

2. Supplementary data

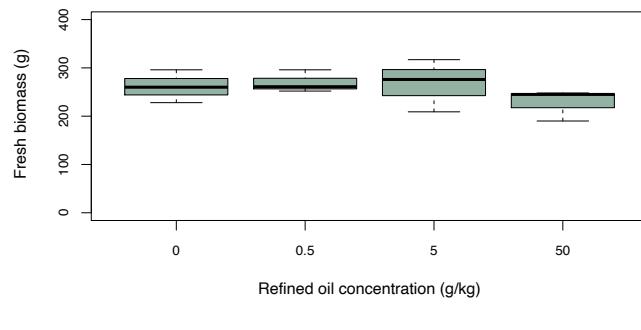
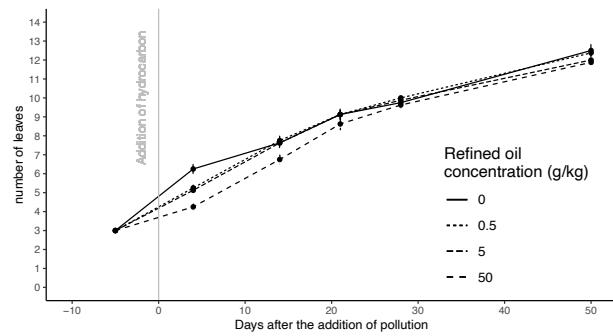
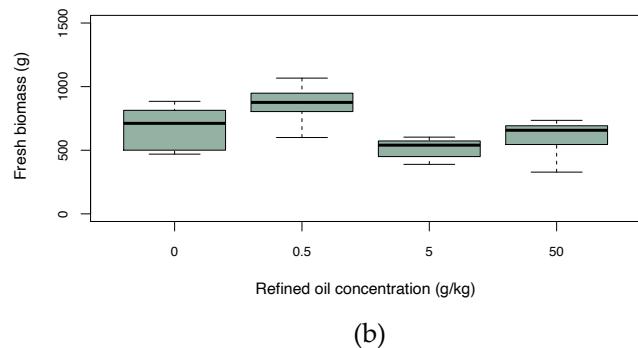
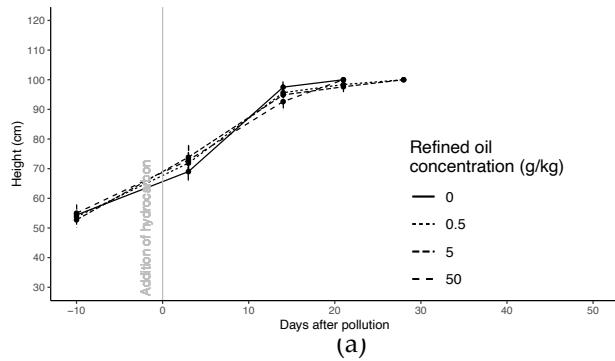


Figure S1. (a) Height of all the crude oil treatments of willow trees before and until 50 days of the addition of the polluted layer. (b) Fresh biomass of crude oil treatments of willow trees at the end of the experiment after 50 days of pollution. (c) Number of leaves in crude oil treatments of maize plants before and until 50 days of the addition of the polluted layer. (d) Fresh biomass of crude oil treatments of maize plants at the end of the experiment after 50 days of pollution.

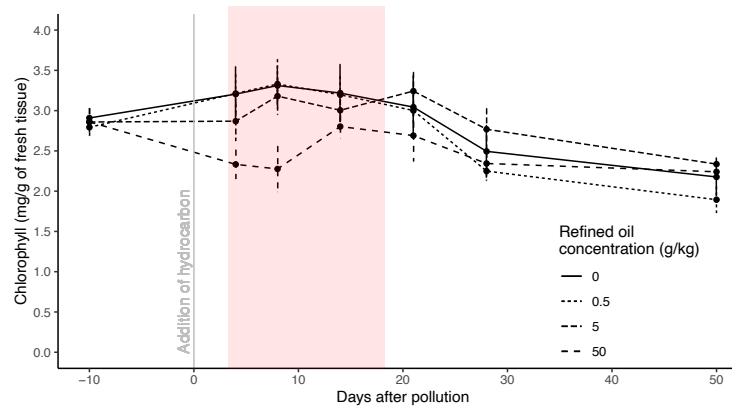
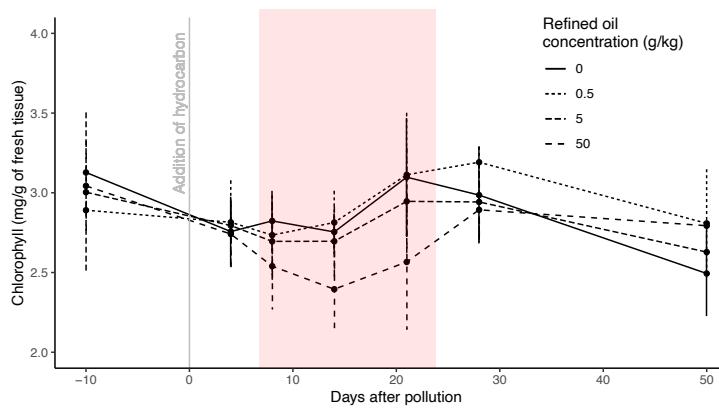


Figure S2. Chlorophyll content in willow (a) and maize (b) for all the refined oil treatments before and until 50 days the addition of the polluted layer. Red square indicates where significant differences calculated with ANOVA are present with control treatments

