Manure Application Using Irrigation Equipment

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How is Manure Irrigation Possible?

- It is possible to run liquid manure through systems designed for water

- Producers must demonstrate how they will avoid contamination
  - Check valves/back flow preventers
  - Physically changing lines
  - Avoiding direct hookup of water
  - No irrigation on food crops

Solids Content

Manure	Solids Content	Handling
Mixed Liquid	$M_{solids} < 1.0\%$	Center Pivot Irrigation
Liquid	$1.0\% < M_{solids} \leq 4\%$	Gun Irrigation Tanker or Injection Application
Slurry	$4\% < M_{solids} \leq 10\%$	Special pumps (chopper pump) Tanker or Injection Application
Semi-Solid	$10\% < M_{solids} \leq 20\%$	Too thick for pumping, Manure spreader
Solid	$M_{solids} \geq 20\%$	Animal Bedding Manure spreader

Manure Irrigation Equipment

Center Pivot

Traveling Gun

Center Pivot

- General Advantages
  - Uses existing equipment
  - Most control over application timing
  - Repeat applications
  - Increased plant nutrient uptake
  - Reduced labor and trucking cost
  - Long term cost efficiencies ($ < 0.01 / gallon)

Center Pivot

- General Disadvantages
  - Upfront Infrastructure Cost
    - Piping
    - Pumps
  - Risk to ground water? (+ or -)
    - Backflow preventer
  - Risk to surface water? (+ or -)
    - Proper application
  - Odor?
    - Digested vs non digested manure
  - Aerial Pathogen transport??

Center Pivot: Distribution

- Solid & liquid separation
- Screening (reduce solids)
- Pump at lagoon
- Piping system (above and below ground)
- Possible second pump at center pivot
- Dilution and mixing at center pivot
- Distribution by center pivot

