Groundfish SDMs for Atlantis

sdmTMB model convergence and ensemble statistics

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Each functional group was modelled as an ensemble of four models. Each sub-model has the same predictors, but the models vary in the assumed functional form of the relationship between predictors and CPUE: models represent the relationship of CPUE with bottom temperature and oxygen as either linear or as a GAM spline. The general model formula, therefore, is:

```
cpue ~ +bottom_temperature + I(bottom_temperature^2) + bottom_oxygen +I(bottom_oxygen^2)
```

For the "linear" (non-spline) environmental relationships, and:

```
cpue~ +s(bottom_temperature, k = 3) + s(bottom_oxygen,k=3)
```

For the spline relationships. The `k=3` parameter denotes the maximum allowable "smoothness" of the fitted spline relationship. This spline k parameter is set at 3 for all models. Furthermore, the models can include spatial random fields, or not. Without spatial random fields, the models reduce to simple GLMs or GAMs. Models were fit with a Tweedie distribution.

We assessed model convergence by interrogating the model output. A convergence code of 0 represents successful convergence, and additional information on model convergence can be obtained with a call to `mod$model$message`. Desirable return codes of this call are 3, 4, 5 and 6, all of which indicate convergence of the function (Gay 1990). Finally, the Matern practical range parameter, defined as the distance at which the spatial correlation in the data drops to ρ=0.13 (Lindgren and Rue 2015), was extracted for fitted models.

With the option for linear or spline environmental relationships, and the option to include spatial random fields, each functional group therefore is modelled as an ensemble of four models. Models are then weighted using a likelihood-based posterior predictive stacking approach, described in Yao et al. 2018 (DOI: 10.1214/17-BA1091), and implemented in `sdmTMB::sdmTMB_stacking()`. These relative model weights are used to determine CPUE predictions, such that each predicted value is a weighted average of the predictions of all four models.

In the following, each of the four models for each Atlantis demersal functional groups is described, along with their relative weighting.

ARR: Arrowtooth Flounder

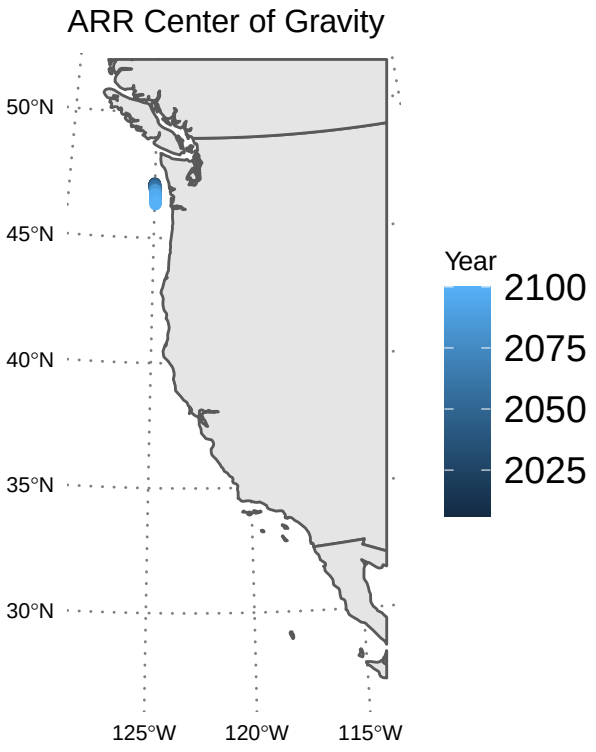
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
ARR	FALSE	FALSE	0.021	0	2.828
ARR	FALSE	TRUE	0.030	0	2.828
ARR	TRUE	FALSE	0.949	0	287.361
ARR	TRUE	TRUE	0.000	0	289.561

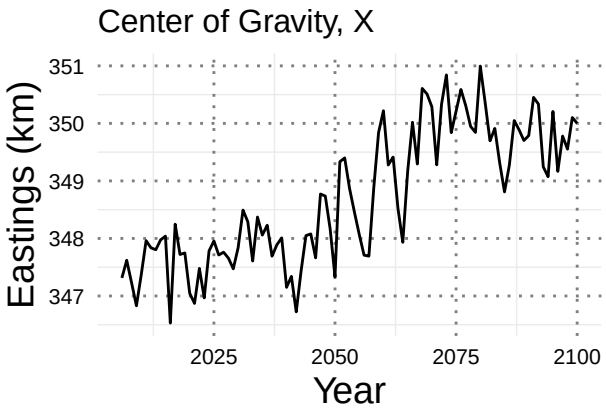
term	estimate	std.error
(Intercept)	7.035	0.046
mean_temp_roms_30_norm	-1.428	0.106
I(mean_temp_roms_30_norm^2)	-2.058	0.088
mean_oxygen_roms_30_norm	2.242	0.103
I(mean_oxygen_roms_30_norm^2)	-1.027	0.051

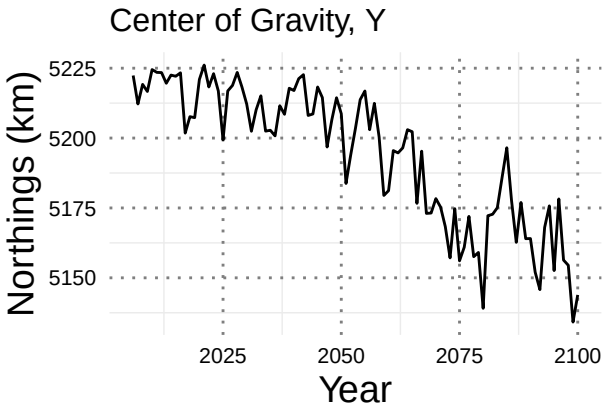
term	estimate	std.error
(Intercept)	4.185	0.056
s(mean_temp_roms_30_norm).1	8.417	0.358
s(mean_temp_roms_30_norm).2	-2.705	0.095
s(mean_oxygen_roms_30_norm).1	5.369	0.279
s(mean_oxygen_roms_30_norm).2	0.753	0.058

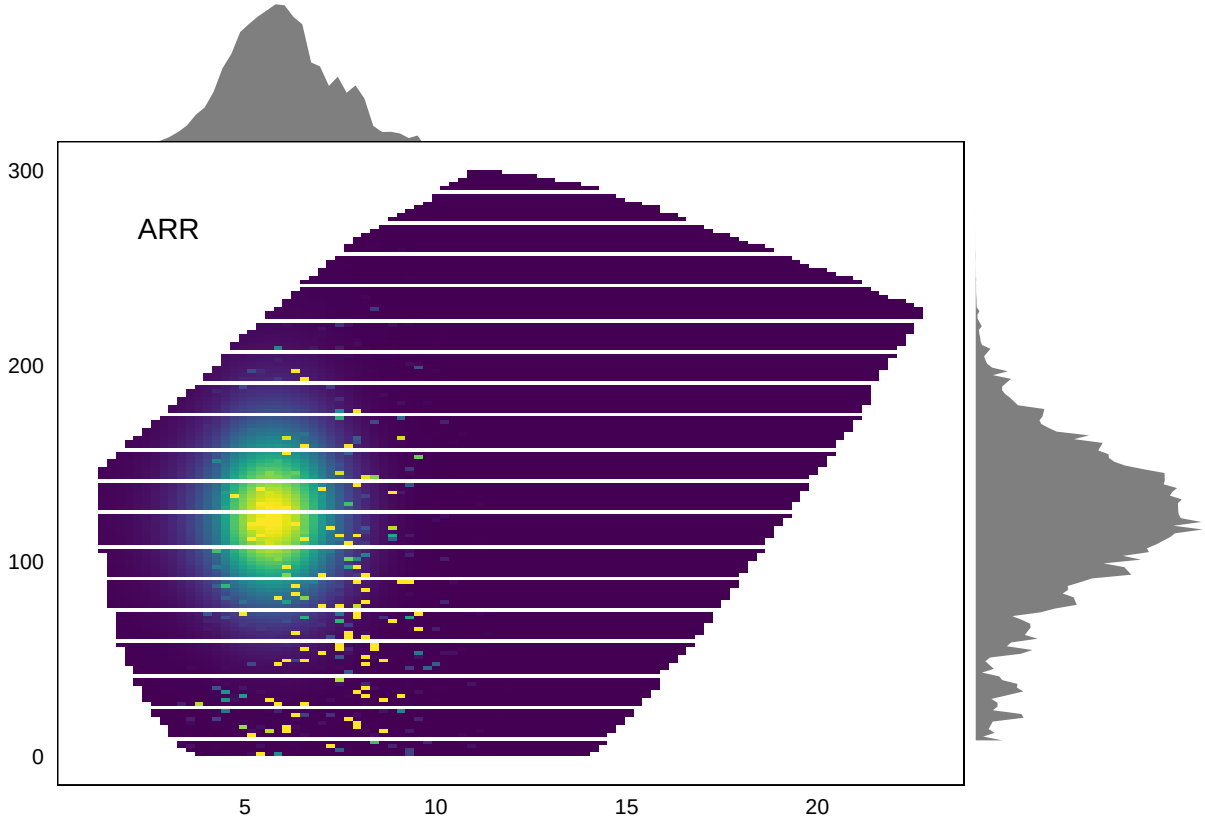
term	estimate	std.error
(Intercept)	-3.416	3.170
mean_temp_roms_30_norm	1.387	0.145
I(mean_temp_roms_30_norm^2)	-2.347	0.120
mean_oxygen_roms_30_norm	-0.697	0.146
I(mean_oxygen_roms_30_norm^2)	-0.300	0.062

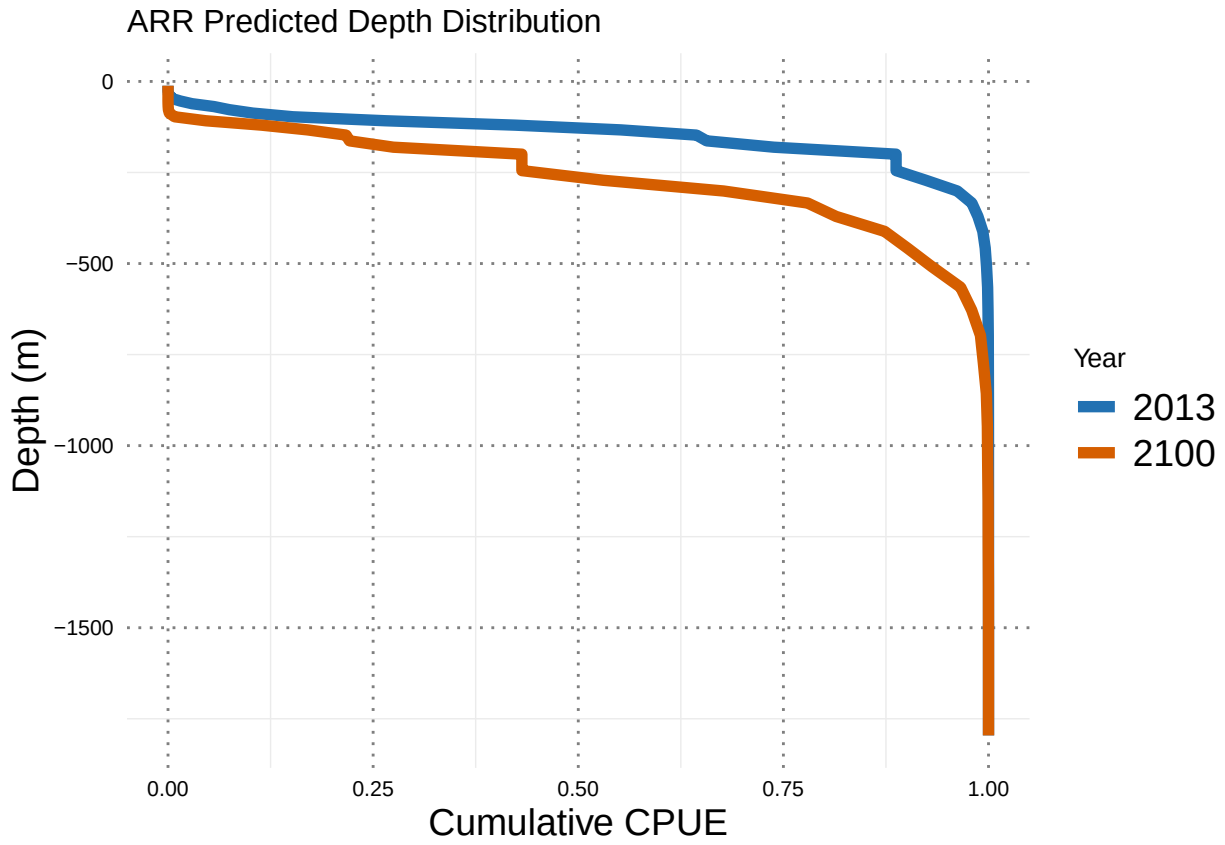
term	estimate	std.error
(Intercept)	-6.117	3.224
s(mean_temp_roms_30_norm).1	9.512	0.492
s(mean_temp_roms_30_norm).2	-0.065	0.130
s(mean_oxygen_roms_30_norm).1	1.480	0.335
s(mean_oxygen_roms_30_norm).2	-1.166	0.099

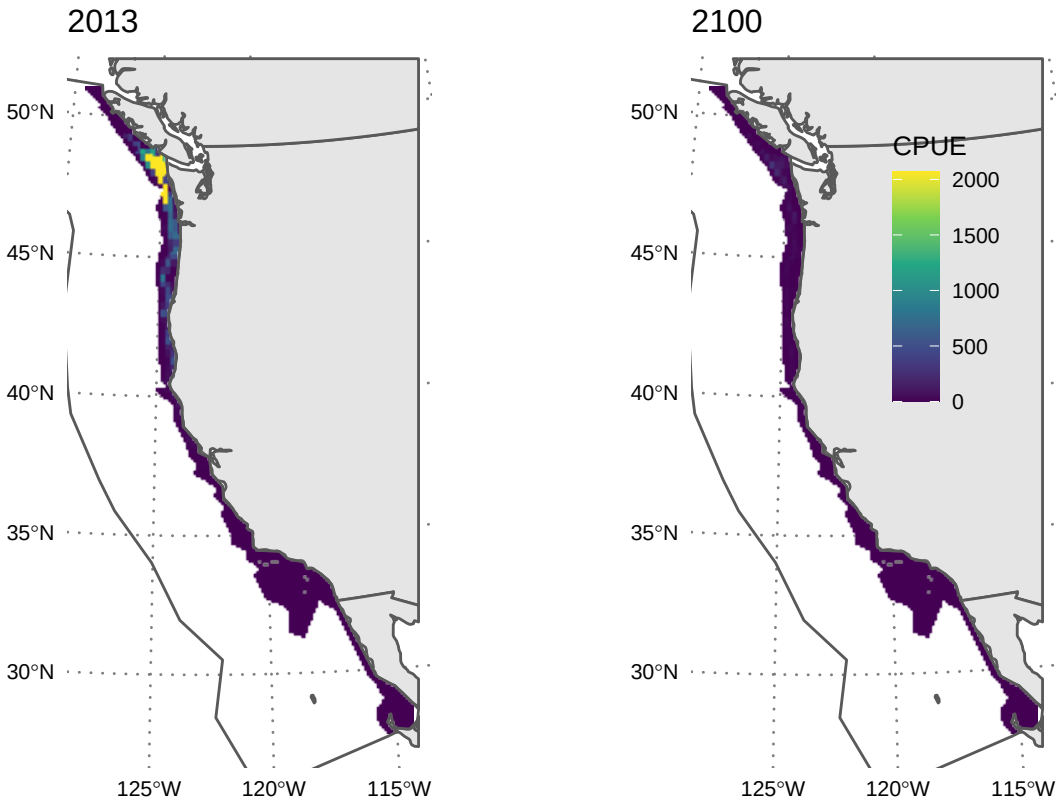

ARR Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025


Center of Gravity, X
Eastings (km)
351
350
349
348
347
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
5225
5200
5175
5150
2025
2050
2075
2100
Year


ARR
300
200
100
0
5
10
15
20


ARR Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
2100
CPUE
2000
1500
1000
500
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

BOC: Bocaccio

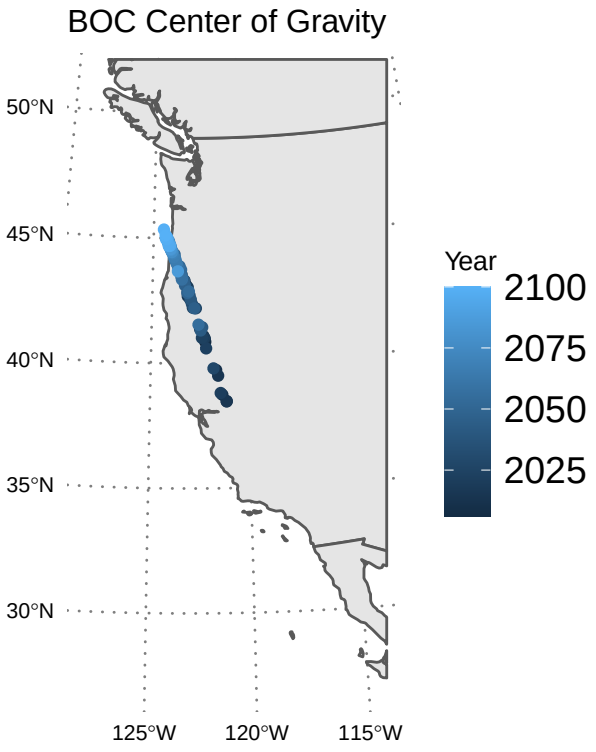
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
BOC	FALSE	FALSE	0.000	0	2.828
BOC	FALSE	TRUE	0.322	0	2.828
BOC	TRUE	FALSE	0.156	0	230.209
BOC	TRUE	TRUE	0.522	0	329.900

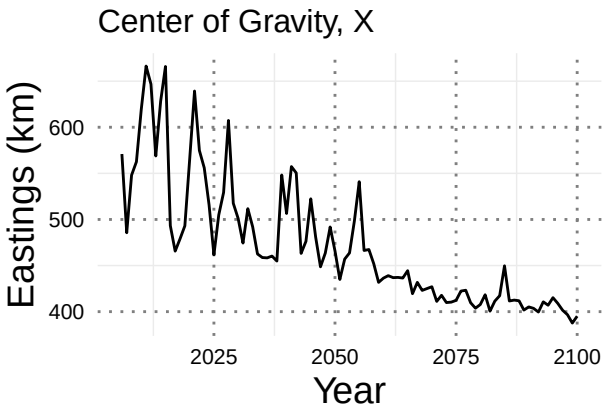
term	estimate	std.error
(Intercept)	1.394	0.221
mean_temp_roms_30_norm	5.206	0.492
I(mean_temp_roms_30_norm^2)	-1.548	0.235
mean_oxygen_roms_30_norm	-0.235	0.363
I(mean_oxygen_roms_30_norm^2)	-0.515	0.224

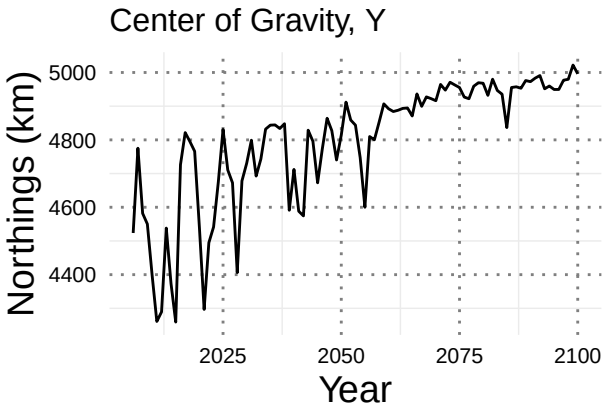
term	estimate	std.error
(Intercept)	-1.251	0.406
s(mean_temp_roms_30_norm).1	8.724	1.226
s(mean_temp_roms_30_norm).2	4.619	0.394
s(mean_oxygen_roms_30_norm).1	2.949	1.080
s(mean_oxygen_roms_30_norm).2	-0.991	0.200

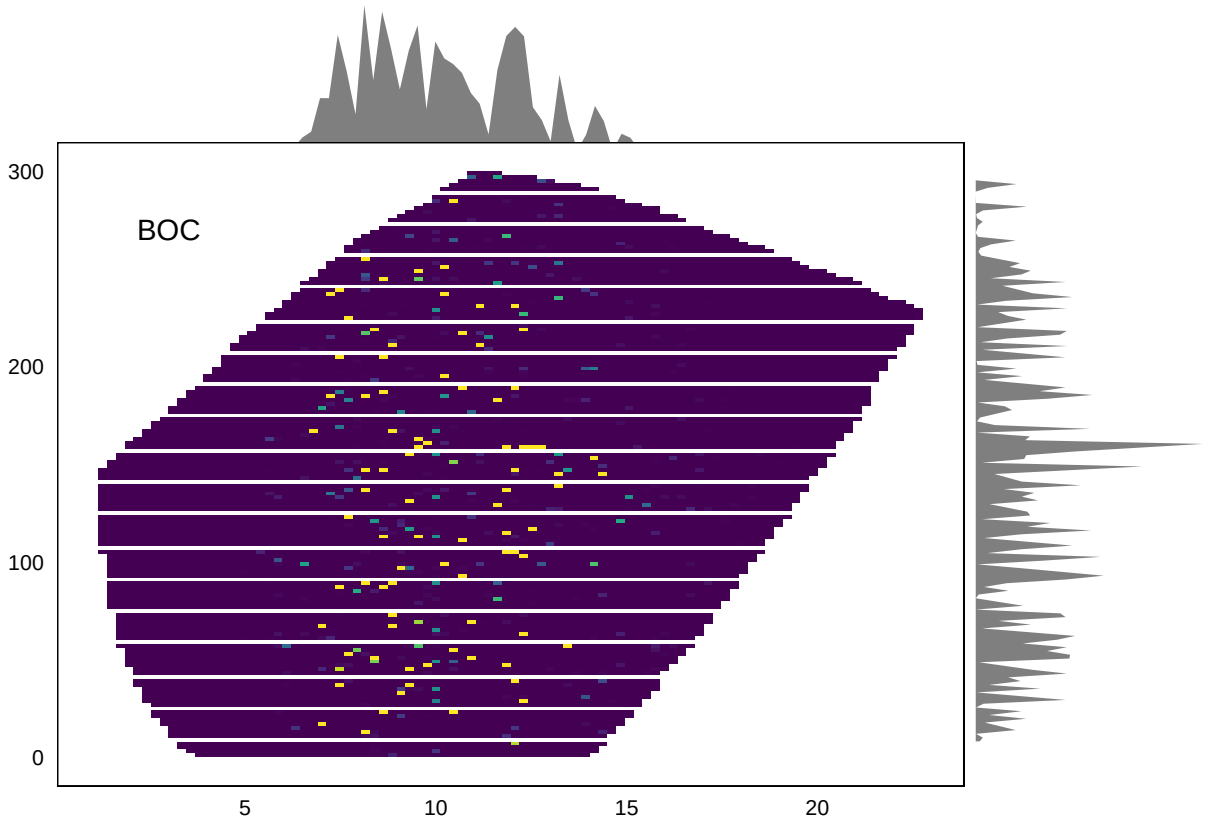
term	estimate	std.error
(Intercept)	-2.625	2.941
mean_temp_roms_30_norm	5.130	0.847
I(mean_temp_roms_30_norm^2)	-1.954	0.325
mean_oxygen_roms_30_norm	1.121	0.596
I(mean_oxygen_roms_30_norm^2)	-0.540	0.327

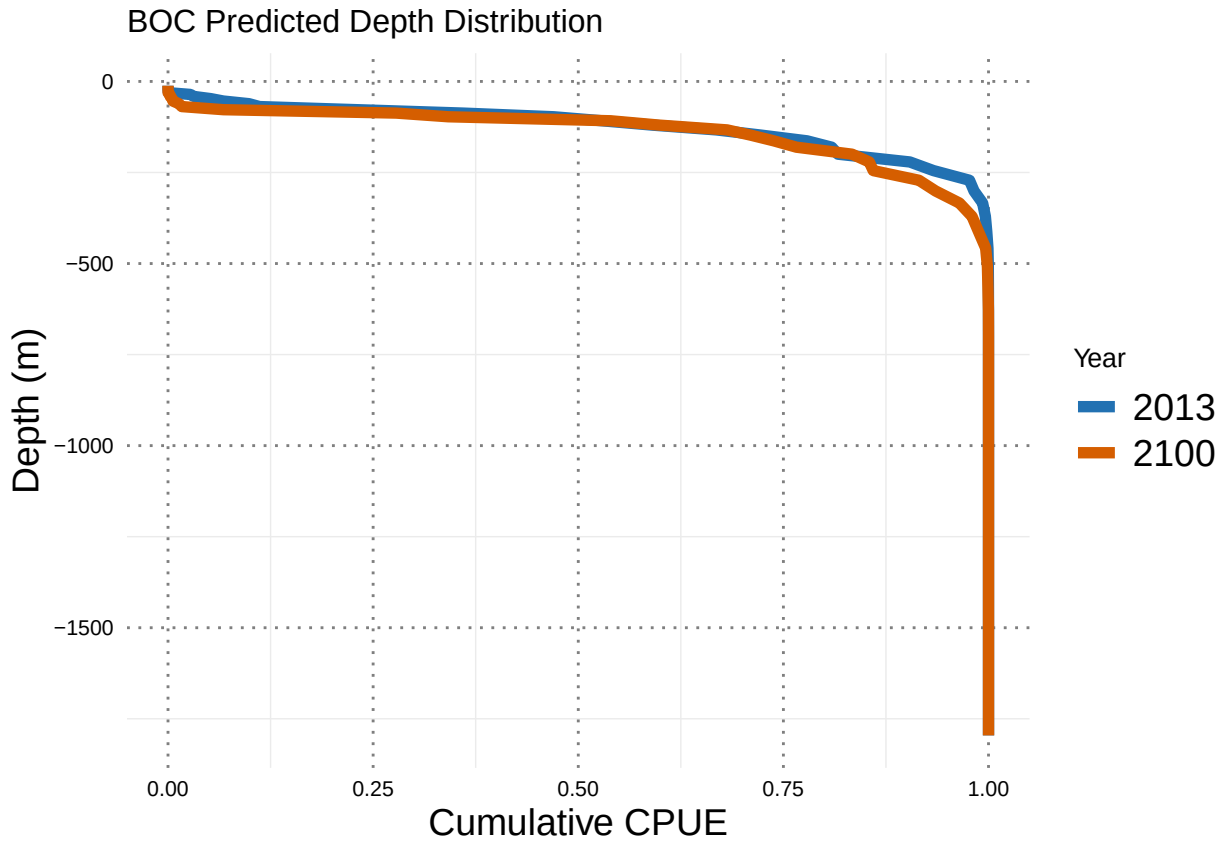
term	estimate	std.error
(Intercept)	-6.746	4.806
s(mean_temp_roms_30_norm).1	12.090	1.686
s(mean_temp_roms_30_norm).2	4.938	0.743
s(mean_oxygen_roms_30_norm).1	2.362	1.517
s(mean_oxygen_roms_30_norm).2	0.333	0.385

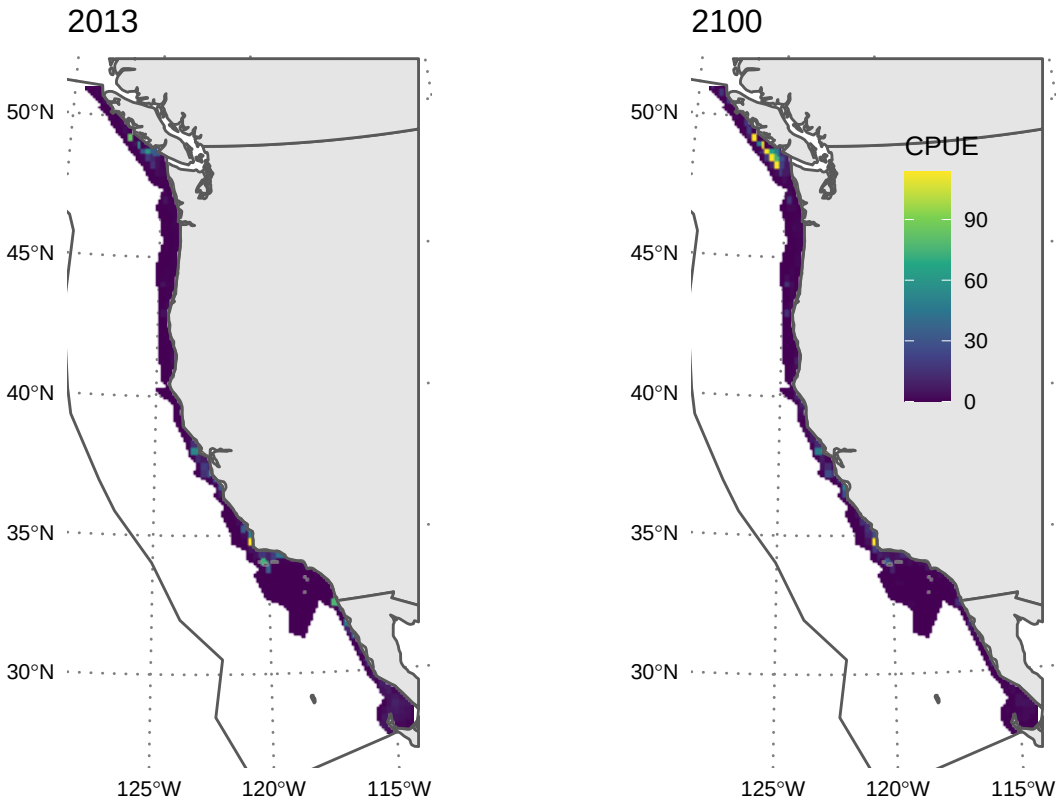

BOC Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025


Center of Gravity, X
Eastings (km)
600
500
400
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
5000
4800
4600
4400
2025
2050
2075
2100
Year


BOC
300
200
100
0
5
10
15
20


BOC Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
2100
CPUE
90
60
30
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

BRF: Black Rockfish

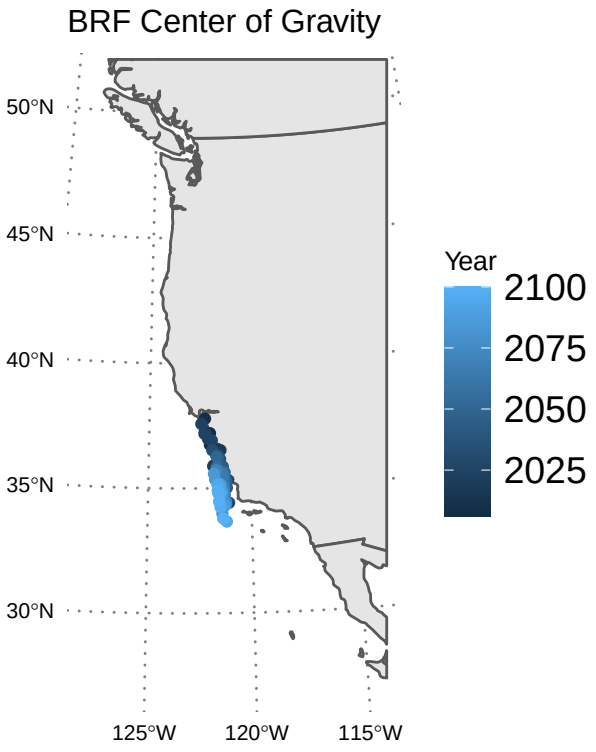
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
BRF	FALSE	FALSE	0	0	2.828
BRF	FALSE	TRUE	0	0	2.828
BRF	TRUE	FALSE	1	0	2.828
BRF	TRUE	TRUE	0	0	0.857

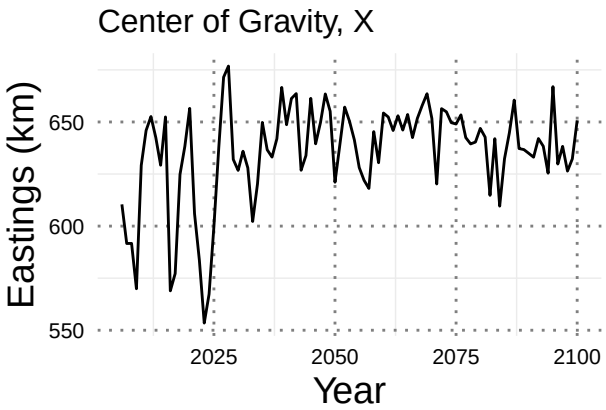
term	estimate	std.error
(Intercept)	-14.149	8.547
mean_temp_roms_30_norm	0.721	3.322
I(mean_temp_roms_30_norm^2)	-0.404	1.464
mean_oxygen_roms_30_norm	25.384	17.582
I(mean_oxygen_roms_30_norm^2)	-12.173	8.838

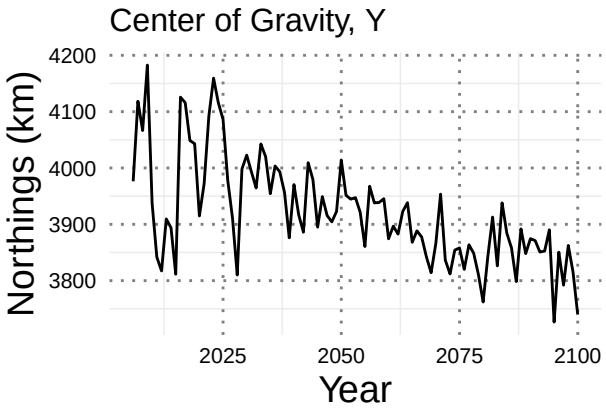
term	estimate	std.error
(Intercept)	-26.845	16.063
s(mean_temp_roms_30_norm).1	5.441	8.718
s(mean_temp_roms_30_norm).2	1.687	3.195
s(mean_oxygen_roms_30_norm).1	56.433	39.993
s(mean_oxygen_roms_30_norm).2	9.401	6.307

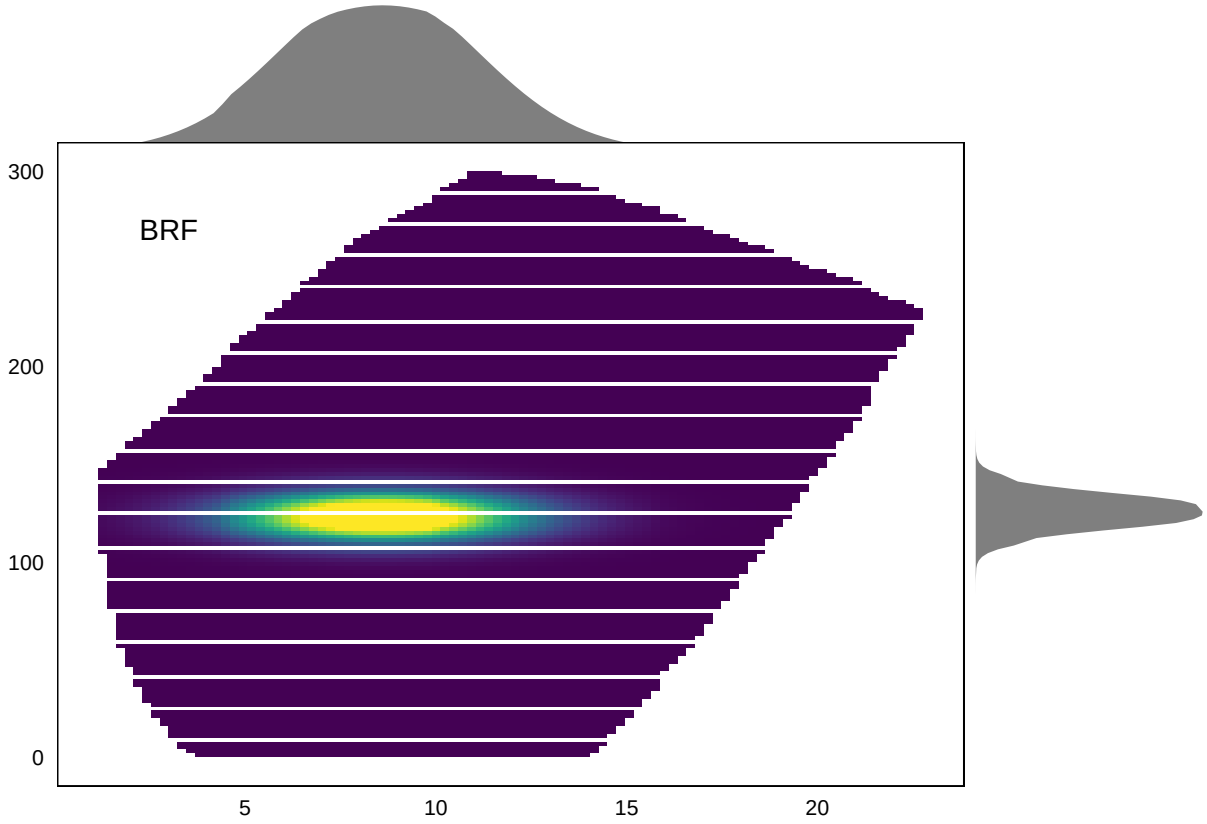
term	estimate	std.error
(Intercept)	-14.149	8.548
mean_temp_roms_30_norm	0.721	3.322
I(mean_temp_roms_30_norm^2)	-0.404	1.465
mean_oxygen_roms_30_norm	25.384	17.588
I(mean_oxygen_roms_30_norm^2)	-12.173	8.841

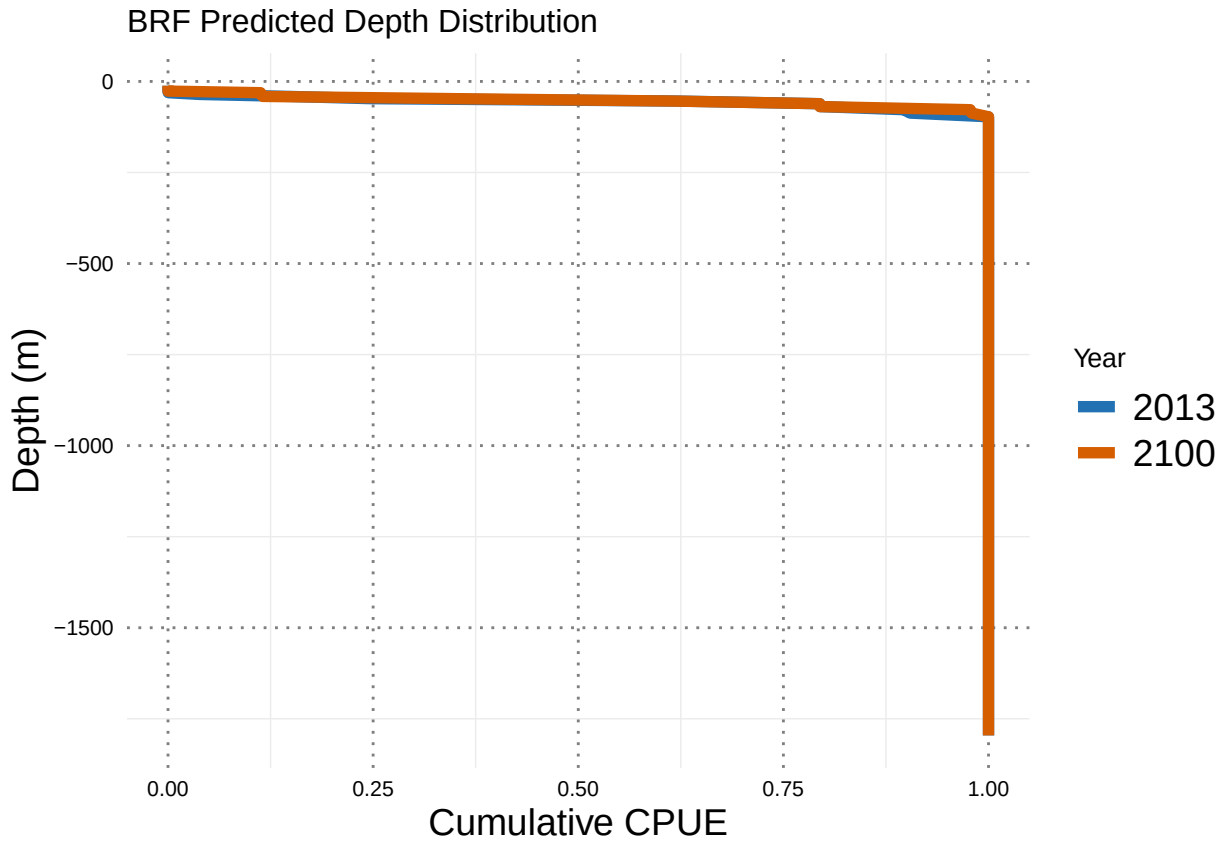
term	estimate	std.error
(Intercept)	-26.835	16.056
s(mean_temp_roms_30_norm).1	5.441	8.718
s(mean_temp_roms_30_norm).2	1.687	3.195
s(mean_oxygen_roms_30_norm).1	56.407	39.976
s(mean_oxygen_roms_30_norm).2	9.397	6.304

