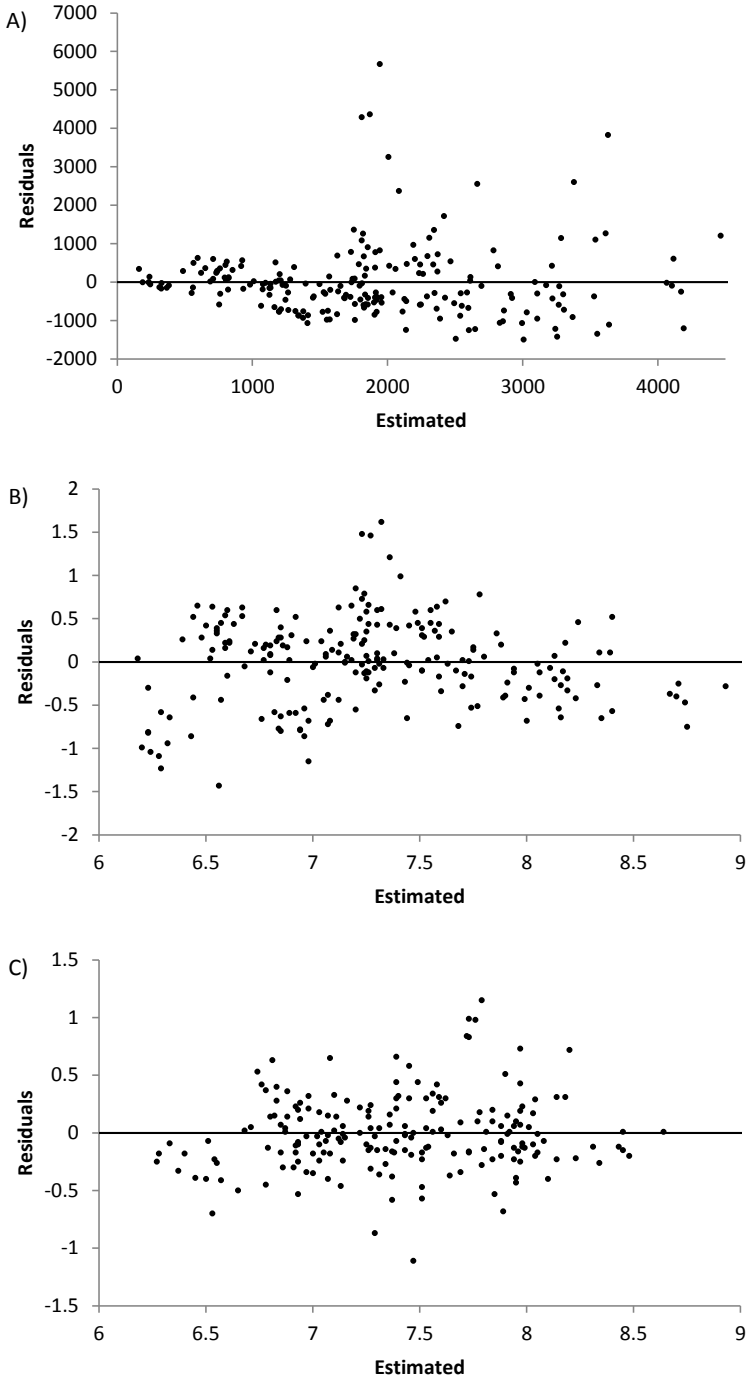
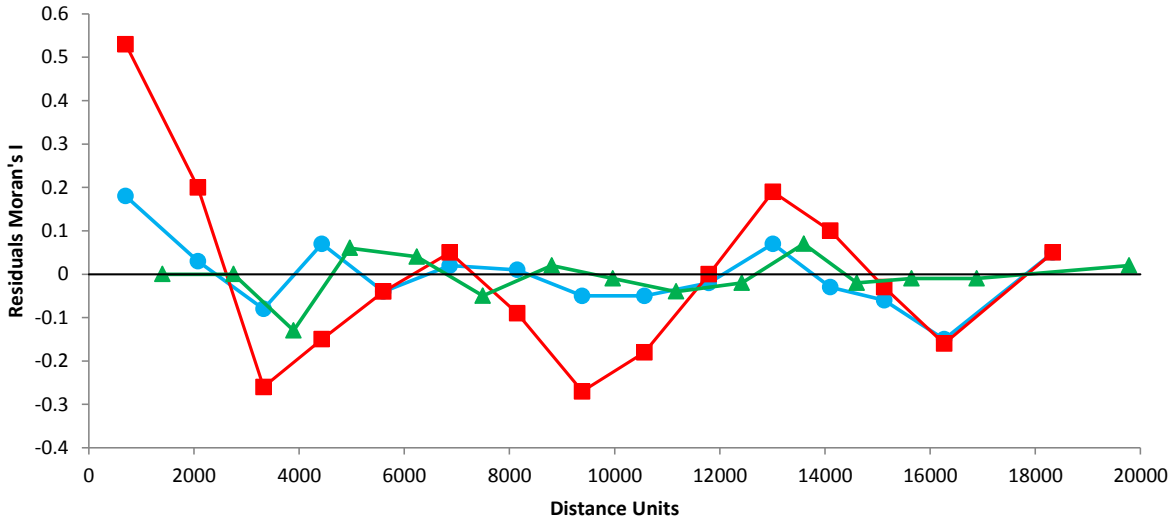
Supplementary Information