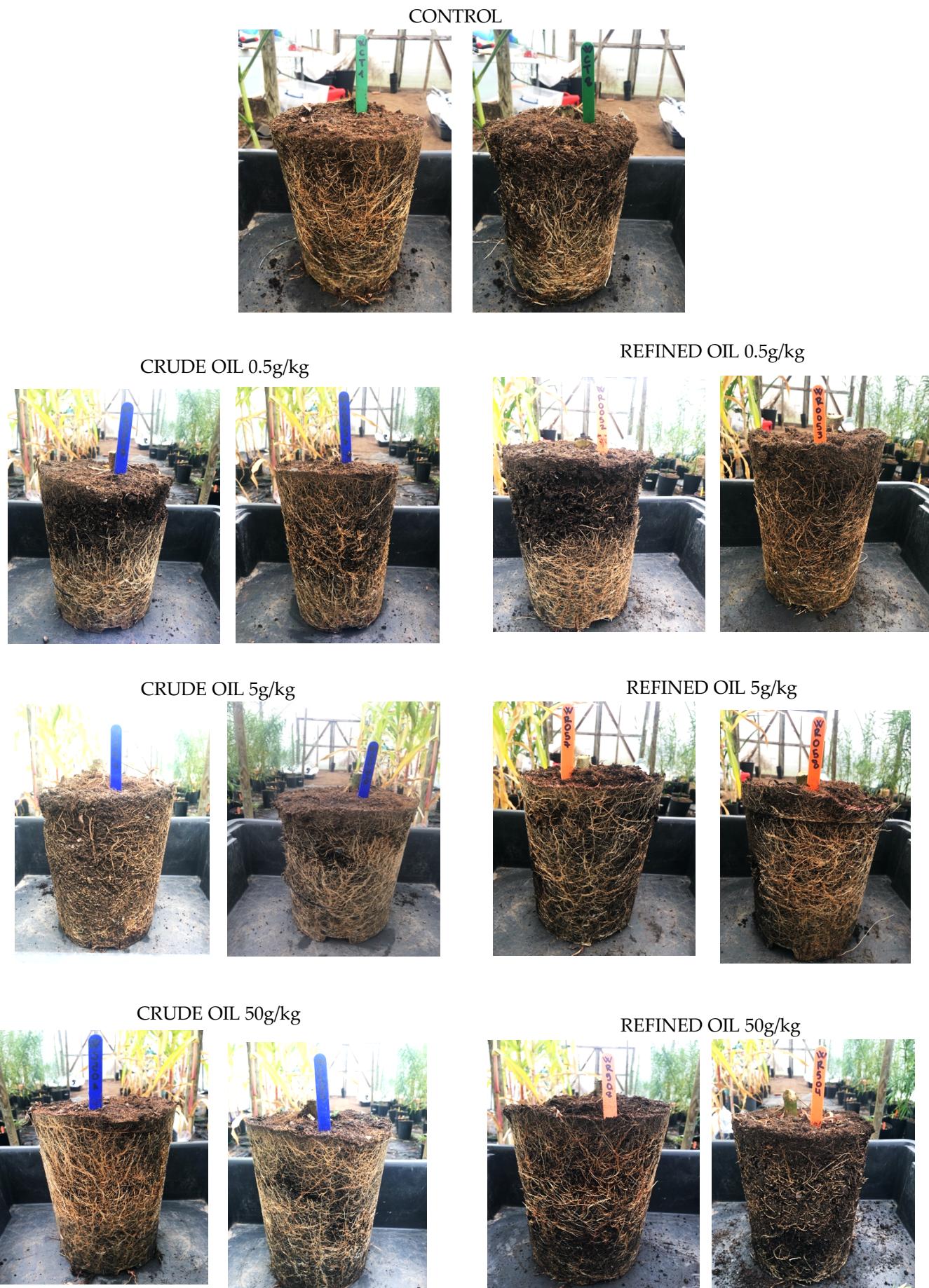


Figure S3 Visible roots of willow trees under different concentrations of crude and refined oil after 50 days of pollution.

CONTROL



CRUDE OIL 0.5 g/kg



REFINED OIL 0.5 g/kg



CRUDE OIL 5 g/kg



REFINED OIL 5g/kg



CRUDE OIL 50g/kg



REFINED OIL 50g/kg



Figure S4. Visible roots of willow trees under different concentrations of crude and refined oil after 50 days of pollution.

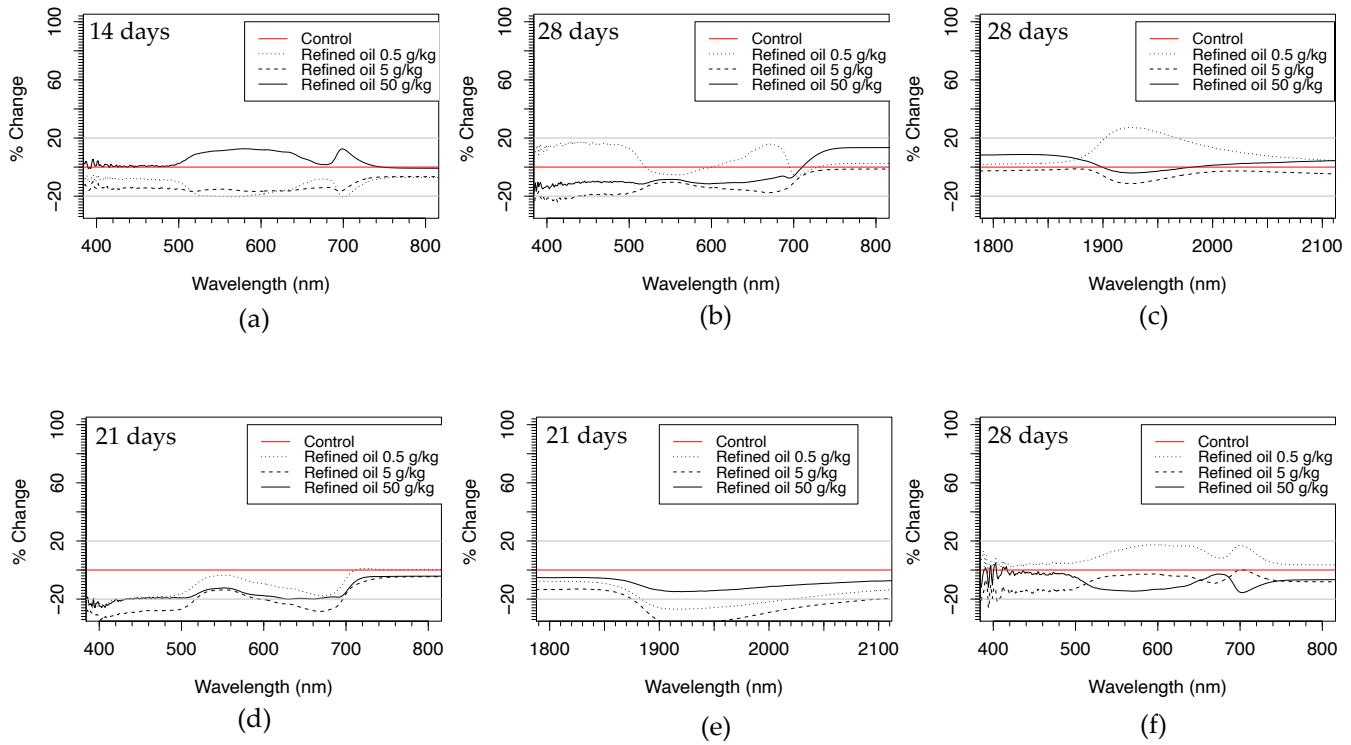


Figure S5. Ratios of reflectance change of refined oil treatments respect to control treatments in willow (a,b,c) and maize plants (d,e,f) in different parts of the spectra and on different days of the experiment.

