Supporting information

Accompanying: Ross et al. “Modelling marine larval dispersal: a cautionary deep-sea tale for ecology and conservation”

S1 – Additional detail on model algorithms and parameterization

S2 – Model release locations

S3 – GLM and drop1 results of parameter importance

S4 – Current ellipses

S1 - Additional detail on model algorithms and parameterization

CMS (Particle simulator)

Full name: Connectivity Modeling System

Primary Reference: Paris CB, *et al.,* 2013. Connectivity Modeling System: A probabilistic modeling tool for the multi-scale tracking of biotic and abiotic variability in the ocean. *Environ. Model. Softw.* 42, 47–54.

Link: https://github.com/beatrixparis/connectivity-modeling-system

The core simulator uses a fourth order Runge-Kutta method to differentiate positions through space and time and employs a flexible interpolation algorithm allowing hydrodynamic parameters to drive particles closer to land than a fixed algorithm. The model is compatible with any z-level vertical grid model outputs.

POLCOMS (Hydrodynamic model)

Full name: Proudman Oceanographic Laboratory Coastal Ocean Modelling System

Primary Reference: Holt JT & James ID, 2001 An S coordinate density evolving model for the northwest European continental shelf. Model description and density structure. *J Geophys. Res.*, 106 (C7), 14015-14034.

Link: https://www.bodc.ac.uk/about/news_and_events/model_polcoms.html (although this study used data directly from Plymouth Marine Laboratory)

This is a baroclinic s-coordinate and sigma-level hydrodynamic model (meaning that the vertical grid consists of terrain following depth bands rather than set depth levels). It uses a sophisticated advection scheme (the Piecewise Parabolic Method (James, 1996)), the Laplacian diffusion with Smagorinsky (1963) algorithm for horizontal diffusion, and the k-ε turbulence closure scheme; a combination that effectively minimizes numerical diffusion and ensures the preservation of hydrodynamic features such as the north-west European slope current. One major drawback of s and sigma coordinate models is the generation of spurious currents as a result of errors in horizontal pressure gradient calculations over steep topography. POLCOMS handles the calculation of horizontal pressure gradients by interpolating the pressure onto horizontal planes to reduce the associated errors.

HYCOM (Hydrodynamic model)

Full name: Hybrid Coordinate Ocean Model

Primary Reference: Chassignet EP, et al. 2007. The HYCOM (HYbrid Coordinate Ocean Model) data assimilative system. *J. Mar. Sys.* 65, 60-83.

Link: https://www.hycom.org/

Its unique hybrid vertical grid system makes it well suited to deep-sea studies due to the isopycnal layering in the open ocean and the transition to sigma levels when encountering terrain where the hydrography may become more complex (and shallow-water studies may also benefit from a transition to a z-level grid in the surface mixed layer). This study used data from HYCOM+NCODA global reanalysis experiment 19.1. The freely available daily snapshot model outputs (http://hycom.org/dataserver/) are reformatted to a 40 layer z-level only grid. The advection and diffusion algorithms are similar to POLCOMS, but HYCOM uses the Mellor-Yamada (1982) Level 2.5 turbulence closure scheme and a massless solution to deep water pressure gradients (Bleck, 2006), so there may be a difference in how the two hydrodynamic models handle numerical diffusion and the aforementioned horizontal pressure gradient error.

Additional References

Bleck, R. Chapter 4: On the use of hybrid vertical coordinates in ocean circulation modeling. *Ocean Weather Forecasting* (ed. Chassignet, E.P., Verron, J.) 190-126 (**Springer,** 2006).

James, I. D. Advection schemes for shelf sea models. *J. Mar. Syst*. 8, 237-254 (1996).

Mellor, G. L., Yamada, T. Development of a turbulence closure model for geophysical fluid problems. *Rev. Geophys. Space Phys*. 20, 851-875 (1982).

Smagorinsky, J. General circulation experiments with the primitive equations. *Monthly Weather Review* 91, 99–164 (1963).

S2 – Model release locations

a) HYCOM Release Locations

b) POLCOMS Release Locations

c) Why there is a difference between the release locations in each model

d) An overview map of release locations

a) HYCOM Release Locations

rel = release position 1-192 in this simulation, loc.= location (Porcupine Bank PB, Anton Dorhn AD, Rosemary Bank RB), pos = position 1-16 per depth band, per locaiton.

