Supplementary Material

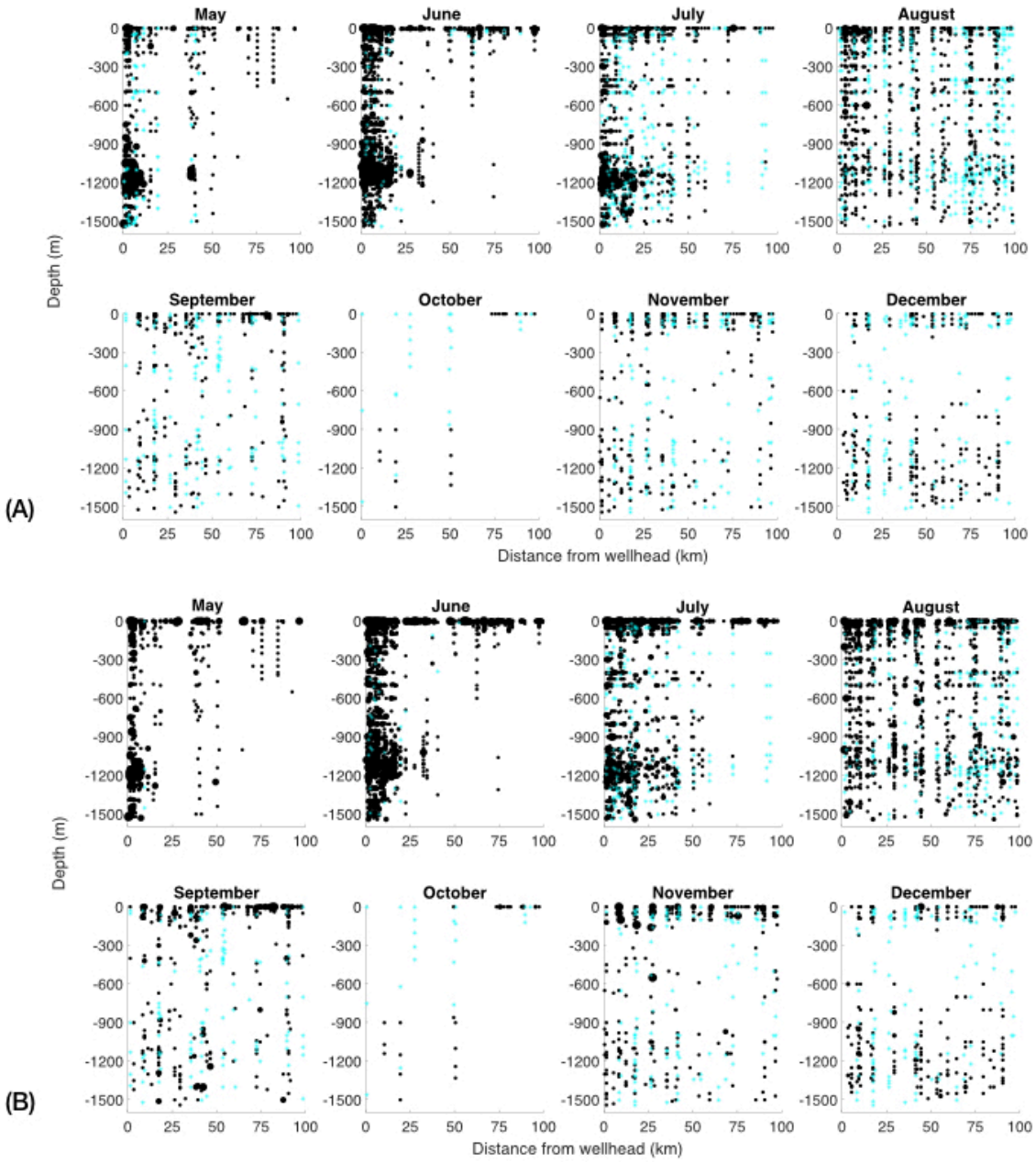


Figure S1. Monthly distributions of oil concentrations from May to December, 2010. Maximum concentrations of (**a**) low (C5-C12) and (**b**) high (C13+) molecular weight hydrocarbon fractions. Values of log (x +1) are computed into a grid of 10 m depth by 1 km bins. Oil contaminated samples are represented by black dots scaled by concentration maximum of 58,731 µg/L and 101,777 µg/L for C5-C12 and C13+, respectively; cyan dots are uncontaminated samples (0 µg/L); white area has no samples.

