Validation of the extended CryoSat-2 ocean data products

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CRYOSAT 2

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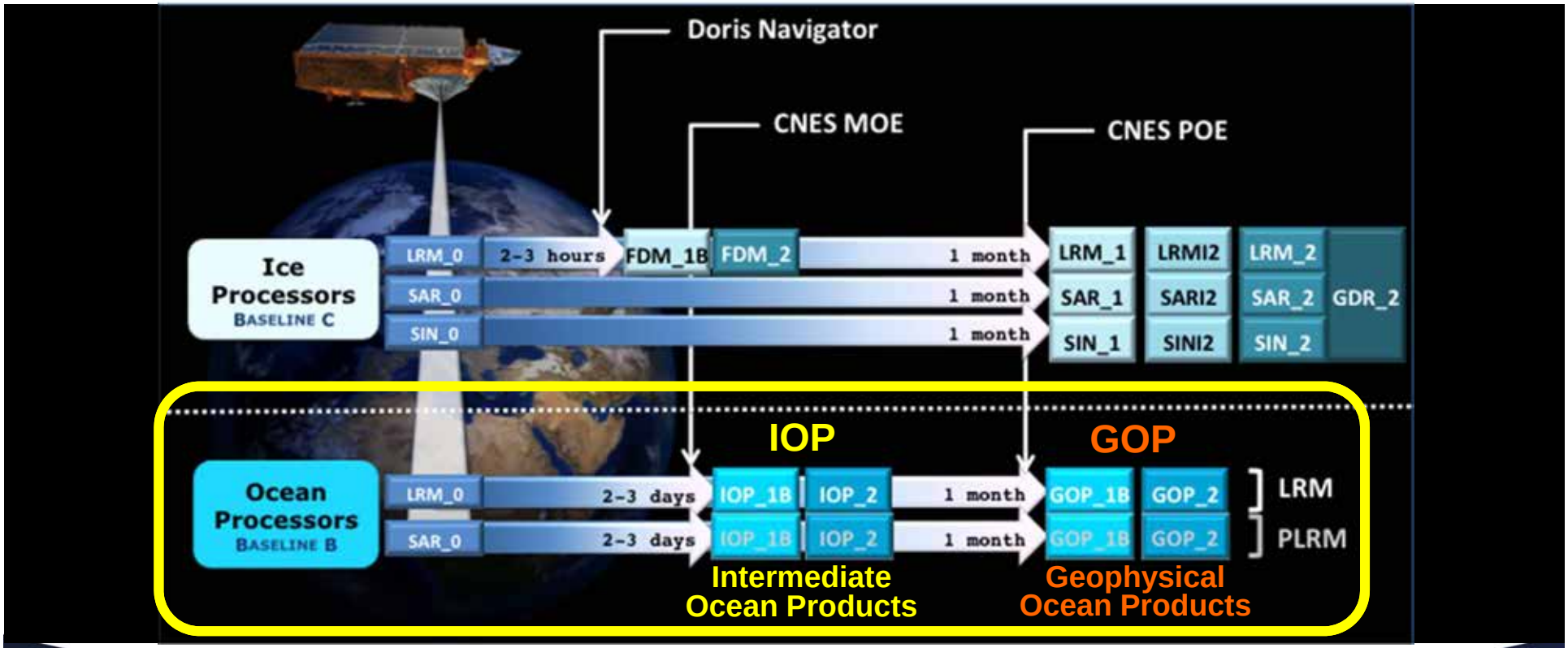
NERC SCIENCE OF THE ENVIRONMENT

CryoSat Ocean Products

Since 2014 ESA has been generating and distributing CryoSat Ocean Products (COP) from a dedicated ocean processor:



CryoSat Ocean Products

Available for registered users from the CryoSat dissemination server ftp://science-pds.cryosat.esa.int . Register at eohelp@esa.int

NOC doing extensive scientific control and validation, including:

- Data flow (latency)
- SSH/SWH/sigma0/wind speed/mispointing coverage and validity
- SSH Crossover analysis
- SWH coverage and validity
- Validation against in situ measurements and models
  - Absolute validation of GOP SSH against selected tide gauges
  - Validation of GOP SSH anomaly against tide gauges
  - Validation of GOP SWH and wind speed against buoy data
  - Validation of GOP SWH against WaveWatch III model data
  - Validation of GOP derived geostrophic velocities
  - Comparison of GOP SSH anomaly with the steric heights derived from temperature and salinity ARGO profiles
- Validation against Jason-2, Jason-3
- Global Mean Sea Level time series

Aim of this talk

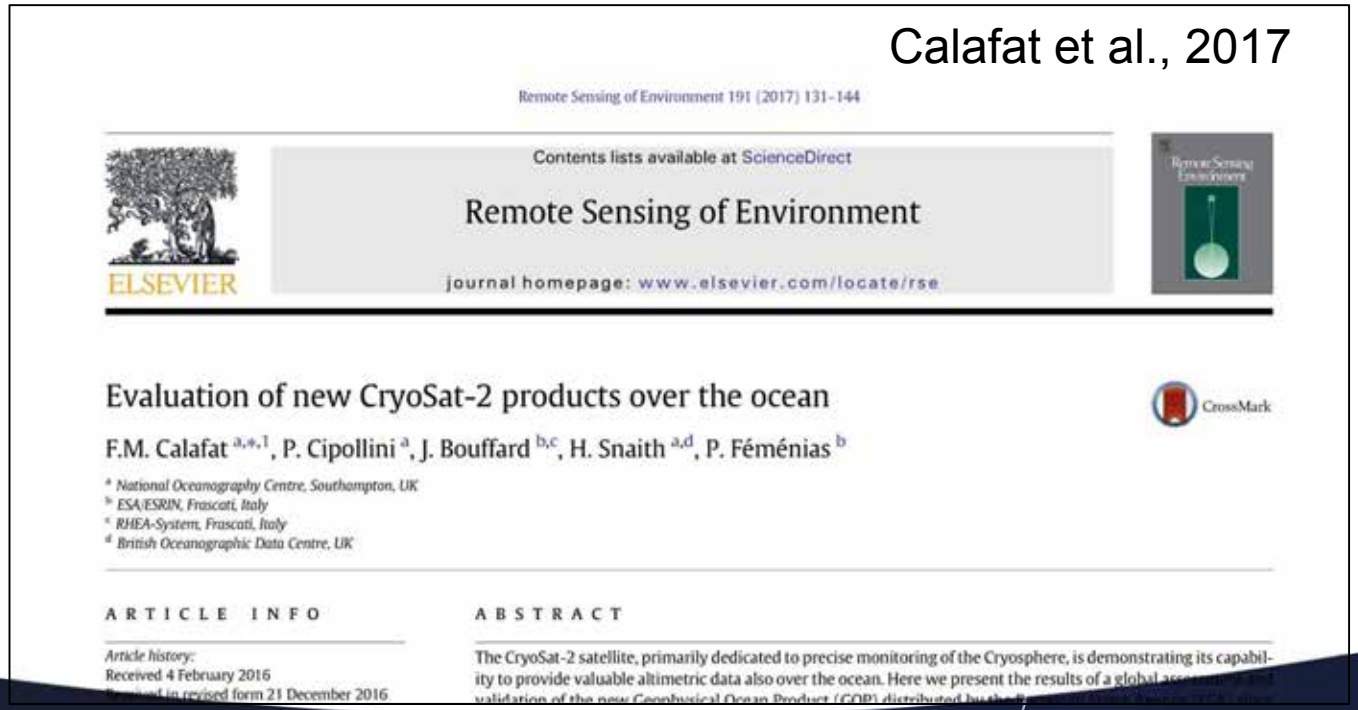
Illustrate some results of the validation

Show that the GOP data are of good quality for oceanography

- …and they are getting even better – products from the new 'baselineC' ocean processor will be distributed end of October 2017 (see also poster CVL_016 by Raynal et al) to include SAR and SARin

Discuss some peculiar results for the Global and regional MSL

Calafat et al., 2017



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Evaluation of new CryoSat-2 products over the ocean

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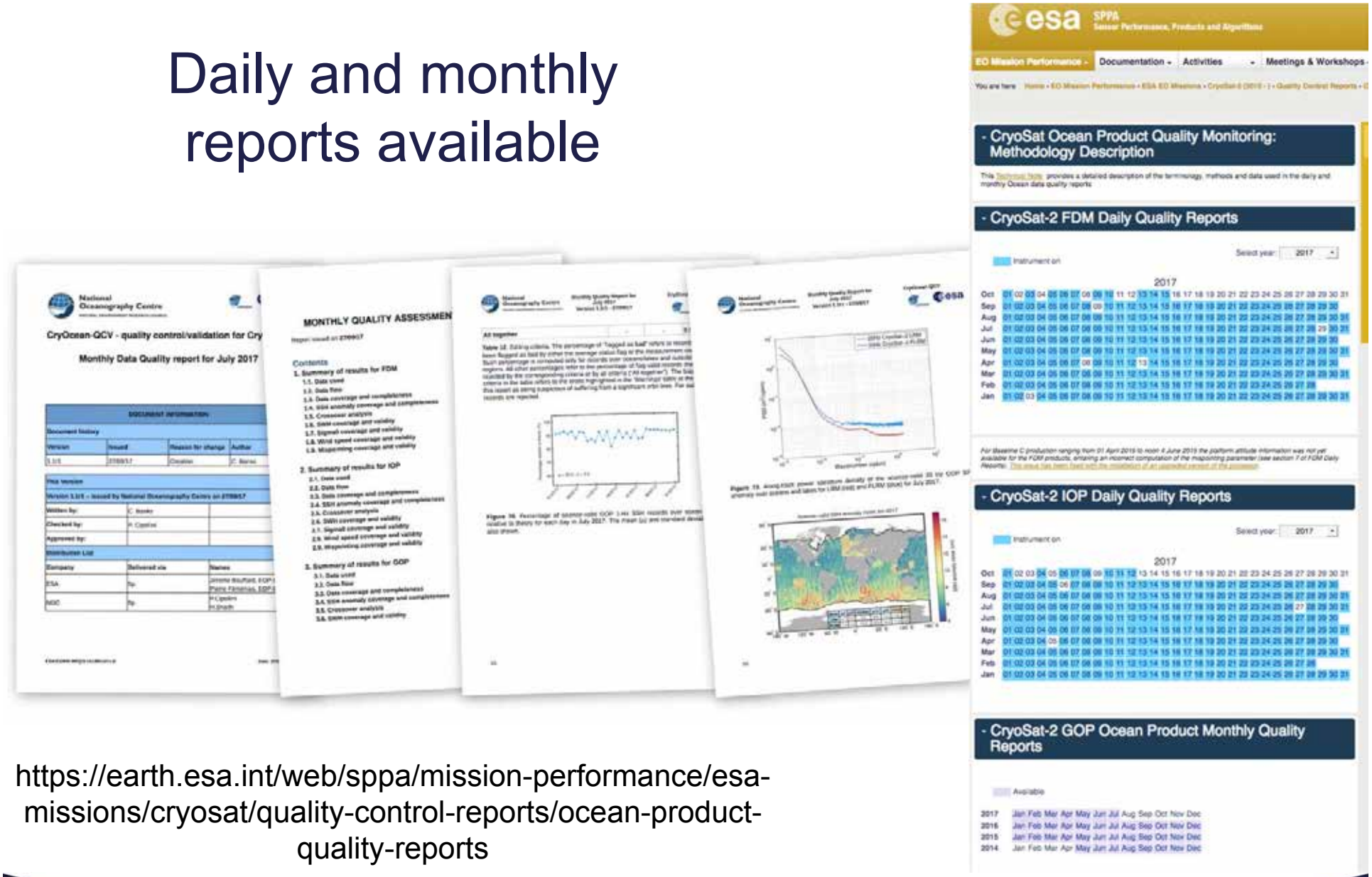
ABSTRACT

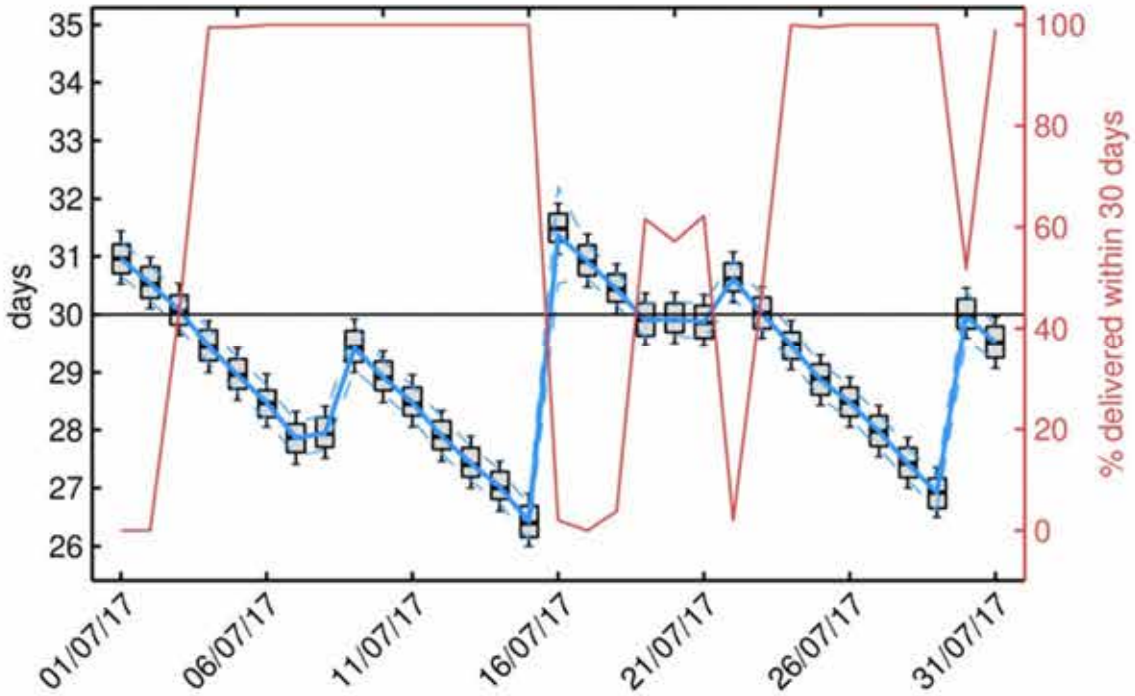
The CryoSat-2 satellite, primarily dedicated to precise monitoring of the Cryosphere, is demonstrating its capability to provide valuable altimetric data also over the ocean. Here we present the results of a global area [illegible] validation of the new Geophysical Ocean Product (GOP) distributed by the [illegible]

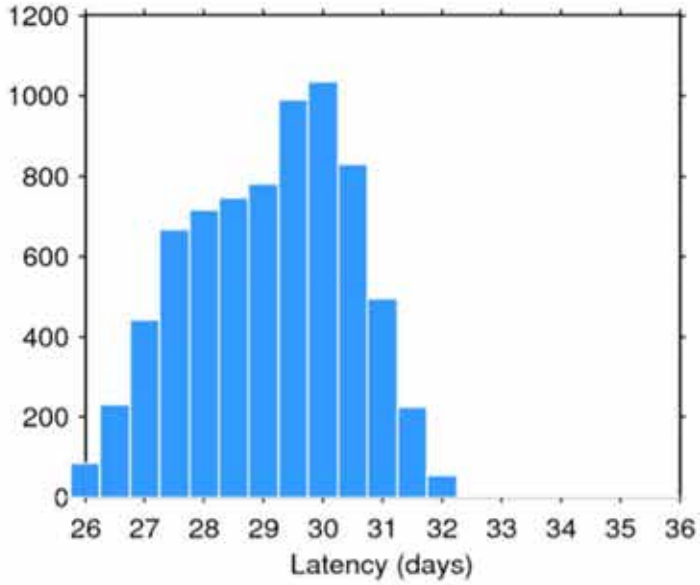
Daily and monthly reports available



https://earth.esa.int/web/sppa/mission-performance/esa-missions/cryosat/quality-control-reports/ocean-product-quality-reports