rel.	long	lat	loc.	Depth	pos.	rel.	long	lat	loc.	Depth	pos.	rel.	long	lat	loc.	Depth	pos.
1	-14.48965	50.93610	PB	700	1	65	-11.17116	57.57136	AD	700	1	129	-10.29721	59.42069	RB	700	1
2	-14.68987	51.03308	PB	700	2	66	-11.10761	57.57136	AD	700	2	130	-10.19389	59.42180	RB	700	2
3	-14.83310	51.17870	PB	700	3	67	-11.04405	57.57136	AD	700	3	131	-10.09056	59.42291	RB	700	3
4	-14.89734	51.39170	PB	700	4	68	-10.98414	57.56299	AD	700	4	132	-9.98963	59.41160	RB	700	4
5	-14.96158	51.60471	PB	700	5	69	-10.94085	57.51646	AD	700	5	133	-9.89773	59.36707	RB	700	5
6	-14.99745	51.82234	PB	700	6	70	-10.90963	57.46528	AD	700	6	134	-9.86111	59.27731	RB	700	6
7	-15.00229	52.04445	PB	700	7	71	-10.91050	57.40173	AD	700	7	135	-9.90248	59.19269	RB	700	7
8	-14.93497	52.25650	PB	700	8	72	-10.94681	57.35211	AD	700	8	136	-9.97917	59.12344	RB	700	8
9	-14.92738	52.47233	PB	700	9	73	-11.00817	57.34717	AD	700	9	137	-10.06817	59.07653	RB	700	9
10	-14.96745	52.69117	PB	700	10	74	-11.06246	57.32927	AD	700	10	138	-10.16925	59.06043	RB	700	10
11	-14.89529	52.90008	PB	700	11	75	-11.11358	57.30528	AD	700	11	139	-10.27258	59.06109	RB	700	11
12	-14.81742	53.10849	PB	700	12	76	-11.17197	57.31725	AD	700	12	140	-10.37144	59.07268	RB	700	12
13	-14.67856	53.27834	PB	700	13	77	-11.21556	57.36351	AD	700	13	141	-10.44571	59.14452	RB	700	13
14	-14.52368	53.43805	PB	700	14	78	-11.25115	57.41290	AD	700	14	142	-10.49723	59.22582	RB	700	14
15	-14.35980	53.58833	PB	700	15	79	-11.25071	57.47645	AD	700	15	143	-10.47379	59.31892	RB	700	15
16	-14.19290	53.73544	PB	700	16	80	-11.21541	57.52574	AD	700	16	144	-10.39324	59.38254	RB	700	16
17	-14.49459	50.68386	PB	1000	1	81	-11.18817	57.61619	AD	1000	1	145	-10.08928	59.53887	RB	1000	1
18	-14.68918	50.86936	PB	1000	2	82	-11.08580	57.61662	AD	1000	2	146	-9.92323	59.53887	RB	1000	2
19	-14.88377	51.05485	PB	1000	3	83	-10.98343	57.61705	AD	1000	3	147	-9.77781	59.46433	RB	1000	3
20	-15.03803	51.26236	PB	1000	4	84	-10.88988	57.58363	AD	1000	4	148	-9.63535	59.37901	RB	1000	4
21	-15.08880	51.52636	PB	1000	5	85	-10.80073	57.53331	AD	1000	5	149	-9.61632	59.23544	RB	1000	5
22	-15.08787	51.79409	PB	1000	6	86	-10.78908	57.43796	AD	1000	6	150	-9.73456	59.11914	RB	1000	6
23	-15.03697	52.04563	PB	1000	7	87	-10.80176	57.34100	AD	1000	7	151	-9.88076	59.04204	RB	1000	7
24	-15.04066	52.19123	PB	1000	8	88	-10.87705	57.27163	AD	1000	8	152	-10.04021	59.01179	RB	1000	8
25	-15.17217	52.36649	PB	1000	9	89	-10.97833	57.26901	AD	1000	9	153	-10.20622	59.00855	RB	1000	9
26	-15.17217	52.63533	PB	1000	10	90	-11.08070	57.26919	AD	1000	10	154	-10.37223	59.00532	RB	1000	10
27	-15.05855	52.87291	PB	1000	11	91	-11.18307	57.26938	AD	1000	11	155	-10.51591	59.05145	RB	1000	11
28	-14.92106	53.10394	PB	1000	12	92	-11.28380	57.27351	AD	1000	12	156	-10.66077	59.09179	RB	1000	12
29	-14.78358	53.33496	PB	1000	13	93	-11.35618	57.34590	AD	1000	13	157	-10.64601	59.25309	RB	1000	13
30	-14.61684	53.53806	PB	1000	14	94	-11.37015	57.44234	AD	1000	14	158	-10.55502	59.39122	RB	1000	14
31	-14.39250	53.68621	PB	1000	15	95	-11.35937	57.54063	AD	1000	15	159	-10.40592	59.46430	RB	1000	15
32	-14.16817	53.83435	PB	1000	16	96	-11.28983	57.61576	AD	1000	16	160	-10.25682	59.53737	RB	1000	16
33	-14.65063	50.79556	PB	1300	1	97	-11.23888	57.66040	AD	1300	1	161	-10.05223	59.62408	RB	1300	1
34	-14.83782	50.97257	PB	1300	2	98	-11.12496	57.65947	AD	1300	2	162	-9.86433	59.60247	RB	1300	2
35	-15.02501	51.14958	PB	1300	3	99	-11.01105	57.65854	AD	1300	3	163	-9.70496	59.49578	RB	1300	3
36	-15.11006	51.37851	PB	1300	4	100	-10.90377	57.62324	AD	1300	4	164	-9.57193	59.35523	RB	1300	4
37	-15.14236	51.63410	PB	1300	5	101	-10.81445	57.55480	AD	1300	5	165	-9.50614	59.18734	RB	1300	5
38	-15.14292	51.88392	PB	1300	6	102	-10.75012	57.46912	AD	1300	6	166	-9.66161	59.07898	RB	1300	6
39	-14.98473	52.07895	PB	1300	7	103	-10.77427	57.36564	AD	1300	7	167	-9.83959	59.00296	RB	1300	7
40	-15.17753	52.15891	PB	1300	8	104	-10.85548	57.28575	AD	1300	8	168	-10.02923	58.98324	RB	1300	8
41	-15.22110	52.37946	PB	1300	9	105	-10.95681	57.23739	AD	1300	9	169	-10.22276	58.98222	RB	1300	9
42	-15.22601	52.63704	PB	1300	10	106	-11.07047	57.23519	AD	1300	10	170	-10.41629	58.98120	RB	1300	10
43	-15.10554	52.86078	PB	1300	11	107	-11.18438	57.23438	AD	1300	11	171	-10.59884	59.04102	RB	1300	11
44	-14.99315	53.09260	PB	1300	12	108	-11.29575	57.25072	AD	1300	12	172	-10.72983	59.14357	RB	1300	12
45	-14.85220	53.30738	PB	1300	13	109	-11.38296	57.31096	AD	1300	13	173	-10.70823	59.33239	RB	1300	13
46	-14.68979	53.50453	PB	1300	14	110	-11.41105	57.41767	AD	1300	14	174	-10.59781	59.48033	RB	1300	14
47	-14.47985	53.65386	PB	1300	15	111	-11.40808	57.53084	AD	1300	15	175	-10.41813	59.55221	RB	1300	15
48	-14.26992	53.80320	PB	1300	16	112	-11.34596	57.62154	AD	1300	16	176	-10.23844	59.62408	RB	1300	16
49	-14.50448	50.54043	PB	1500	1	113	-11.28239	57.70047	AD	1500	1	177	-9.41787	59.34290	RB	1500	1
50	-14.74508	50.71070	PB	1500	2	114	-11.40704	57.62404	AD	1500	2	178	-9.41692	59.18079	RB	1500	2
51	-14.94645	50.92210	PB	1500	3	115	-11.53168	57.54760	AD	1500	3	179	-9.48609	59.08369	RB	1500	3
52	-15.12796	51.15432	PB	1500	4	116	-11.49142	57.40972	AD	1500	4	180	-9.57630	59.01017	RB	1500	4
53	-15.21120	51.43219	PB	1500	5	117	-11.44612	57.27123	AD	1500	5	181	-9.66805	58.93596	RB	1500	5
54	-15.27152	51.72070	PB	1500	6	118	-11.31928	57.19849	AD	1500	6	182	-9.83015	58.93509	RB	1500	6
55	-15.15809	51.96501	PB	1500	7	119	-11.17943	57.17497	AD	1500	7	183	-9.99225	58.93422	RB	1500	7
56	-15.35492	52.08551	PB	1500	8	120	-11.03322	57.17551	AD	1500	8	184	-10.15435	58.93335	RB	1500	8
57	-15.35265	52.38025	PB	1500	9	121	-10.90560	57.22261	AD	1500	9	185	-10.31645	58.93300	RB	1500	9
58	-15.35039	52.67499	PB	1500	10	122	-10.77356	57.28273	AD	1500	10	186	-10.47856	58.93300	RB	1500	10
59	-15.23098	52.94231	PB	1500	11	123	-10.66610	57.37182	AD	1500	11	187	-10.62356	58.96880	RB	1500	11
60	-15.10220	53.20744	PB	1500	12	124	-10.62001	57.50439	AD	1500	12	188	-10.76917	59.00562	RB	1500	12
61	-14.93792	53.44223	PB	1500	13	125	-10.72819	57.58774	AD	1500	13	189	-10.83322	59.10644	RB	1500	13
62	-14.69617	53.61086	PB	1500	14	126	-10.85505	57.66044	AD	1500	14	190	-10.83197	59.26854	RB	1500	14
63	-14.45443	53.77948	PB	1500	15	127	-10.98997	57.70264	AD	1500	15	191	-10.79710	59.39738	RB	1500	15
64	-14.21268	53.94811	PB	1500	16	128	-11.13618	57.70215	AD	1500	16	192	-10.75019	59.51344	RB	1500	16

