Institute for Defense Analyses
4850 Mark Center Drive • Alexandria, Virginia 22311-1882

2007 CBIS Conference
Renaissance Austin Hotel
Austin, Texas
8-12 January 2007

Evaluation of Urban HPAC Predictions with Joint Urban 2003 Field Trial Data

Nathan Platt
Steve Warner
Jeffry Urban
James Heagy

January 11, 2007

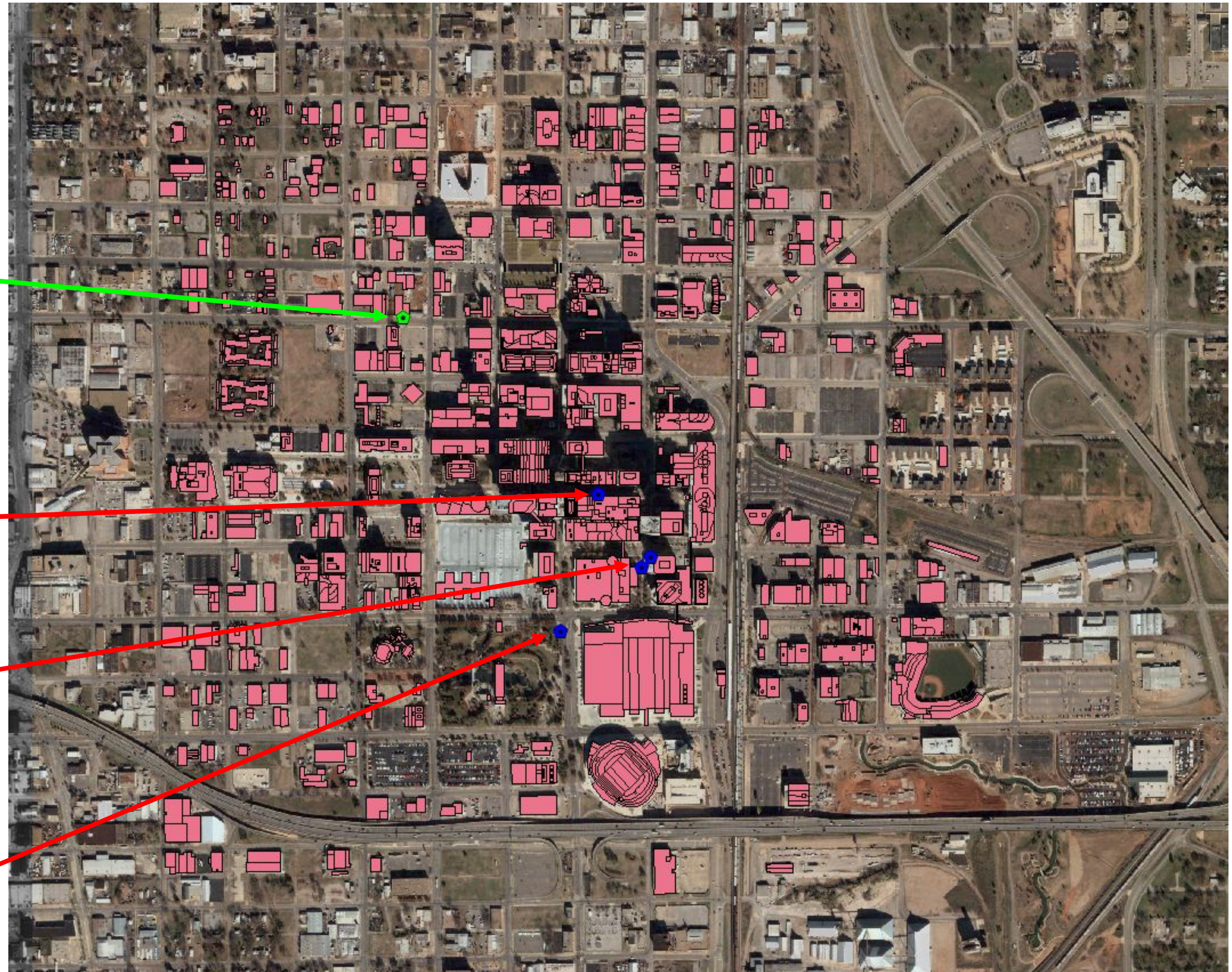
Outline

- Introduction
- Status
- Urban Mode / MET Comparisons
- Altitude MET "Thresholding"
- PROFILE ALL versus MEDOC meteorological input format

Introduction

- **Past IDA studies of Salt Lake City (“Urban 2000”) & MUST**
- **Joint Urban 2003 field trial – a multi agency effort conducted in Oklahoma City during the summer of 2003**
  - For this study, we examined the outdoor SF_6 releases only
- **10 IOP’s**
  - Continuous releases: **29**
  - Puff releases: 40
  - Additional mini-IOP on 7/15/05 to help understand vertical dispersion using crane samplers
- **Wealth of meteorological data**

JU2003 Downtown - Releases



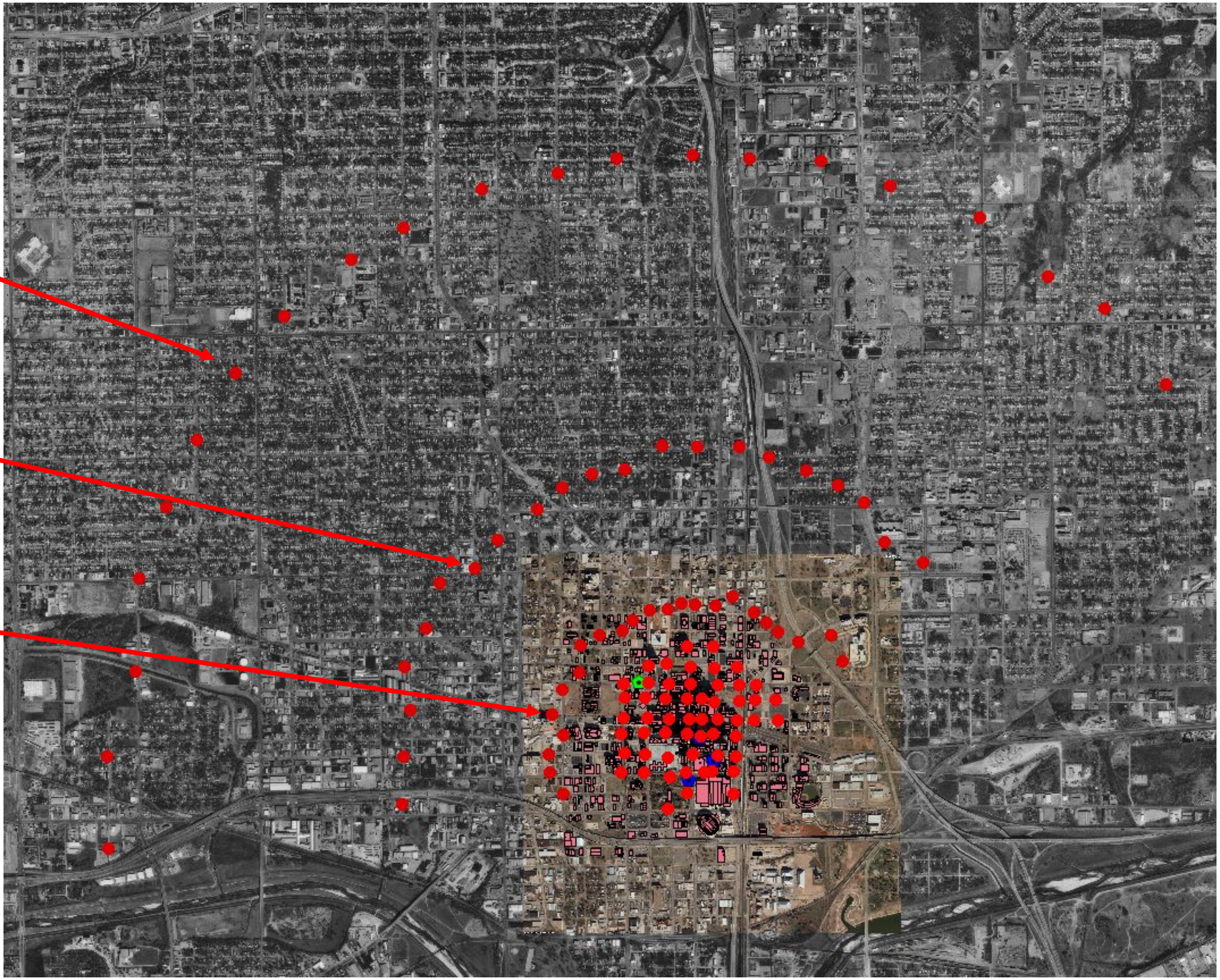
Hudson & Parker mini-IOP

Park

Westin

Botanical Gardens

ARL FRD CBD, Arcs



4km arc

2km arc

1km arc

Urban T&D Evaluation

- **Urban HPAC Configurations**
  - Baseline (UC)
  - UDM (DM)
  - UWM (WM)
  - UWM+UDM (DW)
  - Micro Swift/Spray (MS)

used in this presentation

- **Other Models**
  - MESO/RUSTIC (ITT)
    - » Models are obtained and we're learning how to run them
  - QUIC-URB/QUIC-PLUME (LANL)
    - » Models are obtained and we're learning how to run them

Status

- **To date, we have used over 50 separate MET input options to create HPAC predictions**
  - Some of these MET inputs were created for us by
    - » NCAR (RTFDDA, VLAS)
    - » NGIC (GCAT)
    - » DSTO-Australia (CCAM)
  - These include “low-altitude” MET thresholding for SODARs
- **Created over 2000 HPAC projects**
  - Developed “batching” capability to run multiple Urban HPAC projects without GUI
    - » Based in ICE
  - Total number of HPAC runs is well over 3000!
    - » Large number of projects were run more than once
      - MSS projects
      - SODARs and Profiler MET projects
- **Statistical and graphical evaluations near completion**

Joint Urban 2003
Separate MET Inputs to HPAC

Name	Description	Met Type	IOPs	Release	SMP time Interval	Mass Consistent Wind	Comment
BAS	Surrogate for DTRA met server OBS	sfc+prf	1-10	1-29	150	SWIFT	UC, DM, WM, DW, MS
BA1	**Surrogate for DTRA met server OBS**	**sfc+prf**	**1-10**	**1-29**	**150**	**SWIFT**	**WM, DW, MS**
BSS	Surrogate for DTRA met server OBS	sfc	1-10	1-29	150	SWIFT	UC, DM, WM, DW, MS
BSP	Surrogate for DTRA met server OBS	prf	1-10	1-29	150	SWIFT	UC, DM, WM, DW, MS
BRB	GCAT (PROFILE ALL)	gridded prf	1-10	1-29	150	SWIFT	UC, DM, WM, DW, MS
BR1	**GCAT (PROFILE ALL)**	**gridded prf**	**1-10**	**1-29**	**150**	**SWIFT**	**WM, DW**
GCM	GCAT Medoc format	MEDOC	1-10	1-29	150		UC, DM, WM, DW
PNS	PNNL cluster Sodar	prf	1-10	1-29	150	MC-SCIPUFF	UC, DM, WM, DW, MS
PNP	PNNL cluster Profiler	prf	2-10	3-29	150	MC-SCIPUFF	UC, DM, WM, DW, MS
PNA	PNNL cluster Sodar+Profiler (IOP01 has Sodar only)	prf	2-10	3-29	150	MC-SCIPUFF	UC, DM, WM, DW, MS
P1A	**PNNL cluster Sodar+Profiler (IOP01 has Sodar only)**	**prf**	**2-10**	**3-29**	**150**	**MC-SCIPUFF**	**WM, DW**
SBG	Botanical Gardens mini-Sodar	prf	2-10	3-29	150	MC-SCIPUFF	UC, DM, WM, DW, MS
ACS	ANL CC cluster Sodar	prf	1-2; 4-10	1-5; 9-29	150	MC-SCIPUFF	UC, DM, WM, DW, MS
ACP	ANL CC cluster Profiler	prf	1-10	1-29	150	MC-SCIPUFF	UC, DM, WM, DW, MS
ACA	ANL CC cluster Sodar+Profiler (IOP03 has Profiler only)	prf	1-2; 4-10	1-5; 9-29	150	MC-SCIPUFF	UC, DM, WM, DW, MS
A1C	**ANL CC cluster Sodar+Profiler (IOP03 has Profiler only)**	**prf**	**1-2; 4-10**	**1-5; 9-29**	**150**	**MC-SCIPUFF**	**WM, DW**
PO1	Post Office, 10 sec met data	sfc	1-10	1-29	150	SWIFT	UC and DM only
PO2	Post Office, 5 min Central Scalar Averaging	sfc	1-10	1-29	150	SWIFT	UC and DM only
PO3	Post Office, 5 min Central Vector Averaging	sfc	1-10	1-29	150	SWIFT	UC and DM only
PO4	Post Office, 5 min interval, last 2 min Scalar Averaging	sfc	1-10	1-29	150	SWIFT	UC and DM only
PO5	Post Office, 5 min interval, last 2 min Vector Averaging	sfc	1-10	1-29	150	SWIFT	UC and DM only
PO6	Post Office, 15 min Central Scalar Averaging	sfc	1-10	1-29	150	SWIFT	UC and DM only
PO7	Post Office, 15 min Central Vector Averaging	sfc	1-10	1-29	150	SWIFT	UC, DM, WM, DW, MS
P7A	**Post Office, 15 min Central Vector Averaging**	**sfc**	**1-10**	**1-29**	**150**	**SWIFT**	**WM, DW, MS**
PO8	Post Office, 15 min interval, last 2 min Scalar Averaging	sfc	1-10	1-29	150	SWIFT	UC and DM only
PO9	**Post Office, 15 min interval, last 2 min Vector Averaging**	**sfc**	**1-10**	**1-29**	**150**	SWIFT	**Problem with IOP_02_DM**
C01	CCAM (1 km)	MEDOC	1-10	1-29	150		UC, DM, WM, DW
C08	CCAM (8 km)	MEDOC	1-10	1-29	150		UC, DM, WM, DW
C60	CCAM (60 km)	MEDOC	1-10	1-29	150		UC, DM, WM, DW
SB1	Botanical Gardens mini-Sodar, Cutoff Alt = 30 m	prf	2-10	3-29	150	MC-SCIPUFF	UC, DM
SB2	Botanical Gardens mini-Sodar, Cutoff Alt = 50 m	prf	2-10	3-29	150	MC-SCIPUFF	UC, DM
SB3	Botanical Gardens mini-Sodar, Cutoff Alt = 70 m	prf	2-10	3-29	150	MC-SCIPUFF	UC, DM
PS2	PNNL cluster Sodar, Cutoff Alt = 50 m	prf	1-10	1-29	150	MC-SCIPUFF	UC, DM
PS3	PNNL cluster Sodar, Cutoff Alt = 70 m	prf	1-10	1-29	150	MC-SCIPUFF	UC, DM
PS4	PNNL cluster Sodar, Cutoff Alt = 100 m	prf	1-10	1-29	150	MC-SCIPUFF	UC, DM
PS5	PNNL cluster Sodar, Cutoff Alt = 150 m	prf	1-10	1-29	150	MC-SCIPUFF	UC, DM
PS6	PNNL cluster Sodar, Cutoff Alt = 250 m	prf	1-10	1-29	150	MC-SCIPUFF	UC, DM
PS7	PNNL cluster Sodar, Cutoff Alt = 350 m	prf	1-10	1-29	150	MC-SCIPUFF	UC, DM
AS1	ANL CC cluster Sodar, Cutoff Alt = 30 m	prf	1-2; 4-10	1-5; 9-29	150	MC-SCIPUFF	UC, DM
AS2	ANL CC cluster Sodar, Cutoff Alt = 50 m	prf	1-2; 4-10	1-5; 9-29	150	MC-SCIPUFF	UC, DM
AS3	ANL CC cluster Sodar, Cutoff Alt = 70 m	prf	1-2; 4-10	1-5; 9-29	150	MC-SCIPUFF	UC, DM
AS4	ANL CC cluster Sodar, Cutoff Alt = 100 m	prf	1-2; 4-10	1-5; 9-29	150	MC-SCIPUFF	UC, DM
CRA	Crane 10-minute vector avergaed sonics data	prf	1-10	1-29	150	MC-SCIPUFF	UC, DM
CR1	Crane sonics, Cutoff Alt = 30 m	prf	1-10	1-29	150	MC-SCIPUFF	UC, DM
CR2	Crane sonics, Cutoff Alt = 50 m	prf	1-10	1-29	150	MC-SCIPUFF	UC, DM
CR3	Crane sonics, Cutoff Alt = 70 m	prf	1-10	1-29	150	MC-SCIPUFF	UC, DM
DPG	DPG mini-Sodar	prf	1-10	1-29	150	MC-SCIPUFF	UC, DM
DP0	DPG mini-Sodar, Cutoff Alt = 15 m	prf	1-10	1-29	150	MC-SCIPUFF	UC, DM
DP1	DPG mini-Sodar, Cutoff Alt = 30 m	prf	1-10	1-29	150	MC-SCIPUFF	UC, DM
DP2	DPG mini-Sodar, Cutoff Alt = 50 m	prf	1-10	1-29	150	MC-SCIPUFF	UC, DM
DP3	DPG mini-Sodar, Cutoff Alt = 70 m	prf	1-10	1-29	150	MC-SCIPUFF	UC, DM
DP4	DPG mini-Sodar, Cutoff Alt = 100 m	prf	1-10	1-29	150	MC-SCIPUFF	UC, DM
FRD	FRD Sodar	prf	2-10	3-29	150	MC-SCIPUFF	UC, DM
FR2	FRD mini-Sodar, Cutoff Alt = 50 m	prf	2-10	3-29	150	MC-SCIPUFF	UC, DM
FR3	FRD mini-Sodar, Cutoff Alt = 70 m	prf	2-10	3-29	150	MC-SCIPUFF	UC, DM
FR4	FRD mini-Sodar, Cutoff Alt = 100 m	prf	2-10	3-29	150	MC-SCIPUFF	UC, DM
FR5	FRD mini-Sodar, Cutoff Alt = 150 m	prf	2-10	3-29	150	MC-SCIPUFF	UC, DM