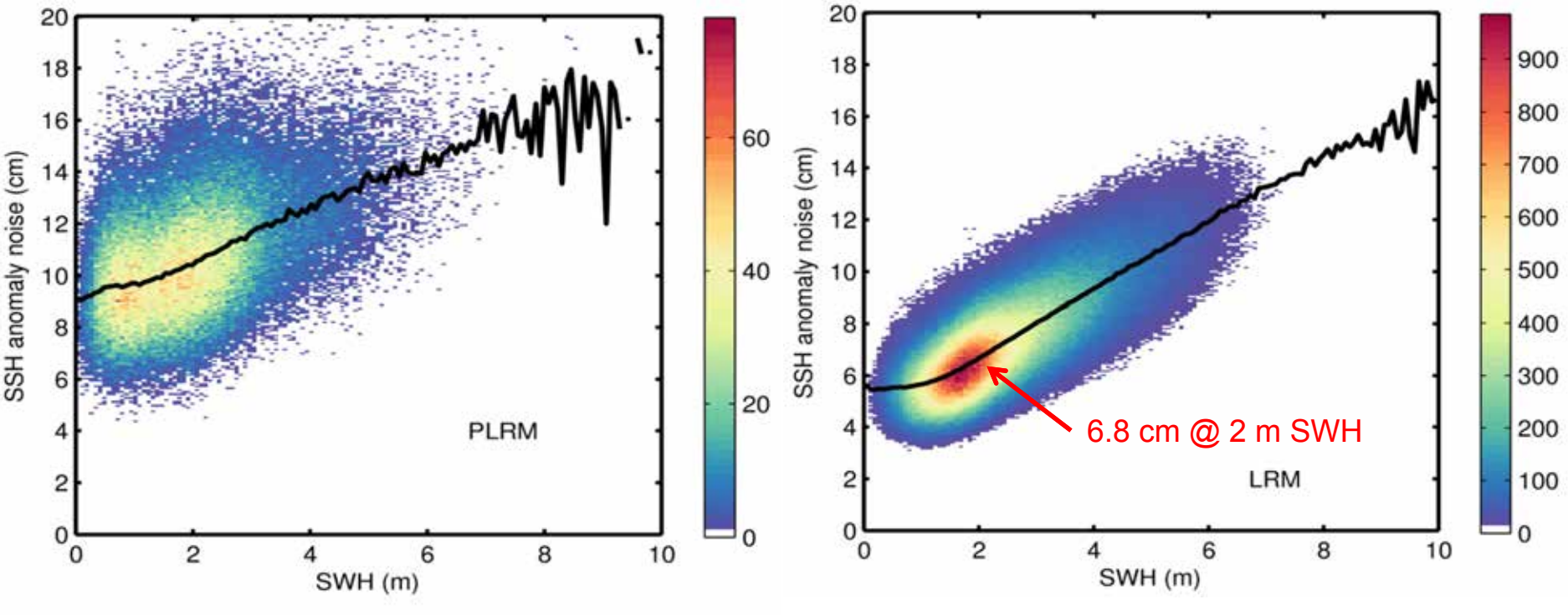
GOP Data Latency July 2017





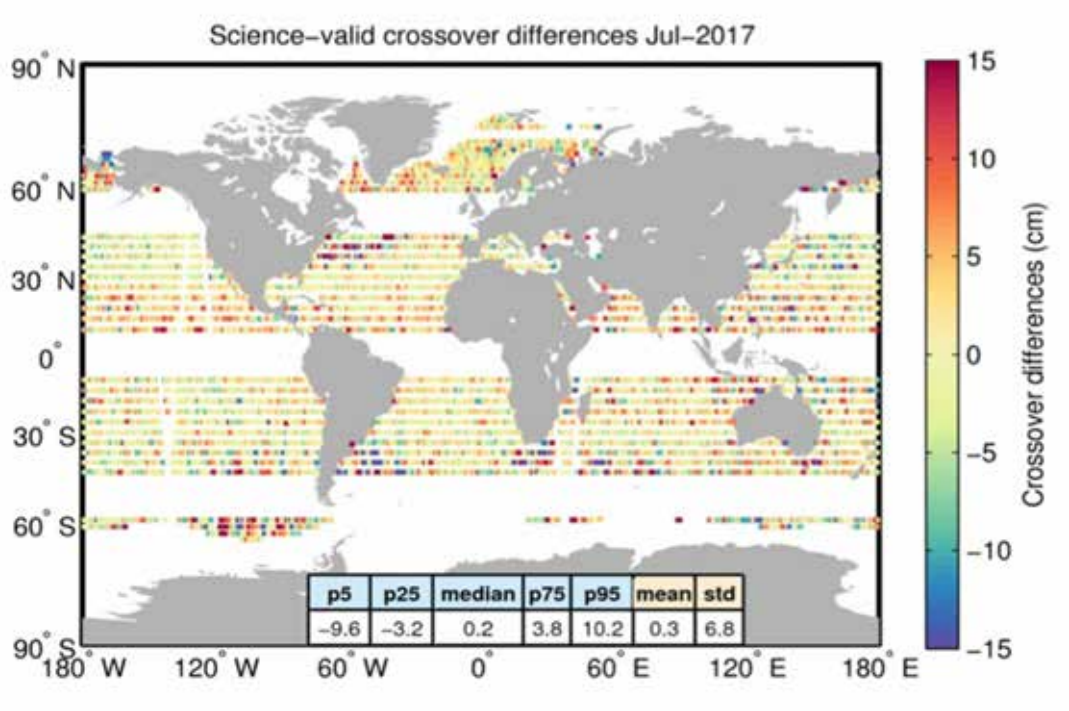
GOP 20-Hz SSHA noise

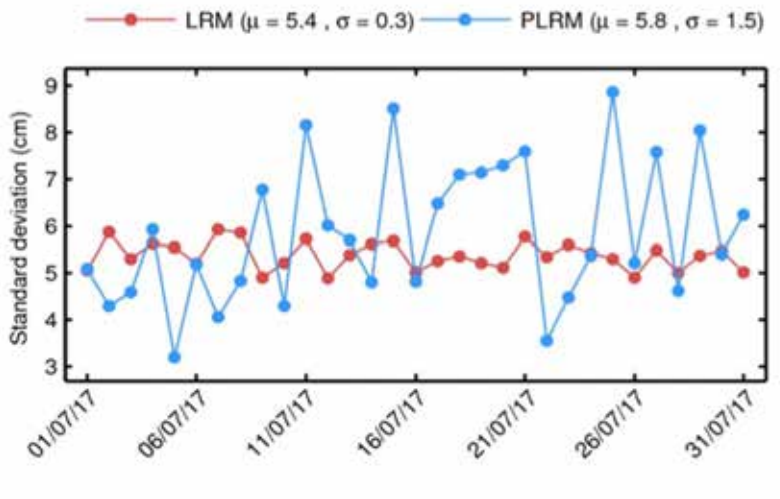
July 2017



Crossover Analysis

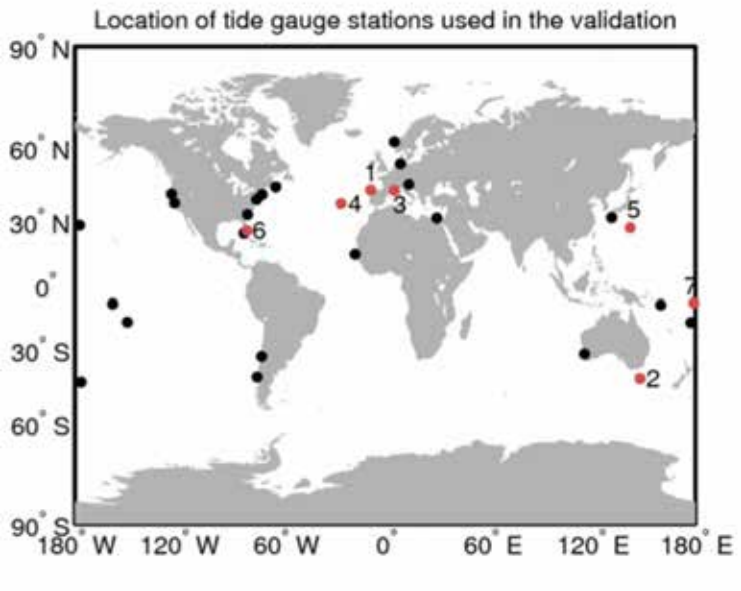
July 2017



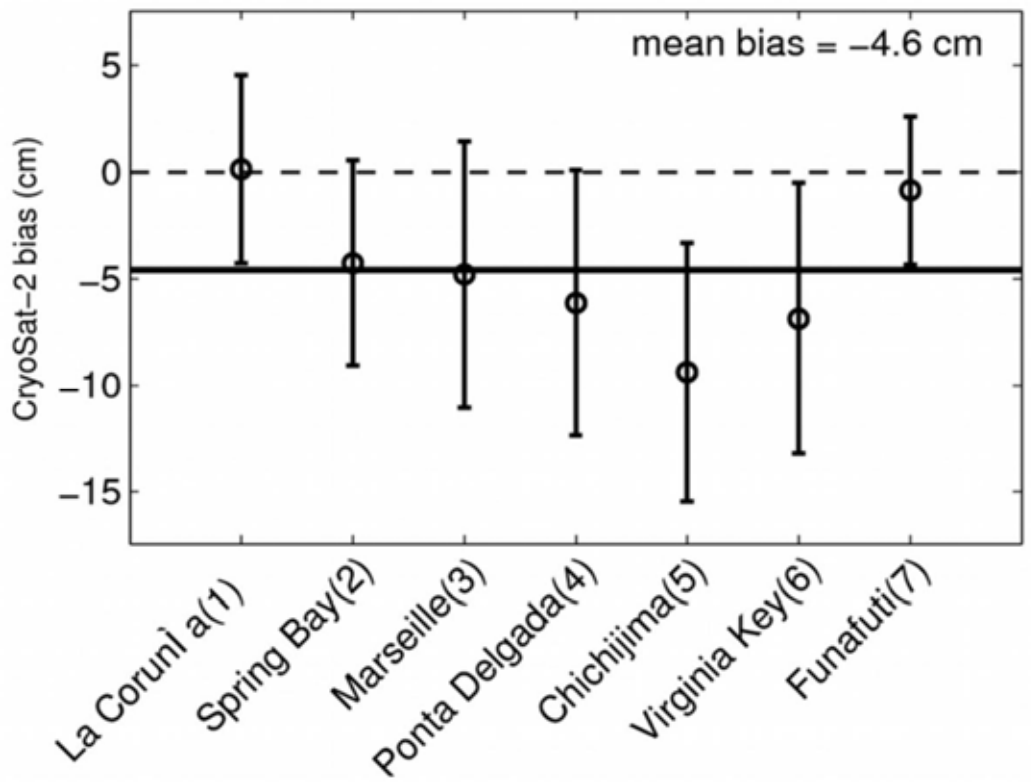


Usual screening:
discard |Xover|> 20cm
and depth<1000 m

Absolute validation of GOP SSH against selected tide gauges



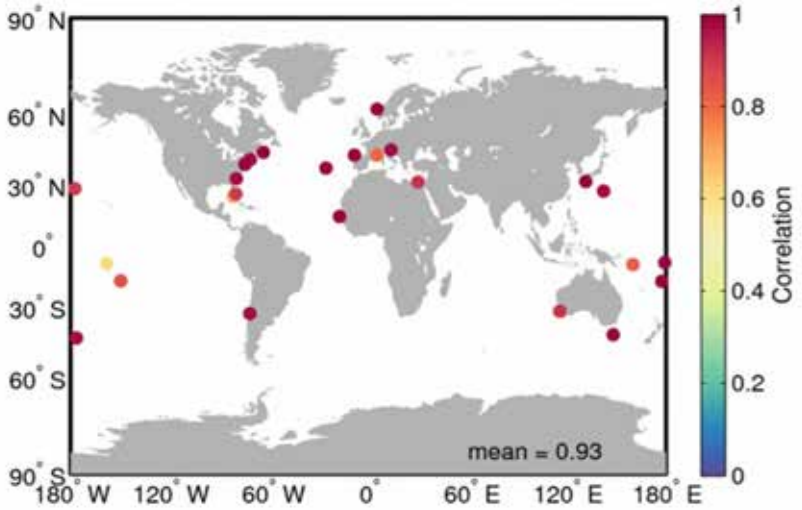
Apr 2014 to July 2017



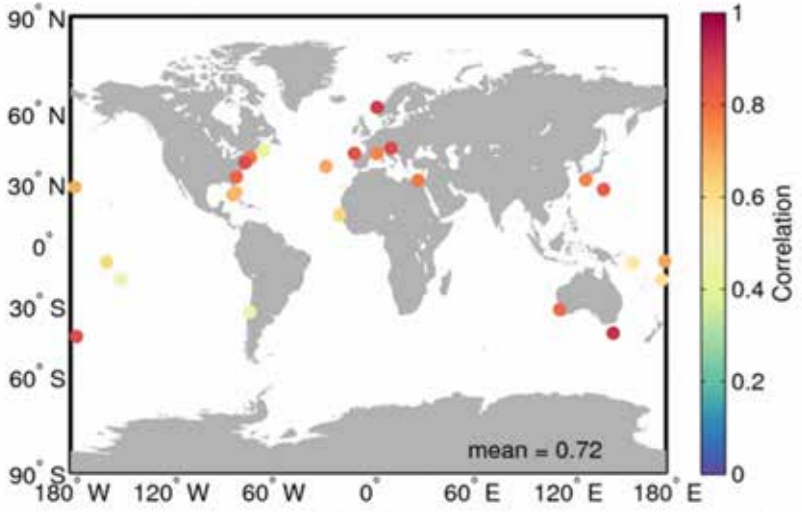
Validation of GOP SSHA against tide gauges

Apr 2014 to July 2017

tidal signals included



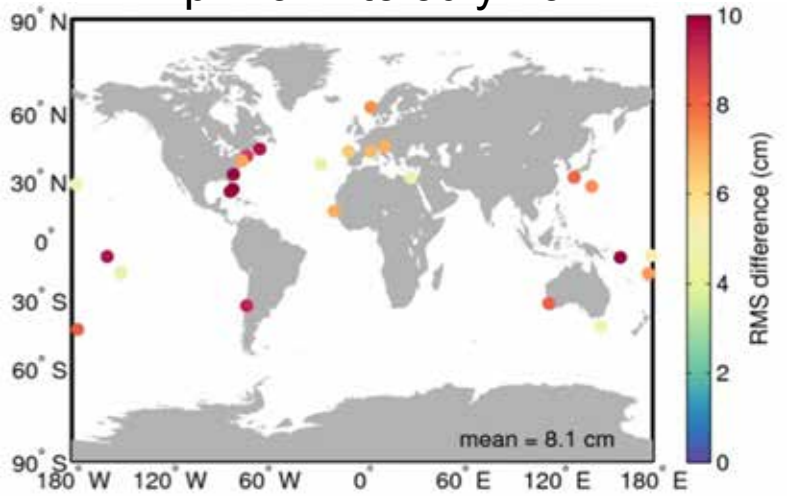
tidal signals removed



Validation of GOP SSHA against tide gauges

Apr 2014 to July 2017

tidal signals included



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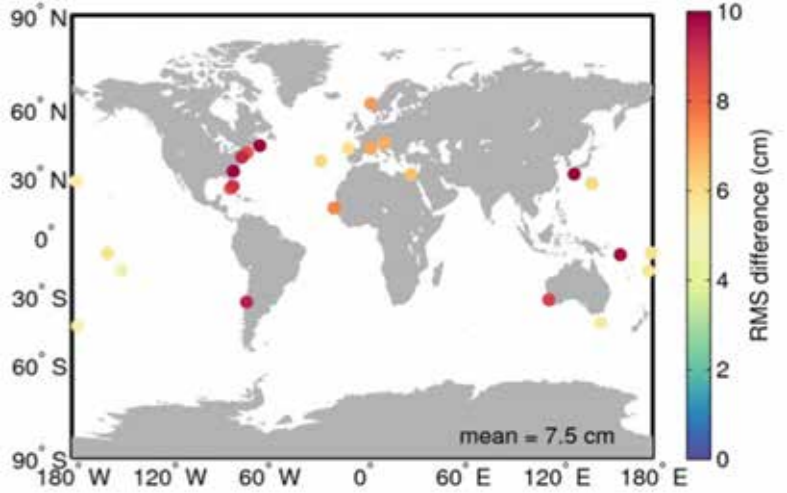
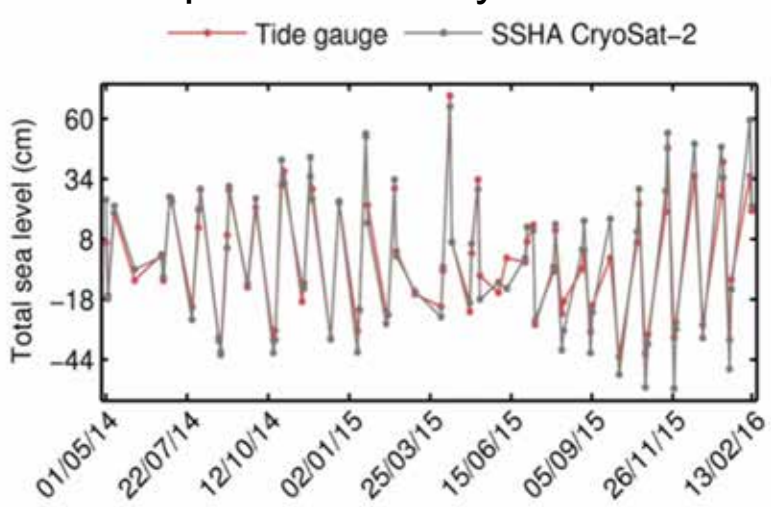