b) POLCOMS Release Locations

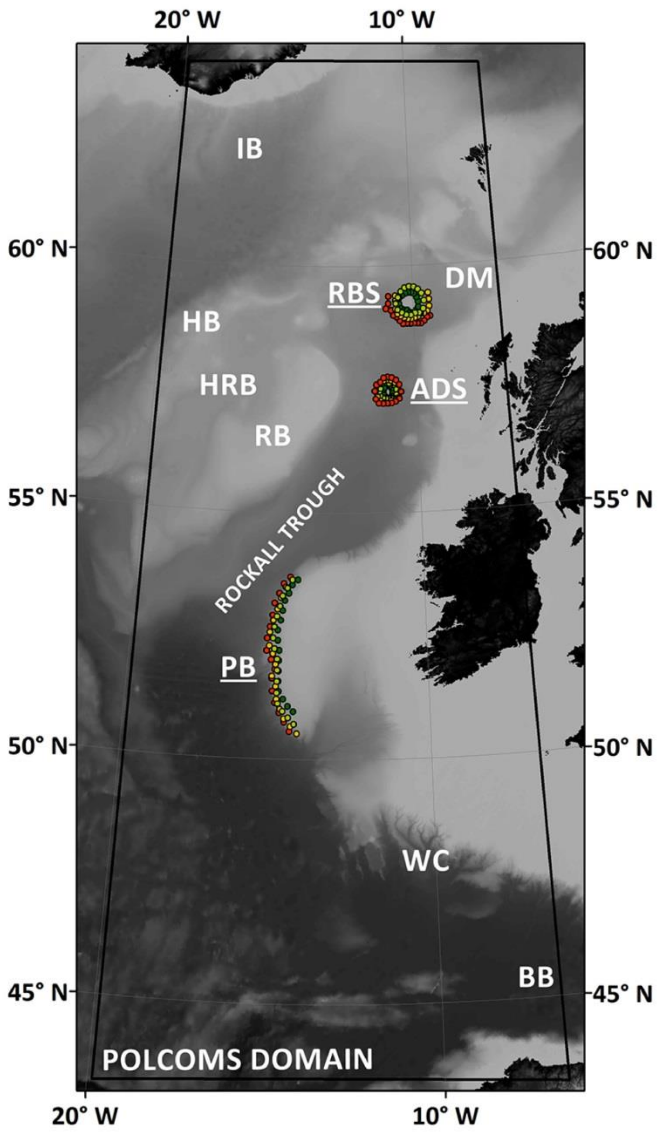
rel = release position 1-192 in this simulation, loc.= location (Porcupine Bank PB, Anton Dorhn AD, Rosemary Bank RB), pos = position 1-16 per depth band, per locaiton.