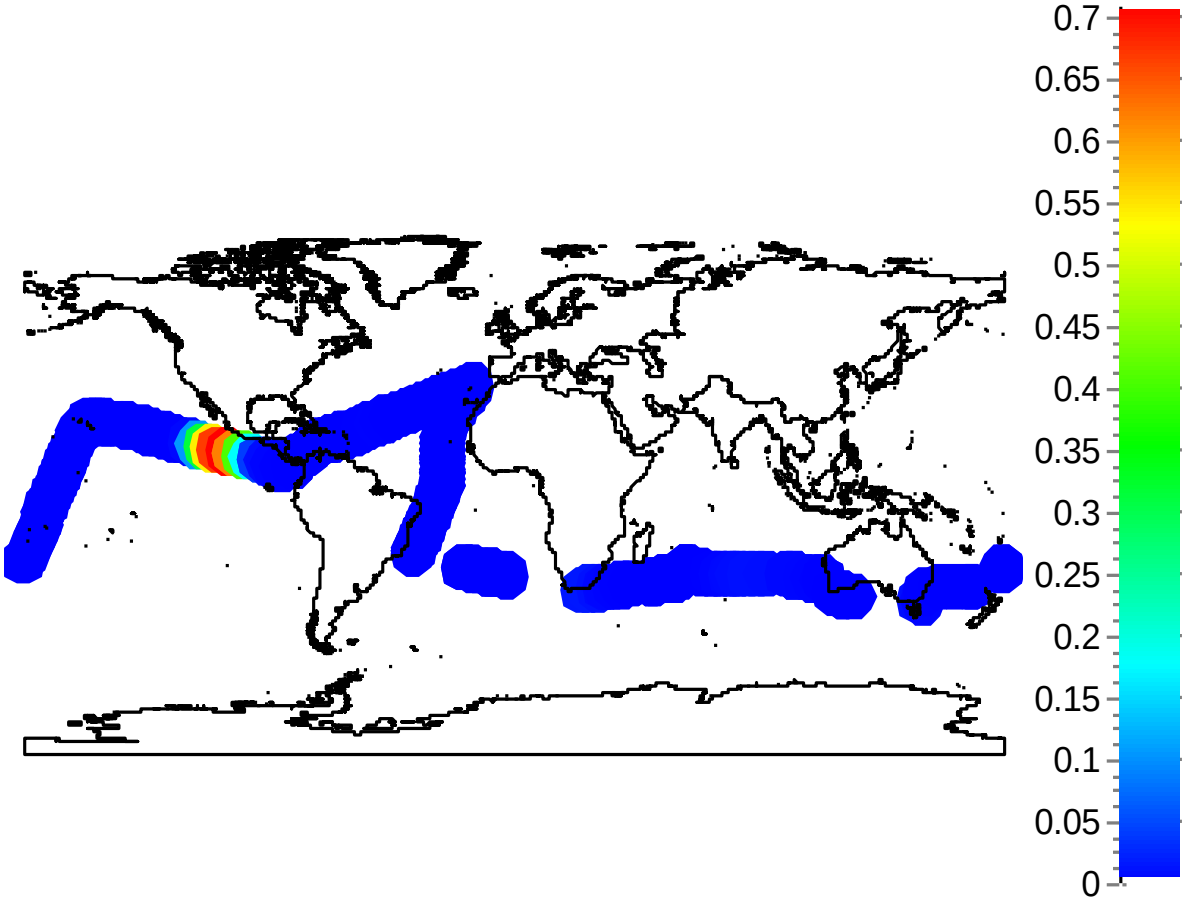
Supplementary Figures:



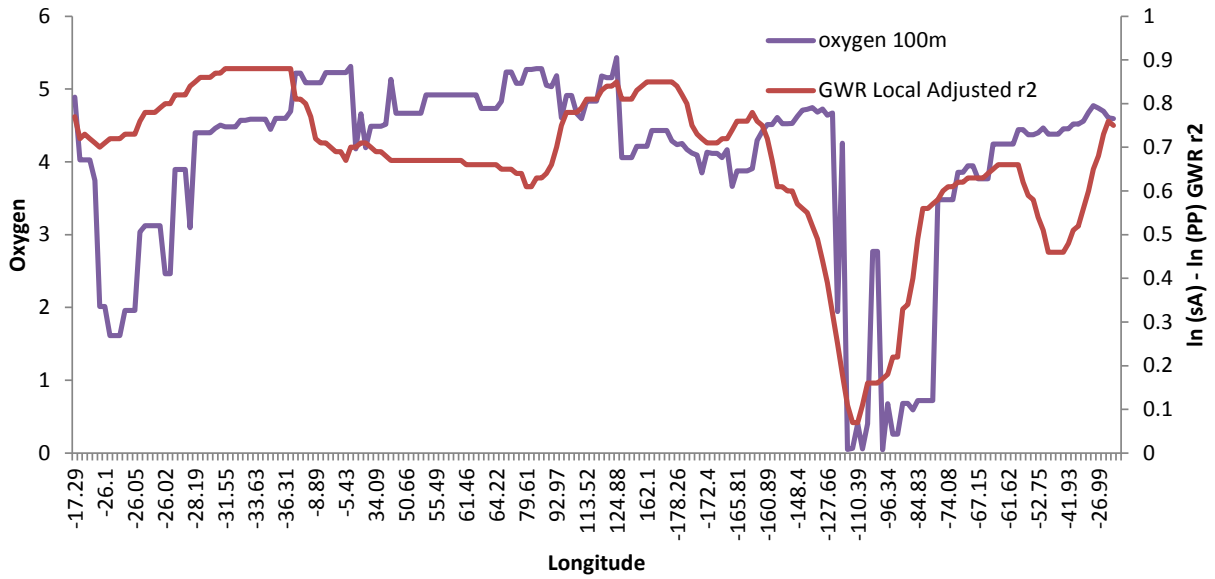
Supplementary Figure 1: Relation between estimates and residuals for the different regressions. A) Non transformed data, B) ln transformed data and C) GWR regression



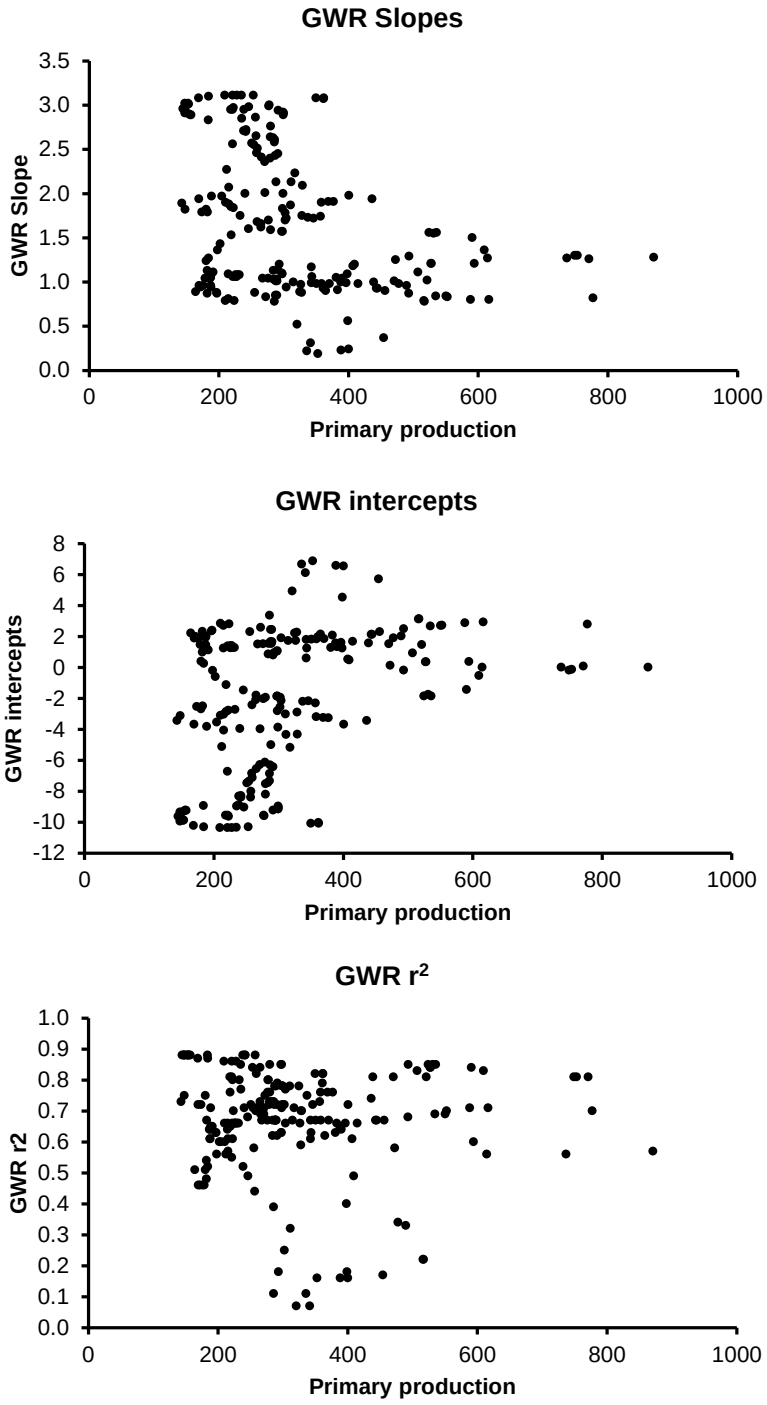
Supplementary Figure 2: Spatial autocorrelation analysis. Moran's I values as a function of distance for the residuals of the different regressions (blue non transformed data, red ln transformed data and green GWR regression)



