Solving societal challenges; working with sediments
23-26 September 2015, Krakow, Poland

Contamination of sediments in large riverine systems – assessment and its apprehension

Ewa Szalińska

Cracow University of Technology

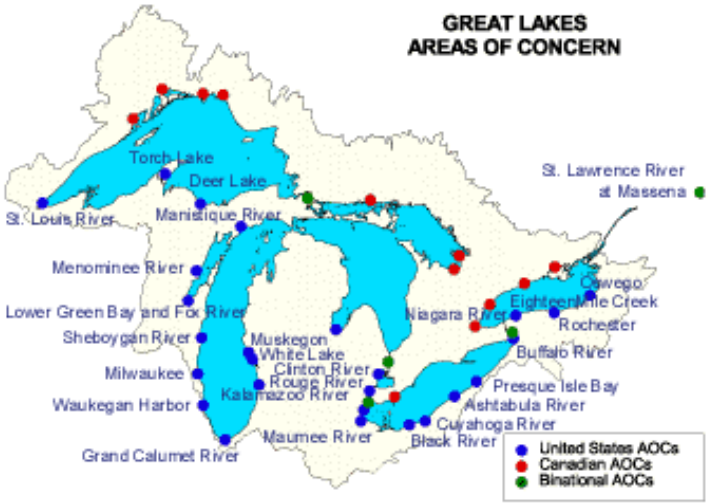
Faculty of Environmental Engineering

Contamination of sediments in large riverine systems – assessment and its apprehension

- *„Sediment quality and perception"*

- State of the system?
- How to evaluate spatial/temporal trends?
- What is the major concern and what to compare with?
- Has anything changed?
- Is it acceptable or negligible?

State of the system?



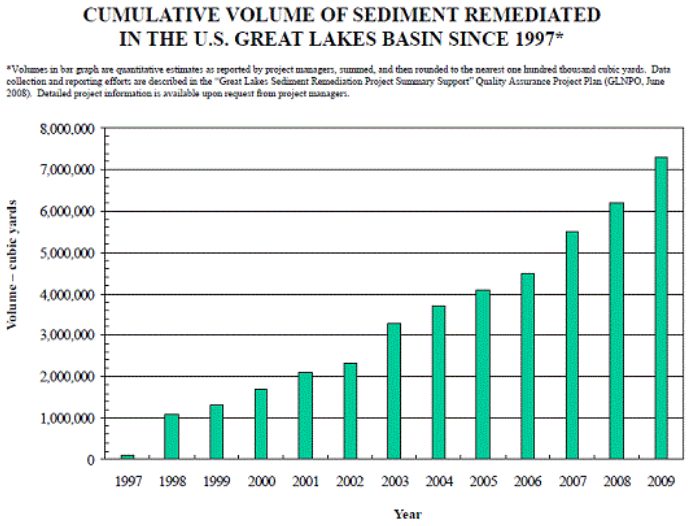
- Great Lakes AOCs (areas of conce
- *areas that show severe environmental degradation*
- *areas that fail to meet the general or specific objectives of the agreement*
- BUI's (beneficial use impairments)
- *a change in the chemical, physical, or biological integrity of the Great Lakes system sufficient to cause…*
- 11of 14 BUI's related to sediment contamination