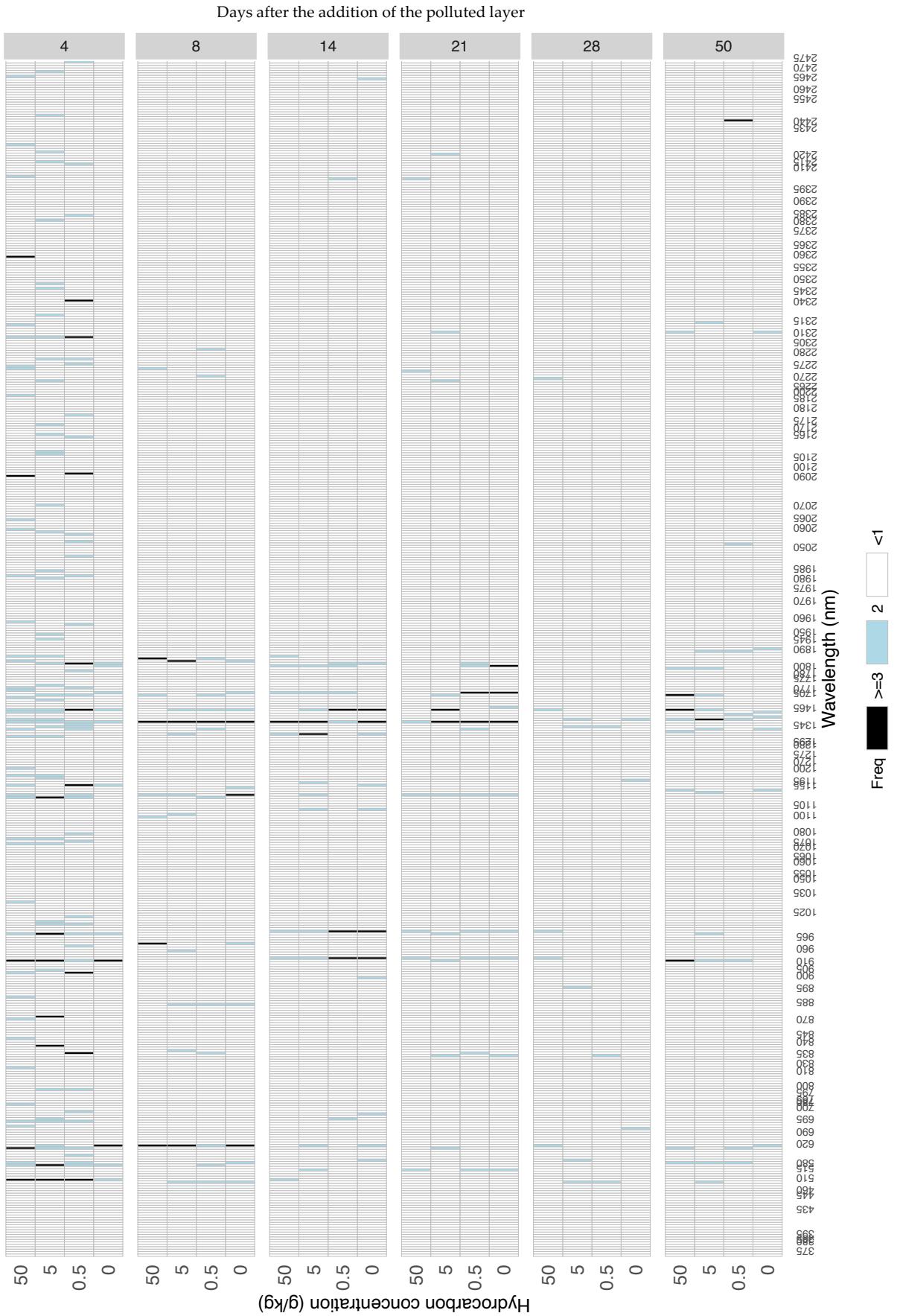


Figure S6. 2D histogram with the frequencies of the absorption features detected in each wavelength position for each concentration from 4 to 50 days after the addition of the refined oil polluted layer in maize plants.