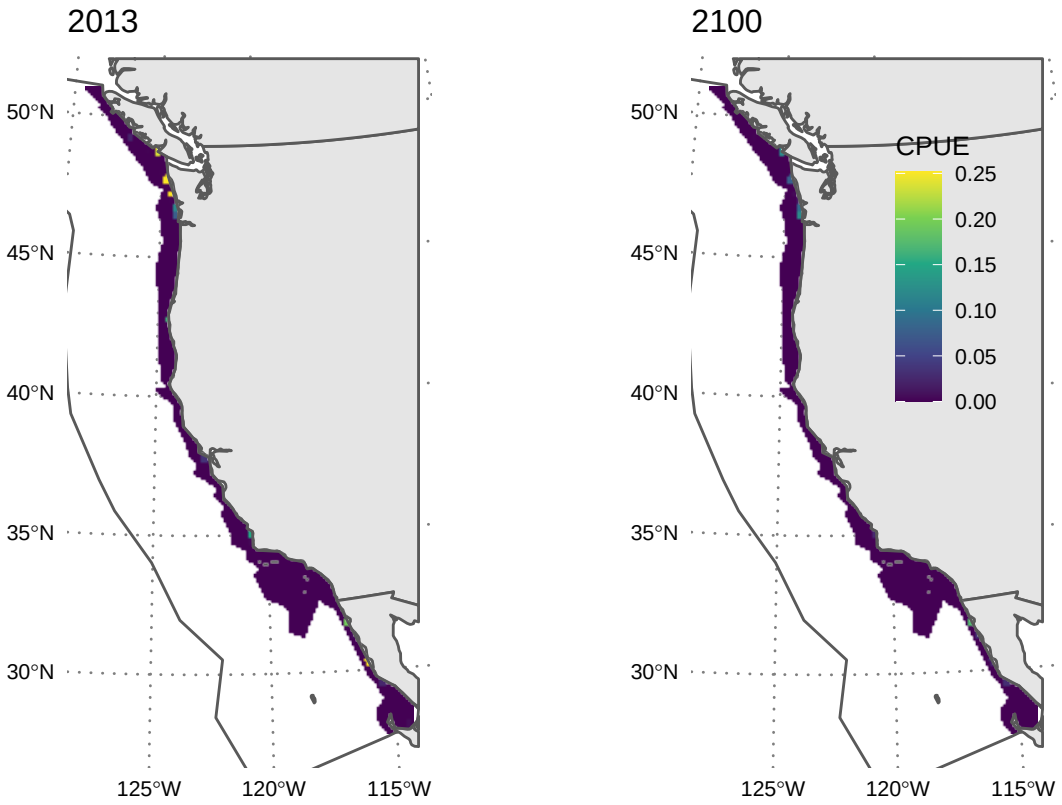

BRF Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025


Center of Gravity, X
Eastings (km)
650
600
550
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
4200
4100
4000
3900
3800
2025
2050
2075
2100
Year


BRF
300
200
100
0
5
10
15
20


BRF Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
2100
CPUE
0.25
0.20
0.15
0.10
0.05
0.00
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

DAR: Darkblotched Rockfish

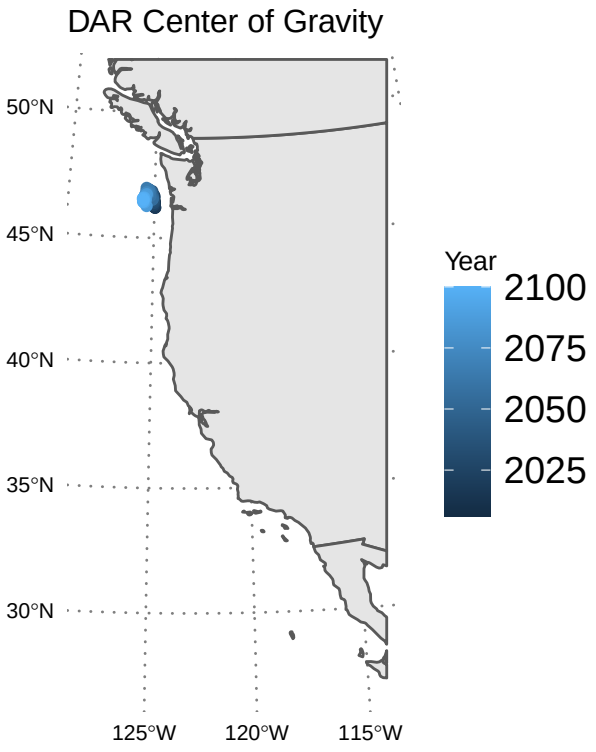
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
DAR	FALSE	FALSE	0.317	0	2.828
DAR	FALSE	TRUE	0.000	0	2.828
DAR	TRUE	FALSE	0.683	0	120.254
DAR	TRUE	TRUE	0.000	0	113.097

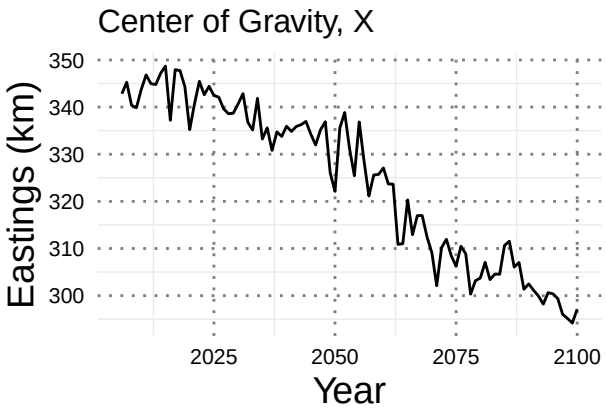
term	estimate	std.error
(Intercept)	6.462	0.076
mean_temp_roms_30_norm	-0.316	0.201
I(mean_temp_roms_30_norm^2)	-3.456	0.178
mean_oxygen_roms_30_norm	2.097	0.171
I(mean_oxygen_roms_30_norm^2)	-1.988	0.093

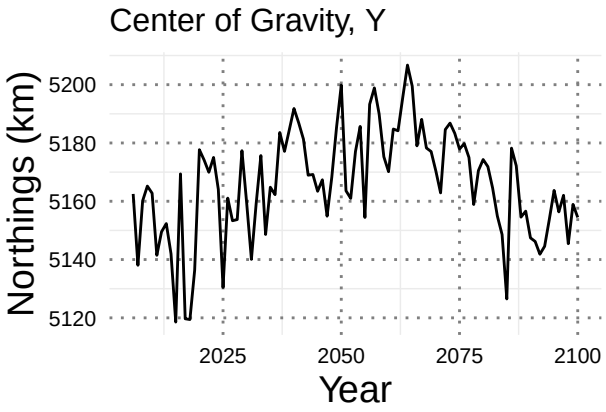
term	estimate	std.error
(Intercept)	1.449	0.121
s(mean_temp_roms_30_norm).1	13.957	0.680
s(mean_temp_roms_30_norm).2	-2.466	0.141
s(mean_oxygen_roms_30_norm).1	10.056	0.494
s(mean_oxygen_roms_30_norm).2	-0.805	0.104

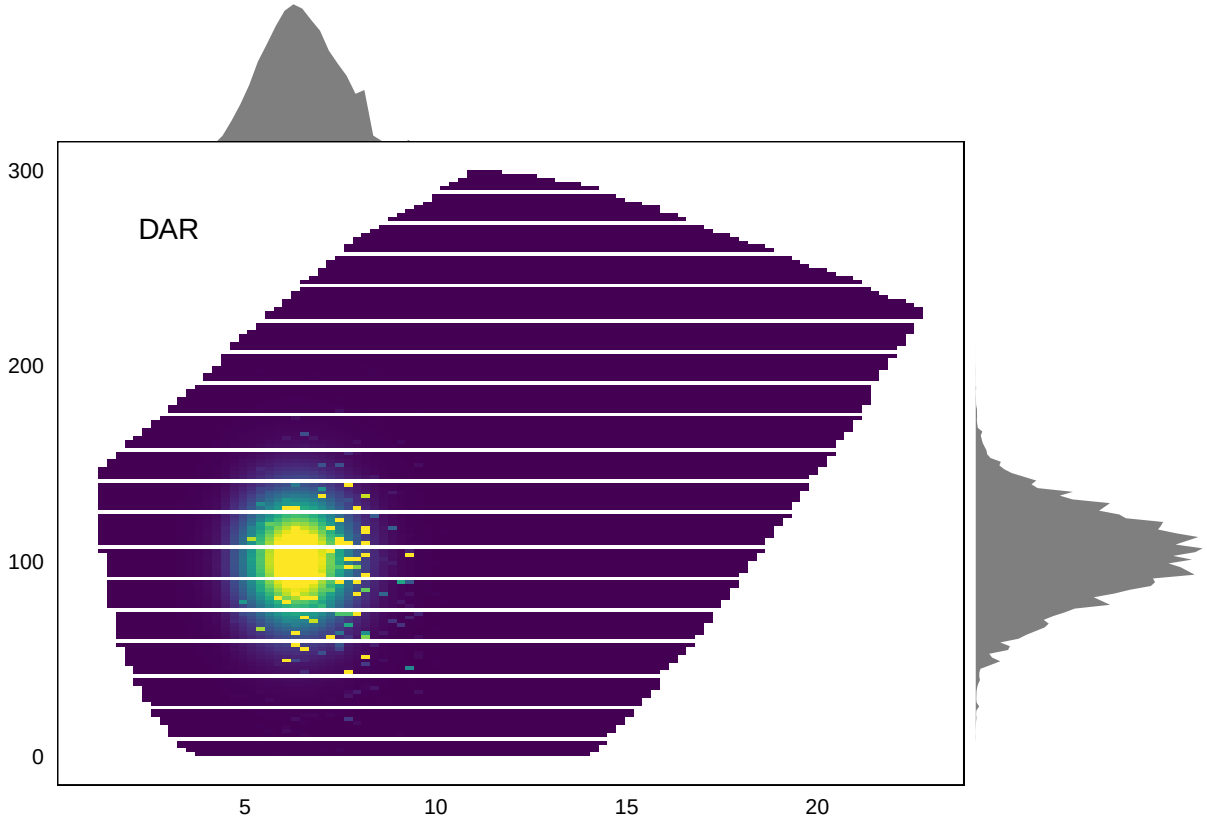
term	estimate	std.error
(Intercept)	0.310	1.598
mean_temp_roms_30_norm	2.350	0.326
I(mean_temp_roms_30_norm^2)	-4.184	0.232
mean_oxygen_roms_30_norm	1.025	0.320
I(mean_oxygen_roms_30_norm^2)	-1.462	0.155

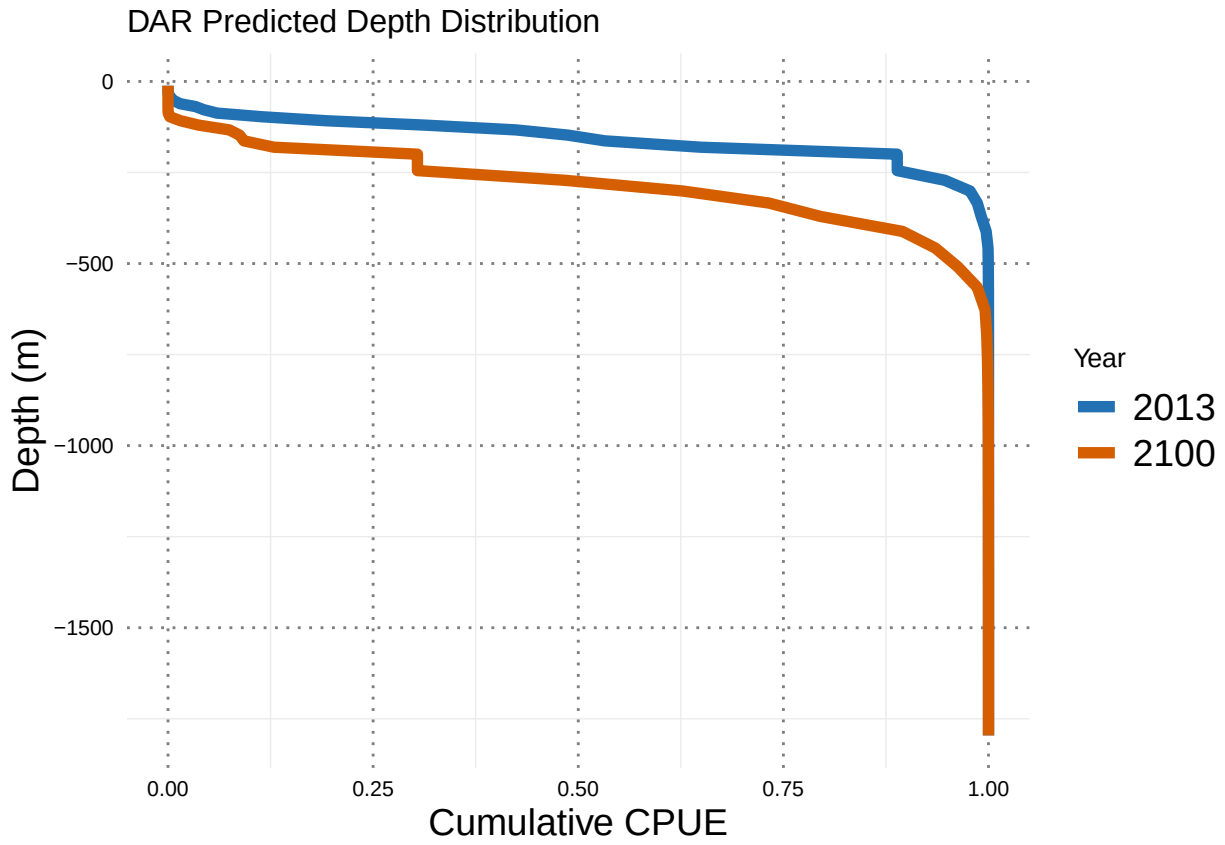
term	estimate	std.error
(Intercept)	-4.870	1.524
s(mean_temp_roms_30_norm).1	16.565	0.891
s(mean_temp_roms_30_norm).2	-0.290	0.276
s(mean_oxygen_roms_30_norm).1	7.178	0.782
s(mean_oxygen_roms_30_norm).2	-1.075	0.231

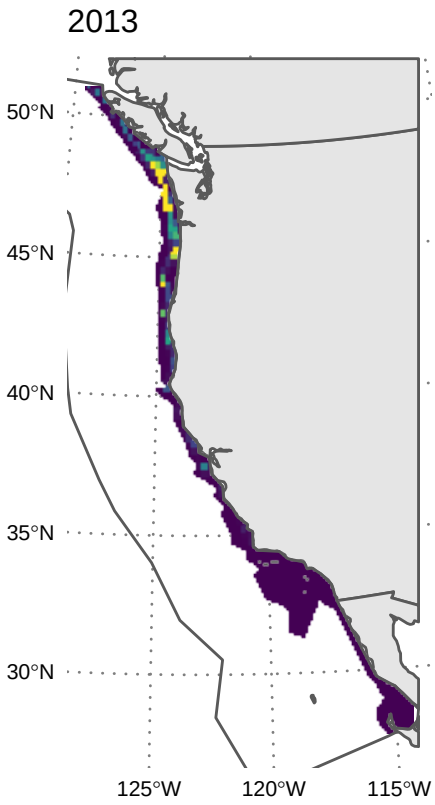

DAR Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025

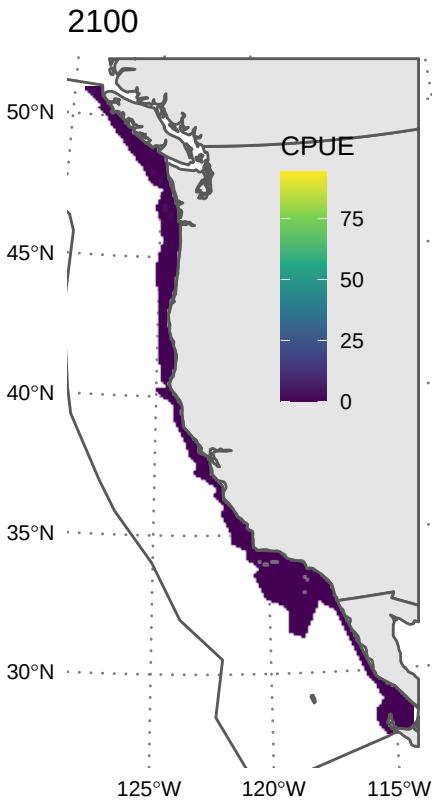

Center of Gravity, X
Eastings (km)
350
340
330
320
310
300
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
5200
5180
5160
5140
5120
2025
2050
2075
2100
Year


DAR
300
200
100
0
5
10
15
20


DAR Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W


2100
CPUE
75
50
25
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

FBP: Deep Vertical Migrators

Lanternfish, California smoothtongue, Argentina sialis

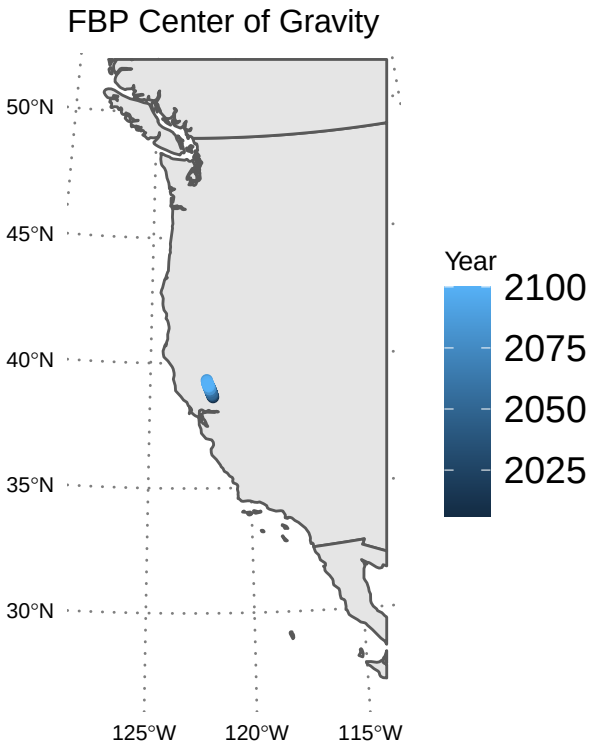
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
FBP	FALSE	FALSE	0.598	0	2.828
FBP	FALSE	TRUE	0.272	0	2.828
FBP	TRUE	FALSE	0.129	0	30.364
FBP	TRUE	TRUE	0.000	0	29.893

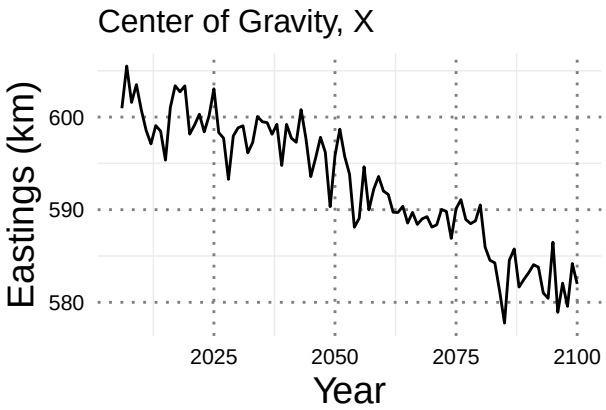
term	estimate	std.error
(Intercept)	-2.051	0.096
mean_temp_roms_30_norm	-0.331	0.146
I(mean_temp_roms_30_norm^2)	-0.309	0.077
mean_oxygen_roms_30_norm	-2.082	0.175
I(mean_oxygen_roms_30_norm^2)	-0.650	0.162

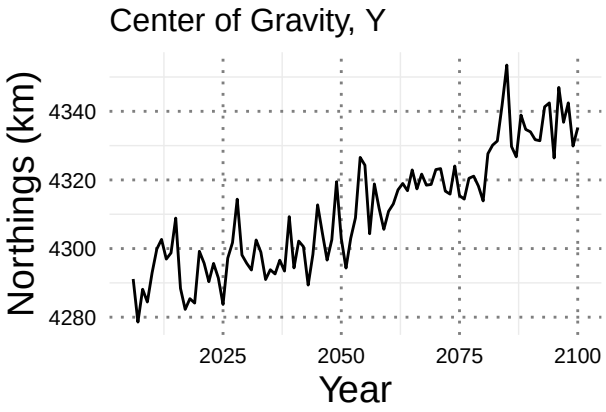
term	estimate	std.error
(Intercept)	-3.055	0.120
s(mean_temp_roms_30_norm).1	1.723	0.338
s(mean_temp_roms_30_norm).2	-0.551	0.171
s(mean_oxygen_roms_30_norm).1	2.919	0.890
s(mean_oxygen_roms_30_norm).2	-2.930	0.313

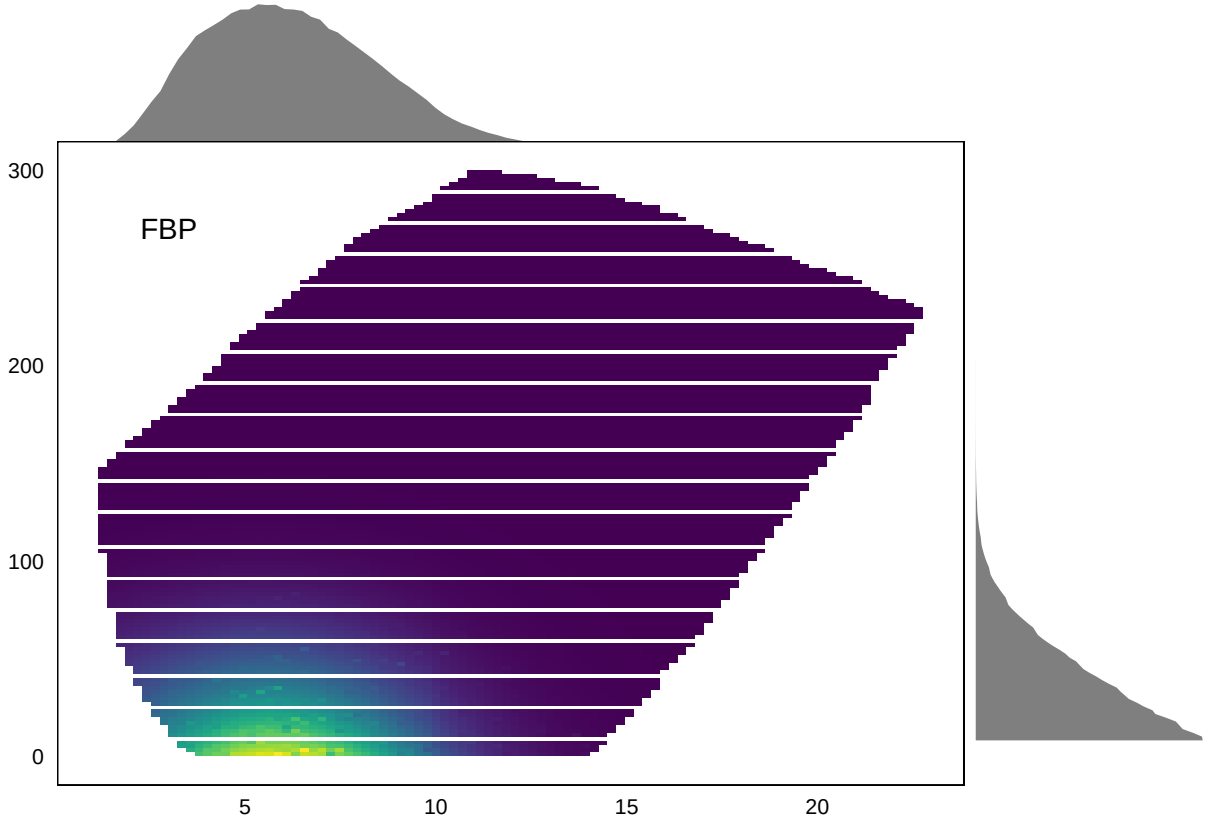
term	estimate	std.error
(Intercept)	-2.757	0.173
mean_temp_roms_30_norm	0.022	0.215
I(mean_temp_roms_30_norm^2)	-0.388	0.092
mean_oxygen_roms_30_norm	-2.372	0.240
I(mean_oxygen_roms_30_norm^2)	-0.064	0.194

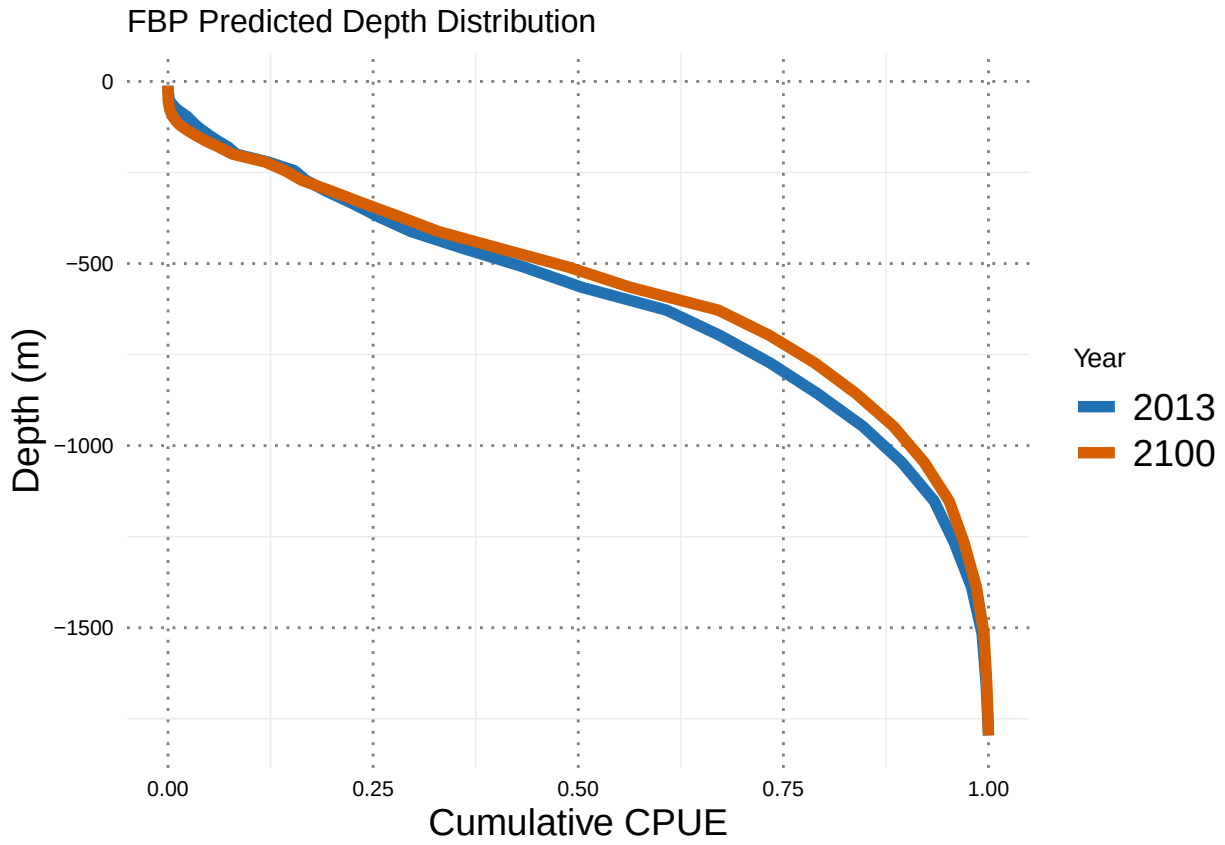
term	estimate	std.error
(Intercept)	-3.261	0.154
s(mean_temp_roms_30_norm).1	1.853	0.402
s(mean_temp_roms_30_norm).2	-0.182	0.233
s(mean_oxygen_roms_30_norm).1	-0.168	1.027
s(mean_oxygen_roms_30_norm).2	-2.416	0.329

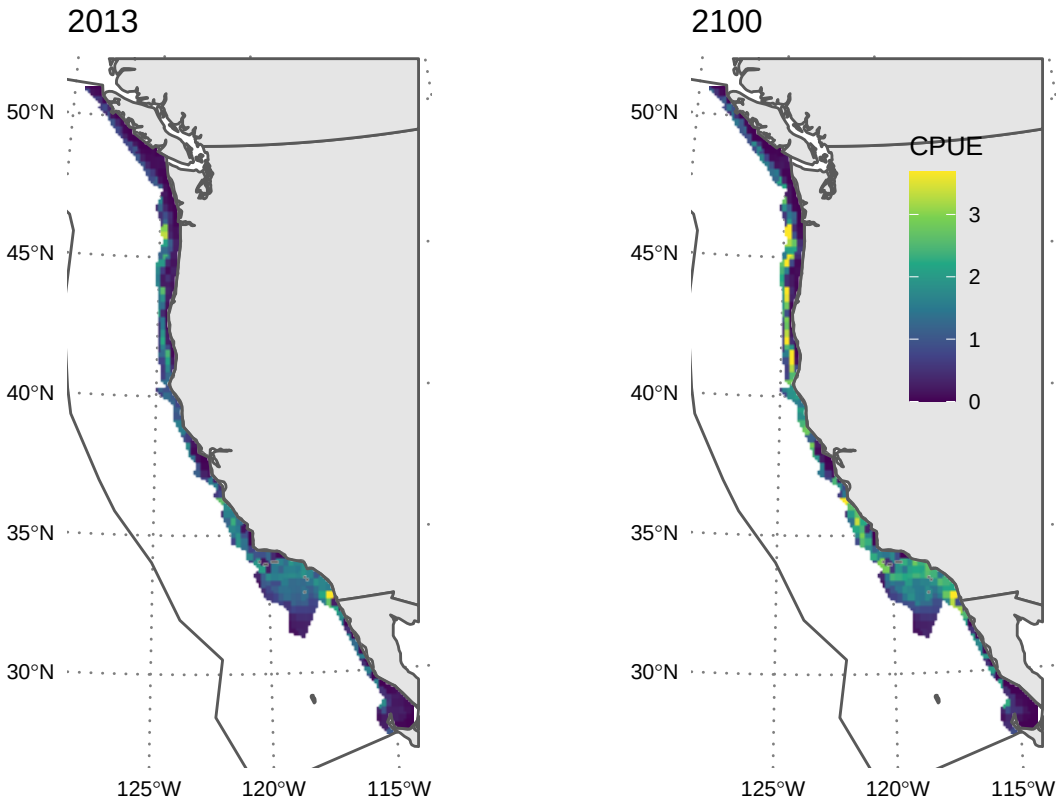

FBP Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025


Center of Gravity, X
Eastings (km)
600
590
580
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
4340
4320
4300
4280
2025
2050
2075
2100
Year


FBP
300
200
100
0
5
10
15
20


FBP Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
2100
CPUE
3
2
1
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

FDB: Shallow Small Rockfish

Gopher, greenstriped, and stripetail rockfish

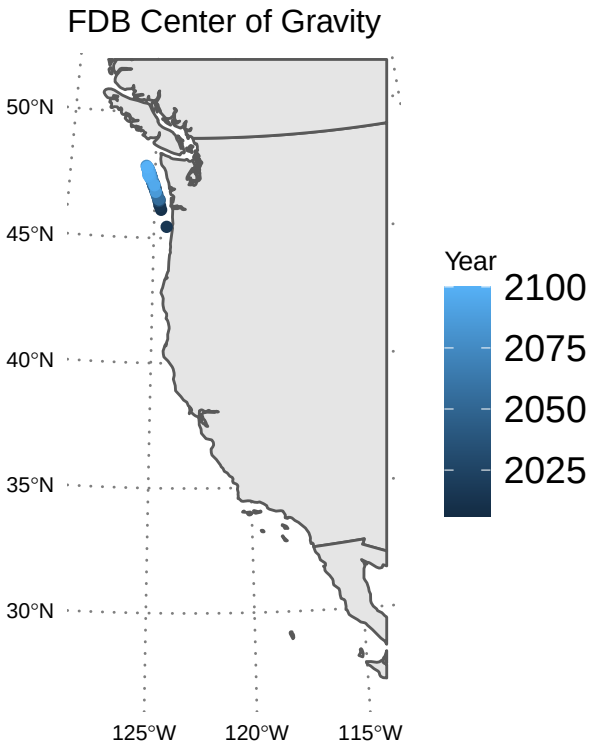
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
FDB	FALSE	FALSE	0.020	0	2.828
FDB	FALSE	TRUE	0.353	0	2.828
FDB	TRUE	FALSE	0.000	0	329.190
FDB	TRUE	TRUE	0.627	0	348.680

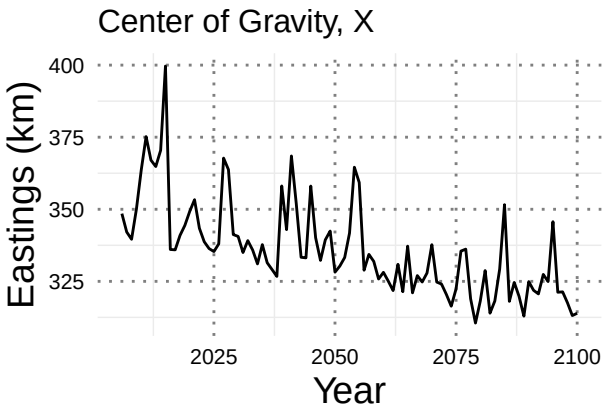
term	estimate	std.error
(Intercept)	5.539	0.065
mean_temp_roms_30_norm	3.105	0.163
I(mean_temp_roms_30_norm^2)	-1.650	0.079
mean_oxygen_roms_30_norm	1.873	0.144
I(mean_oxygen_roms_30_norm^2)	-1.269	0.086

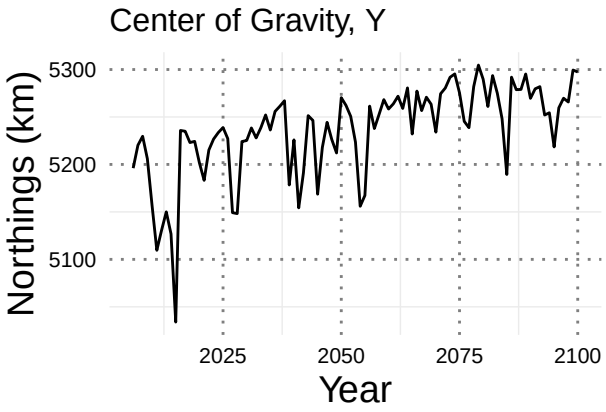
term	estimate	std.error
(Intercept)	2.203	0.119
s(mean_temp_roms_30_norm).1	9.625	0.391
s(mean_temp_roms_30_norm).2	2.393	0.124
s(mean_oxygen_roms_30_norm).1	6.036	0.415
s(mean_oxygen_roms_30_norm).2	0.047	0.077

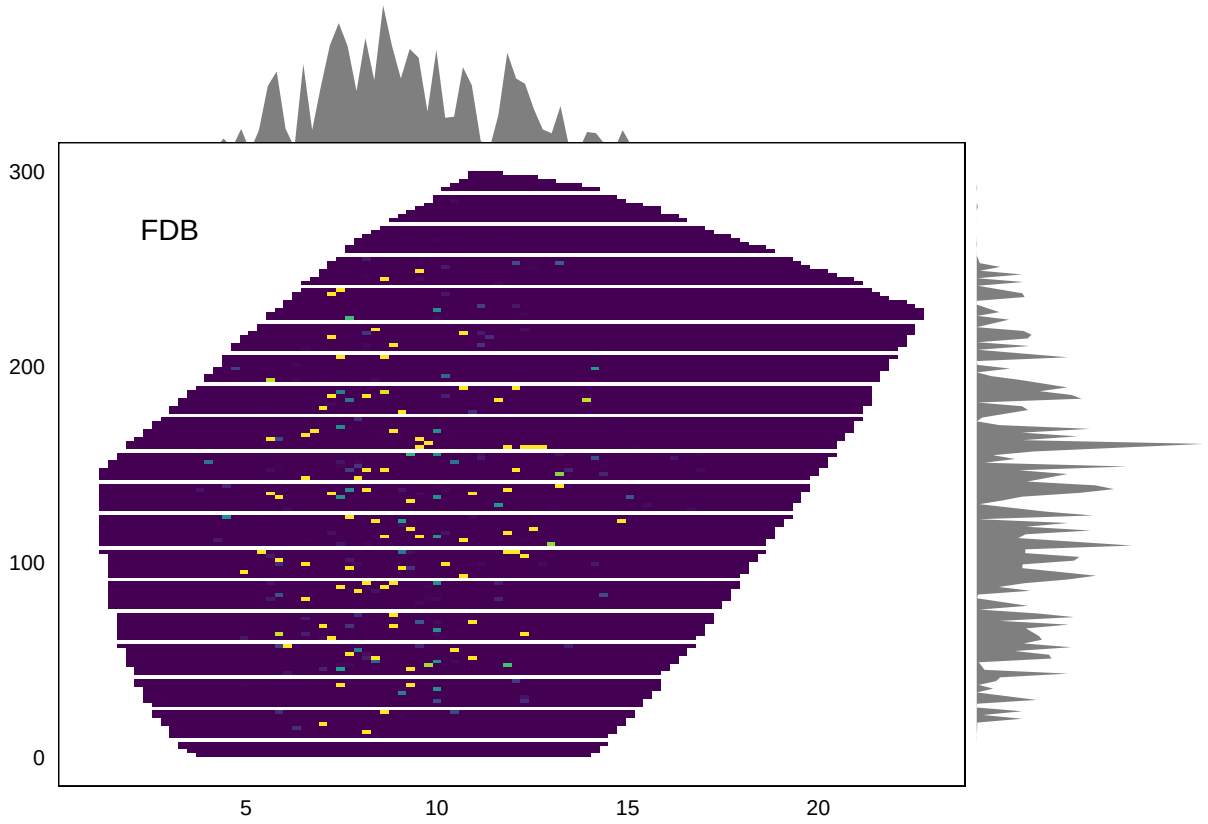
term	estimate	std.error
(Intercept)	-6.722	8.172
mean_temp_roms_30_norm	4.402	0.248
I(mean_temp_roms_30_norm^2)	-2.232	0.111
mean_oxygen_roms_30_norm	2.639	0.222
I(mean_oxygen_roms_30_norm^2)	-1.358	0.104

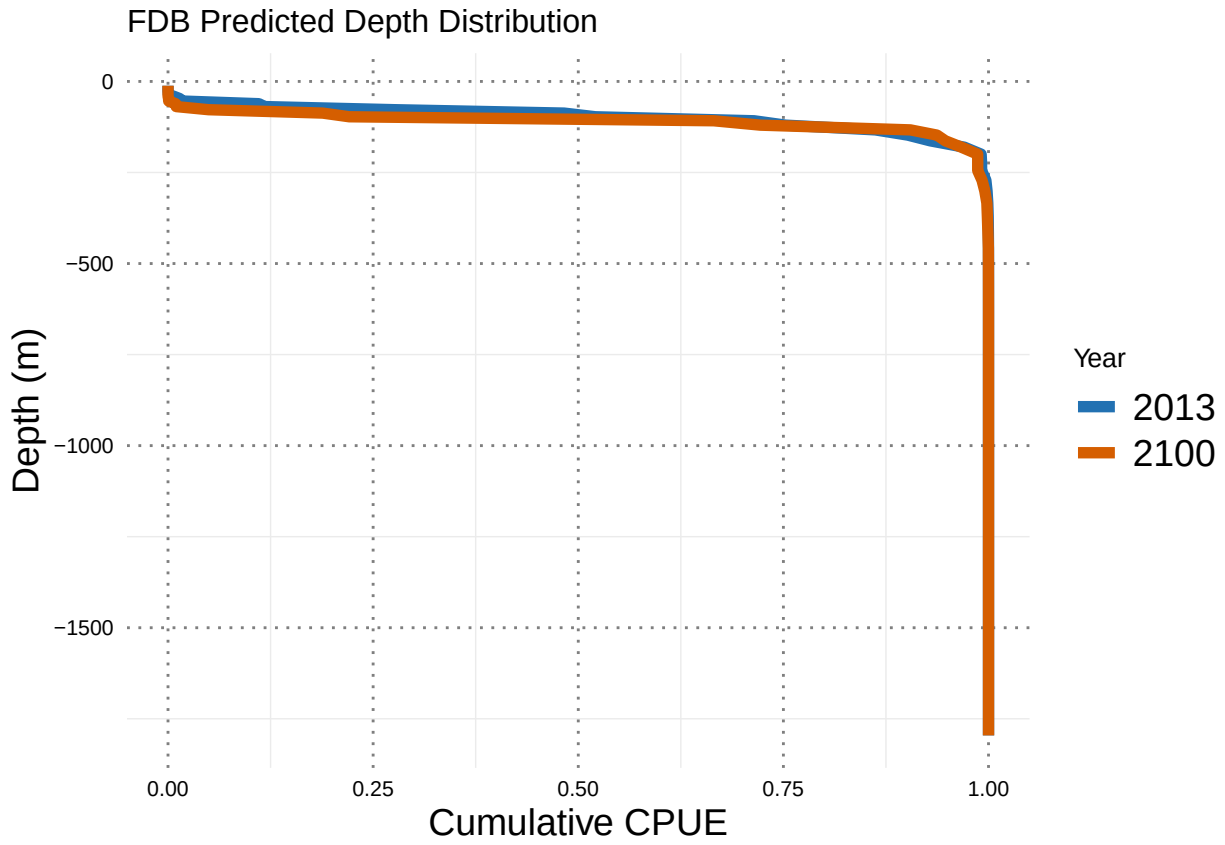
term	estimate	std.error
(Intercept)	-9.967	8.211
s(mean_temp_roms_30_norm).1	12.235	0.525
s(mean_temp_roms_30_norm).2	3.291	0.197
s(mean_oxygen_roms_30_norm).1	6.777	0.509
s(mean_oxygen_roms_30_norm).2	0.752	0.137

