CryOcean-QCV - quality control/validation for CryoSat-2

FDM Daily Data Quality report for 17/04/2019

DOCUMENT INFORMATION			
Document history			
Version	**Issued**	**Reason for change**	**Author**
1.0r2	18/04/19	Creation	F. M. Calafat

This Version		
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Written by:	F. M. Calafat	
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NOC	ftp	P.Cipollini H.Snaith

FDM DAILY QUALITY ASSESSMENT FOR 17/04/2019

Report issued on **18/04/19**

Date and time of the first record: **17 04 2019 00:00:00.537**

Date and time of the last record: **17 04 2019 23:59:59.579**

Range of complete orbits in present day: **47825** to **47837**
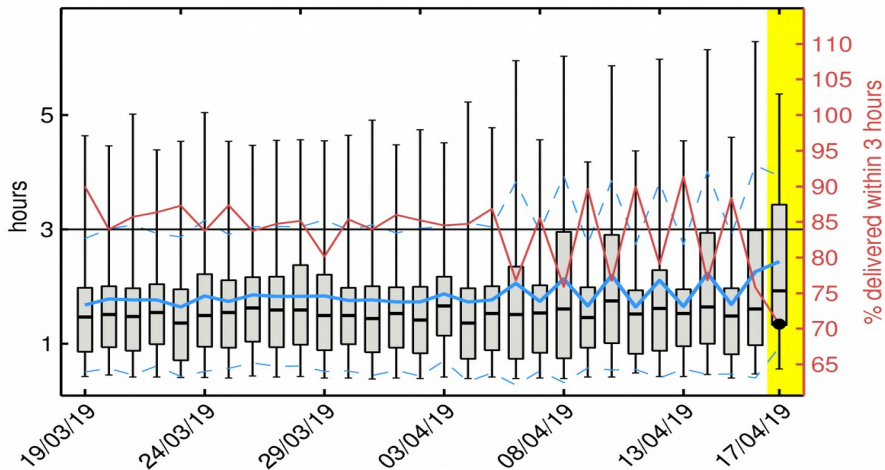
| WARNINGS (see Appendix A for details) |
|---|
| latency_fail: 0.7% of records delivered with a delay of more than 6.4 hours |
| large_orbit_bias suspected for orbit 47827 |
| large_orbit_bias suspected for orbit 47828 |

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1 Data latency

Median latency [min max]: 1.9 hours [0.4 - 6.4]

Figure 1. Box-and-whiskers plot for the latency showing for each day in last 30-day window the first and third quartiles (bottom and top of the box), the median (thick black), the 5% and 95% percentiles (lower and upper whiskers), the mean (blue) and the mean ±1 standard deviation (blue dashed line). The percentage of records delivered within 3 hours is also shown (red, right y-axis). The yellow shading highlights the day analyzed in this report whereas the horizontal black line denotes the 3 hours threshold.
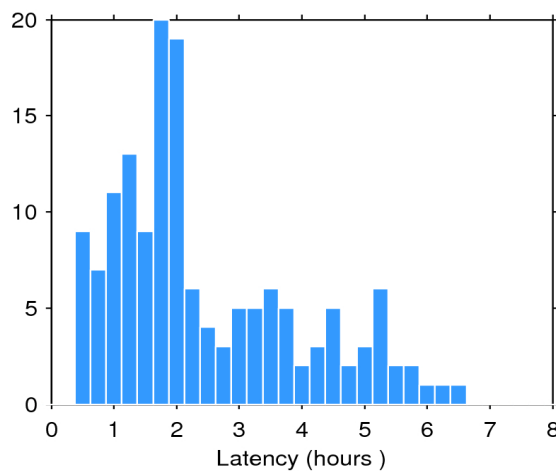

Figure 2. Histogram of the data latency for 17/04/2019. The y-axis denotes the number of files that are made available with a delay of x-hours with respect to the mean time of the records stored in the file.

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2 Data coverage and completeness

	Present in day	Theoretical max.	Percentage (%)
Total	60519	62792	96.4
Oceans and lakes	42253	42521	99.4

Table 1. Number of total (land and ocean/lake) and only ocean/lake records (based on the surface_type flag) together with their percentage relative to the theoretically expected number of measurements from the orbits ground tracks accounting for LRM mode mask for 17/04/2019. Theoretical values are also shown.
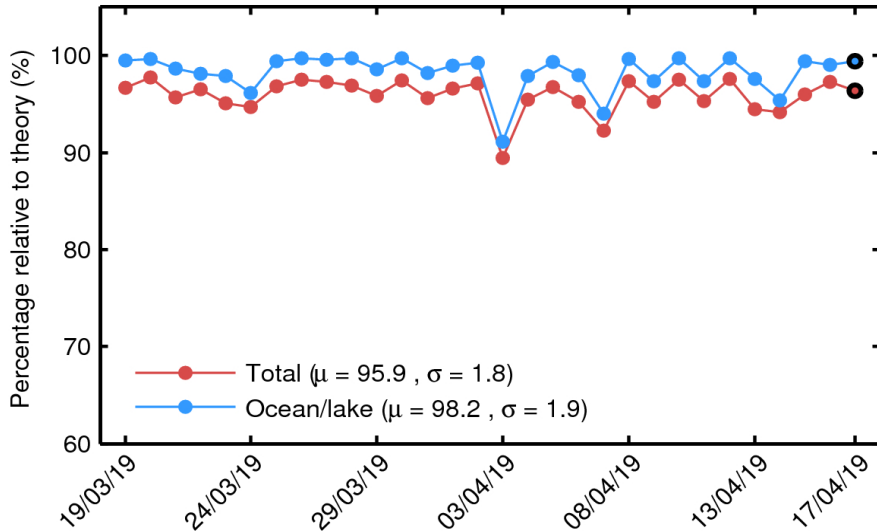
Figure 3. Percentage of 1-Hz records over land and ocean/lake (red) and only over ocean/lake (blue) relative to the theoretically expected number from the orbits ground tracks accounting for LRM mode mask for each day in last 30-day window. The black circle at the end of the time series highlights the day analyzed in this report.
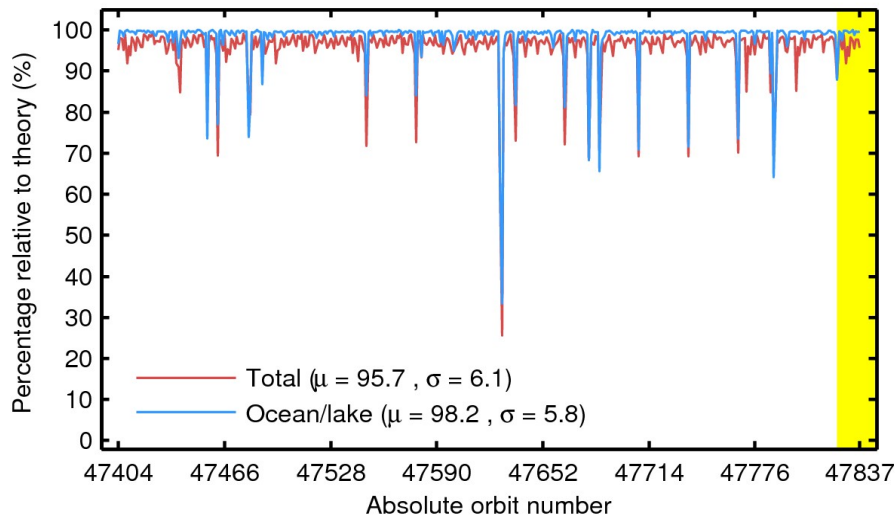
Figure 4. Percentage of 1-Hz records over land and ocean/lake (red) and only over ocean/lake (blue) relative to the theoretically expected number from the orbits ground tracks accounting for LRM mode mask for each orbit in last 30-day window. The yellow shading highlights the day analyzed in this report. The mean (μ) and standard deviation (σ) are also shown.

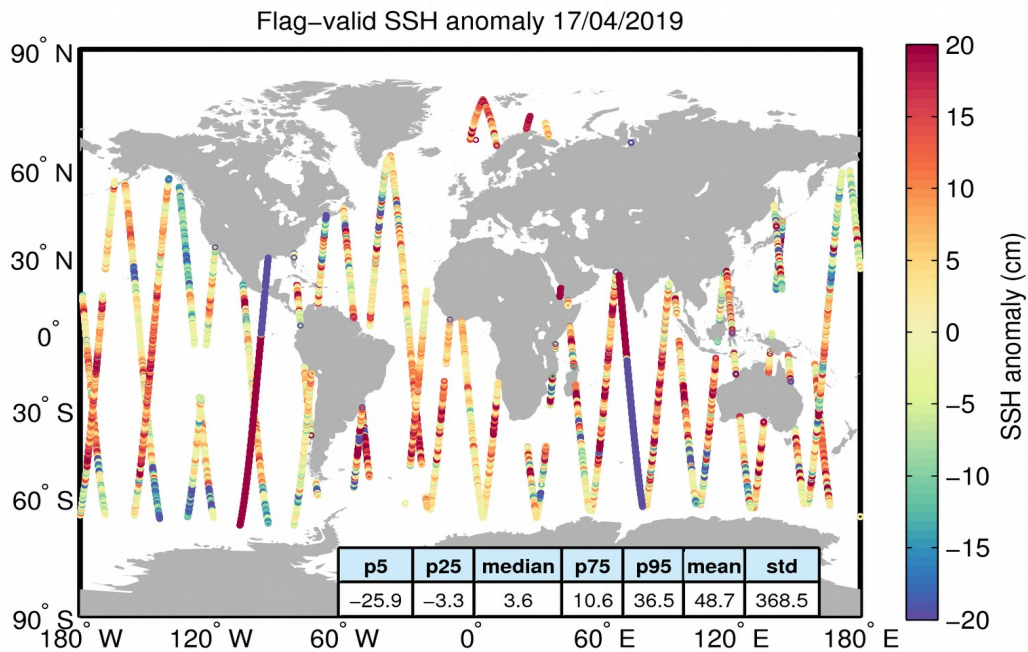# 3 SSH anomaly coverage and validity

3.1. Validity based on flags

Note 3.1: *here "flag-valid" refers to those records that have not been flagged as bad by either the average status flag or the measurement confidence flag.*