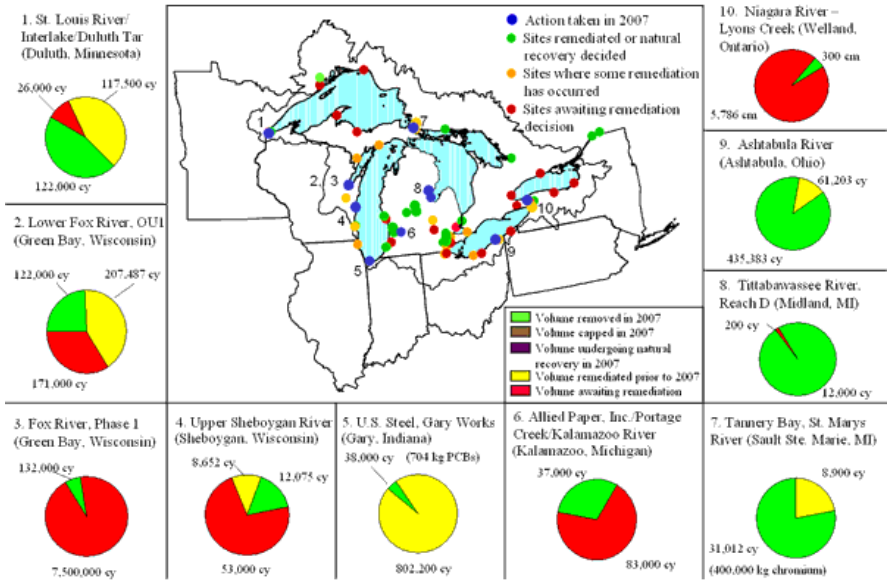
e.g. degradation of benthos; restrictions on dredging activities; degraded fish and wildlife populations…

Source: White Paper by the Sediment Priority Action Committee Great Lakes Water Quality Board ***International Joint Commission****, 1997*

State of the system?

- GLNP (Great Lakes National Program)
- Two-phased sediment assessment approach
- *1st - sampling of AOCs to pinpoint hot-spots*
- *2nd - delineation and remedial decisions*

