NESCAUM

Status of States Strategies to Address Mercury Emissions from Coal-Fired Power Plants

Praveen Amar, Ph.D., P.E.
Director, Science and Policy, NESCAUM

Power Plant Air Pollutant Control “Mega” Symposium

August 28-31, 2006
Baltimore, MD

NESCAUM

States Justification For More Stringent, Timely Controls With No Trading

- States with CAMR and non-CAMR approaches
- Address existing hot spots and cooling them down; potential for quick response to emission reductions (Massachusetts, Florida)
- Apply readily available control options/technologies/strategies
- Implement cost-effective controls
- Achieve substantial human health benefits (potentially in billions, not in millions)

NESCAUM

Goals of STAPPA/ALAPCO Model Rule

- Issued in November 2005
- **Policy Objectives:**
  - Protect public health and welfare (no trading)
  - Reduce U.S. coal-fired EGU emissions of Hg to <7 tons/year (90 to 95 % reduction by 2012)
  - Provide flexibility to reduce cost
  - Spur rapid technological development

NESCAUM

States More Stringent Than CAMR Now or Proposed

- ❑ Connecticut
- ❑ Massachusetts
- ❑ New Hampshire
- ❑ New Jersey
- ❑ New York
- ❑ Delaware
- ❑ Maryland
- ❑ North Carolina

- ❑ Pennsylvania
- ❑ Georgia
- ❑ Illinois
- ❑ Michigan
- ❑ Minnesota
- ❑ Montana
- ❑ Washington
- ❑ Wisconsin (?)
- ❑ Virginia

NESCAUM

States Adopting CAMR

- ❑ West Virginia
- ❑ Alabama
- ❑ Mississippi
- ❑ South Carolina
- ❑ Tennessee
- ❑ Ohio
- ❑ Texas
- ❑ Iowa
- ❑ Kansas
- ❑ Missouri
- ❑ Nebraska
- ❑ North Dakota
- ❑ South Dakota
- ❑ Utah
- ❑ New Mexico
- ❑ Wyoming
- ❑ Louisiana

NESCAUM

State Rules Example: Massachusetts

- Adopted rule
- 85% capture or 0.0075 #/GWh by January 1, 2008
- 95% capture or 0.0025 #/GWh by October 1, 2012
- No interstate trading

