Overview of Meteorology and Chemistry During SHARP

Houston Downtown, seen from UH Moody Tower

Pictures courtesy D. Anderson

Bernhard Rappenglueck and the SHARP team

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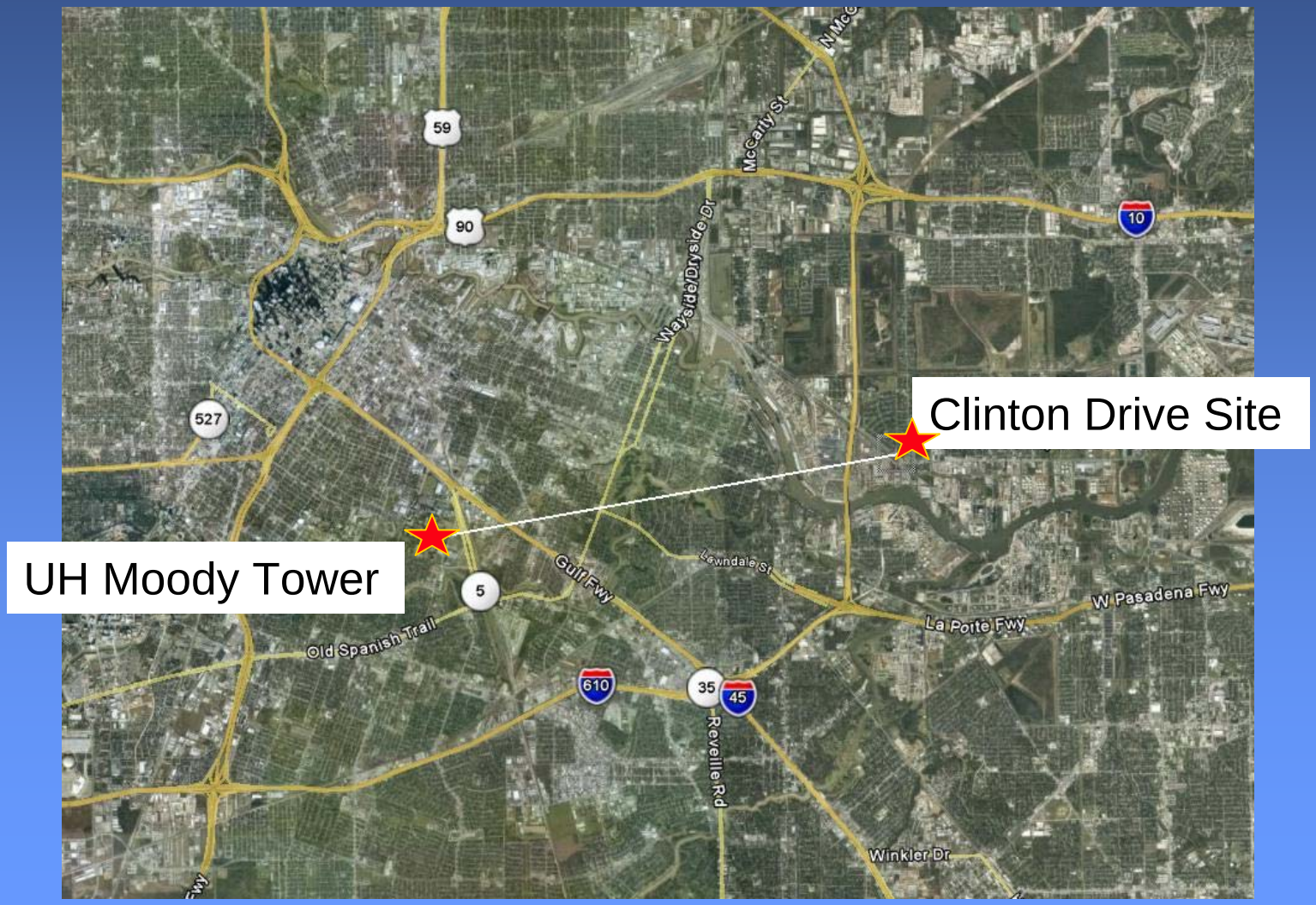
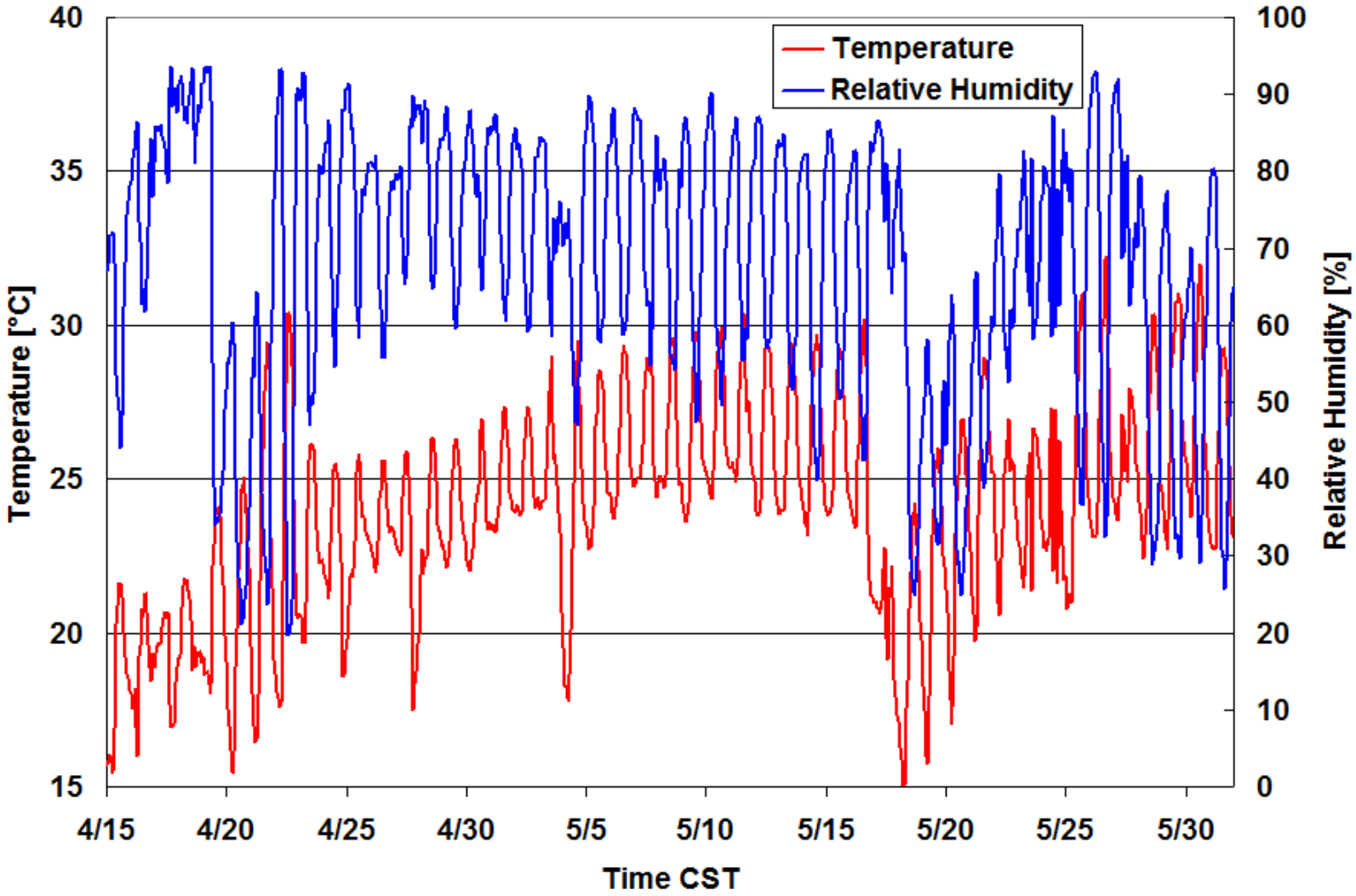
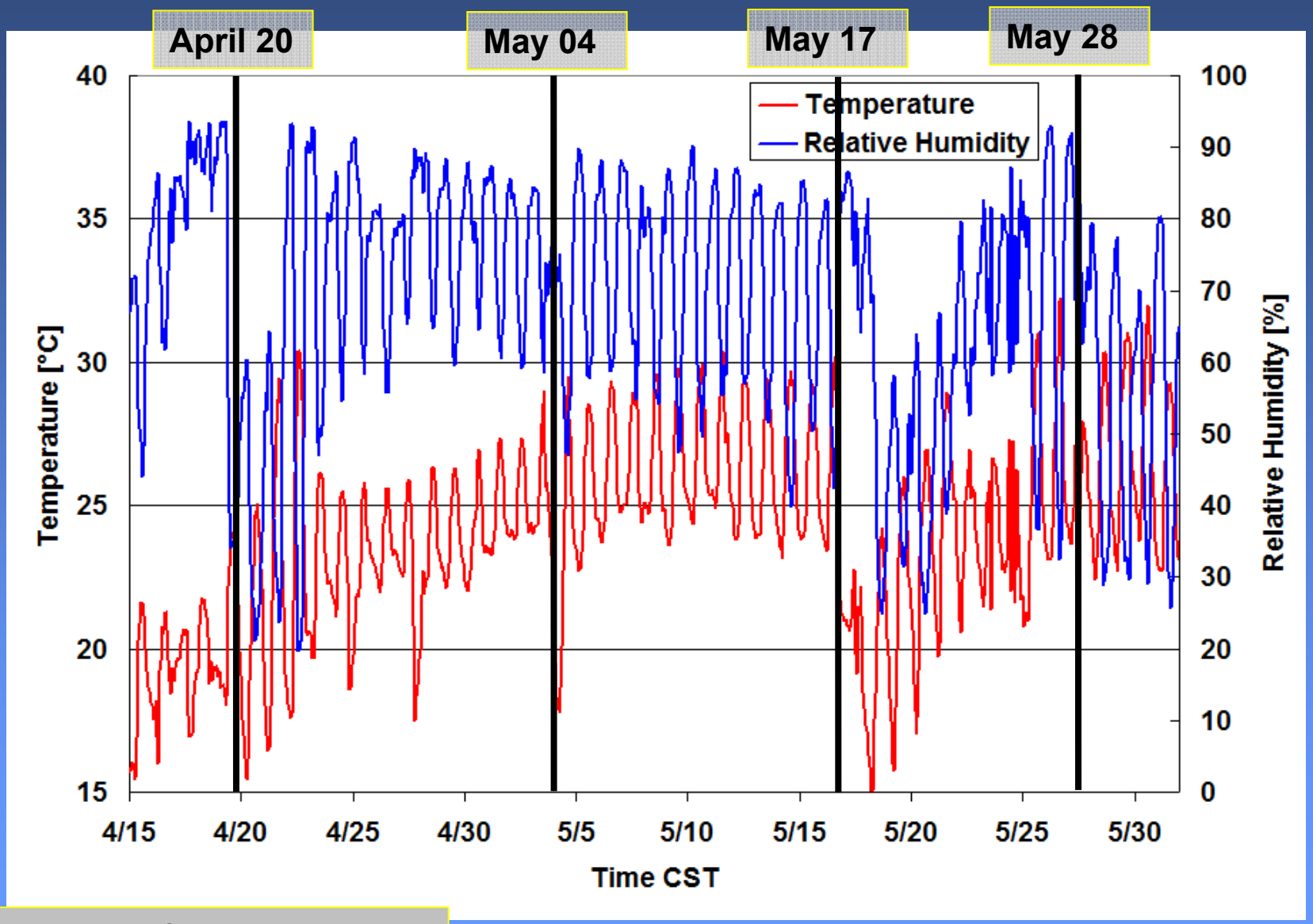
Moody Tower & Clinton Drive



