

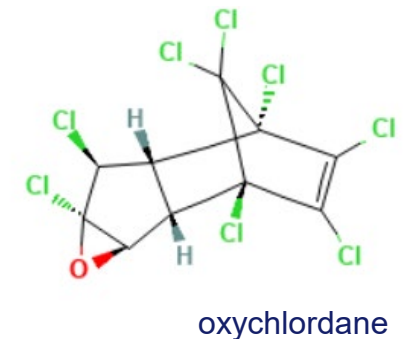
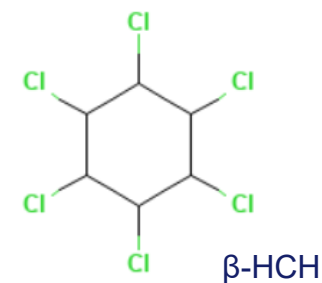
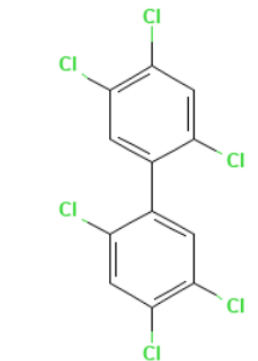
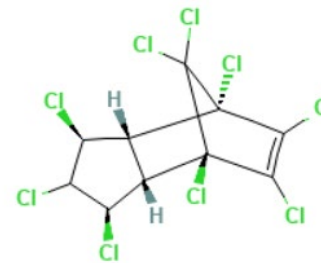
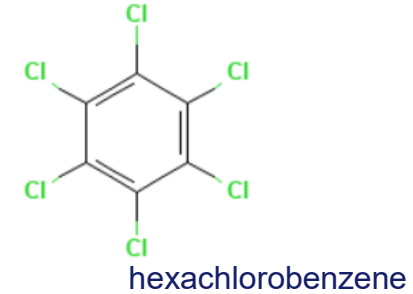
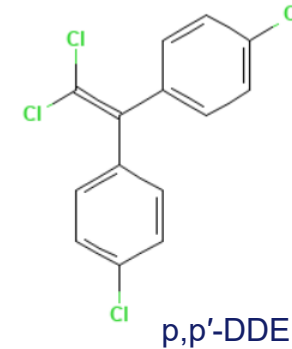
Persistent organic pollutant (POP) levels in Californians: Shouldn't hexachlorobenzene be decreasing?

Ian Tang
Biomonitoring California
Environmental Health Investigations Branch
California Department of Public Health
Scientific Guidance Panel, November 14, 2025