NESCAUM

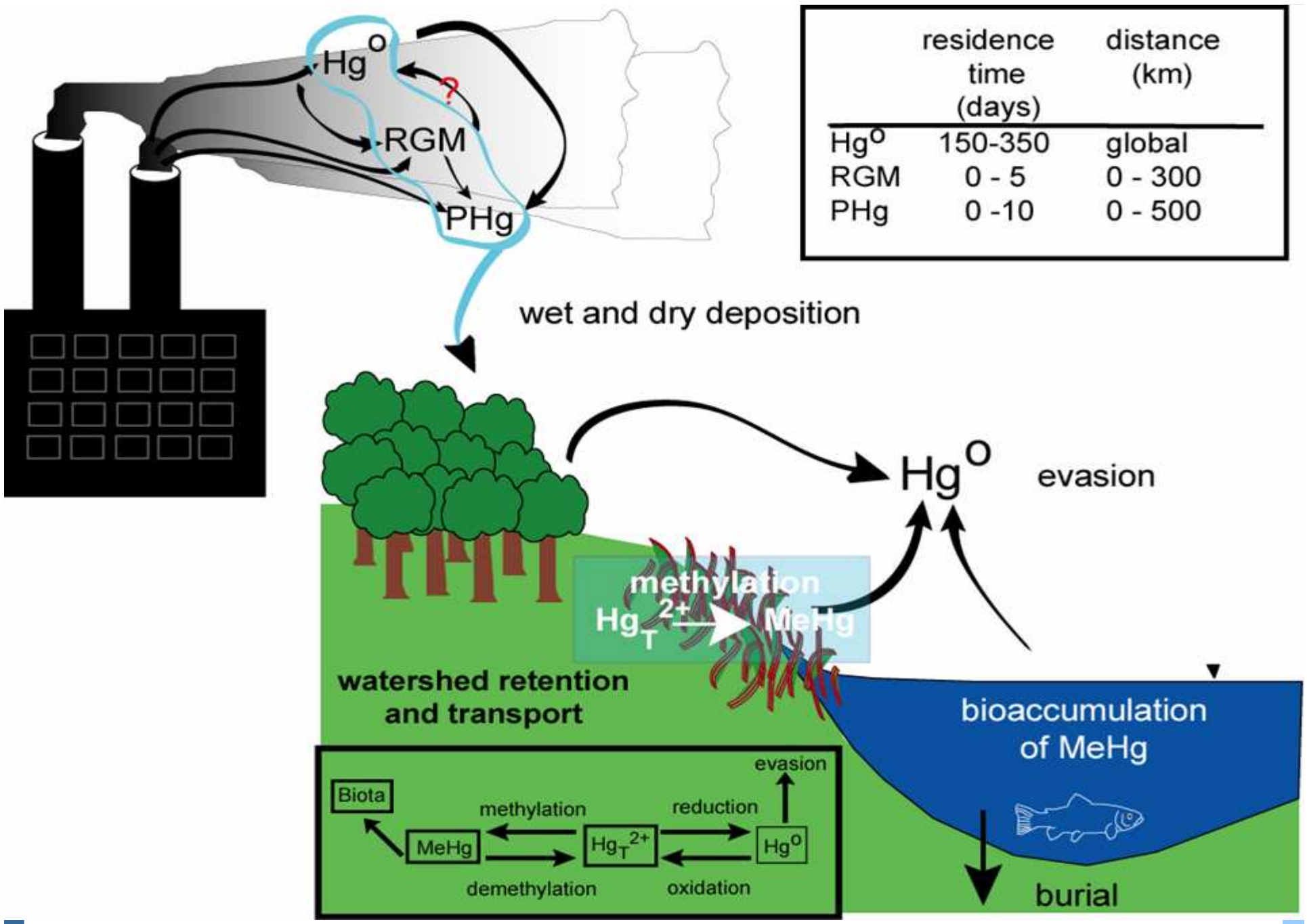
State Rules Example: New Jersey

- Adopted Rule
- 3.00 mg/MWh or 90% control across control device as of December 15, 2007 (one year extension possible)
- Multi-pollutant control option--December 15, 2012;
  - Emission rate limits for SO2, NOx, and PM
  - 50% of MW controlled for mercury by 12/15/2007; 100% by 12/15/2012
  - If necessary, one additional year for optimization of control systems
- No interstate trading

NESCAUM

"Scientific" Scales of Air Pollution

- **Air Pollution is a "Mixture" of Scales**
  - **Local** (CO, ozone, SO2, PM, **mercury**); hot spots
  - **Regional** (ozone, PM, NOx, **mercury**, acid deposition, regional haze); warm to hot spots
  - **Global** (CFC's, CO_2, **mercury**, methane, "background" ozone), "not so hot" cool spots
- Mercury is not just global



	residence time (days)	distance (km)
Hg^0	150-350	global
RGM	0 - 5	0 - 300
PHg	0 -10	0 - 500

Source: Charles Driscoll, Syracuse University

NESCAUM

To Trade or Not to Trade?

- **Balance between public risk management and private cost savings (cap and trade approach; performance-based approach)**
- **Mercury is not just about the averages (“average” fish, “average” exposed person, 36-km grid “averaged” deposition); hot spots exist and could get worse**
- **Properly-designed cap-and-trade approaches are useful when spatial and temporal scales of emissions, transport, *and* effects allow for mostly “harmless” and cost-saving trades (OTC NOx, 110 SIP call, Title IV SO2)**