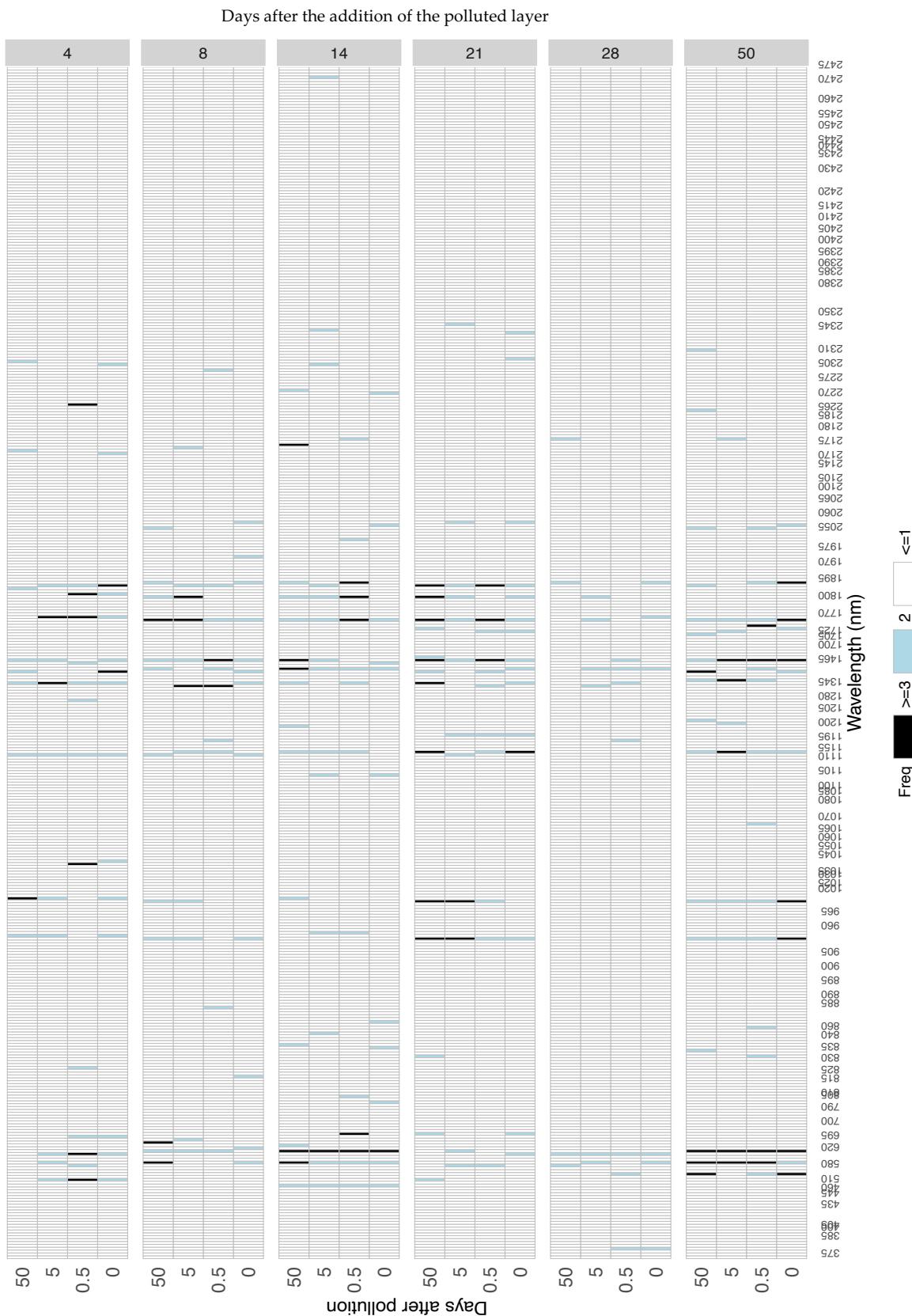


Figure S7. 2D histogram with the frequencies of the absorption features detected in each wavelength position for each concentration from 4 to 50 days after the addition of the refined oil polluted layer in willow trees.

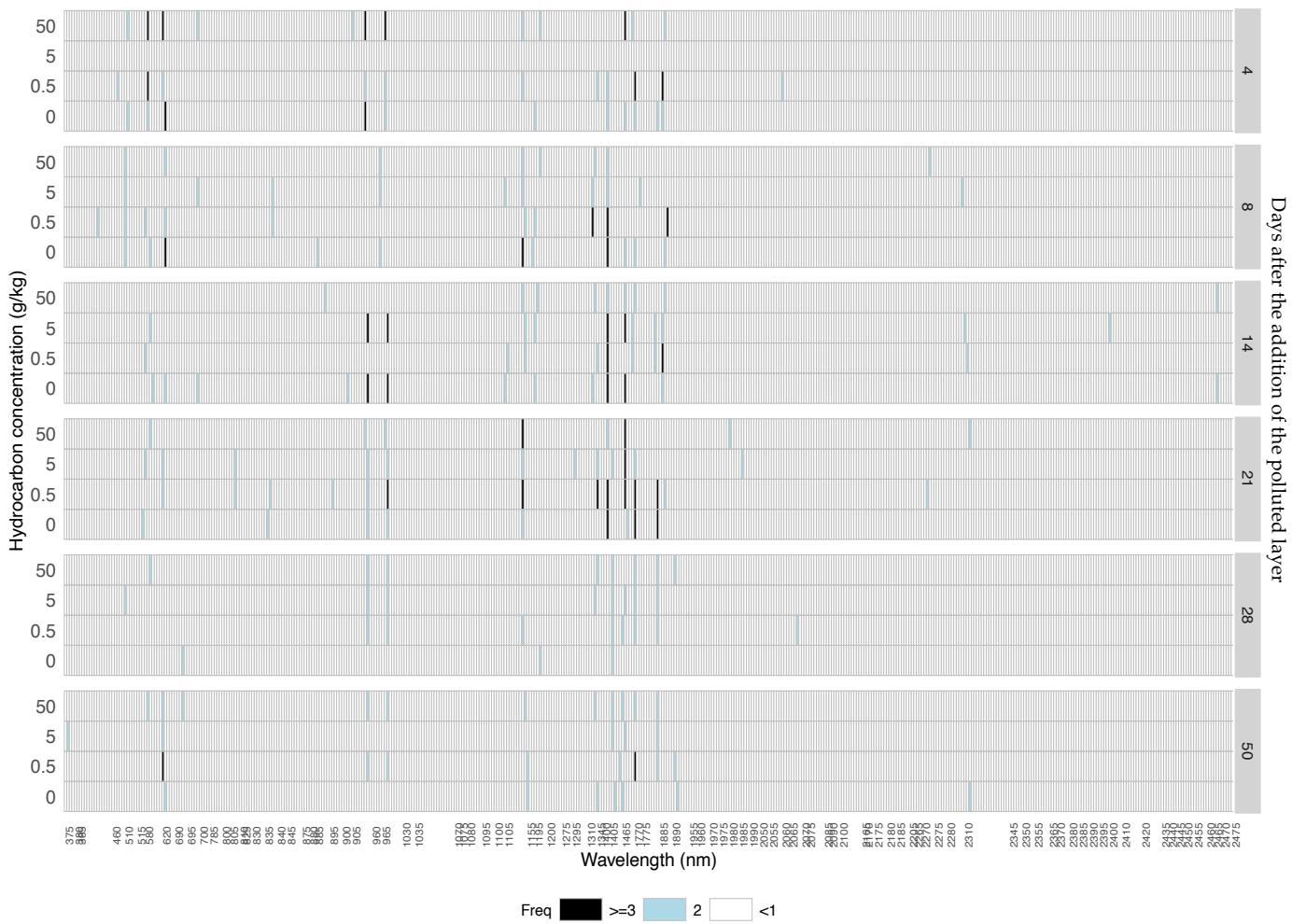


Figure S8. 2D histogram with the frequencies of the absorption features detected in each wavelength position for each concentration from 4 to 50 days after the addition of the crude oil polluted layer in maize plants.

Table S1. Absorption features classified according to the appearance of frequencies in the control treatments during the pollution event in refined oil treatments in willow and maize plants during the experiment. Wavelengths in red are only related to maize, blue to willow trees and black to willow and maize.

Absorption features that occurred in spectra from polluted treatments + Control			Absorption features that occurred in spectra from only in polluted treatments			Absorption features that occurred in spectra only in particular concentration		
Maize	Willow	Both	Maize	Willow	Both	Maize	Willow	Both
1195 nm 1886 nm 1802 nm 2361 nm	1346 nm 1894 nm	512 nm 581 nm 620 nm 957 nm 990 nm 1155 nm 1408 nm 1465 nm 1768 nm	836 nm 880 nm 990 nm 1346 nm 2059 nm 2271 nm 2310 nm	581 nm 696 nm	1726 nm 1802 nm	836 nm 880 nm 1886 nm 2059 nm	2176 nm	

Table S2. Absorption features detected in crude oil and refined oil treatments in willow and maize plants. The absorptions highlighted in red are only related to maize plants, the ones in blue only related to willows and the black the ones in common on both types of plants. References from literature are related on previous results in absorption features -biochemical component links.

