Supplementary Materials for

Insights into the vertical and horizontal movements of a cooperative forager, the false killer whale, in Hawai‘i

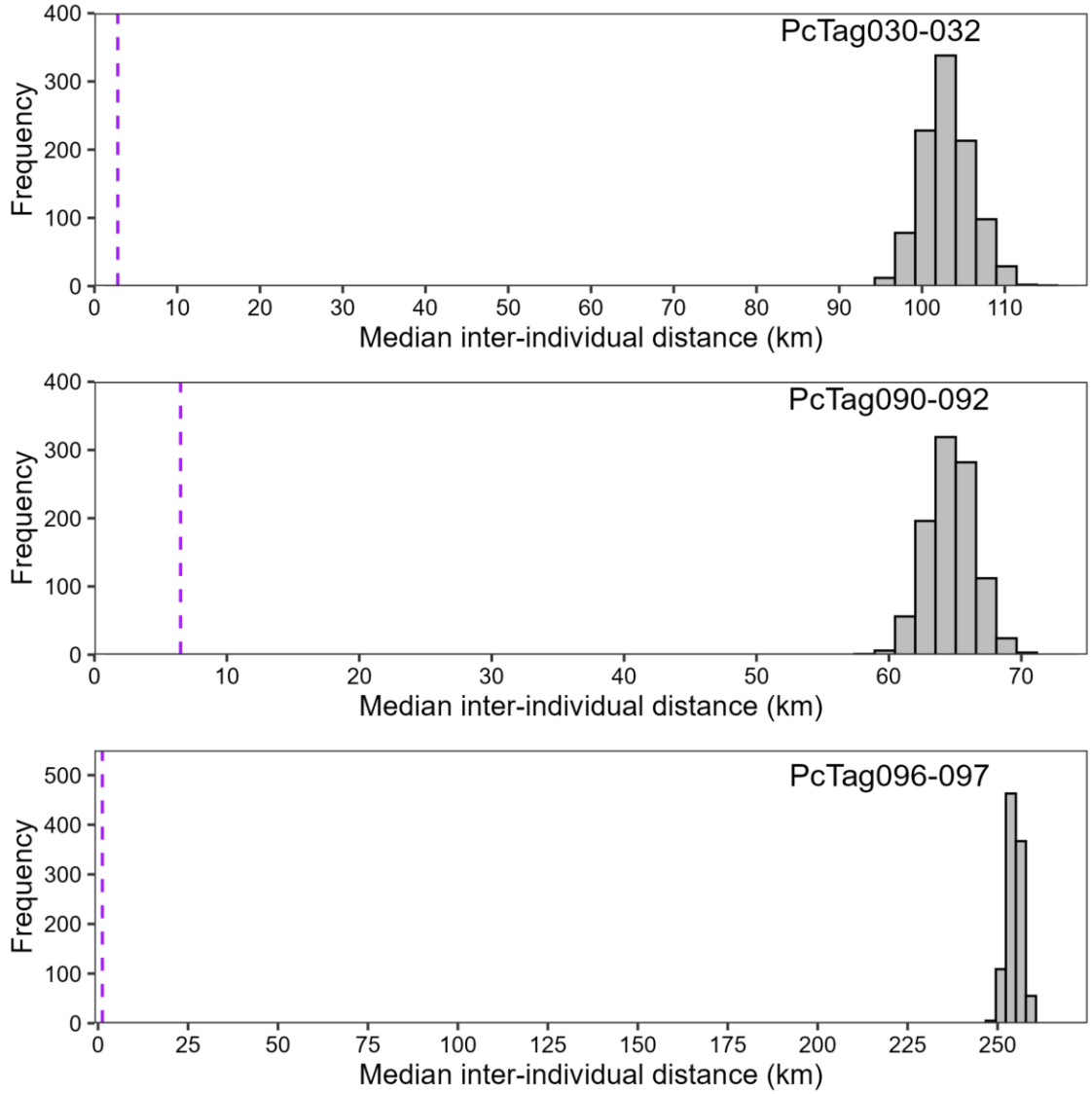


Figure S1. Null distributions of spatial proximity (median inter-individual distance; grey histograms) relative to the observed median inter-individual distance (dashed purple line) for each false killer whale pair.

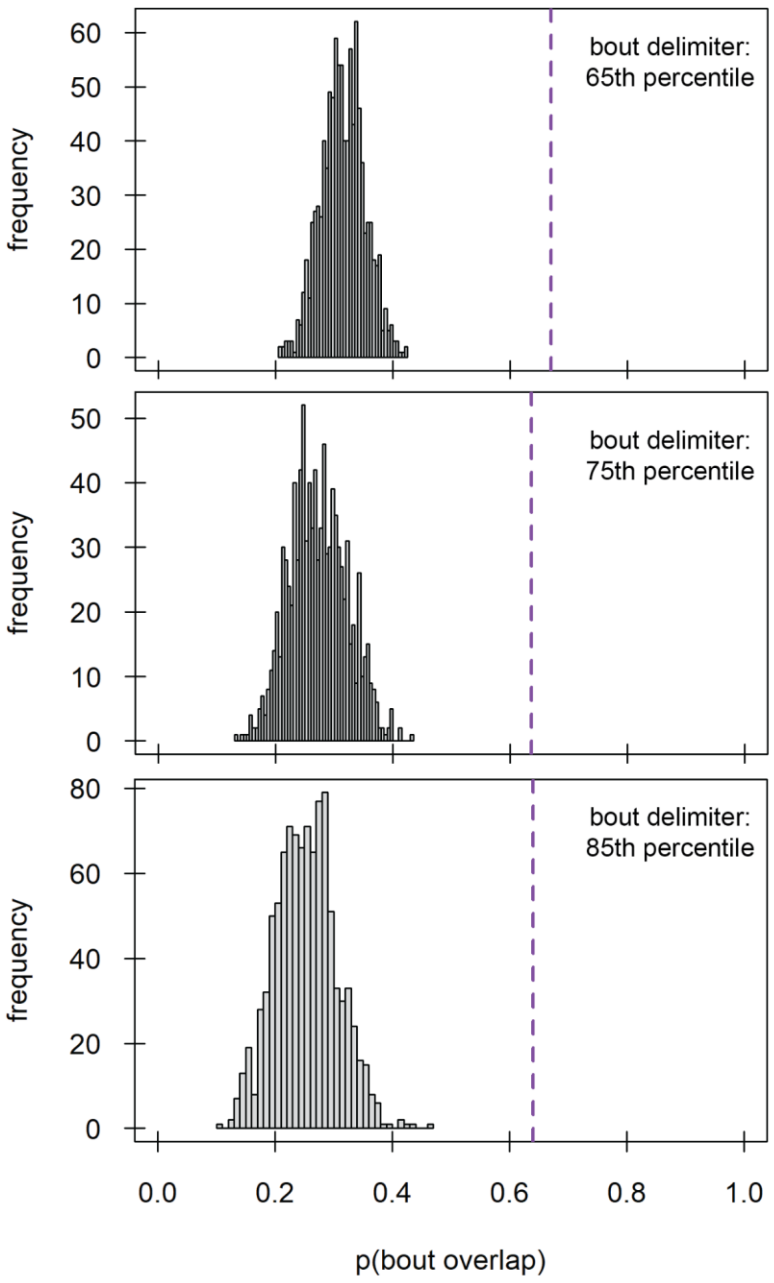


Figure S2. Null distributions of diving bout overlap relative to the observed diving bout overlap (dashed purple line; proportion of shared time) for PcTag030-032 and by each bout delimiter (percentile of distribution of all surface interval durations).

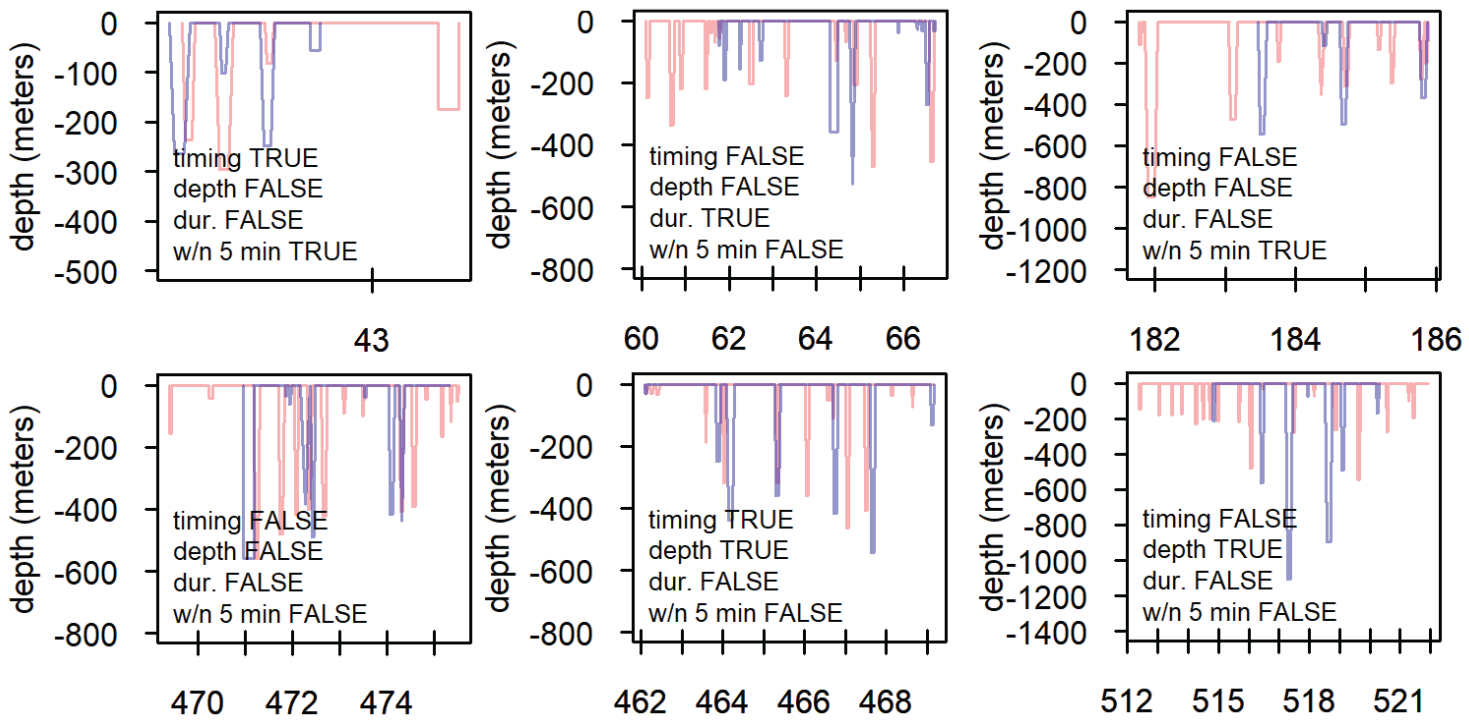


Figure S3. Example diving bout-level dive profile plots for PcTag030 (red lines) and PcTag032 (blue lines), with one-sided null model test results for synchronized dive start/end timing ('timing'), similarity in mean dive depth ('depth') and mean dive duration ('dur.') for the nearest dives in time, and high proportion of dives within 5 minutes of each other ('w/n 5 min) printed on each plot. The x-axis represents 'running hours' or sequential hours of time during the period of overlap (excluding gaps). TRUE indicates that there is evidence ($p < 0.05$) to reject the null hypothesis for each test.

Daily pairwise movement plots

This following section contains pairwise figures showing horizontal movements, straight-line distances, and dive profiles for each false killer whale pair.

For each daily pairwise figure in the following pages:

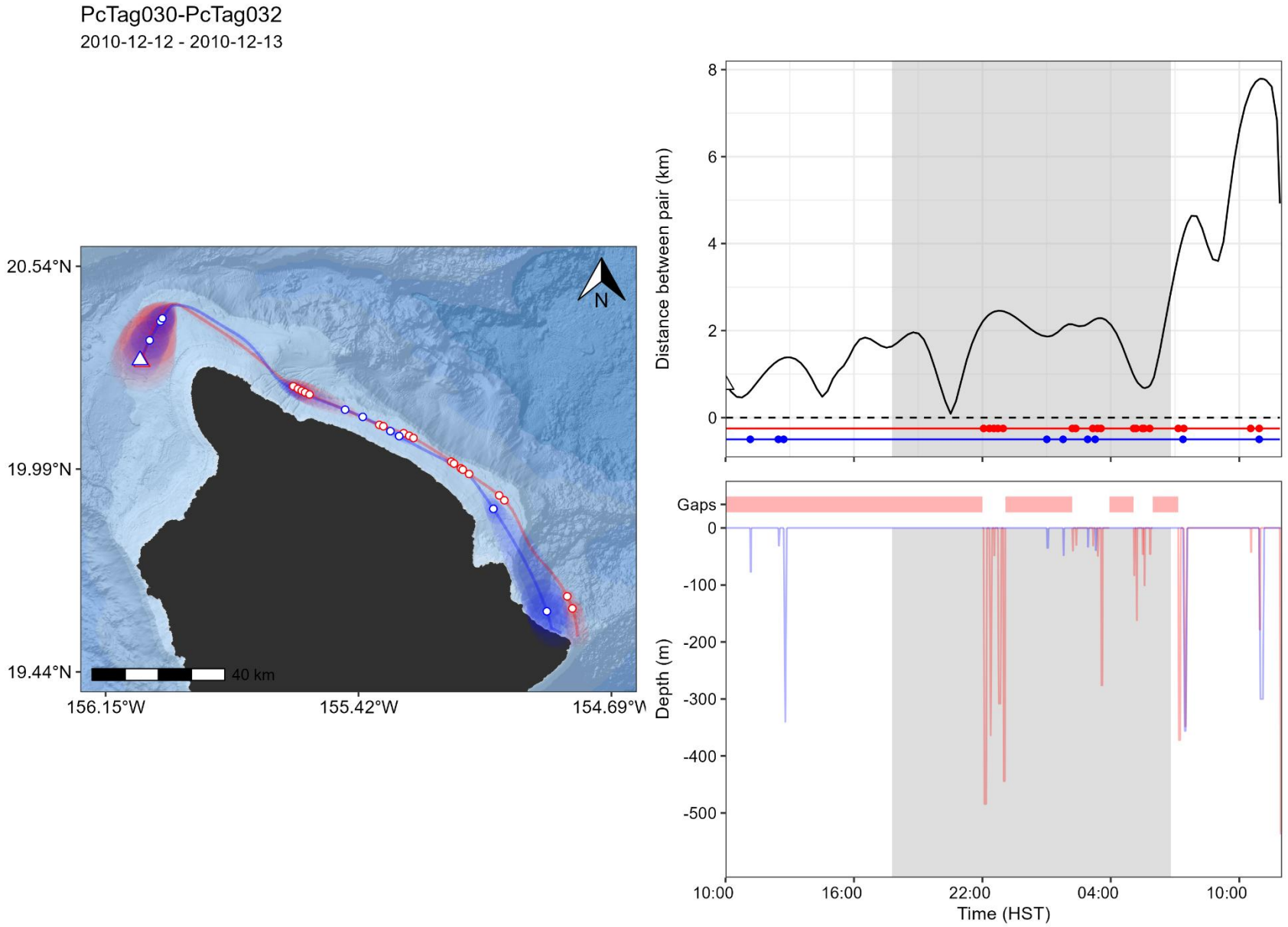
(a) Movement paths (lines), dive positions (points), and error ellipses (outlined ellipses) of the two individuals for a 24-hr period. Ellipses aren't visible for some points, as they are the same or smaller in size of the point; periods with large error ellipses reflect gaps in transmitted location data (note the scale bar may differ among plots). The white triangles indicate the start of the time series for the plotted period.

(b) Straight-line distances between the pair over time (for the period plotted), with dive events indicated by points for each tag below the zero line.

(c) Dive profile plots for the period plotted for each individual (red and blue lines); gray shading indicates nighttime, and the "Gaps" bar represents gaps in the behavior log data stream (i.e., dive behavior unknown during this time).

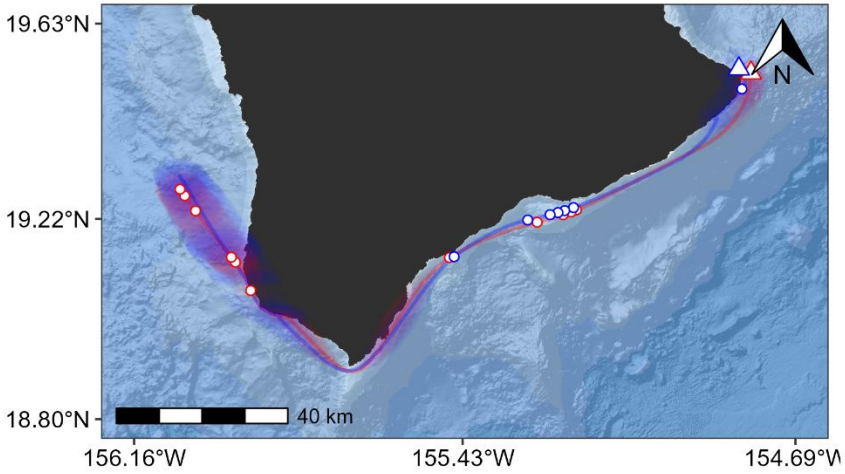
Note: Only days when both tagged individuals had some behavior log data were included. For PcTag030-032, we did not plot the last two days of behavior log data as they occurred during 1- or 2-day duty cycling periods, and thus the positional uncertainty of the tagged individuals during these periods were extremely large (thus precluding inference on spatial proximity in relation to dive synchrony).