NESCAUM

More on Mercury Trading

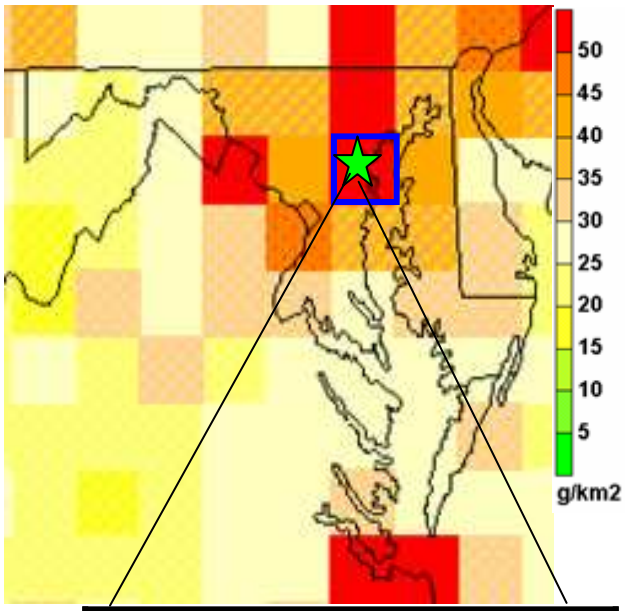
- **Effect of other (CAIR) trading programs on mercury (NOx control without SO2 control; could create brand new hot spots of oxidized Hg!)**
- **We need more focus on what the caps need to be for environmental and human health protection (Title IV, OTC/SIP Call ozone-season control)**

NESCAUM

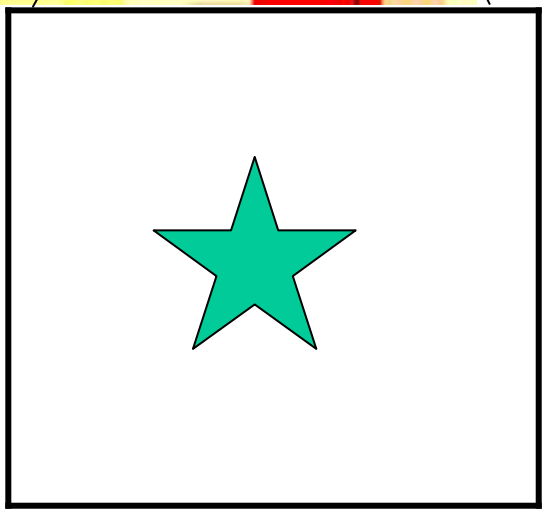
Mercury Hot Spots

- **Many types of hot spots:**
  - **Emission hot spots**
  - **Deposition hot spots**
  - **Biological hot spots (fish)**
  - **Exposure hot spots (environmental justice issues)**
- **Existing hot spots and creating new ones**
  - **Which approach addresses existing and new hot spots more effectively?**
- **CMAQ (alone and as applied) and IPM are not able to spatially resolve hot spots (grid resolution; less confidence down the chain of hot spots)**

NESCAUM



Finer Modeling Resolution Better Highlights Local "Hot Spots" Impacts; Issue of Measured Hot Spots



