Reprocessing a 14-year global 5km Geo-Polar blended L4 SST Using NOAA/NESDIS operational algorithms

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Abstract

A 14-year long (2002-2015) global 5km L4 SST dataset has been generated using global geostationary and polar-orbiting satellite data utilizing state-of-the-art NOAA operational algorithms at NOAA/NESDIS.

For geostationary data, the latest operational algorithm calculates SST by utilizing a new physical retrieval scheme based on modified total least squares (MTLS) and a probabilistic (Bayesian) approach for cloud masking. The geostationary satellites being reprocessed include GOES (GOES-8, 9, 10, 11,12,13 &15) satellites from NOAA, MTSAT (MTSAT1-R and MTSAT-2) satellites from Japan Meteorological Agency (JMA), and also Meteosat (8, 9 and 10) from Eumetsat during the 14-year period. The total raw data volume for geostationary sensors that will be reprocessed is ~200TB in various data formats (HRIT, GVAR, MCIDAS Area File). Reprocessed geostationary SST provides a near complete coverage of the tropics and mid-latitudes with at least hourly time resolution. For the polar orbiting satellites, GAC 4km AVHRR and Metop data are being reprocessed using the Advanced Clear-Sky Processor for Oceans (ACSPO). The geostationary and polar data are then combined to generate the Geo-Polar blended 5-km SST daily global SST analysis.
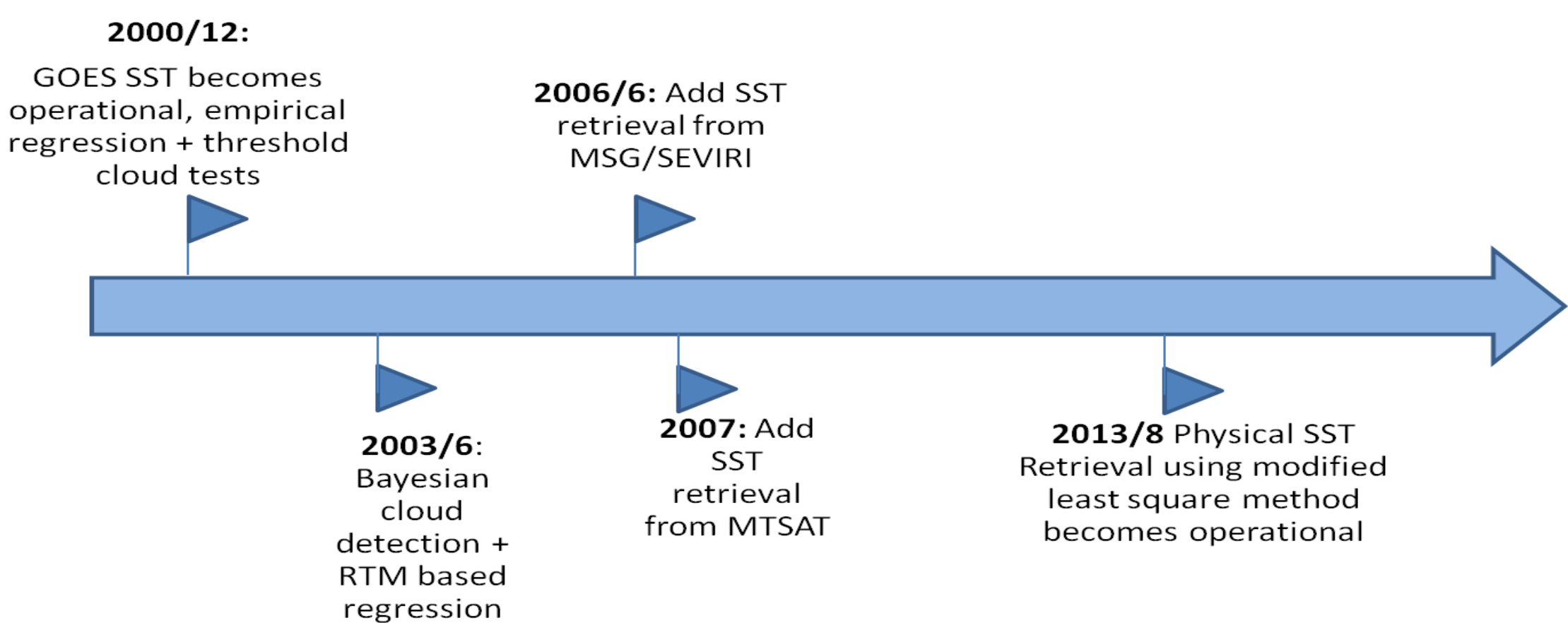
Data

