Diagtool Report

Round Robin (GT cotier) : Ionospheric correction. Eaustralia. J3. Iono filtered vs Iono gim.

7 avril 2022

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1 General description

- Figures and notes have been included in this report to evaluate different altimetry products.
- In order to test different version of the Ionospheric correction used to calculate the sea level anomaly. Each version has been compared with a reference version. In this case the Iono_gim is the reference one.
- The sea level anomaly has been calculated using each version of the variable and has been compared to the sea level anomaly calculated using the reference version.
- The region of study is Eaustralia
- Mission : J3
- Git last tag : 0.5 Mettre à jour les rapports de la wet, range et tide apres application de binning X-track
- Git changeset number : a1e0387-2022-04-07

2 Processing

2.1 sla formula

2.1.1 Iono_filtered product ' sla

sla = ORBIT.ALTI.CNES_POE_F - RANGE.ALTI - MEAN_SEA_SURFACE.MODEL.CNESCLS15 - SEA_STATE_BIAS.ALTI
- IONOSPHERIC_CORRECTION.ALTI.FILTR - WET_TROPOSPHERIC_CORRECTION.RAD - DRY_TROPOSPHERIC_CORRECTION.M
- DYNAMICAL_ATMOSPHERIC_CORRECTION.MODEL.MOG2D_HR - OCEAN_TIDE_HEIGHT.MODEL.FES14B - SO-
LID_EARTH_TIDE_HEIGHT.MODEL.CARTWRIGHT_TAYLER_71 - POLE_TIDE_HEIGHT.MODEL.DESAI_2015

2.1.2 Iono_gim product ' sla

sla = ORBIT.ALTI.CNES_POE_F - RANGE.ALTI - MEAN_SEA_SURFACE.MODEL.CNESCLS15 - SEA_STATE_BIAS.ALTI
- IONOSPHERIC_CORRECTION.MODEL.GIM - WET_TROPOSPHERIC_CORRECTION.RAD - DRY_TROPOSPHERIC_CORRECTION
- DYNAMICAL_ATMOSPHERIC_CORRECTION.MODEL.MOG2D_HR - OCEAN_TIDE_HEIGHT.MODEL.FES14B - SO-
LID_EARTH_TIDE_HEIGHT.MODEL.CARTWRIGHT_TAYLER_71 - POLE_TIDE_HEIGHT.MODEL.DESAI_2015

2.2 Binning

Each track has been divided to a set of sections, where the center of each section is separated by the sample frequency of the satelitte times it's velocity.

The data located within the sections limits represent the altimetry time-series on which the statistics will be calculated and visualized in this report.

2.3 Filtering

- The sla has been filtered by a threashold of 3 m.
- Each sla time-serie has been filtred by a window of $[-4\sigma, 4\sigma]$, where σ is the standard deviation of the sla time serie

3 Spatial coherence analysis

3.1 sla

3.1.1 sla 's count

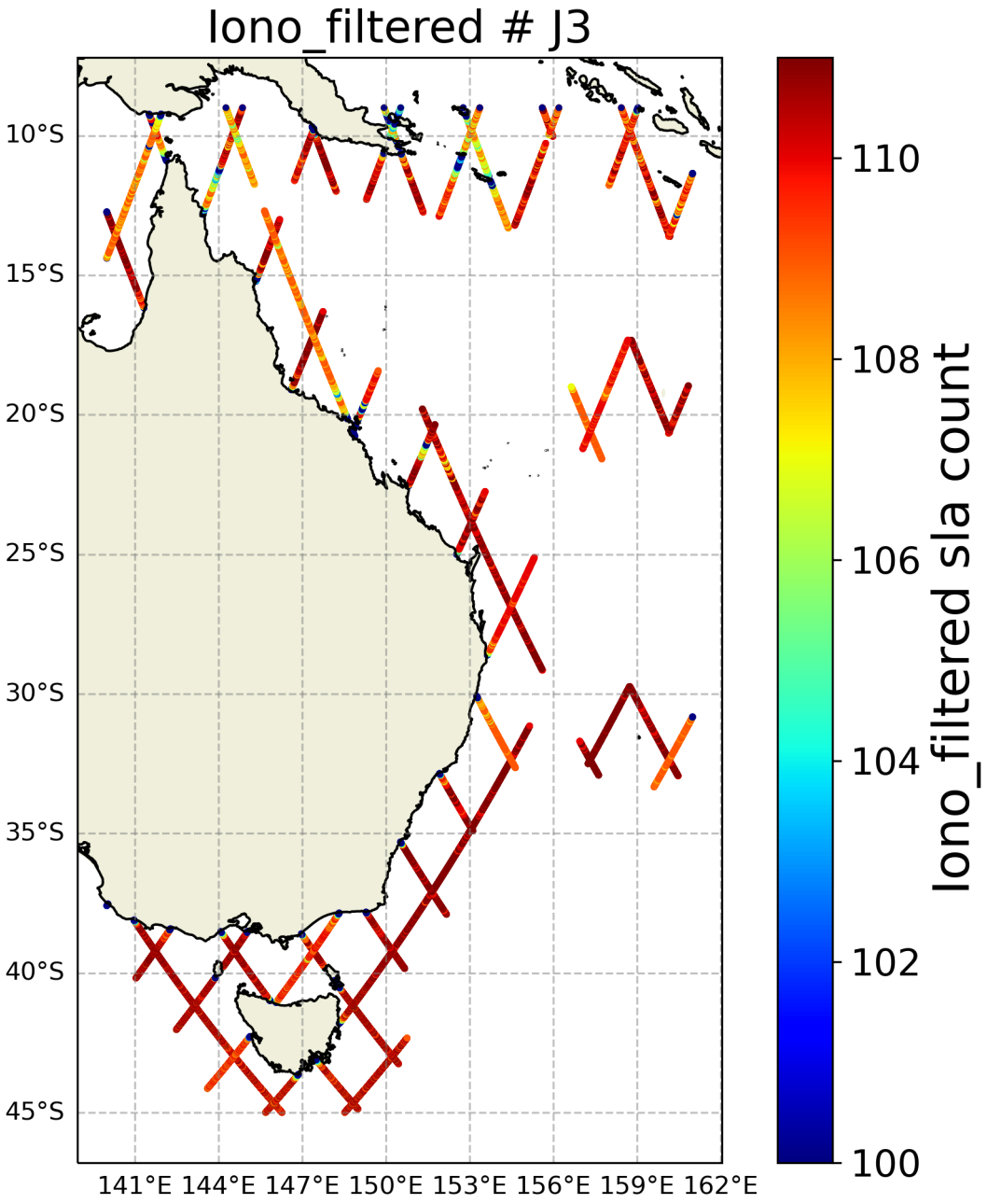

FIGURE 1 – Spatial coherence analysis of the count of the Iono_filtered version of sla variable

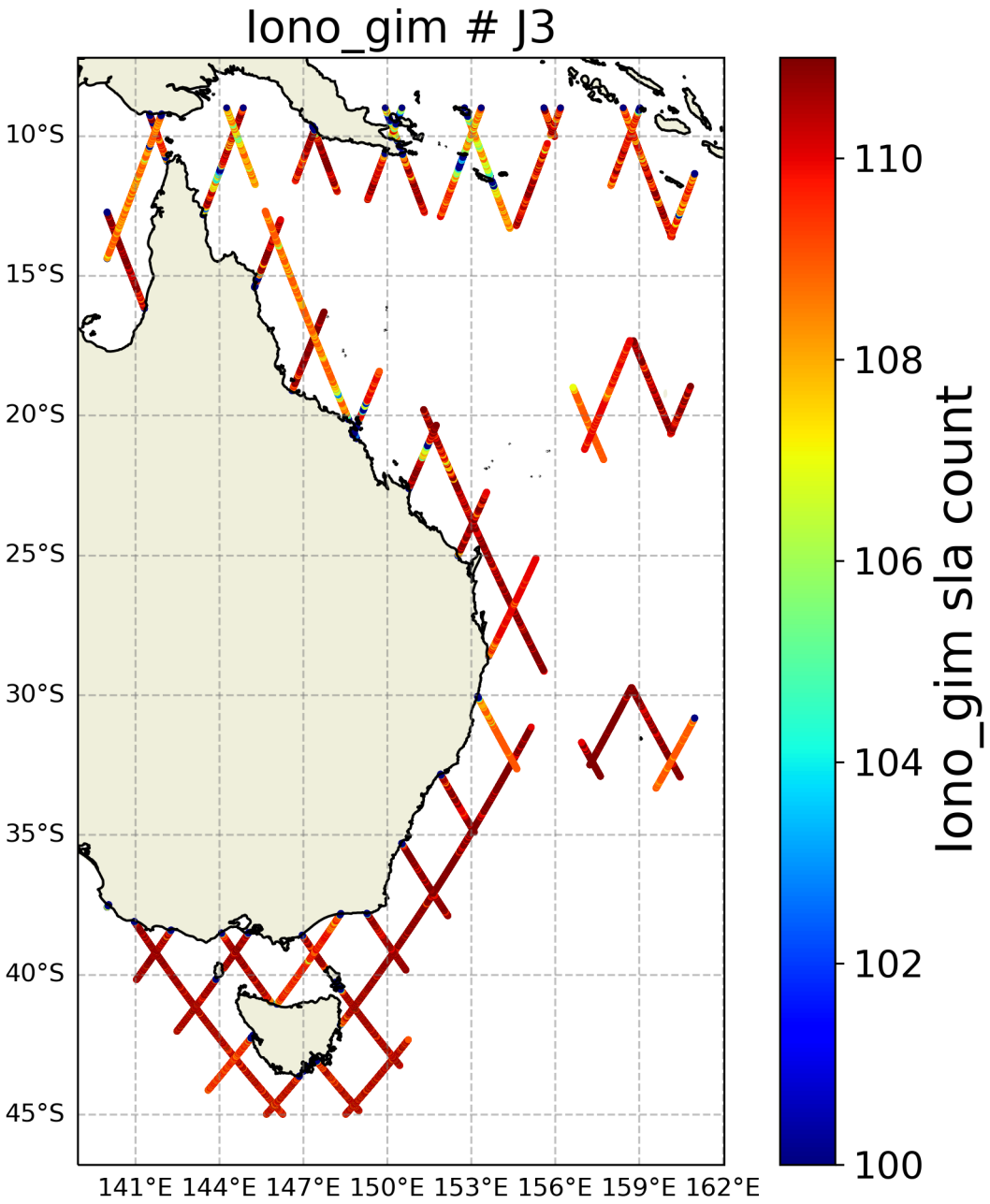

FIGURE 2 – Spatial coherence analysis of the count of the Iono_gim version of sla variable

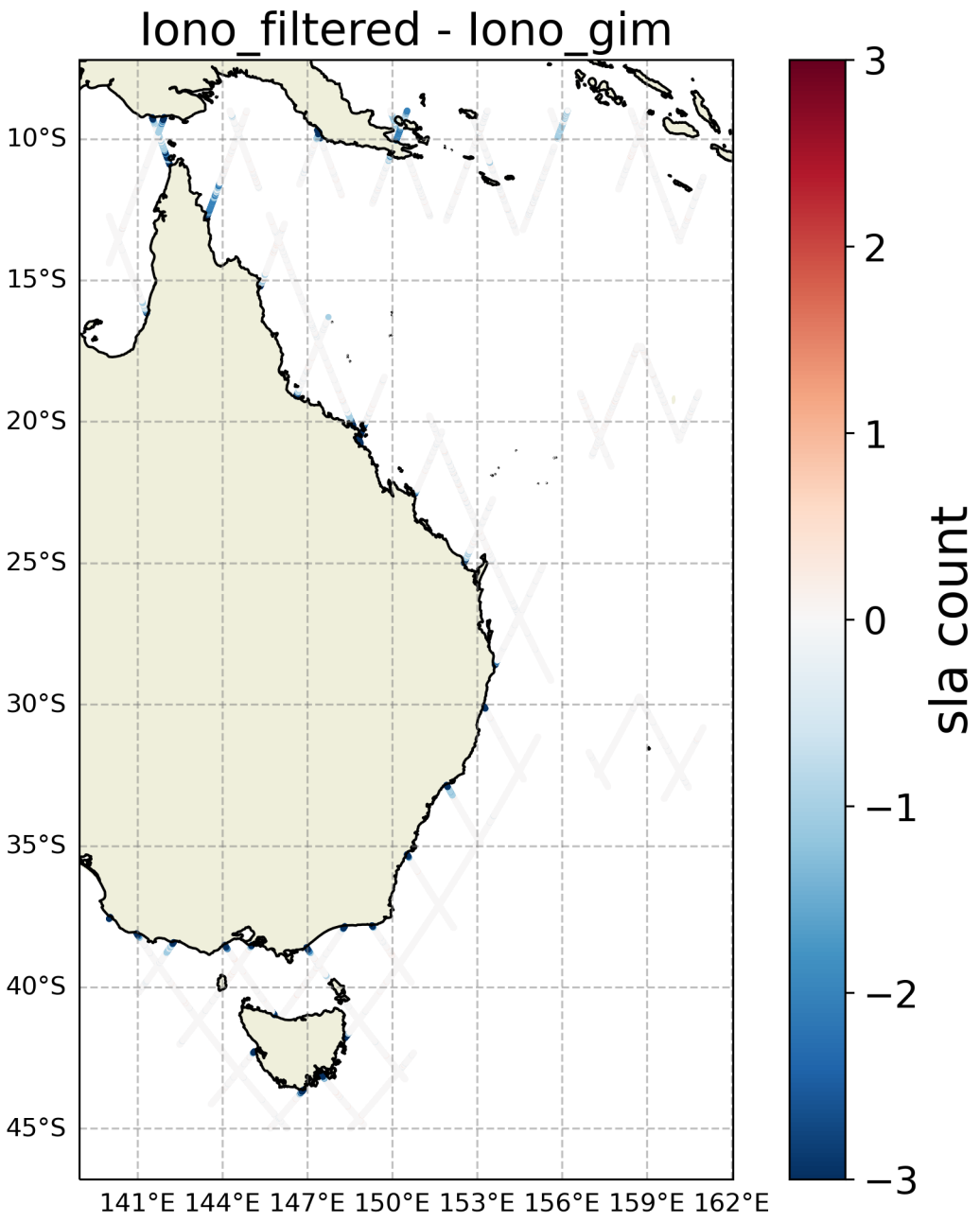

FIGURE 3 – Spatial coherence analysis of the Difference in sla 's count between Iono_filtered and Iono_gim

3.1.2 sla 's std

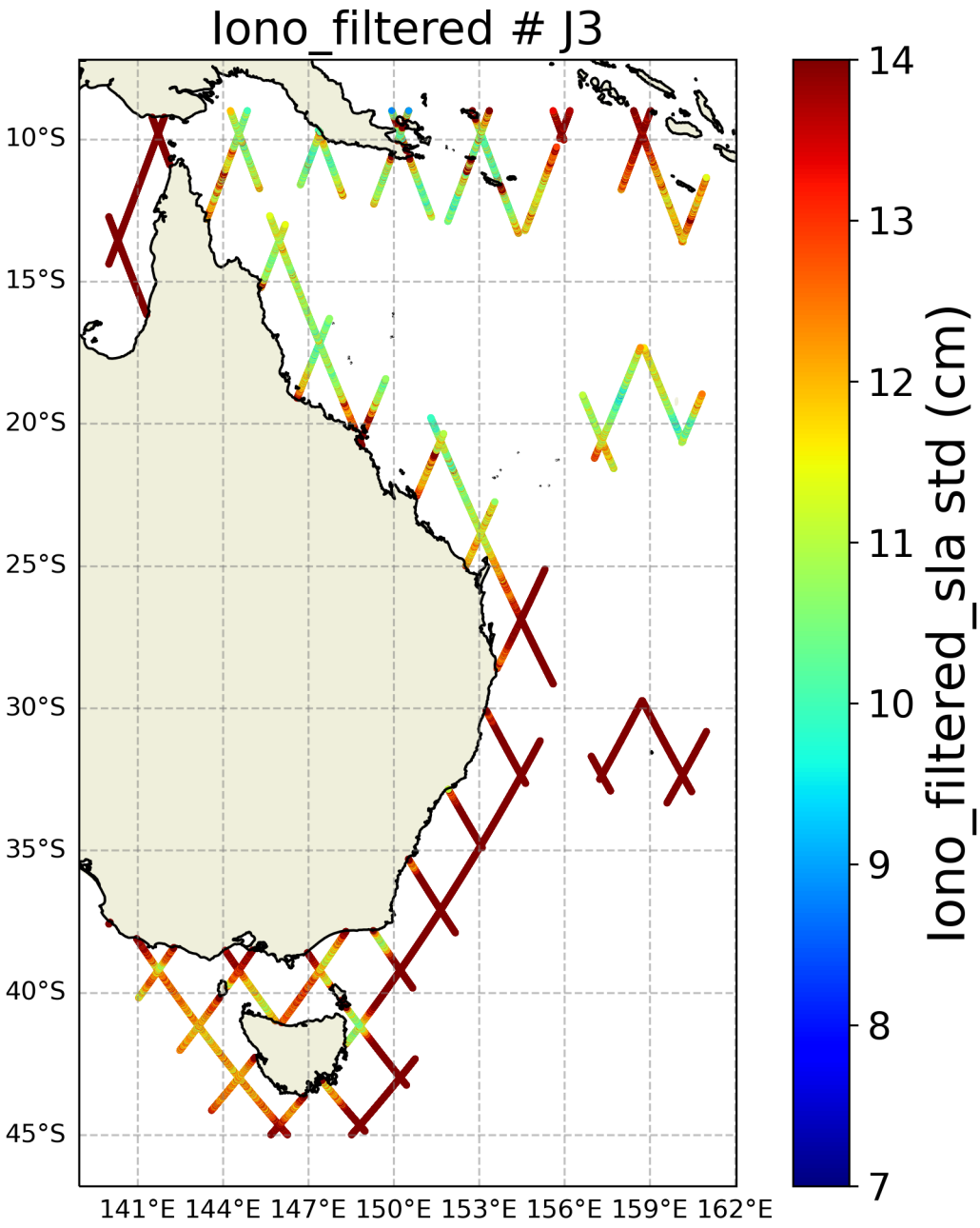

FIGURE 4 – Spatial coherence analysis of the std of the Iono_filtered version of sla variable

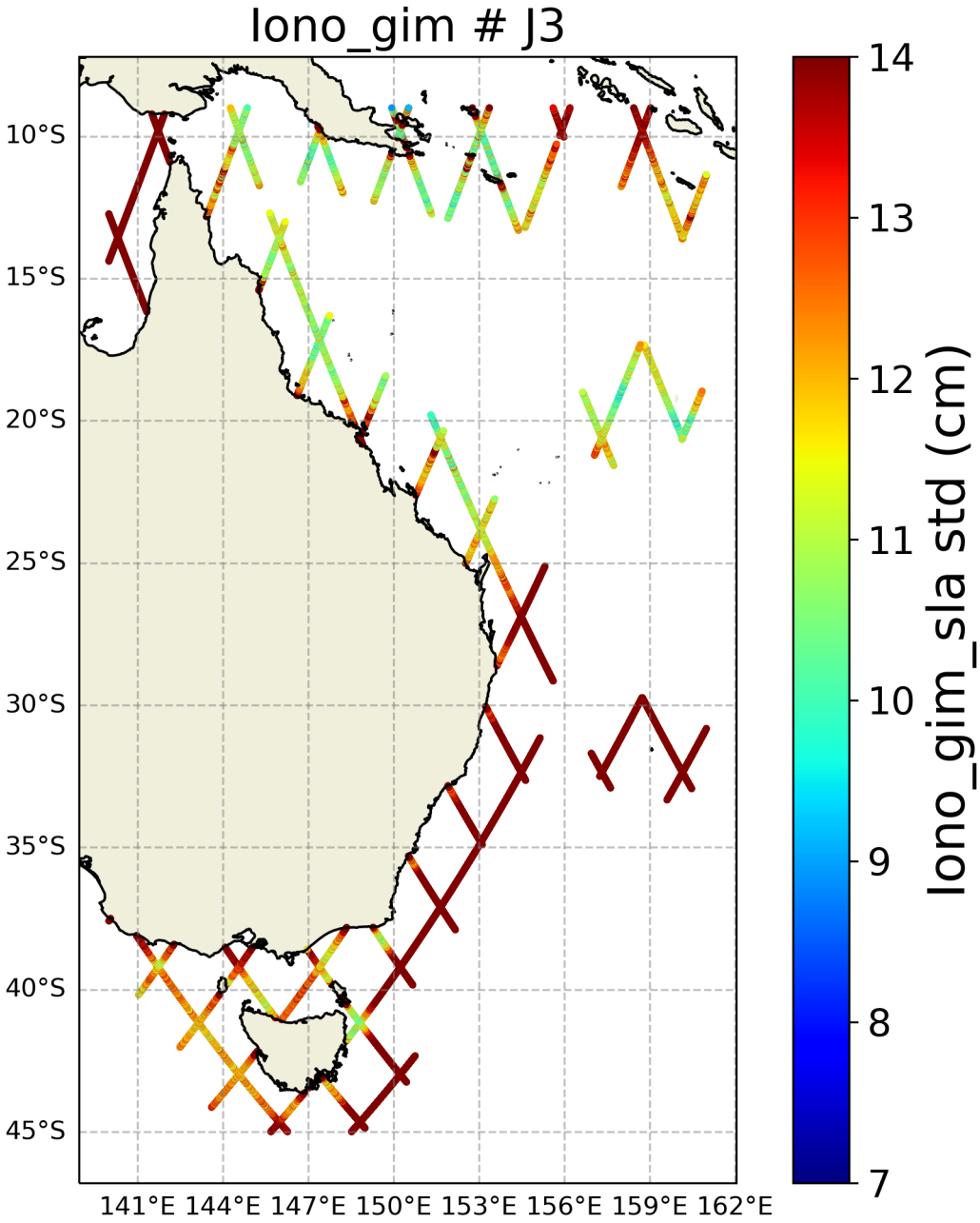

FIGURE 5 – Spatial coherence analysis of the std of the Iono_gim version of sla variable

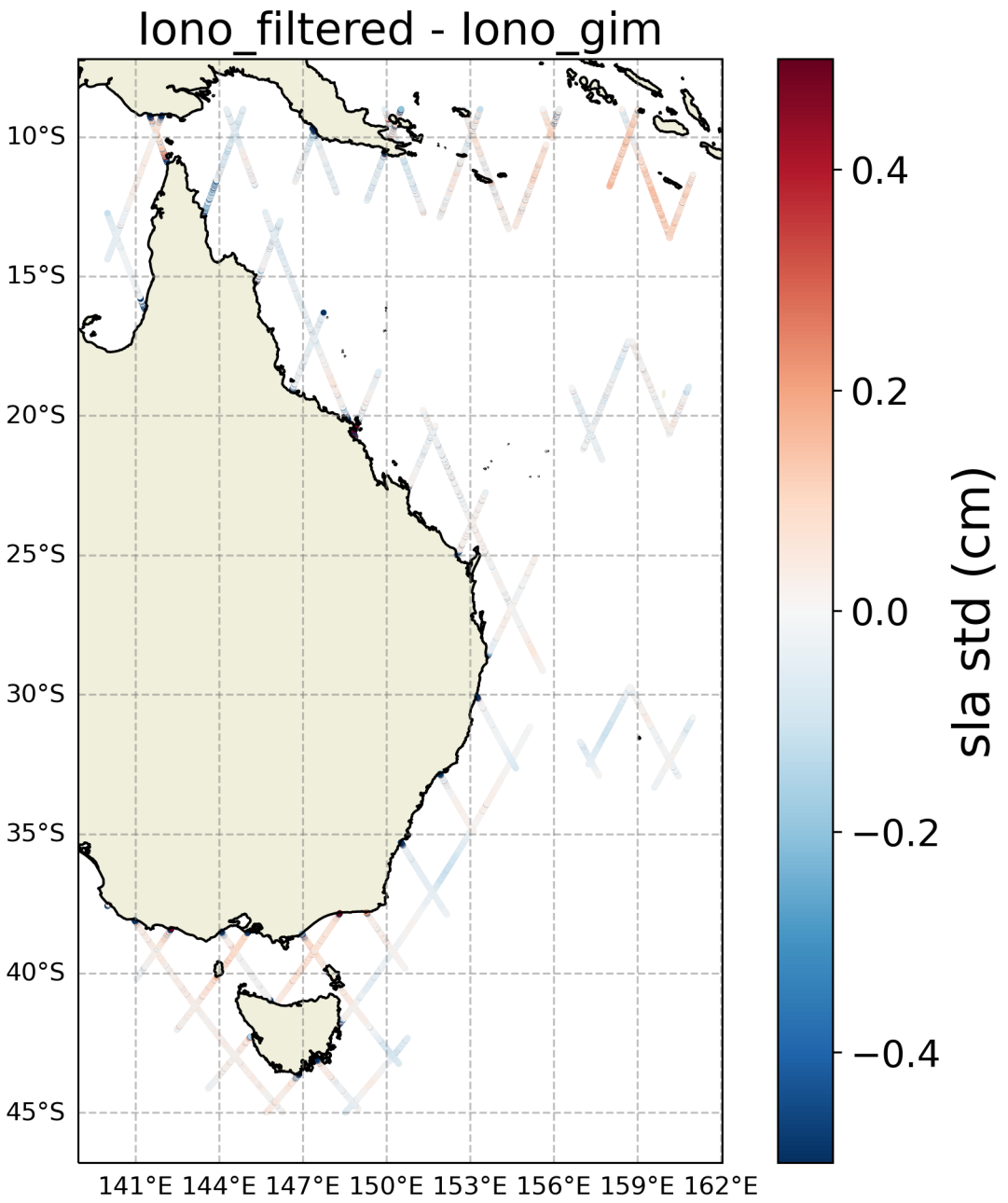

FIGURE 6 – Spatial coherence analysis of the Difference in sla 's std between Iono_filtered and Iono_gim

3.1.3 sla 's mean

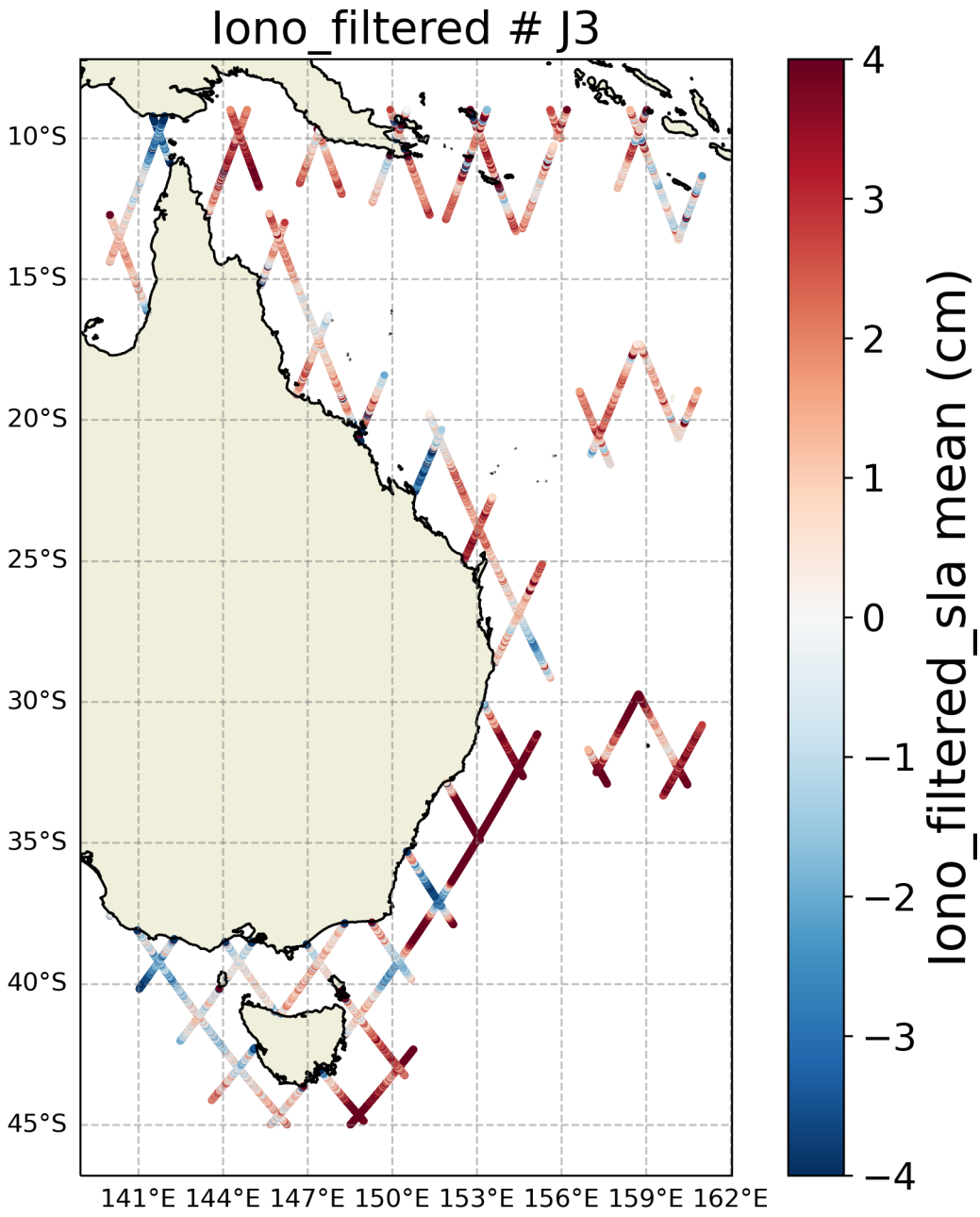

FIGURE 7 – Spatial coherence analysis of the mean of the Iono_filtered version of sla variable

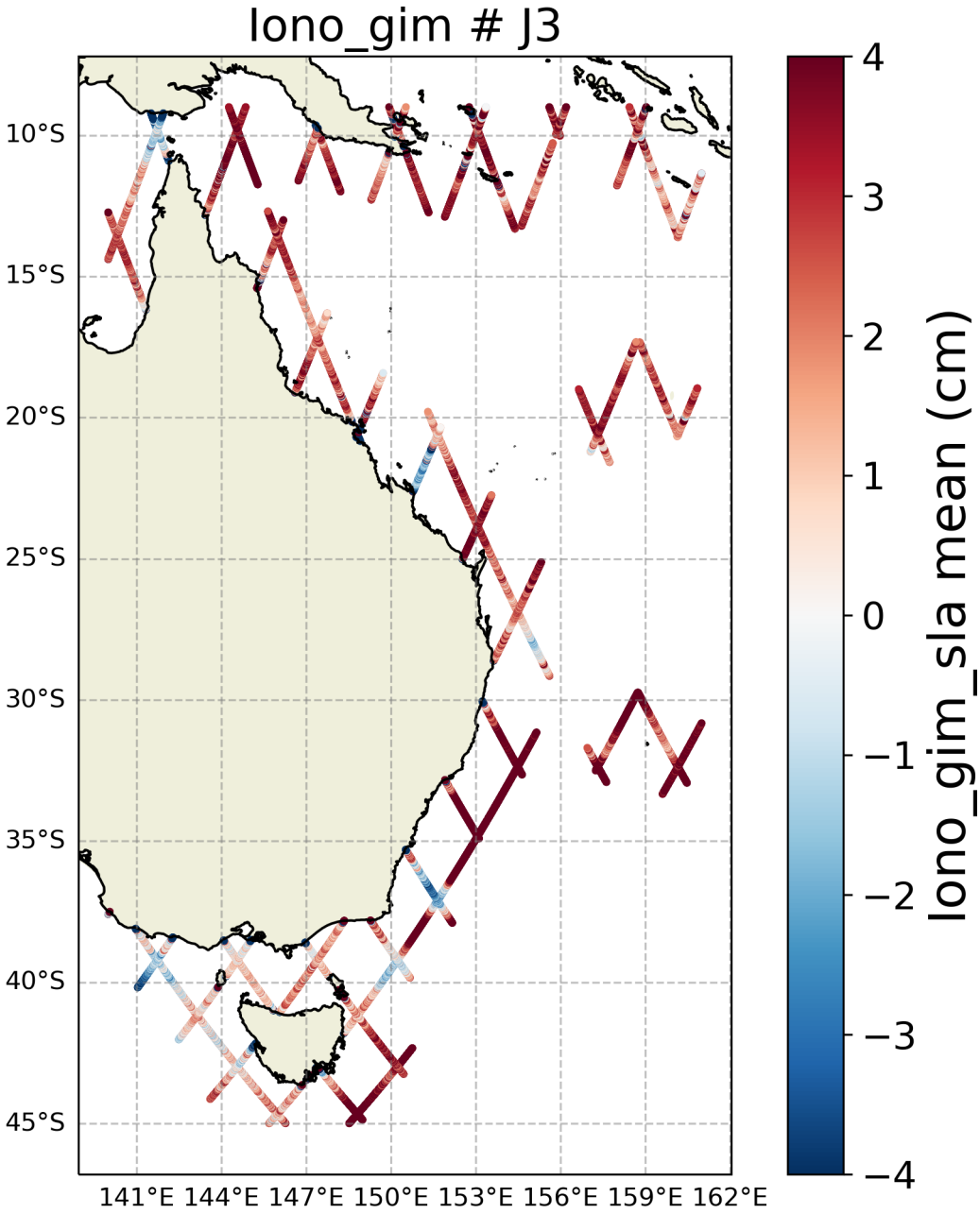

FIGURE 8 – Spatial coherence analysis of the mean of the Iono_gim version of sla variable

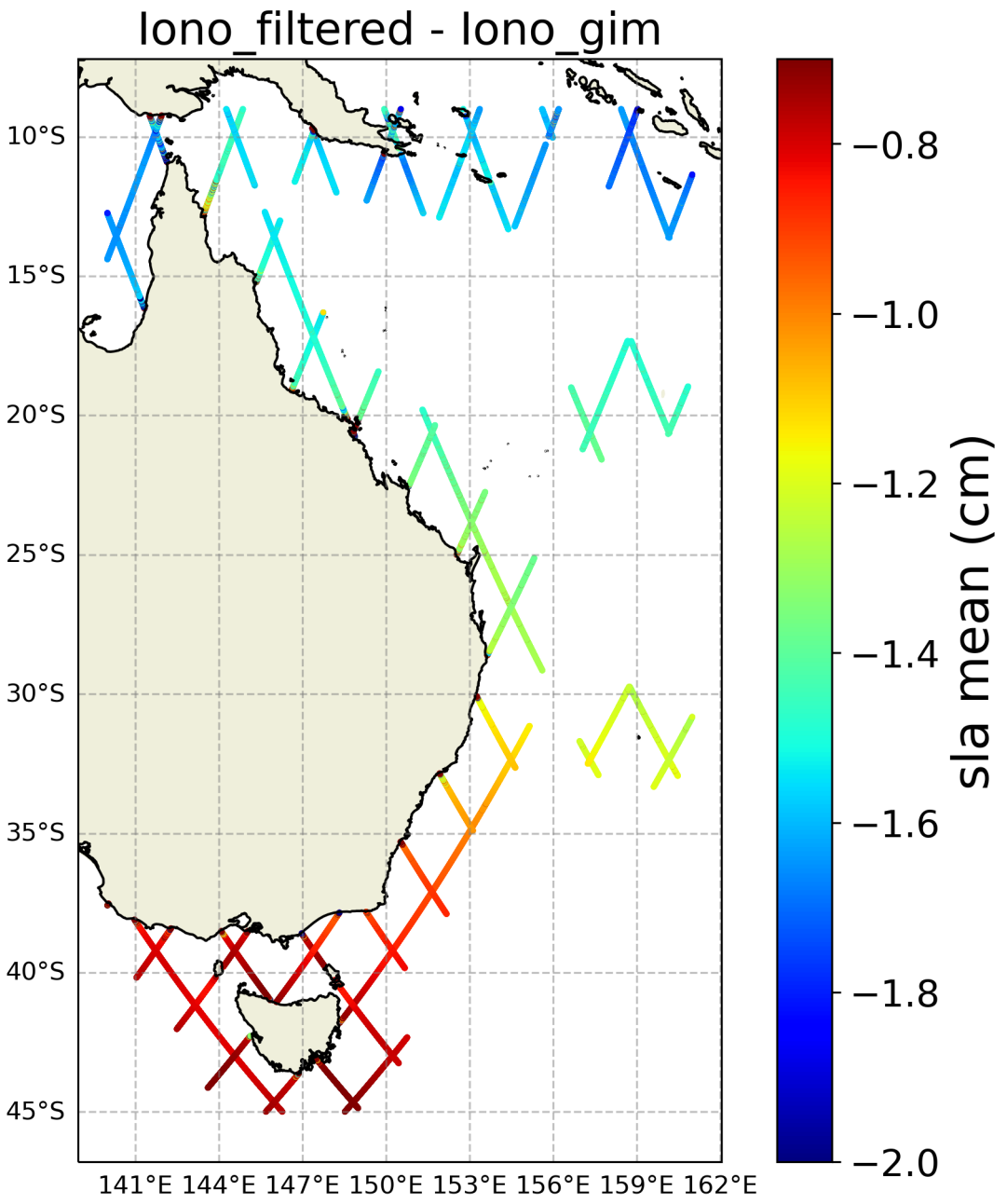

FIGURE 9 – Spatial coherence analysis of the Difference in sla 's mean between Iono_filtered and Iono_gim

