1 Supplement

Hydrographic parameters:

In the RV Ludwig Prandtl, the built-in FerryBox (Petersen, 2014) recorded data using a Teledyne RDI thermosalinograph (temperature and salinity), Aanderaa oxygen optode 4330(oxygen concentration and saturation), Meinsberg pH electrode (pH values), and SCUFA submersible chlorophyll fluorometer (turbidity and fluorescence). The data were stored on board and automatically sent via a mobile phone connection to the Hereon database. The water flow in the FerryBox was approximately 12 L min/1. In the RV Mya II, the built in Ferrybox recorded data using a salinometer (FSI), and SBE38 Digital Oceanographic Thermometer (SBE38) for salinity and temperature. For pH measurements a Meinsberg pH Sensor was used and for oxygen an Aanderaa oxygen optode. On the RV Uthörn and RV Littorina, a portable pocket FerryBox (4HJena, Germany) was used to record the hydrographic parameters using the following sensors: Seabird SBE45 thermosalinograph, Aanderaa oxygen optode, Meinsberg pH electrode, Seapoint Chlorophyll Fluorometer (SCF), and Seapoint Turbidity Meter. The water flow was between 3 and 4 L min/1. Data were saved once per minute.

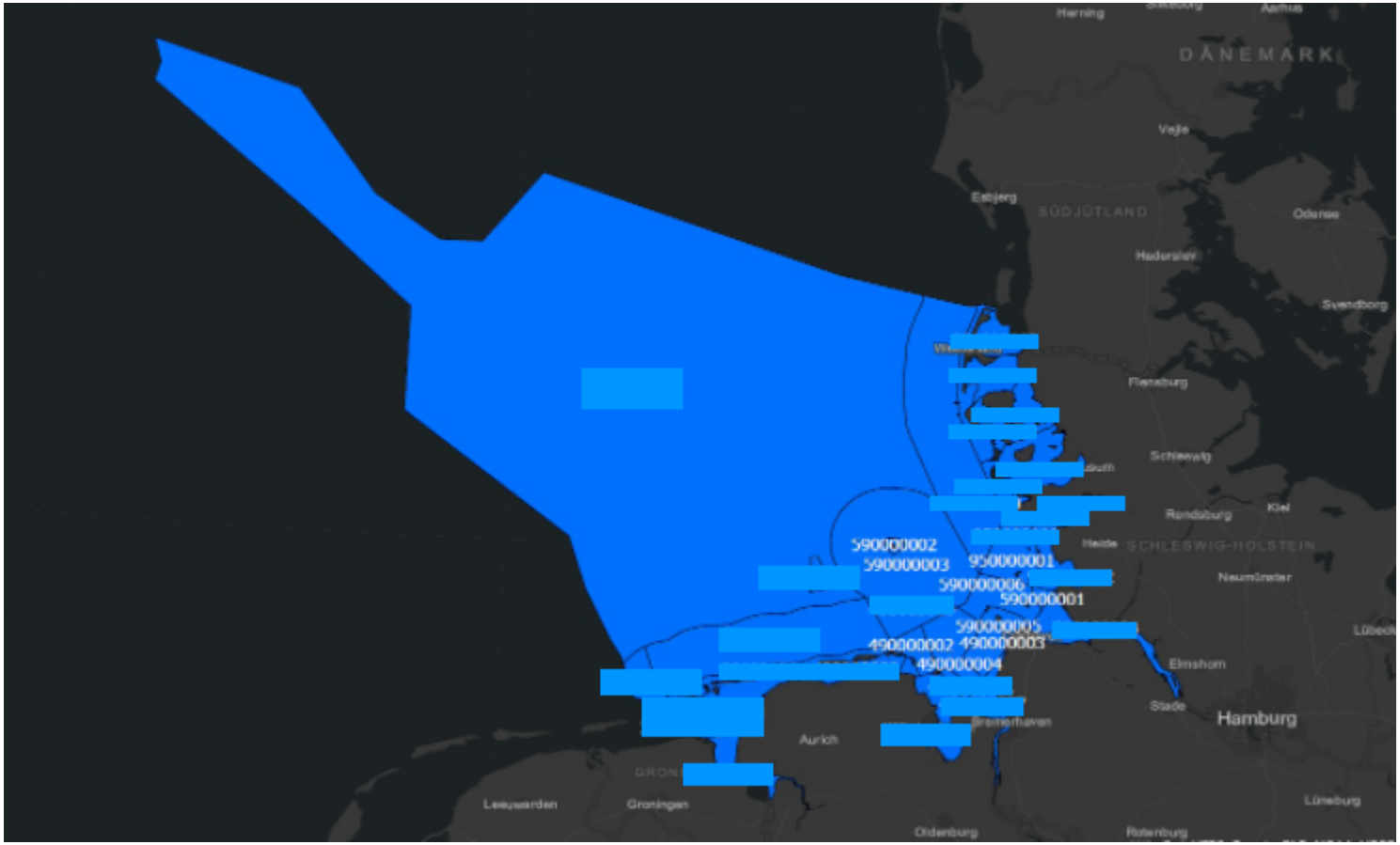
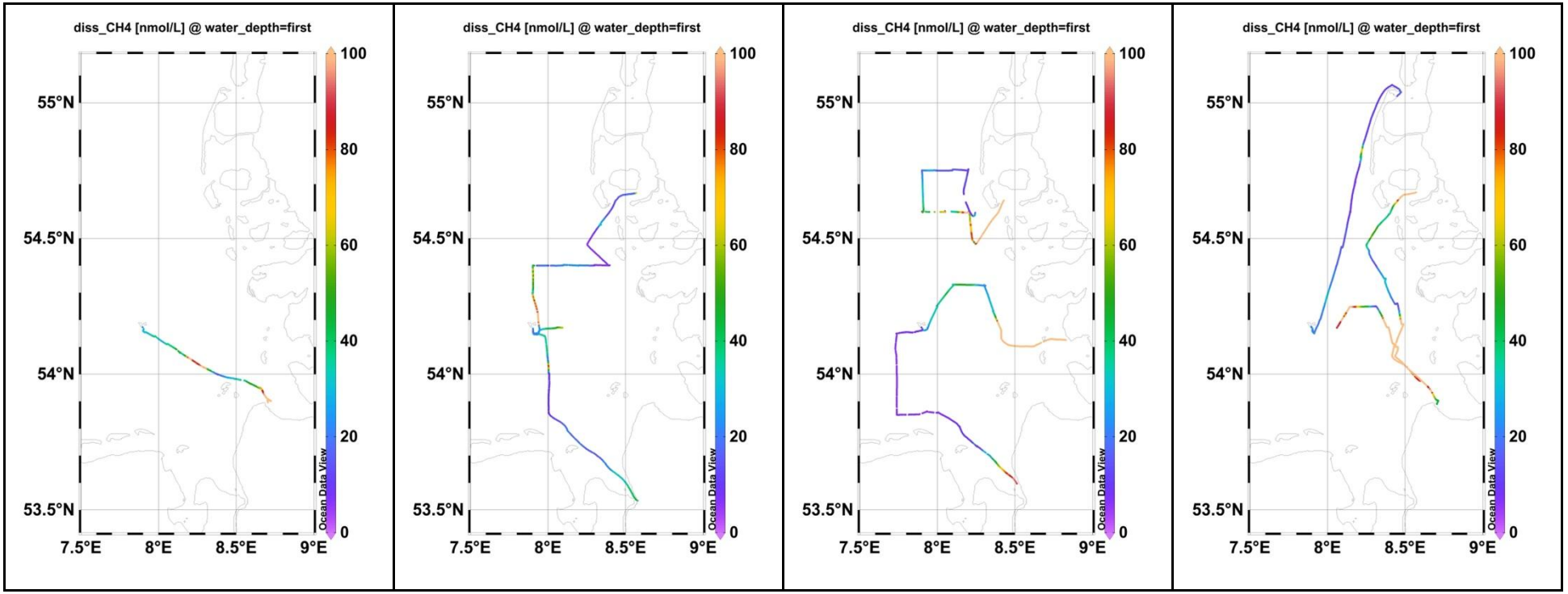
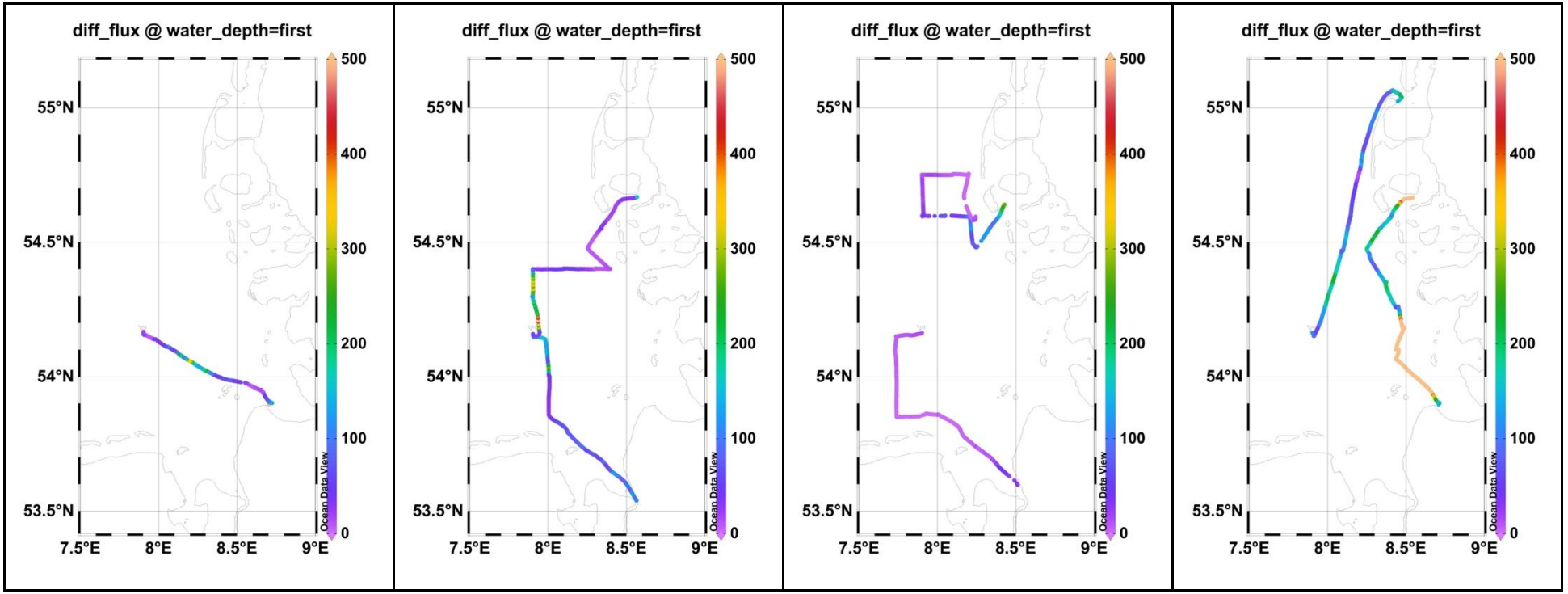


