Organization of Course

INTRODUCTION

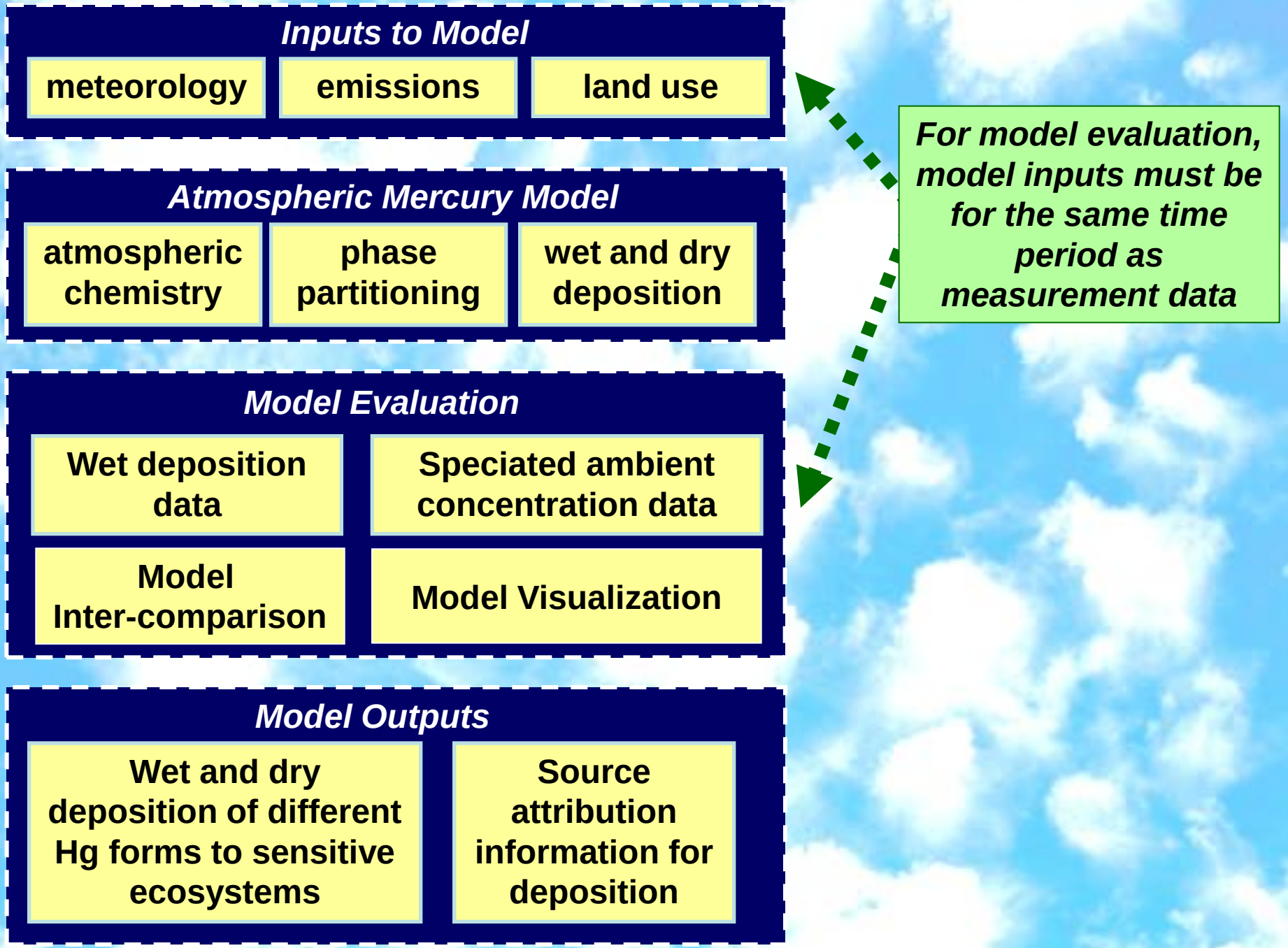
1. Course overview
2. Air Toxics overview
3. HYSPLIT overview