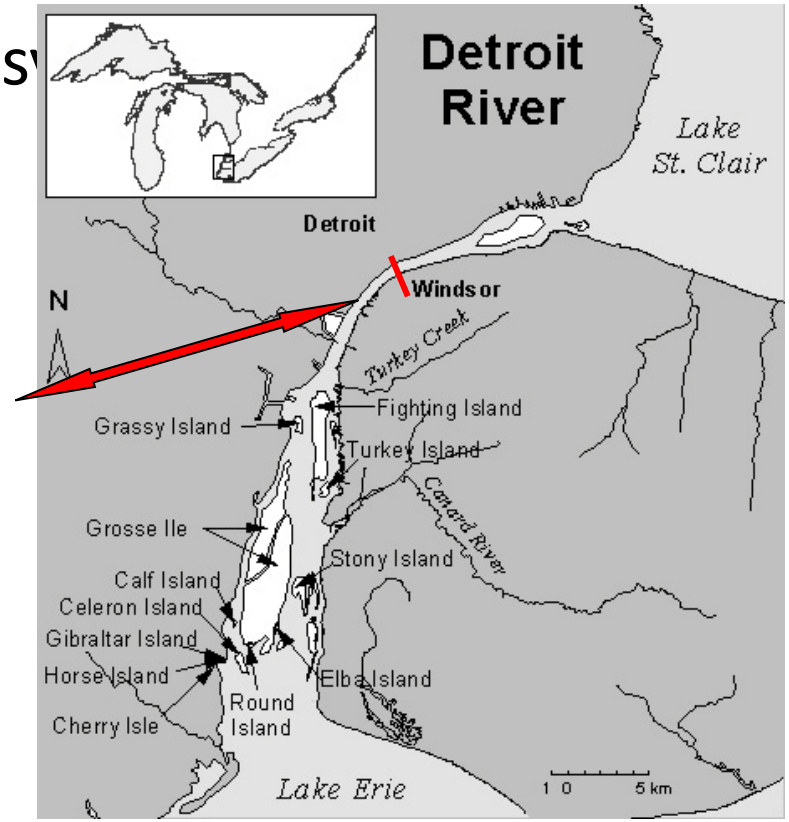




Source: http://www.epa.gov/greatlakes/sediment.html

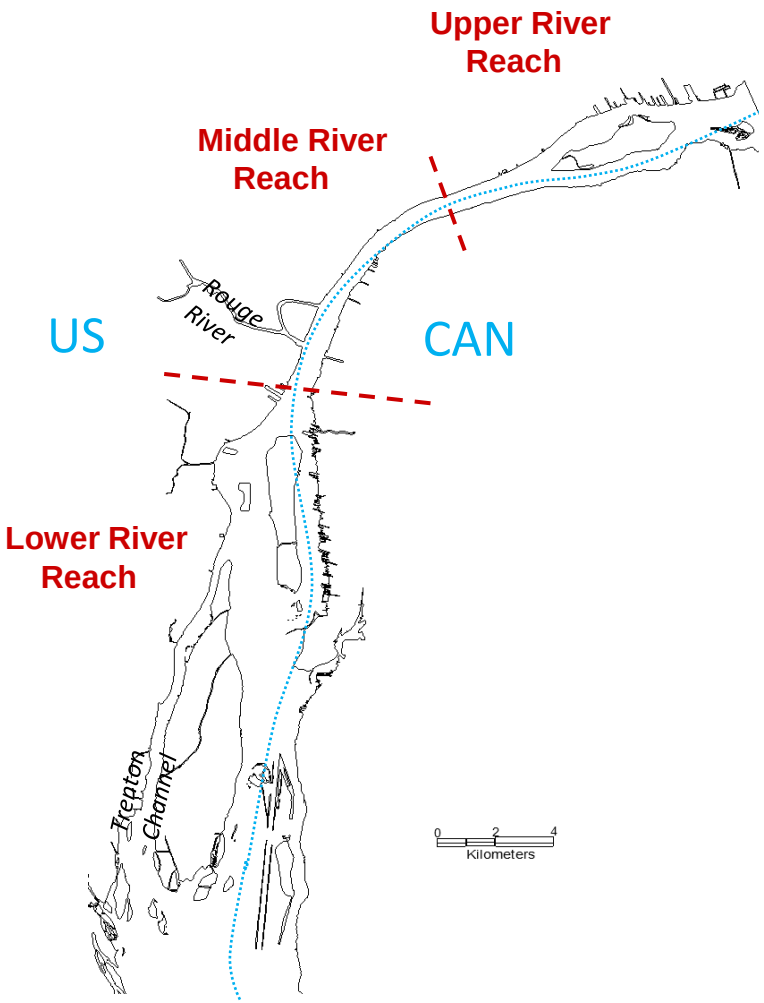
How to evaluate spatial/temporal trends?