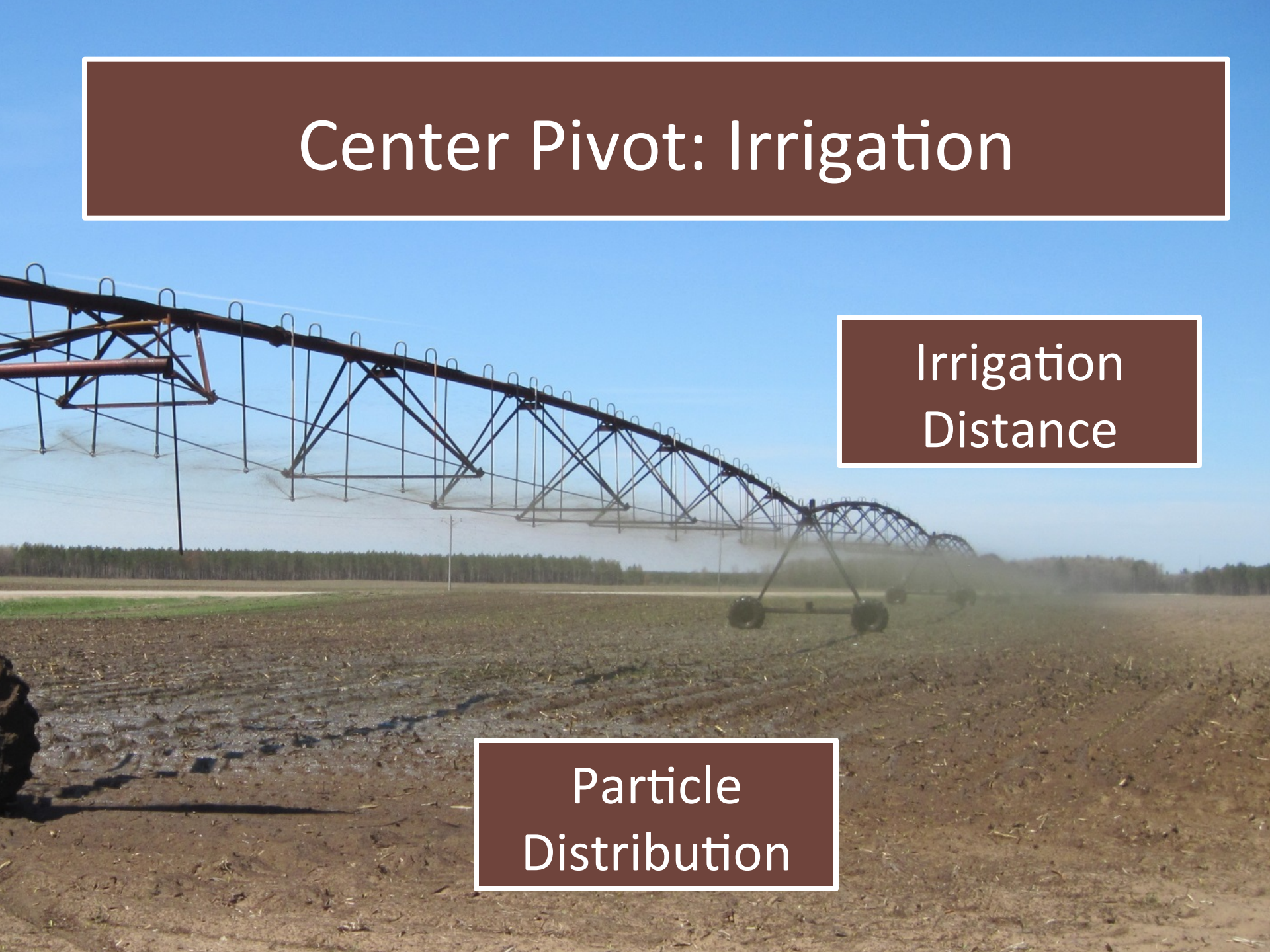
Center Pivot: Screening

Center Pivot: Pump

Center Pivot: Piping

Center Pivot: Dilution

Center Pivot: Irrigation



Irrigation Distance

Particle Distribution

Center Pivot: Daily Concerns

1. Runoff
2. Clogged Nozzles
3. Pipes bursting
4. End-gun over spray

Center Pivot: Daily Concerns

Traveling Gun

Traveling Gun

- General Advantages
  - Uses existing equipment
  - No Infrastructure
  - Reduced labor and trucking cost

Traveling Gun

- General Disadvantages
  - Limited control over application timing
  - Limited ability to repeat applications
  - Odor
  - Risk to ground water? (+ or -)
  - Risk to surface water? (+ or -)
  - Aerial Pathogen transport??

Traveling Gun: Distribution

- Similar process
  - Solid & Liquid Separation
  - Pump from lagoon (increased solids)
  - Above ground pipe to Gun (no buried pipe)
  - Possible second pump at gun
  - Tractor places the gun
  - Distribution by traveling gun


Particle
Distribution


Irrigation
Distance

Traveling Gun: Daily Concerns

- Runoff
- Gun overspray
- Pipe bursts

Aerial Pathogen Transport

- Is manure irrigation hazardous to human health?

