# Air Emissions From Open-Lot Dairy Corrals

## Texas/New Mexico Open-Lot Research

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# Acknowledgments


- Drs. Rick Todd and Andy Cole, USDA-ARS/Bushland
- Dr. Ken Casey, Texas AgriLife Research/Amarillo
- Brad Wilhite, Jack Bush, Gary Marek, Kevin Heflin, and Sharon Sakirkin

# Acknowledgments


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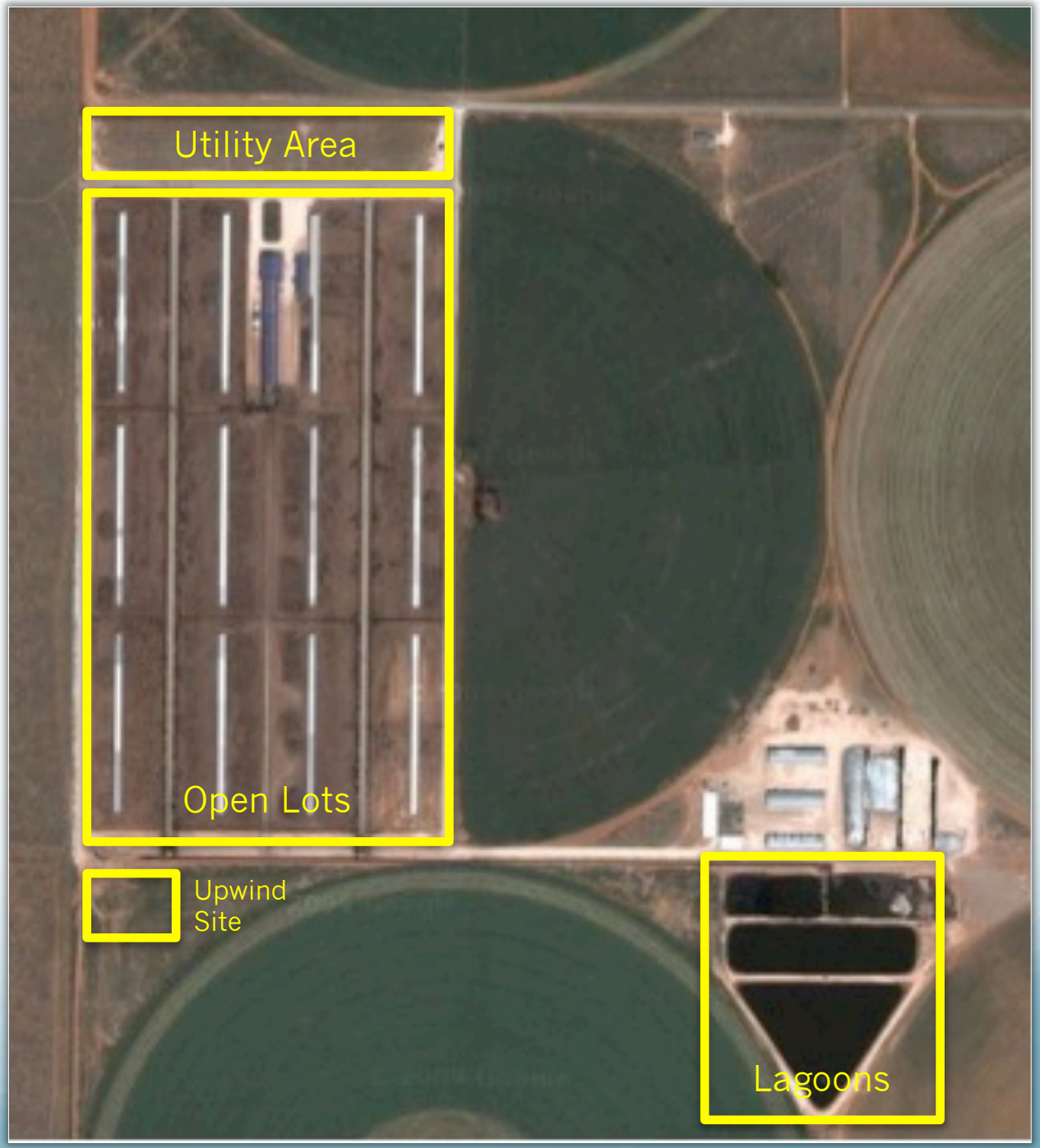
- Dr. Robert Hagevoort, NMSU Extension, Clovis, NM
- Cooperating dairy producer, Curry County, NM
- Dairy Farmers of America, Clovis, NM