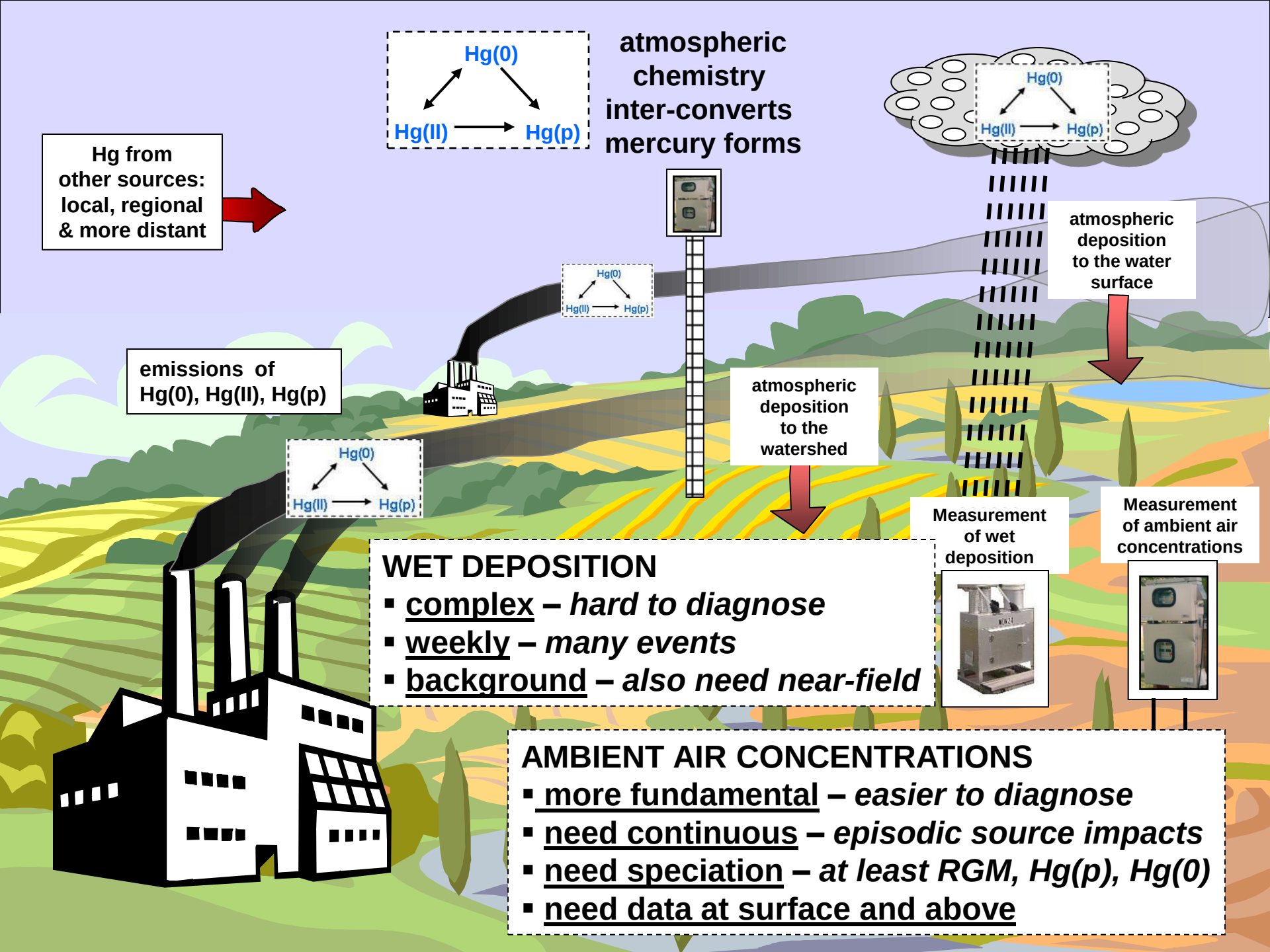
HYSPLIT Theory and Practice

4. Meteorology
5. Back Trajectories
6. Concentrations / Deposition
7. HYSPLIT-SV for semivolatiles (e.g, PCDD/F)
8. HYSPLIT-HG for mercury