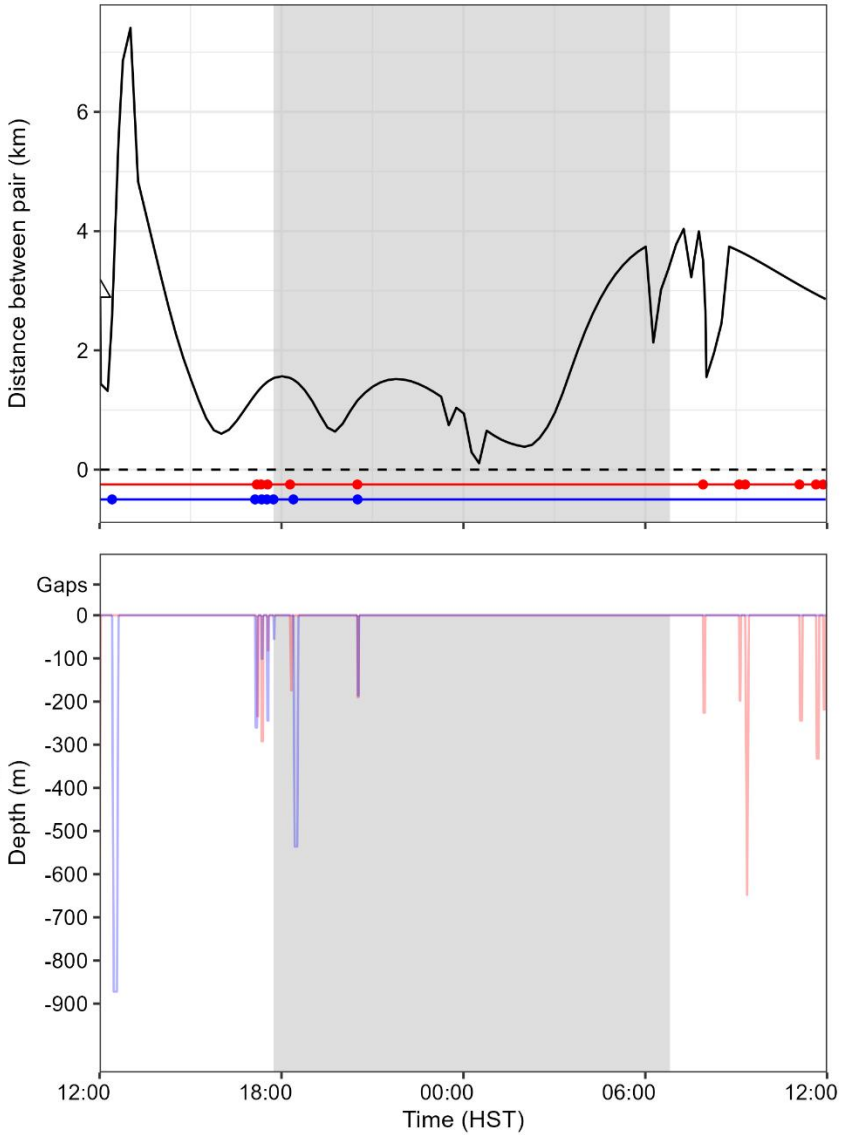
Page numbers corresponding to each pair's plots are listed below for reference:
PcTag030-032: 6-26
PcTag090-092: 27-34
PcTag096-097: 35-40

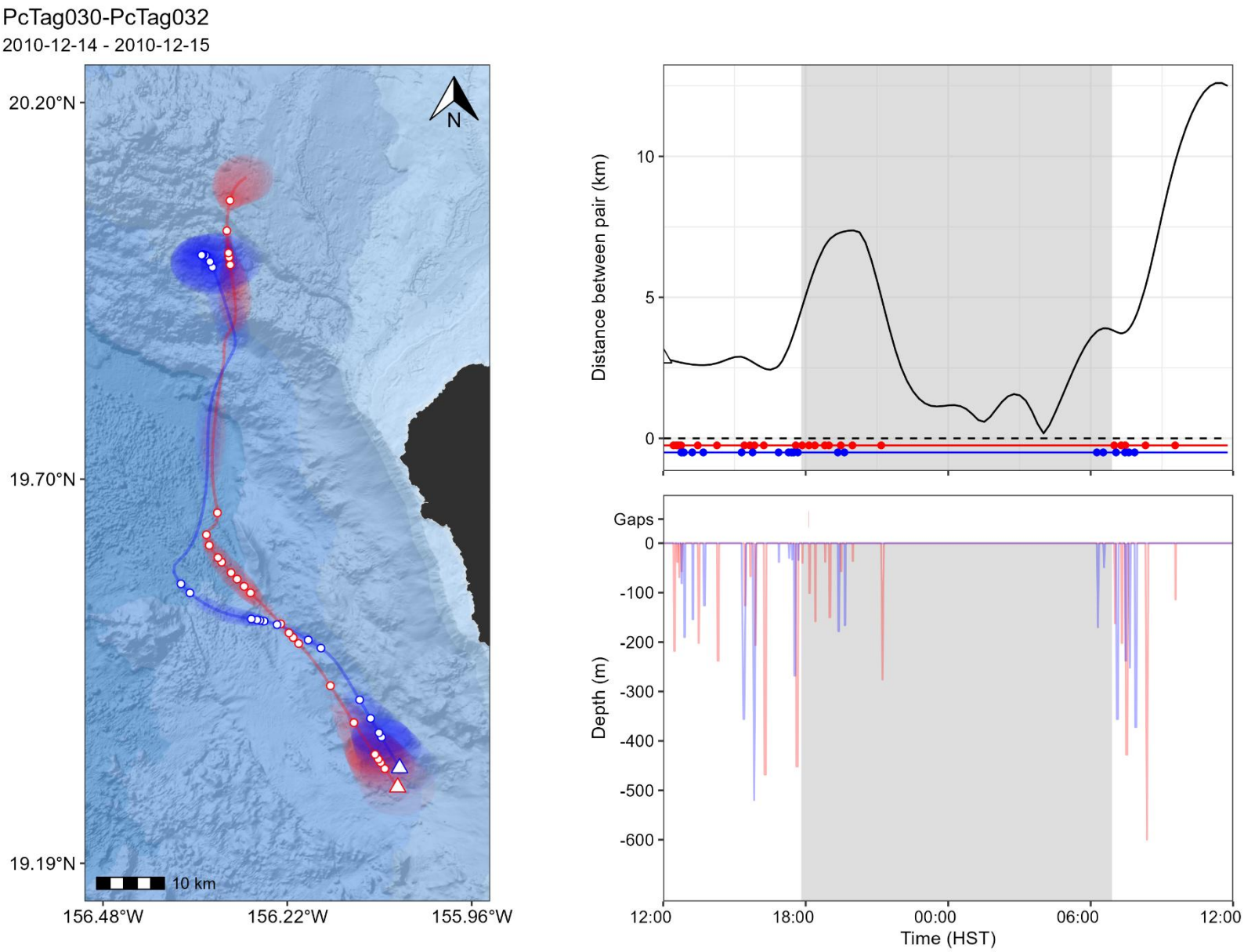

PcTag030-PcTag032
2010-12-12 - 2010-12-13
20.54°N
19.99°N
19.44°N
156.15°W
155.42°W
154.69°W
N
40 km
Distance between pair (km)
8
6
4
2
0
Gaps
0
-100
-200
-300
-400
-500
Depth (m)
10:00
16:00
22:00
04:00
10:00
Time (HST)