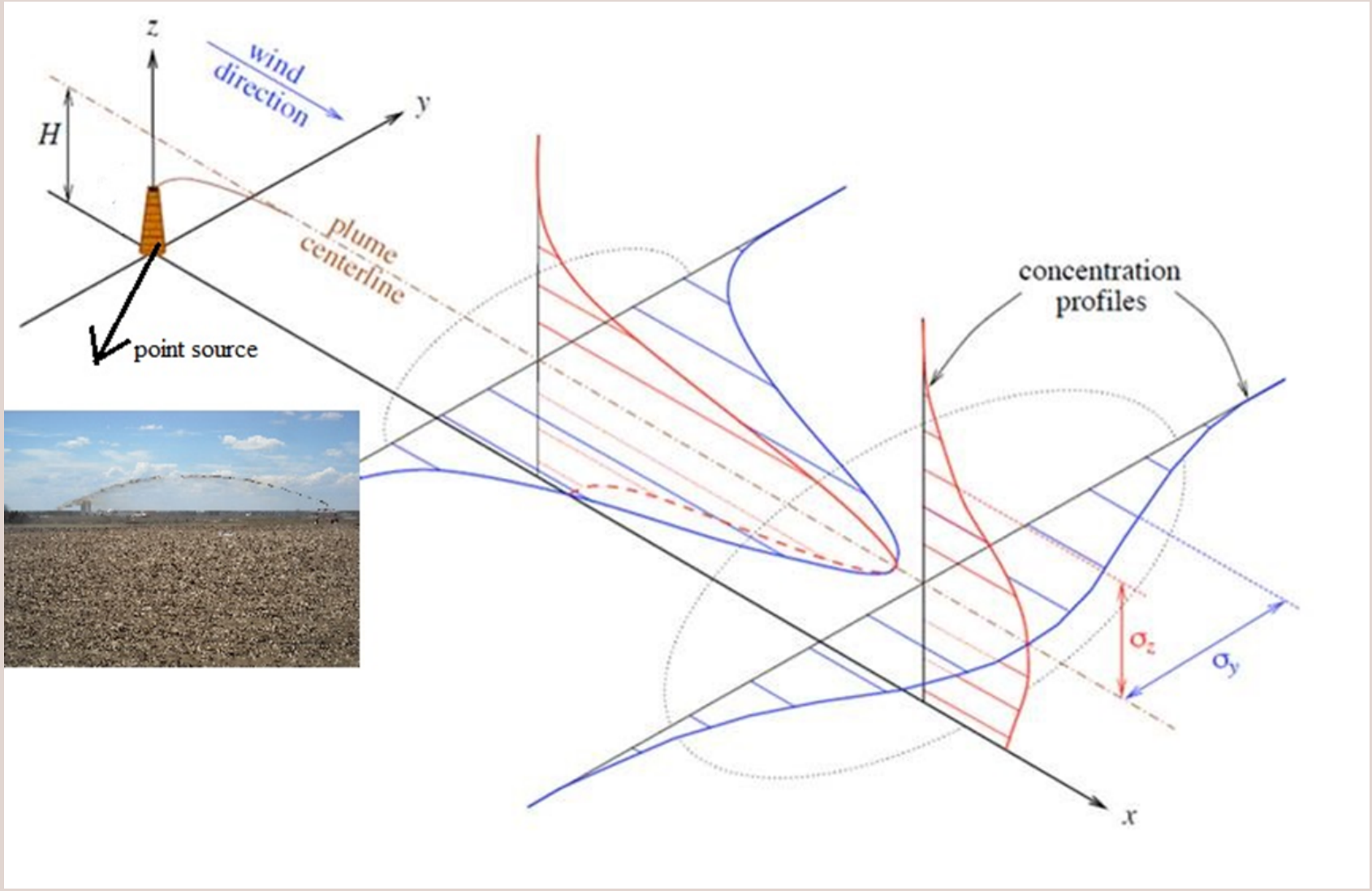
Aerial Pathogen Transport

- Our Research Goal
  - Monitor the air for Bovine pathogens
  - At set distances down wind from irrigation equipment
  - Under differing environmental and treatment conditions
  - Determine if there is a human health risk

Aerial Pathogen Transport

- Our Detection Methods
  - Monitor the air for Bovine pathogens
    - DNA signature testing (Button Sampler)
      - alive or dead
    - Indirect culture sampler (Biosampler)
      - only alive
    - Direct culture sampler (Anderson Sampler)
      - only alive