Radiance data source for GEO SST

Products and Agencies	Time resolution	Platforms	Time length
GOES-East (75˚W), NOAA/USA	30 mins	GOES 12	2004-2010
		GOES 13	2010-present
GOES-West (135˚W), NOAA/USA	30 mins	GOES 10	2004-2006
		GOES 11	2006-2011
		GOES 15	2011- present
MTSAT, JMA/Japan (140˚E)	hourly	GOES-9 (substitute for failed MTSAT-1)	2004-2005
		MTSAT-1R	2005-2010
		MTSAT-2	2010-2014
MSG (Meteorsat Second	15 mins	Meteosat 8	2004-2006
		Meteosat 9	2006-2012

Polar data Source (4km GAC)

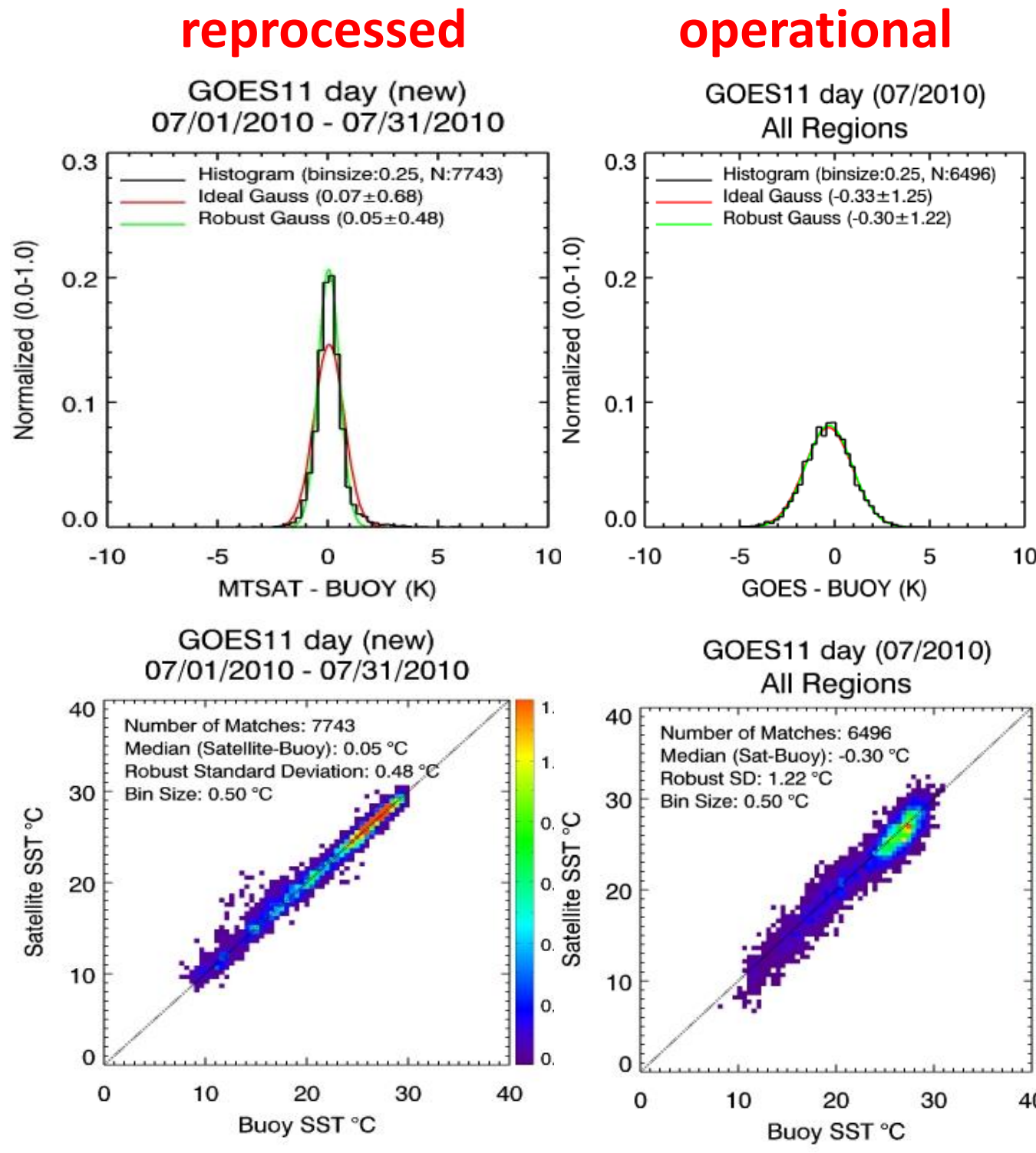| Satellite	Type of Orbit	Night ECT	L1b Data Available	Used in RAN1
NOAA-16	Afternoon/PM	2:00 A.M.	29 December 2000–6 June 2014	30 August 2002–6 June 2005
NOAA-18	Afternoon/PM	2:00 A.M.	20 May 2005–present	7 June 2005–21 February 2009
NOAA-19	Afternoon/PM	2:00 A.M.	6 February 2009–present	22 February 2009–present
NOAA-15	Morning/AM	7:30 P.M.	26 October 1998–time	Not used
NOAA-17	Midmorning/AM	10:00 P.M.	25 June 2002–10 April 2013	30 August 2002–14 December 2006
Metop-A	Midmorning/AM	9:30 P.M.	30 October 2006–present	15 December 2006–present
Metop-B	Midmorning/AM	9:30 P.M.	24 September 2012–present	Not used