3.2 Iono

3.2.1 Iono 's count

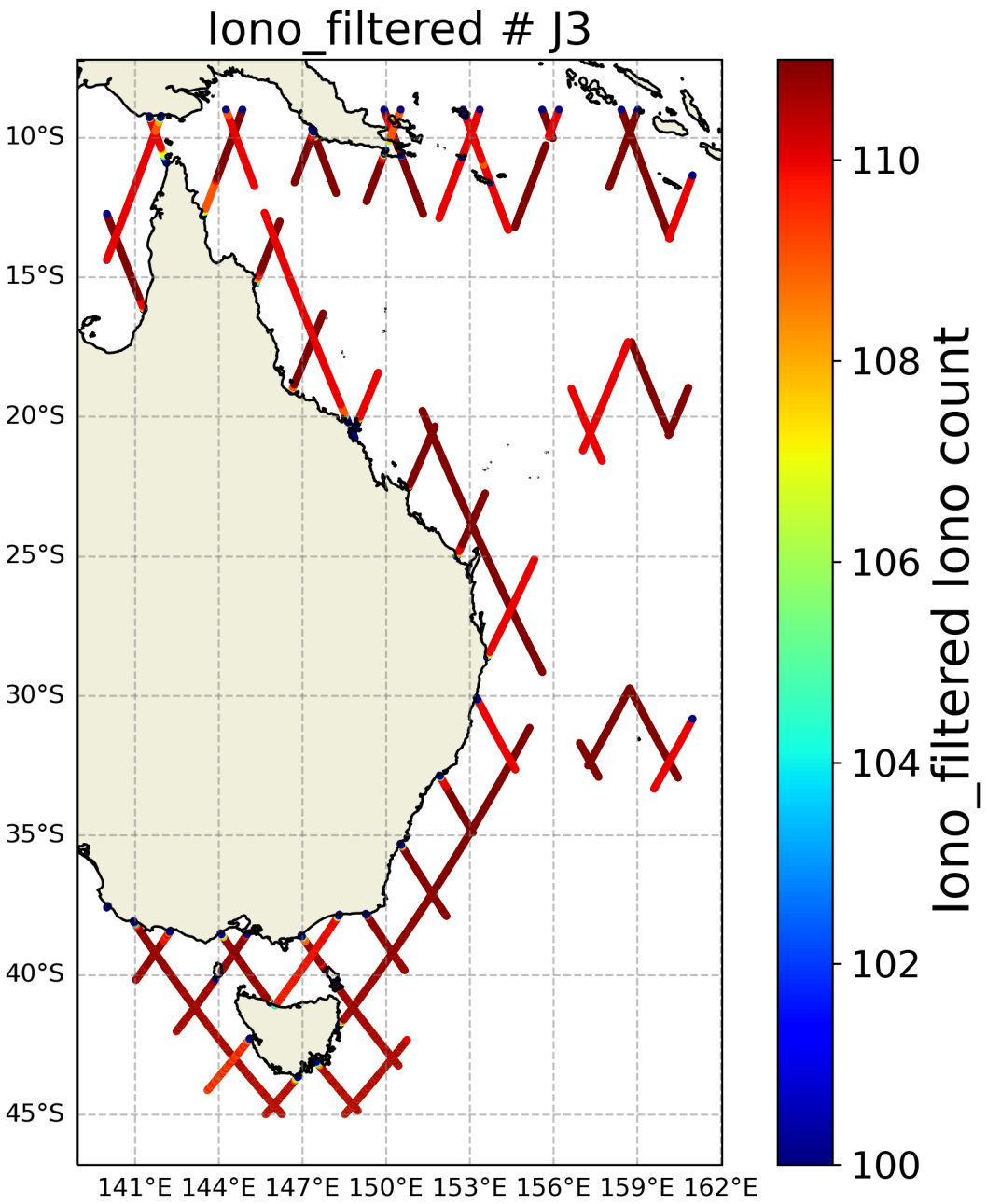

FIGURE 10 – Spatial coherence analysis of the count of the Iono_filtered version of Iono variable

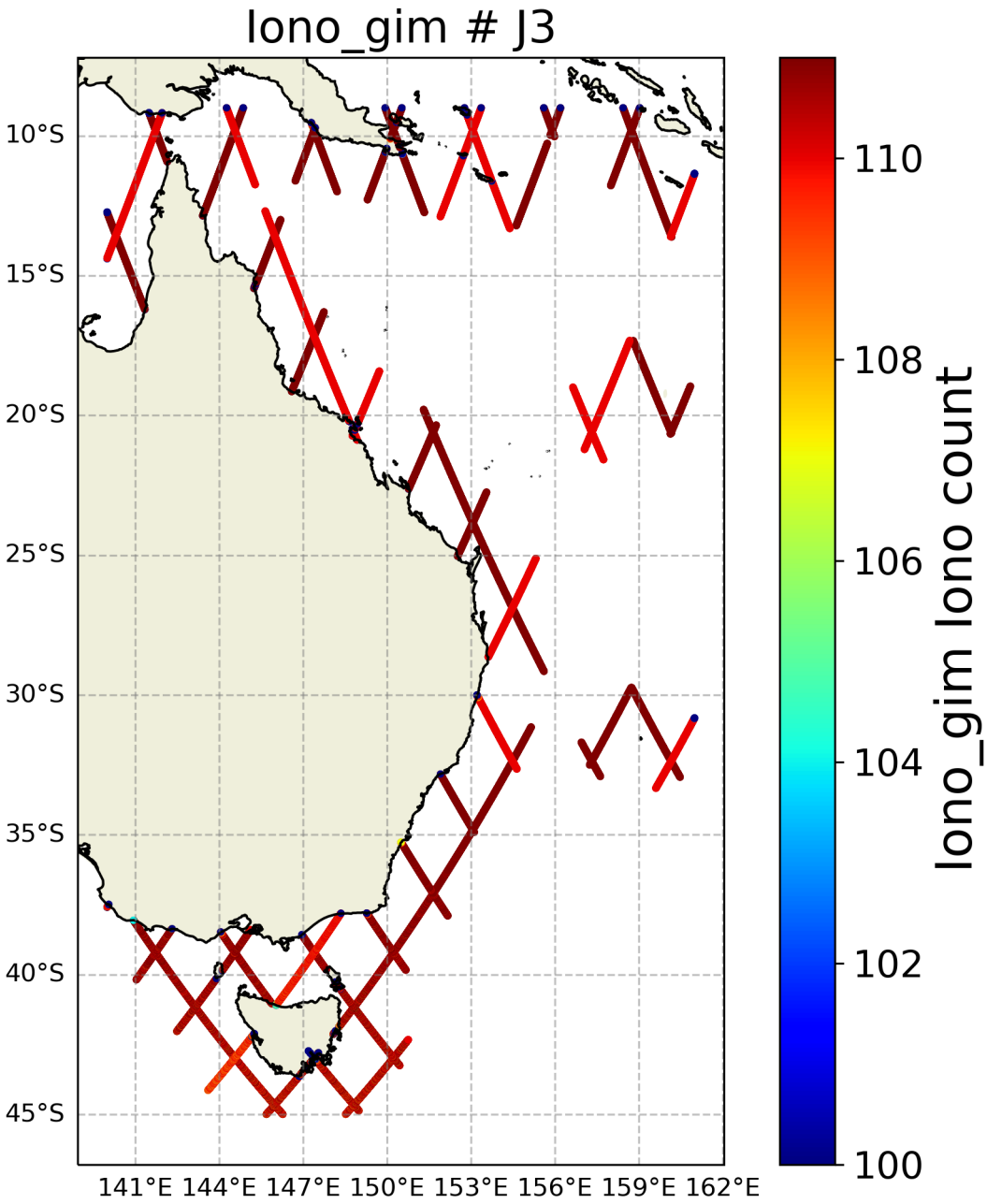

FIGURE 11 – Spatial coherence analysis of the count of the Iono_gim version of Iono variable

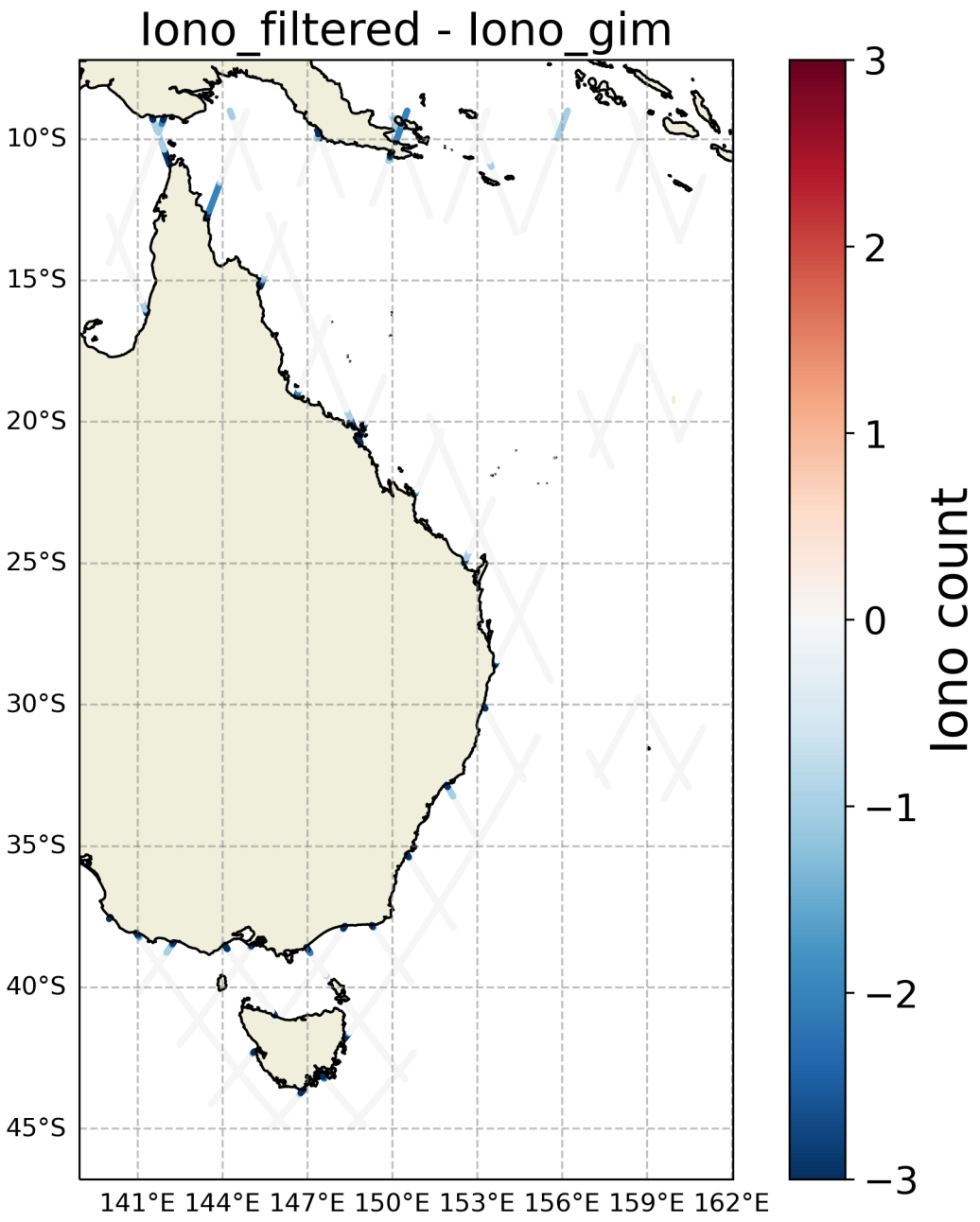

FIGURE 12 – Spatial coherence analysis of the Difference in Iono 's count between Iono_filtered and Iono_gim

3.2.2 Iono 's std

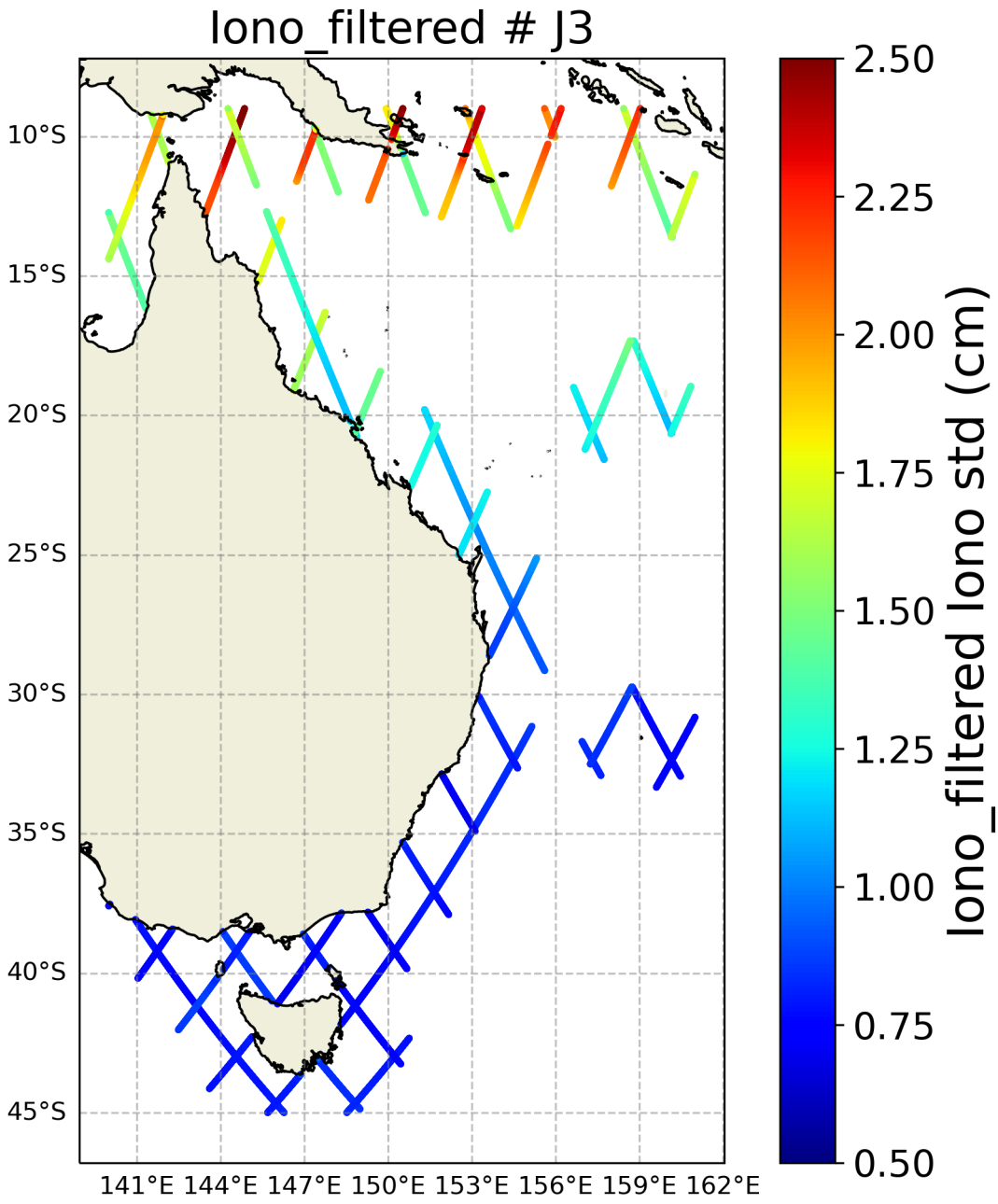

FIGURE 13 – Spatial coherence analysis of the std of the Iono_filtered version of Iono variable

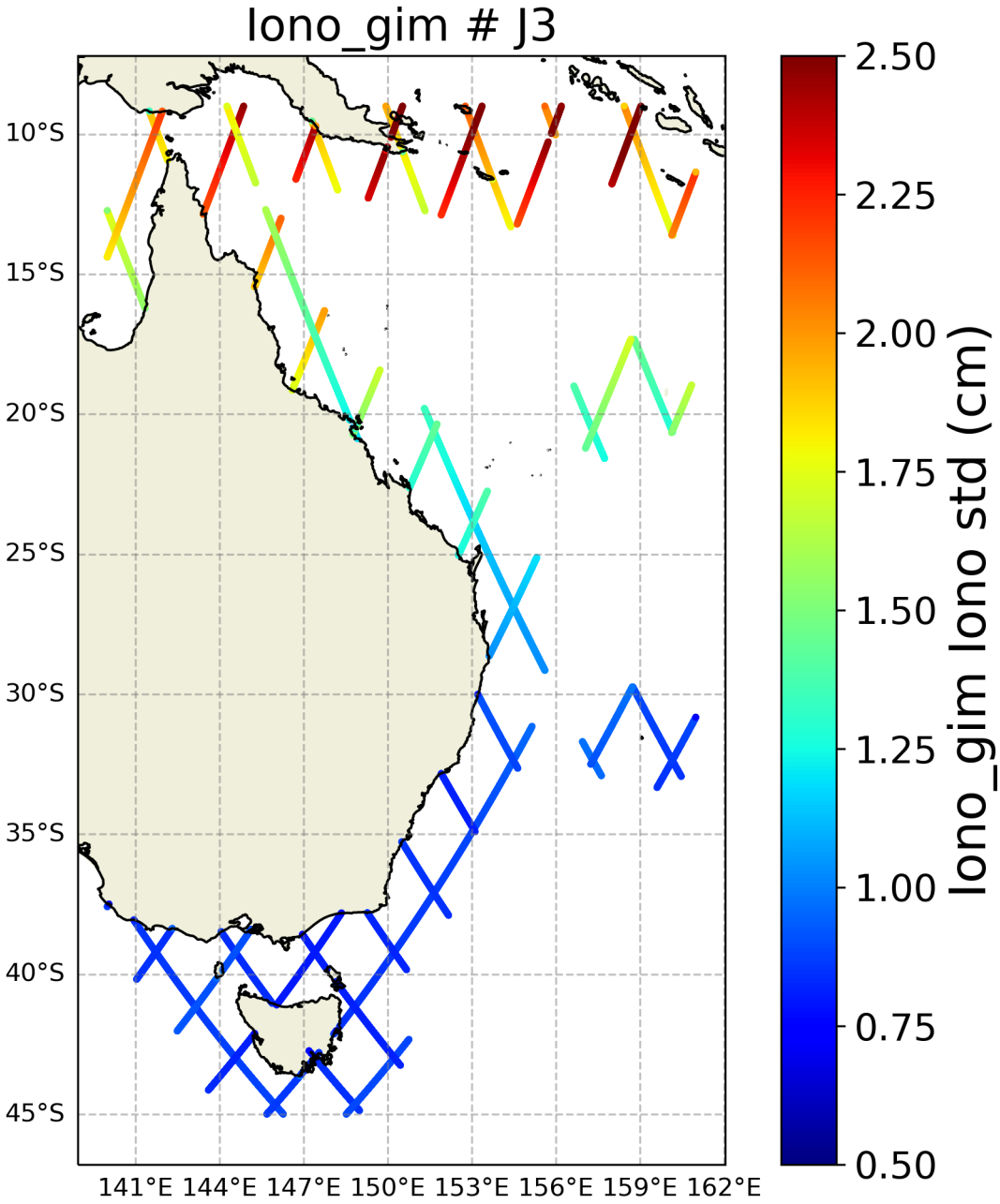

FIGURE 14 – Spatial coherence analysis of the std of the Iono_gim version of Iono variable

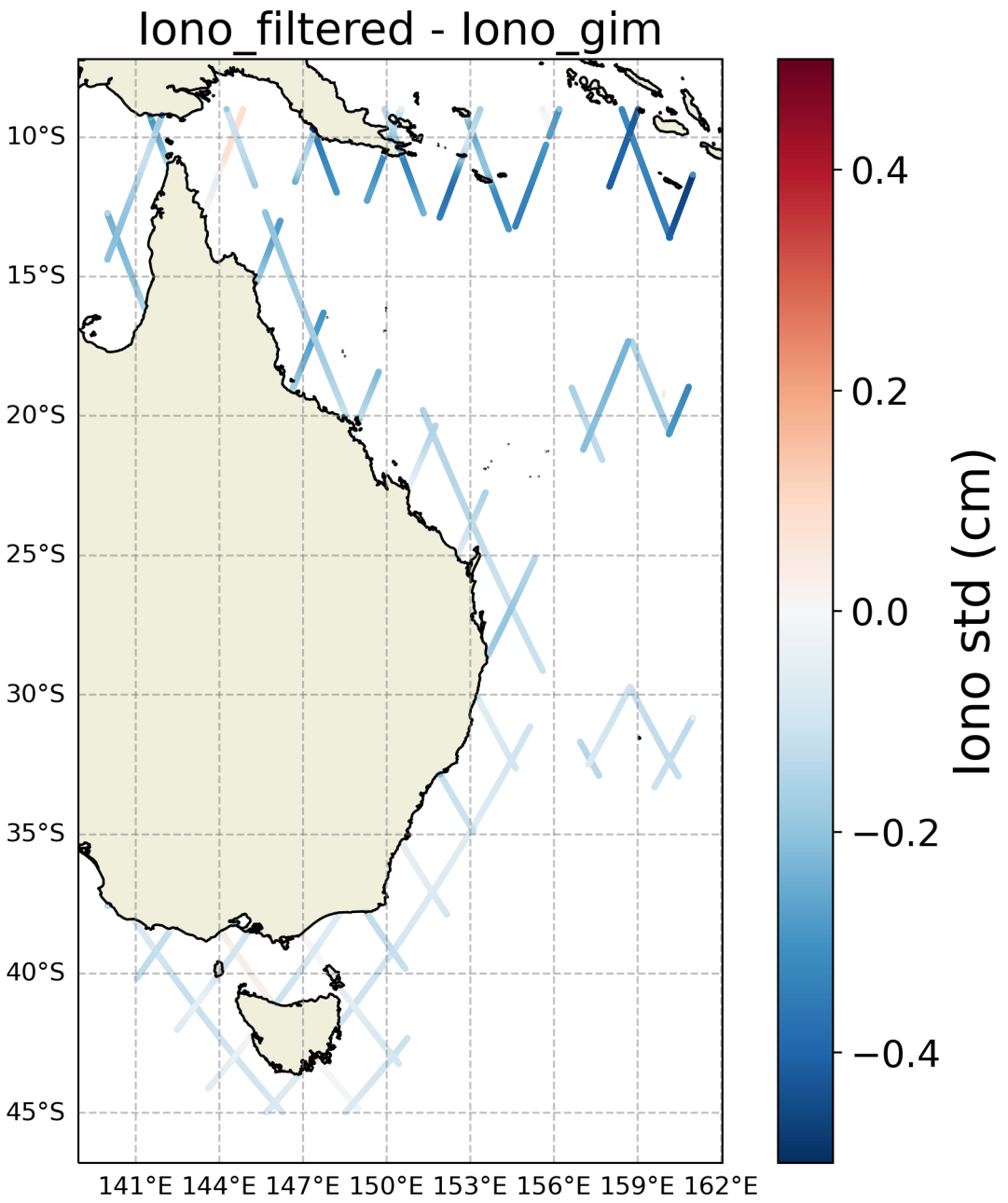

FIGURE 15 – Spatial coherence analysis of the Difference in Iono 's std between Iono_filtered and Iono_gim

3.2.3 Iono 's mean

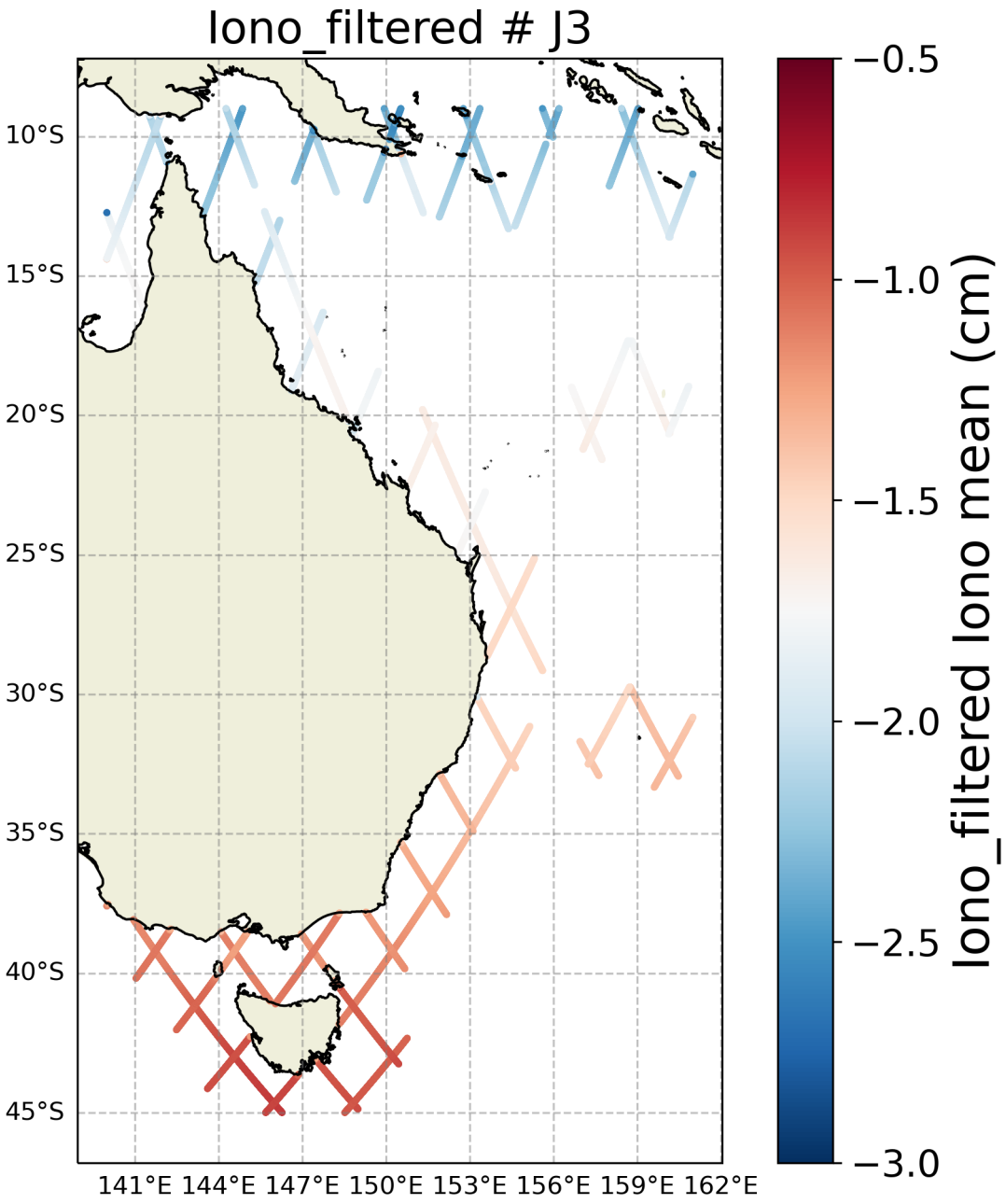

FIGURE 16 – Spatial coherence analysis of the mean of the Iono_filtered version of Iono variable

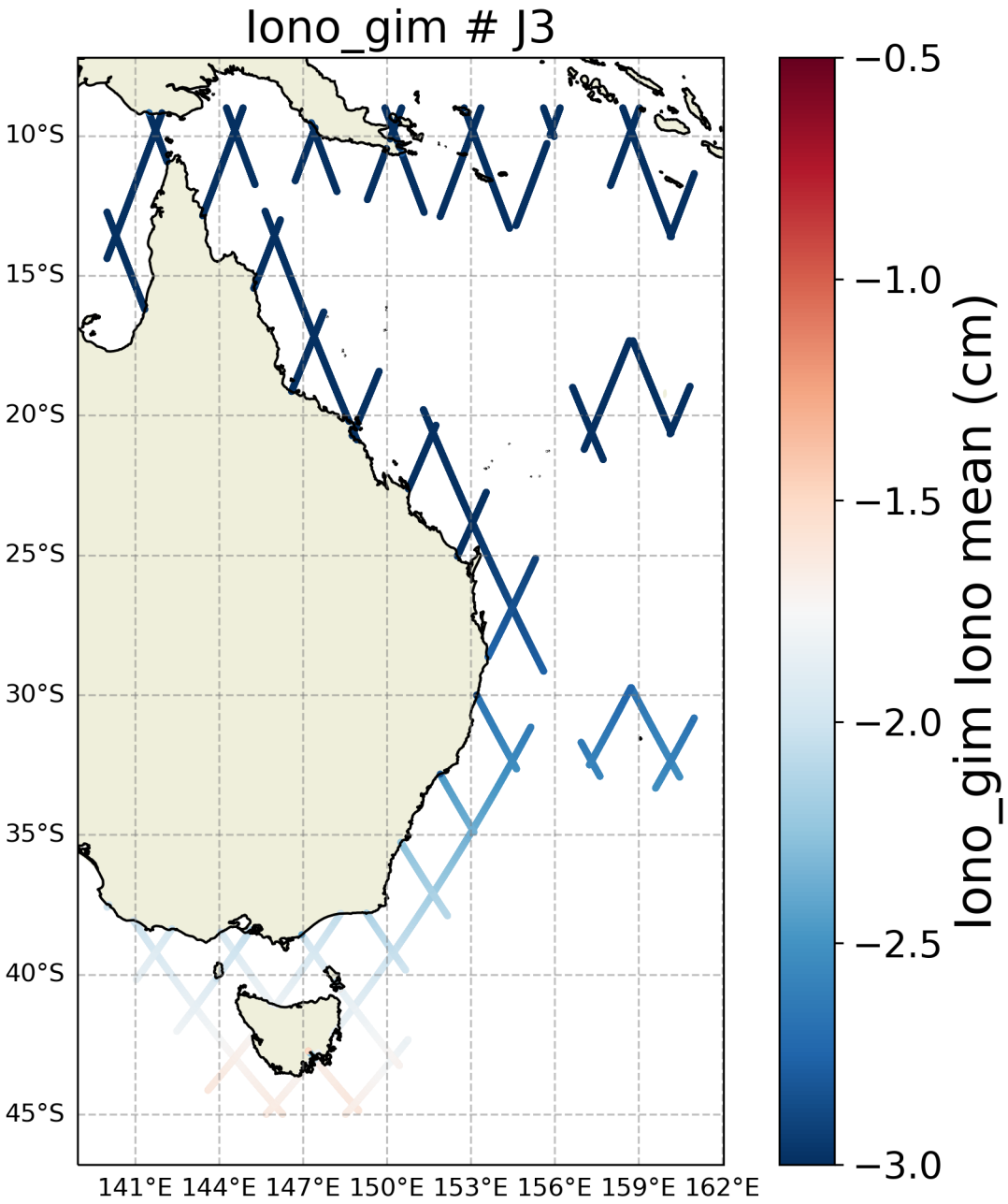

FIGURE 17 – Spatial coherence analysis of the mean of the Iono_gim version of Iono variable

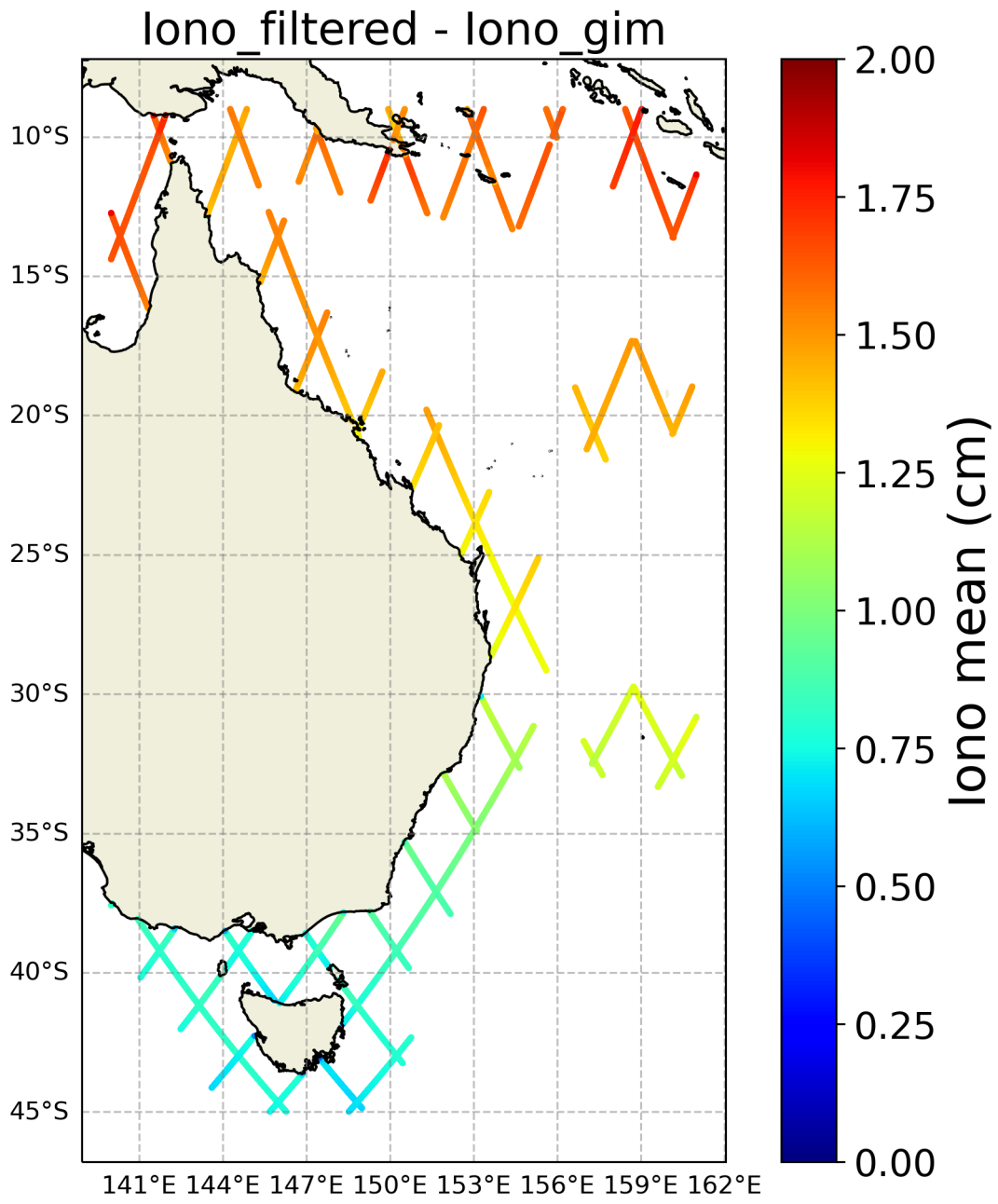

FIGURE 18 – Spatial coherence analysis of the Difference in Iono 's mean between Iono_filtered and Iono_gim