Department of
Toxic Substances
Control

BIOMONITORING
CALIFORNIA

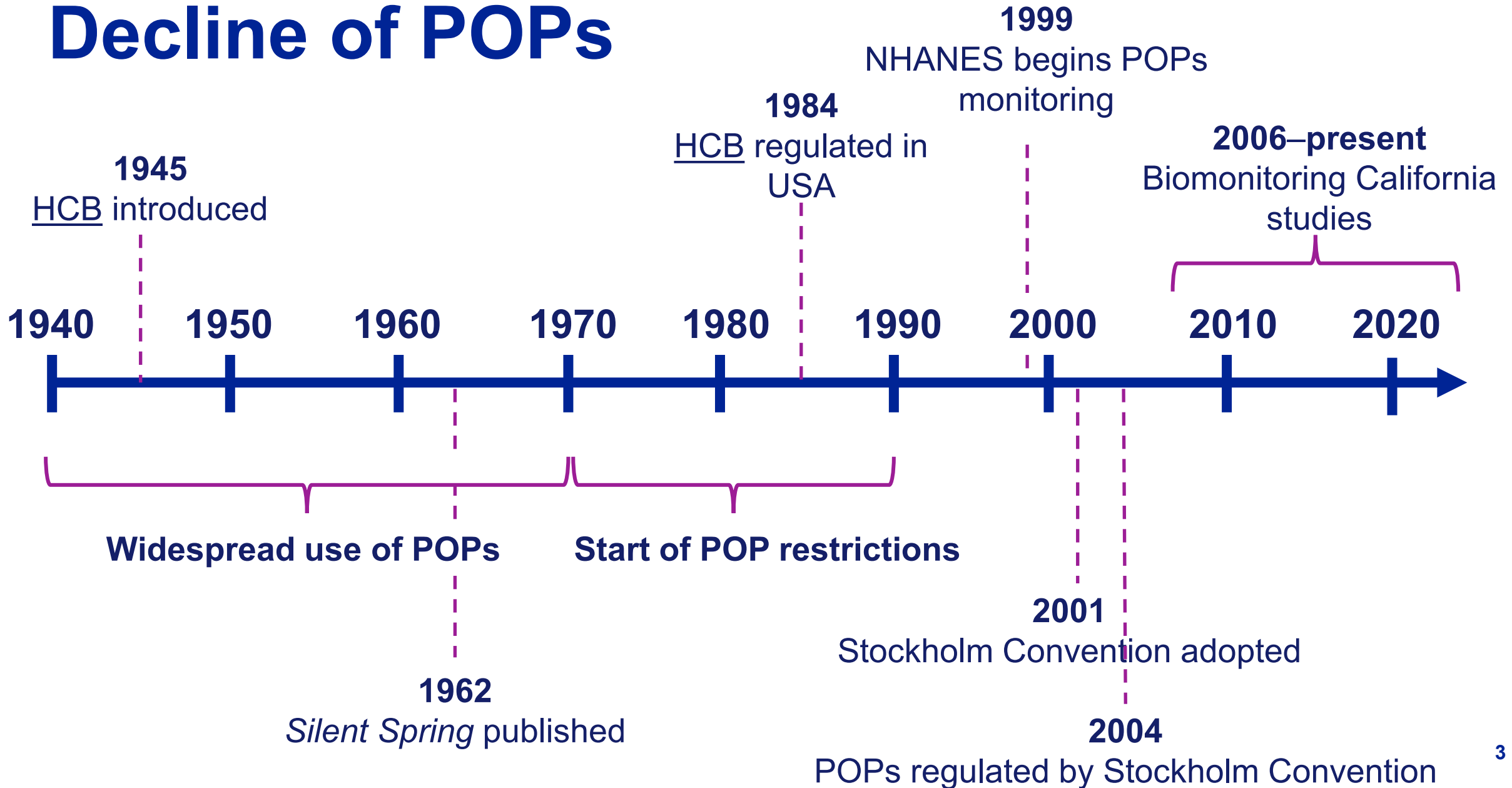


Persistent Organic Pollutants (POP)

- Persistent, bioaccumulative, and toxic
- Organochlorine pesticides:
 - **β -HCH**: β -hexachlorocyclohexane
 - **DDT**: dichlorodiphenyltrichloroethane
 - **DDE**: dichlorodiphenyldichloroethylene
 - **HCB**: hexachlorobenzene
 - **trans-Nonachlor**
 - **Oxychlordan**
- Polychlorinated biphenyls