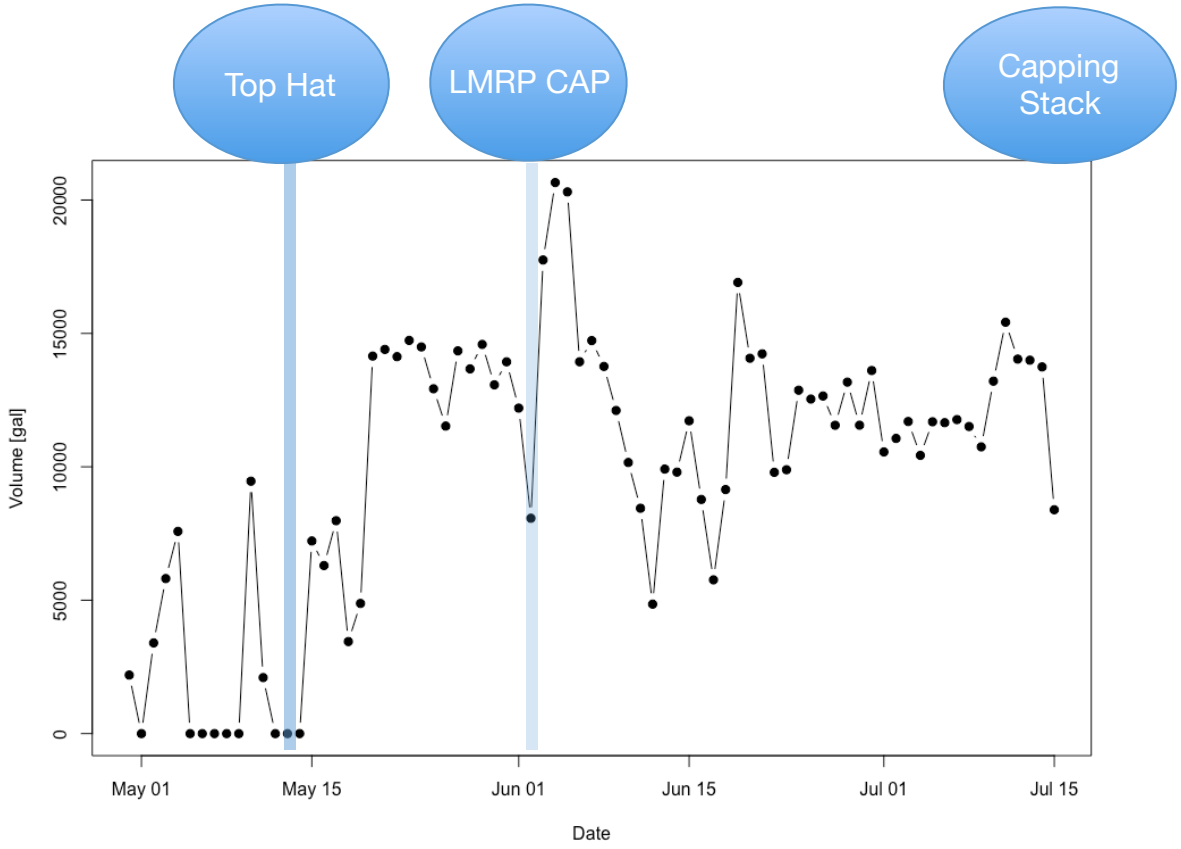


Figure S2. Time series of sub-sea dispersant injection (SSDI). SSDI records from April 30, 2010 to July 15, 2010. SSDI is variable, with days of no dispersant and periods with low, intermediate and high volumes. The light blue lines correspond to the significant splits by days after the blowout in the regression tree analysis of factors explaining the spatio-temporal variance in PAH concentrations (days 23 and 42); opacity decreases with the importance of the split (see Fig.3).