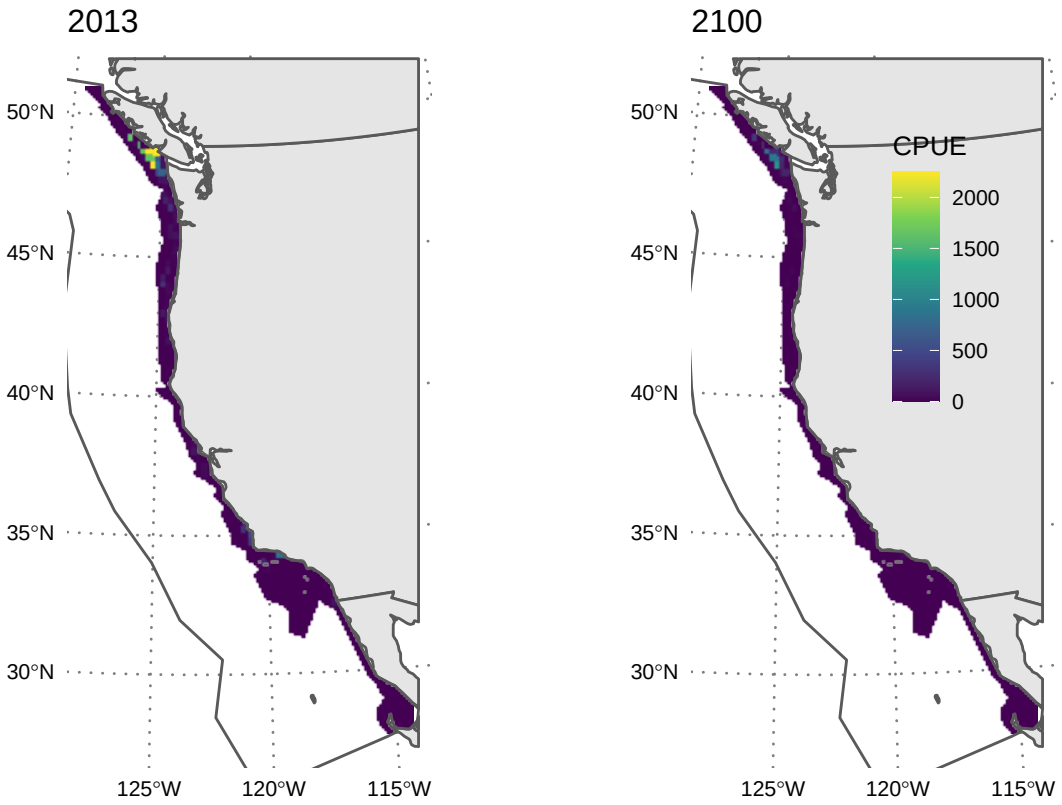

FDB Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025


Center of Gravity, X
Eastings (km)
400
375
350
325
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
5300
5200
5100
2025
2050
2075
2100
Year


FDB
300
200
100
0
5
10
15
20


FDB Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
2100
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
CPUE
2000
1500
1000
500
0

FDC: Deep Small Rockfish

Aurora, sharpchin, and splitnose rockfish, and longspine thornyhead

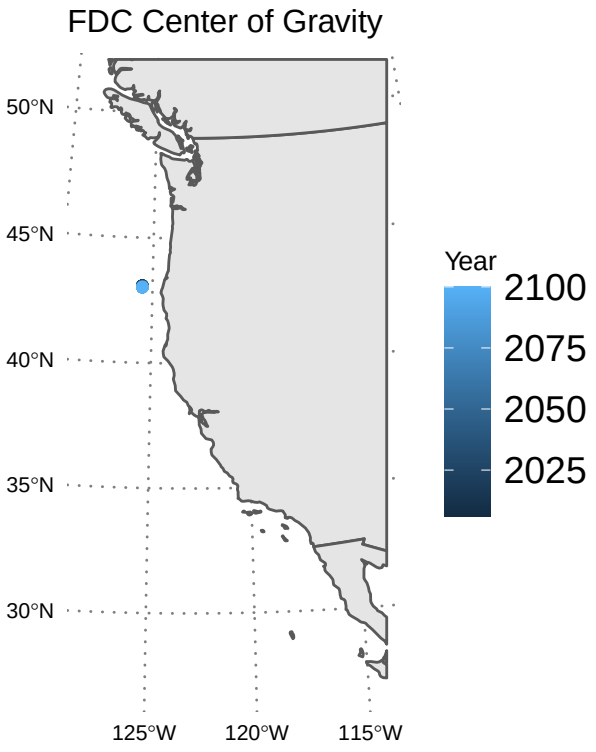
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
FDC	FALSE	FALSE	0.109	0	2.828
FDC	FALSE	TRUE	0.048	0	2.828
FDC	TRUE	FALSE	0.016	0	241.855
FDC	TRUE	TRUE	0.827	0	251.154

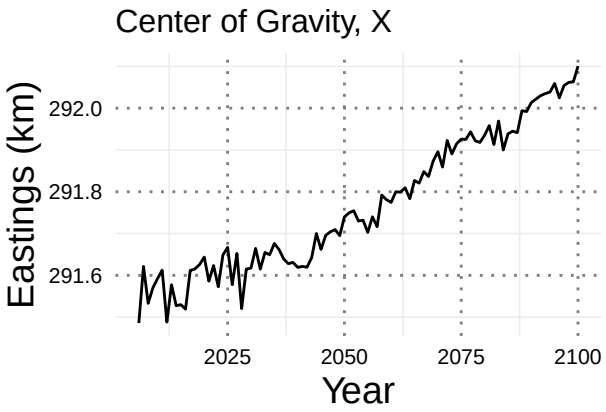
term	estimate	std.error
(Intercept)	8.107	0.042
mean_temp_roms_30_norm	-1.499	0.074
I(mean_temp_roms_30_norm^2)	-0.455	0.041
mean_oxygen_roms_30_norm	-0.253	0.082
I(mean_oxygen_roms_30_norm^2)	-1.445	0.056

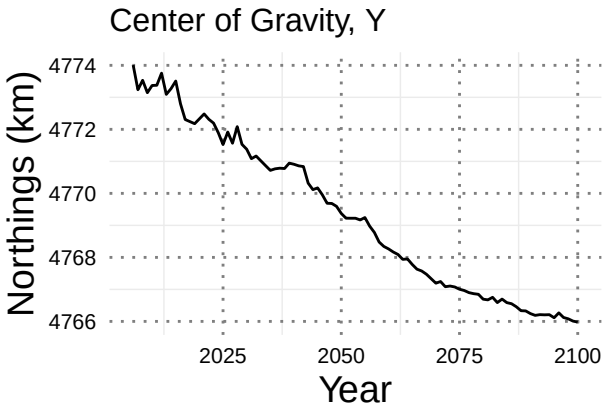
term	estimate	std.error
(Intercept)	6.093	0.035
s(mean_temp_roms_30_norm).1	2.679	0.185
s(mean_temp_roms_30_norm).2	-1.851	0.074
s(mean_oxygen_roms_30_norm).1	7.513	0.317
s(mean_oxygen_roms_30_norm).2	-2.423	0.078

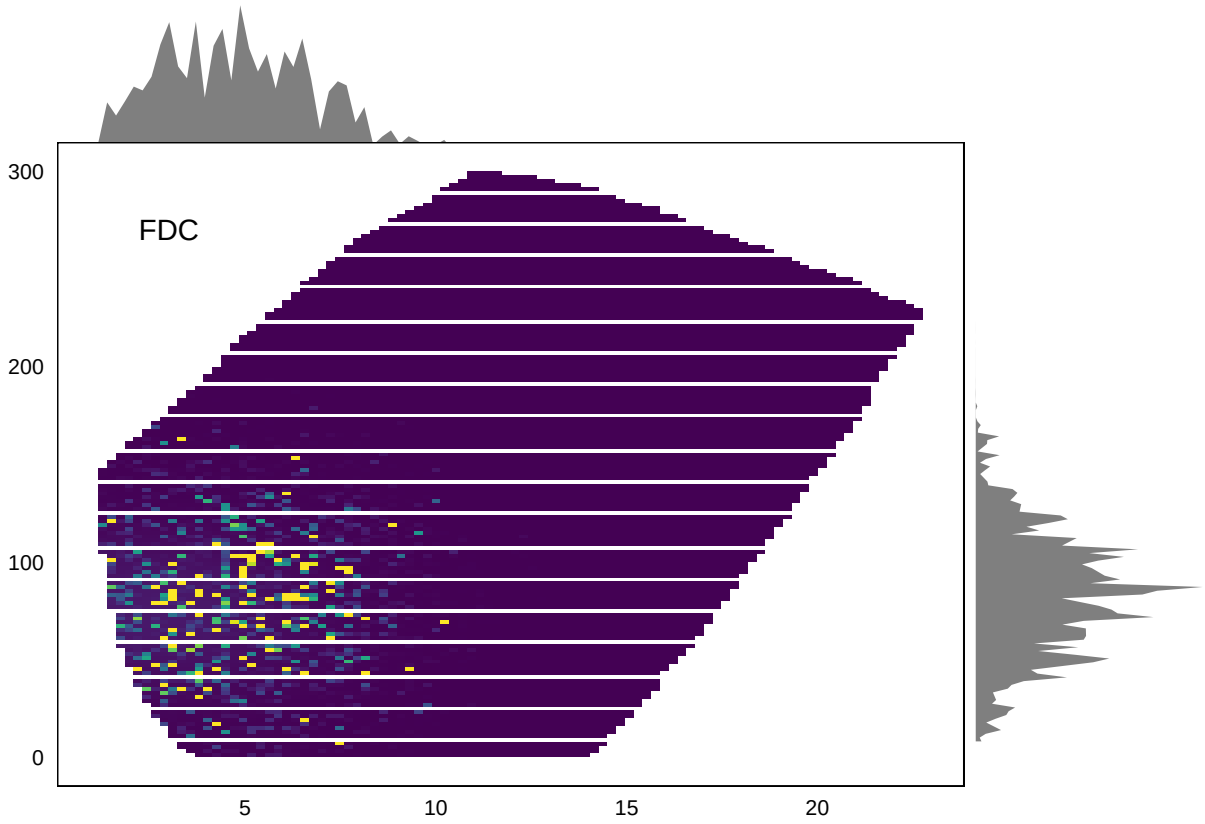
term	estimate	std.error
(Intercept)	4.074	2.732
mean_temp_roms_30_norm	-1.124	0.145
I(mean_temp_roms_30_norm^2)	-0.668	0.065
mean_oxygen_roms_30_norm	0.105	0.147
I(mean_oxygen_roms_30_norm^2)	-1.264	0.088

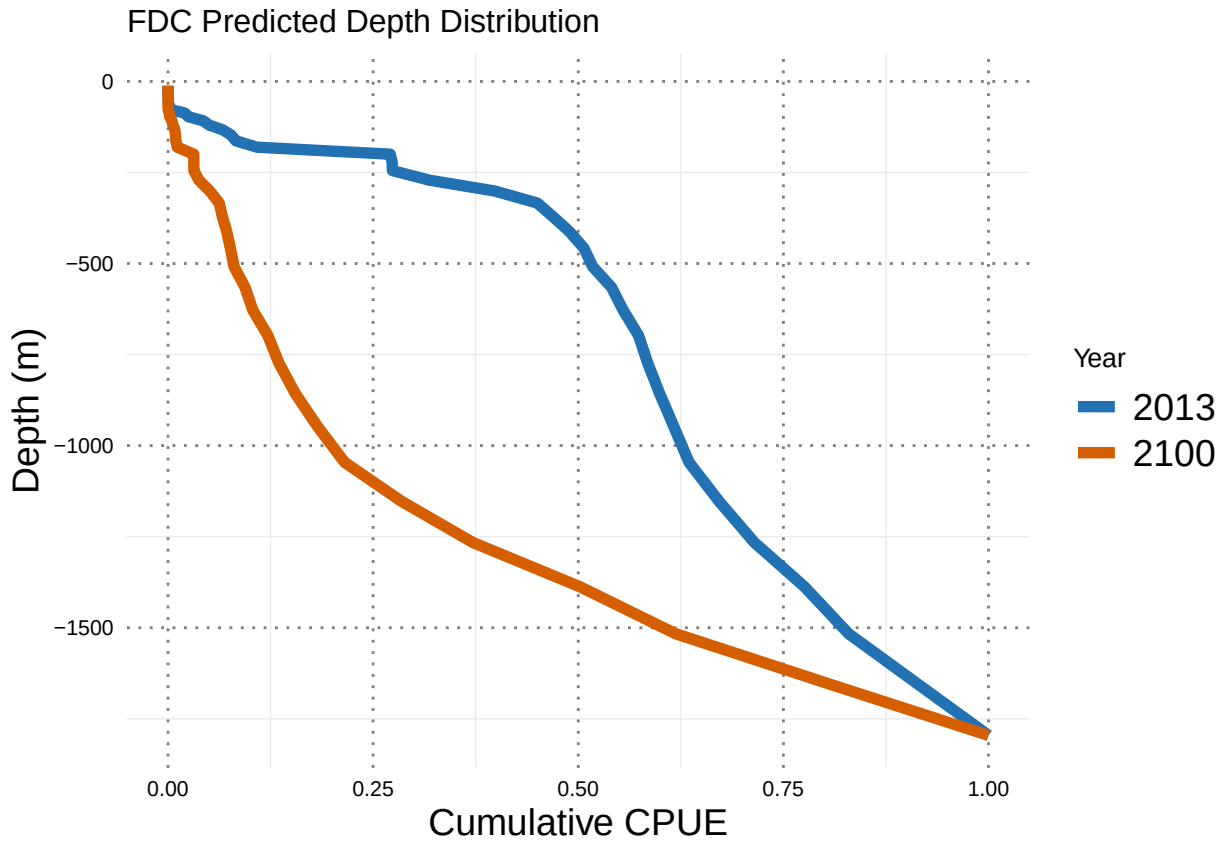
term	estimate	std.error
(Intercept)	2.020	2.768
s(mean_temp_roms_30_norm).1	3.857	0.287
s(mean_temp_roms_30_norm).2	-1.825	0.152
s(mean_oxygen_roms_30_norm).1	7.104	0.461
s(mean_oxygen_roms_30_norm).2	-1.801	0.156

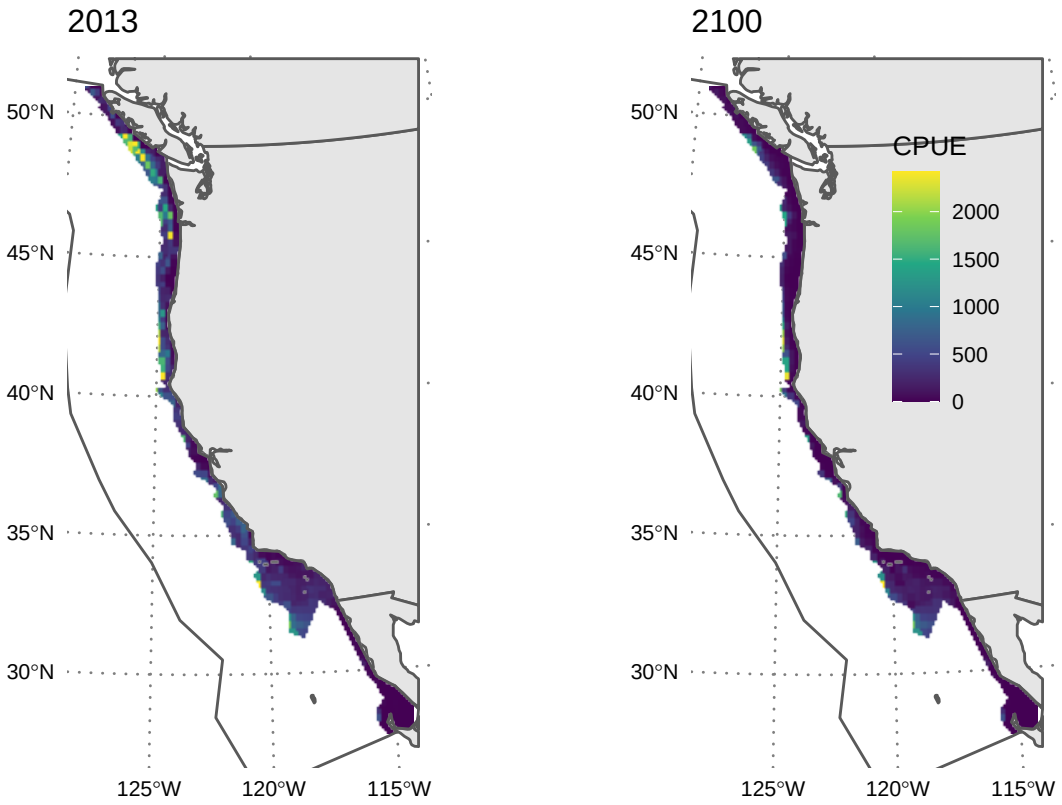

FDC Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025


Center of Gravity, X
Eastings (km)
292.0
291.8
291.6
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
4774
4772
4770
4768
4766
2025
2050
2075
2100
Year


FDC
300
200
100
0
5
10
15
20


FDC Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
2100
CPUE
2000
1500
1000
500
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

FDD: Deep Demersal Fish

Eelpouts, slickheads, and grenadiers.

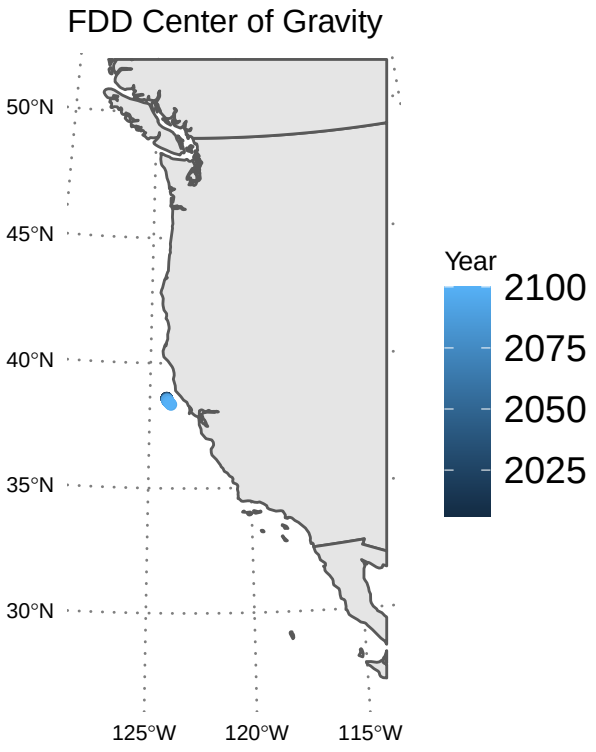
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
FDD	FALSE	FALSE	0.237	0	2.828
FDD	FALSE	TRUE	0.139	0	2.828
FDD	TRUE	FALSE	0.384	0	61.521
FDD	TRUE	TRUE	0.240	0	65.626

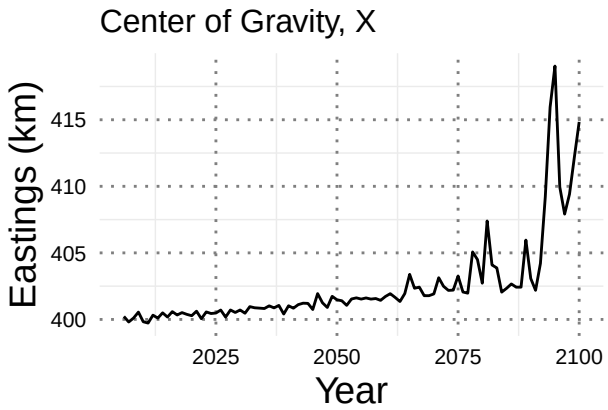
term	estimate	std.error
(Intercept)	4.672	0.039
mean_temp_roms_30_norm	-1.547	0.059
I(mean_temp_roms_30_norm^2)	0.542	0.024
mean_oxygen_roms_30_norm	-0.196	0.075
I(mean_oxygen_roms_30_norm^2)	-0.422	0.036

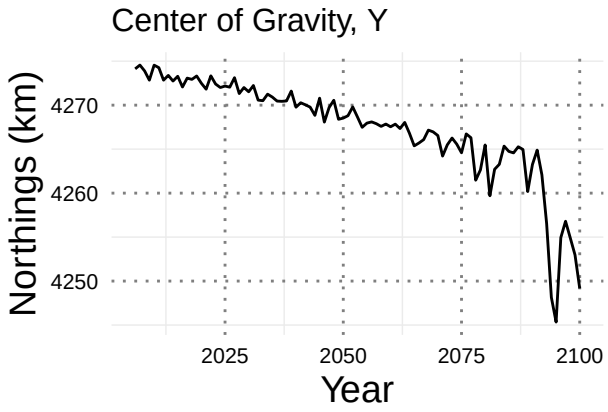
term	estimate	std.error
(Intercept)	4.755	0.024
s(mean_temp_roms_30_norm).1	-2.333	0.112
s(mean_temp_roms_30_norm).2	-1.213	0.059
s(mean_oxygen_roms_30_norm).1	2.246	0.207
s(mean_oxygen_roms_30_norm).2	-0.802	0.048

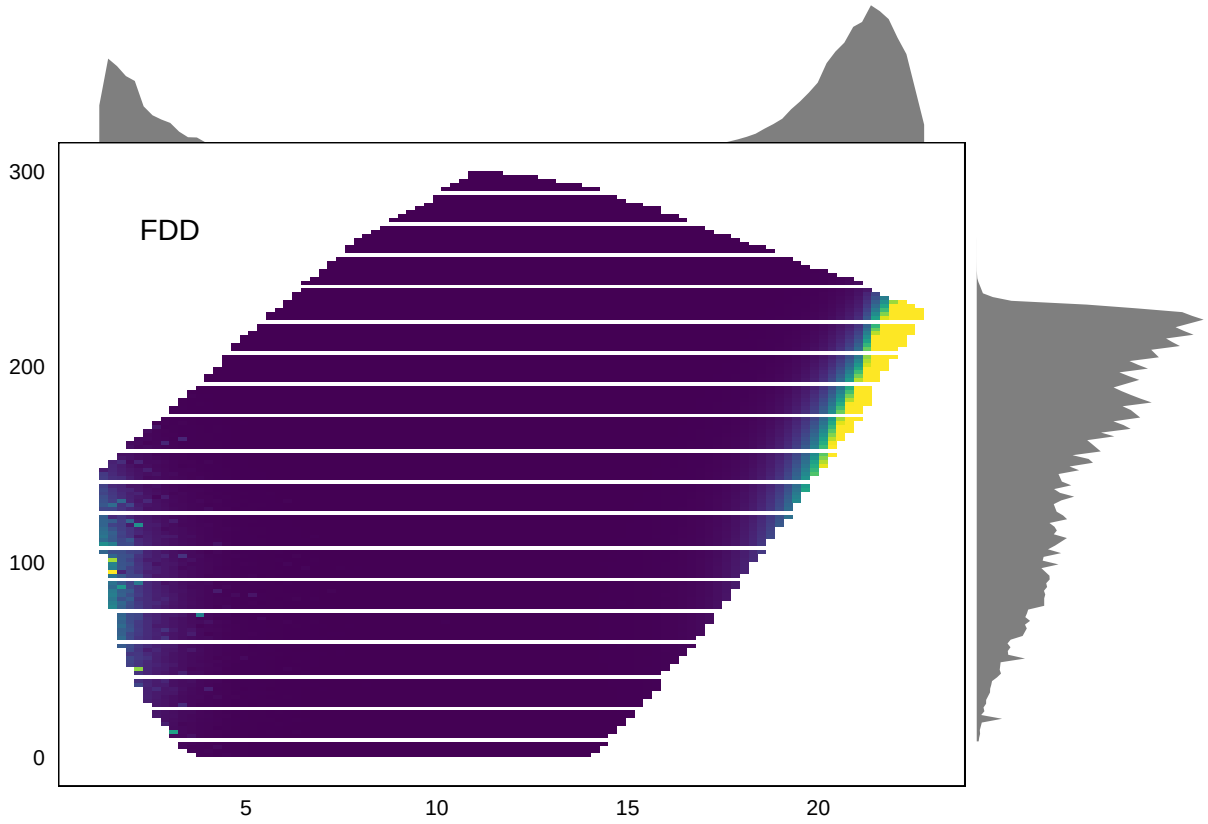
term	estimate	std.error
(Intercept)	4.597	0.233
mean_temp_roms_30_norm	-1.913	0.103
I(mean_temp_roms_30_norm^2)	0.389	0.037
mean_oxygen_roms_30_norm	-0.151	0.118
I(mean_oxygen_roms_30_norm^2)	-0.452	0.044

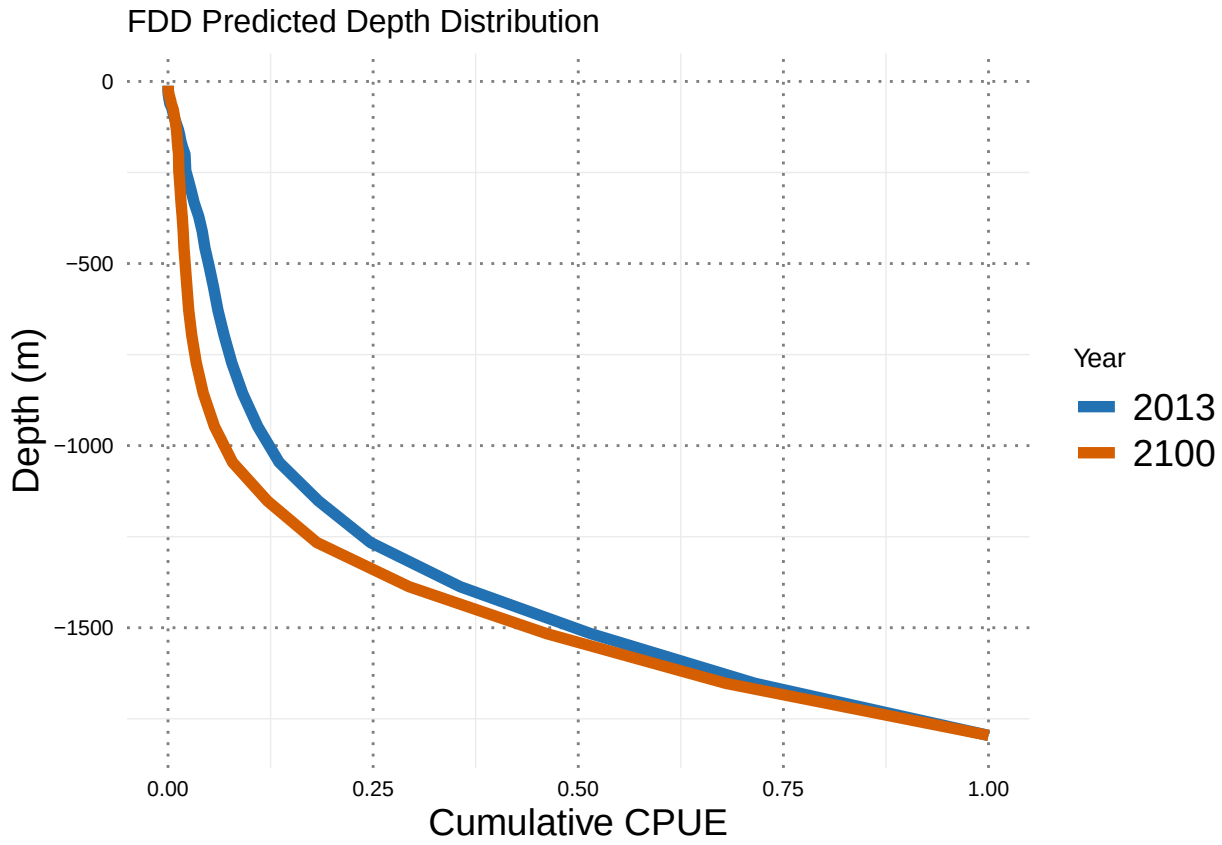
term	estimate	std.error
(Intercept)	4.556	0.249
s(mean_temp_roms_30_norm).1	-1.490	0.172
s(mean_temp_roms_30_norm).2	-1.719	0.106
s(mean_oxygen_roms_30_norm).1	2.470	0.252
s(mean_oxygen_roms_30_norm).2	-0.774	0.100

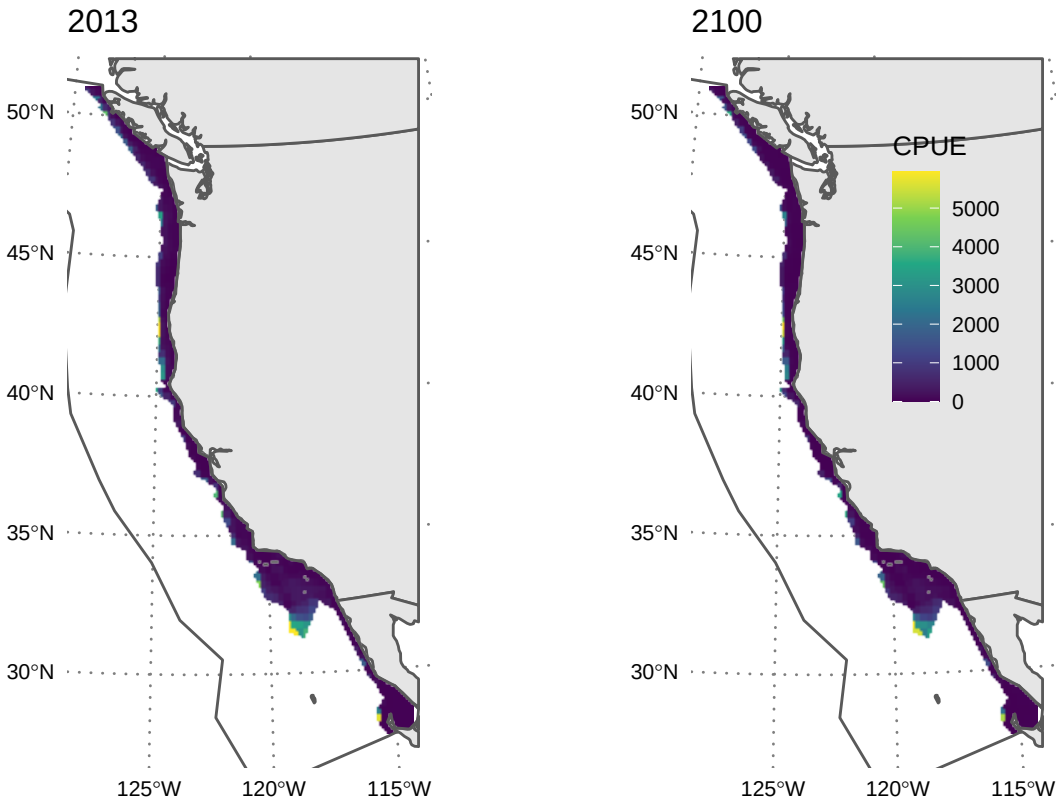

FDD Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025


Center of Gravity, X
Eastings (km)
415
410
405
400
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
4270
4260
4250
2025
2050
2075
2100
Year


FDD
300
200
100
0
5
10
15
20


FDD Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
2100
CPUE
5000
4000
3000
2000
1000
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

FDE: Shallow Miscellaneous Fish

White croaker, plainfin midshipman, and threadfin sculpin

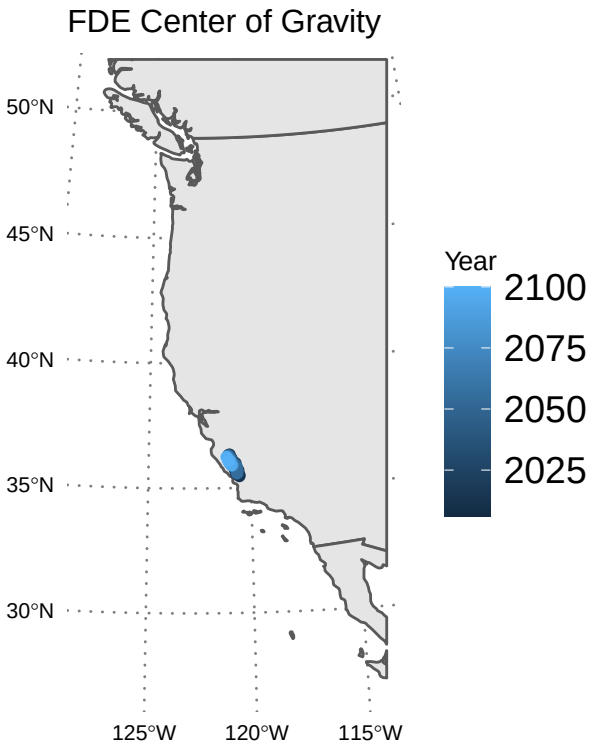
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
FDE	FALSE	FALSE	0.184	0	2.828
FDE	FALSE	TRUE	0.000	0	2.828
FDE	TRUE	FALSE	0.121	0	315.319
FDE	TRUE	TRUE	0.695	0	270.257

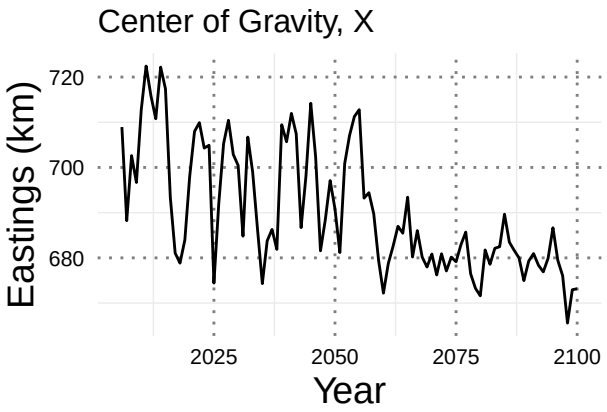
term	estimate	std.error
(Intercept)	-1.794	0.182
mean_temp_roms_30_norm	9.165	0.359
I(mean_temp_roms_30_norm^2)	-2.250	0.126
mean_oxygen_roms_30_norm	-1.215	0.254
I(mean_oxygen_roms_30_norm^2)	0.292	0.104

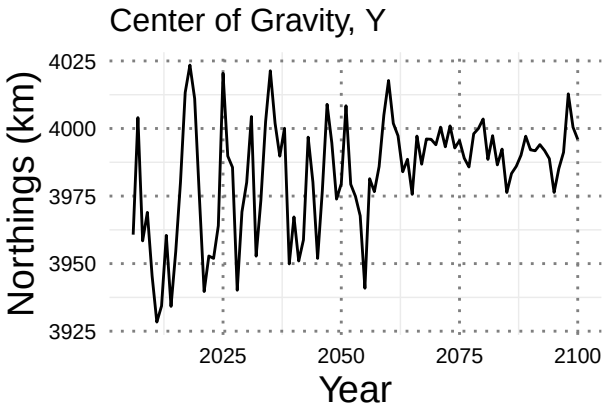
term	estimate	std.error
(Intercept)	-4.191	0.270
s(mean_temp_roms_30_norm).1	12.006	0.789
s(mean_temp_roms_30_norm).2	8.087	0.347
s(mean_oxygen_roms_30_norm).1	-1.079	0.642
s(mean_oxygen_roms_30_norm).2	-0.925	0.142

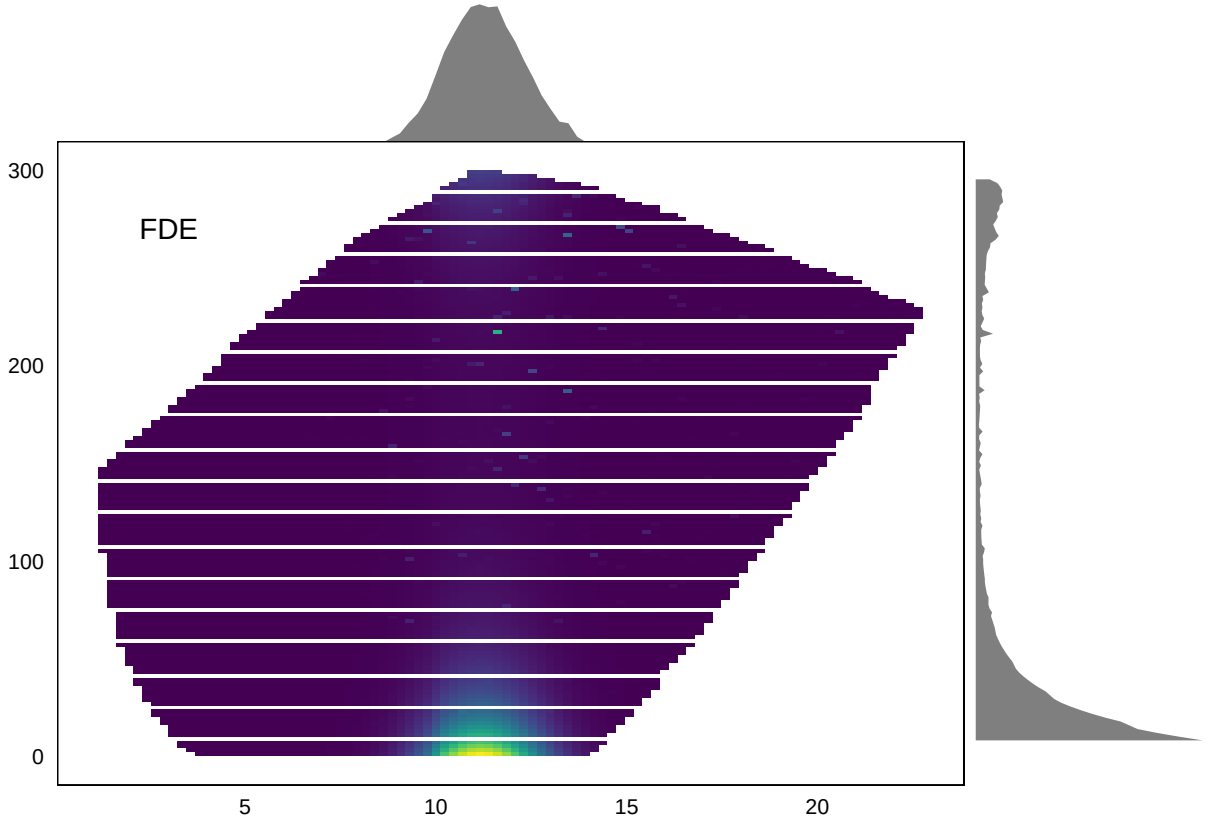
term	estimate	std.error
(Intercept)	-5.943	2.866
mean_temp_roms_30_norm	5.066	0.450
I(mean_temp_roms_30_norm^2)	-1.379	0.148
mean_oxygen_roms_30_norm	0.753	0.280
I(mean_oxygen_roms_30_norm^2)	-0.031	0.108

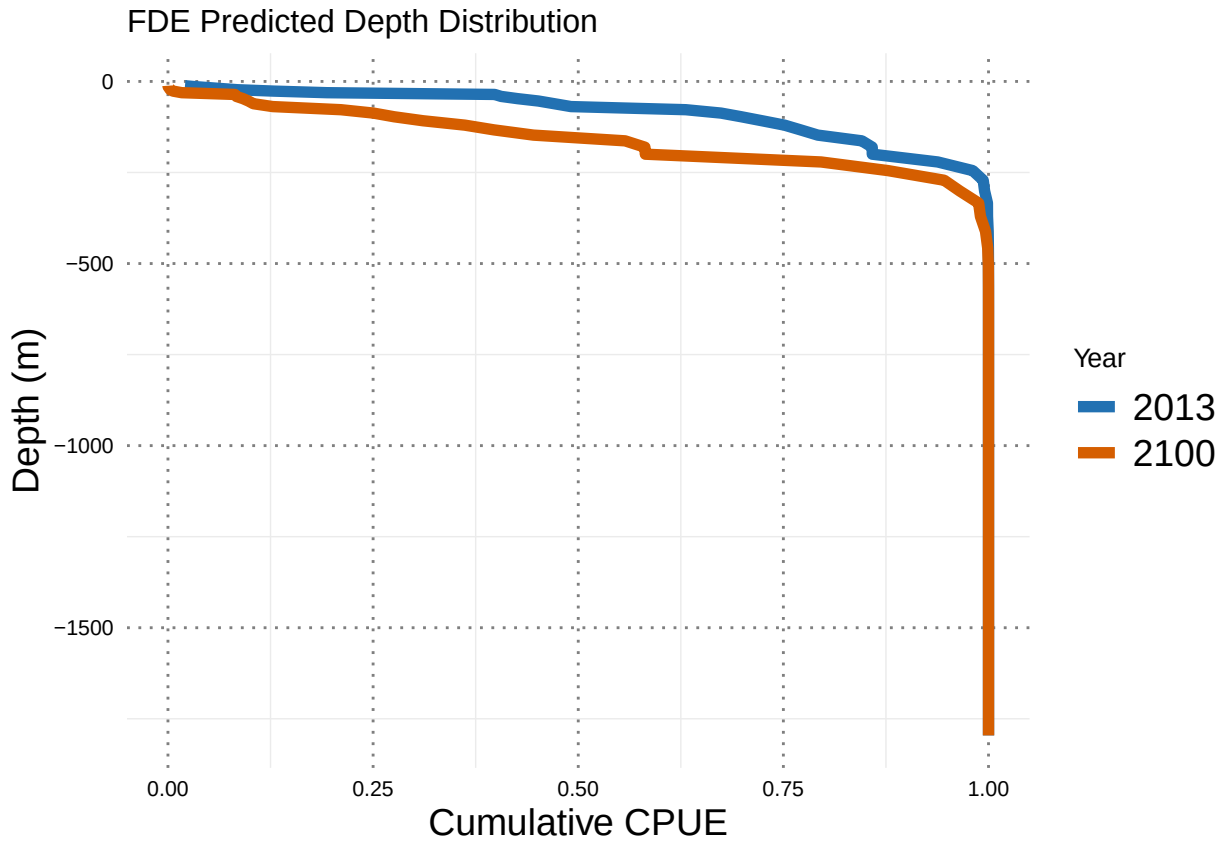
term	estimate	std.error
(Intercept)	-8.446	2.474
s(mean_temp_roms_30_norm).1	9.106	1.006
s(mean_temp_roms_30_norm).2	5.217	0.486
s(mean_oxygen_roms_30_norm).1	0.624	0.643
s(mean_oxygen_roms_30_norm).2	0.670	0.181

