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# TEOM/FDMS in NH

## QA/Validation

## Methods & Issues




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# New Hampshire Continuous PM2.5 Monitoring Sites

-  TEOM  
w/ dryer
-  TEOM  
w/out dryer
-  FDMS

\* All Inside Trailers

Lebanon  
Airport 

 Camp Dodge (Base,  
White Mtns)

Manchester 

 Peirce Island,  
Portsmouth

 Miller State Park  
(Pack Monadnock Summit)

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# QA Procedures

## ■ Weekly

- ❑ Time Check/Adjustment
- ❑ Flow Audit (skip if raining – do others?)
- ❑ Filter Check (change if near 90%)
  - If FDMS, 47mm filter changed at same time

## ■ Monthly

- ❑ *Same as above, PLUS...*
  - ❑ Temp/Pres Check
  - ❑ Part Maintenance (cleaning bonnet, cyclone)
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# QA Procedures

- **Other (in the field)**

- Pump Test (every 3 months)
  - In-line Filter Changes
    - Bypass (every 6 months)
    - Main (every year)
  - Leak Check
    - After FDMS 47mm filter change  
(risk of leak if not filter cartridge/holder not properly installed)
    - If troubleshooting
  - Software Calibration of flow adjustment factors  
(if flow audit fails or near failing)
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# QA Procedures

## ■ Other (in the lab)

### □ Pump Rebuilds

- As needed (when pump approaches -20 inHg)

### □ Dryer Cleaning

- So far, done only when needed (ex. dryer status)
  - Planning to make this routine to prevent dryer failures
    - Every year (ex. just before Annual Maintenance)
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# QA Procedures

- **Annual (everything else!)**
    - ❑ Flow Audit
    - ❑ Temp/Pres Check/Calibration
    - ❑ CPU Battery Test
    - ❑ Analog Board Calibration
    - ❑ KO Confirmation
    - ❑ Mass Transducer Hardware Calibration
    - ❑ Leak Check
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# Data Downloads

- **RPComm** set up remotely to all sites
  - Regularly download data at 5-min (1400AB) and 6-min (FDMS) resolution
  - Downloaded parameters vary by needs, but try to consistently record...
    - Mass Conc
    - Status
    - Dryer-Out RH/Temp or Dew Point, where applicable
  - Input data into spreadsheets every few days
    - Allows visual of recent data to catch problems
    - Plotted data aids in validation
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# Data Validation

## ■ Invalidate if:

- Hourly average  $< -4.0$ 
    - Negative values tend to occur during/after rain events
  - When status code present or channel downed (QA)
    - Use downloaded data to determine interval of affected data, identify captured status codes, etc....
    - When in doubt, invalidate all flagged hours
  - Flow audit failed
    - Invalidate all hours between previous and subsequent passing flow audits
  - Filter Loading  $\geq 99$
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# Data Validation

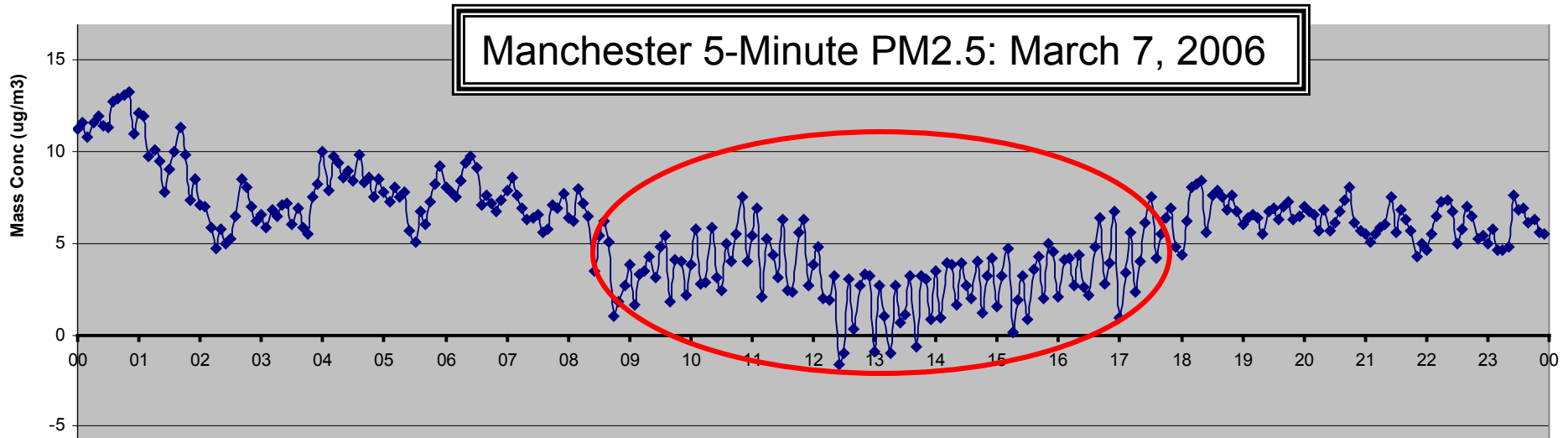
- Consider Invalidation if:
    - Data is highly erratic or isolated spike/dip occurs
      - Refer to downloaded data for greater insight
      - Compare to other sites, look for similar patterns
      - Identify potential effects due to weather (raining?, sudden shift in wind direction or speed?)
  - Dilemma (more on this later):
    - What to do about positive reference mass in FDMS units?
      - Is there a cutoff value, such that hours with high reference mass should be invalidated?
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# Sensitivity to Temperature