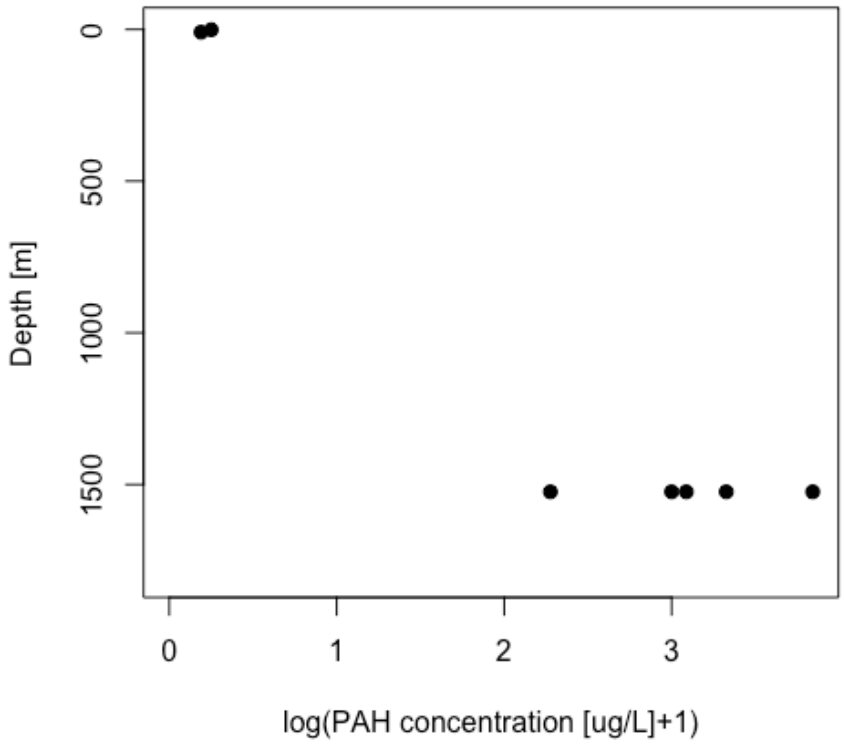


Figure S3. Depth distribution of PAH samples taken before May 13, 2010 (day 23), corresponding to node (a) of the regression tree analysis in Figure 3. All these samples were taken during May 5 and 12, 2010, when there was no sub-sea dispersant injection (SSDI, Figure S2). The highest PAH concentrations are below 1,000 m. Moreover, when the regression tree analysis 9Fig. 3) is run with these 7 samples excluded, the SSDI importance still remains negligible (importance: 0.04, ranked last among the explanatory variables).