rel.	long	lat	loc.	Depth	pos.	rel.	long	lat	loc.	Depth	pos.	rel.	long	lat	loc.	Depth	pos.
1	-14.37838	53.63929	PB	700	1	65	-11.17493	57.56705	AD	700	1	129	-10.33069	59.40637	RB	700	1
2	-14.54903	53.50536	PB	700	2	66	-11.11023	57.56705	AD	700	2	130	-10.21473	59.40637	RB	700	2
3	-14.69372	53.34148	PB	700	3	67	-11.04554	57.56705	AD	700	3	131	-10.09877	59.40637	RB	700	3
4	-14.83840	53.17760	PB	700	4	68	-10.98085	57.56705	AD	700	4	132	-9.98281	59.40637	RB	700	4
5	-14.88448	52.97642	PB	700	5	69	-10.91616	57.56705	AD	700	5	133	-9.88692	59.35046	RB	700	5
6	-14.88448	52.75781	PB	700	6	70	-10.91557	57.50295	AD	700	6	134	-9.81911	59.26647	RB	700	6
7	-14.98403	52.58744	PB	700	7	71	-10.91557	57.43826	AD	700	7	135	-9.83273	59.15678	RB	700	7
8	-15.01843	52.39976	PB	700	8	72	-10.91557	57.37357	AD	700	8	136	-9.92088	59.08143	RB	700	8
9	-14.88040	52.25492	PB	700	9	73	-10.91676	57.31007	AD	700	9	137	-10.02240	59.04232	RB	700	9
10	-14.87960	52.03631	PB	700	10	74	-10.98145	57.31007	AD	700	10	138	-10.13836	59.04232	RB	700	10
11	-14.87881	51.81770	PB	700	11	75	-11.04615	57.31007	AD	700	11	139	-10.25433	59.04232	RB	700	11
12	-14.87801	51.59909	PB	700	12	76	-11.11084	57.31007	AD	700	12	140	-10.37029	59.04232	RB	700	12
13	-14.87722	51.38048	PB	700	13	77	-11.17553	57.31007	AD	700	13	141	-10.48625	59.04232	RB	700	13
14	-14.82151	51.18589	PB	700	14	78	-11.17672	57.37298	AD	700	14	142	-10.49726	59.14727	RB	700	14
15	-14.66151	51.03693	PB	700	15	79	-11.17612	57.43767	AD	700	15	143	-10.49726	59.26324	RB	700	15
16	-14.48350	50.91026	PB	700	16	80	-11.17553	57.50236	AD	700	16	144	-10.42697	59.34173	RB	700	16
17	-14.50296	53.68990	PB	1000	1	81	-11.34387	57.56467	AD	1000	1	145	-10.34021	59.52059	RB	1000	1
18	-14.68872	53.54092	PB	1000	2	82	-11.23917	57.56467	AD	1000	2	146	-10.16853	59.52059	RB	1000	2
19	-14.87449	53.39195	PB	1000	3	83	-11.13448	57.56467	AD	1000	3	147	-9.99685	59.52059	RB	1000	3
20	-14.97428	53.17927	PB	1000	4	84	-11.02978	57.56467	AD	1000	4	148	-9.83077	59.48586	RB	1000	4
21	-15.06155	52.95774	PB	1000	5	85	-10.92508	57.56467	AD	1000	5	149	-9.66778	59.43192	RB	1000	5
22	-15.14049	52.73308	PB	1000	6	86	-10.82039	57.56467	AD	1000	6	150	-9.60496	59.30562	RB	1000	6
23	-15.20371	52.50574	PB	1000	7	87	-10.76090	57.51946	AD	1000	7	151	-9.63976	59.15505	RB	1000	7
24	-15.18129	52.27661	PB	1000	8	88	-10.76090	57.41477	AD	1000	8	152	-9.79200	59.07569	RB	1000	8
25	-15.03631	52.09662	PB	1000	9	89	-10.76090	57.31007	AD	1000	9	153	-9.92784	58.97202	RB	1000	9
26	-15.03631	51.85850	PB	1000	10	90	-10.86560	57.31007	AD	1000	10	154	-10.08510	58.93286	RB	1000	10
27	-15.03631	51.62037	PB	1000	11	91	-10.97029	57.31007	AD	1000	11	155	-10.25678	58.93286	RB	1000	11
28	-15.03631	51.38225	PB	1000	12	92	-11.07499	57.31007	AD	1000	12	156	-10.42200	58.96909	RB	1000	12
29	-15.03631	51.14413	PB	1000	13	93	-11.17969	57.31007	AD	1000	13	157	-10.58312	59.02839	RB	1000	13
30	-14.89574	50.95395	PB	1000	14	94	-11.28438	57.31007	AD	1000	14	158	-10.66620	59.14212	RB	1000	14
31	-14.70364	50.81801	PB	1000	15	95	-11.34387	57.35528	AD	1000	15	159	-10.58770	59.28431	RB	1000	15
32	-14.49907	50.69614	PB	1000	16	96	-11.34387	57.45997	AD	1000	16	160	-10.47318	59.41199	RB	1000	16
33	-14.48072	53.68362	PB	1300	1	97	-11.21476	57.66699	AD	1300	1	161	-10.49726	59.46348	RB	1300	1
34	-14.70728	53.54891	PB	1300	2	98	-11.09517	57.66699	AD	1300	2	162	-10.65355	59.39913	RB	1300	2
35	-14.91922	53.40029	PB	1300	3	99	-10.97558	57.66699	AD	1300	3	163	-10.65906	59.23379	RB	1300	3
36	-15.04262	53.16737	PB	1300	4	100	-10.85599	57.66699	AD	1300	4	164	-10.65906	59.06477	RB	1300	4
37	-15.16602	52.93446	PB	1300	5	101	-10.76328	57.64011	AD	1300	5	165	-10.53423	58.96550	RB	1300	5
38	-15.20518	52.68061	PB	1300	6	102	-10.76328	57.52052	AD	1300	6	166	-10.37579	58.92810	RB	1300	6
39	-15.20518	52.41702	PB	1300	7	103	-10.76328	57.40093	AD	1300	7	167	-10.20677	58.92810	RB	1300	7
40	-15.20518	52.15344	PB	1300	8	104	-10.79490	57.29807	AD	1300	8	168	-10.03775	58.92810	RB	1300	8
41	-15.05562	51.96833	PB	1300	9	105	-10.89376	57.23079	AD	1300	9	169	-9.86872	58.92810	RB	1300	9
42	-15.13020	51.75313	PB	1300	10	106	-11.00479	57.20299	AD	1300	10	170	-9.70608	58.96963	RB	1300	10
43	-15.19380	51.52218	PB	1300	11	107	-11.12438	57.20299	AD	1300	11	171	-9.54484	59.02034	RB	1300	11
44	-15.05001	51.31829	PB	1300	12	108	-11.23118	57.24378	AD	1300	12	172	-9.45981	59.12697	RB	1300	12
45	-15.05319	51.05473	PB	1300	13	109	-11.32935	57.31207	AD	1300	13	173	-9.45981	59.29599	RB	1300	13
46	-14.86654	50.87992	PB	1300	14	110	-11.33673	57.42781	AD	1300	14	174	-9.51588	59.43561	RB	1300	14
47	-14.66225	50.71336	PB	1300	15	111	-11.33673	57.54740	AD	1300	15	175	-9.66208	59.51007	RB	1300	15
48	-14.45796	50.54681	PB	1300	16	112	-11.33673	57.66699	AD	1300	16	176	-9.83101	59.51583	RB	1300	16
49	-14.54812	53.74572	PB	1500	1	113	-11.33673	57.66937	AD	1500	1	177	-10.82086	59.47300	RB	1500	1
50	-14.76475	53.58803	PB	1500	2	114	-11.18753	57.66937	AD	1500	2	178	-10.82086	59.32870	RB	1500	2
51	-14.98138	53.43033	PB	1500	3	115	-11.03834	57.66937	AD	1500	3	179	-10.82086	59.18440	RB	1500	3
52	-15.12171	53.21105	PB	1500	4	116	-10.88914	57.66937	AD	1500	4	180	-10.82086	59.04010	RB	1500	4
53	-15.23060	52.96623	PB	1500	5	117	-10.74427	57.65583	AD	1500	5	181	-10.69912	58.96278	RB	1500	5
54	-15.34317	52.72308	PB	1500	6	118	-10.62274	57.56928	AD	1500	6	182	-10.56769	58.90598	RB	1500	6
55	-15.37740	52.46315	PB	1500	7	119	-10.60624	57.42860	AD	1500	7	183	-10.43023	58.86211	RB	1500	7
56	-15.37424	52.19522	PB	1500	8	120	-10.63796	57.29663	AD	1500	8	184	-10.29159	58.82579	RB	1500	8
57	-15.22606	52.01119	PB	1500	9	121	-10.76313	57.21544	AD	1500	9	185	-10.14729	58.82579	RB	1500	9
58	-15.17419	51.85957	PB	1500	10	122	-10.90864	57.20299	AD	1500	10	186	-10.00299	58.82579	RB	1500	10
59	-15.21881	51.61226	PB	1500	11	123	-11.05784	57.20299	AD	1500	11	187	-9.85869	58.82579	RB	1500	11
60	-15.21881	51.34432	PB	1500	12	124	-11.20703	57.20299	AD	1500	12	188	-9.72023	58.86334	RB	1500	12
61	-15.11430	51.09802	PB	1500	13	125	-11.35141	57.21750	AD	1500	13	189	-9.58274	58.90713	RB	1500	13
62	-14.98524	50.86892	PB	1500	14	126	-11.47099	57.30674	AD	1500	14	190	-9.44765	58.95595	RB	1500	14
63	-14.78058	50.69597	PB	1500	15	127	-11.49139	57.44570	AD	1500	15	191	-9.32732	59.03559	RB	1500	15
64	-14.57593	50.52302	PB	1500	16	128	-11.45936	57.57868	AD	1500	16	192	-9.27659	59.16367	RB	1500	16