Moody Tower: Temperature & Relative Humidity

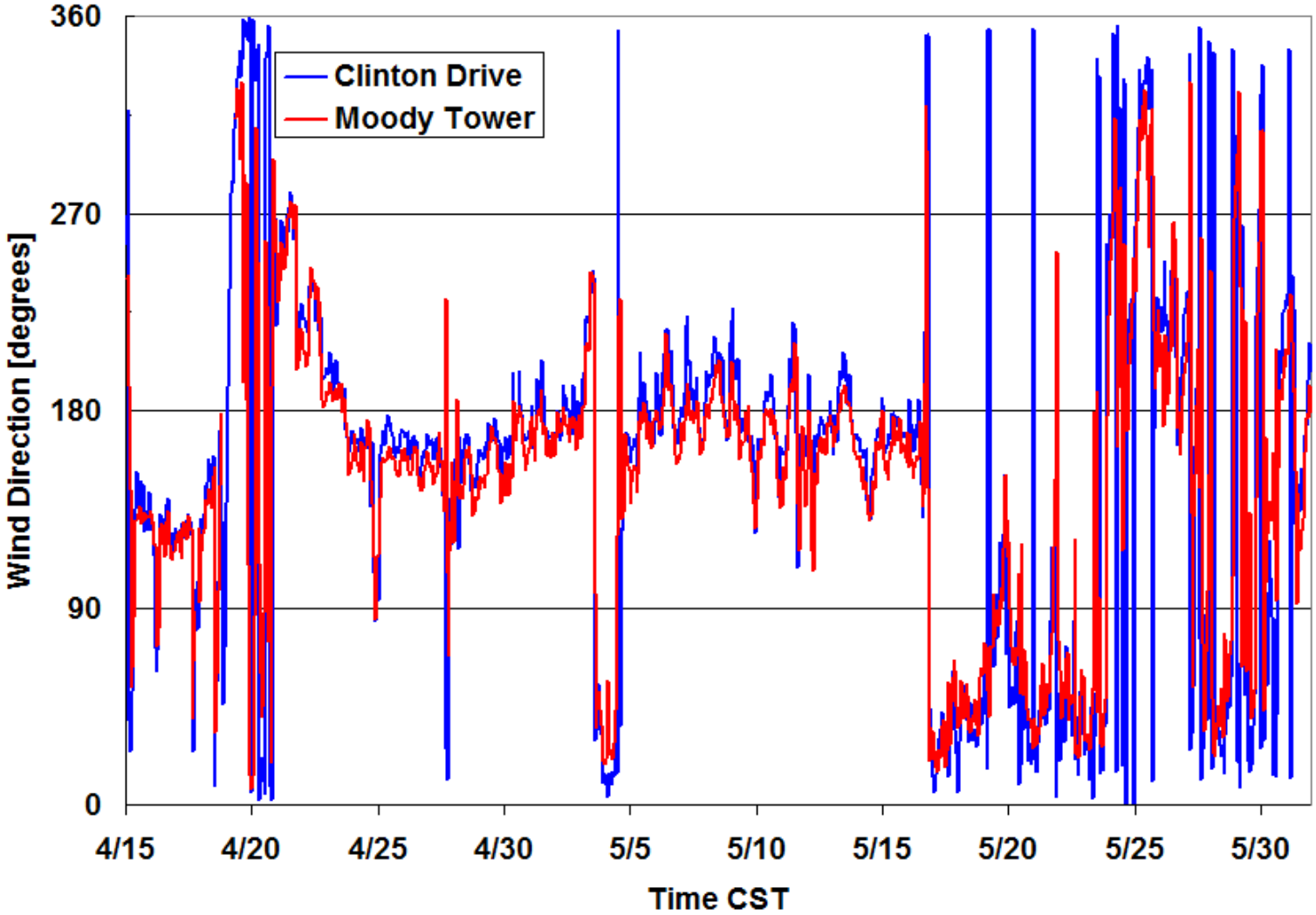


Moody Tower: Temperature & Relative Humidity

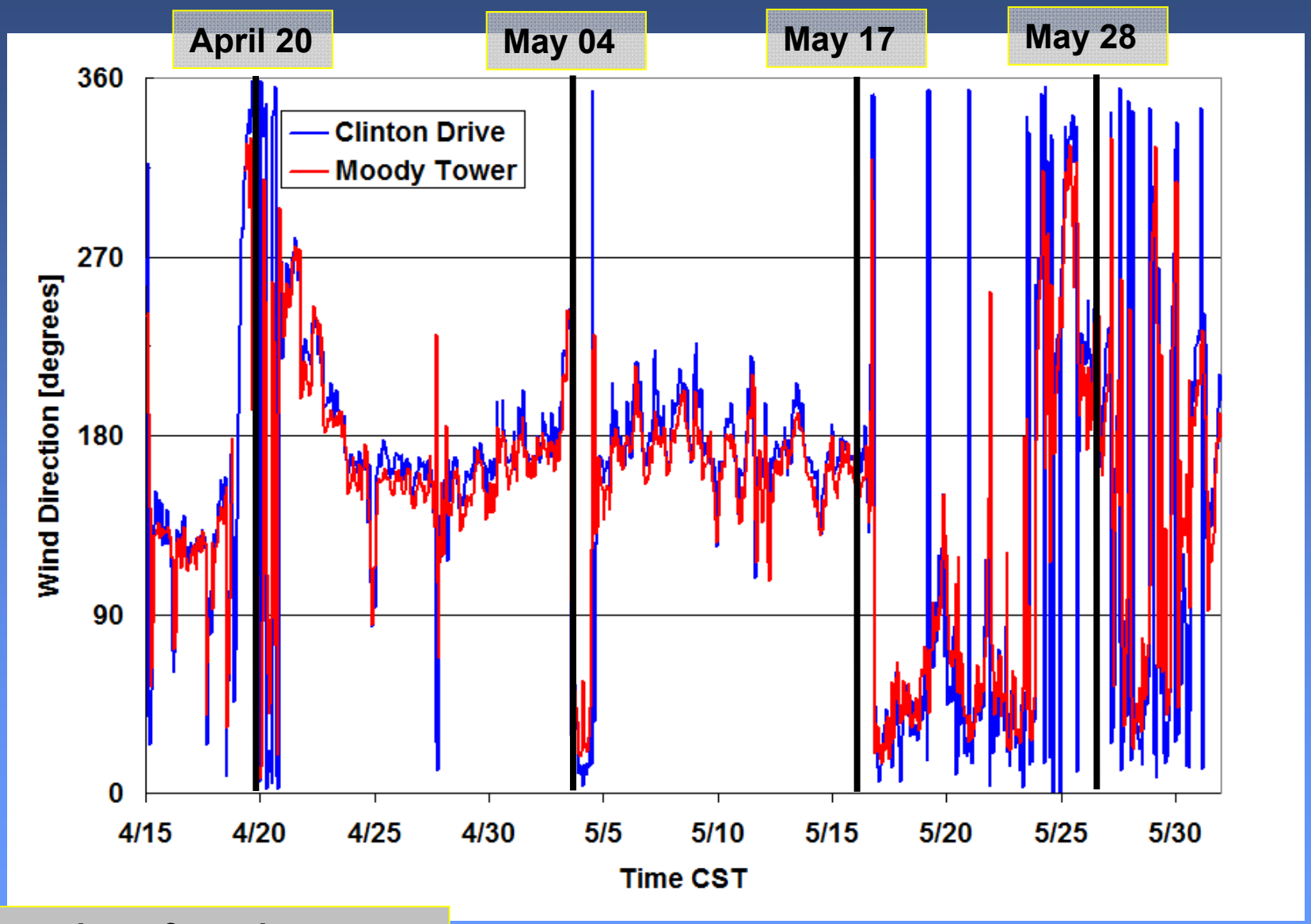


Some days: frontal passages

Moody Tower & Clinton Drive: Wind Direction

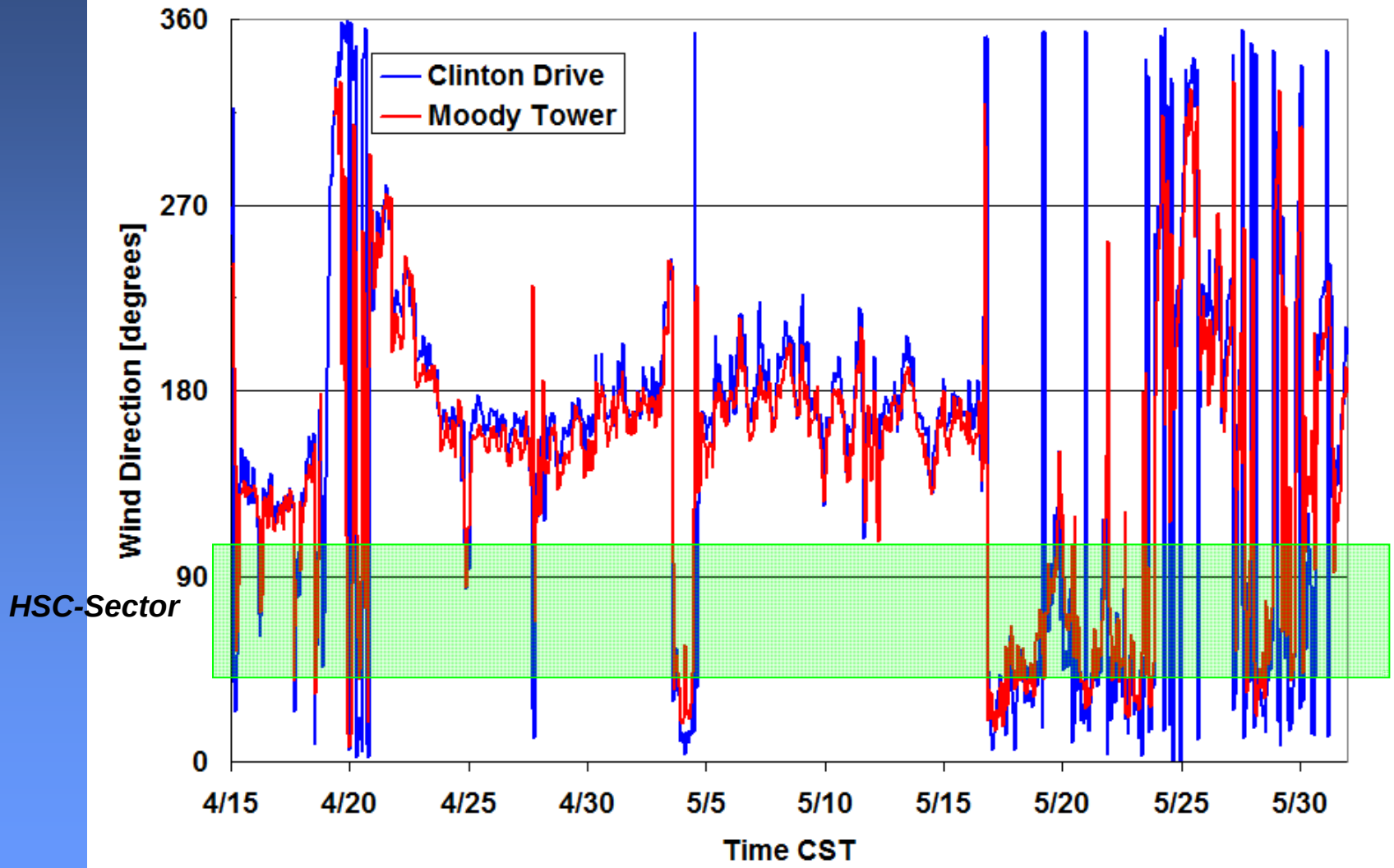


Moody Tower & Clinton Drive: Wind Direction



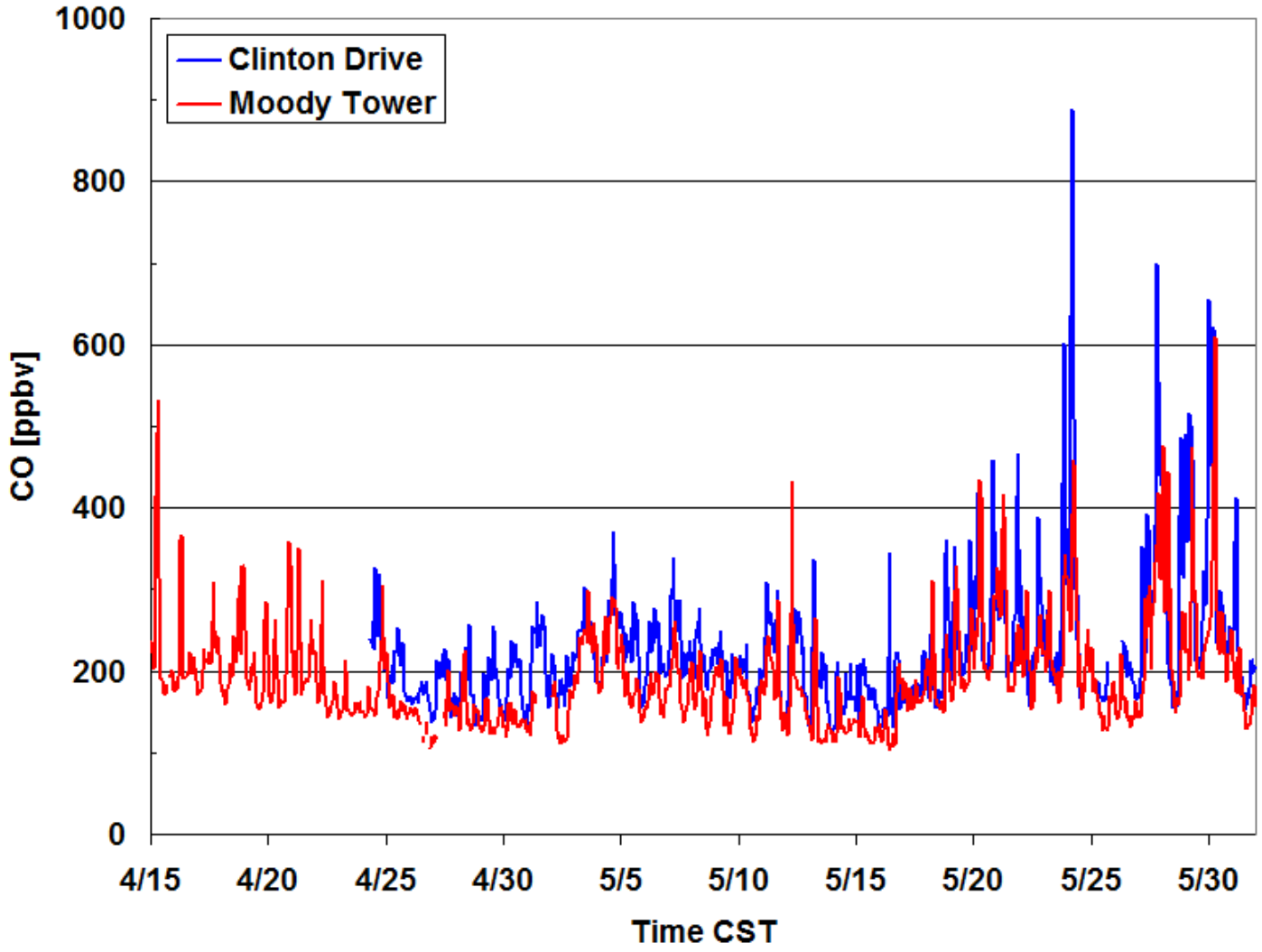
Some days: frontal passages

Moody Tower & Clinton Drive: Wind Direction



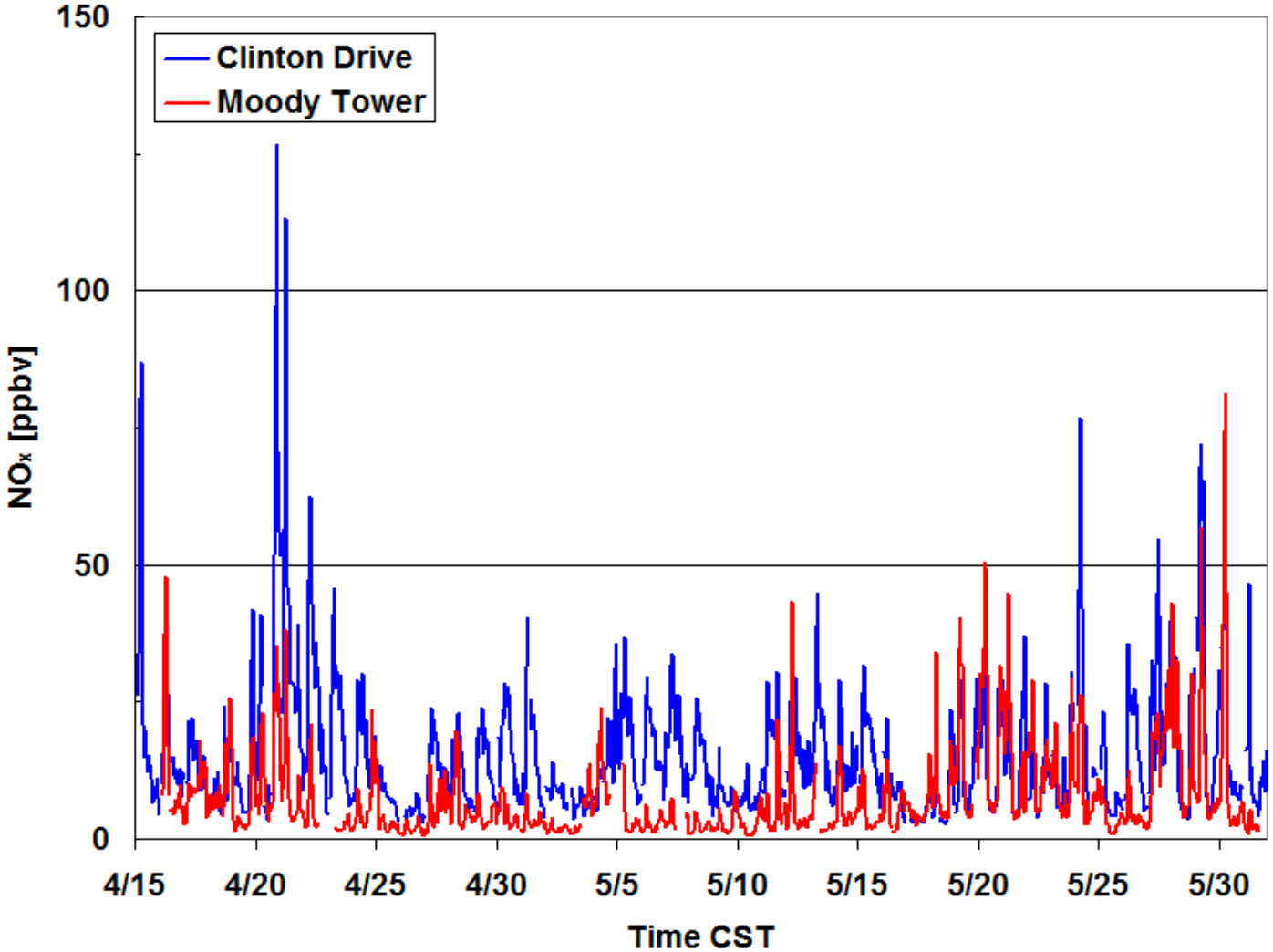
Some days: Moody Tower under HSC influence