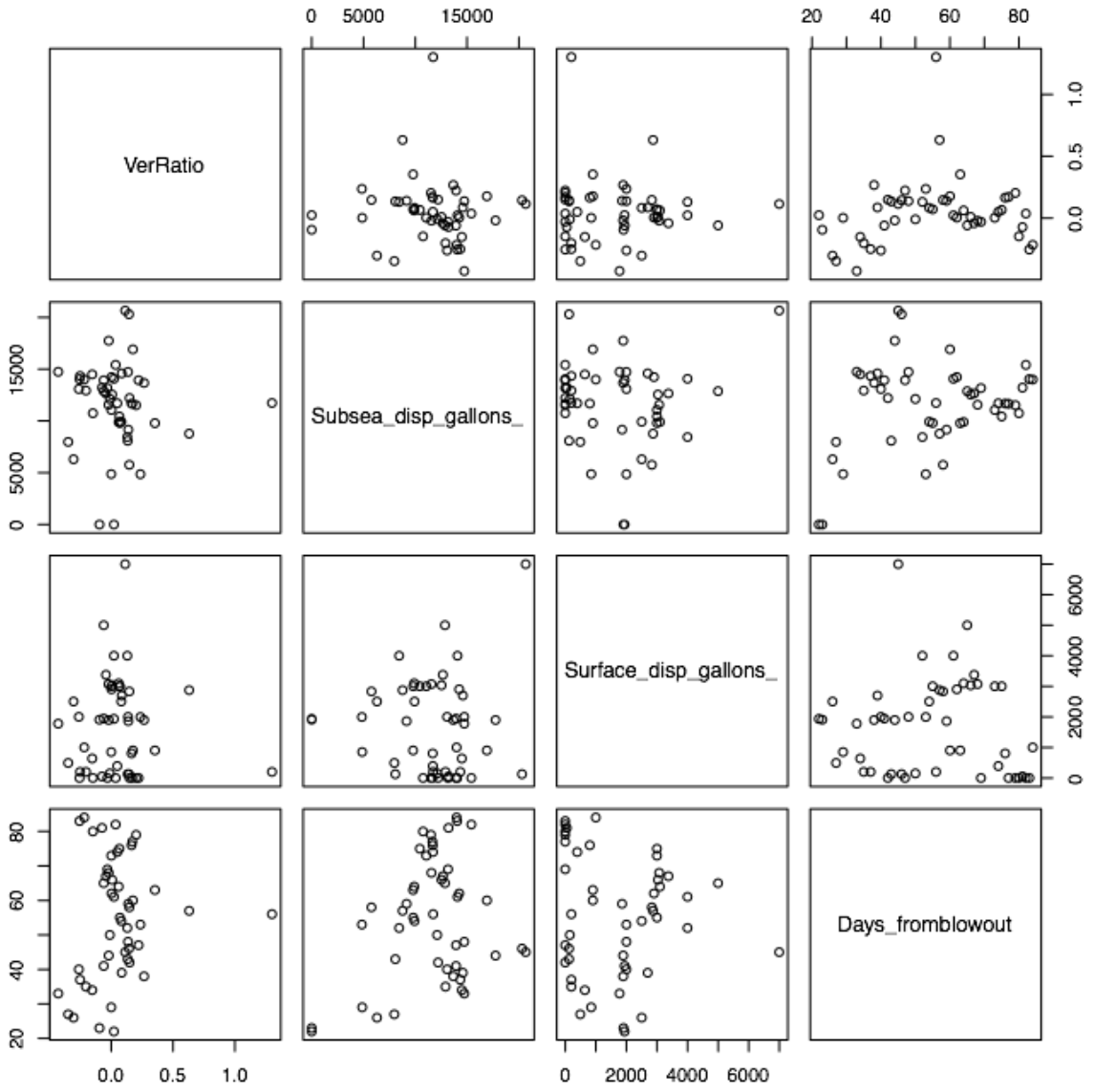
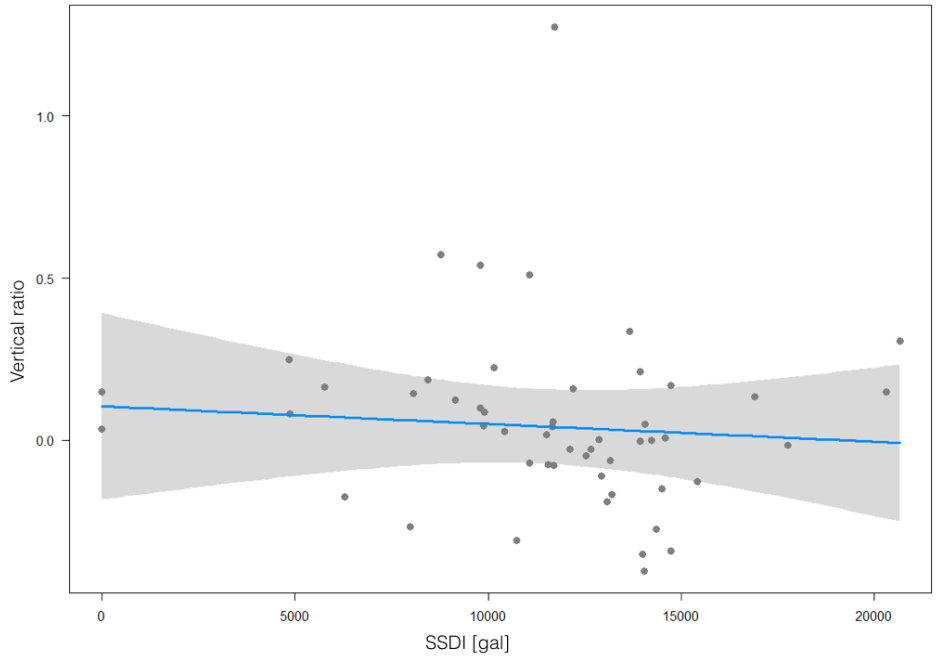