c) Why there is a difference between the release locations in each model

While one release file was trialled initially to be run in both models, the different bathymetry underlying each model meant that some release positions would clash with the topgraphy in the other model. The release file was therefore built for HYCOM and then adjusted for POLCOMS to ensure that all release positions interfaced with the seamounts and bank at a relatively similar position, hence there are two different release files required to reproduce this study.

d) An overview map of release locations



The study area is centred on the Rockall Trough region of the NE Atlantic in the waters west of the UK and Ireland. The study area bounding box is equivalent to the domain of the POLCOMS model. Larvae were released from 16 release positions in four depth bands (700 m [dark green dots]; 1,000 m [light green dots]; 1,300 m [yellow dots]; 1,500 m [red dots]) at Rosemary Bank (RBS), Anton Dohrn Seamount (ADS) and Porcupine Bank (PB). Features of topography mentioned in the text are labelled as follows: Iceland Basin (IB), Hatton Bank (HB), Darwin Mounds (DM), Hatton Rockall Basin (HRB), Rockall Bank (RB), Whittard Canyon (WC), Bay of Biscay (BB). (This map was created in ArcGIS 10.3 (http://www.esri.com) with GEBCO 30 arc-second topography, available from www.gebco.net, and projected Albers Equal Area Conic with modified standard parallels and meridian (sp 1 = 46 °N, sp 2 = 61 °N, m = 13 °W))

S3 - GLM and drop1 results of parameter importance

In order to check that the differences between median straight-line distance travelled (or actual distance for the 0.05m/s estimate) by theoretical larvae in each model is indeed attributable to the **model type** (POLCOMS or HYCOM) rather than **depth** or **location** of release, Generalised Linear Models (GLMs) were built and subjected to the drop1 function in R for backwards selection of variable importance.

After extensive checks (Poisson, Negative Binomial, Gaussian, Gamma, Square root/ 4^{th} root/ Log Transformations etc) we selected Gamma GLMs with 4th root SLD response data as the best fit. A gamma distribution is suitable as we have positive left skewed continuous distance data as our response variable.

All GLMs (for Day 35, Day 69 and Day 270 datasets) show that **model type** (ie. HYCOM / POLCOMS / 0.05m/s estimate) is an important variable affecting the (4th root transformed) SLD values (and this was also the case in every GLM type tested, with and without transformations).

The drop1 results always show that any GLM without MODEL as a variable would always have a higher Akaike's Information Criterion (AIC) than a GLM that keeps this variable.

We therefore conclude that **model type** affects SLD results.

Hereafter we show:

- The libraries used
- The format of the input data
- The results (and instructive code) that led us to this conclusion

Libraries

The GLMs were performed in R and required:

Library(MASS) for the GLMS, and

Library(MuMIn) for the drop1 function

Data

The data after some reorganisation was called **m3** and took the form **str(m3)**:

```
'data.frame': 140172 obs. of 7 variables:
$ track : int 1 2 3 4 5 6 7 8 9 10 ...
$ depth : Factor w/ 4 levels "700","1000","1300",..: 3 3 3 3 3 3 3 3 3 3 ...
$ location: Factor w/ 3 levels "1","2","3": 3 3 3 3 3 3 3 3 3 3 ...
$ model : Factor w/ 3 levels "1","2","3": 1 1 1 1 1 1 1 1 1 1 ...
$ day_35 : num 52.5 49.3 46.2 52.9 49.5 ...
$ day_69 : num 92.5 104 27 110 21.9 ...
$ day_270 : num 400 299 223 594 266 ...
```

Where:

- Day_## = the SLD (in Km) reached on that day of simulation for all tracks 1-70271.
- Model 1=HYCOM, 2=POLCOMS, 3=0.05m/s estimate
- Location 1=Rosemary 2=Anton 3= Porcupine