4 Histograms

4.1 Iono

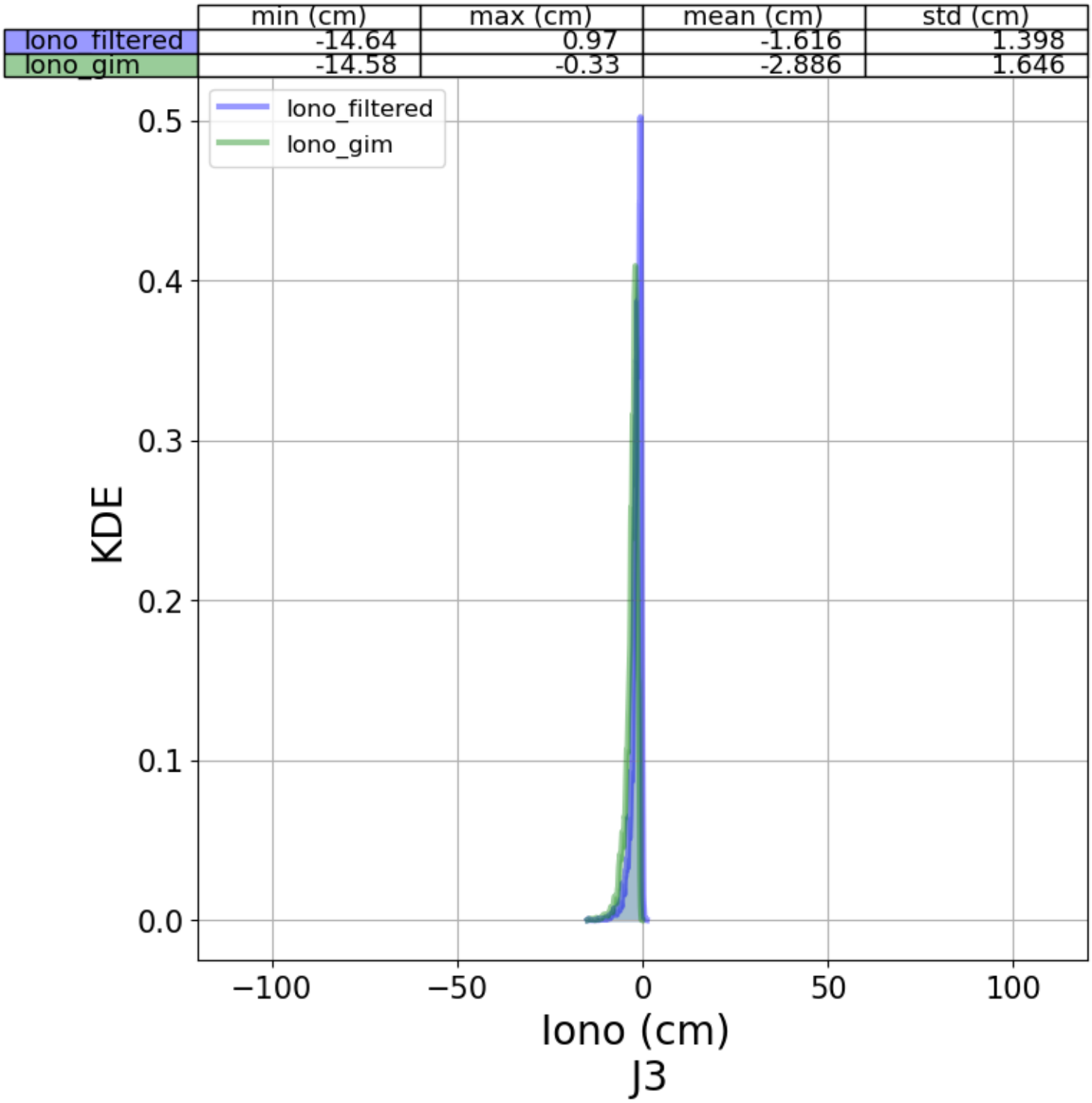

FIGURE 19 – Histogram of each of Iono version

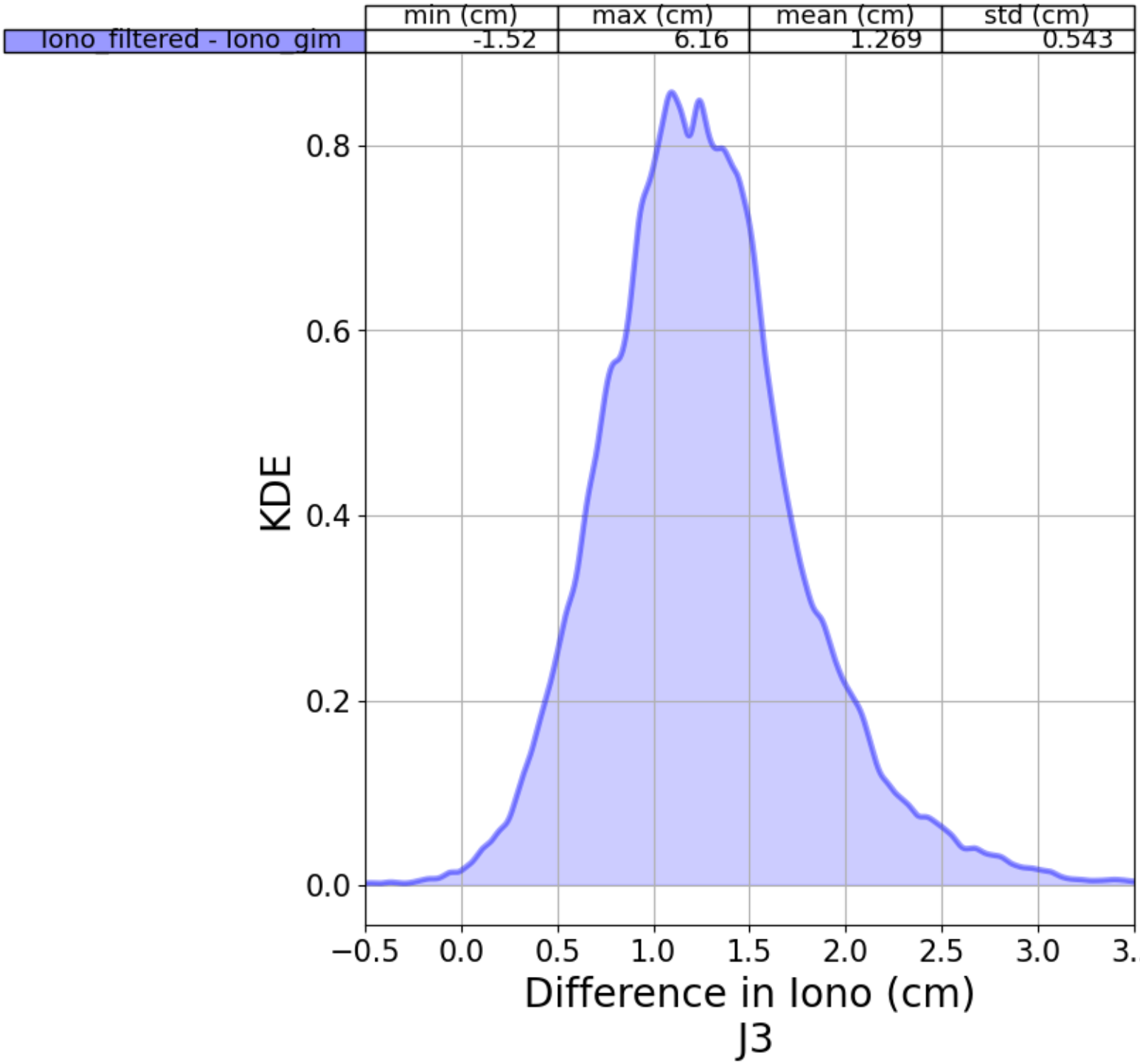

Figure 20 – Histograms of difference of each Iono version and reference one

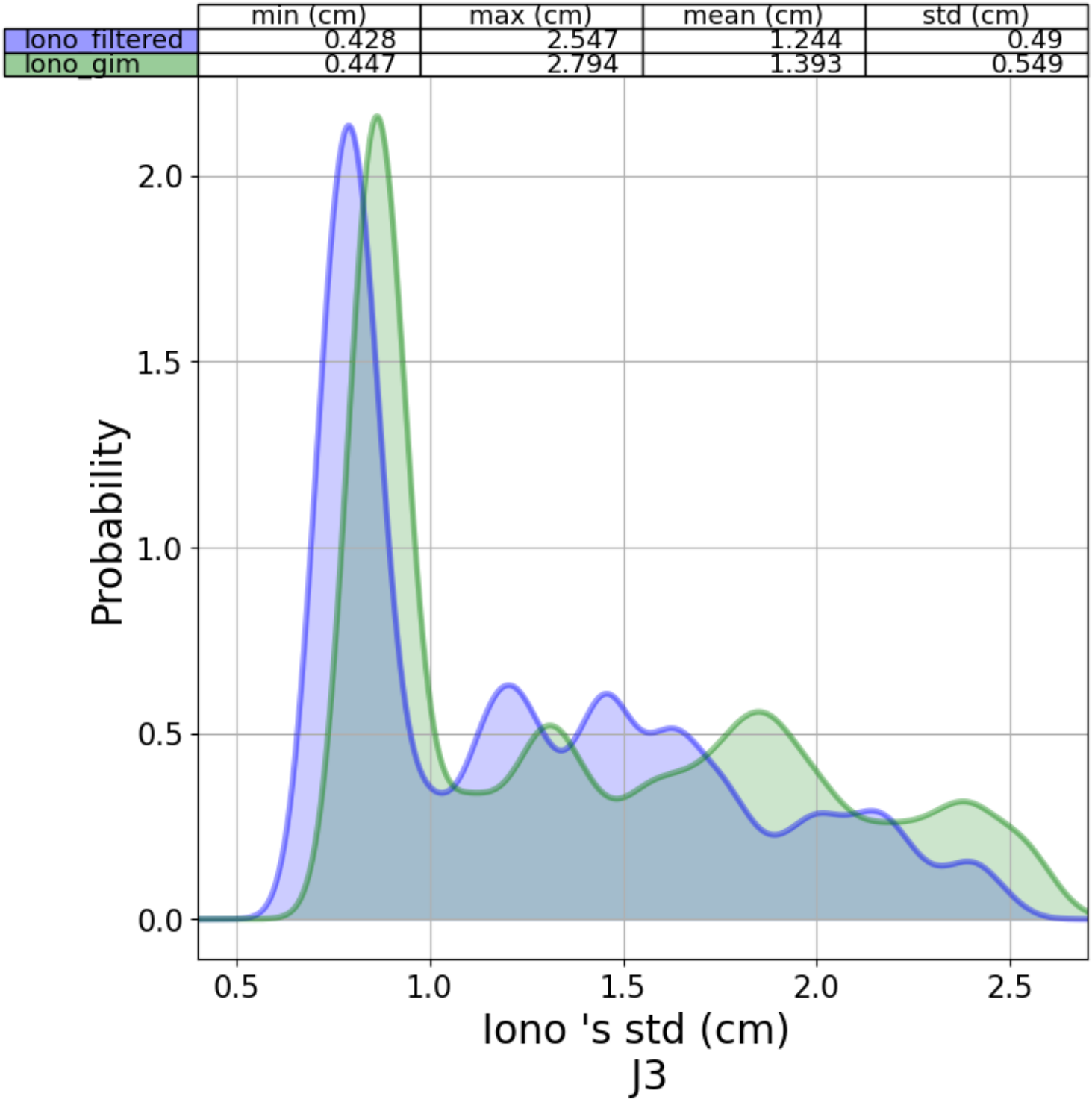

Figure 21 – Histograms of the standard deviation of each Iono version

4.2 sla

5 Along-track analysis

5.1 Iono

5.1.1 Iono 's count

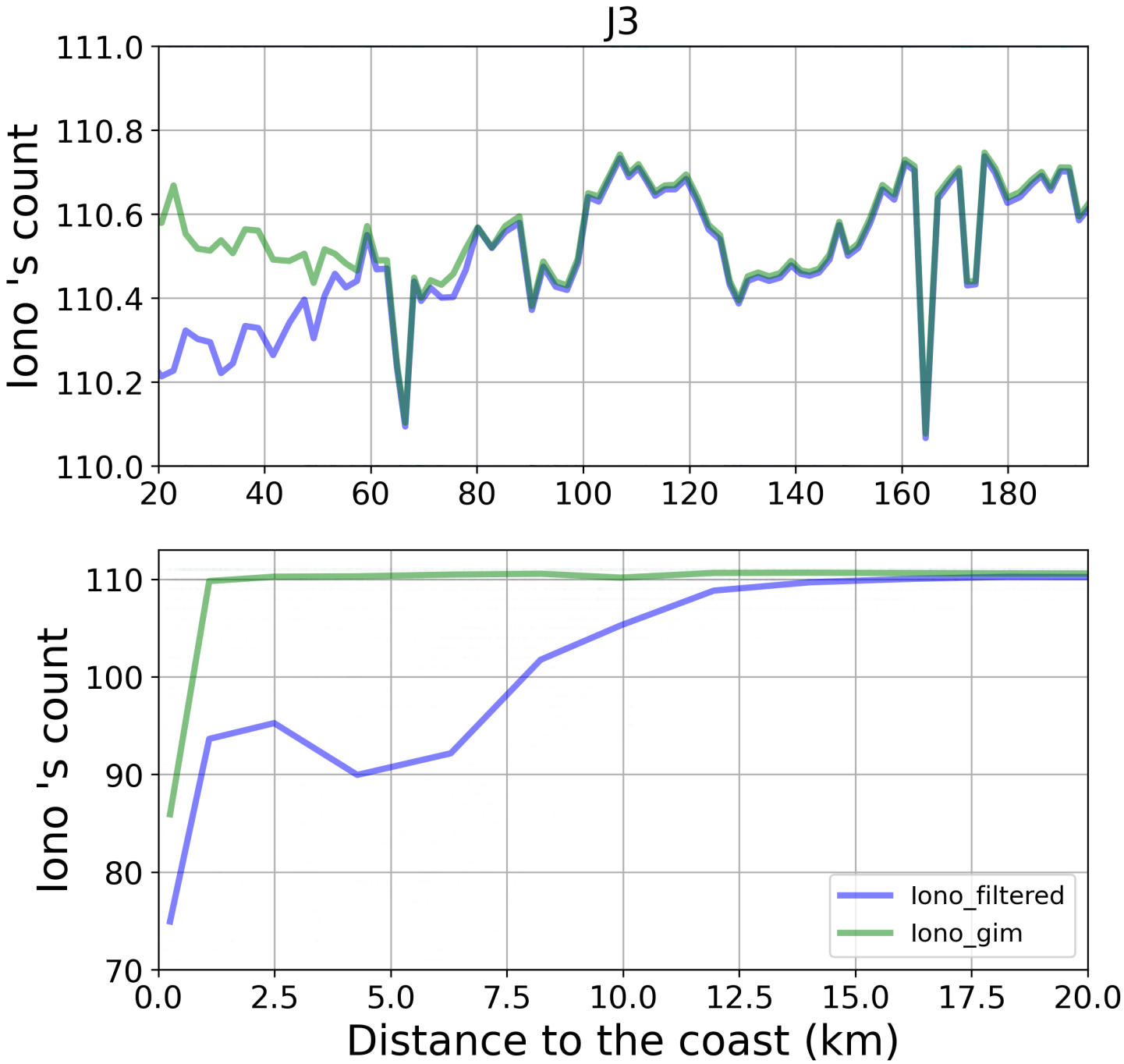

FIGURE 22 – Along-track analysis of Iono 's count

5.1.2 Iono 's std

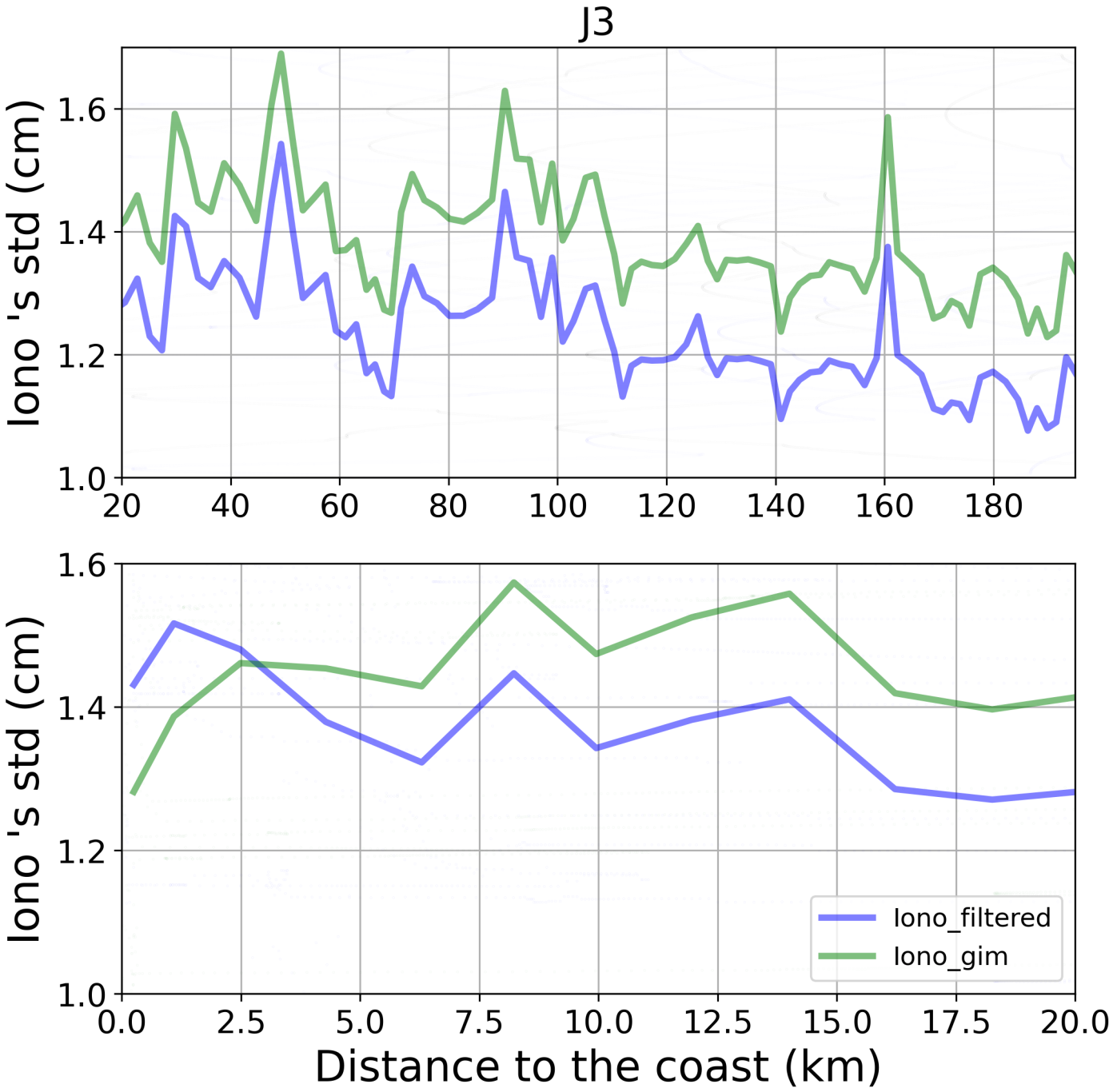

FIGURE 23 – Along-track analysis of Iono 's std

5.1.3 Iono 's mean

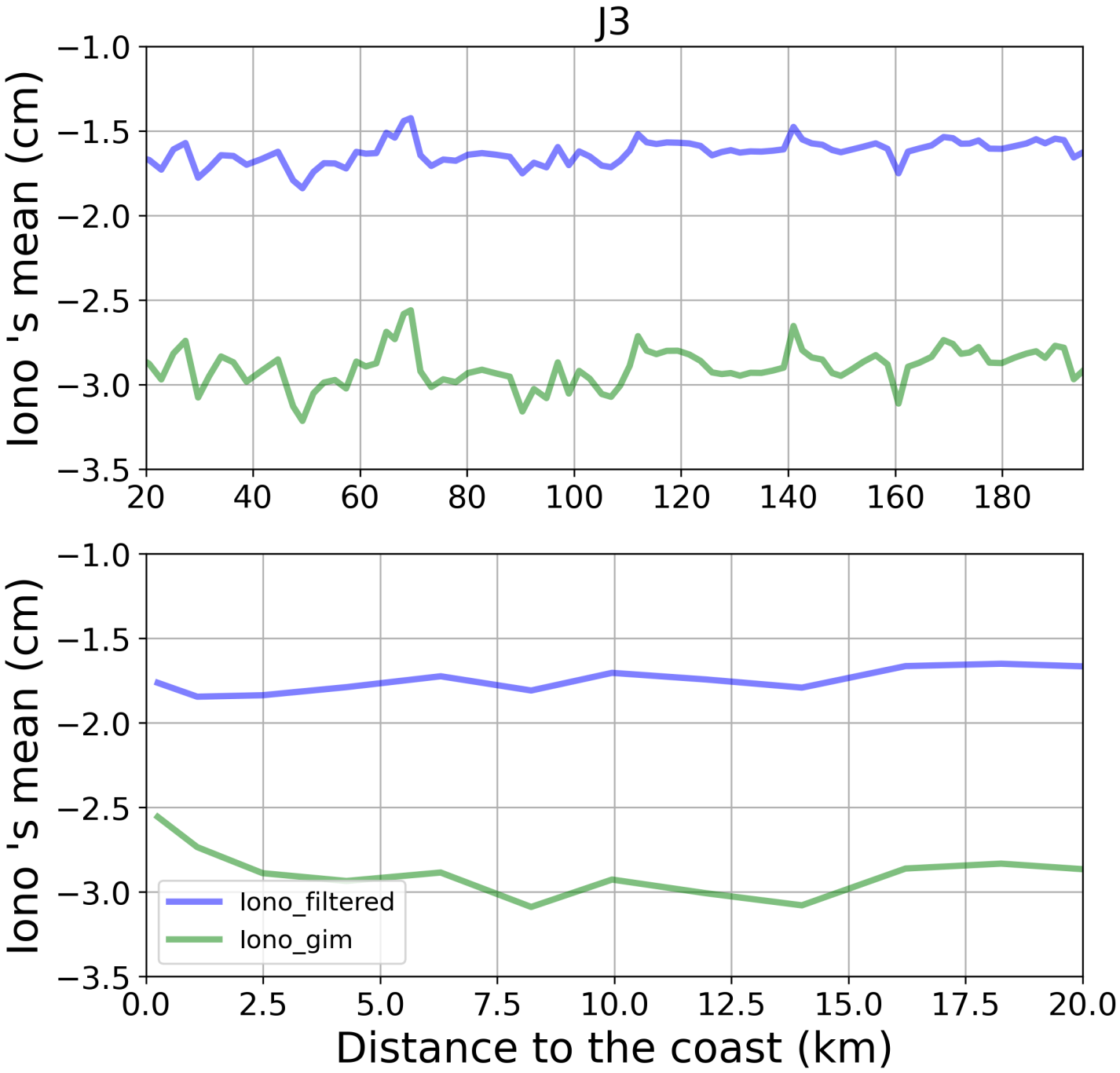

FIGURE 24 – Along-track analysis of Iono 's mean

5.2 sla

5.2.1 sla 's count

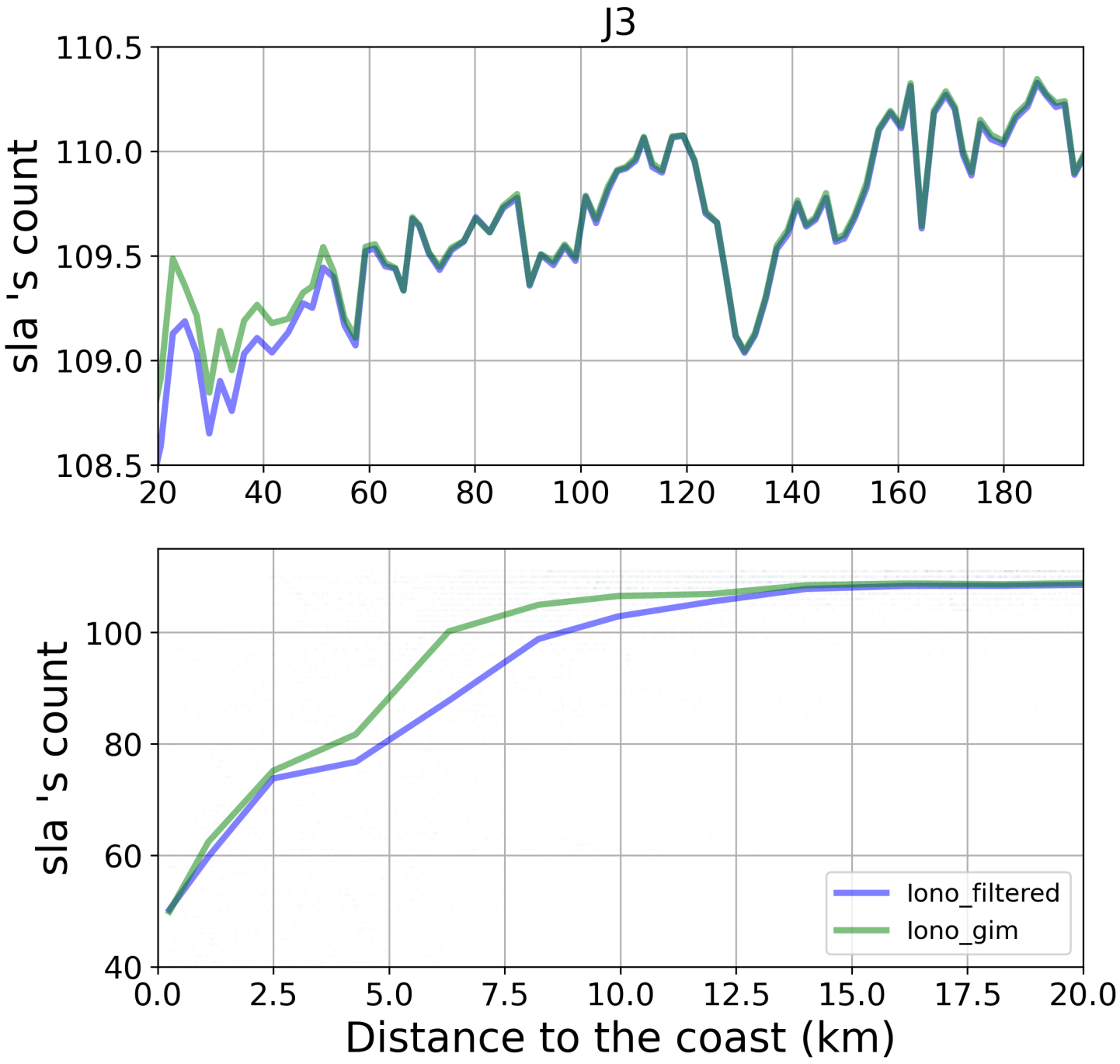

FIGURE 25 – Along-track analysis of sla 's count

5.2.2 sla 's std

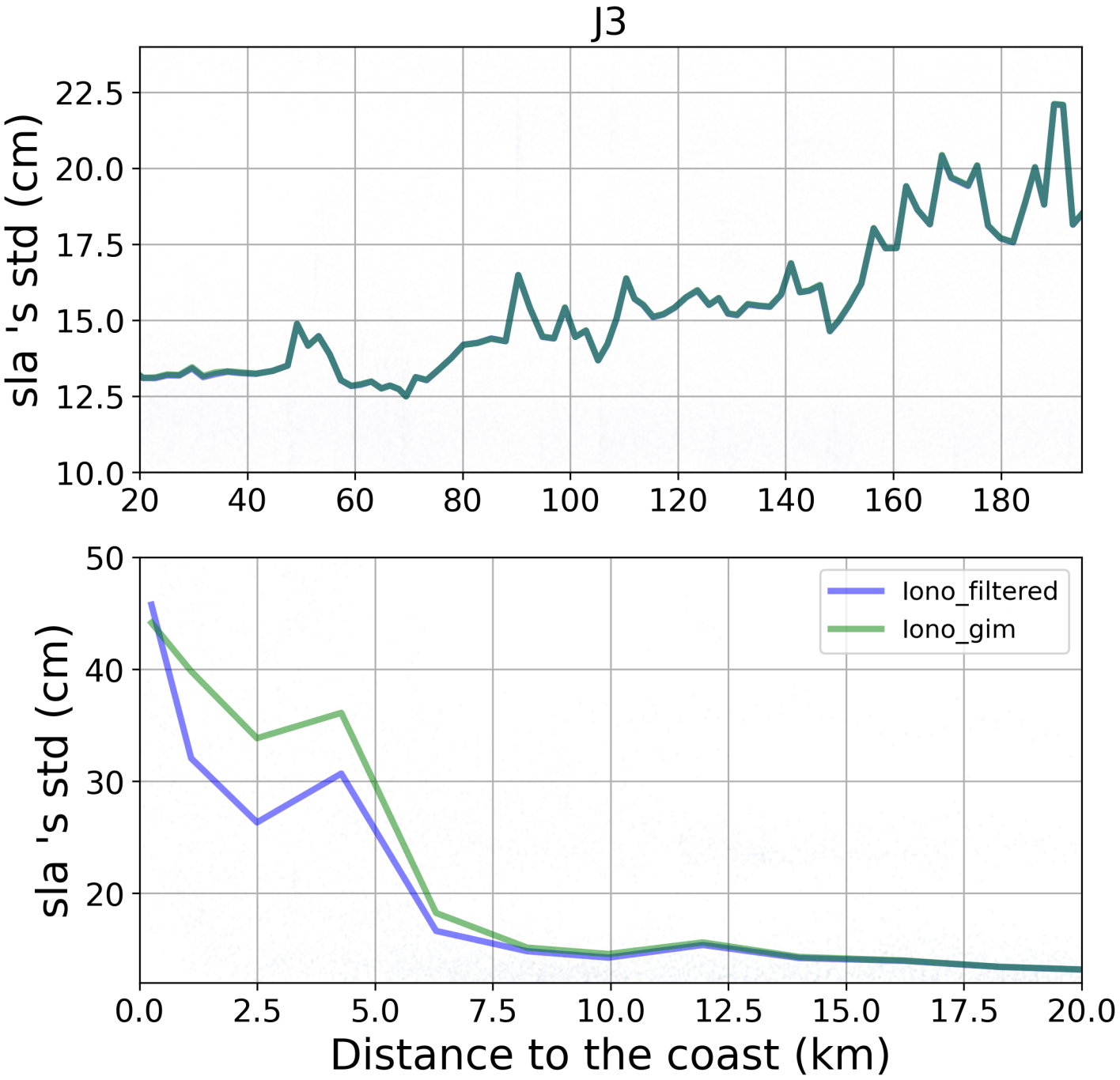

FIGURE 26 – Along-track analysis of sla 's std

5.2.3 sla 's mean

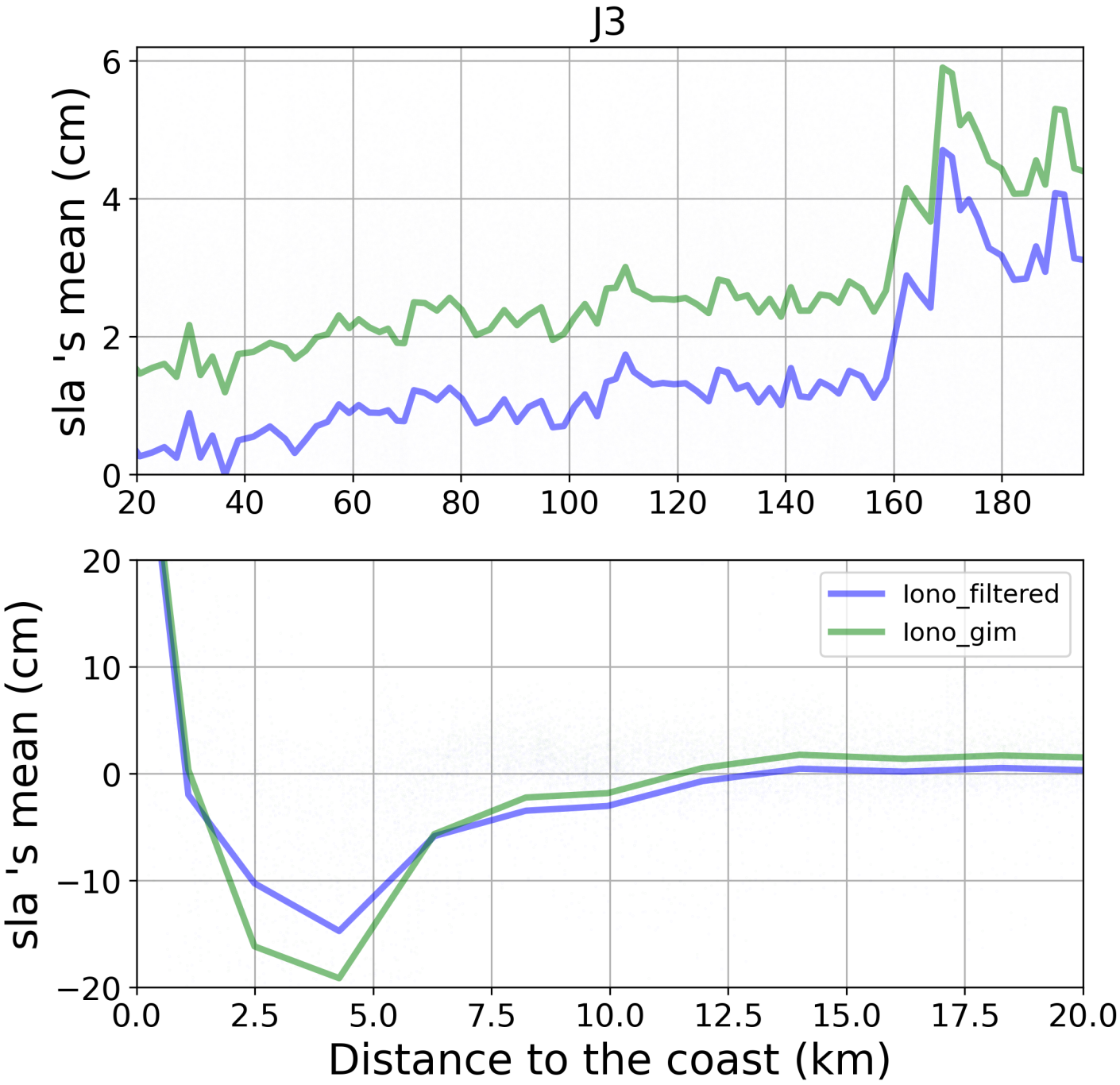

Figure 27 – Along-track analysis of sla 's mean

6 Comparison with Insitu Data (Tide Gauge)

The size of the marker representing each point in the figures below increase by getting closer to the coast

6.1 Station : Lorne_Jetty

- Nearest track to Lorne_Jetty station is the track number track88
- The area of interest is limited by :
  - A circle which it's center is the Lorne_Jetty tide gauge station location and has a Raduis of 40 Km
  - Maximum distance to the coast : 20 Km