- Open-lot dairy in Curry County, NM
- 3,500 hd capacity
- Holstein herd
- ~60 acres open lots
- Excellent separation between open lots and lagoons
- Prevailing SSW winds
- Grassed utility area downwind of open-lot area
- Native rangeland upwind (to SW)



# Monitoring Campaigns

| Year | 2009 | 2010 |
|---|---|---|
| $PM_{10}$ | ✔ | ✔ |
| $H_2S$ | ✔ | ✔ |
| $NH_3$ | ✔ | ✔ |
| $CH_4$ | ✗ | ✔ |
| Visibility | ✔ | ✔ |
| Dates | 5-17 Aug | 23 Jul – 11 Aug |
| Daily $T_{max}$ | 31-38°C | 28-35°C |
| Daily $RH_{min}$ | 13-32% | 20-40% |
| Wind | Southerly/variable<br>6 m/s campaign avg. | Southerly/variable<br>3 m/s campaign avg. |
| Precipitation | 29 mm supercell<br>10 Aug | 52 mm rain 24-25 Jul<br>22 mm 05-09 Aug |

# Measurements

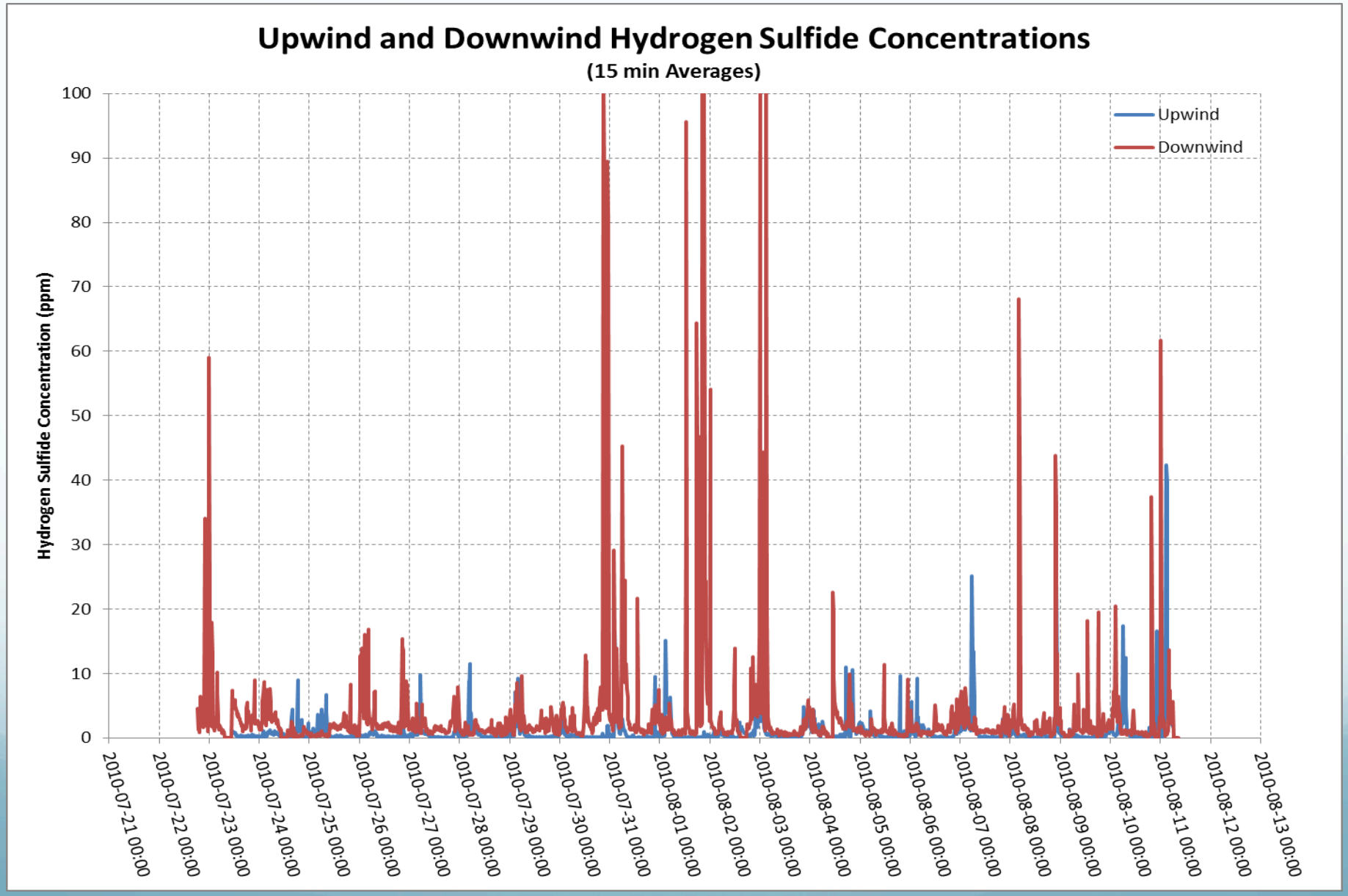
- $PM_{10}$ – tapered-element oscillating microbalance (TEOM)
- $NH_3$ – open-path diode laser; TEI Model 17C chemiluminescence analyzer
- $H_2S$ – TEI pulsed fluorescence analyzer
- $CH_4$ – open-path diode laser; TEI model 55i analyzer
- Visibility – high-contrast target array w/digital photography
- Surface meteorology