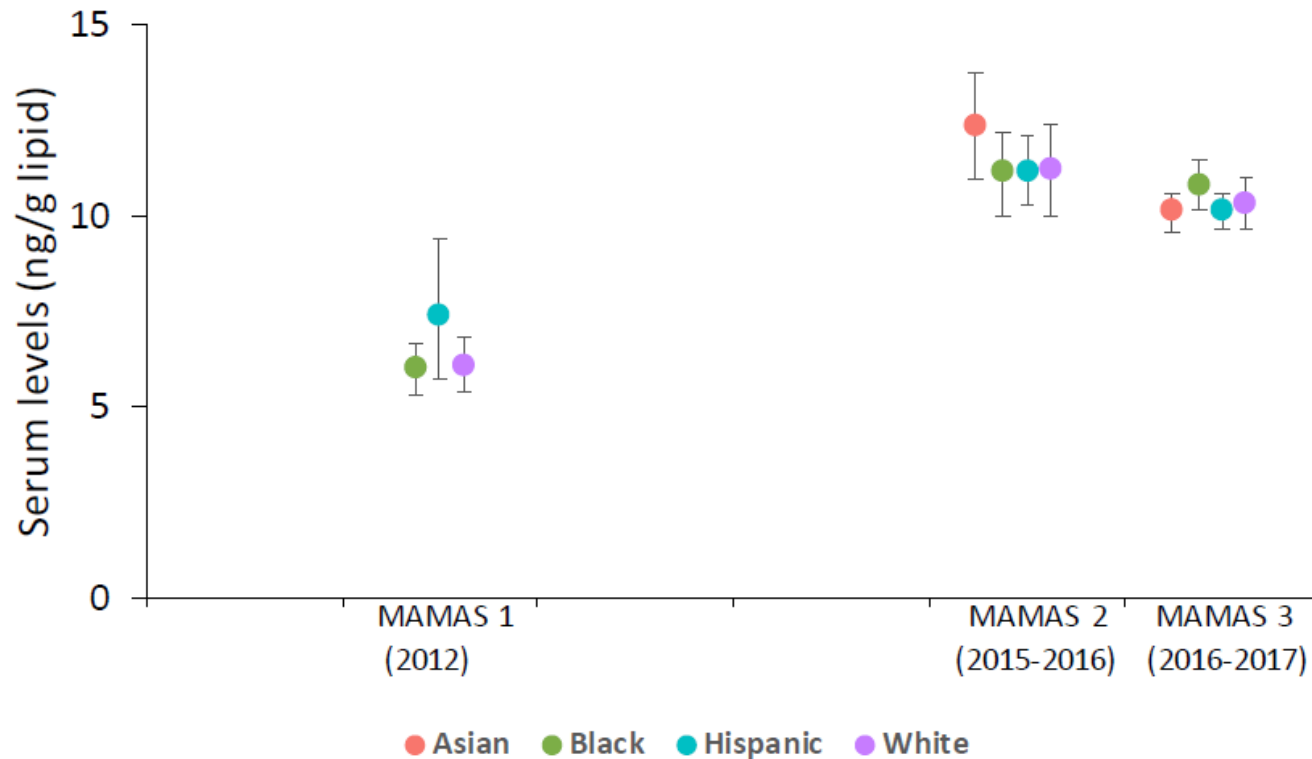
Decline of POPs



An HCB signal ?



Geometric mean (95% CI) of HCB in MAMAS 1-3

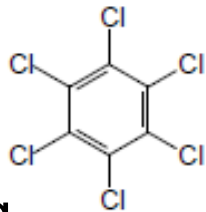


Measuring Analytes in Maternal Archived Samples (MAMAS)

Chemical exposures in pregnant Californians using prenatal screening

Hexachlorobenzene (HCB)

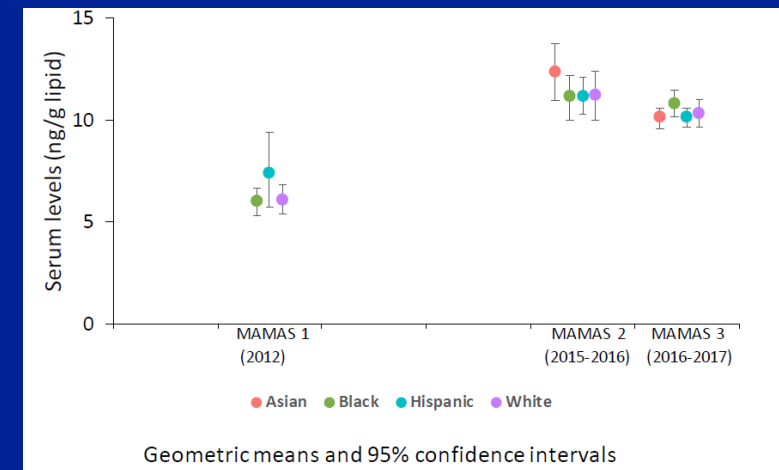
- Half-life: 6-11 years depending on media
- Used as a fungicide, can be a byproduct of other chlorinated solvents



Objective: Investigate time trends of POPs in Californians

Across Biomonitoring California (CA) Studies

Geometric mean (95% CI) of HCB in MAMAS 1-3

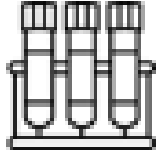


Biomonitoring Studies:

- Test for POPs in women of reproductive age (15-45) in combined California studies
- Total N: 649
- 33% Hispanic
- Mean age: 30 years

Time frame	Study Name	Region	Population	Subsample
2010-2011	(MIEEP) Maternal and Infant Environmental Exposure Project	Bay Area	Mothers	77
2010-2011	(FOX) Firefighter Occupation Exposures	Southern CA	Firefighters	2
2011-2012	(BEST 1) Pilot Biomonitoring Exposures Study	Central Valley	Kaiser members	13
2012	(MAMAS 1) Measuring Analytes in Maternal Archived Samples	Southern CA	Prenatal screening participants	58
2013	(BEST 2) Expanded Biomonitoring Exposures Study	Central Valley	Kaiser members	114
2015-2016	(MAMAS 2) Measuring Analytes in Maternal Archived Samples	Select regions	Prenatal screening participants	242
2016-2017	(MAMAS 3) Measuring Analytes in Maternal Archived Samples	Select regions	Prenatal screening participants	204