6.1.1 correlation visualization in maps view % Lorne_Jetty tide gauge

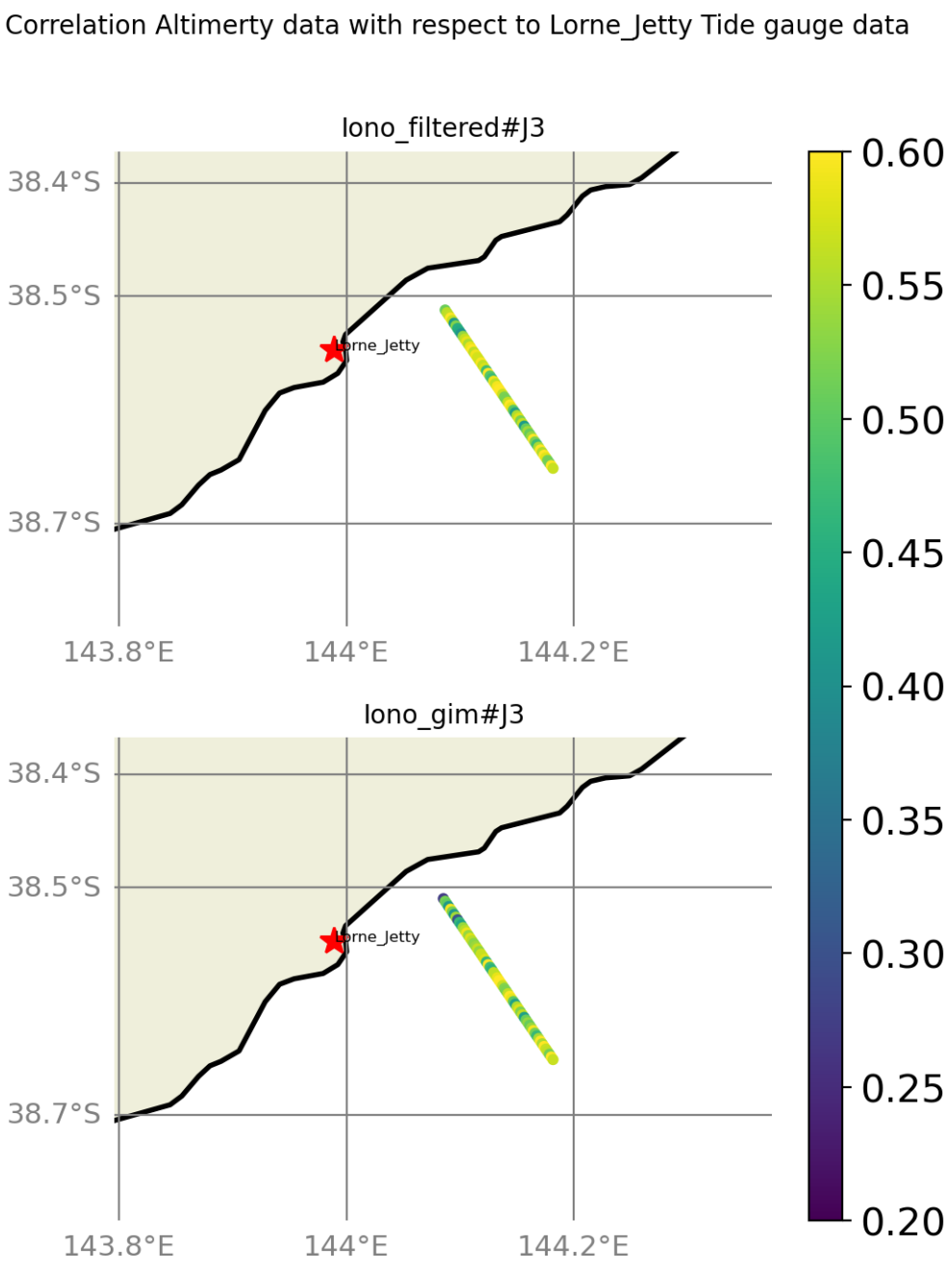

Figure 28 – correlation visualization in maps view % Lorne_Jetty tide gauge

6.1.2 rmsd visualization in maps view % Lorne_Jetty tide gauge

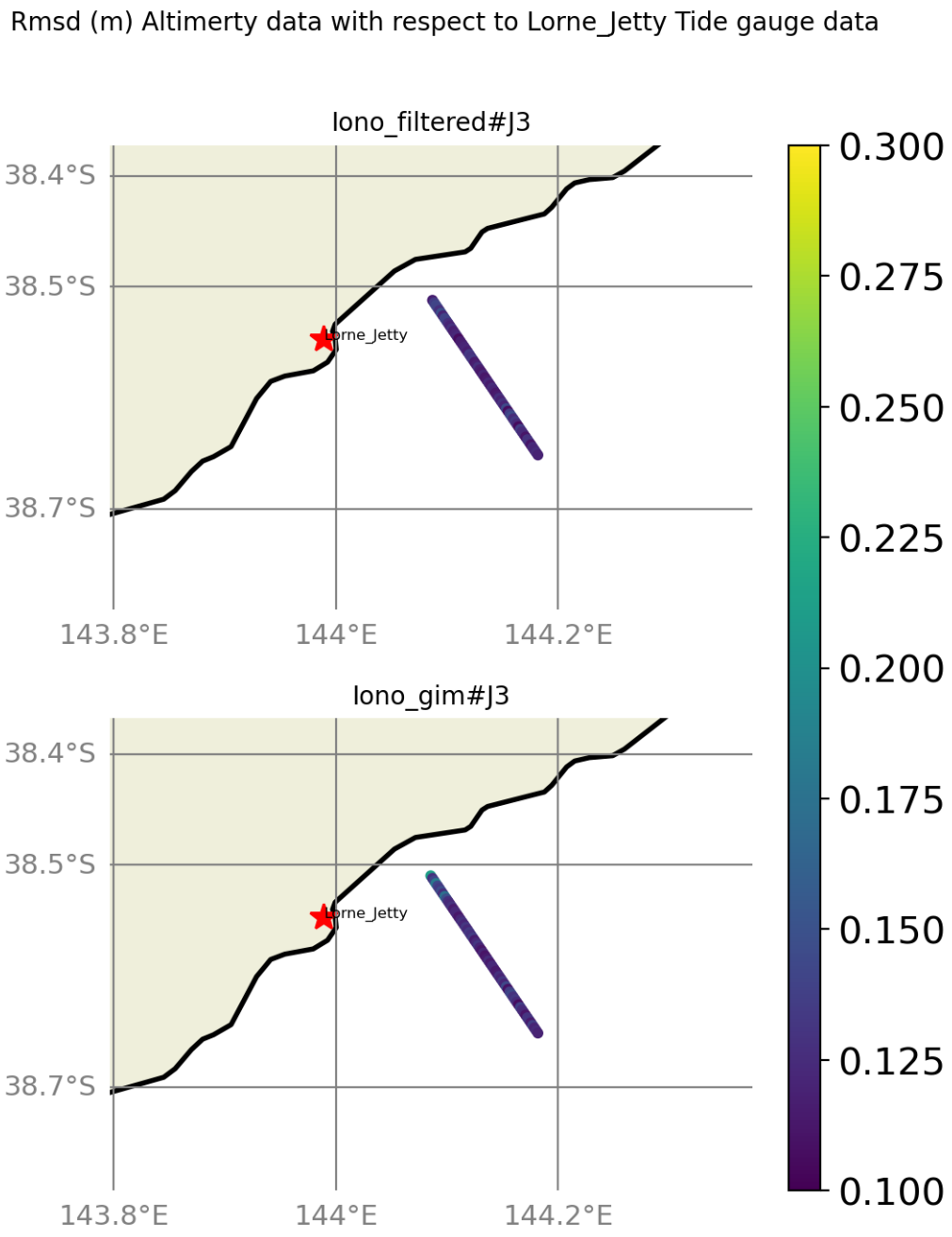

FIGURE 29 – rmsd visualization in maps view % Lorne_Jetty tide gauge

6.1.3 std visualization in maps view % Lorne_Jetty tide gauge

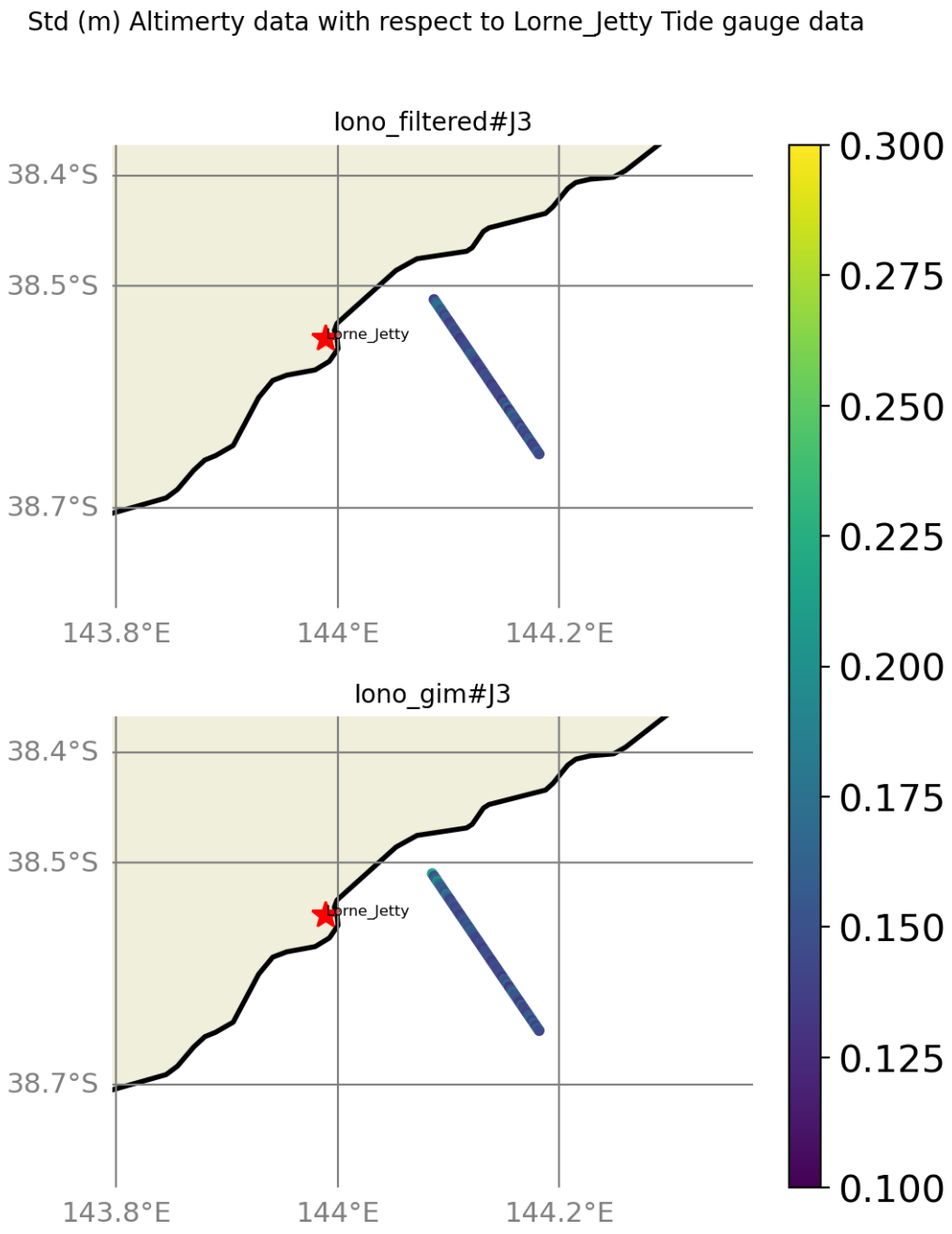

FIGURE 30 – std visualization in maps view % Lorne_Jetty tide gauge

6.1.4 valid_data_percent visualization in maps view % Lorne_Jetty tide gauge

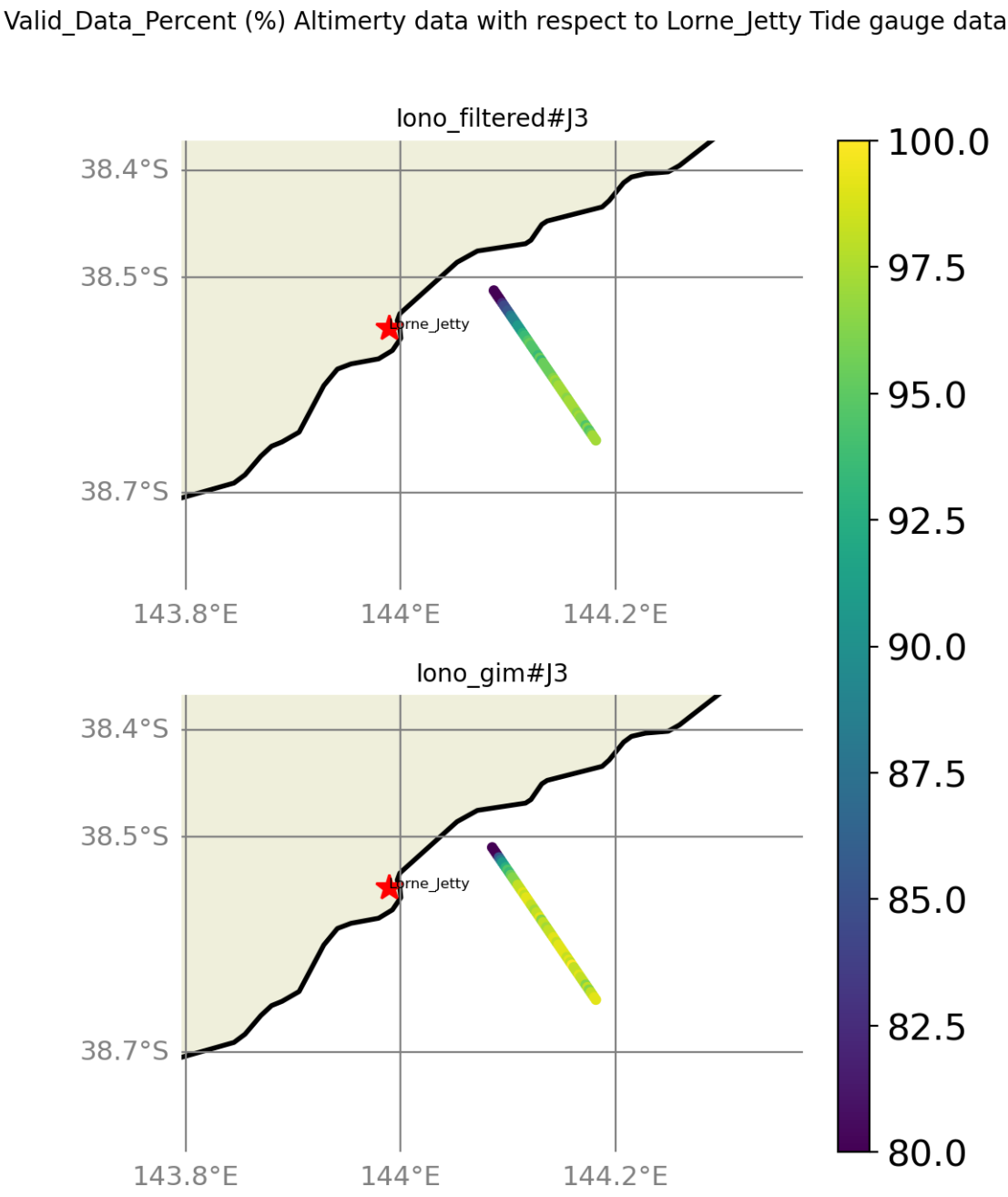

FIGURE 31 – valid_data_percent visualization in maps view % Lorne_Jetty tide gauge

6.1.5 Valid data (%) in function of distance to coast/Lorne_Jetty station

The formula to calculate the percentage of valid data in each time serie is;

$$pvd_i = \frac{nvd_i}{maxNB}, i = 1, np$$

Where *pvd* and *nvd* are the percentage of data and the number of altimetry data in the period covered by the tide gauge sla time serie, respectively in the time serie, i is the index of the time serie, np is the number of the selected altimetry time series. $maxNB = 109$ point is the maximum number of valid altimetry points in the set of all the altimetry sla time series covered by the period of time of the Tide gauge sla time serie.

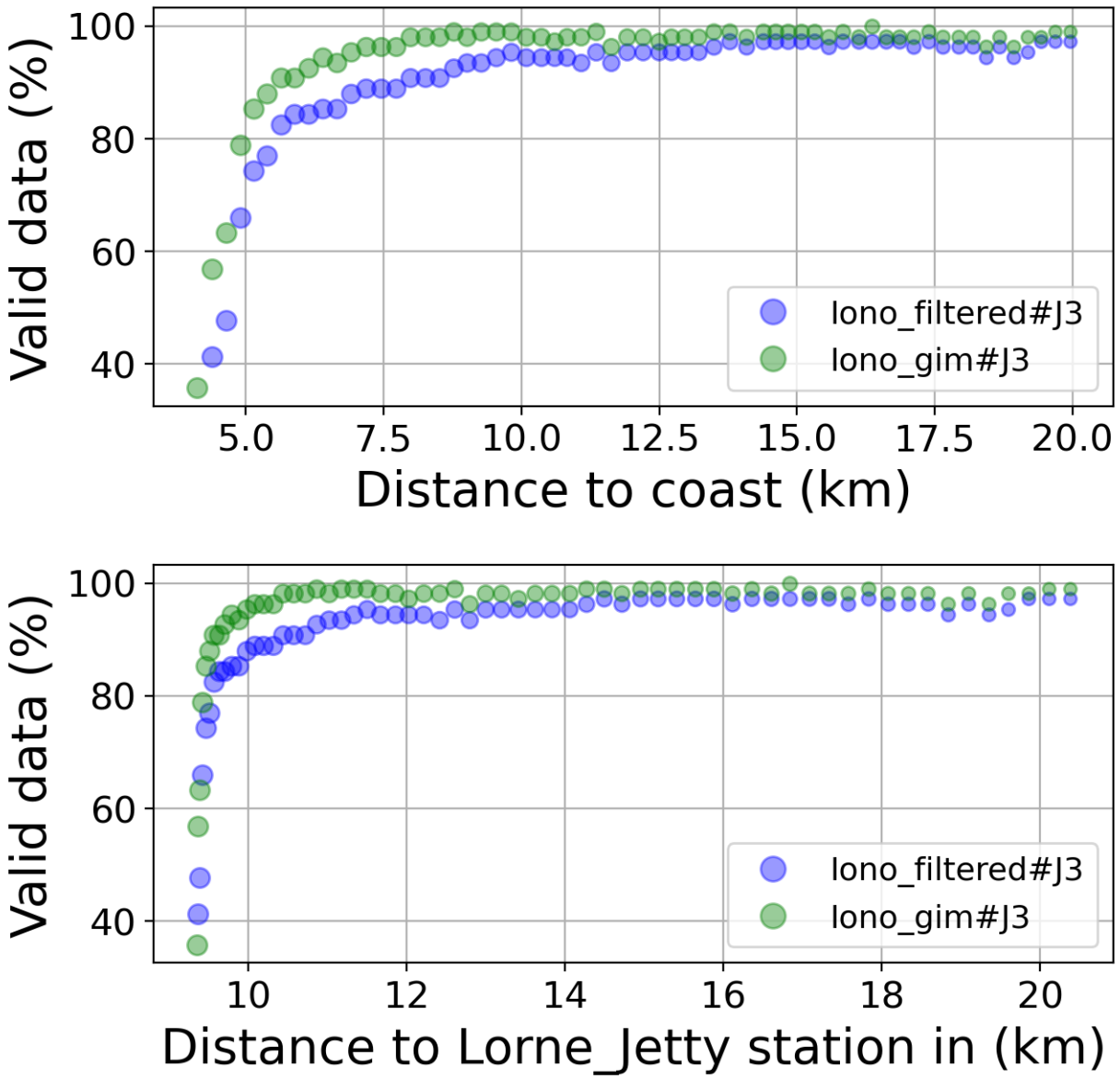

FIGURE 32 – Valid data (%) in function of distance to coast/Lorne_Jetty station

6.1.6 Std in function of distance to coast/Lorne_Jetty station

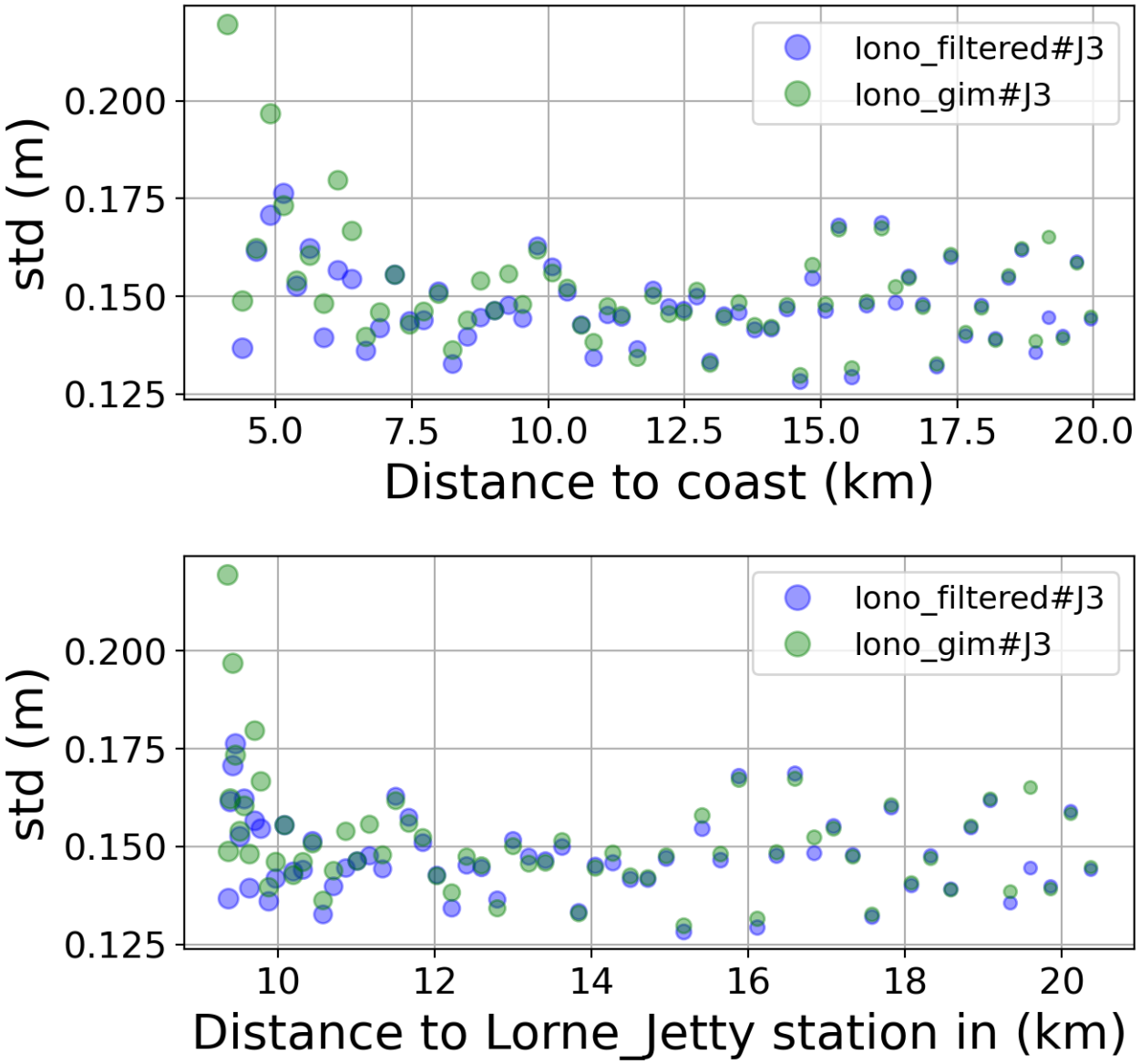

FIGURE 33 – Std in function of the distance to the coast/Lorne_Jetty station

6.1.7 Correlation in function of distance to coast/Lorne_Jetty station

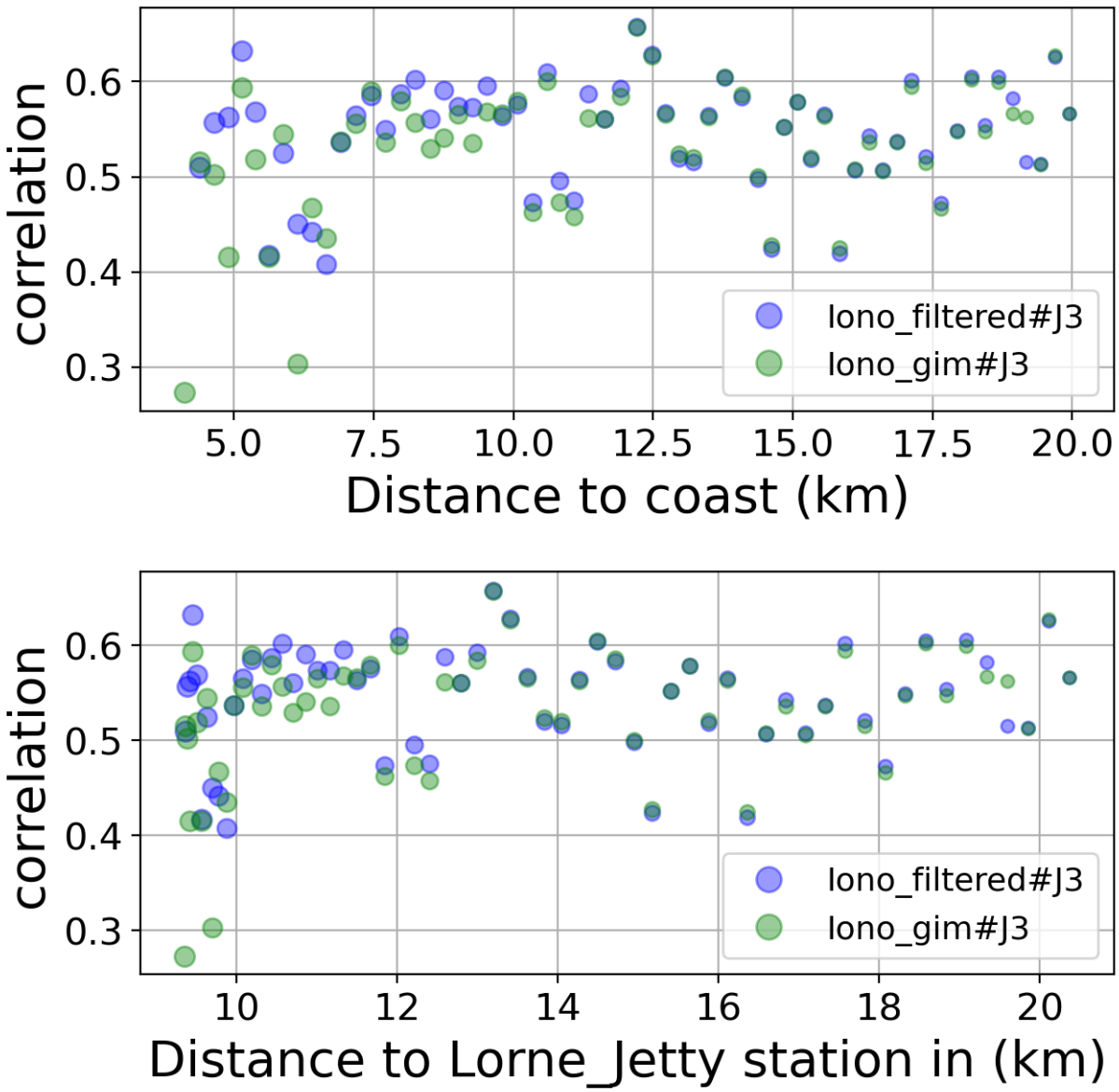

FIGURE 34 – Correlation in function of the distance to the coast/Lorne_Jetty station

6.1.8 Taylor Diagram

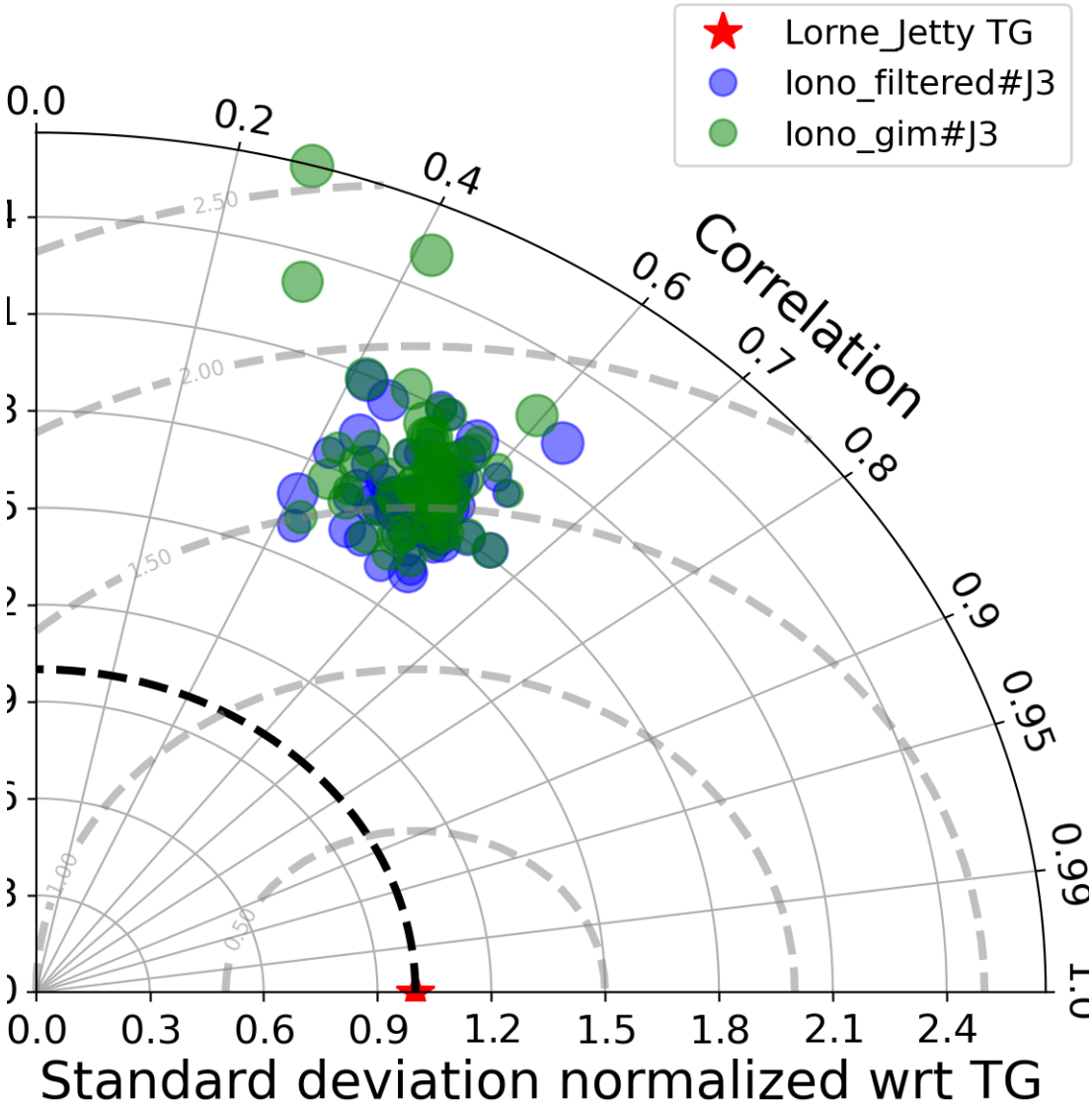

FIGURE 35 – Taylor diagram

6.1.9 Mean statistics table of products comparison with Lorne_Jetty tide gauge data

The table below contains the mean statistics of the common points between the different products in the selected area.

Product	Valid data (%)	Correlation	std (m)	rmsd (m)
iono_filtered#J3	91.352	0.546	0.148	0.124
Iono_gim#J3	95.774	0.536	0.15	0.127

Figure 36 – Mean statistics table of the common points in the altimetry products

6.1.10 The most correlated sla altimetry Time series with the tide gauge sla time serie

The maximum number of valid altimetry points in the set of all the altimetry sla time series covered by the period of time of the Tide gauge sla time serie is 109 point.

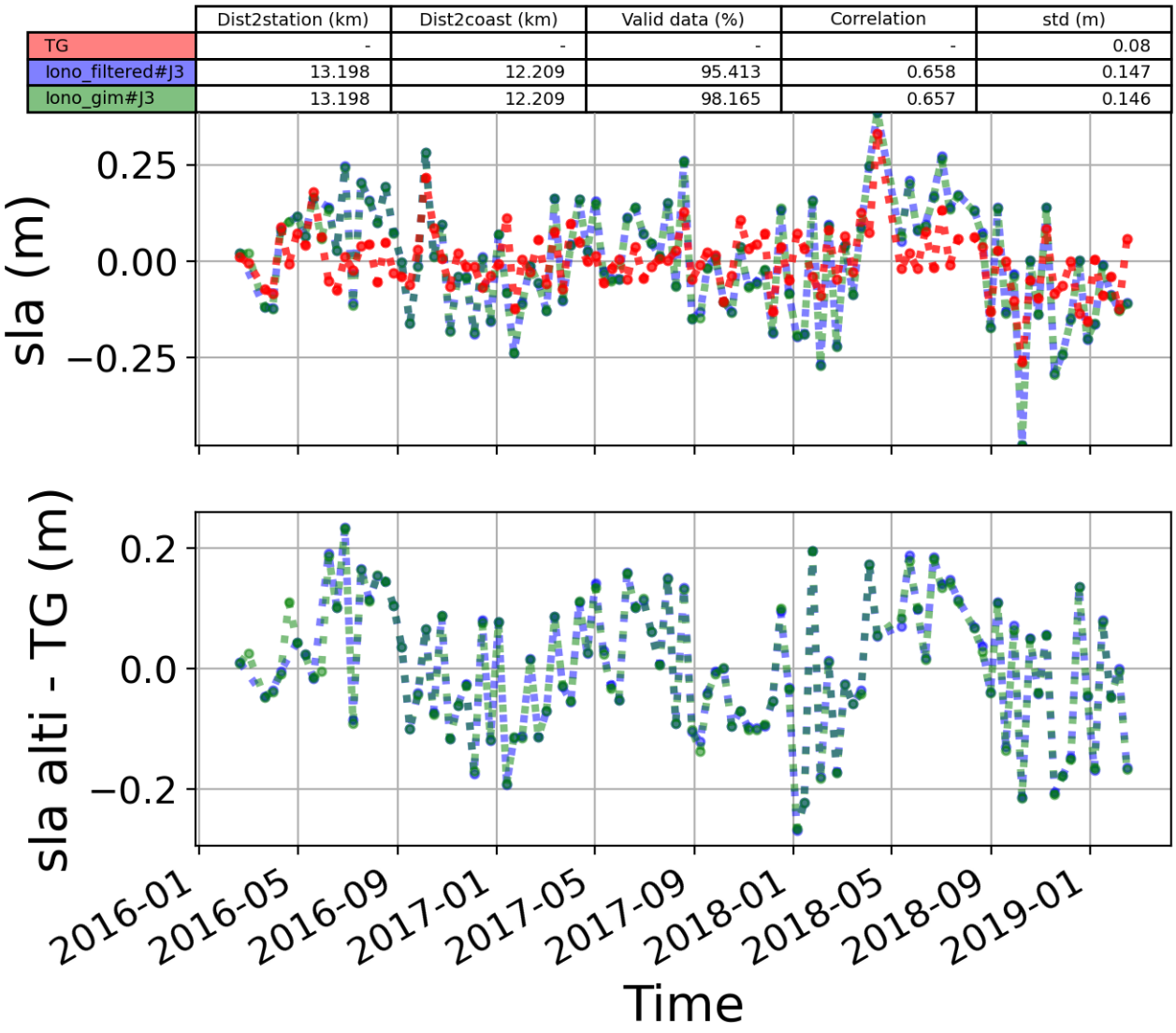

FIGURE 37 – The 1st most correlated sla altimetry Time serie with tide gauge sla time serie

6.2 Station : Bundaberg

- Nearest track to Bundaberg station is the track number track149
- The area of interest is limited by :
  - A circle which it's center is the Bundaberg tide gauge station location and has a Raduis of 40 Km
  - Maximum distance to the coast : 20 Km

6.2.1 correlation visualization in maps view % Bundaberg tide gauge

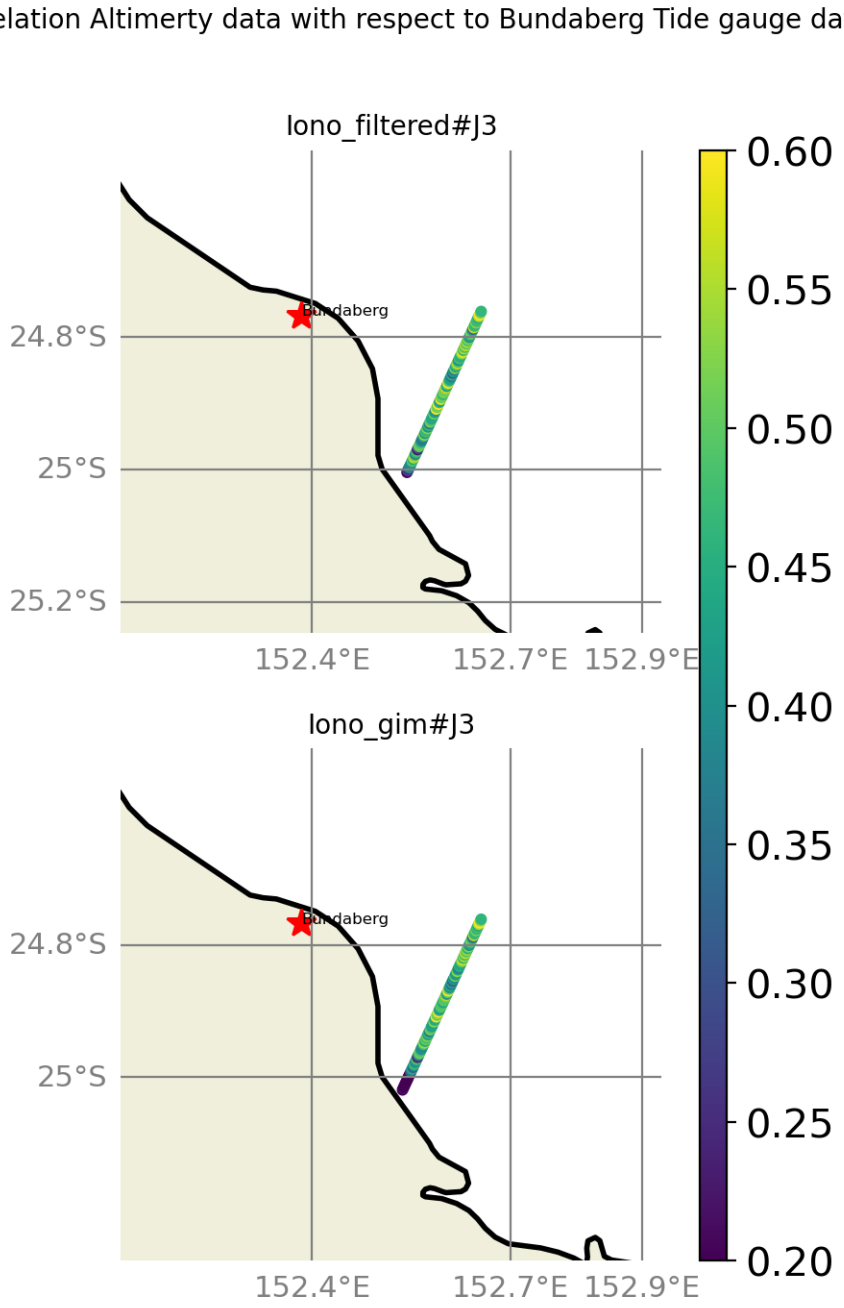

FIGURE 38 – correlation visualization in maps view % Bundaberg tide gauge

6.2.2 rmsd visualization in maps view % Bundaberg tide gauge

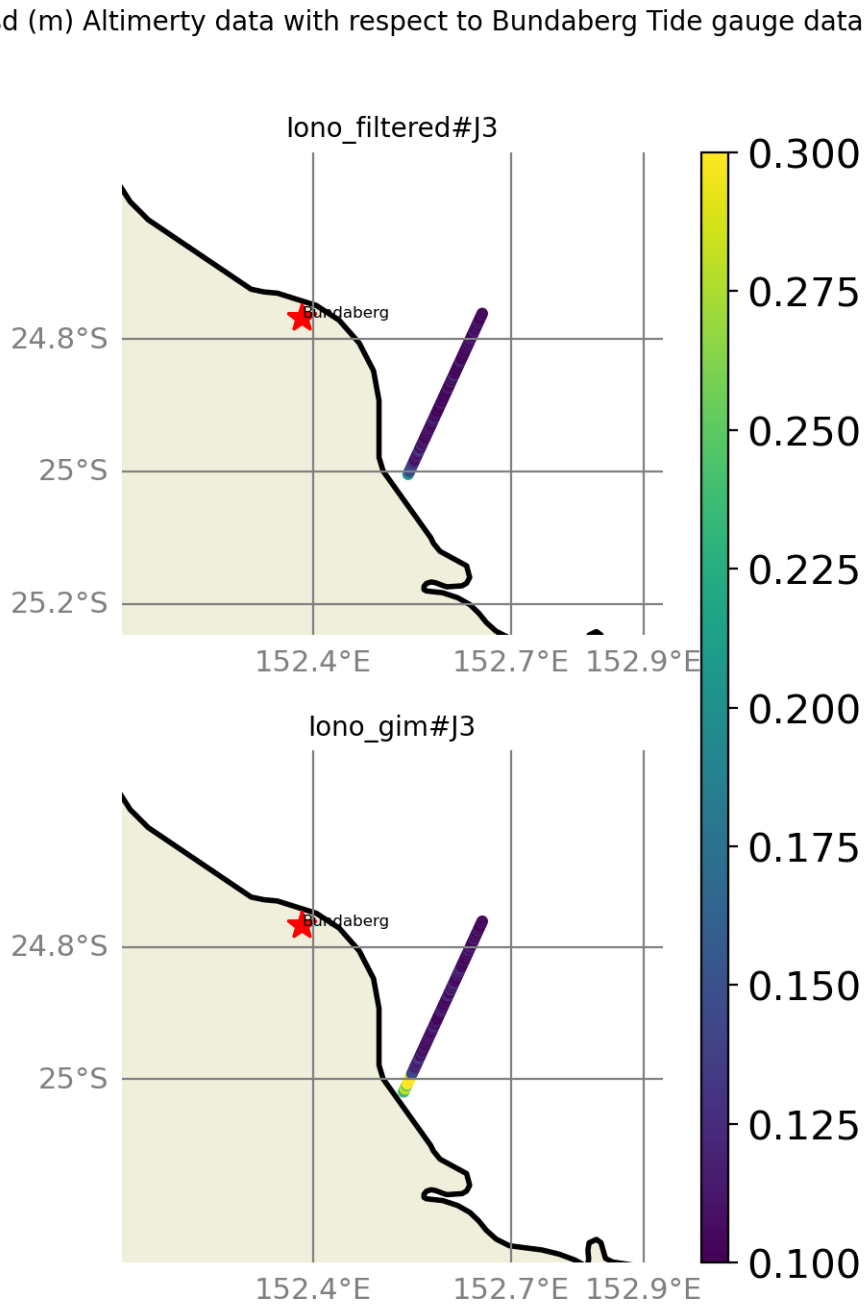

FIGURE 39 – rmsd visualization in maps view % Bundaberg tide gauge

6.2.3 std visualization in maps view % Bundaberg tide gauge

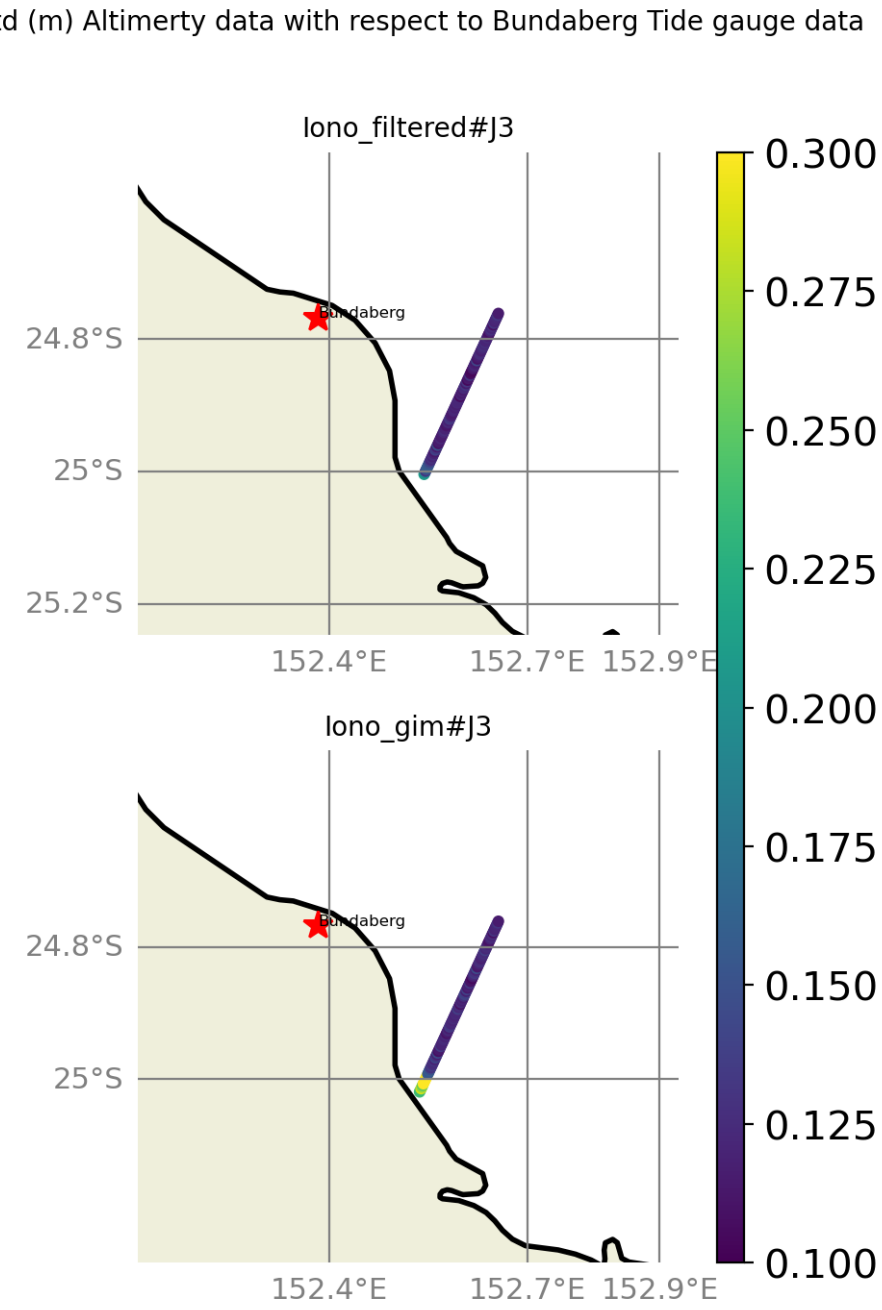

FIGURE 40 – std visualization in maps view % Bundaberg tide gauge

6.2.4 valid_data_percent visualization in maps view % Bundaberg tide gauge

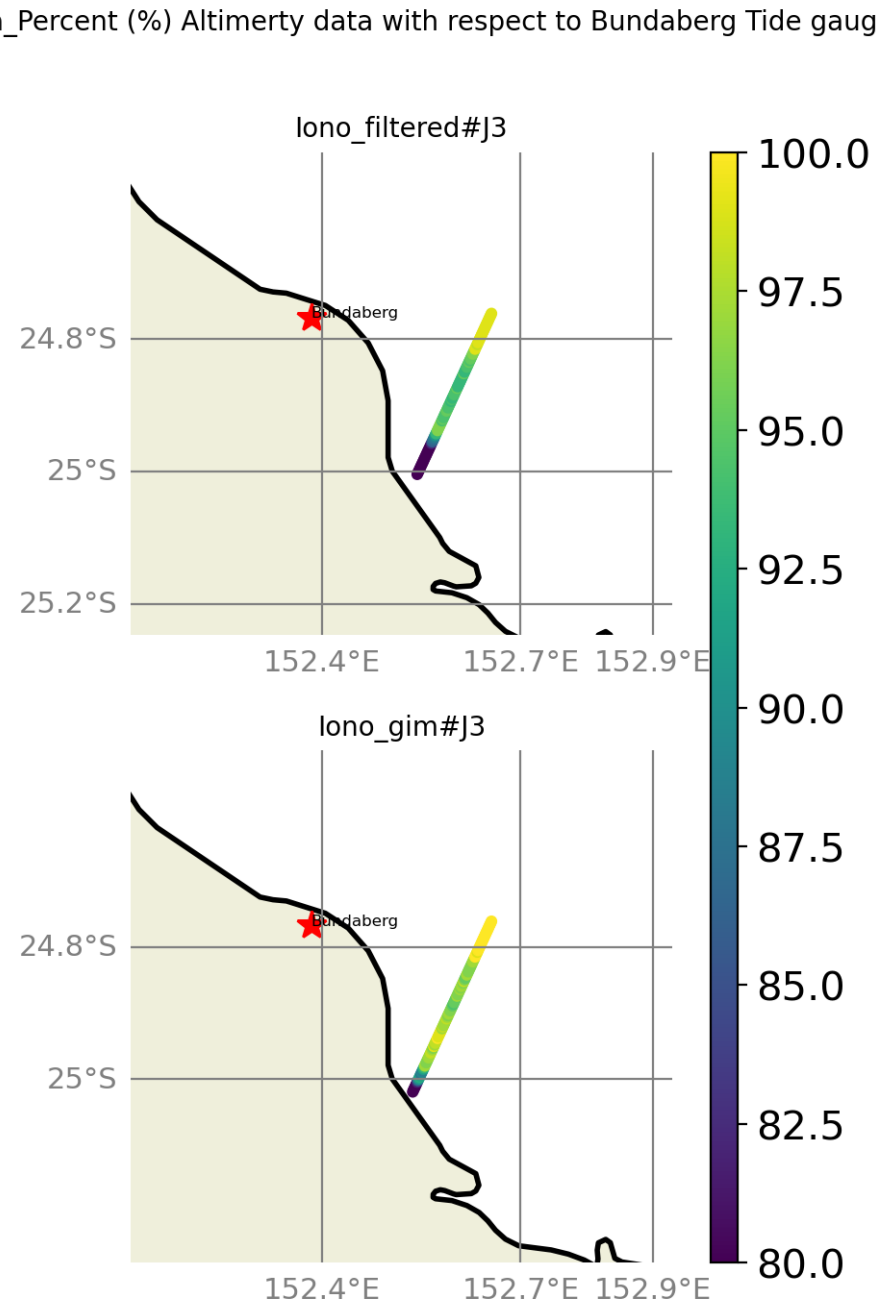

FIGURE 41 – valid_data_percent visualization in maps view % Bundaberg tide gauge

6.2.5 Valid data (%) in function of distance to coast/Bundaberg station

The formula to calculate the percentage of valid data in each time serie is;

$$pvd_i = \frac{nvd_i}{maxNB}, i = 1, np$$

Where *pvd* and *nvd* are the percentage of data and the number of altimetry data in the period covered by the tide gauge sla time serie, respectively in the time serie, i is the index of the time serie, np is the number of the selected altimetry time series. $maxNB = 105$ point is the maximum number of valid altimetry points in the set of all the altimetry sla time series covered by the period of time of the Tide gauge sla time serie.