Moody Tower & Clinton Drive: CO



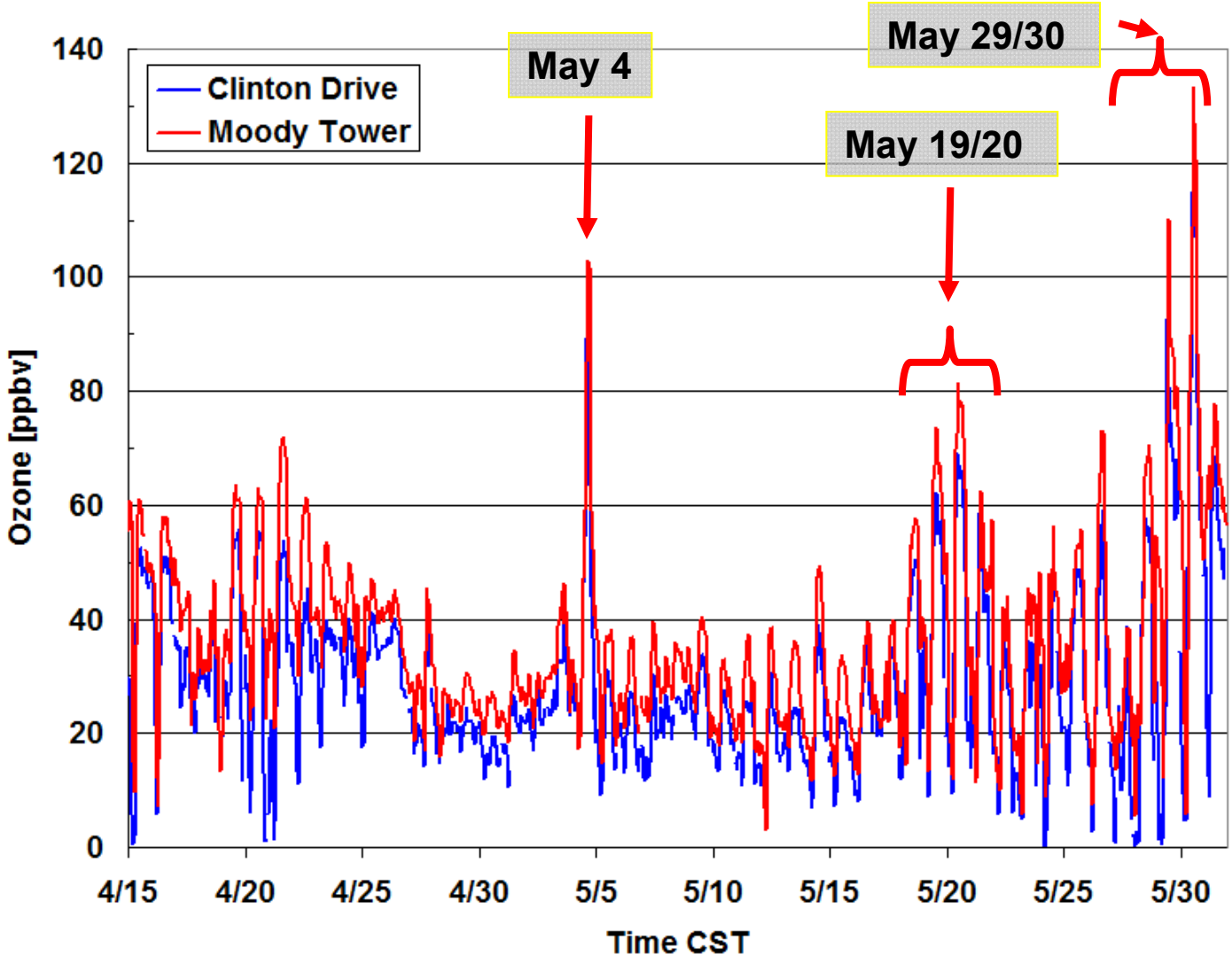
CO more pronounced at Clinton Drive

Moody Tower & Clinton Drive: NO_x



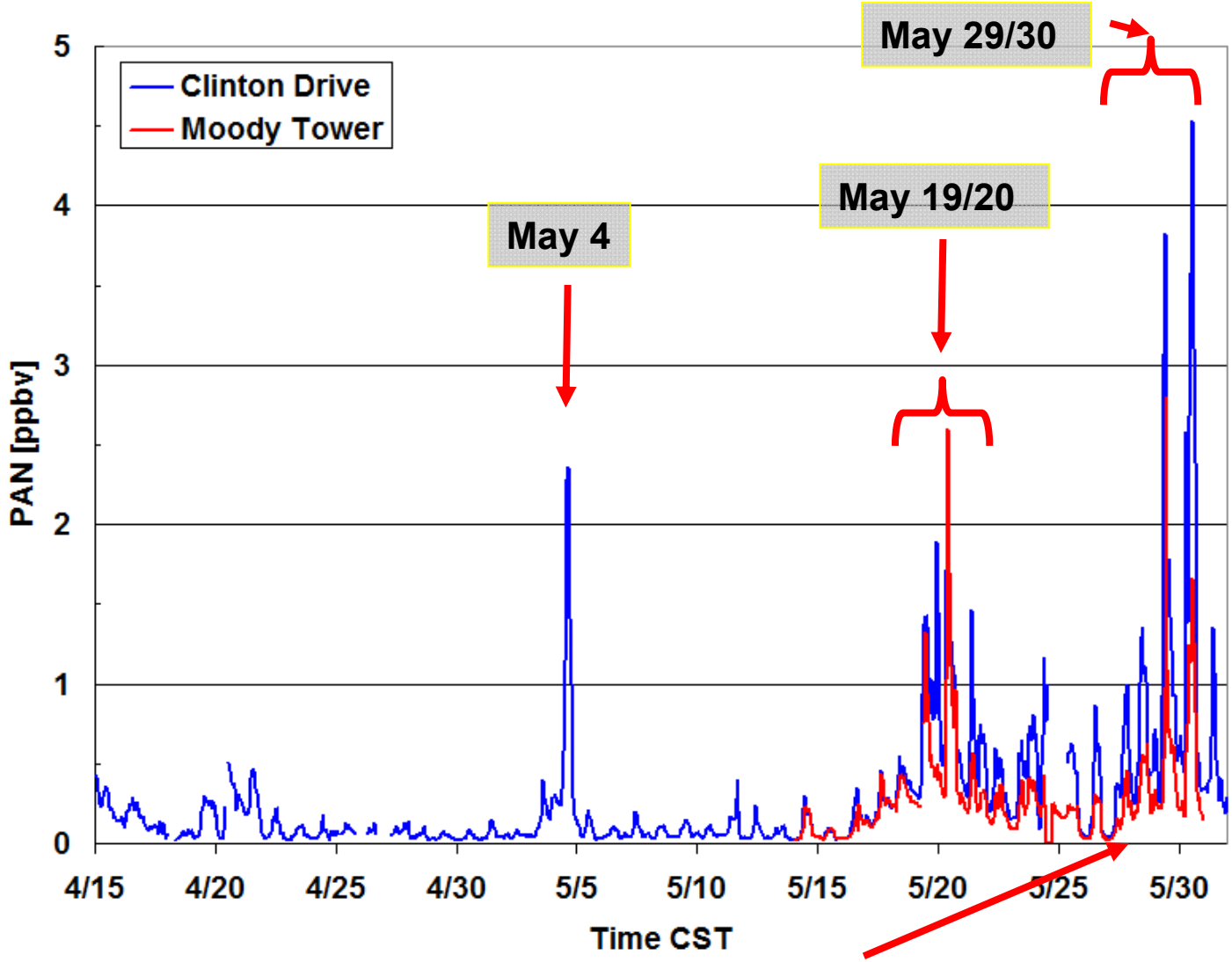
NO_x more pronounced at Clinton Drive

Moody Tower & Clinton Drive: O_3



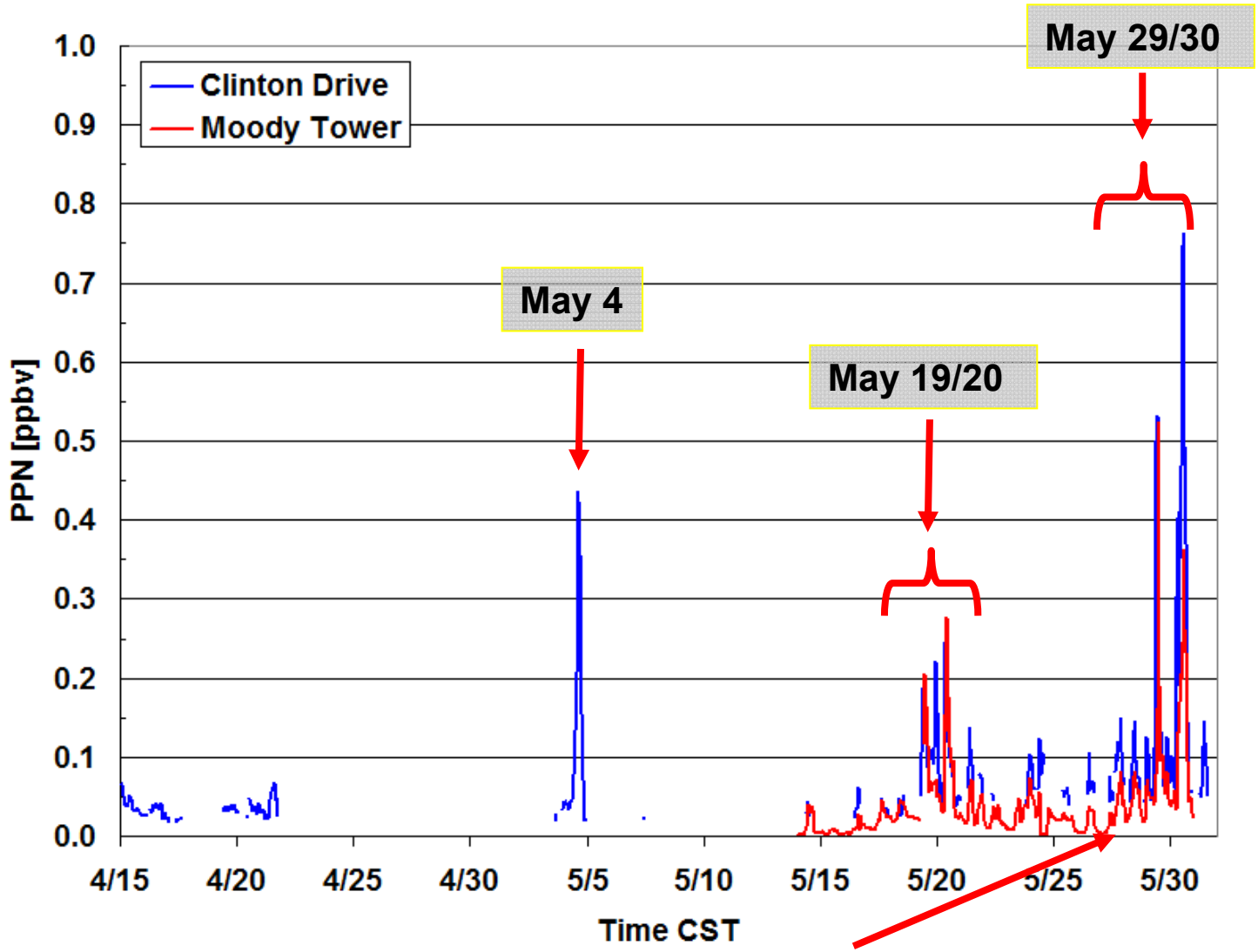
O_3 higher at Moody Tower

Moody Tower & Clinton Drive: PAN



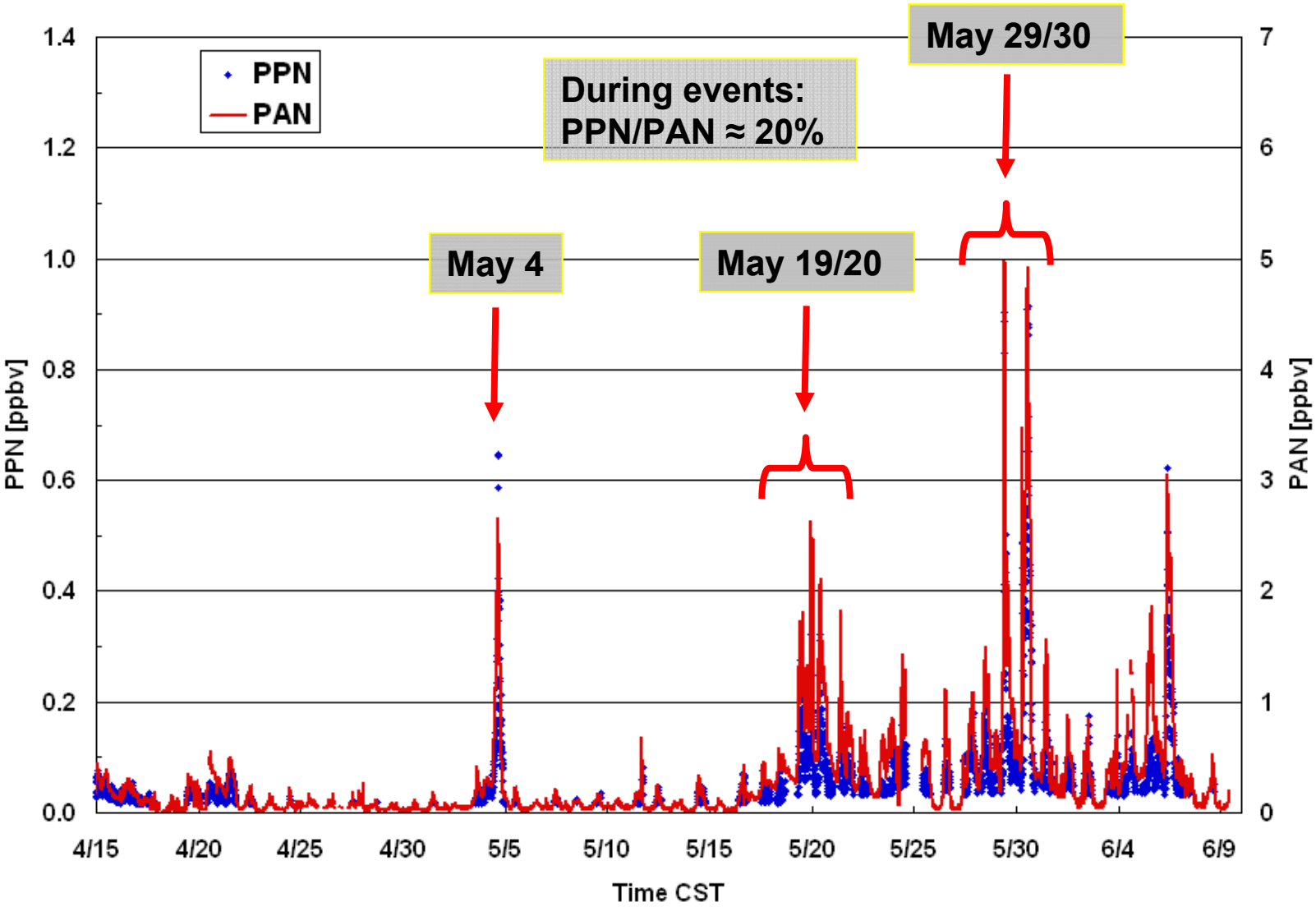
PAN sometimes lower at Moody Tower (Temperature-effect?)

Moody Tower & Clinton Drive: PPN

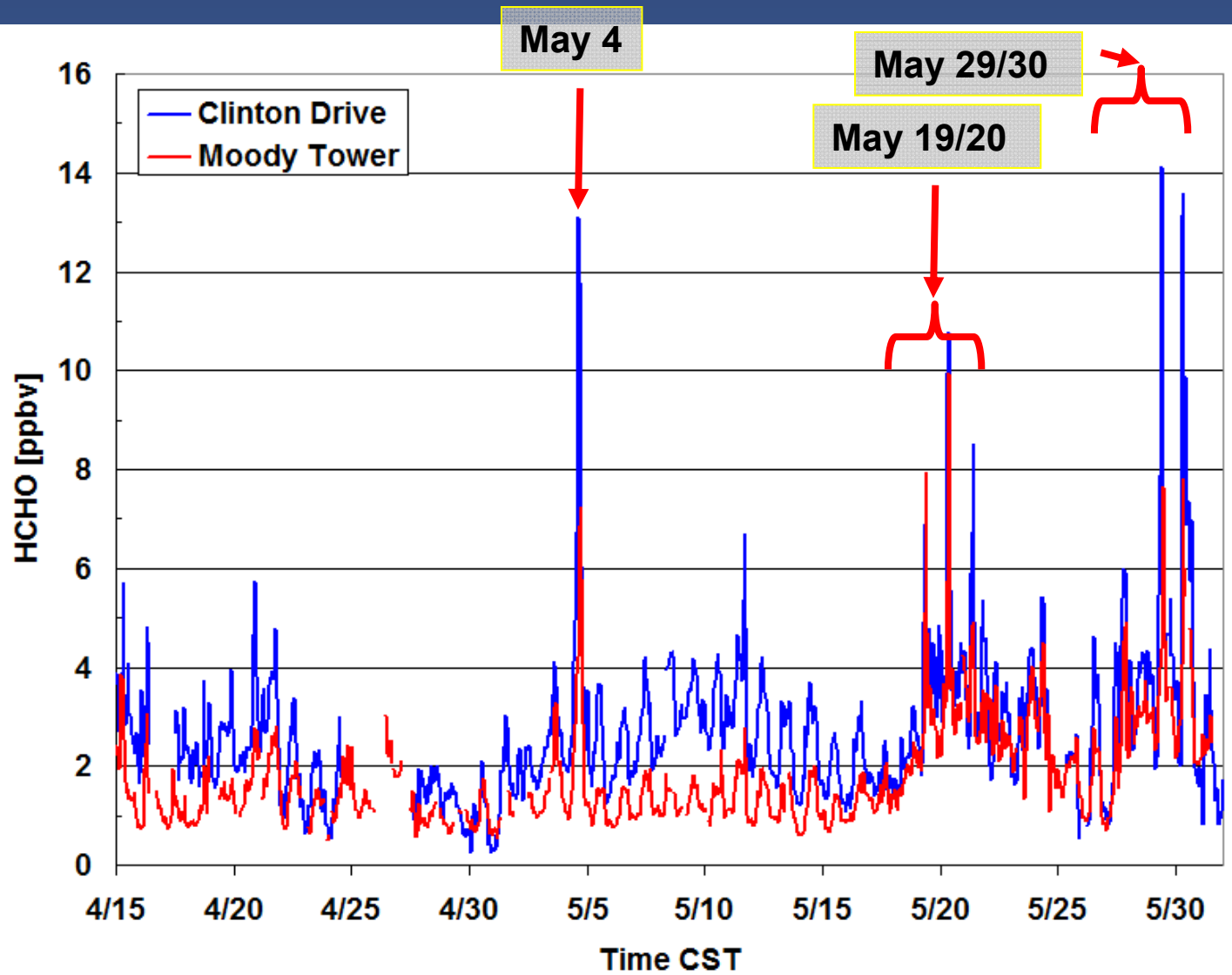


PPN sometimes lower at Moody Tower (Temperature-effect?)

Clinton Drive: PAN and PPN

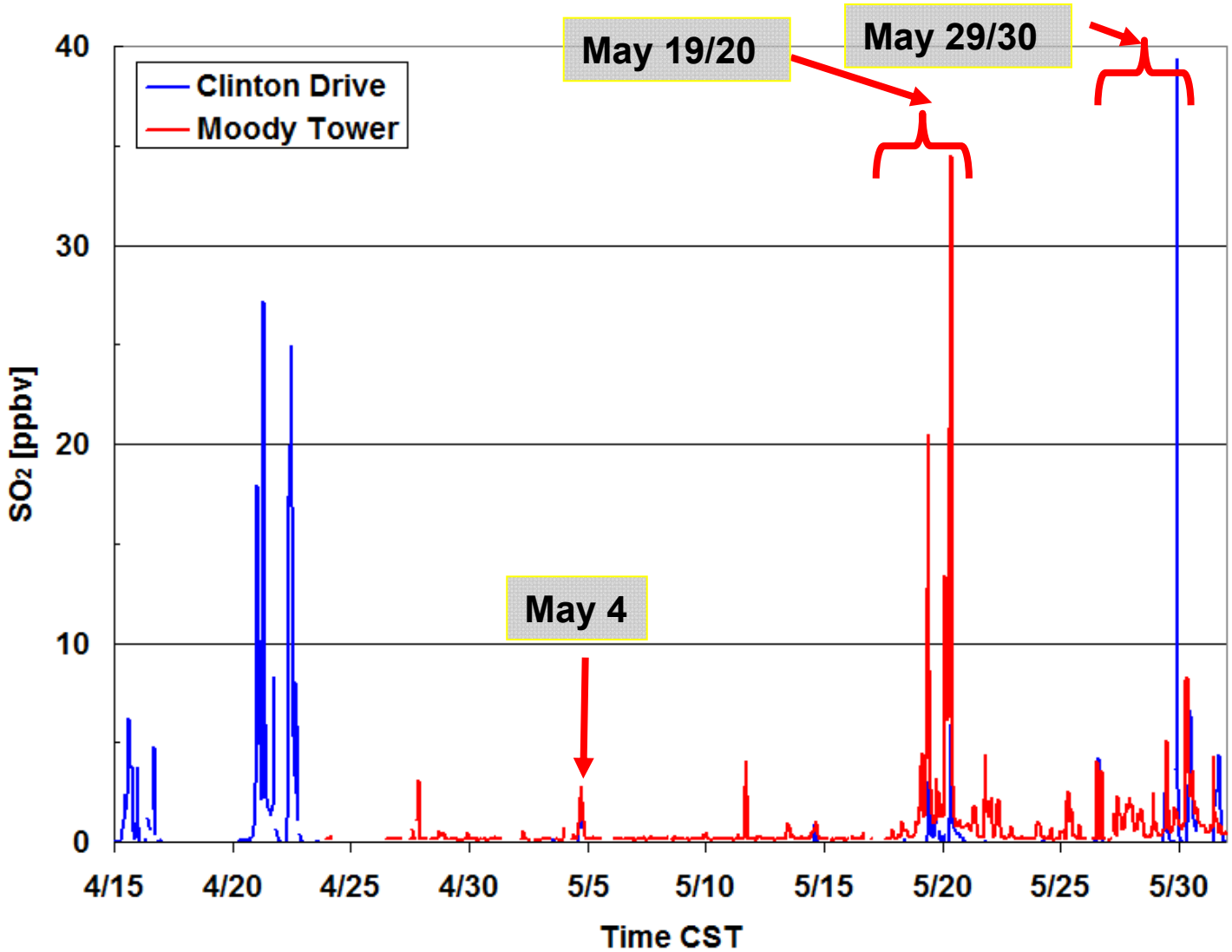


Moody Tower & Clinton Drive: HCHO



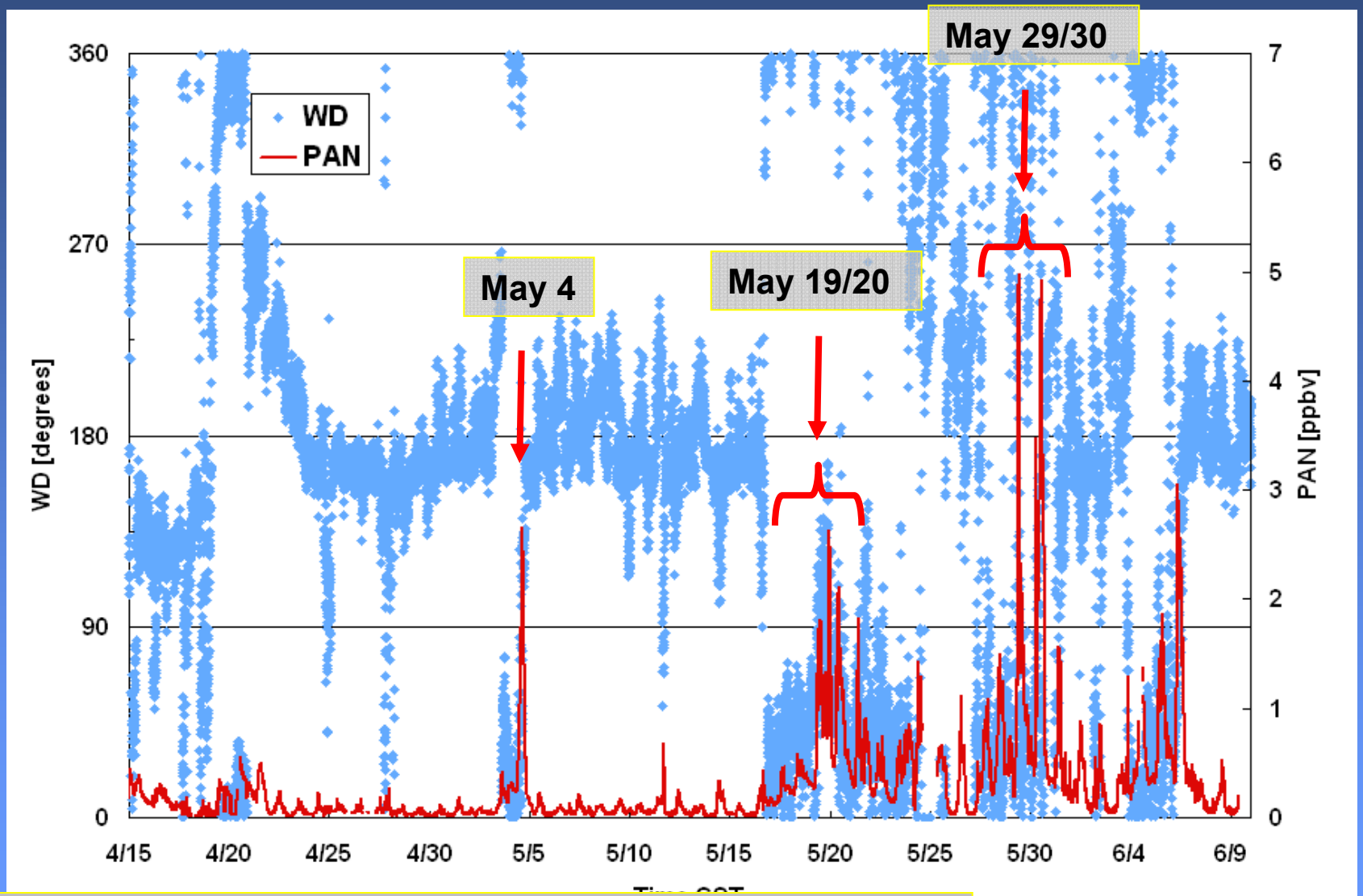
HCHO similar, sometimes higher at Clinton Drive

Moody Tower & Clinton Drive: SO_2



SO_2 very erratic (very specific sources)

Clinton Drive: PAN and Wind Direction



Major parts: persistent S- winds; marine background conditions
During events: weak local circulation

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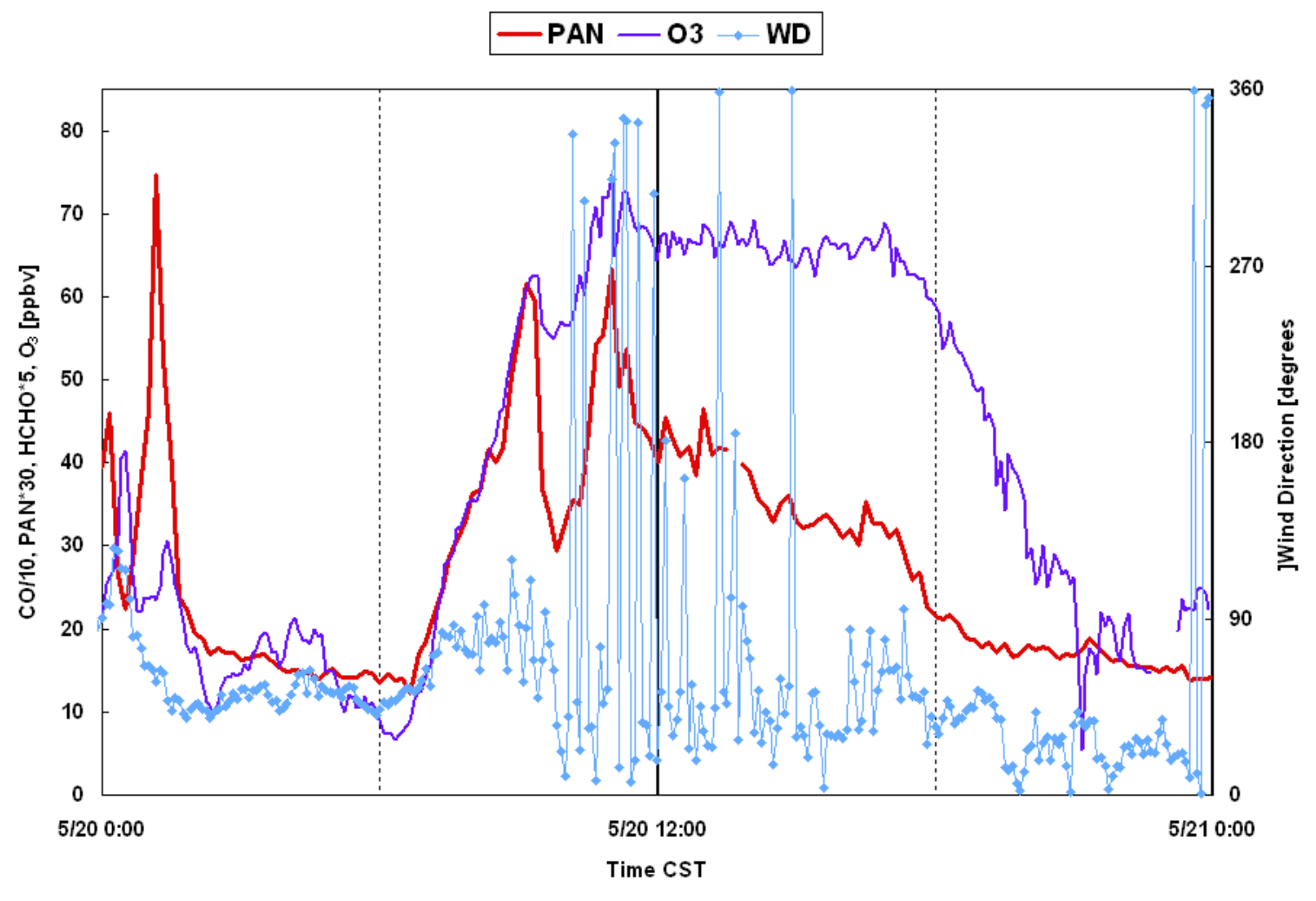
Clinton Drive: Case Study May 20, 2009