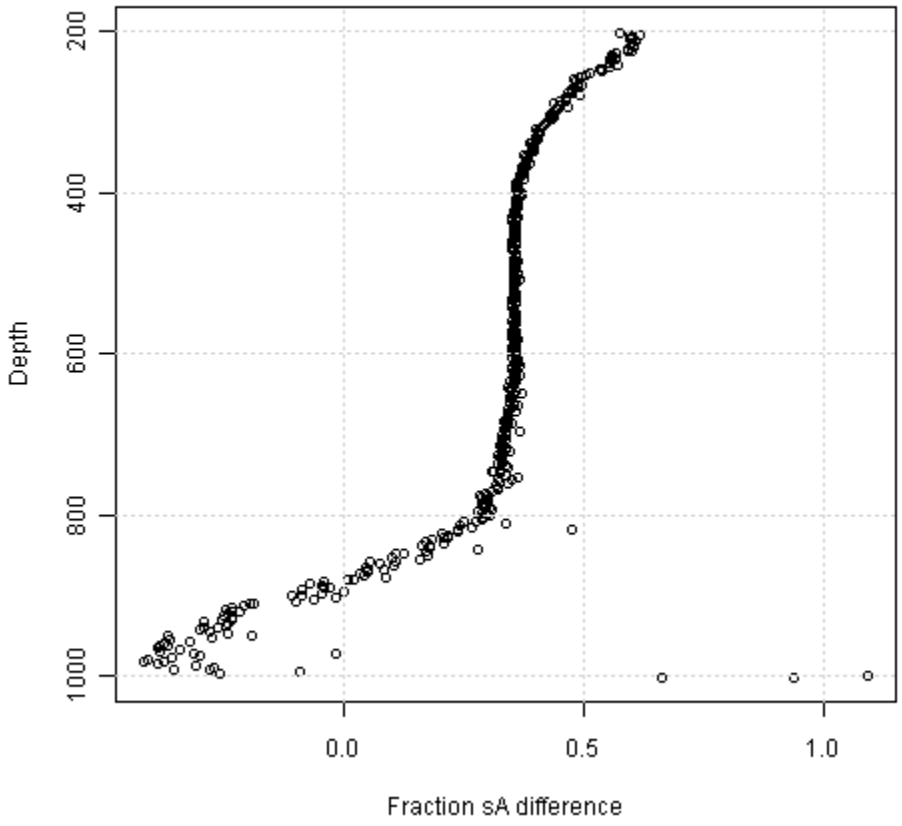
Supplementary Figure 3: Geographycally weighted regression**.** Spatial distribution of the local regressions slope significance using GWR.