Time-trend



Serum Chemicals

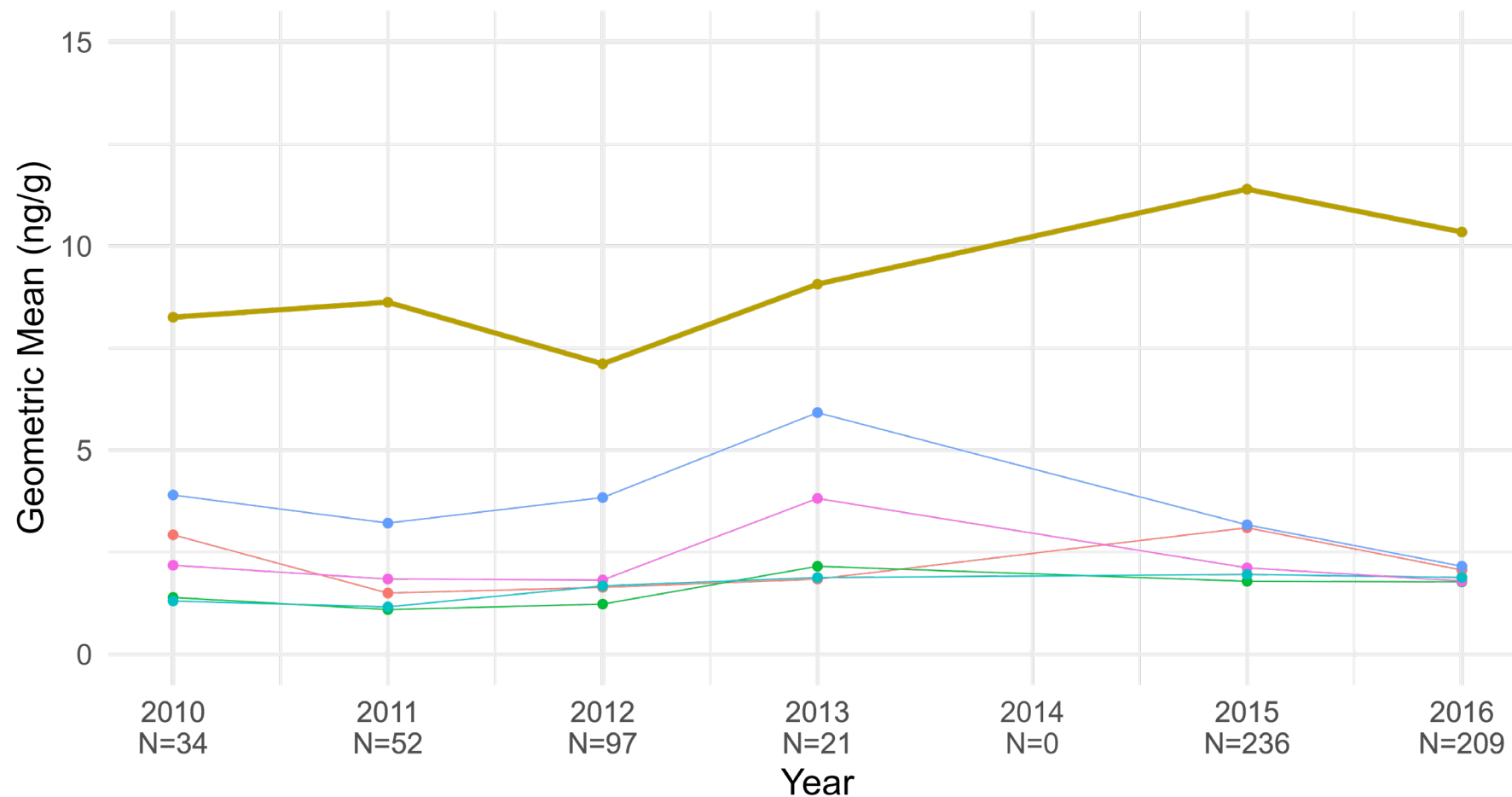
- β -HCH
- p,p'-DDT
- p,p'-DDE
- HCB
- *trans*-Nonachlor
- Oxychlordane
- PCB 153