36km Resolution
Avg. = 98 g/sq.km

72	516	71
44	127	43
33	49	36

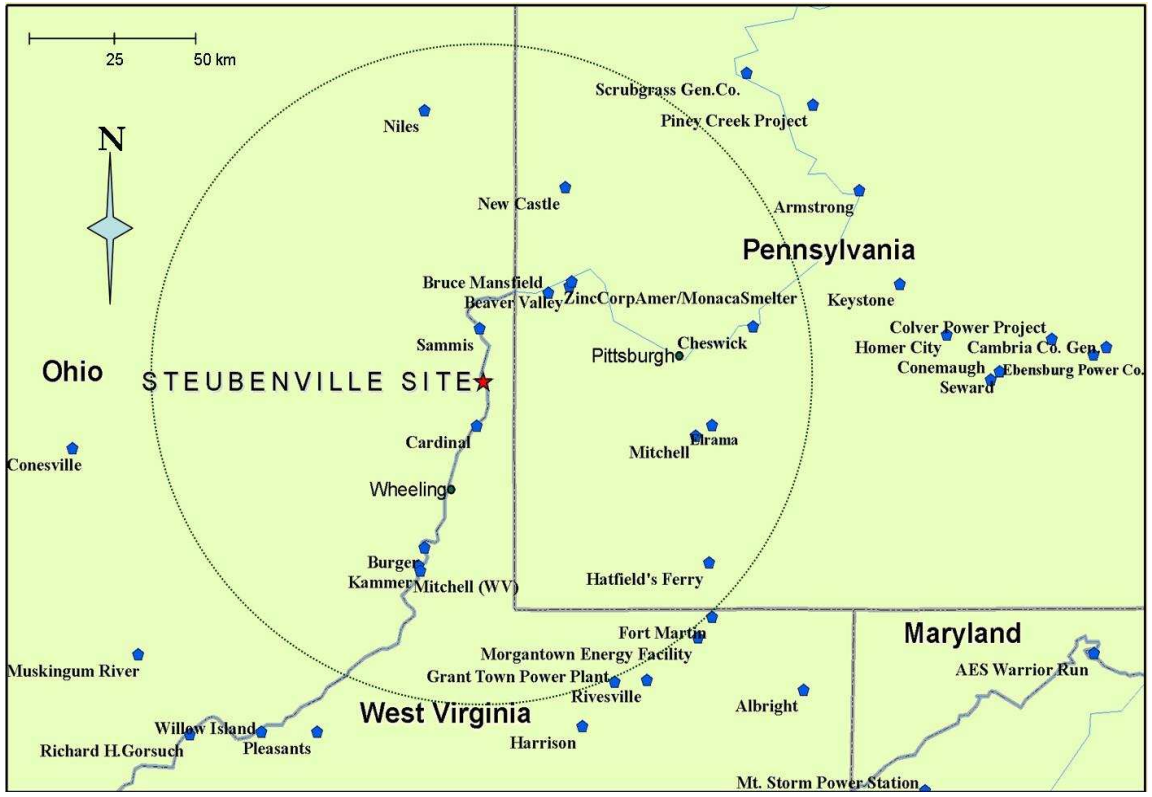
12km Resolution
Avg. = 110 g/sq.km

Source: U.S. EPA

NESCAUM

Primary Objective of the Recent Steubenville Study

Determine the impact of local/regional coal combustion sources on Hg deposition in the Ohio River Valley