Methods

Geostationary SST retrieval: MTLS physical retrieval + Bayesian cloud detection for clear sky (Koner et al 2015, Merchant et al 2005)

2000/12: GOES SST becomes operational, empirical regression + threshold cloud tests

2003/6: Bayesian cloud detection + RTM based regression

2006/6: Add SST retrieval from MSG/SEVIRI

2007: Add SST retrieval from MTSAT

2013/8 Physical SST Retrieval using modified least square method becomes operational

Polar orbiting SST retrieval : ACSPO MCSST (night time) and NLSST (daytime) regression algorithm(Ignatov et al 2016, Petrenko et al 2010)

Geo-Polar Blending: A multi-scale OI with data-adaptive correlation length scale, resulting in 5km global L4 product (Maturi et al 2016)

GEO SST reprocessing statistics

Sample monthly validation statistics for reprocessed vs. operational plots

reprocessed   **operational**

Time series of monthly statistics for reprocessed vs. operational data for GOES, MSG and MTSAT

reprocessed   **operational**

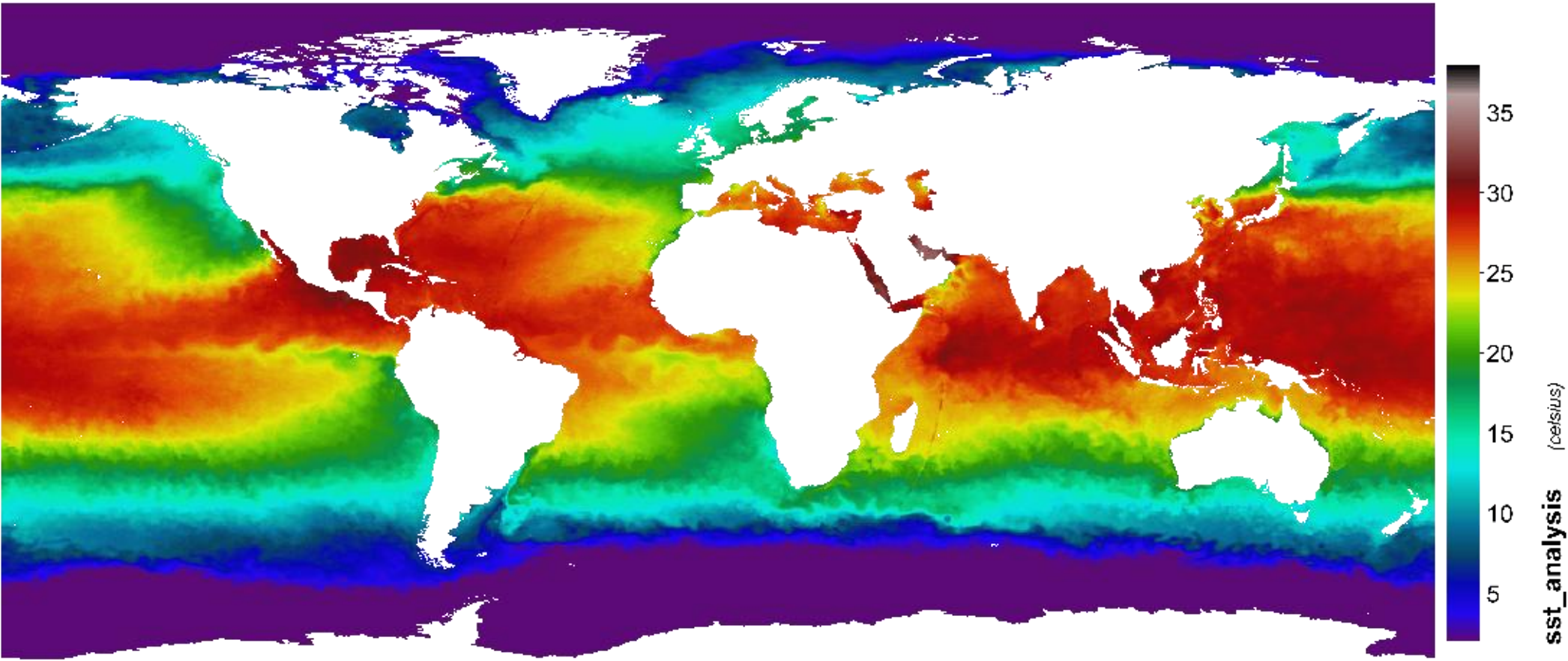GOES night time

MSG night time

MTSAT night time

Reprocessing geostationary SST with new MTLS physical retrieval method dramatically improved the global geostationary SST statistics against IQUAM buoy data .The improvement in statistics GOES > MSG > MTSAT
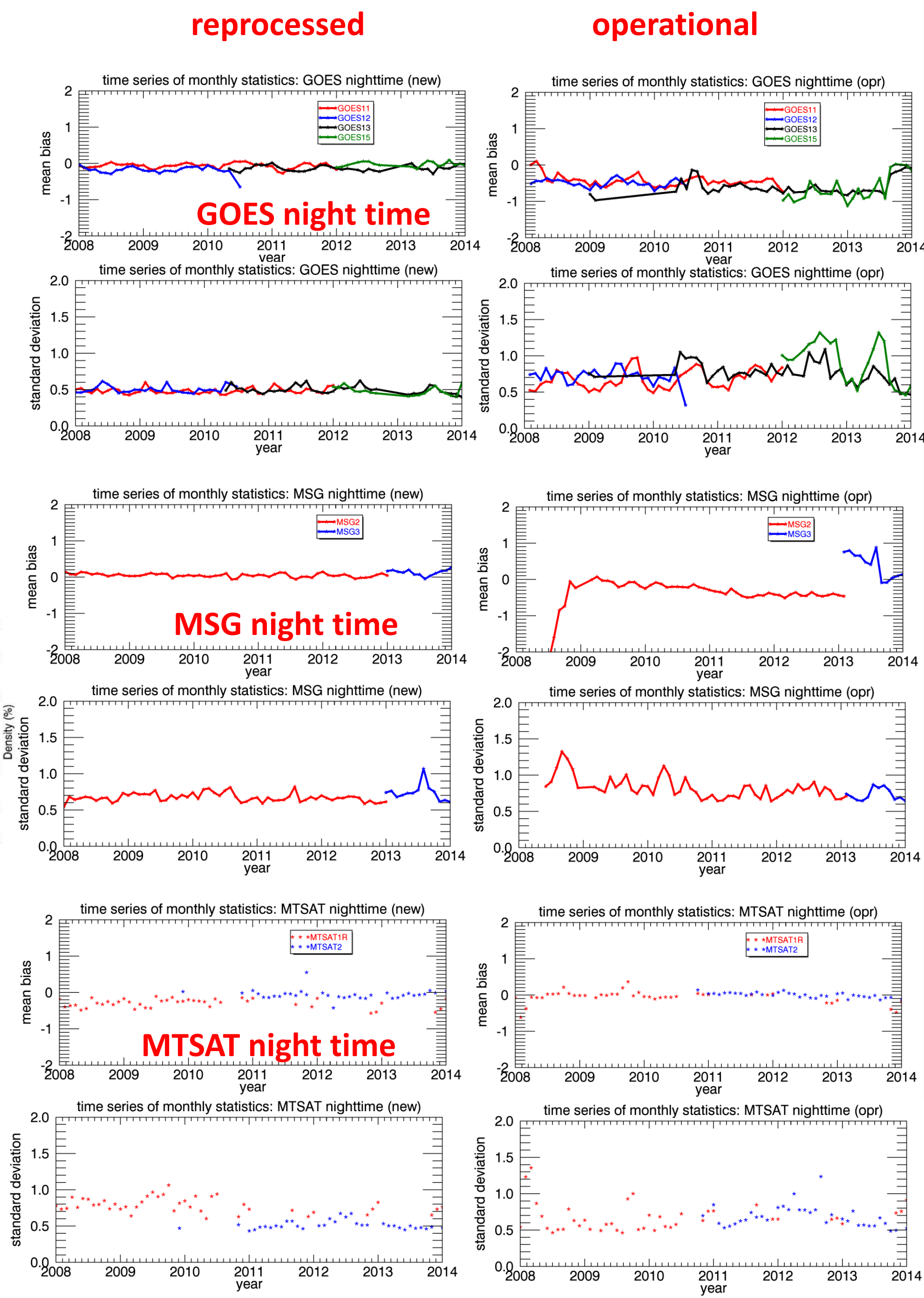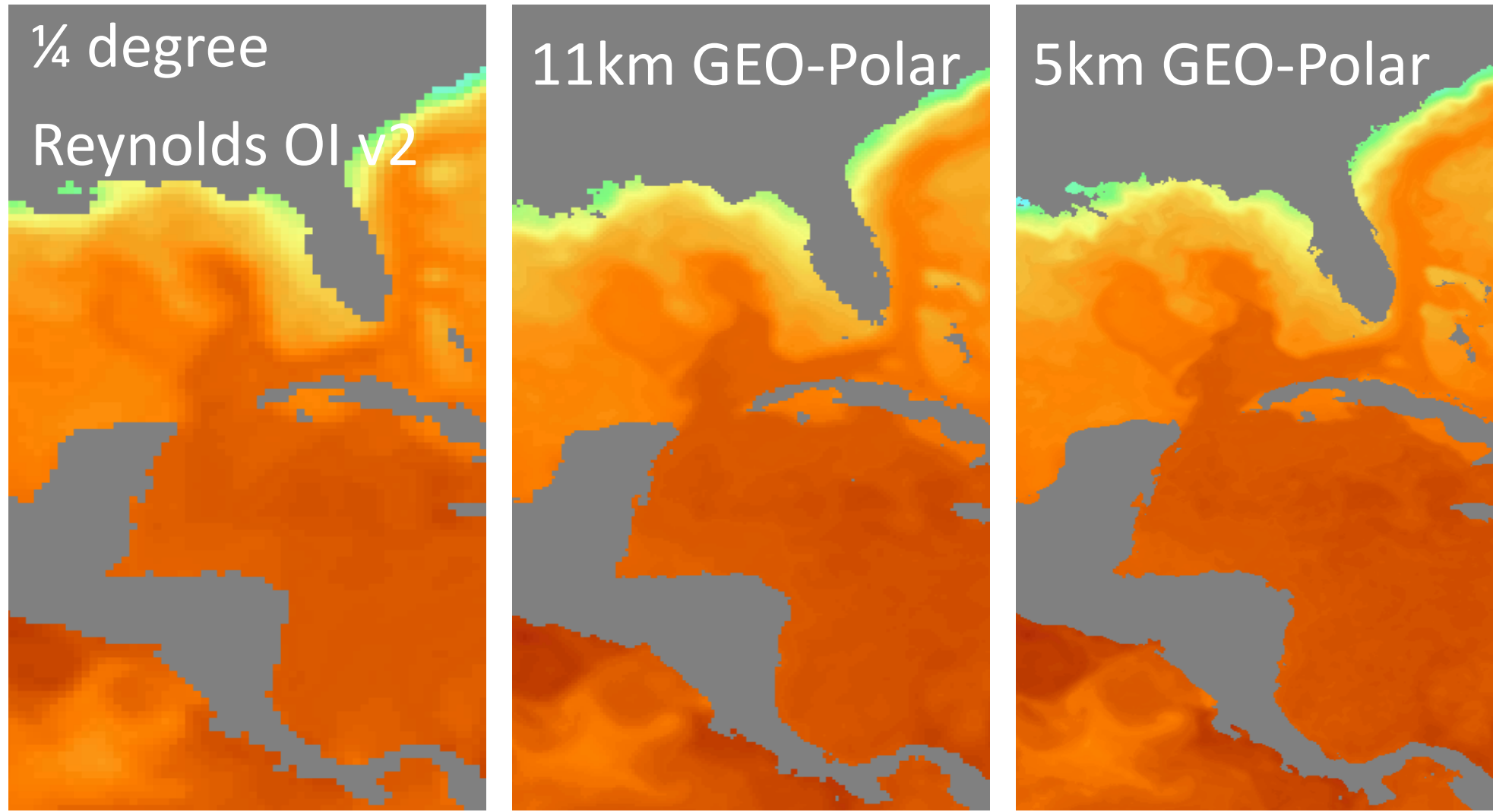
Final Product: 5km Geo-Blended SST