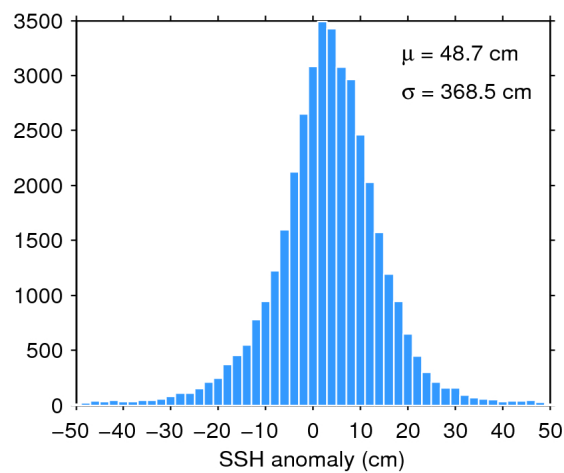Number of flag-valid 1-Hz SSH records over oceans and lakes: **41896**

Percentage of flag-valid 1-Hz SSH records over oceans and lakes relative to theoretical maximum: **98.5%**

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Figure 5. Geographical distribution of flag-valid 1-Hz SSH anomaly data over oceans and lakes for 17/04/2019. The statistical values shown in the table refer to the SSH anomaly in cm and are calculated over all measurements shown in the figure.
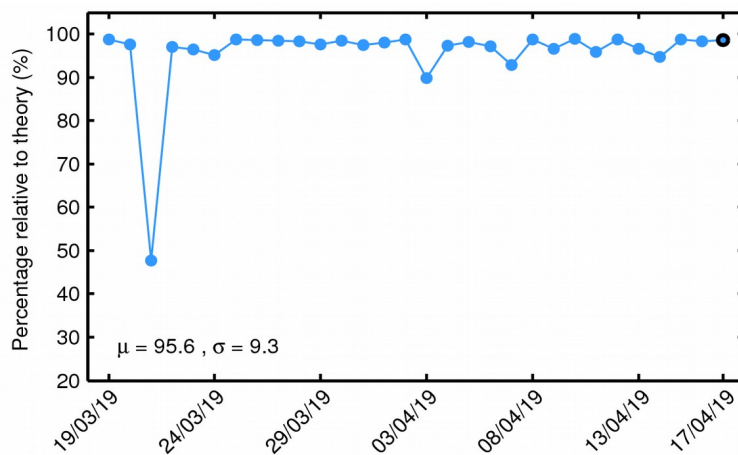
Figure 6. Percentage of flag-valid 1-Hz SSH records over ocean and lakes relative to theory for each day in last 30-day window. The mean (μ) and standard deviation (σ) are also shown.

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Figure 7. Histogram of flag-valid SSH anomaly over oceans and lakes for 17/04/2019. The mean (μ) and standard deviation (σ) are also shown. Note that values outside [-50 50] cm are excluded from the histogram for the sake of readability but not from the computation of μ and σ.

3.2. Analysis of measurement noise

20-Hz measurement noise (average std of 20-Hz sample blocks) for the flag-valid SSH anomaly over oceans and lakes: **8.2 cm**

Equivalent 1-Hz measurement noise for the flag-valid SSH anomaly: **1.8 cm**

Flag–valid SSH anomaly noise 17/04/2019

	p5	p25	median	p75	p95	mean	std
	4.8	6.1	7.3	8.9	12.4	8.2	15.4
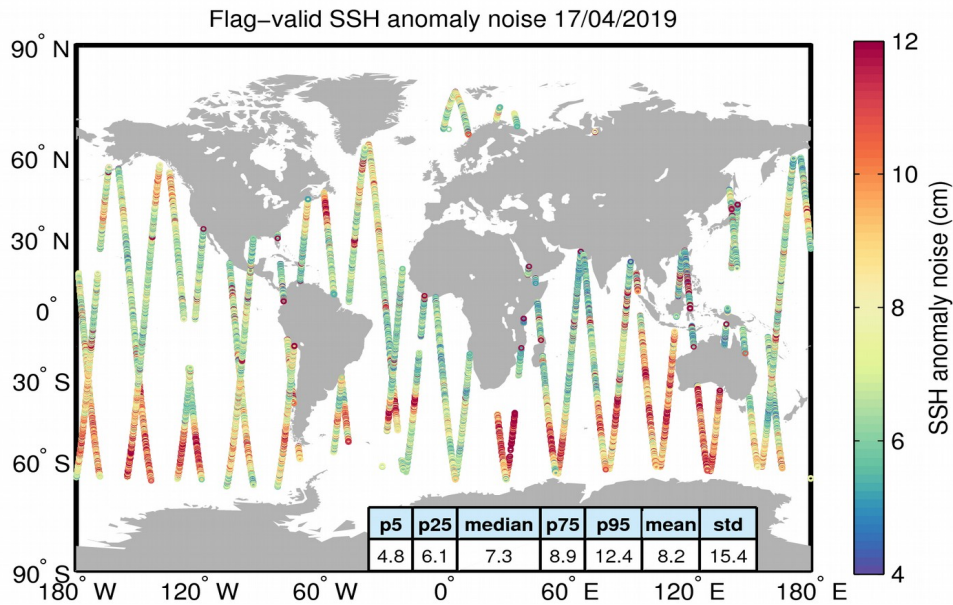
Figure 8. Geographical distribution of flag-valid 20-Hz SSH anomaly measurement noise over oceans and lakes for 17/04/2019. The statistical values shown in the table refer to the SSH anomaly noise and are calculated over all measurements shown in the figure.
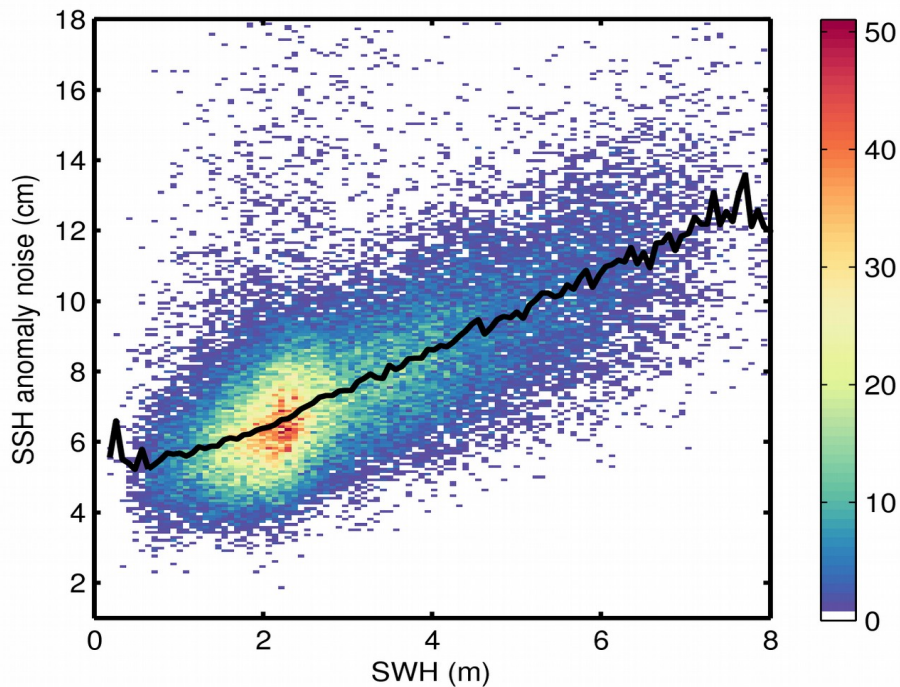
Figure 9. 2D histogram showing flag-valid SSH anomaly noise as a function of SWH for 17/04/2019. The black line denotes the median SSH anomaly noise as a function of SWH.

3.3. Validity based on scientific editing criteria

Note 3.2: *here "science-valid" refers to the flag-valid SSH records over oceans and lakes that meet the editing criteria described in Table 2.*

| Parameter	Min threshold	Max threshold	Percentage edited
SSH anomaly	-3 m	3 m	6.0%
Standard deviation of SSH anomaly	0 m	0.20 m	1.0%
Inverse barometer correction	-2 m	2 m	0.0%
Biased orbit	0 m	0 m	13.7%
Wet tropospheric correction	-0.5 m	-0.001 m	0.0%
Dry tropospheric correction	-2.5 m	-1.9 m	0.0%
Ionospheric correction	-0.4 m	0.04 m	0.0%
Sea state bias	-0.5 m	0 m	0.2%
Sigma0	7 dB	30 dB	0.1%
Standard deviation of sigma0	0 dB	0.23 dB	3.8%
All together	-	-	17.1%

Table 2. Editing criteria. The biased orbit criteria in the table refers to the orbits highlighted in the 'Warnings' table at the beginning of this report as being suspicious of suffering from a significant orbit bias. For such orbits, all records are rejected, hence the 0 m thresholds. The percentage of rejected flag-valid records (excluding polar regions) for each criteria is shown.