Wind direction changes from NE→ E→ NE

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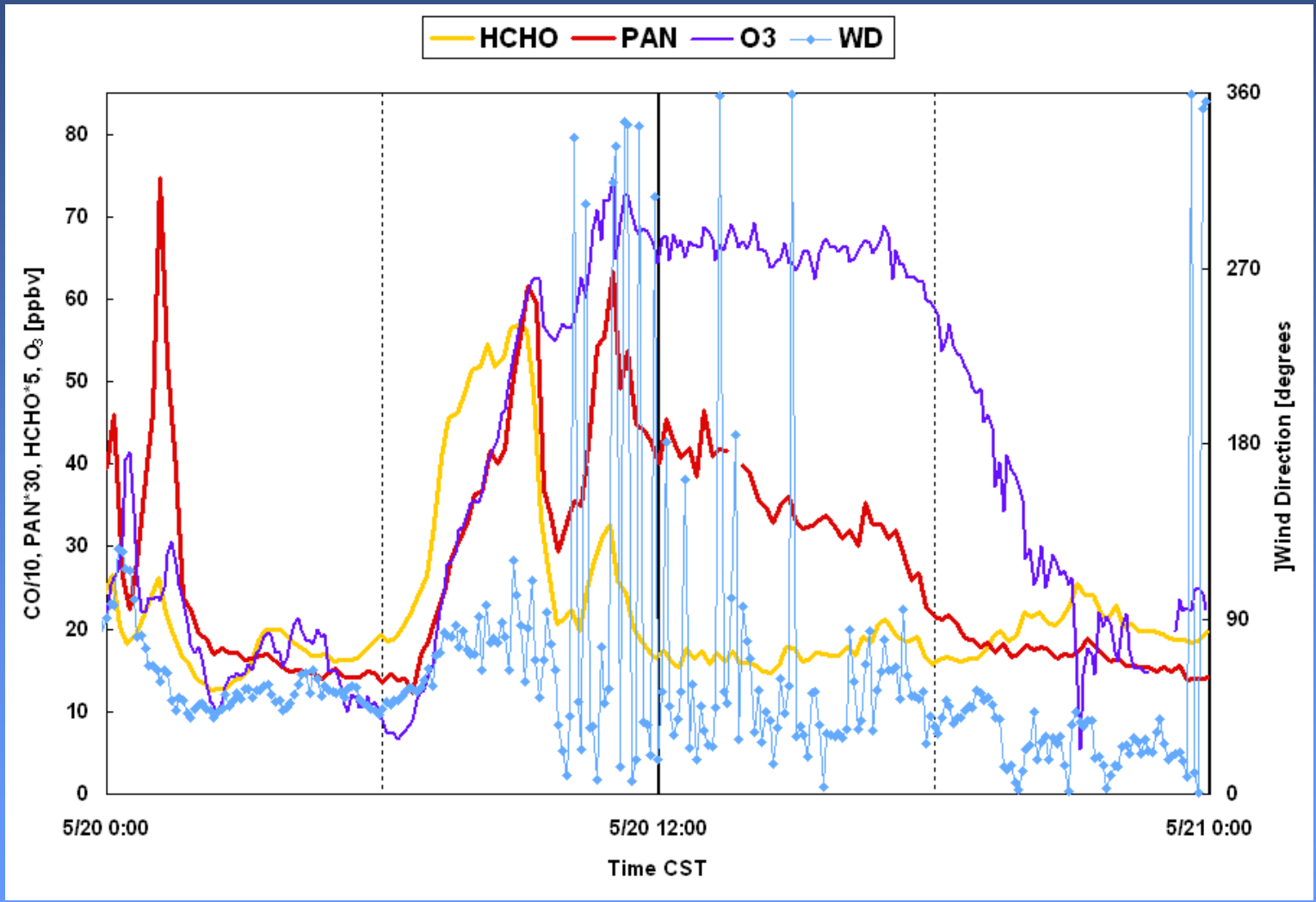
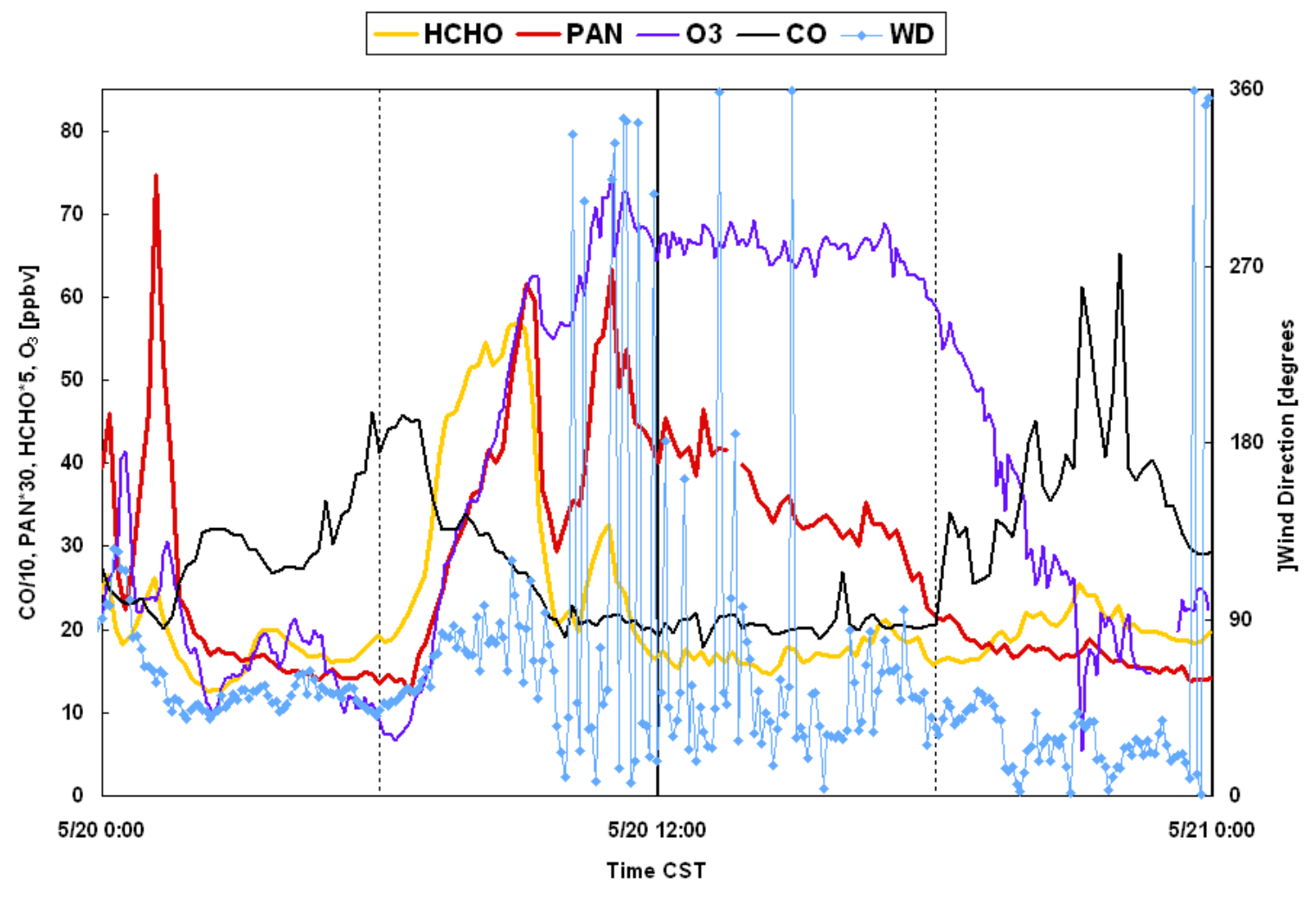
Clinton Drive: Case Study May 20, 2009



HCHO/PAN ratio higher in the morning

Clinton Drive: Case Study May 20, 2009



HCHO starts to increase shortly before 6 am
HCHO increases sharply when CO decreases

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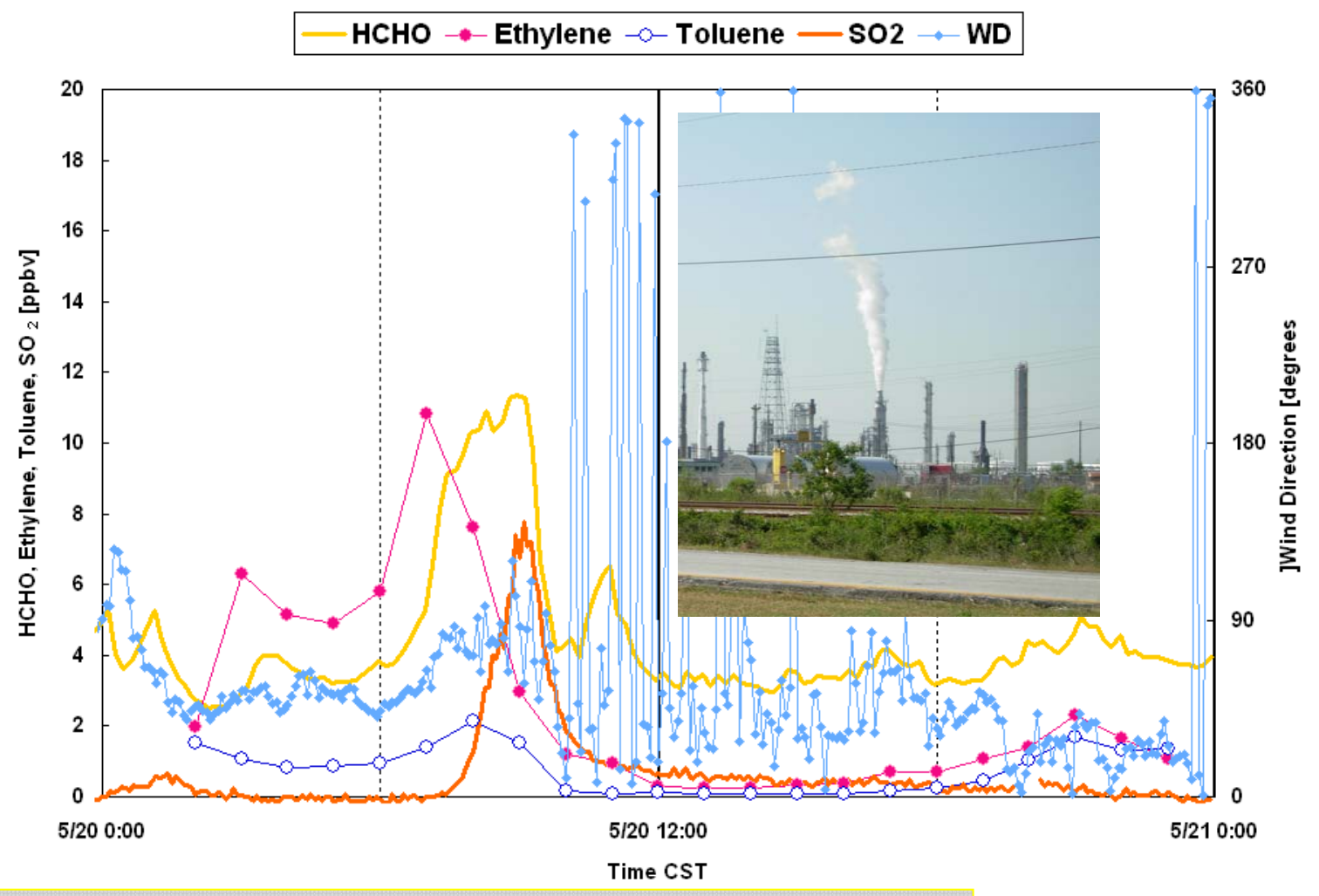
Clinton Drive: Case Study May 20, 2009



Plumes contain VOCs and SO_2 depending on wind direction
HCHO likely produced through different processes
Similar events on May 19, 29, and 30, 2009

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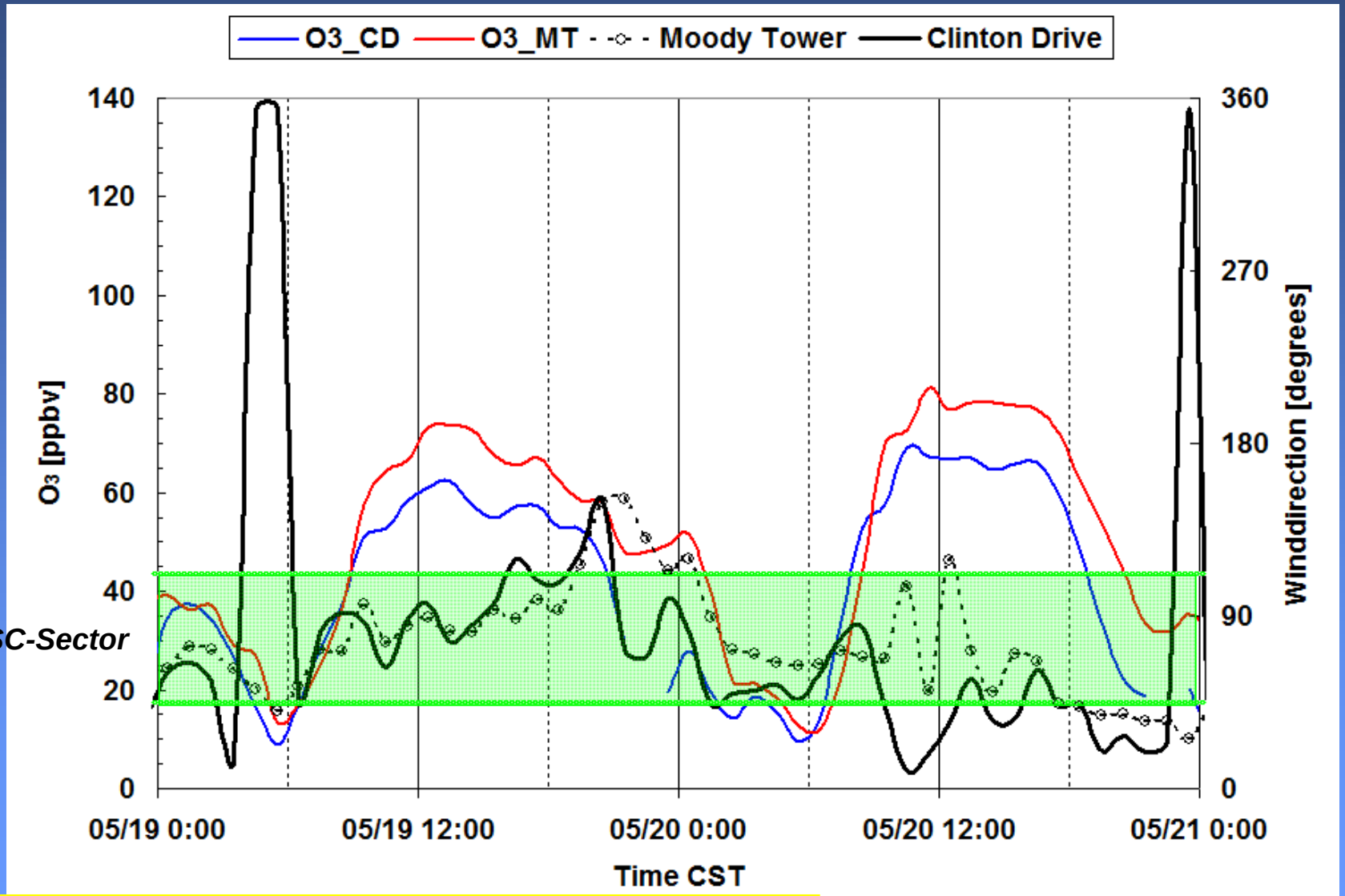
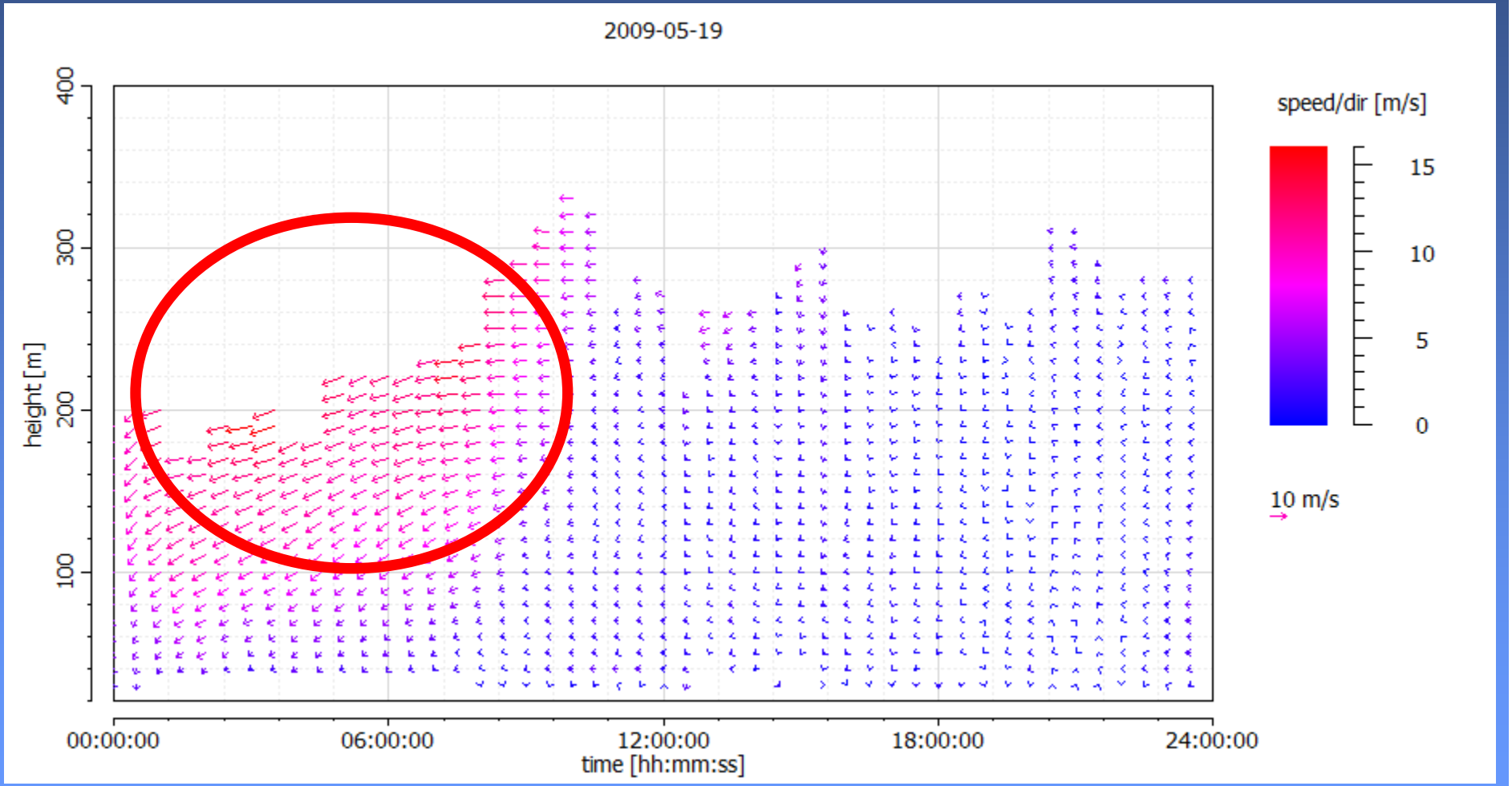
Moody Tower & Clinton Drive: Case Study May 19-20, 2009