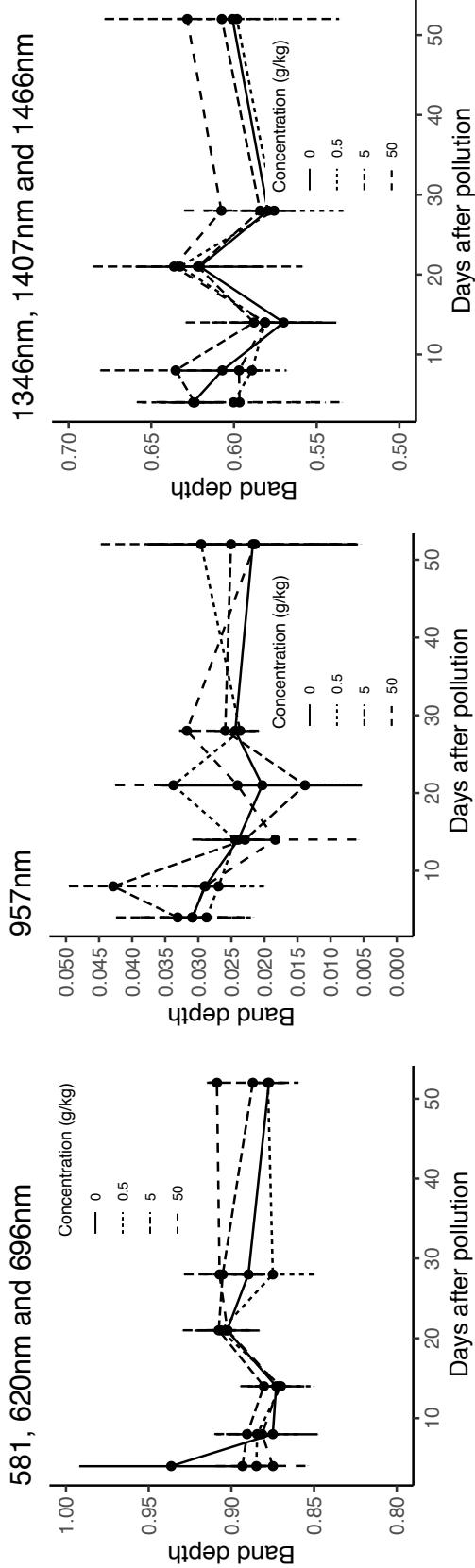
Spectral range	Crude oil	Refined oil	Reference on text	Biochemical component	Reference
VIS 350 nm – 750 nm	510 nm - 513 nm 581 nm - 582 nm 619 nm - 621nm 695 nm - 697nm	510 nm - 513 nm 581 nm-582 nm 619 nm -621 nm 695 nm -697 nm	512 nm 581 nm 620 nm 696 nm	Xanthophylls Chlorosis, yellow 600 nm - 650 nm Chlorophyll-a LAI, Chlorophyll	(Louchard et al., 2002) (Smith , 2002) (Lichtenhaler & Buschmann, 2001) (Asner, 1998)
NIR 750 nm – 1200 nm	836 nm -837nm 879 nm – 886 nm 904 nm	836 nm -837nm 879 nm – 886 nm	836 nm 880 nm 904 nm	910 nm Protein 910 nm Protein	[58]
	956 nm -958 nm 989 nm -991nm 1154 nm -1156 nm 1195 nm – 1198 nm	956 nm -958 nm 989 nm -991 nm 1154 nm -1156 nm 1195 nm – 1198 nm	957 nm 990 nm 1155 nm 1196 nm	970 nm Water and starch 970 nm Water and starch 1120 nm Lignin 1200 Water, starch, cellulose and Lignin	
SWIR 1200 nm – 2500 nm	1345 nm-1346 nm 1407 nm-1408 nm 1466 nm-1465 nm 1726 nm – 1727 nm 1768 nm-1770 nm 1801 nm -1803 nm 1886 nm – 1888 nm 1893 nm-1895 nm 2058 nm-2060 nm 2097 nm – 2099 nm 2175 nm - 2177 nm 2271 nm 2306 nm - 2309nm 2346 nm 2361 nm	1345 nm -1346 nm 1407 nm-1408 nm 1466 nm-1465 nm 1726 nm – 1727 nm 1768 nm-1770 nm 1801 nm -1803 nm 1886 nm – 1888 nm 1893 nm-1895 nm 2058 nm-2060 nm 2097 nm – 2099 nm 2175 nm - 2177 nm 2271 nm 2306 nm - 2309nm 2346 nm 2361 nm	1346 nm 1408 nm 1465 nm 1726 nm 1769 nm 1802 nm 1887 nm 1894 nm 2057 nm 2098 nm 2176 nm 2276 nm 2307 nm 2346 nm 2361 nm	1400 nm Water 1400 nm Water 1450 nm Starch, sugar, lignin, water Lignin, starch, sugar, protein 1780 nm Cellulose 1780nm - 1820 nm Cellulose, sugar, starch 1780nm - 1820 nm Cellulose, sugar, starch 1900 nm Starch Protein and nitrogen 2100 nm Starch and cellulose Protein and nitrogen Starch, sugar and cellulose 2310 nm Oil 2340 nm Cellulose 2350 nm Cellulose, nitrogen and protein	[58]

Louchard, E., Reid, R., Stephens, C., Davis, C., Leathers, R., Downes, T., & Maffione, R. (2002). Derivative analysis of absorption features in hyperspectral remote sensing data of carbonate sediments. *Optics Express*, 10(26), 1573. <https://doi.org/10.1364/oe.10.001573>

Lichtenhaler, Hartmut K., & Buschmann, C. (2001). Chlorophylls and Carotenoids: Measurement And Characterization by UV-VIS Spectroscopy. *Current Protocols in Food Analytical Chemistry*, 1(1), 1–8.
<https://doi.org/10.1002/0471709085.ch21>

Asner, G. P. (1998). Biophysical and biochemical sources of variability in canopy reflectance. *Remote Sensing of Environment*, 64(3), 234–253. [https://doi.org/10.1016/S0034-4257\(98\)00014-5](https://doi.org/10.1016/S0034-4257(98)00014-5)