SWIFT, MC-SCIPUFF Processed MET and MEDOC Formatted MET

- **For MET input options that involve inputs that SWIFT was originally designed for, we used SWIFT to obtain mass consistent winds**
  - "DTRA Server MET" like inputs
    - » Surface station(s) .SFC and Upper Air profile(s) .PRF
  - Regularly spatio-temporally gridded data
    - » Forecasts by MM5
    - » These include GCAT "PROFILE ALL" and RTFFDA from NCAR

- **For MET input options that use JU2003 wind-profile instruments, we used MC-SCIPUFF to obtain mass consistent winds**
  - Profilers
  - (mini) Sodars
  - Crane Sonics
    - » It is possible that Crane Sonics would be compatible with SWIFT, but then results would be incompatible with SODARs

- **For MET input options that would use LIDAR data, we plan to use SWIFT**
  - Running of NCAR's VLAS outputs on IOP 2 seems to confirm this

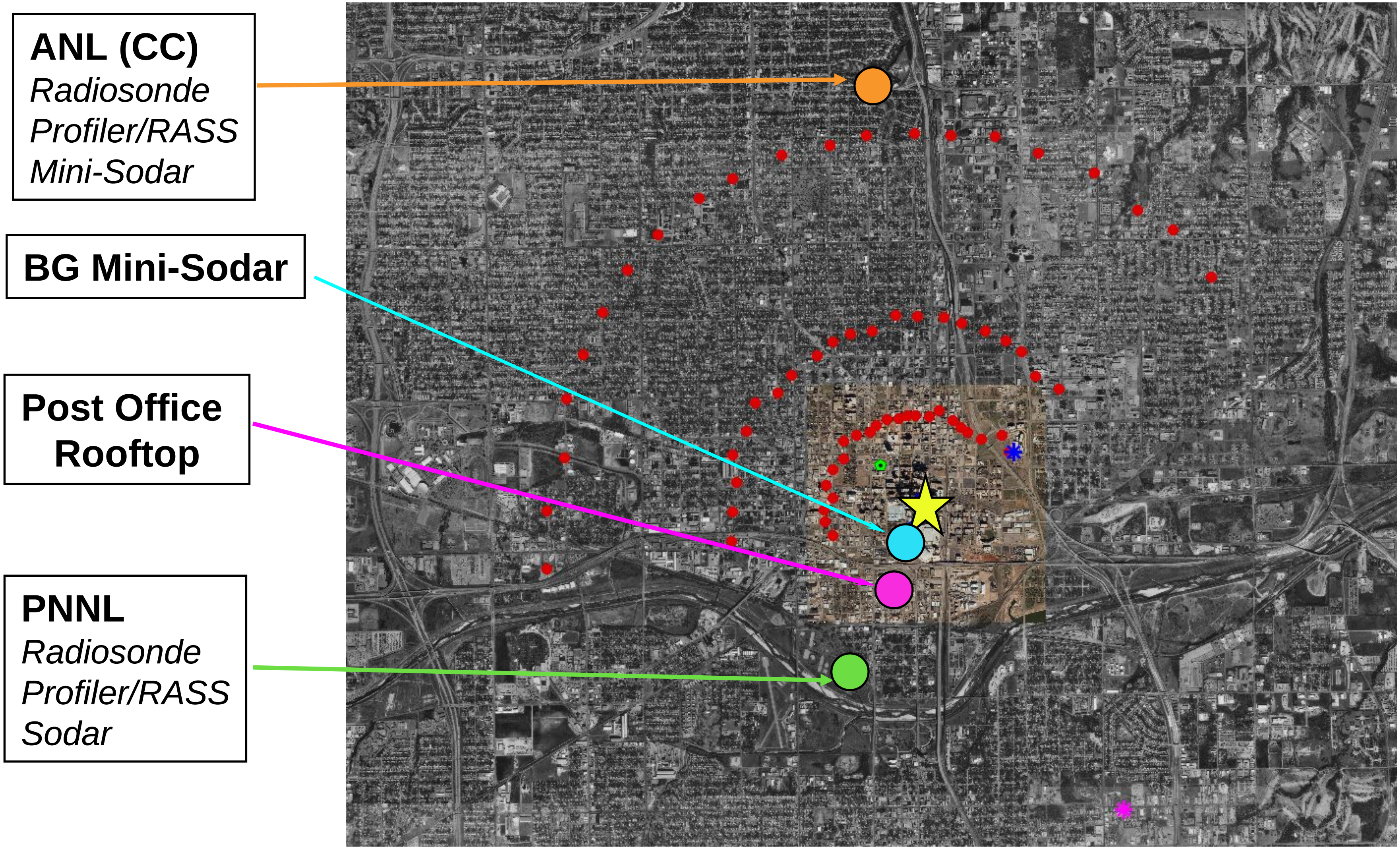
- **CCAM MET (DSTO-Australia) is available only in MEDOC format**
  - Obtained and run GCAT MEDOC formatted MET predictions for comparisons with CCAM

- **This leads to a caution when comparing different MET options**

Urban Mode / MET Comparisons Notation for MET Input Options

- **ACA: ANL (downwind) Sodar + Profiler**
- **PNA: PNNL (upwind) Sodar + Profiler**
- **PO7: Post Office rooftop station**
- **BAS: Baseline (airport) Surface + Profiler**
- **BRB: GCAT "Profile All"**
- **SBG: Botanical Gardens mini-Sodar**

JU 2003 MET Stations: PNNL, ANL Clusters, Post Office Rooftop, & Botanical Gardens



Baseline MET
Within 30km of Releases

- **Surface**
  - Source: University of Utah Mesonet (MesoWest)
    - » Stations: KOUN, KOKC, KPWA, KTIK
- **Upper Air**
  - Source: University of Wyoming
  - Station: KOUN

Red – Surface
Blue – Profile
Black - Releases

Prevailing wind speed is from South

Standard Statistics and 2D Measures of Effectiveness

- **Calculated stats (13 types) and 2D MOEs for 30-min average concentrations for all available ARL FRD samplers**
- **Considered 29 continuous releases (10 IOPs)**
- **Stats and MOEs calculated for each 2-hr observation period, then averaged over releases**
  - Separate averages for day and night releases
- **MOE: 250 ppt threshold "hazard area"**
- **Stats for this discussion:**

$$NAD = \frac{\sum_i |C_p^{(i)} - C_o^{(i)}|}{\sum_i (C_p^{(i)} + C_o^{(i)})}$$

$$FB = \frac{\sum_i (C_p^{(i)} - C_o^{(i)})}{0.5 \sum_i (C_p^{(i)} + C_o^{(i)})}$$

Comparisons done for:

1) *day/night*
2) *all surface samplers, CBD, all arcs, each arc*
3) *each of eight 15-minute periods, each of four 30-minute periods, each of two 1-hour periods, all 30-minute periods , and all 2-hour periods*
4) *In total, ~82,000 metrics computed*

Results

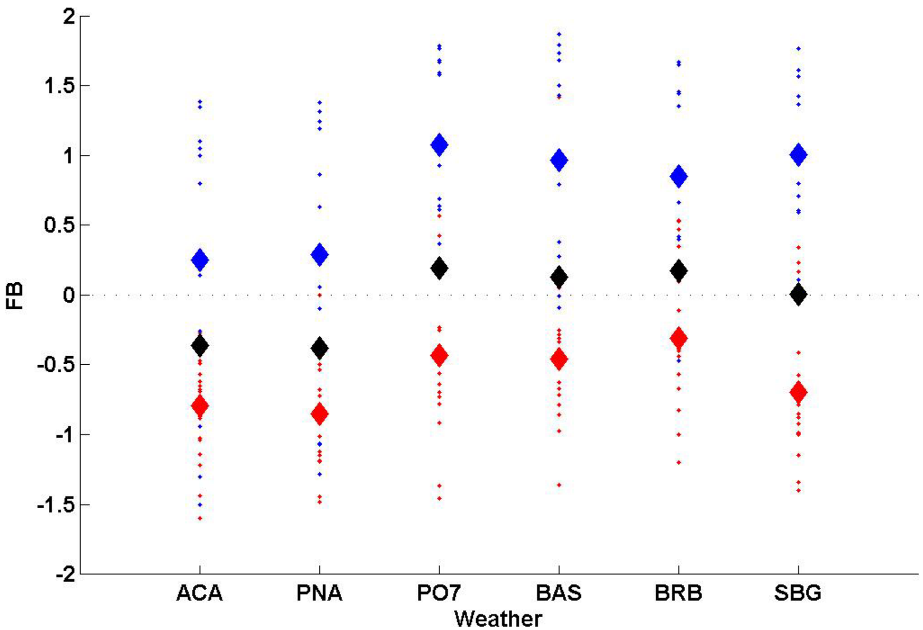
- **Night vs. Day discrepancy for UC, UDM, UWM, UDM+UDW modes**
  - Significant differences in model performance depending on time of day
  - Daytime performance is better than nighttime for MET input options with a large day – night discrepancy (Baseline, GCAT, PO, BG)
    - » For small discrepancies (ANL, PNNL): night slightly better than day
  - UC, UDM, UWM, and UDM+UDW all tend to under-predict during the day and over-predict at night (across nearly all MET input options)

- **Little day – night discrepancy for MSS mode**
  - MSS tends to over-predict during both day and night
  - MSS day and night results are similar (neither has clearly better results)

- **Model performance**
  - Daytime model performance difficult to rank
  - UDM performs better than UC at night for PNA, Baseline, GCAT, BG
  - MSS performs better than UC at night for PO, Baseline, BG
  - MSS has less prediction bias than UC, UDM at night for PO, Baseline, GCAT
    - » During the day, bias is also small (comparable to UDM+UDW with the opposite sign)
  - UWM does not appear to enhance performance over UDM

- **MET input options**
  - Post Office, GCAT, Baseline met perform slightly better than ANL and PNNL MET during the day but over-predict worse at night for UC, UDM, UWM, UDM+UDW
  - ANL MET seems to be the best overall performer at night (small margin)
  - PO MET seems to be the best overall performer during the day (small margin)
  - Botanical Gardens mini-Sodar is the worst performer at night