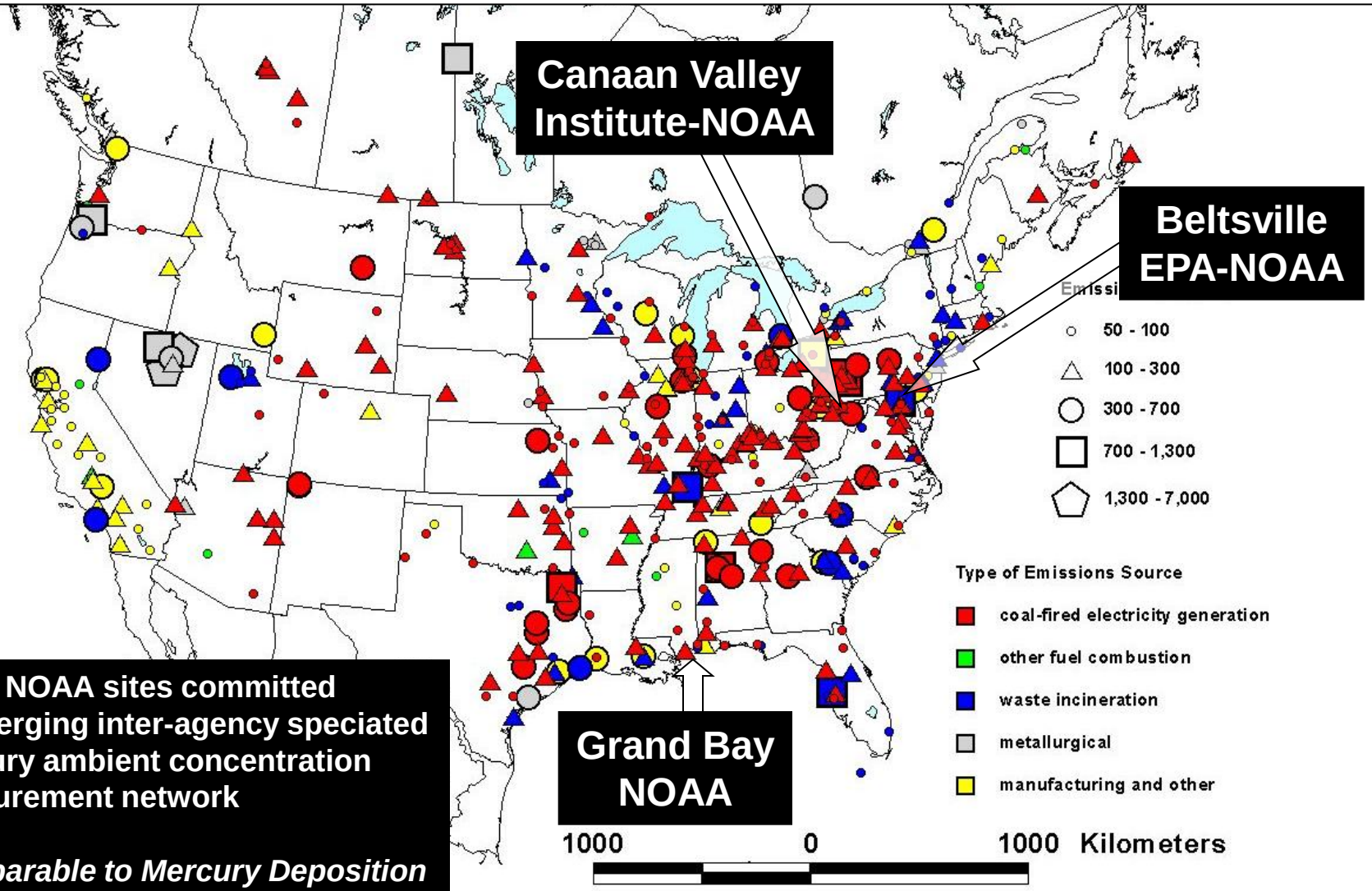
Overall Project Issues & Examples

9. Emissions Inventories
10. Source-Receptor Post-Processing
11. Source-Attribution for Deposition
12. **Model Evaluation**
13. Model Intercomparison
14. Collaboration Possibilities


Inputs to Model
meteorology
emissions
land use
Atmospheric Mercury Model
atmospheric chemistry
phase partitioning
wet and dry deposition
Model Evaluation
Wet deposition data
Speciated ambient concentration data
Model Inter-comparison
Model Visualization
Model Outputs
Wet and dry deposition of different Hg forms to sensitive ecosystems
Source attribution information for deposition
For model evaluation, model inputs must be for the same time period as measurement data