Number of science-valid 1-Hz SSH records over oceans and lakes: **34733**

Percentage of science-valid 1-Hz SSH records over oceans and lakes relative to theoretical maximum: **81.7%**

20-Hz measurement noise (average std of 20-Hz sample blocks) for the science-valid SSH anomaly: **7.7 cm**
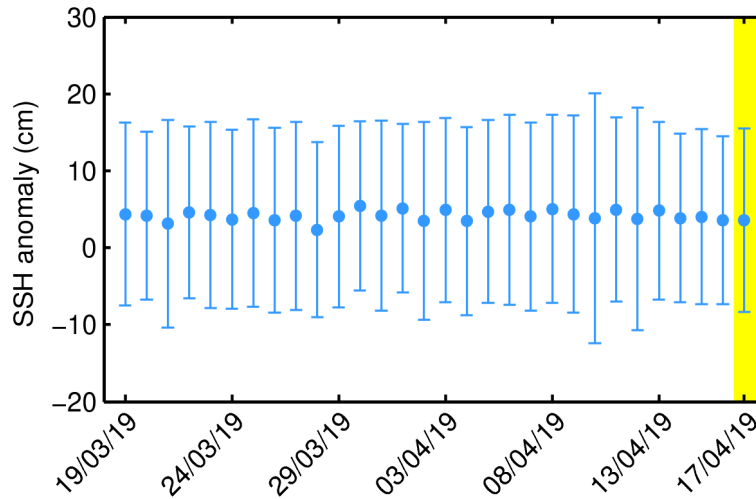
Equivalent 1-Hz measurement noise for the science-valid SSH anomaly: **1.7 cm**
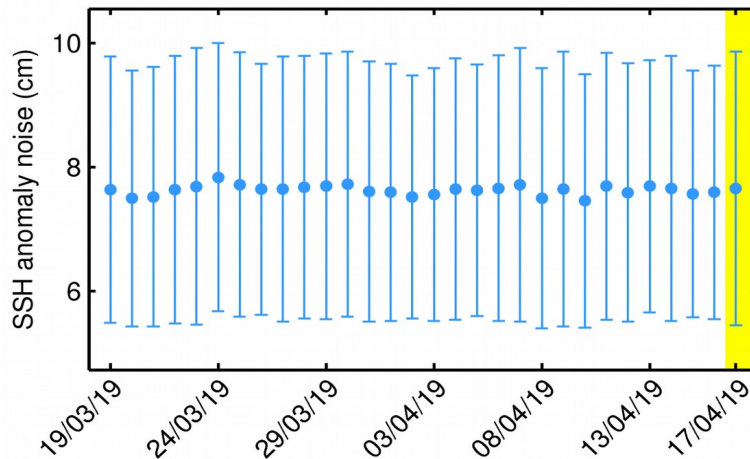
Science–valid SSH anomaly 17/04/2019

	p5	p25	median	p75	p95	mean	std
	−14.9	−2.3	3.7	10.0	20.6	3.5	11.9
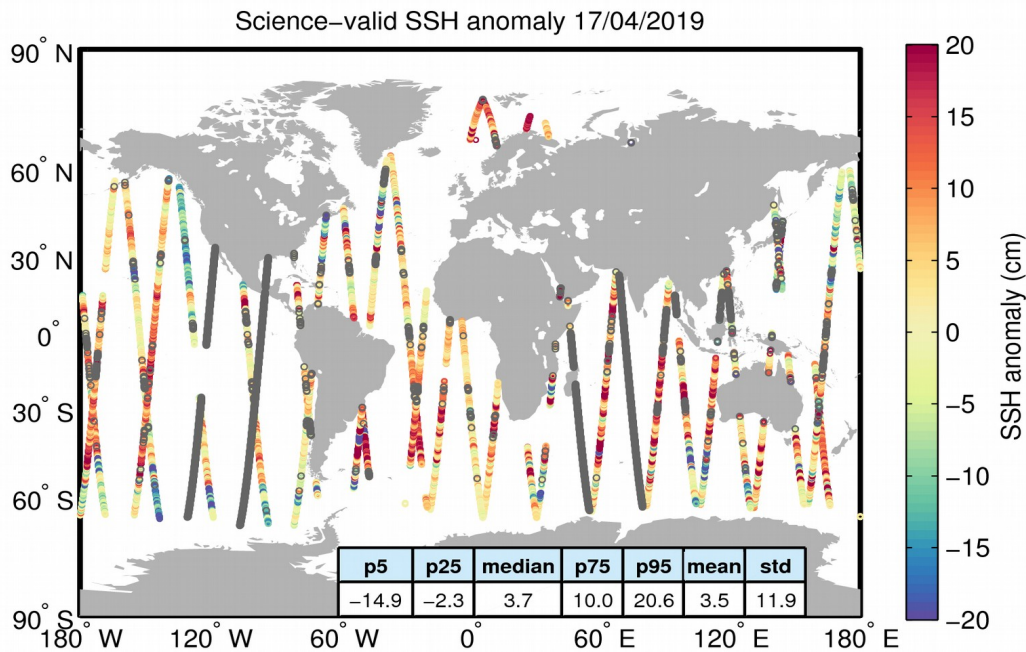
Figure 10. Geographical distribution of science-valid SSH anomaly data over oceans and lakes for . The statistical values shown in the table refer to the SSH anomaly in cm and are calculated over all measurements shown in the figure. Gray circles denote records that have been rejected based on the editing criteria described in Table 2.

$\mu = 3.5$ cm
$\sigma = 11.9$ cm
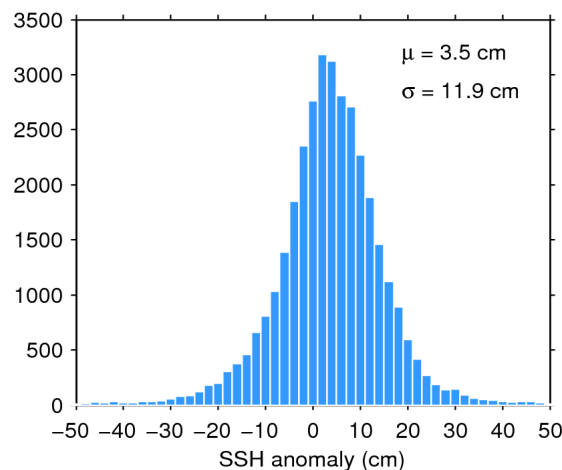
Figure 11. Histogram of science-valid SSH anomaly over oceans and lakes for 17/04/2019. The mean (μ) and standard deviation (σ) are also shown. Note that values outside [-50 50] cm are excluded from the histogram for the sake of readability but not from the computation of μ and σ.

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Figure 12. Mean science-valid SSH anomaly (blue dot) and the corresponding standard deviation (error bar) for each day in last 30-day window. The yellow shading highlights the day analyzed in this report.

Figure 13. Average science-valid SSH anomaly noise (blue dot) and the corresponding standard deviation (error bar) for each day in last 30-day window. The yellow shading highlights the day analyzed in this report.

3.4. Crossover analysis
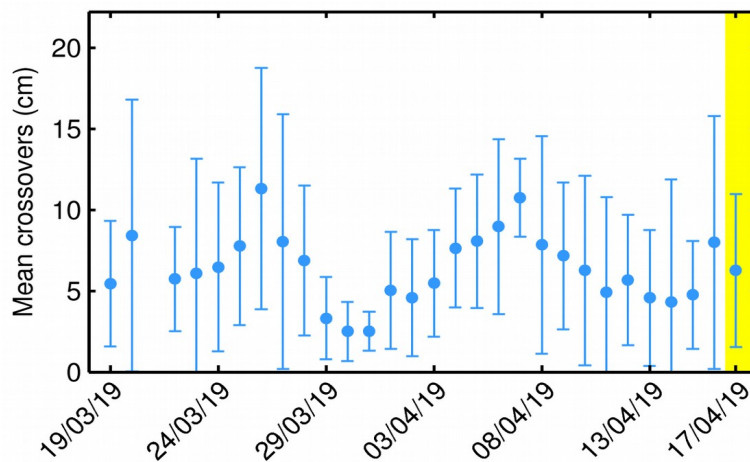
Figure 14. Mean crossover differences (absolute values) for the science-valid SSH anomaly (blue dot) and the corresponding standard deviation (error bar) for each day in last 30-day window. Mean crossover differences are calculated daily by averaging all crossover differences in a day (there are about 12-13 crossovers per day). The difference at each crossover is computed as the difference between median values over 2-s windows centered about the crossover. The yellow shading highlights the day analyzed in this report.
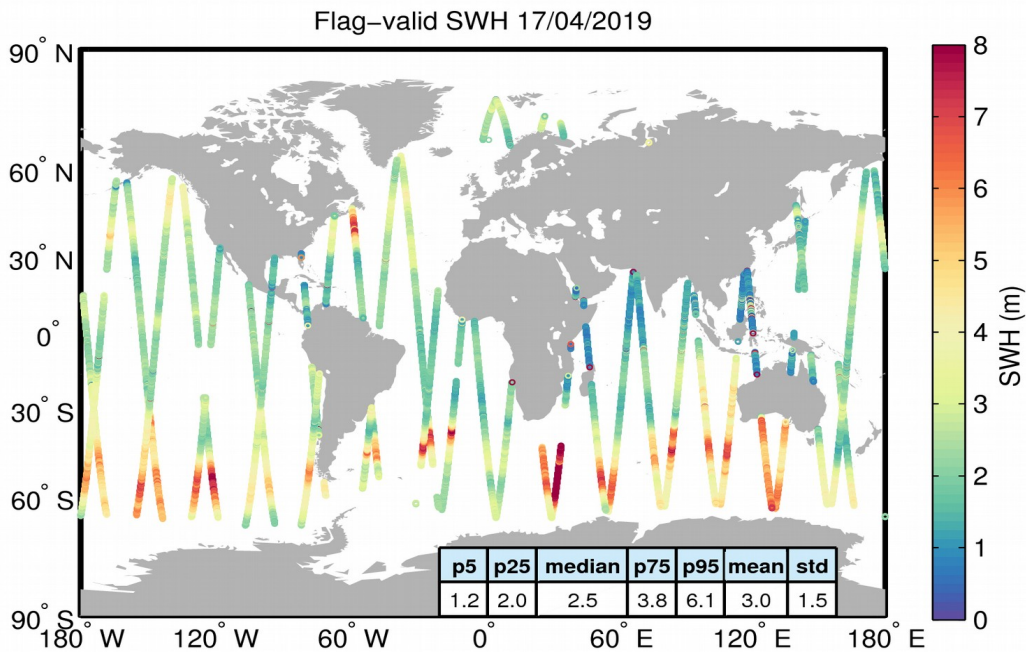
# 4   SWH coverage and validity