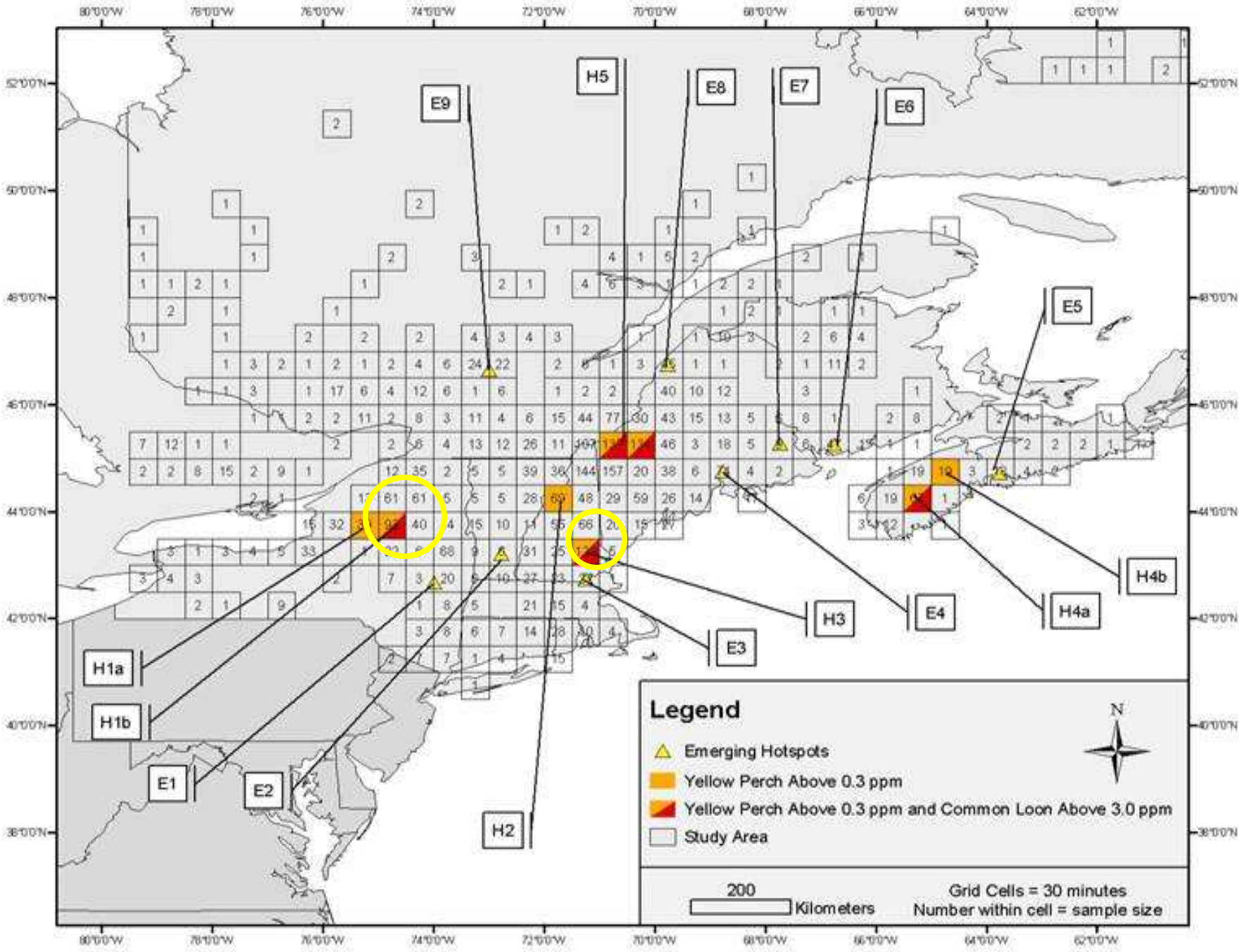


Courtesy: Dr. Jerry Keeler, Univ. of Michigan

NESCAUM

Summary of Steubenville Results

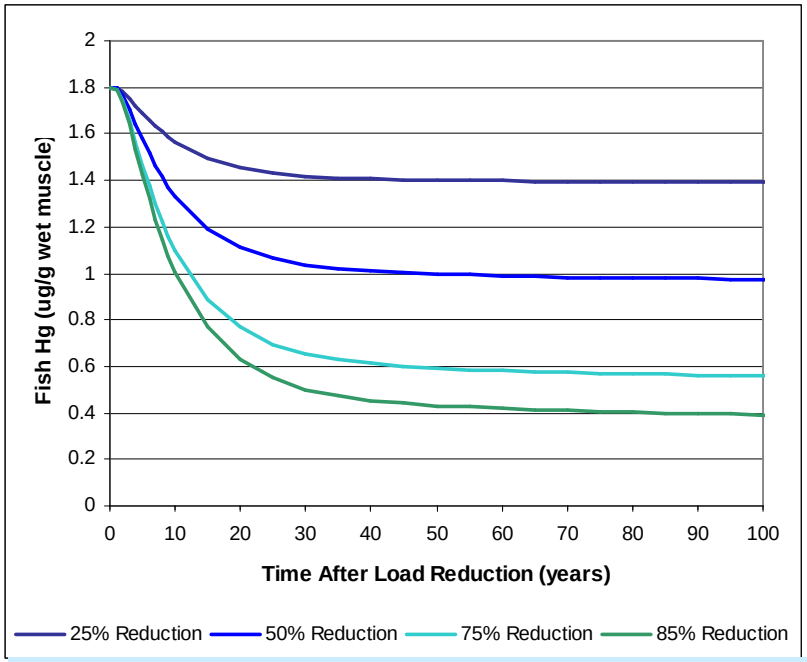
- **Hg wet deposition at Steubenville**
  - **~80% attributable to local/regional anthropogenic sources**
  - **~70% is attributable to coal combustion**
  - **~20% from re emission/global background**
- **A significant portion of total Hg wet deposition is driven by a few local coal combustion-dominated precipitation events**
- **Dry deposition is even more local in origin and is harder to measure**