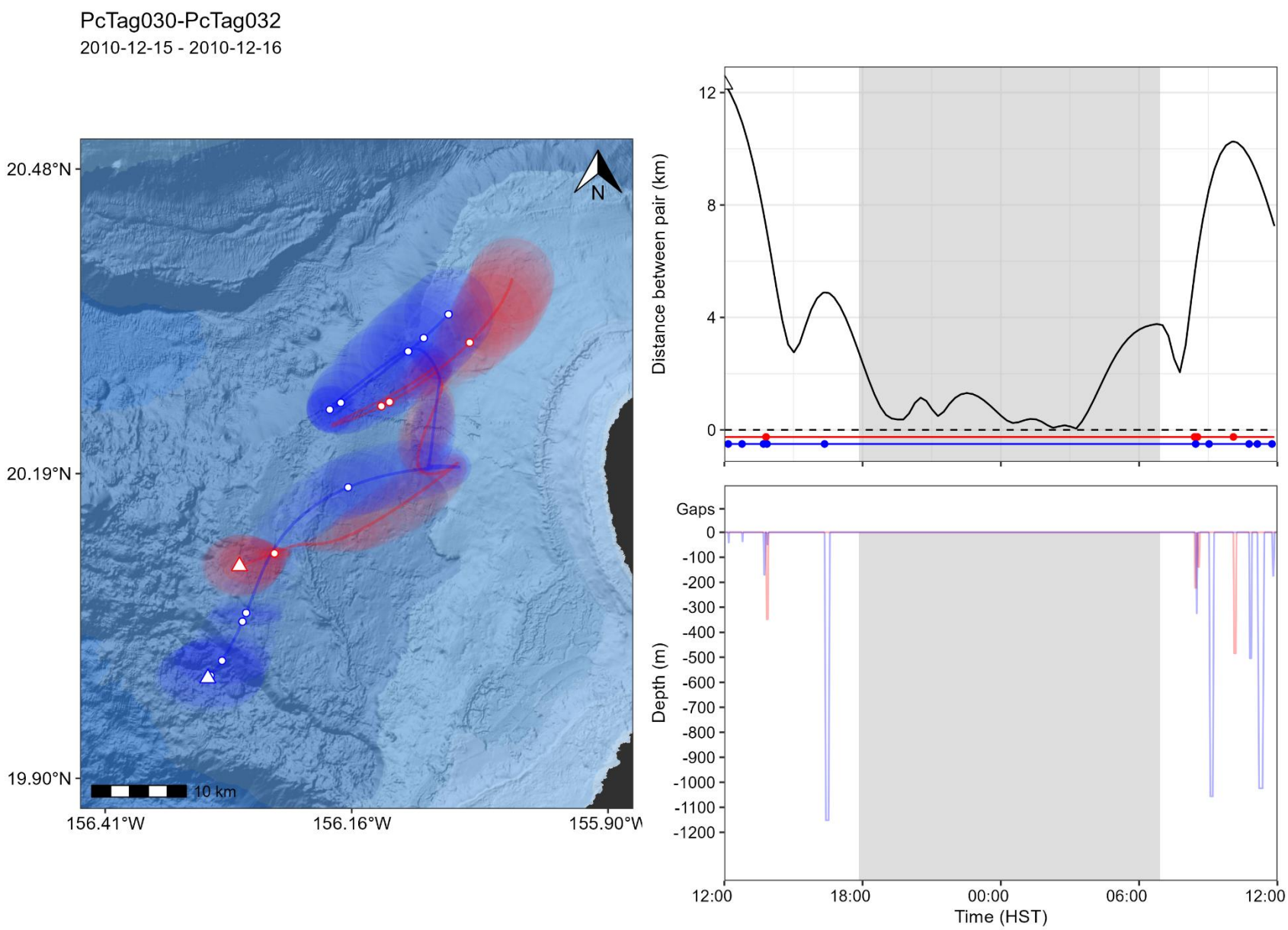
PcTag030-PcTag032

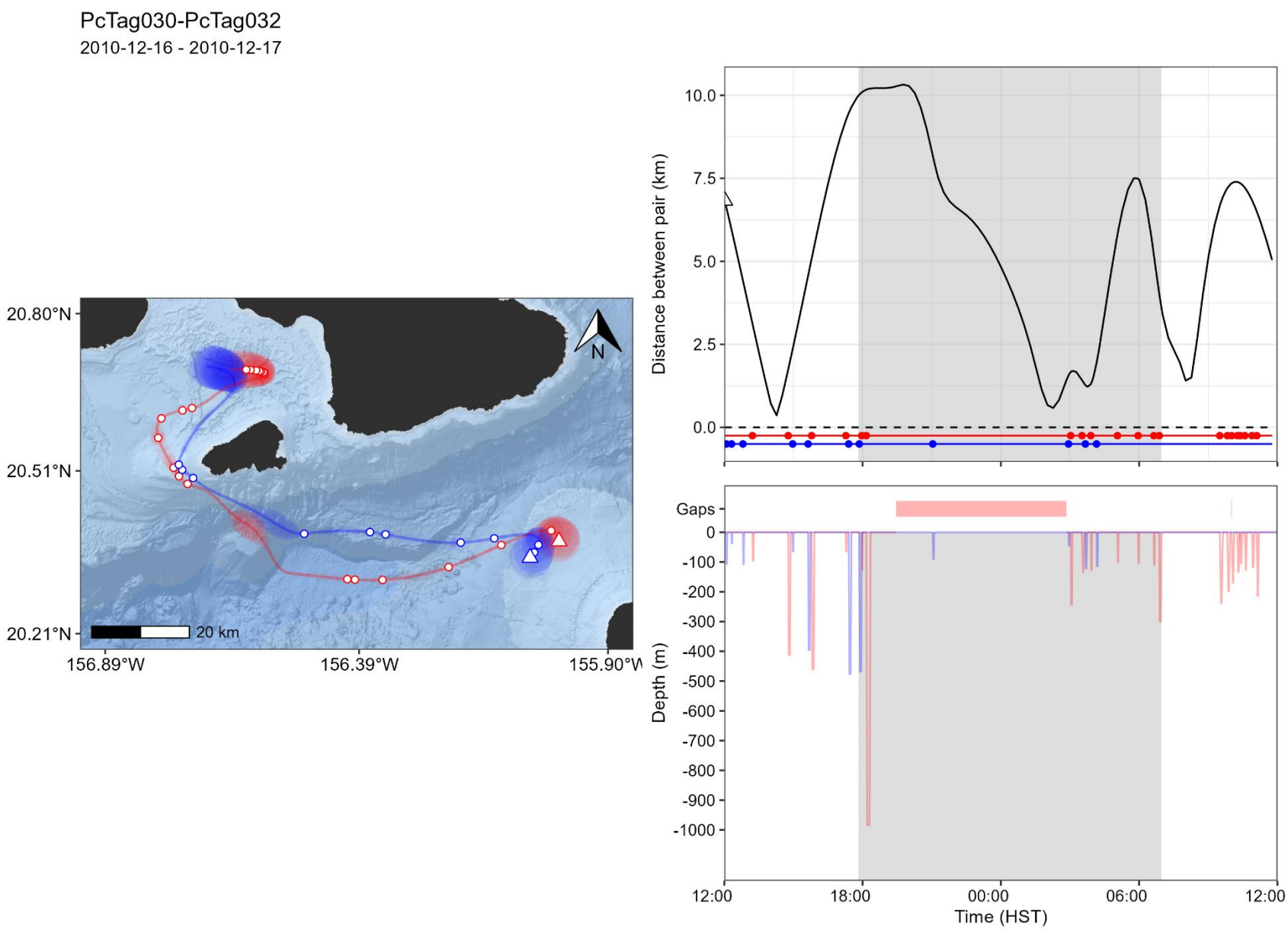
2010-12-13 - 2010-12-14

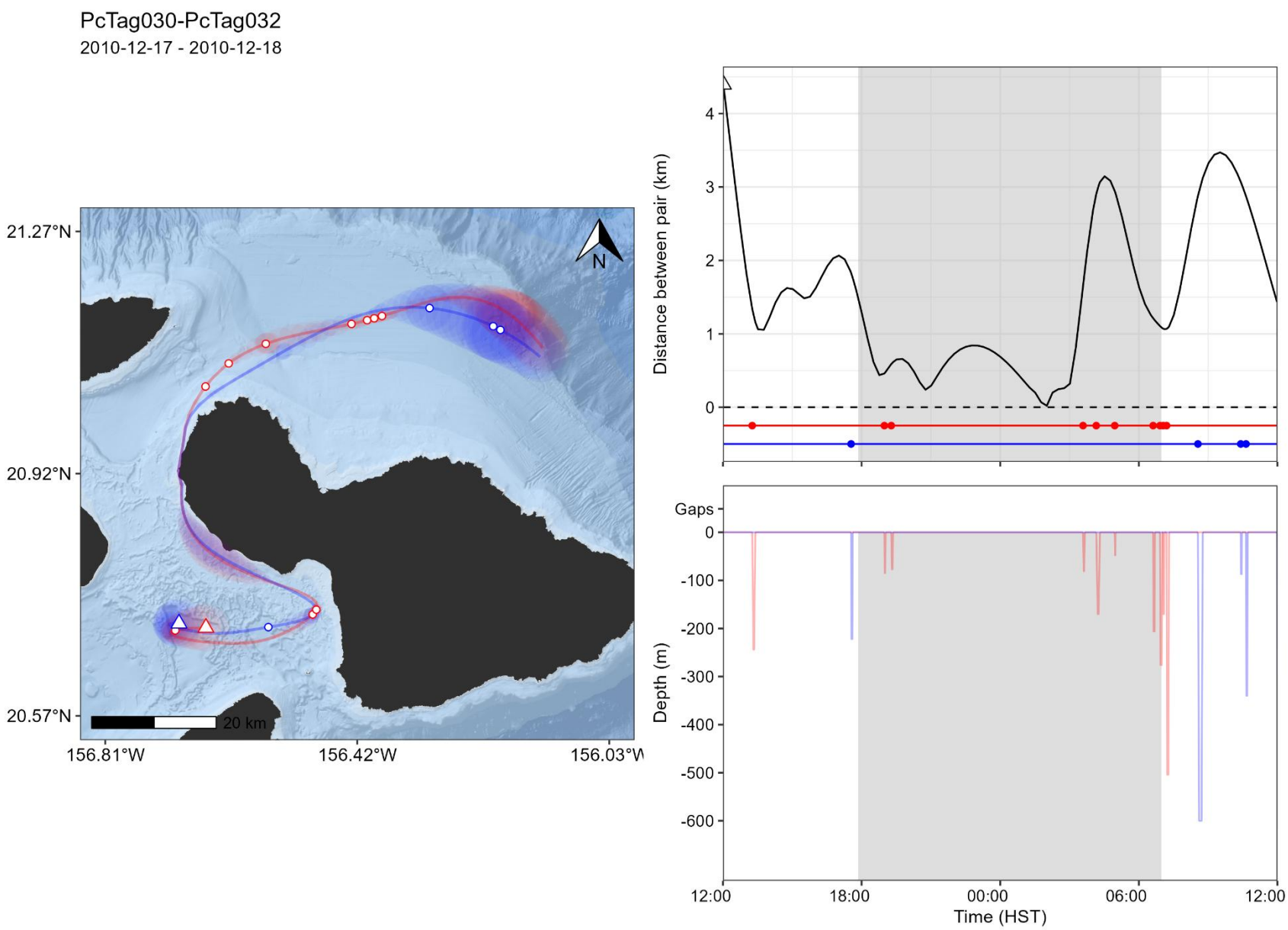


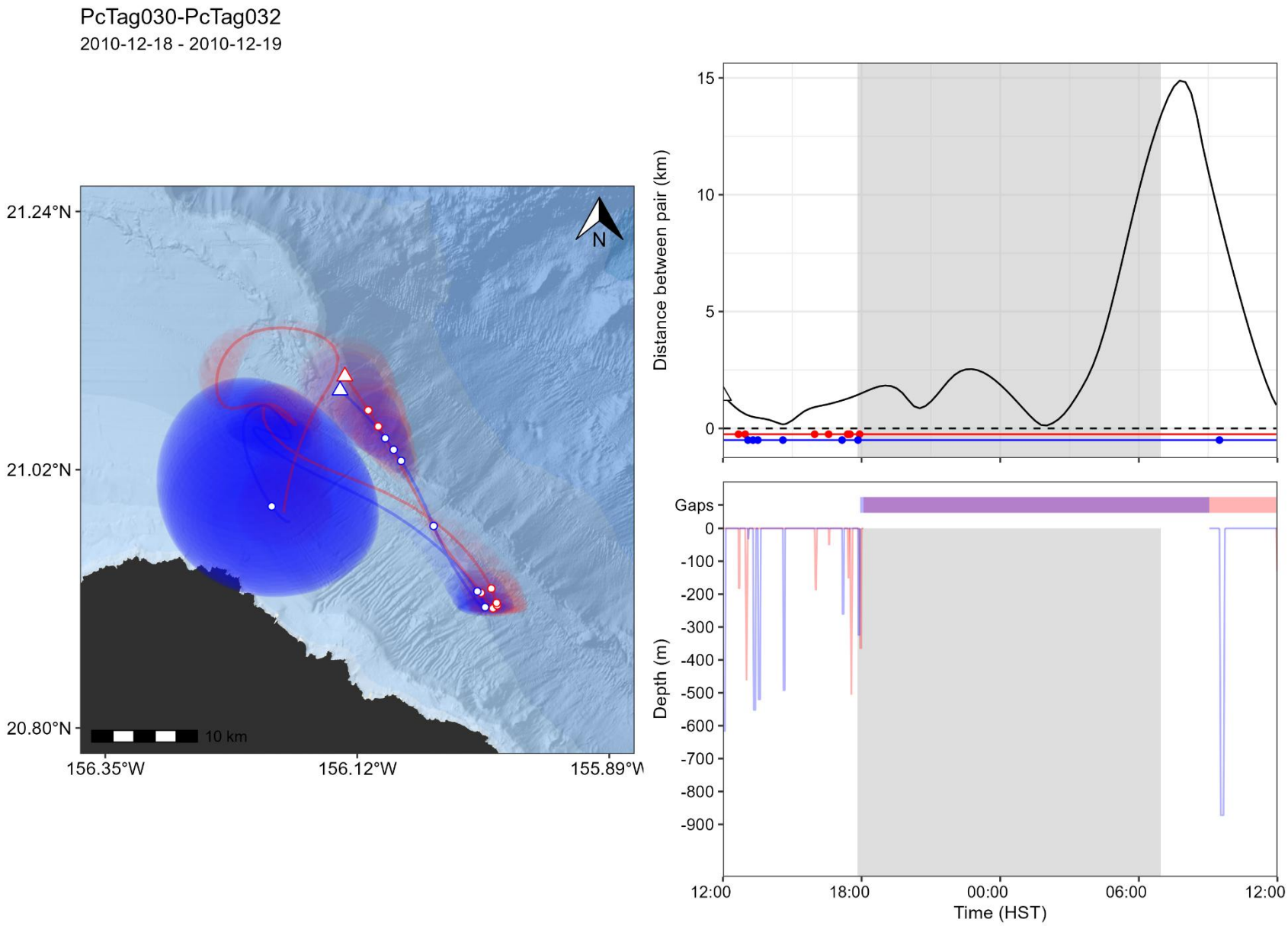


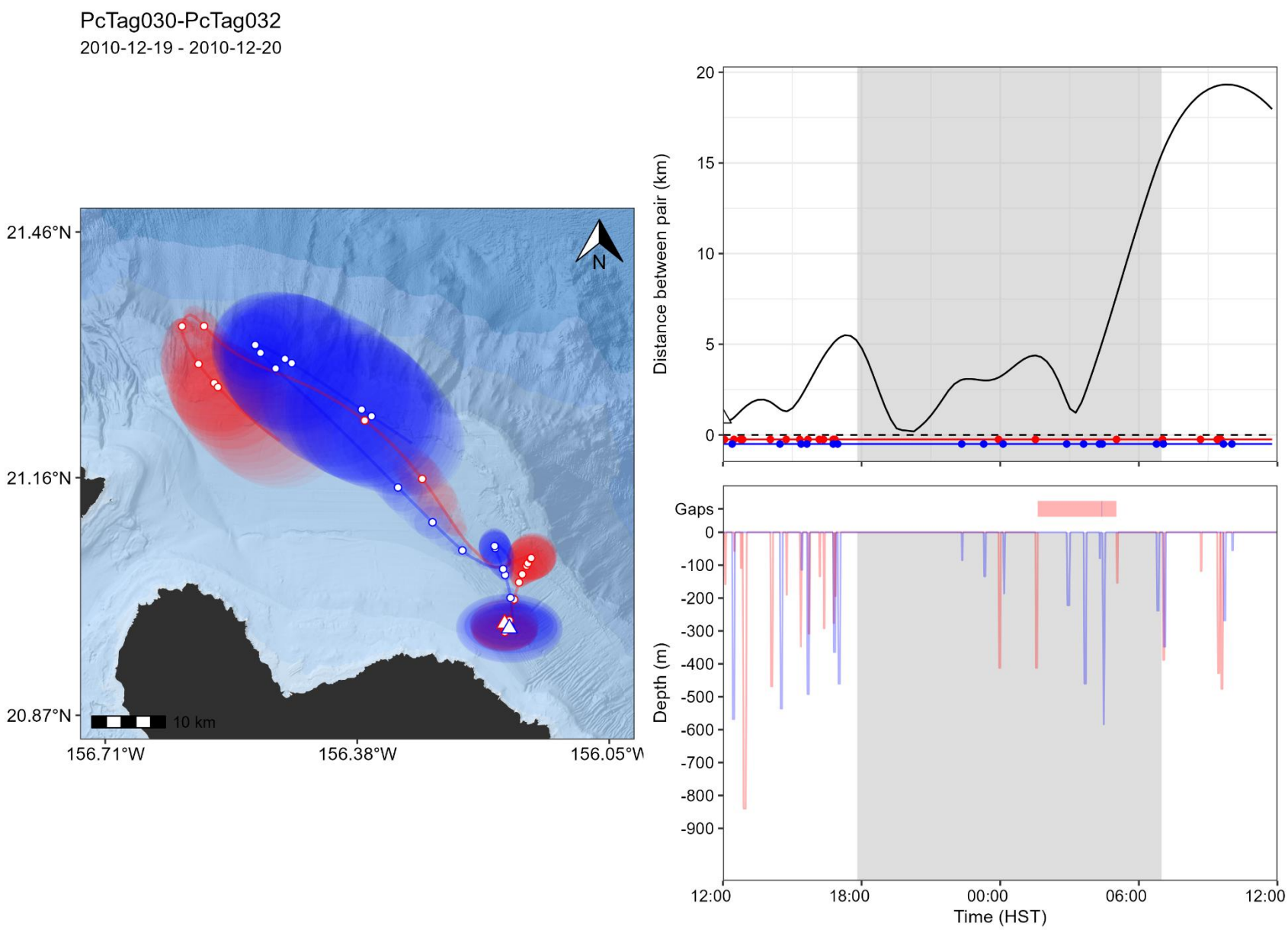

PcTag030-PcTag032
2010-12-14 - 2010-12-15
20.20°N
19.70°N
19.19°N
N
10 km
156.48°W
156.22°W
155.96°W
Distance between pair (km)
10
5
0
Gaps
0
-100
-200
-300
-400
-500
-600
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)


PcTag030-PcTag032
2010-12-15 - 2010-12-16
20.48°N
20.19°N
19.90°N
156.41°W
156.16°W
155.90°W
N
10 km
Distance between pair (km)
12
8
4
0
Gaps
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
-1000
-1100
-1200
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)


PcTag030-PcTag032
2010-12-16 - 2010-12-17
20.80°N
20.51°N
20.21°N
156.89°W
156.39°W
155.90°W
N
20 km
Distance between pair (km)
10.0
7.5
5.0
2.5
0.0
Gaps
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
-1000
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)

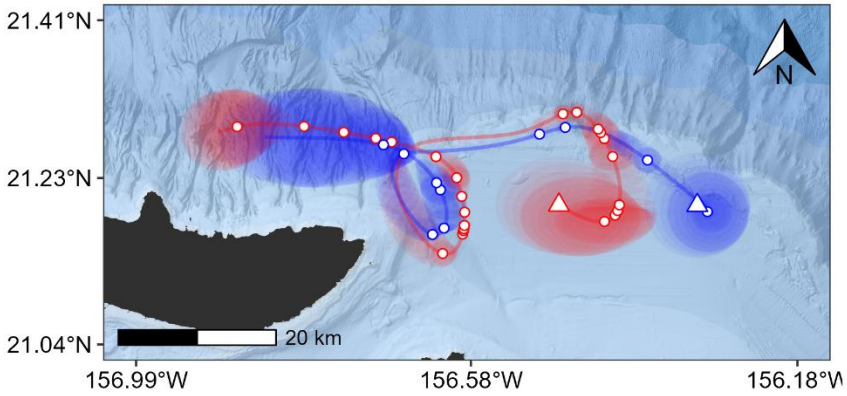

PcTag030-PcTag032
2010-12-17 - 2010-12-18
21.27°N
20.92°N
20.57°N
156.81°W
156.42°W
156.03°W
N
20 km
Distance between pair (km)
4
3
2
1
0
Gaps
0
-100
-200
-300
-400
-500
-600
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)

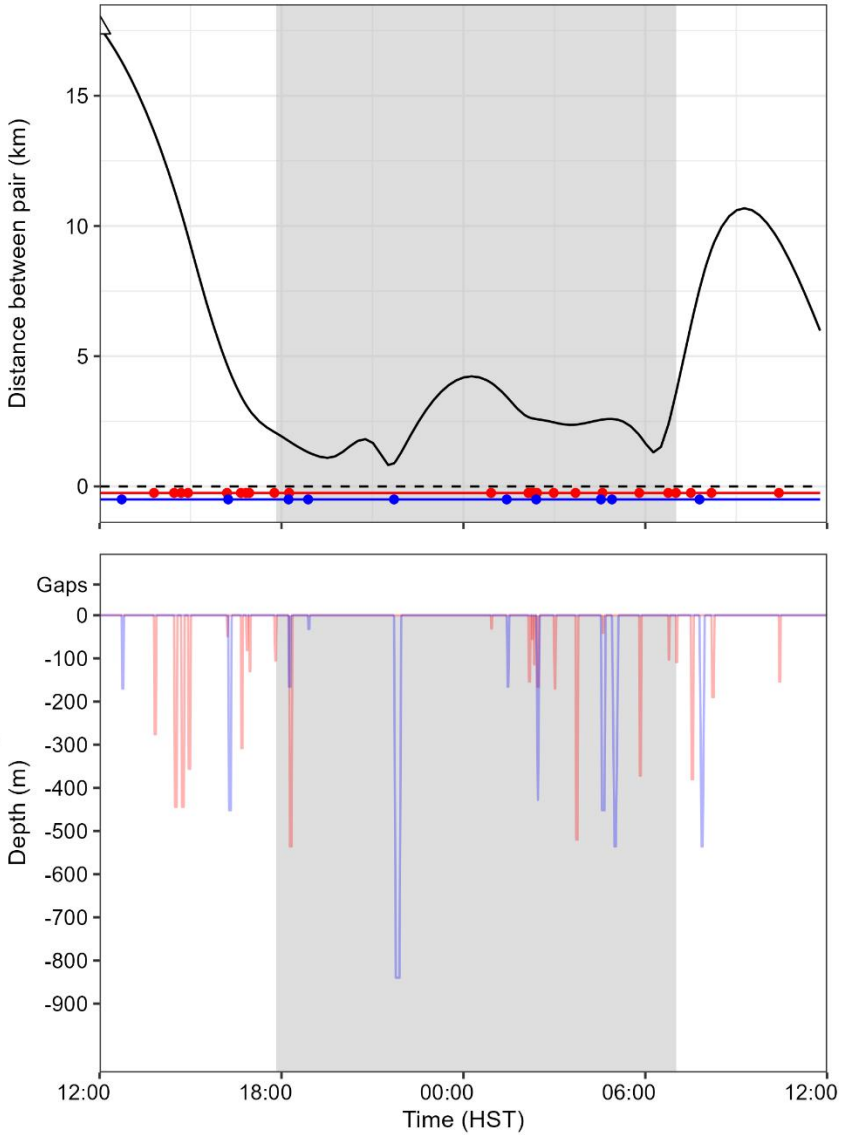

PcTag030-PcTag032
2010-12-18 - 2010-12-19
21.24°N
21.02°N
20.80°N
156.35°W
156.12°W
155.89°W
N
10 km
Distance between pair (km)
15
10
5
0
Gaps
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)

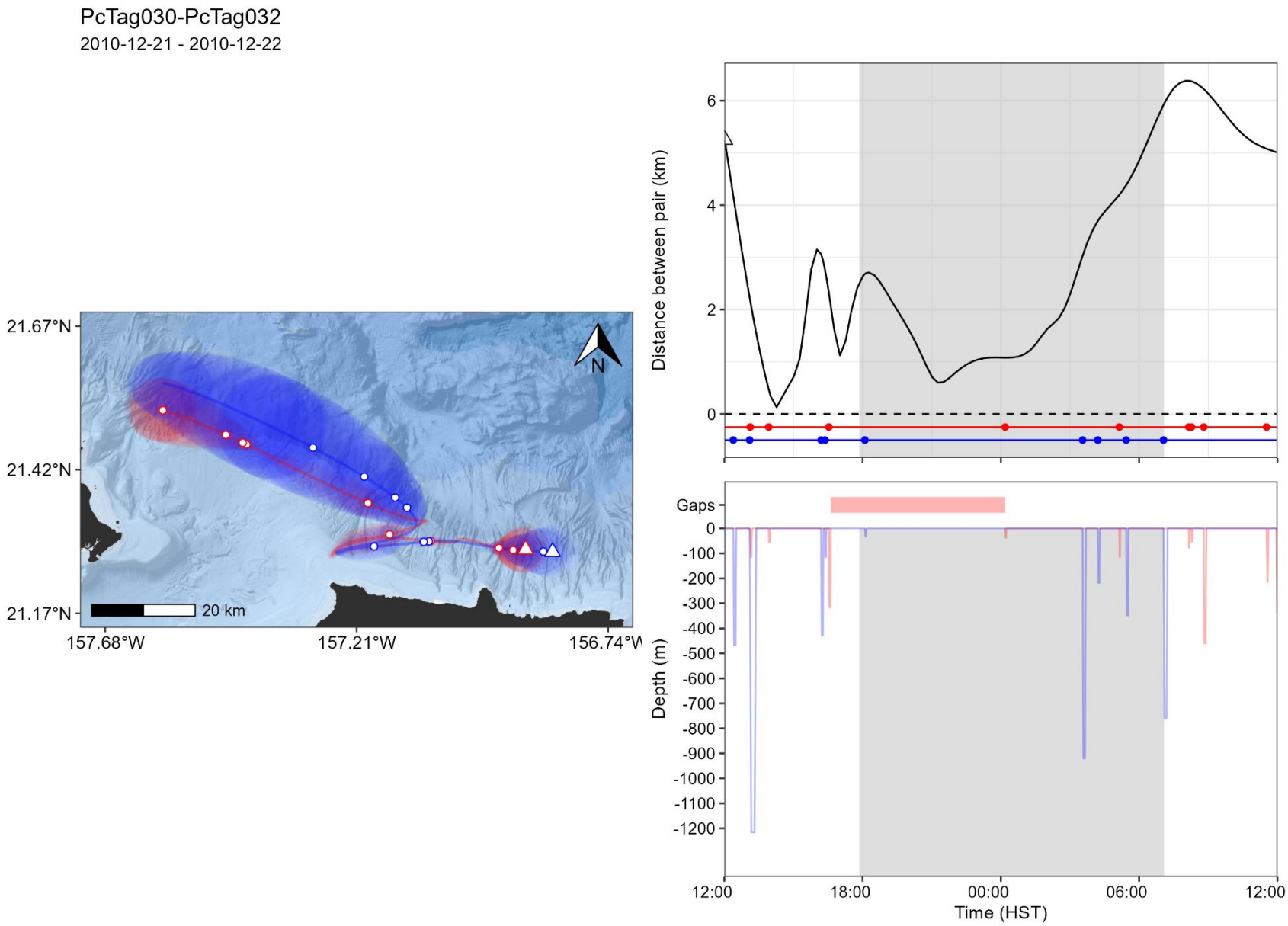

PcTag030-PcTag032
2010-12-19 - 2010-12-20
21.46°N
21.16°N
20.87°N
156.71°W
156.38°W
156.05°W
N
10 km
Distance between pair (km)
20
15
10
5
0
Gaps
Depth (m)
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
12:00
18:00
00:00
06:00
12:00
Time (HST)