# Net $H_2S$ Concentrations

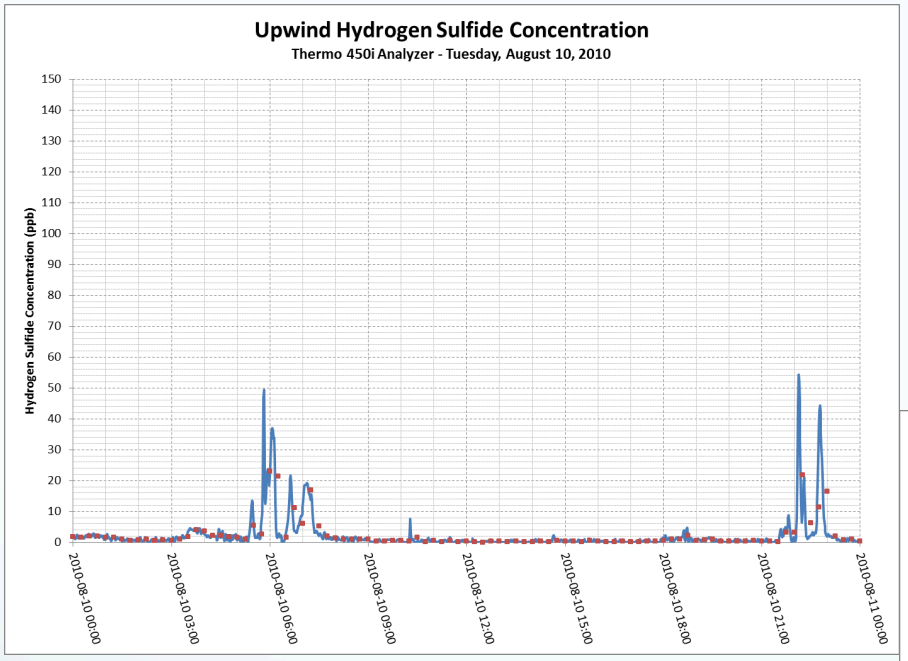
# Mobile Instrument Shelters on Upwind and Downwind Sides of Dairy

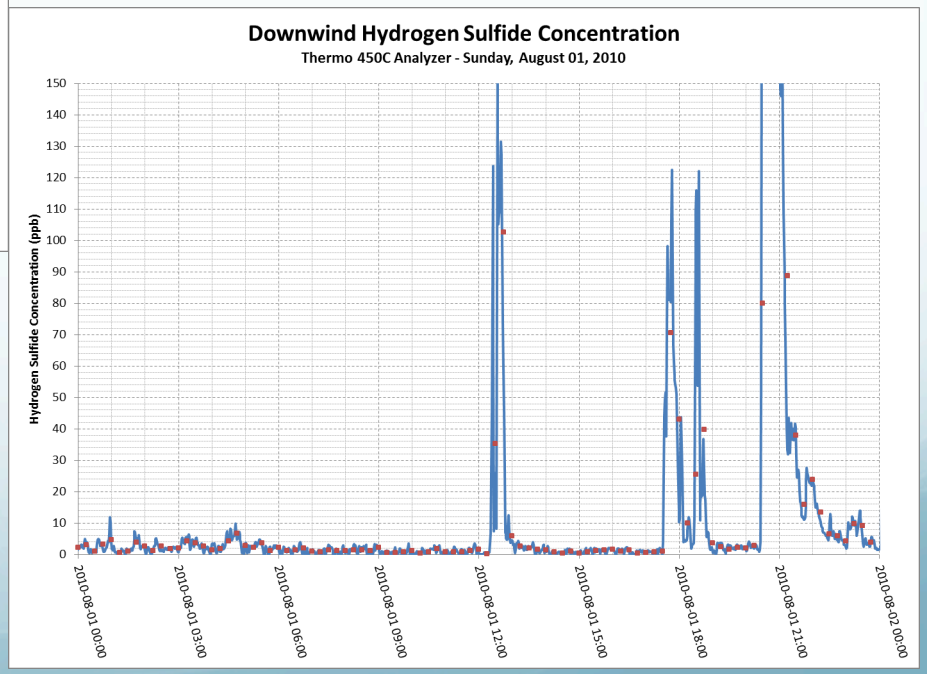
# Redundant, Pulsed Fluorescence $H_2S$ Analyzers in both Mobile Instrument Shelters