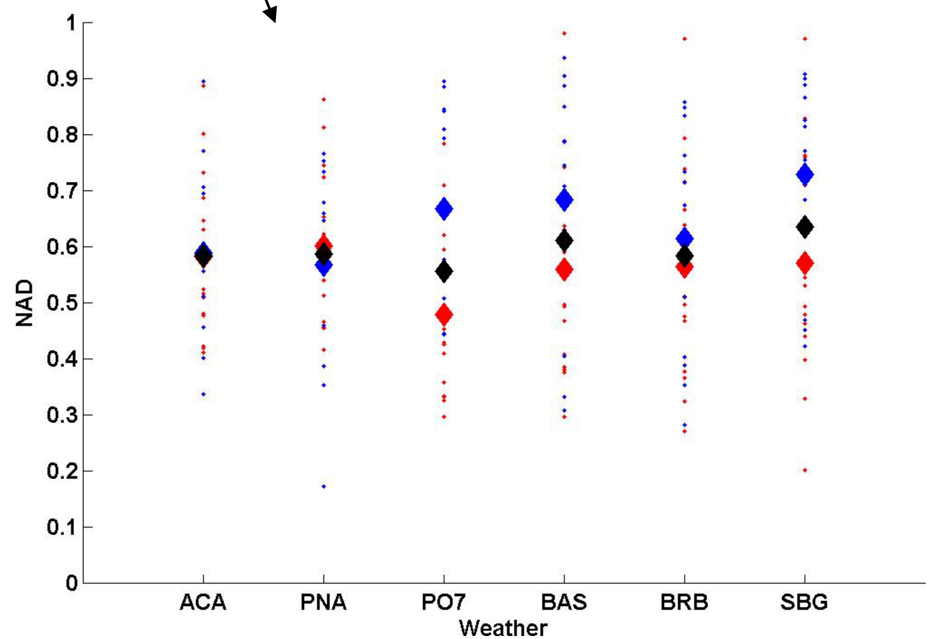
FB and NAD for UDM Mode



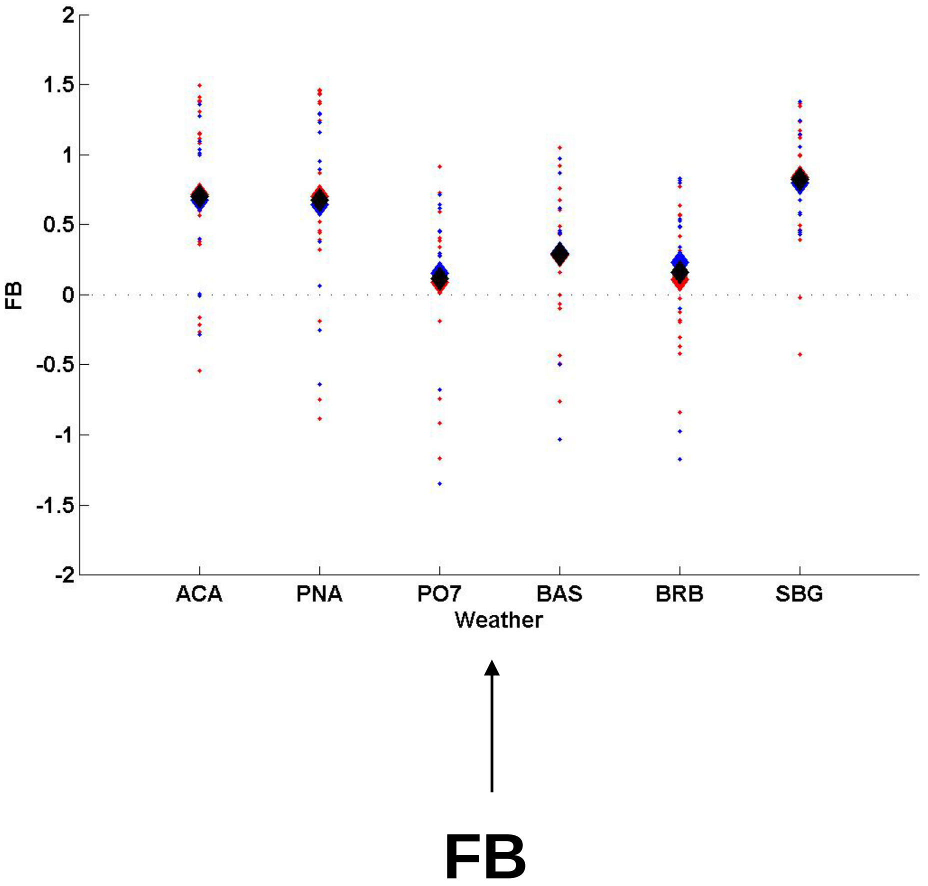
FB

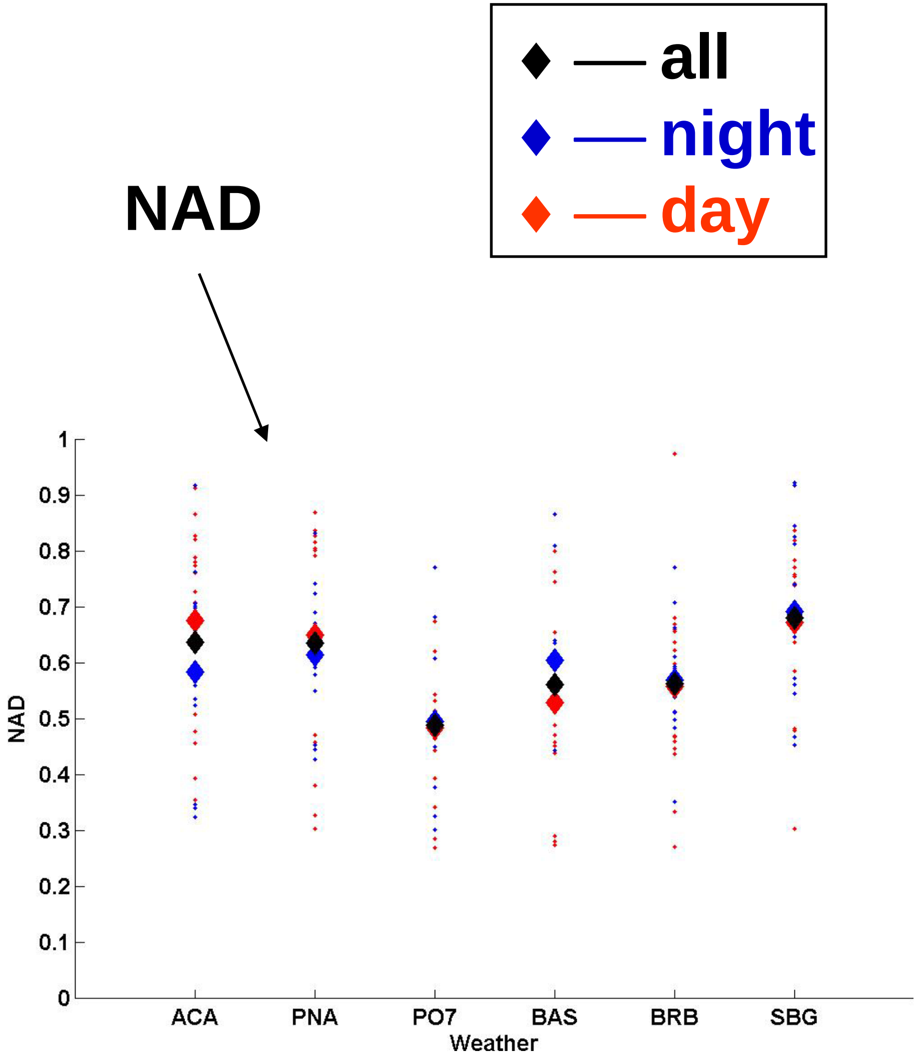
NAD

◆ — all
◆ — night
◆ — day

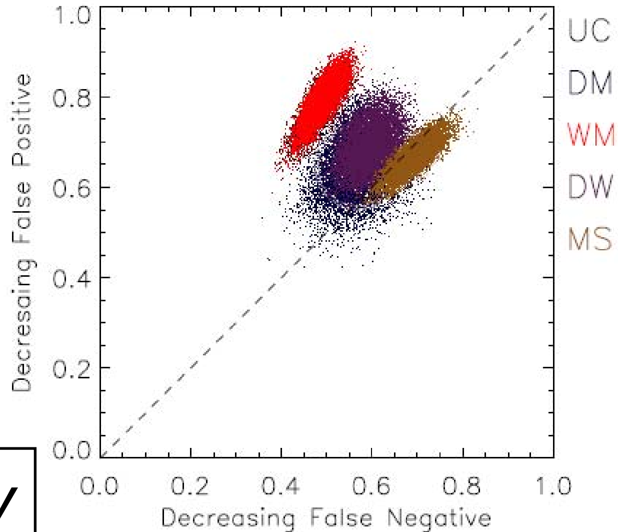


FB and NAD for MSS Mode

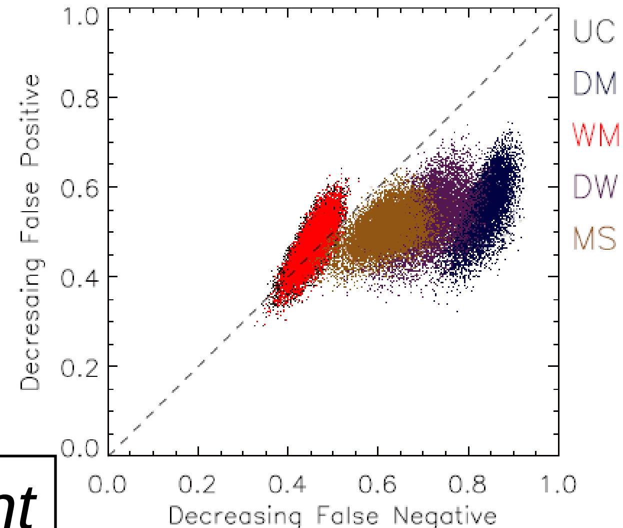




MOE Values (30 minute): Average Concentration and 250 ppt Threshold (for Baseline MET Input Option)

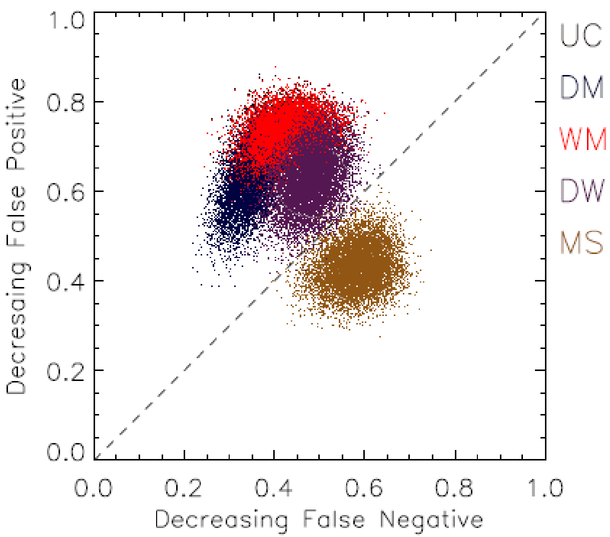


250 ppt threshold

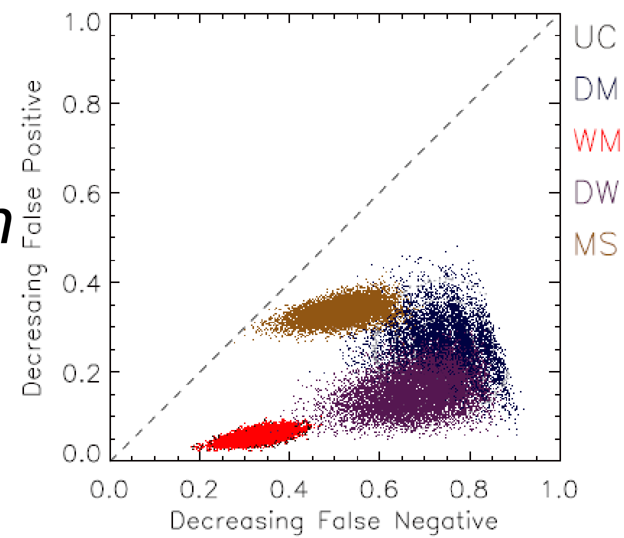


Day

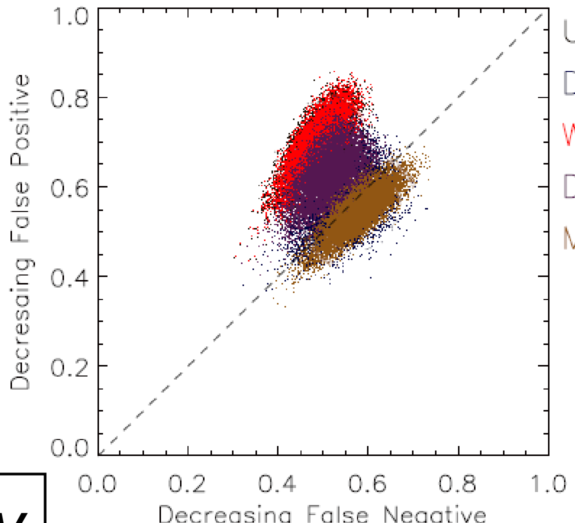
Night



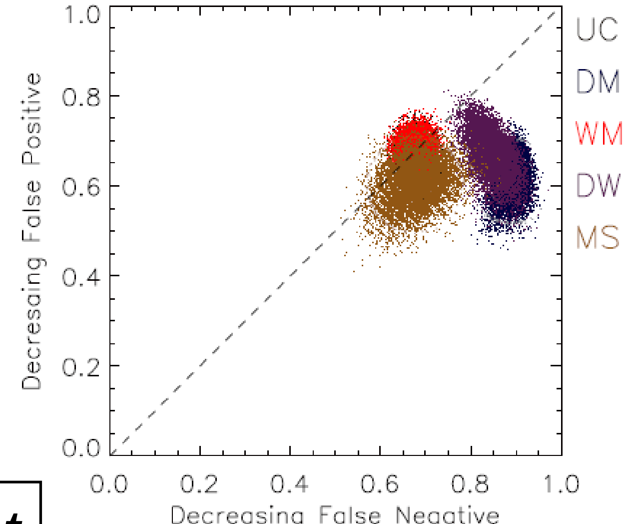
average concentration



MOE Values (30 minute): Average Concentration and 250 ppt Threshold (for GCAT MET Input Option)