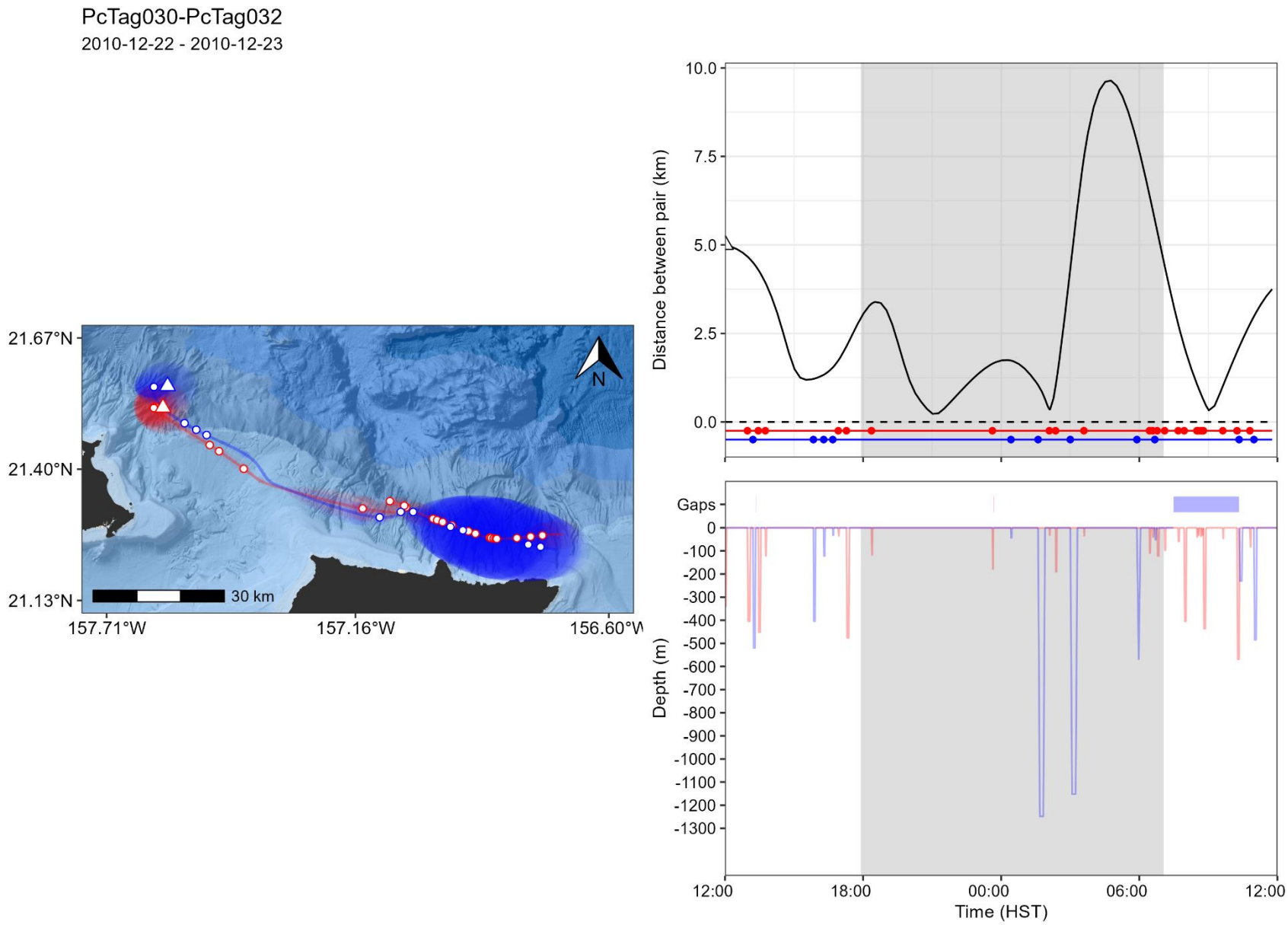
PcTag030-PcTag032

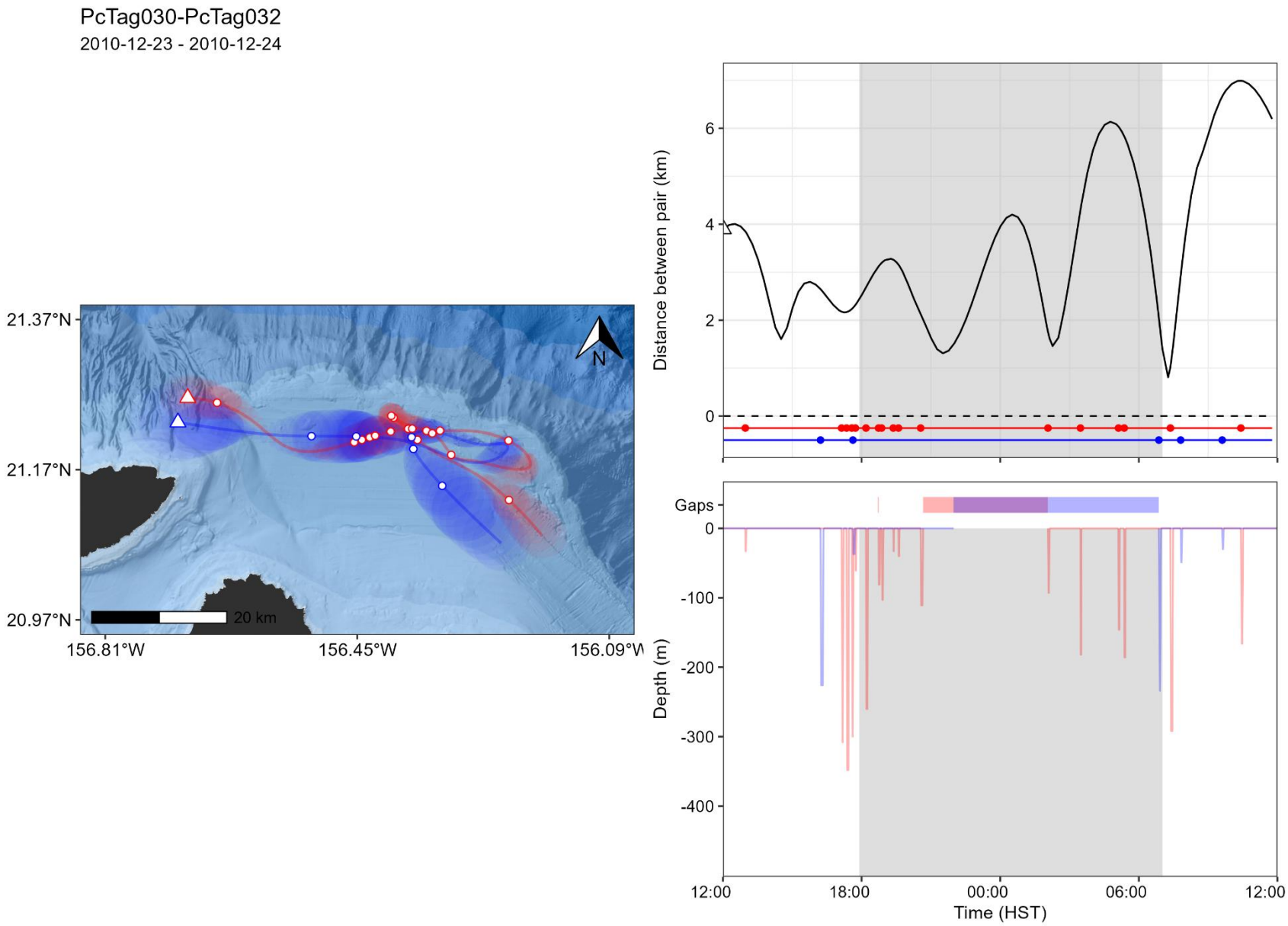
2010-12-20 - 2010-12-21

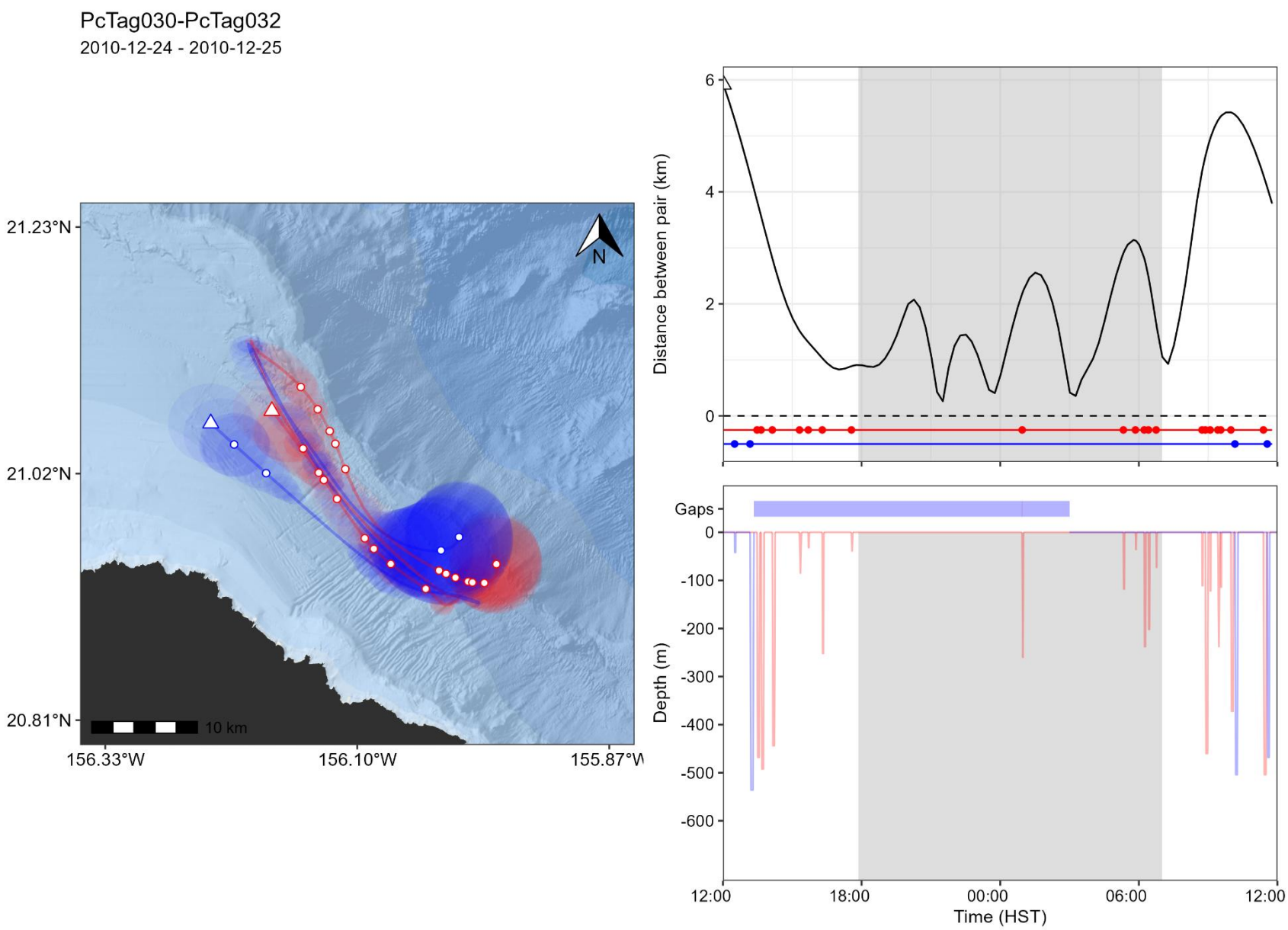


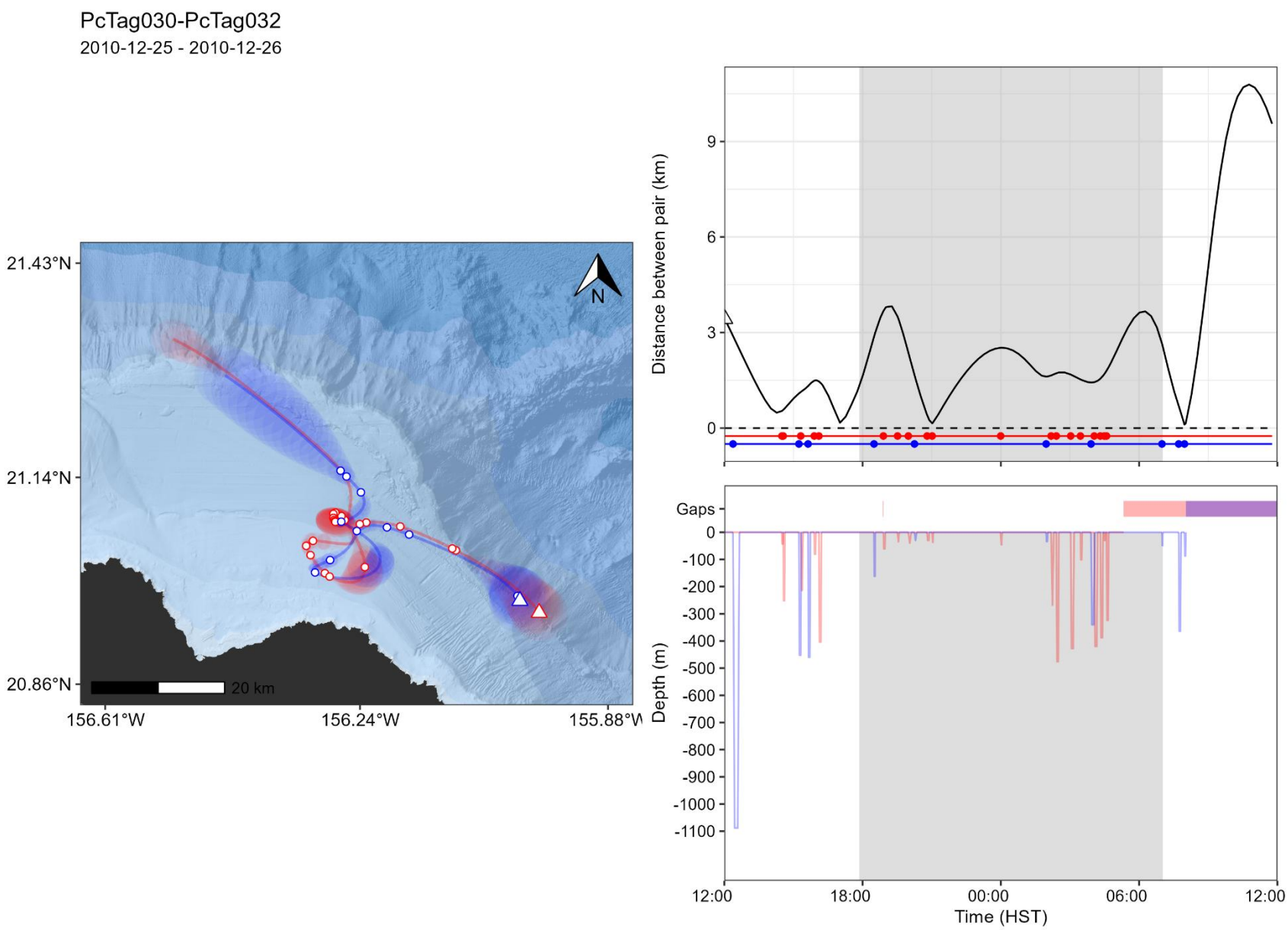


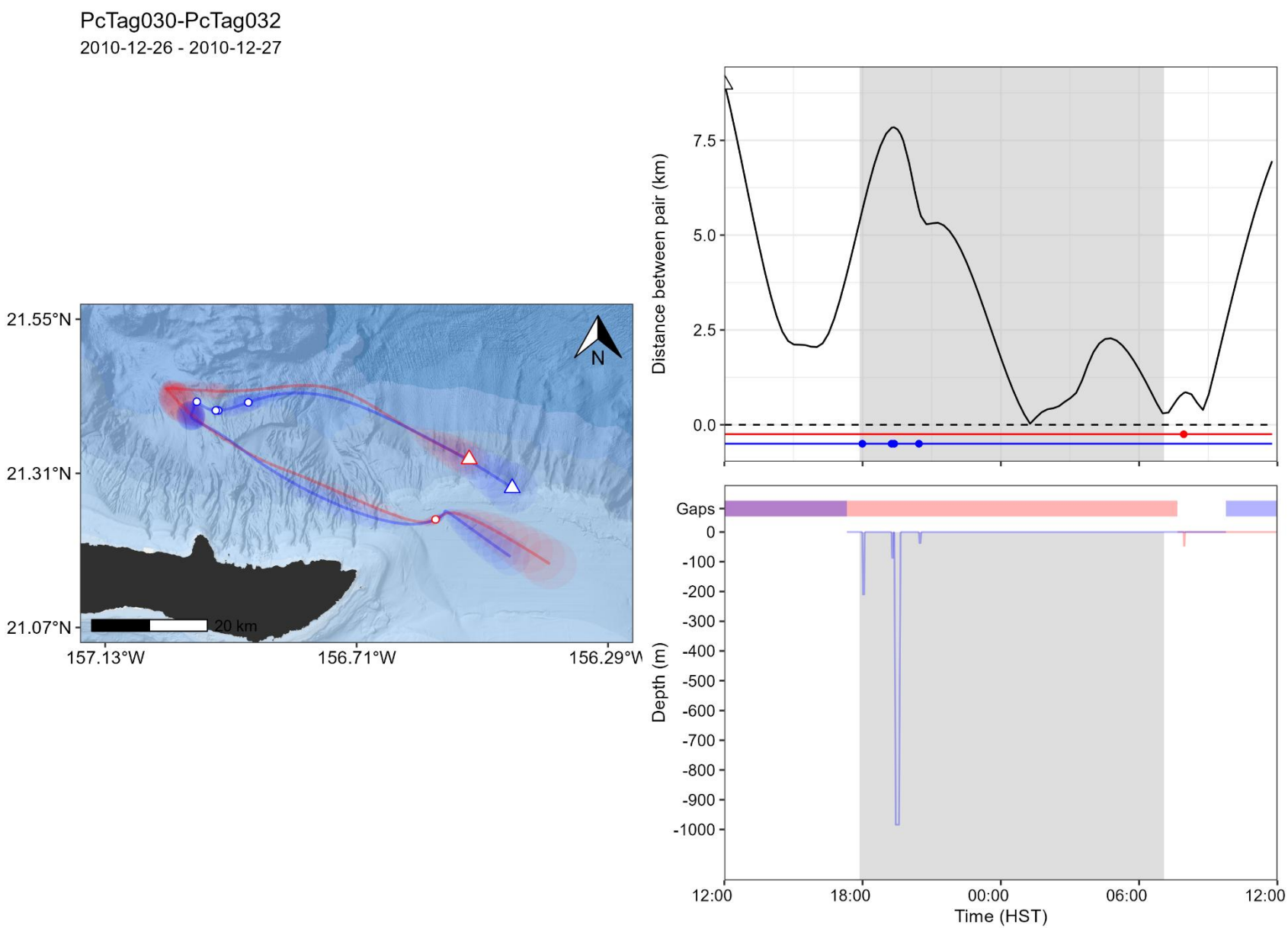

PcTag030-PcTag032
2010-12-21 - 2010-12-22
21.67°N
21.42°N
21.17°N
157.68°W
157.21°W
156.74°W
N
20 km
Distance between pair (km)
6
4
2
0
Gaps
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
-1000
-1100
-1200
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)


PcTag030-PcTag032
2010-12-22 - 2010-12-23
21.67°N
21.40°N
21.13°N
157.71°W
157.16°W
156.60°W
N
30 km
Distance between pair (km)
10.0
7.5
5.0
2.5
0.0
Gaps
Depth (m)
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
-1000
-1100
-1200
-1300
12:00
18:00
00:00
06:00
12:00
Time (HST)


PcTag030-PcTag032
2010-12-23 - 2010-12-24
21.37°N
21.17°N
20.97°N
156.81°W
156.45°W
156.09°W
N
20 km
Distance between pair (km)
6
4
2
0
Gaps
0
-100
-200
-300
-400
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)

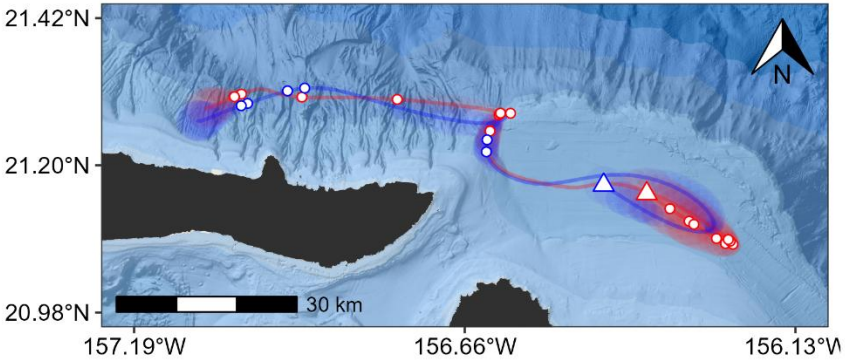

PcTag030-PcTag032
2010-12-24 - 2010-12-25
21.23°N
21.02°N
20.81°N
156.33°W
156.10°W
155.87°W
N
10 km
Distance between pair (km)
6
4
2
0
Gaps
Depth (m)
0
-100
-200
-300
-400
-500
-600
12:00
18:00
00:00
06:00
12:00
Time (HST)

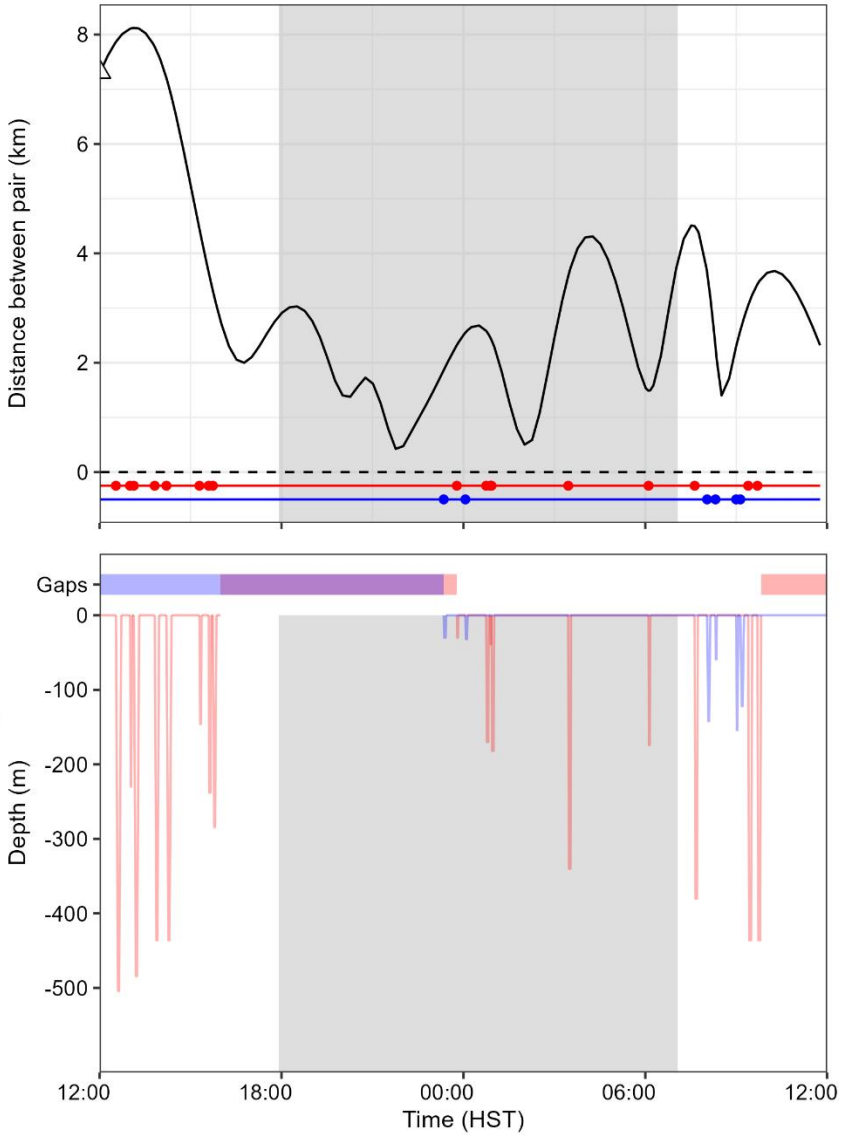

PcTag030-PcTag032
2010-12-25 - 2010-12-26
21.43°N
21.14°N
20.86°N
156.61°W
156.24°W
155.88°W
N
20 km
Distance between pair (km)
9
6
3
0
Gaps
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
-1000
-1100
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)