Additional variables were added with log, squareroot and 4th root transformations of the SLD data, such that the resulting dataset looked like **summary(m3)**:

```
     track          depth        location    model   
 Min.   :    1   700 :35035   1:46702   1:70055  
 1st Qu.:17537   1000:35026   2:46721   2:70080  
 Median :35079   1300:35043   3:46724   3:   12  
 Mean   :35081   1500:35043                      
 3rd Qu.:52623                                   
 Max.   :70271                                   
     day_35            day_69            day_270       
 Min.   :  0.0668   Min.   :  0.1769   Min.   :   0.0594  
 1st Qu.: 29.8710   1st Qu.: 44.5510   1st Qu.:  90.4585  
 Median : 58.3590   Median : 92.0710   Median : 201.5300  
 Mean   : 72.2987   Mean   :113.0019   Mean   : 250.2694  
 3rd Qu.: 98.6410   3rd Qu.:163.2000   3rd Qu.: 374.1150  
 Max.   :477.7100   Max.   :751.9700   Max.   :1311.6000  
     logD35           logD69            logD270      
 Min.   :-1.175   Min.   :-0.7524   Min.   :-1.226  
 1st Qu.: 1.475   1st Qu.: 1.6489   1st Qu.: 1.956  
 Median : 1.766   Median : 1.9641   Median : 2.304  
 Mean   : 1.703   Mean   : 1.8835   Mean   : 2.196  
 3rd Qu.: 1.994   3rd Qu.: 2.2127   3rd Qu.: 2.573  
 Max.   : 2.679   Max.   : 2.8762   Max.   : 3.118  
    sqrtD35           sqrtD69           sqrtD270      
 Min.   : 0.2584   Min.   : 0.4205   Min.   : 0.2437  
 1st Qu.: 5.4654   1st Qu.: 6.6747   1st Qu.: 9.5110  
 Median : 7.6393   Median : 9.5954   Median :14.1961  
 Mean   : 7.8457   Mean   : 9.7716   Mean   :14.3879  
 3rd Qu.: 9.9318   3rd Qu.:12.7750   3rd Qu.:19.3421  
 Max.   :21.8566   Max.   :27.4221   Max.   :36.2160  
    rt4_D35          rt4_D69          rt4_D270     
 Min.   :0.5083   Min.   :0.6485   Min.   :0.4937  
 1st Qu.:2.3378   1st Qu.:2.5835   1st Qu.:3.0840  
 Median :2.7639   Median :3.0976   Median :3.7678  
 Mean   :2.7361   Mean   :3.0465   Mean   :3.6772  
 3rd Qu.:3.1515   3rd Qu.:3.5742   3rd Qu.:4.3980  
 Max.   :4.6751   Max.   :5.2366   Max.   :6.0180  
```

The following three pages show records of the summary outputs from the GLMs and from the drop1 function for each of the three tested timesteps.

DAY 35

```
M35 <- glm(rt4_D35 ~ model + depth + location,
          data = m3, family = Gamma )
summary(M35)
```

```
Call:
glm(formula = rt4_D35 ~ model + depth + location, family = Gamma,
    data = m3)

Deviance Residuals:
     Min        1Q    Median        3Q       Max
-1.30101  -0.13573   0.01441   0.13749   0.46914

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.3249371  0.0004823 673.669  < 2e-16 ***
model2       0.0602918  0.0003863 156.079  < 2e-16 ***
model3      -0.0523457  0.0161069  -3.250  0.00115 **
depth1000    0.0145913  0.0005177  28.185  < 2e-16 ***
depth1300    0.0400546  0.0005374  74.529  < 2e-16 ***
depth1500    0.0360001  0.0005342  67.386  < 2e-16 ***
location2   -0.0021397  0.0004773  -4.483 7.37e-06 ***
location3   -0.0239945  0.0004634 -51.783  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for Gamma family taken to be 0.03845926)

    Null deviance: 7372  on 140146  degrees of freedom
Residual deviance: 6010  on 140139  degrees of freedom
AIC: 232132

Number of Fisher Scoring iterations: 4
```

```
drop1(M35,test= "Chi")
```

```
Single term deletions

Model:
rt4_D35 ~ model + depth + location
         Df Deviance    AIC scaled dev.  Pr(>Chi)
<none>        6010.0 232132
model     2   6957.3 256759     24630.6 < 2.2e-16 ***
depth     3   6293.9 239507      7380.5 < 2.2e-16 ***
location  2   6137.8 235450      3322.4 < 2.2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

DAY 69

```
M69 <- glm(rt4_D69 ~ model + depth + location,
          data = m3, family = Gamma )
summary(M69)
```

```
Call:
glm(formula = rt4_D69 ~ model + depth + location, family = Gamma,
    data = m3)

Deviance Residuals:
     Min        1Q    Median        3Q       Max
-1.21609  -0.14550   0.01299   0.14037   0.49895

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.2944965  0.0004657 632.340  < 2e-16 ***
model2       0.0548209  0.0003716 147.542  < 2e-16 ***
model3      -0.0620028  0.0145432  -4.263 2.01e-05 ***
depth1000    0.0181944  0.0004983  36.511  < 2e-16 ***
depth1300    0.0358497  0.0005131  69.875  < 2e-16 ***
depth1500    0.0365689  0.0005137  71.192  < 2e-16 ***
location2   -0.0078185  0.0004623 -16.913  < 2e-16 ***
location3   -0.0305625  0.0004469 -68.387  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for Gamma family taken to be 0.04412678)

    Null deviance: 8337.3  on 140146  degrees of freedom
Residual deviance: 6830.3  on 140139  degrees of freedom
AIC: 279356

Number of Fisher Scoring iterations: 4
```

```
drop1(M69,test= "Chi")
```

```
Single term deletions

Model:
rt4_D69 ~ model + depth + location
         Df Deviance    AIC scaled dev.  Pr(>Chi)
<none>        6830.3 279356
model     2   7802.3 301379     22026.5 < 2.2e-16 ***
depth     3   7134.5 286244      6893.8 < 2.2e-16 ***
location  2   7056.8 284484      5131.9 < 2.2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

DAY 270

```
M270 <- glm(rt4_D270 ~ model + depth + location,
          data = m3, family = Gamma )
summary(M270)
```

```
Call:
glm(formula = rt4_D270 ~ model + depth + location, family = Gamma,
    data = m3)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-1.5017  -0.1675   0.0149   0.1685   0.5751

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.2460709  0.0004325 568.923  < 2e-16 ***
model2       0.0494246  0.0003436 143.858  < 2e-16 ***
model3      -0.0774566  0.0114837  -6.745 1.54e-11 ***
depth1000    0.0152644  0.0004669  32.693  < 2e-16 ***
depth1300    0.0172382  0.0004687  36.781  < 2e-16 ***
depth1500    0.0245777  0.0004755  51.683  < 2e-16 ***
location2    0.0059669  0.0004359  13.690  < 2e-16 ***
location3   -0.0340266  0.0004056 -83.885  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

(Dispersion parameter for Gamma family taken to be 0.05484397)

    Null deviance: 10585.4  on 140146  degrees of freedom
Residual deviance:  8642.8  on 140139  degrees of freedom
AIC: 363133

Number of Fisher Scoring iterations: 5
```

```
drop1(M270,test= "Chi")
```