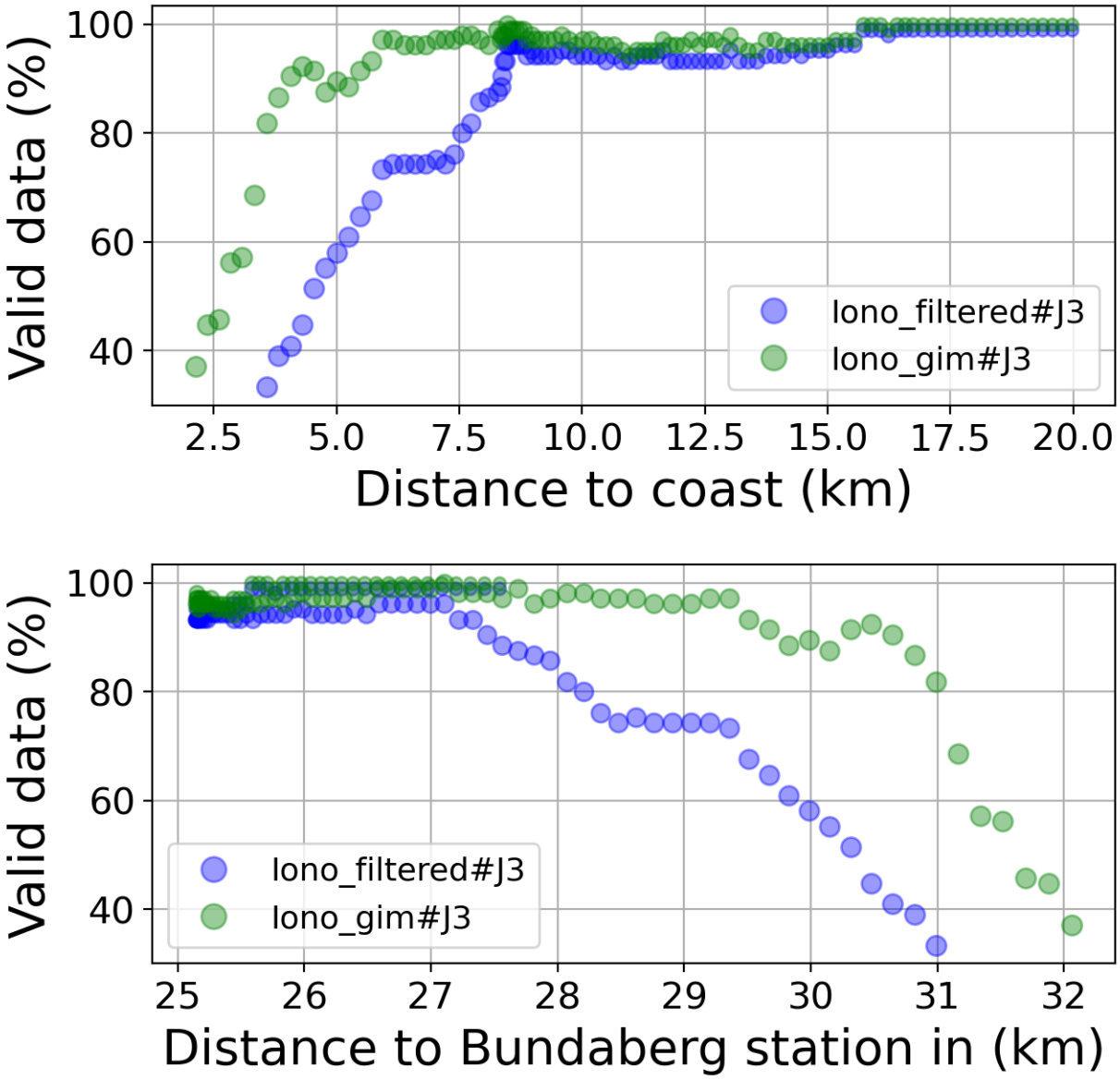

FIGURE 42 – Valid data (%) in function of distance to coast/Bundaberg station

6.2.6 Std in function of distance to coast/Bundaberg station

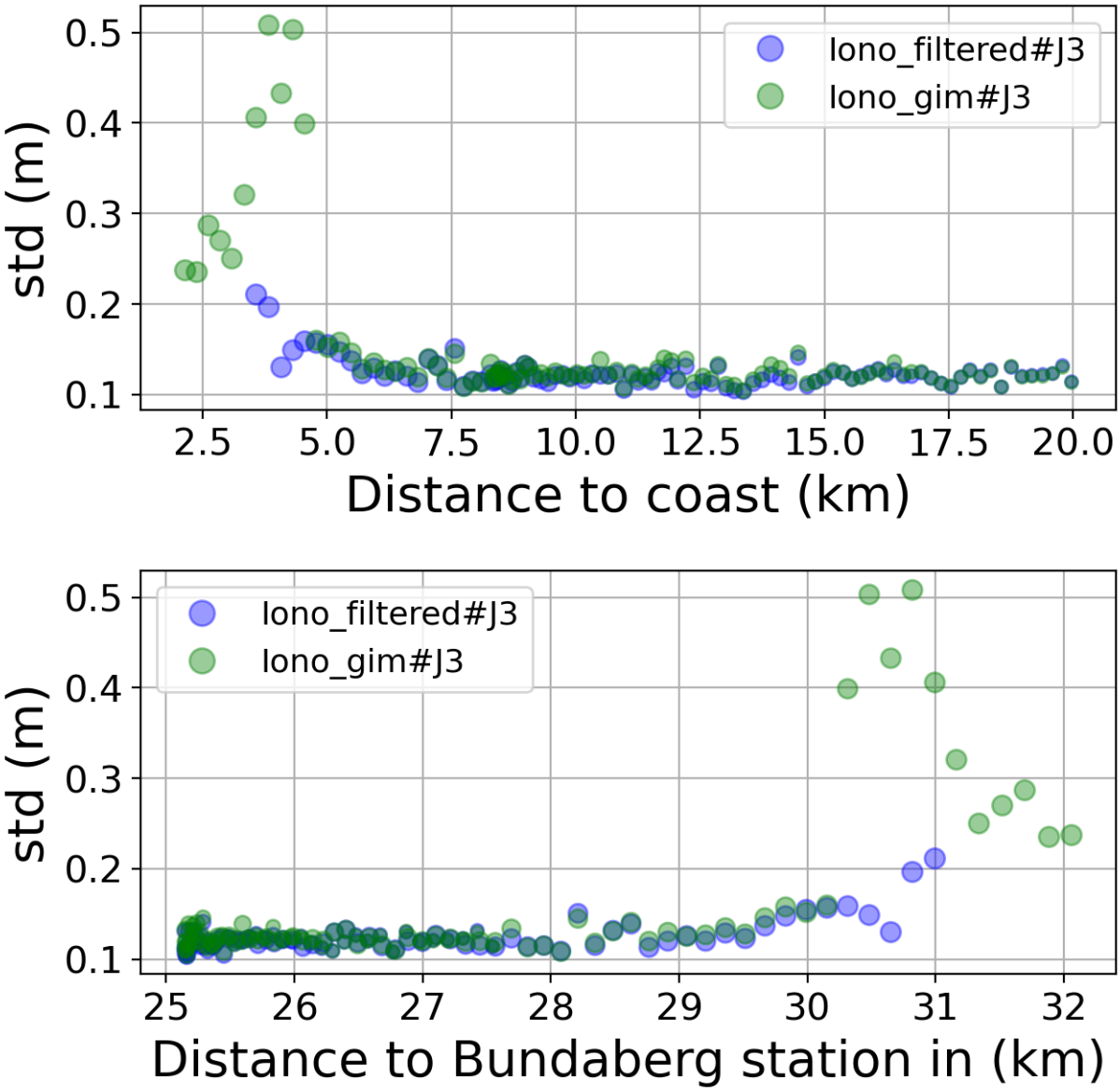

FIGURE 43 – Std in function of the distance to the coast/Bundaberg station

6.2.7 Correlation in function of distance to coast/Bundaberg station

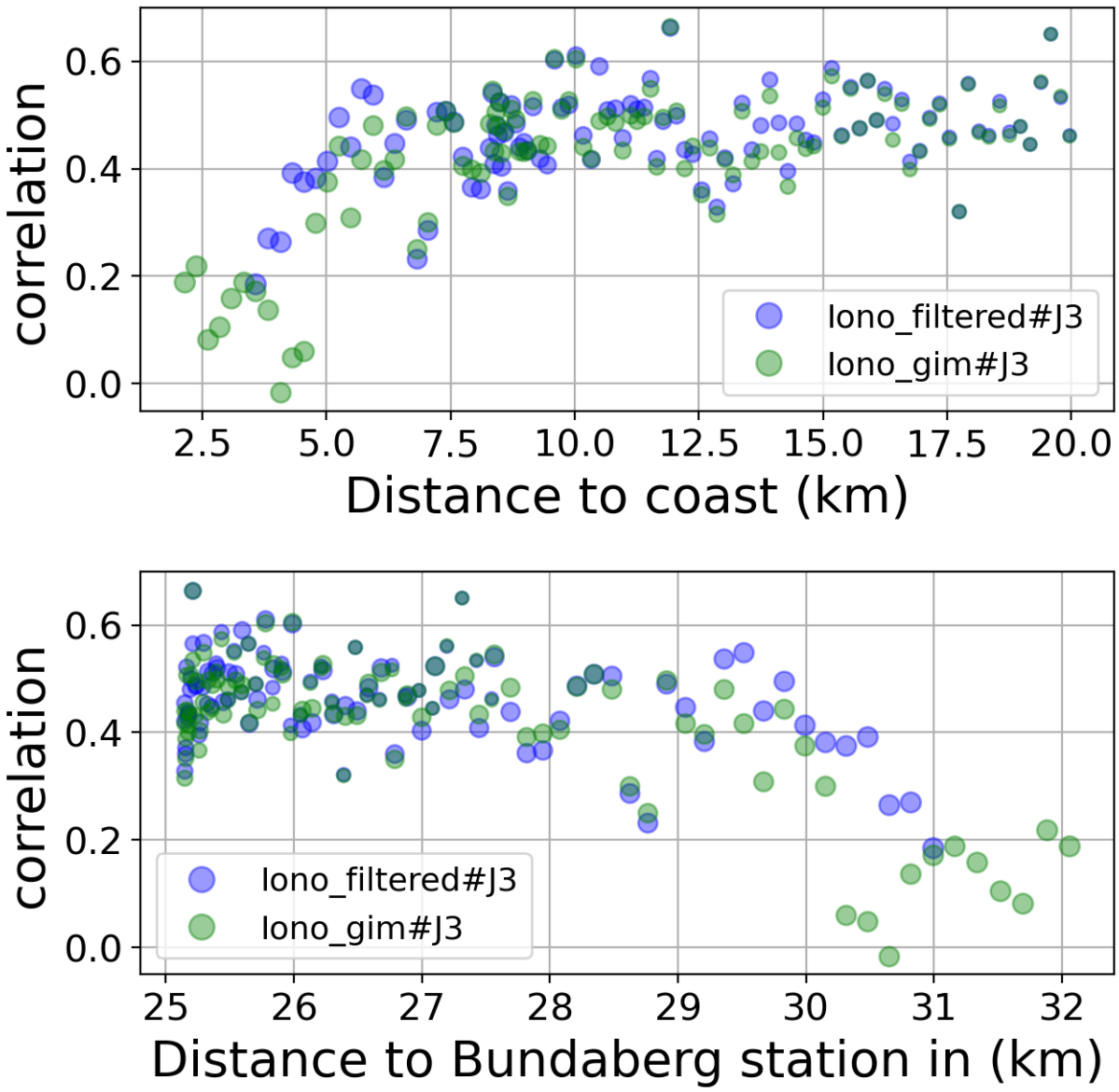

FIGURE 44 – Correlation in function of the distance to the coast/Bundaberg station

6.2.8 Taylor Diagram

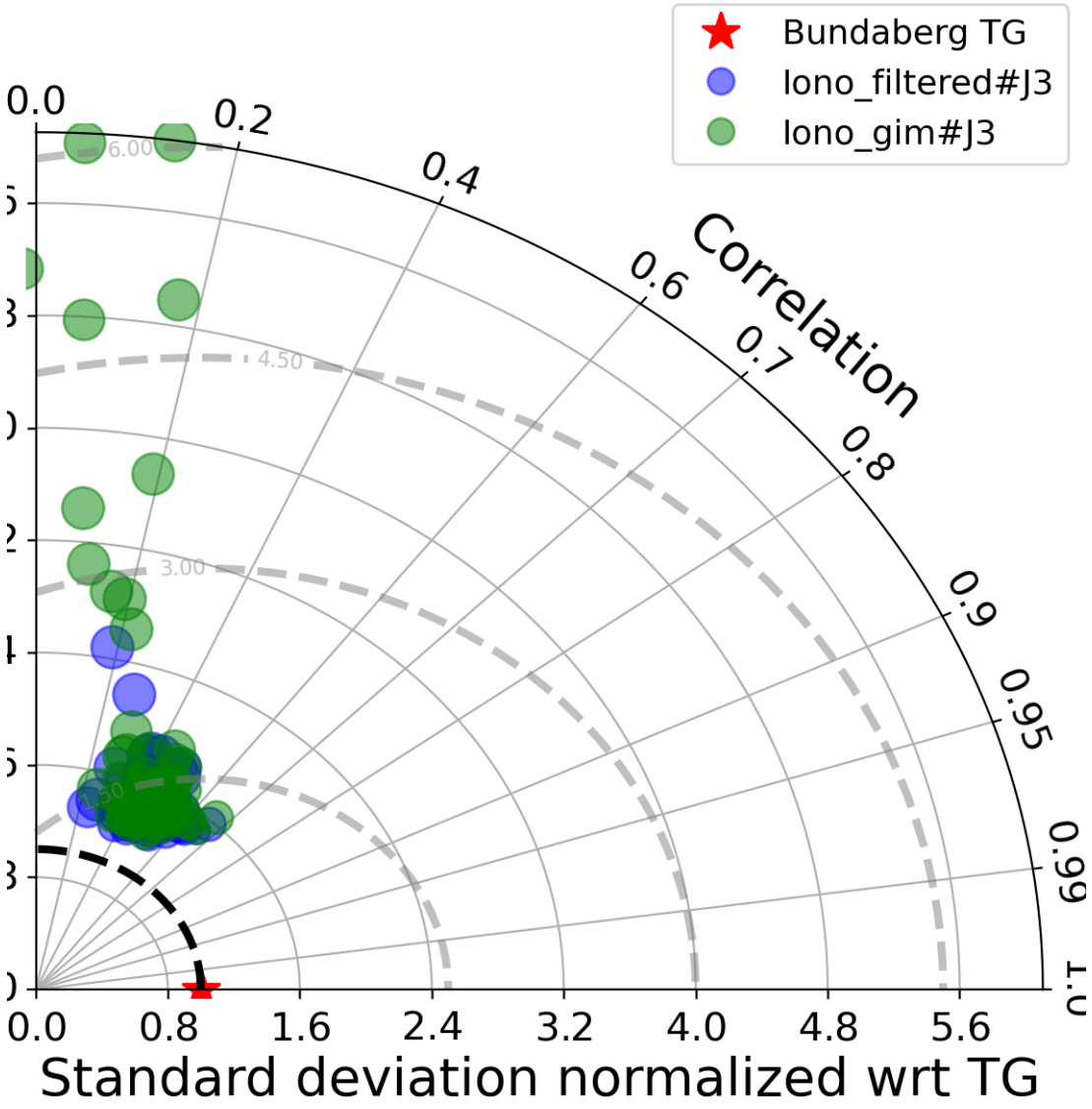

FIGURE 45 – Taylor diagram

6.2.9 Mean statistics table of products comparison with Bundaberg tide gauge data

The table below contains the mean statistics of the common points between the different products in the selected area.

Product	Valid data (%)	Correlation	std (m)	rmsd (m)
iono_filtered#J3	89.038	0.465	0.124	0.113
Iono_gim#J3	96.876	0.445	0.141	0.13

Figure 46 – Mean statistics table of the common points in the altimetry products

6.2.10 The most correlated sla altimetry Time series with the tide gauge sla time serie

The maximum number of valid altimetry points in the set of all the altimetry sla time series covered by the period of time of the Tide gauge sla time serie is 105 point.

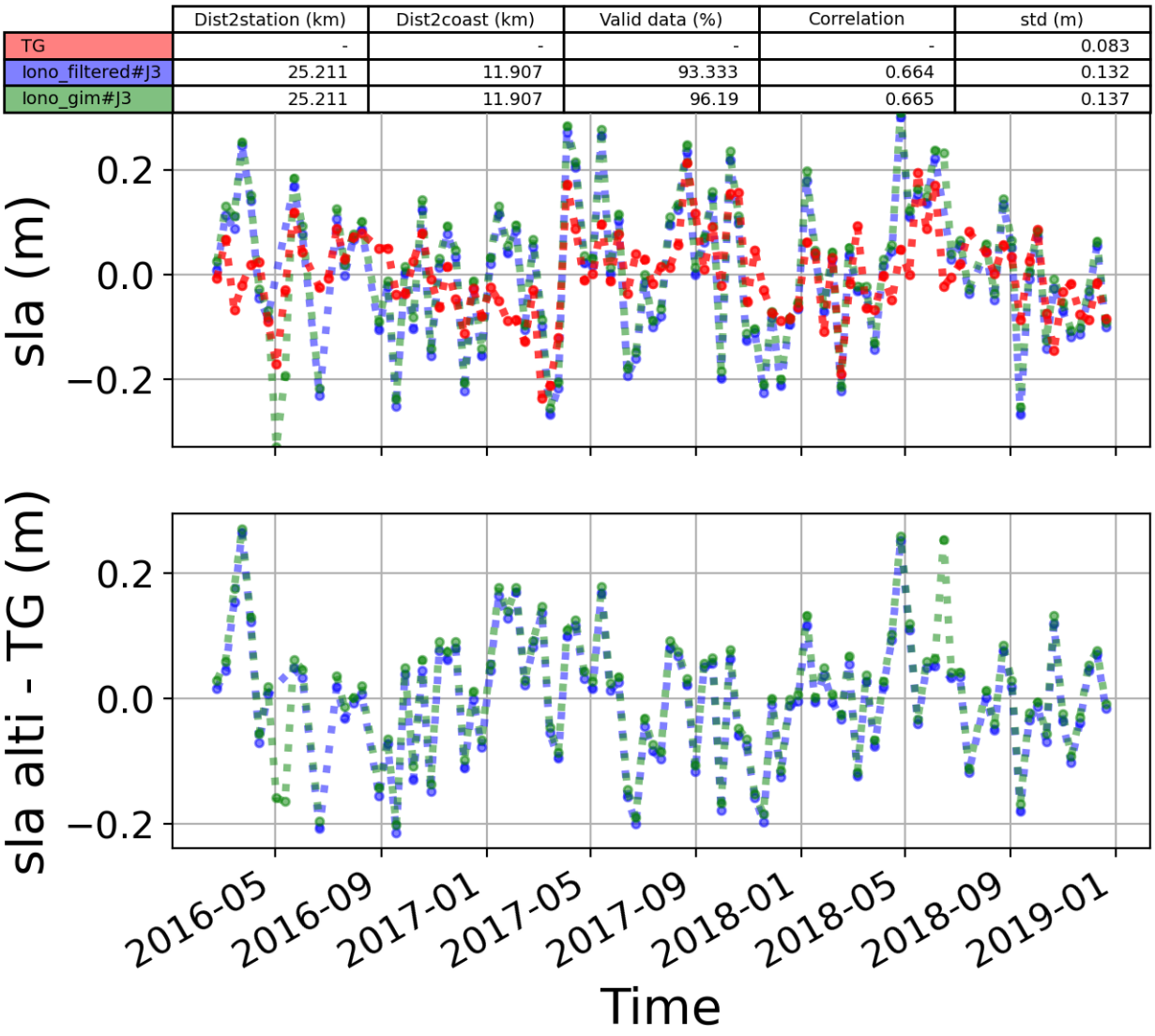

FIGURE 47 – The 1st most correlated sla altimetry Time serie with tide gauge sla time serie

6.3 Station : Thursday_Island

- Nearest track to Thursday_Island station is the track number track138
- The area of interest is limited by :
  - A circle which it's center is the Thursday_Island tide gauge station location and has a Raduis of 40 Km
  - Maximum distance to the coast : 20 Km

6.3.1 correlation visualization in maps view % Thursday_Island tide gauge

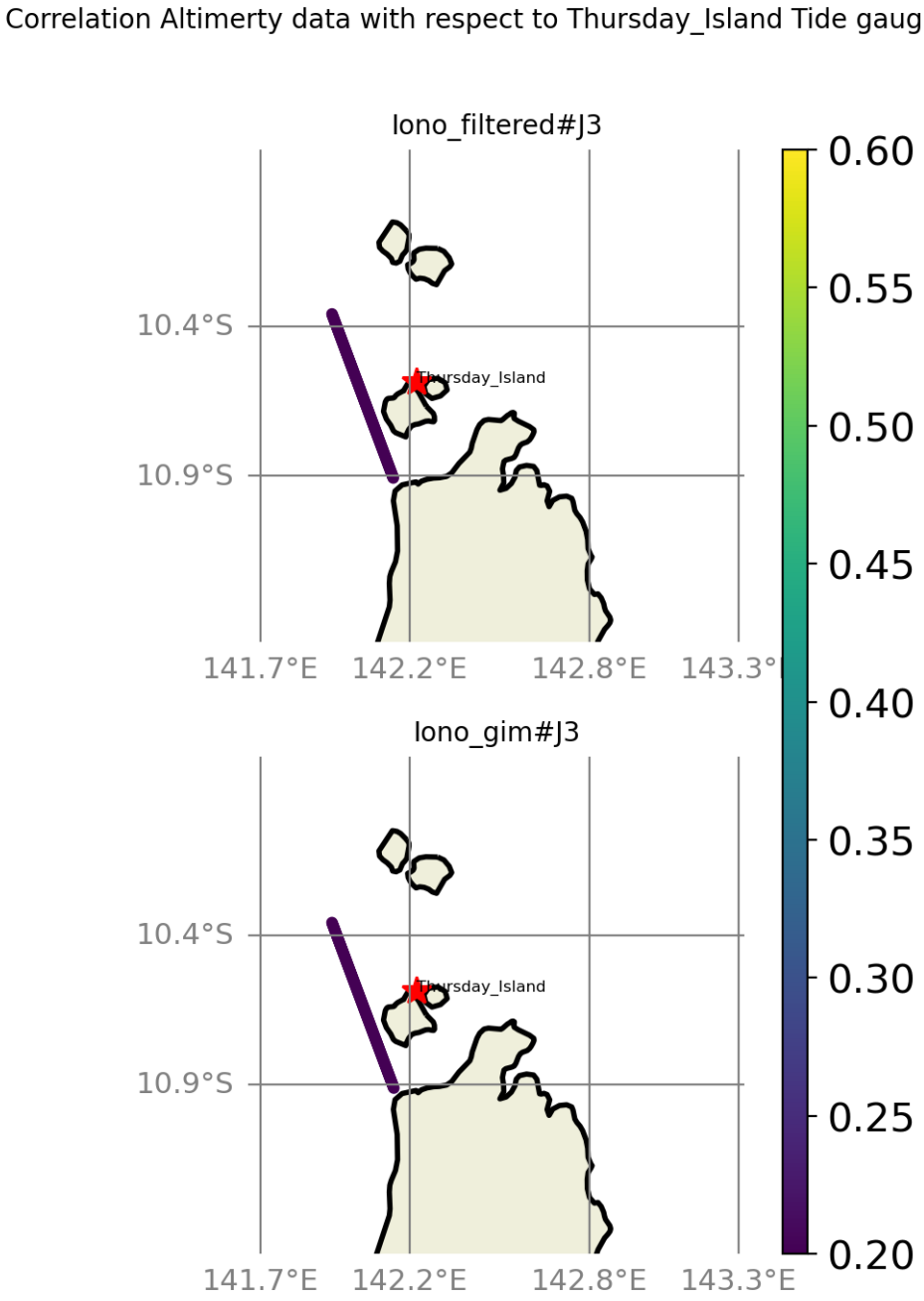

Figure 48 – correlation visualization in maps view % Thursday_Island tide gauge

6.3.2 rmsd visualization in maps view % Thursday_Island tide gauge

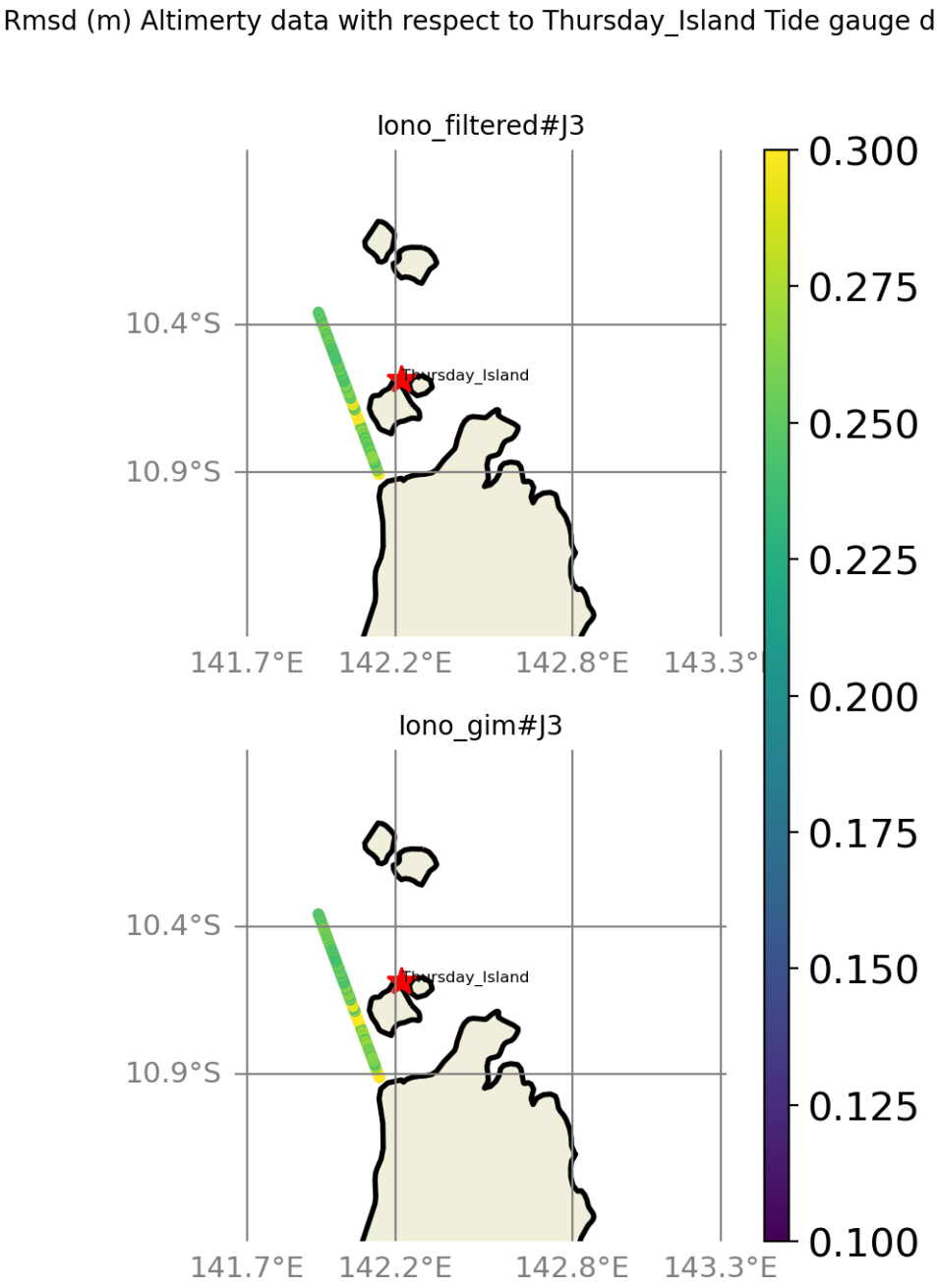

Figure 49 – rmsd visualization in maps view % Thursday_Island tide gauge

6.3.3 std visualization in maps view % Thursday_Island tide gauge

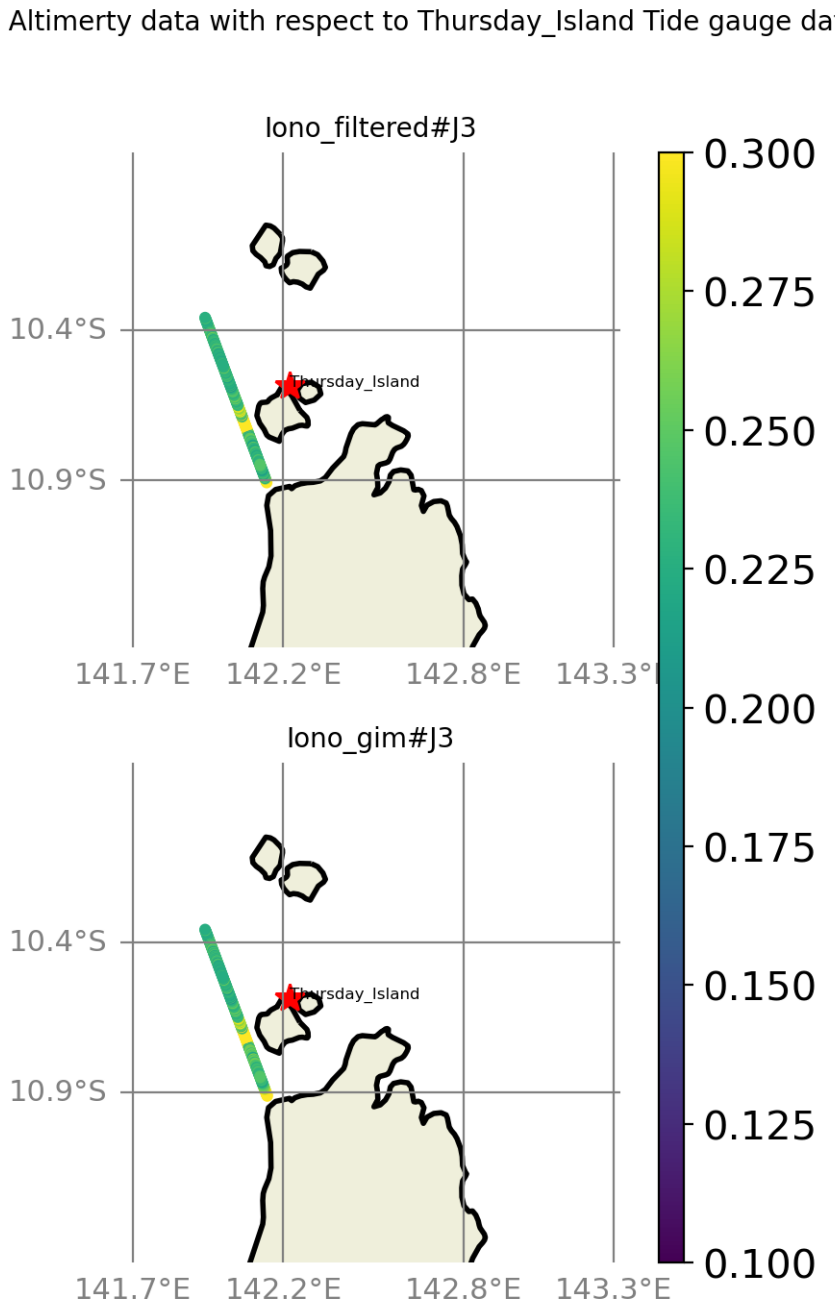

FIGURE 50 – std visualization in maps view % Thursday_Island tide gauge

6.3.4 valid_data_percent visualization in maps view % Thursday_Island tide gauge

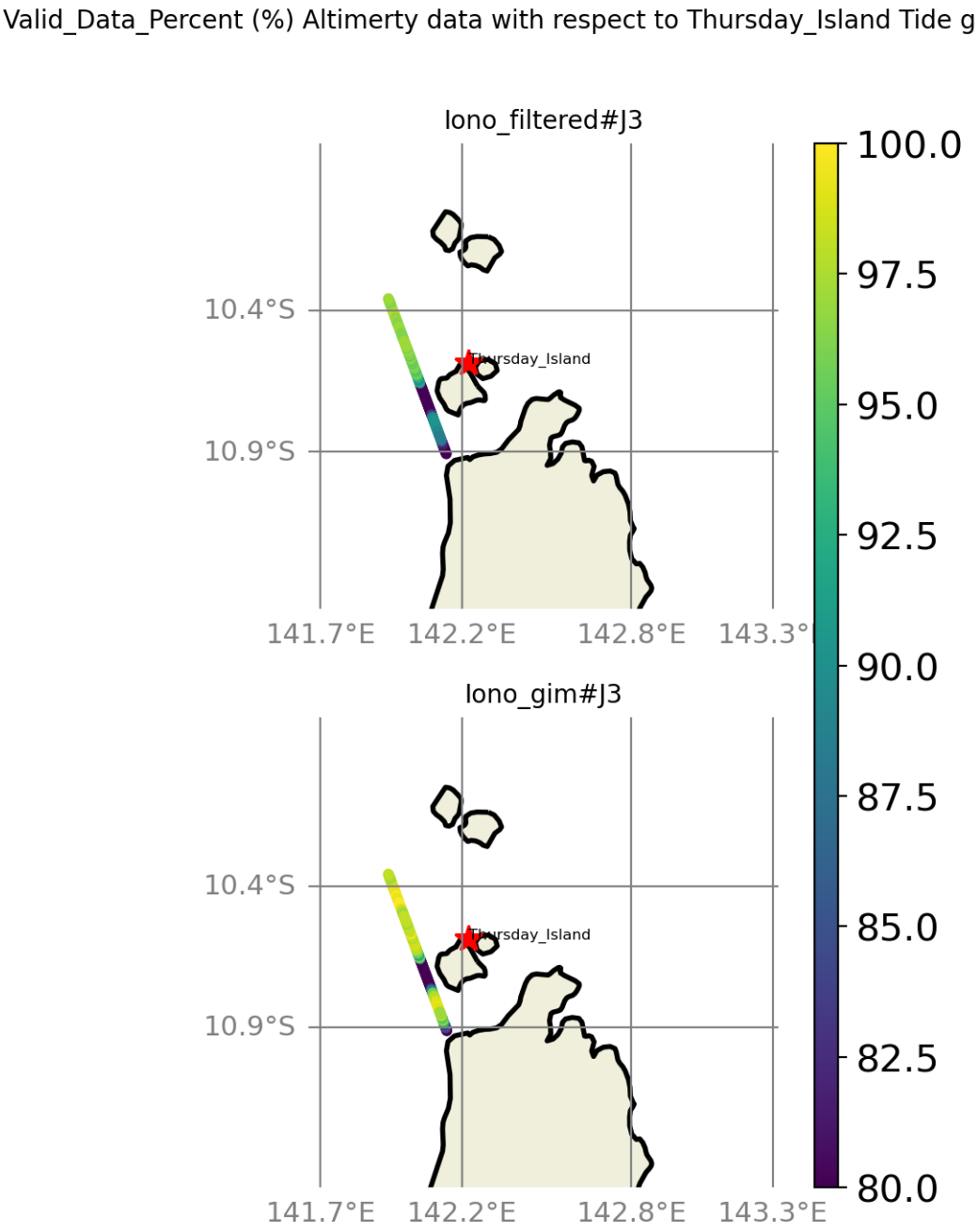

FIGURE 51 – valid_data_percent visualization in maps view % Thursday_Island tide gauge

6.3.5 Valid data (%) in function of distance to coast/Thursday_Island station

The formula to calculate the percentage of valid data in each time serie is;

$$pvd_i = \frac{nvd_i}{maxNB}, i = 1, np$$

Where *pvd* and *nvd* are the percentage of data and the number of altimetry data in the period covered by the tide gauge sla time serie, respectively in the time serie, i is the index of the time serie, np is the number of the selected altimetry time series. $maxNB = 103$ point is the maximum number of valid altimetry points in the set of all the altimetry sla time series covered by the period of time of the Tide gauge sla time serie.