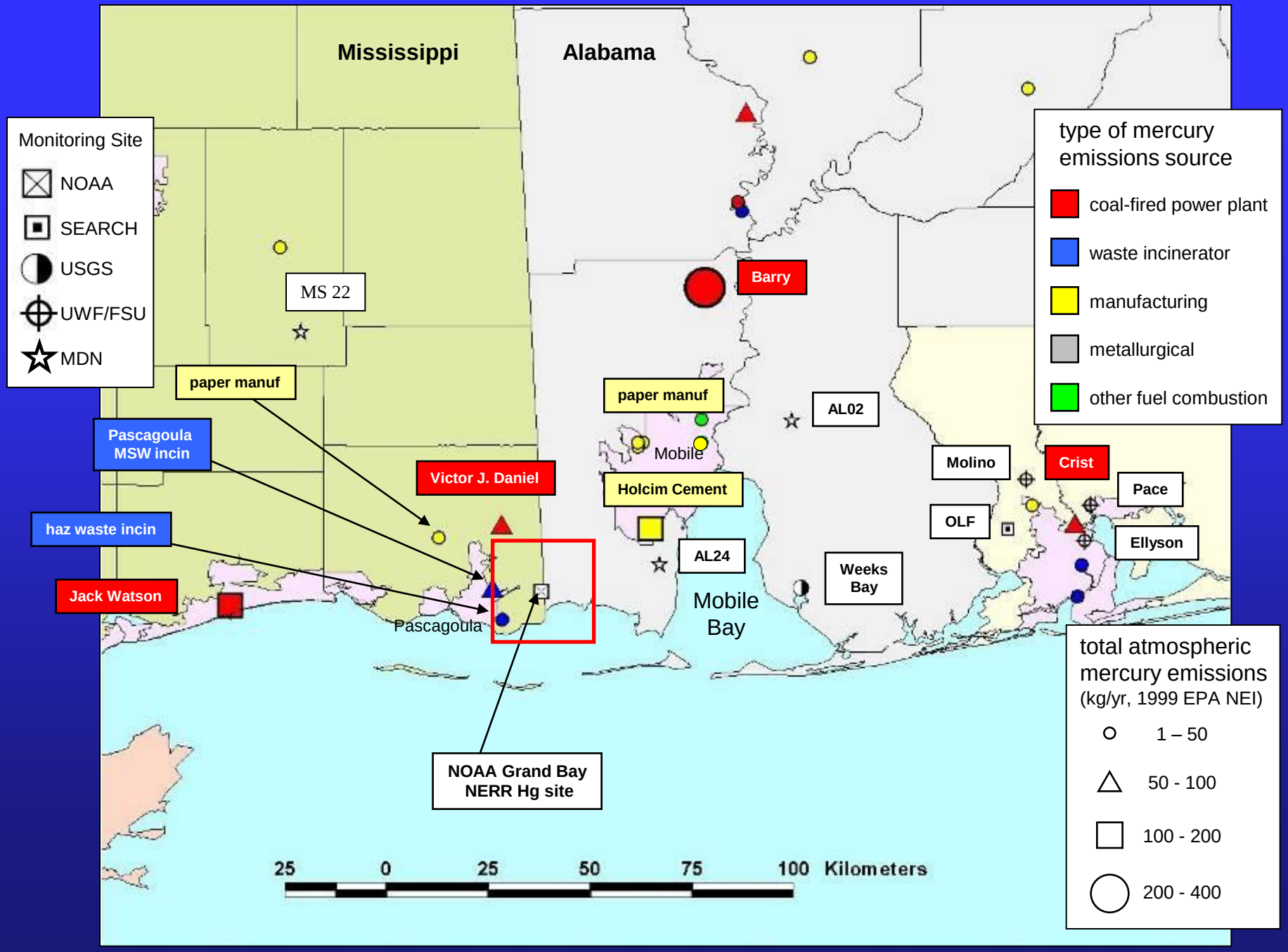

Hg(0)
Hg(II)
Hg(p)
atmospheric chemistry inter-converts mercury forms
Hg from other sources: local, regional & more distant
emissions of Hg(0), Hg(II), Hg(p)
atmospheric deposition to the water surface
atmospheric deposition to the watershed
Measurement of wet deposition
Measurement of ambient air concentrations
WET DEPOSITION
▪ complex – hard to diagnose
▪ weekly – many events
▪ background – also need near-field
AMBIENT AIR CONCENTRATIONS
▪ more fundamental – easier to diagnose
▪ need continuous – episodic source impacts
▪ need speciation – at least RGM, Hg(p), Hg(0)
▪ need data at surface and above

Largest sources of total mercury emissions to the air in the U.S. and Canada, based on the U.S. EPA 1999 National Emissions Inventory and 1995-2000 data from Environment Canada



Three NOAA sites committed to emerging inter-agency speciated mercury ambient concentration measurement network

(comparable to Mercury Deposition Network (MDN) for wet deposition, but for air concentrations)


Mississippi
Alabama
Monitoring Site
NOAA
SEARCH
USGS
UWF/FSU
MDN
MS 22
paper manuf
Pascagoula MSW incin
haz waste incin
Jack Watson
Victor J. Daniel
Pascagoula
Barry
paper manuf
Mobile
Holcim Cement
AL02
AL24
Mobile Bay
Weeks Bay
Molino
Crist
Pace
OLF
Ellyson
NOAA Grand Bay NERR Hg site
type of mercury emissions source
coal-fired power plant
waste incinerator
manufacturing
metallurgical
other fuel combustion
total atmospheric mercury emissions
(kg/yr, 1999 EPA NEI)
1 – 50
50 - 100
100 - 200
200 - 400
25 0 25 50 75 100 Kilometers

Atmospheric Mercury Measurement Site at the Grand Bay NERR, MS

mercury and trace gas monitoring tower (10 meters)

view from top of the tower

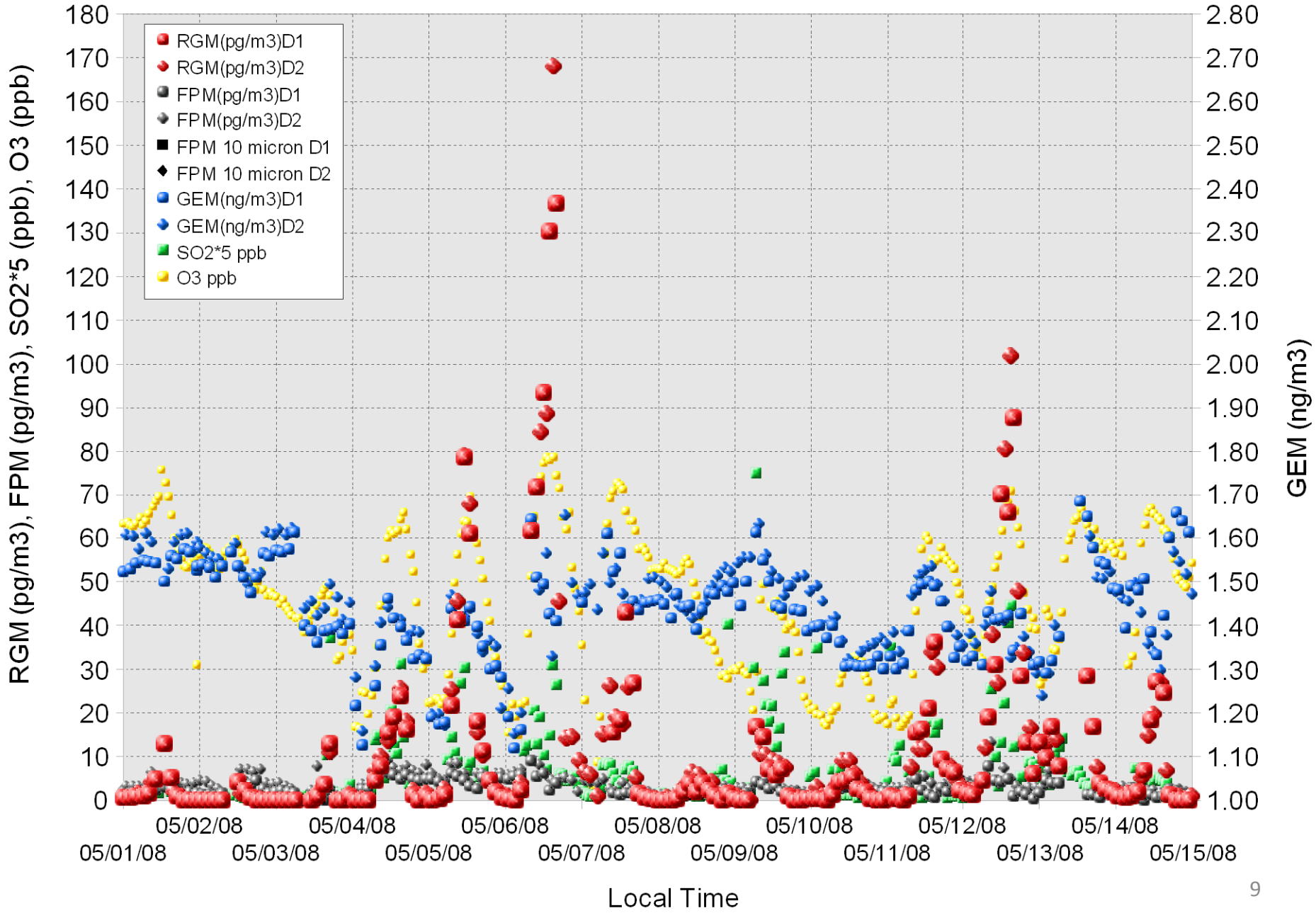
Atmospheric Measurements at the Grand Bay NERR