4.1. Validity based on flags

Note 4.1: *here "flag-valid" refers to those records that have not been flagged as bad by either the average status flag or the measurement confidence flag.*

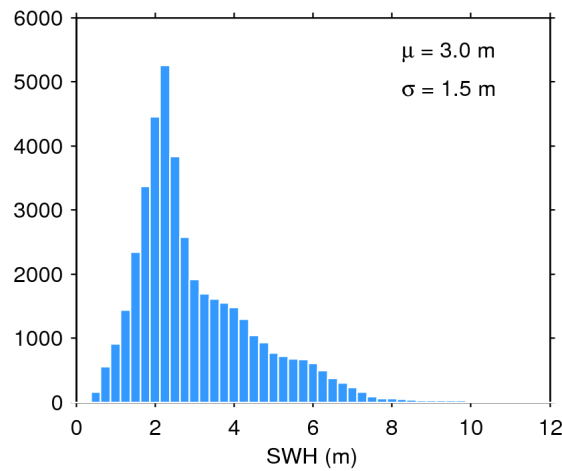Number of flag-valid 1-Hz SWH records over oceans and lakes: **41809**

Percentage of flag-valid 1-Hz SWH records over oceans and lakes relative to theoretical maximum: **98.3%**

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Flag−valid SWH 17/04/2019

p5	p25	median	p75	p95	mean	std
1.2	2.0	2.5	3.8	6.1	3.0	1.5

Figure 15. Geographical distribution of flag-valid SWH data over oceans and lakes for 17/04/2019. The statistical values shown in the table refer to the SWH in m and are calculated over all measurements shown in the figure.

$\mu = 97.1 , \sigma = 2.0$
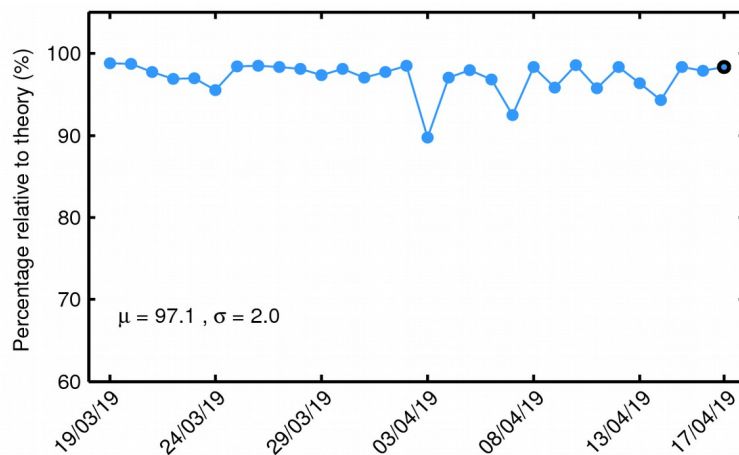
Figure 16. Percentage of flag-valid 1-Hz SWH records over ocean and lakes relative to theory for each day in last 30-day window. The mean (μ) and standard deviation (σ) are also shown.
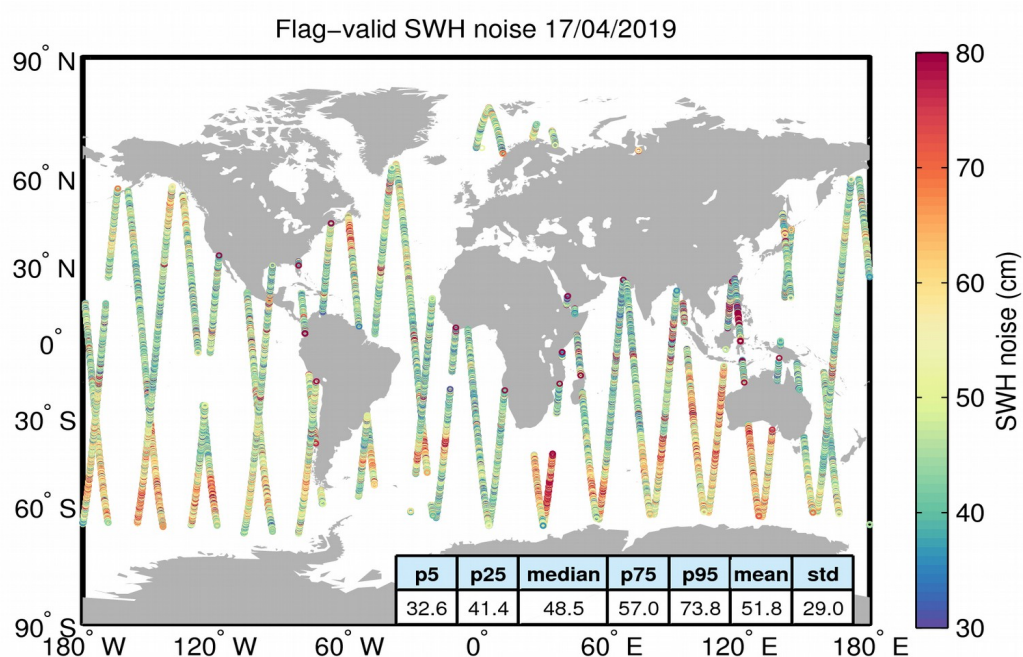
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Figure 17. Histogram of flag-valid SWH over oceans and lakes for 17/04/2019. The mean (μ) and standard deviation (σ) are also shown. Note that values larger than 12 m are excluded from the histogram for the sake of readability but not from the computation of μ and σ.

4.2. Analysis of measurement noise

20-Hz measurement noise (average std of 20-Hz sample blocks) for the flag-valid SWH over oceans and lakes: **51.8 cm**

Equivalent 1-Hz measurement noise for the flag-valid SWH: **11.6 cm**

p5	p25	median	p75	p95	mean	std
32.6	41.4	48.5	57.0	73.8	51.8	29.0

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Figure 18. Geographical distribution of flag-valid 20-Hz SWH measurement noise over oceans and lakes for 17/04/2019. The statistical values shown in the table refer to the SWH noise and are calculated over all measurements shown in the figure.

4.3. Validity based on scientific editing criteria

Note 4.2: *here "science-valid" refers to the flag-valid SWH records over oceans and lakes that meet the editing criteria described in Table 3.*

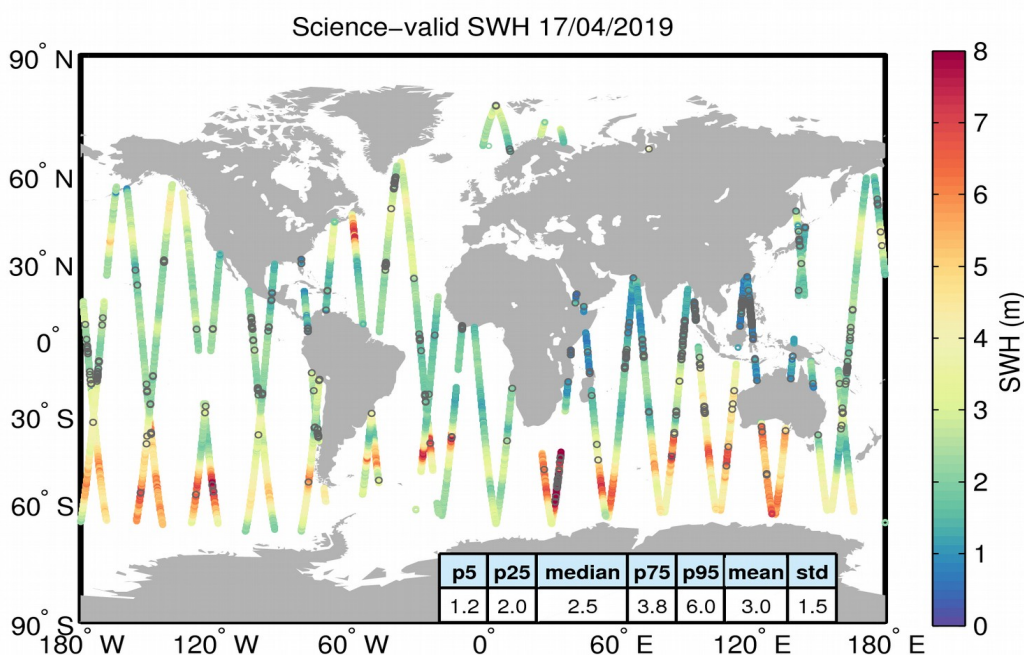| Parameter	Min threshold	Max threshold	Percentage edited
SWH	0 m	15 m	0.0%
Standard deviation of SWH (1-Hz block)	0 m	1 m	1.2%
All together	-	-	1.2%

Table 3. Editing criteria. The percentage of rejected flag-valid records (excluding polar regions) for each criteria is shown.