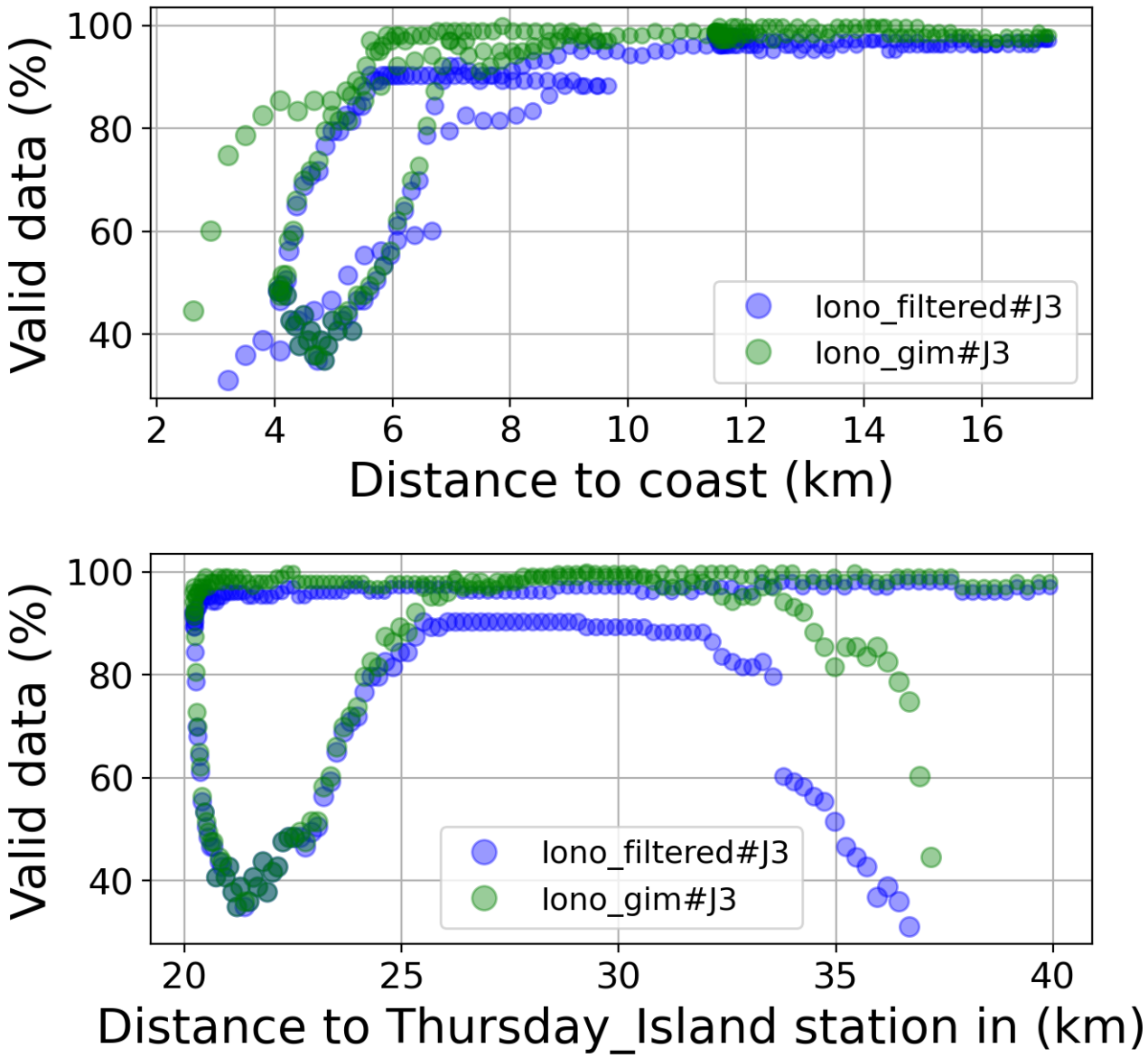

Figure 52 – Valid data (%) in function of distance to coast/Thursday_Island station

6.3.6 Std in function of distance to coast/Thursday_Island station

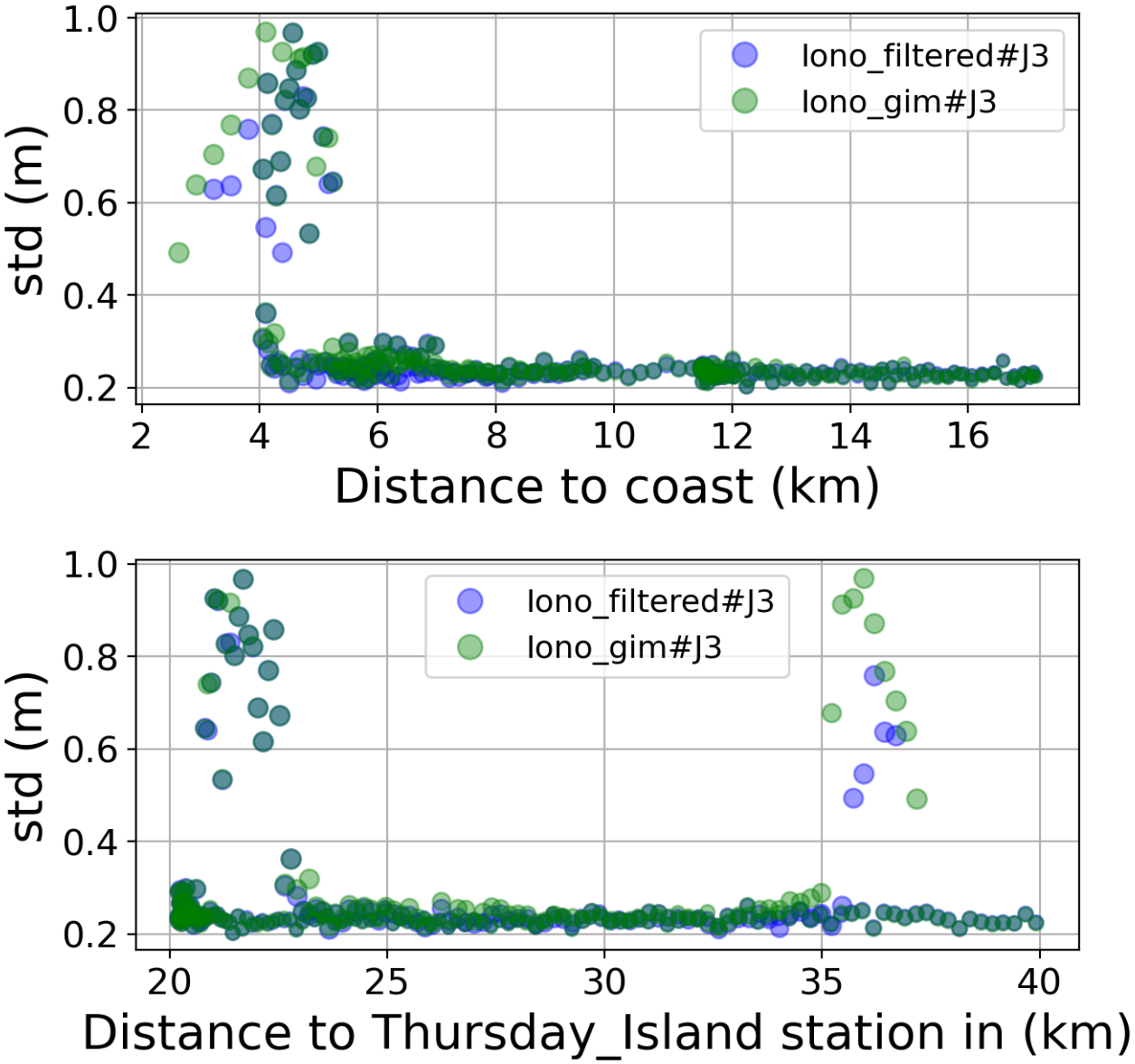

FIGURE 53 – Std in function of the distance to the coast/Thursday_Island station

6.3.7 Correlation in function of distance to coast/Thursday_Island station

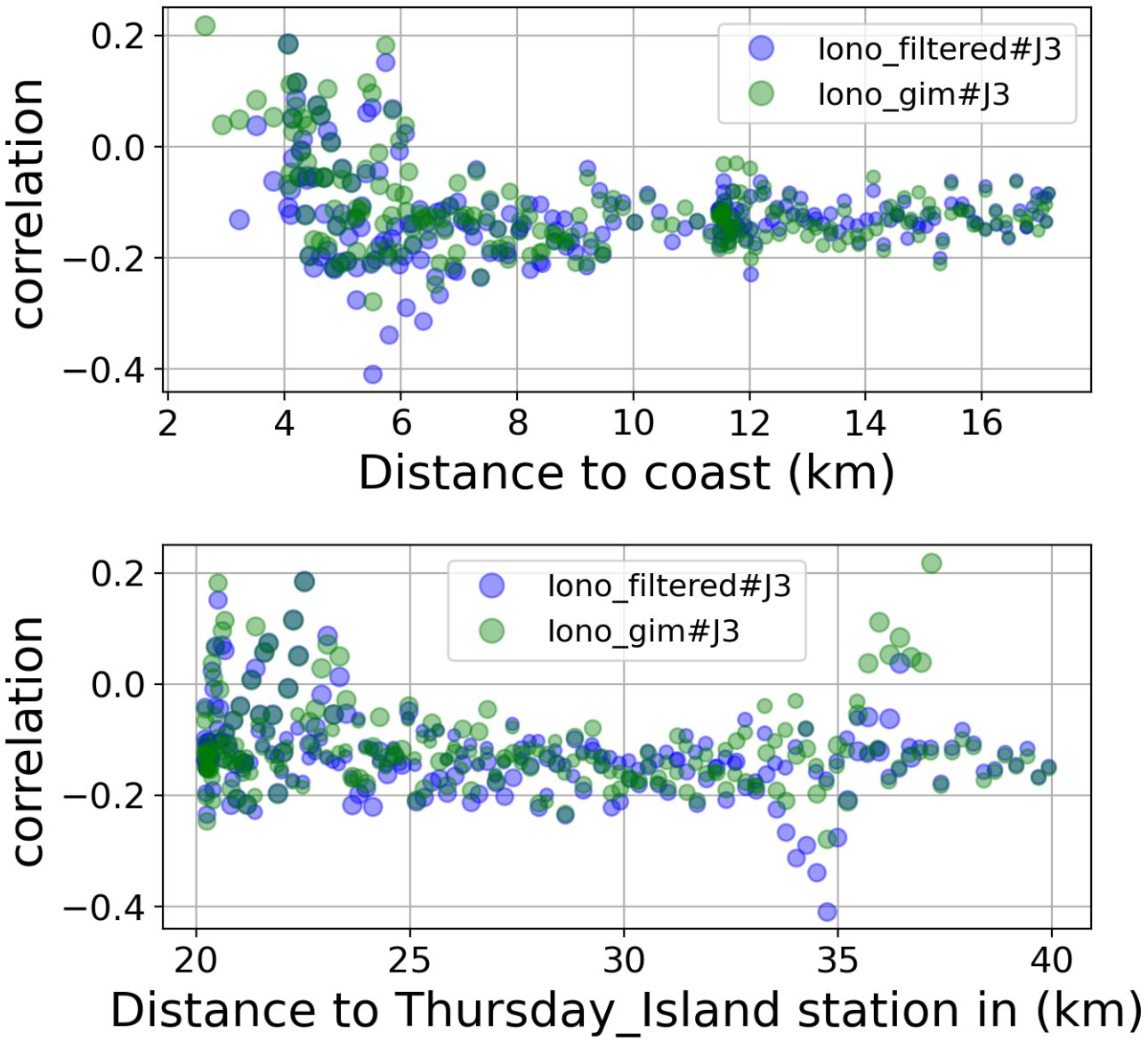

Figure 54 – Correlation in function of the distance to the coast/Thursday_Island station

6.3.8 Taylor Diagram

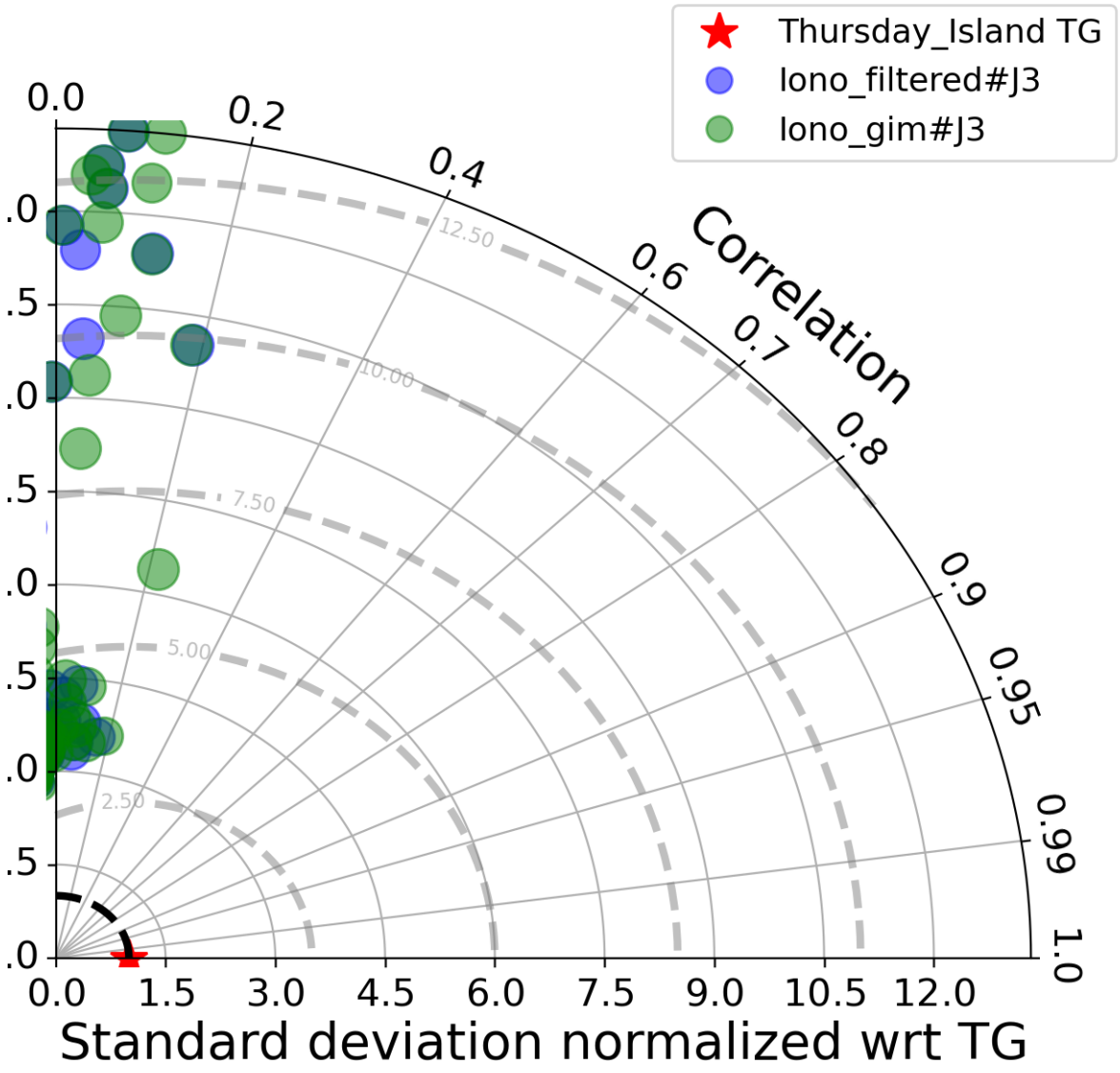

FIGURE 55 – Taylor diagram

6.3.9 Mean statistics table of products comparison with Thursday_Island tide gauge data

The table below contains the mean statistics of the common points between the different products in the selected area.

Product	Valid data (%)	Correlation	std (m)	rmsd (m)
iono_filtered#J3	83.008	-0.125	0.29	0.308
Iono_gim#J3	88.306	-0.112	0.304	0.322

Figure 56 – Mean statistics table of the common points in the altimetry products

6.3.10 The most correlated sla altimetry Time series with the tide gauge sla time serie

The maximum number of valid altimetry points in the set of all the altimetry sla time series covered by the period of time of the Tide gauge sla time serie is 103 point.

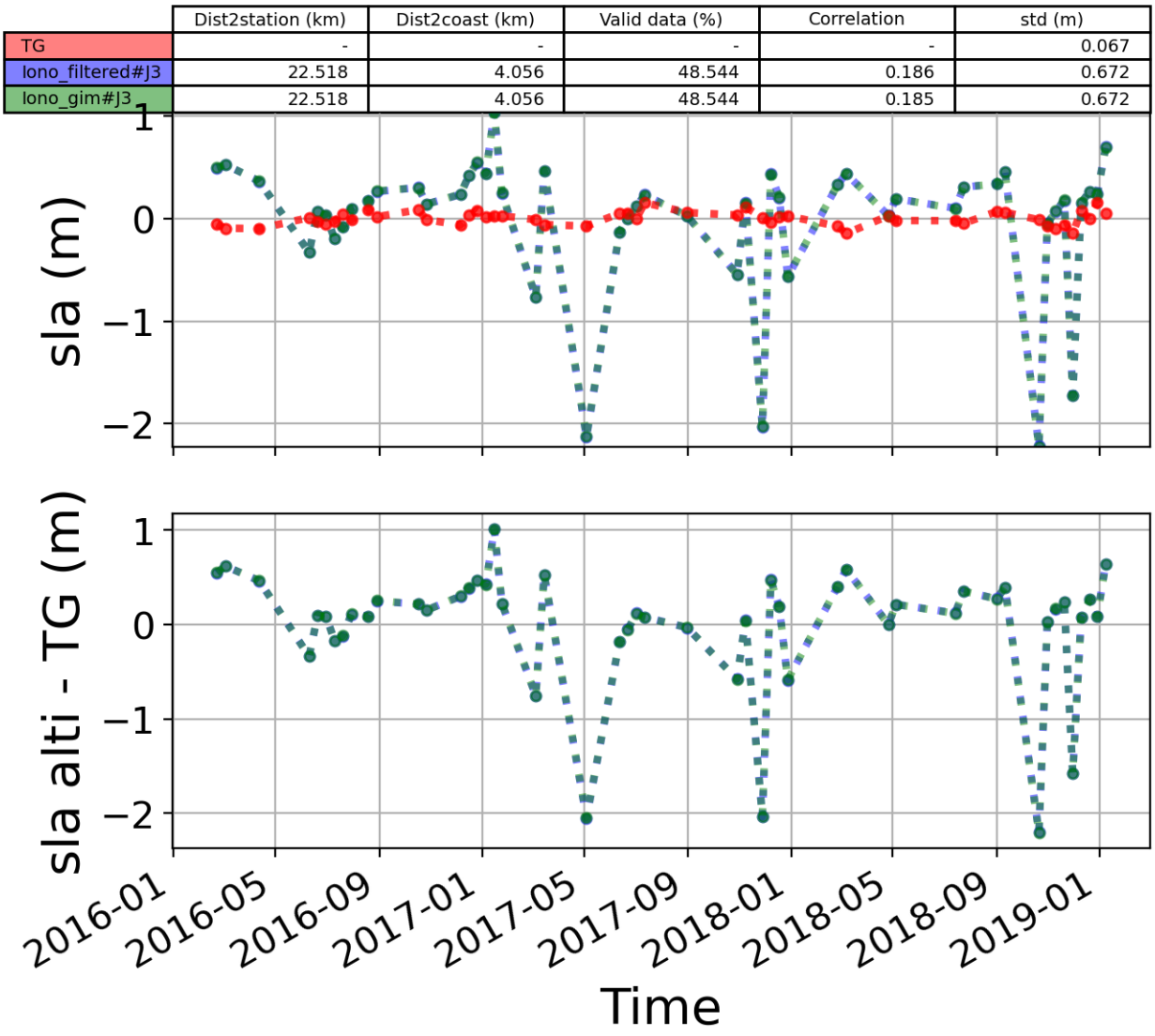

FIGURE 57 – The 1st most correlated sla altimetry Time serie with tide gauge sla time serie

6.4 Station : Southport

- Nearest track to Southport station is the track number track47
- The area of interest is limited by :
  - A circle which it's center is the Southport tide gauge station location and has a Raduis of 40 Km
  - Maximum distance to the coast : 20 Km
  - Latitude limits : [-43.55, -43.2] °

6.4.1 correlation visualization in maps view % Southport tide gauge

6.4.2 rmsd visualization in maps view % Southport tide gauge

6.4.3 std visualization in maps view % Southport tide gauge

6.4.4 valid_data_percent visualization in maps view % Southport tide gauge

6.4.5 Valid data (%) in function of distance to coast/Southport station

The formula to calculate the percentage of valid data in each time serie is ;

$$pvd_i = \frac{nvd_i}{maxNB}, i = 1, np$$

Where *pvd* and *nvd* are the percentage of data and the number of altimetry data in the period covered by the tide gauge sla time serie, respectively in the time serie, i is the index of the time serie, np is the number of the selected altimetry time series. $maxNB = 70$ point is the maximum number of valid altimetry points in the set of all the altimetry sla time series covered by the period of time of the Tide gauge sla time serie.

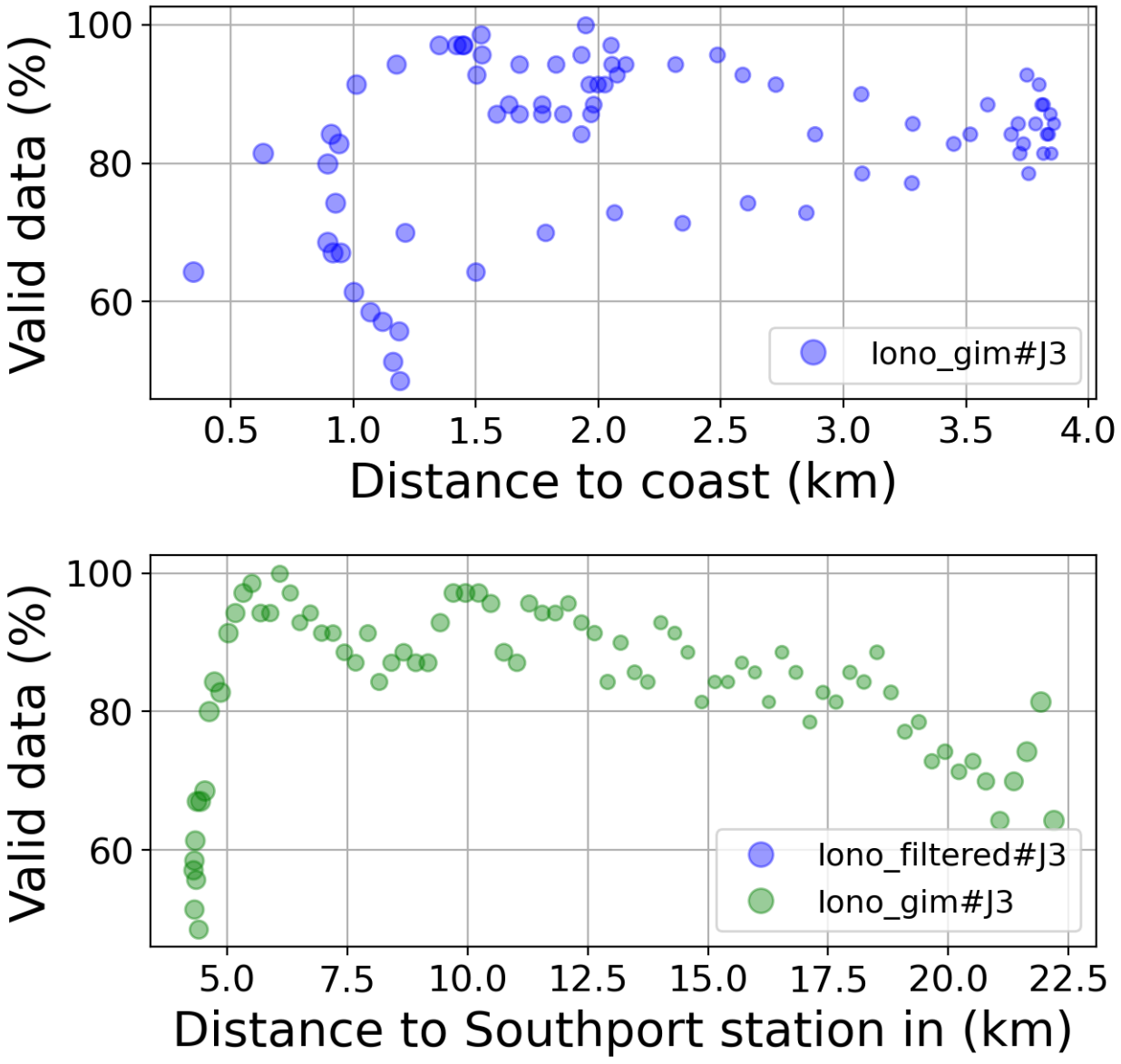

Figure 58 – Valid data (%) in function of distance to coast/Southport station

6.4.6 Std in function of distance to coast/Southport station

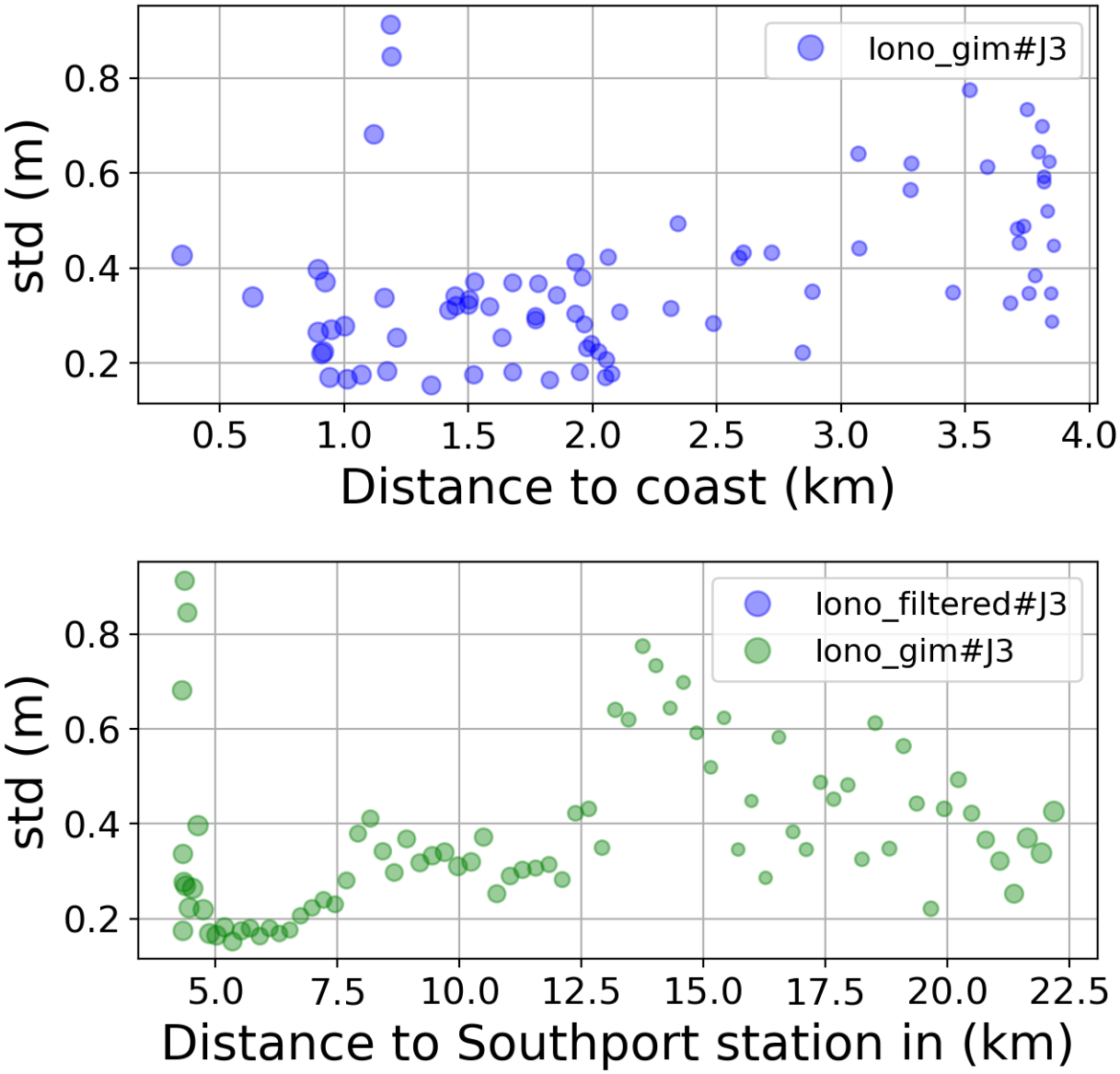

FIGURE 59 – Std in function of the distance to the coast/Southport station

6.4.7 Correlation in function of distance to coast/Southport station

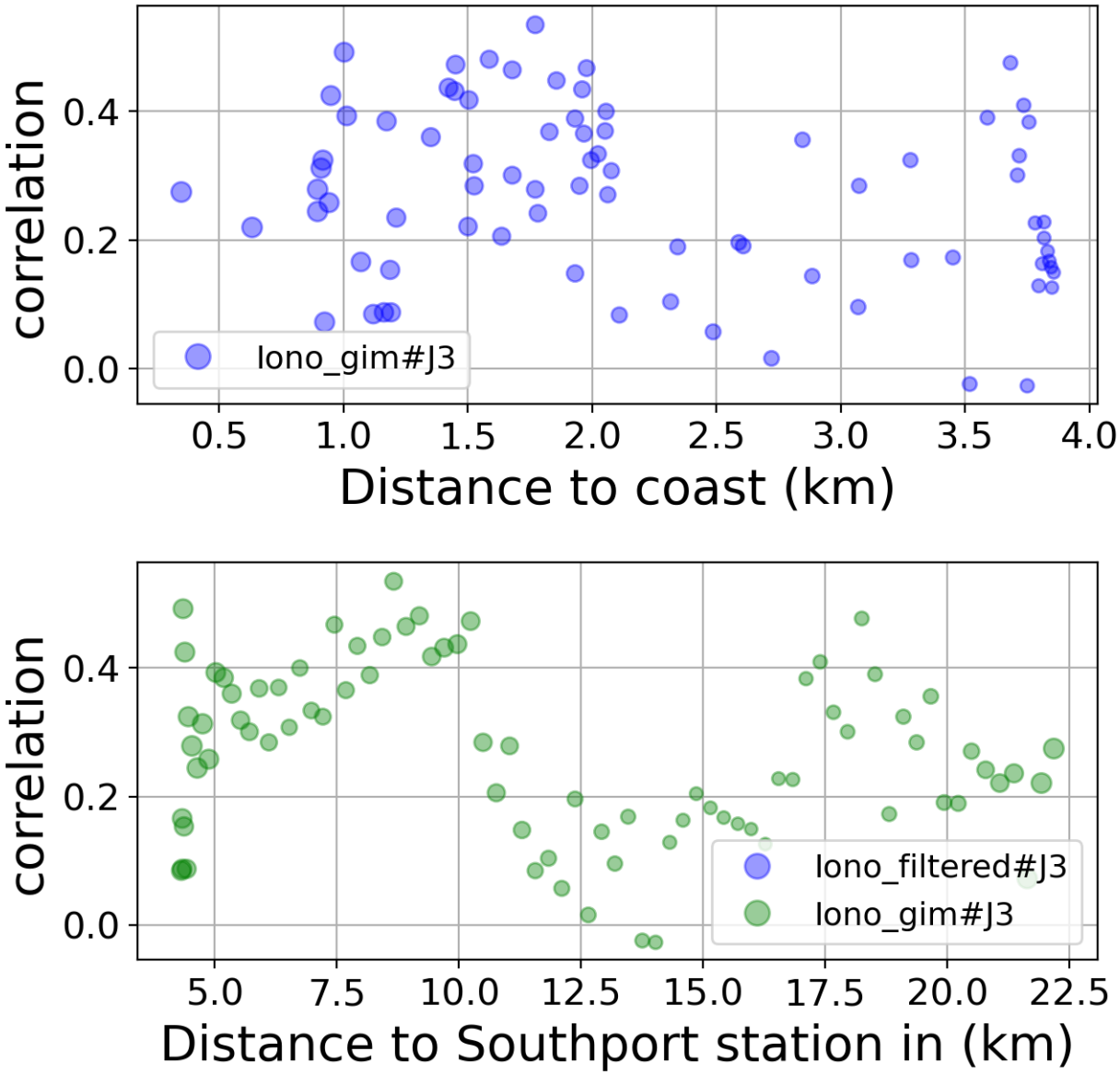

FIGURE 60 – Correlation in function of the distance to the coast/Southport station

6.4.8 Taylor Diagram

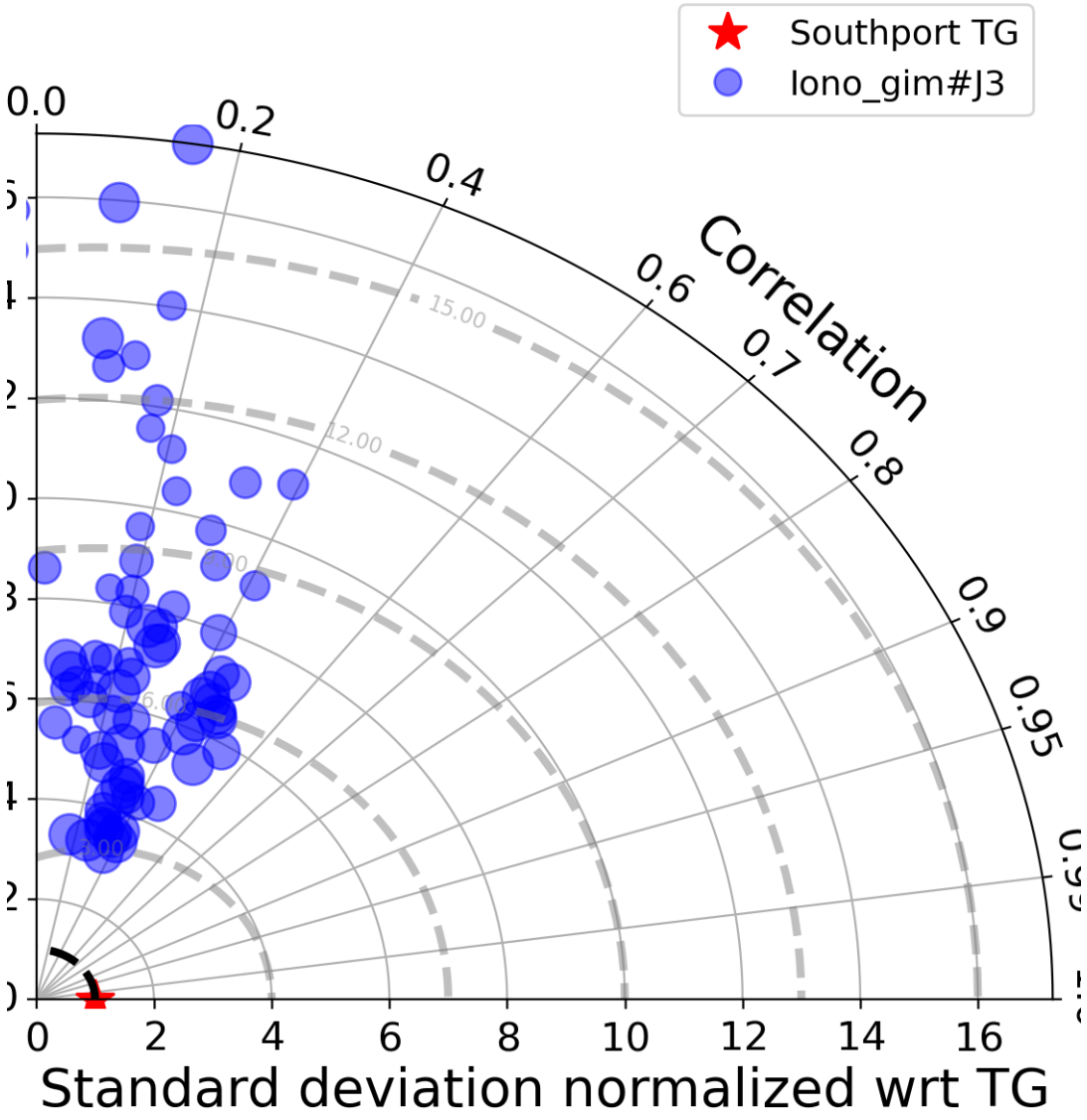

FIGURE 61 – Taylor diagram

6.4.9 Mean statistics table of products comparison with Southport tide gauge data

6.4.10 The most correlated sla altimetry Time series with the tide gauge sla time serie

The maximum number of valid altimetry points in the set of all the altimetry sla time series covered by the period of time of the Tide gauge sla time serie is 70 point.