Surface winds mostly from E; HSC > Moody Tower flow

Moody Tower & Clinton Drive: Case Study May 19-20, 2009

SODAR at K-Ranch



Low BL; Low Level Jet present (mostly E winds

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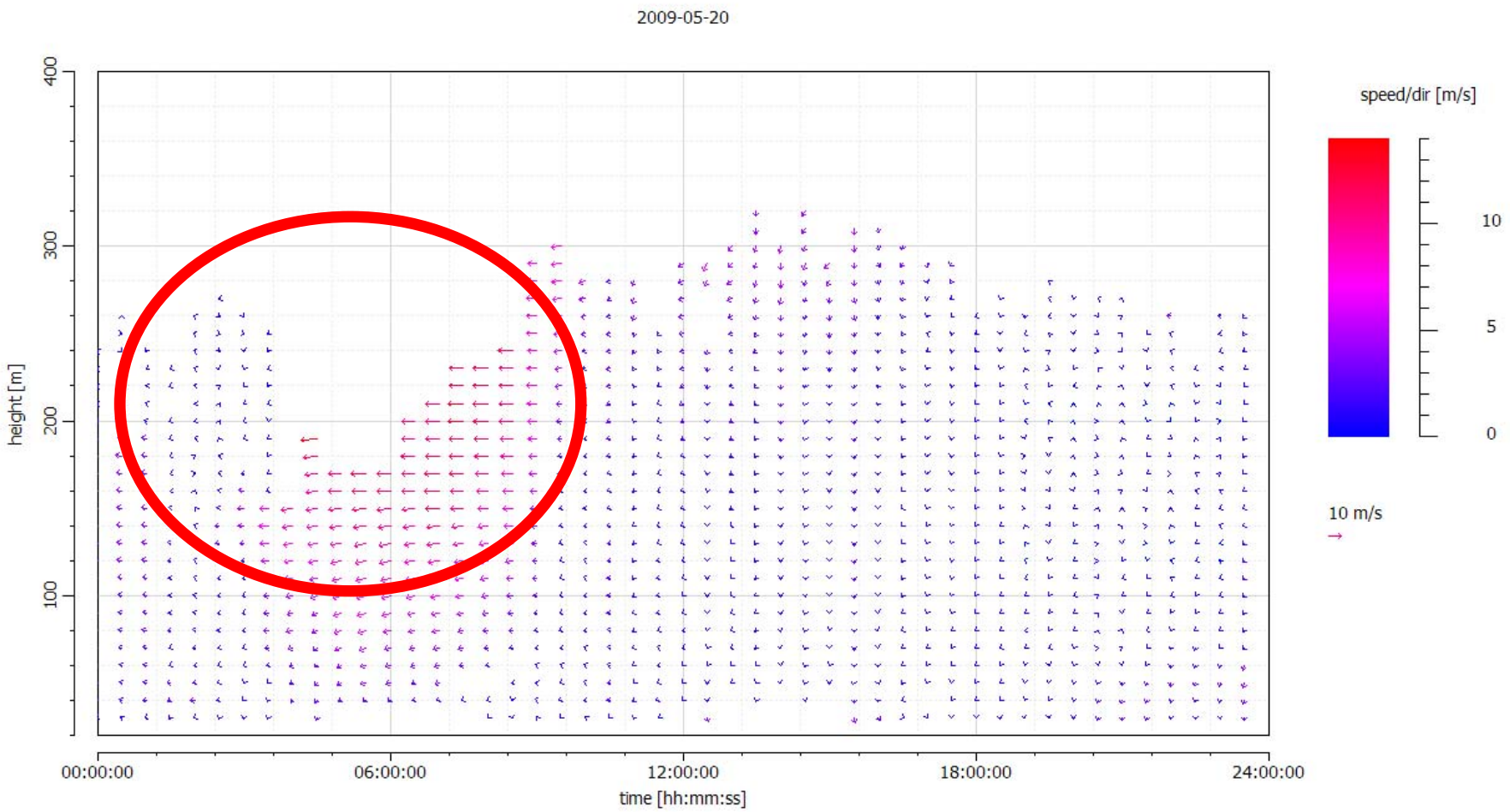
Moody Tower & Clinton Drive: Case Study May 19-20, 2009

SODAR at K-Ranch



Low BL; Low Level Jet present (mostly E winds

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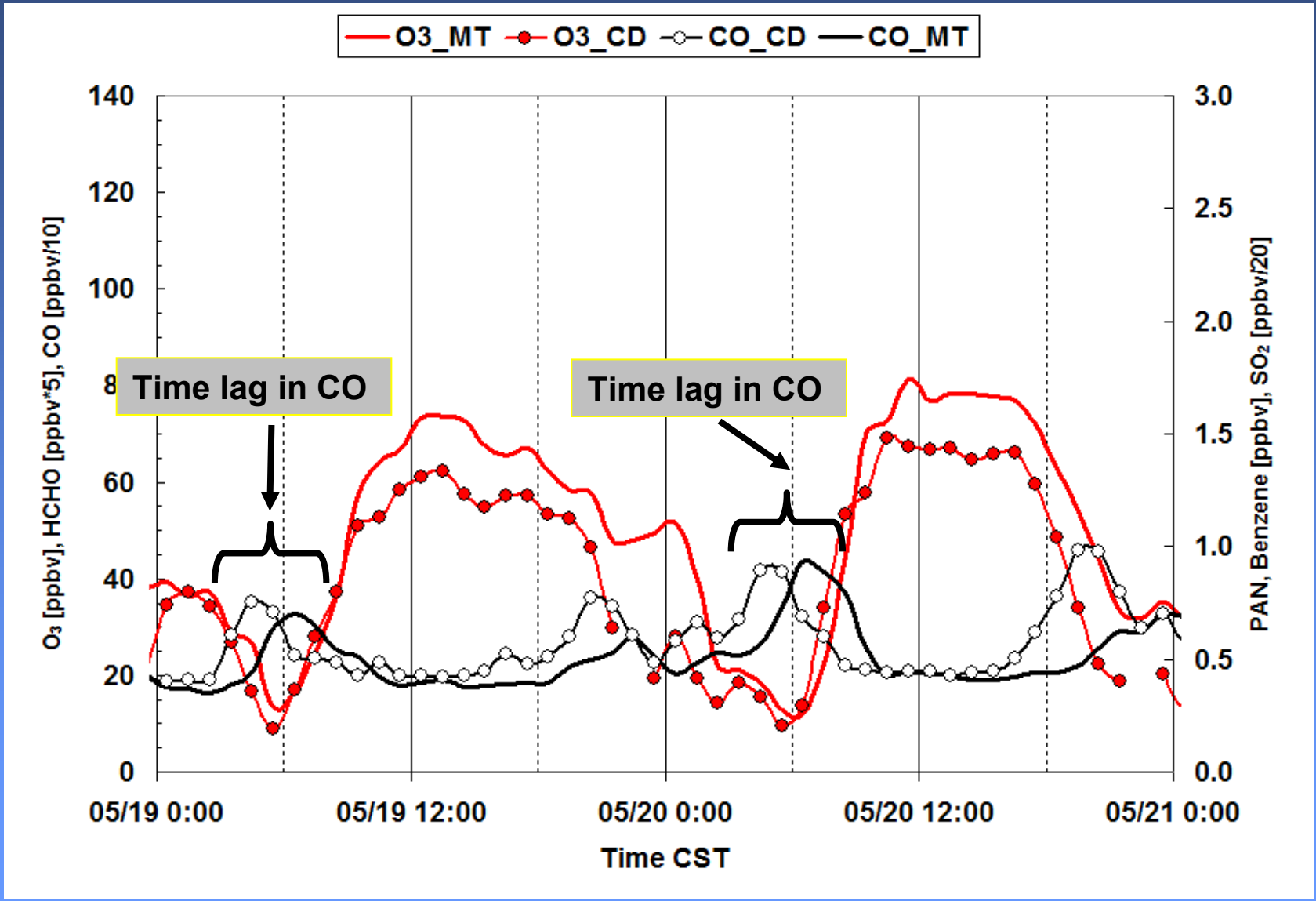
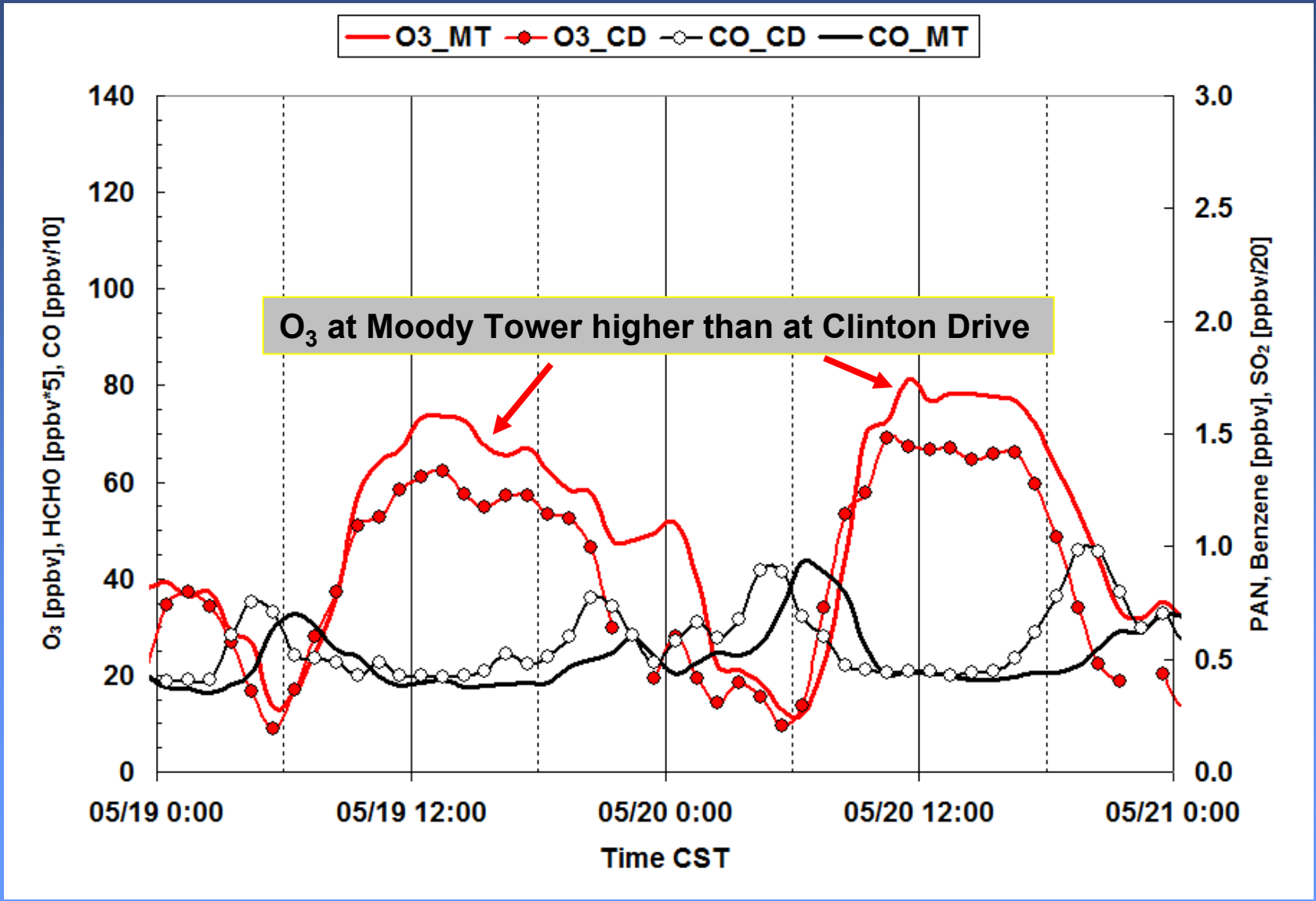
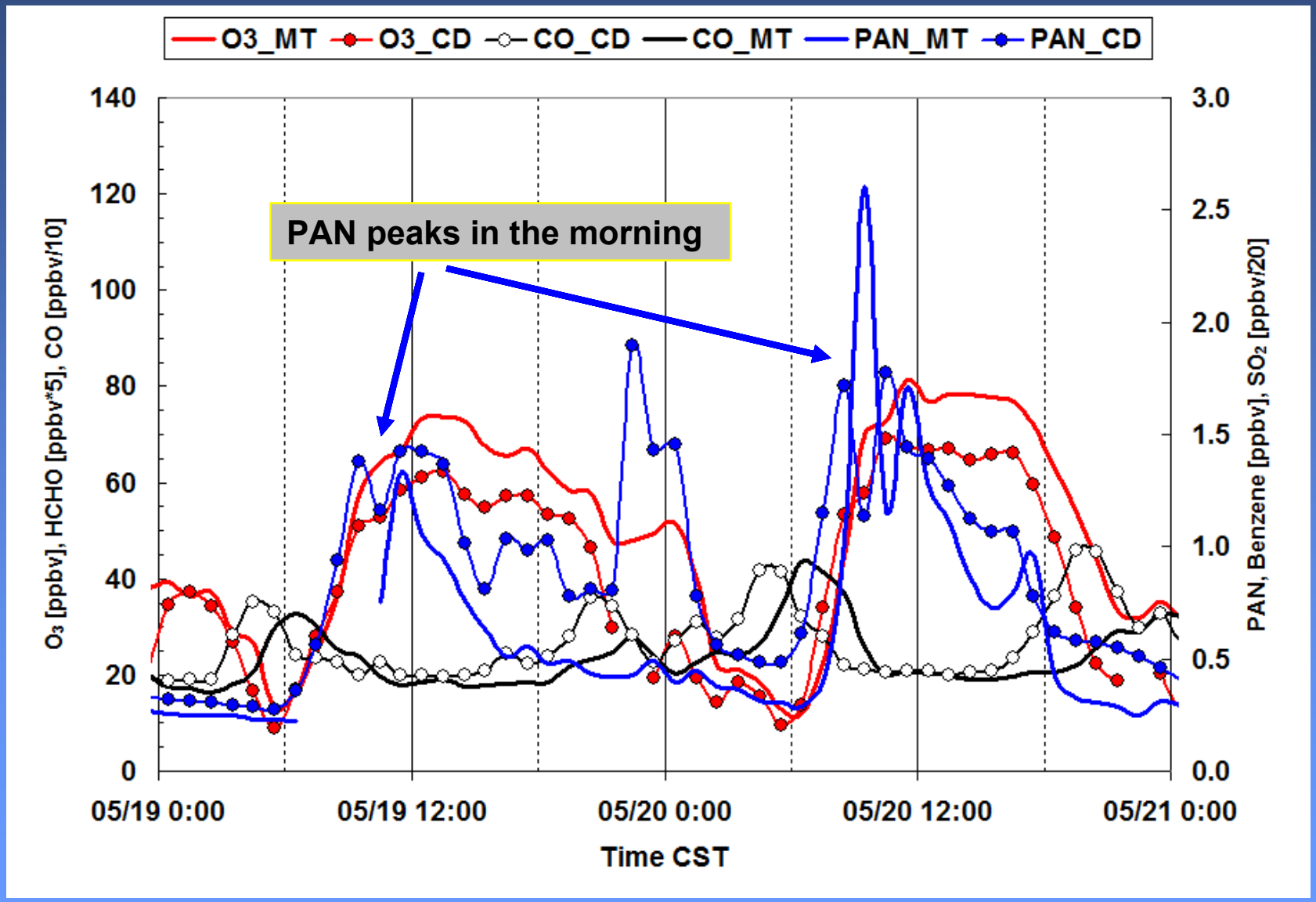
Moody Tower & Clinton Drive: Case Study May 19-20, 2009



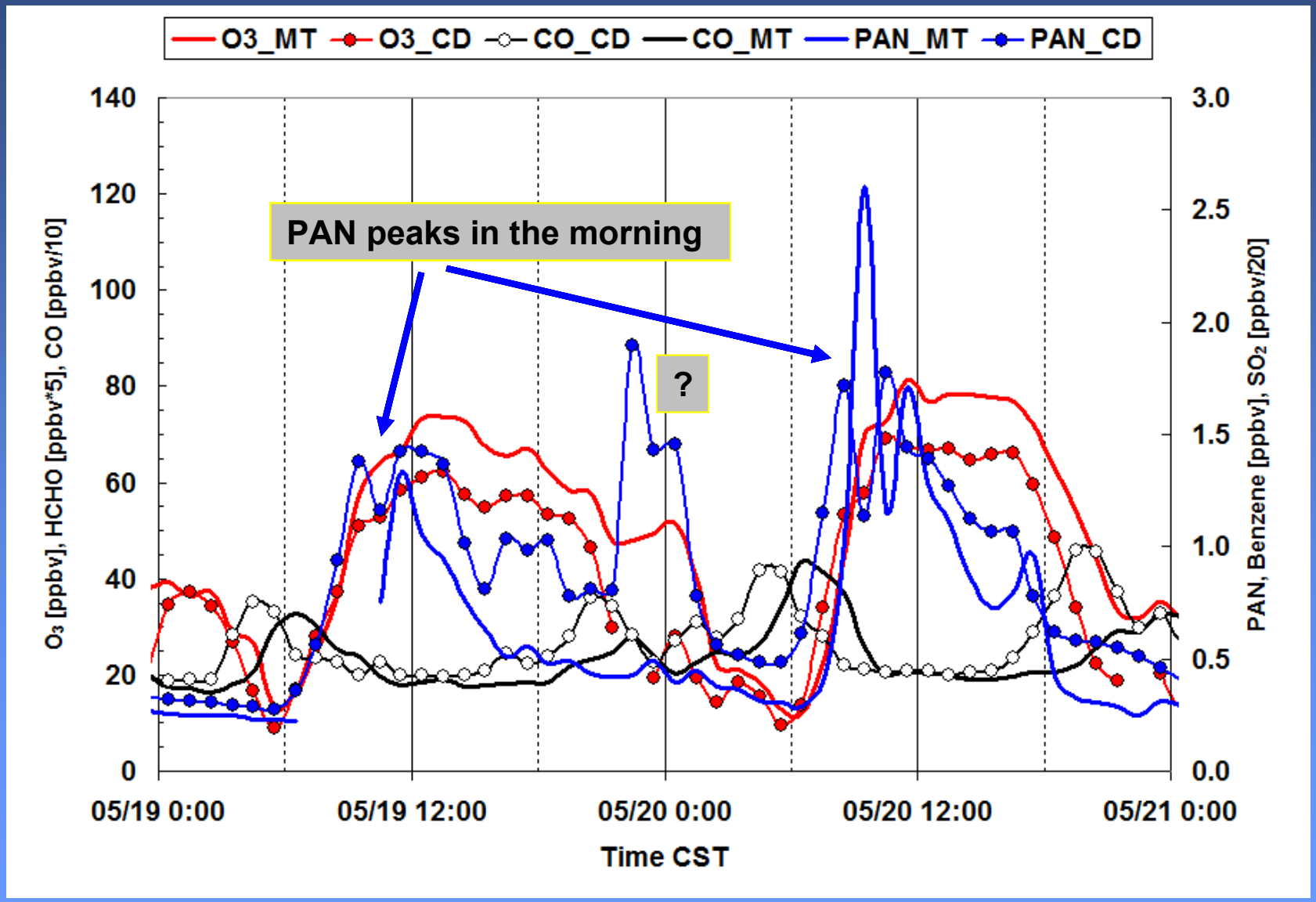
Moody Tower & Clinton Drive: Case Study May 19-20, 2009