Willow



Maize

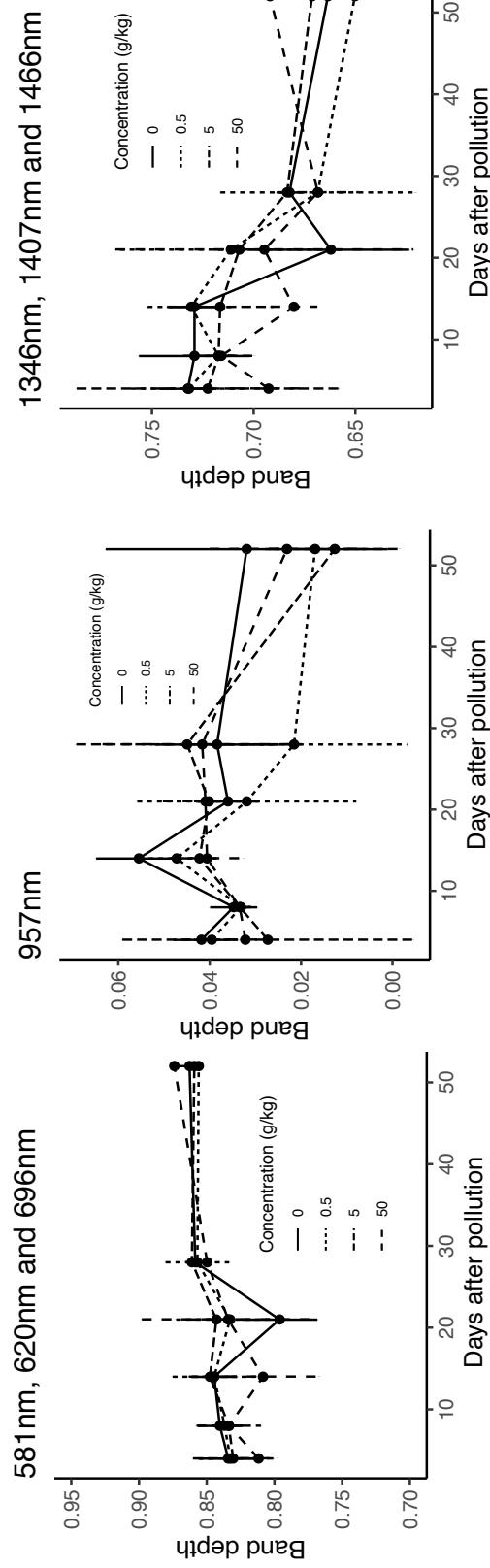
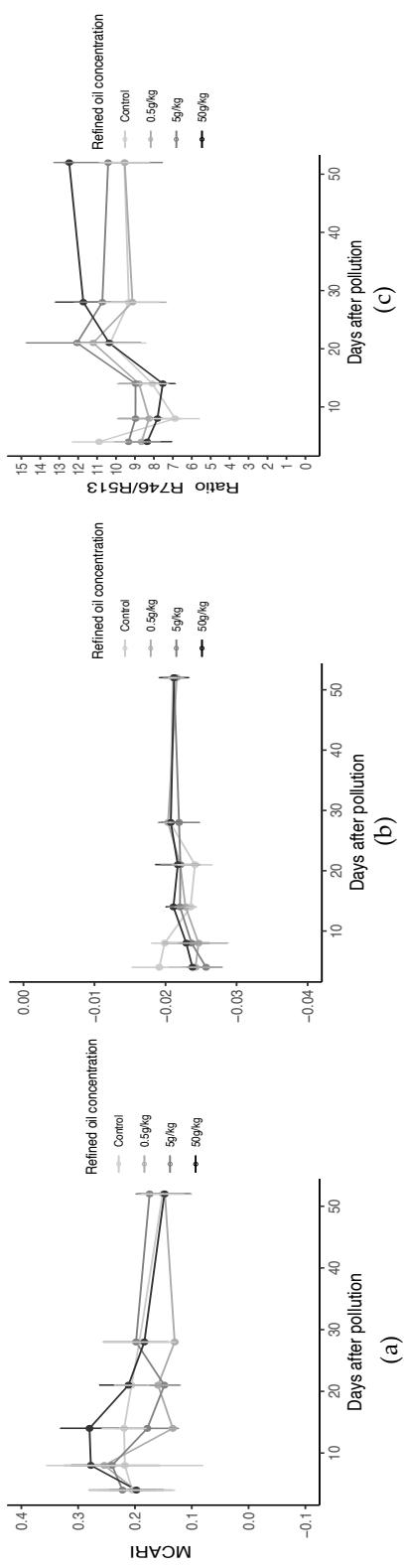


Figure S9. Band depth time series in 512 nm, 620 nm, 957 nm and 1346 nm absorption features in willow (top line charts) and maize plants (bottom line charts) during the whole experiment in refined oil treatments.

