Institute for Defense Analyses
4850 Mark Center Drive • Alexandria, Virginia 22311-1882 • U.S.A.

11th International Conference on Harmonisation within
Atmospheric Dispersion Modelling for Regulatory Purposes
Cambridge, United Kingdom
2-5 July, 2007

Effects of Meteorological Data Thresholding on the Quality of Urban HPAC Predictions of the Joint Urban 2003 Field Trial Observations

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Introduction

- **Joint Urban 2003 field trial (JU2003) – a multi agency effort conducted in Oklahoma City during the summer of 2003**
  - Perhaps the most comprehensive urban transport and dispersion field trial ever conducted
  - For now, evaluation will deal with outdoor SF_6 releases only
- **10 Intensive Operating Periods (IOPs)**
  - Additional mini-IOP on 7/15/05 to help understand vertical dispersion using crane samplers
  - Continuous releases: 29
    - » Release duration 30 minutes
  - Puff releases: 40
- **Wealth of meteorological data**
- **This talk examines URBAN HPAC predictions produced by using SODAR and mini-SODAR wind profiles collected at JU2003 field trials**
  - Examine effects of varying the minimum cutoff altitude for wind profiles
- **Another talk (on Monday, Jeff Urban) dealt with general results**

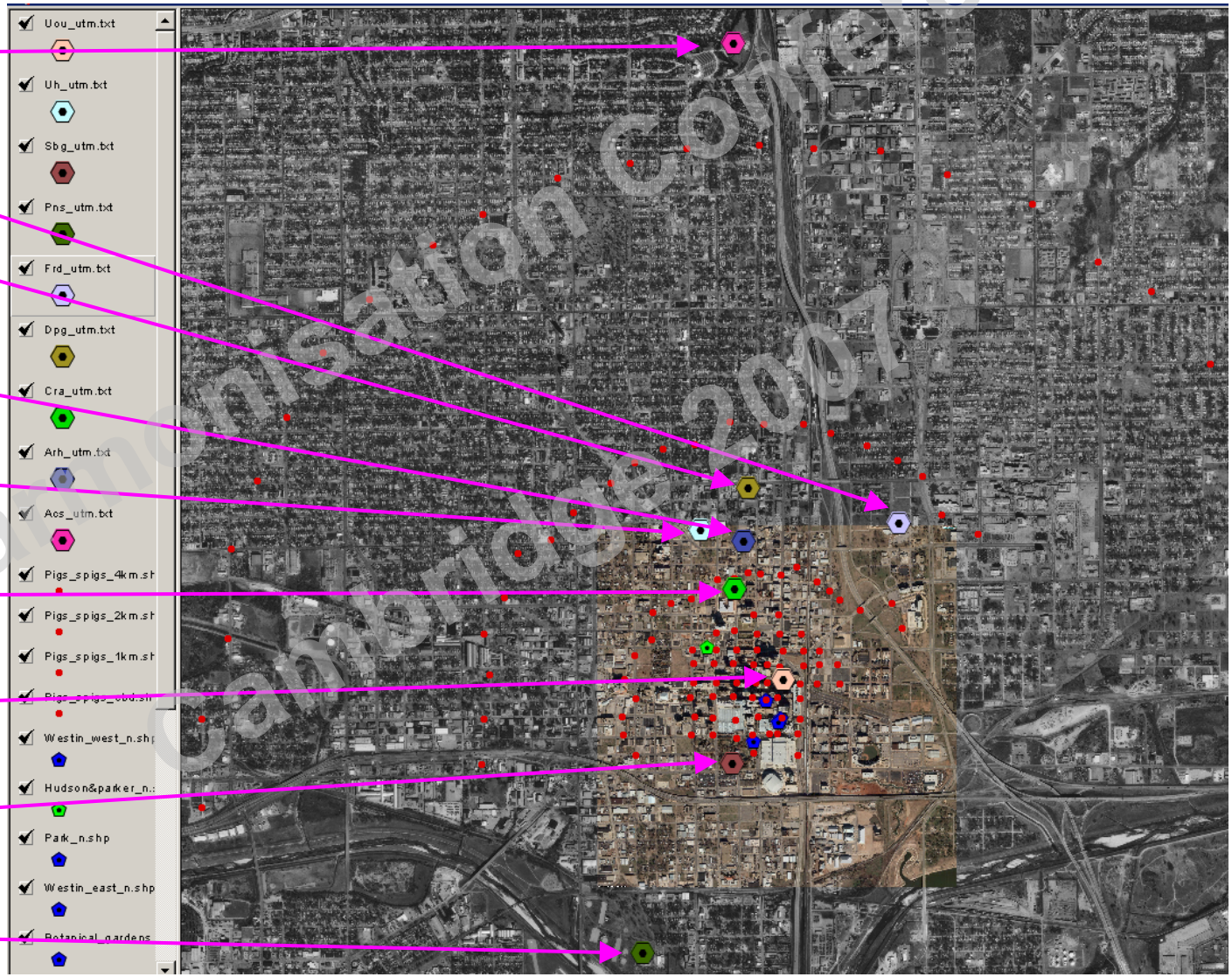
Wind Measurements Within Urban Canopy and Its Effects on HPAC Predictions

- **Intuitively, to obtain better hazard predictions, one would like to measure meteorology as close as possible to the release location**
  - In terms of urban releases, this leads to the suggestion to use wind measurements that include altitudes that are within the urban canopy
    - » Rooftop measurement from the tallest building
      - LDS building in Salt Lake City field trials
    - » (mini) SODAR located within City
      - Botanical Gardens mini-SODAR in JU2003