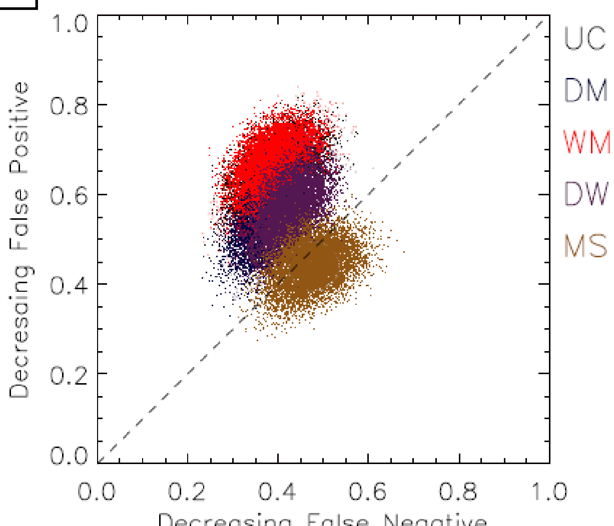


250 ppt threshold

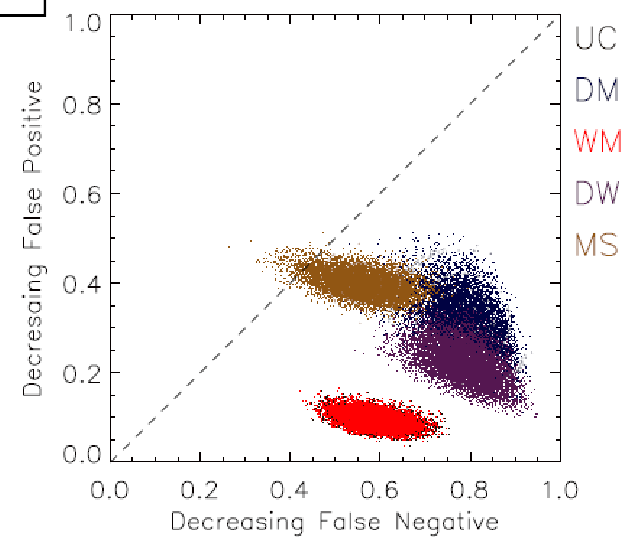


Day

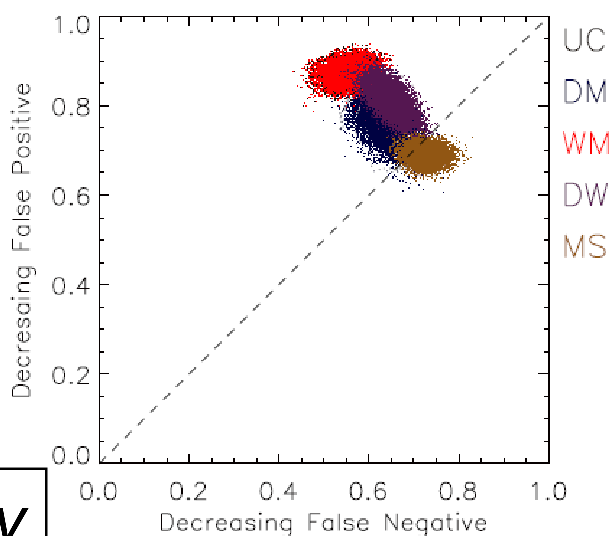
Night



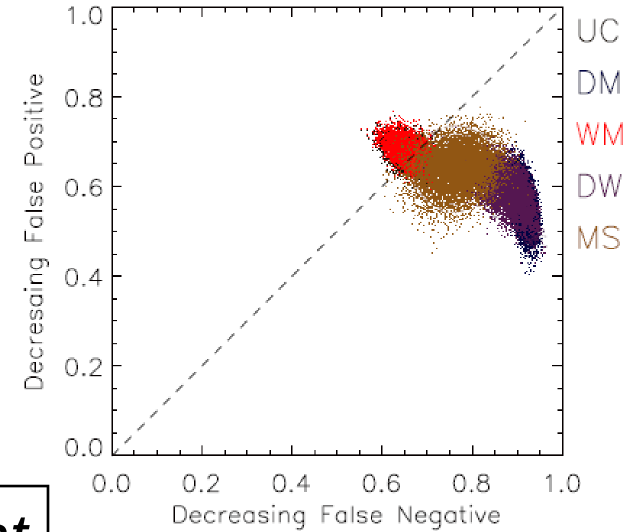
average concentration



MOE Values (30 minute): Average Concentration and 250 ppt Threshold (for Post Office MET Input Option)

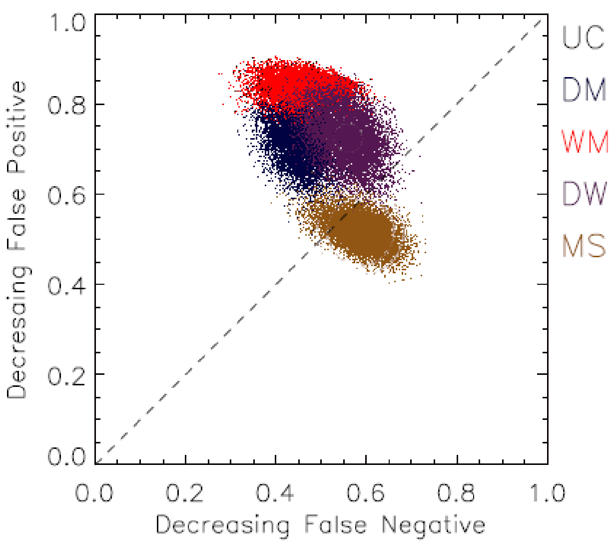


250 ppt threshold

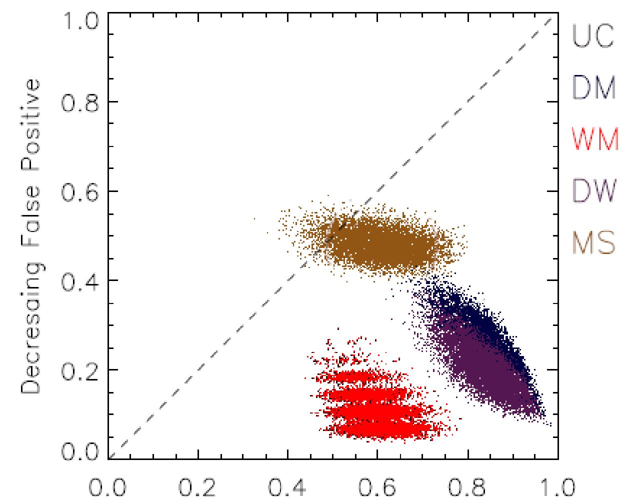


Day

Night



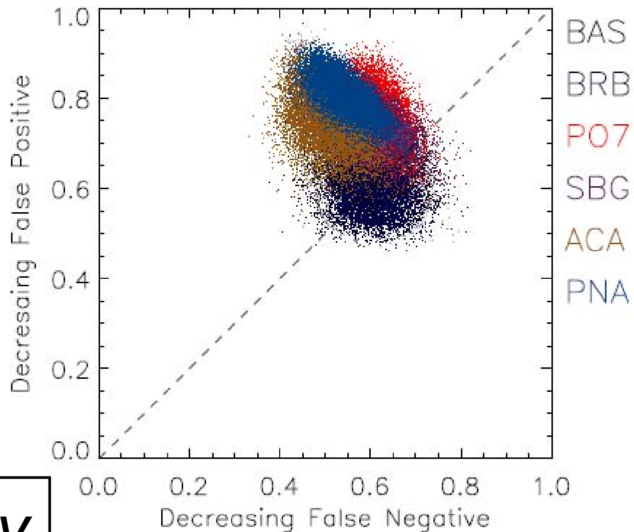
average concentration



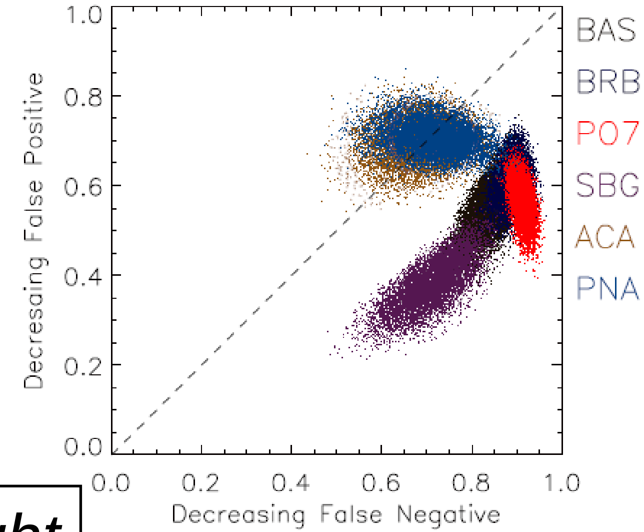
MOE Values (30 minute): Average Concentration and 250 ppt Threshold (for UDM mode)

250 ppt threshold

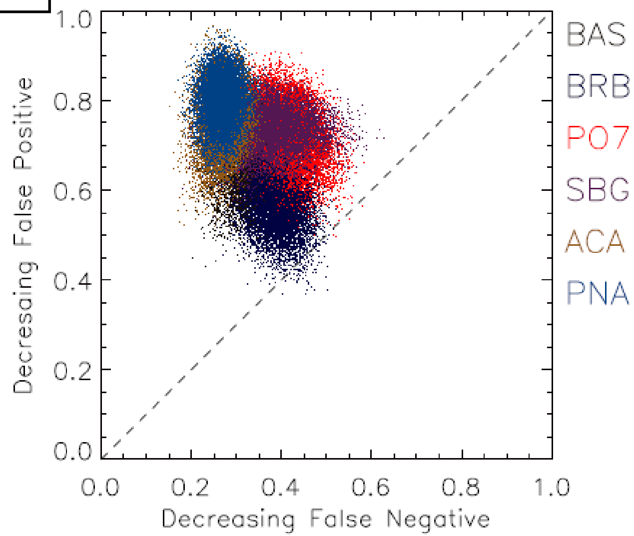
Day

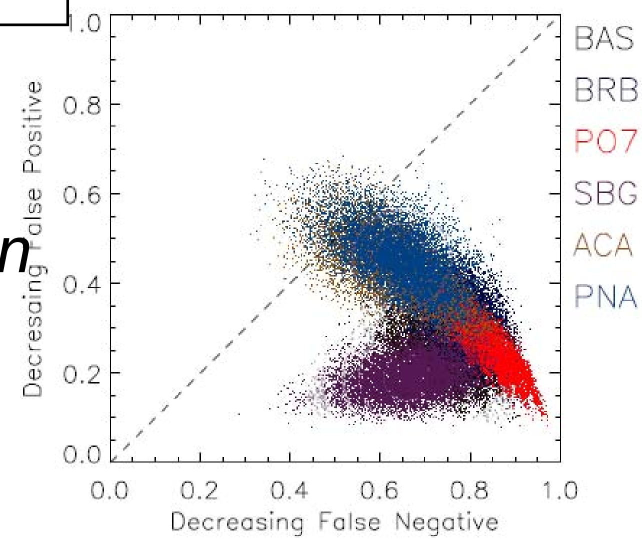


Night

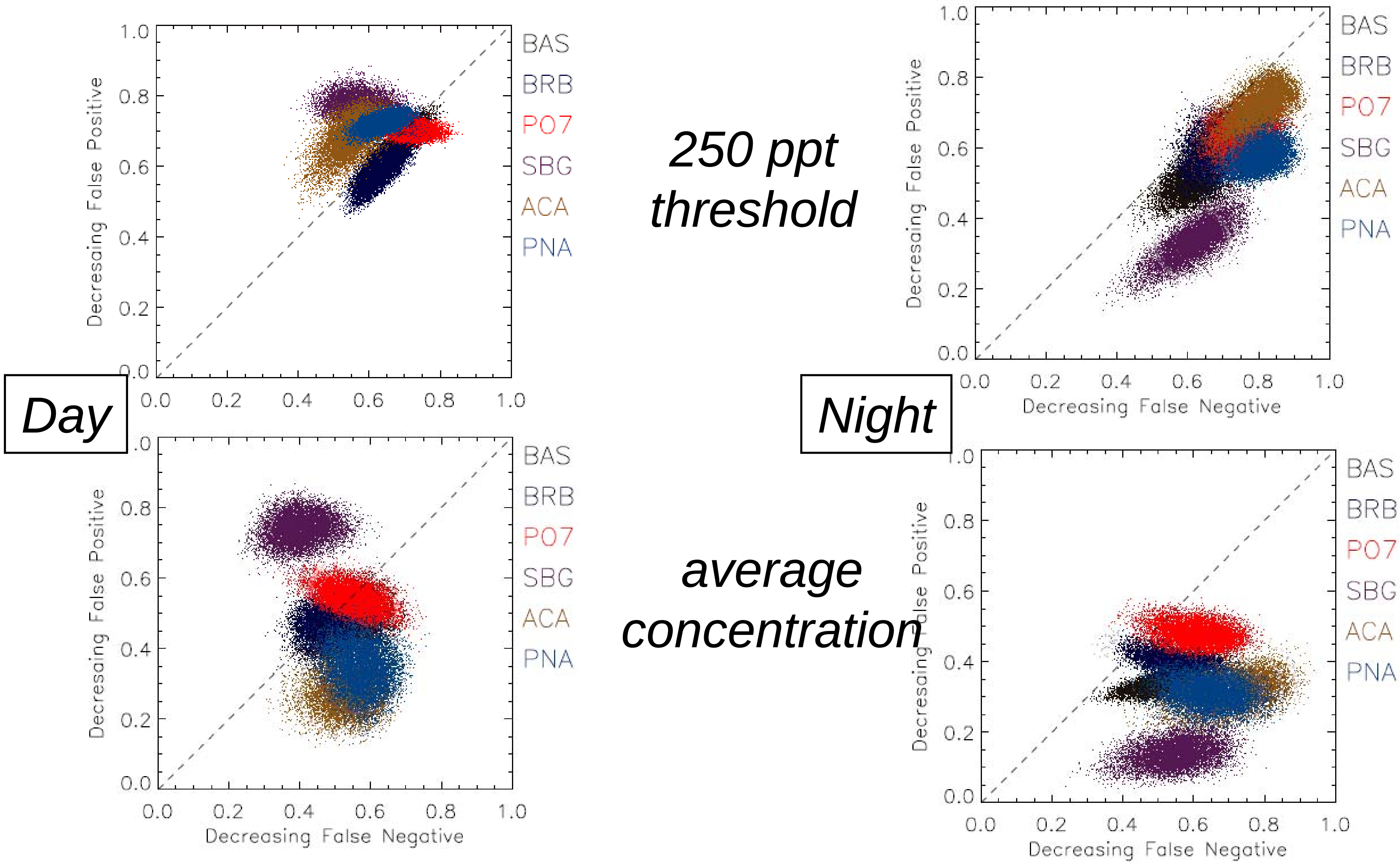


average concentration





MOE Values (30 minute): Average Concentration and 250 ppt Threshold (for MSS mode)