Willow



Maize

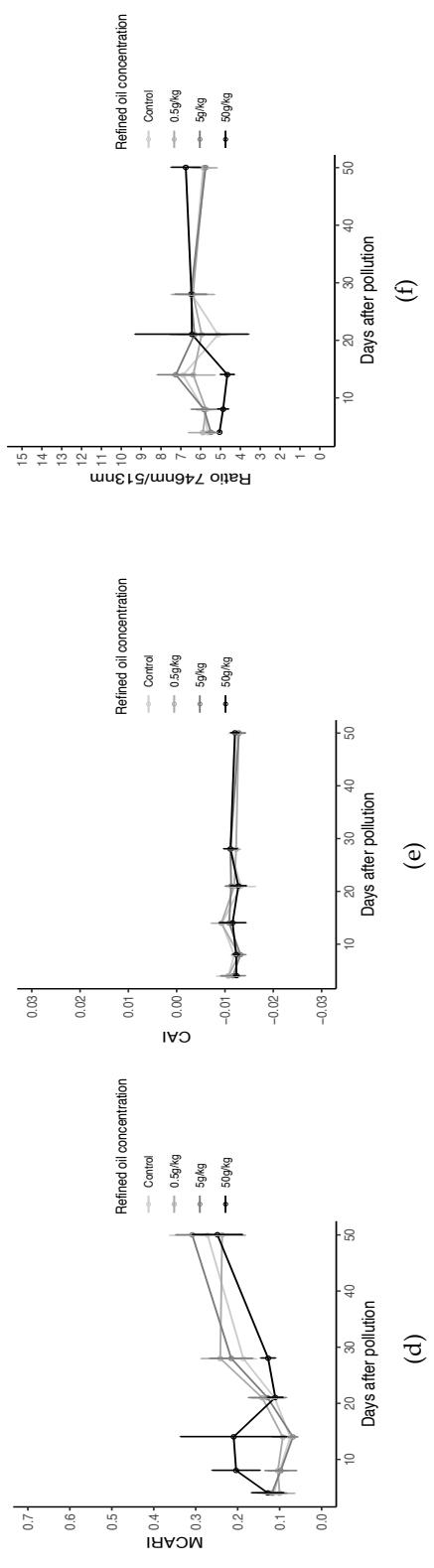
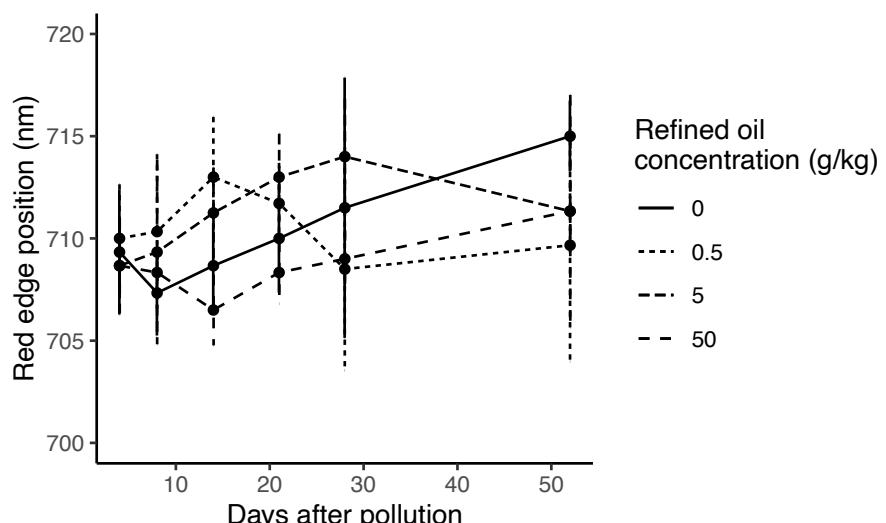
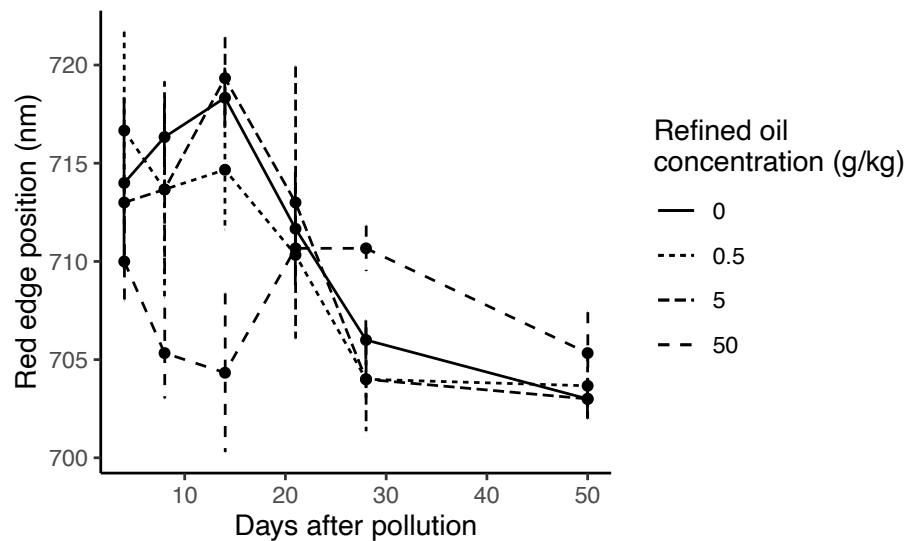


Figure S10. Time series of vegetation indices MCARI (a) (d), CAI (b)(e) and RARS (c)(f) in refined oil treatments in willow (top) and maize (bottom) from 4 days after the addition of the polluted layer until 50 days later.



(a)



(b)

Figure S11. Mean and standard error time series red edge position in refined oil treatments in willow (a) and maize (b) during the whole experiment.

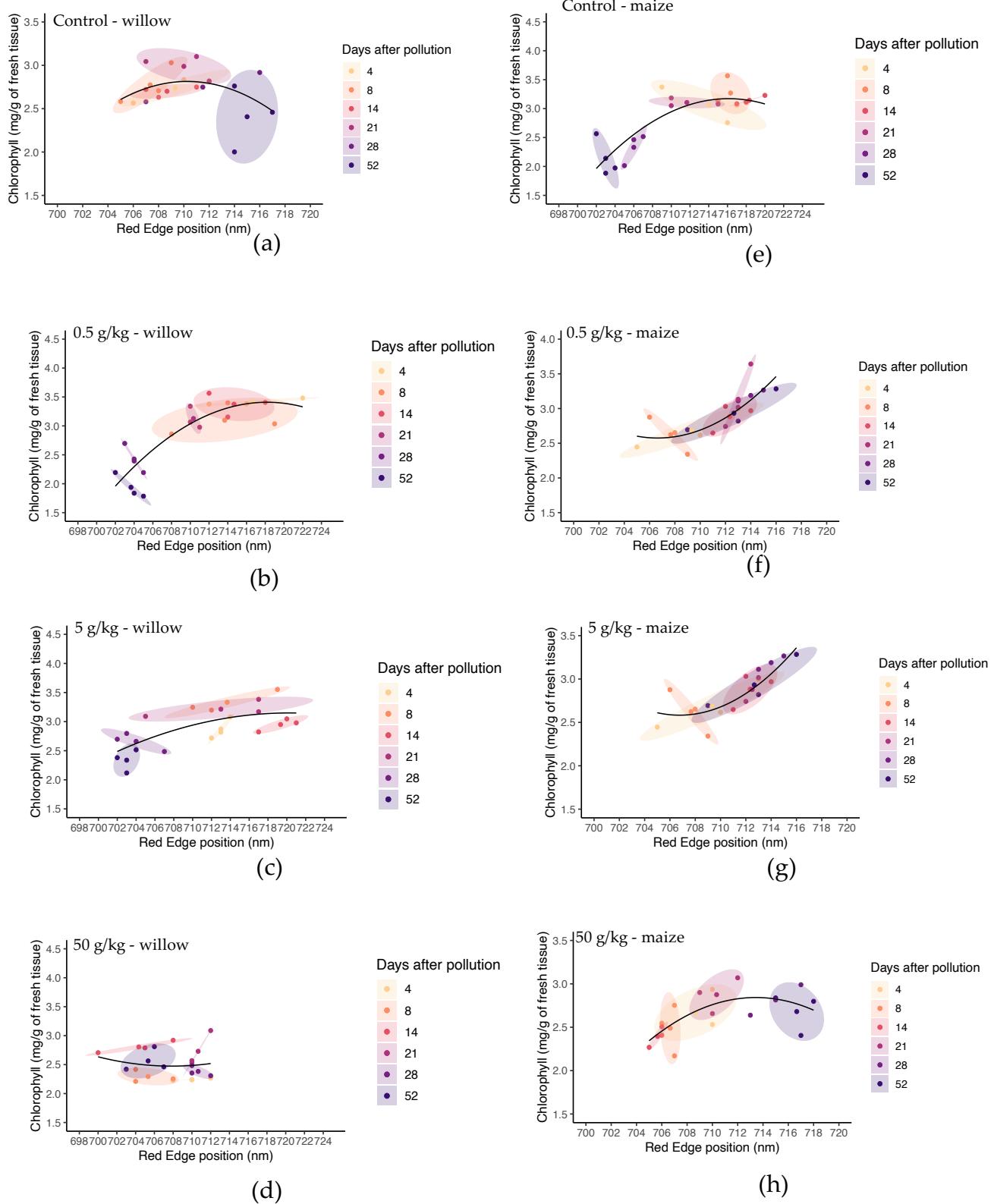


Figure S12. Red edge and chlorophyll relationships with 0.95% confidence ellipsis for each treatment in willow ((a), (b), (c) and (d)) and maize plants ((e),(f), (g) and (h))