Aerial Pathogen Transport



Aerial Pathogen Transport

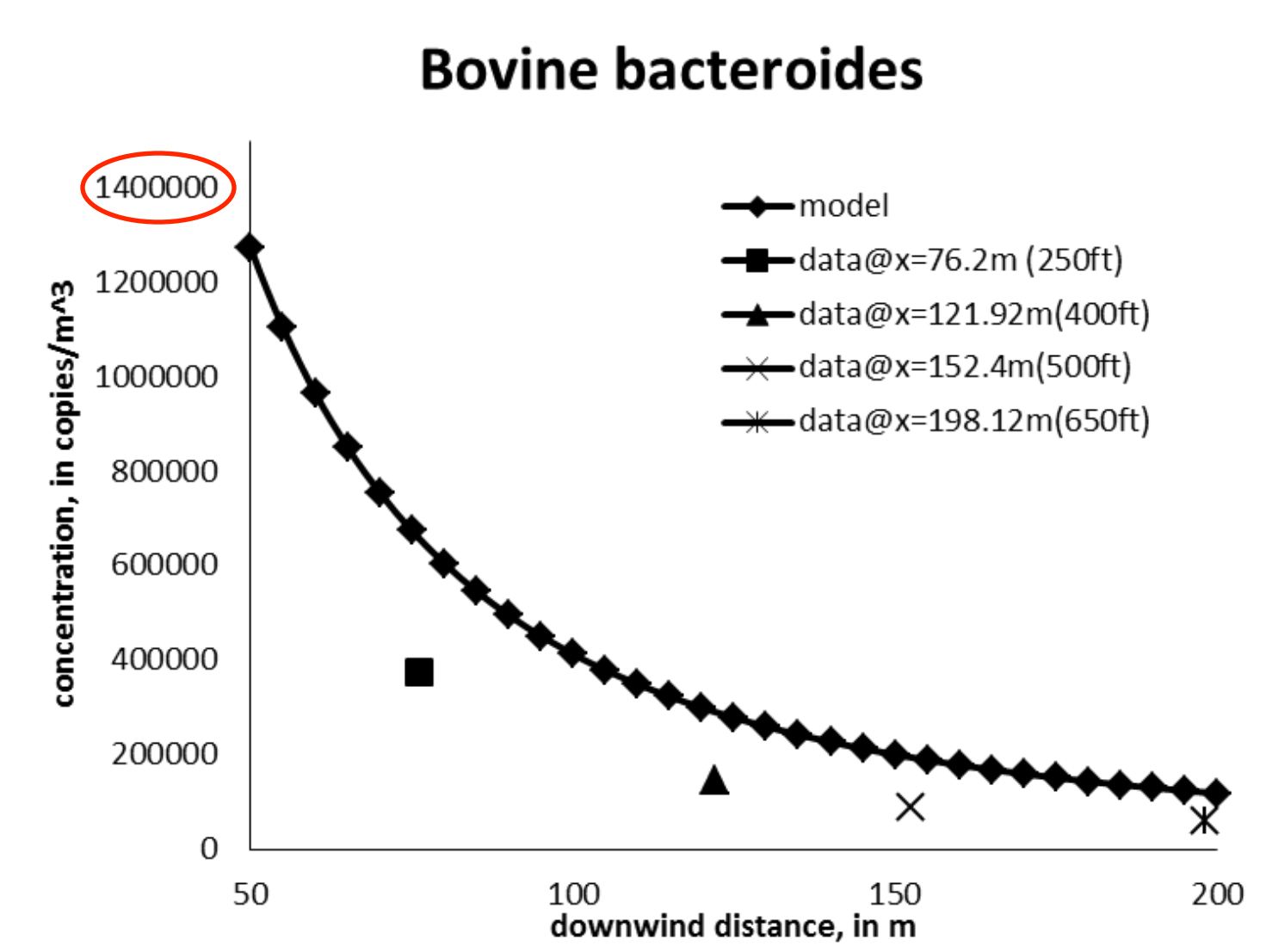
Aerial Pathogen Transport

Aerial Pathogen Transport

- Is manure irrigation hazardous?
  - Its not an easy answer
    - What's in the manure (animal or human pathogens)?
    - How is the manure processed or treated?
    - What are the weather conditions?
    - What's your exposure?
    - How's you immune system?