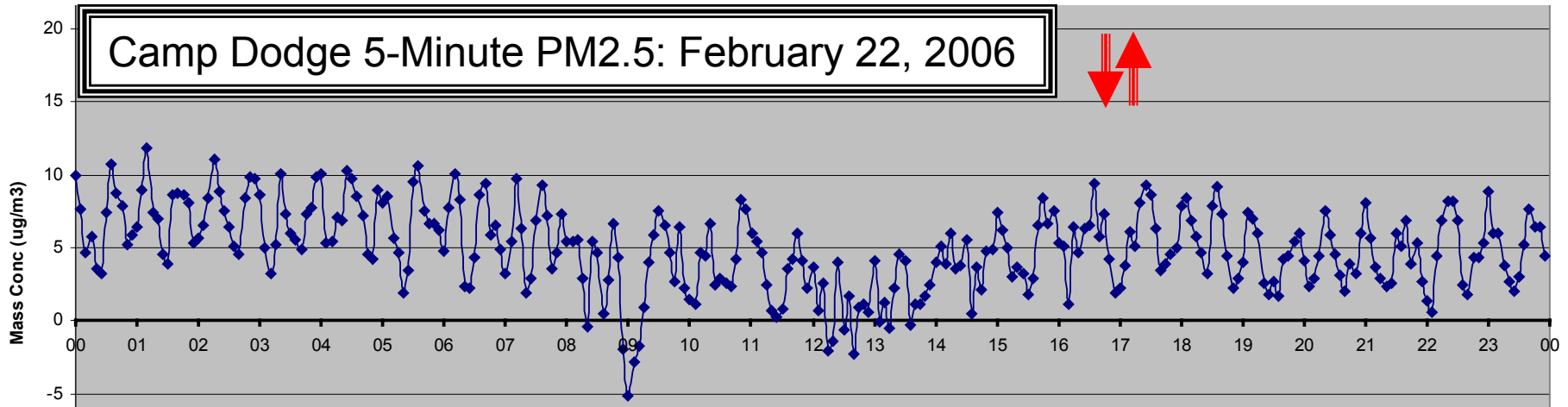
- At about 4pm, April 13<sup>th</sup>, the door of the enclosure around the TEOM pump at Manchester was closed  
(just to drown noise while doing work unrelated to the TEOM)
  - Late that night, a temperature status was triggered due to an elevated case temp
  - When the pump door was re-opened in the morning, the temp status disappeared
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# “Normal” Oscillations?