# Downwind Concentrations (15 min averages) are 2.7 ppm greater than Upwind Concentrations.

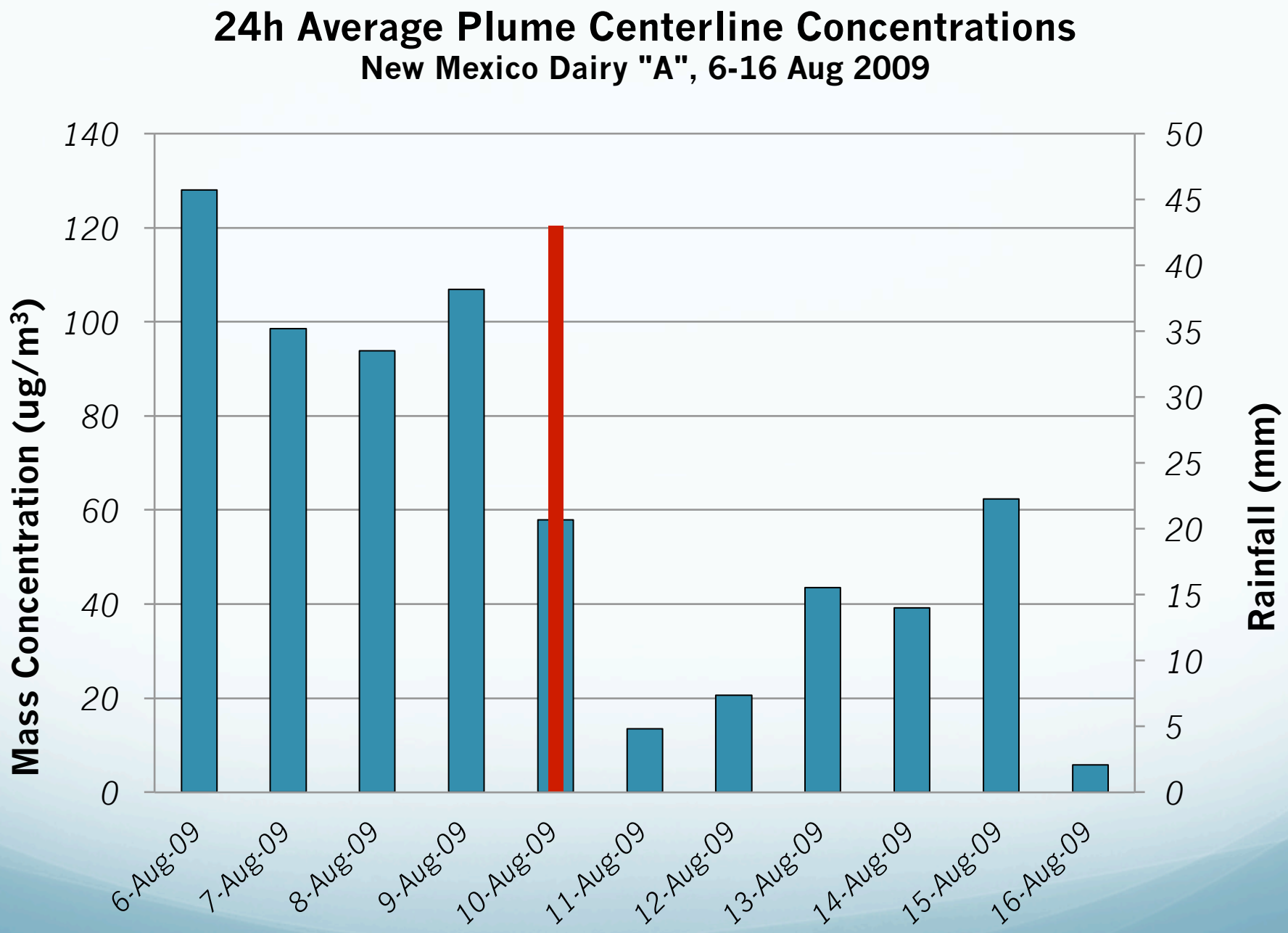