> The altimetry products don't share a common point which is close to the tide gauge station and has more than 80 % of data

6.5 Station : Townsville

- Nearest track to Townsville station is the track number track175
- The area of interest is limited by :
  - A circle which it's center is the Townsville tide gauge station location and has a Raduis of 40 Km
  - Maximum distance to the coast : 20 Km

6.5.1 correlation visualization in maps view % Townsville tide gauge

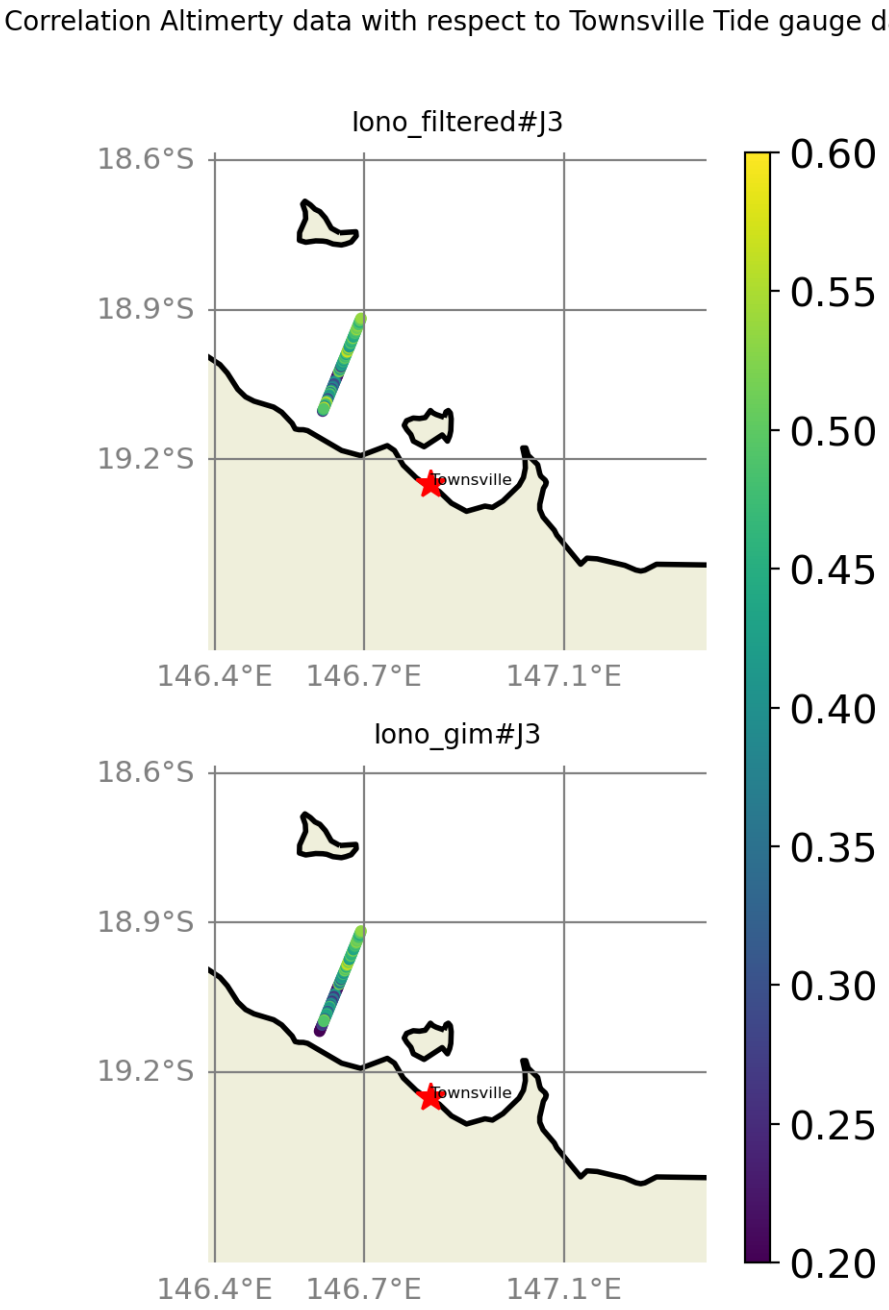

FIGURE 62 – correlation visualization in maps view % Townsville tide gauge

6.5.2 rmsd visualization in maps view % Townsville tide gauge

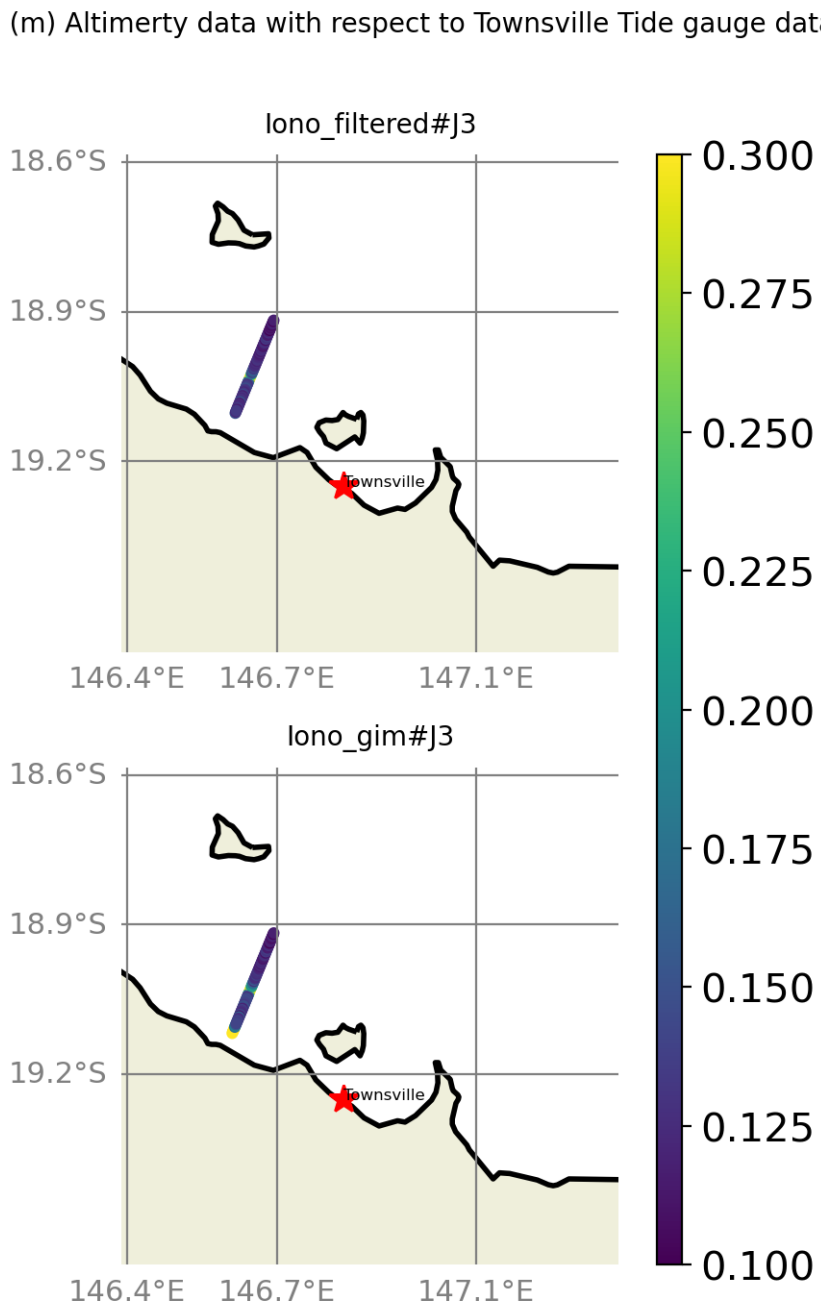

FIGURE 63 – rmsd visualization in maps view % Townsville tide gauge

6.5.3 std visualization in maps view % Townsville tide gauge

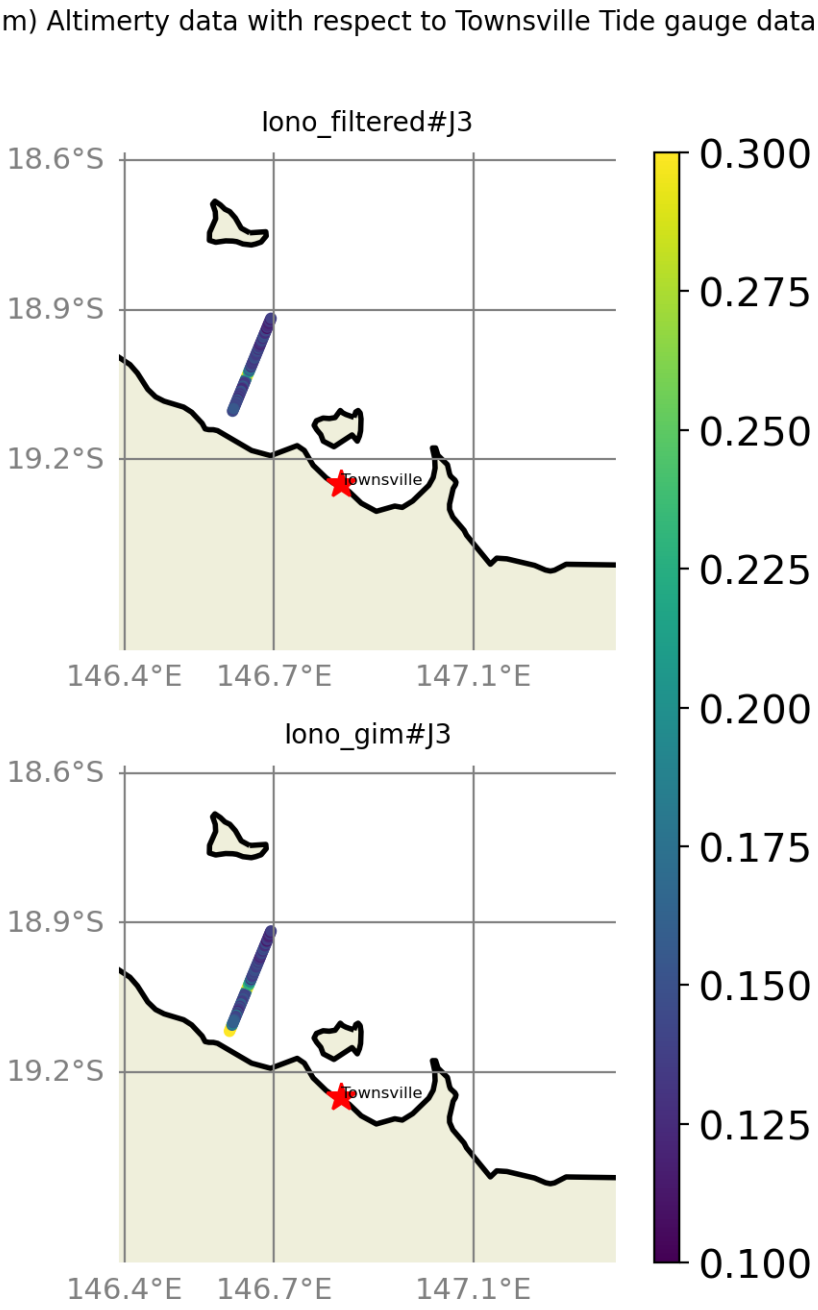

Figure 64 – std visualization in maps view % Townsville tide gauge

6.5.4 valid_data_percent visualization in maps view % Townsville tide gauge

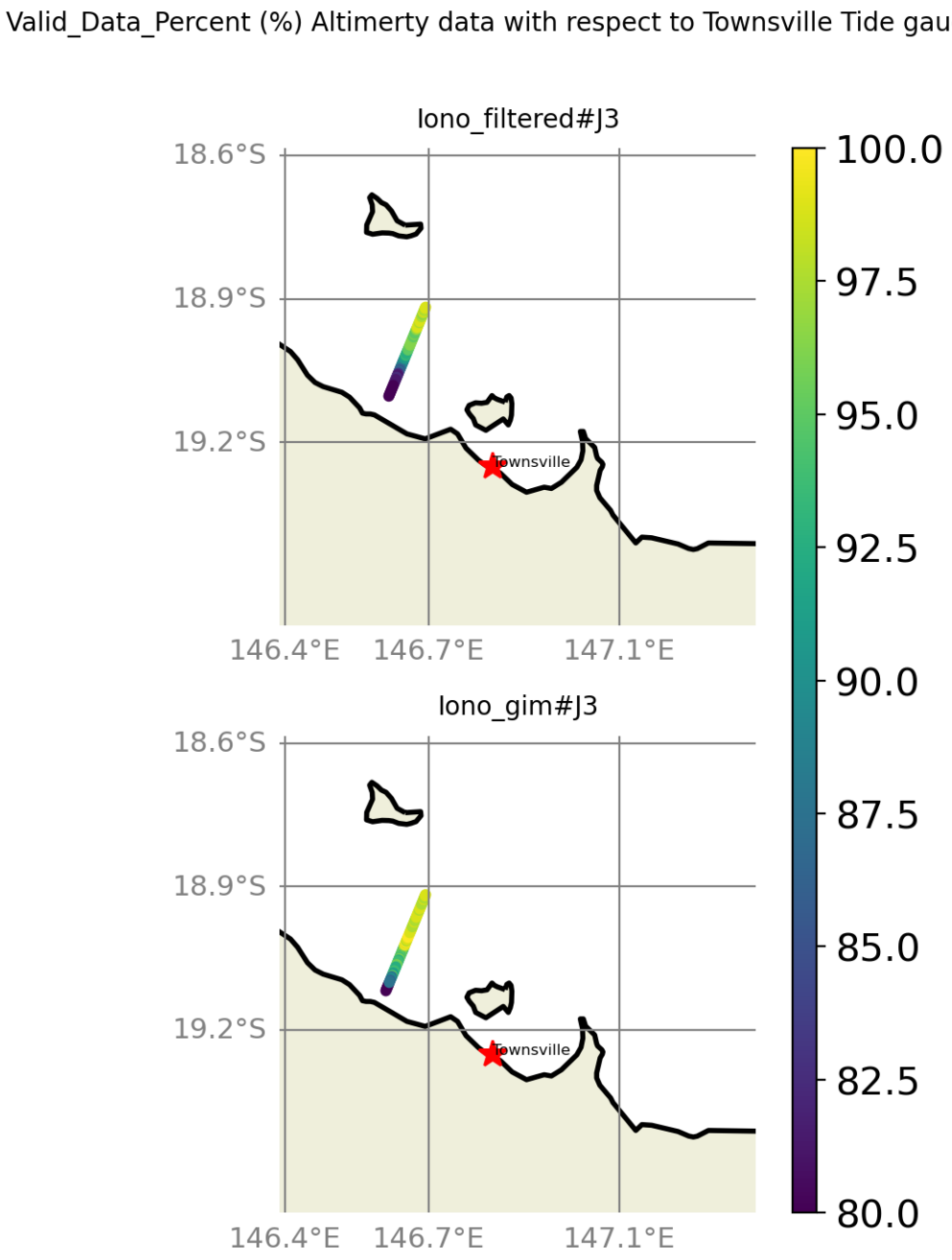

FIGURE 65 – valid_data_percent visualization in maps view % Townsville tide gauge

6.5.5 Valid data (%) in function of distance to coast/Townsville station

The formula to calculate the percentage of valid data in each time serie is;

$$pvd_i = \frac{nvd_i}{maxNB}, i = 1, np$$

Where *pvd* and *nvd* are the percentage of data and the number of altimetry data in the period covered by the tide gauge sla time serie, respectively in the time serie, i is the index of the time serie, np is the number of the selected altimetry time series. $maxNB = 80$ point is the maximum number of valid altimetry points in the set of all the altimetry sla time series covered by the period of time of the Tide gauge sla time serie.

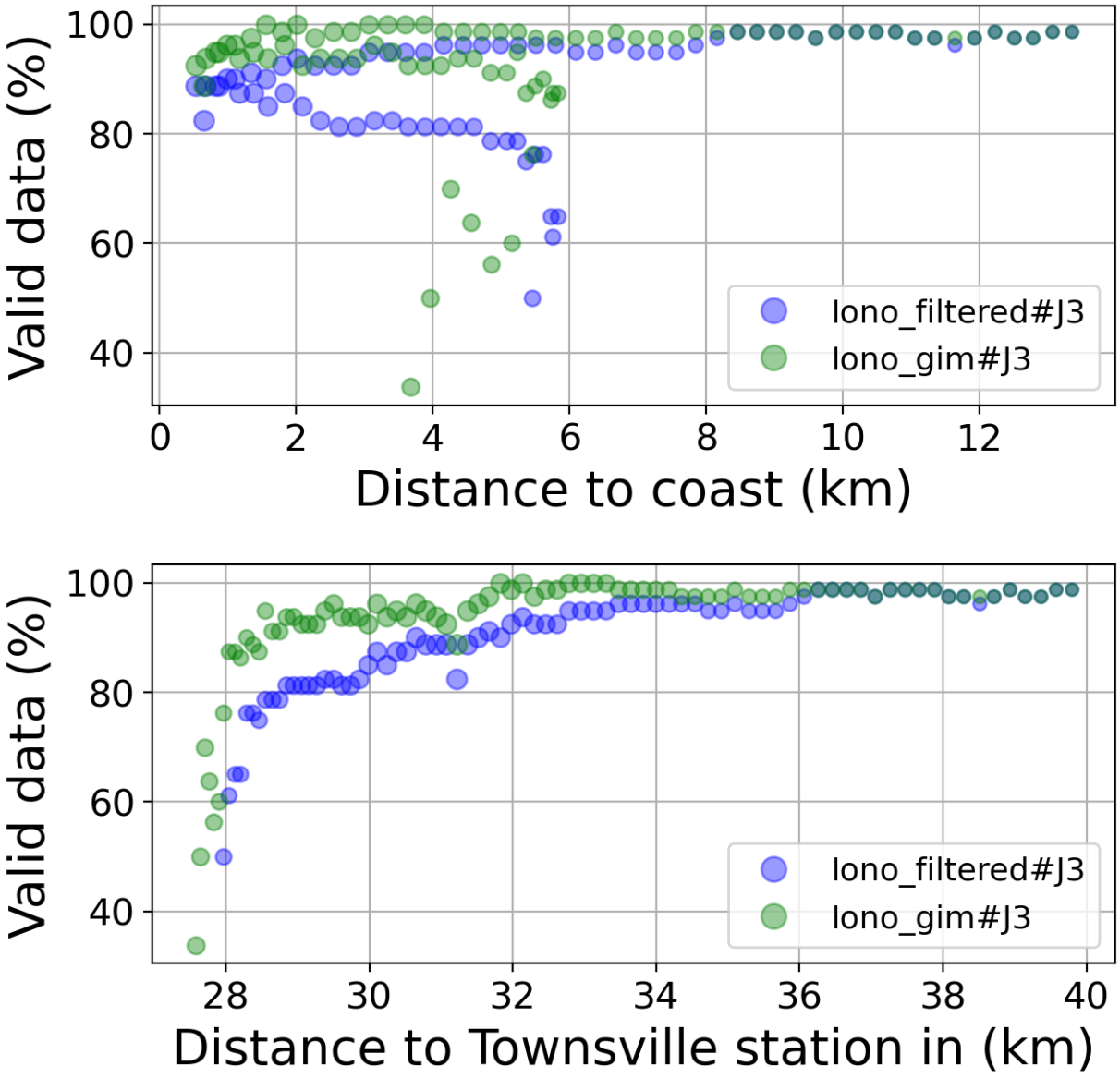

Figure 66 – Valid data (%) in function of distance to coast/Townsville station

6.5.6 Std in function of distance to coast/Townsville station

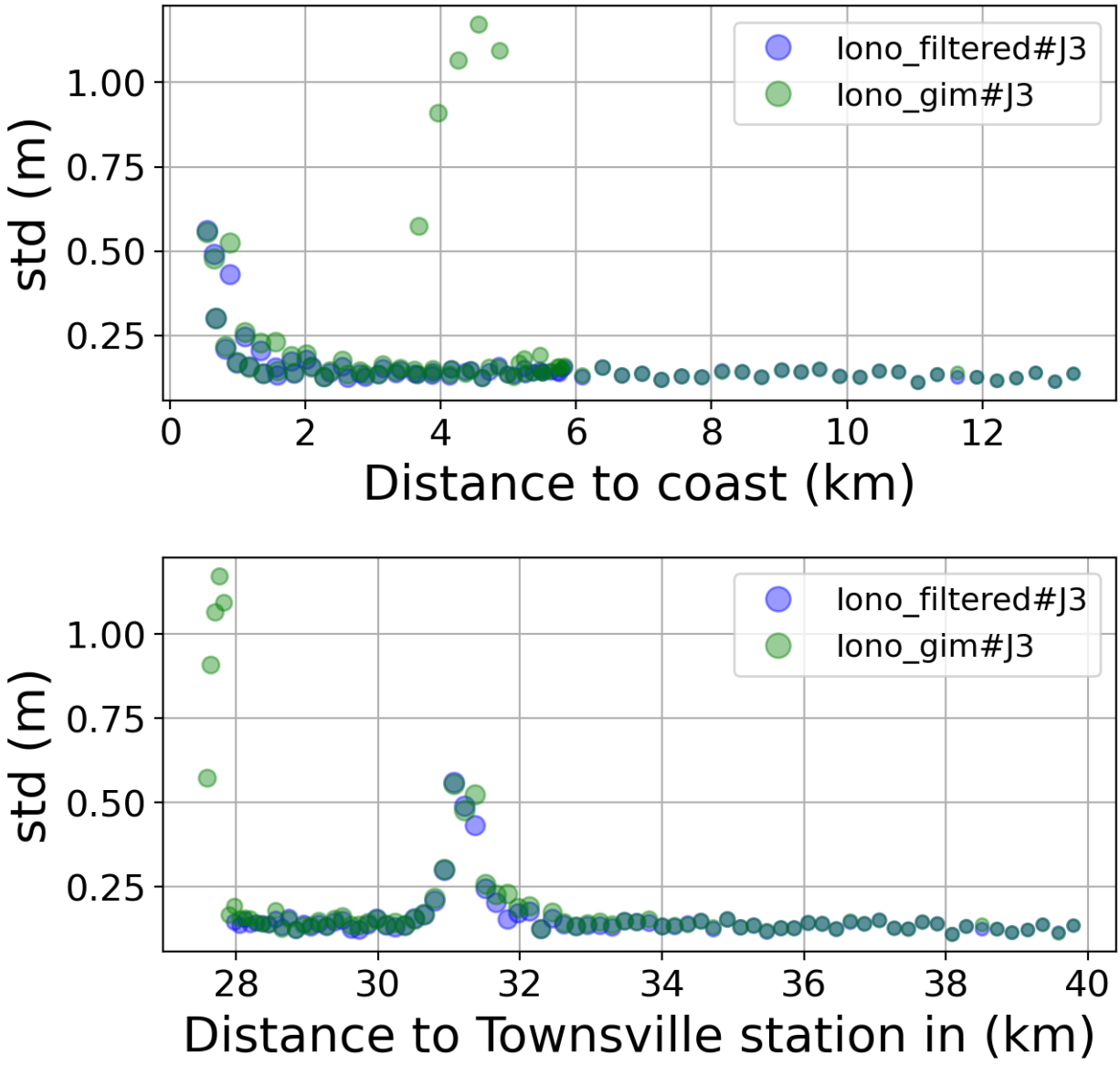

FIGURE 67 – Std in function of the distance to the coast/Townsville station

6.5.7 Correlation in function of distance to coast/Townsville station

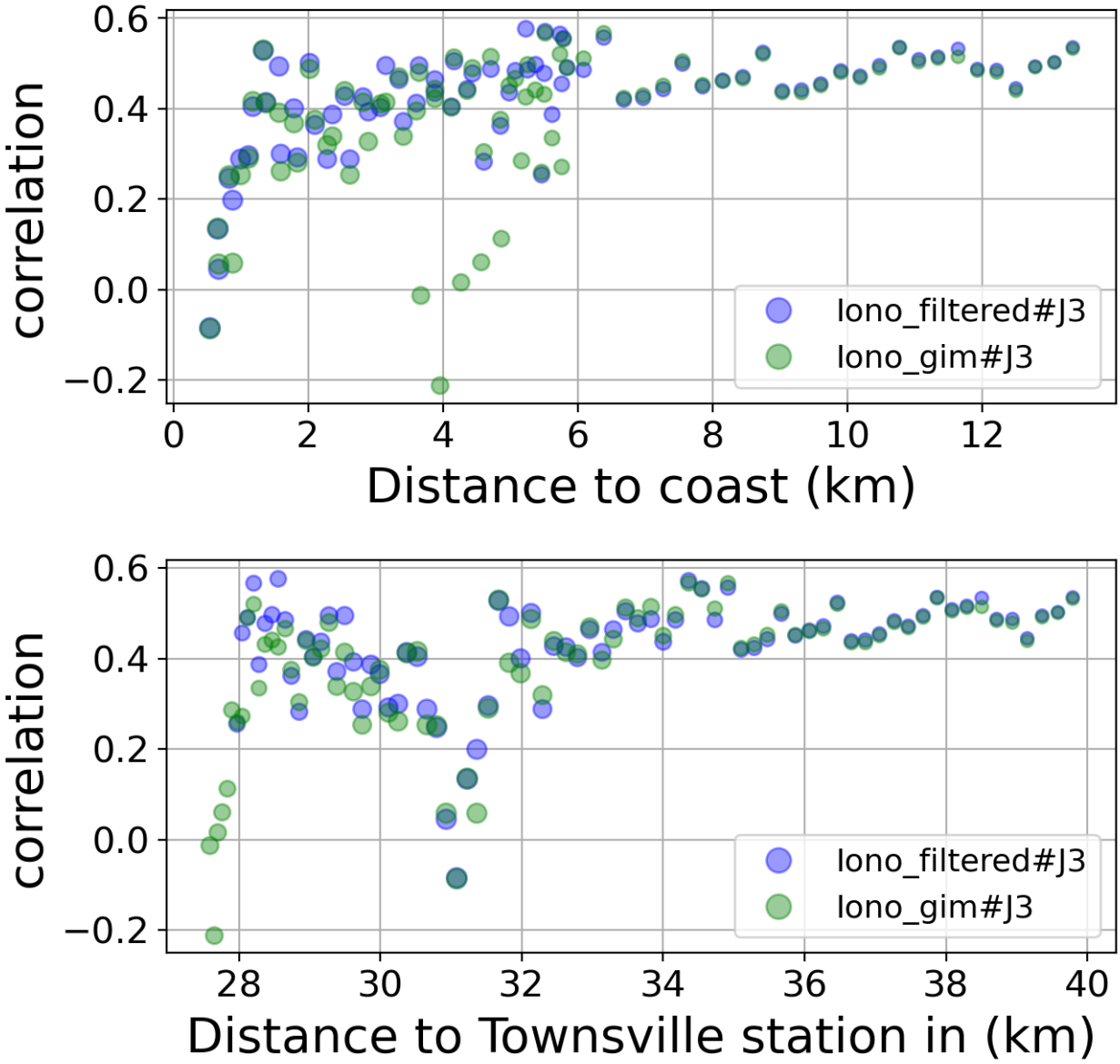

Figure 68 – Correlation in function of the distance to the coast/Townsville station

6.5.8 Taylor Diagram

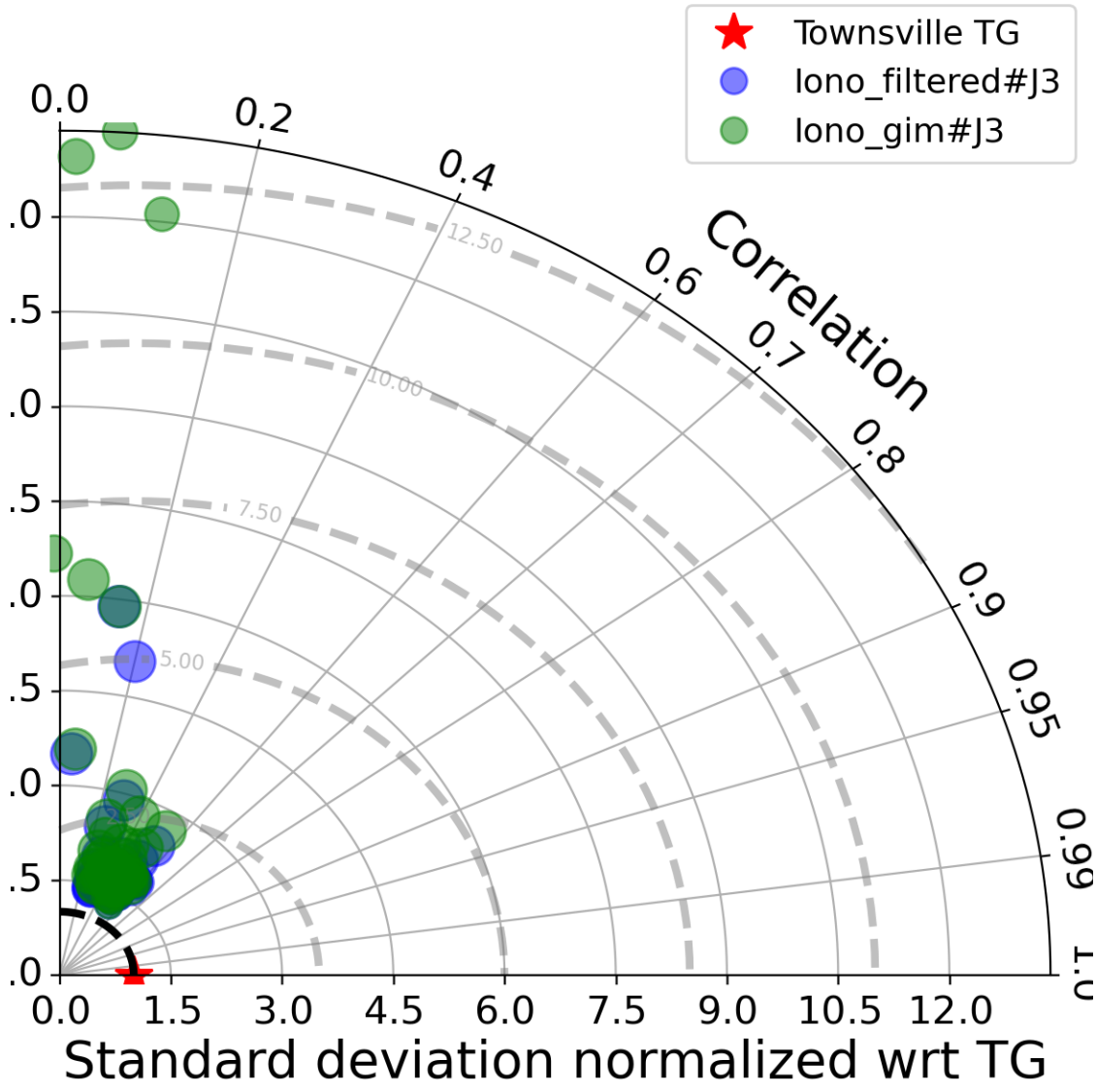

FIGURE 69 – Taylor diagram

6.5.9 Mean statistics table of products comparison with Townsville tide gauge data

The table below contains the mean statistics of the common points between the different products in the selected area.

Product	Valid data (%)	Correlation	std (m)	rmsd (m)
iono_filtered#J3	89.507	0.427	0.159	0.147
Iono_gim#J3	95.789	0.412	0.165	0.154

Figure 70 – Mean statistics table of the common points in the altimetry products

6.5.10 The most correlated sla altimetry Time series with the tide gauge sla time serie

The maximum number of valid altimetry points in the set of all the altimetry sla time series covered by the period of time of the Tide gauge sla time serie is 80 point.