Sample global 5km SST map for August 6th, 2012

¼ degree Reynolds OI v2   11km GEO-Polar   5km GEO-Polar

Clearer details of gulf stream and gulf loop currents are visible in 5km product
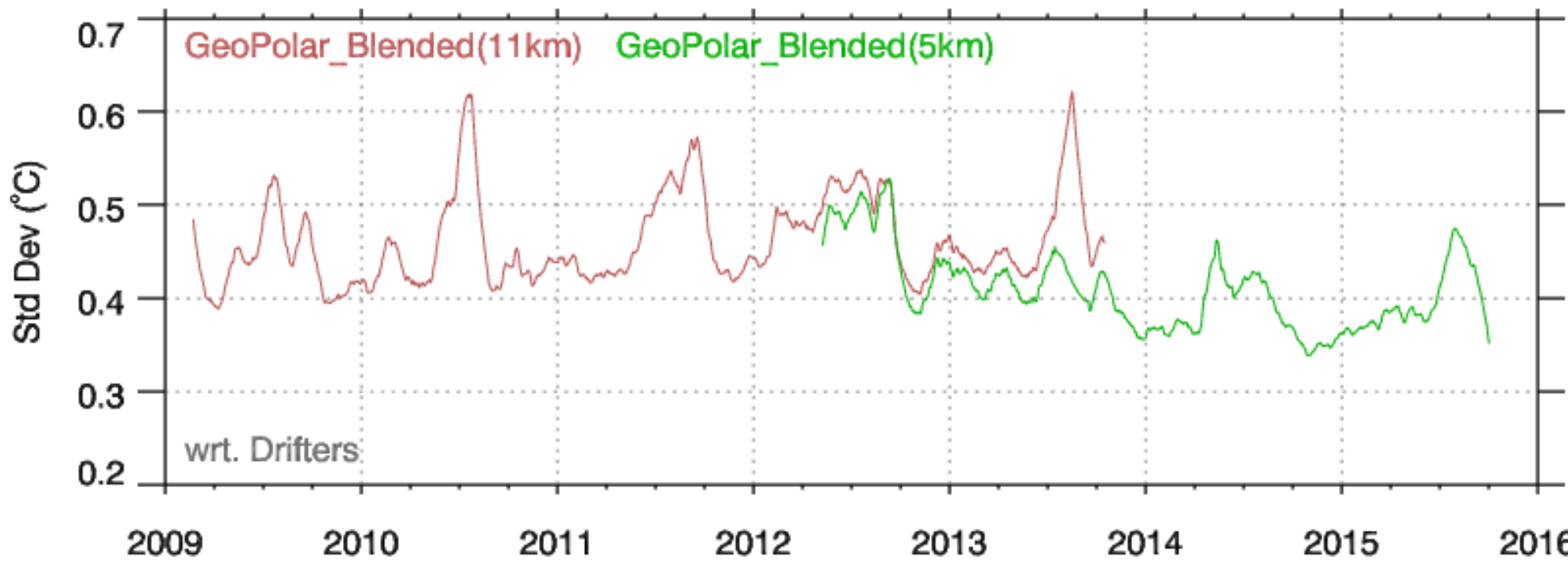
Time series of standard deviation for the GEO-Polar SST

References

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Ignatov, A., Zhou, X,et al . AVHRR GAC SST reanalysis Version 1 (RAN1).*Remote Sensing, 2016*

Koner, P., Harris, A. , Maturi, E.,. A physical deterministic inverse method for operational satellite remote sensing: an application for sea surface temperature retrievals. IEEE Transaction on Geoscience, (2015) Volume 53, Issue 11

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