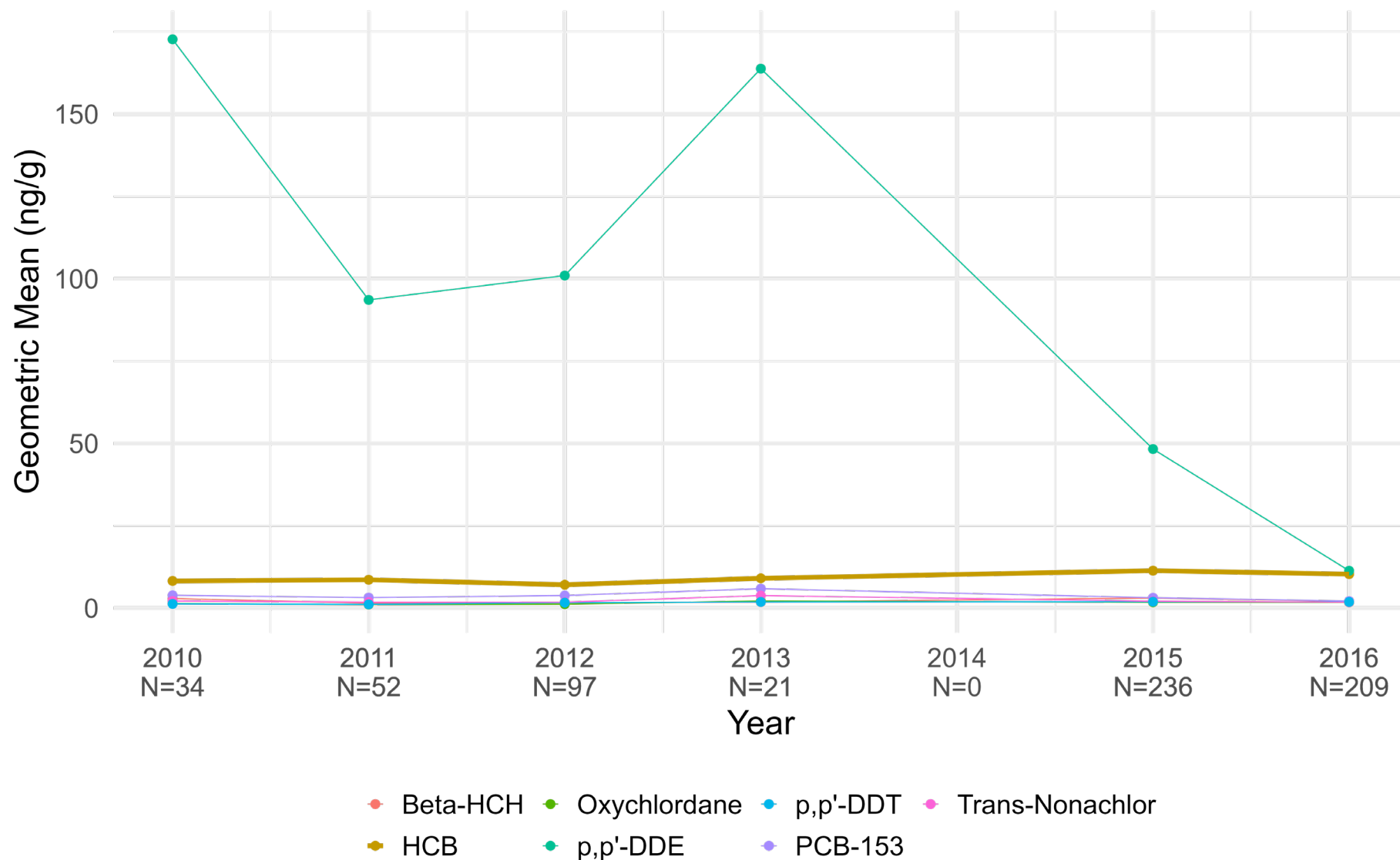
Analysis: Individual-level

- N= 649
- Linear regression
 - **Outcome:** Log-transformed analyte concentration
 - **Predictor:** Year of sample collection
 - **Covariates:** Age, race/ethnicity
- Lipid-normalized
- Level of detection standardized to highest among studies
- Back-transformed to % change
- Spearman Correlation