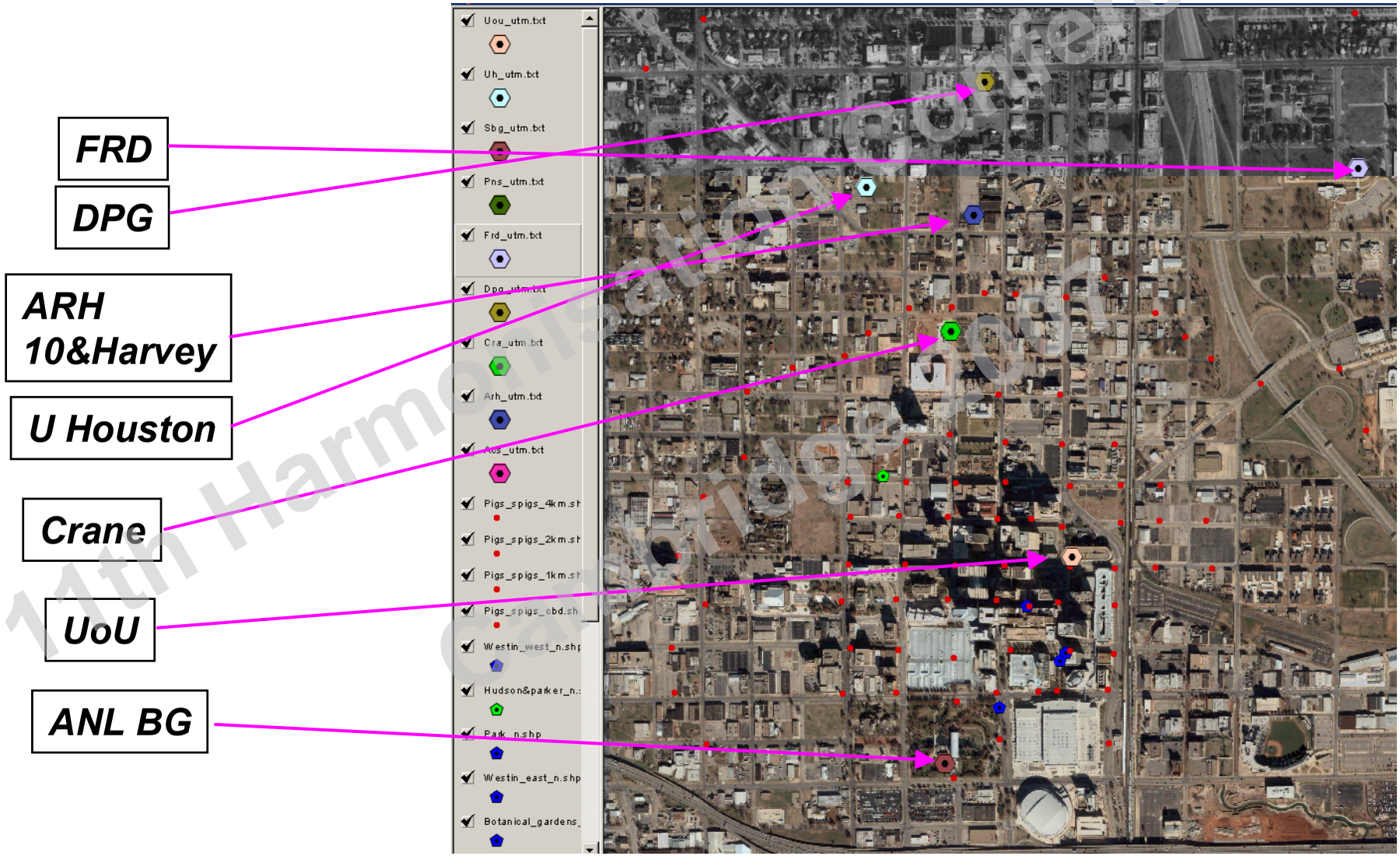
- **We have somewhat contradictory results from SLC and MUST studies**
  - LDS MET in SLC performed **worst** in terms of predicting potential hazards
    - » Most likely reason is that there were too much (non-representative) fluctuation in the wind direction
  - Sonic MET at 16 meters in MUST performed **best**
    - » 16 meters is ~ 6 times higher than the height of the shipping containers, and thus most likely samples "unperturbed" flow

- **How will this affect SODARs in JU2003**
  - **Some of the measurements are within the urban canopy**