Results

- **Night vs. Day discrepancy for UC, UDM, UWM, UDM+UDW modes**
  - Significant differences in model performance depending on time of day
  - Daytime performance is better than nighttime for MET input options with a large day – night discrepancy (Baseline, GCAT, PO, BG)
    - » For small discrepancies (ANL, PNNL): night slightly better than day?
  - UC, UDM, UWM, and UDM+UDW all tend to underpredict during the day and overpredict at night (across nearly all MET input options)

- **Little day – night discrepancy for MSS mode**
  - MSS tends to overpredict during both day and night
  - MSS day and night results are similar (neither has clearly better results)

- **Model performance**
  - Daytime model performance difficult to rank
  - UDM performs better than UC at night for PNA, Baseline, GCAT, BG
  - MSS performs better than UC at night for PO, Baseline, BG
  - MSS has less prediction bias than UC, UDM at night for PO, Baseline, GCAT
    - » During the day, bias is also small (comparable to UDM+UDW with the opposite sign)
  - UWM does not appear to enhance performance over UDM

- **Met inputs**
  - Post Office, GCAT, Baseline met perform slightly better than ANL and PNNL MET during the day but overpredict worse at night for UC, UDM, UWM, UDM+UDW
  - ANL MET seems to be the best overall performer at night (small margin)
  - PO MET seems to be the best overall performer during the day (small margin)
  - Botanical Gardens mini-Sodar is the worst performer at night

Altitude Met Thresholding

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

ANL CC

FRD

DPG

ARH 10&Harvey

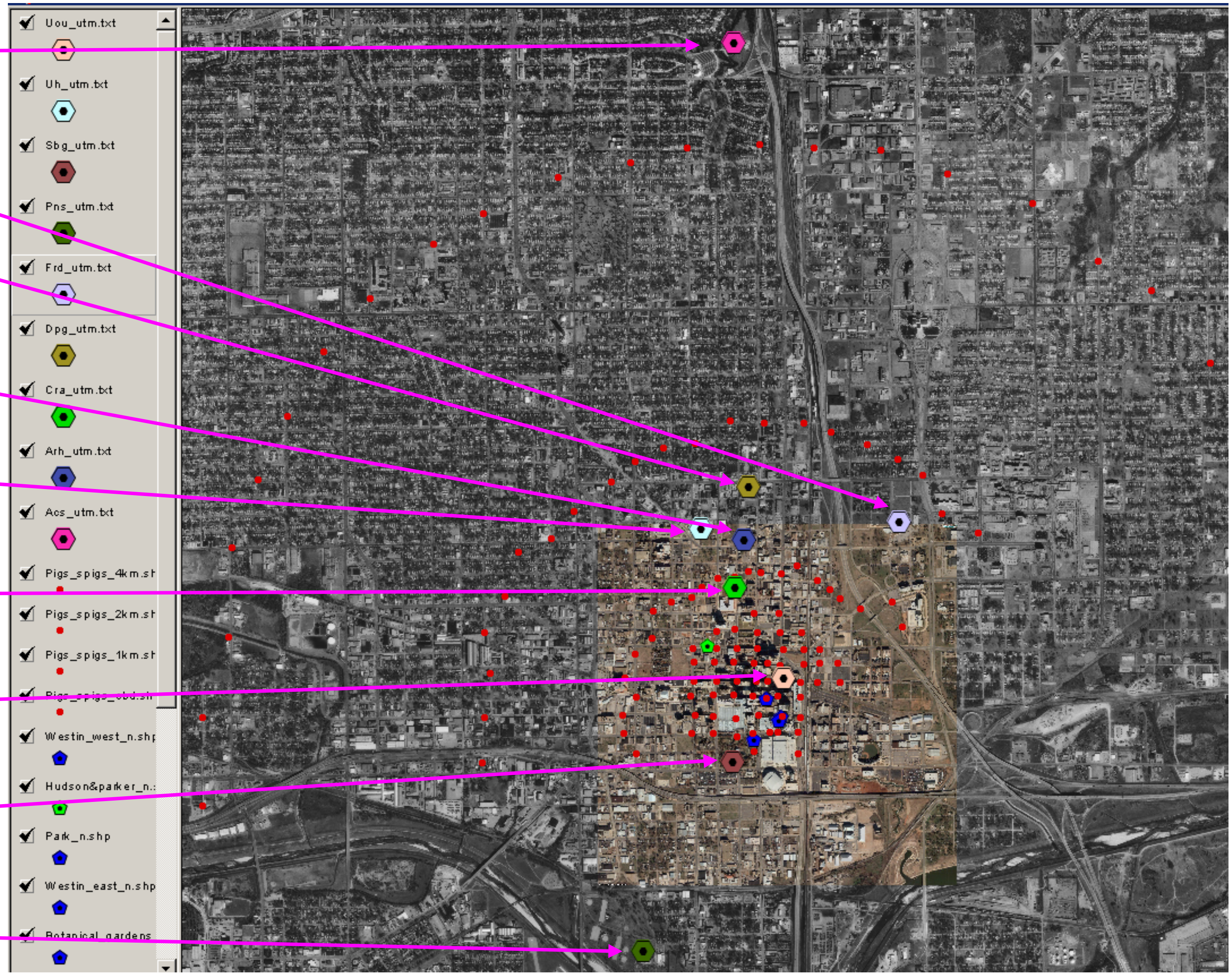
U Houston

Crane

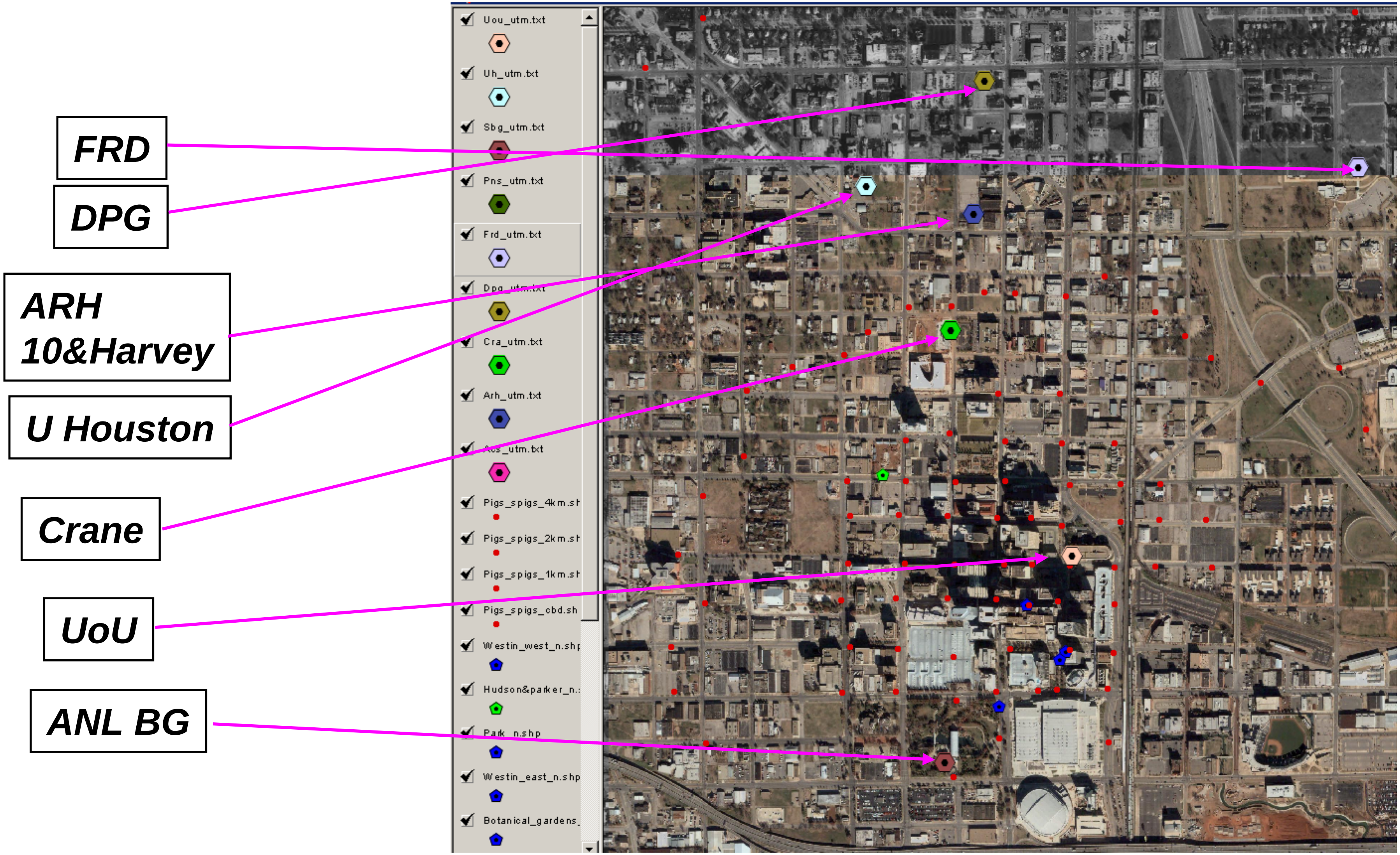
UoU

ANL BG

PNNL



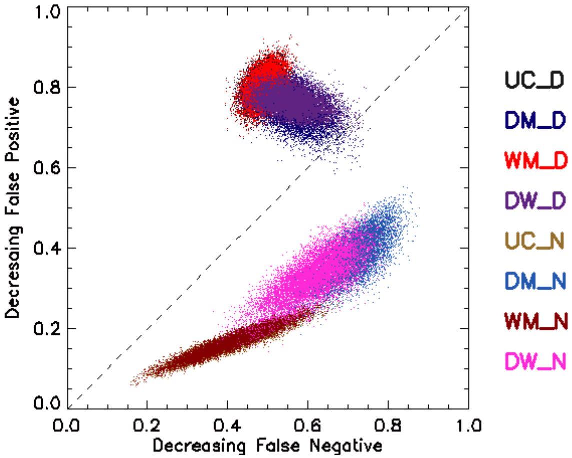
JU2003 FRD Samplers, (mini) Sodars and Crane Downtown Region