Validation of GOP SSHA against tide gauges

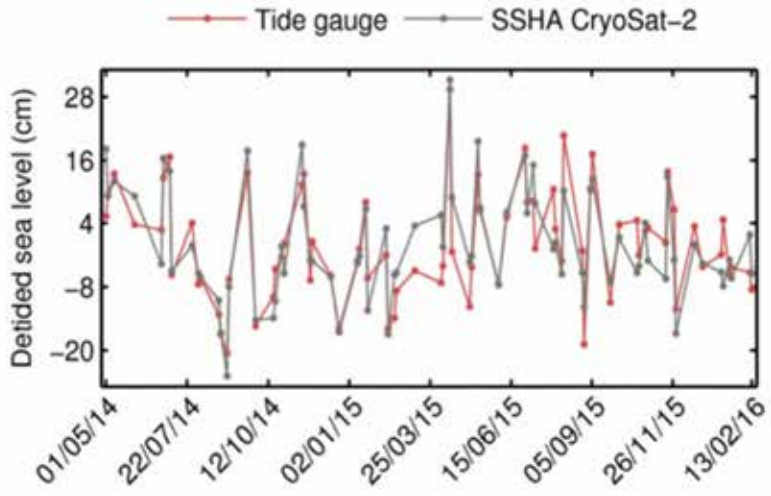
Chatham Island TG

Apr 2014 to July 2017

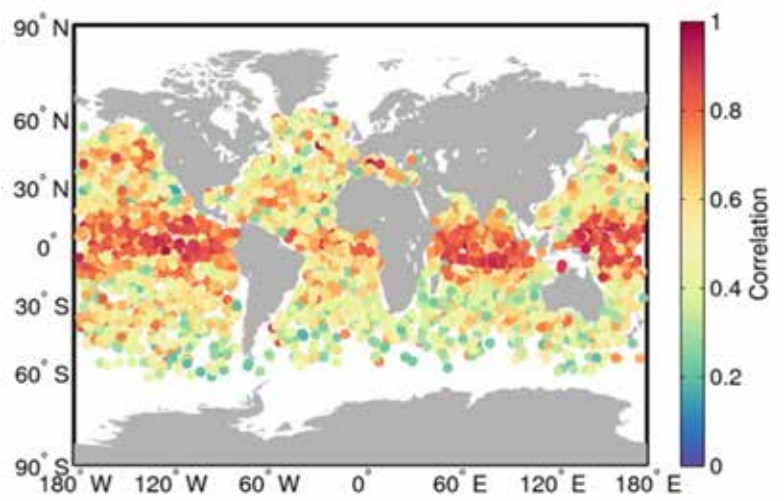
tidal signals included

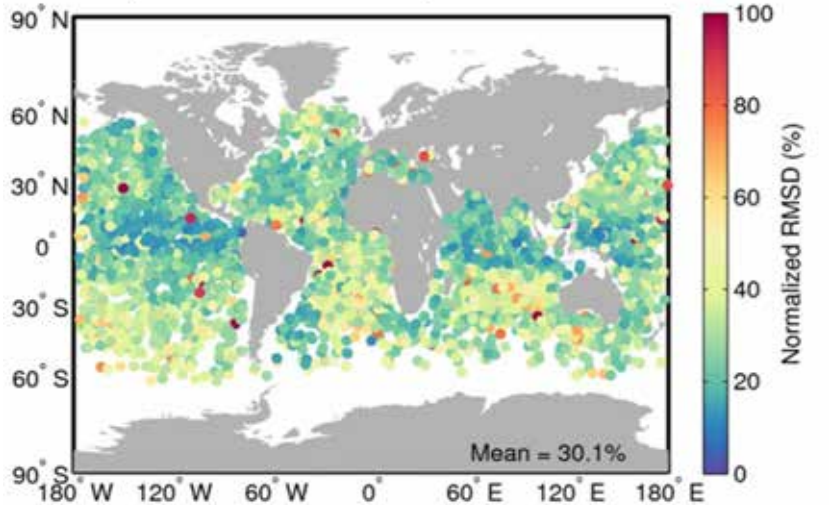


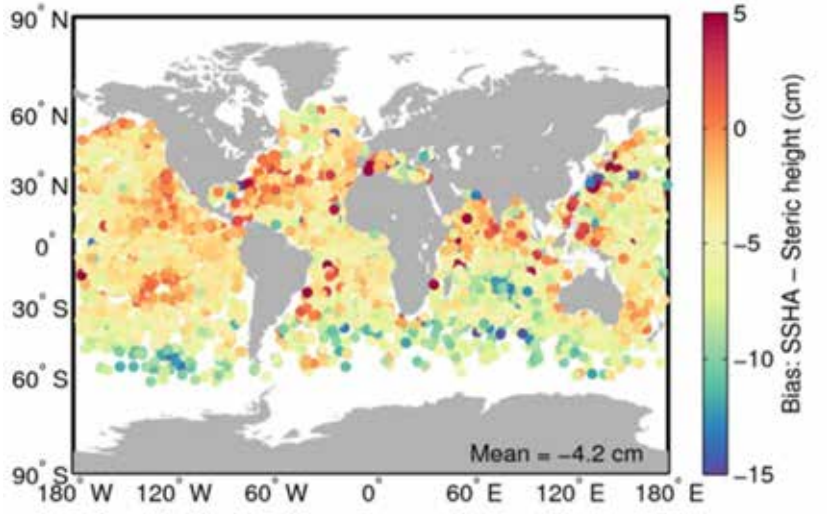
tidal signals removed

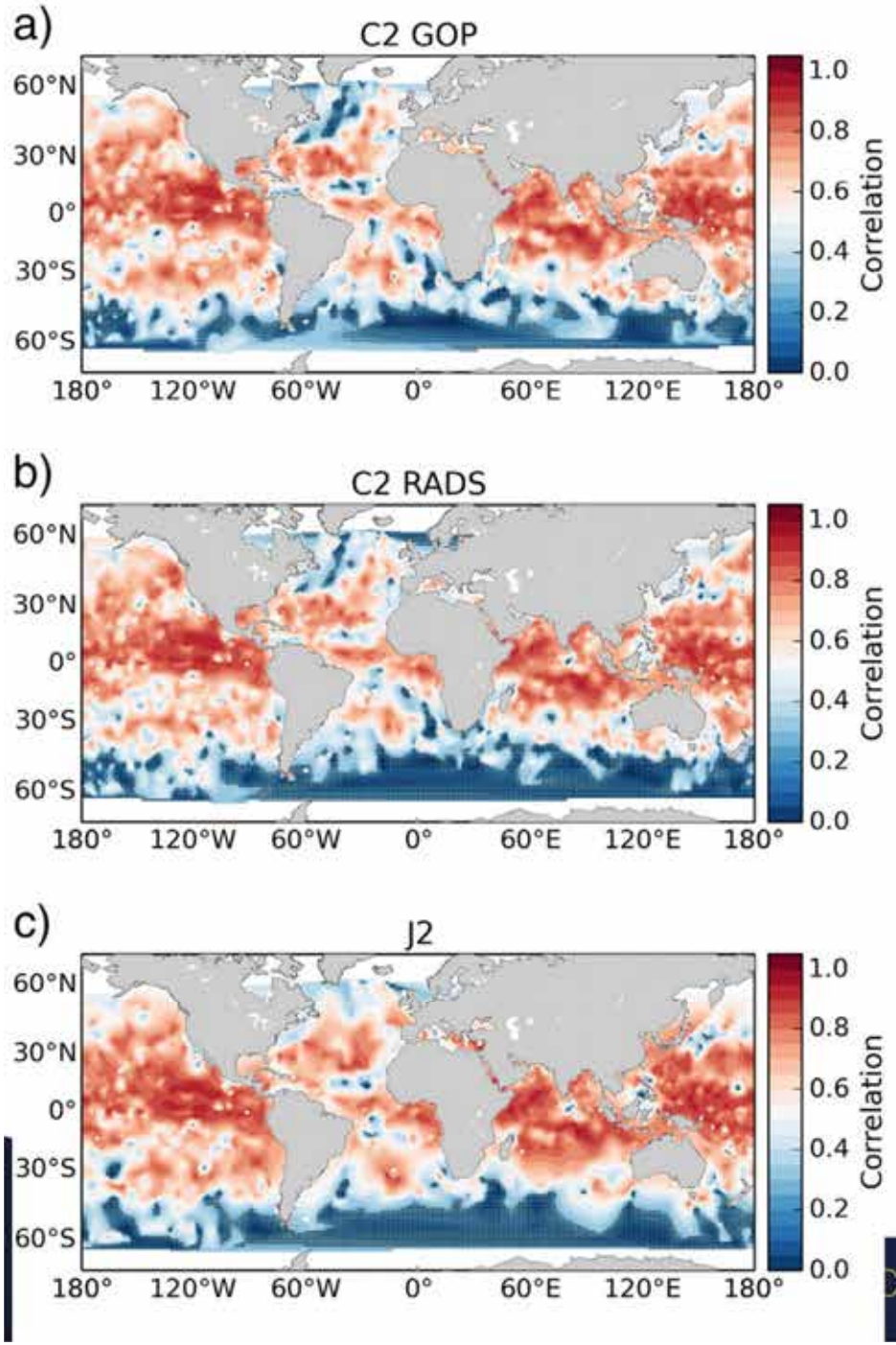


Comparison of GOP SSH anomaly with the steric heights derived from temperature and salinity ARGO profiles Apr 2014 to July 2017









Comparison of GOP SSH anomaly with the steric heights derived from temperature and salinity ARGO profiles Apr 2014 to April 2016

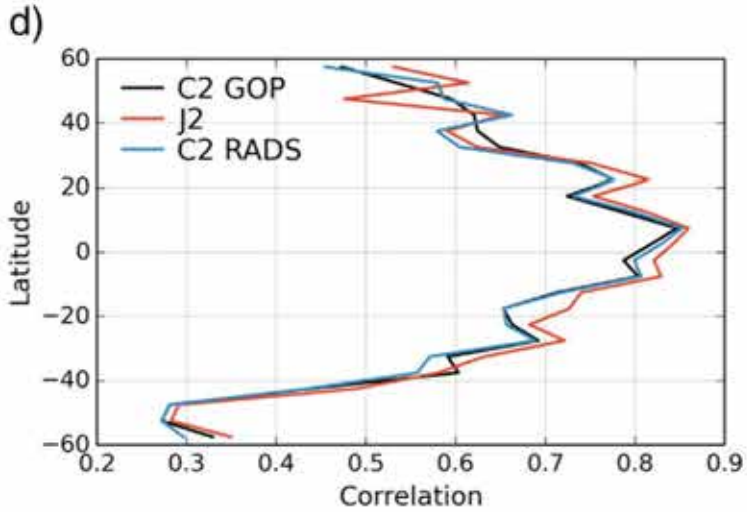
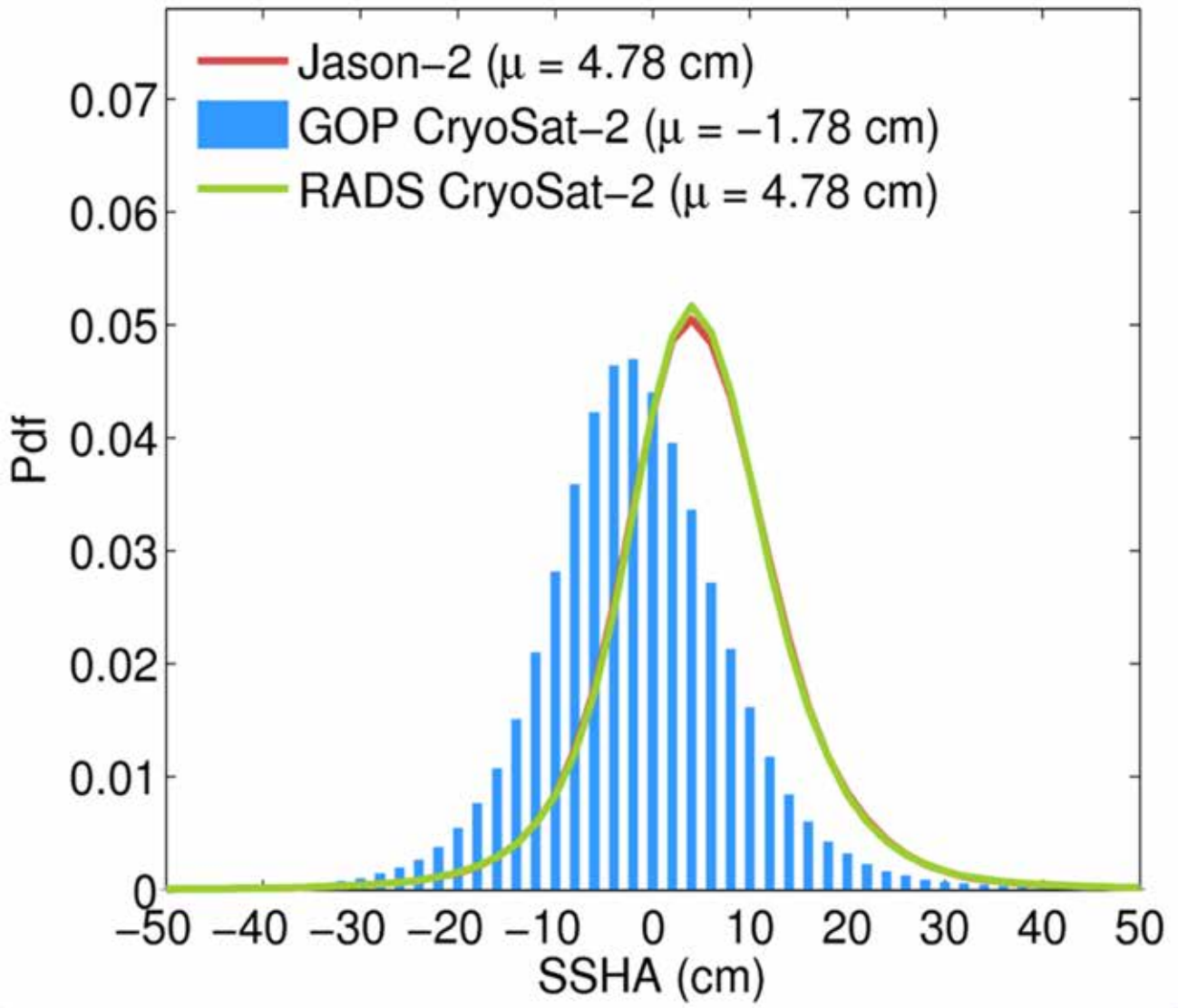


Fig. 9. Maps showing the correlation between SSHAs and Argo-derived steric heights over the period April 2014 to April 2016 for: (a) C2 GOP; (b) C2 RADS; and (c) J2. Black dots denote non-significant correlation at the 95% confidence level. The median correlation as a function of latitude is also shown in (d).