JU2003 FRD Samplers, (mini) SODARs and Crane

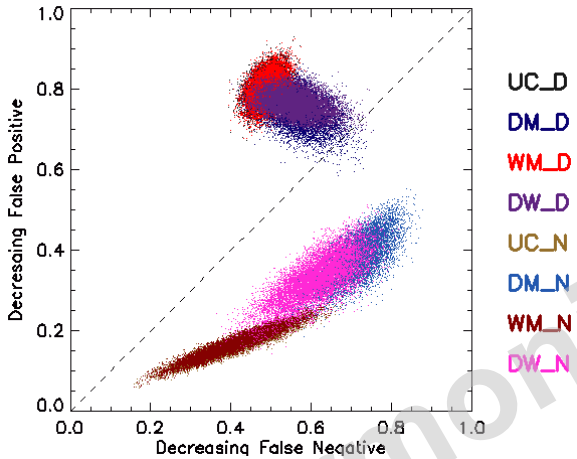


JU2003 FRD Samplers, (mini) SODARs and Crane Downtown Region



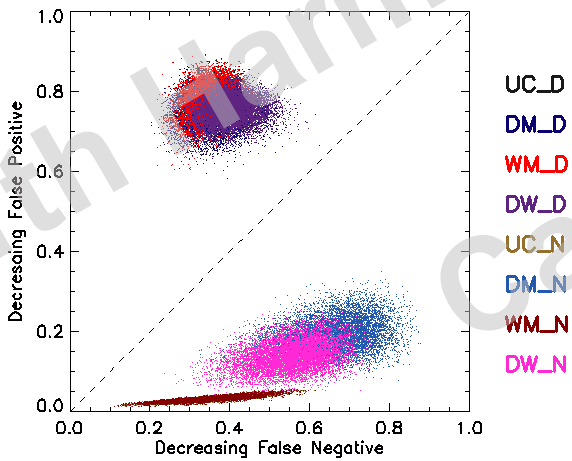
ANL BG and PNNL (mini) SODAR MOE Plots

Botanical Gardens mini-SODAR



UC_D
DM_D
WM_D
DW_D
UC_N
DM_N
WM_N
DW_N

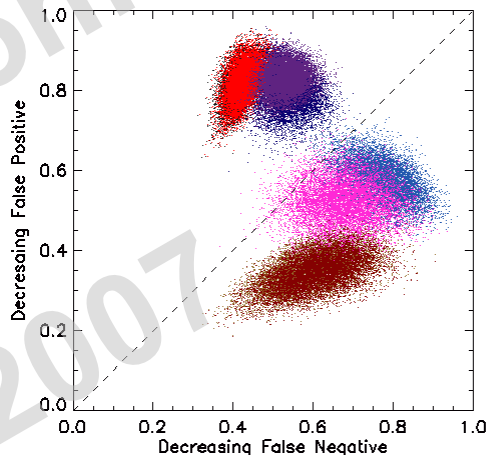
250 ppt threshold



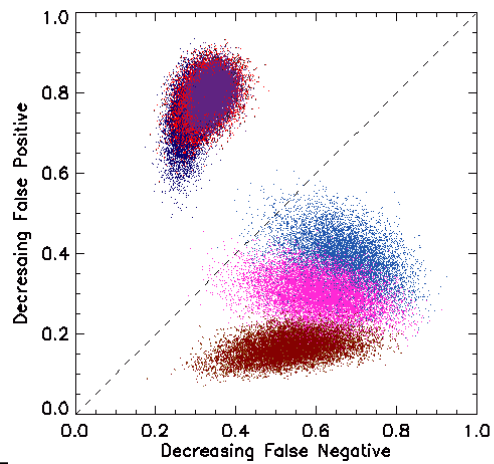
UC_D
DM_D
WM_D
DW_D
UC_N
DM_N
WM_N
DW_N

average concentration

PNNL SODAR



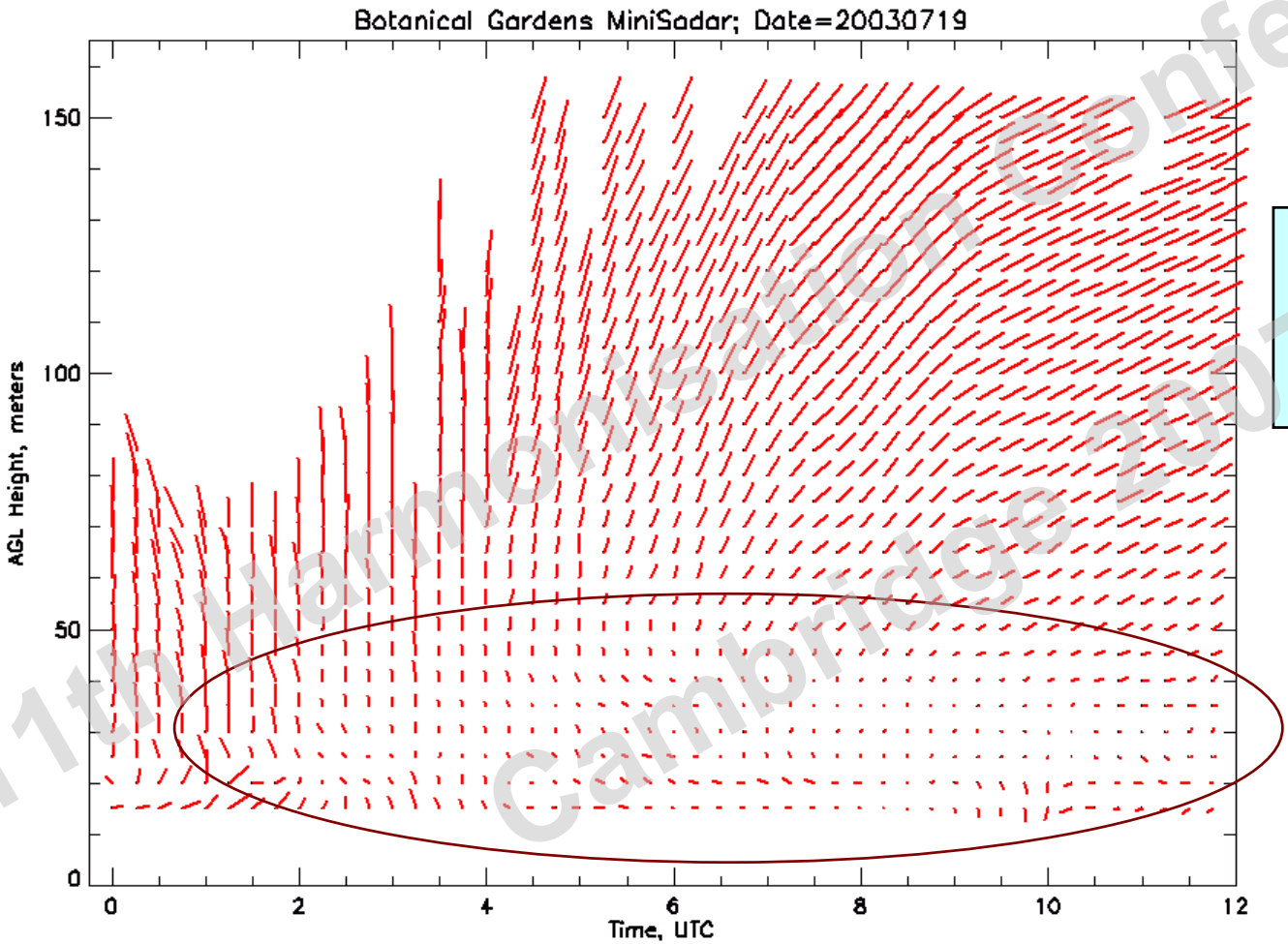
UC_D
DM_D
WM_D
DW_D
UC_N
DM_N
WM_N
DW_N



UC_D
DM_D
WM_D
DW_D
UC_N
DM_N
WM_N
DW_N

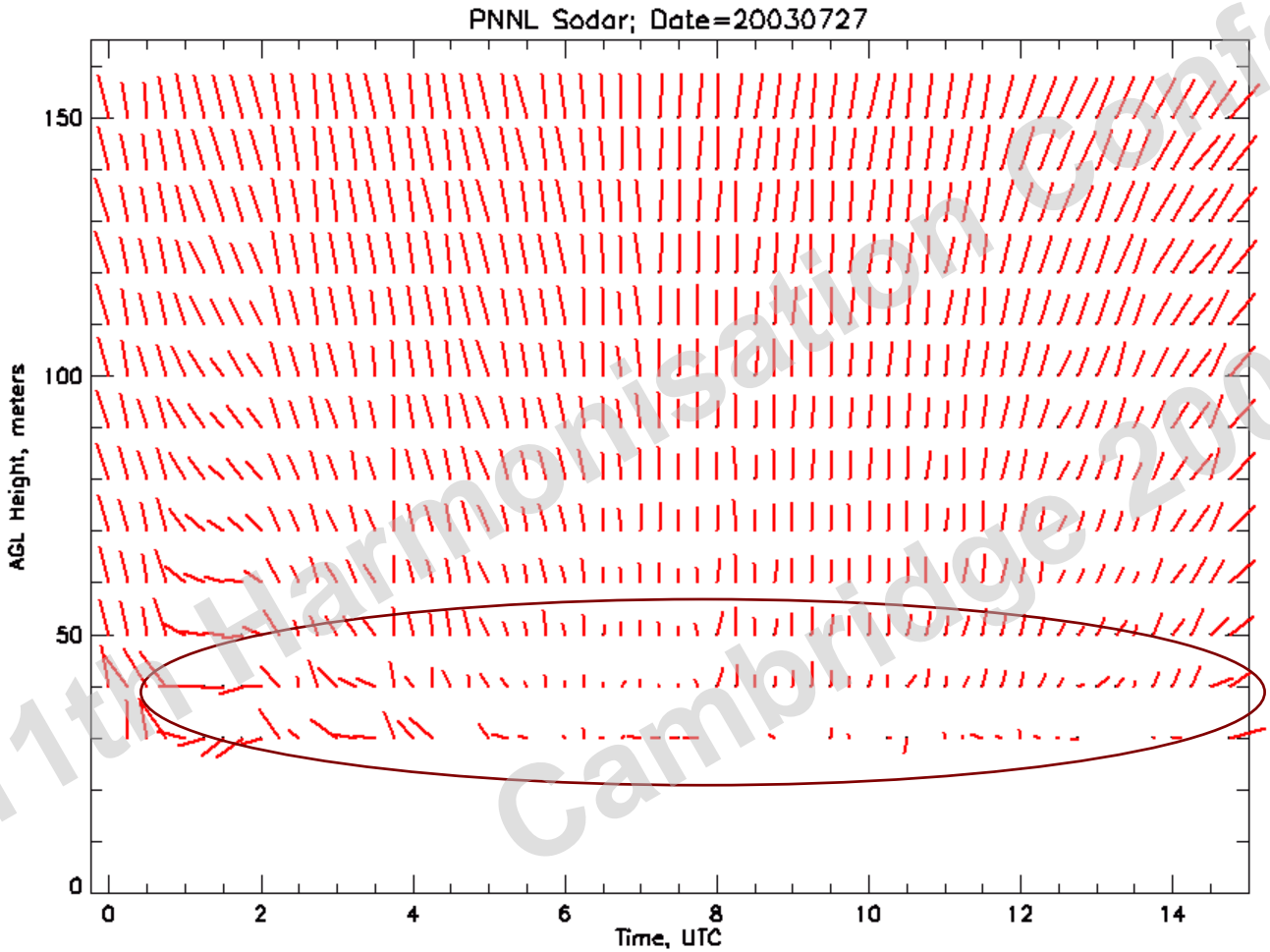
Differences between night and day predictions / Night results seems to be significantly degraded with respect to day predictions

ANL BG mini-SODAR Profiles