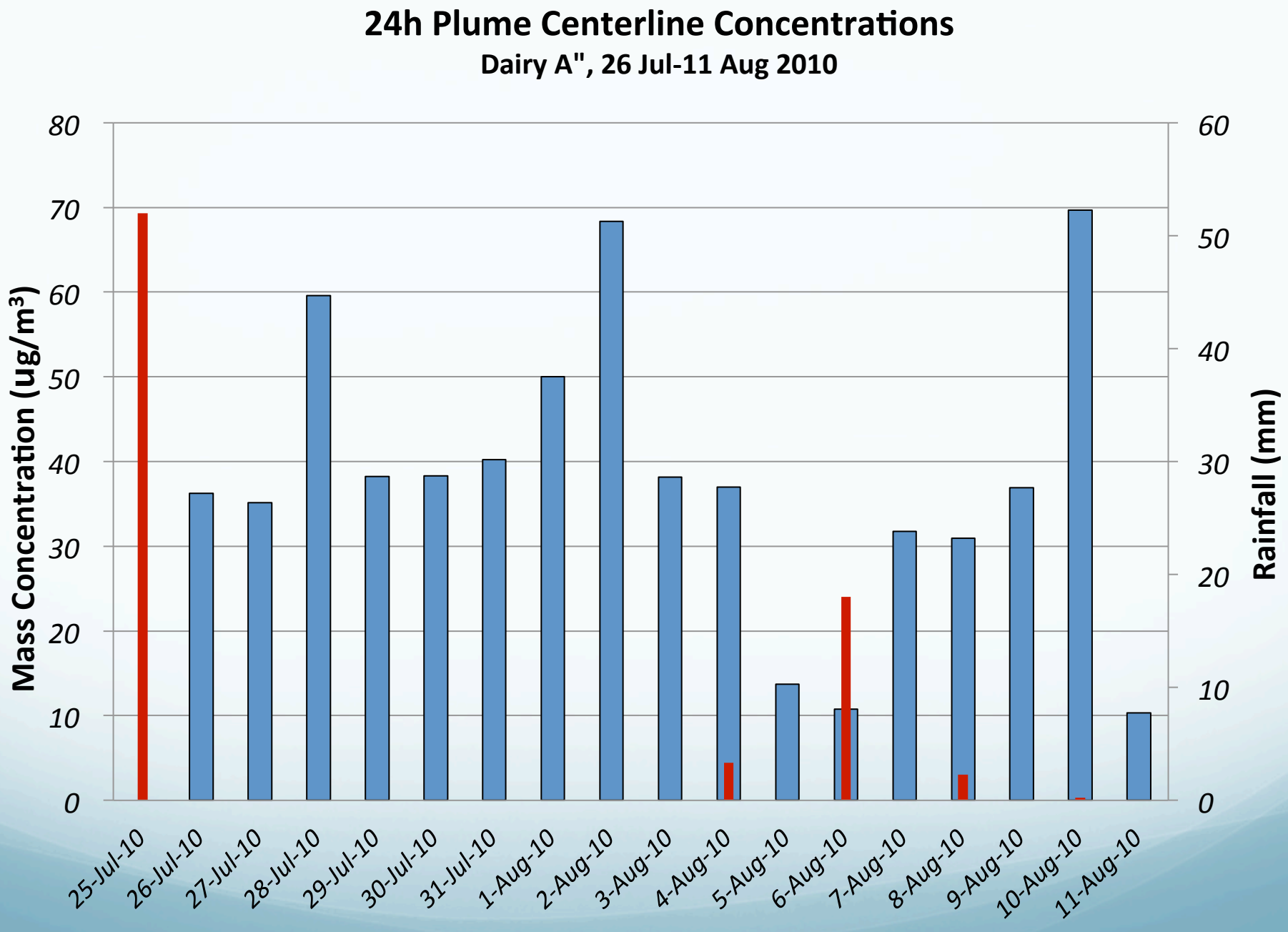
# Intermittent spikes associated with calms, wind shifts, and lagoon disturbances