PcTag030-PcTag032
2010-12-26 - 2010-12-27
21.55°N
21.31°N
21.07°N
157.13°W
156.71°W
156.29°W
N
20 km
Distance between pair (km)
7.5
5.0
2.5
0.0
Gaps
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
-1000
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)

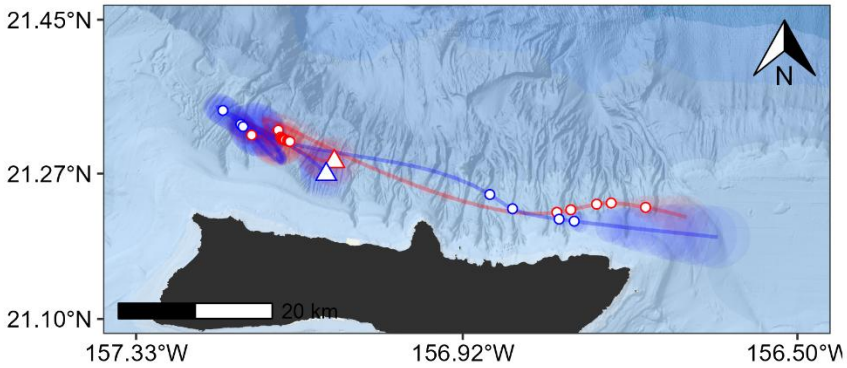
PcTag030-PcTag032

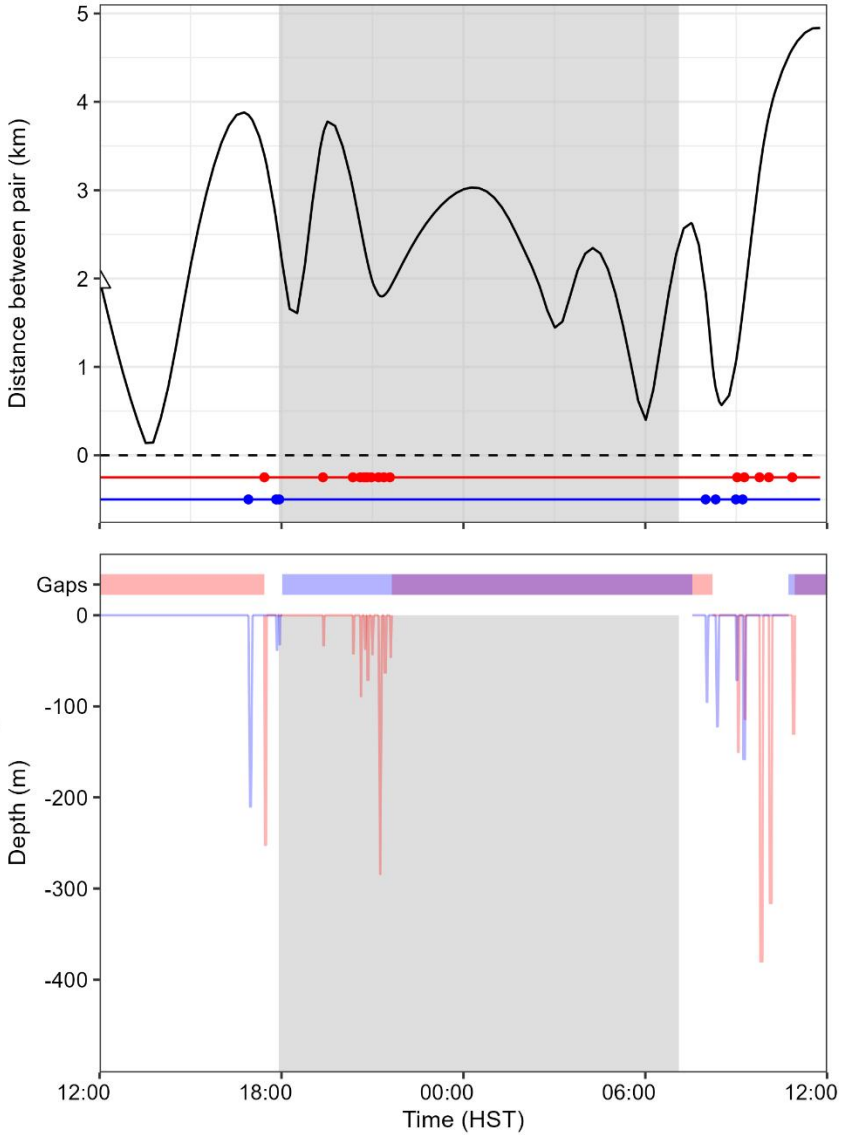
2010-12-27 - 2010-12-28





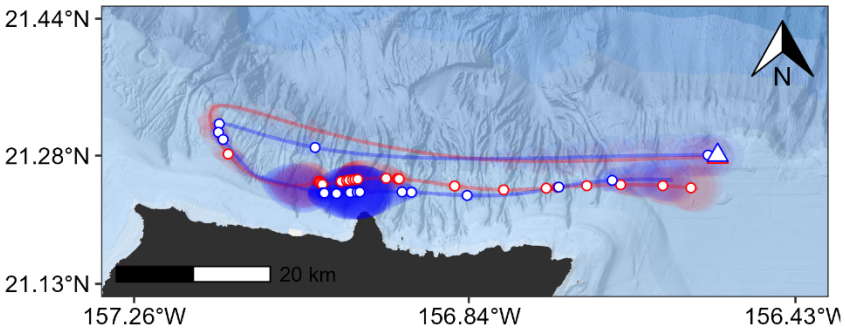
PcTag030-PcTag032
2010-12-28 - 2010-12-29

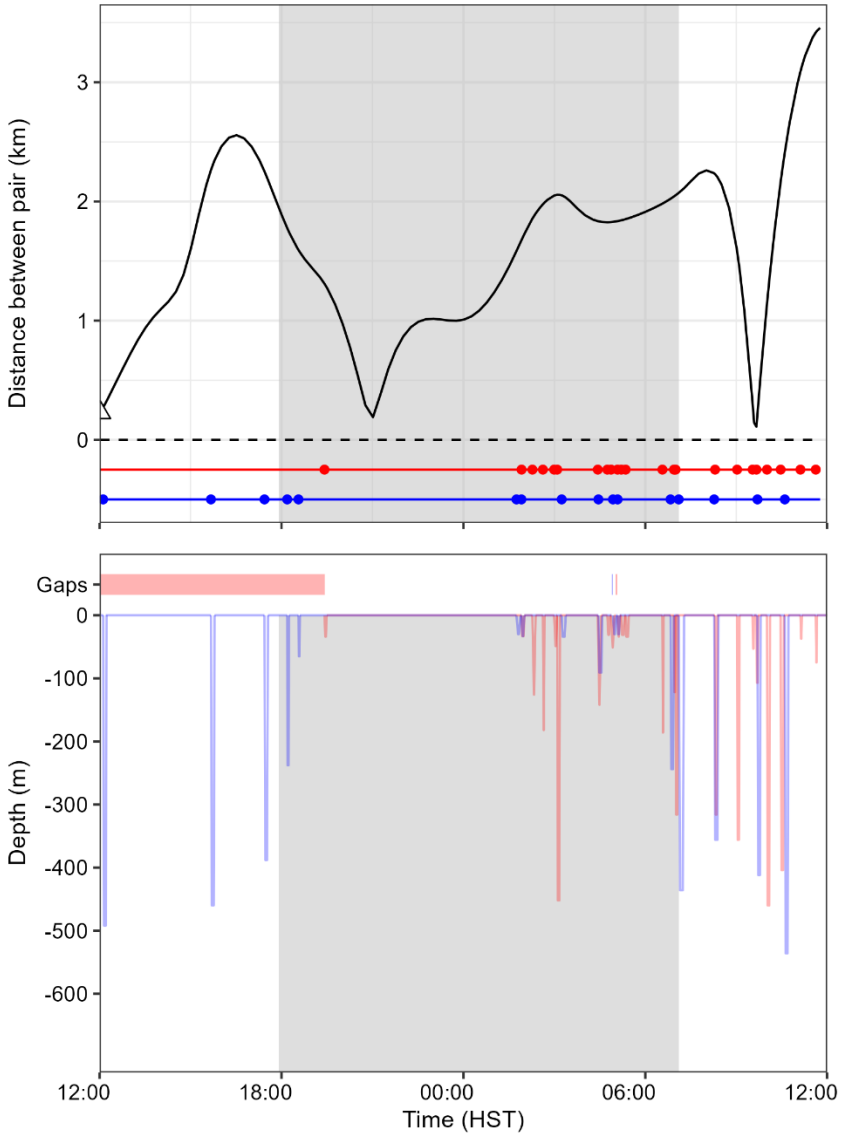


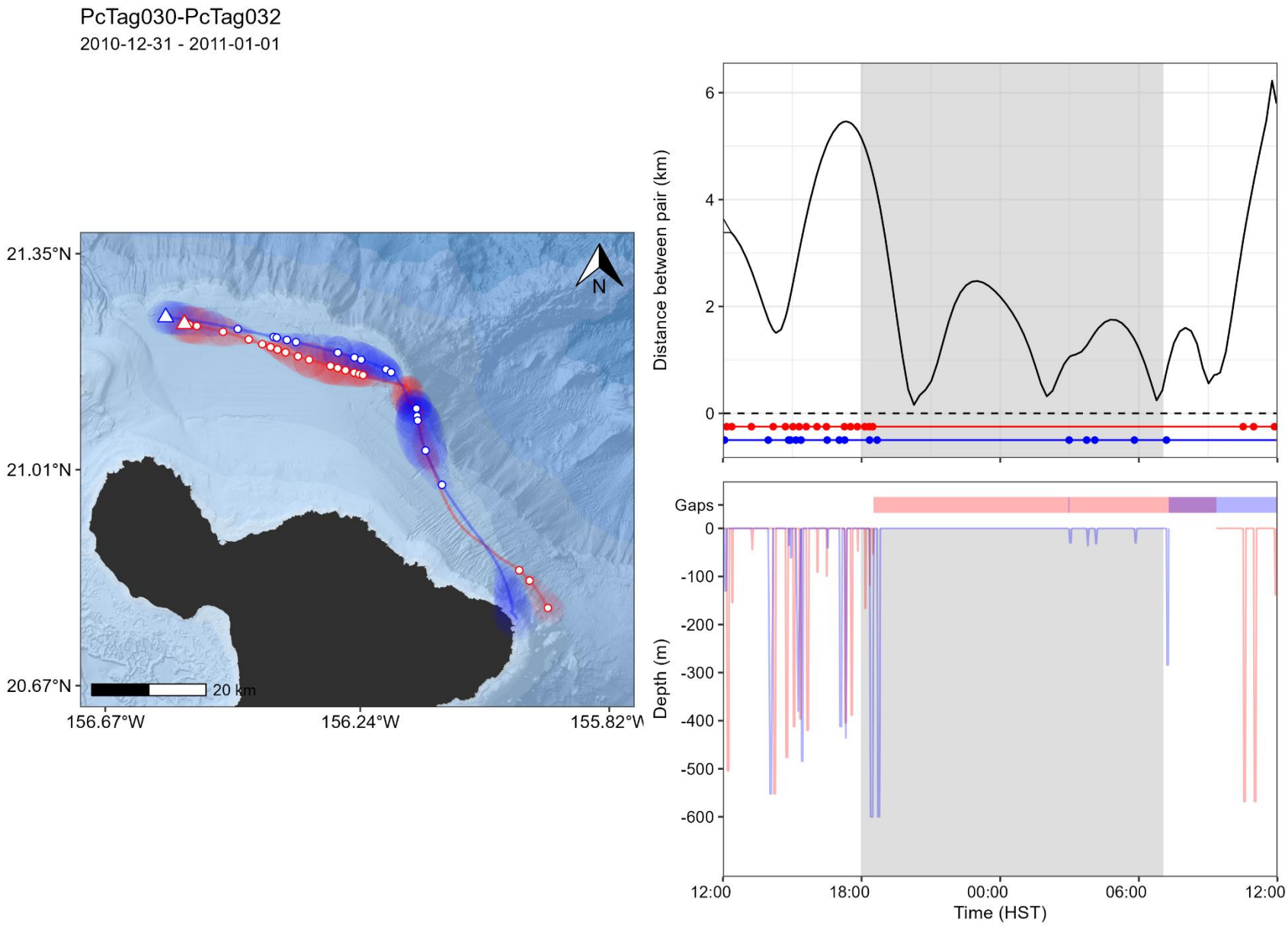


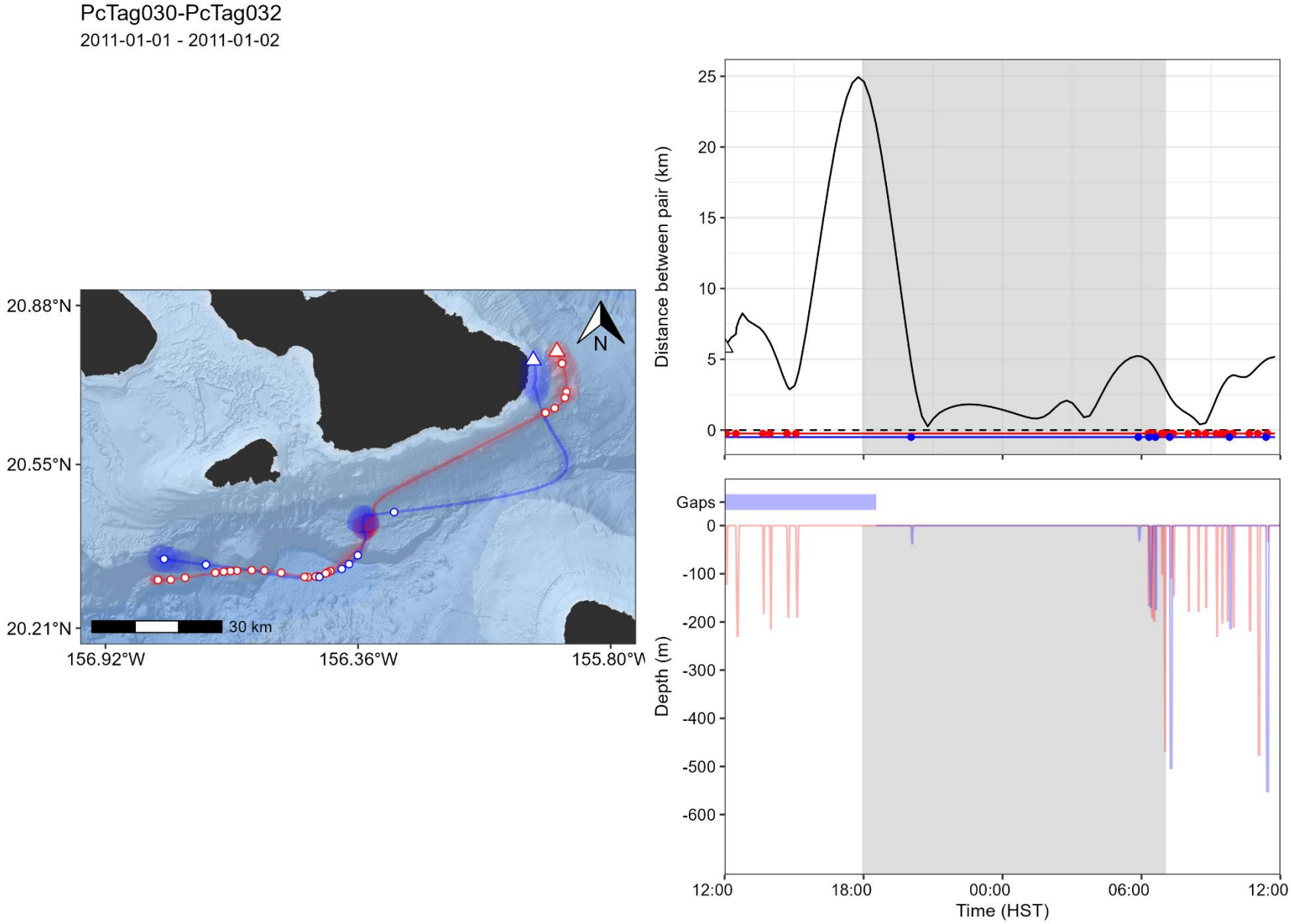
PcTag030-PcTag032

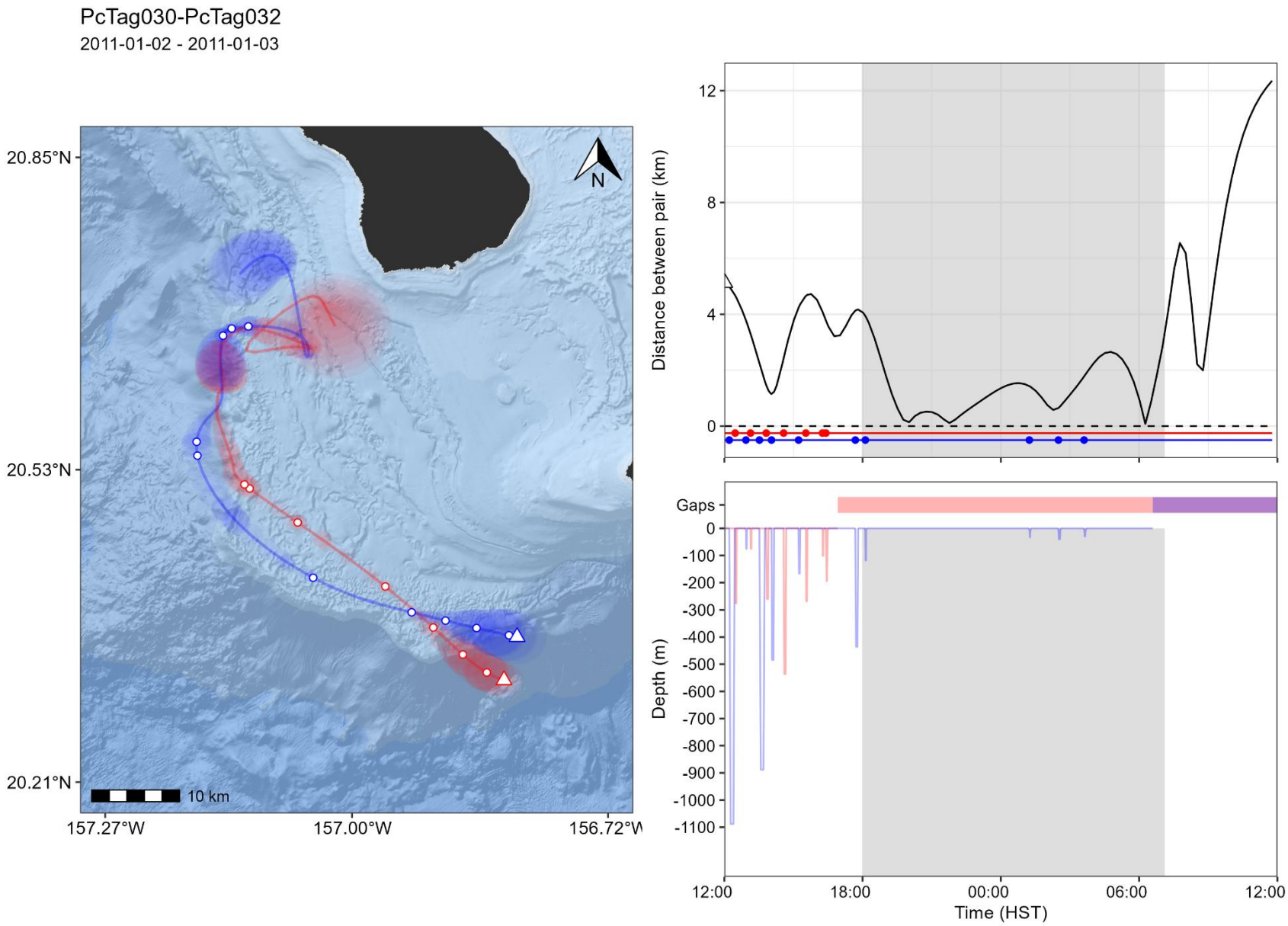
2010-12-30 - 2010-12-31





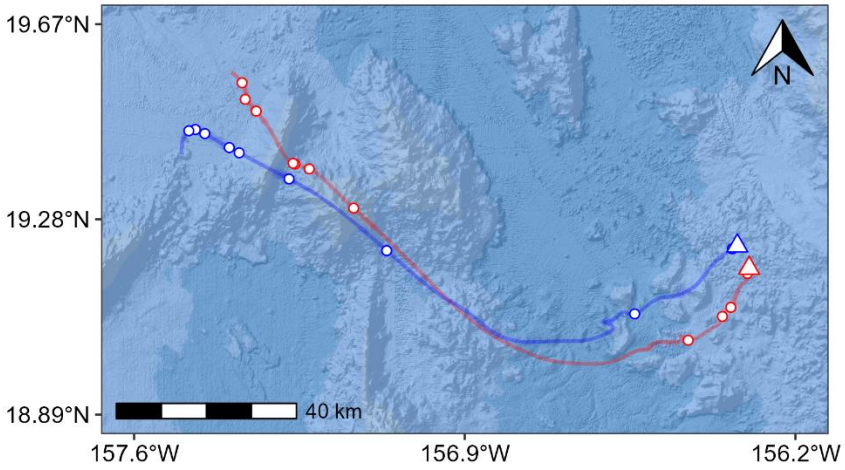

PcTag030-PcTag032
2010-12-31 - 2011-01-01
21.35°N
21.01°N
20.67°N
156.67°W
156.24°W
155.82°W
N
20 km
Distance between pair (km)
6
4
2
0
Gaps
0
-100
-200
-300
-400
-500
-600
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)