Number of science-valid 1-Hz SWH records over oceans and lakes: **41289**

Percentage of science-valid 1-Hz SWH records over oceans and lakes relative to theoretical maximum: **97.1%**

20-Hz measurement noise (average std of 20-Hz sample blocks) for the science-valid SWH: **49.6 cm**

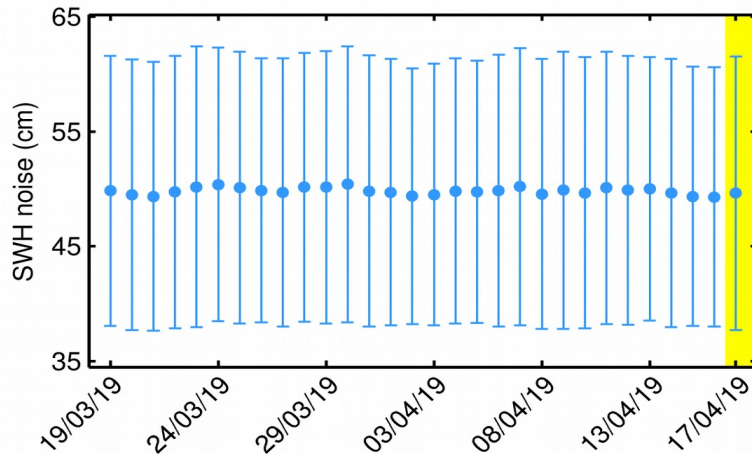Equivalent 1-Hz measurement noise for the science-valid SWH: **11.1 cm**

Science–valid SWH 17/04/2019

p5	p25	median	p75	p95	mean	std
1.2	2.0	2.5	3.8	6.0	3.0	1.5

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Figure 19. Geographical distribution of science-valid SWH data over oceans and lakes for 17/04/2019. The statistical values shown in the table refer to the SWH in m and are calculated over all measurements shown in the figure. Gray circles denote records that have been rejected based on the editing criteria described in Table 3.
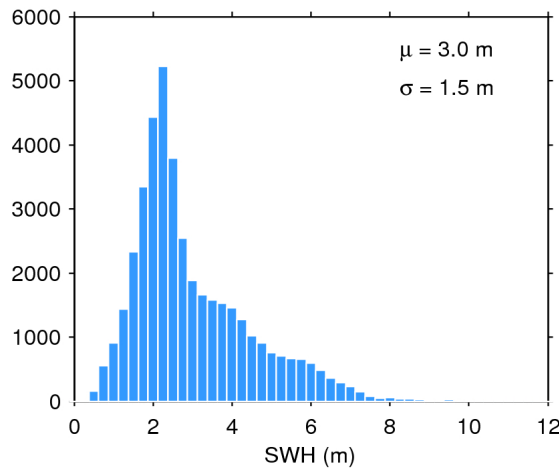
Figure 20. Histogram of science-valid SWH over oceans and lakes for 17/04/2019. The mean (μ) and standard deviation (σ) are also shown. Note that values larger than 12 m are excluded from the histogram for the sake of readability but not from the computation of μ and σ.
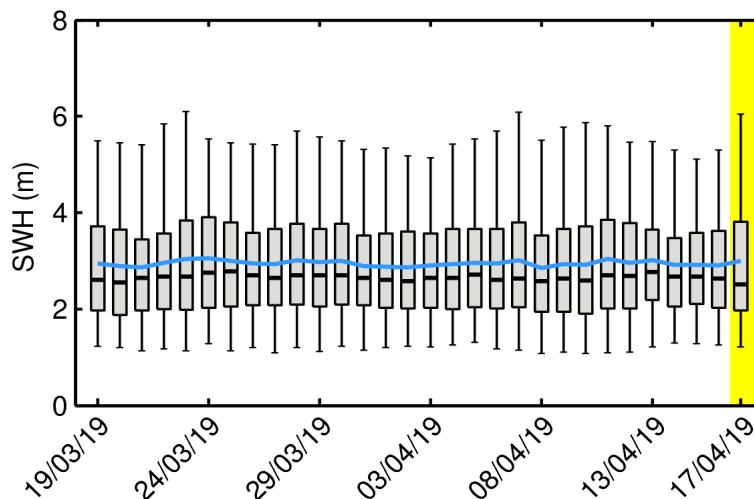
Figure 21. Box-and-whiskers plot for the science-valid SWH showing for each day in last 30-day window the first and third quartiles (bottom and top of the box), the median (thick black), the 5% and 95% percentiles (lower and upper whiskers), and the mean (blue). The yellow shading highlights the day analyzed in this report.

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Figure 22. Average science-valid SWH noise (blue dot) and the corresponding standard deviation (error bar) for each day in last 30-day window. The yellow shading highlights the day analyzed in this report.

# 5   Sigma0 coverage and validity

5.1. Validity based on flags

Note 5.1:   *here "flag-valid" refers to those records that have not been flagged as bad by either the average status flag or the measurement confidence flag.*

Number of flag-valid 1-Hz sigma0 records over oceans and lakes: **42022**
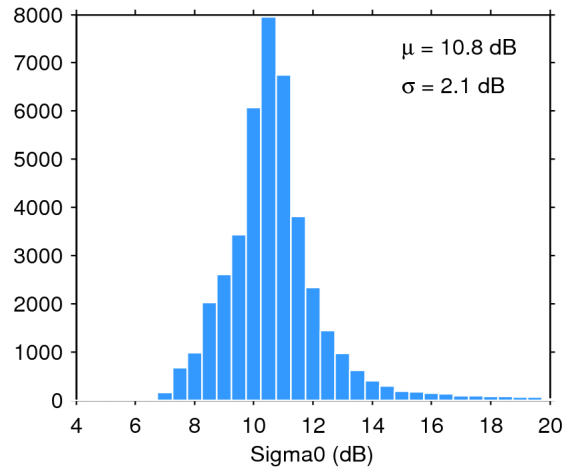
Percentage of flag-valid 1-Hz sigma0 records over oceans and lakes relative to theoretical maximum: **98.8%**

Flag−valid Sigma0 17/04/2019

p5	p25	median	p75	p95	mean	std
8.3	9.8	10.6	11.3	13.9	10.8	2.1
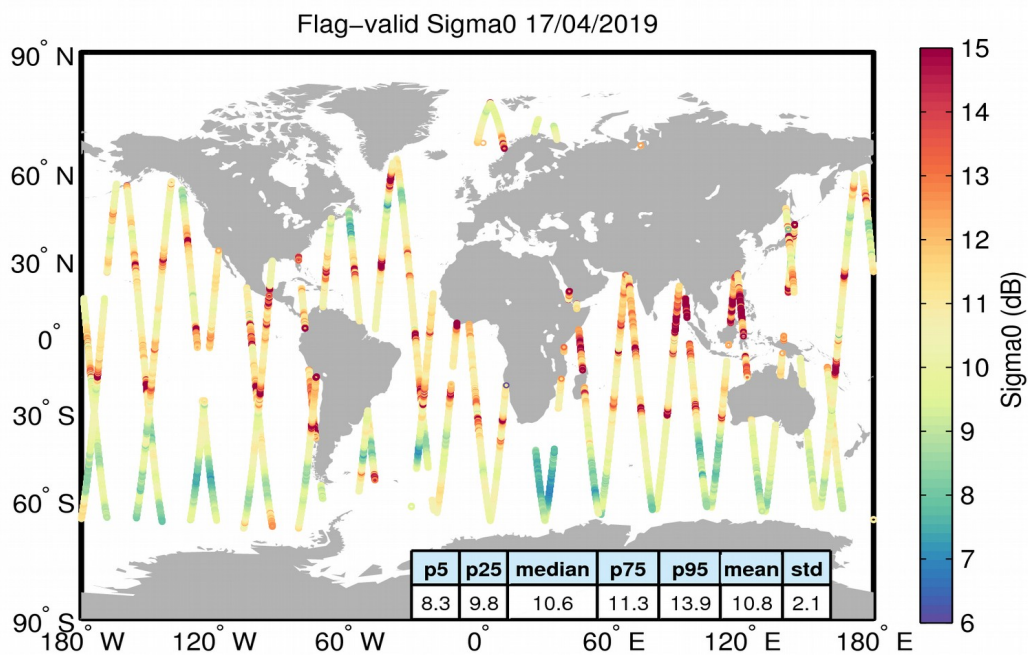
Figure 23. Geographical distribution of flag-valid sigma0 data over oceans and lakes for 17/04/2019. The statistical values shown in the table refer to the sigma0 in dB and are calculated over all measurements shown in the figure.

$\mu = 97.6$, $\sigma = 2.0$
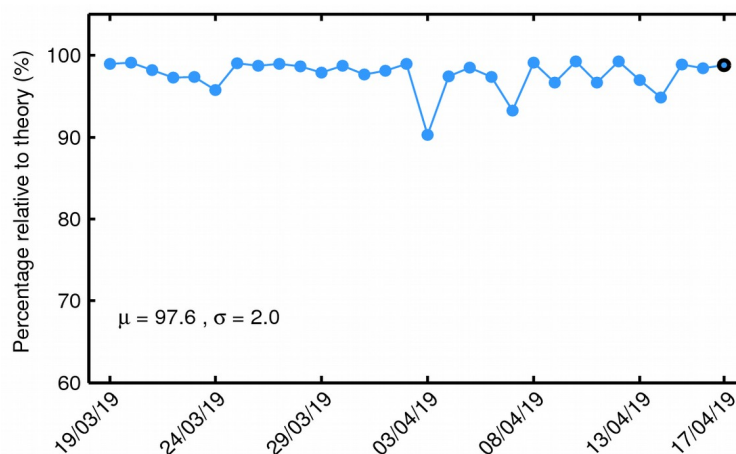
Figure 24. Percentage of flag-valid 1-Hz sigma0 records over ocean and lakes relative to theory for each day in last 30-day window. The mean (μ) and standard deviation (σ) are also shown.

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Figure 25. Histogram of flag-valid sigma0 over oceans and lakes for 17/04/2019. The mean (μ) and standard deviation (σ) are also shown. Note that values outside [4 20] dB are excluded from the histogram for the sake of readability but not from the computation of μ and σ.