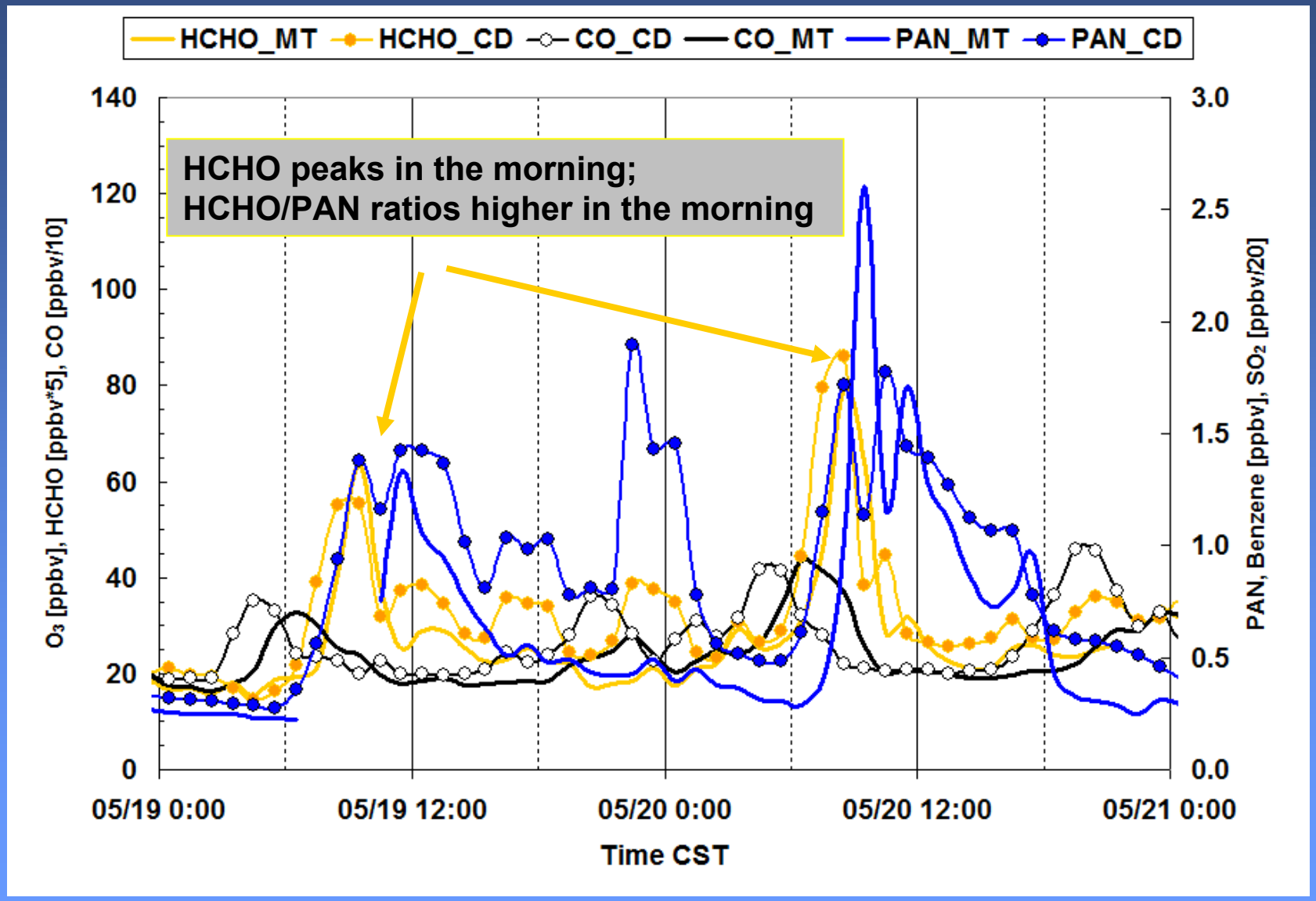
Moody Tower & Clinton Drive: Case Study May 19-20, 2009



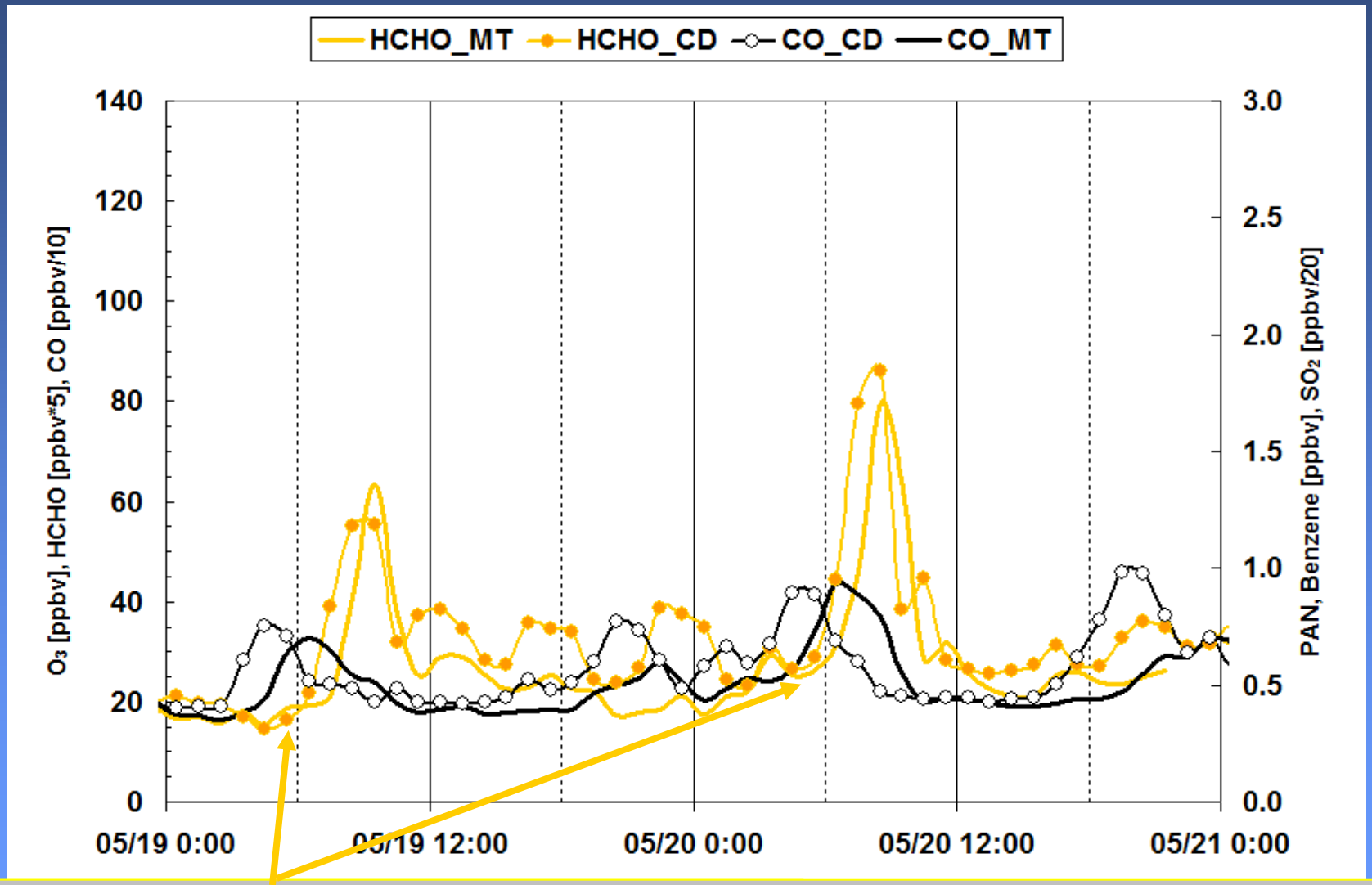
Moody Tower & Clinton Drive: Case Study May 19-20, 2009



Moody Tower & Clinton Drive: Case Study May 19-20, 2009

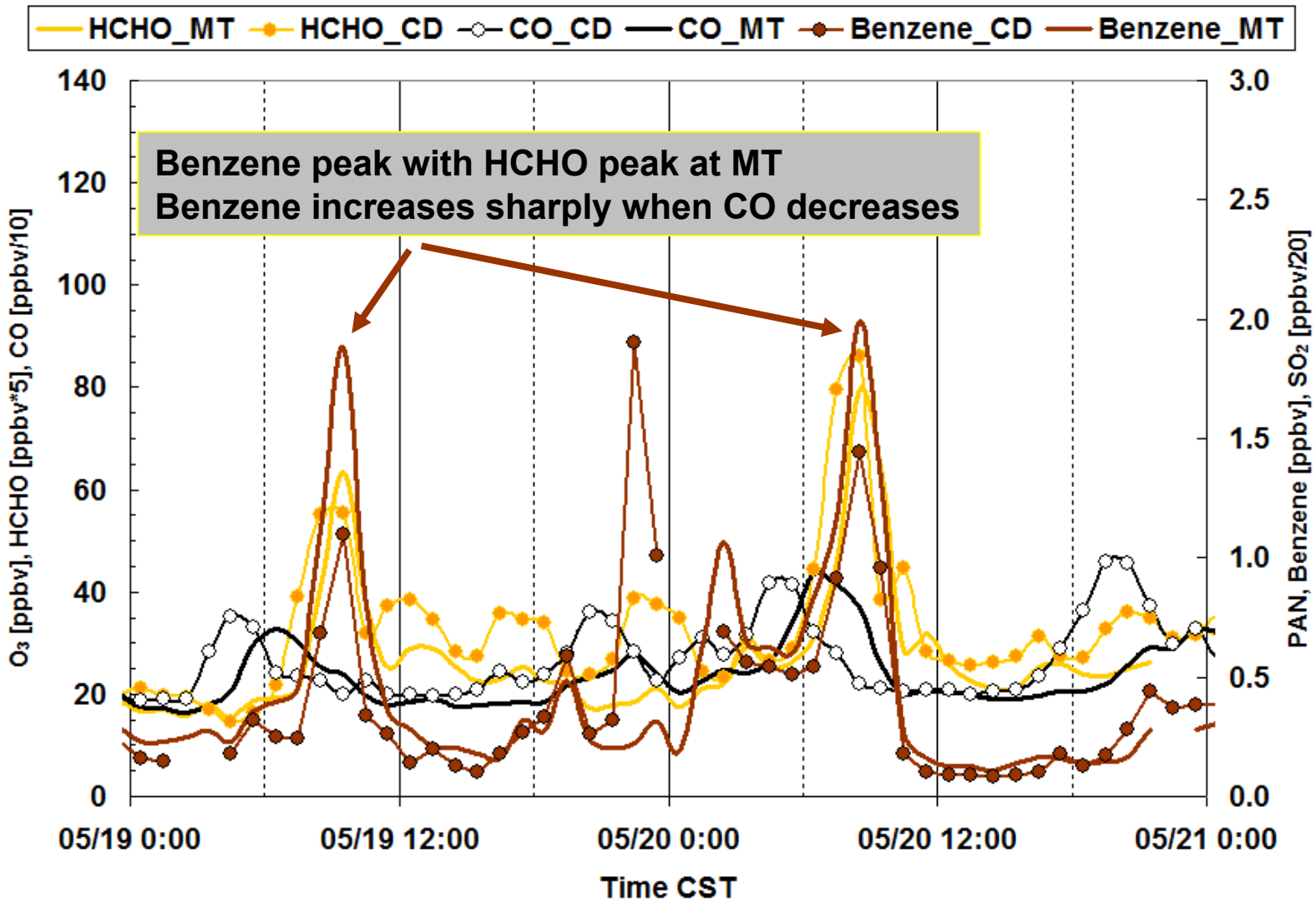


Moody Tower & Clinton Drive: Case Study May 19-20, 2009

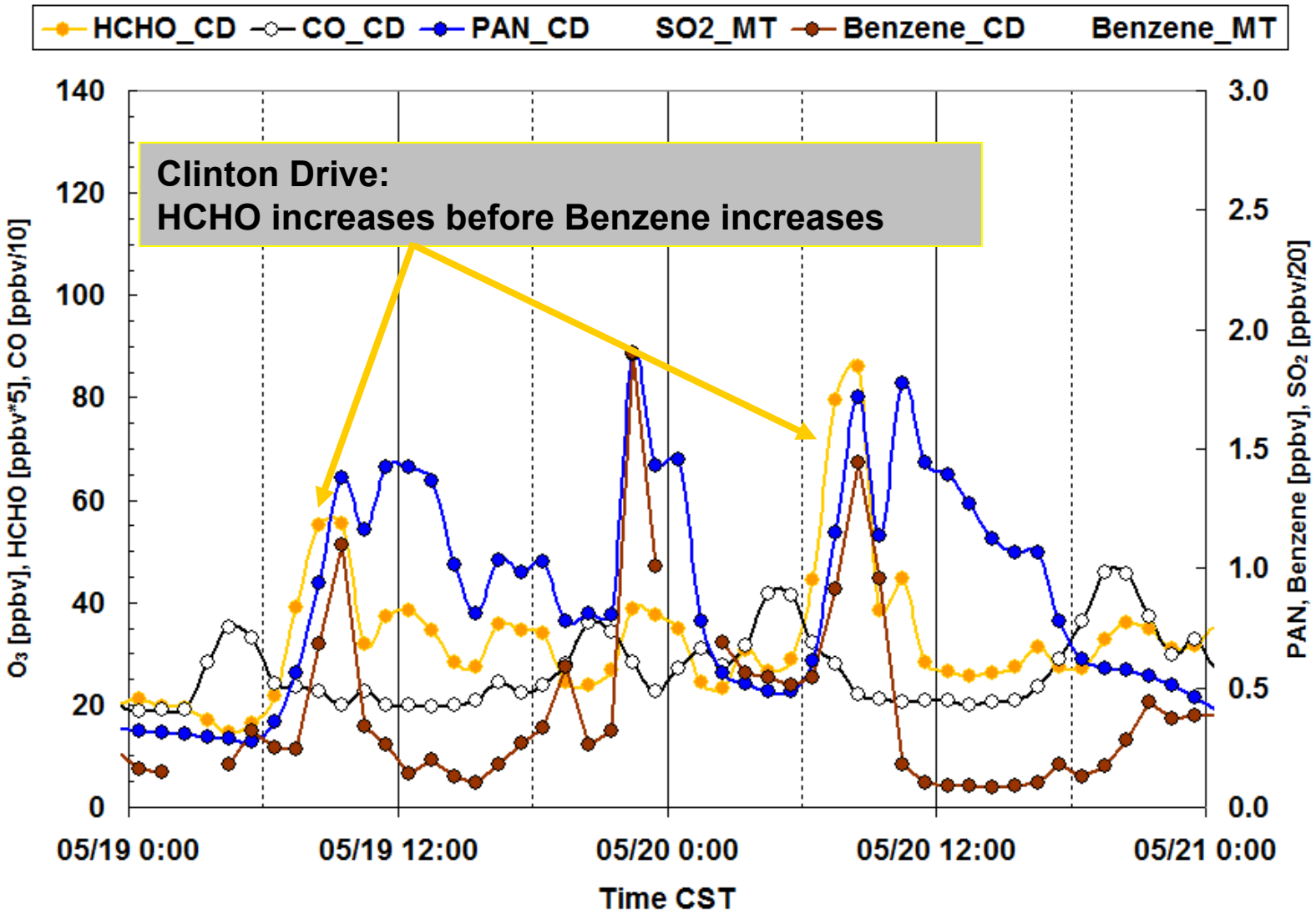


HCHO starts to increase shortly before 6 am
HCHO increases sharply when CO decreases (different from traffic related HCHO)!

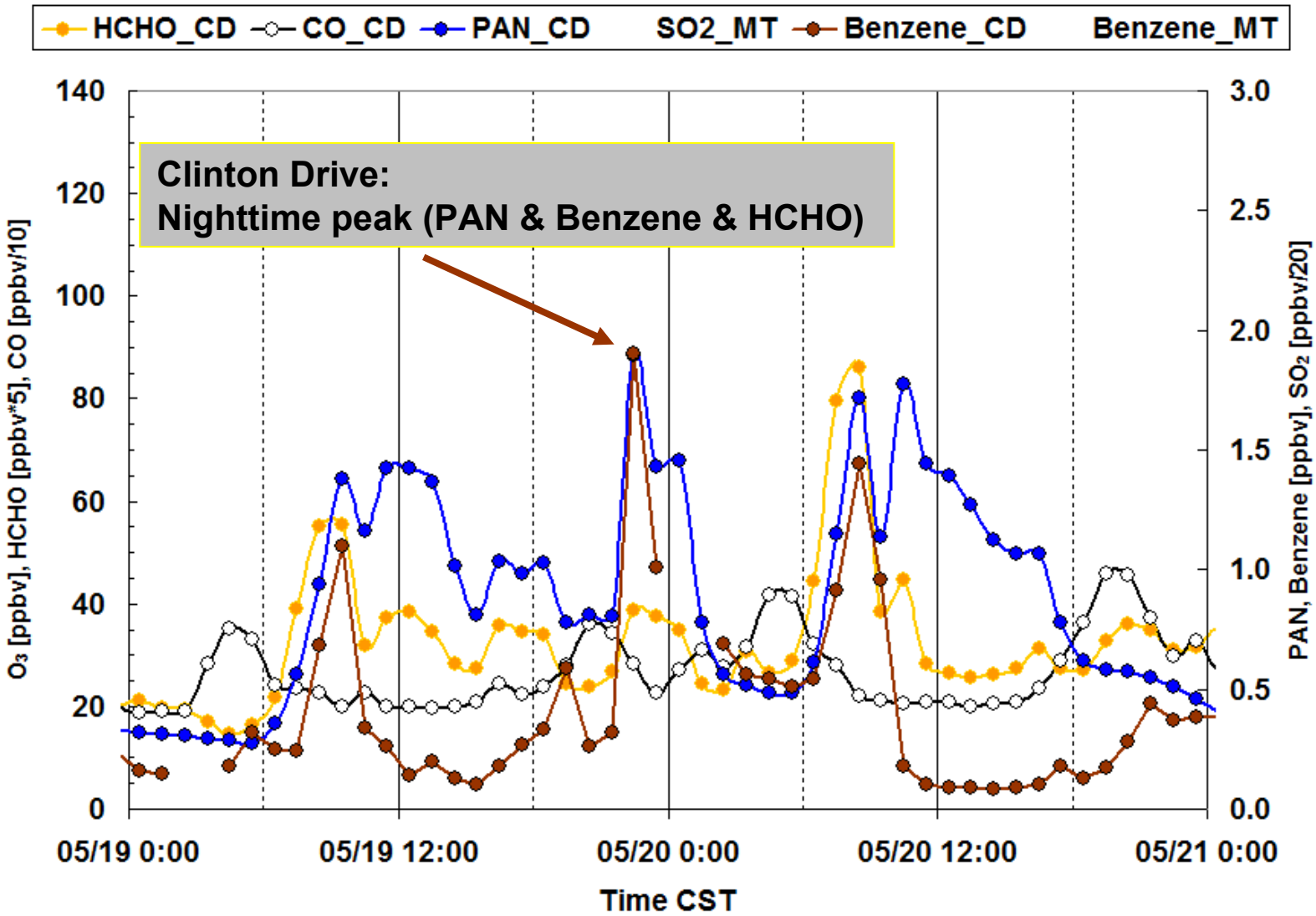
Moody Tower & Clinton Drive: Case Study May 19-20, 2009



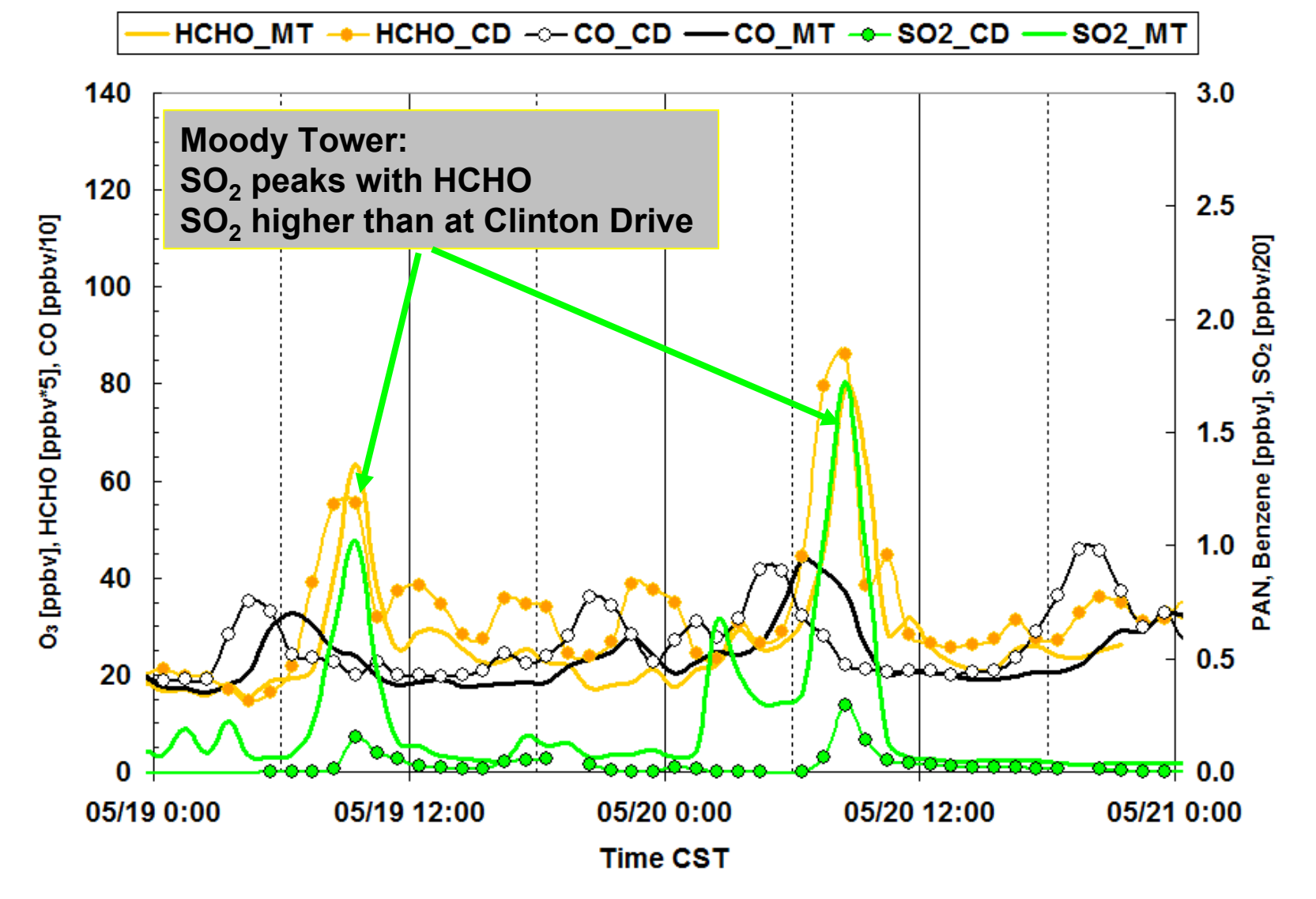
Moody Tower & Clinton Drive: Case Study May 19-20, 2009