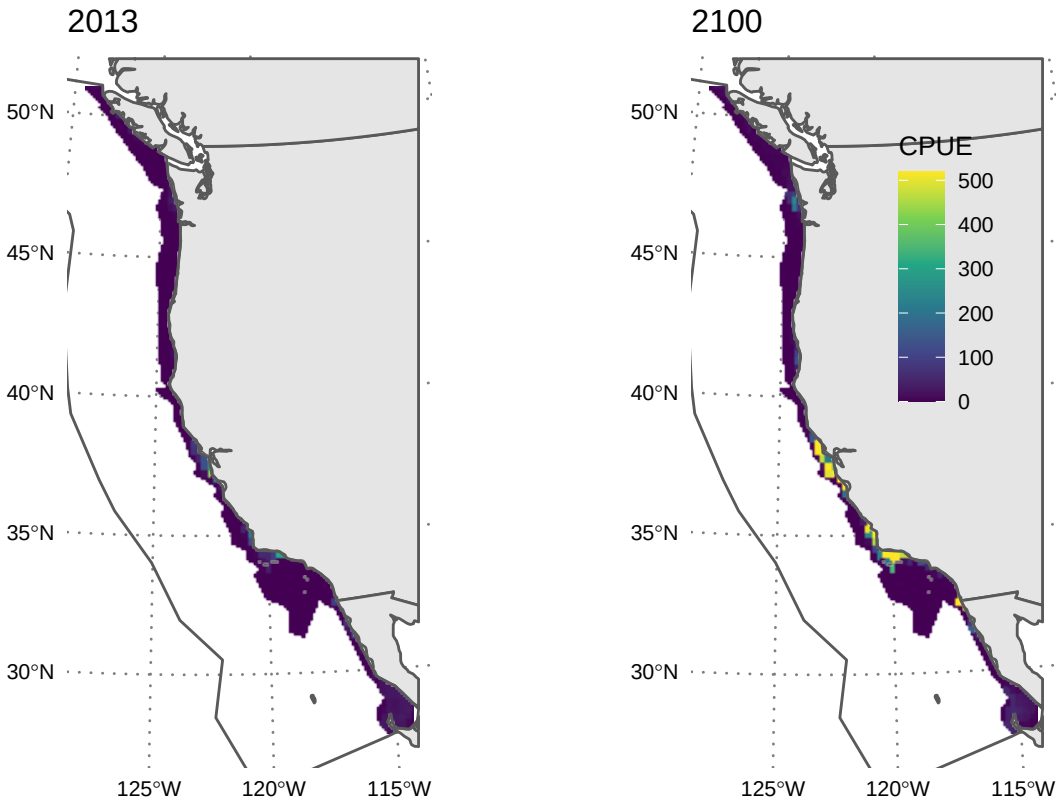

FDE Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025


Center of Gravity, X
Eastings (km)
720
700
680
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
4025
4000
3975
3950
3925
2025
2050
2075
2100
Year


FDE
300
200
100
0
5
10
15
20


FDE Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
2100
CPUE
500
400
300
200
100
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

FDF: Flatfish

Pacific sanddab, rex sole, slender sole, starry flounder, english sole, deepsea sole

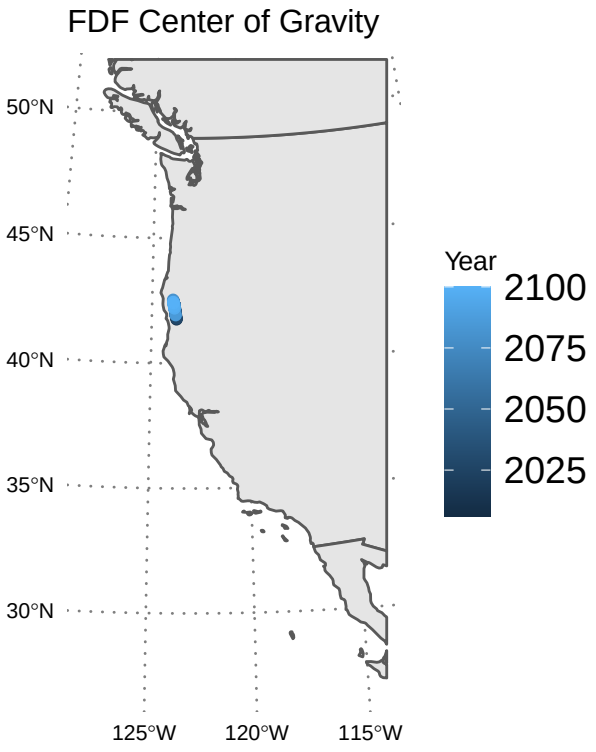
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
FDF	FALSE	FALSE	0.034	0	2.828
FDF	FALSE	TRUE	0.075	0	2.828
FDF	TRUE	FALSE	0.268	0	207.569
FDF	TRUE	TRUE	0.623	0	210.415

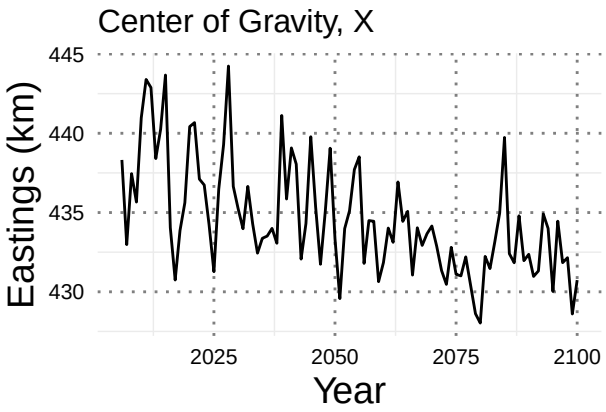
term	estimate	std.error
(Intercept)	7.384	0.025
mean_temp_roms_30_norm	0.410	0.045
I(mean_temp_roms_30_norm^2)	-0.242	0.019
mean_oxygen_roms_30_norm	0.703	0.054
I(mean_oxygen_roms_30_norm^2)	-0.177	0.021

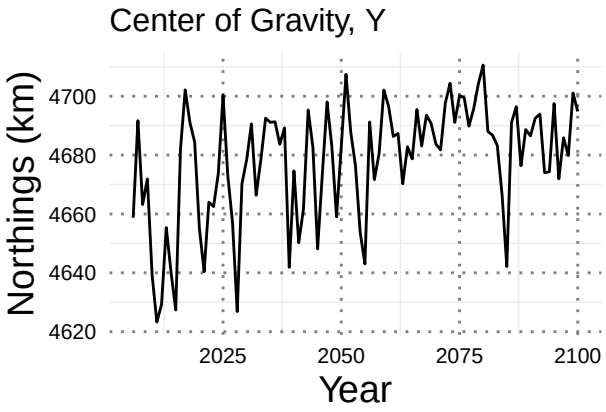
term	estimate	std.error
(Intercept)	6.985	0.018
s(mean_temp_roms_30_norm).1	1.008	0.091
s(mean_temp_roms_30_norm).2	0.192	0.041
s(mean_oxygen_roms_30_norm).1	1.262	0.124
s(mean_oxygen_roms_30_norm).2	0.466	0.032

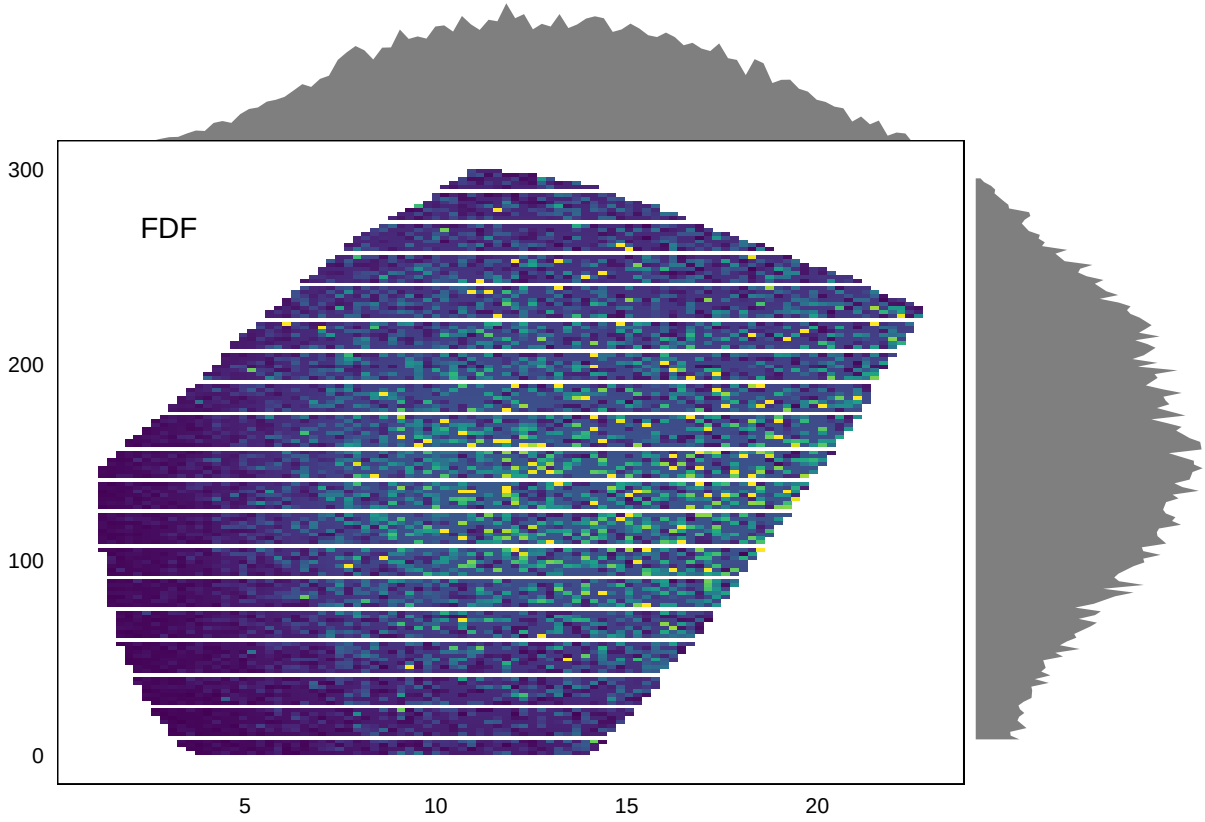
term	estimate	std.error
(Intercept)	6.683	0.656
mean_temp_roms_30_norm	0.740	0.068
I(mean_temp_roms_30_norm^2)	-0.170	0.025
mean_oxygen_roms_30_norm	0.316	0.071
I(mean_oxygen_roms_30_norm^2)	-0.116	0.026

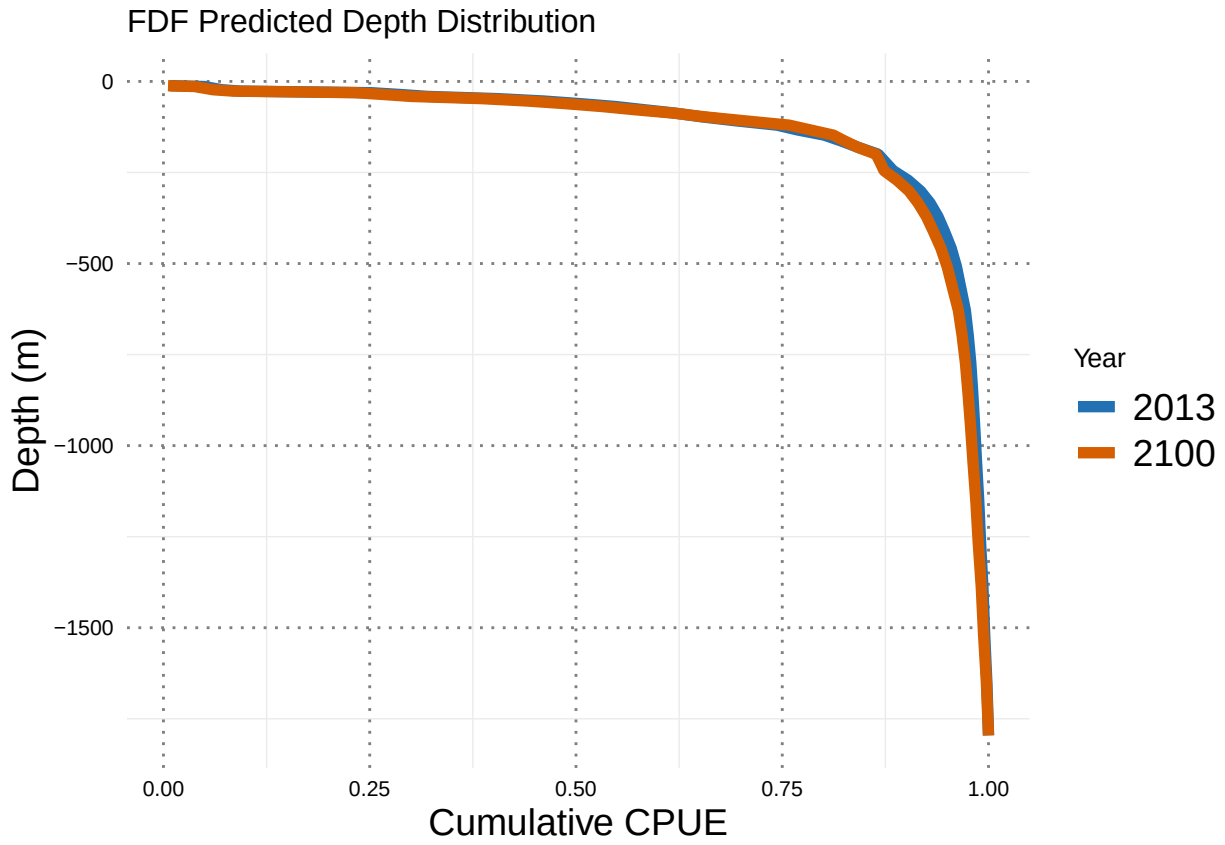
term	estimate	std.error
(Intercept)	6.408	0.666
s(mean_temp_roms_30_norm).1	0.757	0.119
s(mean_temp_roms_30_norm).2	0.577	0.063
s(mean_oxygen_roms_30_norm).1	0.813	0.151
s(mean_oxygen_roms_30_norm).2	0.166	0.051

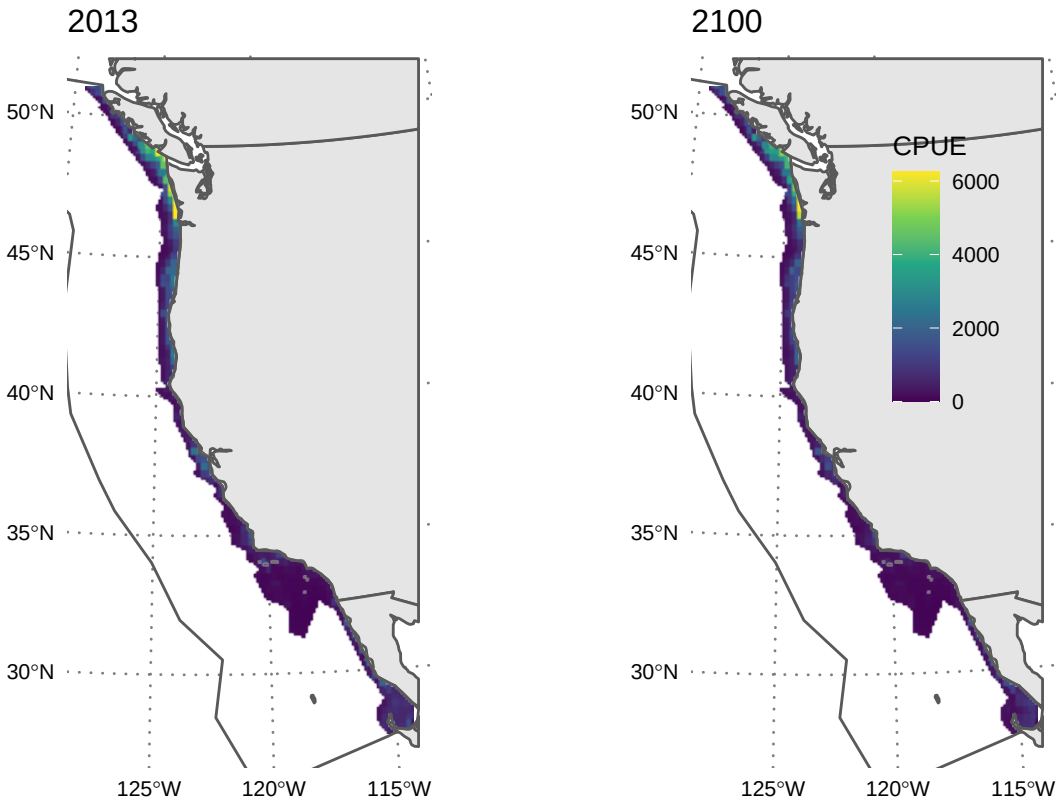

FDF Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025


Center of Gravity, X
Eastings (km)
445
440
435
430
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
4700
4680
4660
4640
4620
2025
2050
2075
2100
Year


FDF
300
200
100
0
5
10
15
20


FDF Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
2100
CPUE
6000
4000
2000
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

FDO: Deep Large Fish

Blackgill, rougheye, and blackspotted rockfish, and shortspine thornyhead

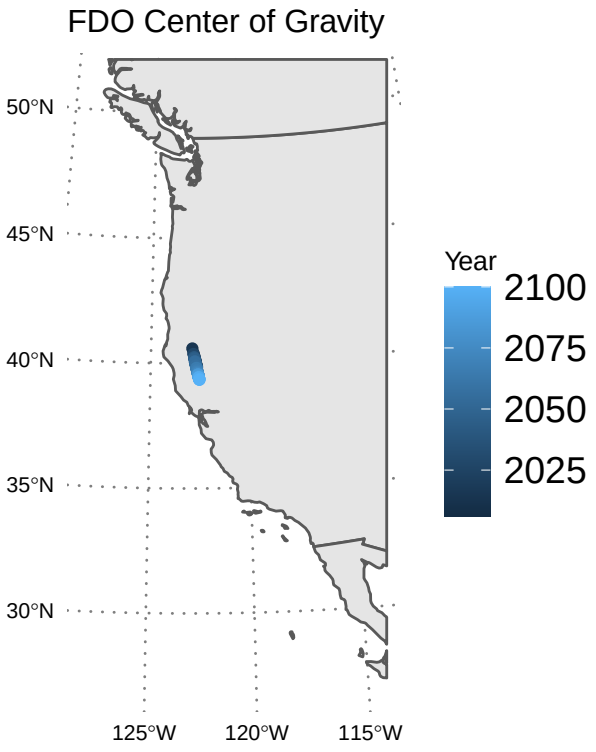
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
FDO	FALSE	FALSE	0.040	0	2.828
FDO	FALSE	TRUE	0.129	0	2.828
FDO	TRUE	FALSE	0.000	0	100.936
FDO	TRUE	TRUE	0.831	0	86.489

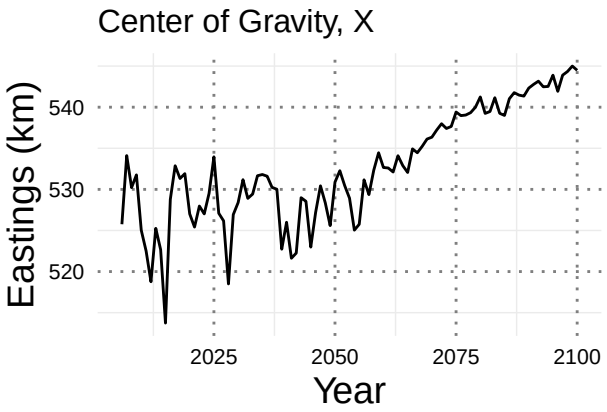
term	estimate	std.error
(Intercept)	6.125	0.039
mean_temp_roms_30_norm	-2.659	0.088
I(mean_temp_roms_30_norm^2)	-1.652	0.052
mean_oxygen_roms_30_norm	-0.539	0.068
I(mean_oxygen_roms_30_norm^2)	-0.998	0.056

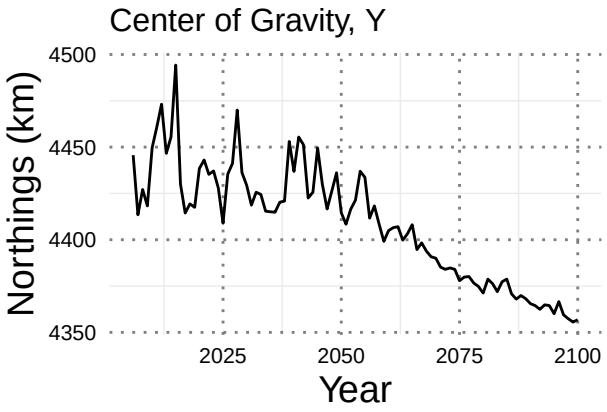
term	estimate	std.error
(Intercept)	3.252	0.057
s(mean_temp_roms_30_norm).1	8.930	0.251
s(mean_temp_roms_30_norm).2	-4.172	0.118
s(mean_oxygen_roms_30_norm).1	4.746	0.296
s(mean_oxygen_roms_30_norm).2	-1.924	0.089

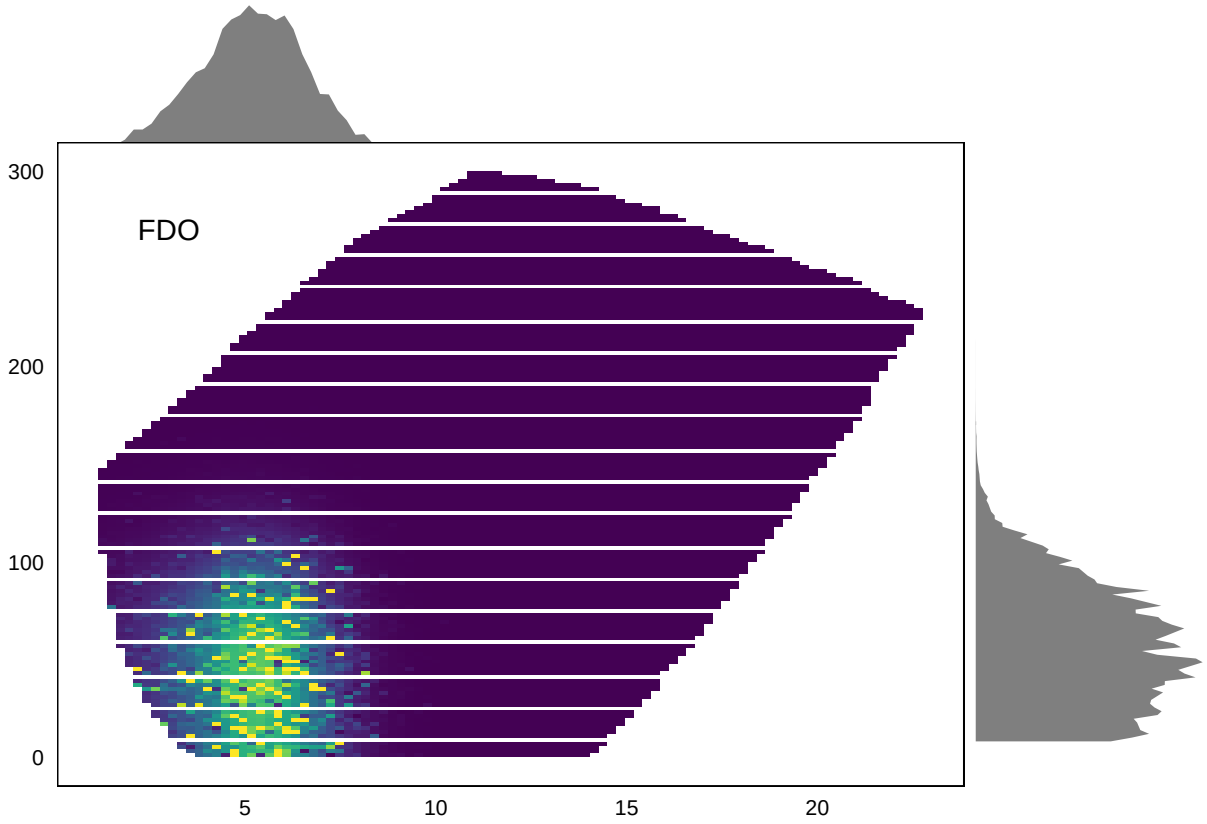
term	estimate	std.error
(Intercept)	5.815	0.457
mean_temp_roms_30_norm	-1.656	0.139
I(mean_temp_roms_30_norm^2)	-1.401	0.068
mean_oxygen_roms_30_norm	-1.354	0.128
I(mean_oxygen_roms_30_norm^2)	-1.116	0.086

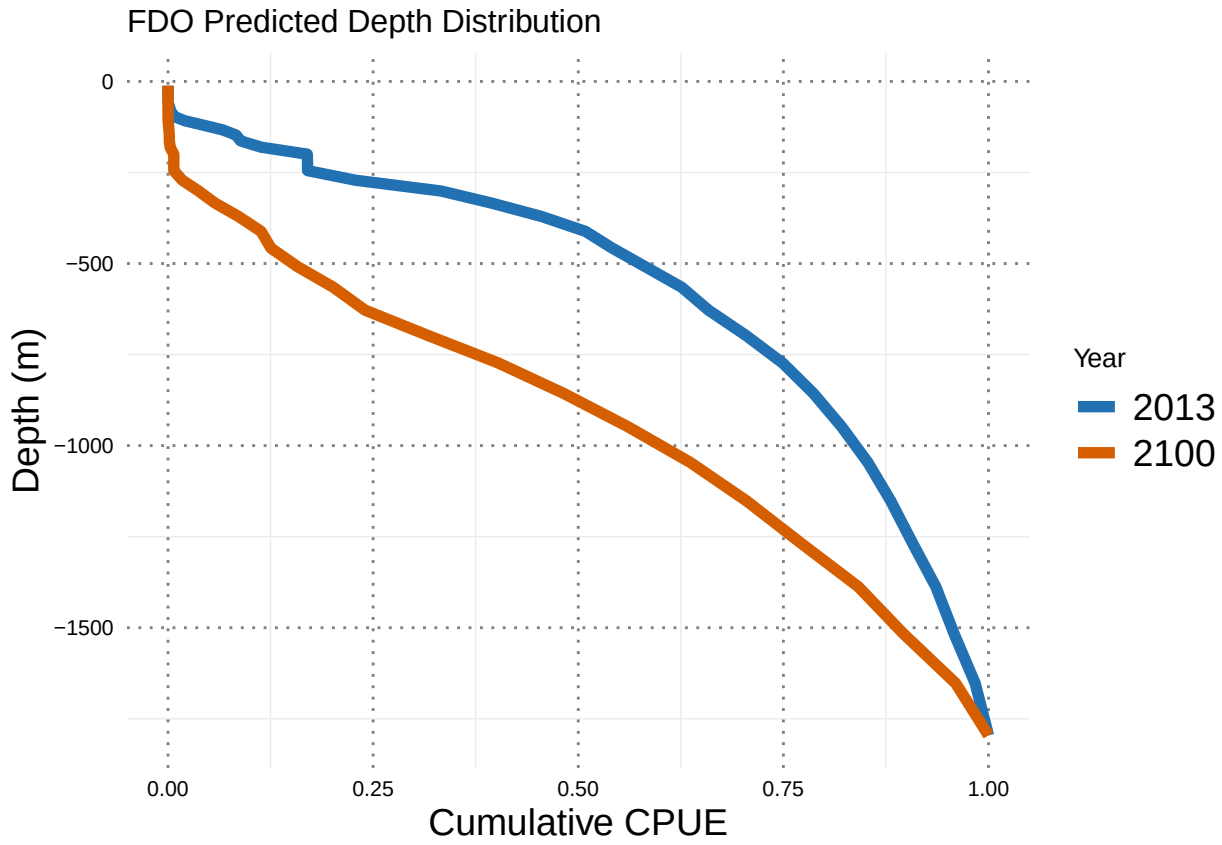
term	estimate	std.error
(Intercept)	3.014	0.362
s(mean_temp_roms_30_norm).1	7.829	0.318
s(mean_temp_roms_30_norm).2	-2.998	0.166
s(mean_oxygen_roms_30_norm).1	5.155	0.447
s(mean_oxygen_roms_30_norm).2	-2.879	0.154

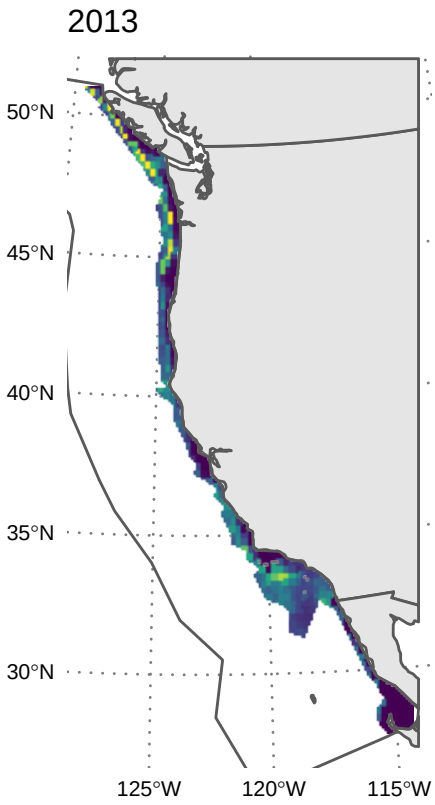

FDO Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025

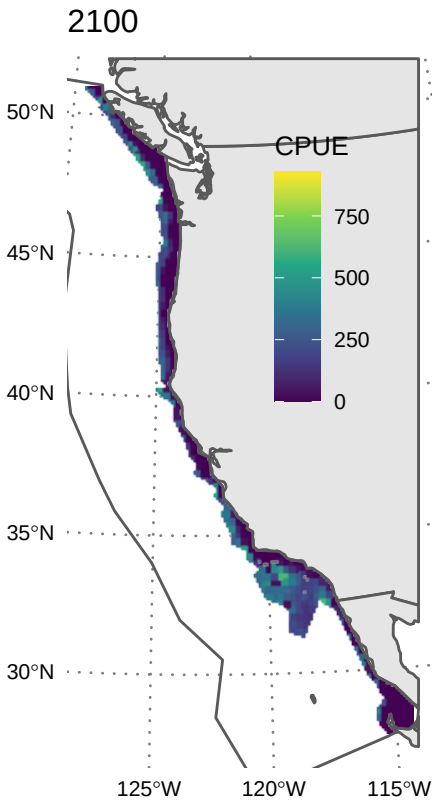

Center of Gravity, X
Eastings (km)
540
530
520
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
4500
4450
4400
4350
2025
2050
2075
2100
Year


FDO
300
200
100
0
5
10
15
20


FDO Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W


2100
CPUE
750
500
250
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

FDP: Dover Sole

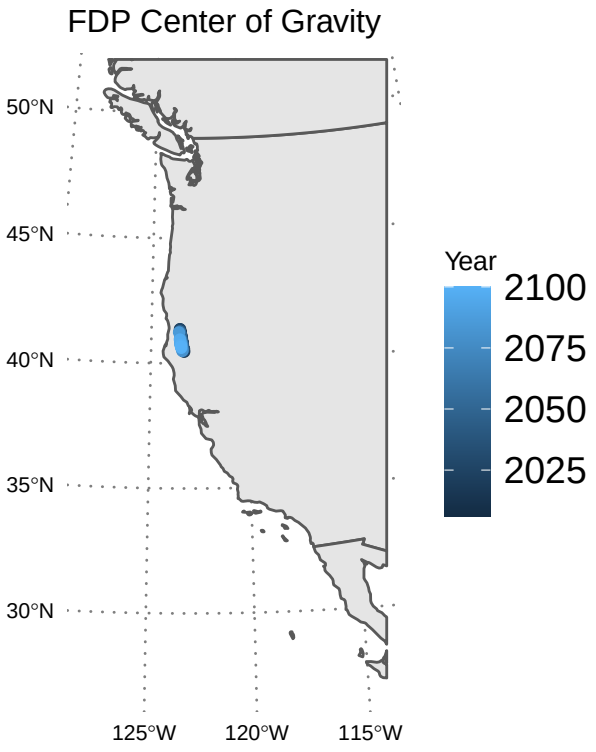
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
FDP	FALSE	FALSE	0.000	0	2.828
FDP	FALSE	TRUE	0.132	0	2.828
FDP	TRUE	FALSE	0.868	0	238.331
FDP	TRUE	TRUE	0.000	0	200.022

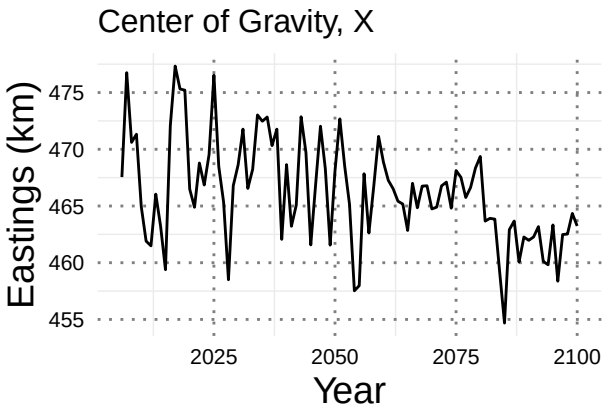
term	estimate	std.error
(Intercept)	8.408	0.027
mean_temp_roms_30_norm	-0.862	0.052
I(mean_temp_roms_30_norm^2)	-1.130	0.024
mean_oxygen_roms_30_norm	0.213	0.058
I(mean_oxygen_roms_30_norm^2)	-0.061	0.027

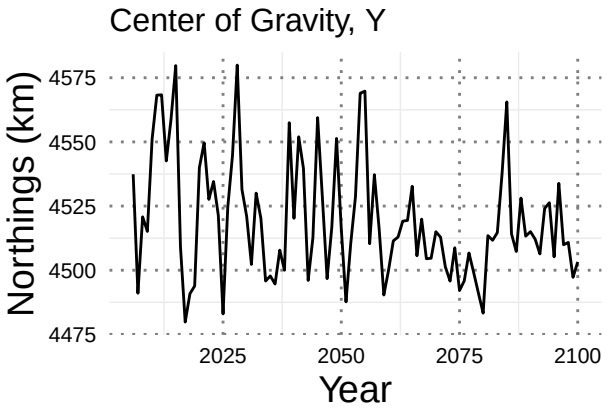
term	estimate	std.error
(Intercept)	7.226	0.020
s(mean_temp_roms_30_norm).1	5.352	0.116
s(mean_temp_roms_30_norm).2	-1.621	0.050
s(mean_oxygen_roms_30_norm).1	0.182	0.147
s(mean_oxygen_roms_30_norm).2	0.084	0.035

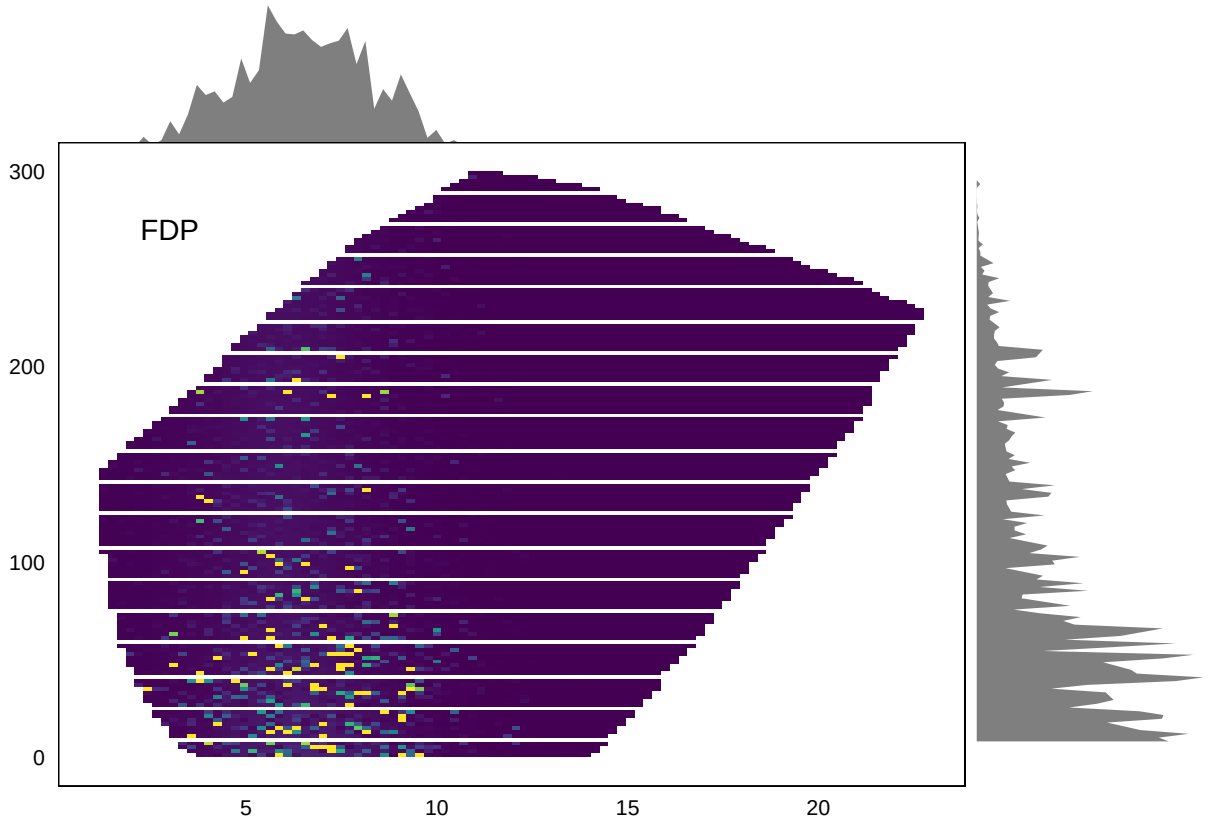
term	estimate	std.error
(Intercept)	5.874	1.406
mean_temp_roms_30_norm	0.097	0.079
I(mean_temp_roms_30_norm^2)	-1.083	0.033
mean_oxygen_roms_30_norm	-0.856	0.086
I(mean_oxygen_roms_30_norm^2)	0.113	0.033

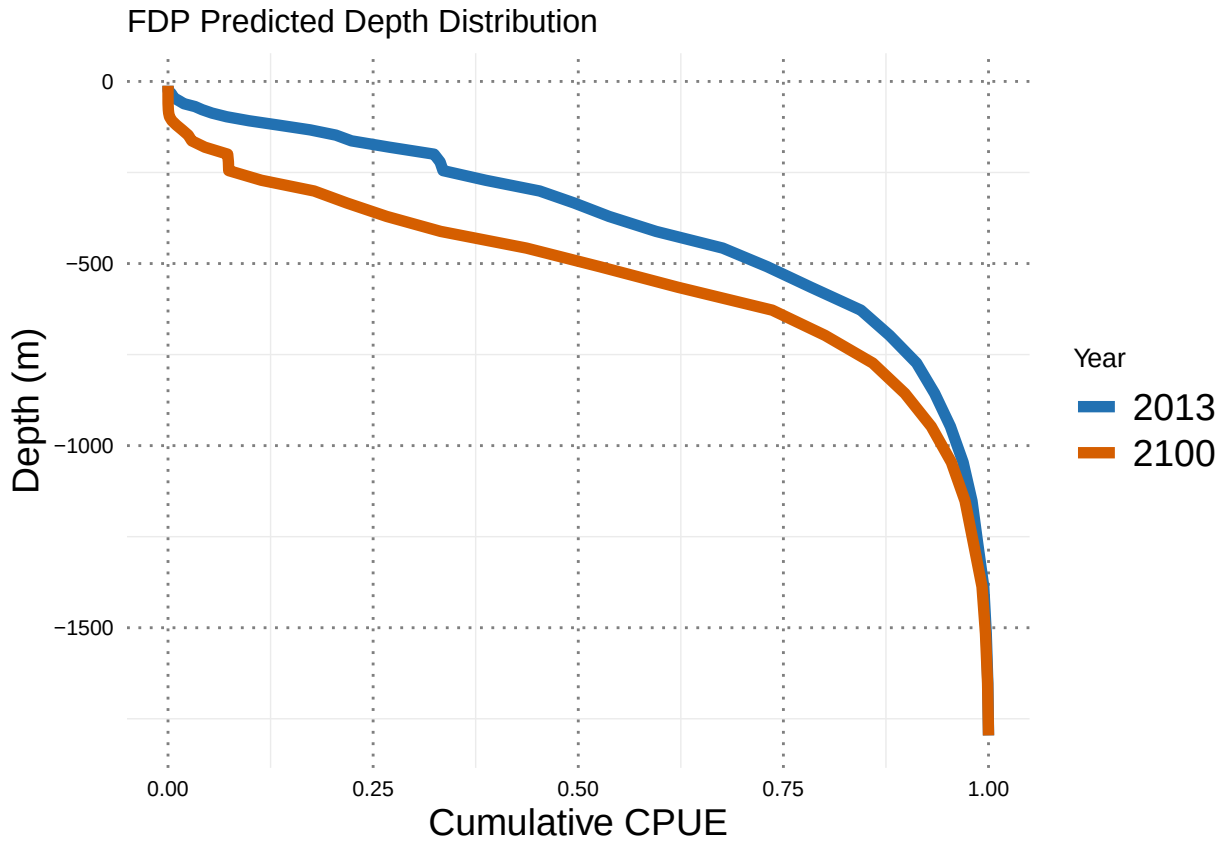
term	estimate	std.error
(Intercept)	5.122	1.104
s(mean_temp_roms_30_norm).1	4.984	0.151
s(mean_temp_roms_30_norm).2	-0.596	0.076
s(mean_oxygen_roms_30_norm).1	-0.844	0.182
s(mean_oxygen_roms_30_norm).2	-0.742	0.065