Figure S1: Marine ecosystems of the German Bight, with the areas of eastern Wadden Sea of the Weser, open coastal sea of the Weser, coastal sea of the Weser, Helgoland, coastal sea of the Elbe, western Wadden Sea of the Elbe, Outer Elbe North and Piep Tidal basin all indicated with their respective key numbers.


diss_CH4 [nmol/L] @ water_depth=first
55°N
54.5°N
54°N
53.5°N
7.5°E
8°E
8.5°E
9°E
100
80
60
40
20
0
Ocean Data View
diss_CH4 [nmol/L] @ water_depth=first
55°N
54.5°N
54°N
53.5°N
7.5°E
8°E
8.5°E
9°E
100
80
60
40
20
0
Ocean Data View
diss_CH4 [nmol/L] @ water_depth=first
55°N
54.5°N
54°N
53.5°N
7.5°E
8°E
8.5°E
9°E
100
80
60
40
20
0
Ocean Data View
diss_CH4 [nmol/L] @ water_depth=first
55°N
54.5°N
54°N
53.5°N
7.5°E
8°E
8.5°E
9°E
100
80
60
40
20
0
Ocean Data View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54.5°N
54°N
53.5°N
7.5°E
8°E
8.5°E
9°E
500
400
300
200
100
0
Ocean Data View
diff_flux @ water_depth=first
55°N
54.5°N
54°N
53.5°N
7.5°E
8°E
8.5°E
9°E
500
400
300
200
100
0
Ocean Data View
diff_flux @ water_depth=first
55°N
54.5°N
54°N
53.5°N
7.5°E
8°E
8.5°E
9°E
500
400
300
200
100
0
Ocean Data View
diff_flux @ water_depth=first
55°N
54.5°N
54°N
53.5°N
7.5°E
8°E
8.5°E
9°E
500
400
300
200
100
0
Ocean Data View