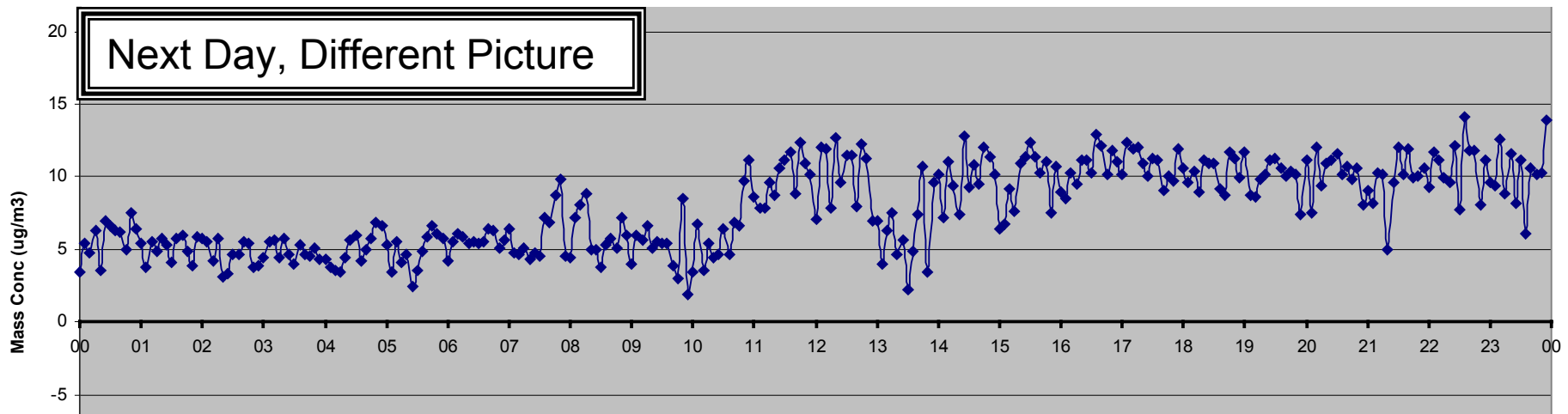


- Data downloaded at 5-minute interval shows rapid up/down pattern, but not all the time
- Is this inherent to the instrument calculations, or does it indicate a problem, changing conditions?
- Have other states seen this pattern in their data?

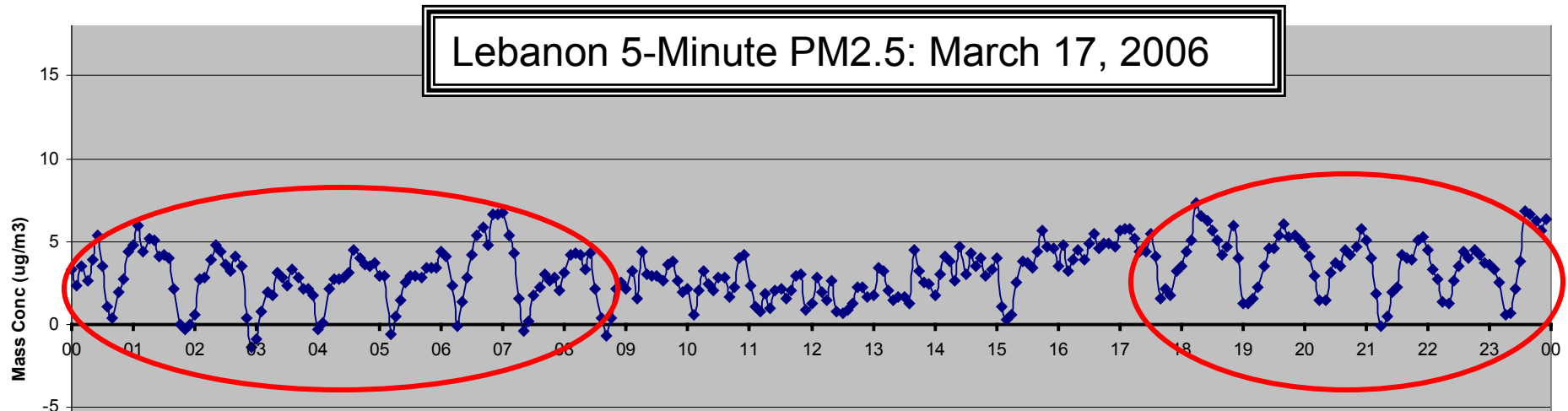
# Up/Down...Up/Down...



- Wider oscillations at remote site
- This pattern seemed isolated to that day
  - Ended (or at least “calmed down”) by the next day