At night, low altitude winds are significantly different from higher altitude

PNNL SODAR Profiles



At night, low altitude winds are significantly different from higher altitude

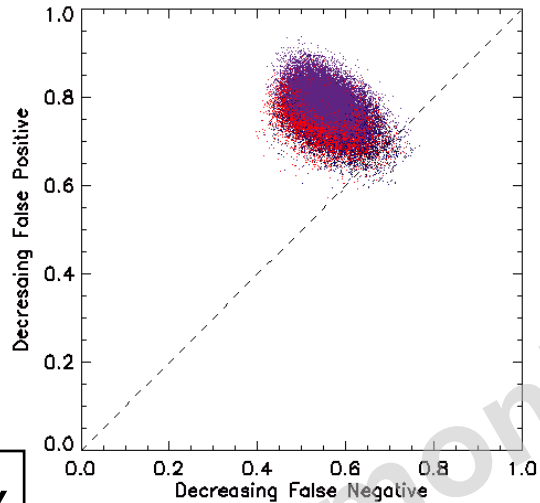
Rules of the Game
Notation Key

- Run URBAN HPAC predictions for all (mini) SODARs
  - Use MC-SCIPUFF mass consistent wind-field module
    - » Instead of SWIFT
  - Urban Canopy (UC) and UDM (DM)
  - Vary cut-off altitude below which wind is ignored
  - Calculate MOE
    - » Night, Day
    - » 250 ppt exceedance threshold, average concentrations (based on 30-minute interval)

Notation Key

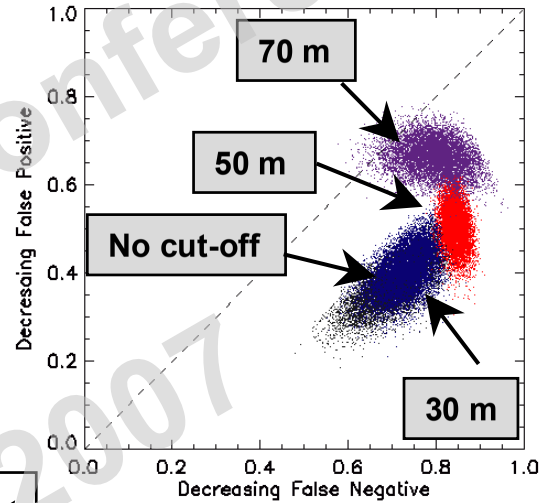
Third Character in Name	Example	Cut-Off Altitude, meters	Sodar
0	DP0	15	Dugway
1	DP1	30	Dugway
2	PS2	50	PNNL
3	PS3	70	PNNL
4	PS4	100	PNNL
5	PS5	150	PNNL
6	PS6	250	PNNL
7	PS7	350	PNNL