Figure S4. Scatterplots of the factors used in the Generalized Least Squares regression analysis (see Table S3).

Figure S5. The effect of volume of SSDI on the concentrations and vertical distribution of oil. **(a)** The linear fit of the GLS analysis represents the effect of SSDI on the vertical ratio between the mean oil concentration of the shallower layer (< 600 m) and the mean oil concentration of the deeper layer (≥ 600 m) while holding all other explanatory variables of their medians, regardless the trend that is not significant (see section 3.2) Shaded areas represent 95 % confidence regions of the GLS regression. **(b)** Scatterplot of the depth center of mass of oil concentrations and SSDI volume, between which no significant trend was detected. The data of both panels is computed within a 10 km radius from the Macondo wellhead. Oil concentrations [ug/L] were log(x+1) transformed.

a.



b.

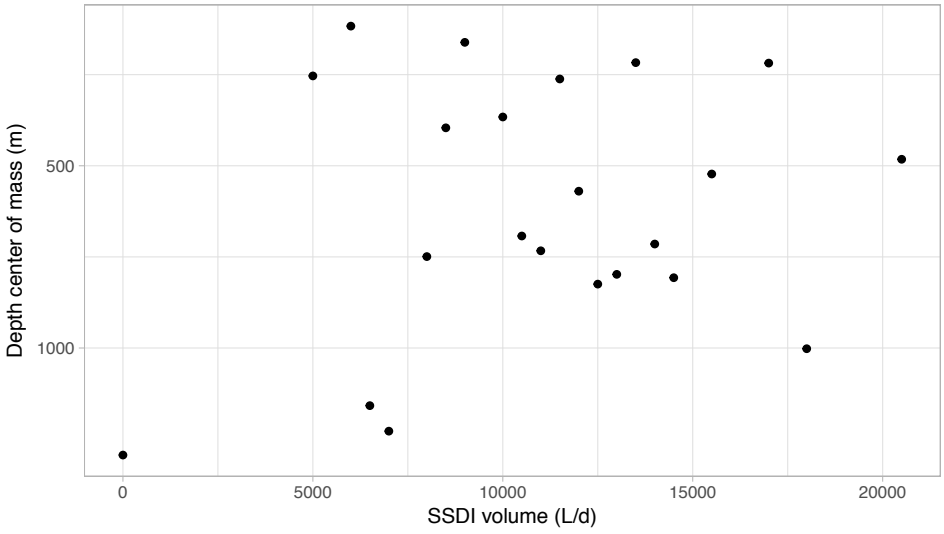


Table S1a. Classification of the Gulf Science Data Water Chemistry Data.
The hydrocarbon compounds from the Deepwater Horizon samples were classified into two mass fractions based on their molecular weight. a. C5-C12: low molecular weight compounds between five and twelve carbons. The data can be found on the GRIID-C website; filename: WaterChemistry_W-01v02-01.csv.