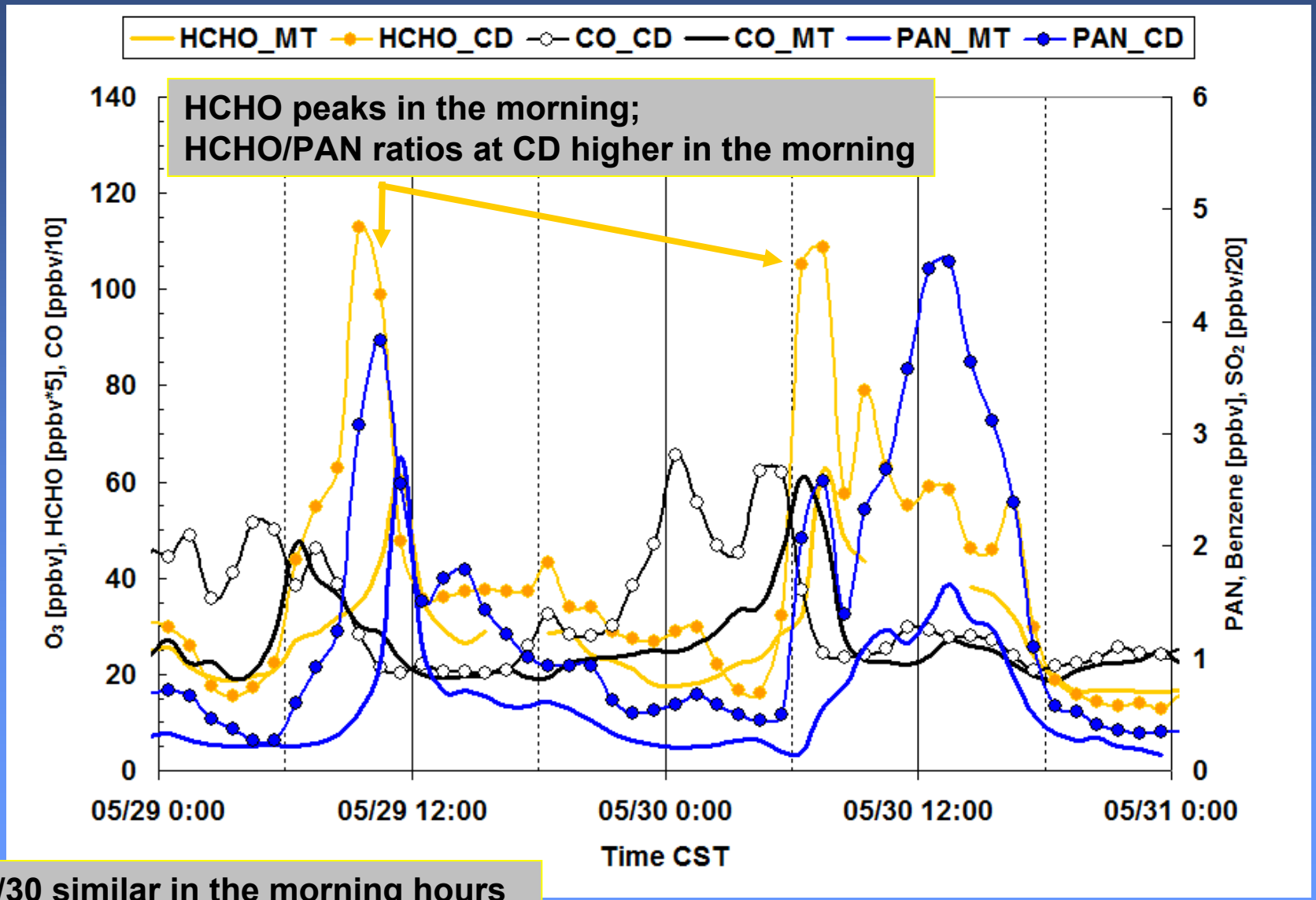
Moody Tower & Clinton Drive: Case Study May 19-20, 2009



Moody Tower & Clinton Drive: Case Study May 19-20, 2009

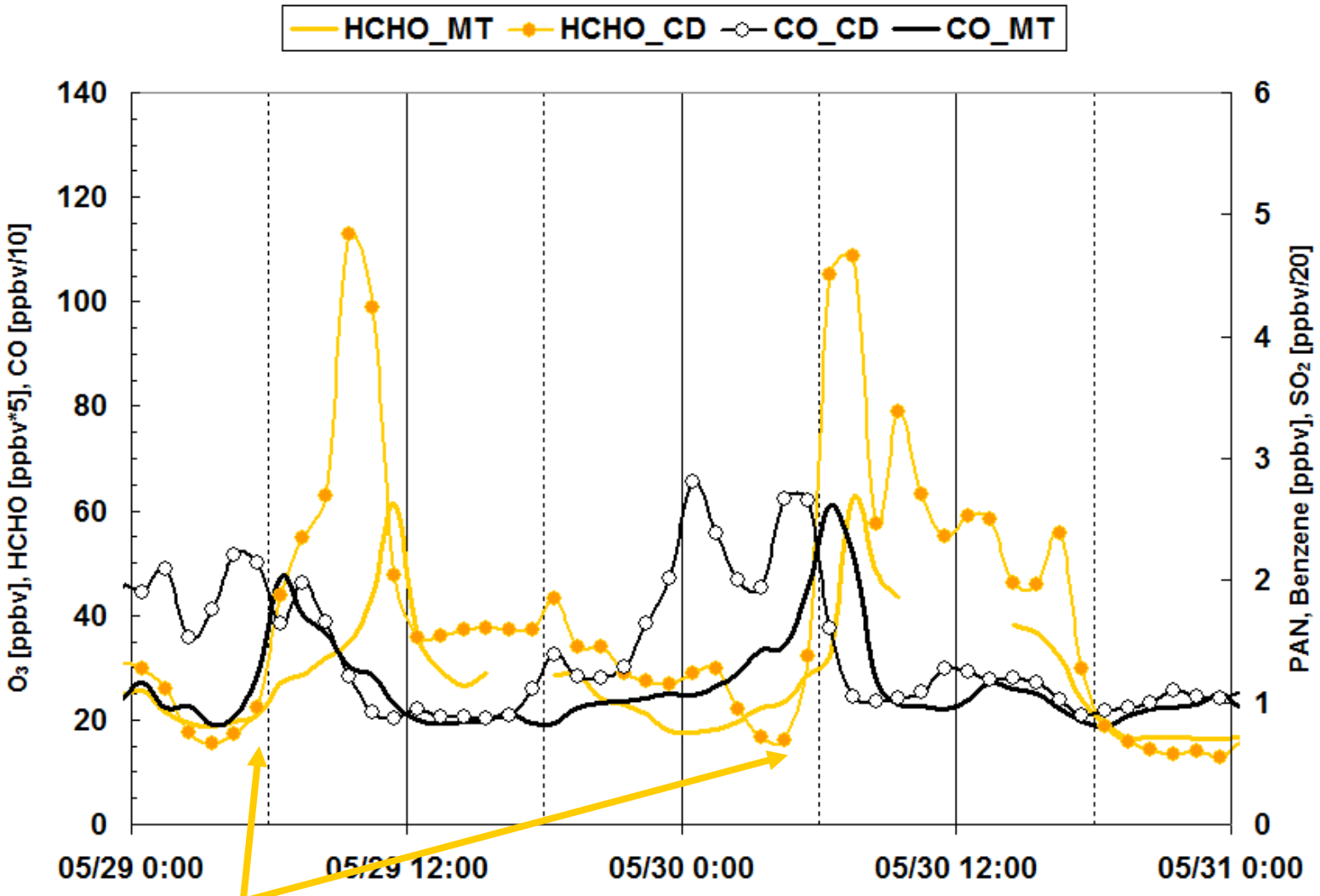


Moody Tower & Clinton Drive: Case Study May 29-30, 2009



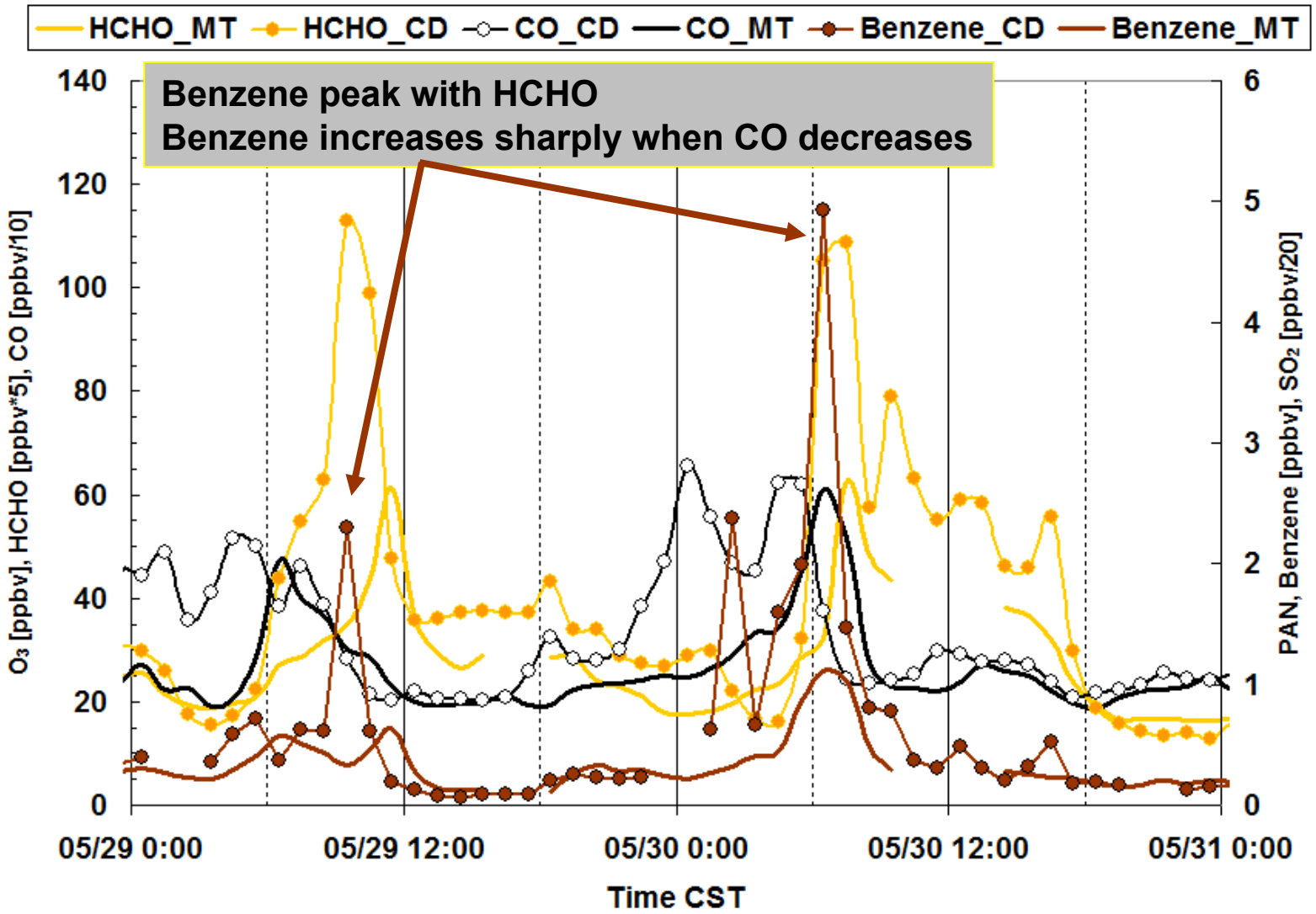
May 29/30 similar in the morning hours (surface winds from HSC sector)

Moody Tower & Clinton Drive: Case Study May 29-30, 2009

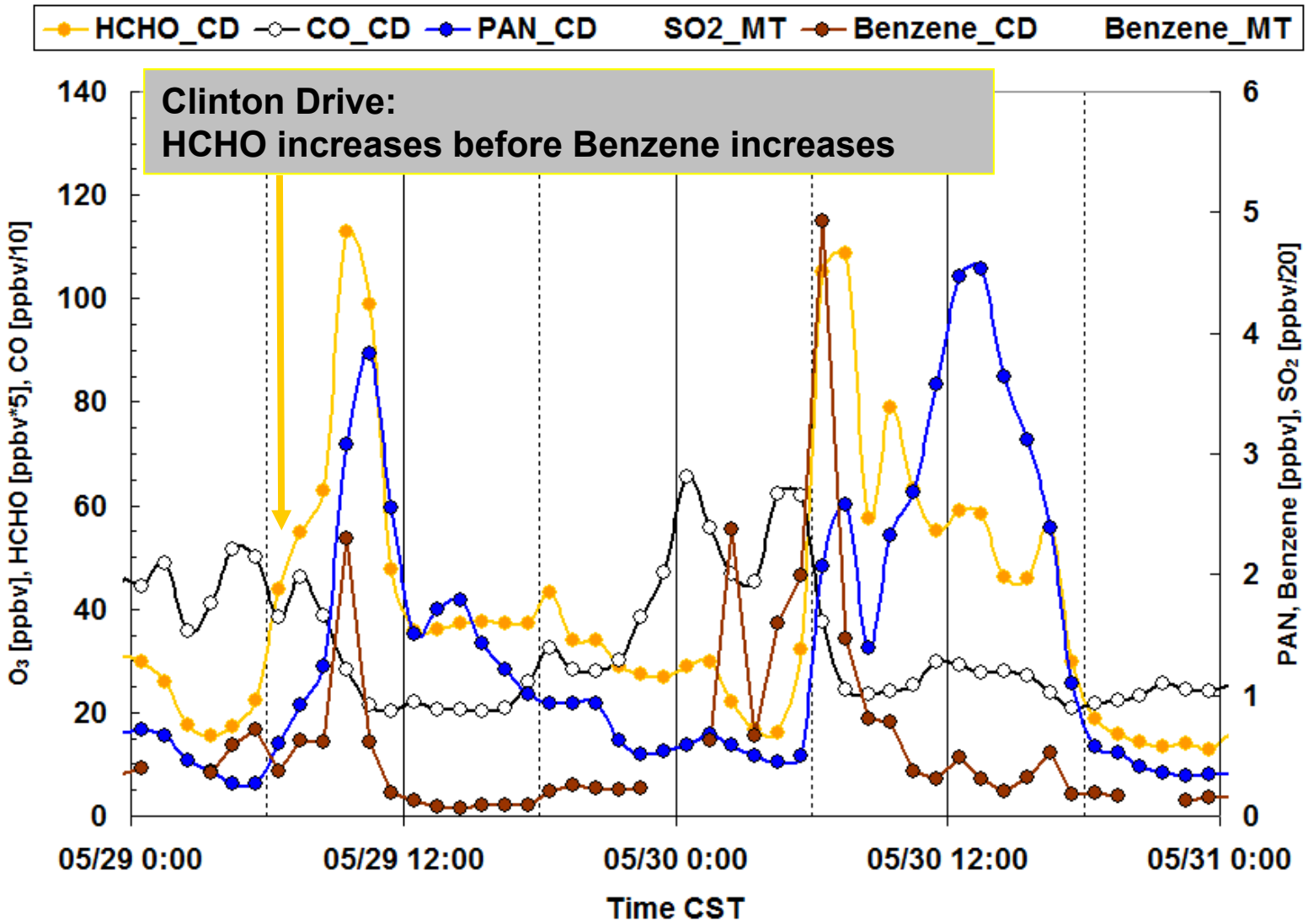


HCHO starts to increase shortly before 6 am
HCHO increases sharply when CO decreases

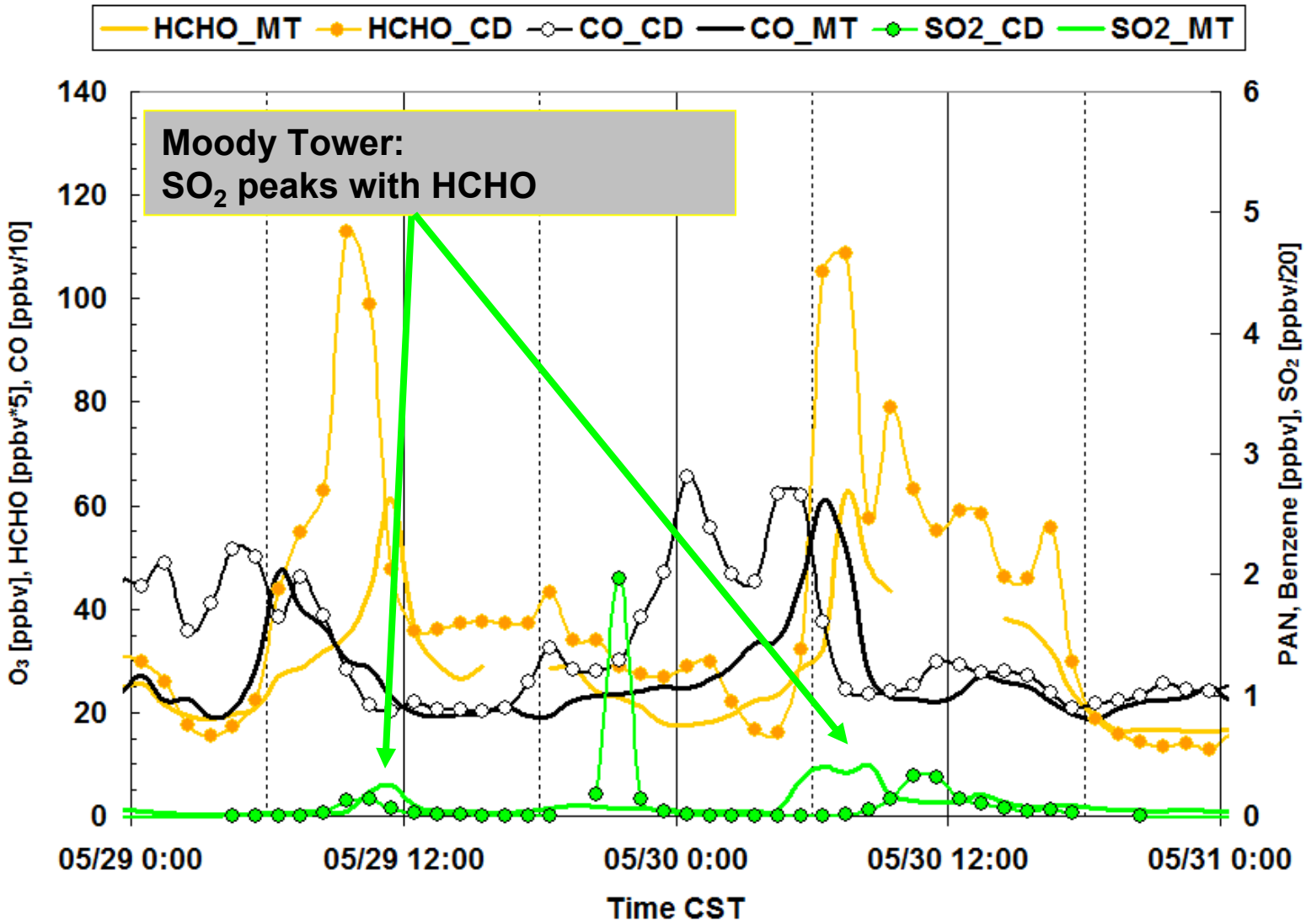
Moody Tower & Clinton Drive: Case Study May 29-30, 2009