ANL Botanical Gardens mini-SODAR MOEs as a function of cutoff altitude for DM



SBG
SB1
SB2
SB3

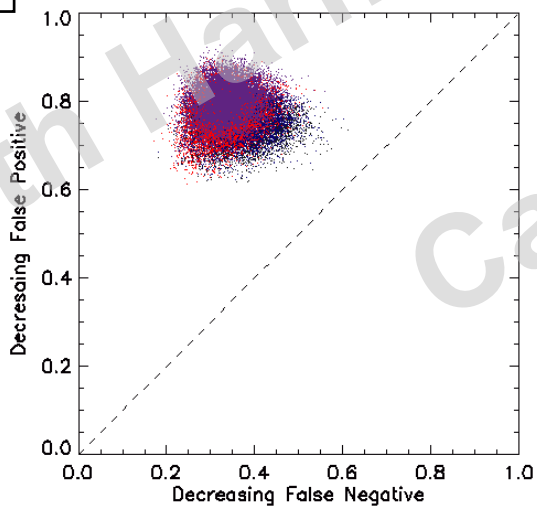
250 ppt threshold



SBG
SB1
SB2
SB3

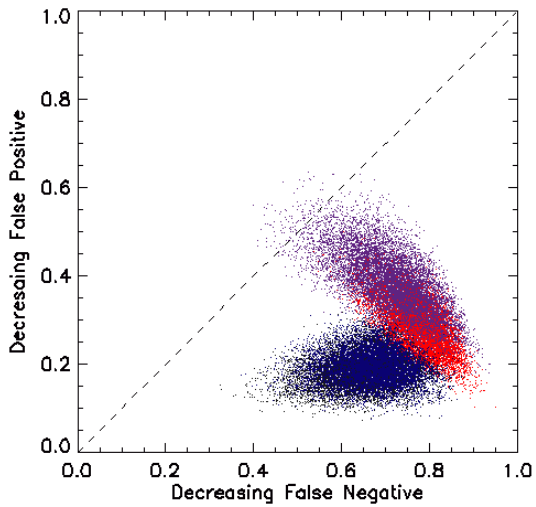
Day

Night



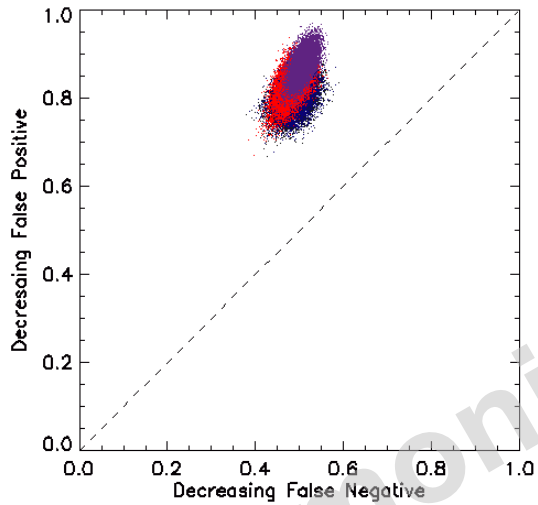
SBG
SB1
SB2
SB3

average concentration



SBG
SB1
SB2
SB3

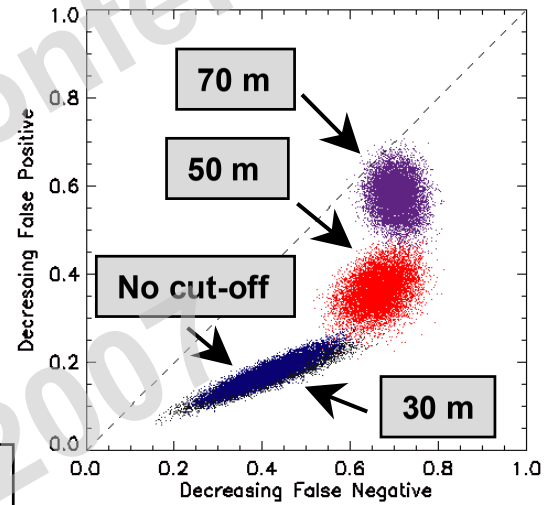
ANL Botanical Gardens mini-SODAR MOEs as a function of cutoff altitude for UC