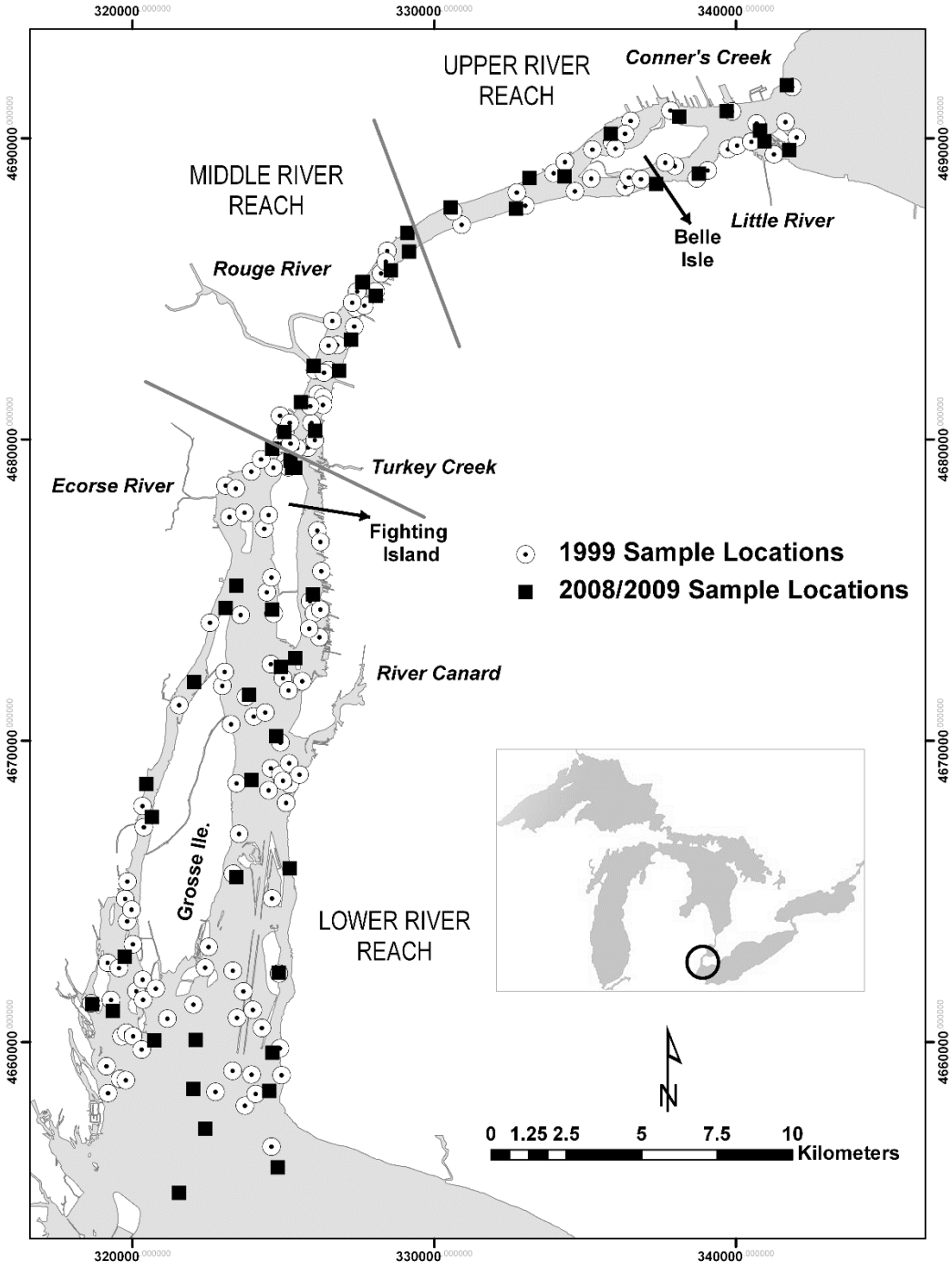
- Judgmental/probablility based
- Temporal – trend analysis of time series
- Confounding factors in large s



- Lenght: 51 km
- Width: 1 – 4 km
- Catchment: 2000 km^2
- Flow: 5200 m^3/s

How to evaluate spa





Source: Szalinska et al. (2013) Chemosphere 93, 1771-1781

What is the major concern and what to compare with?

- Metals (Cd, Cu, Pb, Zn, and Hg)
- Organics (PCBs, PAHs)
- Sediment quality guidelines – **LEL/SEL, TEL/PEL,**
- Consensus based values - **TEC/PEC**
- PECs - outdated, have low predictive reliability, do not reflect state-of-the-art sediment science
- Local background concentrations?!

Source: Persaud et al. (1992), Smith et al. (1996), and MacDonald et al. (2000);
Becker & Durda (2013) Seventh International Conference on Remediation of Contaminated Sediments (Dallas, US)

What is the major concern and what to compare with?