Calafat et al., 2017

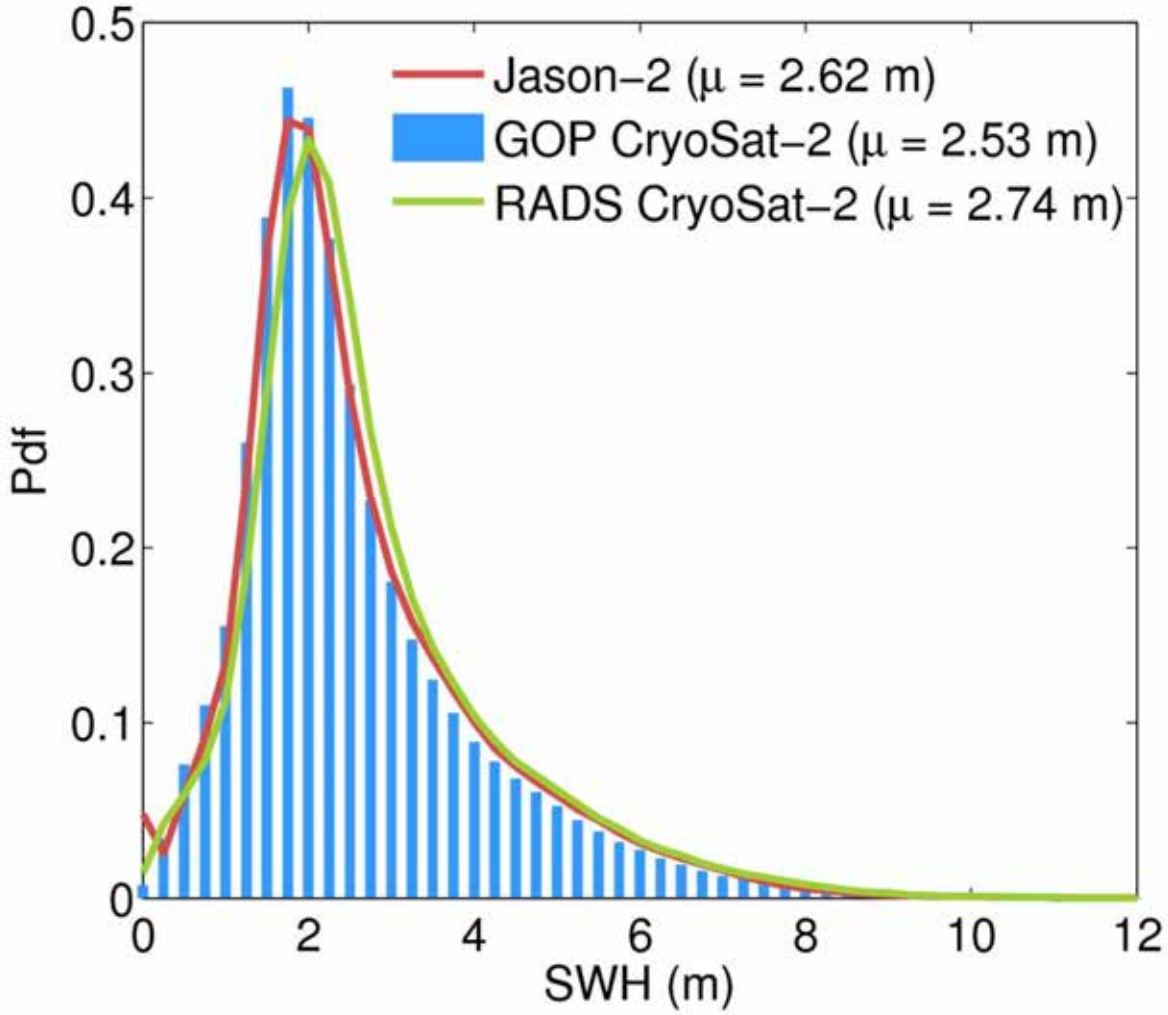
Validation against Jason-2 September 2016

SSHA

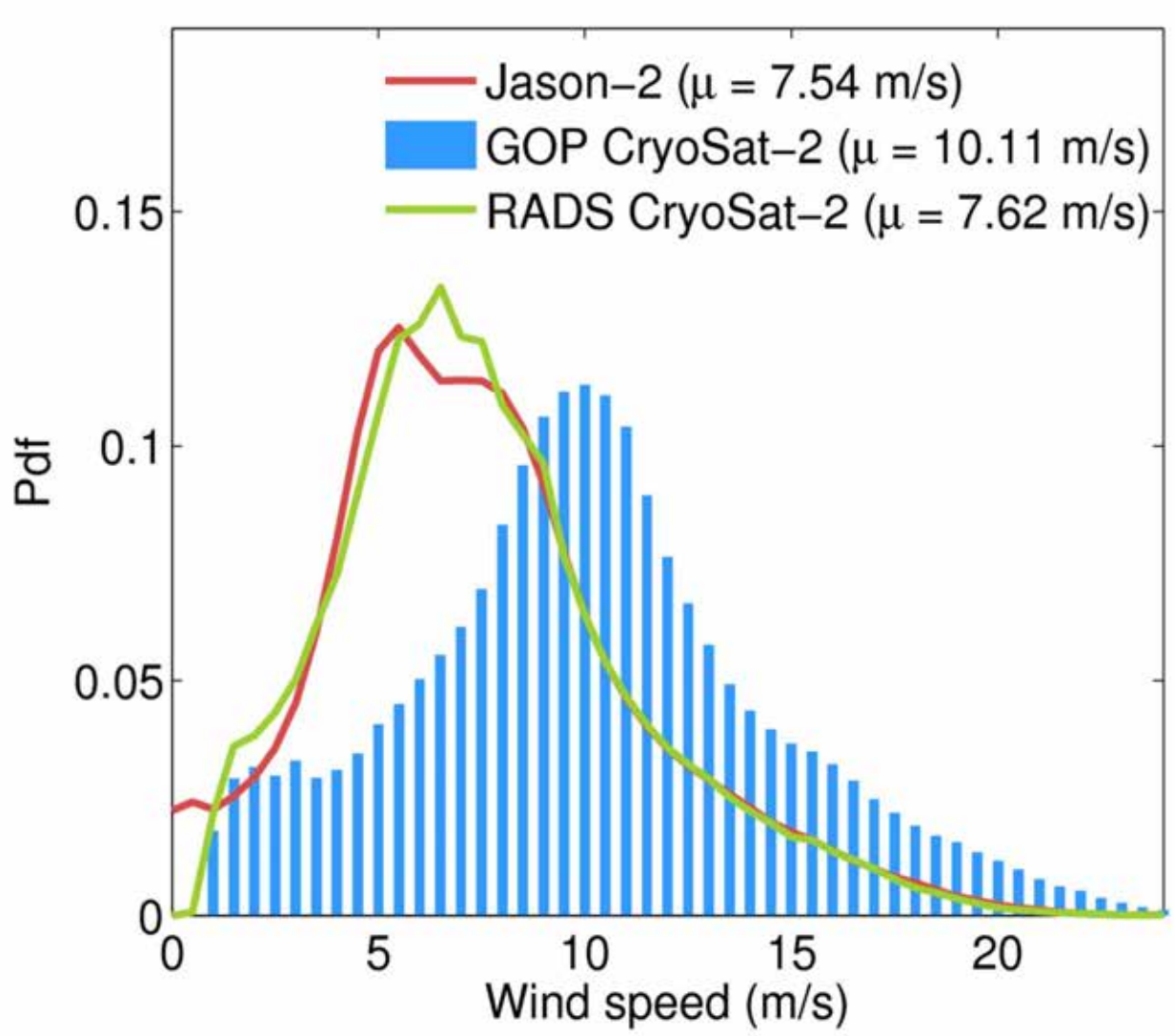


Validation against Jason-2 September 2016

SWH



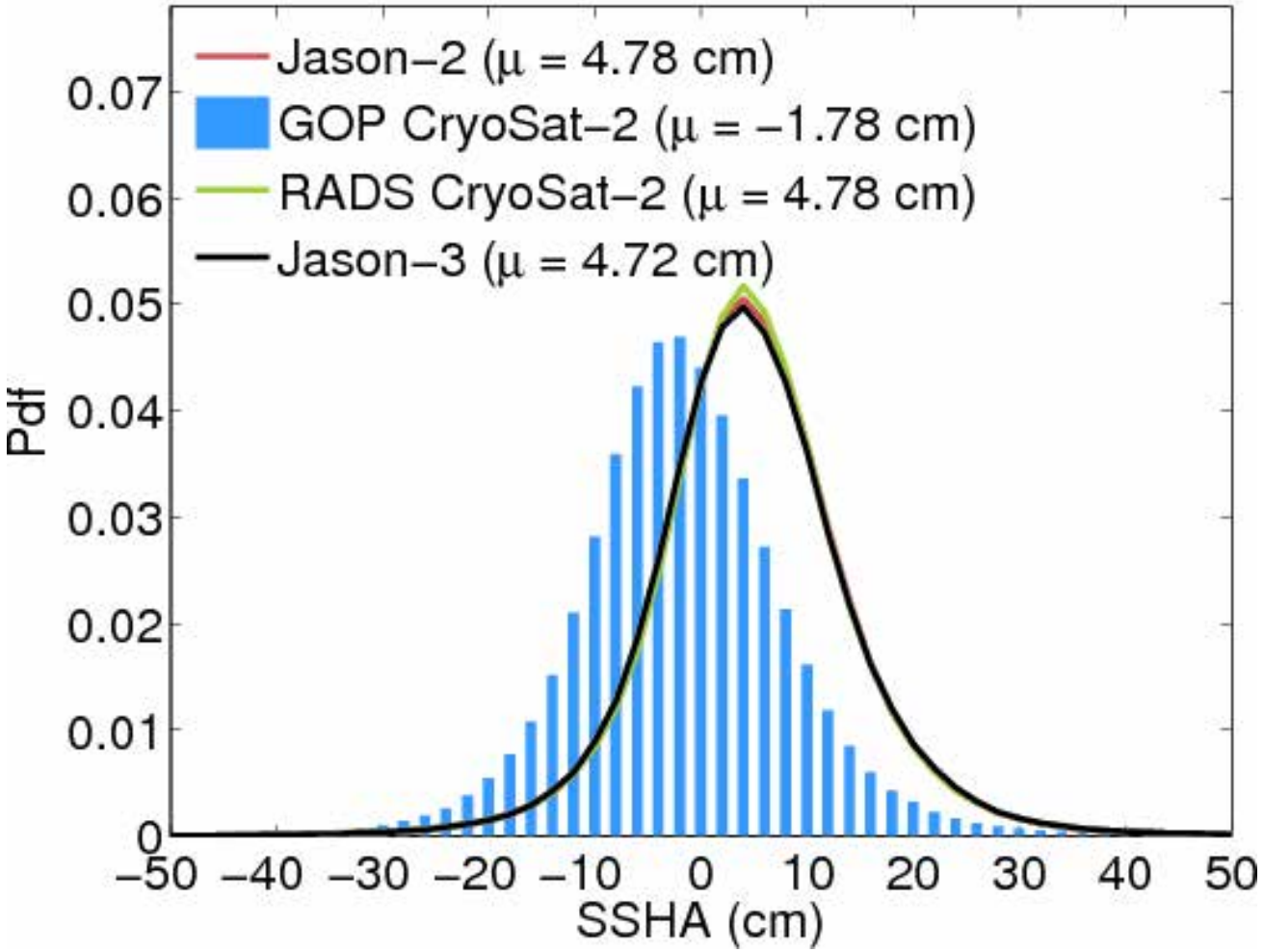
Validation against Jason-2 September 2016



Wind Speed

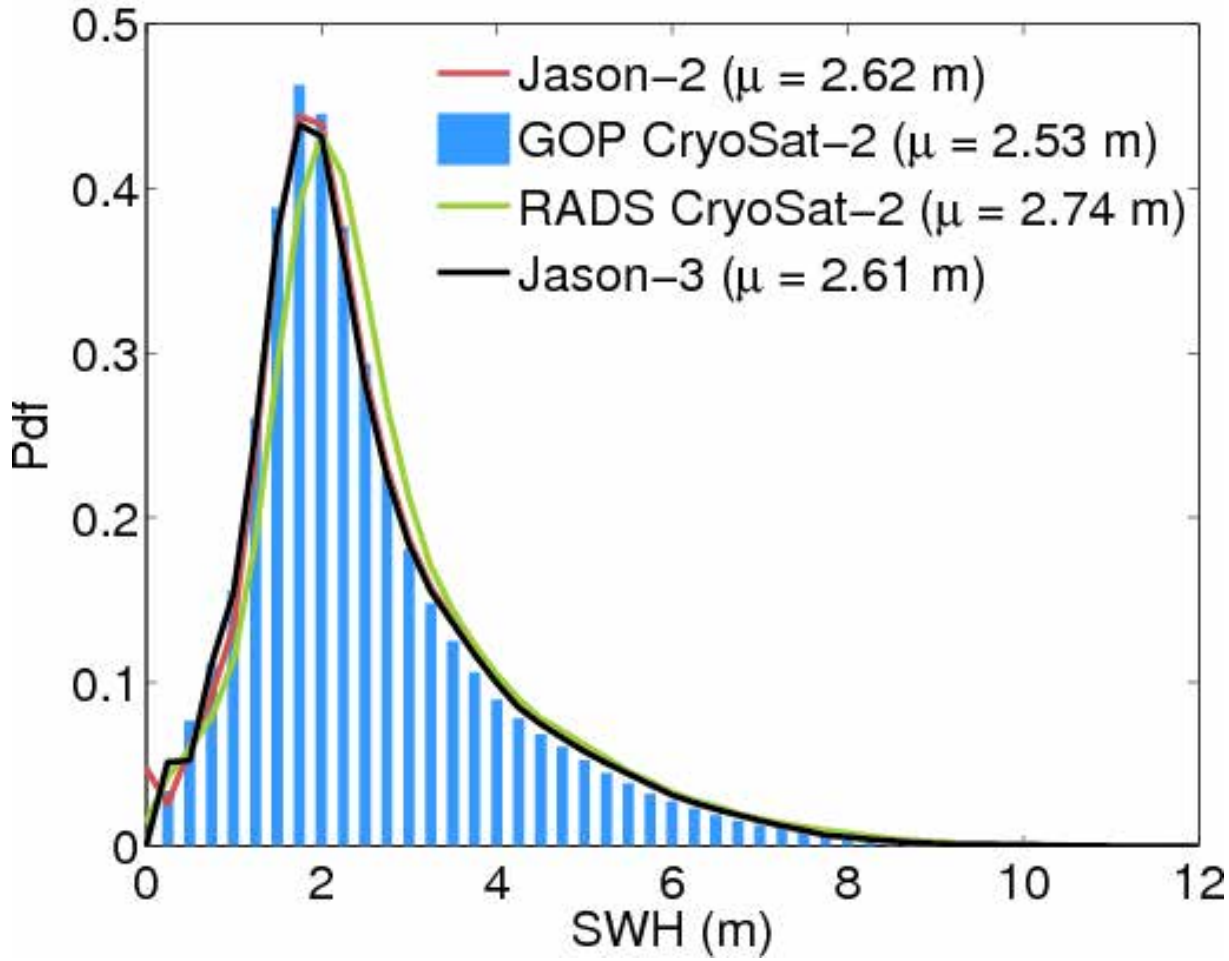
Validation against Jason-2 and -3 Sept 2016

SSHA



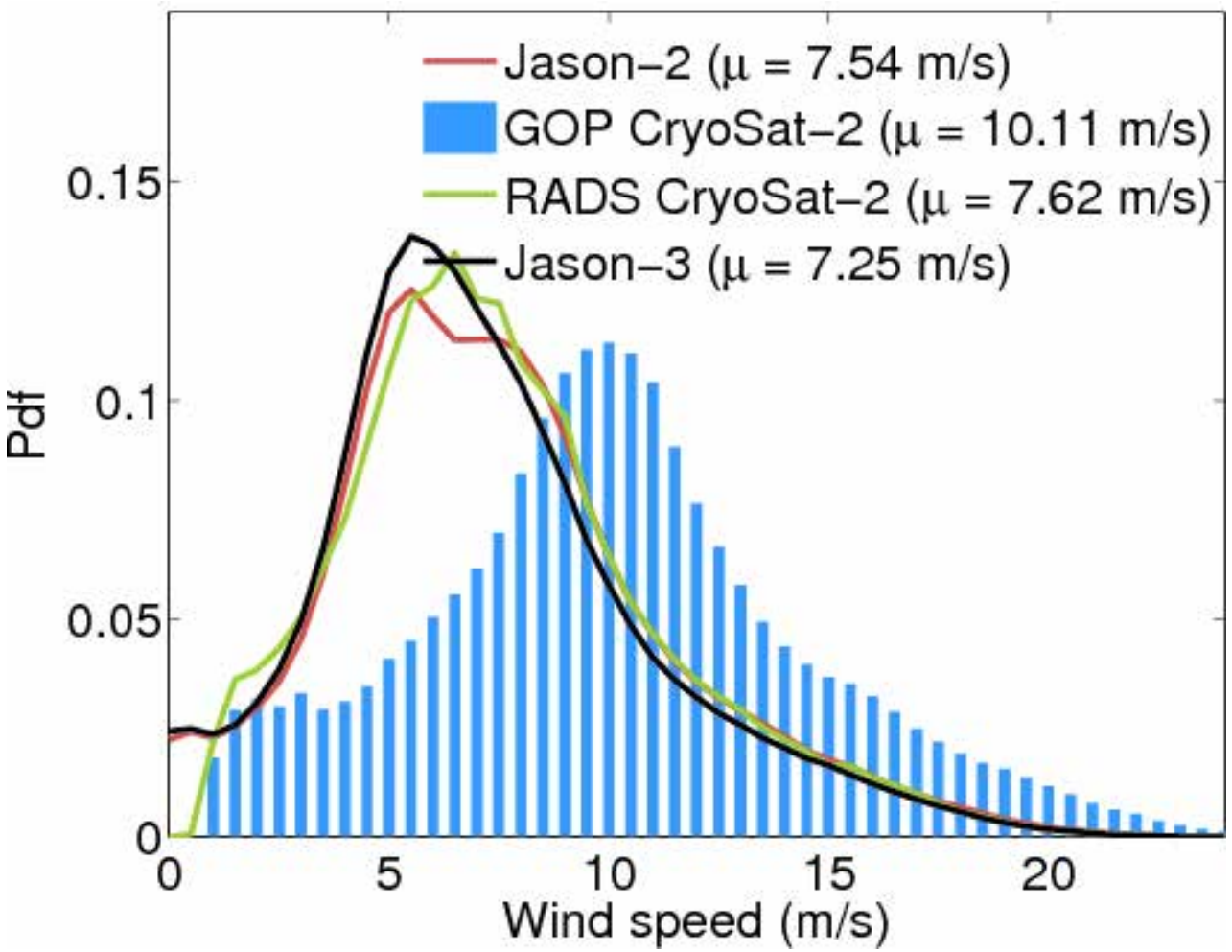
Validation against Jason-2 and -3 Sept 2016