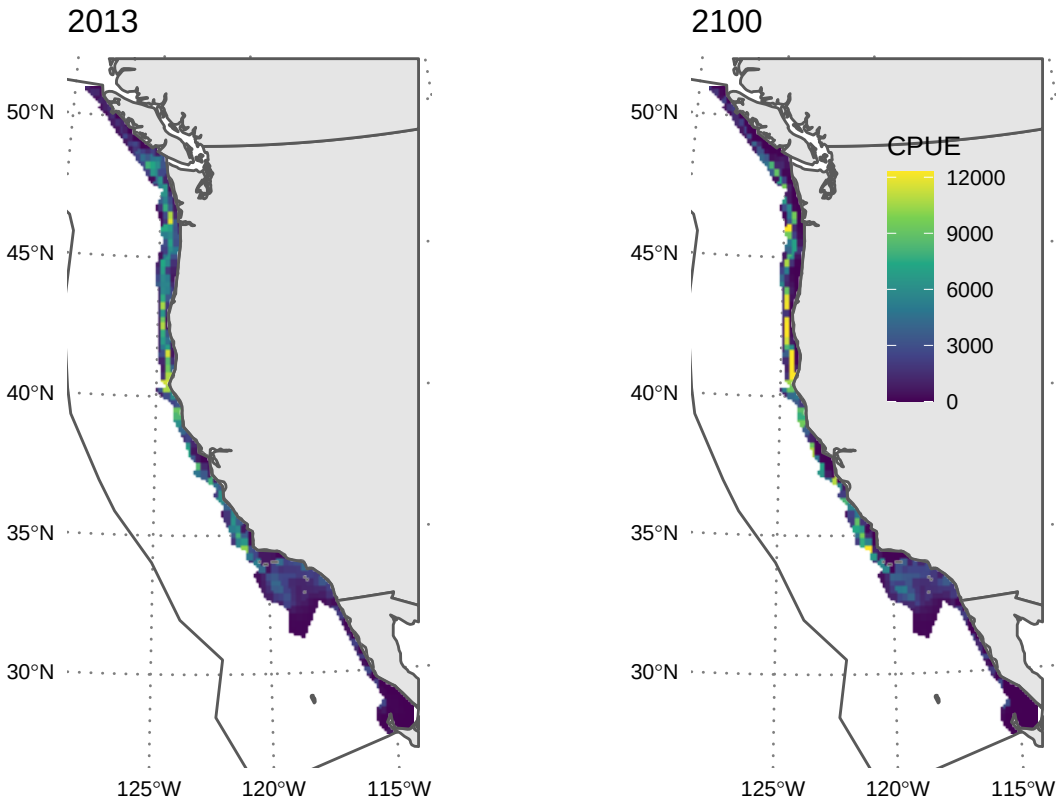

FDP Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025


Center of Gravity, X
Eastings (km)
475
470
465
460
455
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
4575
4550
4525
4500
4475
2025
2050
2075
2100
Year


FDP
300
200
100
0
5
10
15
20


FDP Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
2100
CPUE
12000
9000
6000
3000
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

FDS: Midwater Rockfish

Chilipepper, vermillion, sunset, widow, and yellowtail rockfish

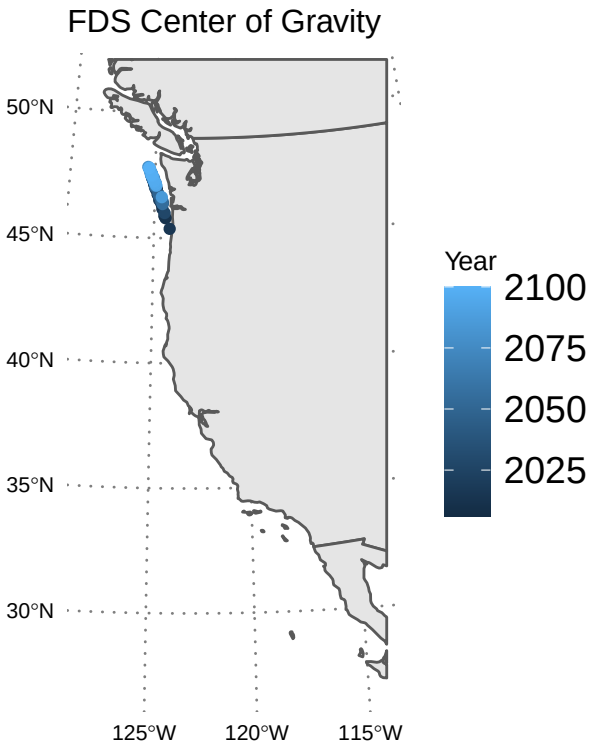
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
FDS	FALSE	FALSE	0.020	0	2.828
FDS	FALSE	TRUE	0.280	0	2.828
FDS	TRUE	FALSE	0.000	0	66.773
FDS	TRUE	TRUE	0.699	0	79.300

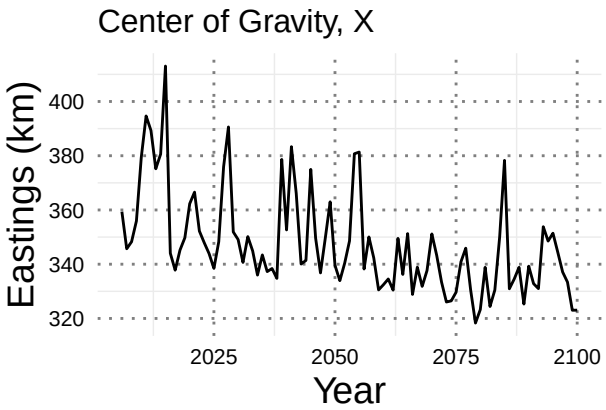
term	estimate	std.error
(Intercept)	5.367	0.109
mean_temp_roms_30_norm	4.691	0.253
I(mean_temp_roms_30_norm^2)	-2.103	0.117
mean_oxygen_roms_30_norm	1.712	0.185
I(mean_oxygen_roms_30_norm^2)	-0.961	0.099

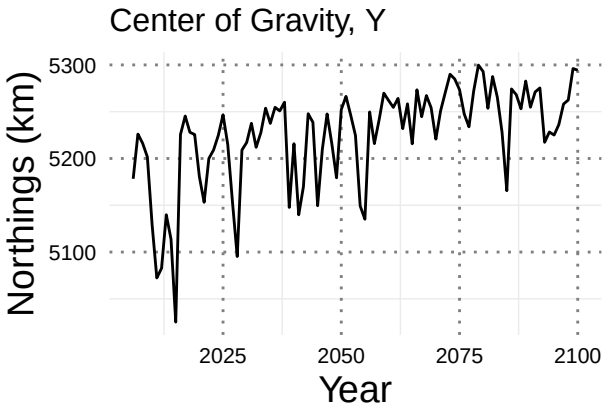
term	estimate	std.error
(Intercept)	1.703	0.190
s(mean_temp_roms_30_norm).1	11.644	0.599
s(mean_temp_roms_30_norm).2	3.686	0.196
s(mean_oxygen_roms_30_norm).1	5.717	0.571
s(mean_oxygen_roms_30_norm).2	0.243	0.100

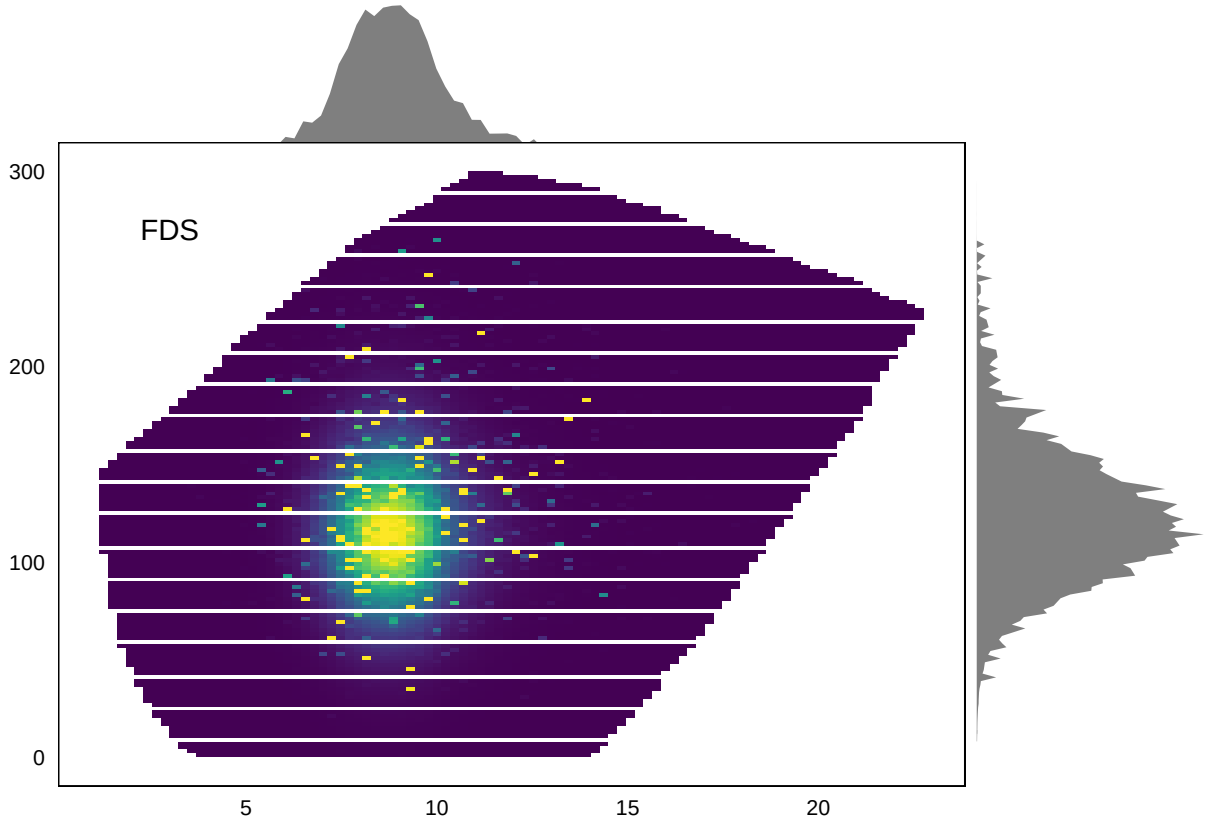
term	estimate	std.error
(Intercept)	2.371	0.760
mean_temp_roms_30_norm	3.573	0.346
I(mean_temp_roms_30_norm^2)	-1.594	0.133
mean_oxygen_roms_30_norm	3.032	0.303
I(mean_oxygen_roms_30_norm^2)	-1.207	0.119

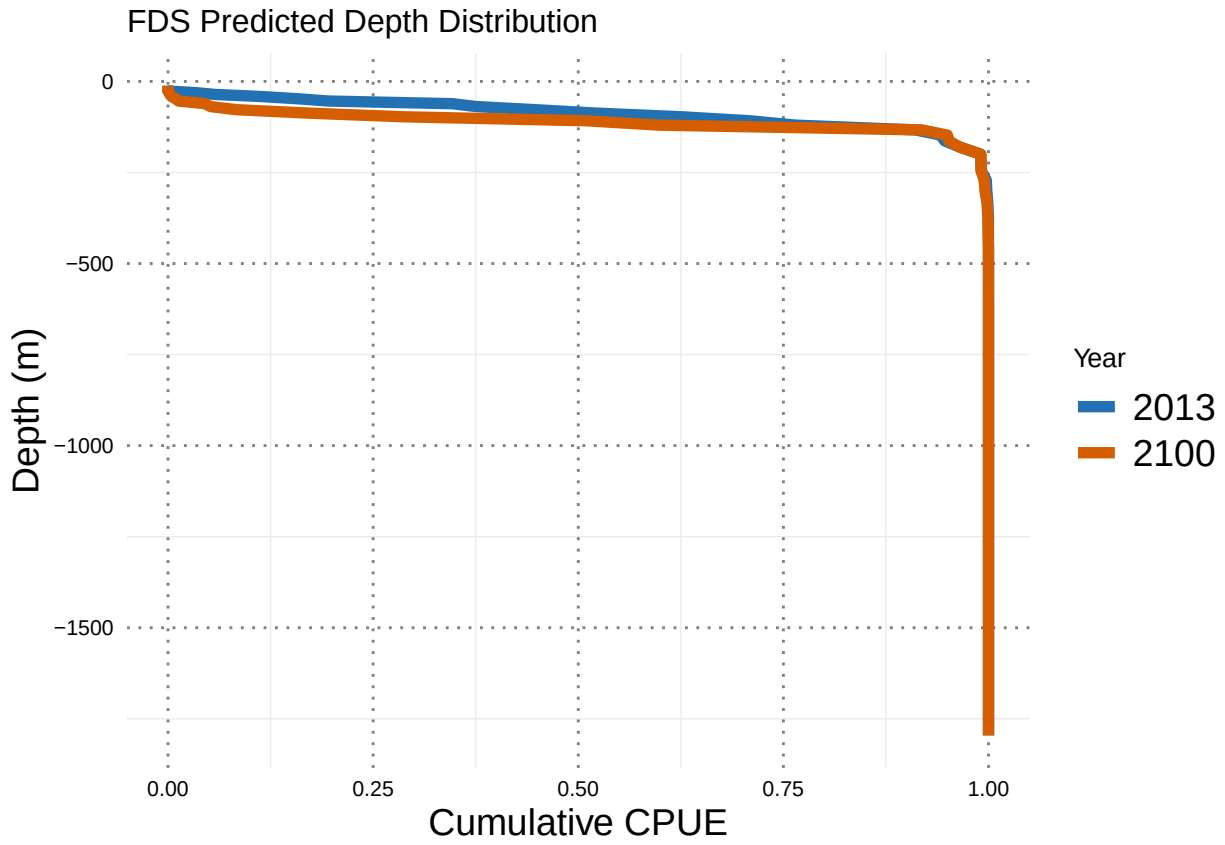
term	estimate	std.error
(Intercept)	-0.703	0.920
s(mean_temp_roms_30_norm).1	8.675	0.686
s(mean_temp_roms_30_norm).2	2.825	0.300
s(mean_oxygen_roms_30_norm).1	6.654	0.686
s(mean_oxygen_roms_30_norm).2	1.239	0.210

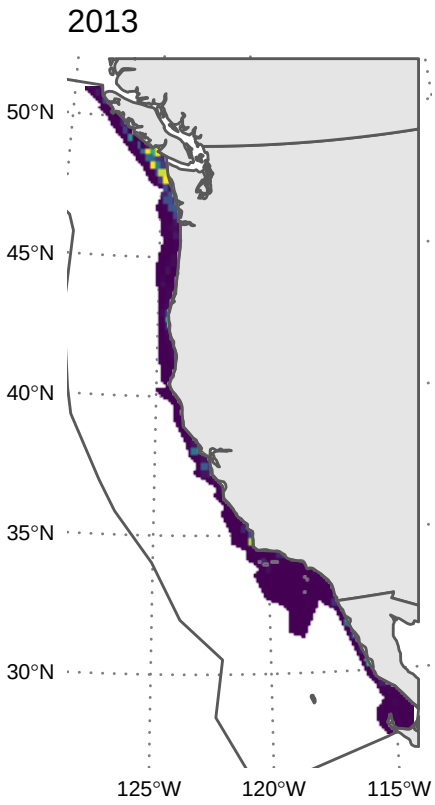

FDS Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025

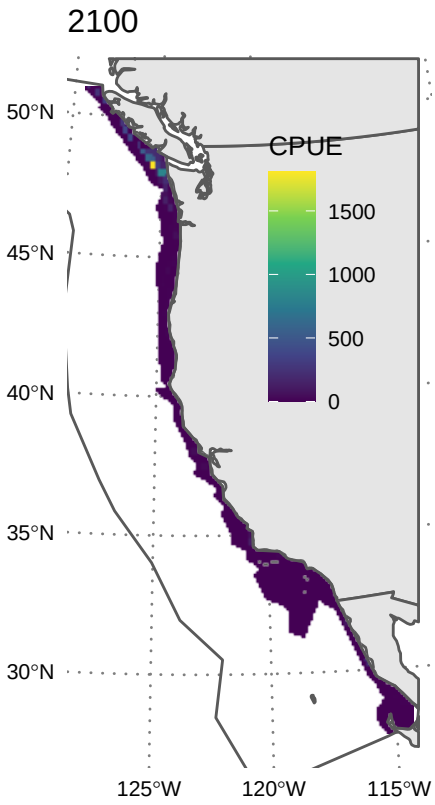

Center of Gravity, X
Eastings (km)
400
380
360
340
320
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
5300
5200
5100
2025
2050
2075
2100
Year


FDS
300
200
100
0
5
10
15
20


FDS Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W


2100
CPUE
1500
1000
500
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

FMM: Hake

Pacific hake

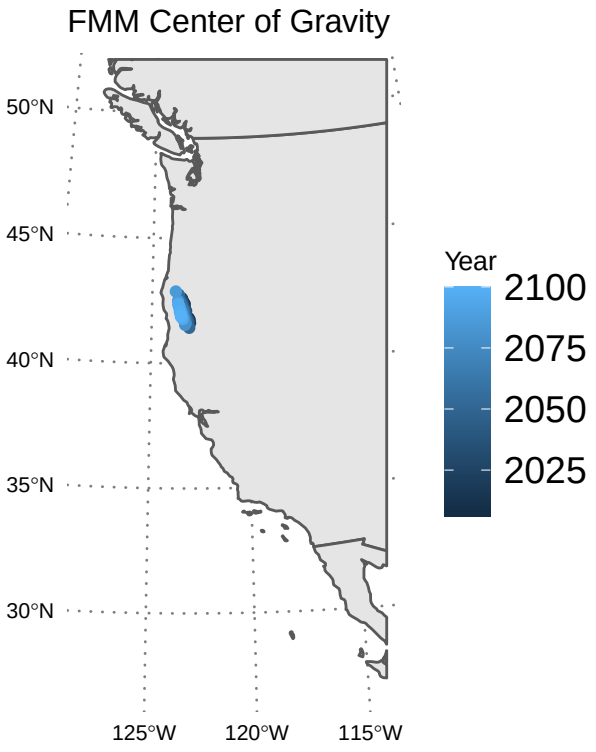
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
FMM	FALSE	FALSE	0.238	0	2.828
FMM	FALSE	TRUE	0.000	0	2.828
FMM	TRUE	FALSE	0.000	0	53.987
FMM	TRUE	TRUE	0.762	0	58.990

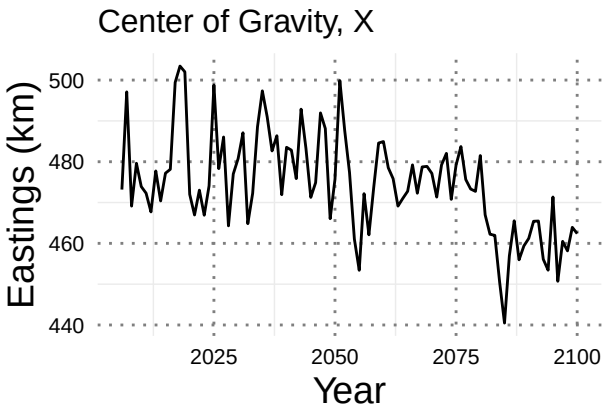
term	estimate	std.error
(Intercept)	7.574	0.040
mean_temp_roms_30_norm	1.539	0.089
I(mean_temp_roms_30_norm^2)	-1.804	0.043
mean_oxygen_roms_30_norm	0.535	0.089
I(mean_oxygen_roms_30_norm^2)	-0.213	0.041

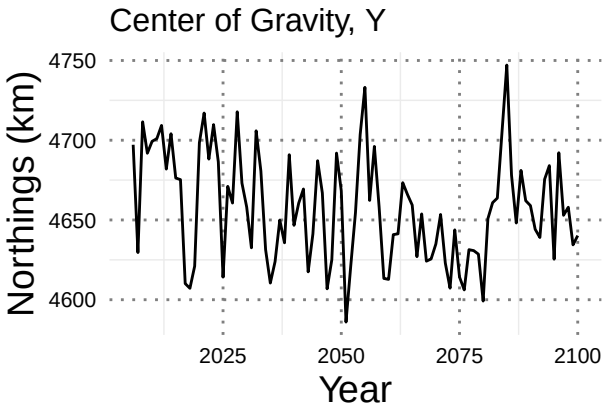
term	estimate	std.error
(Intercept)	5.620	0.038
s(mean_temp_roms_30_norm).1	8.228	0.205
s(mean_temp_roms_30_norm).2	0.423	0.076
s(mean_oxygen_roms_30_norm).1	0.948	0.227
s(mean_oxygen_roms_30_norm).2	0.157	0.050

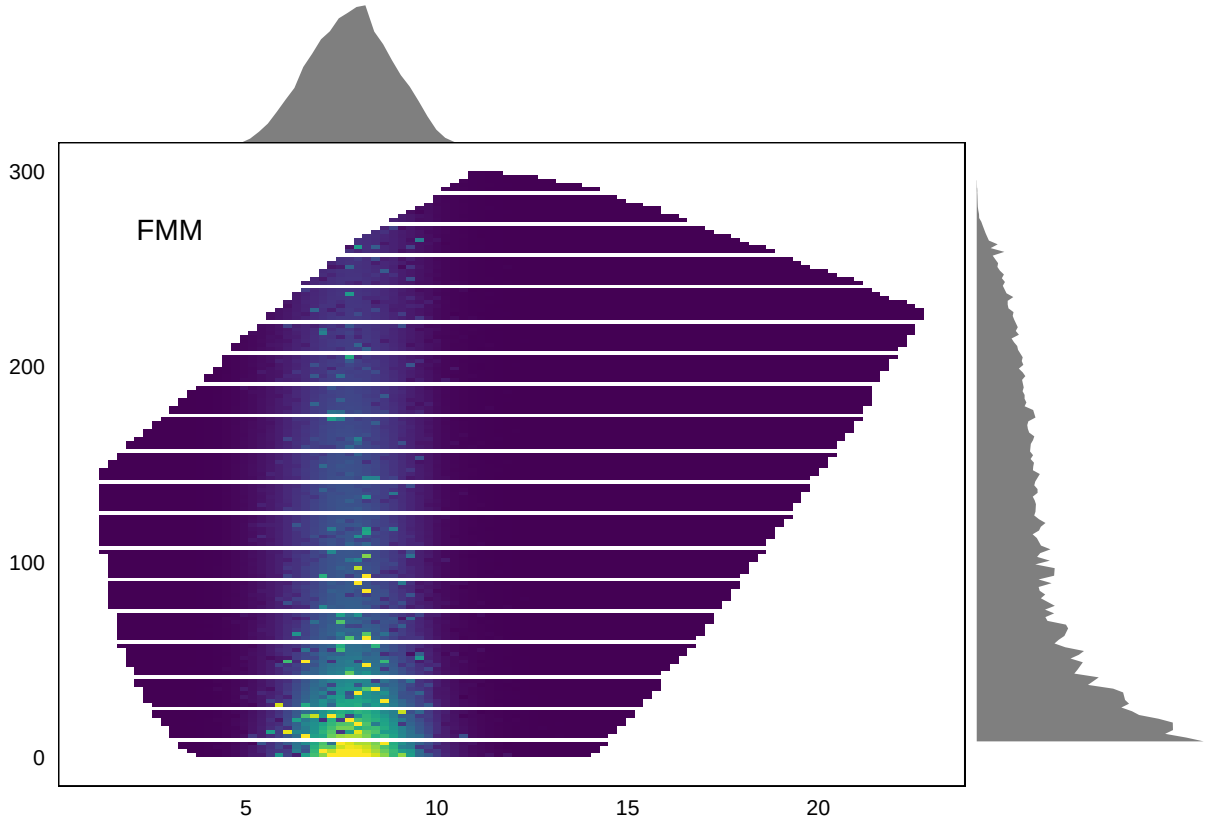
term	estimate	std.error
(Intercept)	6.563	0.209
mean_temp_roms_30_norm	2.221	0.146
I(mean_temp_roms_30_norm^2)	-1.894	0.060
mean_oxygen_roms_30_norm	-0.454	0.153
I(mean_oxygen_roms_30_norm^2)	0.075	0.057

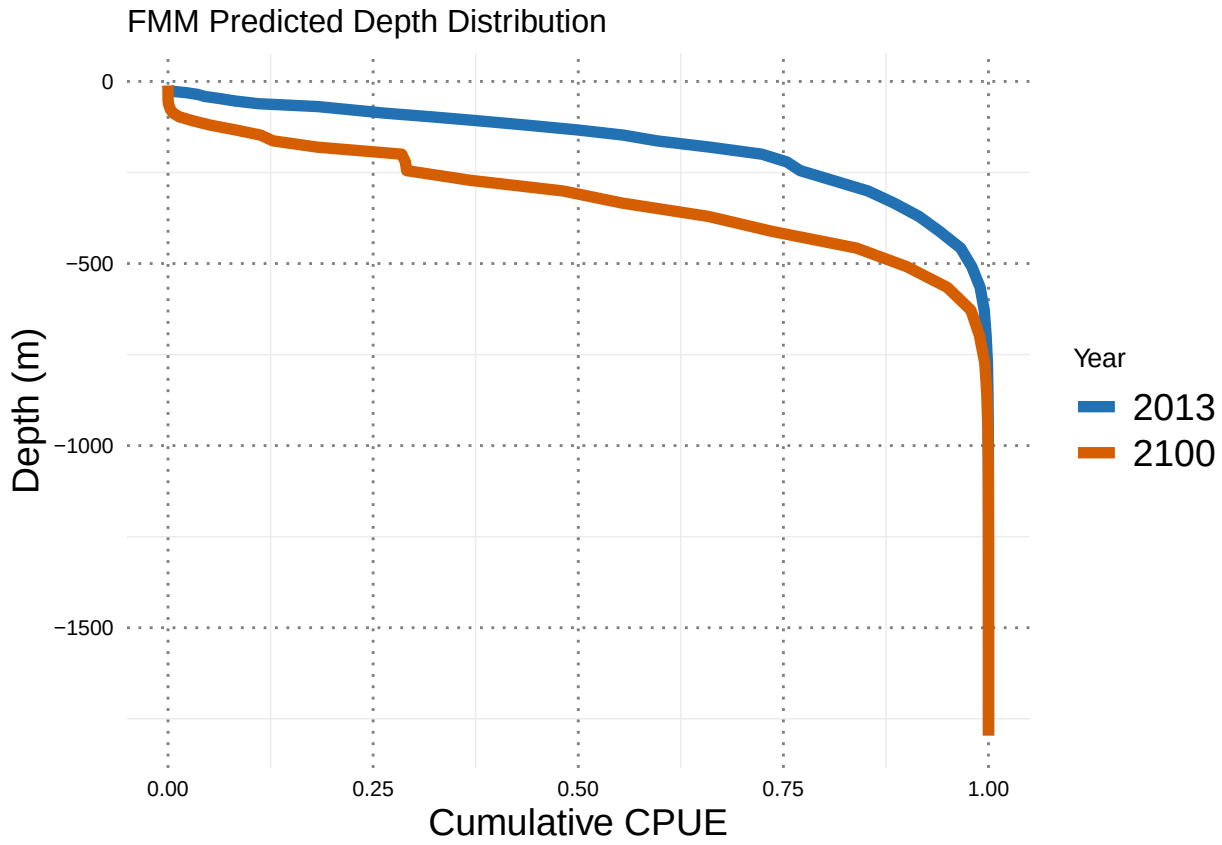
term	estimate	std.error
(Intercept)	4.756	0.206
s(mean_temp_roms_30_norm).1	8.724	0.278
s(mean_temp_roms_30_norm).2	1.170	0.131
s(mean_oxygen_roms_30_norm).1	-1.023	0.322
s(mean_oxygen_roms_30_norm).2	-0.470	0.104

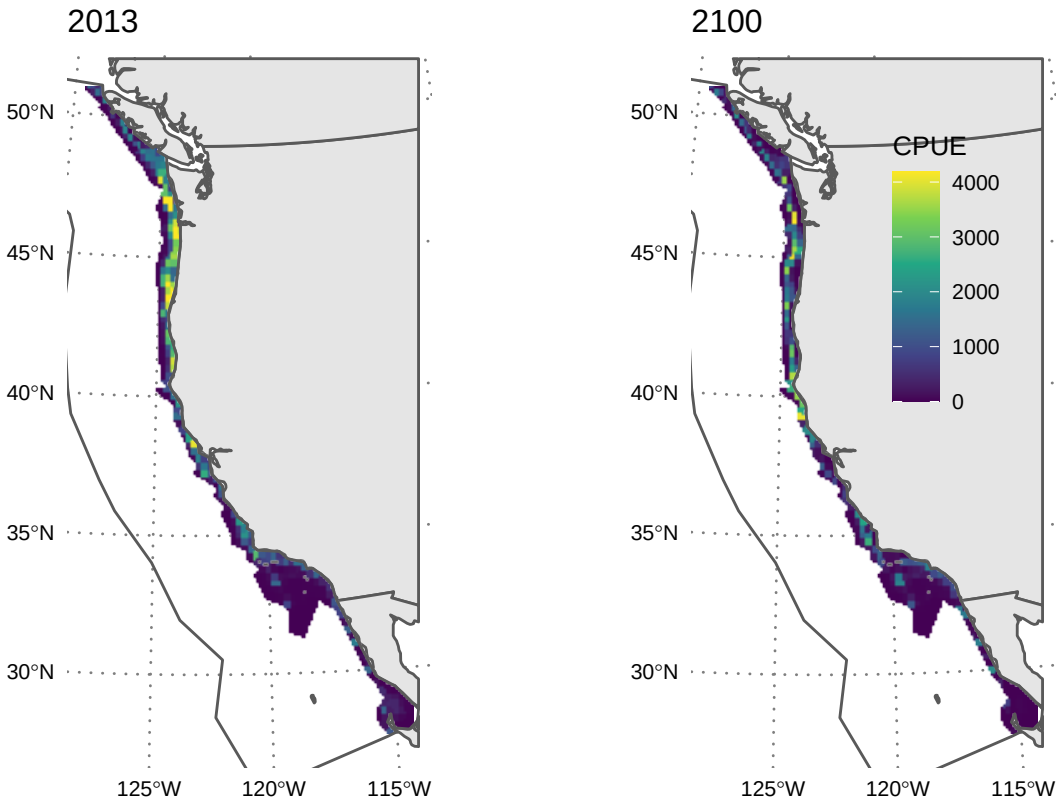

FMM Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025


Center of Gravity, X
Eastings (km)
500
480
460
440
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
4750
4700
4650
4600
2025
2050
2075
2100
Year


FMM
300
200
100
0
5
10
15
20


FMM Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
2100
CPUE
4000
3000
2000
1000
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

FMN: Sablefish

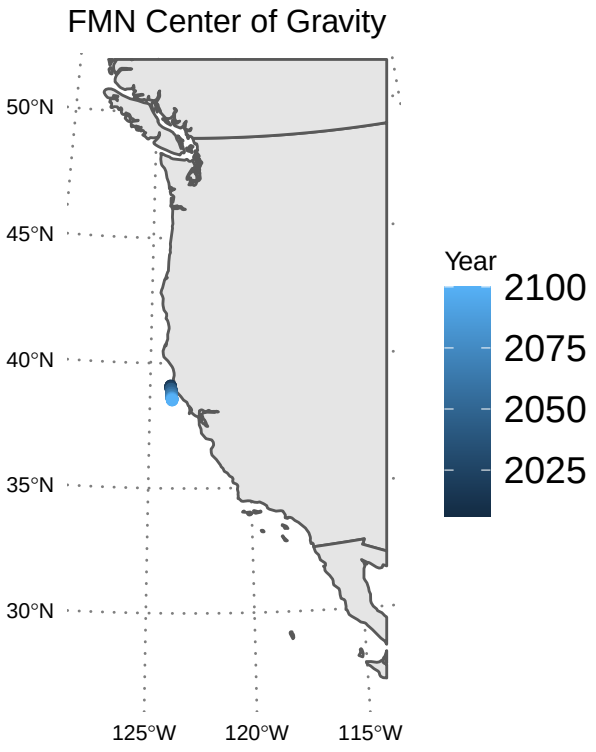
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
FMN	FALSE	FALSE	0.178	0	2.828
FMN	FALSE	TRUE	0.000	0	2.828
FMN	TRUE	FALSE	0.000	0	76.576
FMN	TRUE	TRUE	0.822	0	77.926

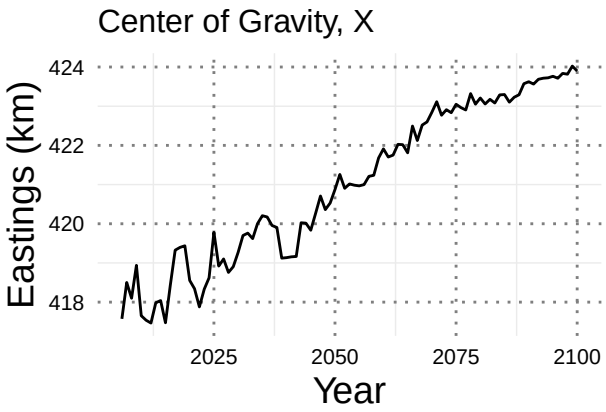
term	estimate	std.error
(Intercept)	7.196	0.035
mean_temp_roms_30_norm	-1.320	0.060
I(mean_temp_roms_30_norm^2)	-0.248	0.031
mean_oxygen_roms_30_norm	0.634	0.069
I(mean_oxygen_roms_30_norm^2)	-0.813	0.041

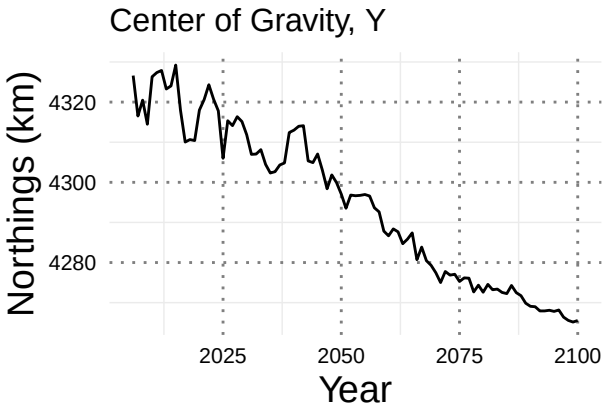
term	estimate	std.error
(Intercept)	6.127	0.025
s(mean_temp_roms_30_norm).1	1.311	0.136
s(mean_temp_roms_30_norm).2	-1.465	0.057
s(mean_oxygen_roms_30_norm).1	4.251	0.225
s(mean_oxygen_roms_30_norm).2	-0.573	0.047

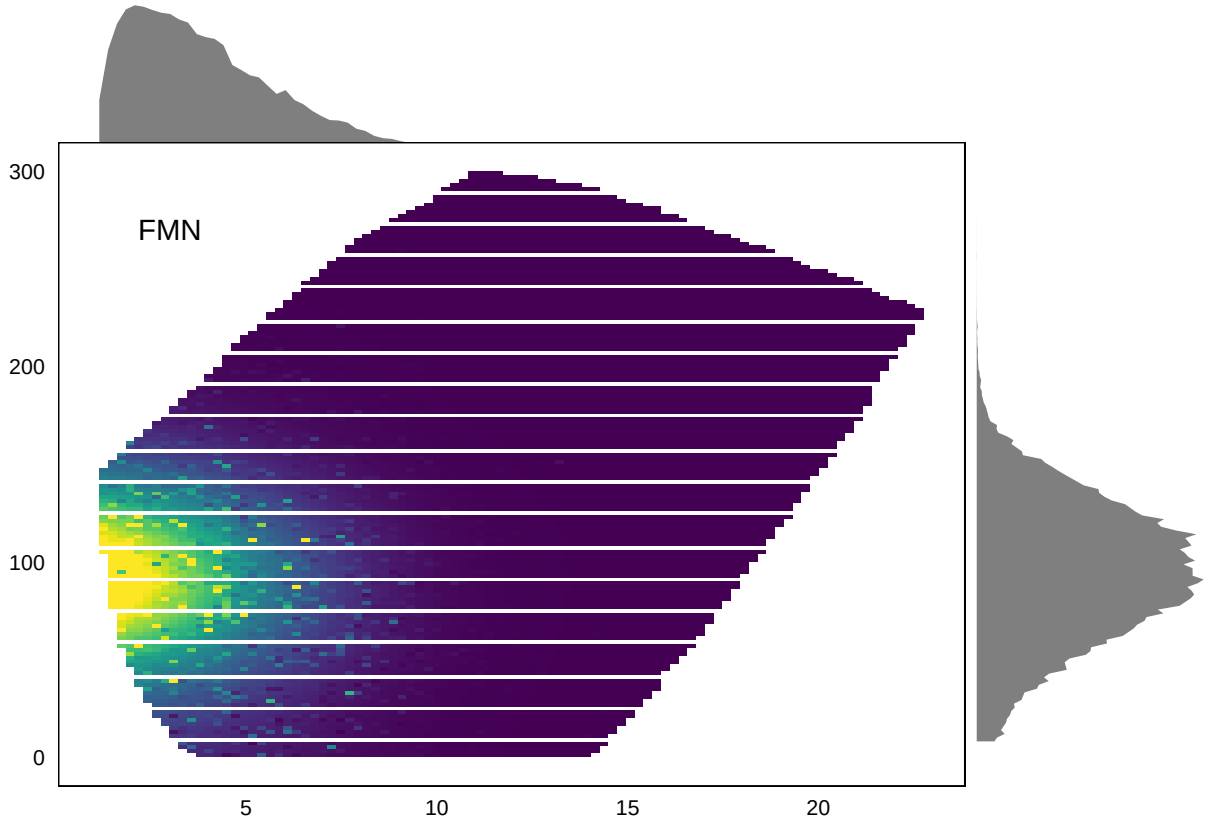
term	estimate	std.error
(Intercept)	6.020	0.251
mean_temp_roms_30_norm	-1.083	0.106
I(mean_temp_roms_30_norm^2)	-0.251	0.042
mean_oxygen_roms_30_norm	0.137	0.115
I(mean_oxygen_roms_30_norm^2)	-0.536	0.055

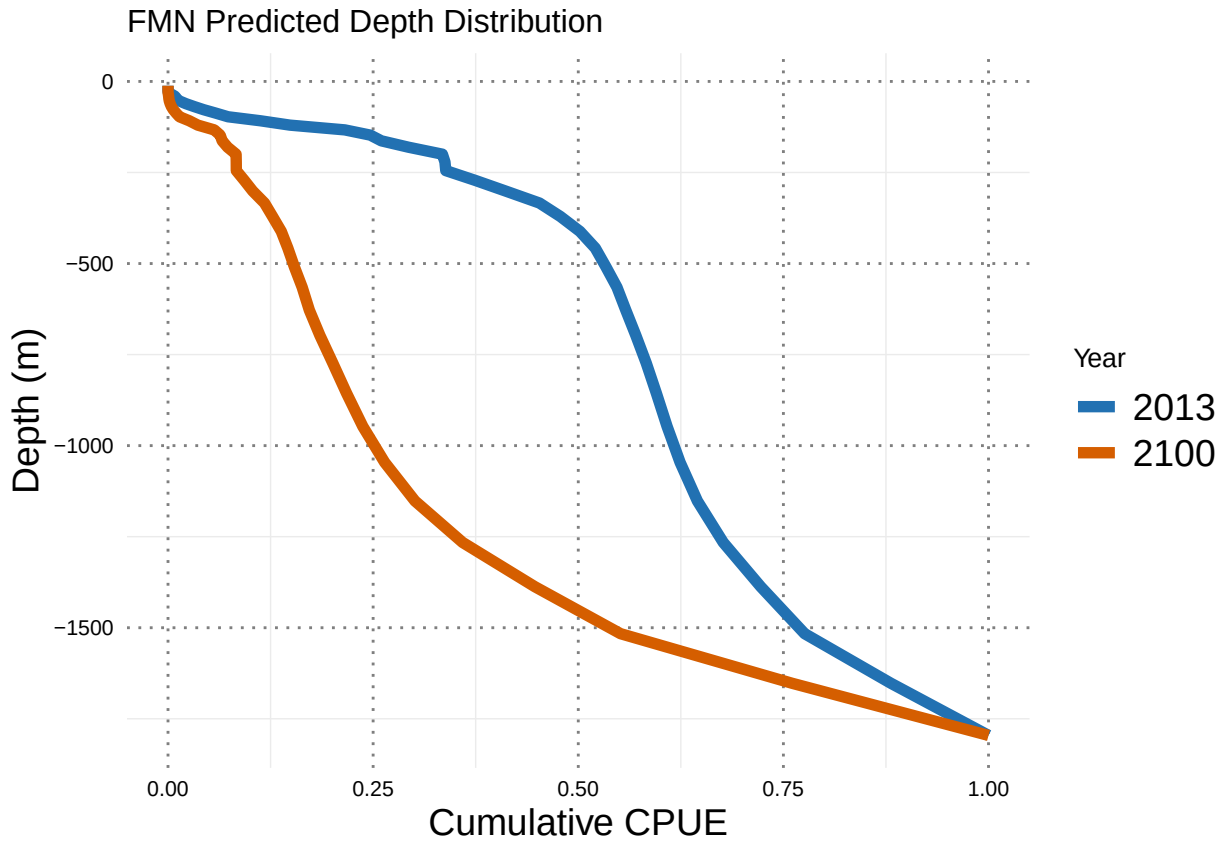
term	estimate	std.error
(Intercept)	5.210	0.245
s(mean_temp_roms_30_norm).1	1.326	0.188
s(mean_temp_roms_30_norm).2	-1.239	0.102
s(mean_oxygen_roms_30_norm).1	2.767	0.297
s(mean_oxygen_roms_30_norm).2	-0.664	0.091

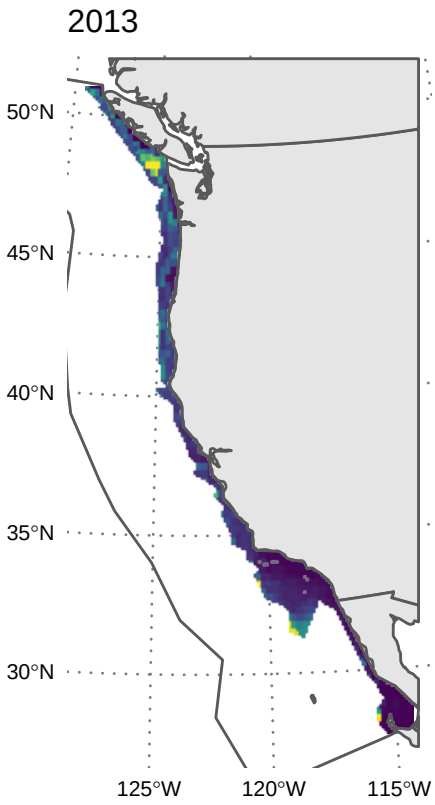

FMN Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025

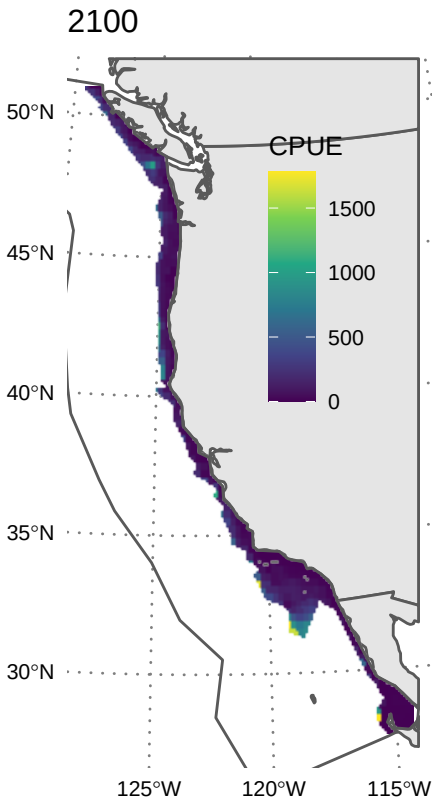

Center of Gravity, X
Eastings (km)
424
422
420
418
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
4320
4300
4280
2025
2050
2075
2100
Year