POP geometric mean by year, excluding p,p'-DDE



POP geometric mean by year



Percent change of POP concentration per year

POP	GM (ng/g lipid)	Adjusted % change (95% CI)	Spearman Rho	Direction of estimate
Beta-HCH	2.78	-4.89 (-7.42, -2.30)	-0.11*	↓
p,p'-DDT	2.30	-6.34 (-8.91, -3.69)	-0.05*	↓
p,p'-DDE	39.9	-33.38 (-36.26, -30.38)	-0.68*	↓
HCB	10.5	0.68 (-0.55, 1.94)	0.001	
trans-Nonachlor	2.29	-6.90 (-8.46, -5.32)	-0.05*	↓
Oxychlorane	2.06	-3.46 (-4.58, -2.32)	-0.14*	↓
PCB 153	3.11	-12.45 (-14.26, -10.61)	-0.35*	↓

GM = Geometric Mean
Adjusted for age and race/ethnicity

* = p<0.05

POPs in Biomonitoring participants

- Limitations in this study
 - Different populations & geographic locations
 - Unable to differentiate study effect by year
 - Low N in some years
- Sensitivity analyses are consistent
 - Combined gender
 - All women
 - Excluding highest LOD
 - Meta-regression
- Future directions
 - Include one more study
 - Adjust for more confounders



HCB at ~ 7-10 ng/g lipid?

- Pooled NHANES 11-12 to 15-16
- Hispanic Females

Age	Survey Year	Weighted Arithmetic Mean (ng/g)
12-19	11-12	6.08
	13-14	7.12
	15-16	5.58
20-39	11-12	6.56
	13-14	7.86
	15-16	6.85
40-59	11-12	12.4
	13-14	12.2
	15-16	9.99

2005-2006 to 2015-2016

- N=12,421
- NHANES cycles
(Li et al., 2022 – IJERPH)
- LSGM range 8.9-9.6 ng/g
- -1.6% change of HCB over time

2012-2015

- N=209
- **Flemish** Environmental Health Study Adjusted
(Schoeters et al., 2016 – IJHEH)
- GM: 13.7 ng/g in adults

2014-2017

- N=54
- Pregnant African Americans, **Atlanta, USA**
(Ortlund et al., 2025 – Environmental Research)
- GM= 11.7 ng/g

2018-2021

- N=243
- Matched Controls to **National USA** ALS cases
(Talbot et al., 2024 – ALSFTD)
- Median= 7.8 ng/g