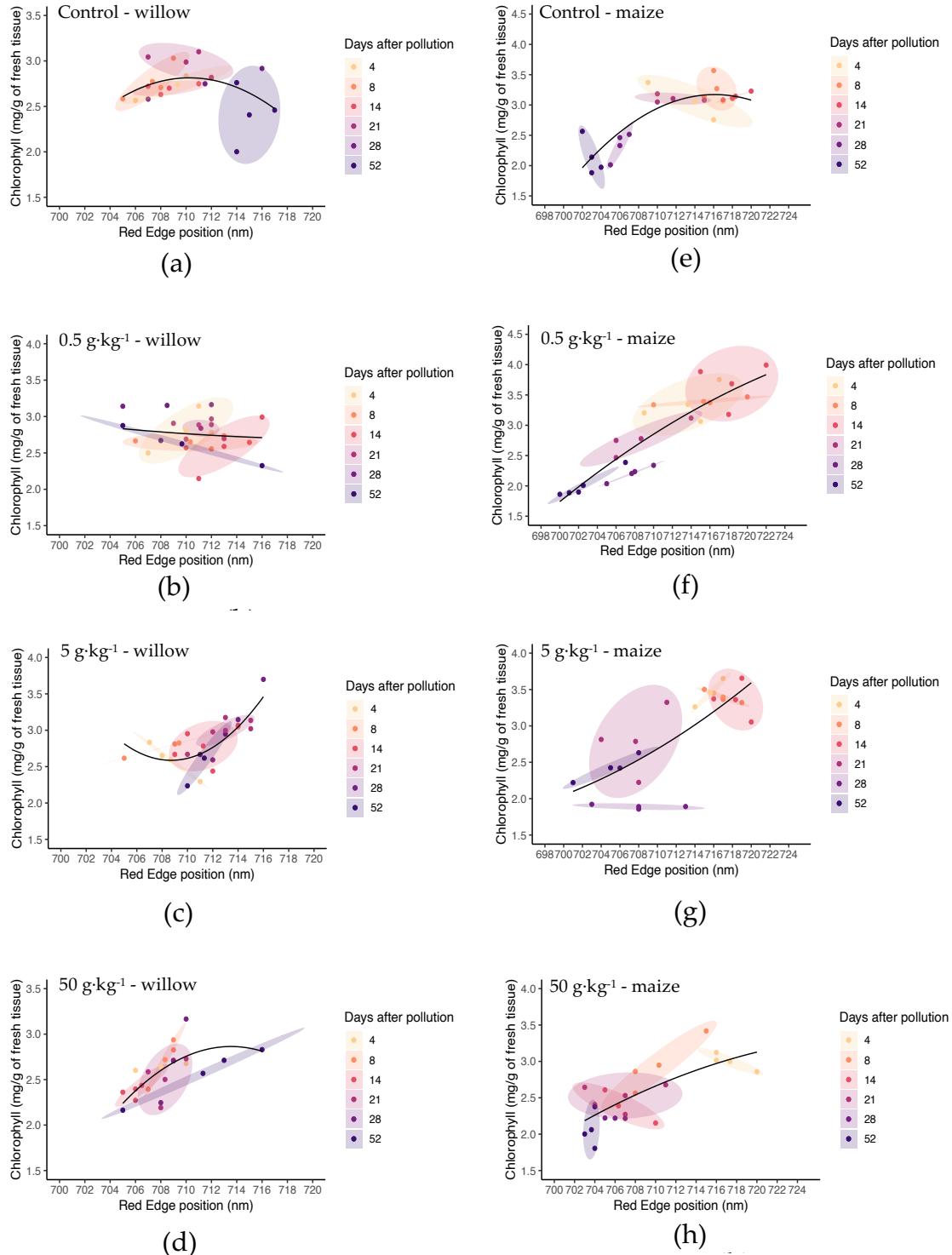


Figure S13. Red edge and chlorophyll relationships with 0.95% confidence ellipsis for each crude oil treatment in willow ((a),(b), (c) and (d)) and maize plants ((e),(f), (g) and (h))



(a)



(b)



(c)

Figure S14. Set up of reflectance data collection in willow trees using ASD FieldSpec® Pro 3. (a) willow leaves needed to cover the field of view of the contact probe ASD FieldSpec® Pro, (b) arrangement of willow leaves at the low reflectance petri dish, (c) contact probe on top of the leaves collecting reflectance spectra.

Table S3. Spectral vegetation indices selected according to the results obtained in the derivative, absorption feature analysis and previously published literature.

	<i>Index</i>	<i>Use</i>	<i>Formula</i>	<i>Range</i>	<i>References</i>
STRUCTURE AND BIOMASS	NDWI	Water, canopy moisture	$(R860-R1240)/(R860-R1240)$	-1 to 1	[48]
	CAI	Cellulose	$0.5 \cdot (R2000+R2200) - R2100$	-3 to >4	[45]
BIOCHEMISTRY	NDLI	Lignin	$\frac{(\log(1/R1754) - \log(1/R1680)) / (\log(1/R1754) + \log(1/R1680))}{}$	0 to 1	[49]
	CARI	Chlorophyll	$\frac{[(R700-R670)-0.2*(R700-R550)]}{(R700-R670)-0.2*(R700-R550)}$	0 to 1	[46]
PLANT PHYSIOLOGY AND STRESS	MCARI	Chlorophyll	$\frac{(R700-R670)-0.2*(R700-R550)* (R700 / R670)}{}$	0 to 1	[46]
	ARI	Anthocyanins	$\frac{(1/R550) \cdot (1/R700)}{(1/R510) - (1/R550)}$	0 to 0.2	[50]
	CRI	Carotenoids	$R746 / R513$	0 to 15	[51]
PRI * CI	RARS	Ratio analysis of reflectance spectra			[47]
	PRI	Photochemical Reflectance Index	$(R531-R570)/(R531-R570)$	-1 to 1	[52]
Carotenoid / Chlorophyll Ratio Index			$(R680 - R500) / (R750)$	-1 to 1	[59]