FMN
300
200
100
0
5
10
15
20


FMN Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W


2100
CPUE
1500
1000
500
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

FPO: Canary Rockfish

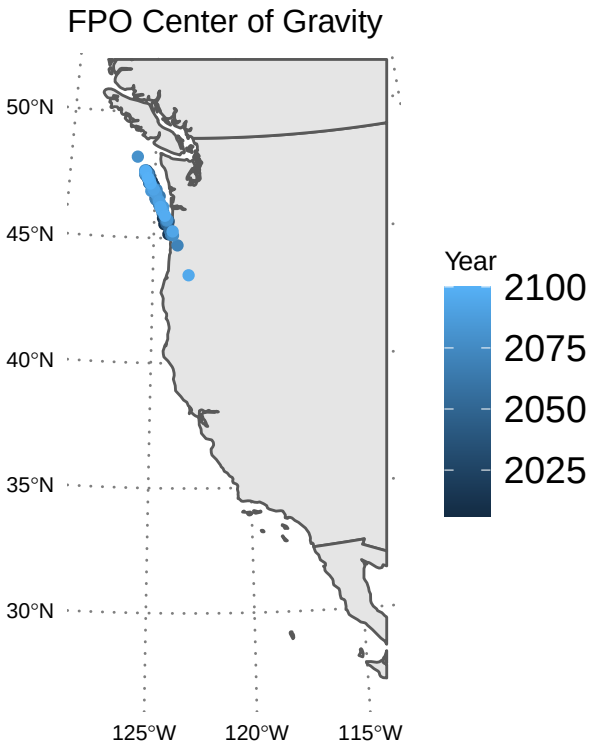
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
FPO	FALSE	FALSE	0.449	0	2.828
FPO	FALSE	TRUE	0.143	0	2.828
FPO	TRUE	FALSE	0.000	0	19.515
FPO	TRUE	TRUE	0.408	0	18.630

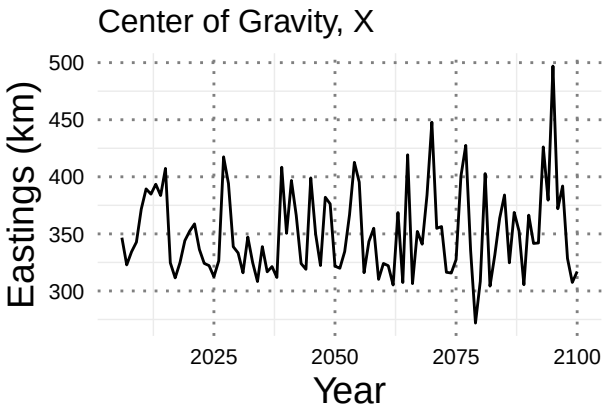
term	estimate	std.error
(Intercept)	2.797	0.247
mean_temp_roms_30_norm	3.673	0.531
I(mean_temp_roms_30_norm^2)	-2.578	0.261
mean_oxygen_roms_30_norm	4.191	0.412
I(mean_oxygen_roms_30_norm^2)	-1.663	0.155

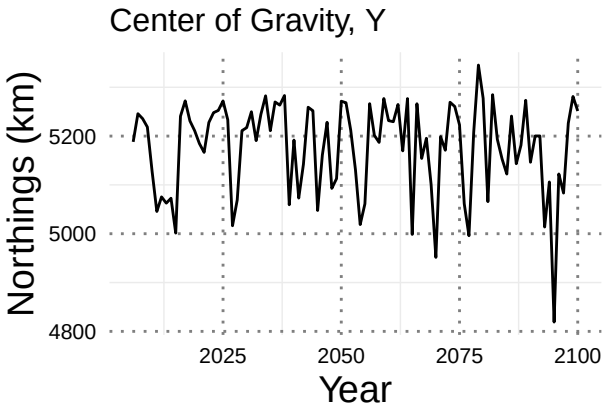
term	estimate	std.error
(Intercept)	-1.959	0.567
s(mean_temp_roms_30_norm).1	12.103	1.326
s(mean_temp_roms_30_norm).2	2.194	0.422
s(mean_oxygen_roms_30_norm).1	10.172	0.952
s(mean_oxygen_roms_30_norm).2	1.973	0.238

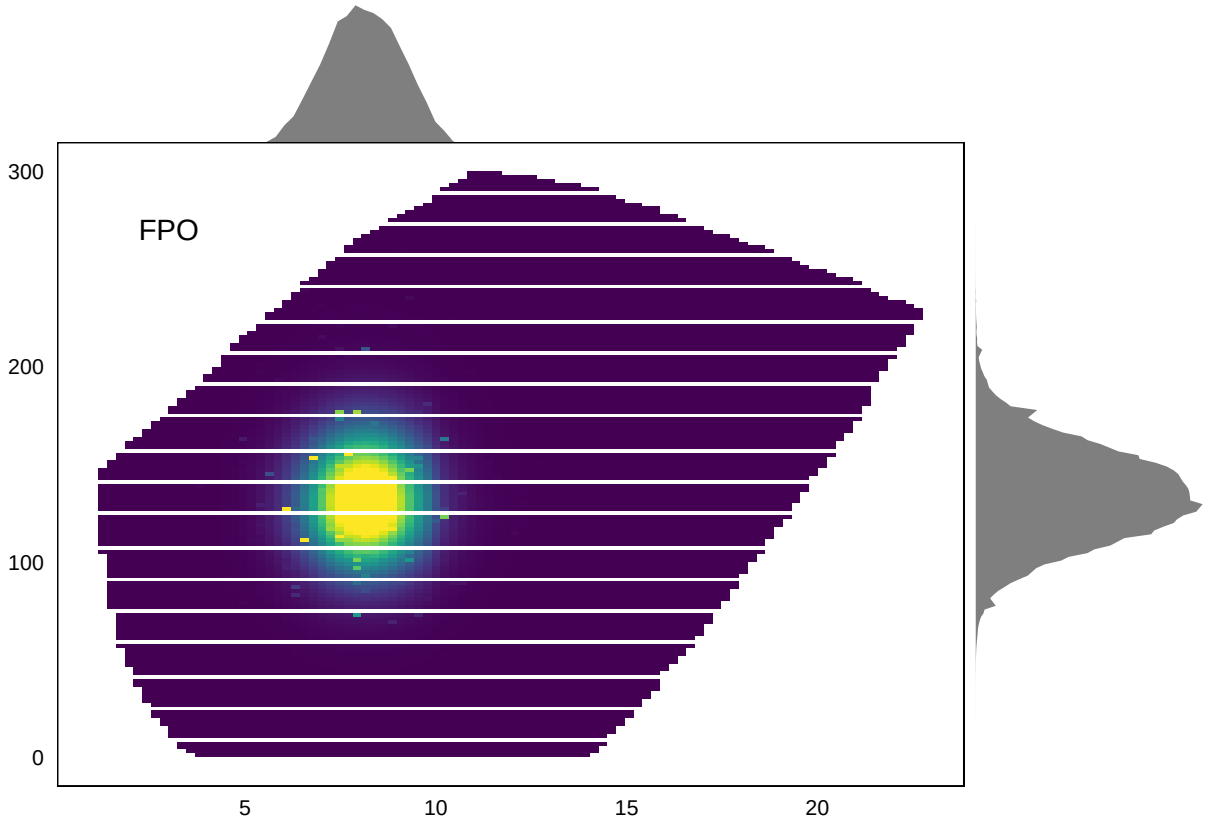
term	estimate	std.error
(Intercept)	0.752	0.445
mean_temp_roms_30_norm	2.745	0.578
I(mean_temp_roms_30_norm^2)	-1.870	0.282
mean_oxygen_roms_30_norm	4.165	0.498
I(mean_oxygen_roms_30_norm^2)	-1.593	0.188

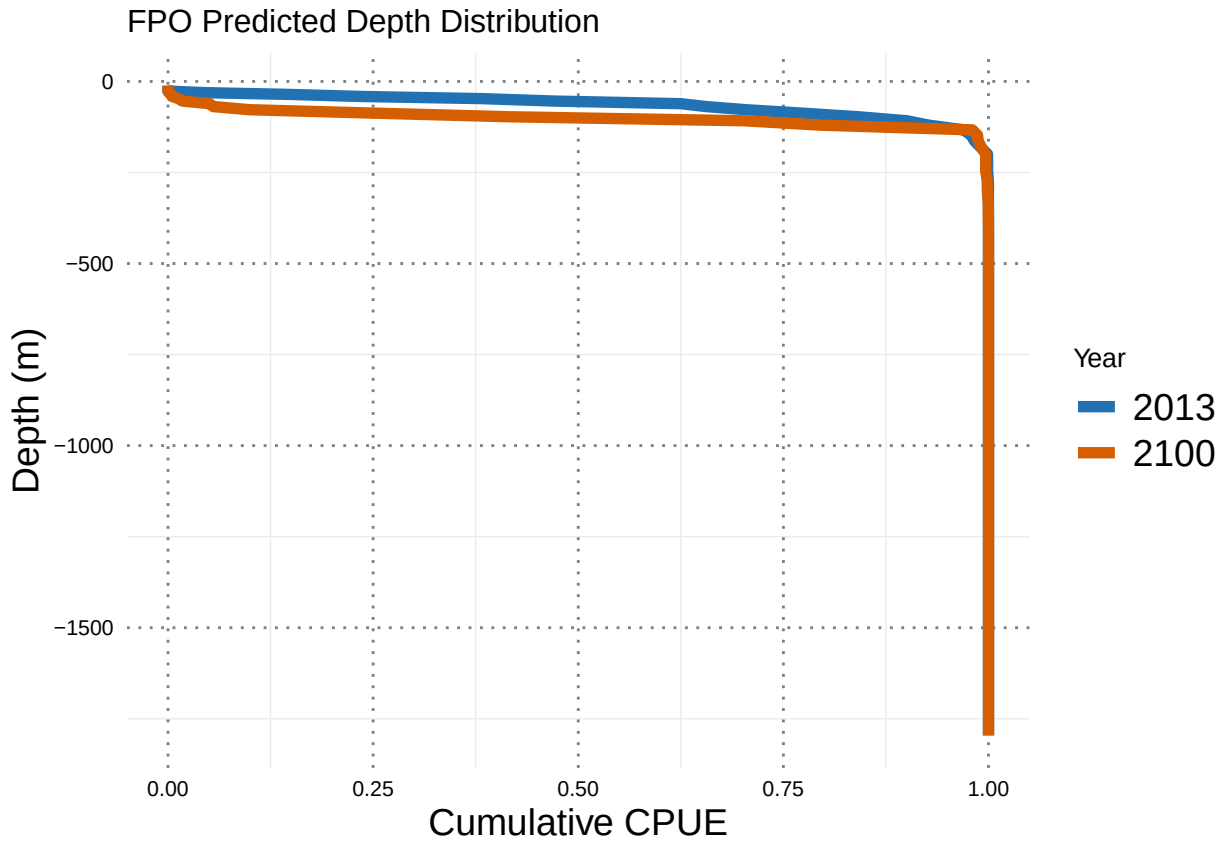
term	estimate	std.error
(Intercept)	-2.875	0.590
s(mean_temp_roms_30_norm).1	8.722	1.337
s(mean_temp_roms_30_norm).2	1.516	0.462
s(mean_oxygen_roms_30_norm).1	9.426	1.070
s(mean_oxygen_roms_30_norm).2	2.033	0.303

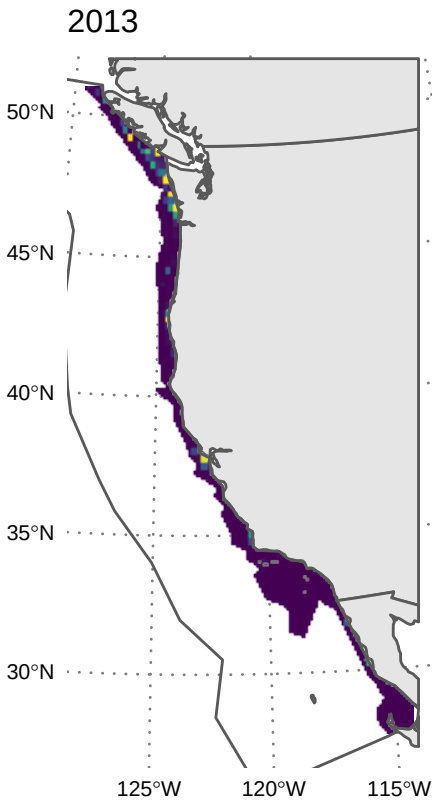

FPO Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025

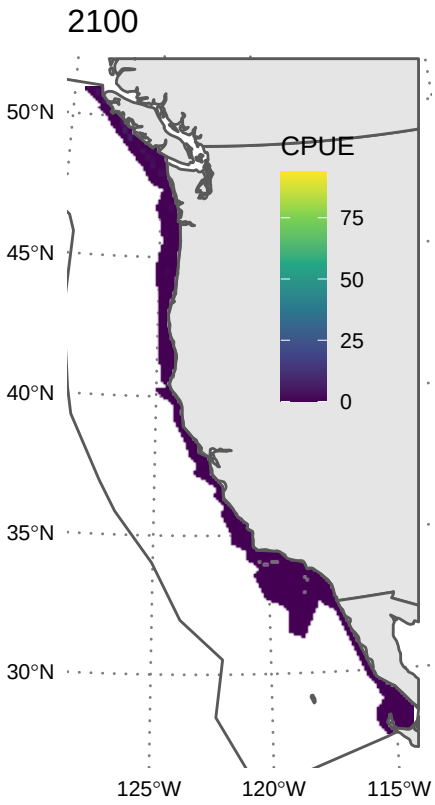

Center of Gravity, X
Eastings (km)
500
450
400
350
300
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
5200
5000
4800
2025
2050
2075
2100
Year


FPO
300
200
100
0
5
10
15
20


FPO Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W


2100
CPUE
75
50
25
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

FVD: Large Piscivorous Fish

California halibut, Pacific halibut

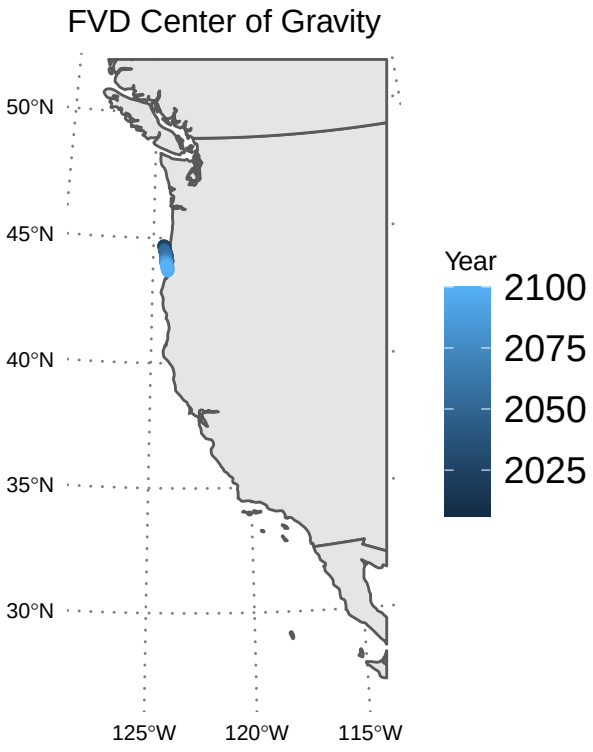
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
FVD	FALSE	FALSE	0.196	0	2.828
FVD	FALSE	TRUE	0.000	0	2.828
FVD	TRUE	FALSE	0.000	0	115.766
FVD	TRUE	TRUE	0.804	0	109.688

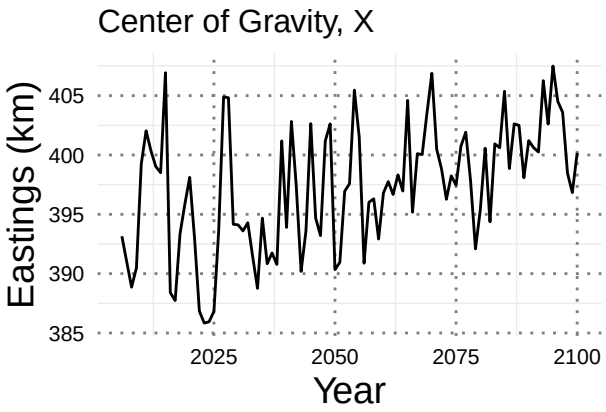
term	estimate	std.error
(Intercept)	4.127	0.086
mean_temp_roms_30_norm	0.167	0.209
I(mean_temp_roms_30_norm^2)	-0.603	0.095
mean_oxygen_roms_30_norm	1.711	0.191
I(mean_oxygen_roms_30_norm^2)	-0.472	0.078

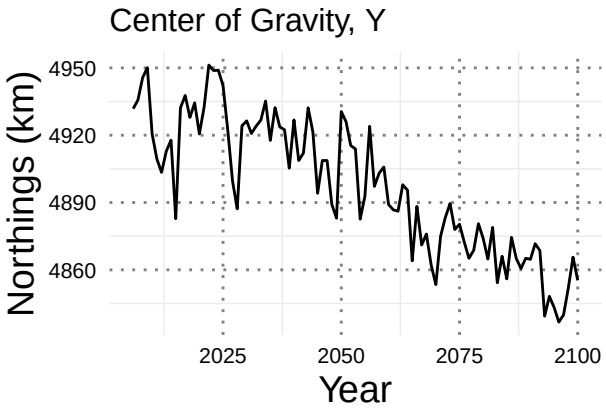
term	estimate	std.error
(Intercept)	2.999	0.119
s(mean_temp_roms_30_norm).1	3.347	0.494
s(mean_temp_roms_30_norm).2	-0.142	0.171
s(mean_oxygen_roms_30_norm).1	2.519	0.453
s(mean_oxygen_roms_30_norm).2	0.982	0.110

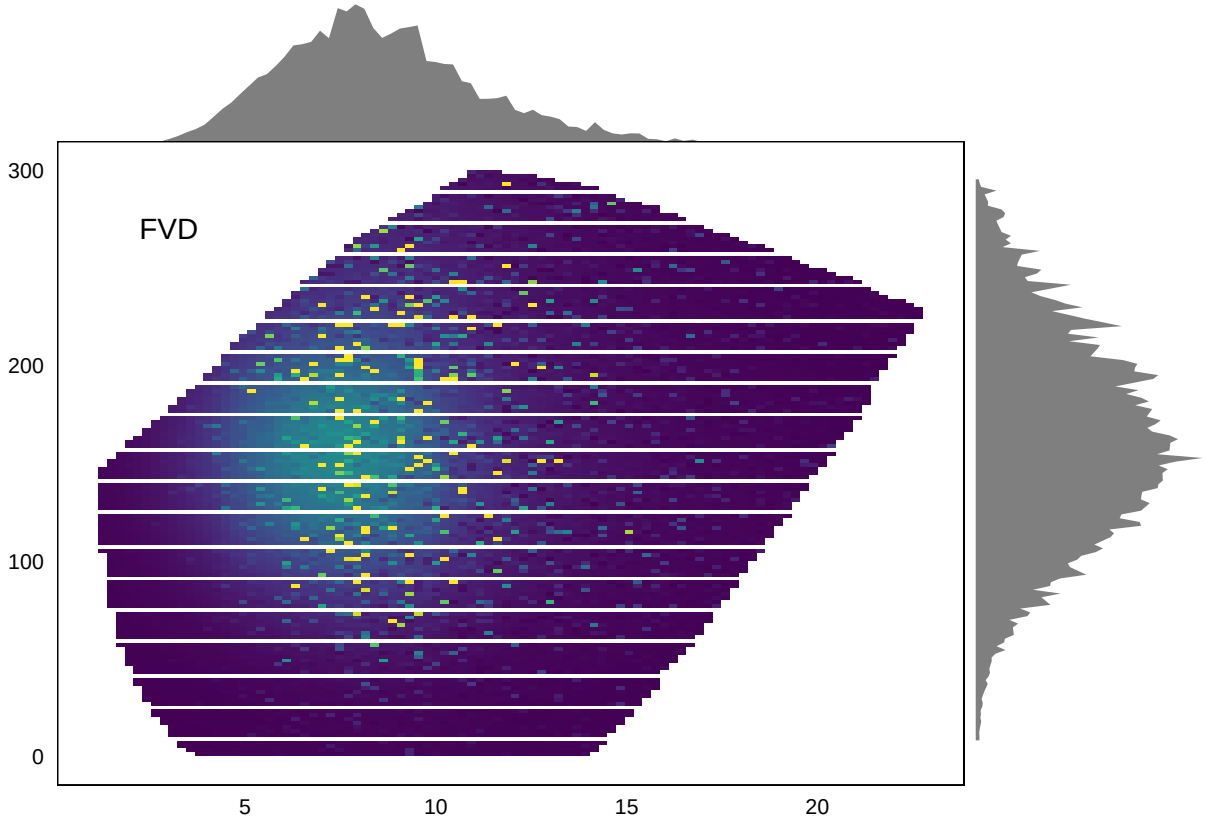
term	estimate	std.error
(Intercept)	1.722	0.624
mean_temp_roms_30_norm	1.270	0.310
I(mean_temp_roms_30_norm^2)	-0.474	0.140
mean_oxygen_roms_30_norm	1.132	0.283
I(mean_oxygen_roms_30_norm^2)	-0.320	0.094

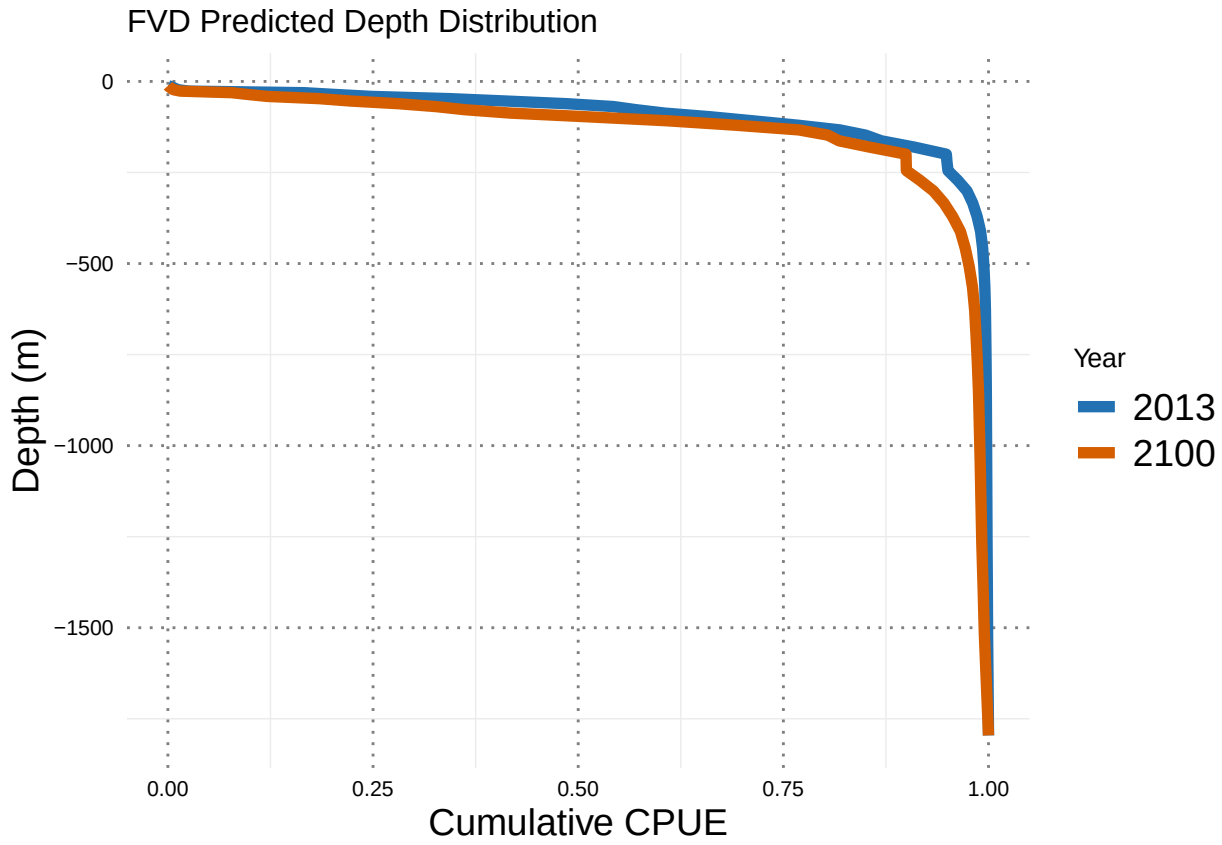
term	estimate	std.error
(Intercept)	0.966	0.586
s(mean_temp_roms_30_norm).1	2.805	0.694
s(mean_temp_roms_30_norm).2	0.992	0.274
s(mean_oxygen_roms_30_norm).1	1.676	0.572
s(mean_oxygen_roms_30_norm).2	0.645	0.196

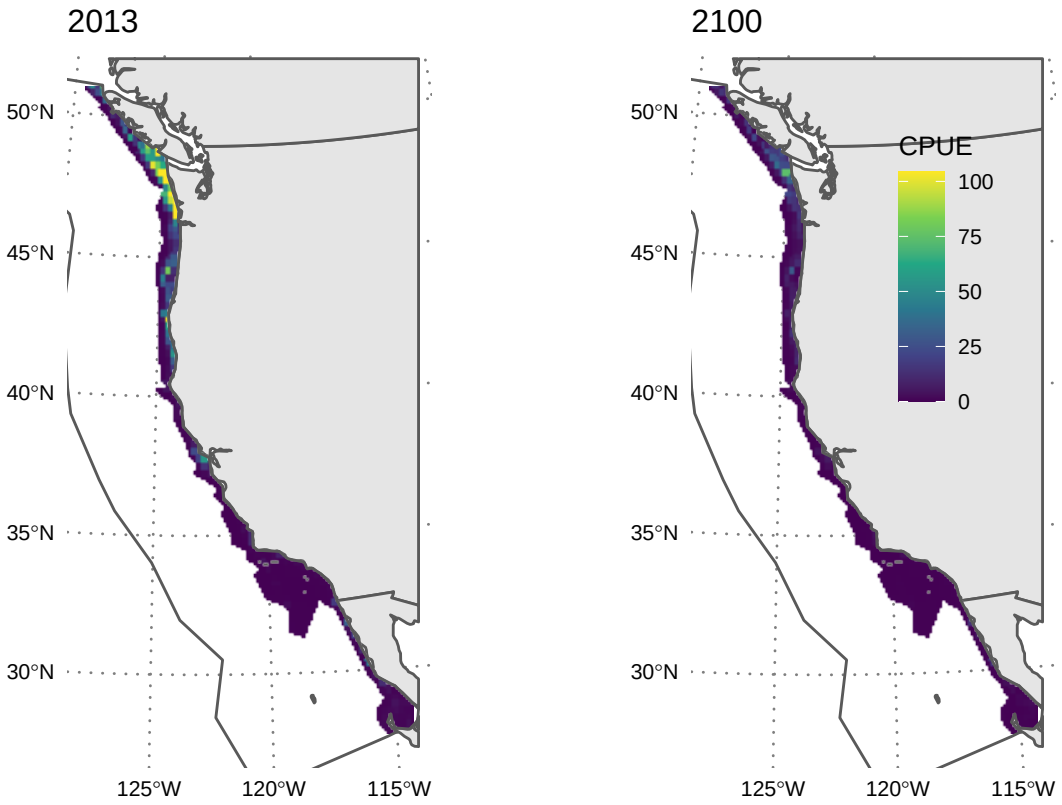

FVD Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025


Center of Gravity, X
Eastings (km)
405
400
395
390
385
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
4950
4920
4890
4860
2025
2050
2075
2100
Year


FVD
300
200
100
0
5
10
15
20


FVD Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
2100
CPUE
100
75
50
25
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

FVS: Large Demersal Fish

Lingcod, cabezon

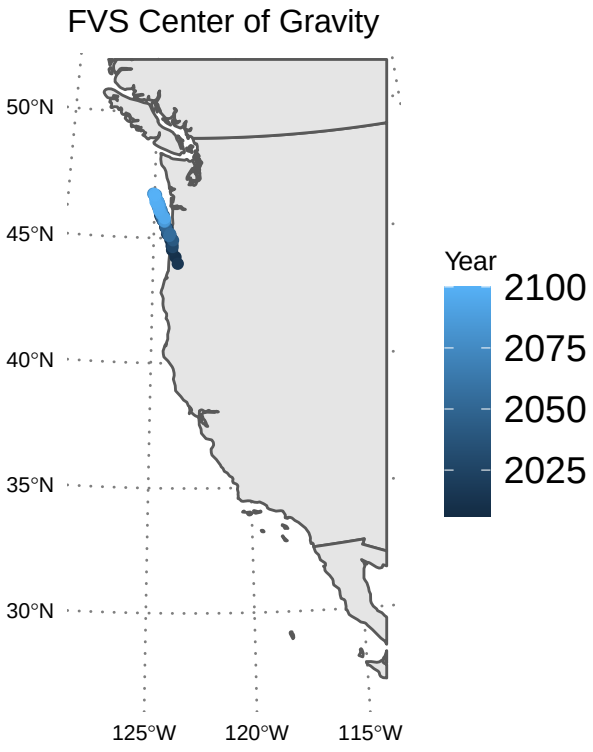
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
FVS	FALSE	FALSE	0.112	0	2.828
FVS	FALSE	TRUE	0.168	0	2.828
FVS	TRUE	FALSE	0.000	0	54.940
FVS	TRUE	TRUE	0.721	0	61.210

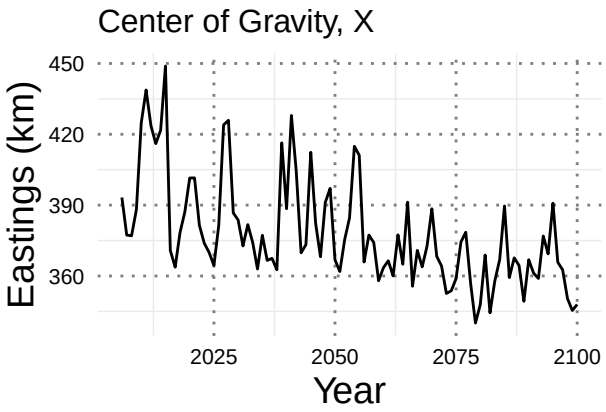
term	estimate	std.error
(Intercept)	5.018	0.066
mean_temp_roms_30_norm	2.824	0.162
I(mean_temp_roms_30_norm^2)	-1.608	0.064
mean_oxygen_roms_30_norm	1.789	0.139
I(mean_oxygen_roms_30_norm^2)	-0.822	0.060

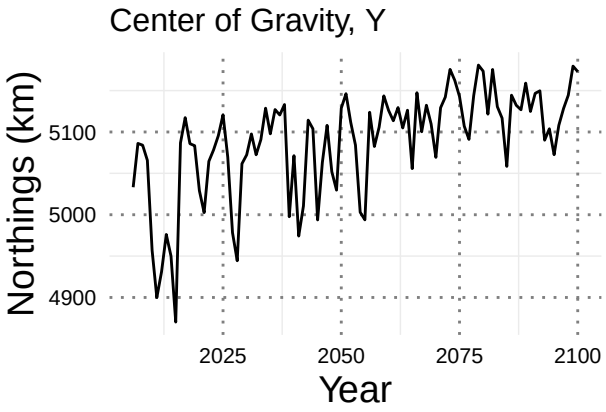
term	estimate	std.error
(Intercept)	2.176	0.117
s(mean_temp_roms_30_norm).1	9.081	0.355
s(mean_temp_roms_30_norm).2	2.121	0.133
s(mean_oxygen_roms_30_norm).1	4.252	0.333
s(mean_oxygen_roms_30_norm).2	0.517	0.074

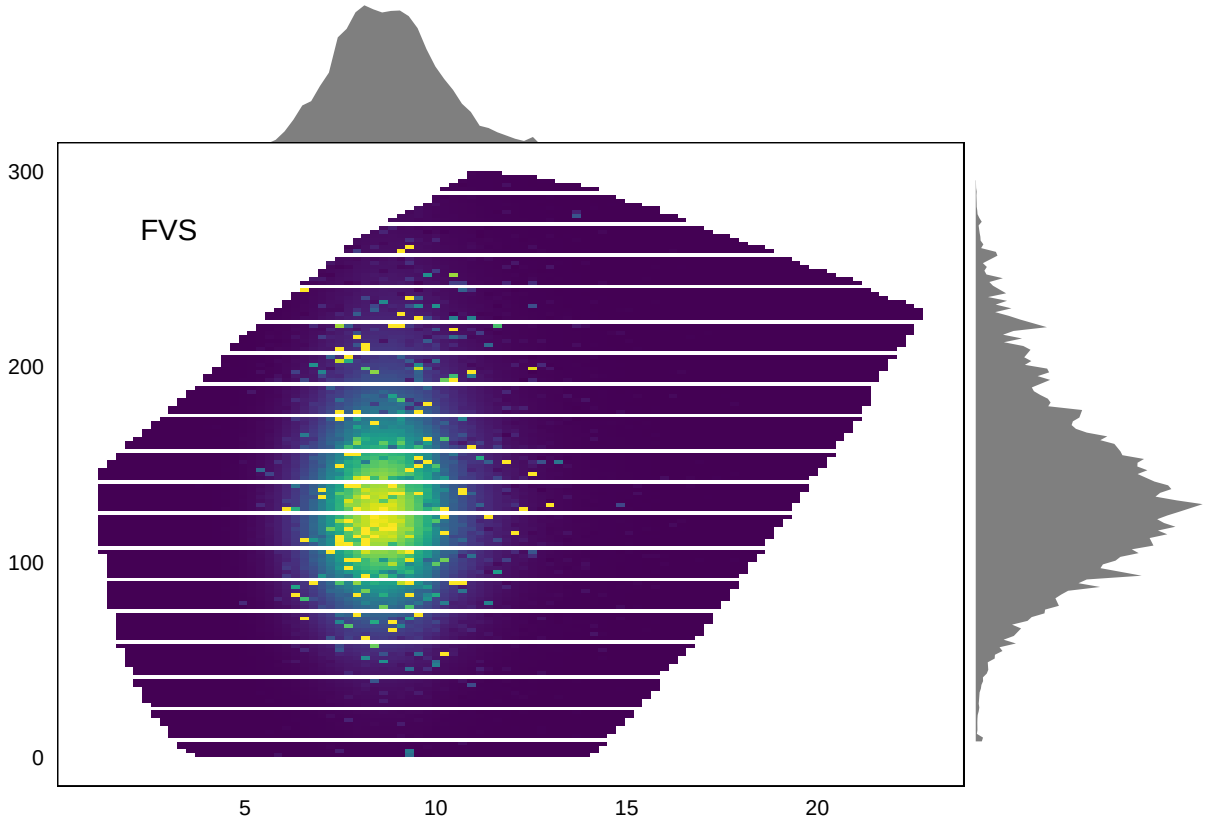
term	estimate	std.error
(Intercept)	2.584	0.416
mean_temp_roms_30_norm	3.499	0.217
I(mean_temp_roms_30_norm^2)	-1.483	0.090
mean_oxygen_roms_30_norm	1.751	0.195
I(mean_oxygen_roms_30_norm^2)	-0.637	0.072

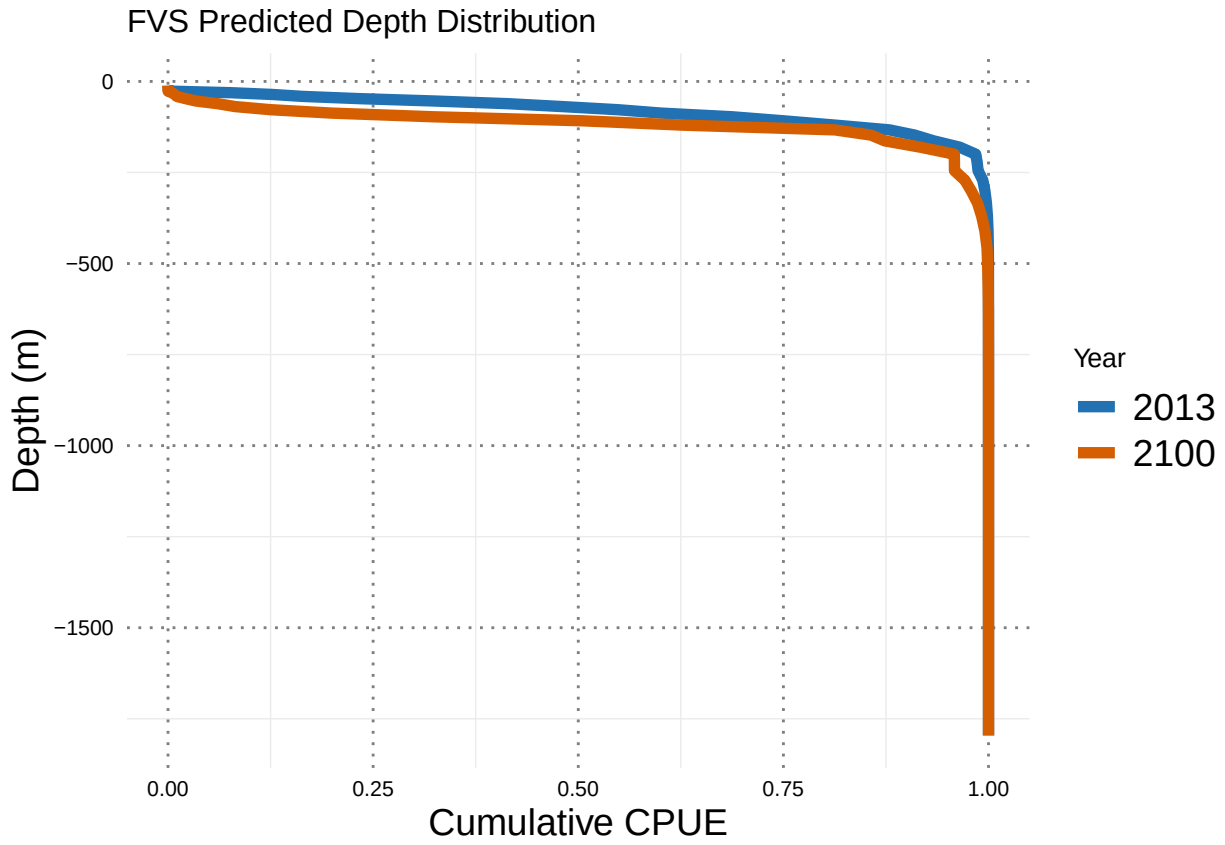
term	estimate	std.error
(Intercept)	0.282	0.444
s(mean_temp_roms_30_norm).1	8.206	0.460
s(mean_temp_roms_30_norm).2	2.790	0.185
s(mean_oxygen_roms_30_norm).1	3.275	0.401
s(mean_oxygen_roms_30_norm).2	0.788	0.126

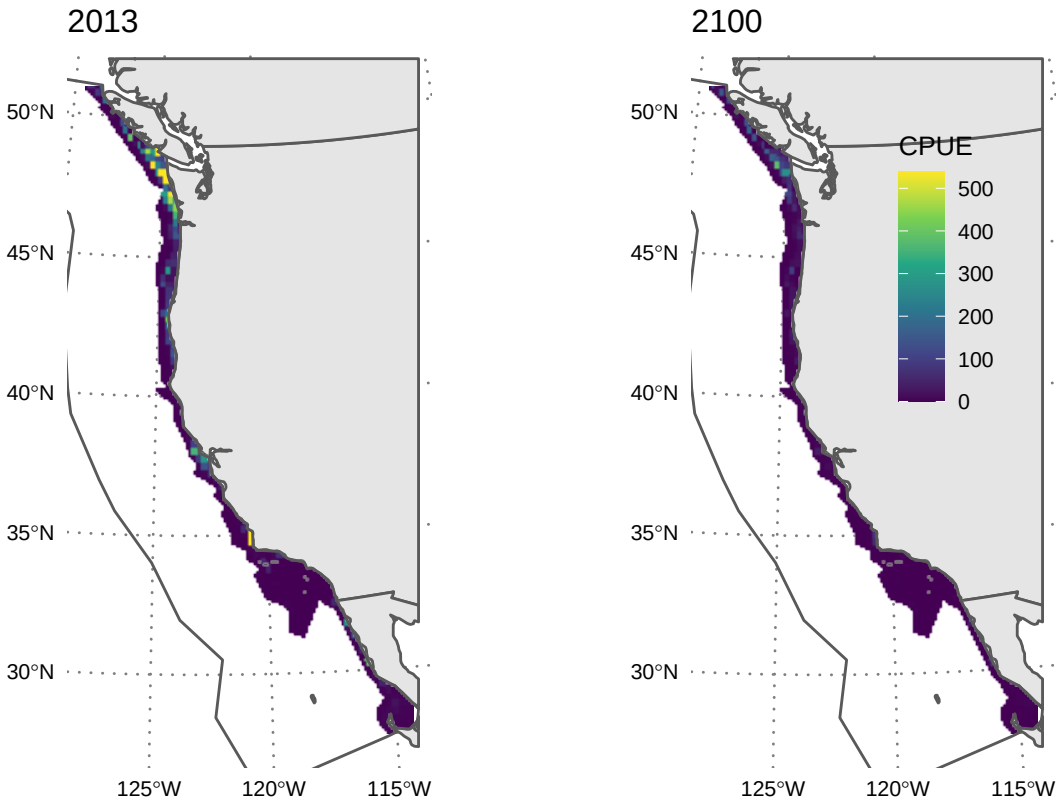

FVS Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025


Center of Gravity, X
Eastings (km)
450
420
390
360
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
5100
5000
4900
2025
2050
2075
2100
Year