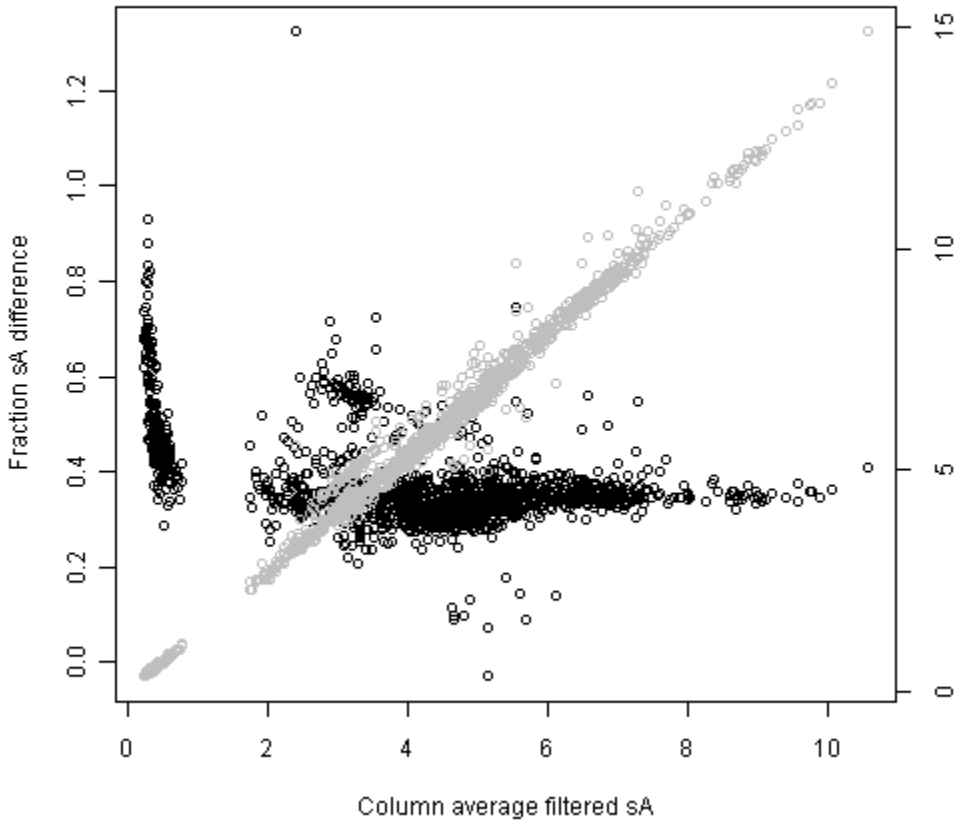
Supplementary Figure 4: Ln (sA) – Ln (PP) GWR local r^2 and oxygen at 100 m depth along the Malaspina transect.



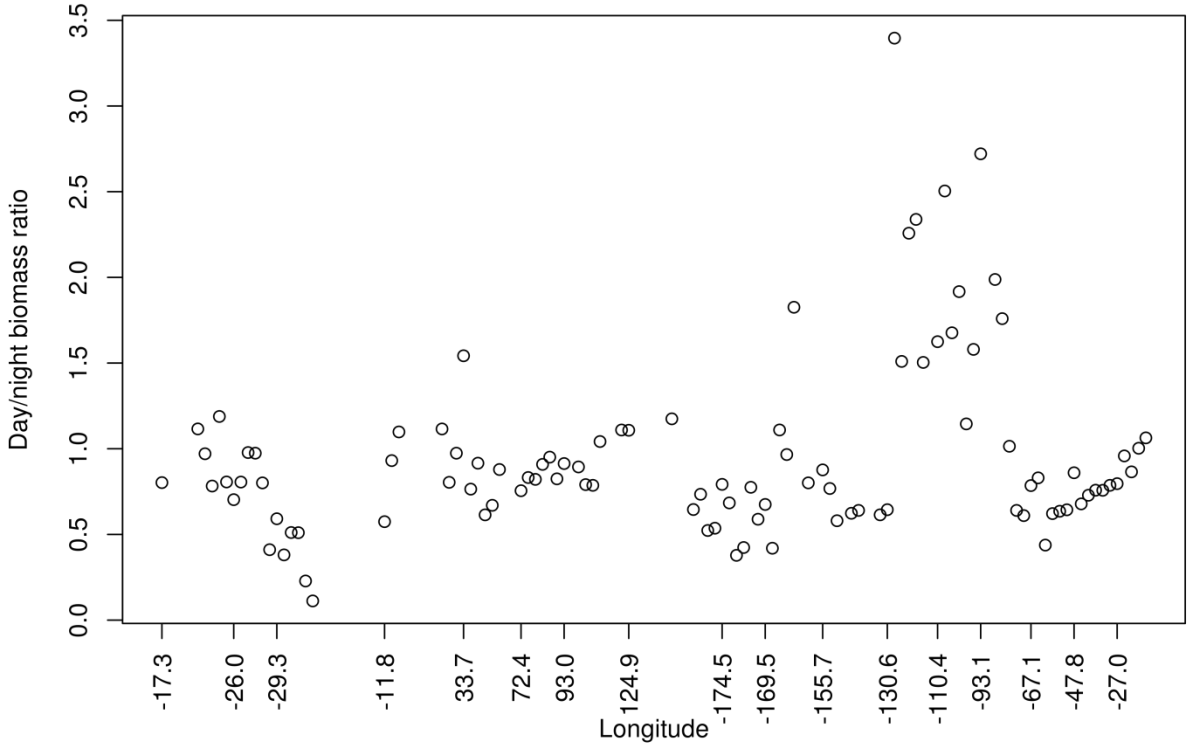
Supplementary Figure 5: Parameters of the geographically weighted regression. Slope (top panel), intercept (middle panel) and r^2 of the geographically weighted regression as a function of primary production.