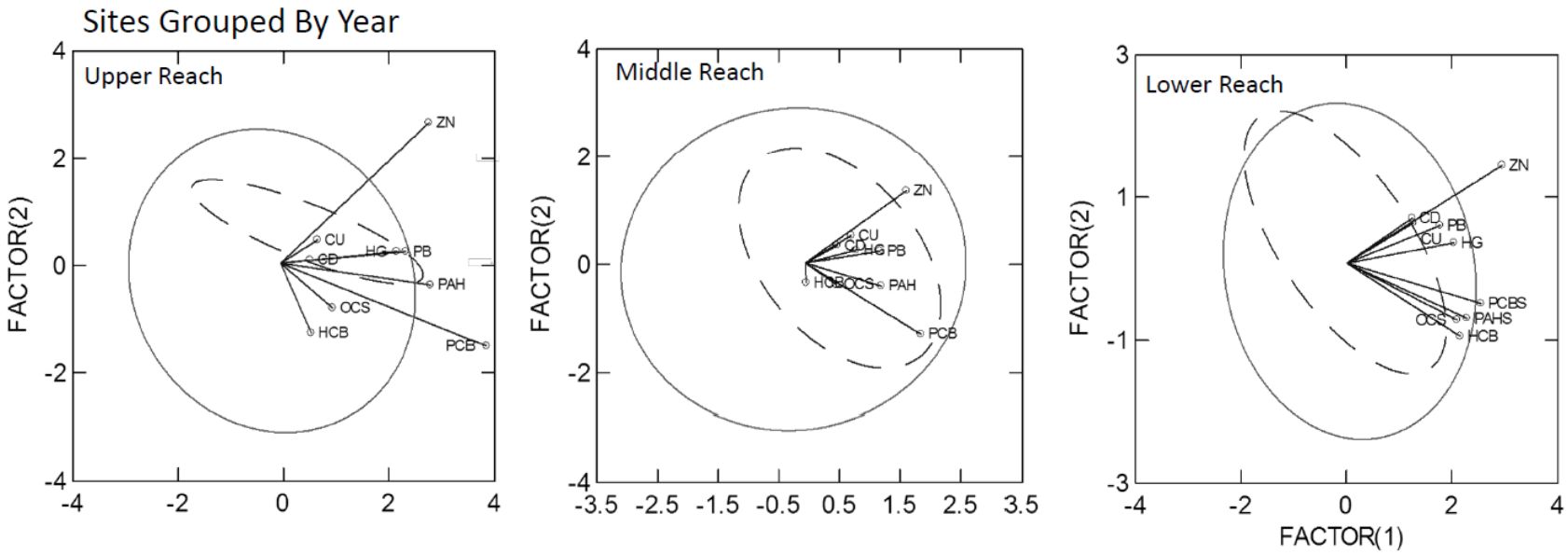
Element (LEL, SEL)	Upper		Middle		Lower	
	1999	2009	1999	2009	1999	2009
Cd (0.6, 10) 1.3	**0.7 (0.6–0.8)**	**1.4 (1.1–1.7)**	**0.8 (0.7–0.9)**	**1.5 (1.3–1.7)**	**1.1 (1.0–1.3)**	**1.4 (1.2–1.6)**
Cu (16, 110) 15.0	**16.2 (**14.4**–18.2)**	**19.9 (16.3–24.4)**	**32.1 (28.1–36.7)**	**33.1 (25.0–43.8)**	**29.8 (27.8–31.9)**	**26.0 (21.8–31.0)**
Hg (0.2, 2) 0.2	0.04 (0.03–0.06)	0.10 (0.08–0.13)	0.05 (0.03–0.06)	0.13 (0.10–0.16)	0.15 (0.13–0.18)	0.18 (0.16–**0.21**)
Pb (31, 250) 17.0	4.8 (3.6–6.4)	13.3 (10.4–17.0)	16.5 (12.4–22.1)	26.2 (17.5–**39.4**)	15.5 (14.1–17.0)	17.1 (14.5–20.2)
Zn (120, 820) 46.0	3.3 (2.2–5.0)	56.1 (46.2–68.1)	10.7 (6.5–17.6)	108.1 (78.5–**148.9**)	40.3 (31.9–50.8)	77.8 (64.4–94.1)
PCBs (70, 5300)	5.9 (3.9–9.0)	14.8 (9.1–24.0)	16.9 (10.4–27.5)	80.6 (48.6–**133.8**)	33.1 (27.5–40.0)	30.6 (23.4–39.9)
PAHs (4, 100)	0.6 (0.4–0.8)	0.8 (0.5–1.4)	3.2 (2.1–**5.0**)	**5.9 (4.1–8.6)**	2.7 (2.3–3.2)	3.1 (2.2–**4.1**)

µg/g dw; geomean; 95% confidence interval

Source: Szalinska et al. (2013) Chemosphere 93, 1771-1781; IJC (1982)