Elemental mercury * 2	"Speciated" Atmospheric Mercury Concentrations
Fine particulate mercury * 2	
Reactive gaseous mercury * 2	
Sulfur dioxide	Trace gases to help understand and interpret mercury data
Ozone	
Carbon Monoxide	
Nitrogen Oxides (NO, NOy)	
Wind speed, Wind Direction	Meteorological Data
Temperature, Relative Humidity	
Precipitation Amount	
Total Mercury & Methyl Mercury in Precipitation	WET DEPOSITION: Currently being added, in collaboration with MS DEQ and U.S. EPA
Trace Metals in Precipitation	
Major Ions in Precipitation	

Instrumentation inside the trailer at the Grand Bay NERR site

Speciated Atmospheric Mercury and Selected Trace Gas Concentration Measurements at Grand Bay NERR

Courtesy of Winston Luke and Paul Kelley (NOAA ARL) and Jake Walker (Grand Bay NERR) (Preliminary Values)



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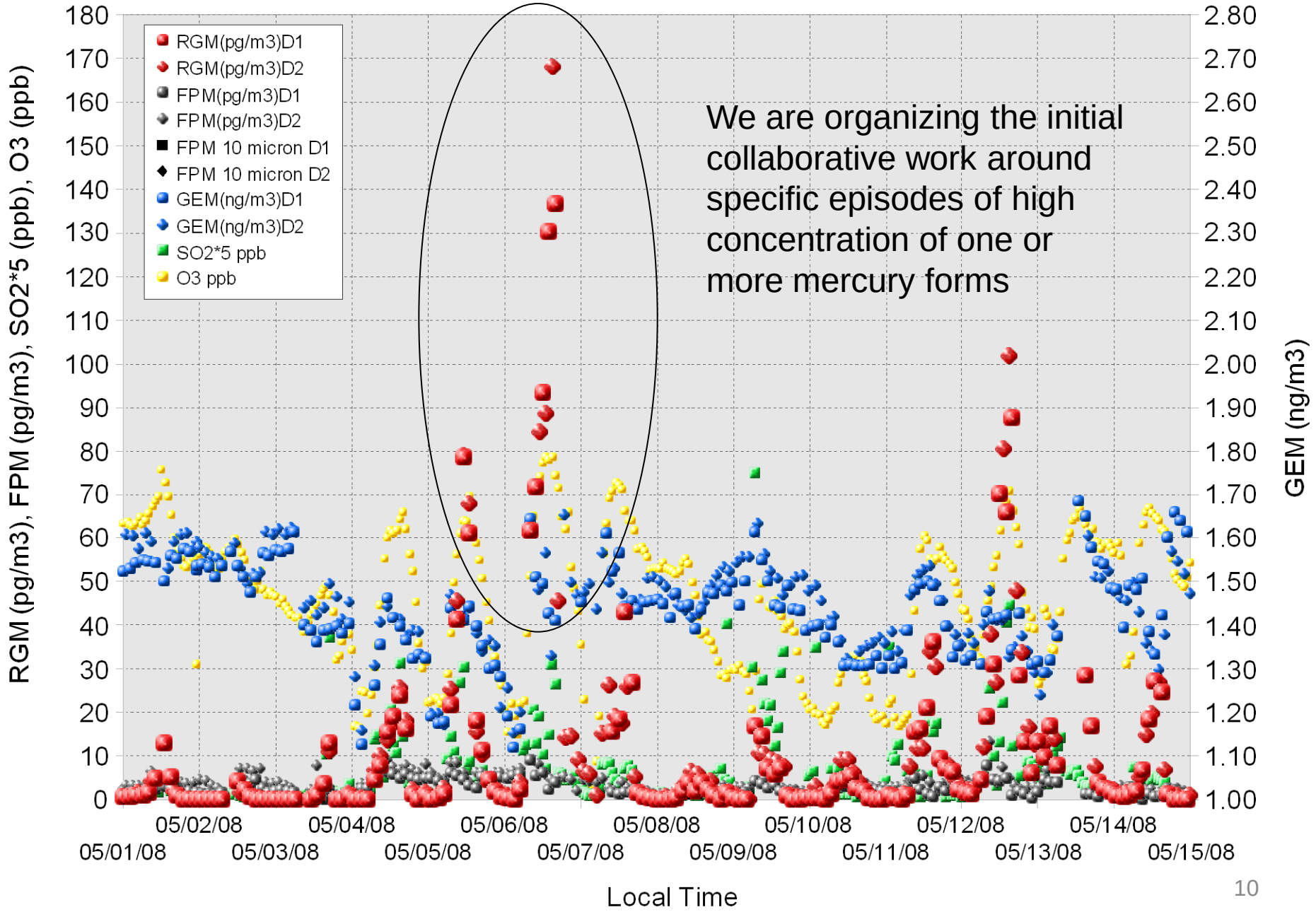
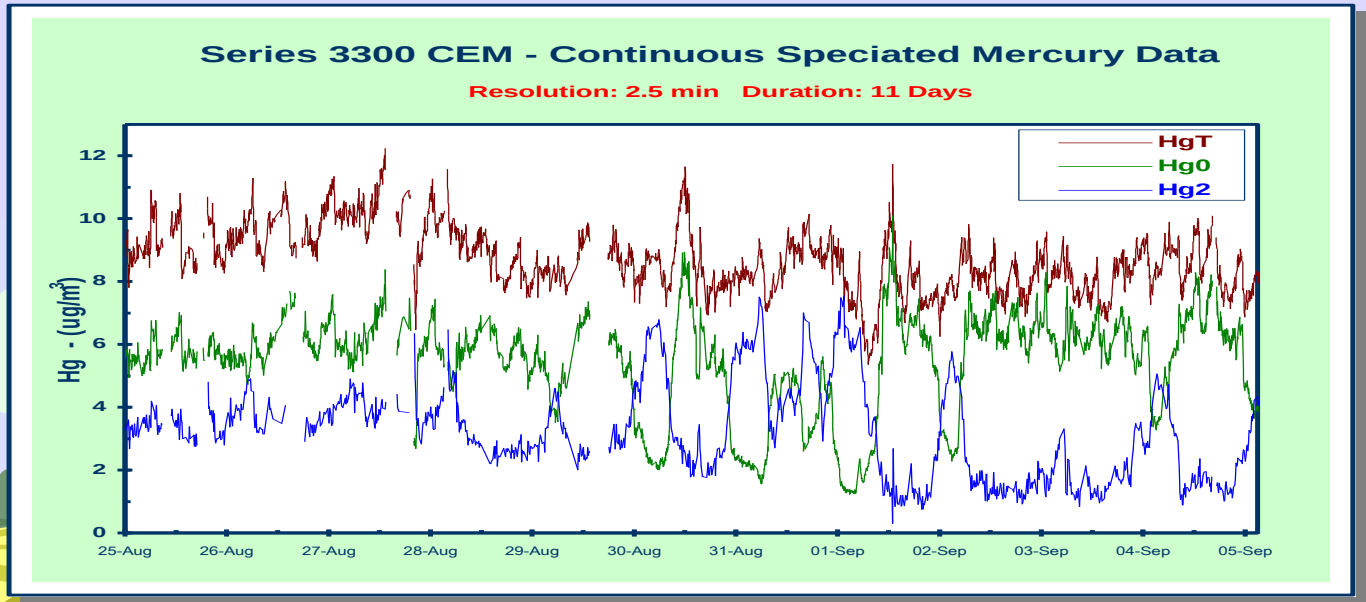
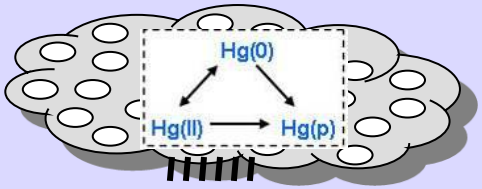