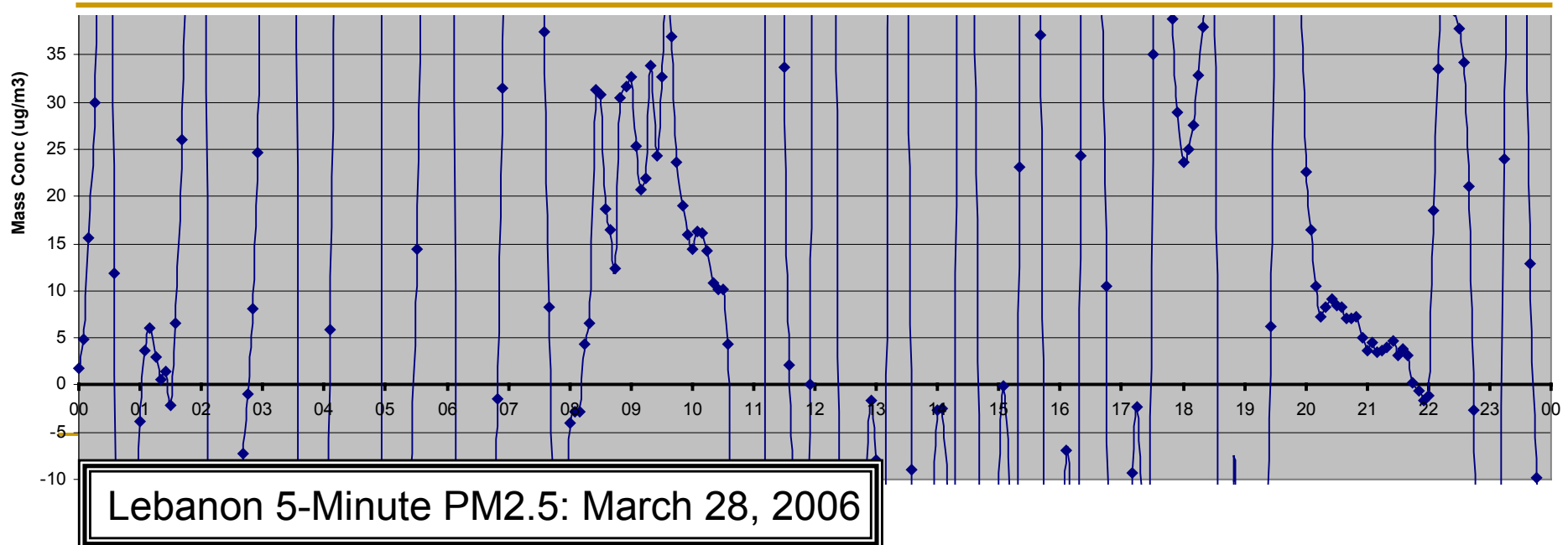
# Yet Another Variation: “Take 1”



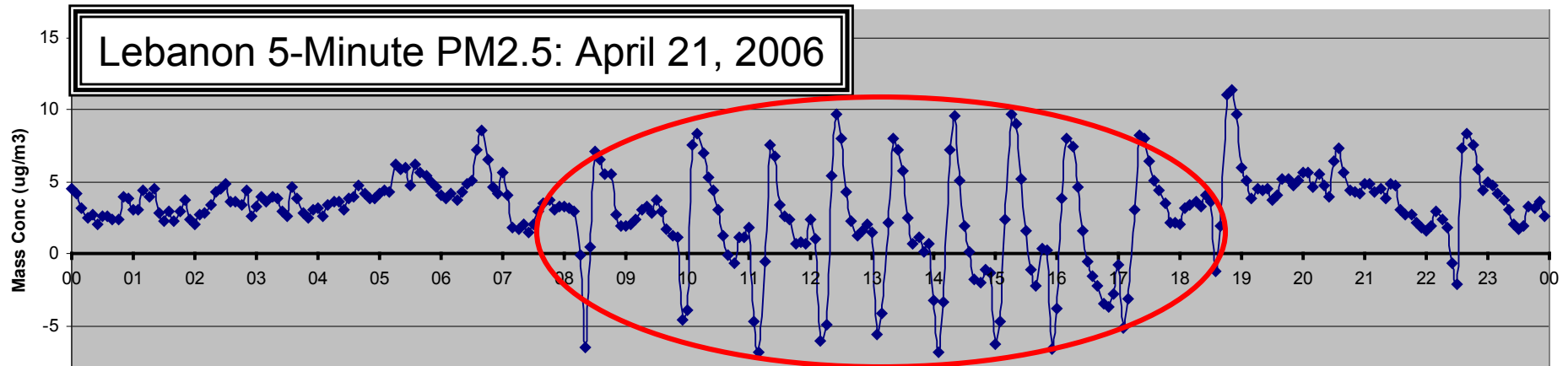
- Lebanon had previously had an FDMS, but this was replaced with the 1400AB in mid-March
- Almost immediately, starting seeing pattern of peaks and troughs cycling on an ~hourly basis
- Seemed to have diurnal pattern
  - Either stopped or was masked during daytime hours