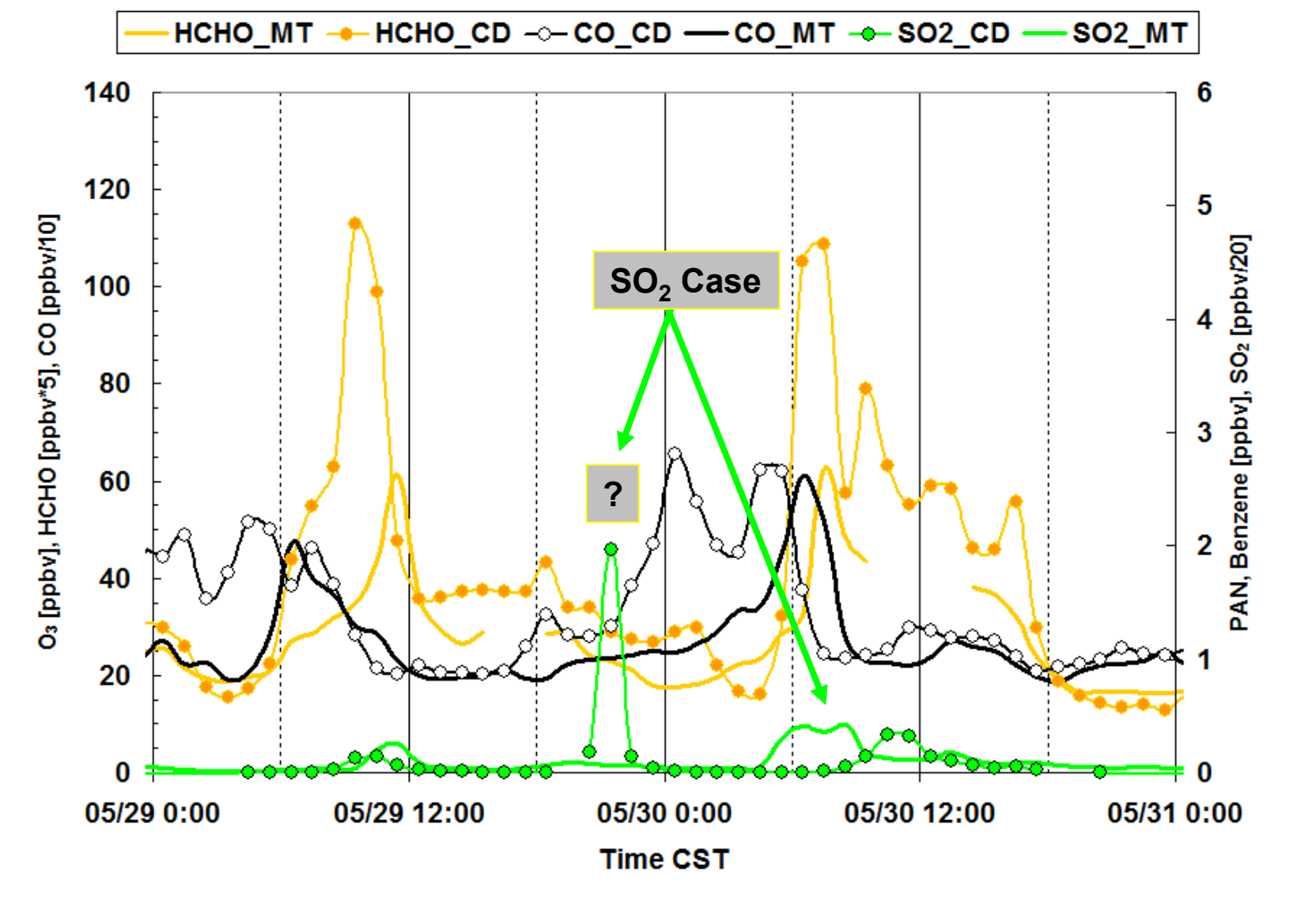
Moody Tower & Clinton Drive: Case Study May 29-30, 2009



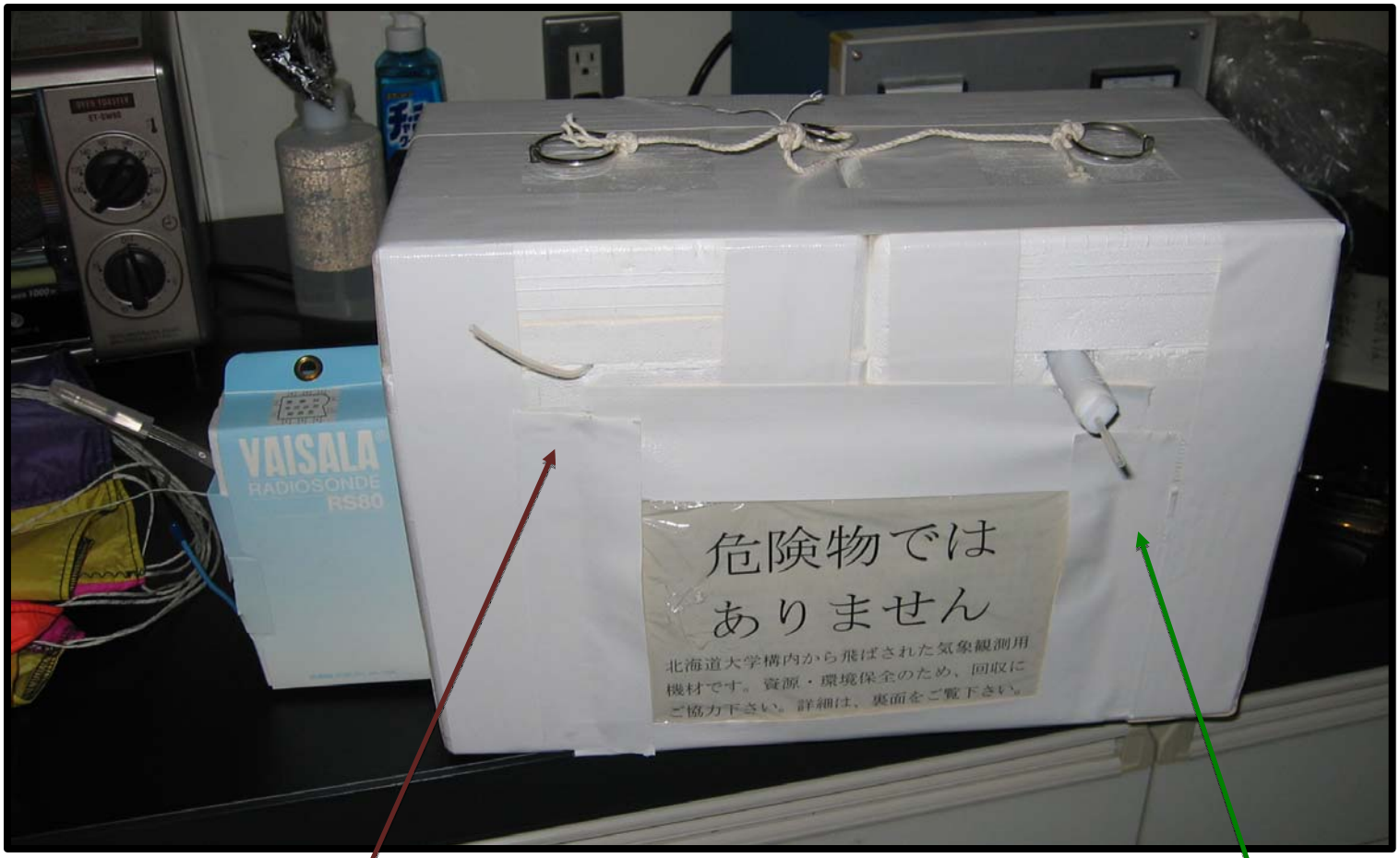
Moody Tower & Clinton Drive: Case Study May 29-30, 2009



Moody Tower & Clinton Drive: Case Study May 29-30, 2009



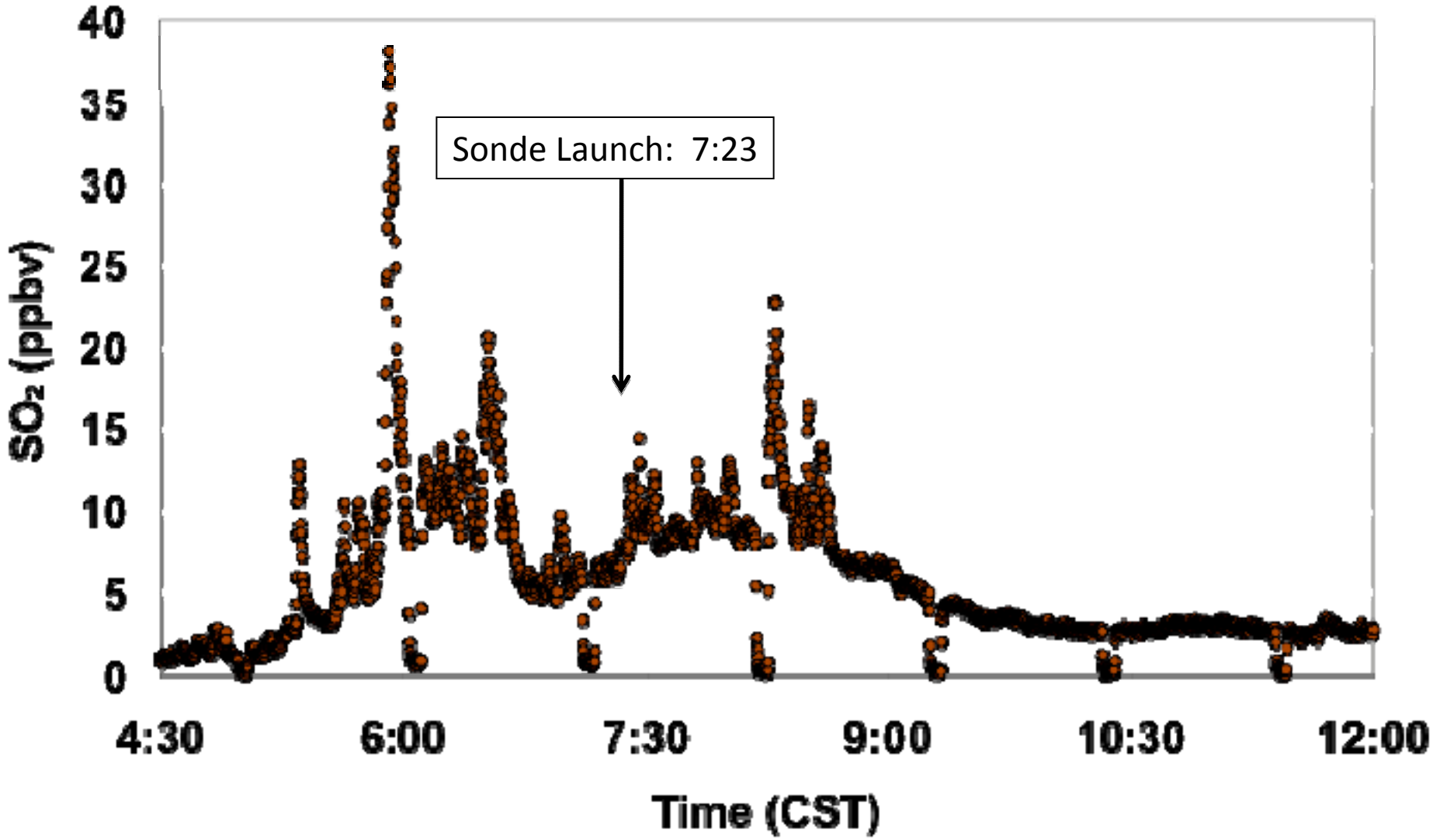
Differential SO_2 Sonde Method



Unfiltered sonde measures
$[O_3] - [SO_2]$

Filtered sonde measures
$[O_3]$

Moody Tower (UH) – 30 May 2009

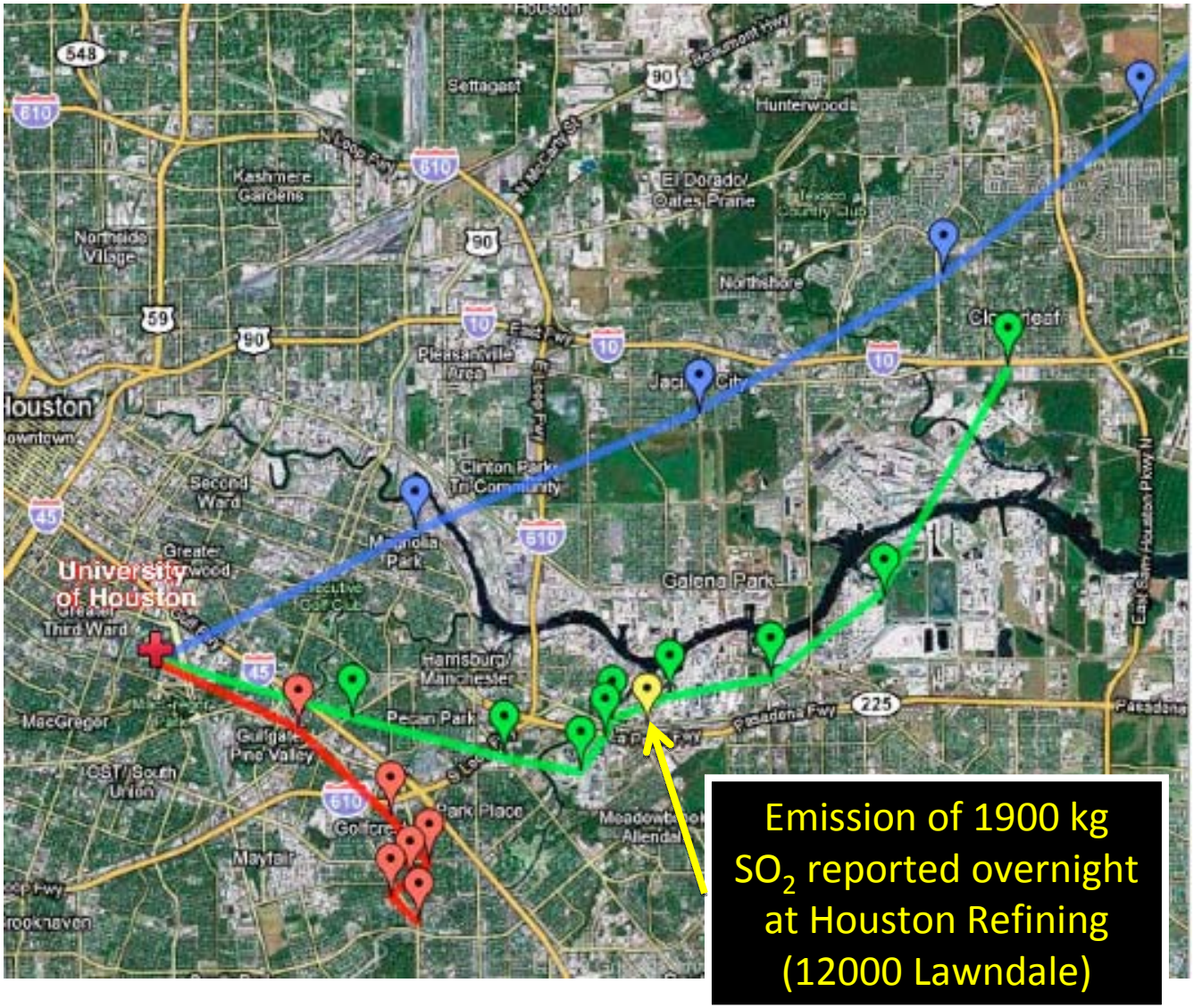


Back trajectories for 30 May 2009

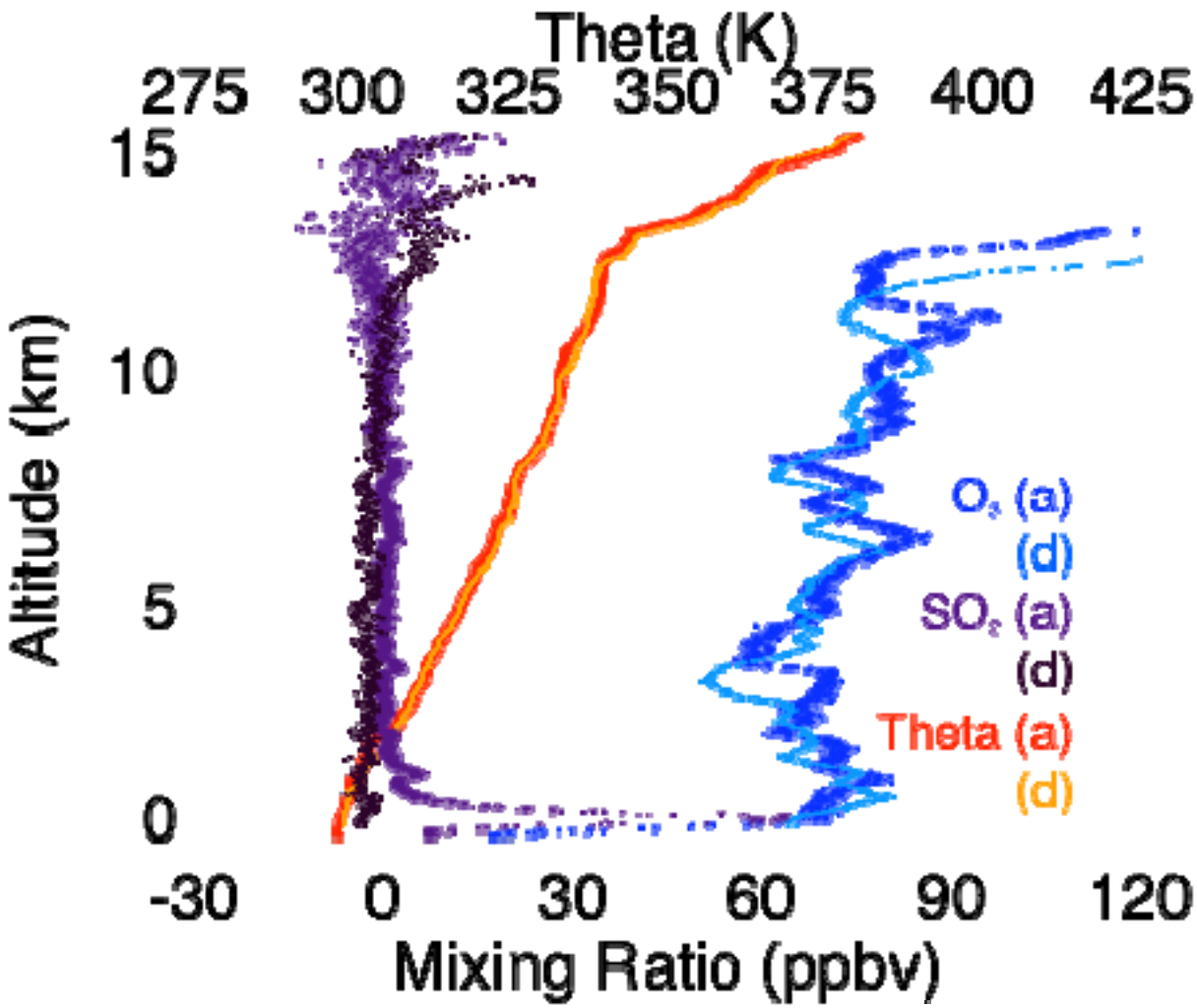
UH-RDAS 700-m

HYSPLIT 400-m

HYSPLIT 300-m



SO_2 on the morning of 30 May 2009



Launch at 7:23 am CST

Houston Regional Office (CAMS 81)
7 – 8 am: 7.7 ppb
8 – 9 am: 12.4 ppb

Moody Tower
7 – 8 am: 8.4 ppb
8 – 9 am: 9.3 ppb

Some Conclusions

- Major part during SHARP showed background conditions due to persistent southerly winds.
- May 4, 19-20, and 29-30 were event days with enhanced photochemistry and weak local circulation.
- May 19-20 and May 29-30 showed impacts from HSC (however, more complicated structure for May 29-30) with early morning HCHO peaks. Also elevated SO_2 observed.
- SHARP data indicate presence of different - at times overlapping - plumes of HCHO, PAN, and VOC, VOC+SO_2, SO_2, Toluene+Ethylene, etc.
- Further trajectory analysis needed.
- CMAQ modeling planned.
- Currently: new Moody Tower and Clinton Drive measurement campaign; August 15 –October 15, 2010; funded by TCEQ

Acknowledgements:
- HARC
- Clinton Drive (Julia Golovko, Sergio Alvarez, TCEQ, City of Houston), University of
- Houston – Moody Towers (Barry Lefer, James Flynn, Winston Luke, Tom Jobson, Greg Huey), SO_2 sondes (Gary Morris), SODAR (Richard Fuller)

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