FVS
300
200
100
0
5
10
15
20


FVS Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
2100
CPUE
500
400
300
200
100
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

FVV: Shortbelly Rockfish

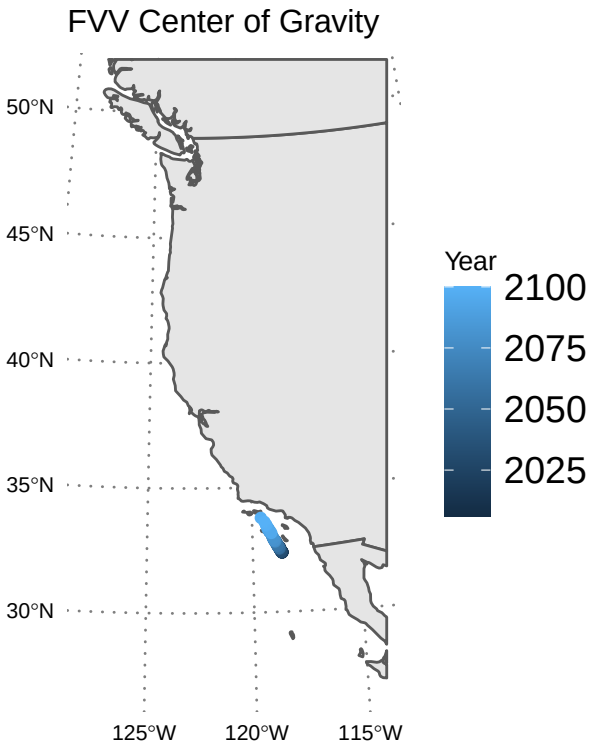
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
FVV	FALSE	FALSE	0.103	0	2.828
FVV	FALSE	TRUE	0.227	0	2.828
FVV	TRUE	FALSE	0.067	0	84.464
FVV	TRUE	TRUE	0.602	0	95.039

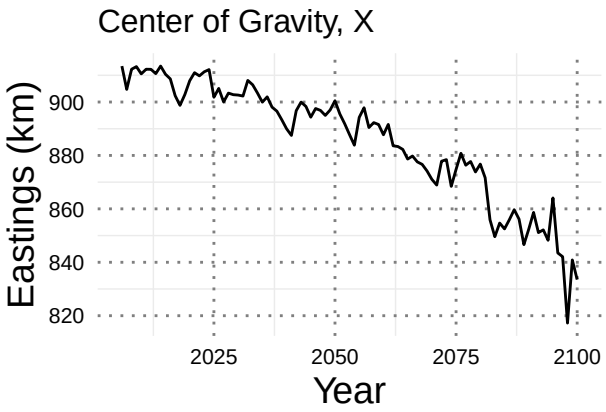
term	estimate	std.error
(Intercept)	0.535	0.319
mean_temp_roms_30_norm	13.577	0.798
I(mean_temp_roms_30_norm^2)	-3.971	0.337
mean_oxygen_roms_30_norm	-5.440	0.592
I(mean_oxygen_roms_30_norm^2)	0.643	0.322

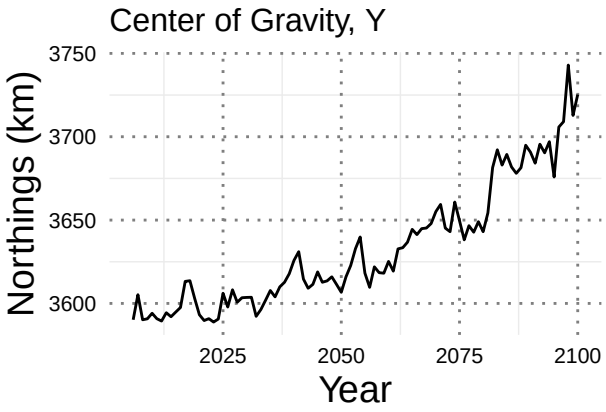
term	estimate	std.error
(Intercept)	-4.739	0.517
s(mean_temp_roms_30_norm).1	23.433	1.637
s(mean_temp_roms_30_norm).2	12.380	0.600
s(mean_oxygen_roms_30_norm).1	-3.899	1.400
s(mean_oxygen_roms_30_norm).2	-4.508	0.375

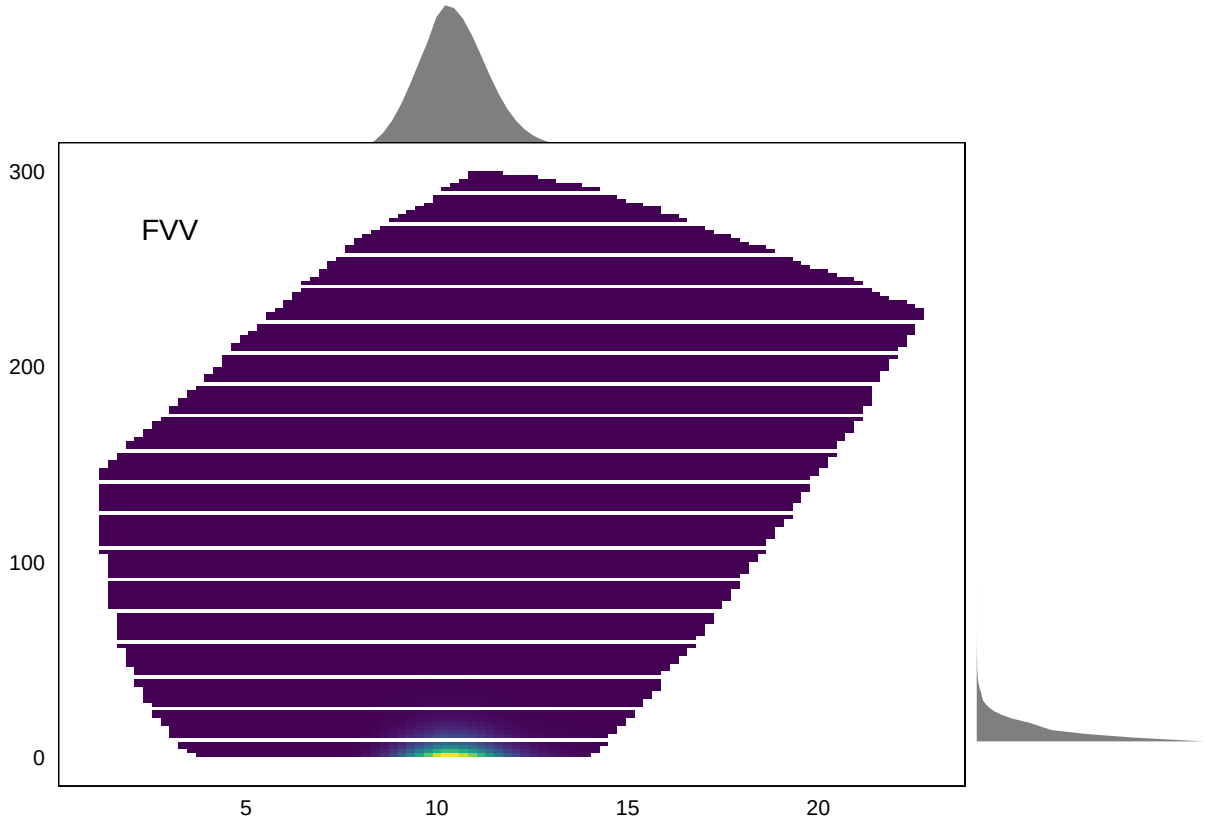
term	estimate	std.error
(Intercept)	-5.034	1.867
mean_temp_roms_30_norm	5.100	0.968
I(mean_temp_roms_30_norm^2)	-2.202	0.392
mean_oxygen_roms_30_norm	3.240	0.720
I(mean_oxygen_roms_30_norm^2)	-1.877	0.432

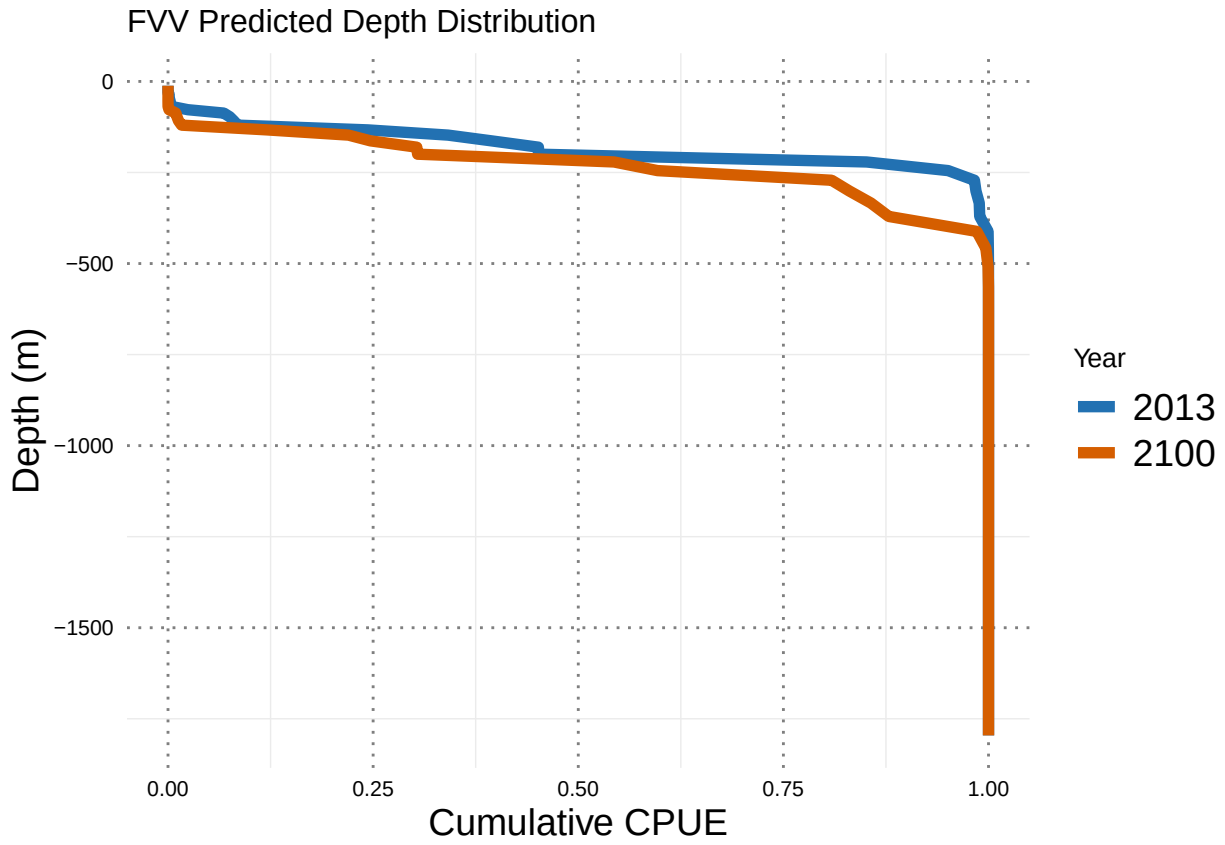
term	estimate	std.error
(Intercept)	-10.436	2.117
s(mean_temp_roms_30_norm).1	16.009	2.088
s(mean_temp_roms_30_norm).2	5.572	0.849
s(mean_oxygen_roms_30_norm).1	6.388	1.976
s(mean_oxygen_roms_30_norm).2	0.674	0.492

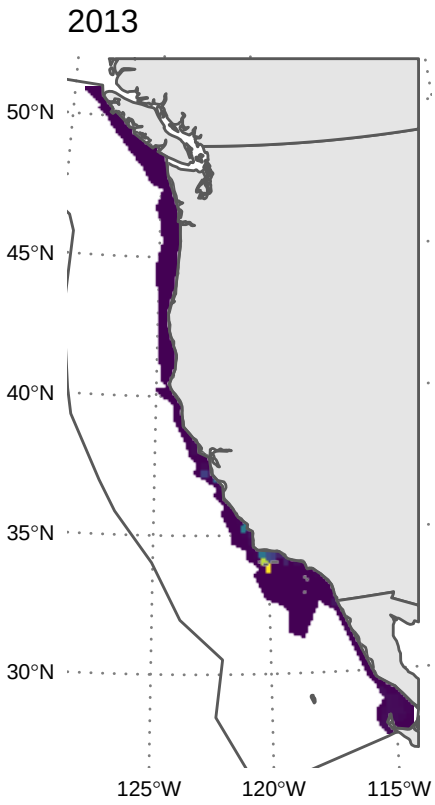

FVV Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025

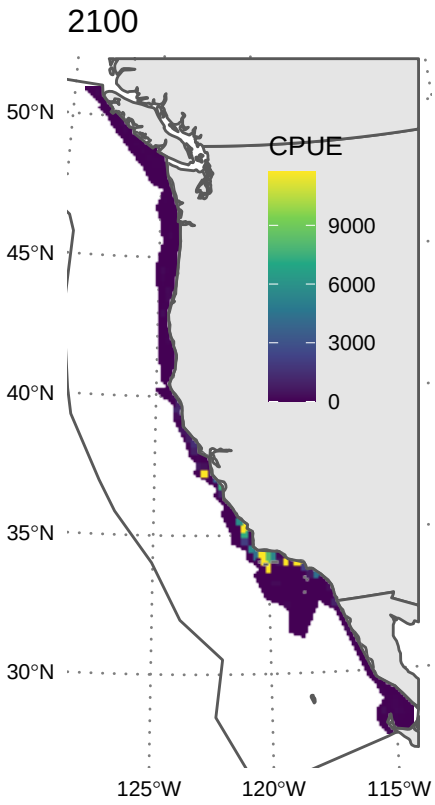

Center of Gravity, X
Eastings (km)
900
880
860
840
820
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
3750
3700
3650
3600
2025
2050
2075
2100
Year


FVV
300
200
100
0
5
10
15
20


FVV Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W


2100
CPUE
9000
6000
3000
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

PET: Petrale sole

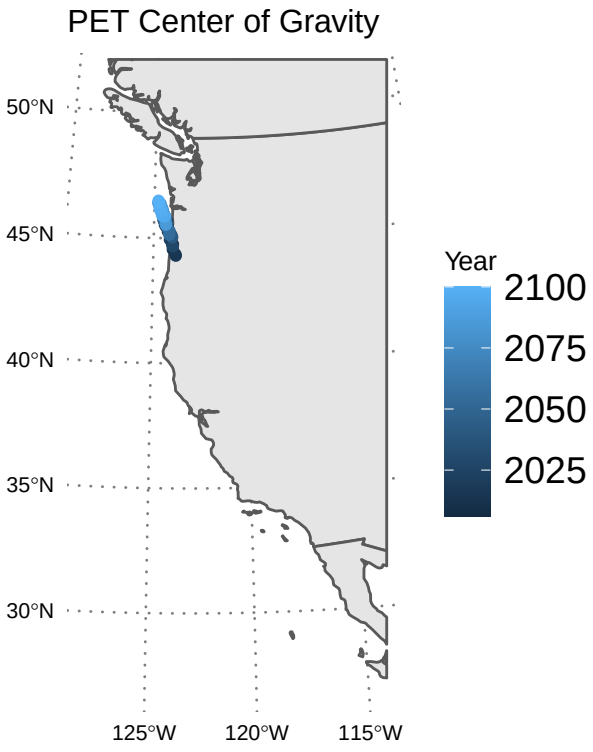
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
PET	FALSE	FALSE	0.120	0	2.828
PET	FALSE	TRUE	0.194	0	2.828
PET	TRUE	FALSE	0.000	0	116.786
PET	TRUE	TRUE	0.686	0	113.432

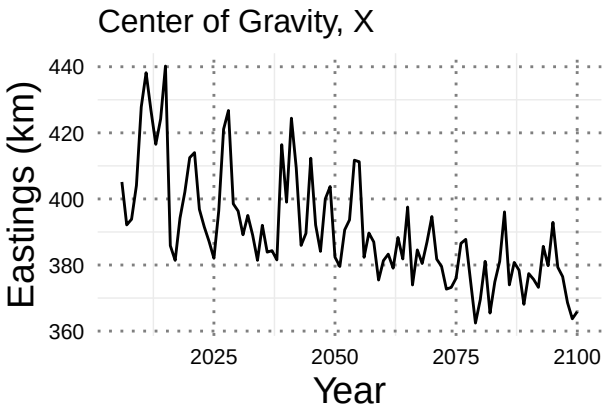
term	estimate	std.error
(Intercept)	4.235	0.050
mean_temp_roms_30_norm	3.603	0.120
I(mean_temp_roms_30_norm^2)	-1.707	0.061
mean_oxygen_roms_30_norm	1.124	0.083
I(mean_oxygen_roms_30_norm^2)	-0.469	0.035

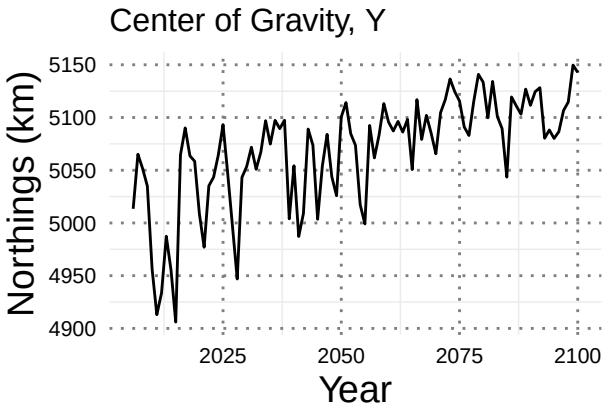
term	estimate	std.error
(Intercept)	2.020	0.095
s(mean_temp_roms_30_norm).1	7.775	0.295
s(mean_temp_roms_30_norm).2	2.562	0.094
s(mean_oxygen_roms_30_norm).1	2.782	0.203
s(mean_oxygen_roms_30_norm).2	0.428	0.046

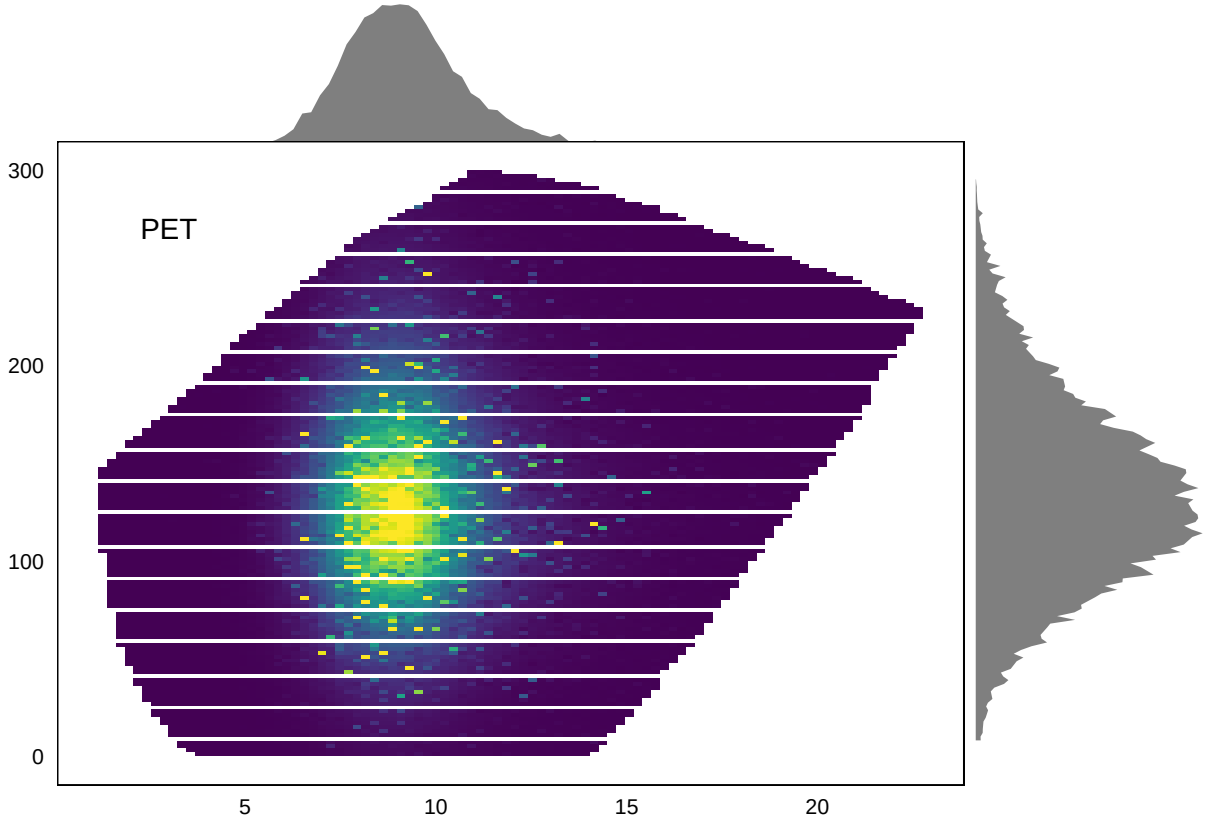
term	estimate	std.error
(Intercept)	3.093	0.483
mean_temp_roms_30_norm	2.919	0.145
I(mean_temp_roms_30_norm^2)	-1.226	0.069
mean_oxygen_roms_30_norm	1.067	0.115
I(mean_oxygen_roms_30_norm^2)	-0.464	0.043

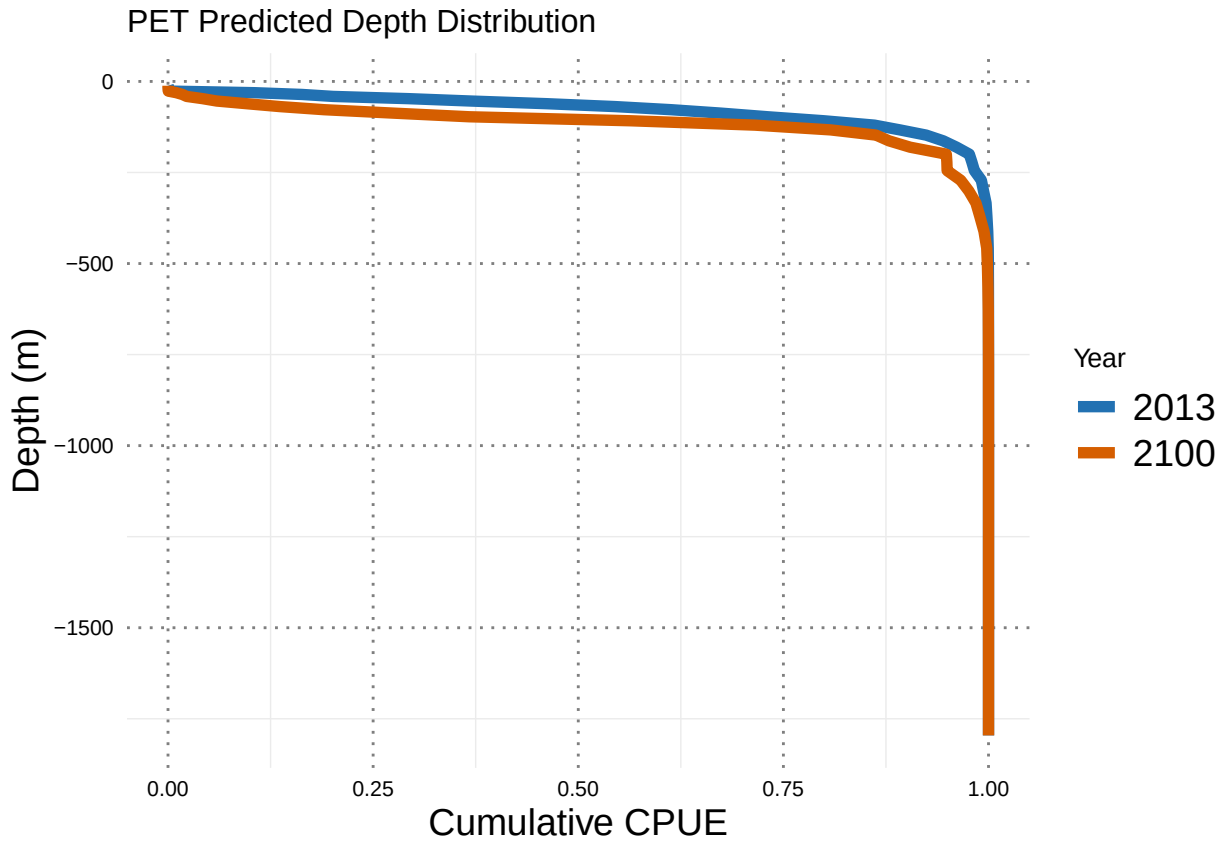
term	estimate	std.error
(Intercept)	1.356	0.461
s(mean_temp_roms_30_norm).1	5.797	0.331
s(mean_temp_roms_30_norm).2	2.180	0.119
s(mean_oxygen_roms_30_norm).1	2.748	0.254
s(mean_oxygen_roms_30_norm).2	0.416	0.076

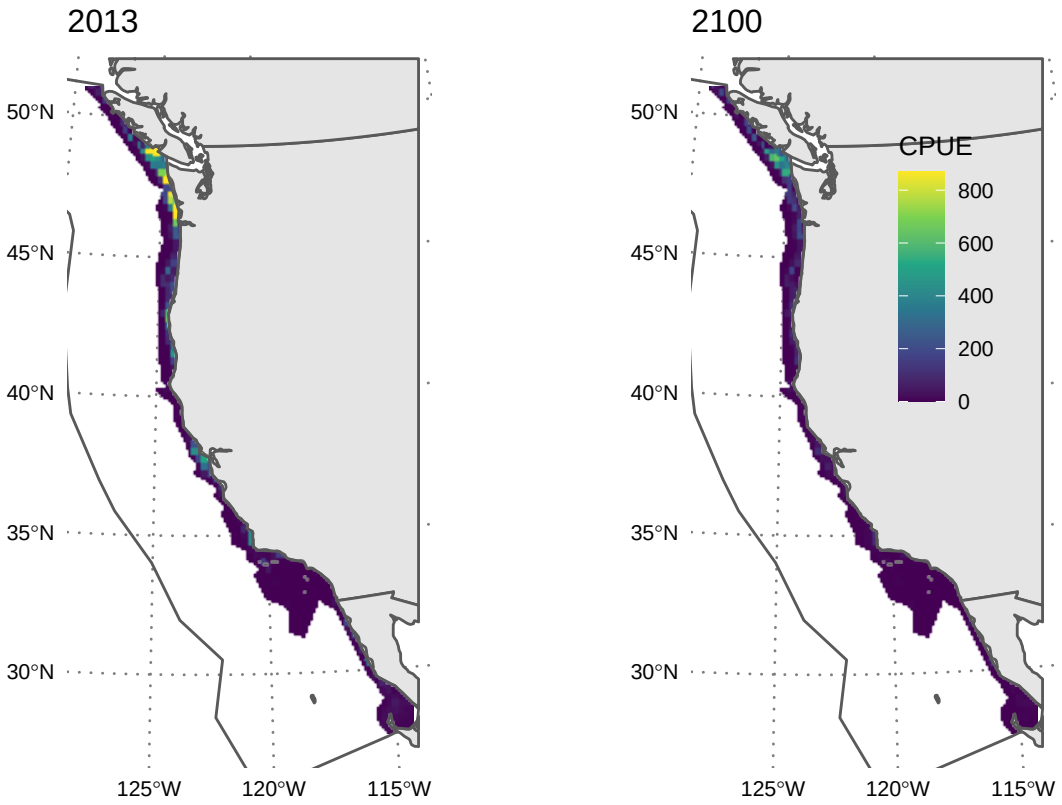

PET Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025


Center of Gravity, X
Eastings (km)
440
420
400
380
360
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
5150
5100
5050
5000
4950
4900
2025
2050
2075
2100
Year


PET
300
200
100
0
5
10
15
20


PET Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
2100
CPUE
800
600
400
200
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

POP: Pacific Ocean Perch

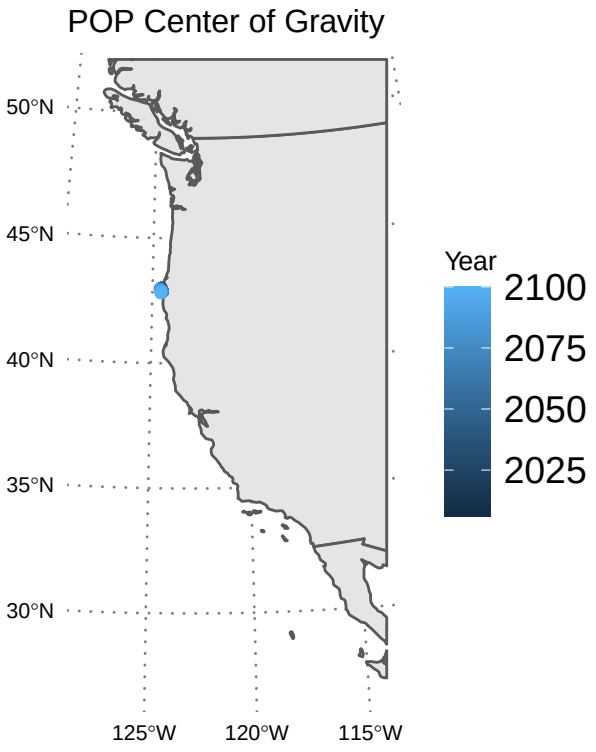
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
POP	FALSE	FALSE	0.329	0	2.828
POP	FALSE	TRUE	0.193	0	2.828
POP	TRUE	FALSE	0.478	0	325.316
POP	TRUE	TRUE	0.000	0	299.412

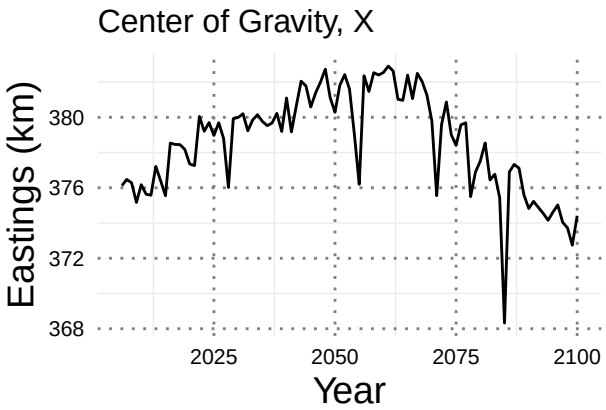
term	estimate	std.error
(Intercept)	5.962	0.134
mean_temp_roms_30_norm	-6.573	0.373
I(mean_temp_roms_30_norm^2)	-2.433	0.285
mean_oxygen_roms_30_norm	6.810	0.378
I(mean_oxygen_roms_30_norm^2)	-5.837	0.321

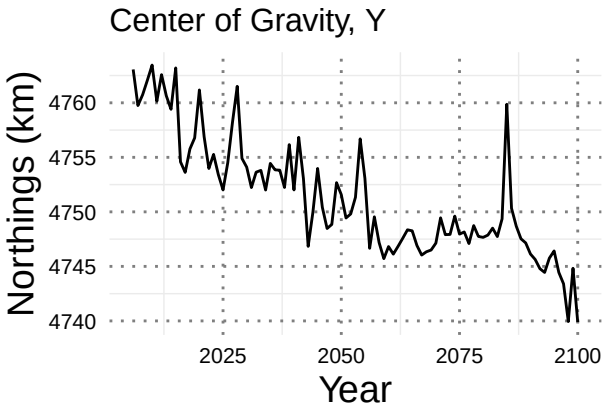
term	estimate	std.error
(Intercept)	-1.828	0.204
s(mean_temp_roms_30_norm).1	11.965	1.099
s(mean_temp_roms_30_norm).2	-7.807	0.308
s(mean_oxygen_roms_30_norm).1	27.198	1.528
s(mean_oxygen_roms_30_norm).2	-1.393	0.279

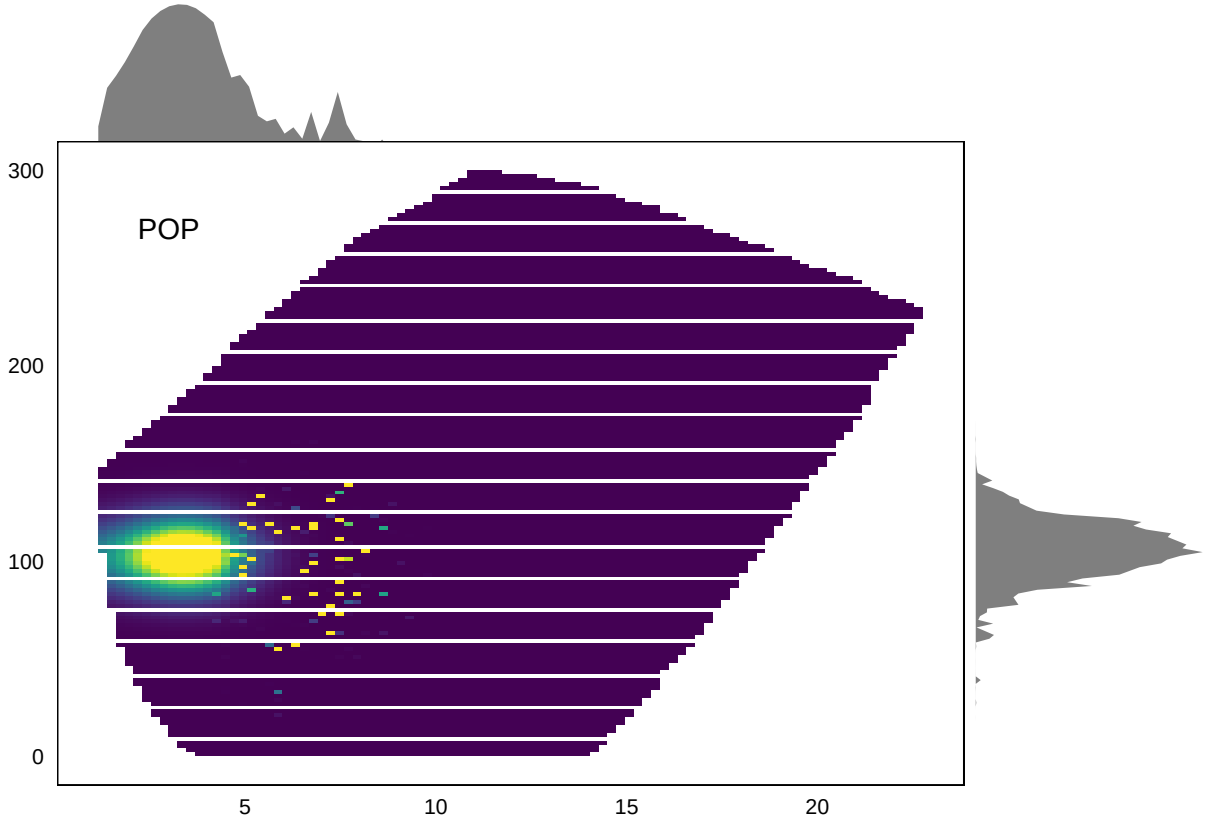
term	estimate	std.error
(Intercept)	-12.699	9.370
mean_temp_roms_30_norm	0.668	0.588
I(mean_temp_roms_30_norm^2)	-5.286	0.524
mean_oxygen_roms_30_norm	1.716	0.534
I(mean_oxygen_roms_30_norm^2)	-3.246	0.394

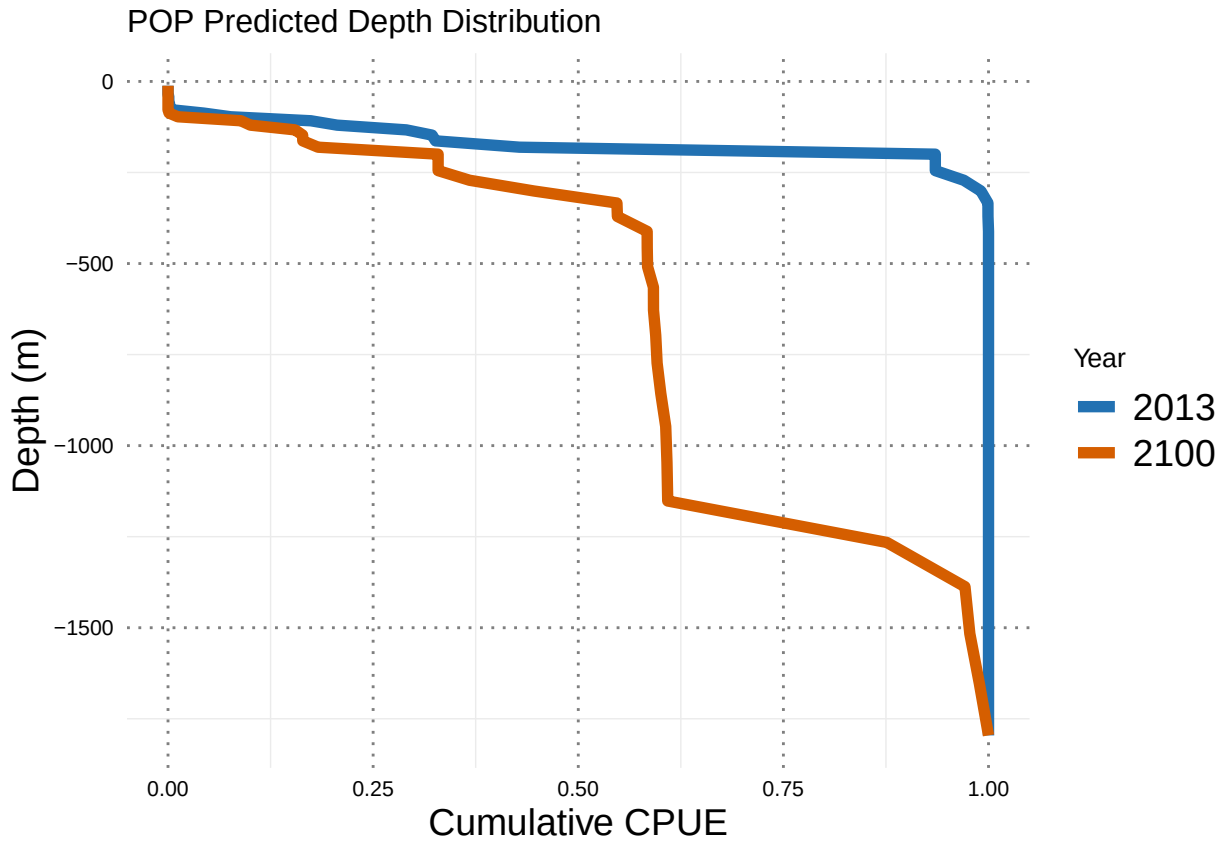
term	estimate	std.error
(Intercept)	-19.223	8.475
s(mean_temp_roms_30_norm).1	22.217	1.973
s(mean_temp_roms_30_norm).2	-2.771	0.599
s(mean_oxygen_roms_30_norm).1	15.014	1.820
s(mean_oxygen_roms_30_norm).2	-2.809	0.438

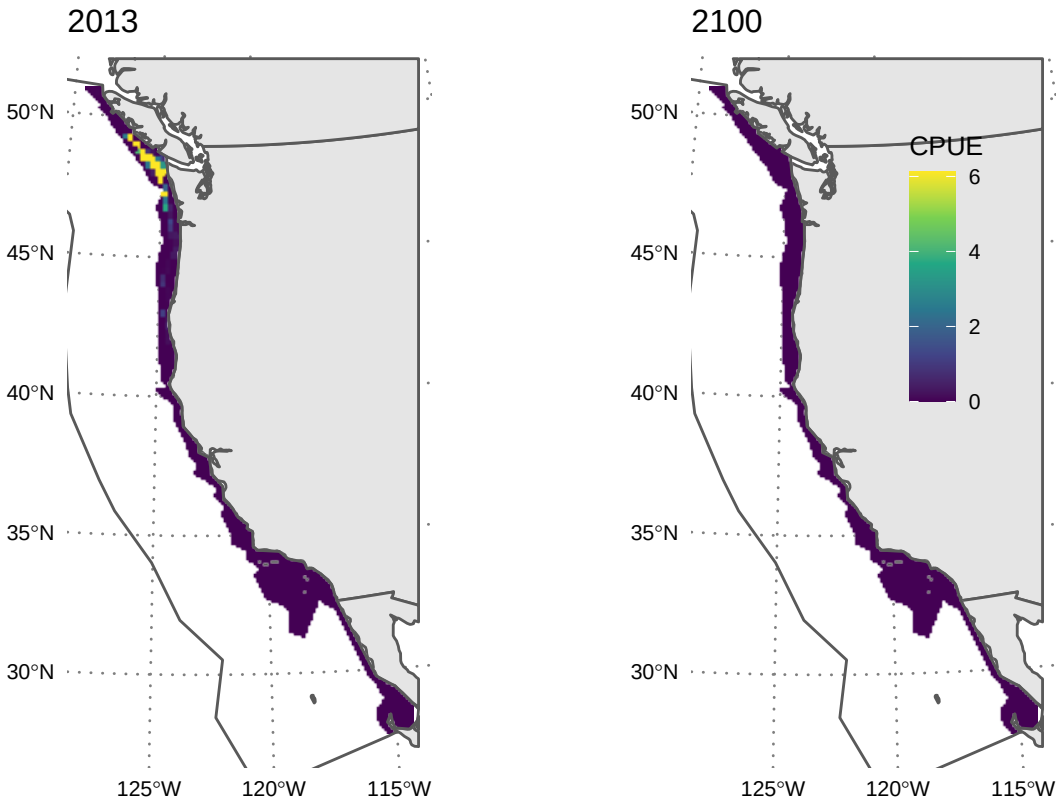

POP Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025


Center of Gravity, X
Eastings (km)
380
376
372
368
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
4760
4755
4750
4745
4740
2025
2050
2075
2100
Year


