RELATIONSHIP BETWEEN CONCENTRATIONS OF PCDDS, PCDFS, and DIOXIN-LIKE PCBS IN VEGETATION AND SOIL ON RESIDENTIAL PROPERTIES

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Introduction & Objectives

- As part of The University of Michigan Dioxin Exposure Study (UMDES), soil samples were analyzed from 766 residential properties and vegetation samples from 415 of these properties. This poster examines the relationship between the TEQ and 2,3,4,7,8-PeCDF concentrations measured in the soil and vegetation around the house perimeter.

Methods

- **Soil and Vegetation:** Samples were collected from five areas, designated as Floodplain (the 100-year floodplain of the Tittabawassee River), Near Floodplain, Plume (located downwind from Dow Chemical in Midland, MI), Other Midland/Saginaw Counties, and Jackson/Calhoun Counties (Fig. 1).
- Four sampling stations were located around the house (Fig. 2). A sampling ring, 3 feet in diameter, was laid on the ground and three soil cores were collected from within the ring. Vegetation was collected separately by clipping the grass (or weeds) just above ground level within the ring. Both soil and vegetation samples were analyzed by HRGC/HRMS by Vista Analytical Laboratory (El Dorado Hills, CA, USA) for the 29 congeners with published toxic equivalency factors (TEFs). If the concentration was below the limit of detection (LOD), it was recorded as LOD/√2. The results were survey-weighted to reflect the population statistics. TEQs were calculated using the WHO 2005 TEFs (van den Berg et al., 2006).

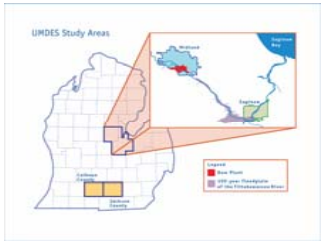


Figure 1: UMDES study areas

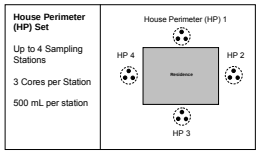


Figure 2: Sampling stations around each house

- **Statistical Analysis:** Linear regression analysis was run in a stepwise manner using $\log_{10}$ (vegetation concentration) as the outcome and explanatory variables such as $\log_{10}$ (soil concentration), region, sampling season, cumulative rainfall in the last three days, burning trash or yard waste, having pets, use of property as a farm, pesticide use, flooding history and fire damage. Significance was determined as $p < 0.10$.