SWH

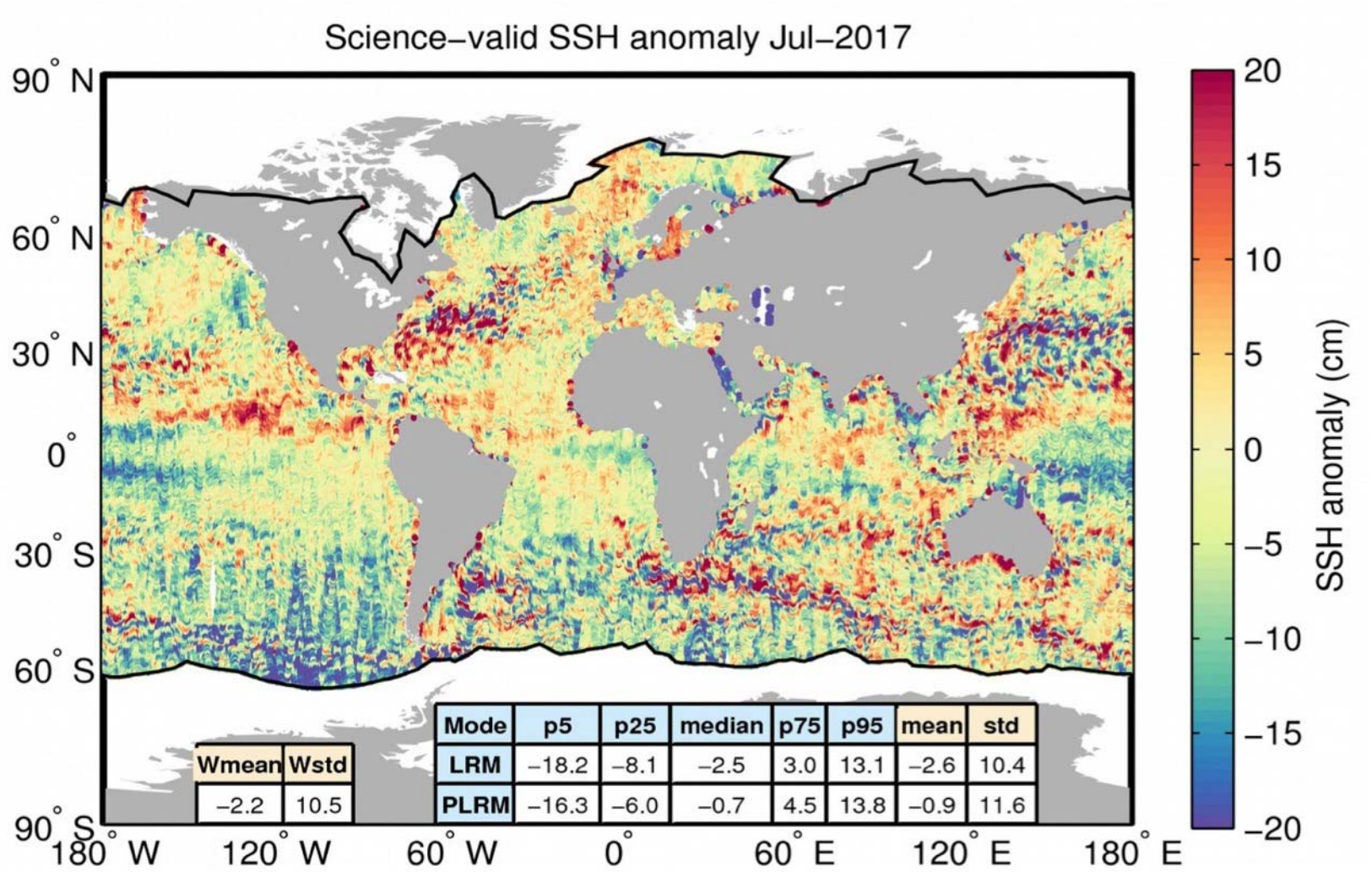


Validation against Jason-2 September 2016

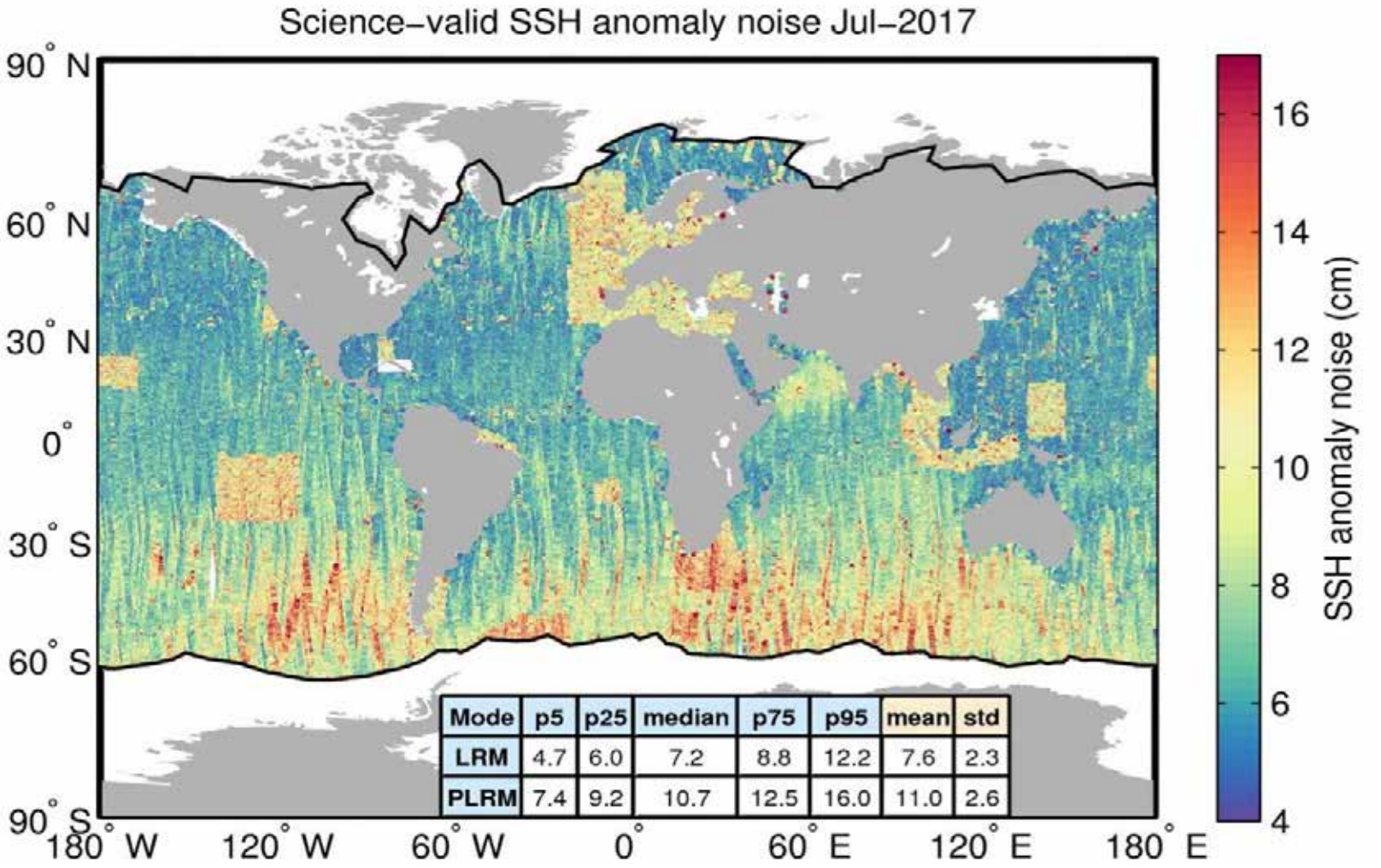
Wind Speed



SSHA July 2017

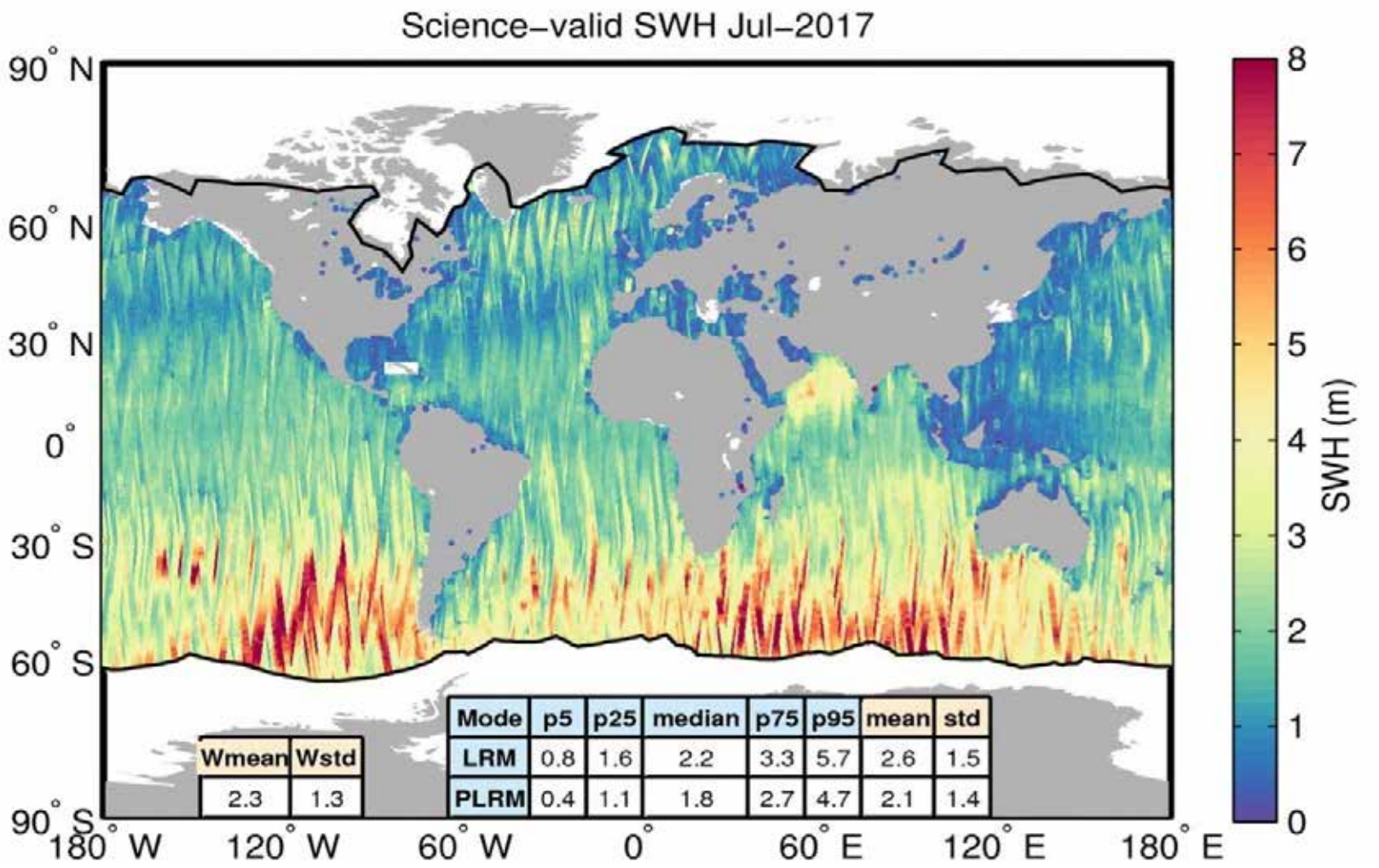


SSHA Noise July 2017

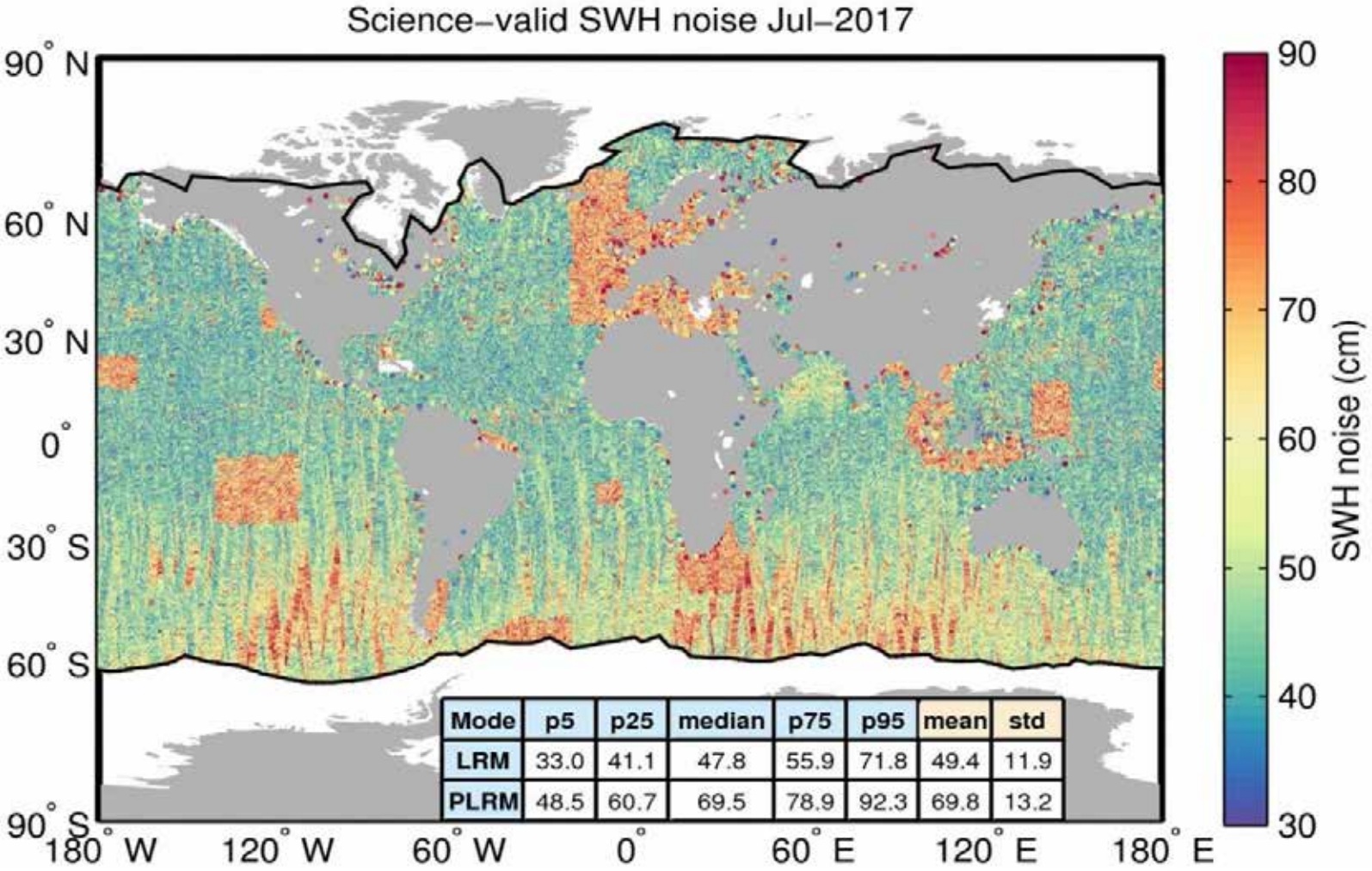


Mode	p5	p25	median	p75	p95	mean	std
LRM	4.7	6.0	7.2	8.8	12.2	7.6	2.3
PLRM	7.4	9.2	10.7	12.5	16.0	11.0	2.6