Source: Charles Driscoll, Syracuse University

NESCAUM

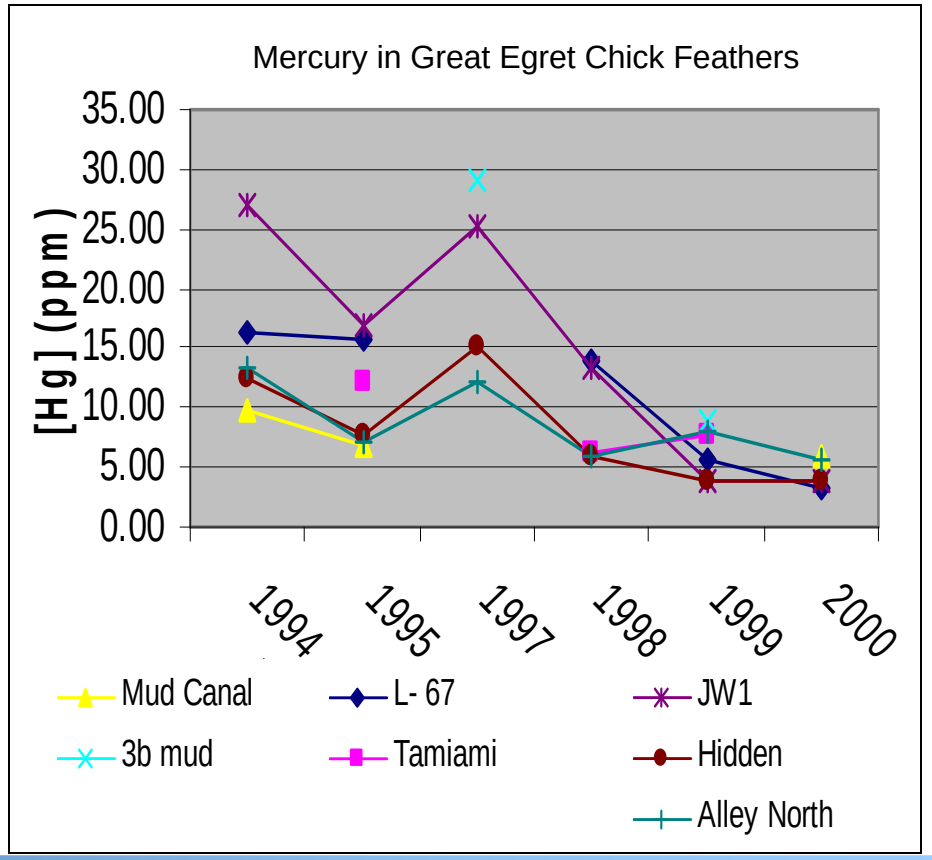
Reduced Mercury Deposition in Florida Quickly Reduces Concentrations in Fish



The graphic above is from: Florida DEP: Integrating Atmospheric Mercury Deposition and Aquatic Cycling in the Florida Everglades, Tallahassee, October 2002. The graphic at the right is from South Florida Water Management District, 2003 Everglades Consolidated Report, West Palm Beach, January 2003.