Hg from other sources: local, regional & more distant





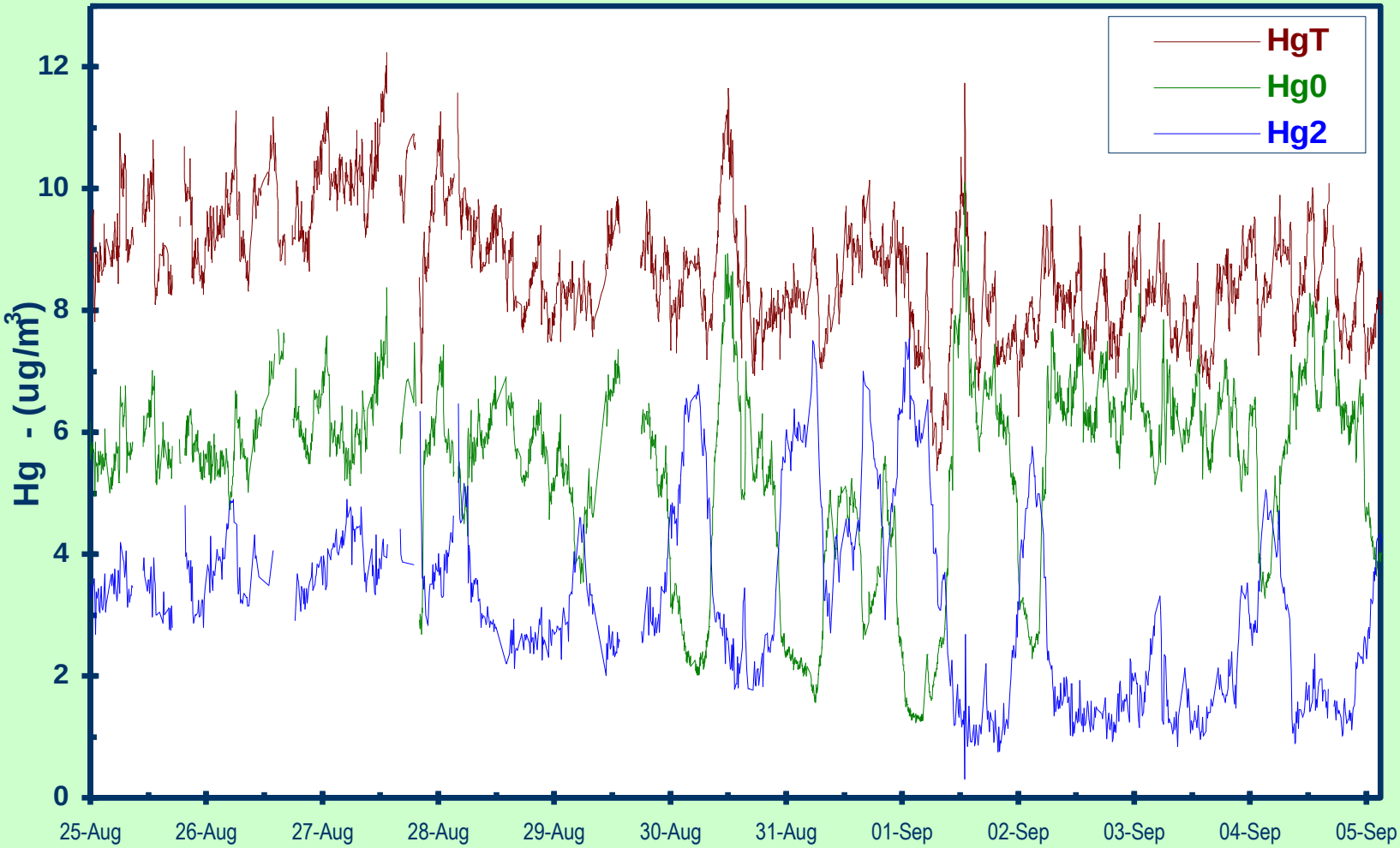
atmospheric deposition to the water surface