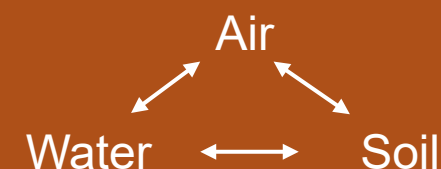


Diet

Seafood, meat, chicken, milk, cheese, butter, eggs, vegetables, rice



Re-emissions



Possible human exposures



Industrial sources

- No known hazardous waste incinerators nor industry that produces HCB in CA

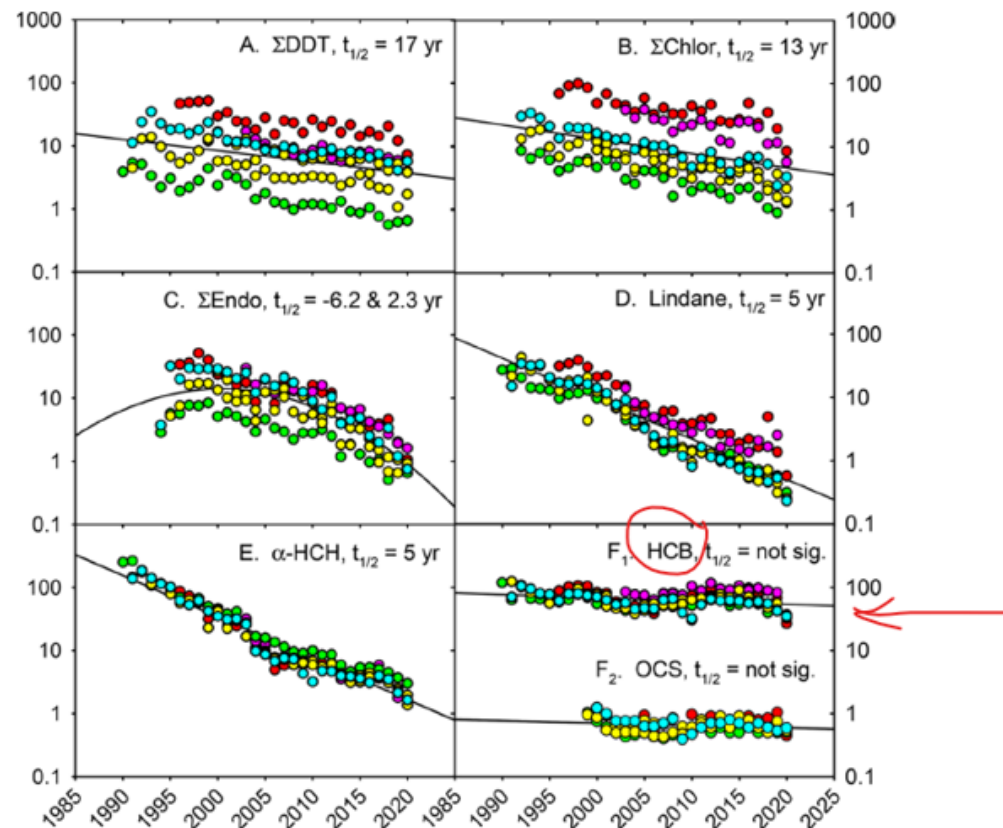


Byproduct / historical

- Wood preservative, rubber, aluminum, magnesium, and dye

Constant in environment?

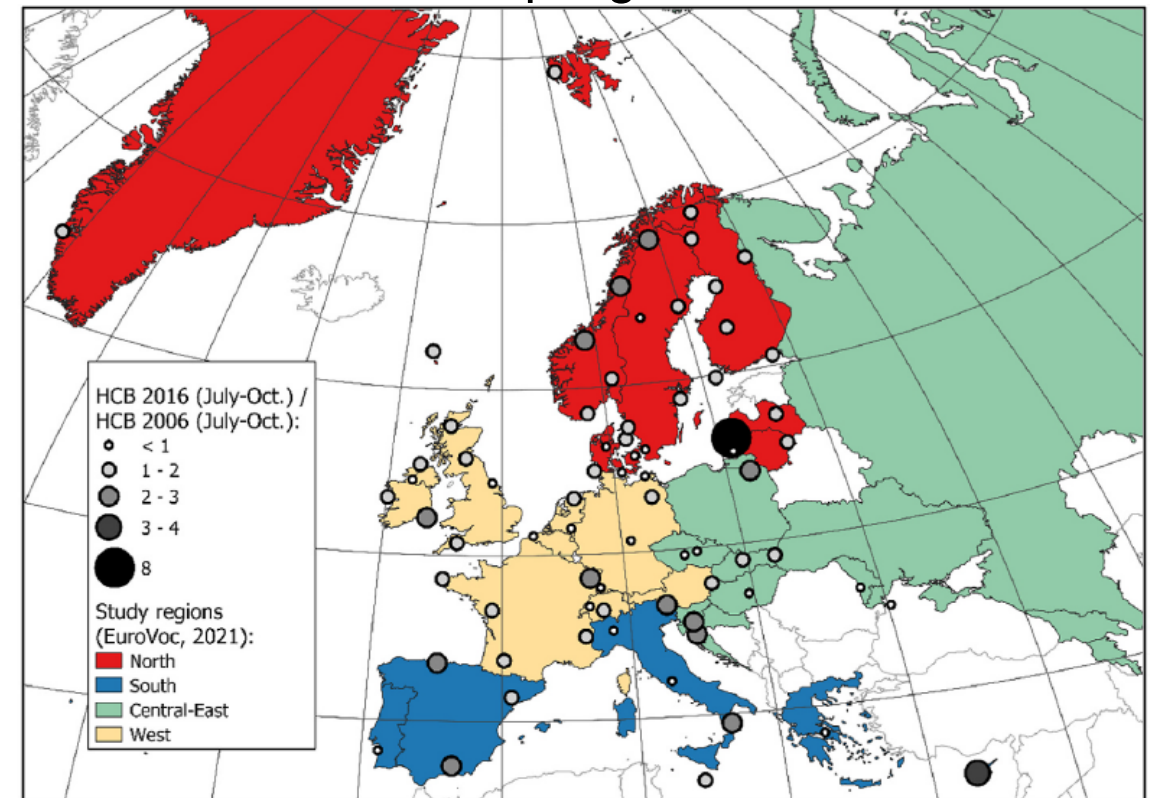
Annual geometric mean (pg/m^3) at 6 air monitoring sites on North American Great Lakes