Has anything changed? NO

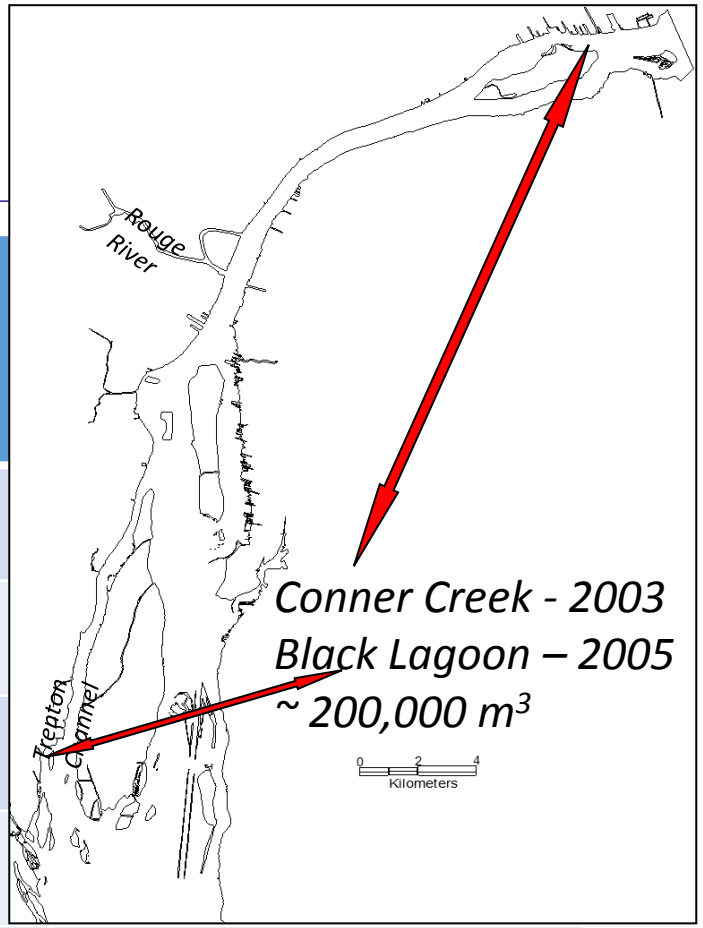
- PCA (principal component analysis)
- River wide mass balance
- Getis-Ord Gi* statistics



Note: About technical details on Getis-Ord PLEASE ask: Alice Grgicak-Mannion (grgicak3@uwindsor.ca)!

Has anything changed? NO

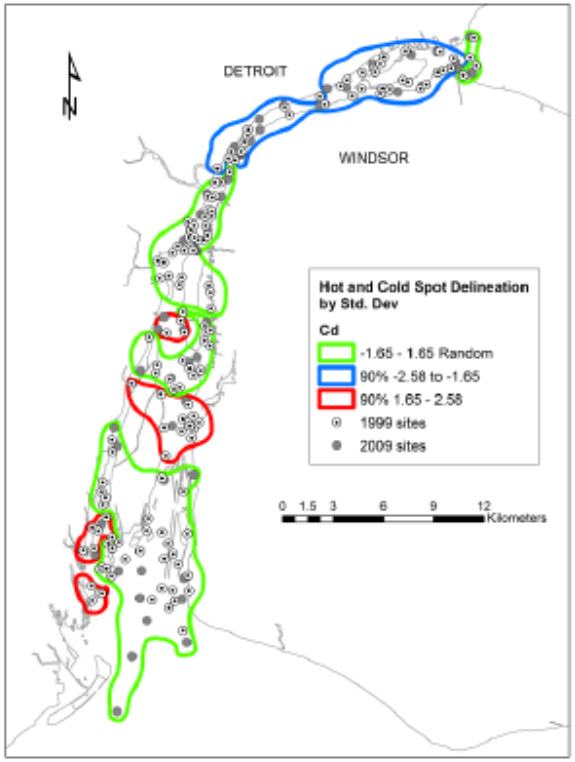
Element/ Chemical	1999	
Cd	14.8 (14.7–15.1)	
Cu	366.1 (361.0–371.3)	
Hg	2.84 (2.78–2.89)	
Pb	272.1 (267.8–276.5)	
Zn	1007 (989–1023)	1343 (1323–1363)
PCBs	1.00 (0.98–1.02)	1.09 (1.6–1.11)
PAHs	110.5 (108.3–122.7)	74.8 (73.8–75.8)