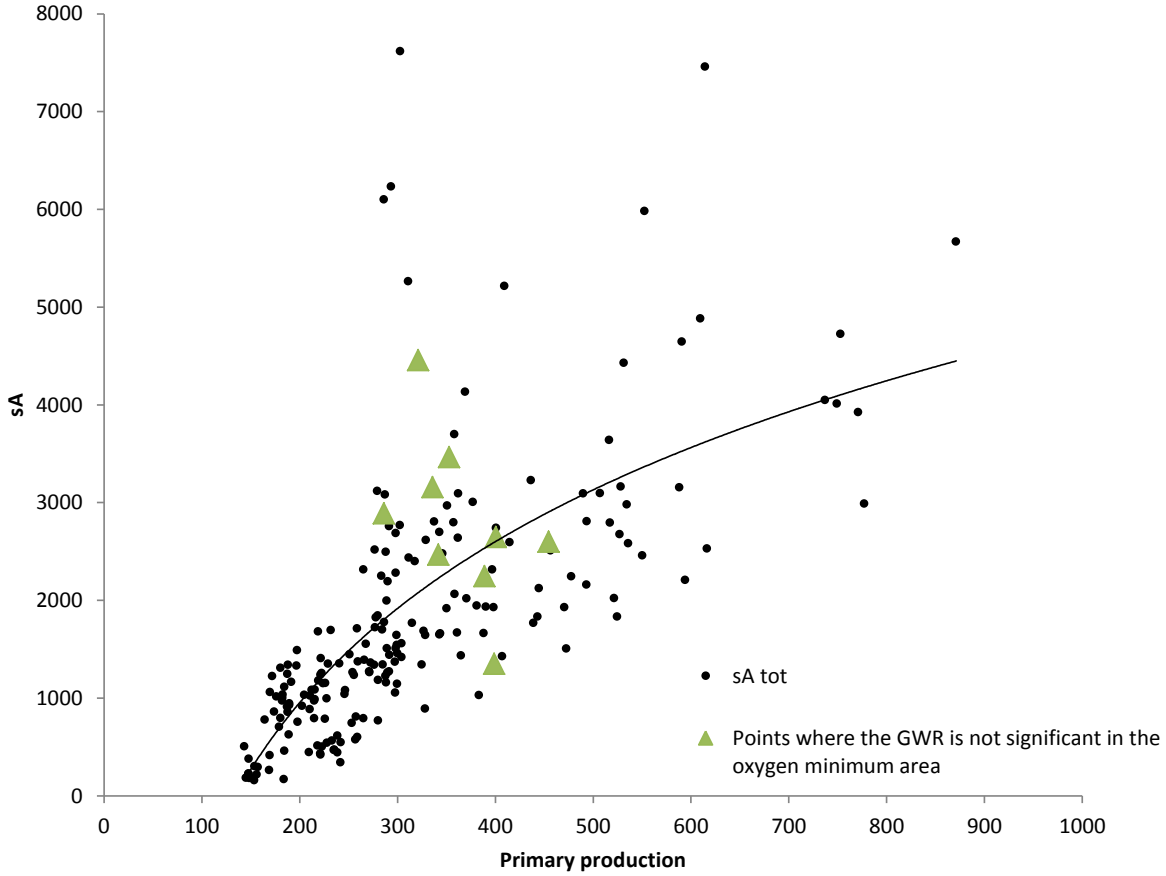
Supplementary Figure 6: Analysis of the acoustic processing bias. Ratio of difference between the two estimates and the median filtered s_A values, plotted in relation to depth.