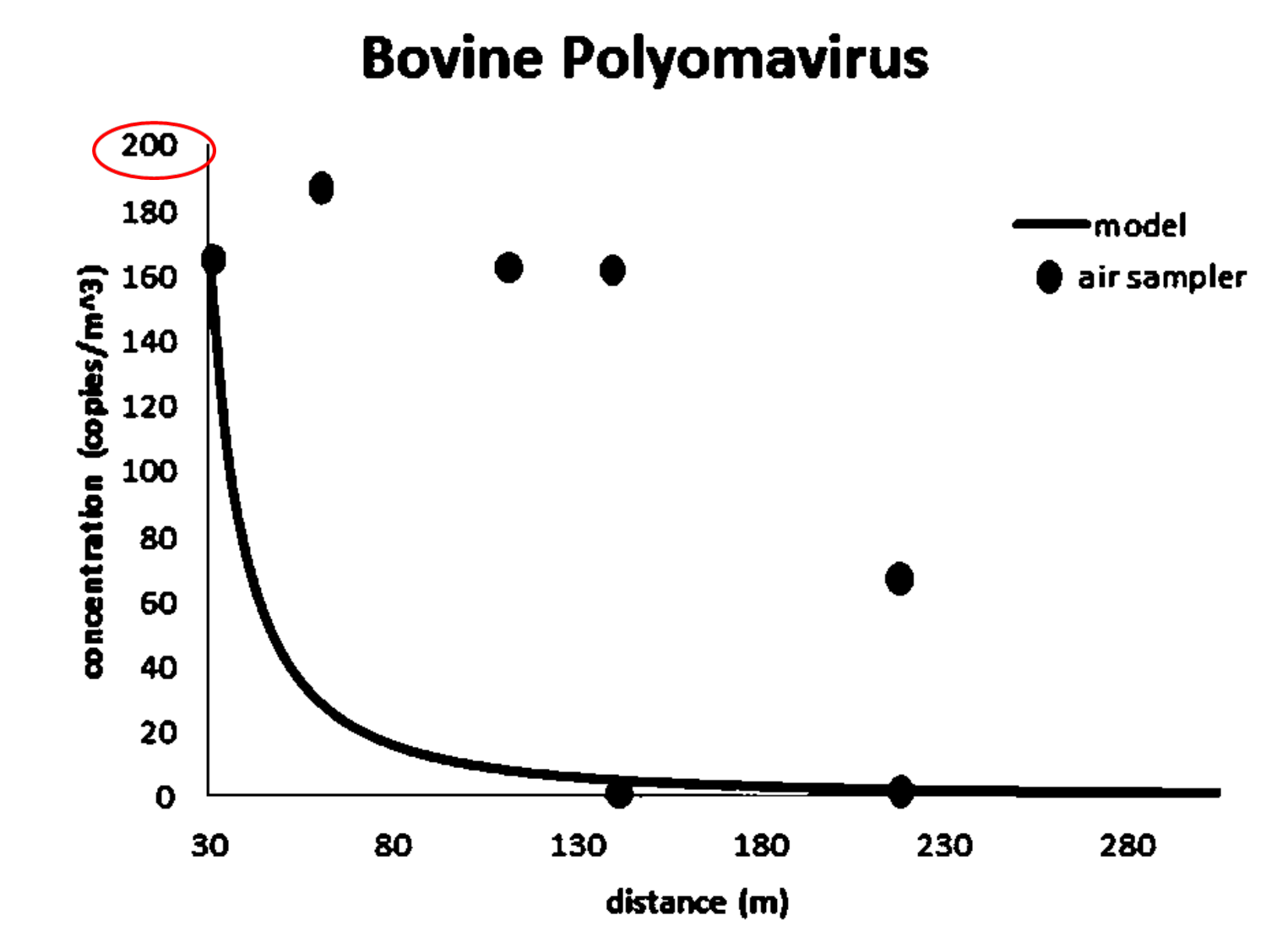
Travelling gun run

- Avg. Wind Speed = 5.8m/s; Avg. Solar Intensity = 402.9 $W/m\hat{}2$
- 99.98% Reduction from Lagoon to 650 ft (Bleach kills 99.9% clorox.com)



Center Pivot Run

- Avg. Wind Speed = 2.82m/s; Avg. Solar Intensity = 567.8 W/m^2
- 99.9999% reduction from pipe inlet to 650 ft



Aerial Pathogen Transport

- Is manure irrigation hazardous?
  - "Distance" can be an effective neutralizer or diluent
  - Currently working to determine relative health risk

Questions?