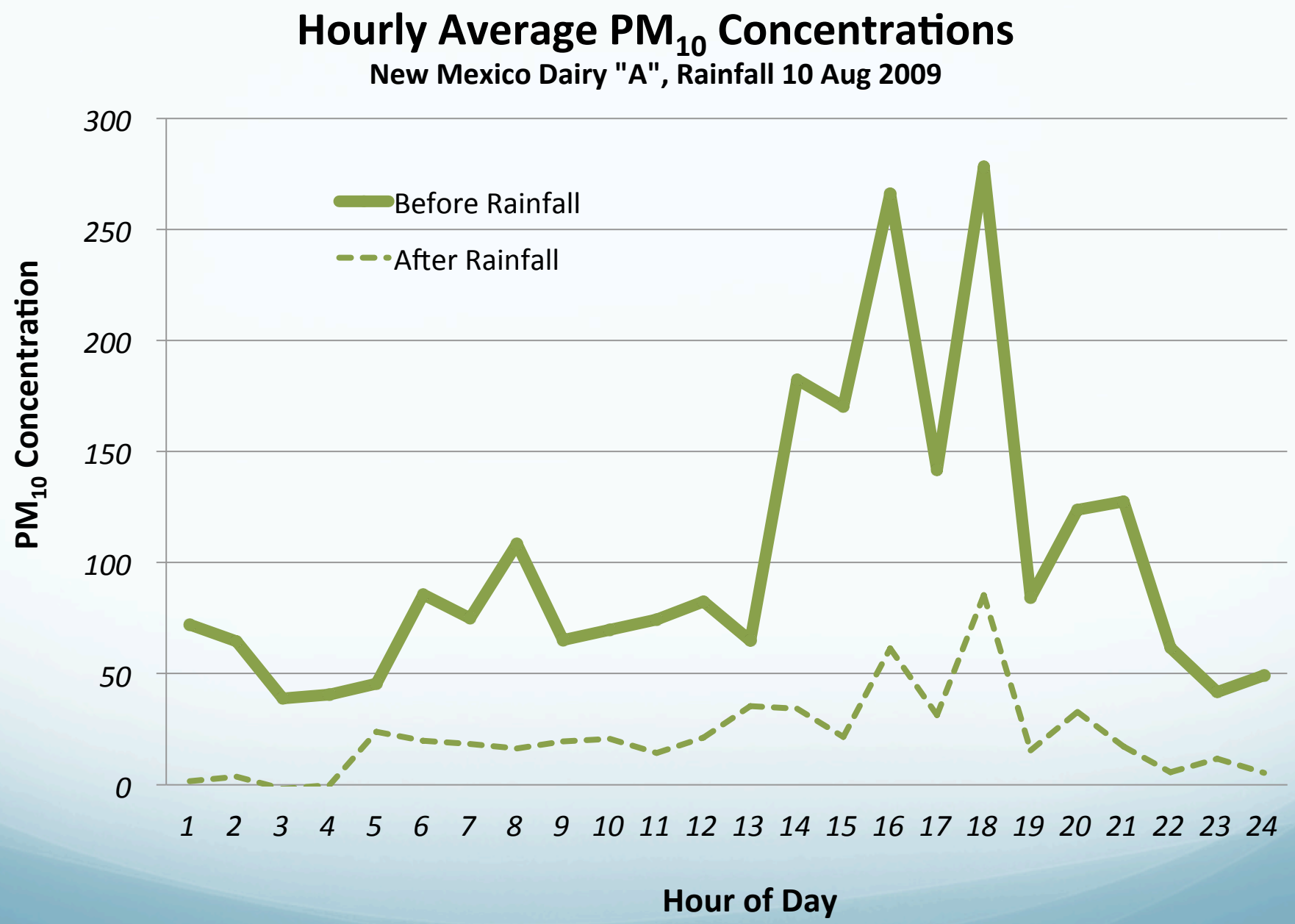


# Net $PM_{10}$ Concentrations

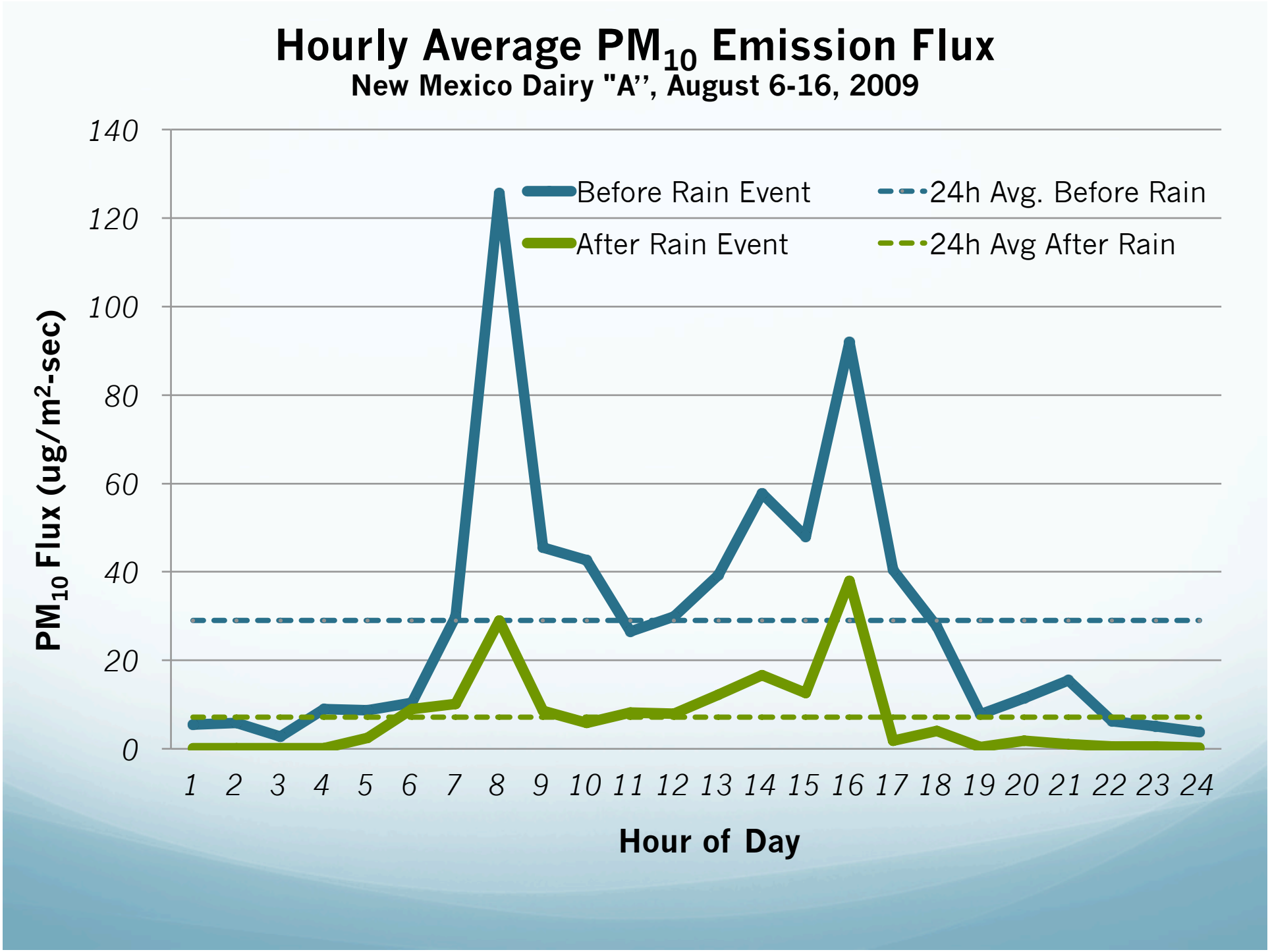

24h Average Plume Centerline Concentrations
New Mexico Dairy "A", 6-16 Aug 2009
Mass Concentration (ug/m³)
Rainfall (mm)
140
120
100
80
60
40
20
0
50
45
40
35
30
25
20
15
10
5
0
6-Aug-09
7-Aug-09
8-Aug-09
9-Aug-09
10-Aug-09
11-Aug-09
12-Aug-09
13-Aug-09
14-Aug-09
15-Aug-09
16-Aug-09


24h Plume Centerline Concentrations
Dairy A", 26 Jul-11 Aug 2010
Mass Concentration (Ug/m³)
Rainfall (mm)
0
10
20
30
40
50
60
70
80
0
10
20
30
40
50
60
25-Jul-10
26-Jul-10
27-Jul-10
28-Jul-10
29-Jul-10
30-Jul-10
31-Jul-10
1-Aug-10
2-Aug-10
3-Aug-10
4-Aug-10
5-Aug-10
6-Aug-10
7-Aug-10
8-Aug-10
9-Aug-10
10-Aug-10
11-Aug-10


Hourly Average PM10 Concentrations
New Mexico Dairy "A", Rainfall 10 Aug 2009
Before Rainfall
After Rainfall
PM10 Concentration
300
250
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour of Day

