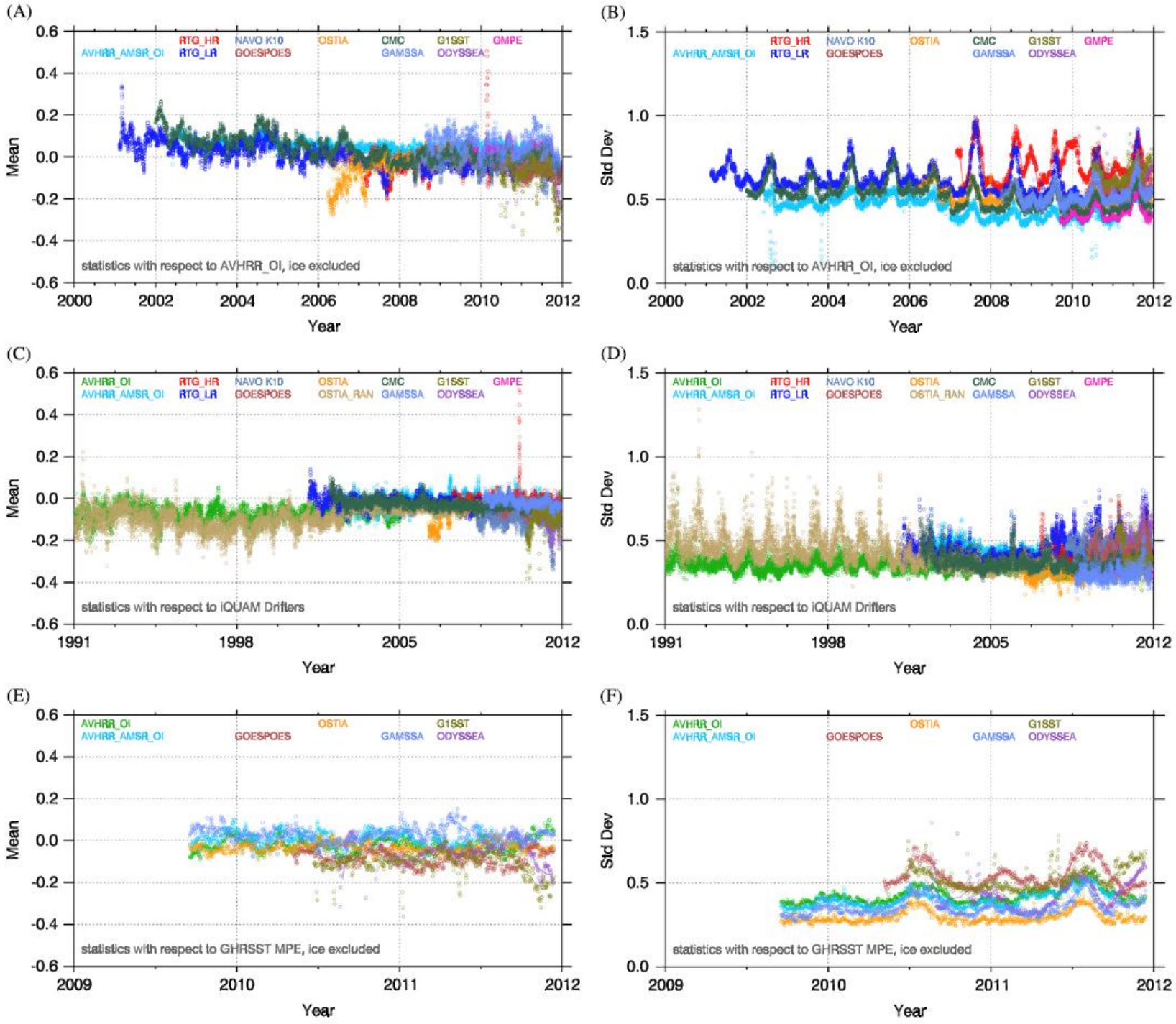


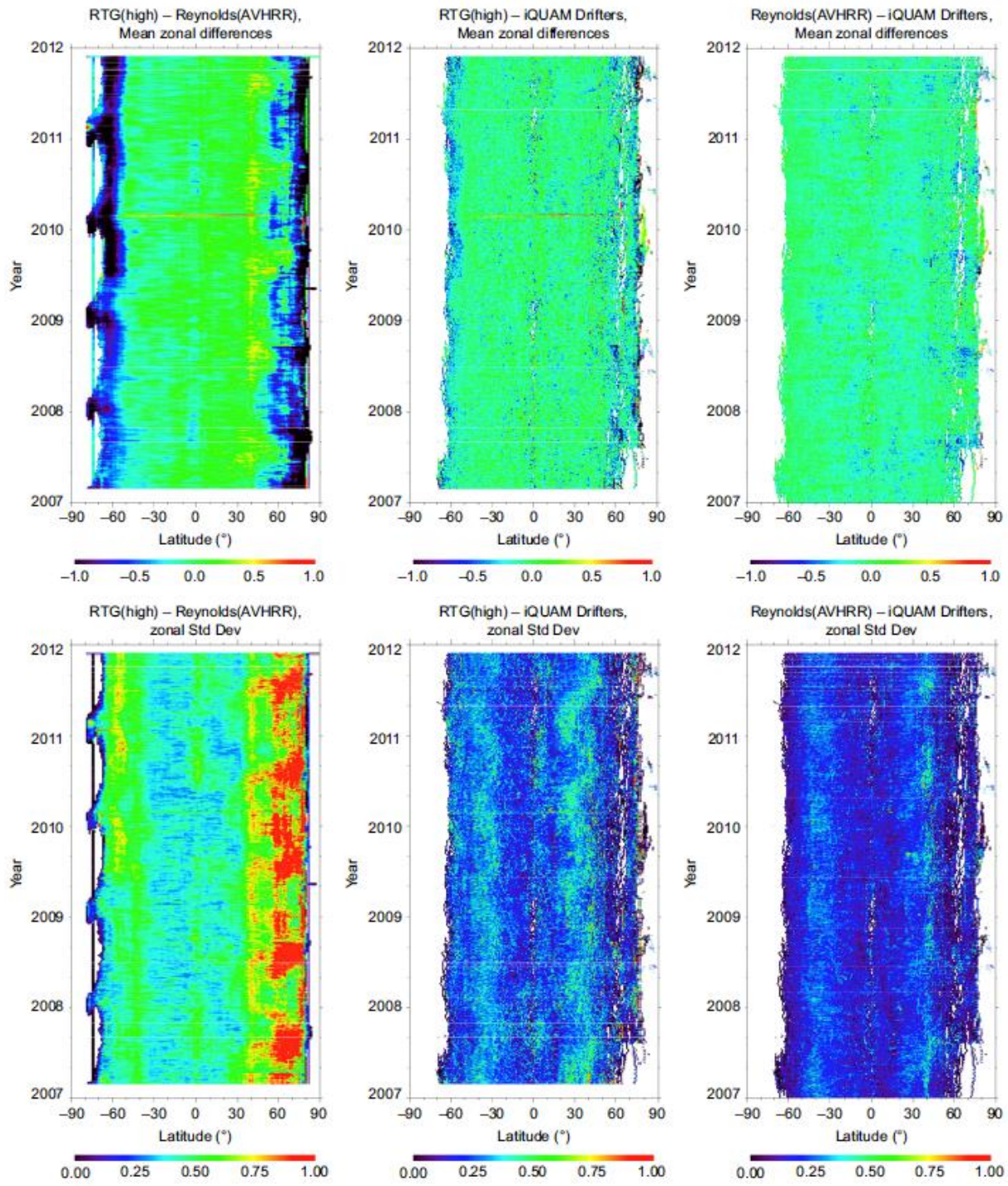


GMPE ensemble median is more **accurate** than individual members (left); GMPE ensemble spread can be used as a **proxy** for the error in its median (up). Suppose we've reduced the number of L4 products to 1 or 2: **GMPE ensemble**

Impacts of AATSR loss on the L4 products

- Sasha noticed the recent increase in the spread between some L4 products and independent data in SQUAM. It might be a manifestation of the the AATSR data loss.
- Prasanjit agreed to investigate further and to try to document this using SQUAM (**action item**). If successful, this might become a useful illustration of the importance of the AATSR data source.