SWH July 2017

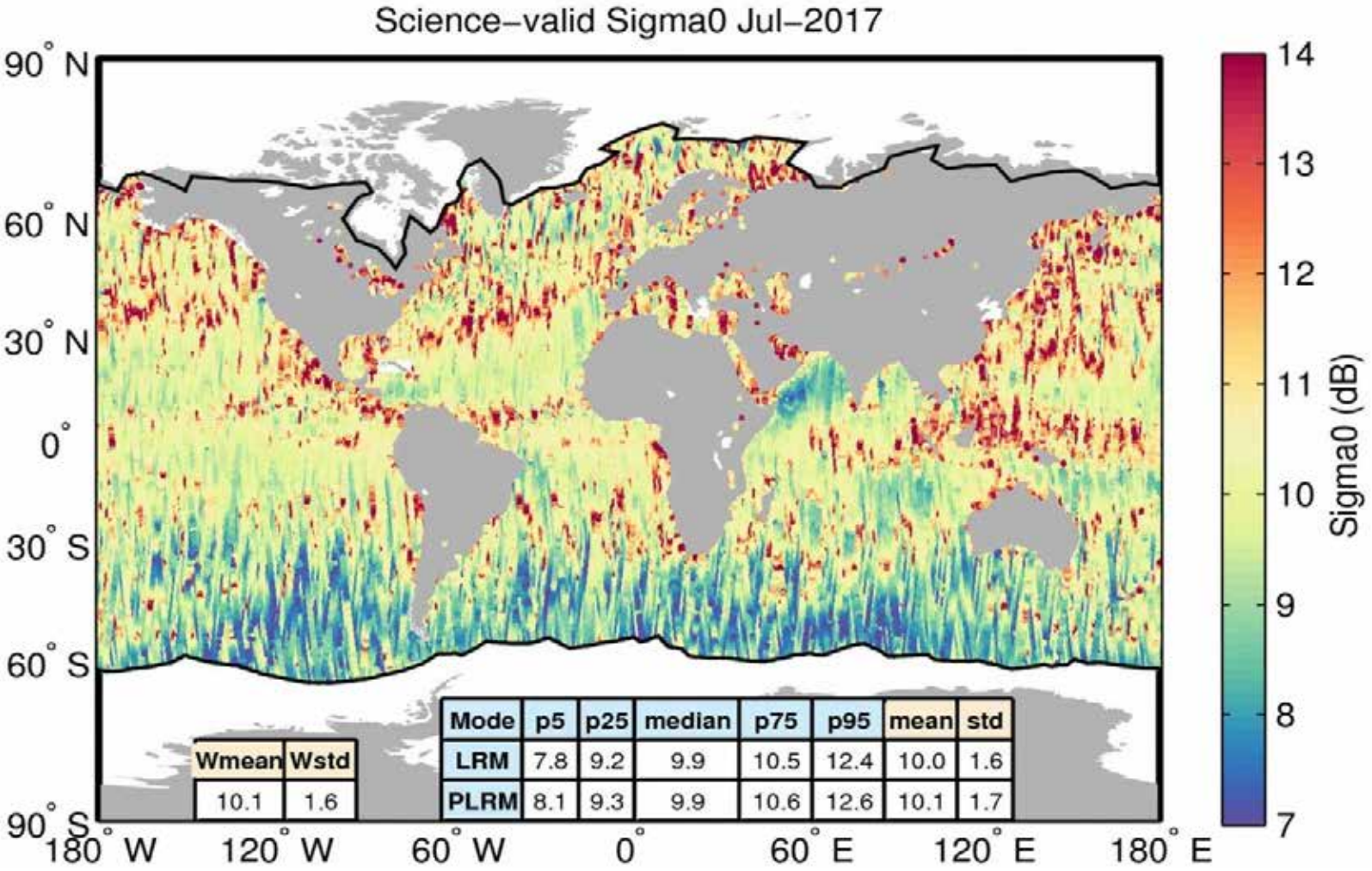


SWH Noise July 2017



Mode	p5	p25	median	p75	p95	mean	std
LRM	33.0	41.1	47.8	55.9	71.8	49.4	11.9
PLRM	48.5	60.7	69.5	78.9	92.3	69.8	13.2

Sigma0 July 2017

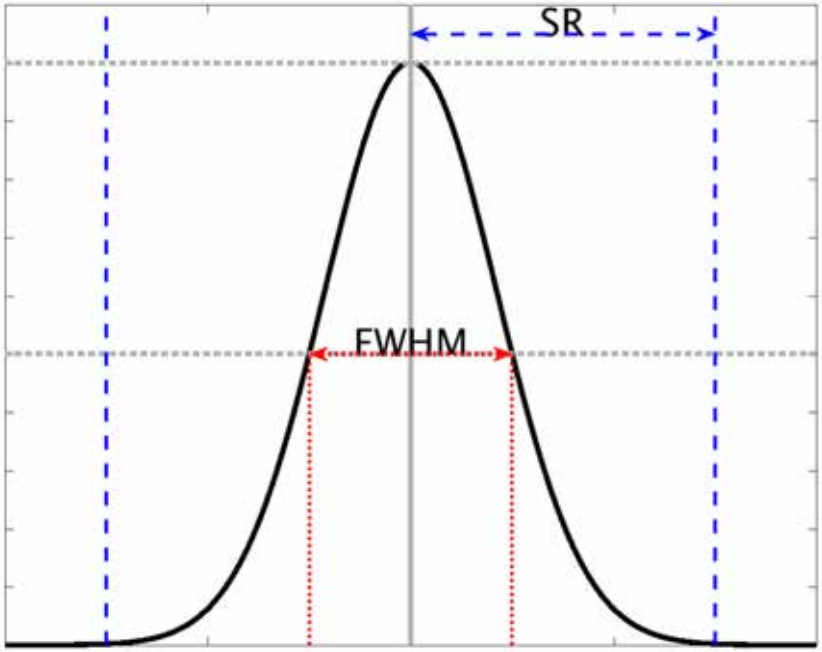


Building a L3 SSHA Product

Spatial and temporal averaging

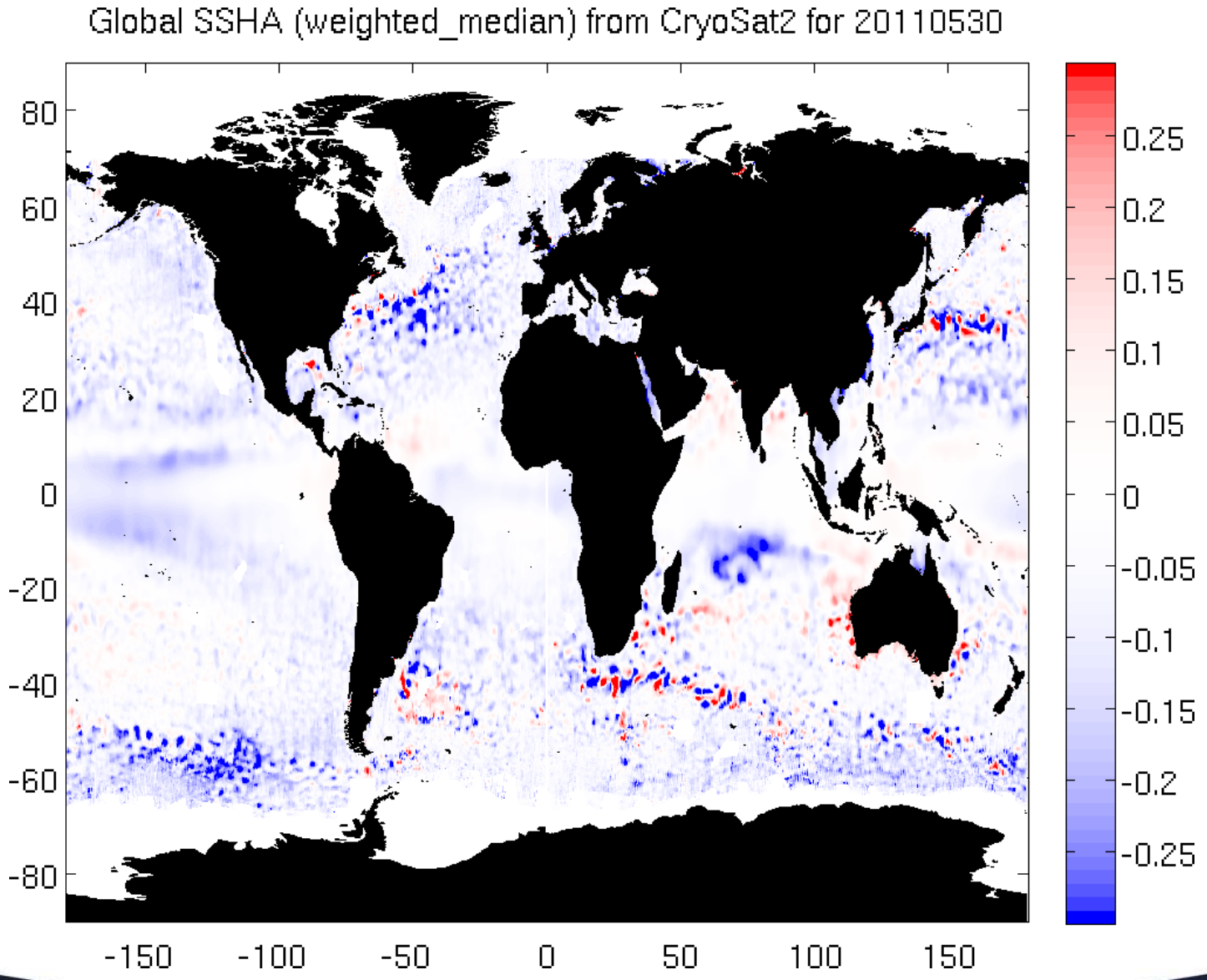
Weighted using product of normalised weights in space & time

Variable	FWHM	SR
Space (km)	2 x RRoD*	3 x RRoD
Time (days)	30	45



* RRoD is Rossby Radius of deformation from Chelton et al (1998)
www-po.coas.oregonstate.edu/research/po/research/rossby_radius/

GOP SSHA L3 movie



GOP SSHA L3 movie

Global Mean Sea Level Anomaly

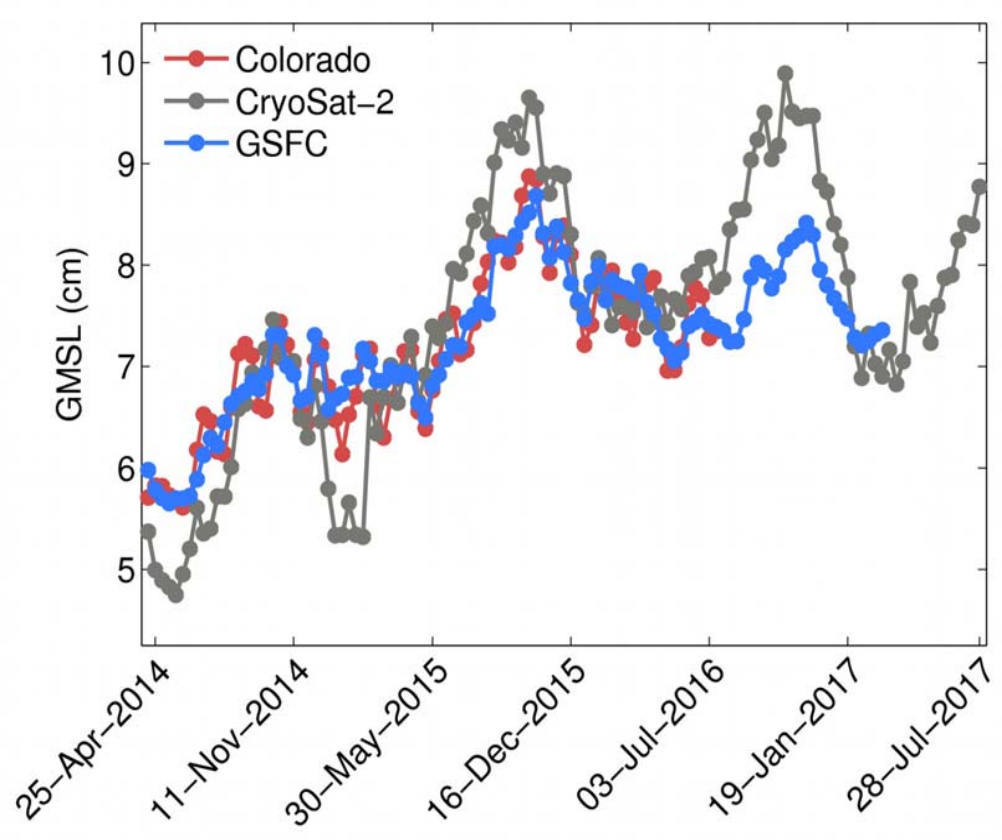
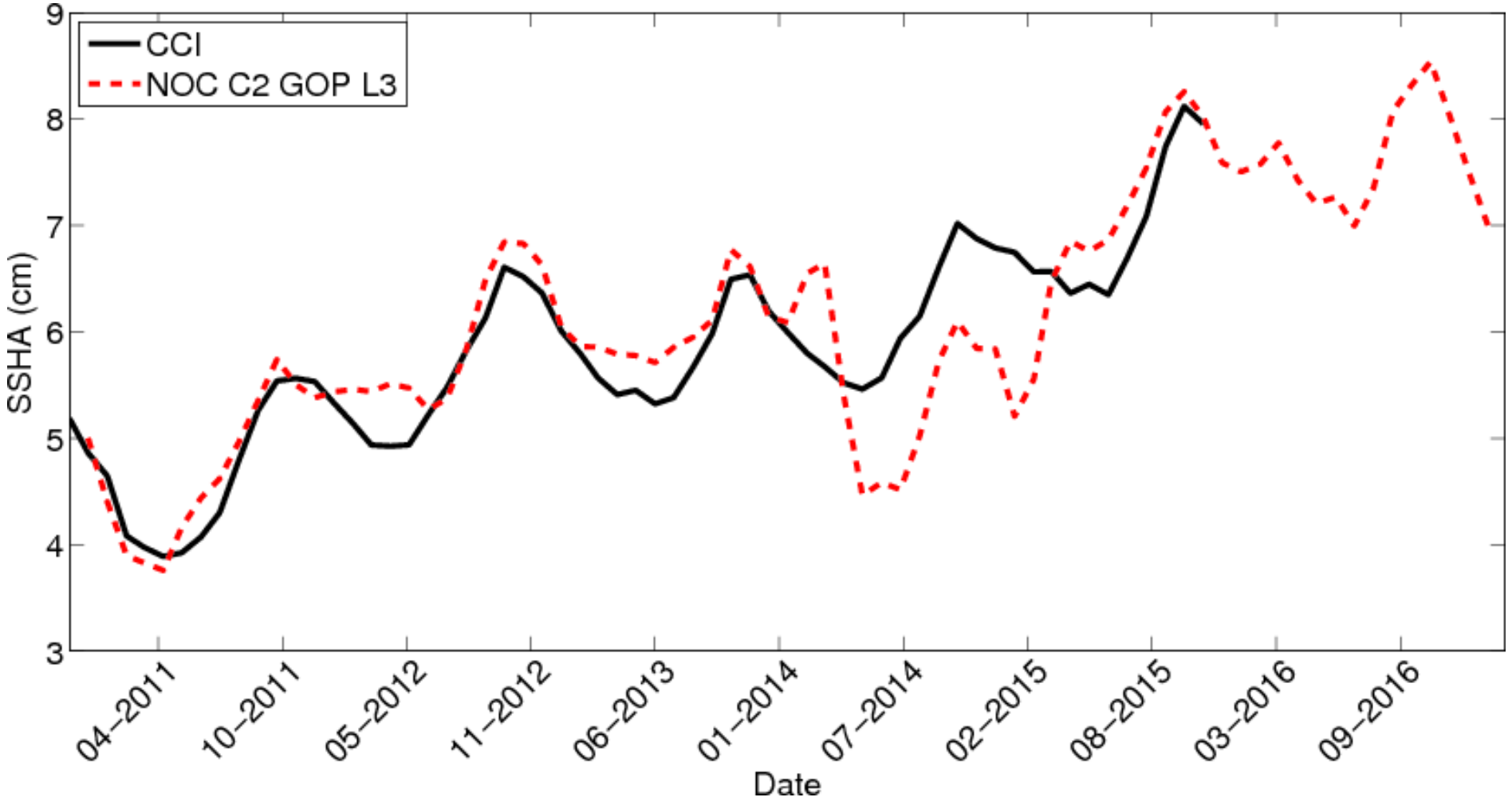
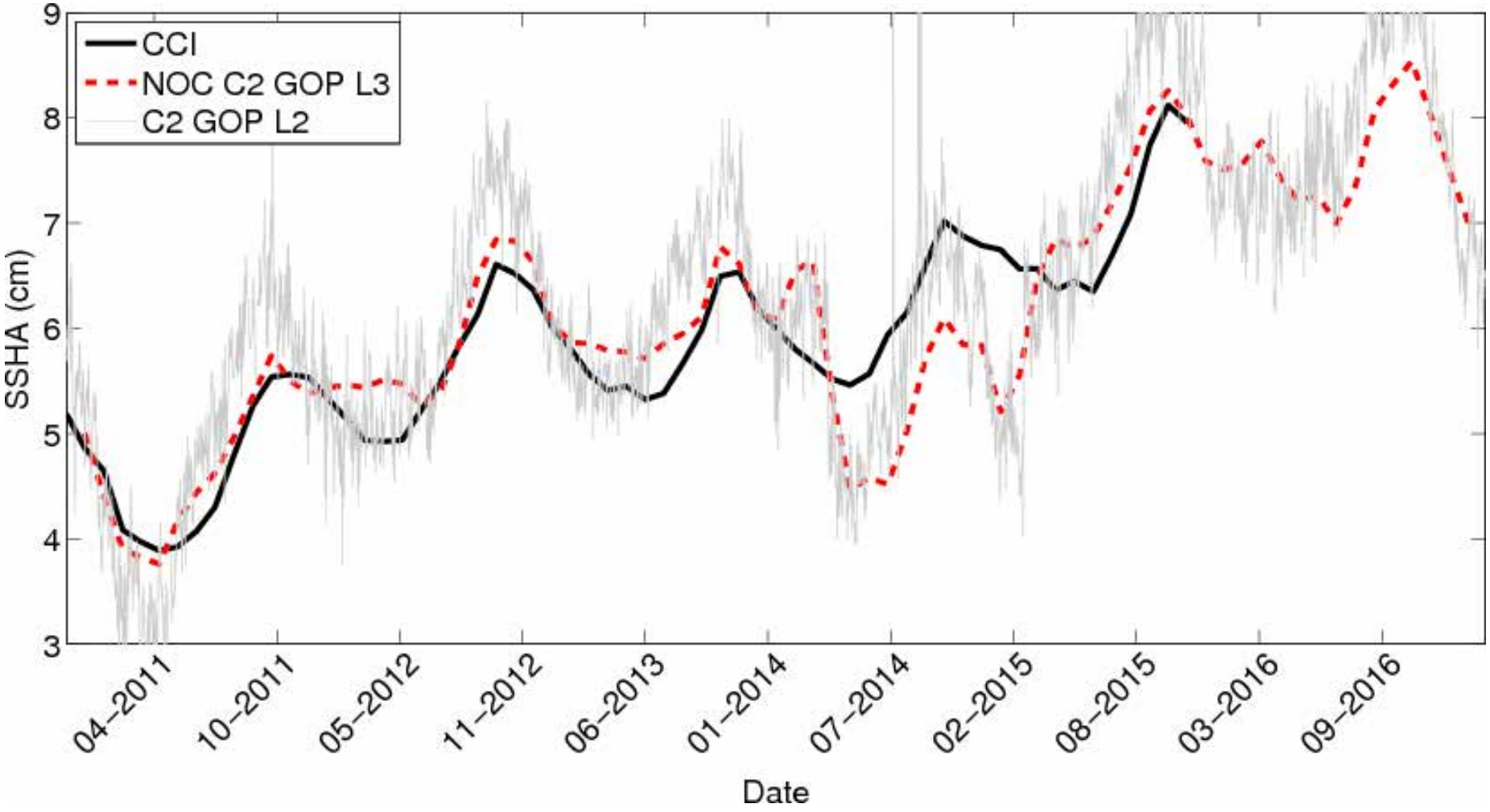


Figure 127. Global mean sea level (latitude < 65º) from GOP CryoSat-2 (grey) together with that derived from OSTM/Jason-2 at the University of Colorado (red) and GSFC (blue).