Measurement of wet deposition

Measurement of ambient air concentrations

Series 3300 CEM - Continuous Speciated Mercury Data

Resolution: 2.5 min Duration: 11 Days



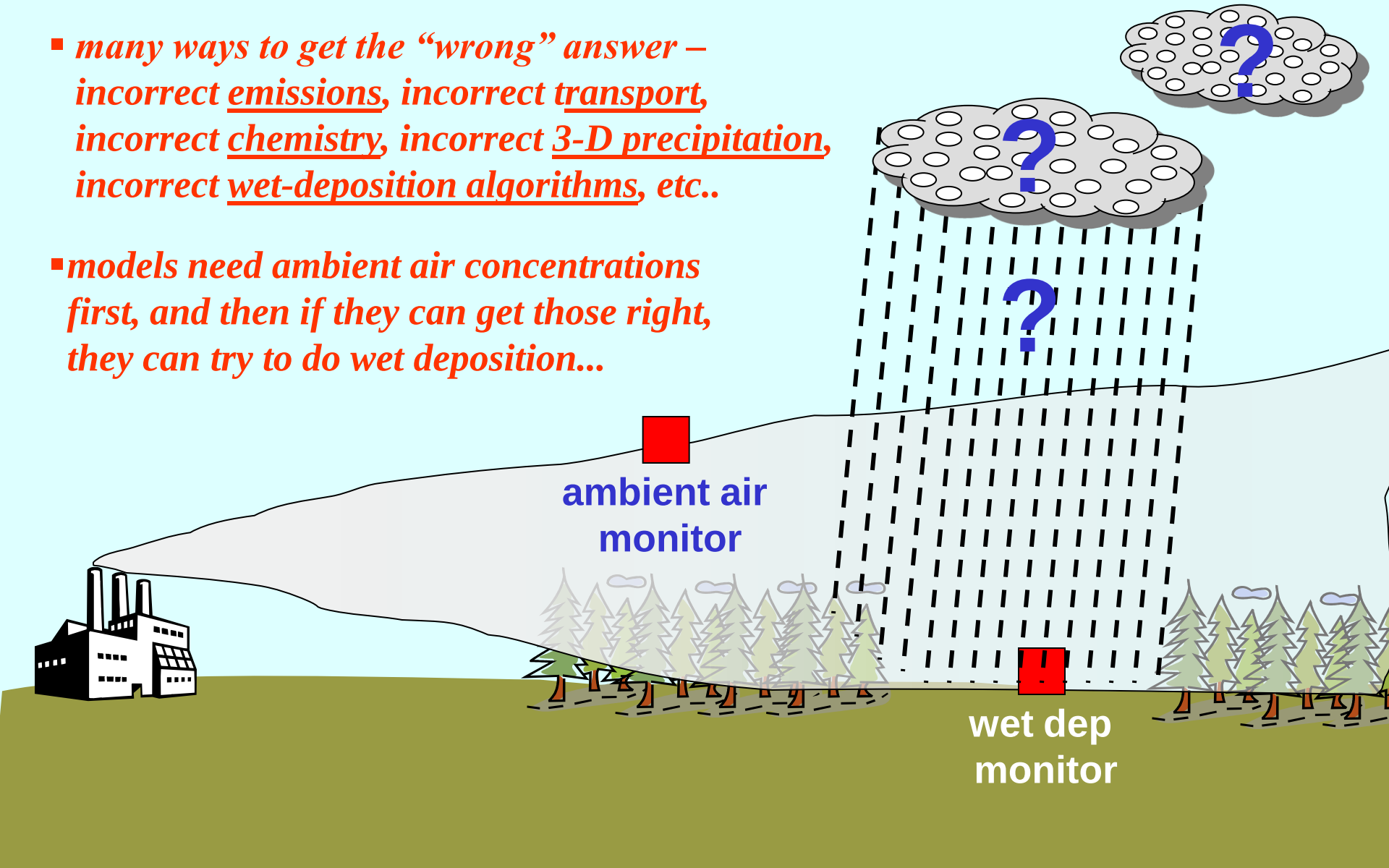
Some Additional Measurement Issues (from a modeler's perspective)

- **Data availability**
- **Simple vs. Complex Measurements**

Simple vs. Complex Measurements:
1. Wet deposition is a very complicated phenomena...