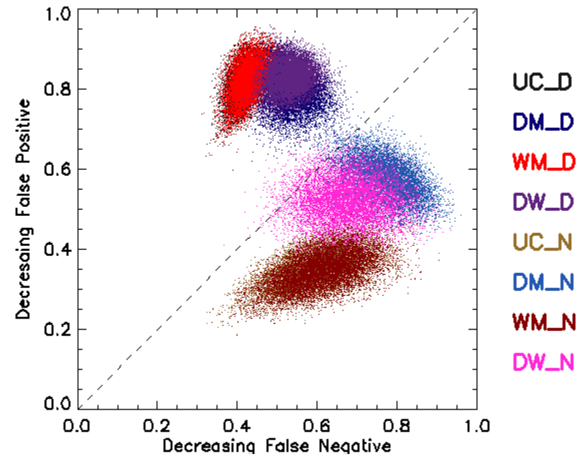


ANL BG and PNNL (mini) Sodar MOE Plots

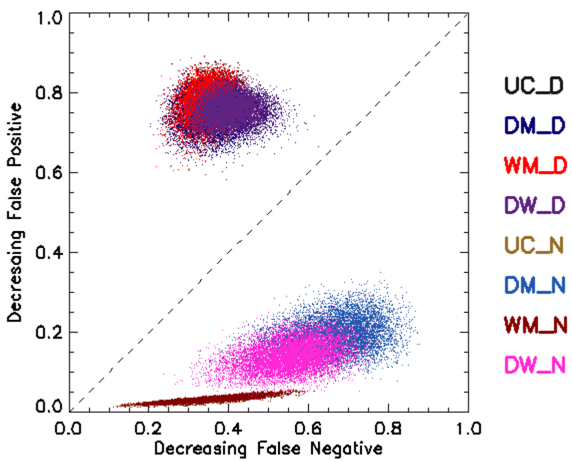
Botanical Gardens mini-Sodar

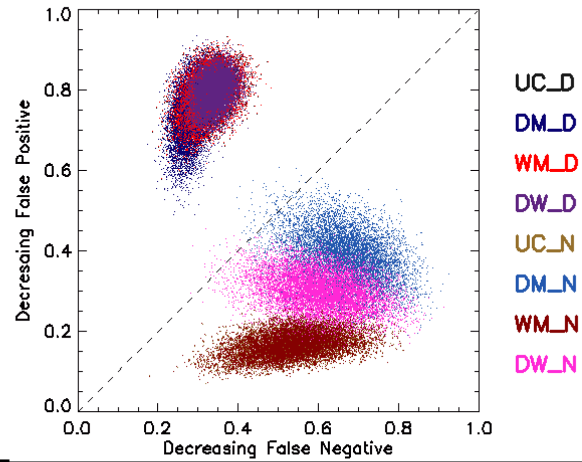
PNNL Sodar





250 ppt threshold

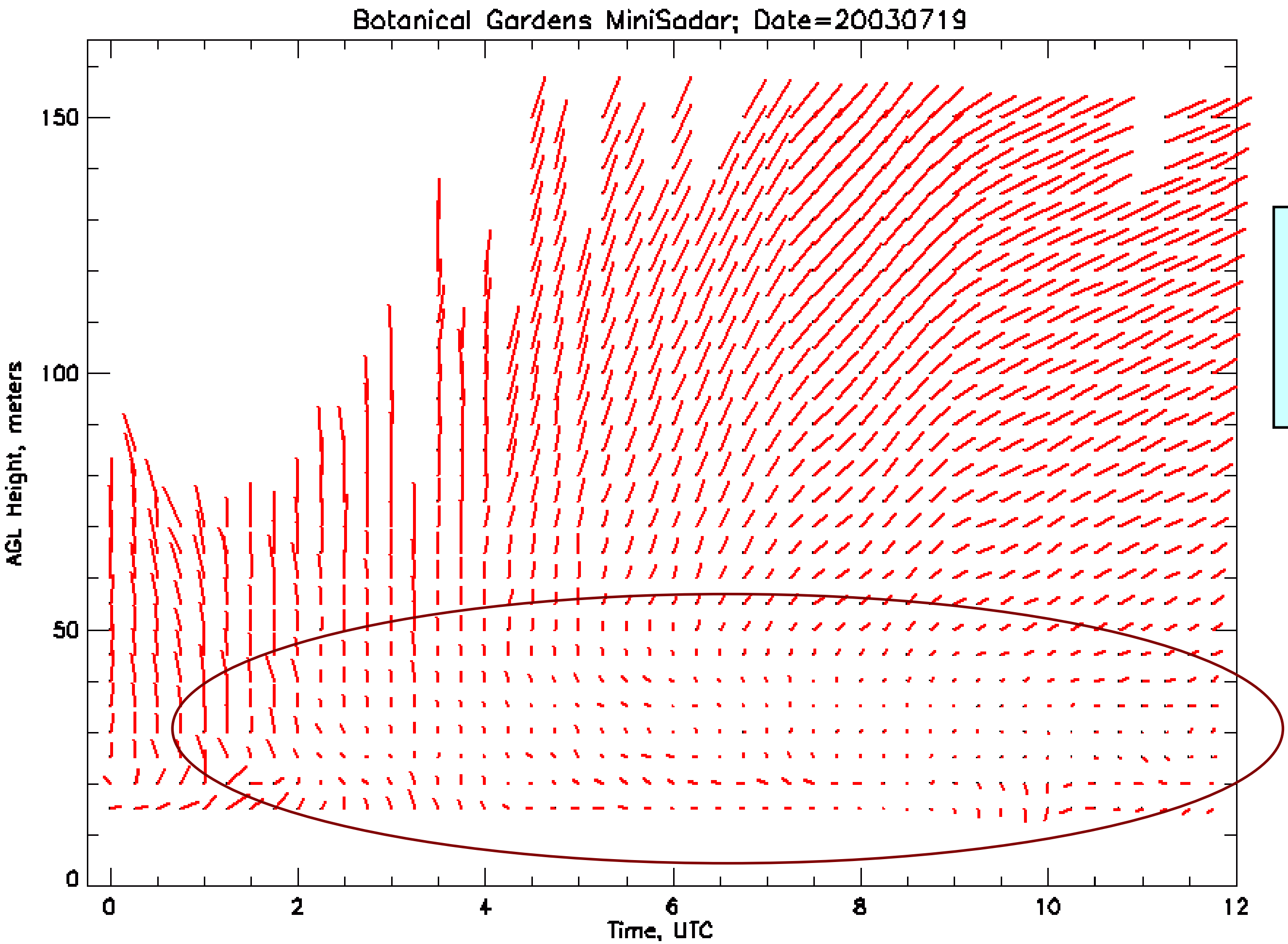




average concentration

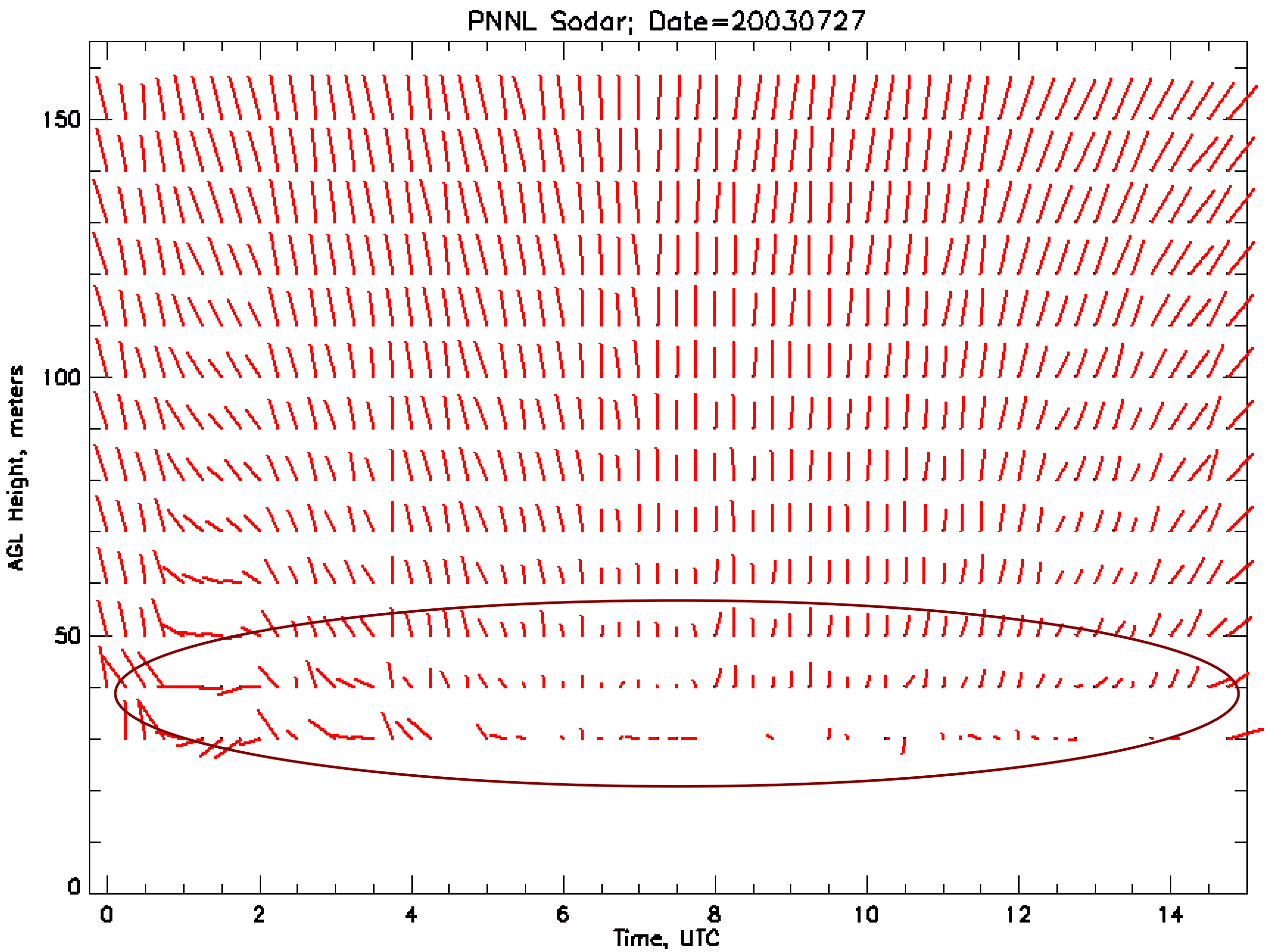
Differences between night and day predictions / Night results seems to be significantly degraded with respect to day predictions

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

Consider effects on URBAN HPAC predictions by removing low lever wind vectors

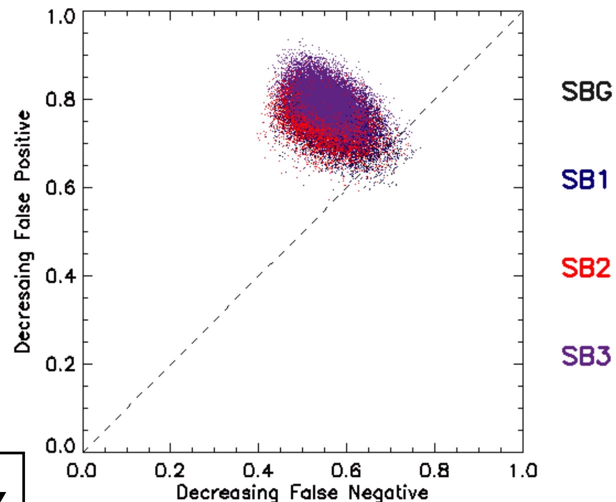
Rules of the Game
Notation Key

- Run URBAN HPAC predictions for all (mini) Sodars
  - 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)

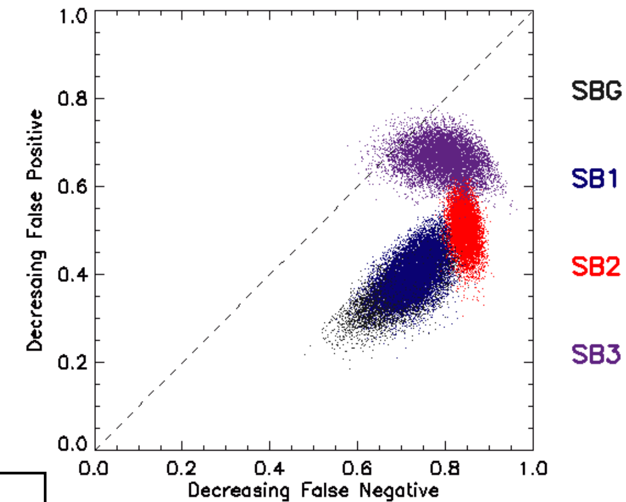
Notation Key

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

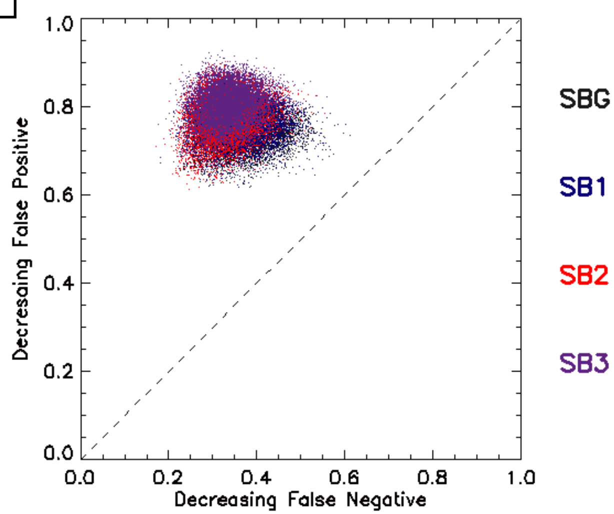


250 ppt threshold

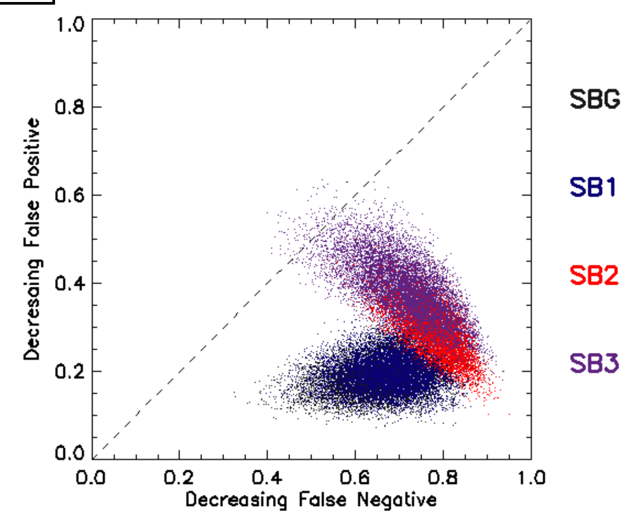


Day

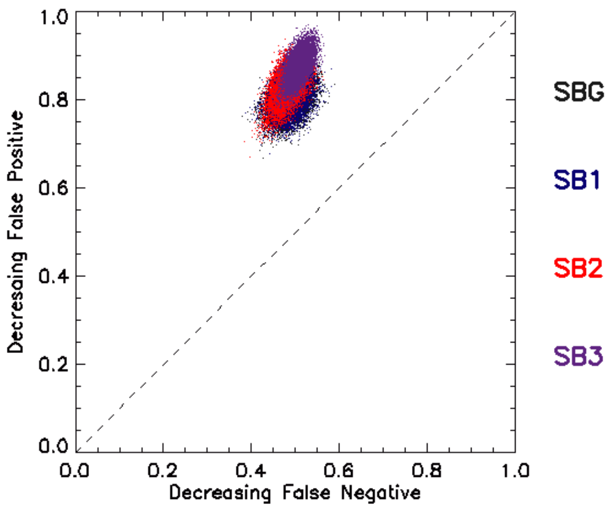
Night



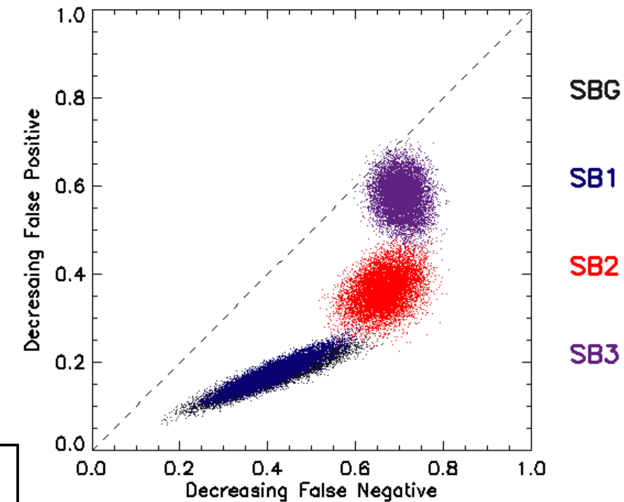
average concentration



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

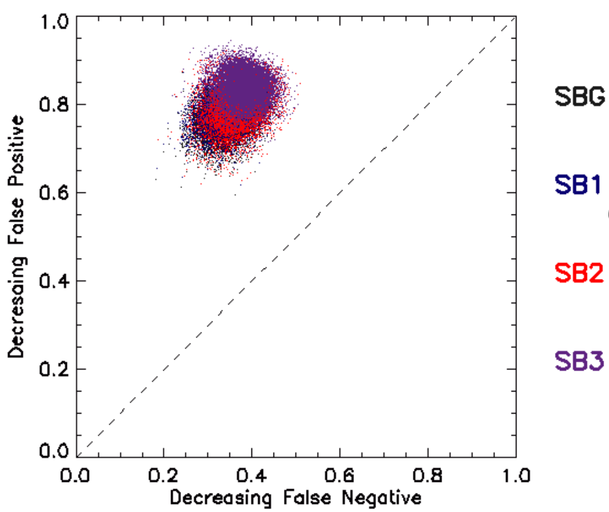


250 ppt threshold

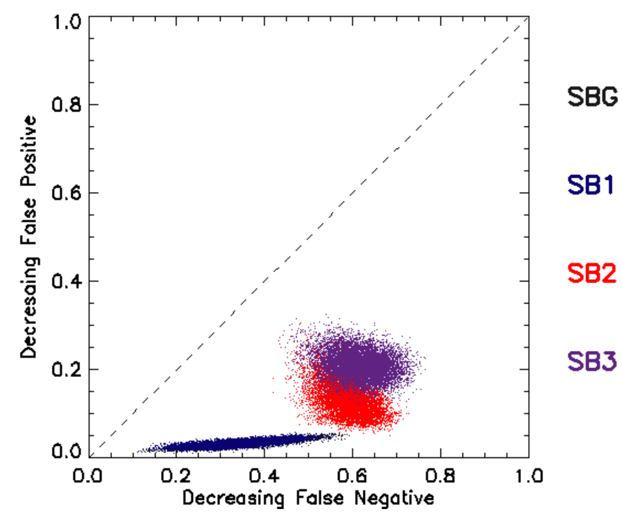


Day

Night

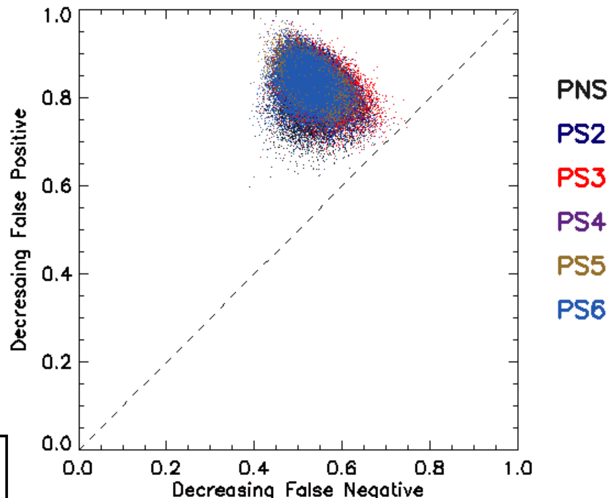


average concentration



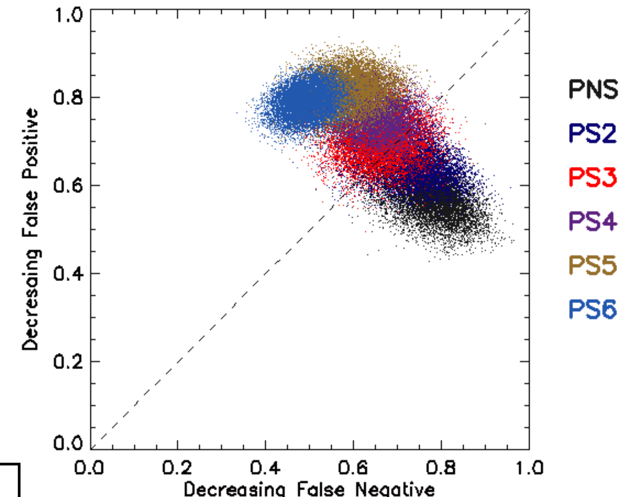
PNNL Sodar MOEs as a function of cutoff altitude for DM