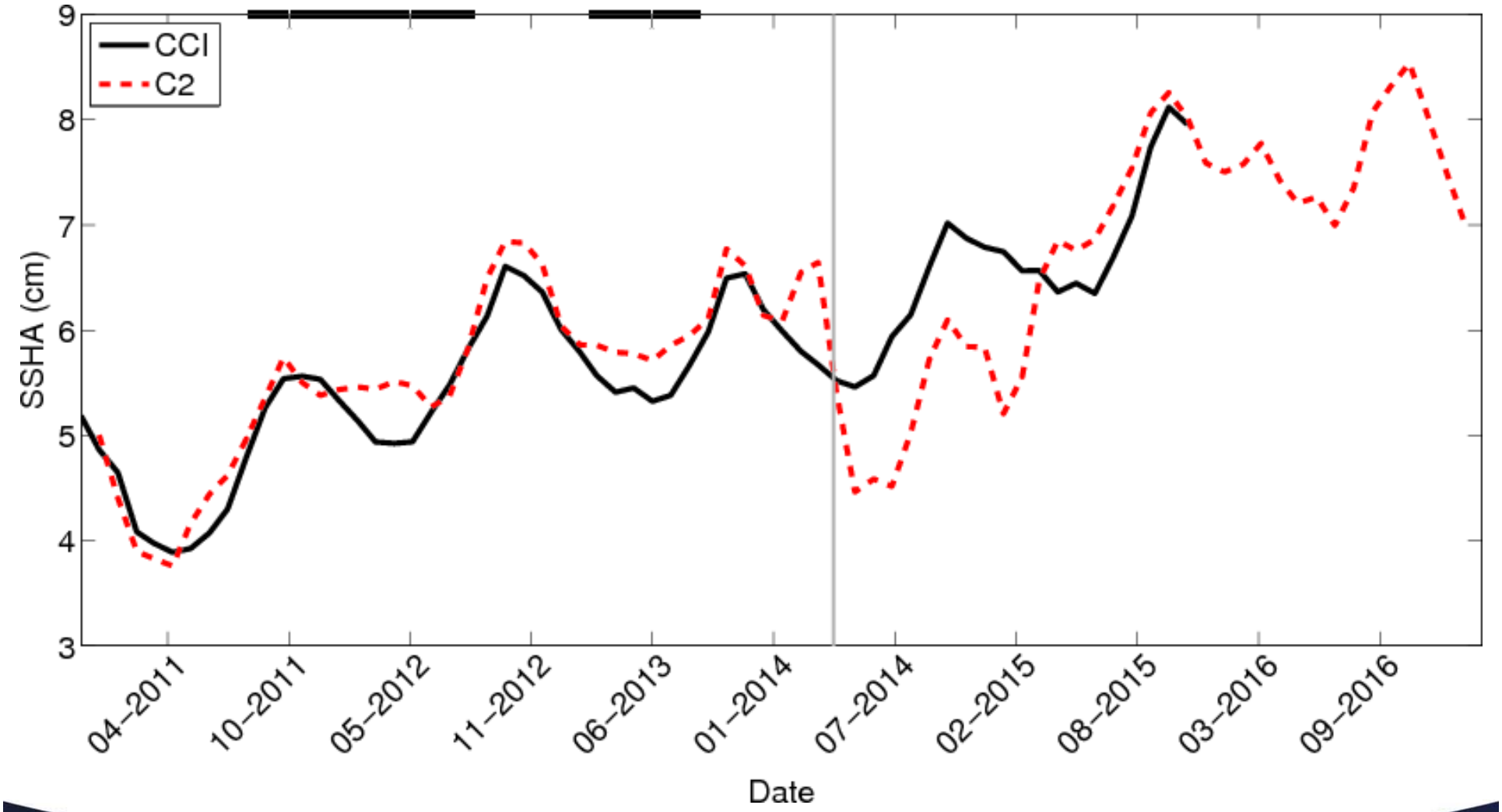
Global Mean Sea Level Anomaly



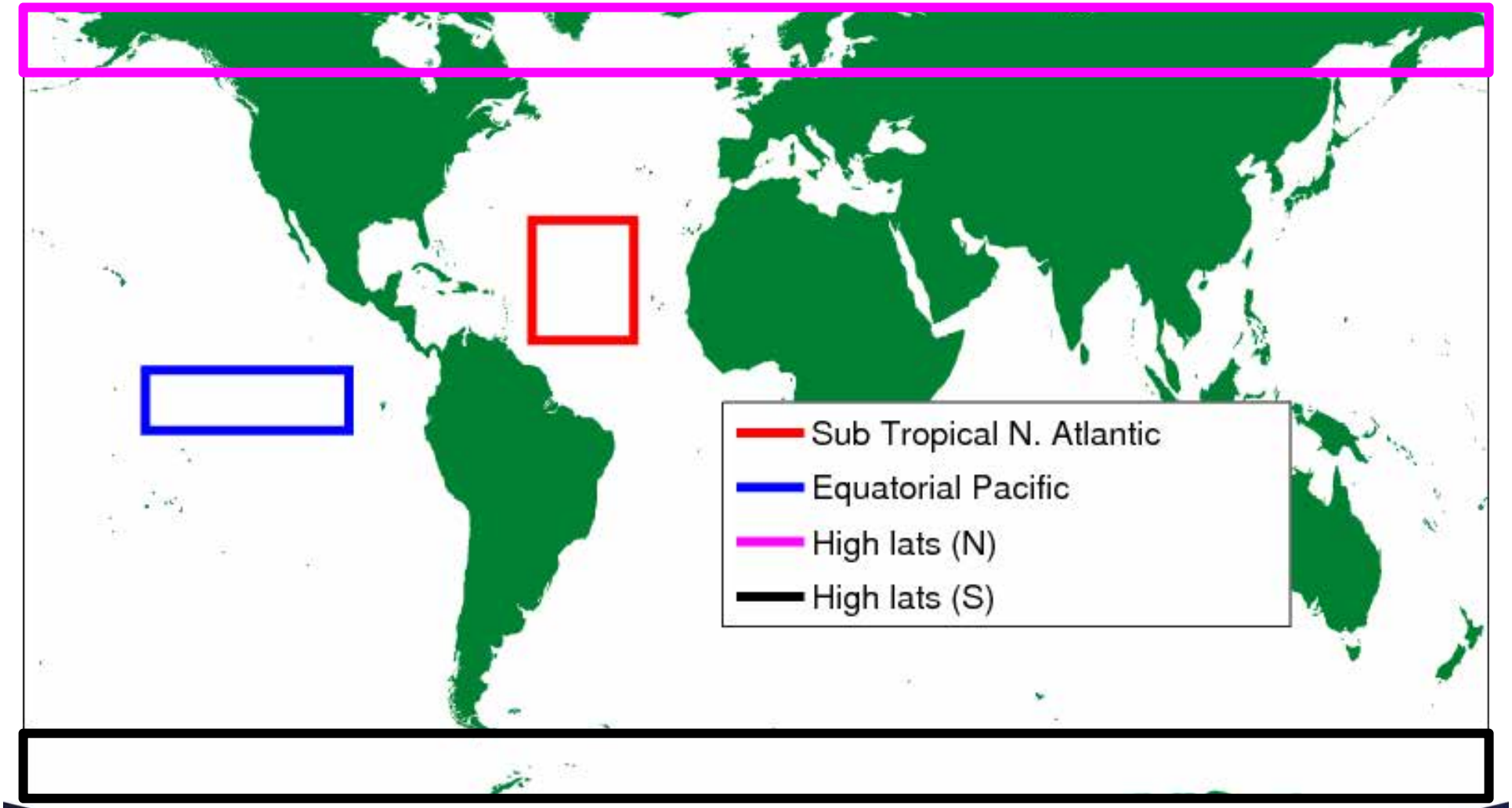
Global Mean Sea Level Anomaly



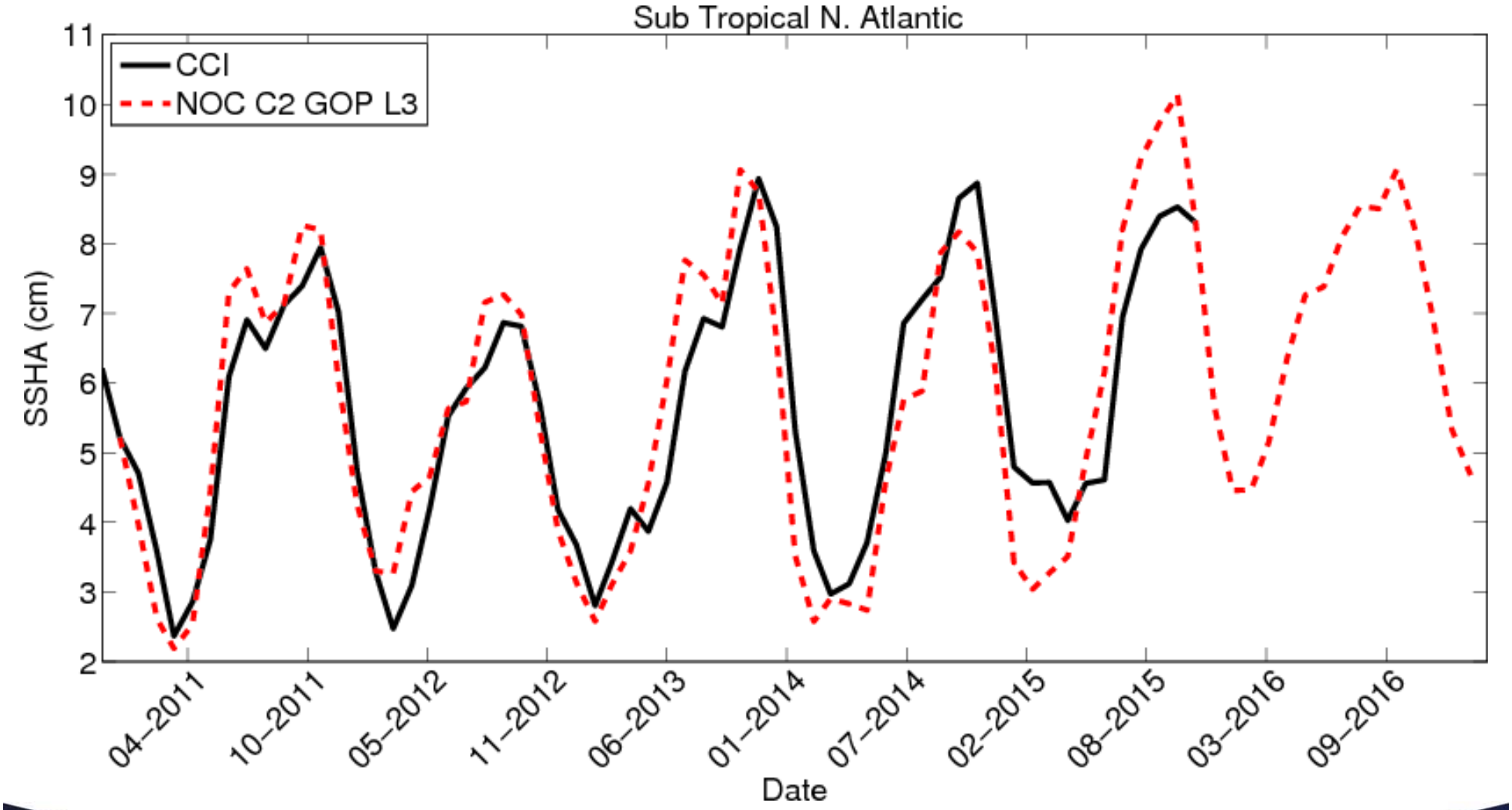
Global Mean Sea Level Anomaly



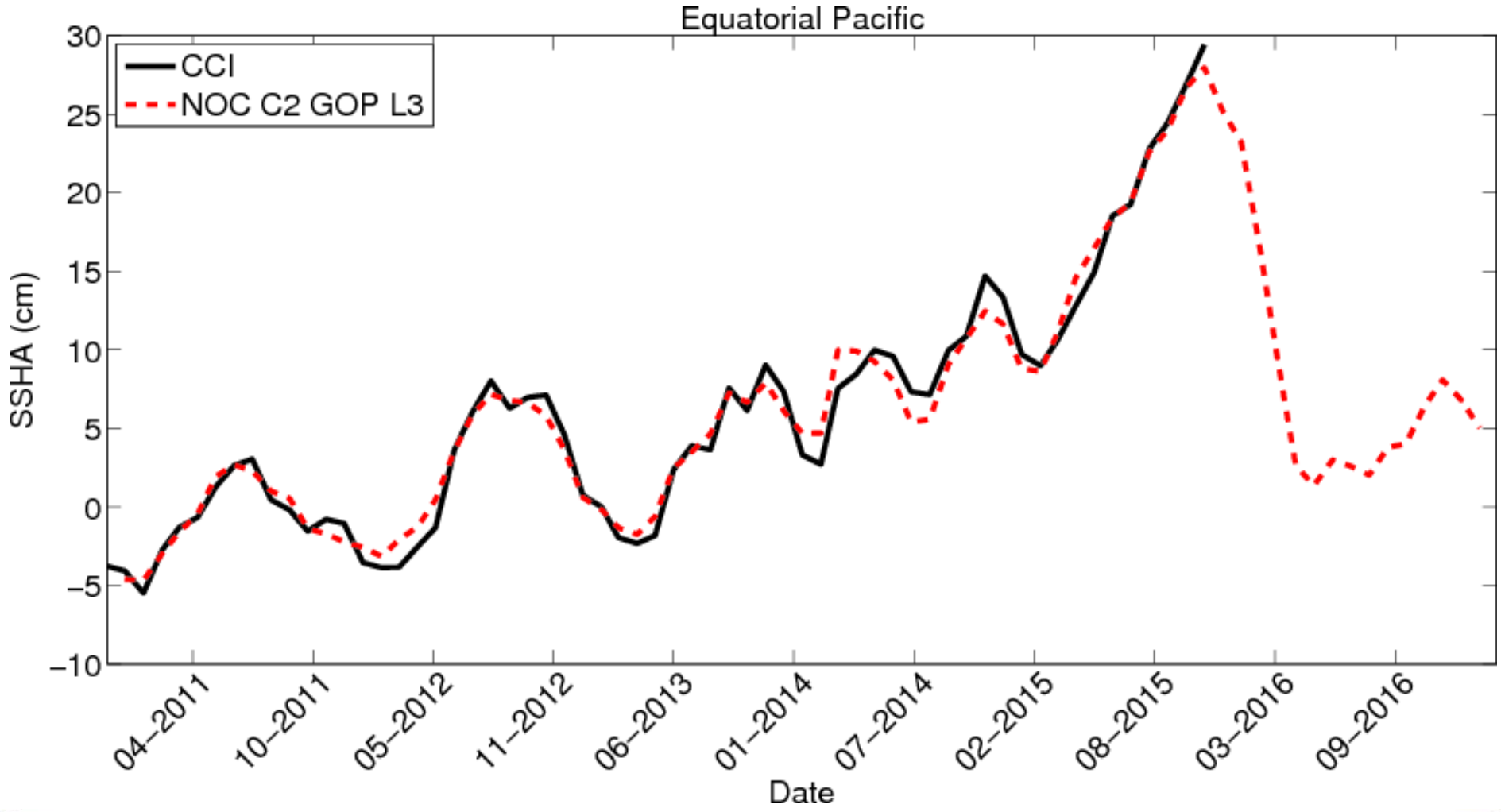
Regional Mean Sea Level Anomaly



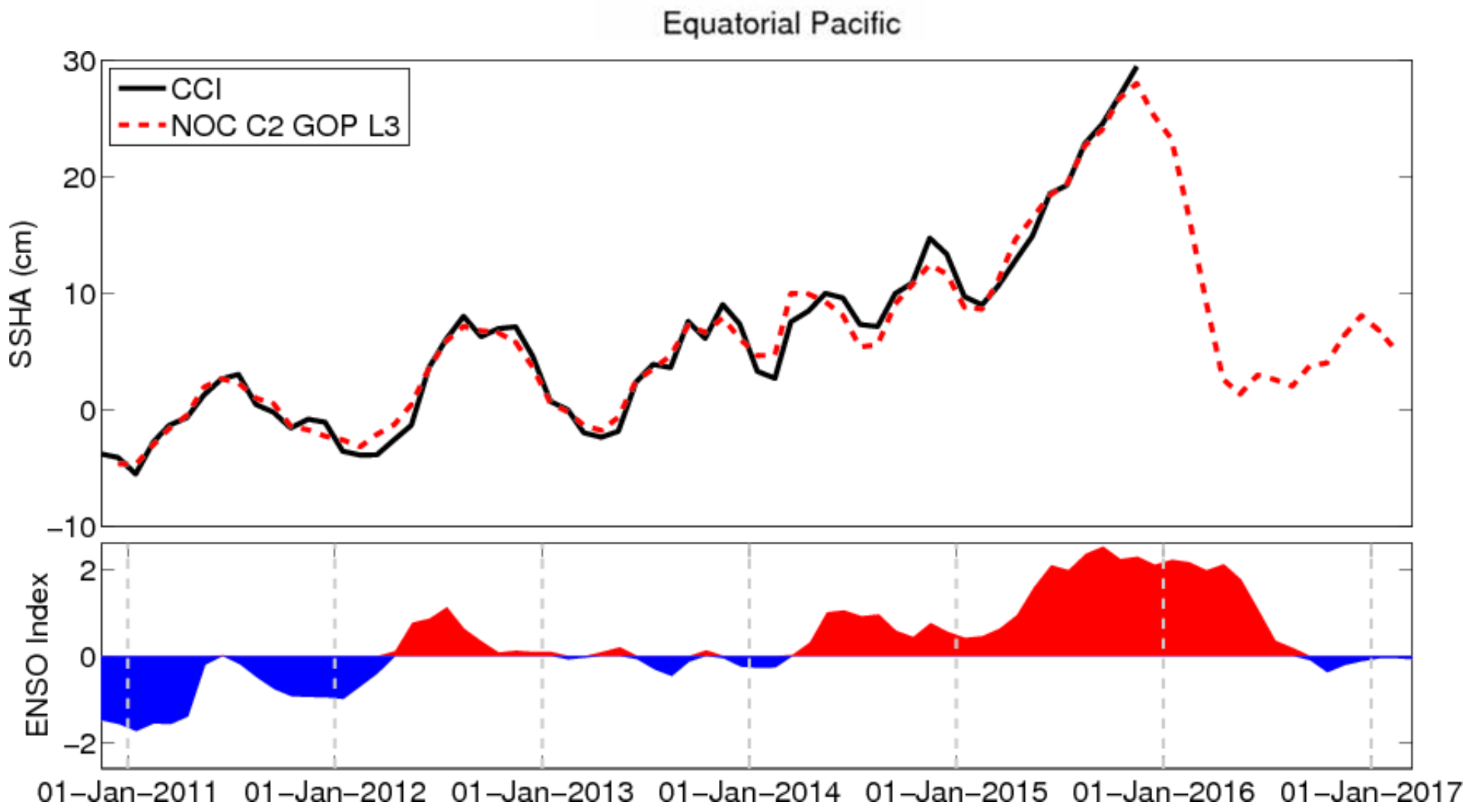
Regional Mean Sea Level Anomaly



Regional Mean Sea Level Anomaly



Regional Mean Sea Level Anomaly



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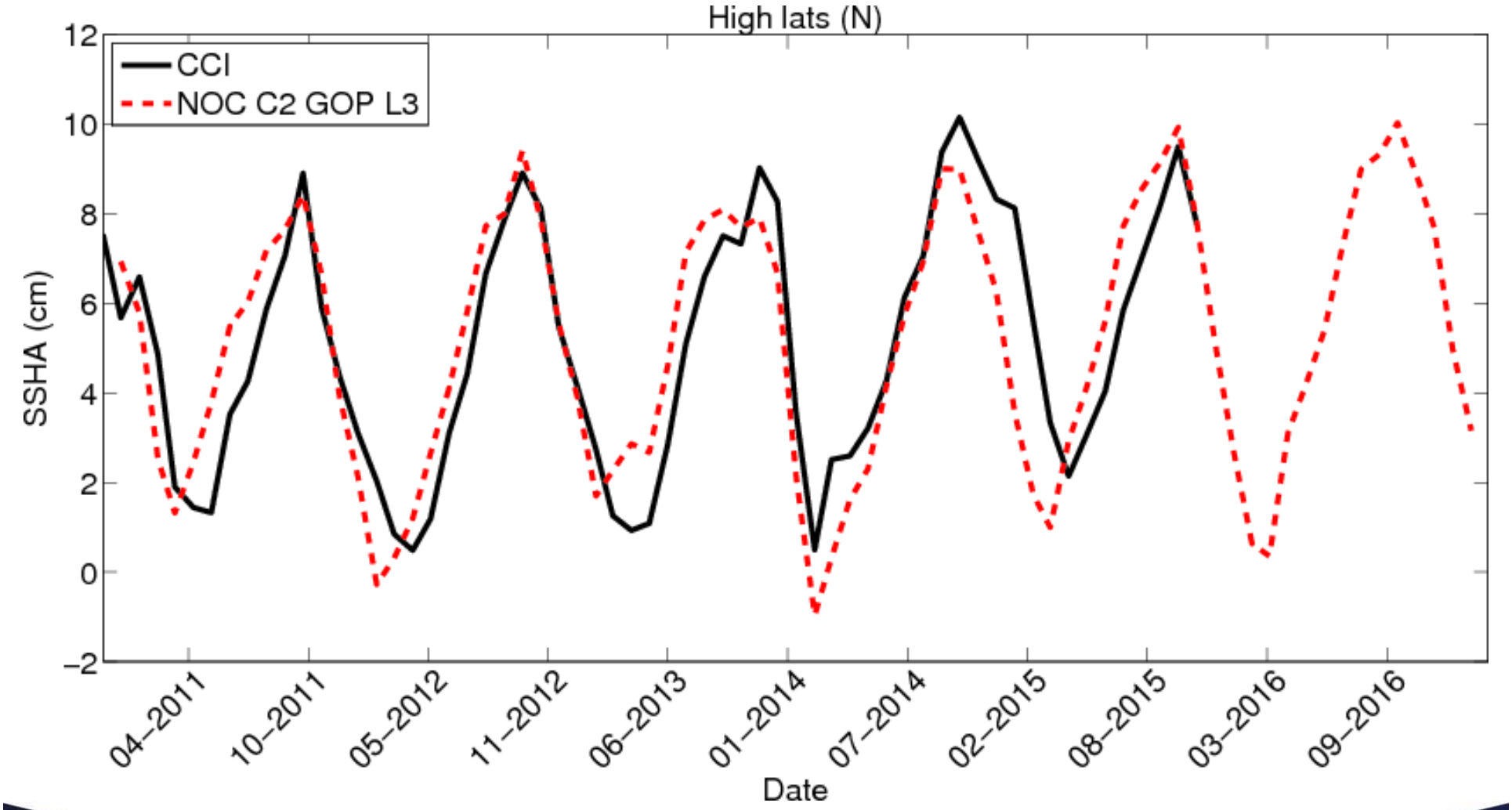

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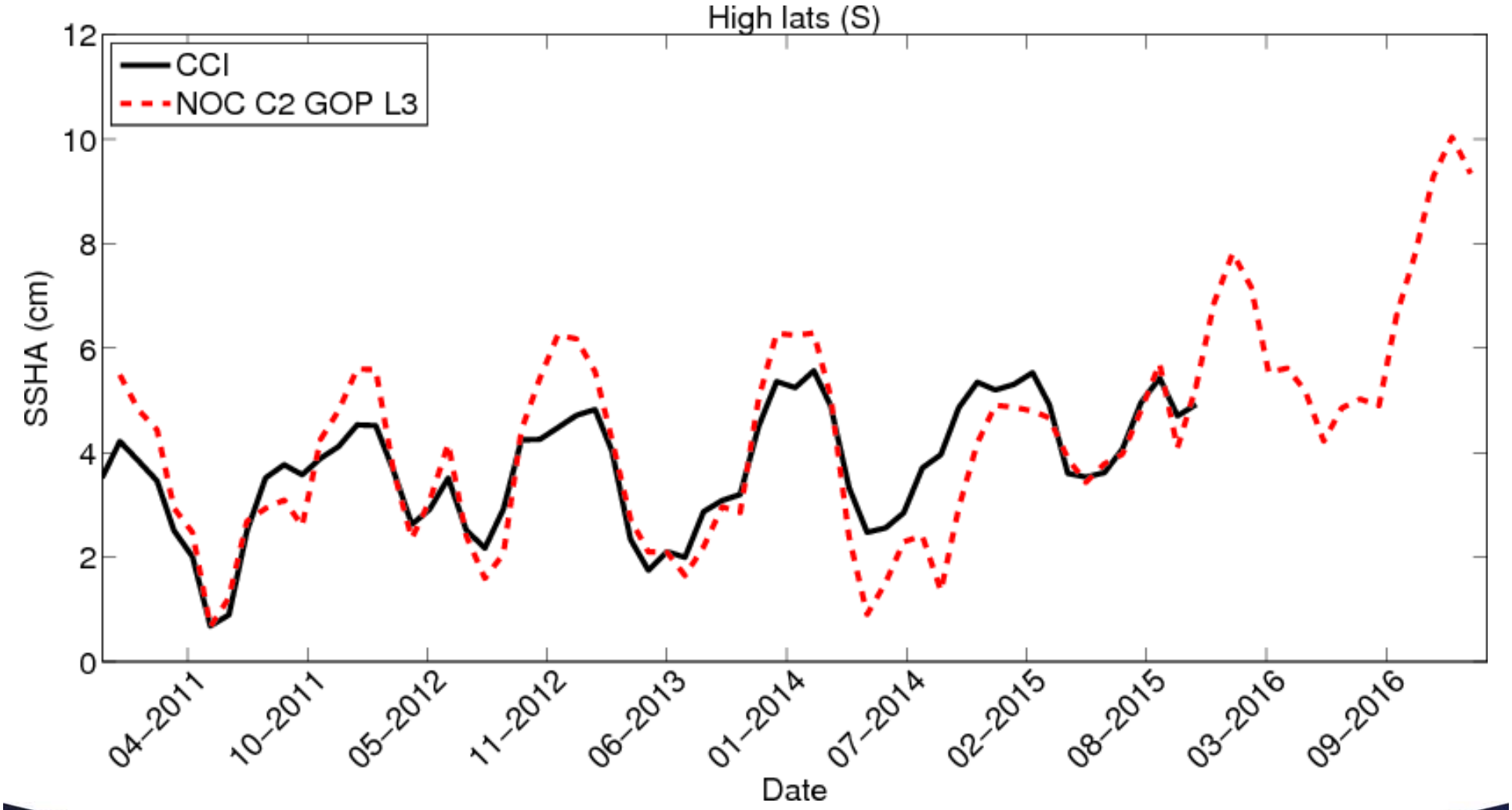

Global Mean Sea Level Anomaly

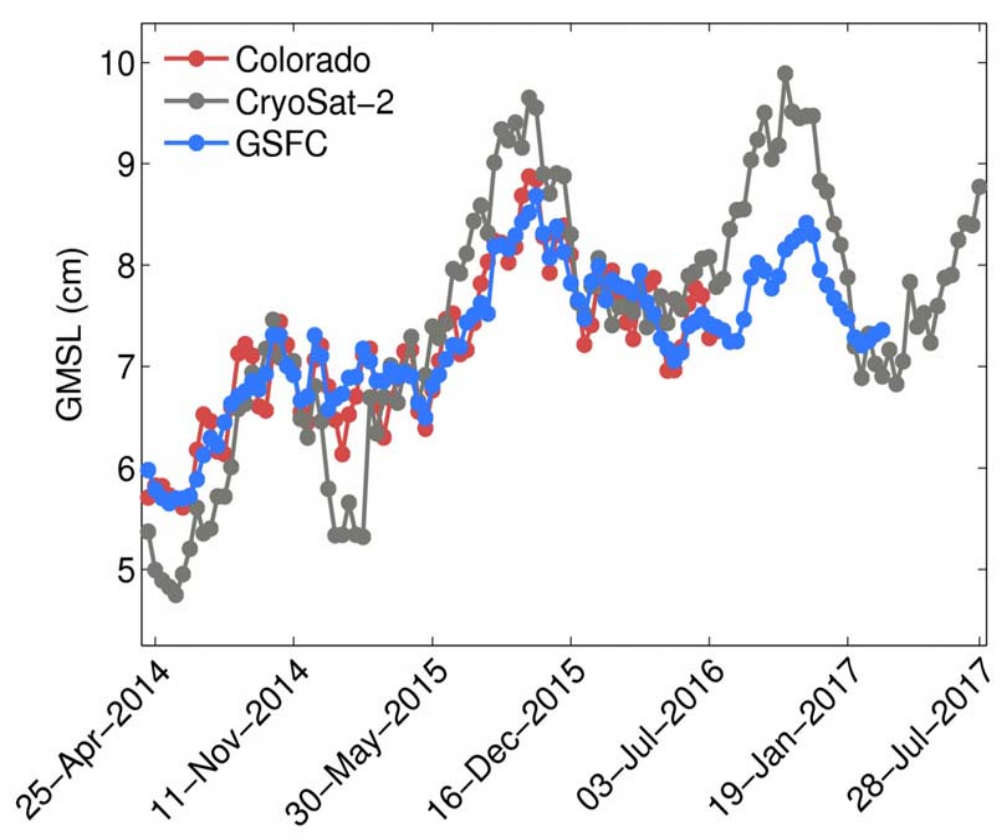

Figure 127. Global mean sea level (latitude < 65º) from GOP CryoSat-2 (grey) together with that derived from OSTM/Jason-2 at the University of Colorado (red) and GSFC (blue).

Evolution to Baseline C

Available from Oct 31!

CryoSat Baseline-C Ocean Products

Types	Main Parameters	Mode	Latency	FMT	Specification (uncertainty)	Measured in Baseline B