SBG
SB1
SB2
SB3

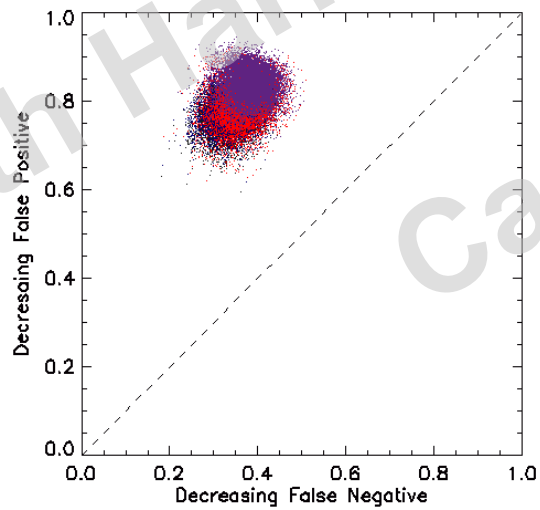
250 ppt threshold

Day



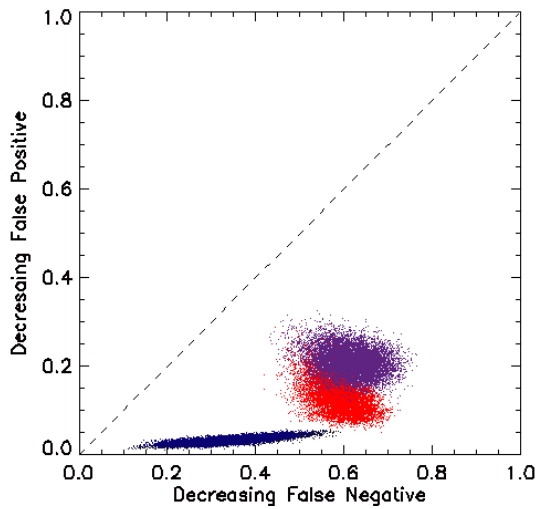
SBG
SB1
SB2
SB3

Night



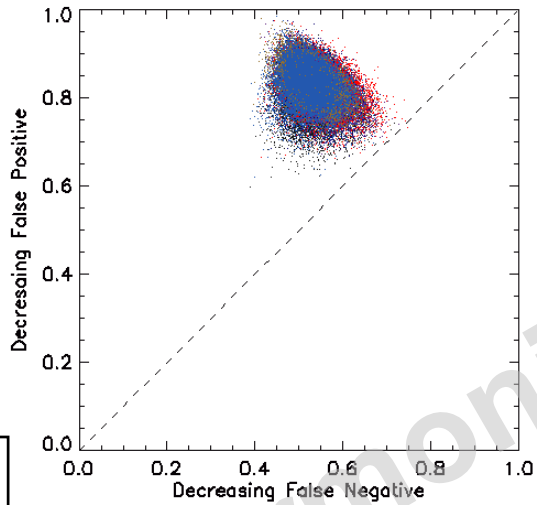
SBG
SB1
SB2
SB3

average concentration



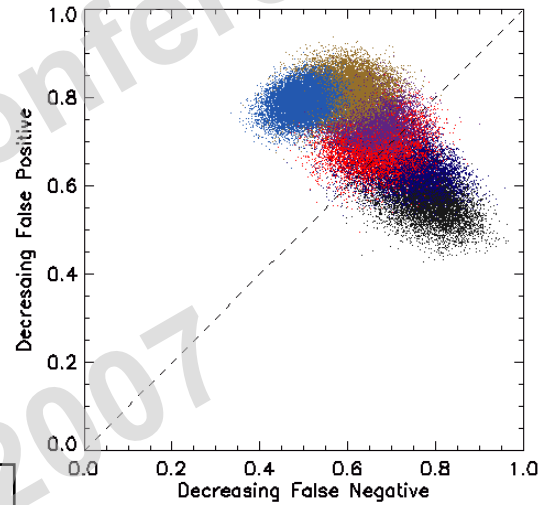
SBG
SB1
SB2
SB3

PNNL SODAR MOEs as a function of cutoff altitude for DM



PNS
PS2
PS3
PS4
PS5
PS6

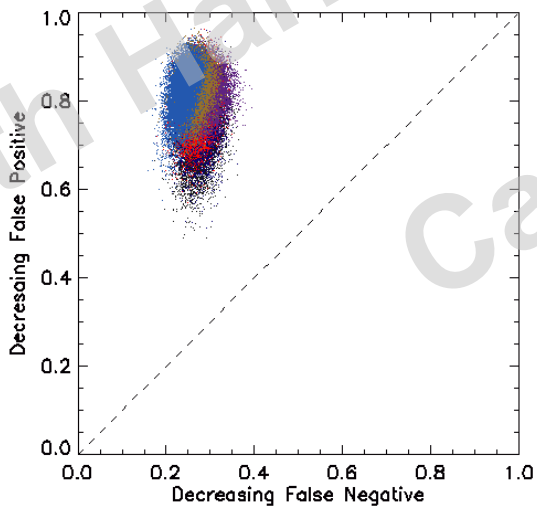
250 ppt threshold



PNS
PS2
PS3
PS4
PS5
PS6

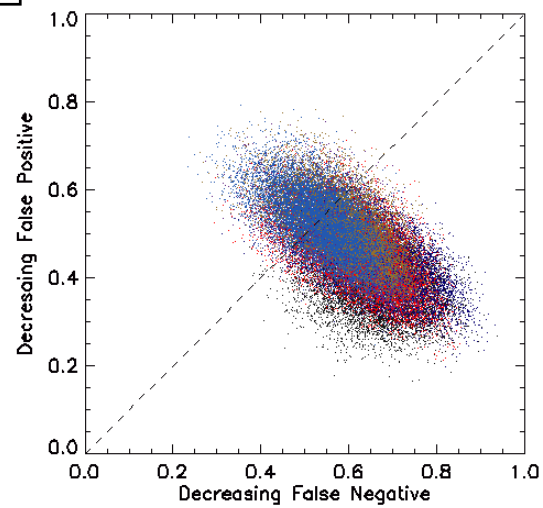
Day

Night



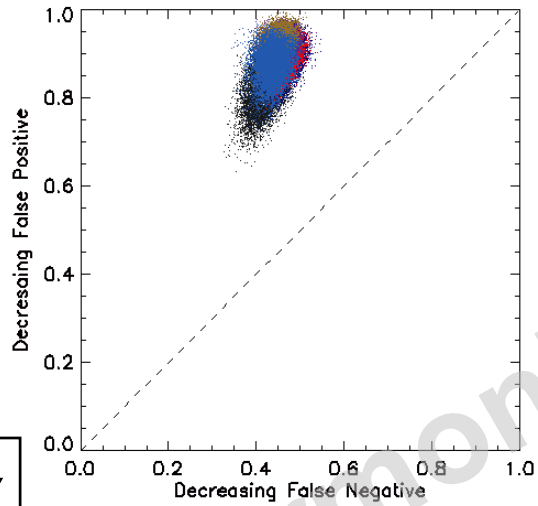
PNS
PS2
PS3
PS4
PS5
PS6

average concentration



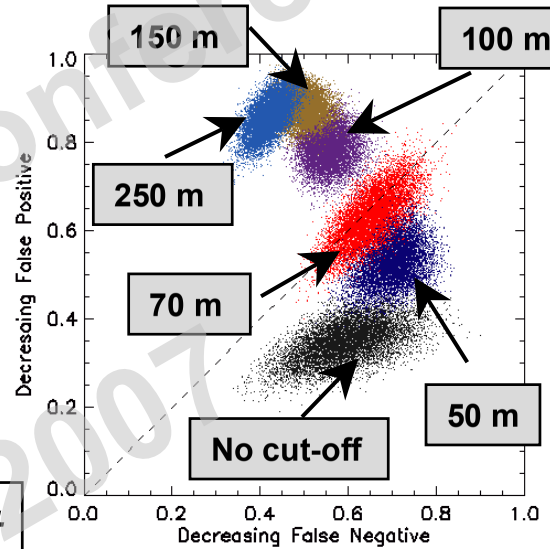
PNS
PS2
PS3
PS4
PS5
PS6

PNNL SODAR MOEs as a function of cutoff altitude for UC



PNS
PS2
PS3
PS4
PS5
PS6

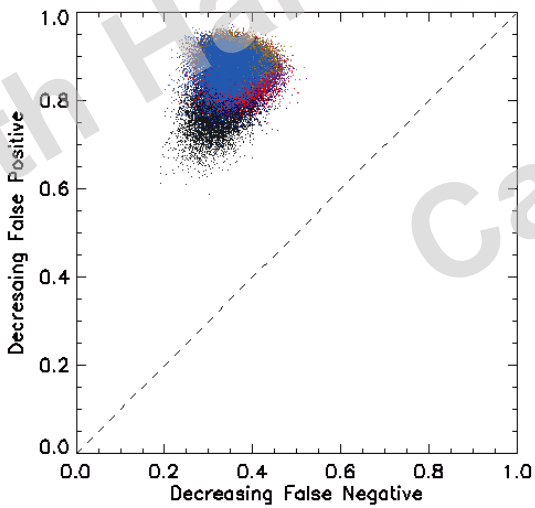
250 ppt threshold



PNS
PS2
PS3
PS4
PS5
PS6

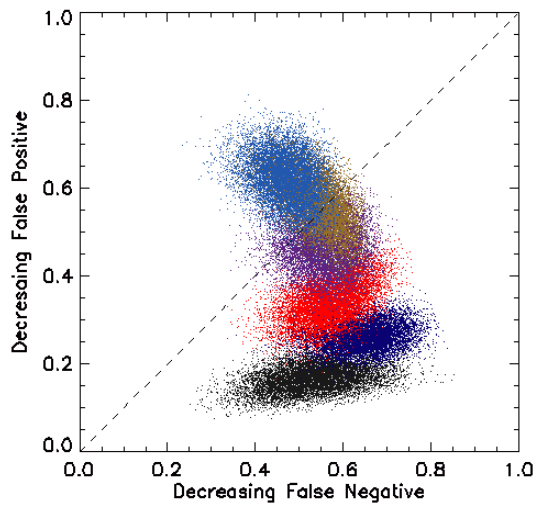
Day

Night



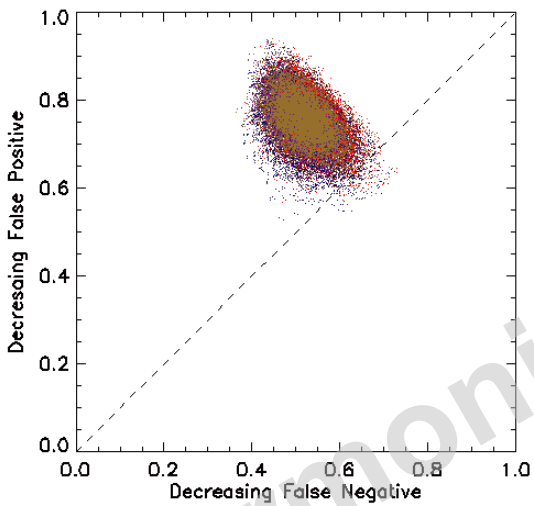
PNS
PS2
PS3
PS4
PS5
PS6

average concentration



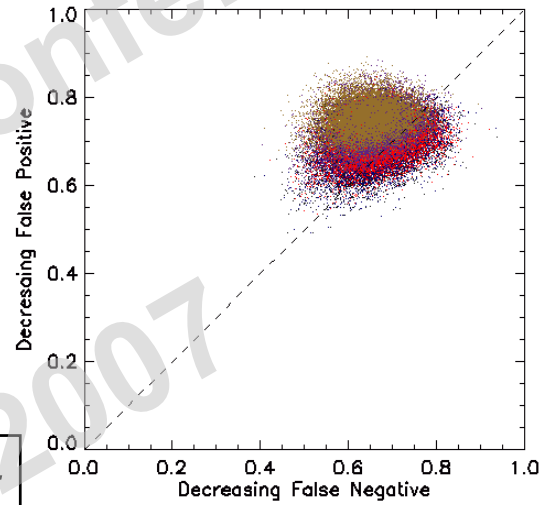
PNS
PS2
PS3
PS4
PS5
PS6