5.2. Analysis of measurement noise

20-Hz measurement noise (average std of 20-Hz sample blocks) for the flag-valid sigma0 over oceans and lakes: **11.3 10^{-2} dB**

Equivalent 1-Hz measurement noise for the flag-valid sigma0: **2.5 10^{-2} dB**
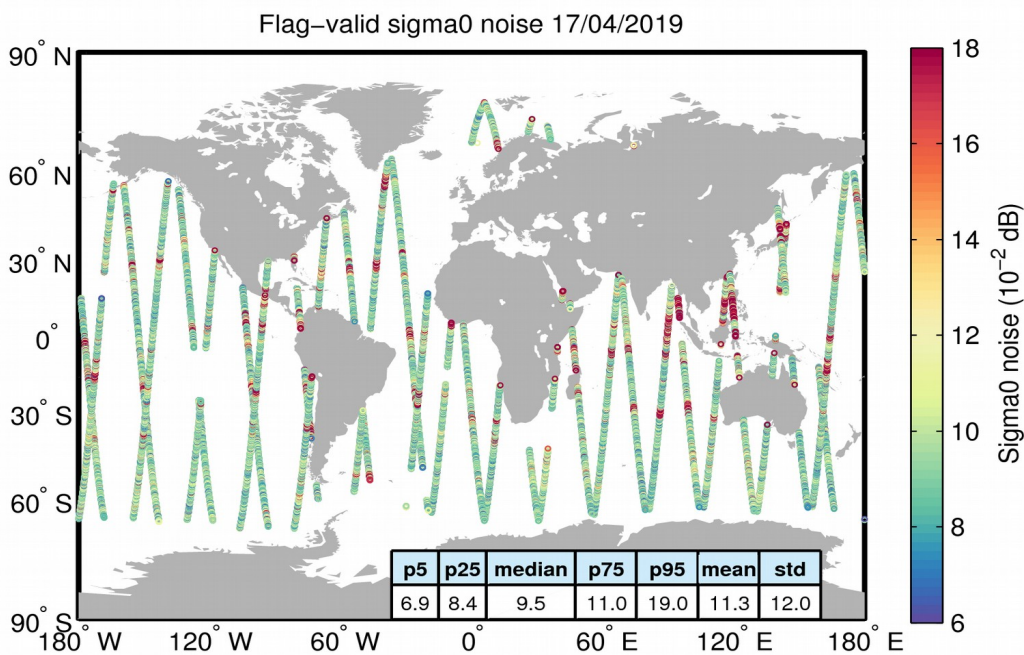
Figure 26. Geographical distribution of flag-valid 20-Hz sigma0 measurement noise over oceans and lakes for 17/04/2019. The statistical values shown in the table refer to the sigma0 noise and are calculated over all measurements shown in the figure.

5.3. Validity based on scientific editing criteria

Note 5.2: here "science-valid" refers to the flag-valid sigma0 records over oceans and lakes that meet the editing criteria described in Table 4.

| Parameter	Min threshold	Max threshold	Percentage edited
Sigma0	7 dB	30 dB	0.1%
Standard deviation of Sigma0 (1-Hz block)	0 dB	0.23 dB	3.8%
All together	-	-	3.9%

Table 4. Editing criteria. The percentage of rejected flag-valid records (excluding polar regions) for each criteria is shown.

Number of science-valid 1-Hz sigma0 records over oceans and lakes: **40367**

Percentage of science-valid 1-Hz sigma0 records over oceans and lakes relative to theoretical maximum: **94.9%**

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20-Hz measurement noise (average std of 20-Hz sample blocks) for the science-valid sigma0: **9.8 10^{-2} dB**

Equivalent 1-Hz measurement noise for the science-valid sigma0: **2.2 10^{-2} dB**
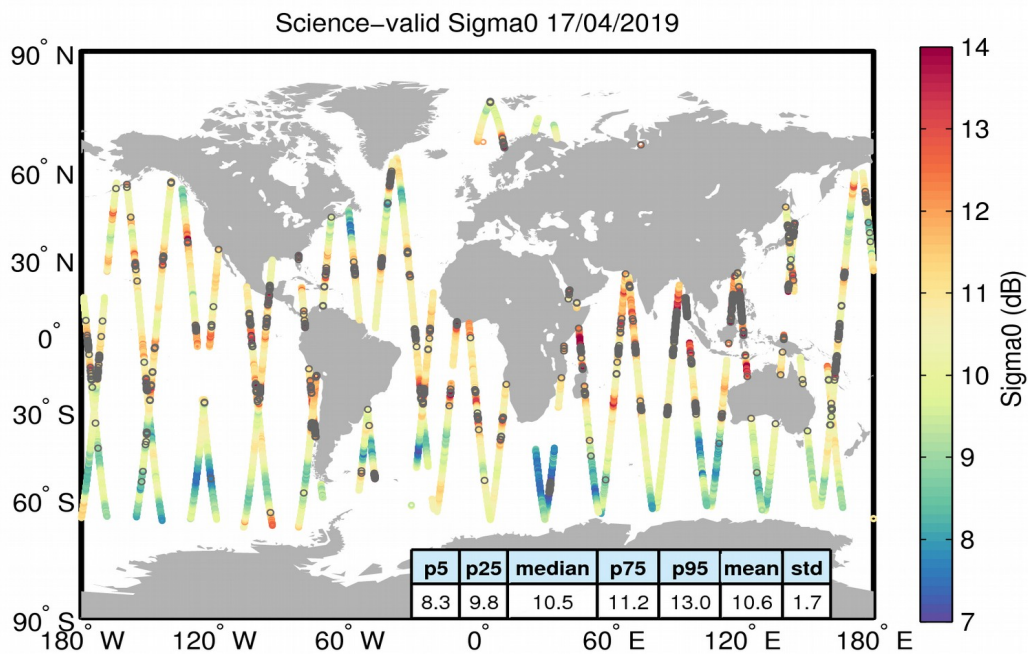
Figure 27. Geographical distribution of science-valid sigma0 data over oceans and lakes for 17/04/2019. The statistical values shown in the table refer to the sigma0 in dB and are calculated over all measurements shown in the figure. Gray circles denote records that have been rejected based on the editing criteria described in Table 4.
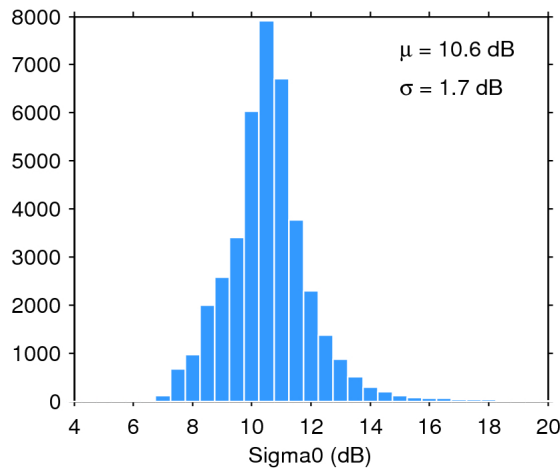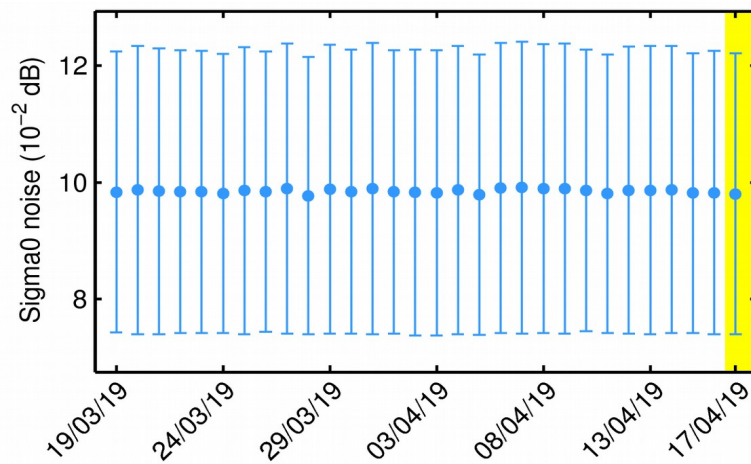
Figure 28. Histogram of science-valid sigma0 over oceans and lakes for 17/04/2019. The mean (μ) and standard deviation (σ) are also shown. Note that values outside [4 20] dB are excluded from the histogram for the sake of readability but not from the computation of μ and σ.
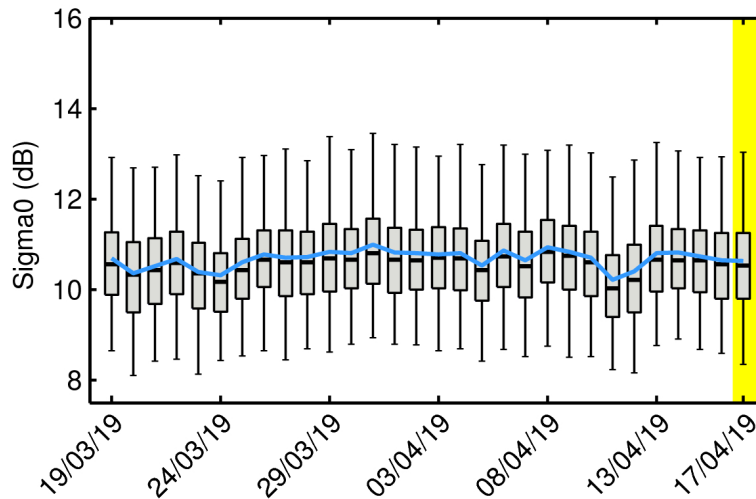
Figure 29. Box-and-whiskers plot for science-valid sigma0 showing for each day in last 30-day window the first and third quartiles (bottom and top of the box), the median (thick black), the 5% and 95% percentiles (lower and upper whiskers), and the mean (blue). The yellow shading highlights the day analyzed in this report.