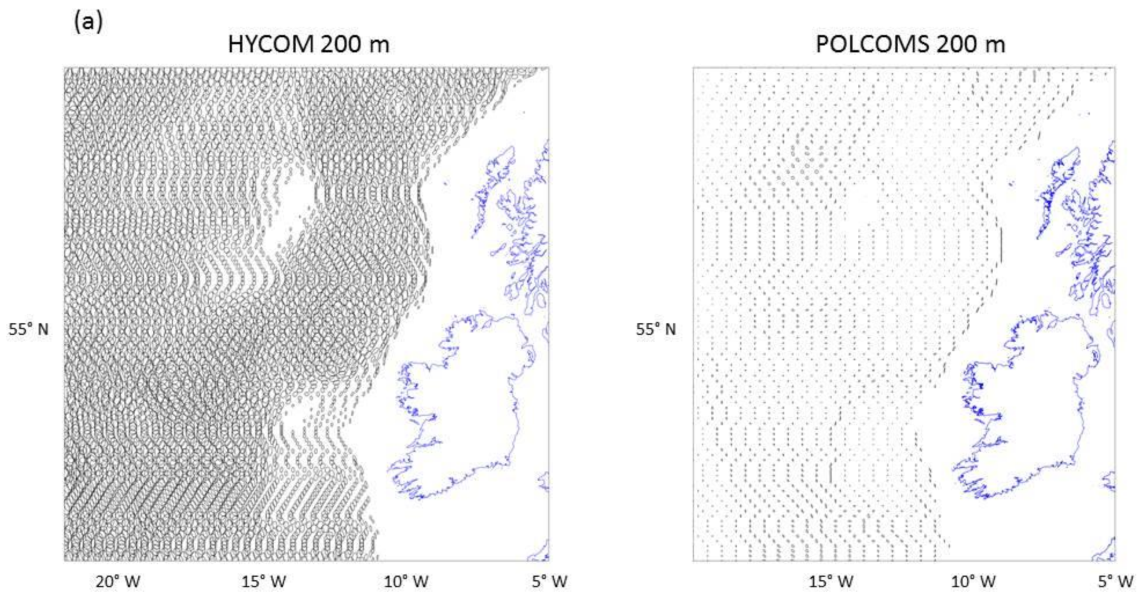
```
Single term deletions

Model:
rt4_D270 ~ model + depth + location
         Df Deviance    AIC scaled dev.  Pr(>Chi)
<none>        8642.8 363133
model     2   9795.1 384138     21009.9 < 2.2e-16 ***
depth     3   8800.6 366003      2876.2 < 2.2e-16 ***
location  2   9267.9 374525     11397.0 < 2.2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

S4 – Current ellipses

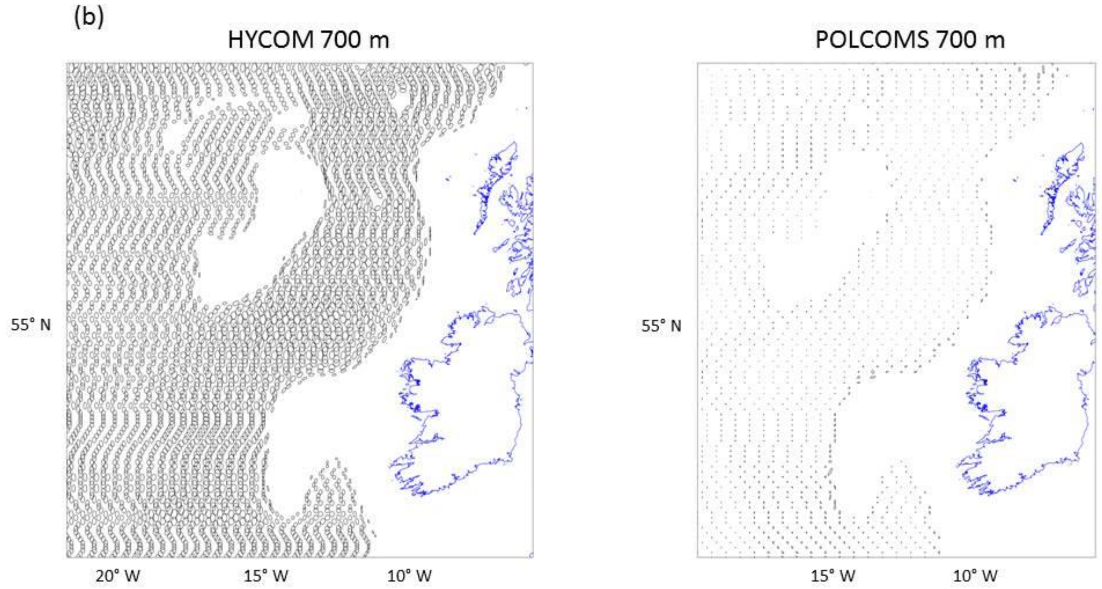
The following pairs of plots show current ellipses per model per depth for **(a)** 200 m, **(b)** 700 m, **(c)** 1,000 m, **(d)** 1,300 m[1], **(e)** 1,500 m. The current ellipses use the two main principle components of modelled velocity data to represent the variability in current strength and direction over the entire simulated period (728 days for this study). Oval ellipses are oriented in the predominant direction of the current with the width representing variability in current direction (circles = highly variable, narrow ovals = little variability). Larger ellipses represent stronger current speeds. A current ellipse is plotted for every 5th grid point. 