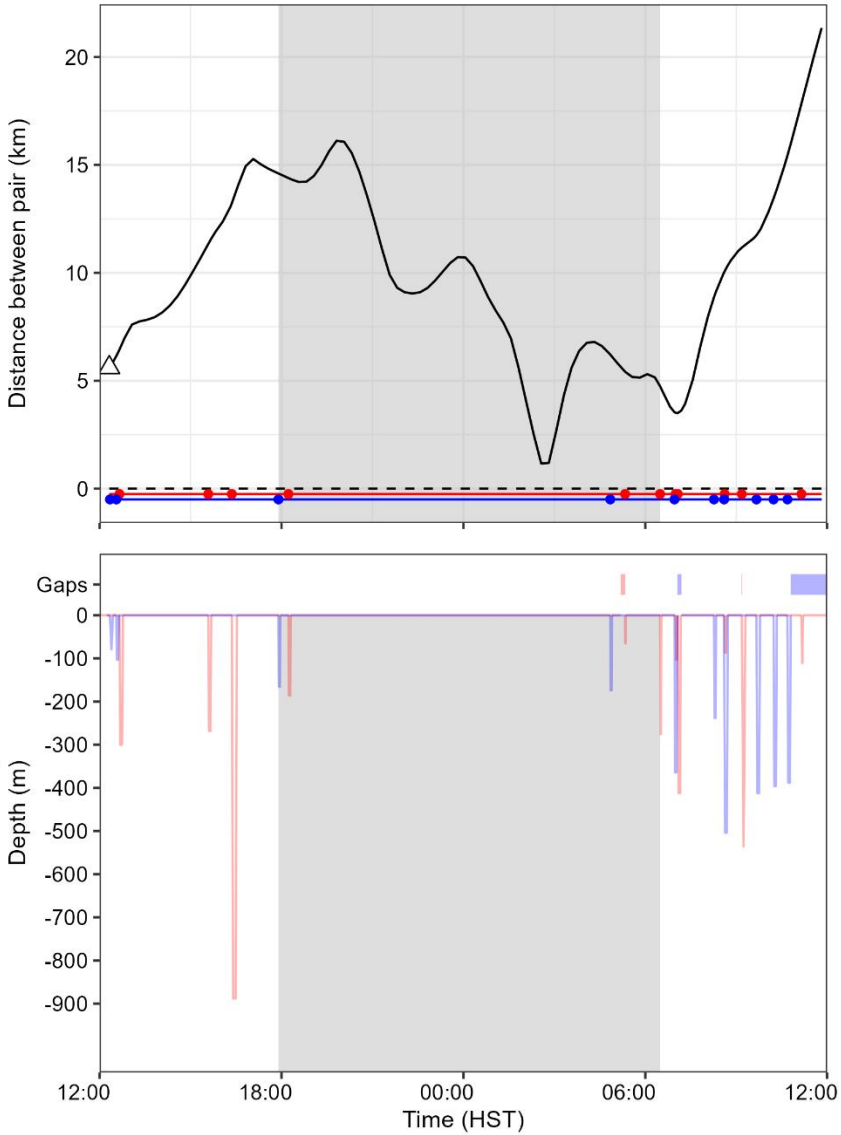

PcTag030-PcTag032
2011-01-01 - 2011-01-02
20.88°N
20.55°N
20.21°N
156.92°W
156.36°W
155.80°W
N
30 km
Distance between pair (km)
25
20
15
10
5
0
Gaps
0
-100
-200
-300
-400
-500
-600
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)


PcTag030-PcTag032
2011-01-02 - 2011-01-03
20.85°N
20.53°N
20.21°N
157.27°W
157.00°W
156.72°W
N
10 km
Distance between pair (km)
12
8
4
0
Gaps
0
-100
-200
-300
-400
-500
-600
-700
-800
-900
-1000
-1100
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)