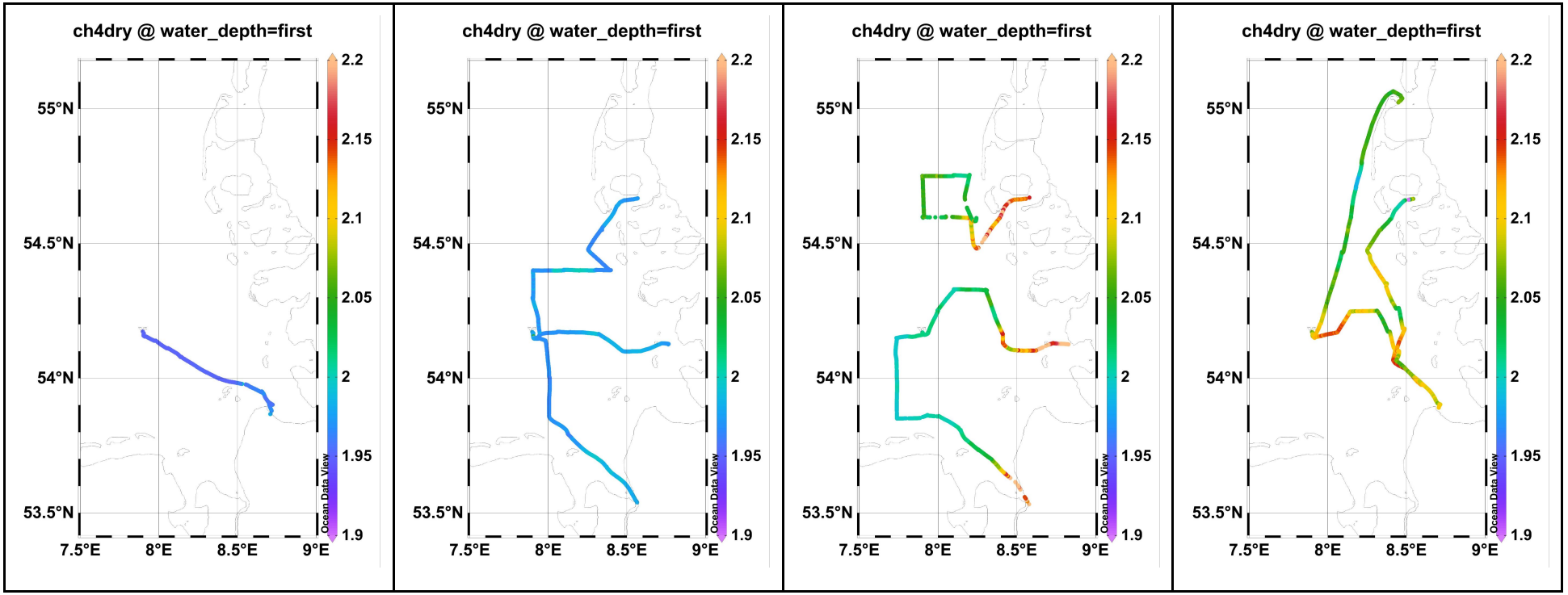

Figure S2: Concentrations of dissolved CH_4 (top), diffusive CH_4 flux (middle) and atmospheric CH_4 (bottom) on 30.8; 1.9; 2.9 and 3.9.2020 (from left to right)