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Figure 30. Average science-valid sigma0 noise (blue dot) and the corresponding standard deviation (error bar) for each day in last 30-day window. The yellow shading highlights the day analyzed in this report.
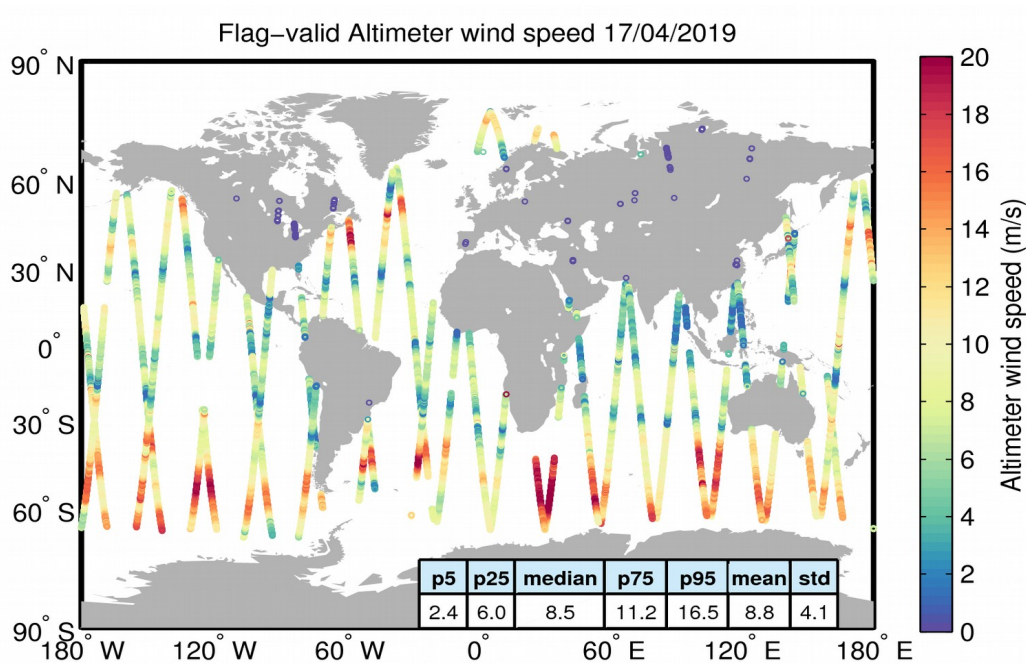
6 Altimeter wind speed coverage and validity

6.1. Validity based on flags

> ***Note 6.1:*** *here "flag-valid" refers to those records that have not been flagged as bad by either the average status flag or the measurement confidence flag.*

Number of flag-valid 1-Hz wind records over oceans and lakes: **42204**
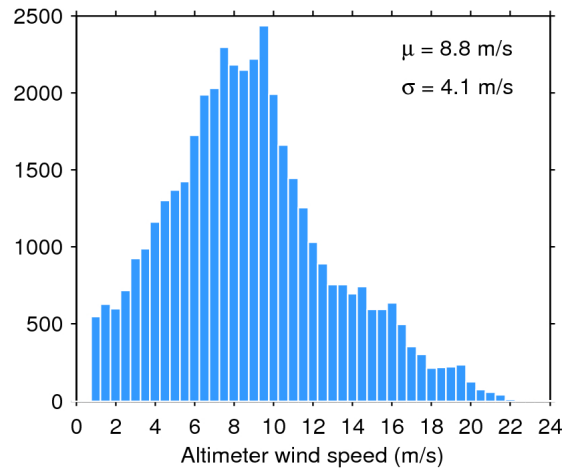
Percentage of flag-valid 1-Hz wind records over oceans and lakes relative to theoretical maximum: **99.3%**

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Figure 31. Geographical distribution of flag-valid wind data over oceans and lakes for 17/04/2019. The statistical values shown in the table refer to the wind in m/s and are calculated over all measurements shown in the figure.
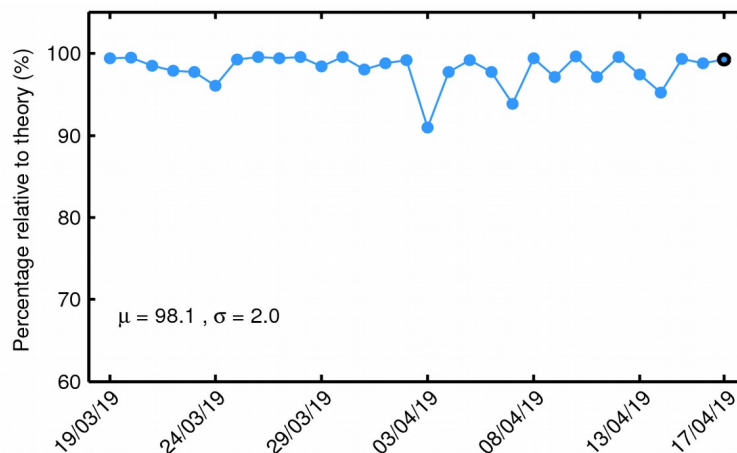
Figure 32. Percentage of flag-valid 1-Hz wind records over ocean and lakes relative to theory for each day in last 30-day window. The mean (μ) and standard deviation (σ) are also shown.

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Figure 33. Histogram of flag-valid wind over oceans and lakes for 17/04/2019. The mean (μ) and standard deviation (σ) are also shown. Note that values larger than 24 m/s are excluded from the histogram for the sake of readability but not from the computation of μ and σ.

6.2. Validity based on scientific editing criteria

Note 6.2: here "science-valid" refers to the flag-valid wind records over oceans and lakes that meet the editing criteria described in Table 5.

| Parameter	Min threshold	Max threshold	Percentage edited
Altimeter wind speed	0 m/s	30 m/s	0.0%

Table 5. Editing criteria. The percentage of rejected flag-valid records (excluding polar regions) for each criteria is shown.

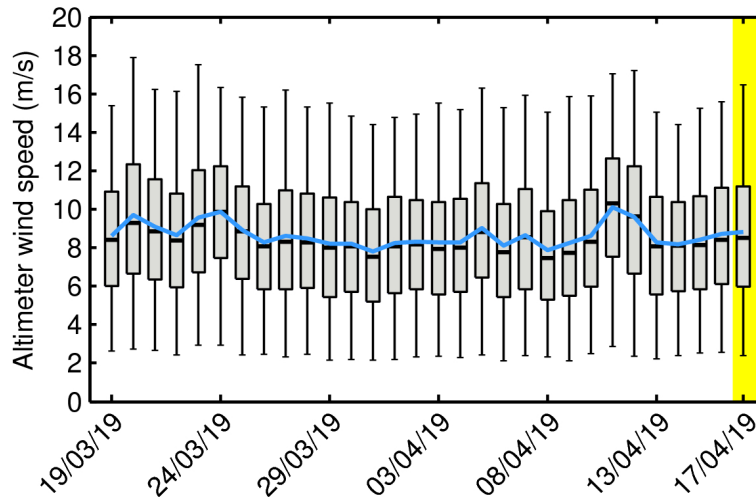Number of science-valid 1-Hz wind records over oceans and lakes: **42204**

Percentage of science-valid 1-Hz wind records over oceans and lakes relative to theoretical maximum: **99.3%**

Science–valid Altimeter wind speed 17/04/2019

p5	p25	median	p75	p95	mean	std
2.4	6.0	8.5	11.2	16.5	8.8	4.1
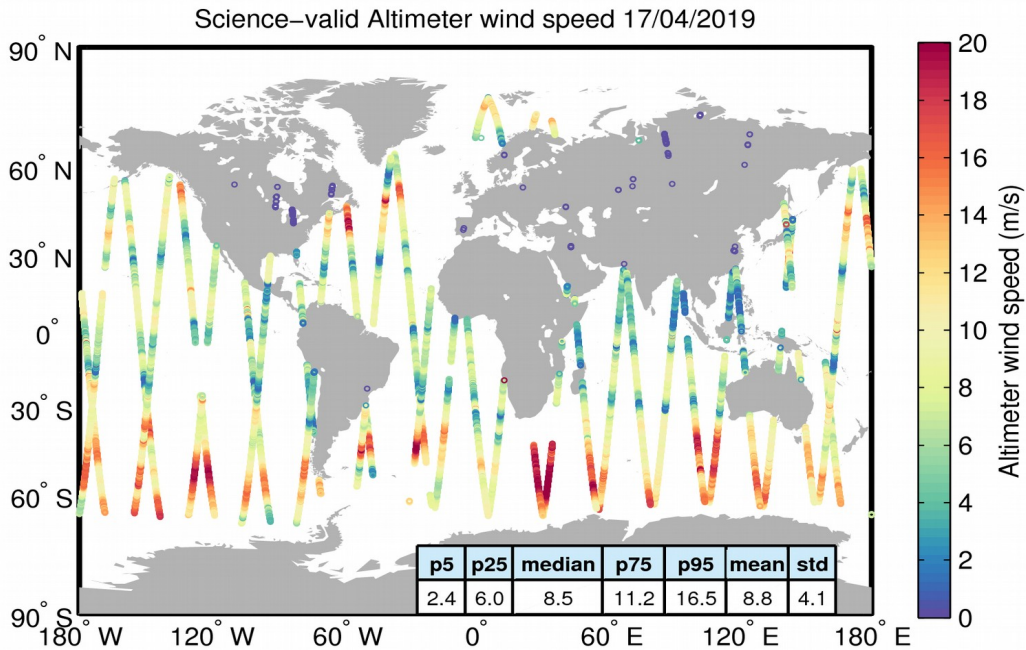
Figure 34. Geographical distribution of science-valid wind data over oceans and lakes for 17/04/2019. The statistical values shown in the table refer to the wind in m/s and are calculated over all measurements shown in the figure. Gray circles denote records that have been rejected based on the editing criteria described in Table 5.