L1b	• Coherently multi-looked echoes (SAR, SARin) • Averaged Waveform Power (LRM, PLRM) • Full engineering corrections applied	LRM SAR PLRM SARIN	NOP (3 hours) IOP (3 days) GOP(30 days)	NetCDF	• **Sea Level Anomaly** (20Hz) **None in initial MRD / Rival Envisat** • **Significant wave height: None in initial MRD / Rival Envisat** • **Wind speed: None in the initial MRD / Rival Envisat**	✔ **< 5 cm std** **< 0.5 mm/yr** ✔ **< 1,2 m std** ✔ **< 4 m/s std**
L2 P2P	• **Sea Level Anomaly** • **Significant Wave Height** • **Wind Speed** • Geophysical corrections provided but not applied	LRM SAR PLRM PSAR	NOP (3 hours) IOP (3 days) GOP(30 days)	NetCDF		

Updated corrections
Content and format more aligned with S-3

Summary

CryoSat Ocean Products available since April 2014 from ESA, then reprocessed from start of the mission – 7 years of data.

Good performance in terms of noise, validate well against TGs and ARGO, compares well with Jason products

Suitable to be used **for an independent look at ocean processes**

Ongoing evolution to BaselineC – including SAR and SARin

CryoSat Ocean Products nicely complement the ocean altimetry record from repeat-orbit missions

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