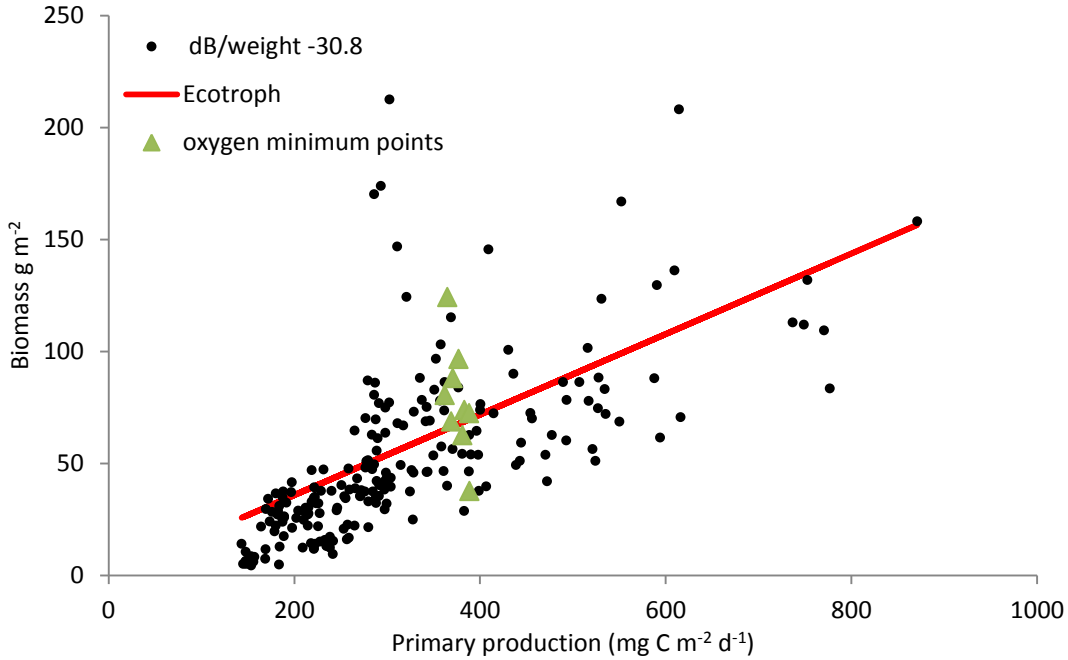
Supplementary Figure 7: Analysis of the acoustic processing bias. Paired s_A estimates produced by standard postprocessing methods plotted in relation to median-filtered s_A values, in periods of little noise [grey circles] and the ratio of the difference between the 2 estimates and the median filtered s_A values, plotted in relation to median filtered s_A values [black circles].



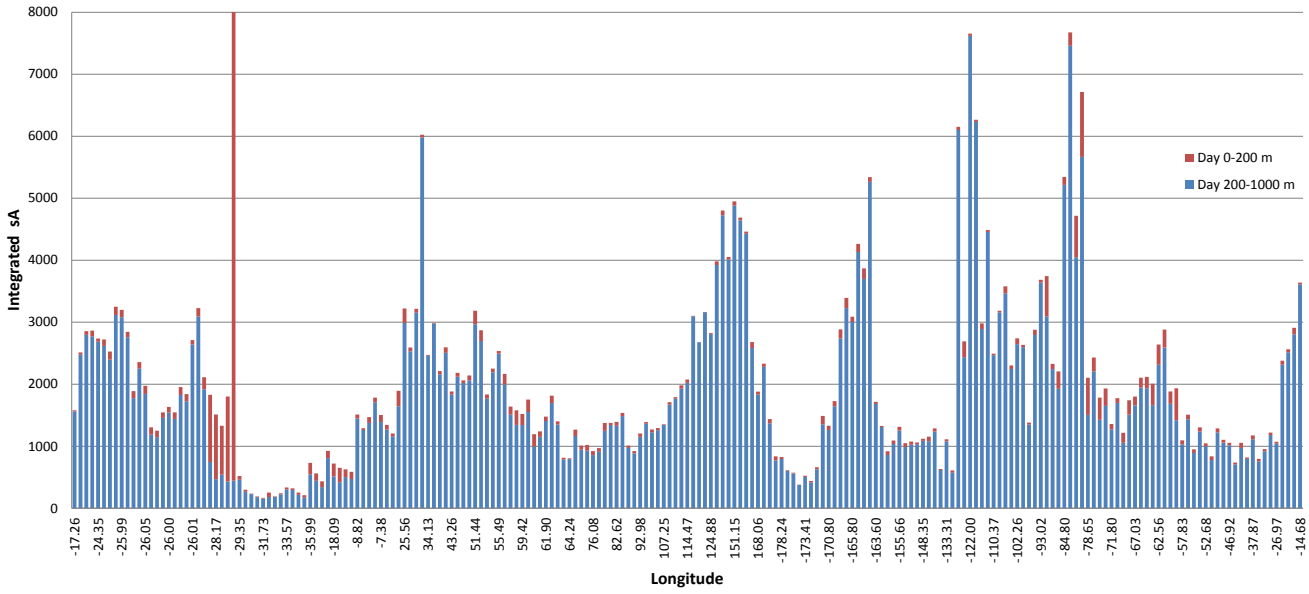
Supplementary Figure 8: Ratio of paired total day and night backscatter values.