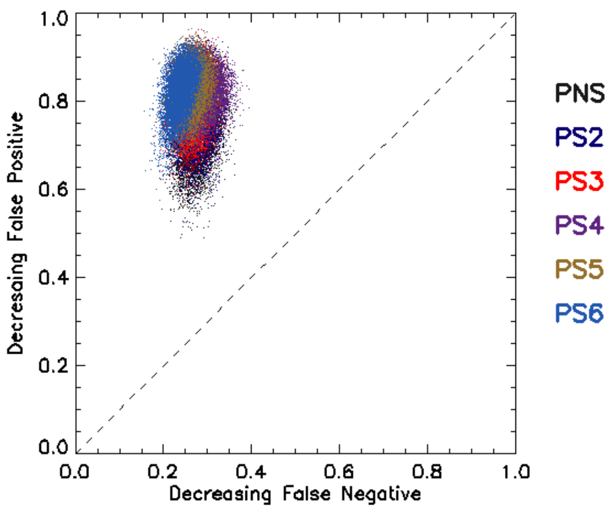
Day



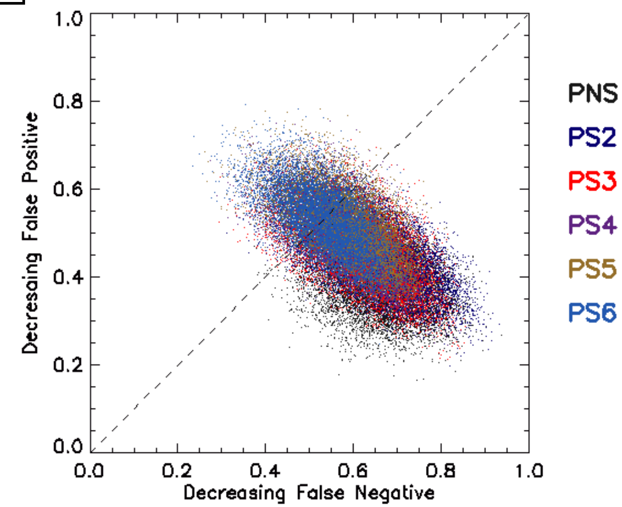
250 ppt threshold

Night

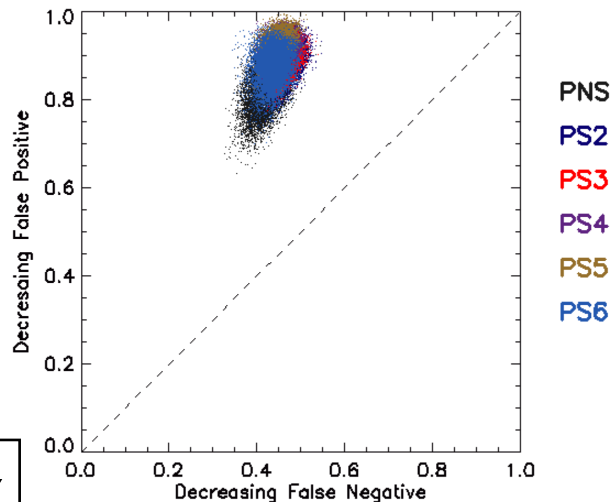




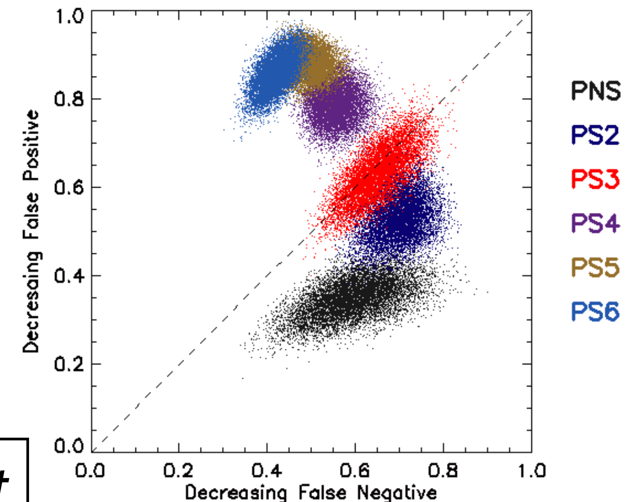
average concentration



PNNL Sodar MOEs
as a function of cutoff altitude for UC

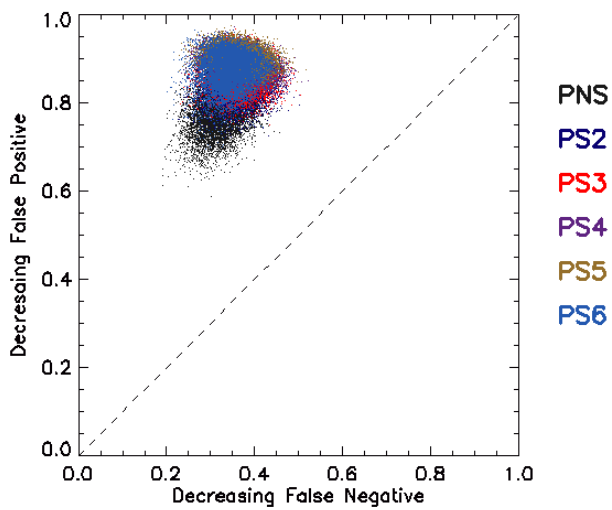


250 ppt threshold

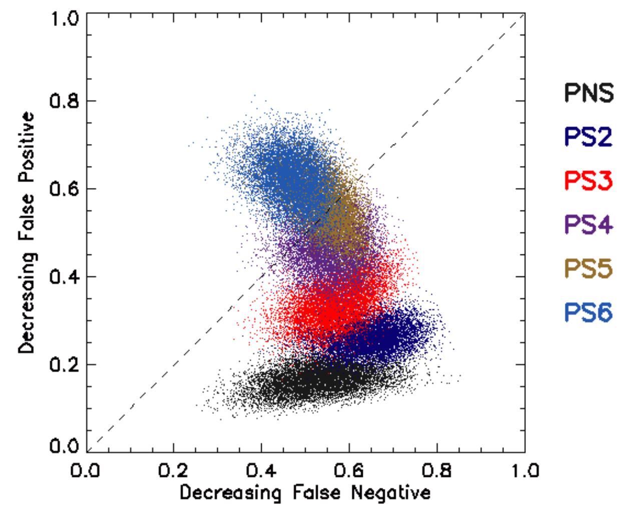


Day

Night



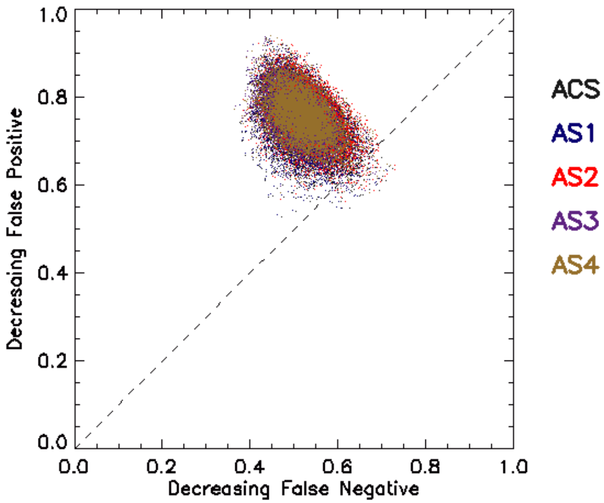
average concentration



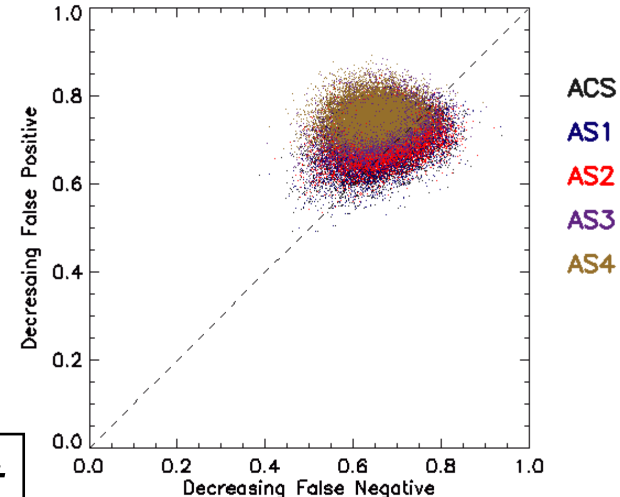
ANL CC Sodar MOEs as a function of cutoff altitude for DM