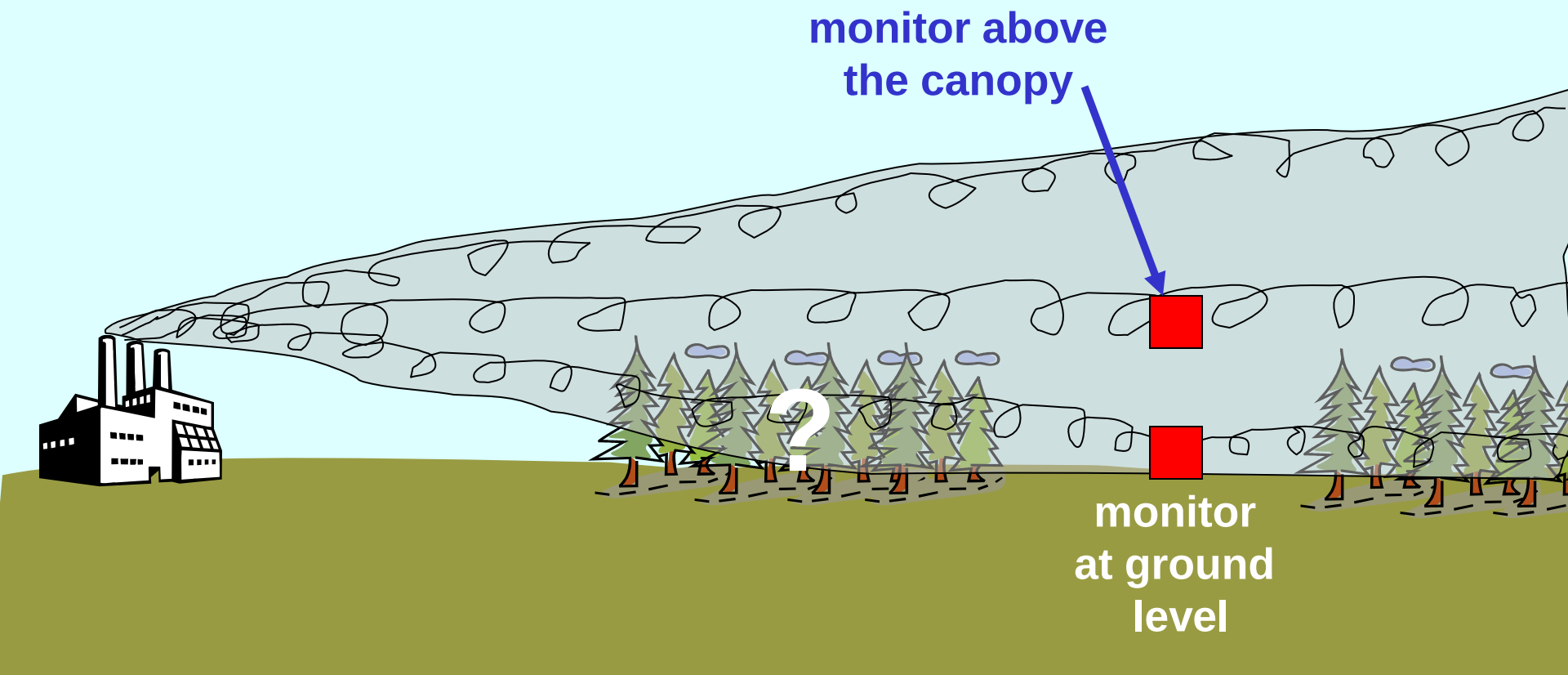
- ***many ways to get the "wrong" answer – incorrect emissions, incorrect transport, incorrect chemistry, incorrect 3-D precipitation, incorrect wet-deposition algorithms, etc..***

- ***models need ambient air concentrations first, and then if they can get those right, they can try to do wet deposition...***



Simple vs. Complex Measurements:
2. Potential complication with ground-level monitors...
("fumigation", "filtration", etc.)...

- ***atmospheric phenomena are complex and not well understood;***
- ***models need "simple" measurements for diagnostic evaluations;***
- ***ground-level data for rapidly depositing substances (e.g., RGM) hard to interpret***
- ***elevated platforms might be more useful (at present level of understanding)***



Simple vs. Complex measurements - 3. Urban areas:

a. **Emissions inventory poorly known**

b. **Meteorology very complex (flow around buildings)**

c. **So, measurements in urban areas not particularly useful for current large-scale model evaluations**

Simple vs. Complex Measurements – 4: extreme near-field measurements

- Sampling near intense sources?
- Must get the fine-scale met "perfect"

Ok, if one wants to develop hypotheses regarding *whether or not this is actually a source* of the pollutant *(and you can't do a stack test for some reason!).*

Complex vs. Simple Measurements – 5: Need some source impacted measurements

- **Major questions regarding plume chemistry and near-field impacts (are there "hot spots"?)**
- **Most monitoring sites are designed to be "regional background" sites (e.g., most Mercury Deposition Network sites).**
- **We need some source-impacted sites as well to help resolve near-field questions**
- ***But not too close – maybe 20-30 km is ideal (?)***