PcTag090-PcTag092

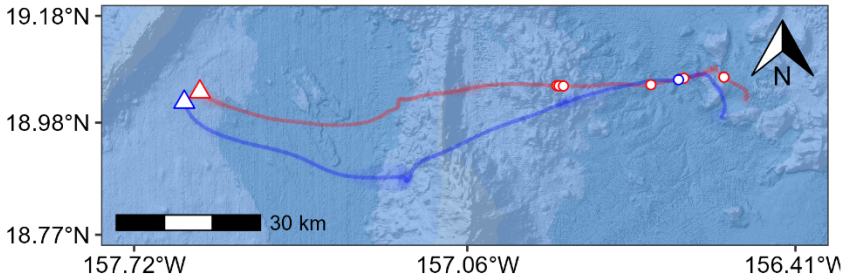
2023-10-31 - 2023-11-01

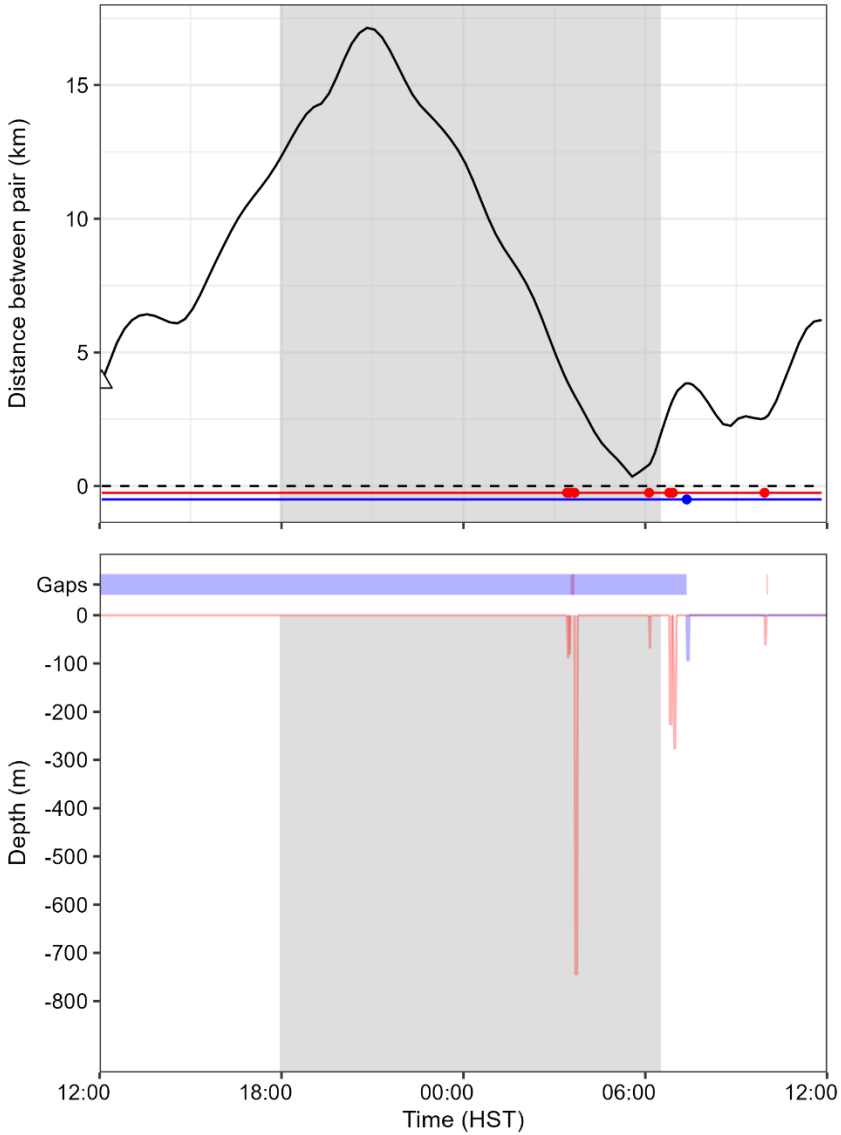


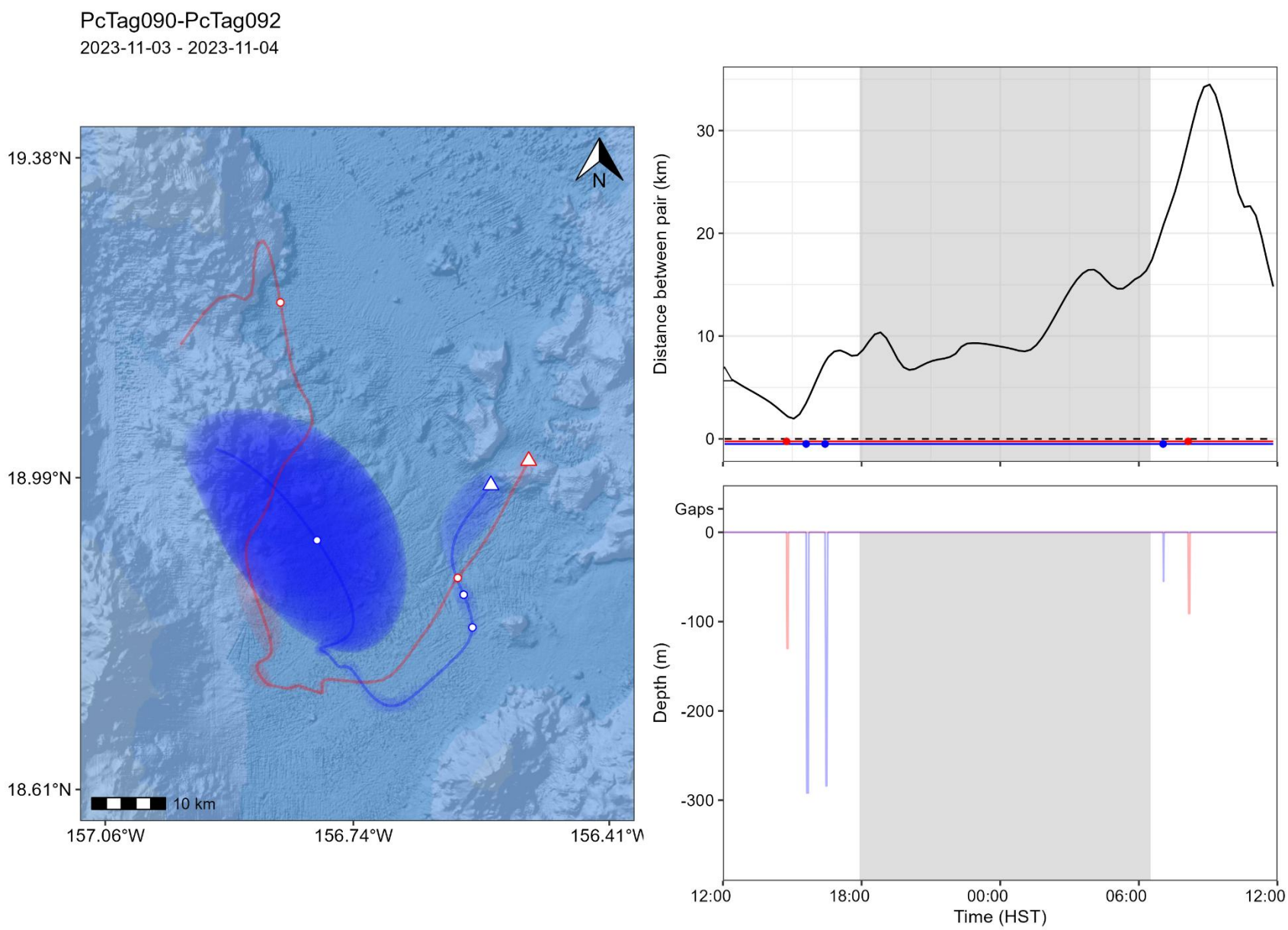


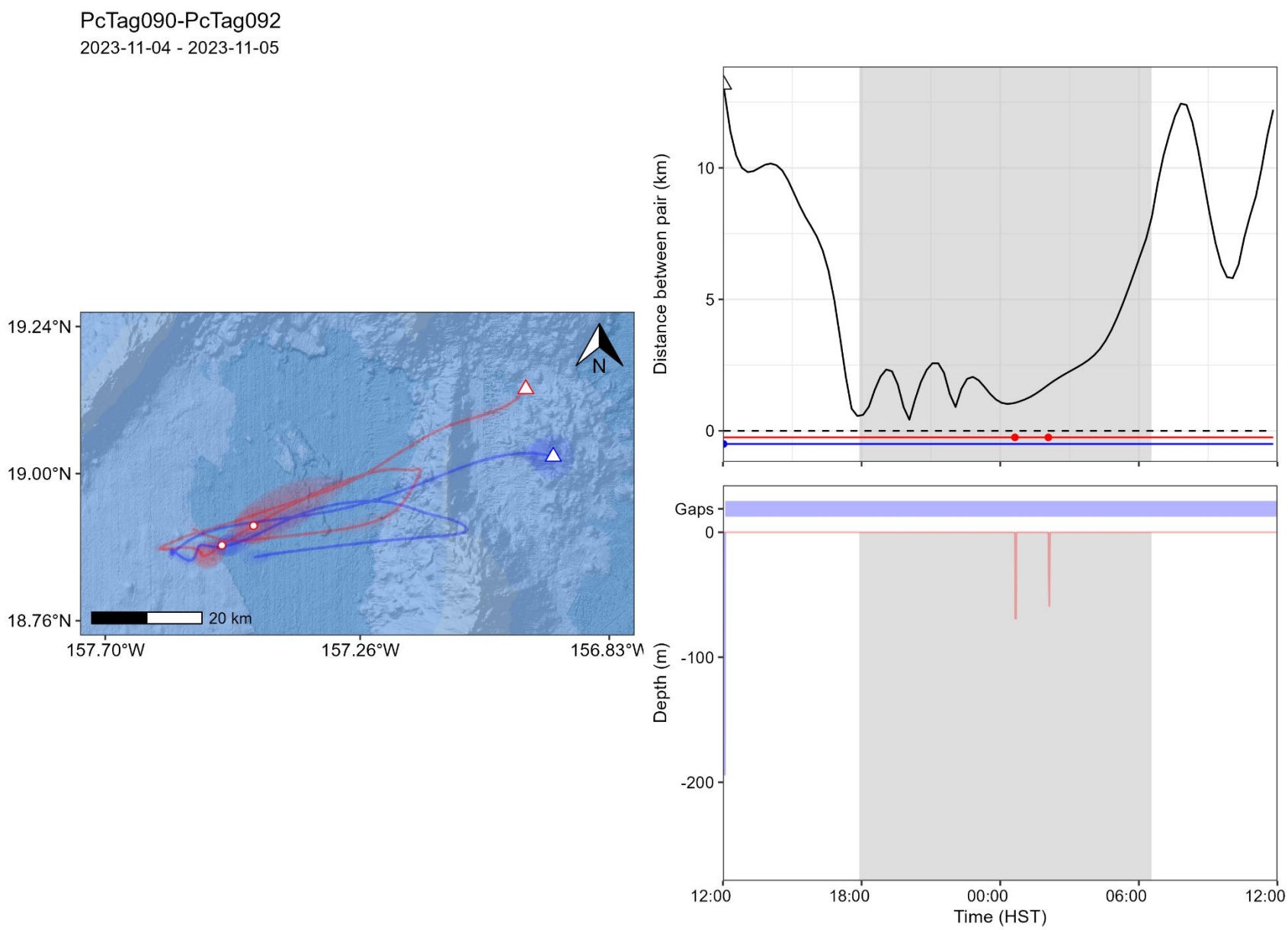
PcTag090-PcTag092

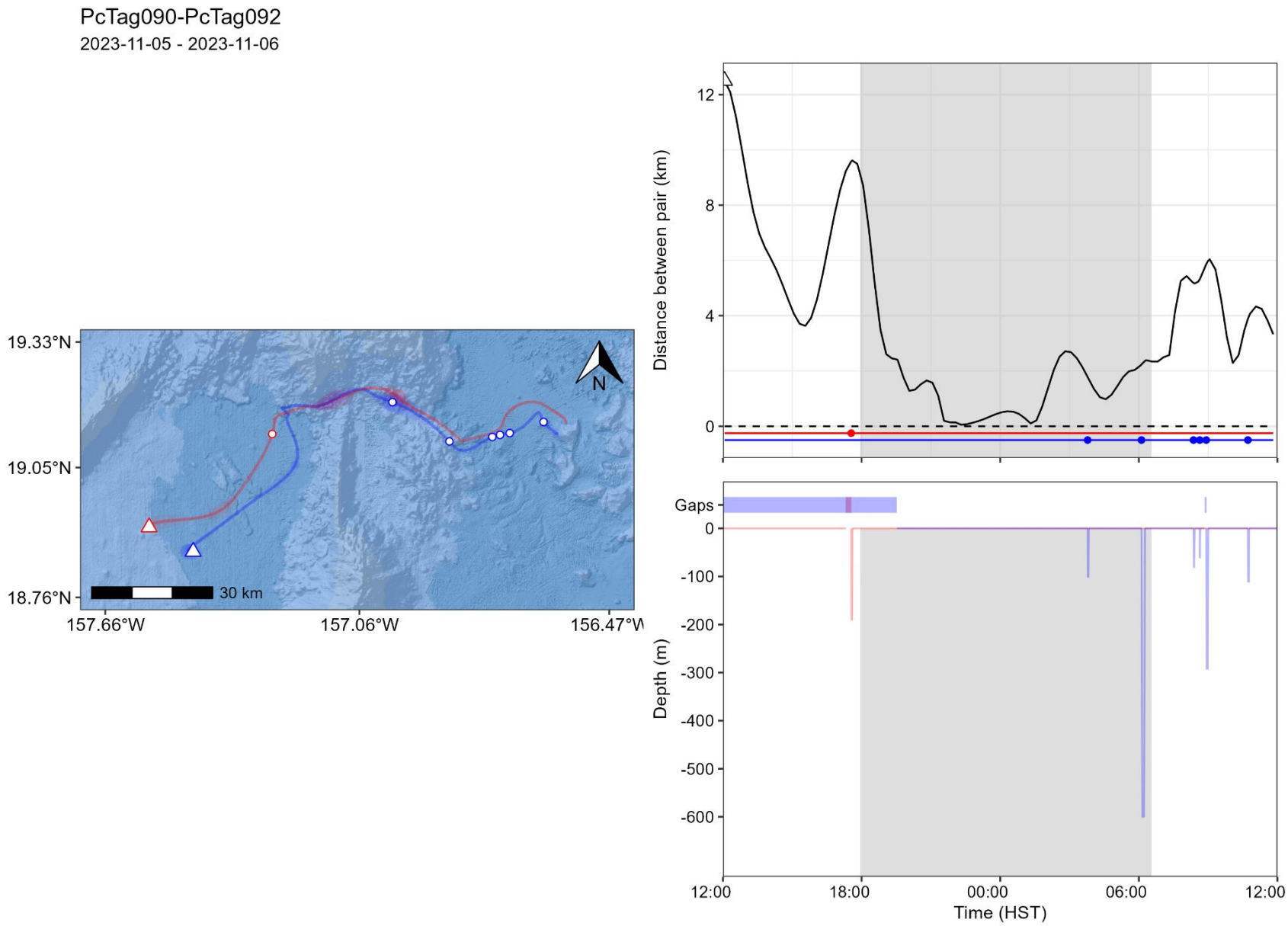
2023-11-02 - 2023-11-03

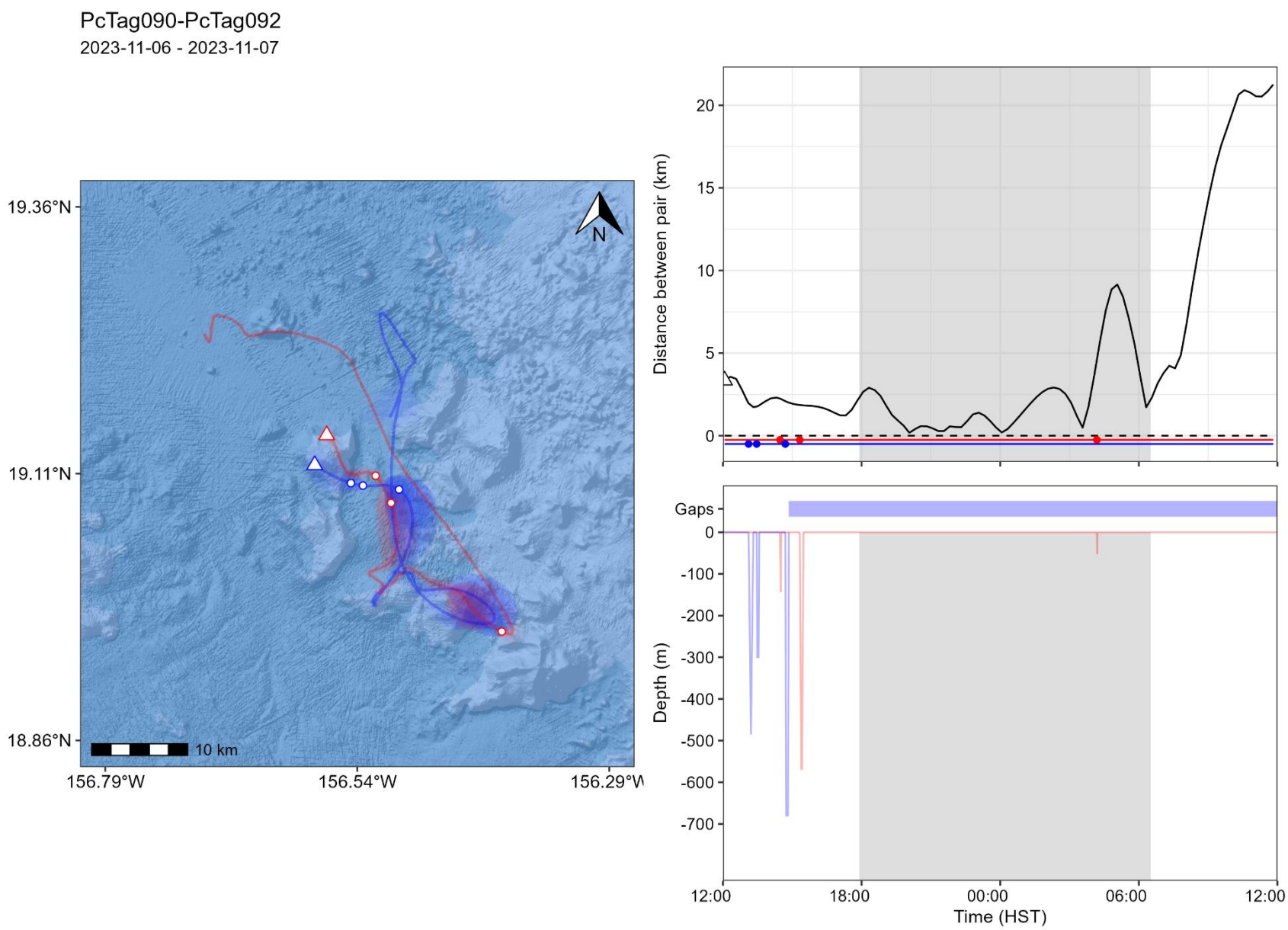


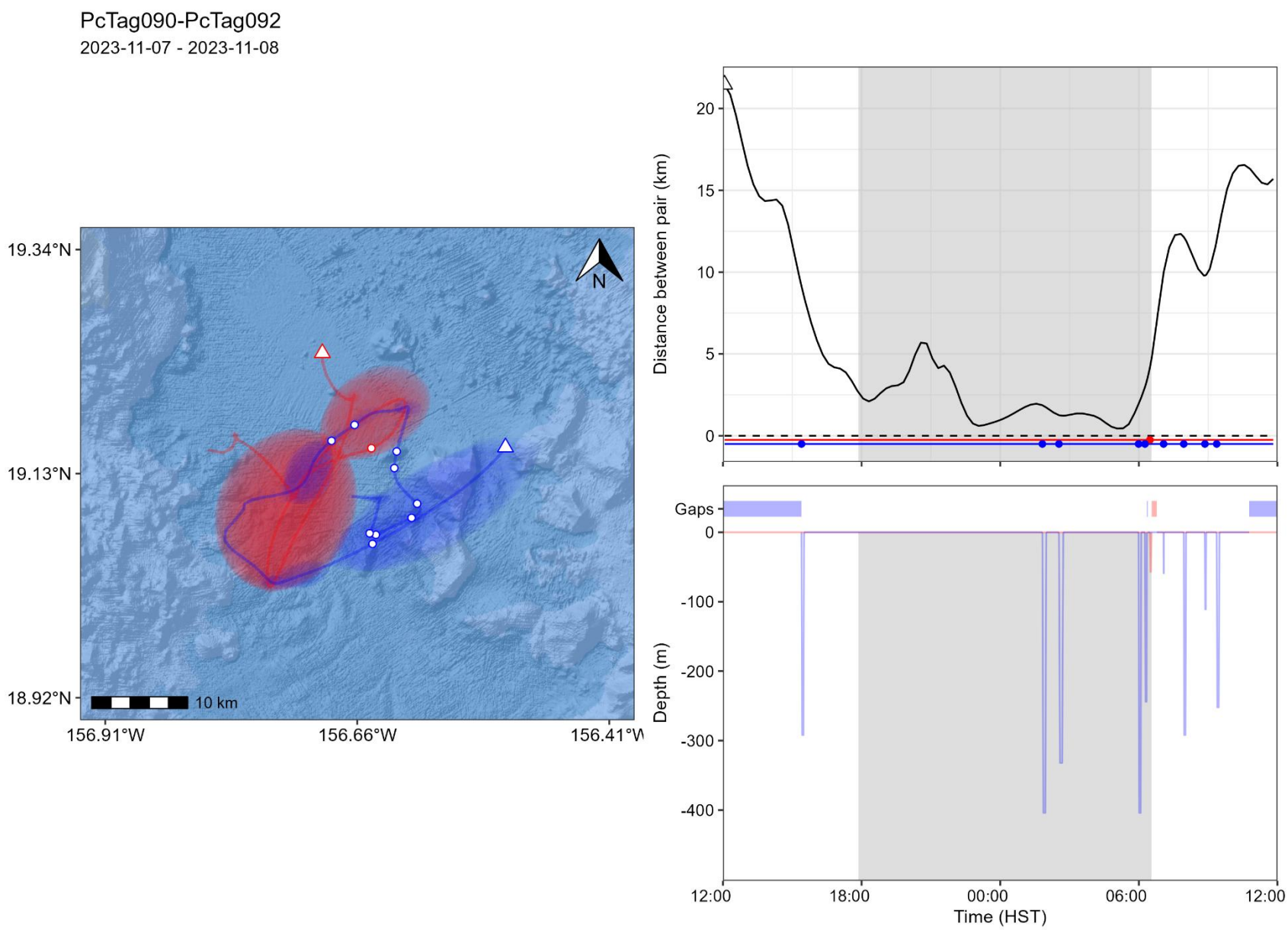


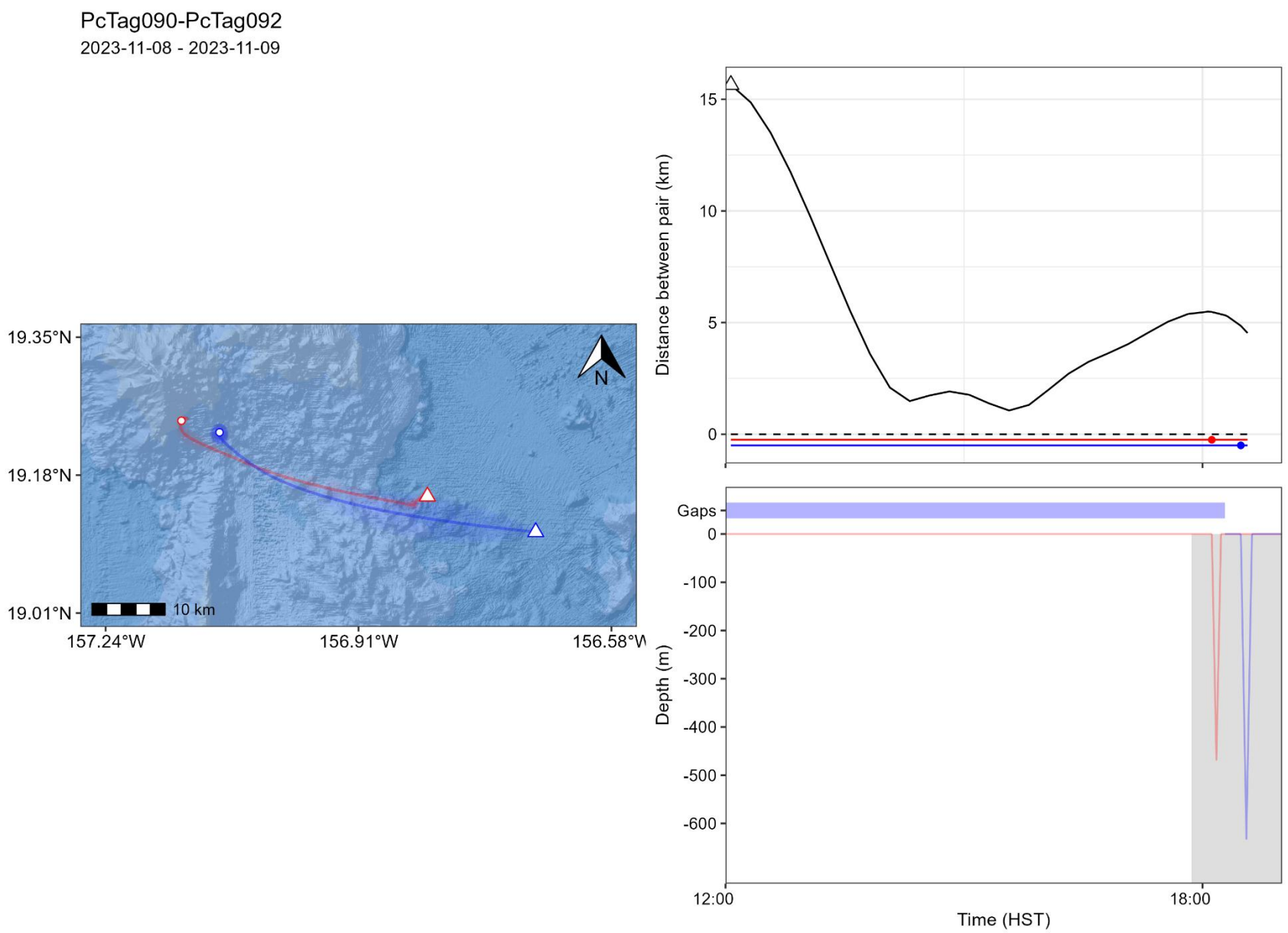

PcTag090-PcTag092
2023-11-03 - 2023-11-04
19.38°N
18.99°N
18.61°N
157.06°W
156.74°W
156.41°W
N
10 km
Distance between pair (km)
30
20
10
0
Gaps
0
-100
-200
-300
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)


PcTag090-PcTag092
2023-11-04 - 2023-11-05
19.24°N
19.00°N
18.76°N
157.70°W
157.26°W
156.83°W
N
20 km
Distance between pair (km)
10
5
0
Gaps
0
-100
-200
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)


PcTag090-PcTag092
2023-11-05 - 2023-11-06
19.33°N
19.05°N
18.76°N
157.66°W
157.06°W
156.47°W
N
30 km
Distance between pair (km)
12
8
4
0
Gaps
0
-100
-200
-300
-400
-500
-600
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)

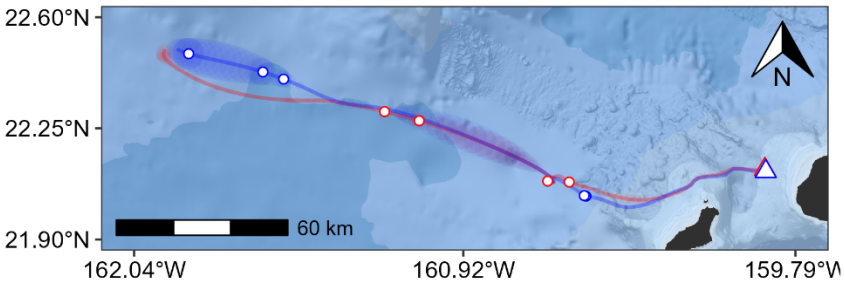

PcTag090-PcTag092
2023-11-06 - 2023-11-07
19.36°N
19.11°N
18.86°N
156.79°W
156.54°W
156.29°W
N
10 km
Distance between pair (km)
20
15
10
5
0
Gaps
0
-100
-200
-300
-400
-500
-600
-700
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)

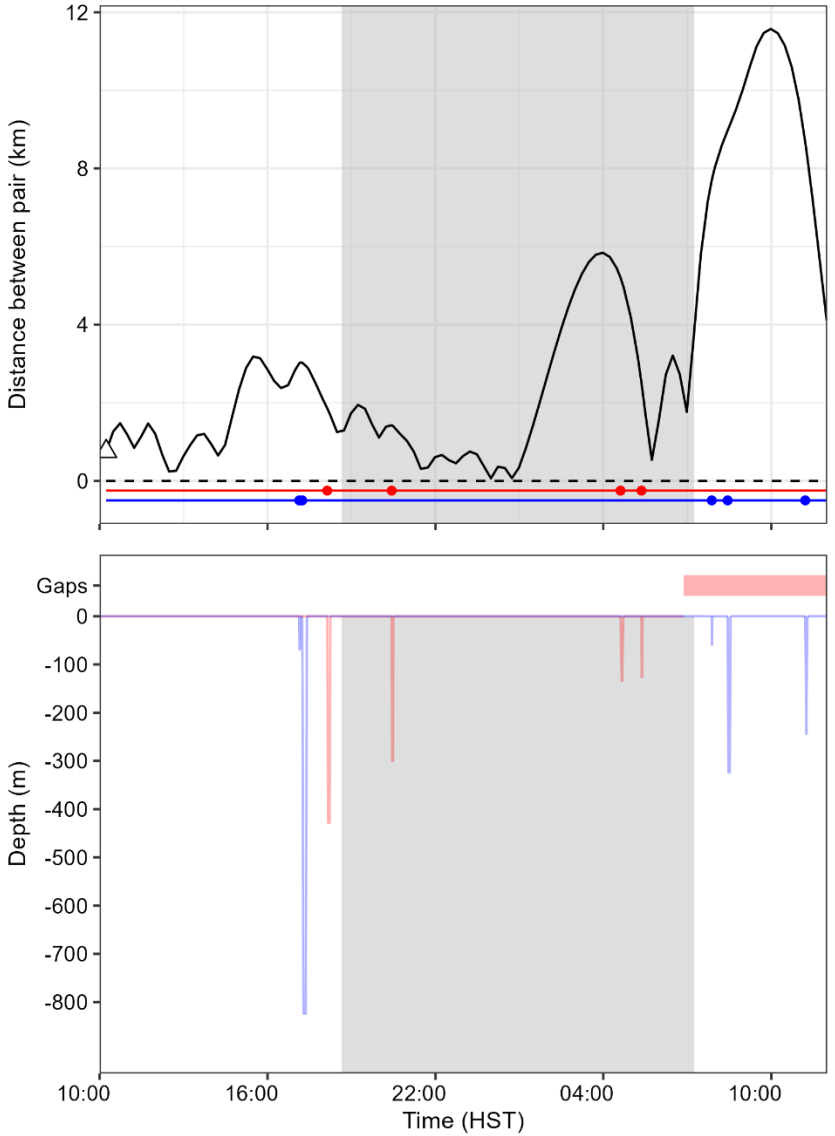

PcTag090-PcTag092
2023-11-07 - 2023-11-08
19.34°N
19.13°N
18.92°N
156.91°W
156.66°W
156.41°W
N
10 km
Distance between pair (km)
20
15
10
5
0
Gaps
0
-100
-200
-300
-400
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)