ANL CC mini-SODAR MOEs as a function of cutoff altitude for DM



ACS
AS1
AS2
AS3
AS4

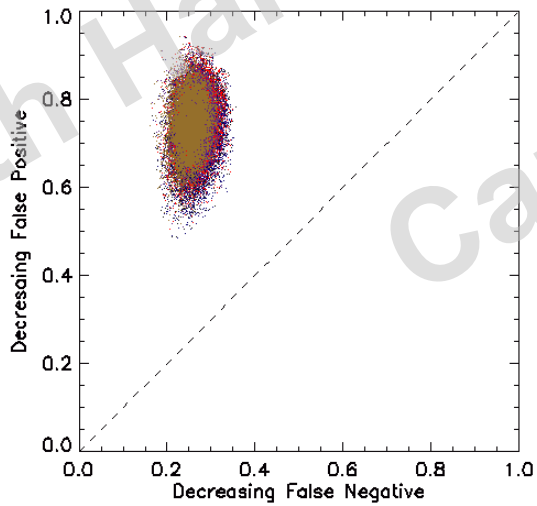
250 ppt threshold



ACS
AS1
AS2
AS3
AS4

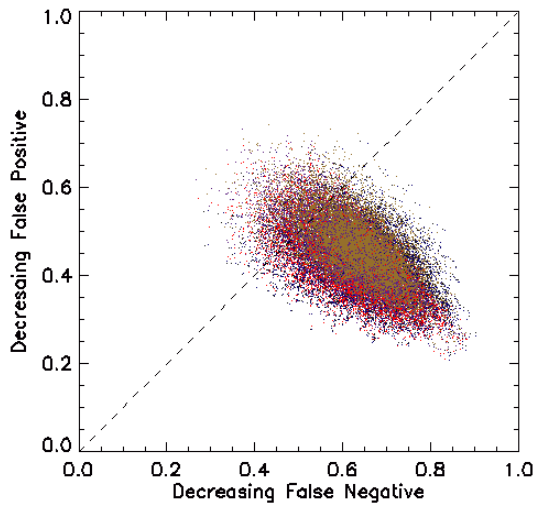
Day

Night



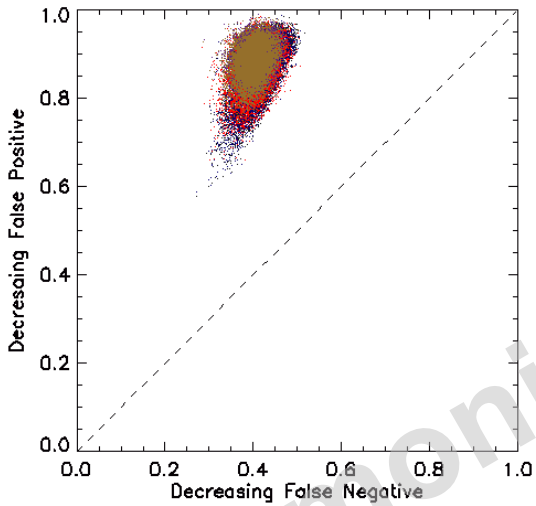
ACS
AS1
AS2
AS3
AS4

average concentration



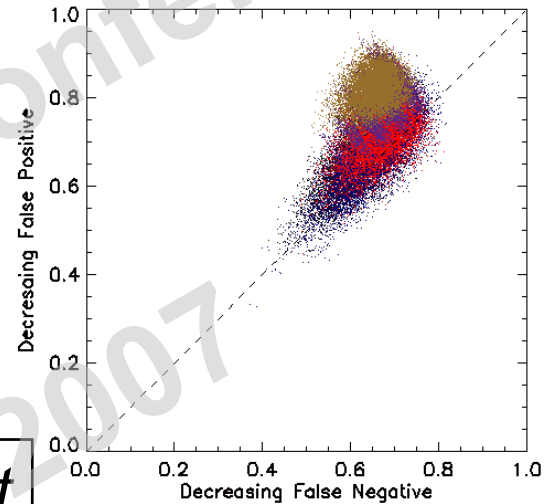
ACS
AS1
AS2
AS3
AS4

ANL CC mini-SODAR MOEs as a function of cutoff altitude for UC



ACS
AS1
AS2
AS3
AS4

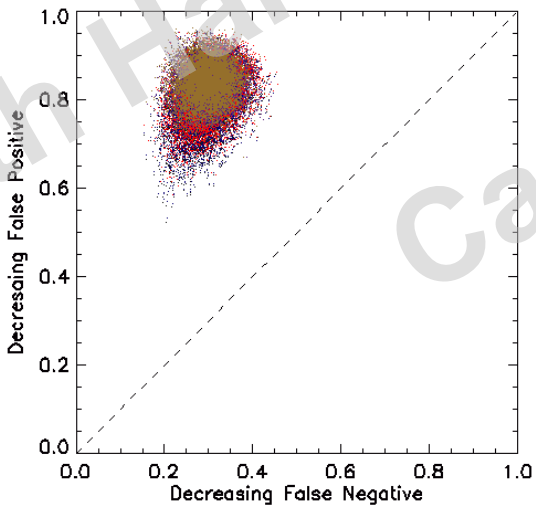
250 ppt threshold



ACS
AS1
AS2
AS3
AS4

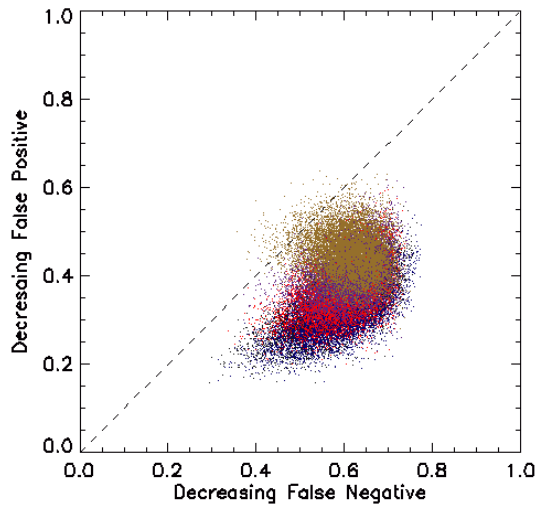
Day

Night



ACS
AS1
AS2
AS3
AS4

average concentration



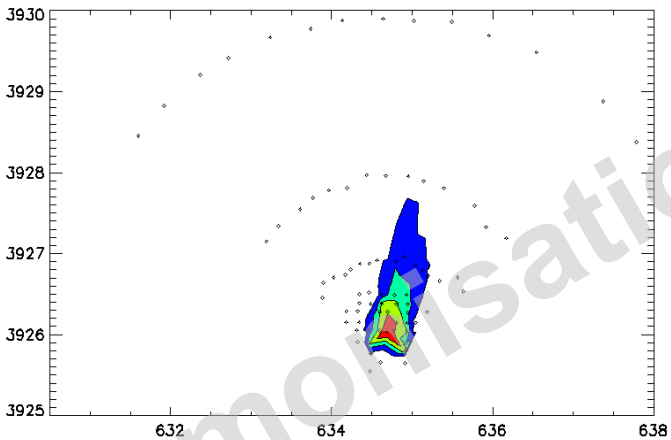
ACS
AS1
AS2
AS3
AS4

Conclusions

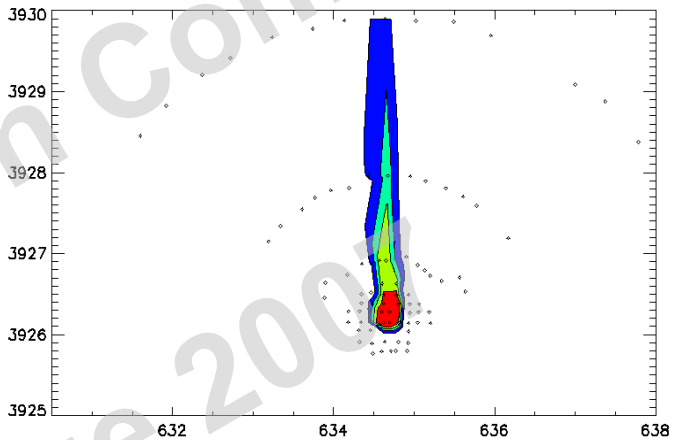
- **At night, (mini) SODAR measurement below ~70-100 meters should not be used when running URBAN HPAC predictions for JU2003**
  - At least when MC-SCIPUFF mass consistent wind-field model is used
  - This is consistent for all (mini) SODARs that have enough altitude data collected
- **There is something going on in Oklahoma City at night that seems to create different flow at low altitude vs. higher altitude**