Hites & Venier 2023; ES&T

Ratio of HCB (pg/m^3) in 2016 and 2006 at European passive air monitors (n=73)

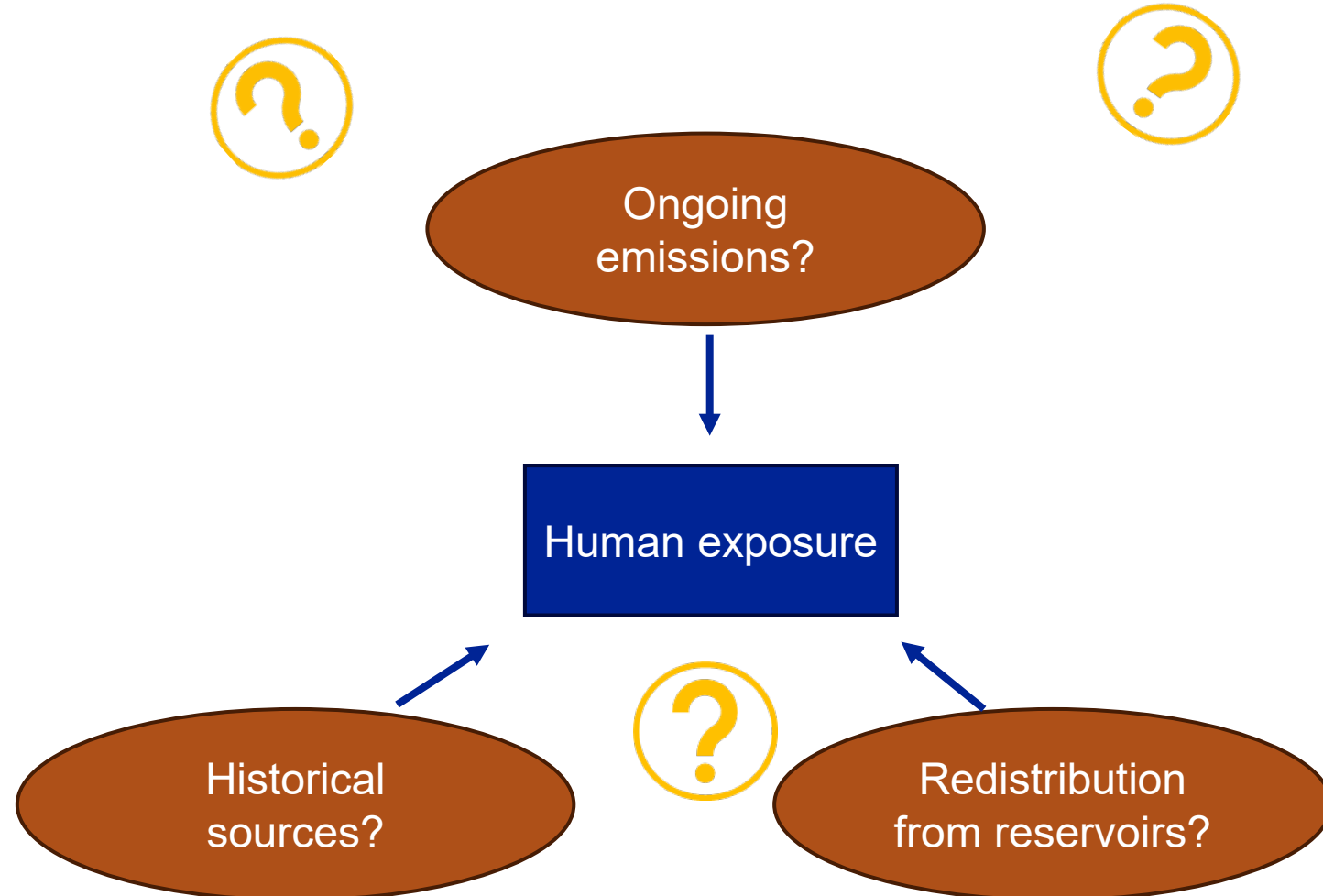
- 68% of sampling sites had a ratio >1.2



Halvorsen 2023; Atmospheric Environment

Continual HCB exposure?

- HCB concentrations in humans plateauing?
- A cause for concern given toxicity
- Cautionary tale
- Need for continual surveillance of POPs
- Need for investigation on possible sources



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