200 m plots are shown in reference to the shelf edge current (which is more apparent in HYCOM at 200 m). All maps are plotted in MATLAB R2015a (http://uk.mathworks.com).

HYCOM displays larger (= strong current speeds), and more circular (= high variability in current direction) ellipses. This higher variability throughout HYCOM plots suggests there may be a less strict handling of the horizontal pressure gradient errors than in POLCOMS.

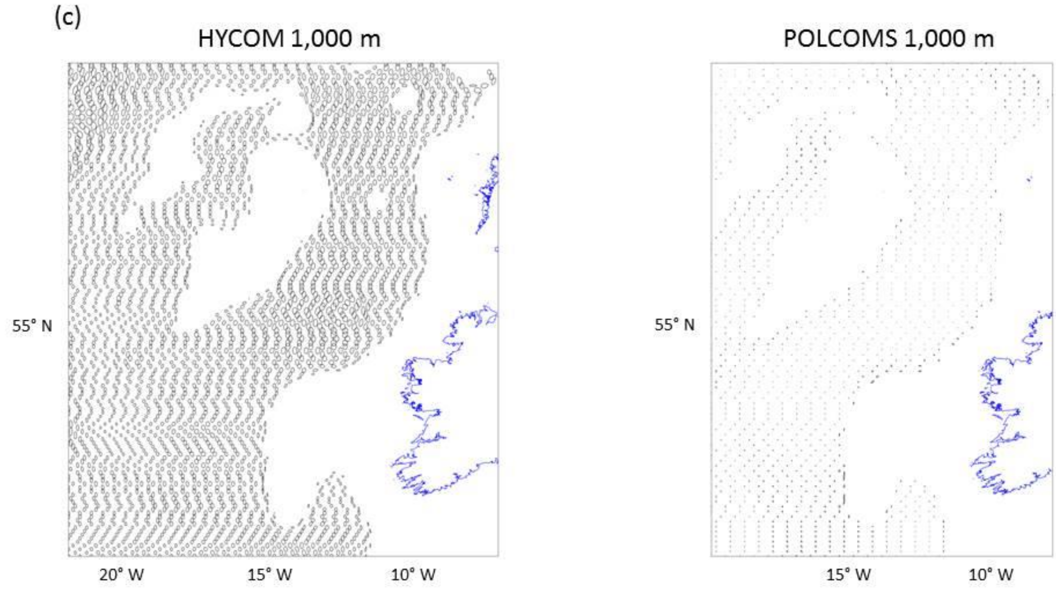


[1] 1250m is shown for HYCOM as these are the nearest data points to the simulated 1300m larval tracks (the connectivity modeling system ran the simulation at 1300m in HYCOM by running an interpolation between the available data points).

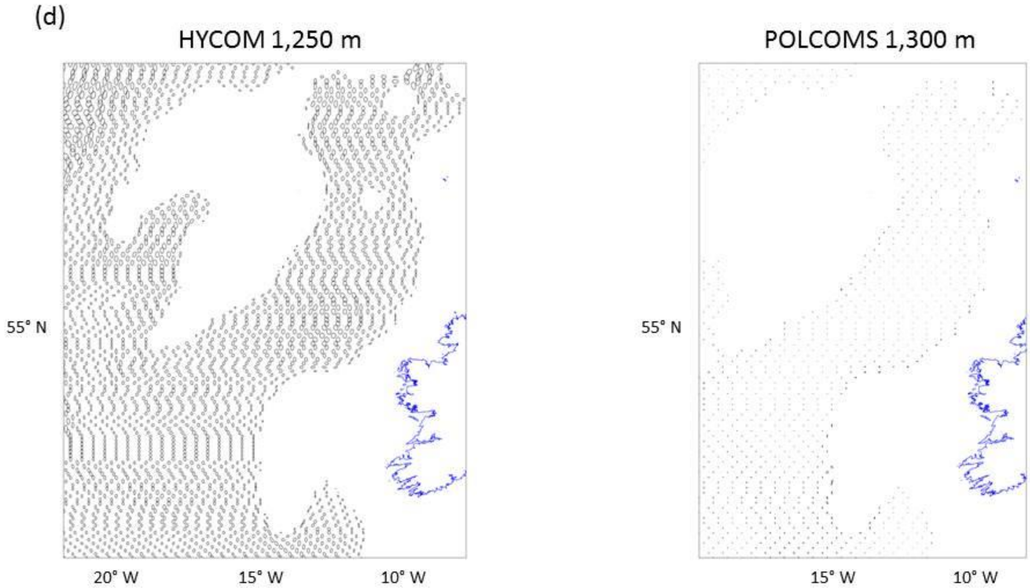
(b)


HYCOM 700 m
POLCOMS 700 m
55° N
20° W
15° W
10° W
55° N
15° W
10° W

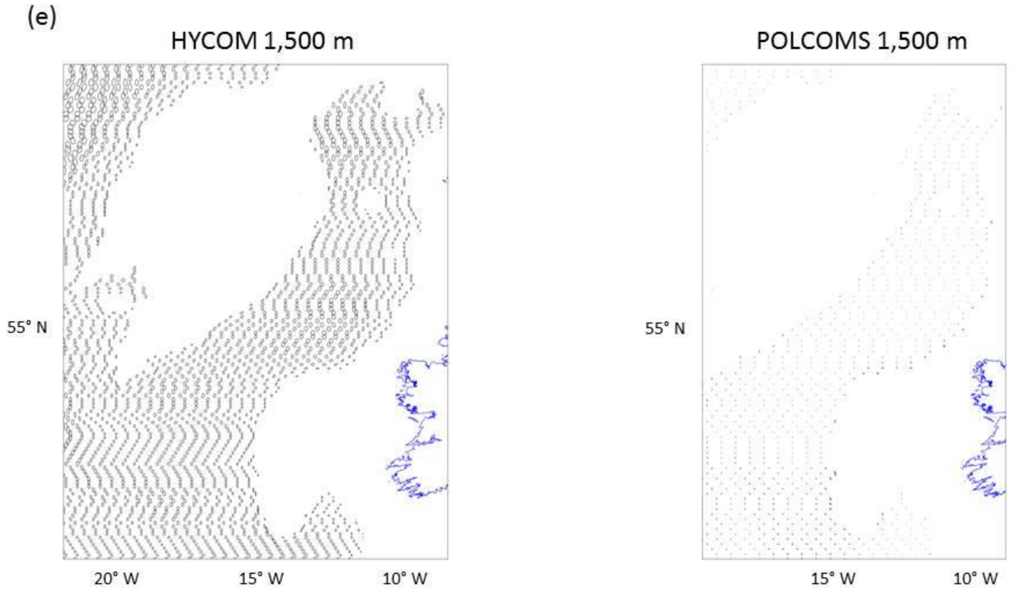
(c)


HYCOM 1,000 m
POLCOMS 1,000 m
55° N
20° W
15° W
10° W
55° N
15° W
10° W

(d)


HYCOM 1,250 m
POLCOMS 1,300 m
55° N
20° W
15° W
10° W
55° N
15° W
10° W

(e)


HYCOM 1,500 m
POLCOMS 1,500 m
55° N
20° W
15° W
10° W
55° N
15° W
10° W