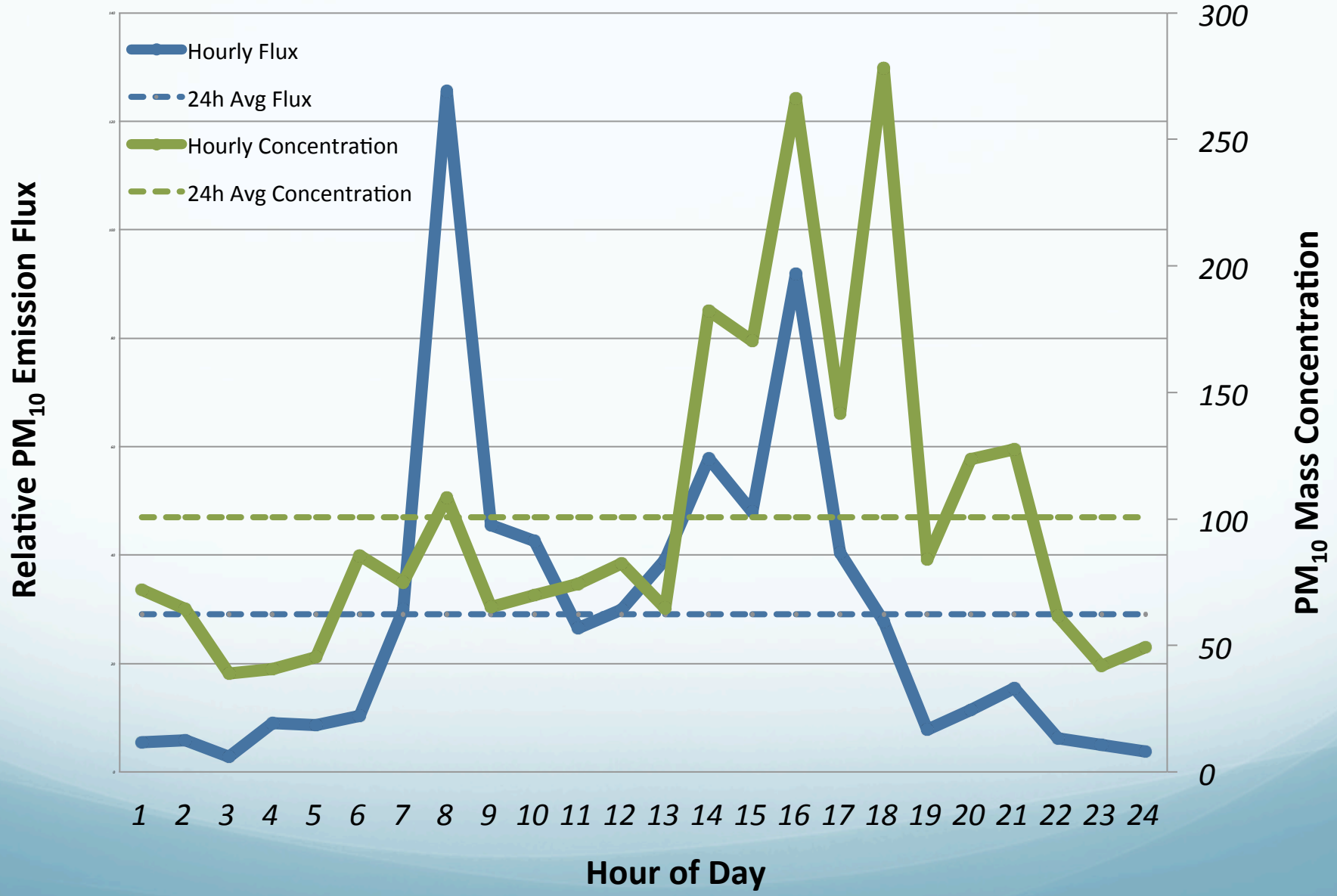
# $PM_{10}$ Emission Fluxes**

** Relative, semi-quantitative


Hourly Average PM10 Emission Flux
New Mexico Dairy "A'', August 6-16, 2009
Before Rain Event
After Rain Event
24h Avg. Before Rain
24h Avg After Rain
PM10 Flux (ug/m2-sec)
0
20
40
60
80
100
120
140
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour of Day

# Concentrations vs. Fluxes**

** Relative, semi-quantitative

# Hourly Average $PM_{10}$ Emission Flux and Concentrations

## New Mexico Dairy "A", August 6-10, 2010