# Yikes!

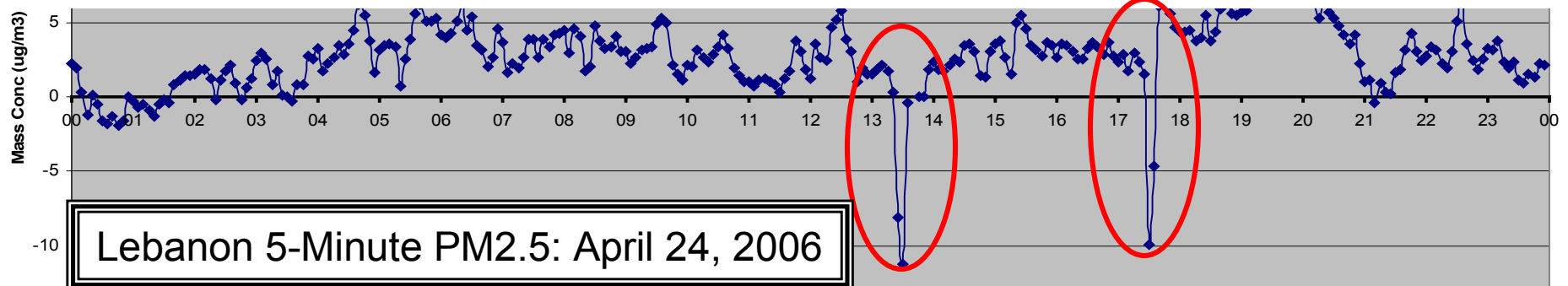
- First thought: loose filter  
(can lead to extreme ranges in values)
- Multiple troubleshooting attempts, but believe problem was: loose latch on mass transducer!
  - check that screw stays tight  
(loosens with repeated opening/closing)



# Yet Another Variation: “Take 2”

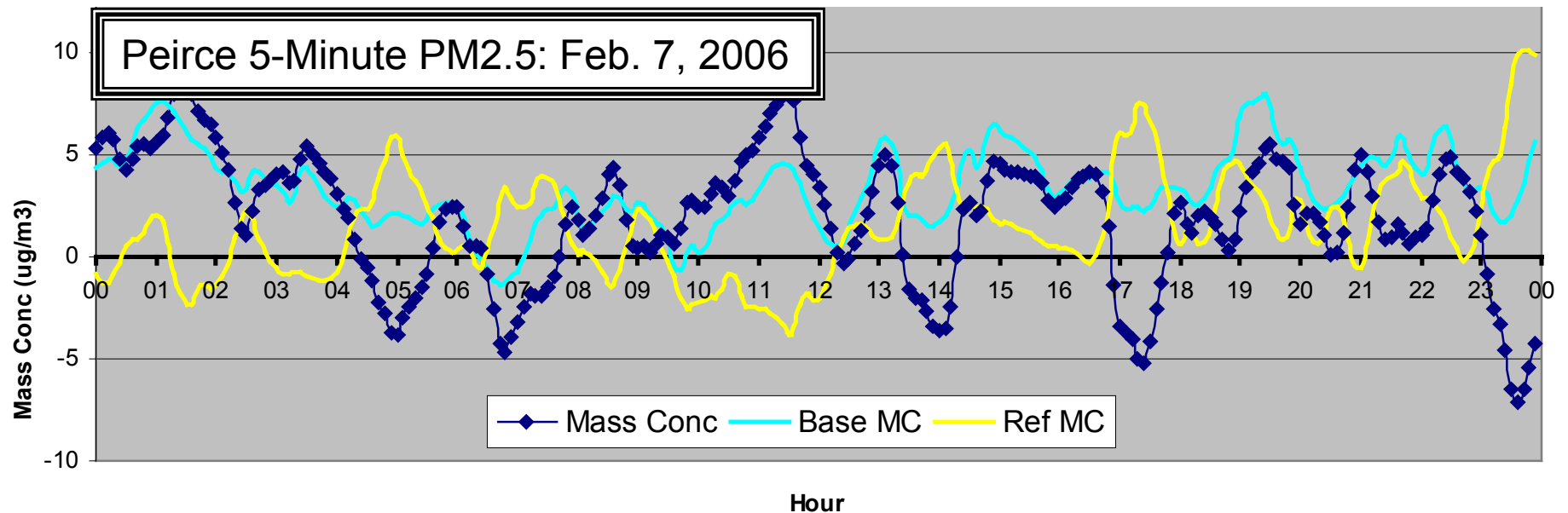


- After the episode with the loose filter, nighttime pattern seemed to have disappeared – was it also related to a loosening latch?
- Now, different, daytime pattern frequently observed (above)
- OR sometimes sudden, isolated dips (below)
- Also, clock constantly falling behind, despite calibrations
- Cause(s) unknown; investigating possible voltage issues



# Positive Reference Mass (FDMS)

- Our seacoast site, as an FDMS, always ran higher than others
- 8500 unit was replaced with a new one  
(initially just for dryer cleaning, but ended up staying at the site)
- Suddenly, site concentrations seemed lower
- When started recording reference mass, saw that the reference mass was very often positive





# Positive Reference Mass (FDMS)

- No indication of a problem with the unit
  - No status, all tests passed, including leak test
- Pattern continued after dryer cleaned
- Recently, reinstalled original 8500 unit
- Now, site runs high again, and reference mass is almost always negative!