C5-C12	cis-Decalin	Dibenzothiophene	C4-Benzo(b)thiophenes	Ethylbenzene
	trans-Decalin	C1-Dibenzothiophenes	Naphthalene	o-Xylene
	cis/trans-Decalins	C2-Dibenzothiophenes	C1-Naphthalenes	m-Xylene
	C1-Decalins	C3-Dibenzothiophenes	C2-Naphthalenes	p-Xylene
	C2-Decalins	C4-Dibenzothiophenes	C3-Naphthalenes	m&p-Xylenes
	C3-Decalins	1-Methylnaphthalene	C4-Naphthalenes	Xylenes, Total
	C4-Decalins	2,6-Dimethylnaphthalene	Biphenyl	n-Nonane (C9)
	Benzo(b)thiophene	2-Methylnaphthalene	Dibenzofuran	n-Decane (C10)
	C1-Benzo(b)thiophenes	Carbazole	Acenaphthylene	n-Undecane (C11)
	C2-Benzo(b)thiophenes	Benzene	Acenaphthene	n-Dodecane (C12)
	C3-Benzo(b)thiophenes	Toluene		

Table S1b. Classification of the PB Gulf Science Data, Water Chemistry Data.
The hydrocarbon compounds from the Deepwater Horizon samples were classified into two mass fractions based on their molecular weight. b. C13+: higher molecular weight compounds with more than thirteen carbons. The reported mass fractions correspond to species-averaged retention times in the column. The data can be found on the GRIID-C website; filename: WaterChemistry_W-01v02-01.csv.

C13+	Fluorene	C3-Naphthobenzothiophenes	2-Methylanthracene	n-Eicosane (C20)
	C1-Fluorenes	C4-Naphthobenzothiophenes	2-Methylphenanthrene	n-Heneicosane (C21)
	C2-Fluorenes	Benz(a)anthracene	3-Methylphenanthrene	n-Docosane (C22)
	C3-Fluorenes	Chrysene	4/9-Methylphenanthrene	n-Tricosane (C23)
	Anthracene	C1-Chrysenes	4-Methyldibenzothiophene	n-Tetracosane (C24)
	Phenanthrene	C2-Chrysenes	Chrysene	n-Pentacosane (C25)
	C1-Phenanthrenes/ Anthracenes	C3-Chrysenes	Chrysene/Triphenylene	n-Hexacosane (C26)
	C2-Phenanthrenes/ Anthracenes	C4-Chrysenes	Benzo(b)fluoranthene	n-Heptacosane (C27)
	C3-Phenanthrenes/ Anthracenes	Benzo(b)fluoranthene	Benzo(k)fluoranthene	n-Octacosane (C28)
	C4-Phenanthrenes/ Anthracenes	Benzo(k)fluoranthene	Dibenz(a,h)anthracene	n-Nonacosane (C29)
	Retene	Benzo(a)fluoranthene	2,6,10 Trimethyldodecane (1380)	n-Triacontane (C30)
	Benzo(b)fluorene	Benzo(e)pyrene	n-Tetradecane (C14)	n-Hentriacontane (C31)
	Fluoranthene	Benzo(a)pyrene	2,6,10 Trimethyltridecane (1470)	n-Dotriacontane (C32)
	Pyrene	Perylene	n-Pentadecane (C15)	n-Tritriacontane (C33)
	C1-Fluoranthenes/Pyrenes	Indeno(1,2,3-cd)Pyrene	n-Hexadecane (C16)	n-Tetratriacontane (C34)
	C2-Fluoranthenes/Pyrenes	Dibenz(a,h)anthracene	Norpristane (1650)	n-Pentatriacontane (C35)
	C3-Fluoranthenes/Pyrenes	Benzo(g,h,i)perylene	n-Heptadecane (C17)	n-Hexatriacontane (C36)
	C4-Fluoranthenes/Pyrenes	1,6,7-Trimethylnaphthalene	Pristane	n-Heptatriacontane (C37)
	Naphthobenzothiophene	1-Methyldibenzothiophene	n-Octadecane (C18)	n-Octatriacontane (C38)
	C1-Naphthobenzothiophenes	1-Methylphenanthrene	Phytane	n-Nonatriacontane (C39)
	C2-Naphthobenzothiophenes	2/3-Methyldibenzothiophene	n-Nonadecane (C19)	n-Tetracontane (C40)