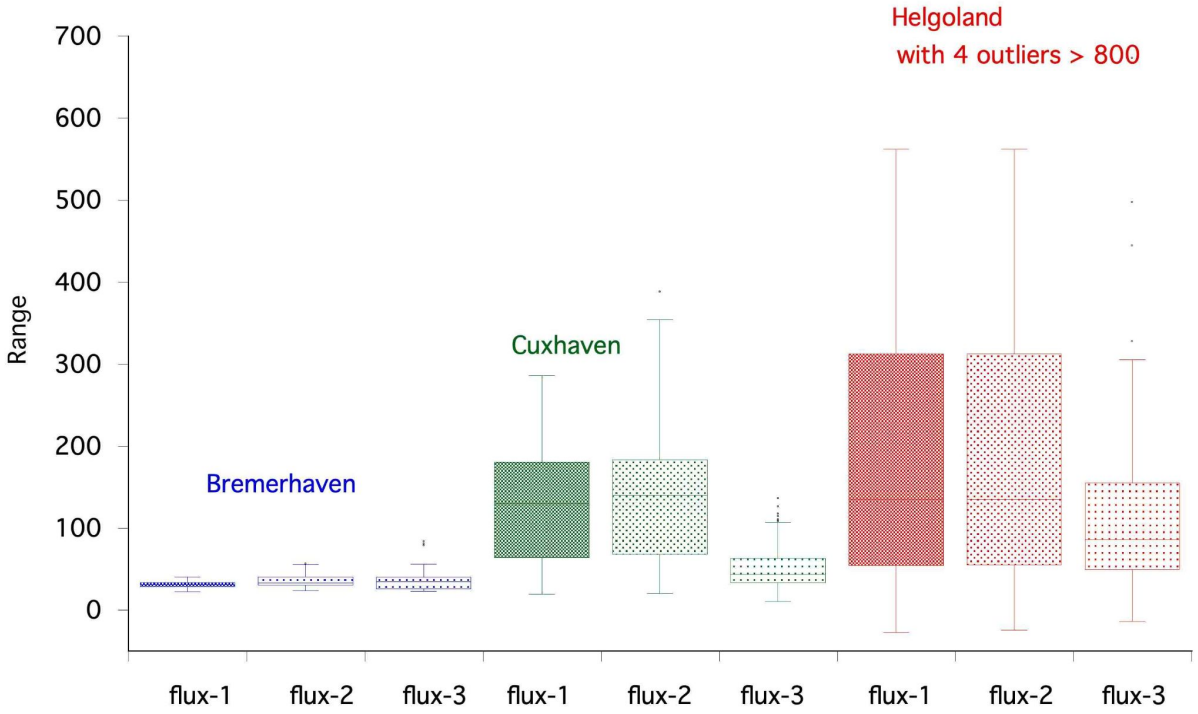

Fig. S3: Range of diffusive fluxes calculated with all in-situ data from 2019 (flux-1), within-situ data and atmospheric CH_4 from the land station (flux-2) and within-situ data and atmospheric CH4 and wind from a land stations (flux-3). The calculations were performed for the region of Bremerhaven (blue), for Cuxhaven (green) and Helgoland (red, see Fig. 2).

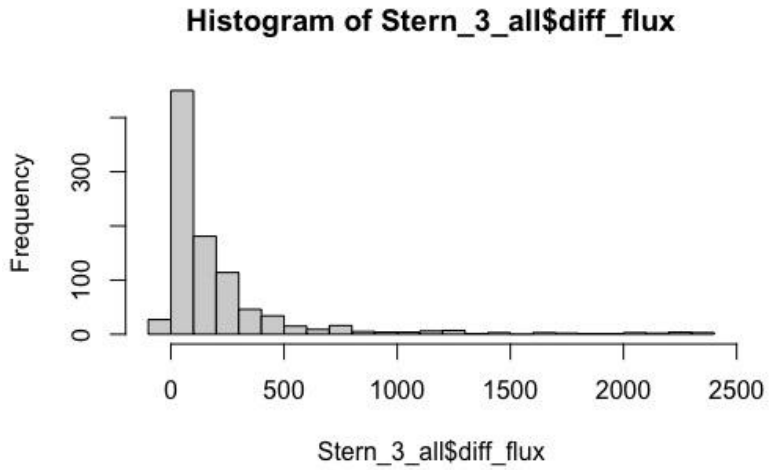

Figure S4: Frequency distribution (n) of the diffusive fluxes (flux-1, in µmol m^{-2} d^{-1}) in September 2019

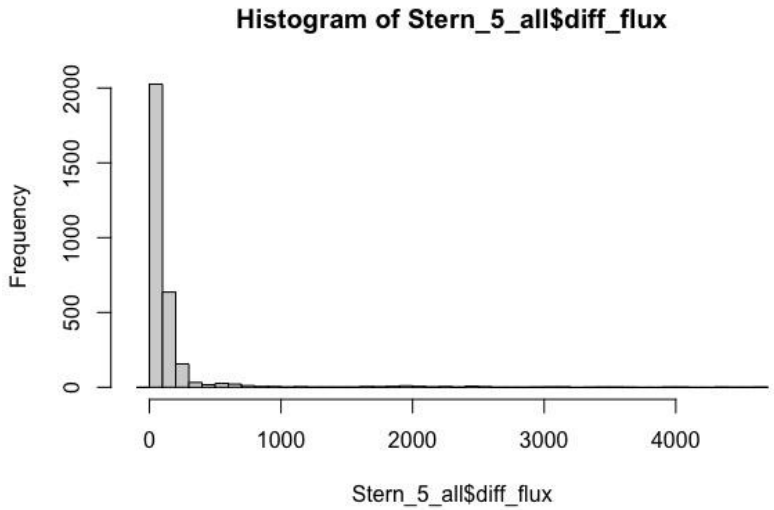

Figure S5: Frequency distribution (n) of the diffusive fluxes (flux-1, in µmol m^{-2} d^{-1}) in September 2020