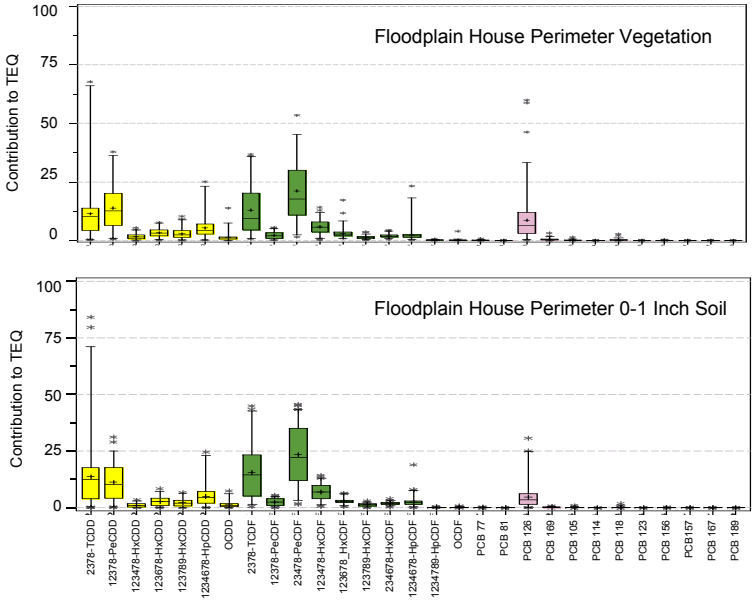
Results and Discussion

- **Tables below** summarize the TEQ measurements for the soil (top) and vegetation (bottom) for the house perimeter (HP) samples. The mean TEQ for the HP 0-1 inch soil composites was 56.5 pg/g in the Floodplain and 109.2 pg/g in the Plume, the two areas known to be contaminated, whereas the mean TEQ for the HP vegetation composites was 14.2 pg/g and 37.5 pg/g for the same areas. Thus, the mean TEQ of the vegetation is 0.25 and 0.34 of that of the soil for these areas. These ratios roughly correspond to the value of 0.27 reported by Meneses et al. (2002) (based on I-TEQ) for grass and weeds.

Soil Composites HP 0-1 Inch	N	$TEQ_{DFP29-2005}$ (pg/g)						
		Mean	S.E.	Median	75th%ile	95th%ile	Min	Max
Floodplain	203	56.5	9.7	11.4	35.4	223.1	1.1	1881.4
Near Floodplain	164	52.0	36.7	3.9	10.4	102.9	0.8	2299.8
Other M/S	168	13.5	2.0	5.3	13.2	59.4	0.8	157.7
Plume	37	109.2	31.0	58.2	111.9	257.2	6.3	745.5
Jackson/Calhoun	194	6.9	0.8	3.6	7.6	22.6	0.4	186.2

Vegetation Composites House Perimeter	N	$TEQ_{DFP29-2005}$ (pg/g dry wt)						
		Mean	S.E.	Median	75th%ile	95th%ile	Min	Max
Floodplain	188	14.2	3.4	3.4	7.4	50.2	0.4	1427.2
Near Floodplain	69	376.6	354.1	3.3	10.1	152.0	0.6	7994.9
Other M/S	71	4.2	0.4	3.3	5.1	10.1	1.0	27.5
Plume	36	37.5	12.7	18.3	31.1	125.4	0.8	268.9
Jackson/Calhoun	52	4.5	0.6	3.3	6.7	8.7	0.6	25.9

Results and Discussion, continued



- **Figures above** show the congener patterns from the Floodplain house perimeter vegetation (top) and soil (bottom) samples. The patterns are very similar, with, for example, 2,3,4,7,8-PeCDF the dominant contributor to the TEQ in both, unlike in other studies where a dissimilarity between soil and vegetation patterns has been reported (e.g., Welsh-Pausch et al., 1995). This similarity suggests that the major mechanism of contamination of the vegetation is deposition of soil particles.

Variable (only showing variables whose R^2 difference > 1.0) *Relative to Jackson/Calhoun	Log_{10} Vegetation TEQ (overall R^2 = 49.9)		Log_{10} Vegetation 23478-PeCDF (overall R^2 = 56.5)	
	Estimate	R^2 difference	Estimate	R^2 difference
Log_{10} Soil conc. HP 1-6 inch	0.428	29.270	0.537	48.430
Region Floodplain*	-0.023	12.230	0.086	3.850
Region Near Floodplain*	0.020		0.141	
Region Other Midland/Saginaw*	-0.139		-0.114	
Region Plume*	0.356		0.194	
Sampling in fall versus summer	0.132	4.000	0.103	3.480
Sampling in spring versus summer	-0.116		-0.166	
Having pets	0.009	1.840		
Burning trash or yard waste	-0.014	1.030		

- **Table above** shows the regression results, which suggest a strong association between soil and vegetation concentrations, corroborating the similarity in the figures above. In addition, sampling season was significantly associated with vegetation concentration, with an increase in the fall and a decrease in the spring, relative to the summer. Region was also strongly correlated with concentration; however, variables such as cumulative rainfall in the last three days or use of property as a farm showed no significant correlation.

References and Acknowledgements

Meneses, M., et al., 2002. Chemosphere 46:1393.

Van den Berg, M. et al., 2006. Toxicological Sci. 93:223.

Welsh-Pausch, K. et al., 1995. ES&T 29:1090.

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