(A)
Mean
Year
AVHRR_AMSR_OI
RTG_HR
RTG_LR
NAVO K10
GOESPOES
OSTIA
CMC
GAMSSA
G1SST
ODYSSEA
GMPE
statistics with respect to AVHRR_OI, ice excluded
(B)
Std Dev
Year
statistics with respect to AVHRR_OI, ice excluded
(C)
Mean
Year
AVHRR_OI
OSTIA_RAN
statistics with respect to iQUAM Drifters
(D)
Std Dev
Year
statistics with respect to iQUAM Drifters
(E)
Mean
Year
statistics with respect to GHRSST MPE, ice excluded
(F)
Std Dev
Year
statistics with respect to GHRSST MPE, ice excluded


RTG(high) – Reynolds(AVHRR),
Mean zonal differences
RTG(high) – iQUAM Drifters,
Mean zonal differences
Reynolds(AVHRR) – iQUAM Drifters,
Mean zonal differences
RTG(high) – Reynolds(AVHRR),
zonal Std Dev
RTG(high) – iQUAM Drifters,
zonal Std Dev
Reynolds(AVHRR) – iQUAM Drifters,
zonal Std Dev
Year
2012
2011
2010
2009
2008
2007
Latitude (°)
–90 –60 –30 0 30 60 90
–1.0 –0.5 0.0 0.5 1.0
0.00 0.25 0.50 0.75 1.00

Synthetic data tests for L4 products (*Chelton and Reynolds* method)

- HR ECCO model SST is sub-sampled/corrupted as if it came as the satellite data stream. Obj. An. procedure for a given L4 product is applied, the results are compared with the true model values. First (by G12) was done for the NCDC OI
- Now has been done for OSTIA too (J.R.-J & M.M.)
- L4 producers at the breakout were enthusiastic to do this too (Helen, Jacob, Viva, Mike, Jean-Francois) and have a joint paper about it.
- We'll offer this to all L4 producers

Translation to the **action items** (1)

Dudley will write a “Proposal to a Producer”:

- what will be provided: synthetic “satellite” data sets,
- what will be expected of them: run their analyses send the results out,
- what will come out of this: test of their L4 analysis method, good illustration of feature resolution and stat. properties of their L4 fields in comparison with the truth, and in the context of other L4 products; possibly a joint paper.

Translation to the **action items** (2)

Will send this proposal to all L4 producers, and depending on the response will follow on as proposed:

- Dudley and Dick will provide synthetic satellite data sets (will need help in converting to the GHRSST format);
- L4 producers will run analyses for these data;
- PO.DAAC will consider participating in collecting and processing the results;

Note: If successful, similar approach “common data input” could be used for formal evaluation of the actual impact of various satellite missions the L4 products (if a subset of real input data sets rather than synthetic data is used).

Appendix-1

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Introduction: *Members*

- The IC-TAG includes representatives from each of the L4 analysis producers which are contributing to GMPE, HRDDS and SQUAM, plus technical experts from the GMPE, HRDDS and SQUAM systems.
- Until recently IC-TAG was chaired by Matt Martin, with vice-chair A.Kaplan
- As well as a chair, Matt Martin was also the manager of OSTIA and of GMPE. Because of the change in his job responsibilities in the U.K. Met Office, Matt has resigned his position on the IC-TAG. We are looking forward to working with Alison McLaren, a new manager of OSTIA and GMPE projects. And we a lucky that both GMPE and OSTIA have been represented on the last few meetings by Jonah Roberts-Jones as well, and he is here today. Meanwhile Alexey Kaplan promoted the Chair position and Mike Chin has accepted the Vice-Chair responsibilities
- HRDDS status is unclear, b/c Dave Poulter has left a position where he was developing it.

1) Latency of GMPE
-- what is it?
-- how can it be improved if possible?

2) Metric for which L4 products go into each GMPE analysis:
-- could this be readily available from GMPE and SQUAM web sites?
-- how can we ensure as many global L4 products as possible go into GMPE each day?
-- improve pathway for L4 products to reach MetOffice?