Table S1: Excel sheet for the calculation of the area weighted flux.

		total number of samples		total area (m^2)				
		3028		3779470000				
					sum of relative flux (µmol/d) (SUMME(F7:F48))	sum of relative flux (kmol/d)		
					6.00217E+11	600		
					20747454895	21	std deviation from column F	
scores / bins range (µmol/m2/d)	mean diffusive flux of each bin (µmol/m2/d)	Freqency (number of samples in this bin)	relative frequency (C7/C2)	relative area in m^2 (D7*E2)	relative flux in µmol/d (E7*B7)			
(0,100]	34	2026	0.669	2528799941	86485460243			
(100,200]	140	636	0.210	793838480.8	1.1112E+11			
(200,300]	233	156	0.052	194715099.1	45438933283			
(300,400]	334	32	0.011	39941558.78	13354141174			
(400,500]	459	17	0.006	21218953.1	9730448397			
(500,600]	556	26	0.009	32452516.51	18044021432			
(600,700]	662	21	0.007	26211647.95	17348183034			

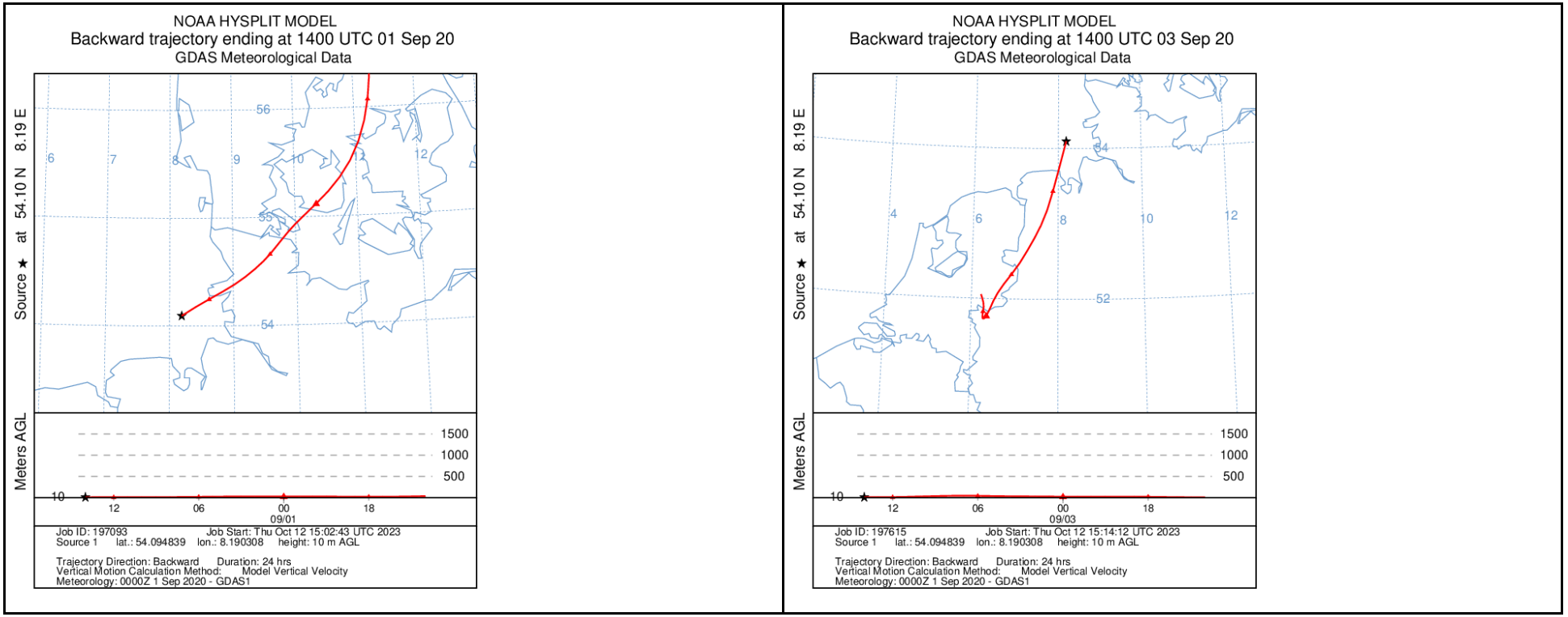

Figure S6: Backward trajectory over 24 hours for air mass at 10 m height for 1 and 3 September 2020. The star indicates an arbitrary point in our study area.