POP
300
200
100
0
5
10
15
20


POP Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
2100
CPUE
6
4
2
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

SHC: Cowcod

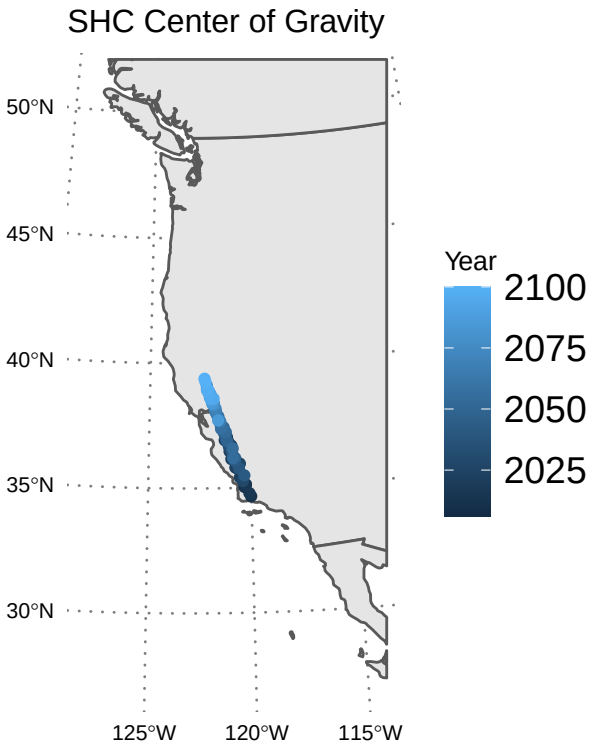
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
SHC	FALSE	FALSE	0.000	0	2.828
SHC	FALSE	TRUE	0.411	0	2.828
SHC	TRUE	FALSE	0.412	0	124.148
SHC	TRUE	TRUE	0.177	0	128.372

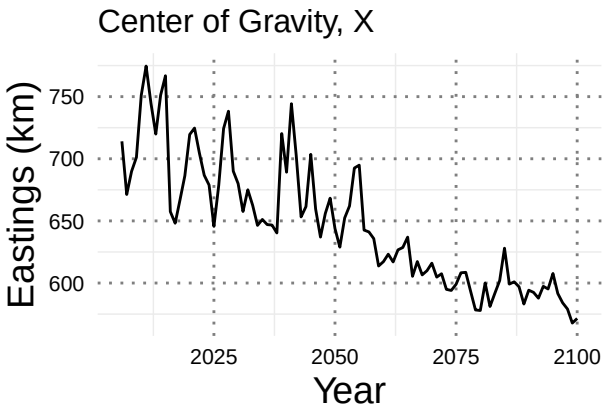
term	estimate	std.error
(Intercept)	-1.875	0.395
mean_temp_roms_30_norm	7.850	0.883
I(mean_temp_roms_30_norm^2)	-2.717	0.441
mean_oxygen_roms_30_norm	-0.379	0.614
I(mean_oxygen_roms_30_norm^2)	-1.253	0.471

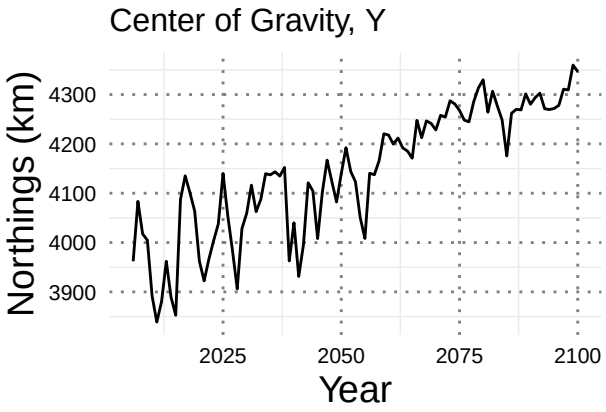
term	estimate	std.error
(Intercept)	-6.791	0.802
s(mean_temp_roms_30_norm).1	14.813	2.394
s(mean_temp_roms_30_norm).2	6.905	0.744
s(mean_oxygen_roms_30_norm).1	6.444	2.172
s(mean_oxygen_roms_30_norm).2	-2.220	0.458

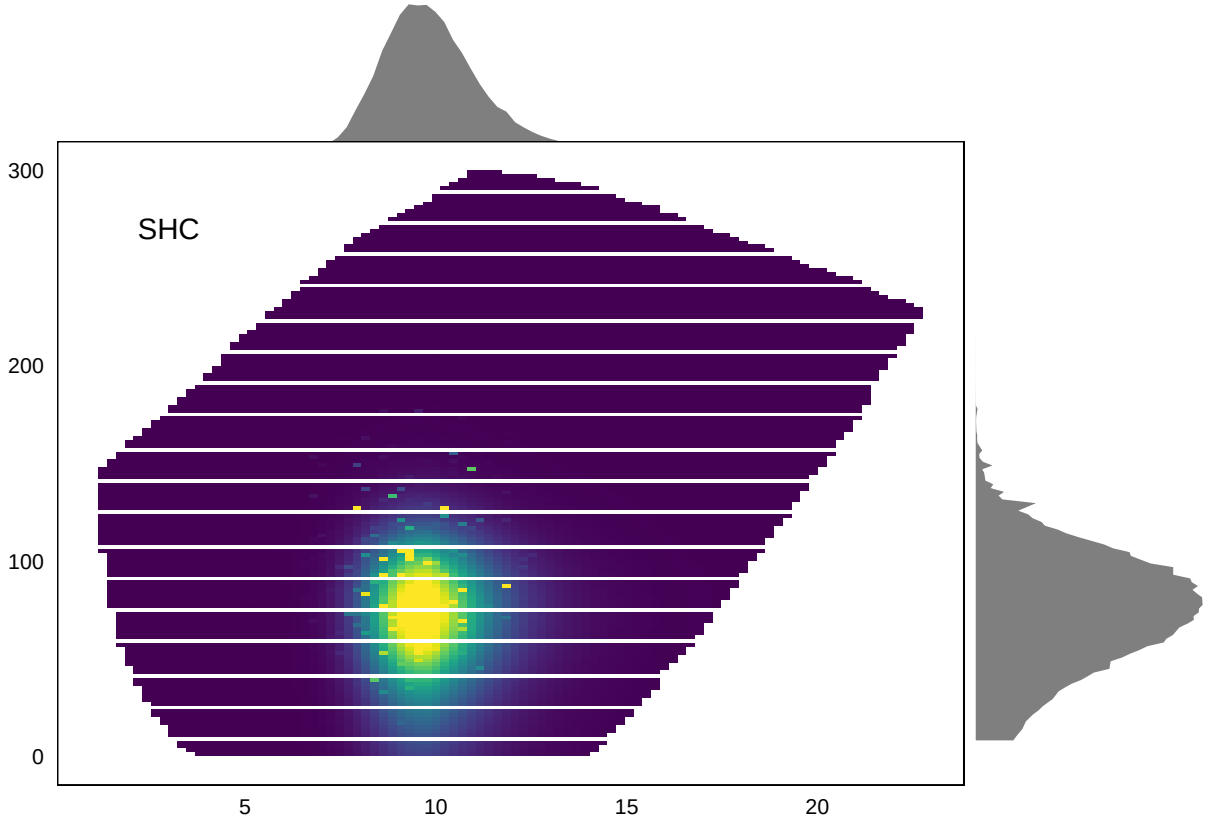
term	estimate	std.error
(Intercept)	-5.619	1.572
mean_temp_roms_30_norm	6.236	1.565
I(mean_temp_roms_30_norm^2)	-2.581	0.608
mean_oxygen_roms_30_norm	2.256	1.041
I(mean_oxygen_roms_30_norm^2)	-1.853	0.696

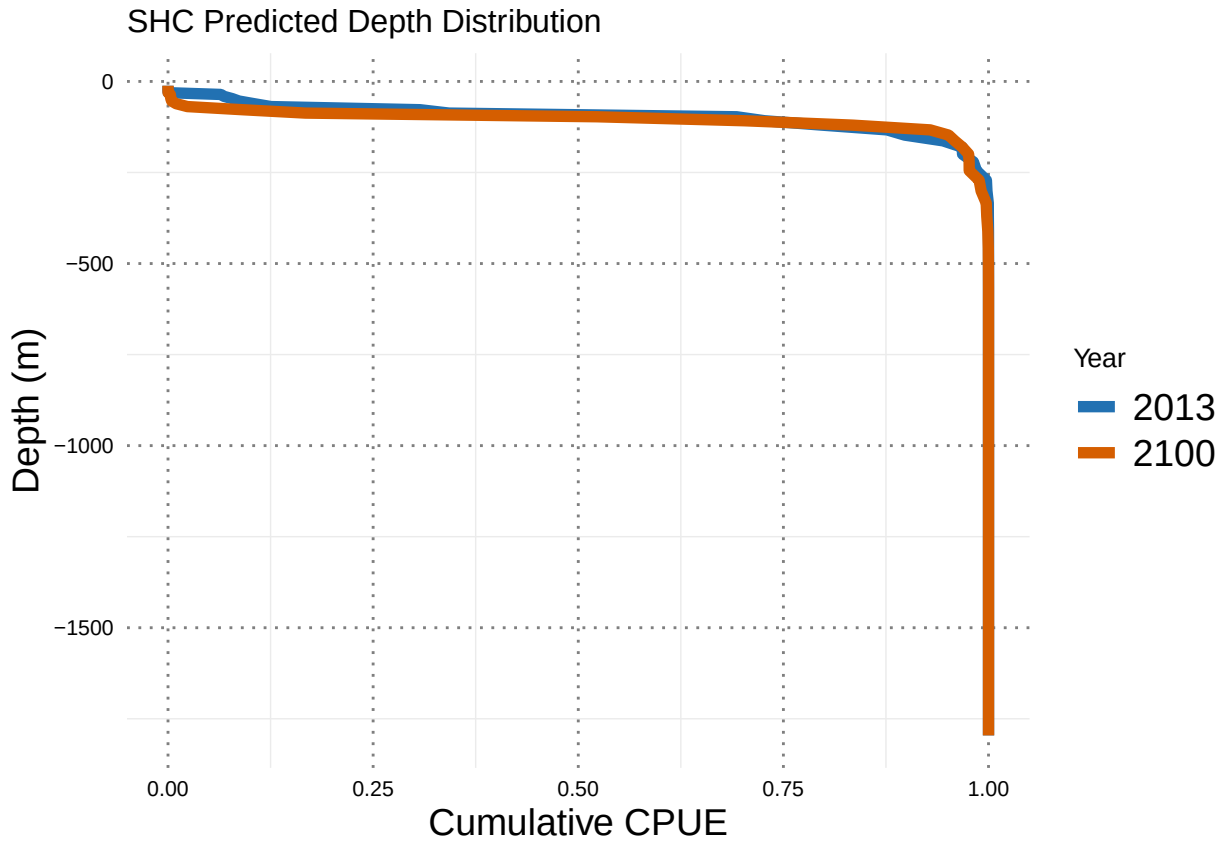
term	estimate	std.error
(Intercept)	-11.690	1.973
s(mean_temp_roms_30_norm).1	16.526	3.410
s(mean_temp_roms_30_norm).2	6.314	1.439
s(mean_oxygen_roms_30_norm).1	7.704	3.099
s(mean_oxygen_roms_30_norm).2	-0.315	0.616

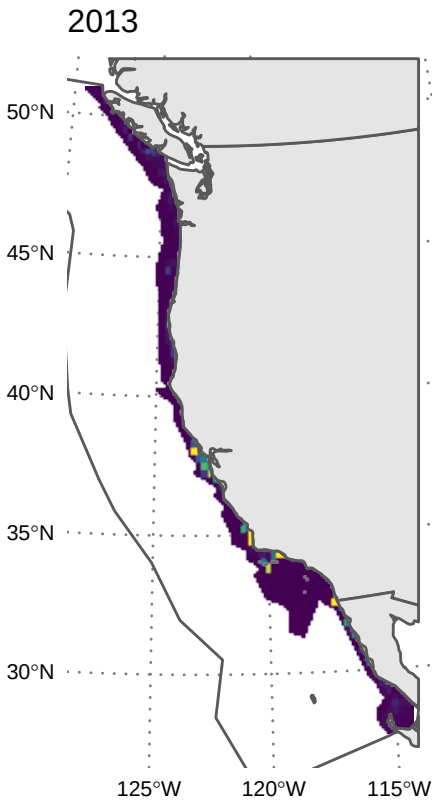

SHC Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025

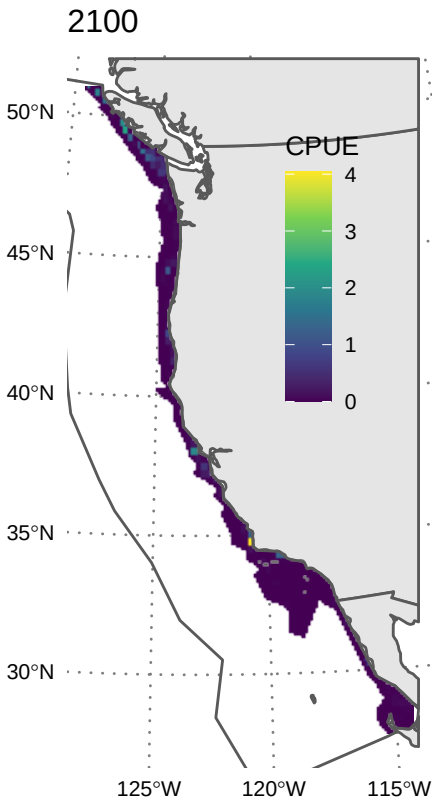

Center of Gravity, X
Eastings (km)
750
700
650
600
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
4300
4200
4100
4000
3900
2025
2050
2075
2100
Year


SHC
300
200
100
0
5
10
15
20


SHC Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W


2100
CPUE
4
3
2
1
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

SHR: Shallow Large Rockfish

Brown, copper, greenspotted, and blue rockfish, and kelp greenling

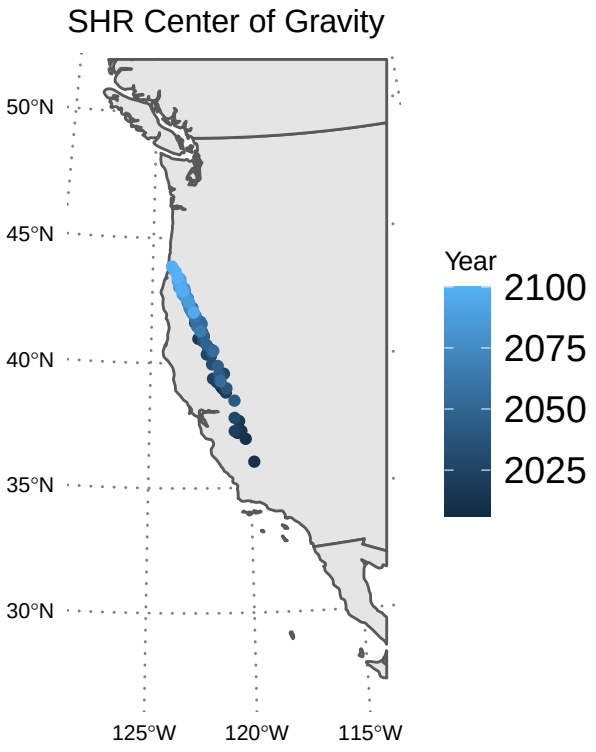
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
SHR	FALSE	FALSE	0.000	0	2.828
SHR	FALSE	TRUE	0.575	0	2.828
SHR	TRUE	FALSE	0.425	0	35.465
SHR	TRUE	TRUE	0.000	0	37.357

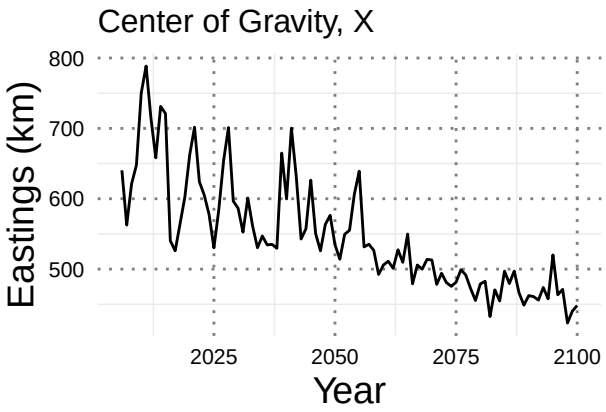
term	estimate	std.error
(Intercept)	0.245	0.234
mean_temp_roms_30_norm	6.816	0.510
I(mean_temp_roms_30_norm^2)	-2.297	0.192
mean_oxygen_roms_30_norm	0.461	0.331
I(mean_oxygen_roms_30_norm^2)	-0.292	0.145

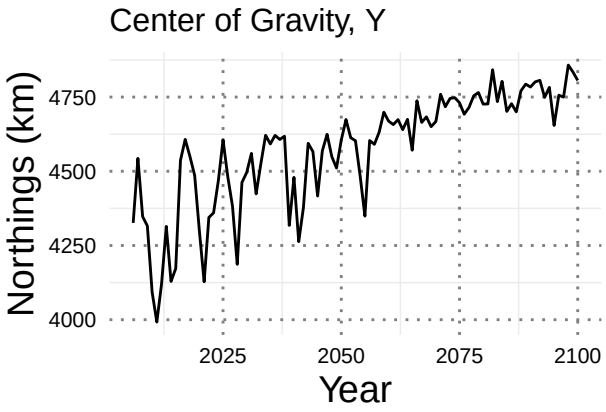
term	estimate	std.error
(Intercept)	-3.528	0.440
s(mean_temp_roms_30_norm).1	13.918	1.161
s(mean_temp_roms_30_norm).2	6.485	0.477
s(mean_oxygen_roms_30_norm).1	1.090	0.787
s(mean_oxygen_roms_30_norm).2	-0.125	0.177

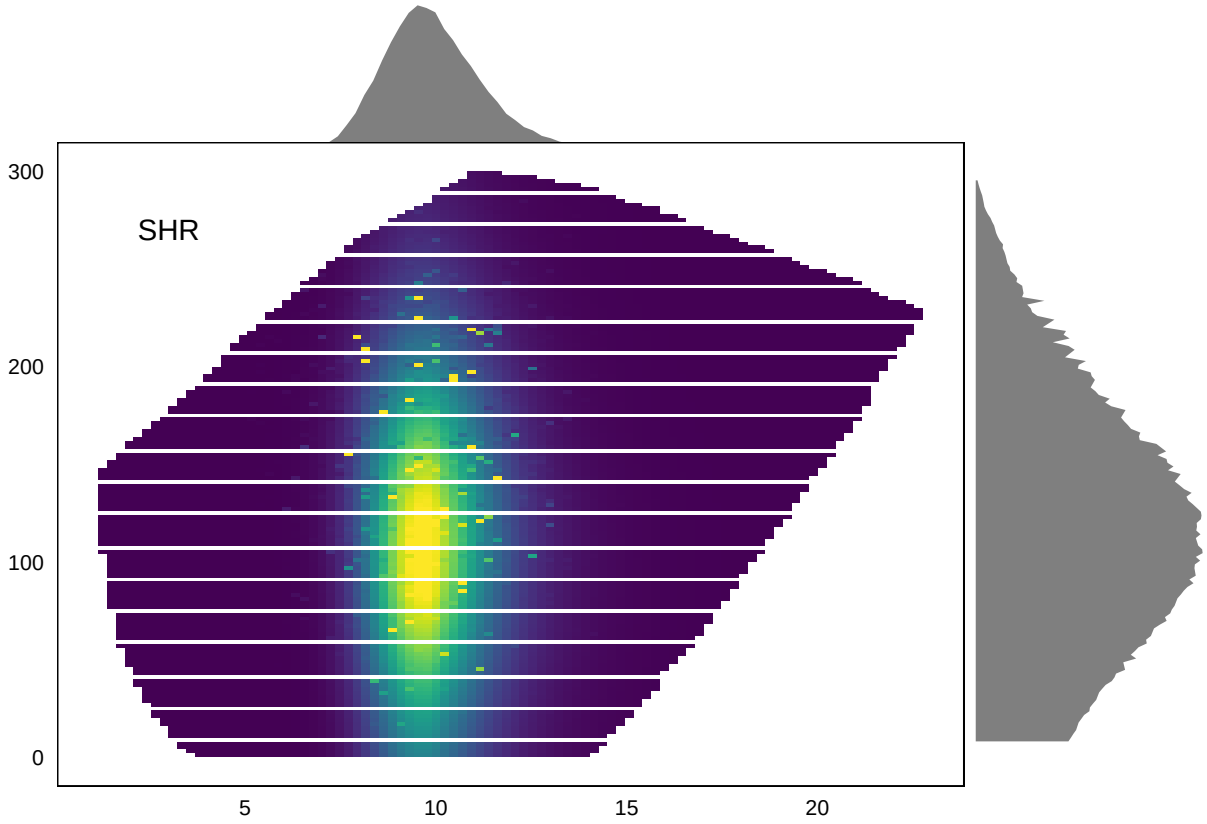
term	estimate	std.error
(Intercept)	-1.221	0.463
mean_temp_roms_30_norm	4.773	0.595
I(mean_temp_roms_30_norm^2)	-1.645	0.209
mean_oxygen_roms_30_norm	1.768	0.432
I(mean_oxygen_roms_30_norm^2)	-0.464	0.161

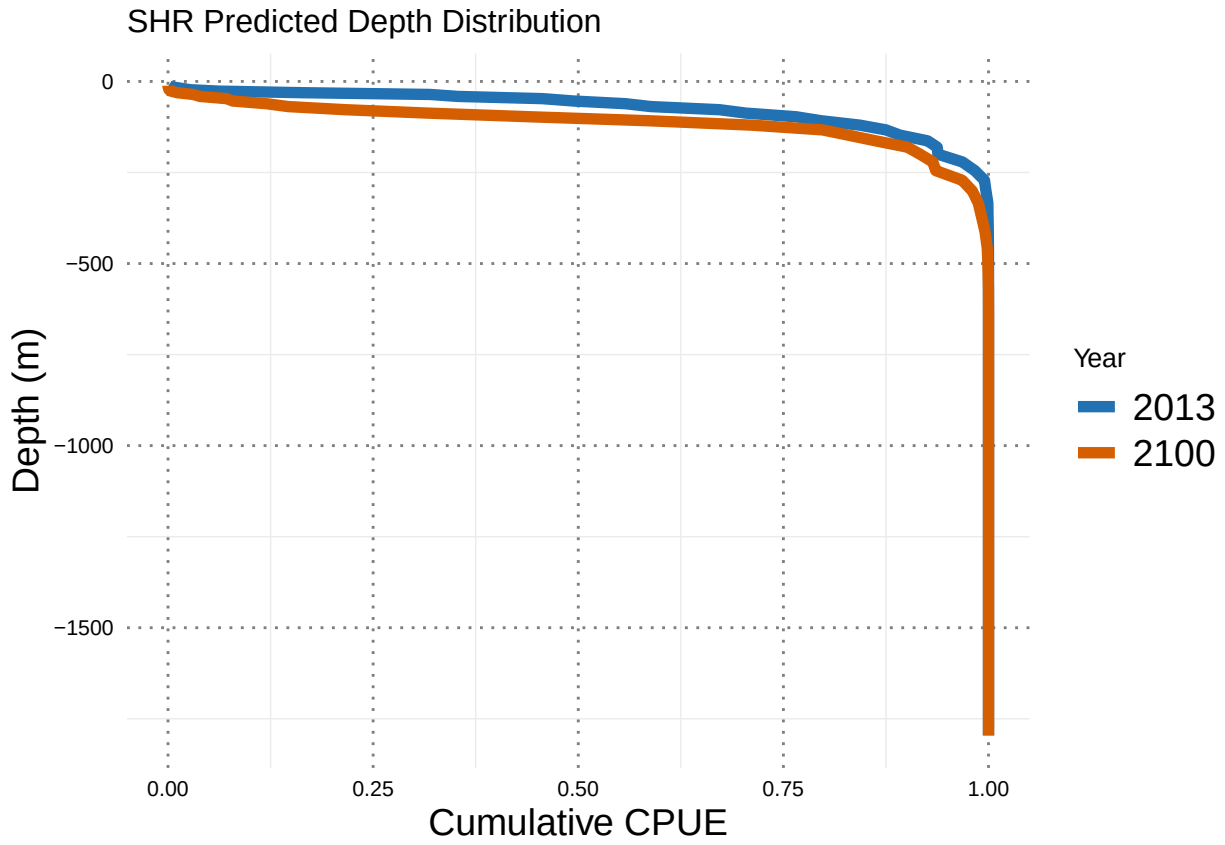
term	estimate	std.error
(Intercept)	-4.066	0.615
s(mean_temp_roms_30_norm).1	9.924	1.253
s(mean_temp_roms_30_norm).2	4.442	0.573
s(mean_oxygen_roms_30_norm).1	2.374	0.908
s(mean_oxygen_roms_30_norm).2	1.081	0.278

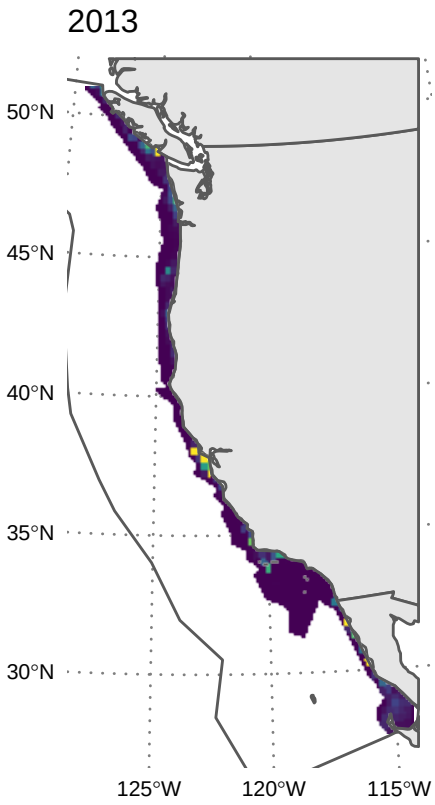

SHR Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025

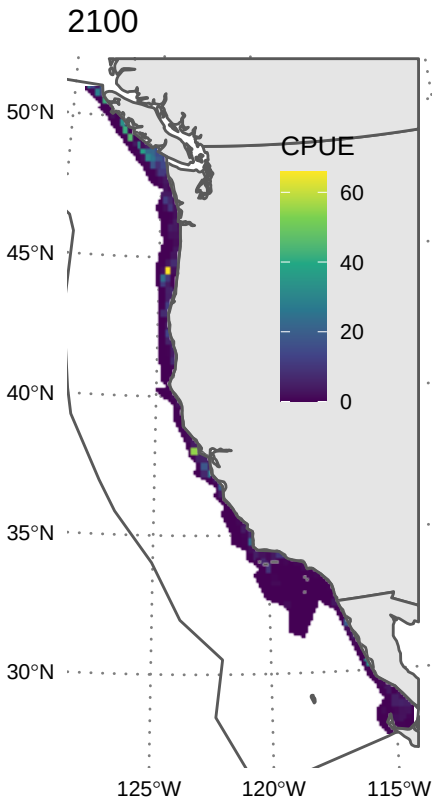

Center of Gravity, X
Eastings (km)
800
700
600
500
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
4750
4500
4250
4000
2025
2050
2075
2100
Year


SHR
300
200
100
0
5
10
15
20


SHR Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W


2100
CPUE
60
40
20
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W

YEL: Yelloweye Rockfish

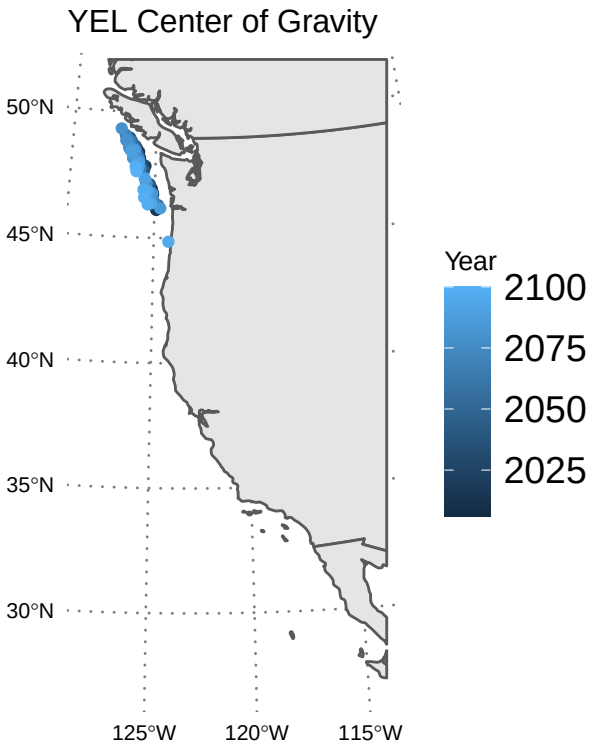
Group	Spatial RF	Env Spline	Weight	Convergence	Matern Range
YEL	FALSE	FALSE	0.000	0	2.828
YEL	FALSE	TRUE	0.968	0	2.828
YEL	TRUE	FALSE	0.000	0	40.781
YEL	TRUE	TRUE	0.032	0	41.324

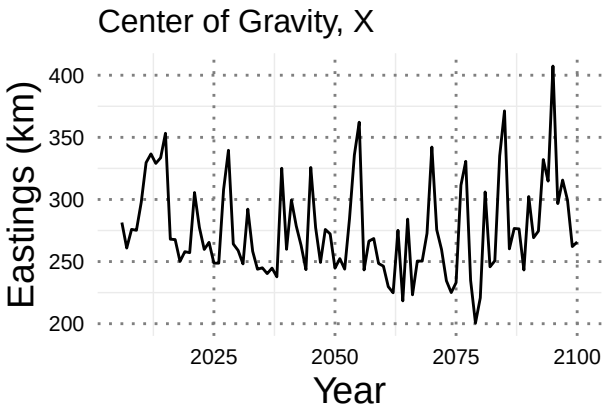
term	estimate	std.error
(Intercept)	1.582	0.339
mean_temp_roms_30_norm	1.351	0.867
I(mean_temp_roms_30_norm^2)	-2.491	0.559
mean_oxygen_roms_30_norm	4.908	0.720
I(mean_oxygen_roms_30_norm^2)	-2.405	0.415

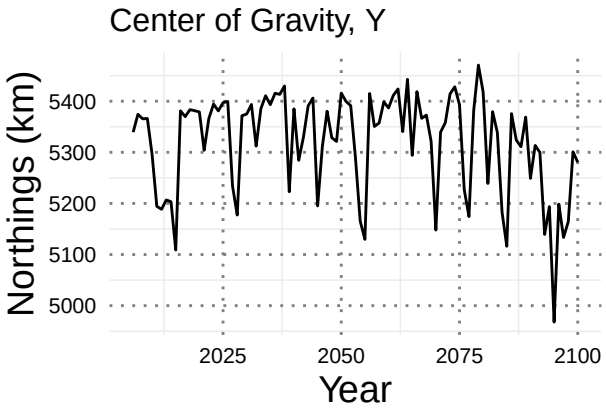
term	estimate	std.error
(Intercept)	-3.022	0.848
s(mean_temp_roms_30_norm).1	10.944	2.378
s(mean_temp_roms_30_norm).2	-0.063	0.585
s(mean_oxygen_roms_30_norm).1	11.327	1.943
s(mean_oxygen_roms_30_norm).2	1.582	0.292

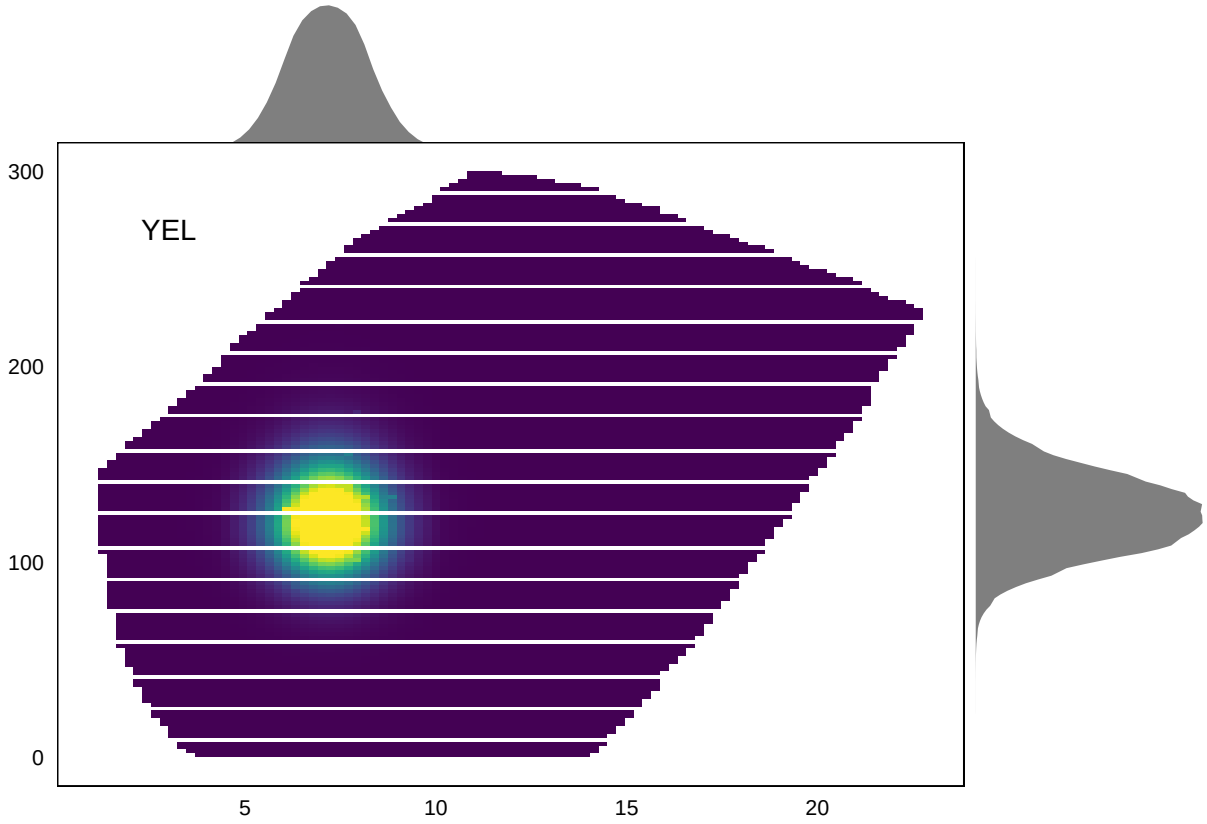
term	estimate	std.error
(Intercept)	-1.538	0.887
mean_temp_roms_30_norm	2.946	1.165
I(mean_temp_roms_30_norm^2)	-3.847	0.891
mean_oxygen_roms_30_norm	5.798	0.892
I(mean_oxygen_roms_30_norm^2)	-2.511	0.458

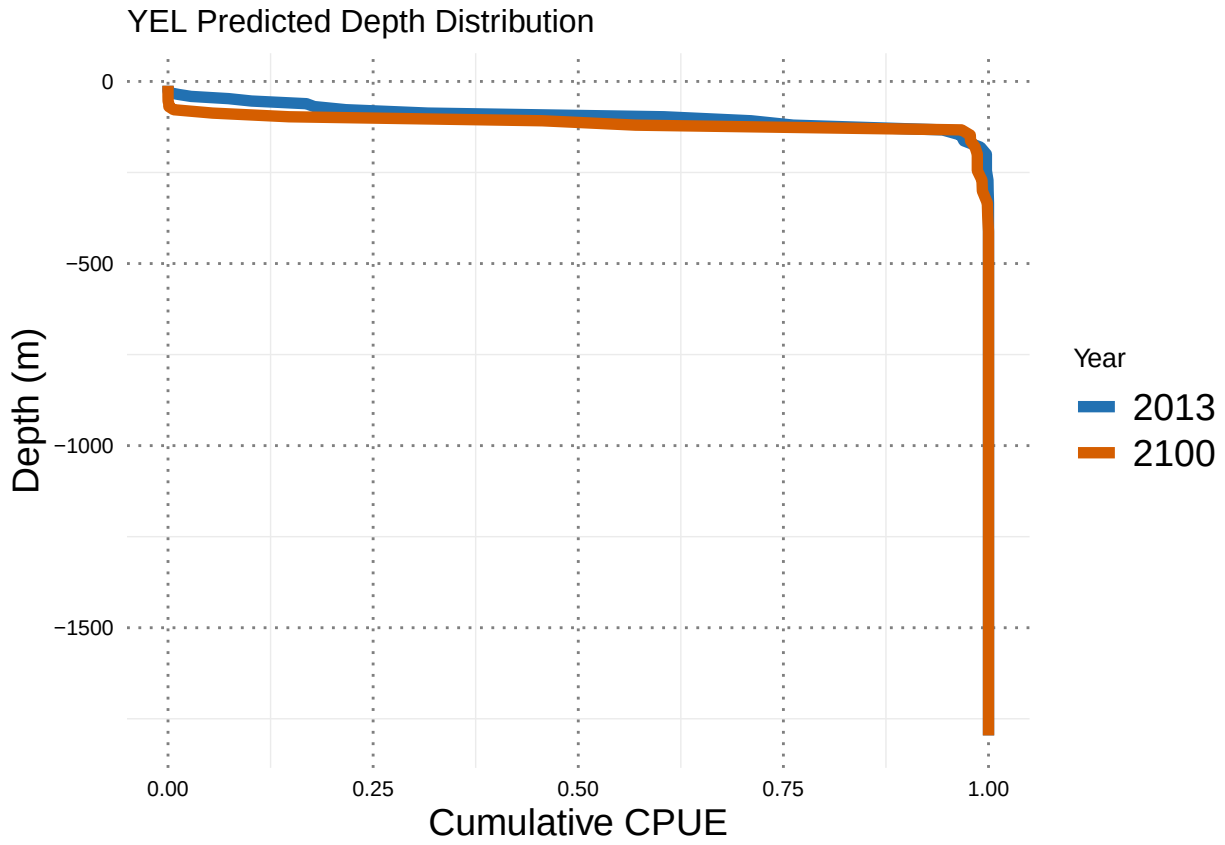
term	estimate	std.error
(Intercept)	-7.354	1.409
s(mean_temp_roms_30_norm).1	15.975	3.579
s(mean_temp_roms_30_norm).2	0.628	0.773
s(mean_oxygen_roms_30_norm).1	12.032	2.157
s(mean_oxygen_roms_30_norm).2	2.328	0.444

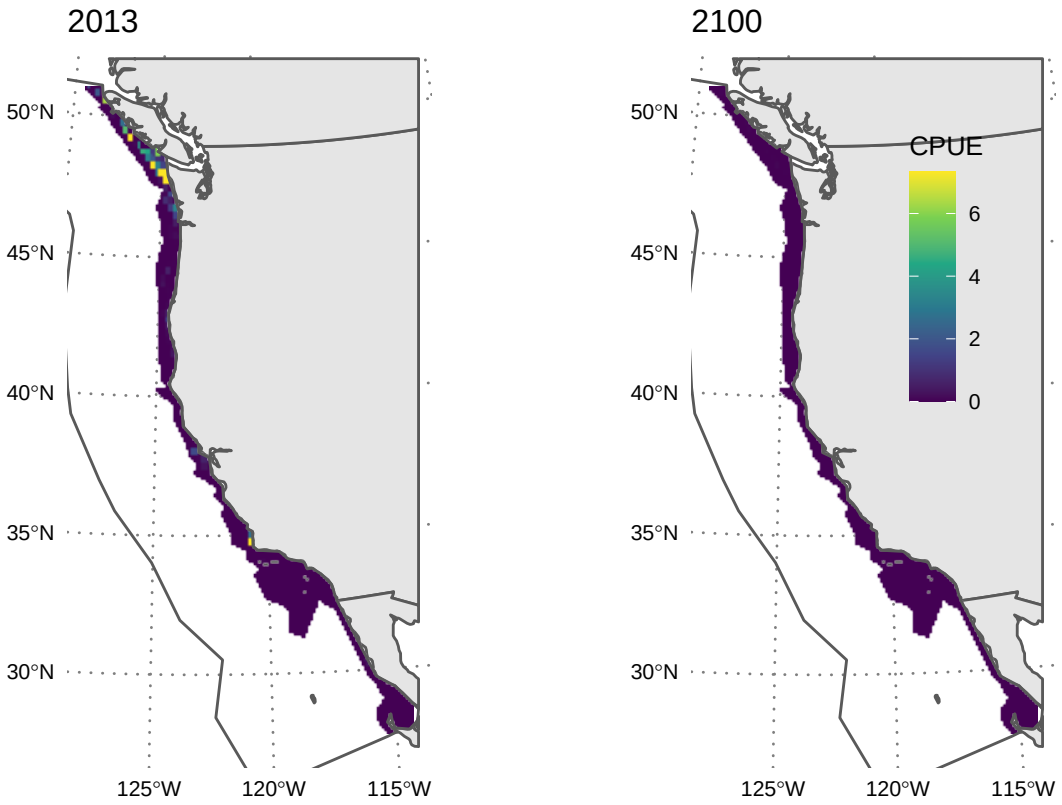

YEL Center of Gravity
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W
Year
2100
2075
2050
2025


Center of Gravity, X
Eastings (km)
400
350
300
250
200
2025
2050
2075
2100
Year


Center of Gravity, Y
Northings (km)
5400
5300
5200
5100
5000
2025
2050
2075
2100
Year


YEL
300
200
100
0
5
10
15
20


YEL Predicted Depth Distribution
0
−500
−1000
−1500
Depth (m)
0.00
0.25
0.50
0.75
1.00
Cumulative CPUE
Year
2013
2100


2013
2100
CPUE
6
4
2
0
50°N
45°N
40°N
35°N
30°N
125°W
120°W
115°W