Supplementary Figure 9: Analysis of the potential resonance effect. Relation between primary production and backscatter indicating the points in the area of a shallow oxygen minimum where the GWR is not significant and the day/night ratio of the backscatter was between 2 and 3.



Supplementary Figure 10: Analysis of the potential resonance effect. Biomass estimates from acoustics and Ecotroph as a function of the primary production along the Malaspina transect. The triangles indicate the points in the area of a shallow oxygen minimum where the GWR is not significant and the day/night ratio of the backscatter was between 2 and 3.



Supplementary Figure 11: Epipelagic fish. Total backscatter values in the 0 – 200 layer [red] and 200 – 1000 layer [blue] in the daytime along the cruise trajectory.

Supplementary Tables

Supplementary Table 1: Parameters of the three regression approaches considered. Non-transformed data ordinary least squares regression (OLS), Ln transformed data (OLS ln-ln) and geographically weighted regression on ln transformed data (GWR ln-ln)

	OLS	OLS ln-ln	GWR ln-ln
Effective Number of Parameters:	2.00	2.00	15.96
Akaike Information Criterion (AICc):	3470.92	306.84	157.65
Correlation Coefficient (r):	0.69	0.77	0.91
Coefficient of Determination (r^2):	0.48	0.59	0.83
Adjusted r-square (r^2 Adj):	0.48	0.59	0.81
F (r^2):	192.28	293.47	61.06
P-value (r^2):	<0.001	<0.001	<0.001
Slope	2374.00	1.52	
Median slope			1.36
Lower quartile slope			1.00
Upper quartile slope			2.27
Minimum slope			0.19
Maximum slope			3.11
Median slope for PP values < 400 mg C m^{-2} d^{-1}			1.72
Median slope for PP values >400 mg C m^{-2} d^{-1}			1.11
Constant	11624.00	-1.36	
Median constant			-0.20
lower quartile constant			-5.18
Upper quartile constant			1.66
Minimum constant			-10.36
Maximum constant			6.87
Median constant for PP values < 400 mg C m^{-2} d^{-1}			-2.21
Median constant for PP values >400 mg C m^{-2} d^{-1}			0.93

Supplementary Table 2: Average temperatures in different layers during the Malaspina cruise. WMD refers to the weighted mean depth of the acoustic backscatter in the 200 to 1000 m layer.

Temperature ^{o}C	Average temperature 0 – 4000 m	Average temperature 0 – 1000 m	Daytime Acoustic WMD* temperature	Average temperature between daytime and night-time WMD*
Cruise Average	5.6	11.5	9.2	9.1
Cruise standard deviation	1.7	1.6	1.9	2.0
Cruise Maximum	14.3	14.6	13.1	13.2
Cruise minimum	3.8	9.1	5.7	5.9

Supplementary Table 3: Effects of water clarity on the theoretical search volume [$c^{-2}K^{-1}$] when going from clear oceanic water to murky coastal water. The attenuation coefficient for downwelling irradiance [K] is the observed attenuation of PAR given as an average of all stations during the cruise. The beam attenuation coefficient was approximated from the relationship in Kaartvedt *et al.*[1]: $K = 0.22c - 0.029$ [$r^2 = 0.98$, n =4984], where c was measured at 660 nm.

	K m^{-1}	K^{-1} m	c^{-2} m^2	$c^{-2}K^{-1}$ m^3
Malaspina cruise	0.044	22.7	9.1	207
Murky coastal water	0.10 0.15	10.0 6.7	2.9 1.5	29 10

Supplementary References

1. Kaartvedt, S., Staby, A. & Aksnes, D. L. Efficient trawl avoidance by mesopelagic fishes causes large underestimation of their biomass. *Mar Ecol-Prog Ser* **456**, 1-6 (2012).