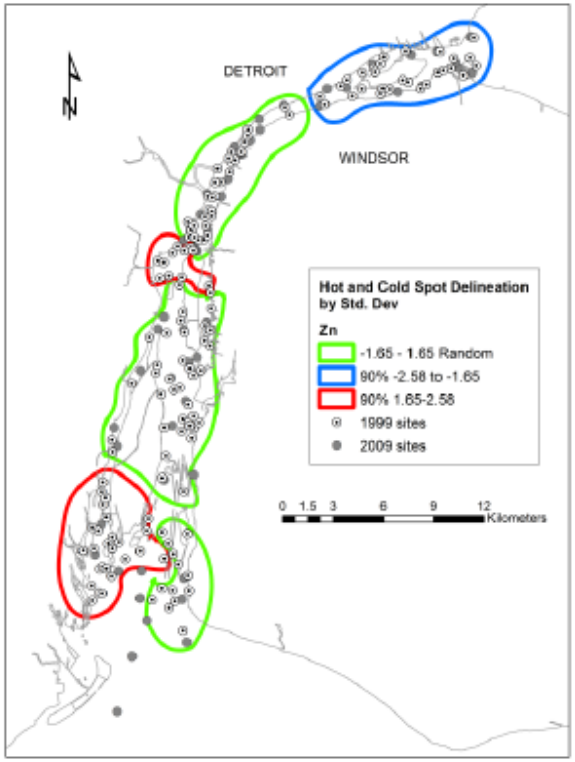


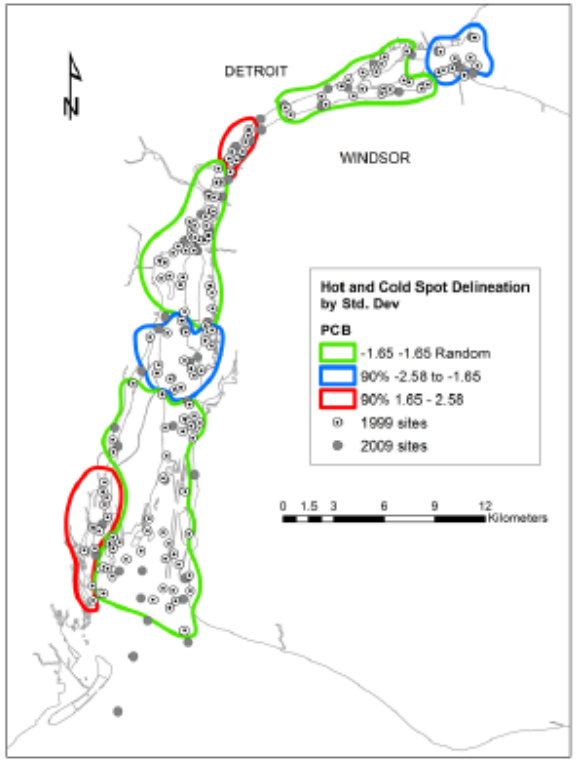
t; geomean; 95% confidence interval

Source: Szalinska et al. (2013) Chemosphere 93, 1771-1781

Has anything changed? NO, NOT REALLY







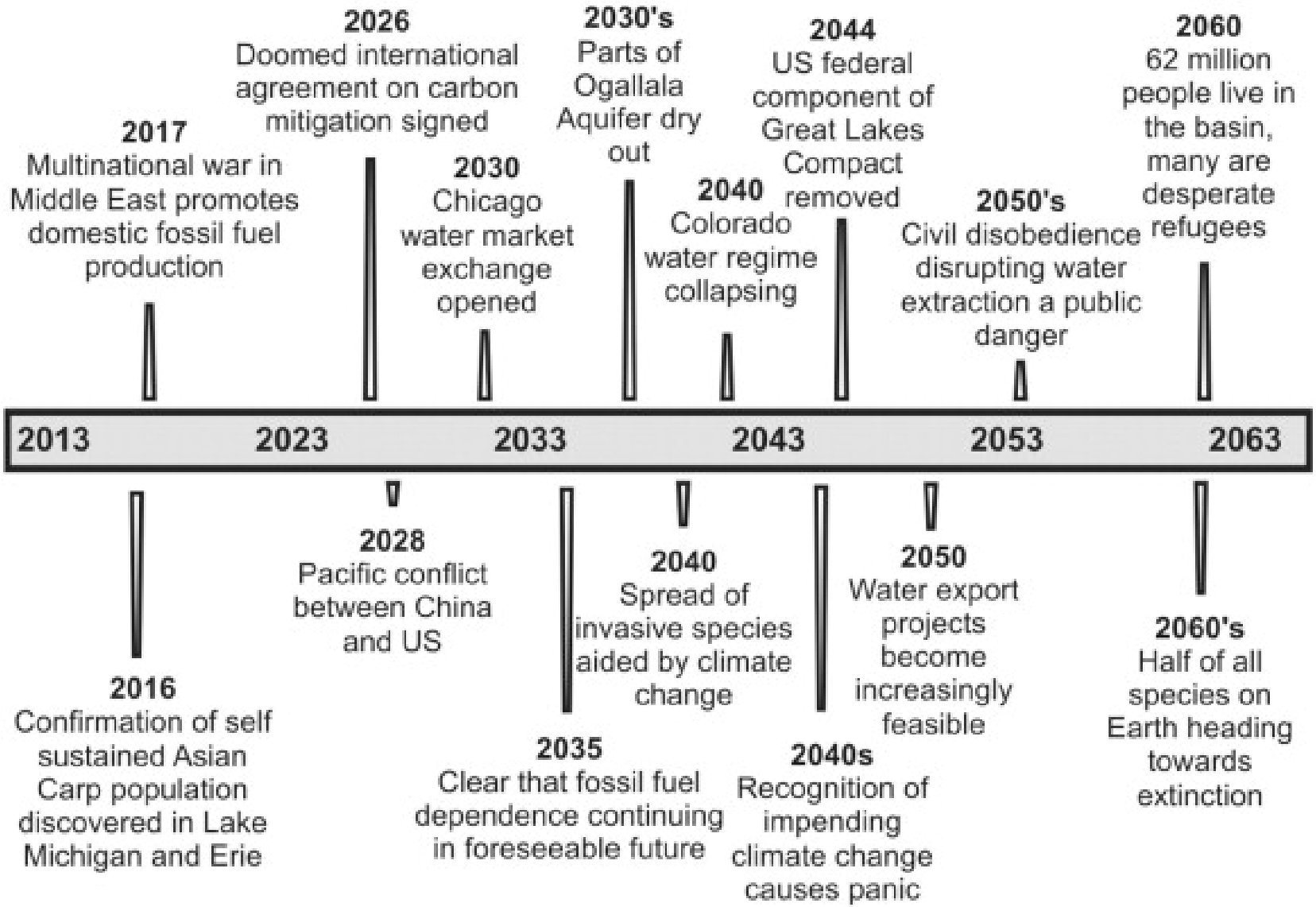
Polygon boundaries: blue – cold, red – hot, green – intermediate
Delineation based on p-value and z-score

Source: Szalinska et al. (2013) Chemosphere 93, 1771-1781

Is it acceptable or negligible?

- **No changes**
  (according to the performed assessment)
- Do we care?
- *„Out of control: How we failed to adapt and suffered the consequences”*

Source: Kalafatis et al. (2015) J of Great Lakes Research 41 (sup.1), 20-29



Source: Kalafatis et al. (2015) J of Great Lakes Research 41 (sup.1), 20-29

Is it acceptable or negligible?

3 scenarios:

- Status quo: “The Fog”
- A dystopian future: “The Wreckage”
- A utopian future: “The Lighthouse”

Source: Bartolai et al. (2015) J of Great Lakes Research 41 (sup.1), 45-58

Source: Kalafatis et al. (2015) J of Great Lakes Research 41 (sup.1), 20-29

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Questions???