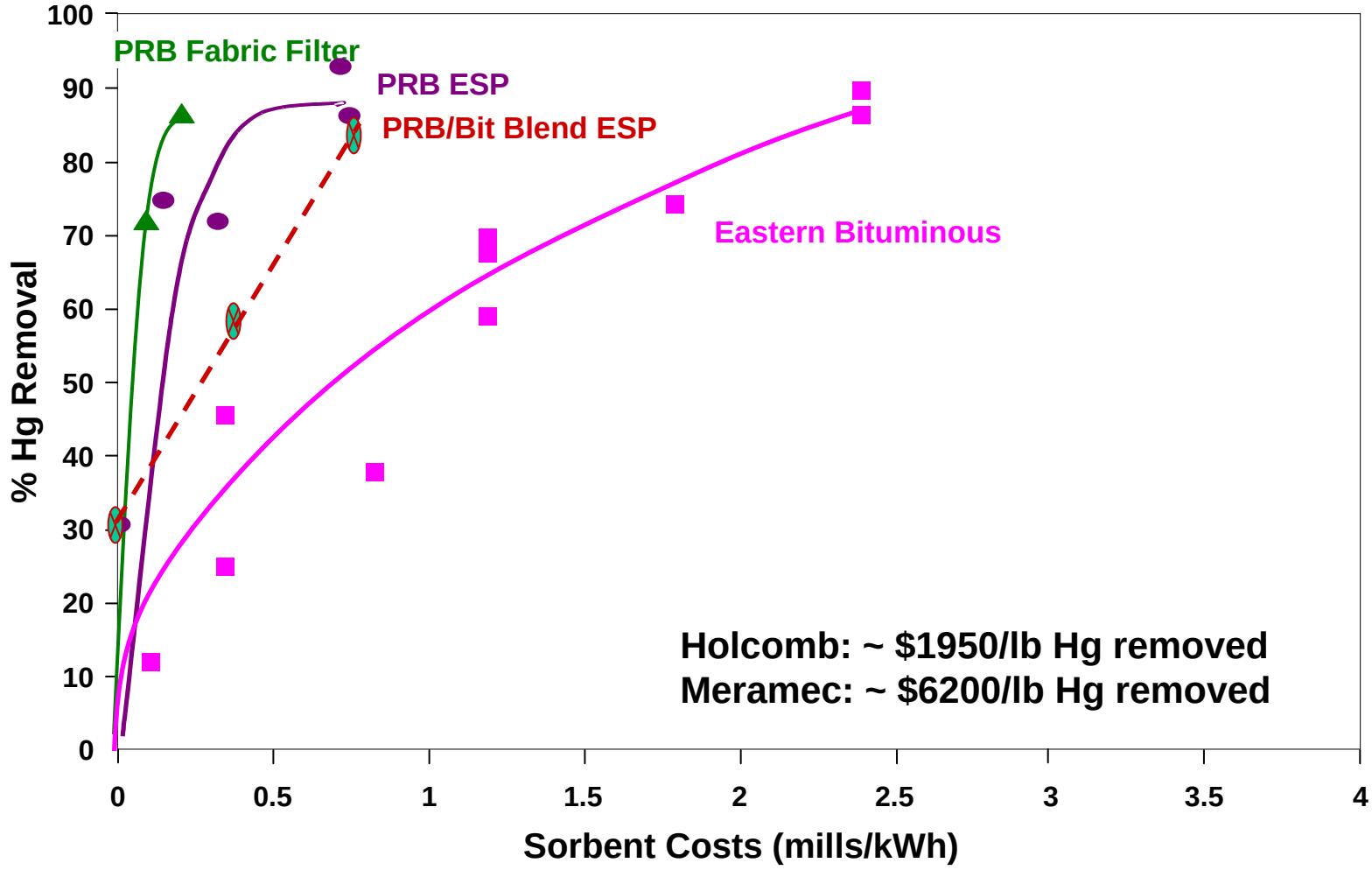
- Lower amounts of mercury deposition in the Florida Everglades were evident within 5 years as lower amounts of mercury in Great Egret chicks.
- Mercury concentrations in egret feathers mirrored the decline in emissions from municipal waste combustors (MWCs).

- Fish tissue mercury concentrations begin declining sharply in the Everglades as soon as load reductions begin.
- Steep declines in fish tissue concentrations continue for many years.



NESCAUM

Improvement in Cost and Performance: 2005



Source: ADA-ES

NESCAUM

A Comparative Estimate of Hg Control Costs with ACI (mills/kWh)

Control Type	Annual Levelized Cost
Activated Carbon Injection for Hg	0.2 to 0.8 mills/kwh (capital cost : $2-4/kw)
FGD for SO2	3 to 5 mills/kwh(capital cost: $150-250/kw)
SCR for NOx control	1 to 2 mills/kwh (capital cost :$50-125/kw)

NESCAUM

Courtesy: ICAC

Commercial Mercury Control Technology Bookings

Air pollution control vendors are reporting booking new contracts for mercury control equipment for more than a dozen power plant boilers. The contracts for commercial systems are attributed to federal and state regulations, including new source permit requirements and consent decrees, which specify high levels of mercury capture. Below is a summary of the mercury control equipment that has been procured to date:

	Plant Size (MW)	Location	Prime OEM Contractor	Coal	APC Configuration	Hg Control	New Plant or Retrofit	Regulatory Driver
Unit 1	270	Midwest	Wheelabrator/ NORIT	PRB	TOXECON	ACI	Retrofit	Consent Decree
Unit 2	250	East	Wheelabrator	Bituminous	SDA/FF	ACI	Retrofit	State Regulatory
Unit 3	250	East	Wheelabrator	Bituminous	SDA/FF	ACI	Retrofit	State Regulatory
Unit 4	650	East	Wheelabrator	Bituminous	ESP	ACI	Retrofit	State Regulatory
Unit 5	740	Midwest	B&W	PRB	SDA/FF	Br-ACI	New Plant	New Construction Permit
Unit 6	550	Midwest	B&W	PRB	SDA/FF	Br-ACI	New Plant	New Construction Permit
Unit 7	350	West	B&W	PRB	SDA/FF	Br-ACI	Retrofit	Consent Decree
Unit 8	350	West	B&W	PRB	SDA/FF	Br-ACI	Retrofit	Consent Decree
Unit 9	800	West	B&W	PRB	SDA/FF	Br-ACI	New Plant	New Construction Permit
Unit 10	350	East	ADA-ES	Bituminous	ESP	ACI	Retrofit	Consent Decree
Unit 11	350	East	ADA-ES	Bituminous	ESP	ACI	Retrofit	Consent Decree
Unit 12	204	MidWest	Dustex	PRB	TOXECON	ACI	Retrofit	Consent Decree
Unit 13	375	East	Wheelabrator	Bituminous		ACI	Retrofit	Concent Decree
Unit 14	650	Midwest	Alstom Power	PRB	SDA/FF	Br-ACI	New Plant	New Construction Permit
Unit 15	215	Midwest	Powerspan	Bituminous	Multipollutant	ECO	Retrofit	Construction Permit
Unit 16		Midwest	Mobotec	PRB	ESP	MinPlus	Retrofit	Construction Permit
Unit 17	750	Midwest	Wheelabrator	High Sul. Bit	ESP/WFGD/WESP	ACI	New Plant	Construction Permit
Unit 18	680	South	Alstom Power	PRB	DFGD/FF	Br-ACI	New Plant	Construction Permit
Unit 19	107	East	BPI	Bit./Bio-Mass	FT-SNCR/CDS/FF	ACI	Retrofit	DOE Demo.
Unit 20	860	South	BPI	Lignite	SCR/FF/WFGD	ACI	New Plant	Construction Permit
Unit 21	860	South	BPI	Lignite	SCR/FF/WFGD	ACI	New Plant	Construction Permit

NESCAUM

Economic Valuation of Human Health Benefits of Controlling Mercury Emissions from U.S. Coal-Fired Power Plants

February 2005

A NESCAUM Report (Praveen Amar) with Harvard Center for Risk Analysis (Glenn Rice, ScD Candidate, and Dr. James Hammitt, Director)

NESCAUM

www.nescaum.org

Spectrum of Health Effects Certainty and Benefits

	Persistent IQ deficits from fetal exposures above MeHg RfD	Persistent IQ deficits in all children from fetal MeHg exposures	Cardiovascular effects and premature mortality in male consumers of non -fatty freshwater fish with high MeHg levels	Cardiovascular effects and premature mortality in male fish consumers	Cardiovascular effects and premature mortality in all fish consumers
Scenario 1 (26 TPY)	$75M	$194M	$48M	$1.5B	$3.3B
Scenario 2 (18 TPY)	$119M	$288M	$86M	$2.3B	$4.9B

Decreasing Certainty

Increasing Benefit

Spectrum of Certainty of Causal Association of Health Effect with Mercury Exposure with Estimated Benefit Overlay in Millions ($M) and Billions ($B) of Dollars (2000$)

NESCAUM

The Future

- **November 17, 2006, deadline for state plans with fully adopted rules and demonstration that state's Hg budget would be met**
- **Impact of non-participating states on national trading system: a question mark**
- **Legal battles continue**
- **Greatest certainty may be in those states with stringent (90-95% control) MACT-like rules**

NESCAUM

Some Final Observations

- Small cost savings to industry of trading-based approaches are not worth the forgone benefits to the general public associated with lowered risks of “cooled” hot spots (fish or human exposure)

- Mercury is not just about the averages – hot spots (emissions, deposition, biological (fish), and exposure (people)) need to be considered