Table S2. List of 50 specific polycyclic aromatic hydrocarbons (PAHs) used in the Sub-Sea Dispersant Injection (SSDI) analysis. The chemicals listed below are presented as PAH sums in the BP Gulf Science Data (GSD), Water Chemistry Data. The data can be found on the GRIID-C website; filename: WaterChemistry_W-01v02-01.csv.

Naphthalene	Fluoranthene
C1-Naphthalenes	Pyrene
C2-Naphthalenes	C1-Fluoranthenes/Pyrenes
C3-Naphthalenes	C2-Fluoranthenes/Pyrenes
C4-Naphthalenes	C3-Fluoranthenes/Pyrenes
Biphenyl	C4-Fluoranthenes/Pyrenes
Dibenzofuran	Naphthobenzothiophene
Acenaphthylene	C1-Naphthobenzothiophenes
Acenaphthene	C2-Naphthobenzothiophenes
Fluorene	C3-Naphthobenzothiophenes
C1-Fluorenes	C4-Naphthobenzothiophenes
C2-Fluorenes	Benz(a)anthracene
C3-Fluorenes	Chrysene
Anthracene	C1-Chrysenes
Phenanthrene	C2-Chrysenes
C1-Phenanthrenes/Anthracenes	C3-Chrysenes
C2-Phenanthrenes/Anthracenes	C4-Chrysenes
C3-Phenanthrenes/Anthracenes	Benzo(b)fluoranthene
C4-Phenanthrenes/Anthracenes	Benzo(k)fluoranthene
Dibenzothiophene	Benzo(a)fluoranthene
C1-Dibenzothiophenes	Benzo(e)pyrene
C2-Dibenzothiophenes	Benzo(a)pyrene
C3-Dibenzothiophenes	Indeno(1,2,3-cd)Pyrene
C4-Dibenzothiophenes	Dibenz(a,h)anthracene
Benzo(b)fluorene	Benzo(g,h,i)perylene

Table S3. Summary of Generalized Least Squares Regression Analysis for Variables used in the Generalized Least of Squares regression of the two layers 0-600 m and 600-1500 m. The data is computed within a 10 km radius from Macondo. Response variables for the different permutations were: (1) (2) (3) (4) (5) (6), (1L) (2L) (3L) (4L) (5L) (6L) where "L" indicate a lagged effect of the SSDI (see Figure S4). Vertical concentration ratio [ug/L] was computed as the logarithmic (log(x+1)) mean oil concentration of the two given depth ranges. For example in permutation (1) vertical ratio was computed as the mean oil concentration in upper layers (0-20 m and 20-400 m) minus the logarithmic mean oil concentration of the depth range of the second intrusion (400-1000 m).

	Value	Std.Error	t.value	p.value
(Intercept)	-0.0513	0.2074	-0.2472	0.81
Subsea dispersant [gal]	-10^{-6}	10^{-5}	-0.1072	0.92
Surface dispersant [gal]	-3×10^{-5}	2×10^{-5}	-1.3817	0.17
Time from blowout [d]	0.0025	0.0035	0.7159	0.48