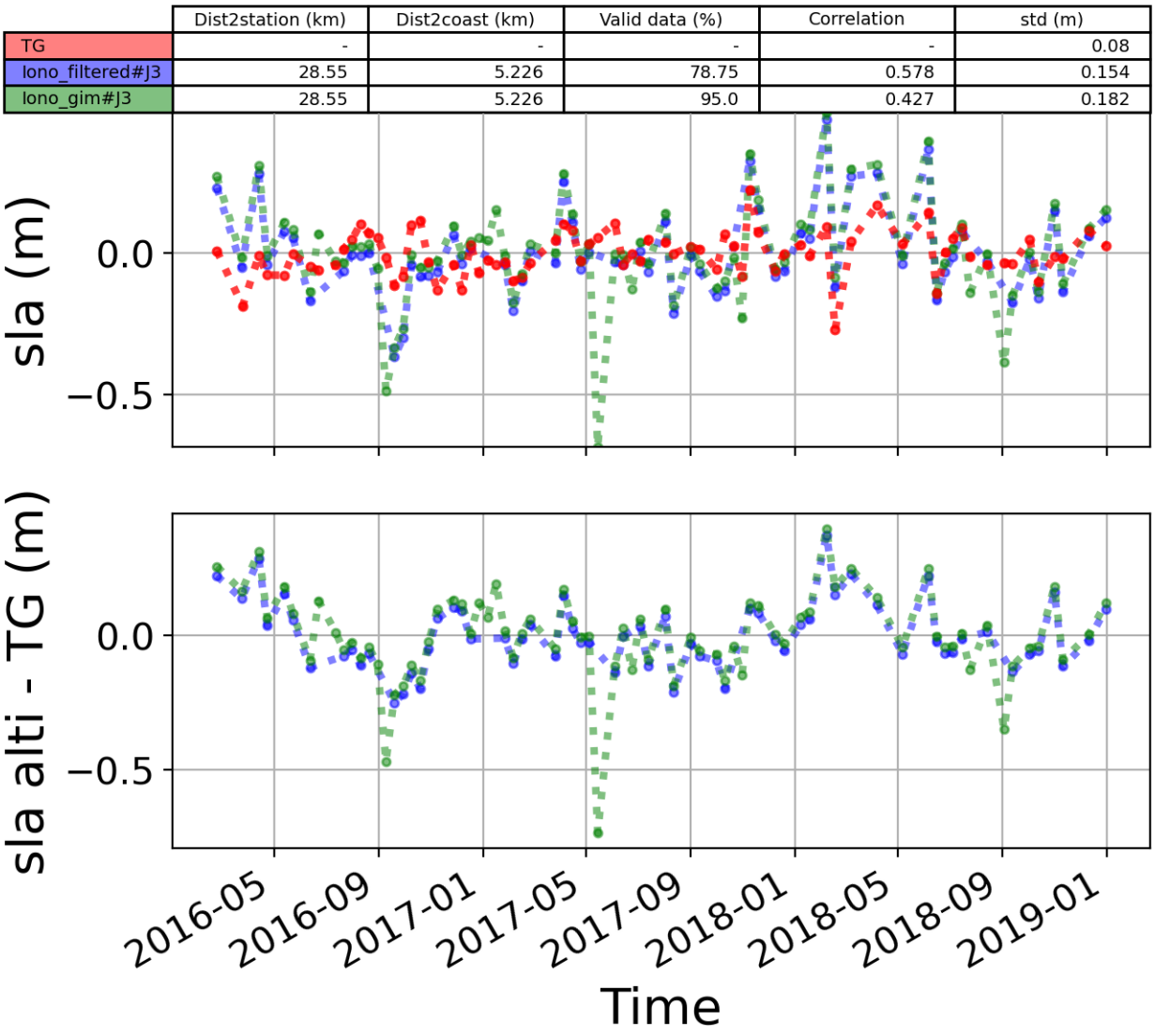

FIGURE 71 – The 1st most correlated sla altimetry Time serie with tide gauge sla time serie

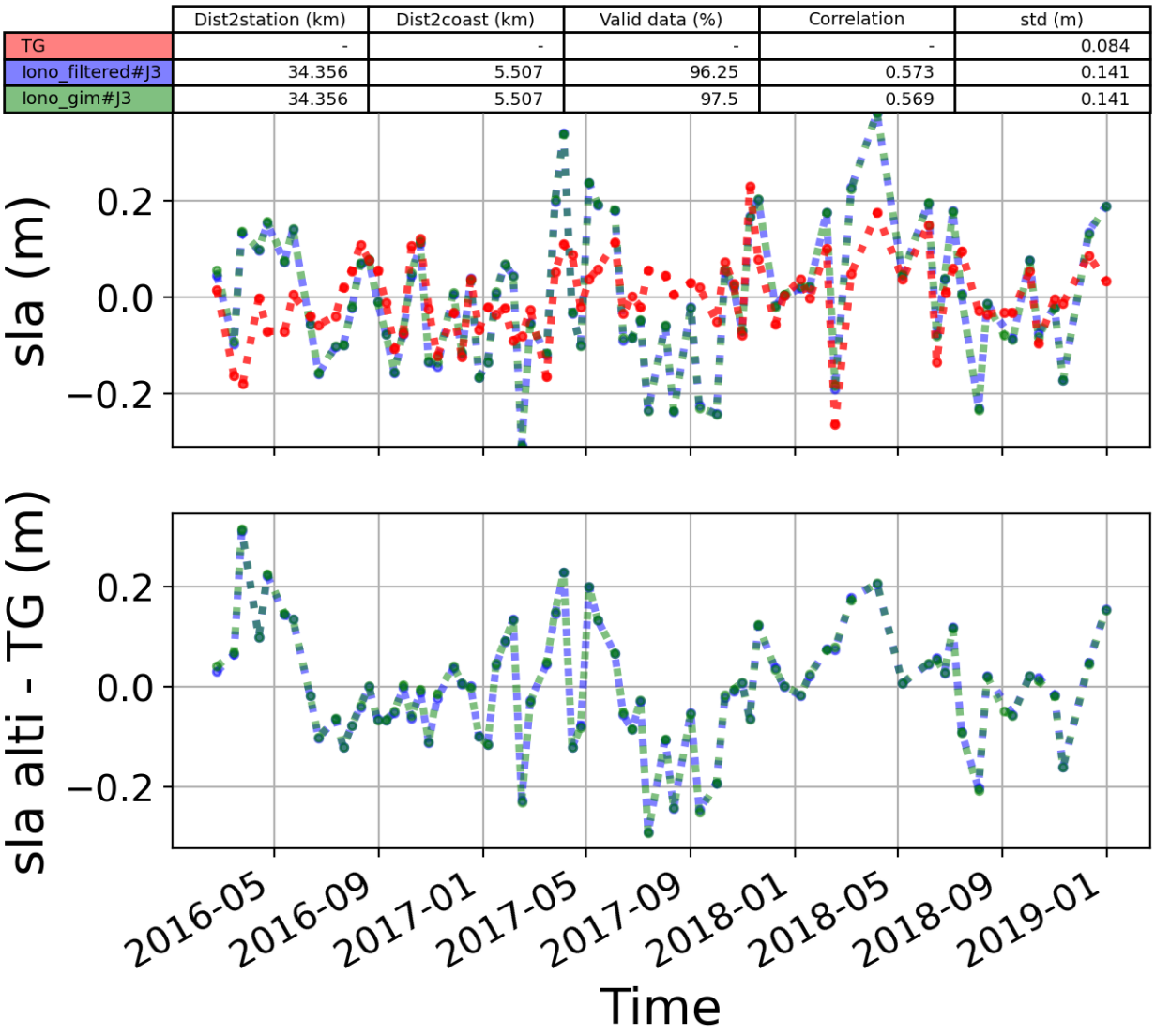

FIGURE 72 – The 2nd most correlated sla altimetry Time serie with tide gauge sla time serie

6.6 Station : Booby_island

- Nearest track to Booby_island station is the track number track138
- The area of interest is limited by :
  - A circle which it's center is the Booby_island tide gauge station location and has a Raduis of 40 Km
  - Maximum distance to the coast : 20 Km

6.6.1 correlation visualization in maps view % Booby_island tide gauge

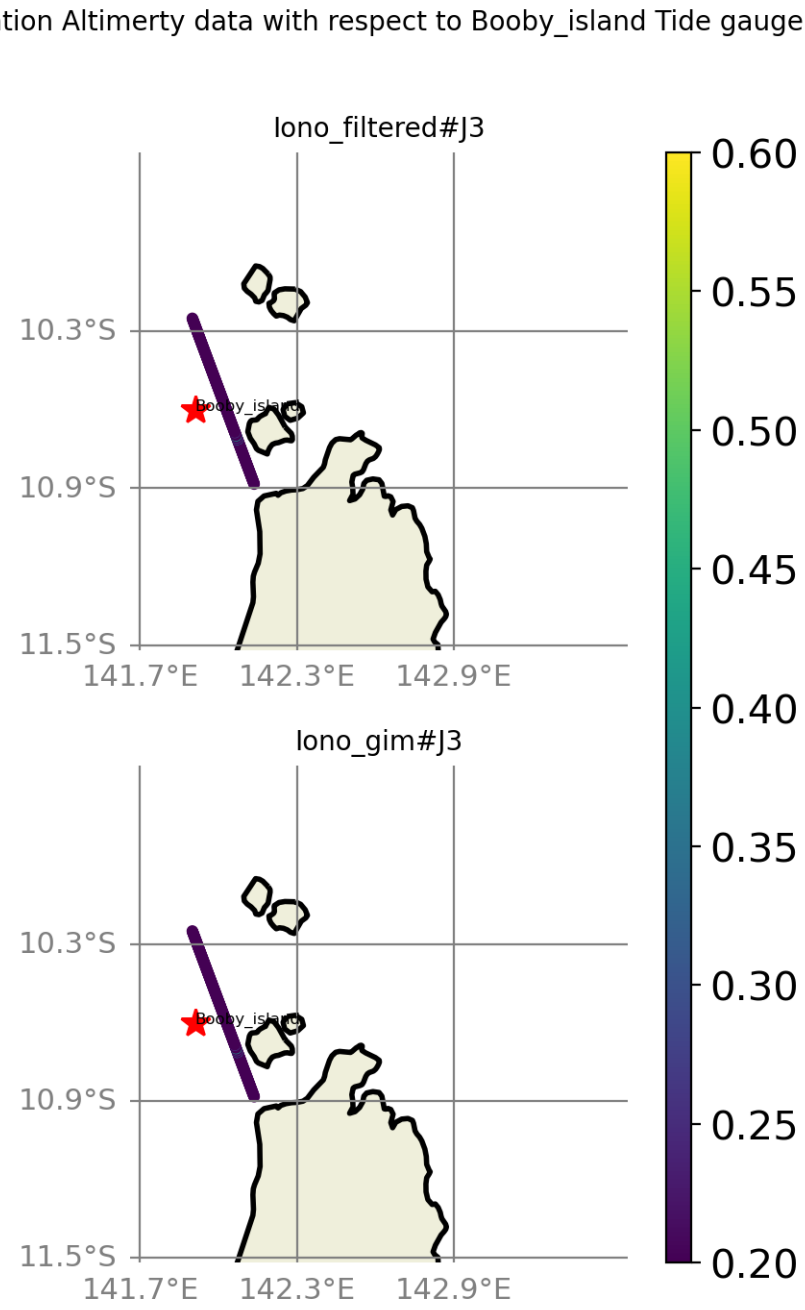

FIGURE 73 – correlation visualization in maps view % Booby_island tide gauge

6.6.2 rmsd visualization in maps view % Booby_island tide gauge

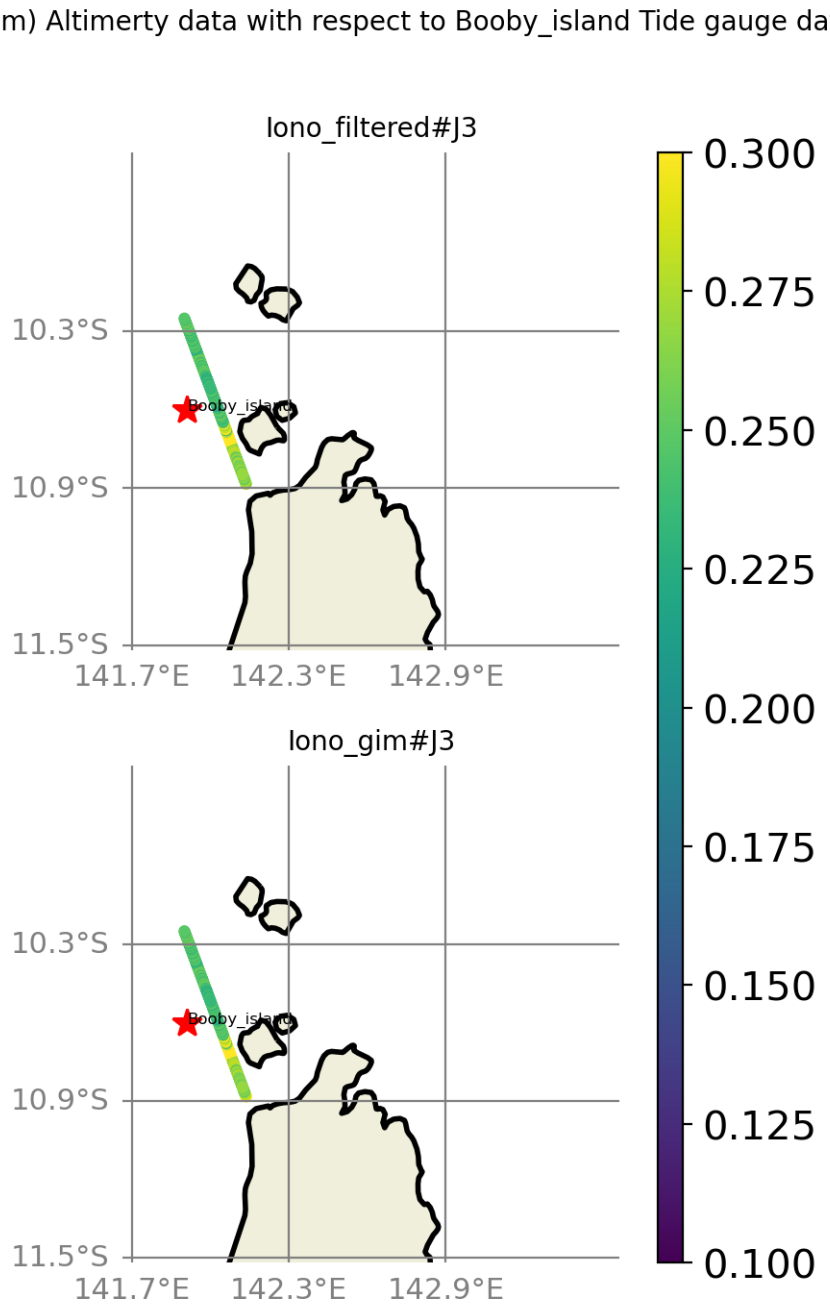

Figure 74 – rmsd visualization in maps view % Booby_island tide gauge

6.6.3 std visualization in maps view % Booby_island tide gauge

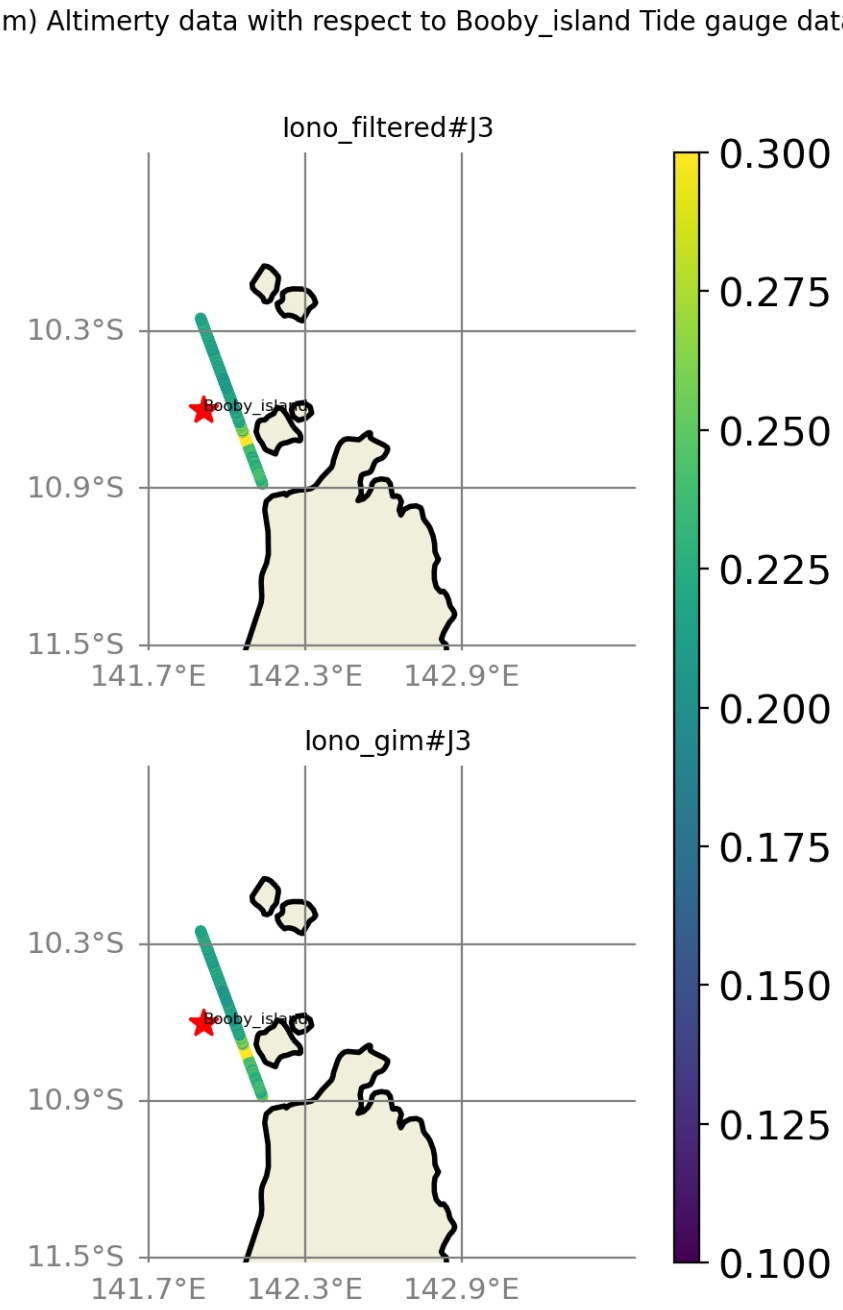

FIGURE 75 – std visualization in maps view % Booby_island tide gauge

6.6.4 valid_data_percent visualization in maps view % Booby_island tide gauge

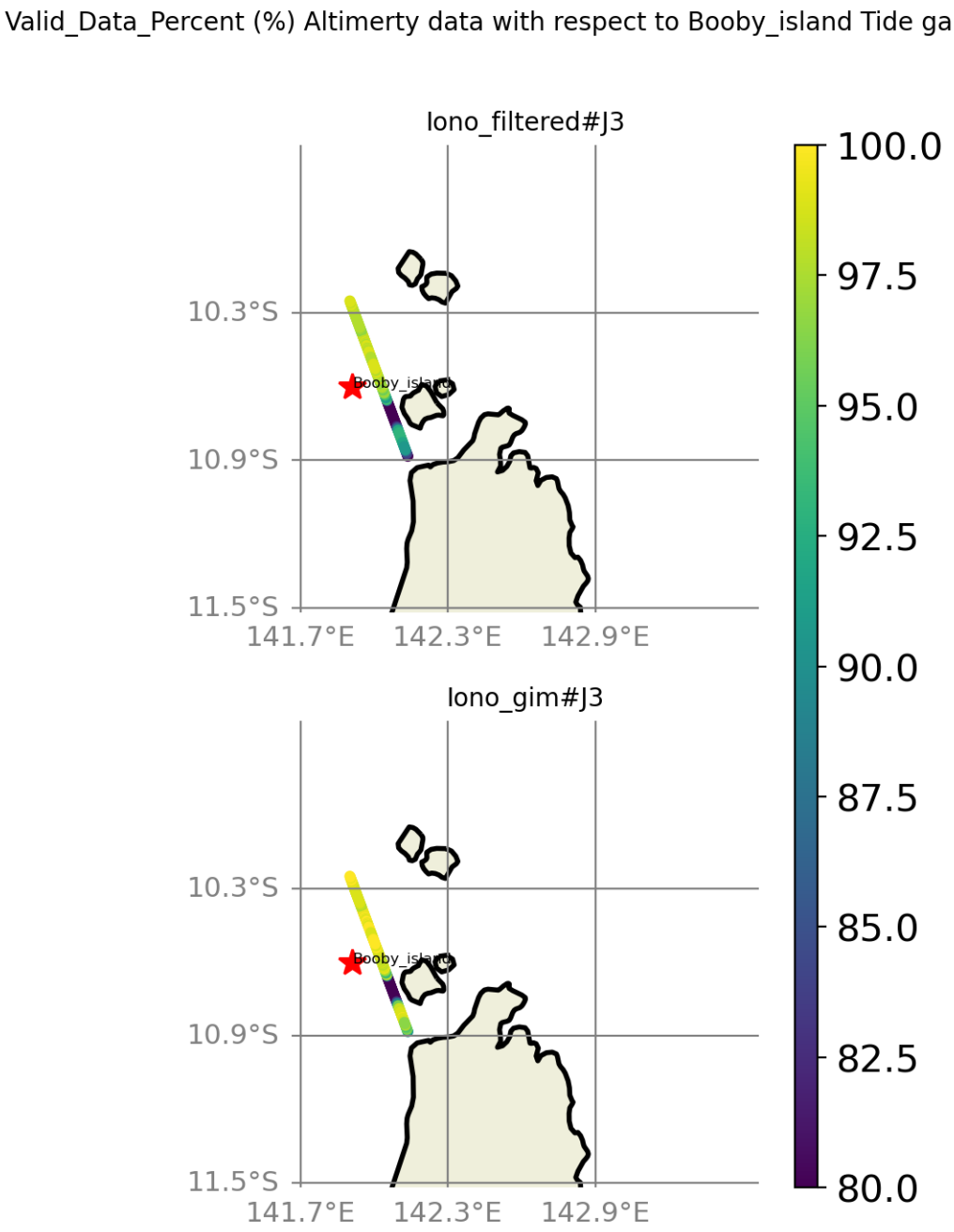

FIGURE 76 – valid_data_percent visualization in maps view % Booby_island tide gauge

6.6.5 Valid data (%) in function of distance to coast/Booby_island station

The formula to calculate the percentage of valid data in each time serie is;

$$pvd_i = \frac{nvd_i}{maxNB}, i = 1, np$$

Where *pvd* and *nvd* are the percentage of data and the number of altimetry data in the period covered by the tide gauge sla time serie, respectively in the time serie, i is the index of the time serie, np is the number of the selected altimetry time series. $maxNB = 86$ point is the maximum number of valid altimetry points in the set of all the altimetry sla time series covered by the period of time of the Tide gauge sla time serie.

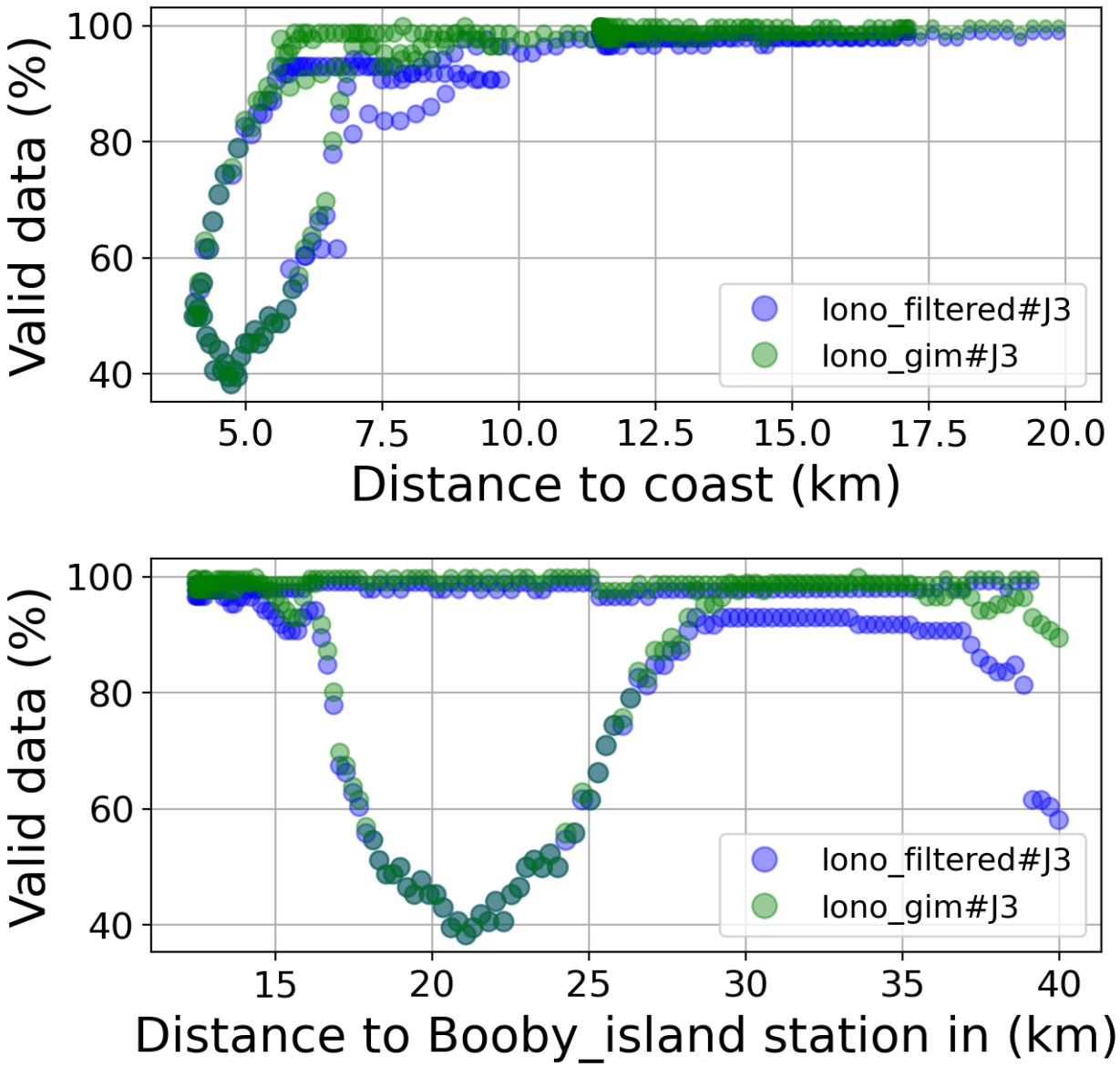

FIGURE 77 – Valid data (%) in function of distance to coast/Booby_island station

6.6.6 Std in function of distance to coast/Booby_island station

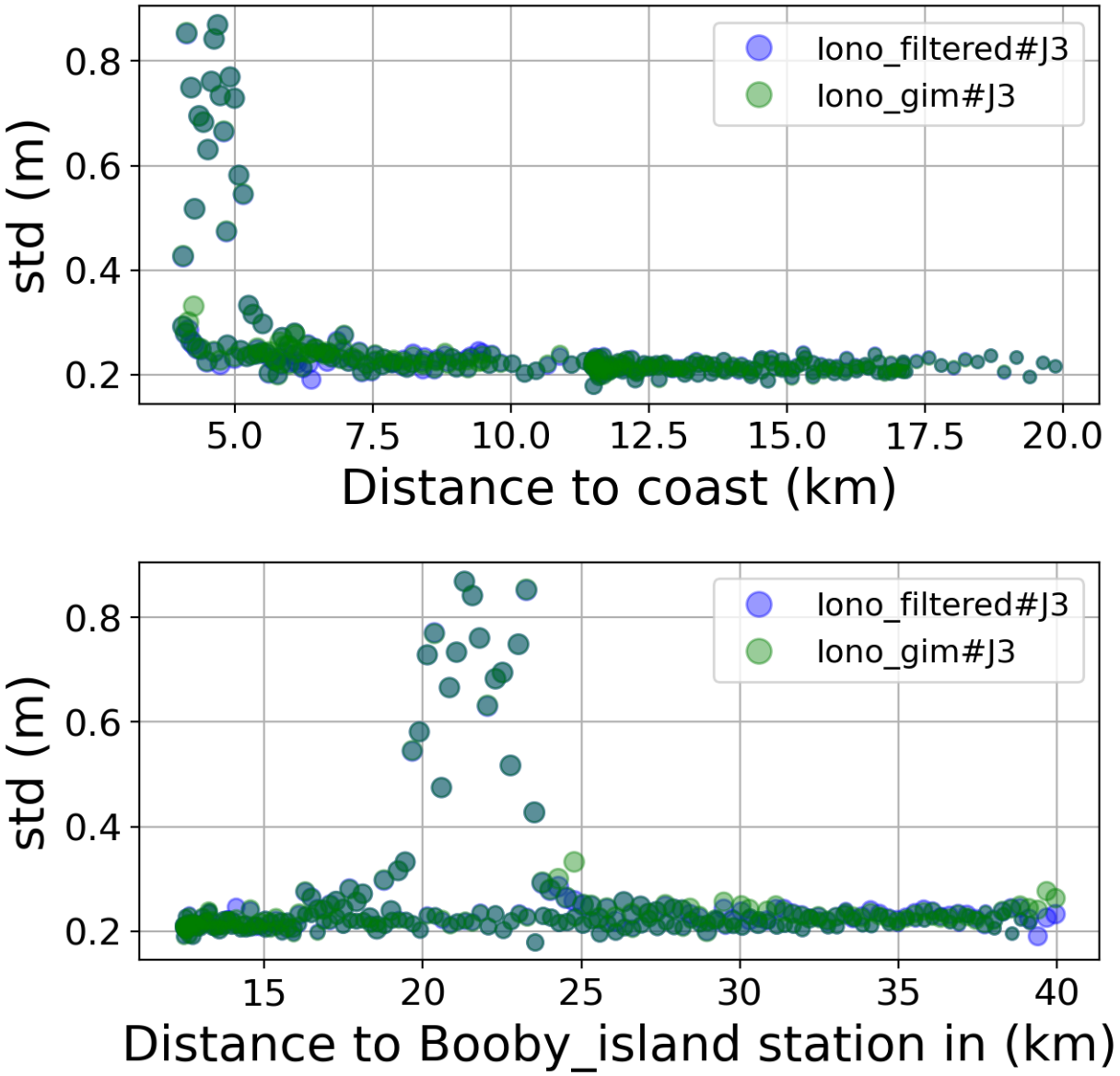

FIGURE 78 – Std in function of the distance to the coast/Booby_island station

6.6.7 Correlation in function of distance to coast/Booby_island station

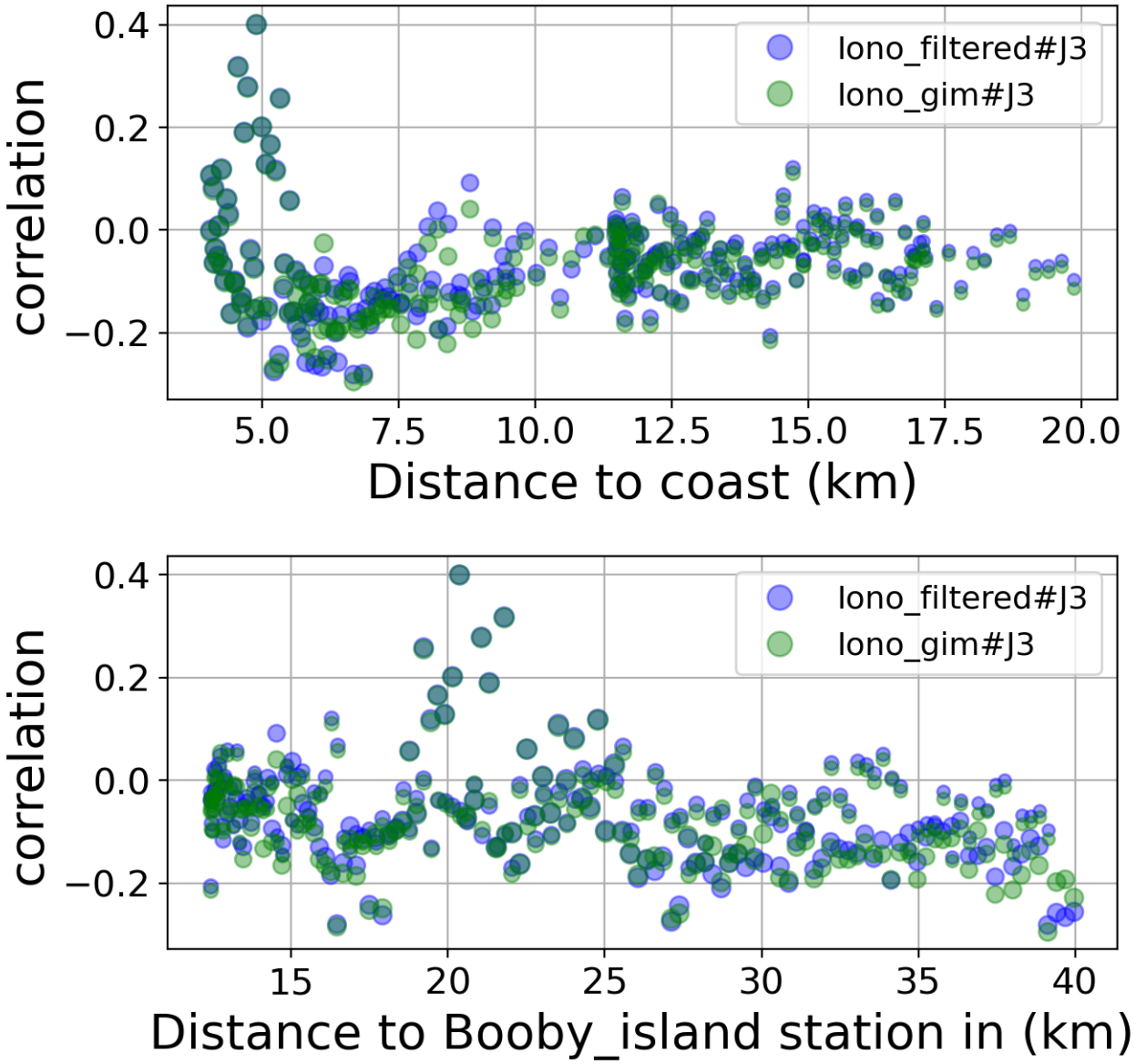

FIGURE 79 – Correlation in function of the distance to the coast/Booby_island station

6.6.8 Taylor Diagram

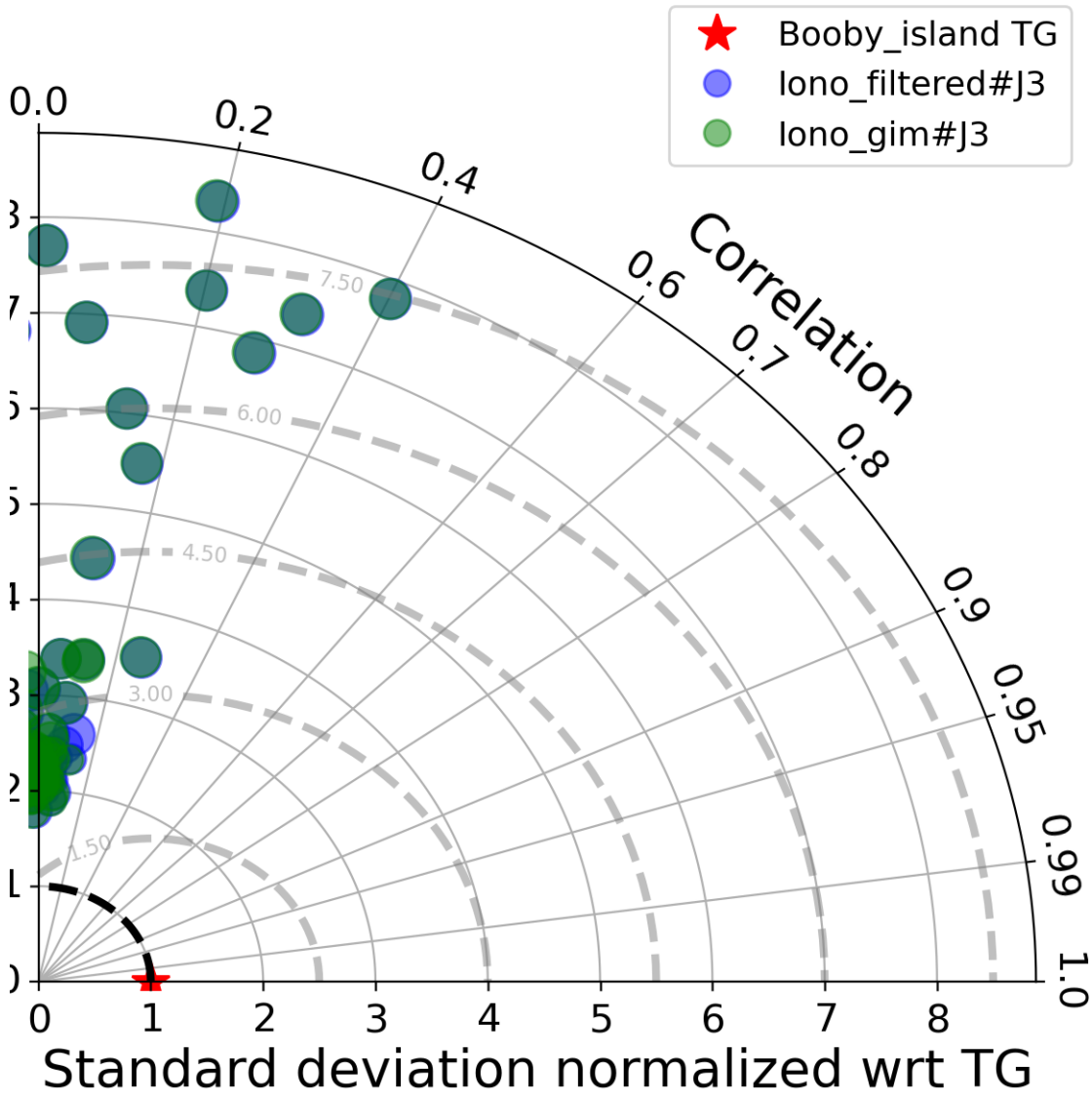

FIGURE 80 – Taylor diagram

6.6.9 Mean statistics table of products comparison with Booby_island tide gauge data

The table below contains the mean statistics of the common points between the different products in the selected area.

Product	Valid data (%)	Correlation	std (m)	rmsd (m)
iono_filtered#J3	88.436	-0.063	0.254	0.28
Iono_gim#J3	90.935	-0.071	0.256	0.282

Figure 81 – Mean statistics table of the common points in the altimetry products

6.6.10 The most correlated sla altimetry Time series with the tide gauge sla time serie

The maximum number of valid altimetry points in the set of all the altimetry sla time series covered by the period of time of the Tide gauge sla time serie is 86 point.

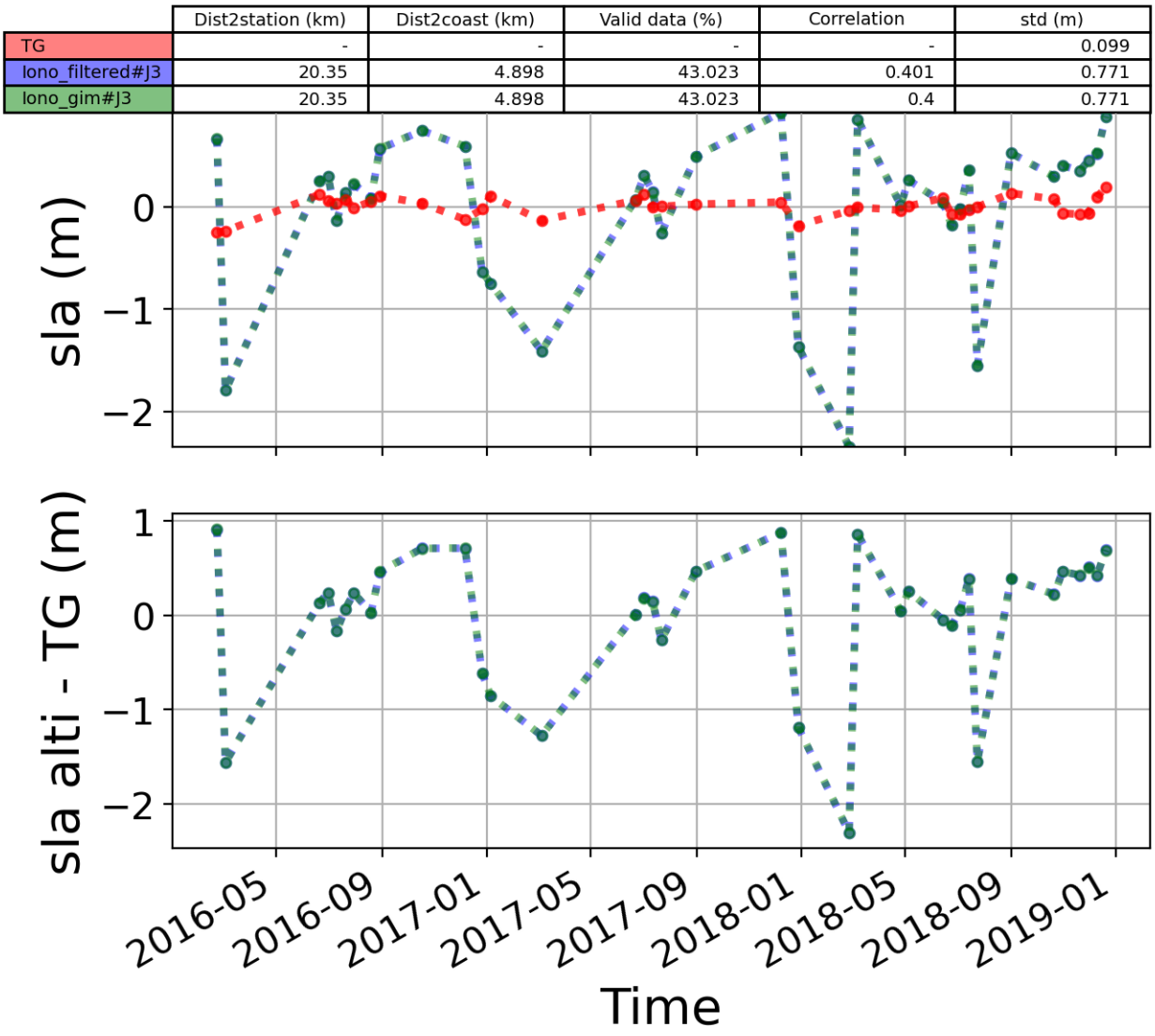

FIGURE 82 – The 1st most correlated sla altimetry Time serie with tide gauge sla time serie