  - Seems to have a "separated" flow in the city from outside flow
  - This seems to be consistent for all (mini) SODARs that have enough altitude data collected
  - Could be similar to changing stability category from Unstable/Neutral to Stable
    - » Observed SF_6 sampler measurements support this notion

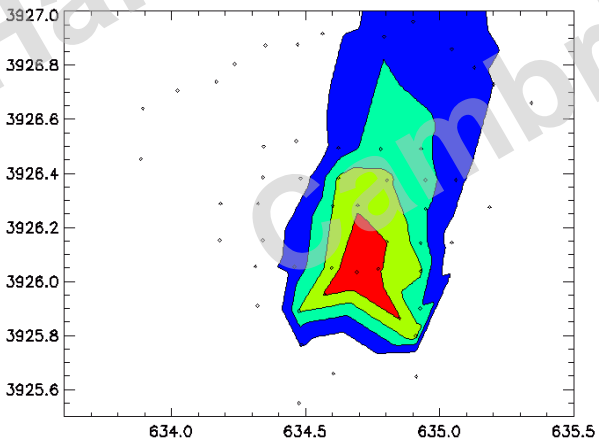
Typical Daytime vs Nighttime Release
1st hour Observed SF_6 Averaged Concentrations

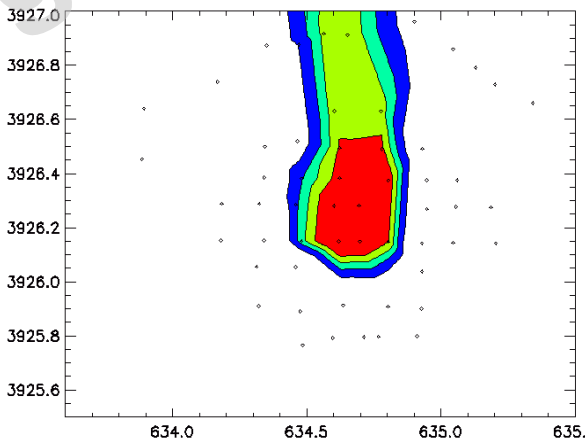
Daytime, IOP 4, Release 2



Nighttime, IOP 9, Release 2







Levels, ppt = 100, 250, 500, 1000

Release Rate Scaled to 2 g/sec

Future Plans

- **Work in progress**
- **Will look at additional wind profile data**
  - Couple of wind profilers, but lowest altitude is ~80 meters
- **Would like to see if similar conclusions holds with other urban modeling systems**
  - MESO/RUSTIC (ITT Industries)
  - QUIC-URB/QUIC-PLUME (Los Alamos National Laboratory)
- **Will examine LiDAR and other sources of real-time data**
  - Not sure about line-of-sight