$\mu = 8.8$ m/s

$\sigma = 4.1$ m/s
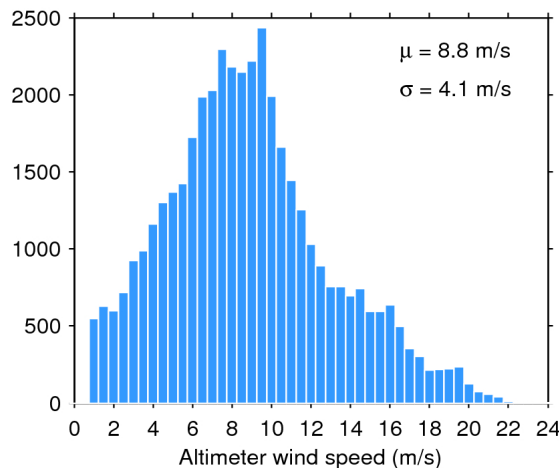
Figure 35. Histogram of science-valid wind over oceans and lakes for 17/04/2019. The mean (μ) and standard deviation (σ) are also shown. Note that values larger than 24 m/s are excluded from the histogram for the sake of readability but not from the computation of μ and σ.
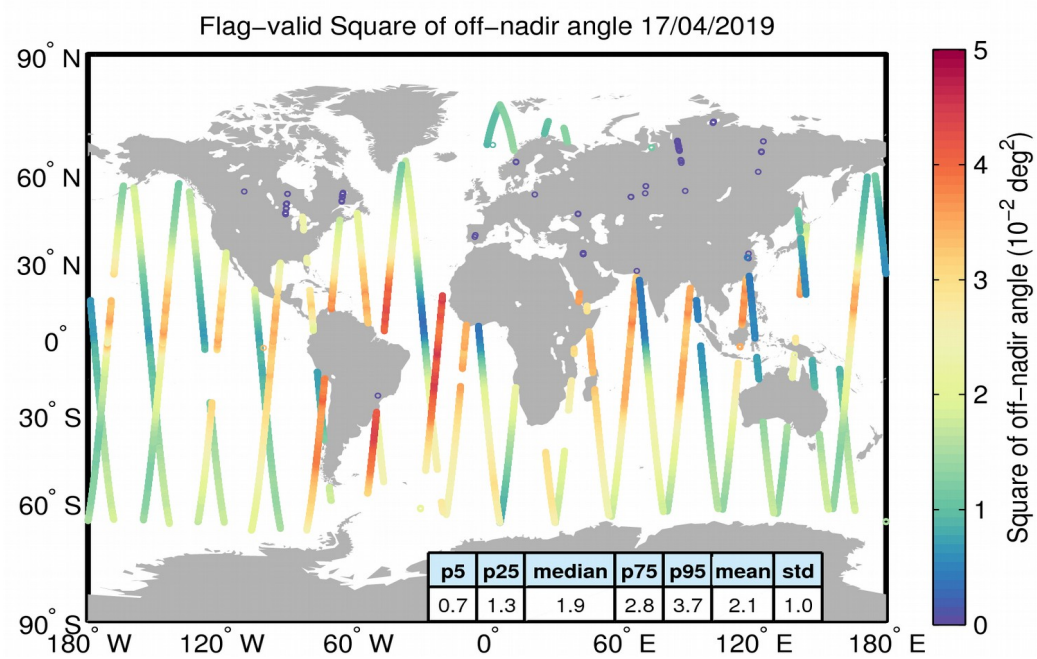
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Figure 36. Box-and-whiskers plot for the science-valid wind showing for each day in last 30-day window the first and third quartiles (bottom and top of the box), the median (thick black), the 5% and 95% percentiles (lower and upper whiskers), and the mean (blue). The yellow shading highlights the day analyzed in this report.

7   Mispointing coverage and validity

Note 7.1:   *here "flag-valid" refers to those records that have not been flagged as bad by either the average status flag or the measurement confidence flag.*

Number of flag-valid 1-Hz mispointing records over oceans and lakes: **42253**

Percentage of flag-valid 1-Hz mispointing records over oceans and lakes relative to theoretical maximum: **99.4%**

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Figure 37. Geographical distribution of flag-valid mispointing data over oceans and lakes for 17/04/2019. The statistical values shown in the table refer to the mispointing in 10^{-2} deg^2 and are calculated over all measurements shown in the figure.
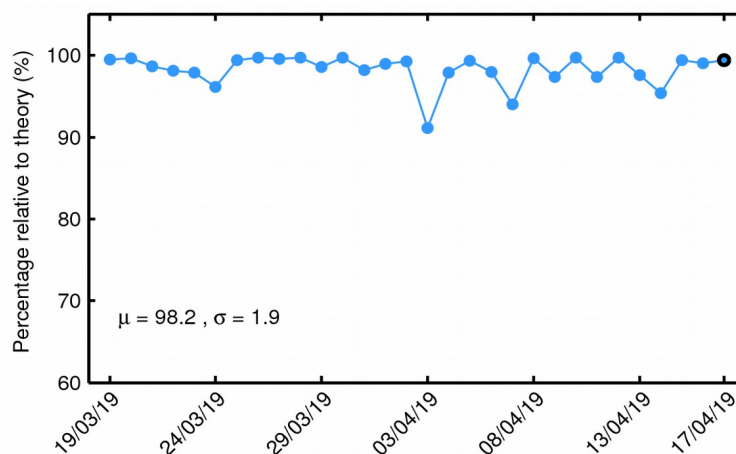

Figure 38. Percentage of flag-valid 1-Hz mispointing records over ocean and lakes relative to theory for each day in last 30-day window. The mean (μ) and standard deviation (σ) are also shown.
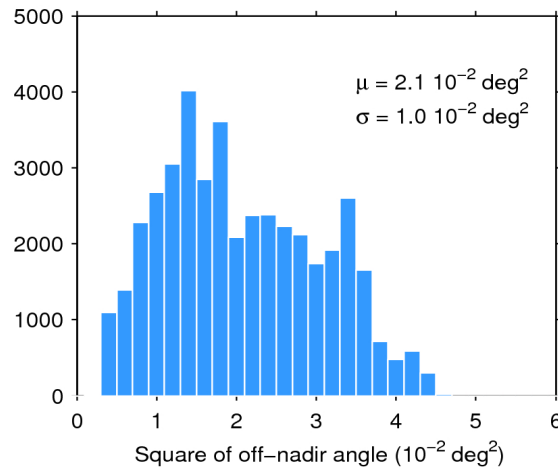
Figure 39. Histogram of flag-valid mispointing over oceans and lakes for 17/04/2019. The mean (μ) and standard deviation (σ) are also shown. Note that values larger than $6 \cdot 10^{-2}$ deg^2 are excluded from the histogram for the sake of readability but not from the computation of μ and σ.
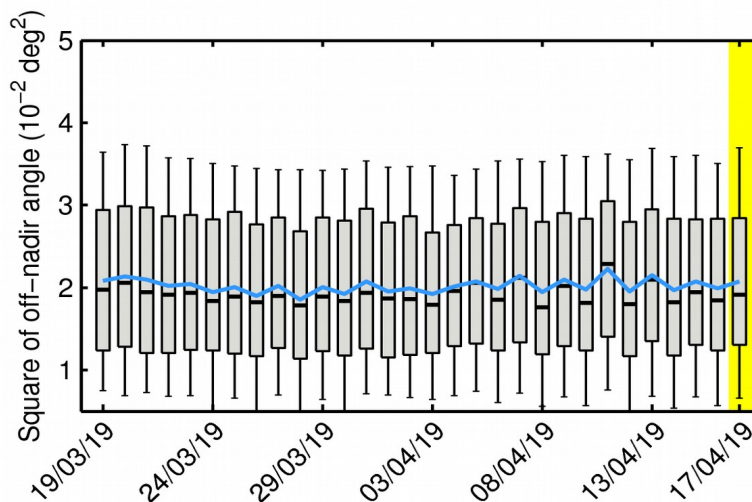
Figure 40. Box-and-whiskers plot for flag-valid mispointing showing for each day in last 30-day window the first and third quartiles (bottom and top of the box), the median (thick black), the 5% and 95% percentiles (lower and upper whiskers), and the mean (blue). The yellow shading highlights the day analyzed in this report.

APPENDIX A

In this appendix we briefly describe the meaning of the warning codes summarized in page 2 of the document.

- **latency_fail:** this warning is issued whenever one or more data files for the day analysed in this report are made available with a delay of more than 6.4 hours with respect to the mean time of the records stored in the file. The 6.4 hours refers to the median latency + 1.48*3*MAD(latency) over a 1-year period. MAD: median absolute deviation.

- **latency_mean_high:** this warning is issued whenever the mean of the latencies over all data files for the day analyzed in this report is larger than 3 hours.

- **ocean_dropout:** this warning is issued whenever the percentage of 1-Hz records over ocean and lakes relative to the theoretically expected number per day is smaller than 80% for the day analyzed in this report.

- **orbit_dropout:** this warning refers to individual orbits and is issued whenever the percentage of 1-Hz records over oceans and lakes relative to the theoretically expected number per orbit is smaller than 80% for one or more orbits for the day analyzed in this report.

- **large_orbit_bias:** this warning refers to individual orbits and is issued whenever there are more than 100 flag-valid records with a SSH anomaly larger than ±90 cm.

- **iono_missing:** the whole ionospheric correction is missing for the day analyzed in this report.

- **dry_missing:** the whole dry tropospheric correction is missing for the day analyzed in this report.

- **wet_missing:** the whole wet tropospheric correction is missing for the day analyzed in this report.

- **atm_missing:** the whole atmospheric (both IB and DAC) correction is missing for the day analyzed in this report.

- **ssb_missing:** the whole sea state bias correction is missing for the day analyzed in this report.

(end of Document)