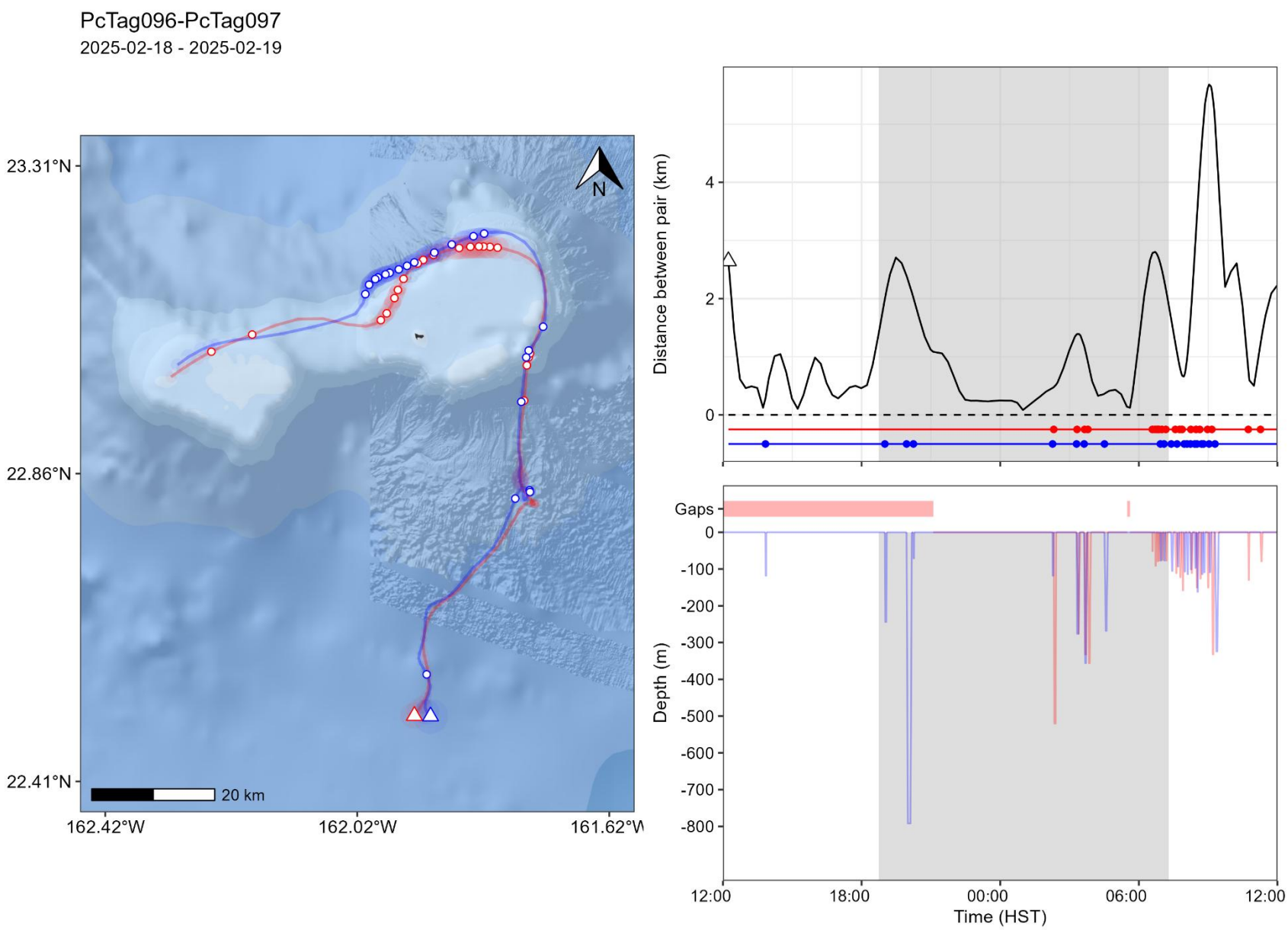

PcTag090-PcTag092
2023-11-08 - 2023-11-09
19.35°N
19.18°N
19.01°N
157.24°W
156.91°W
156.58°W
N
10 km
Distance between pair (km)
15
10
5
0
Gaps
0
-100
-200
-300
-400
-500
-600
Depth (m)
12:00
18:00
Time (HST)

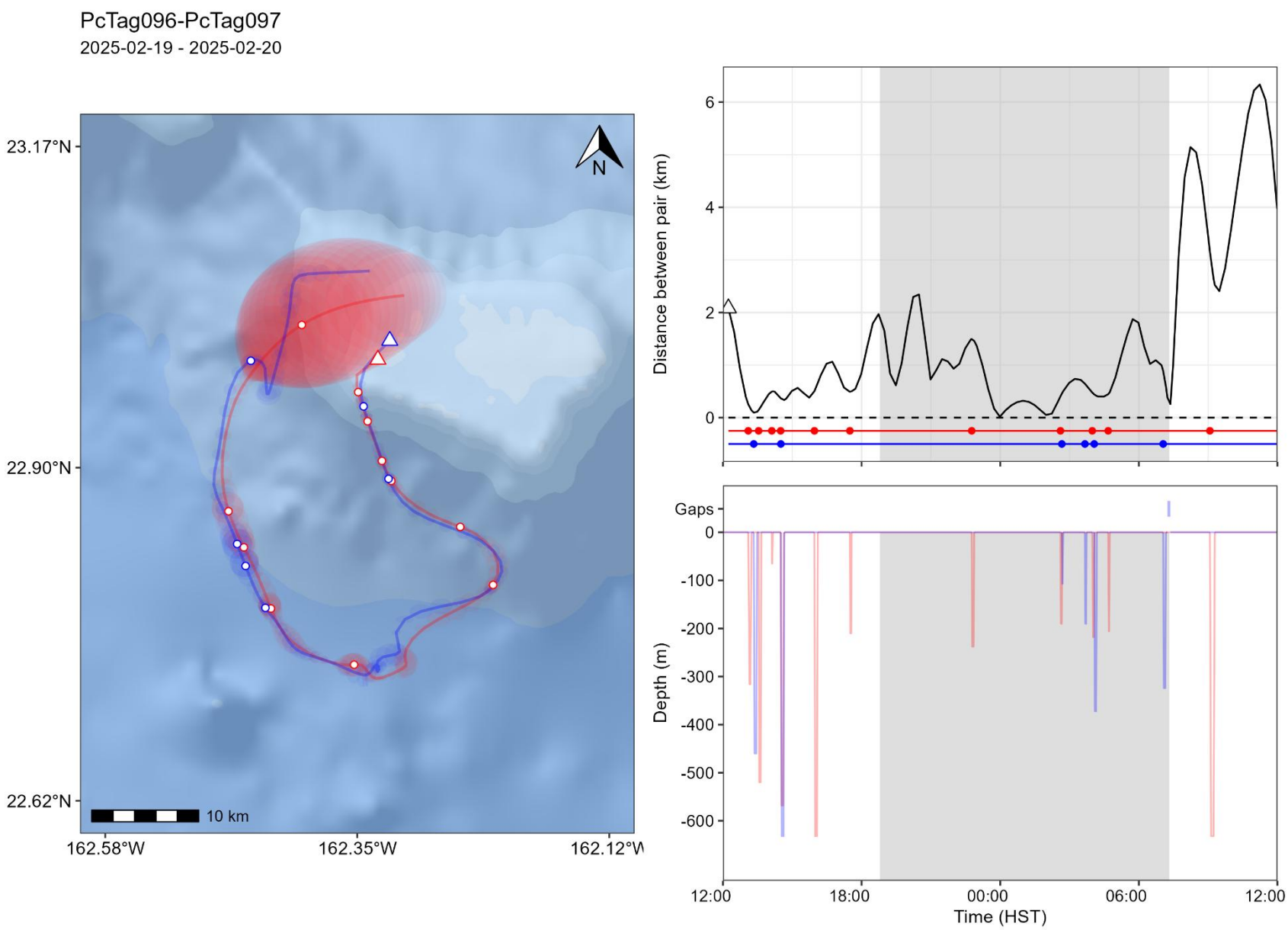
PcTag096-PcTag097

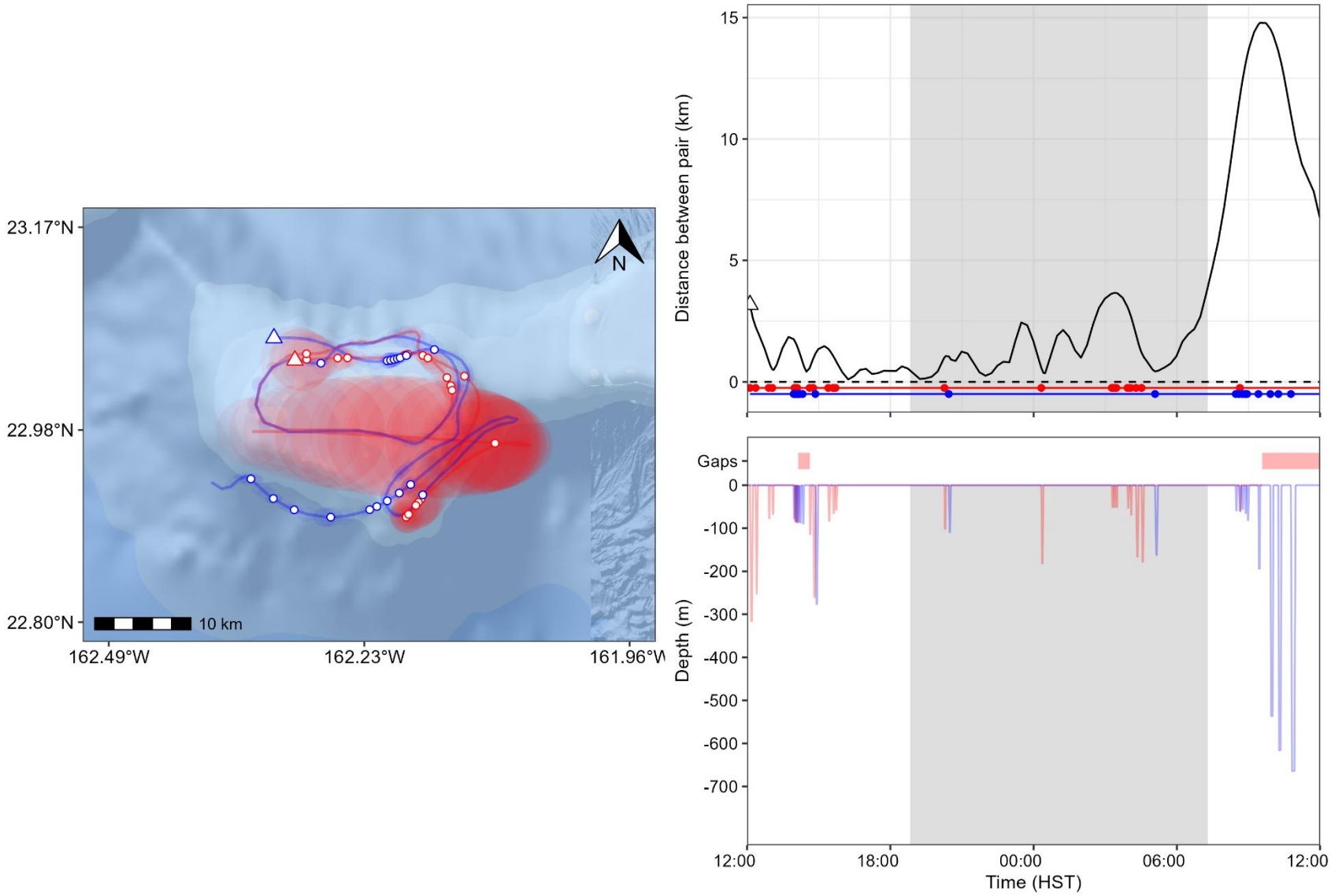
2025-02-17 - 2025-02-18

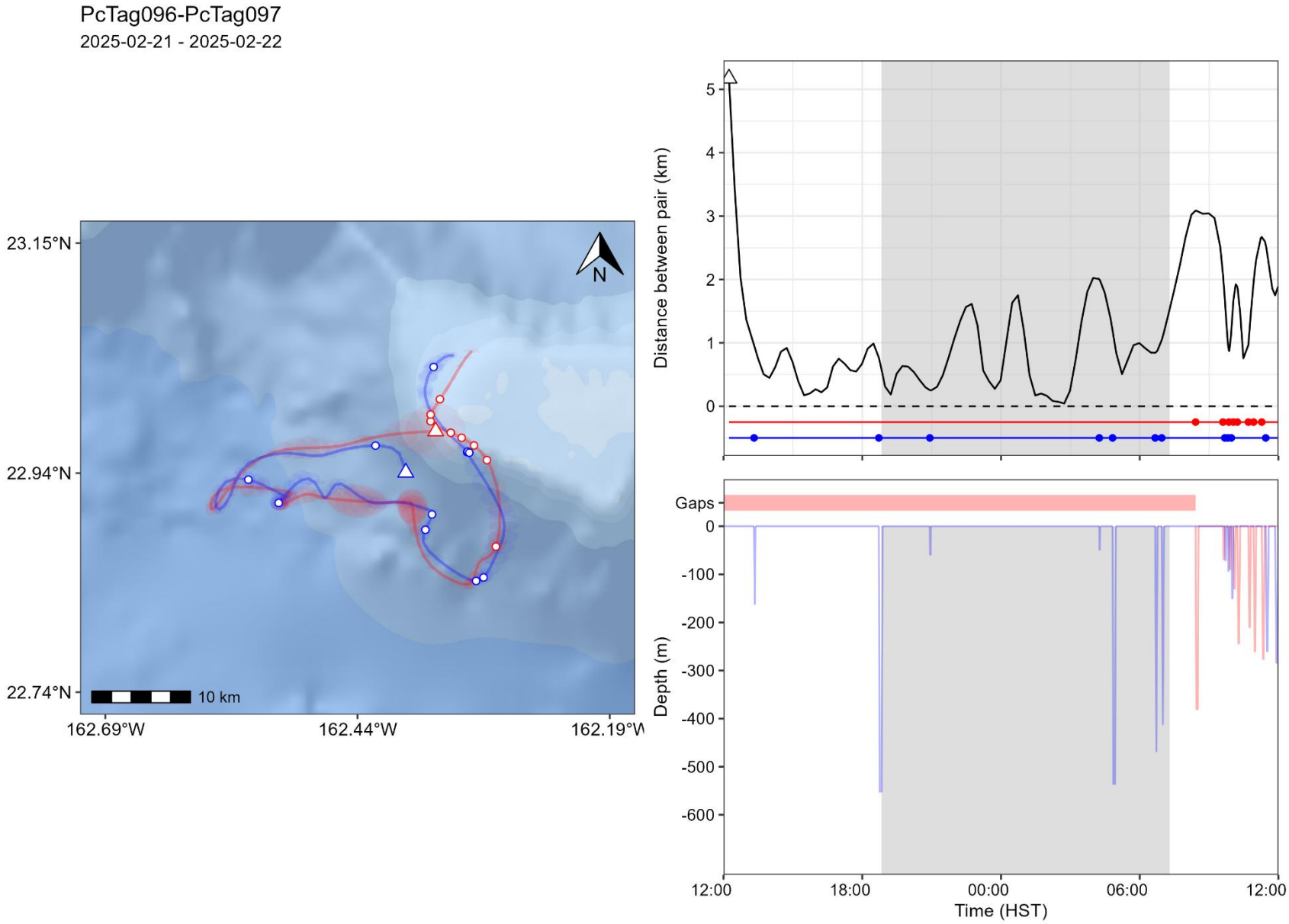


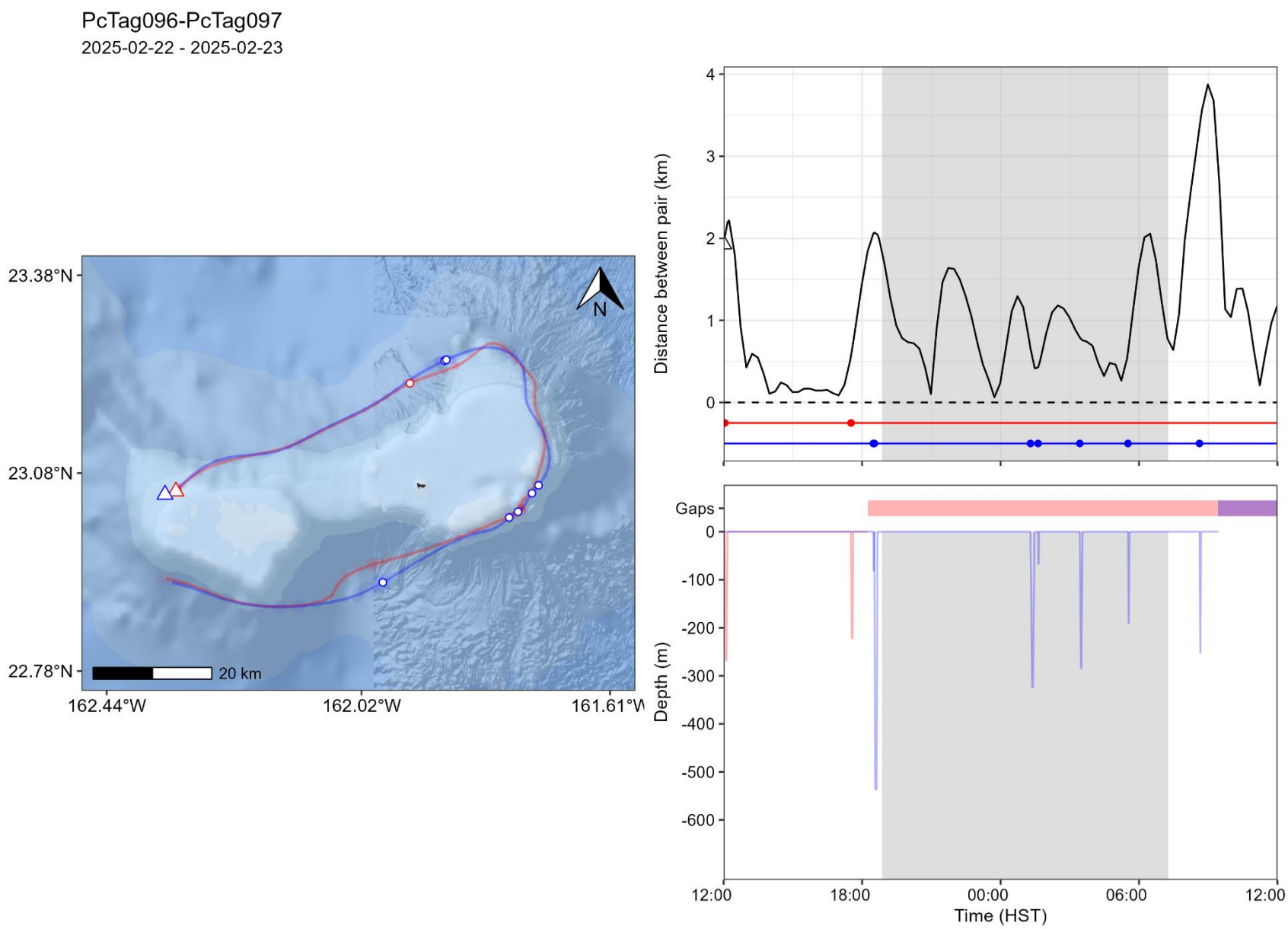



PcTag096-PcTag097
2025-02-18 - 2025-02-19
23.31°N
22.86°N
22.41°N
162.42°W
162.02°W
161.62°W
N
20 km
Distance between pair (km)
4
2
0
Gaps
0
-100
-200
-300
-400
-500
-600
-700
-800
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)


PcTag096-PcTag097
2025-02-19 - 2025-02-20
23.17°N
22.90°N
22.62°N
N
10 km
162.58°W
162.35°W
162.12°W
Distance between pair (km)
6
4
2
0
Gaps
0
-100
-200
-300
-400
-500
-600
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)


PcTag096-PcTag097
2025-02-20 - 2025-02-21
23.17°N
22.98°N
22.80°N
162.49°W
162.23°W
161.96°W
N
10 km
Distance between pair (km)
15
10
5
0
Gaps
0
-100
-200
-300
-400
-500
-600
-700
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)


PcTag096-PcTag097
2025-02-21 - 2025-02-22
23.15°N
22.94°N
22.74°N
162.69°W
162.44°W
162.19°W
N
10 km
Distance between pair (km)
5
4
3
2
1
0
Gaps
0
-100
-200
-300
-400
-500
-600
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)


PcTag096-PcTag097
2025-02-22 - 2025-02-23
23.38°N
23.08°N
22.78°N
162.44°W
162.02°W
161.61°W
N
20 km
Distance between pair (km)
4
3
2
1
0
Gaps
0
-100
-200
-300
-400
-500
-600
Depth (m)
12:00
18:00
00:00
06:00
12:00
Time (HST)