250 ppt threshold

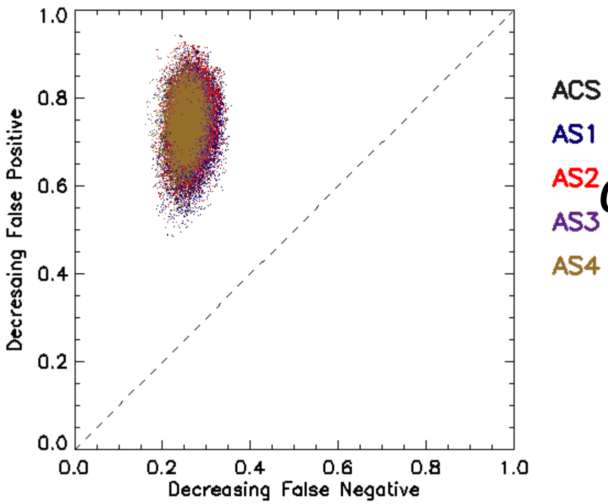
Day

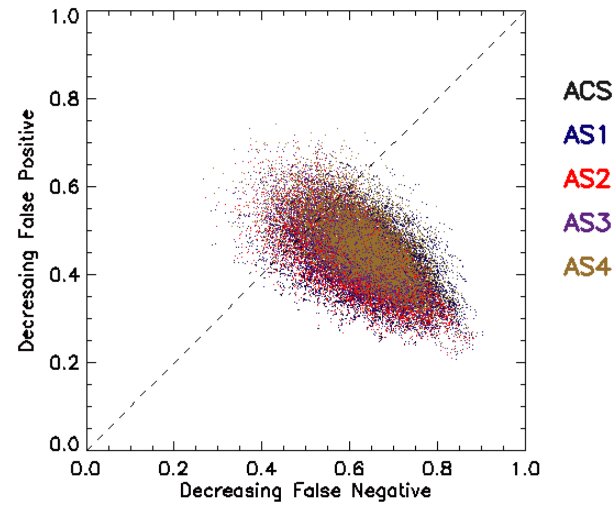


Night

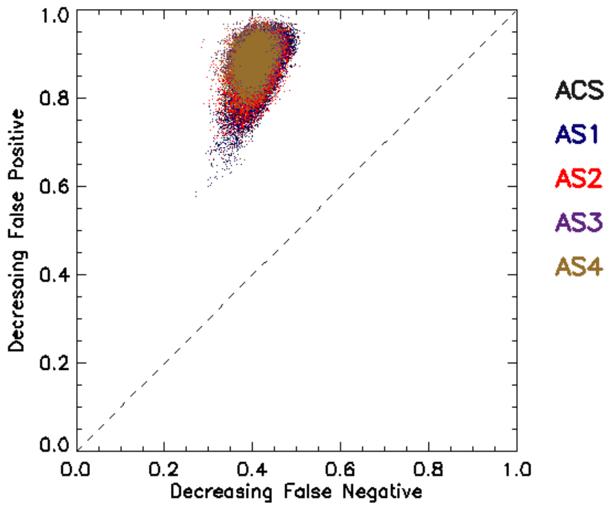


average concentration

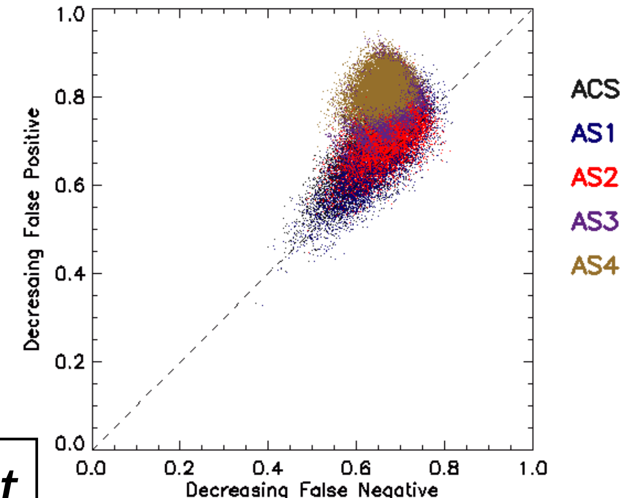




ANL CC Sodar MOEs as a function of cutoff altitude for UC

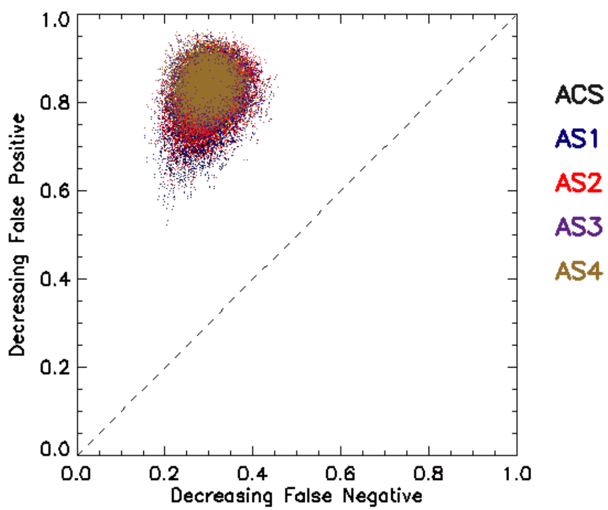


250 ppt threshold

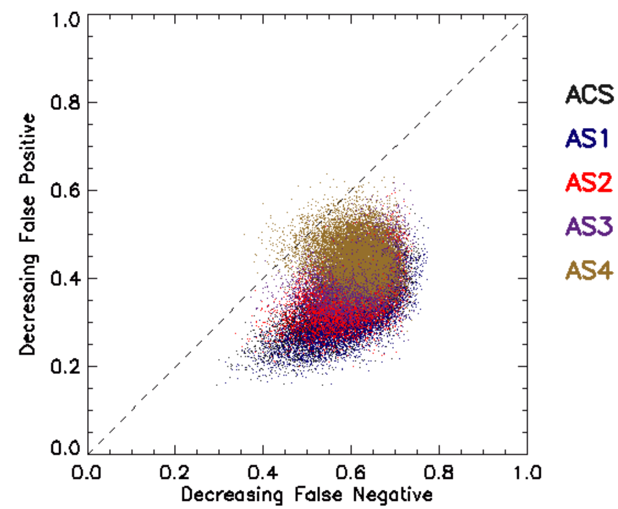


Day

Night



average concentration



Conclusions

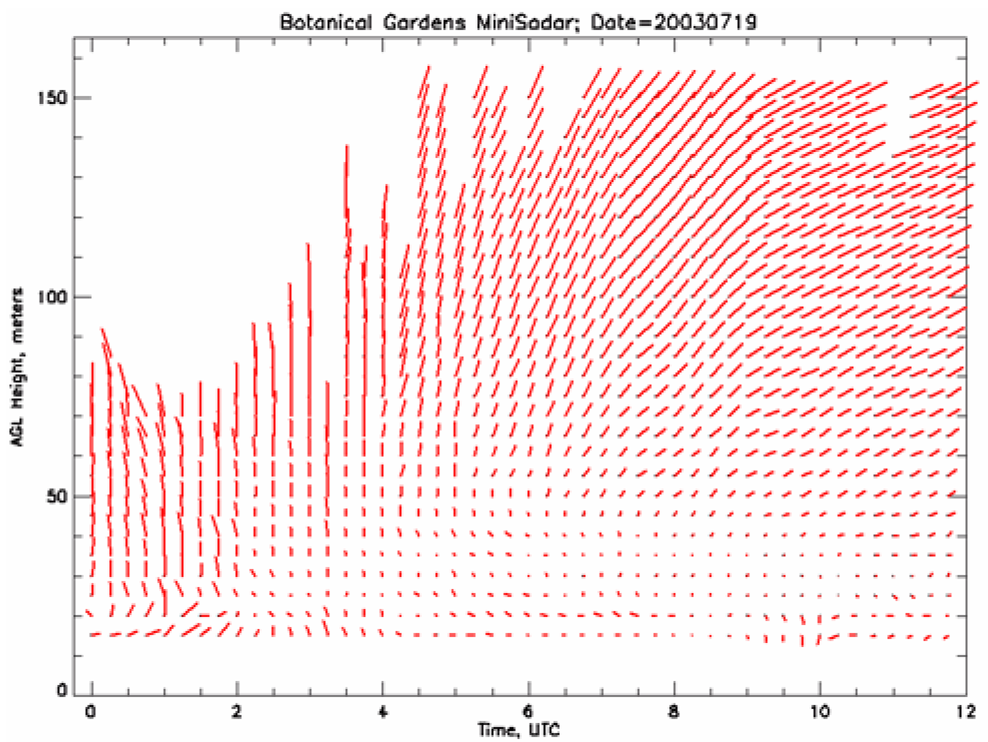
- **At night, (mini) Sodar measurement below ~70-100 meters should not be used when running URBAN HPAC predictions for JU2003**
  - This is consistent for all (mini) sodars that have enough altitude data collected
- **There is something going on in Oklahoma City at night that seems to create different 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

Are (mini) Sodars prone to miscalculate winds at low altitude at night?

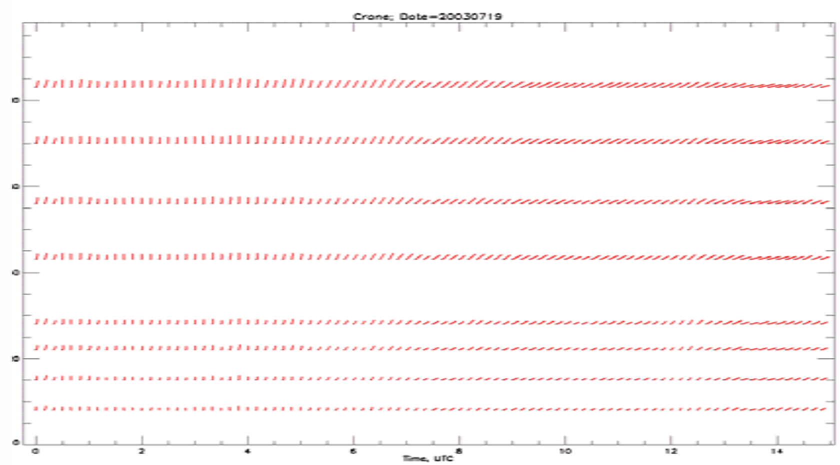
Are there exceptions?

- Crane Sonics produce different behavior as low altitude winds are removed

Botanical Gardens mini-Sodar



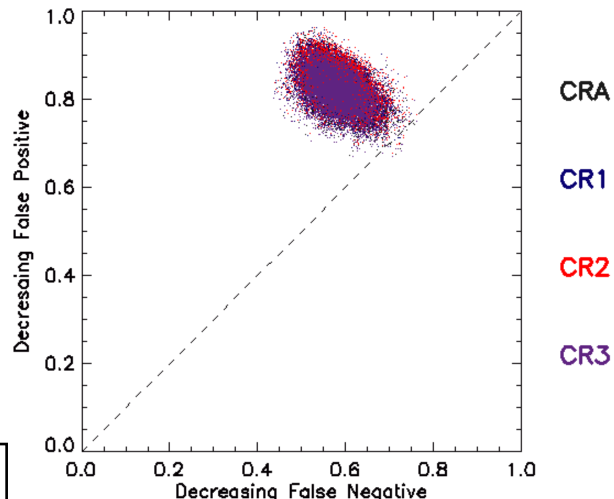
Crane Sonics



- **Crane Sonics wind data itself is different from mini (Sodars)**
  - **No high altitude data (above 85 meters)**
  - **Altitude data is sparce**

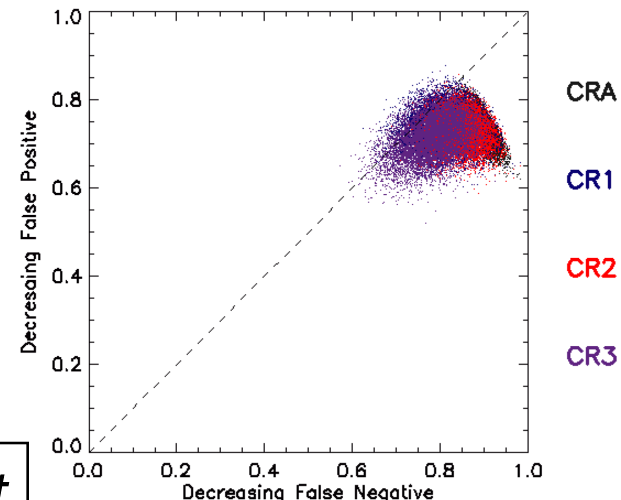
Crane MOEs
as a function of cutoff altitude for DM

250 ppt threshold

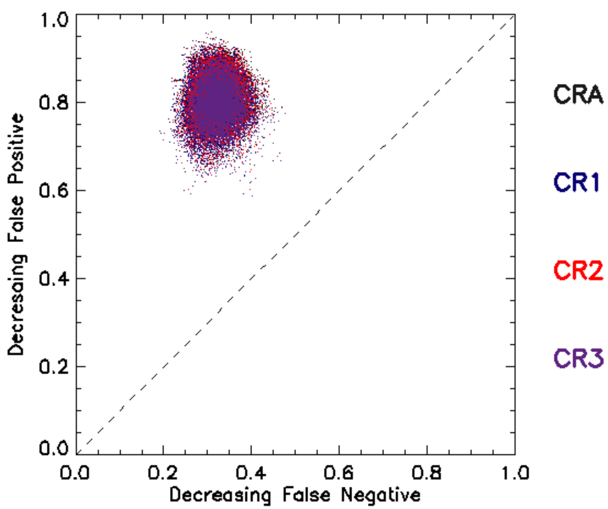


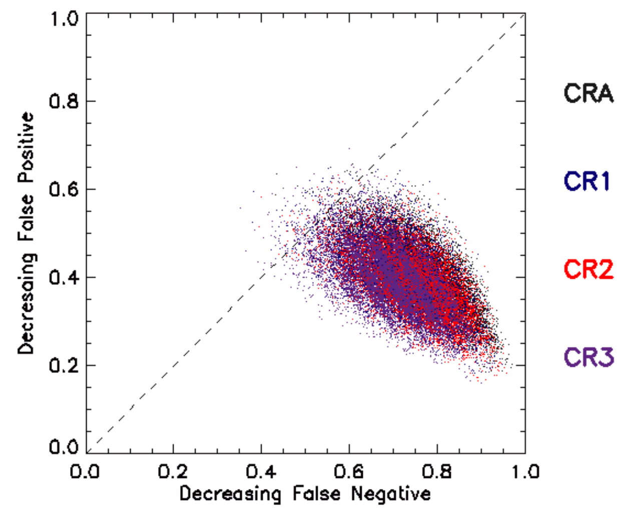
Day

Night



average concentration





Future Plans

- **Work in progress**
- **Will try to 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 models**
  – MESO/RUSTIC
  – QUIC-URB/QUIC-PLUME
- **Will examine Lidar and other sources of real-time data**

MEDOC vs PROFILE ALL met input formats

Work in Progress …

CCAM Met

- **CCAM is an Australian wind field prediction model developed by the Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO)**
  - In 2005, Ralph Gailis (from Defense Science and Technology Organization (DSTO)) asked if we could use CCAM to drive HPAC JU2003 predictions to compare with observations and other wind models
- **Received CCAM MET in May 2006**
  - Files are MEDOC files
    - » Cannot be used with MSS
- **Run Urban HPAC predictions using CCAM MET input options**
- **Observed that predictions based on CCAM behave quite differently from predictions based on other met options**

For MET files in MEDOC format HPAC runs very fast

Which MET input Options Should be Used for Comparison with CCAM

- **Originally, we wanted to use GCAT (PROFILE ALL) and BAS (nearby airport observations) MET input options for comparison**
  - Unfortunately, both of these use SWIFT first to obtain mass-consistent winds that could produce significant effects on resulting predictions
    - » Incidentally, we run "low-resolution" WM and DW configuration for Post Office rooftop met with MC-SCIPUFF instead of SWIFT, and we were quite "surprised" by the results

- **Early GCAT files were in MEDOC format, so we decided to compare CCAM predictions to GCAT- MEDOC predictions**

- **Interestingly enough, GCAT MEDOC and PROFILE ALL MET input options produce quite differently behaving predictions**
  - GCAT MEDOC (GCM1) predictions seem to push simulant clouds much faster than GCAT PROFILE ALL (GCP1) predictions
    - » Observations support slower speeds

MEDOC to PROFILE ALL Converter

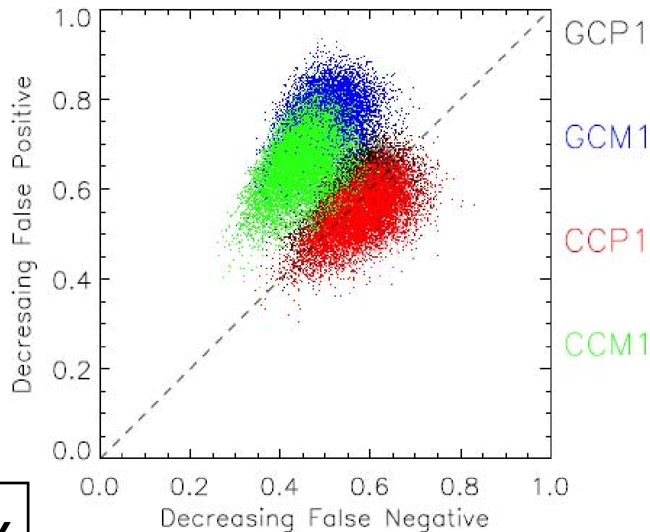
- **Contacted NGIC to find out what is going on with GCAT**
- **NGIC contacted GCAT developer (NCAR)**
- **As part of diagnostic, NCAR wrote a MEDOC to PROFILE ALL met converter and graciously offered source code to us**
- **We created 4 sets of predictions**
  - **GCM1** based on early GCAT MEDOC met input
  - **GCP1** based on converted GCAT MEDOC met input
  - **CCM1** based on CCAM 1 km MEDOC met input
  - **CCP1** based on converted CCAM 1 km MEDOC met input
- **Observed that MEDOC predictions are comparable to each other, but different from PROFILE ALL predictions**

Note: For GCAT MEDOC files converter is not 1-to-1 because some temperature data was not recorded in the original MEDOC file

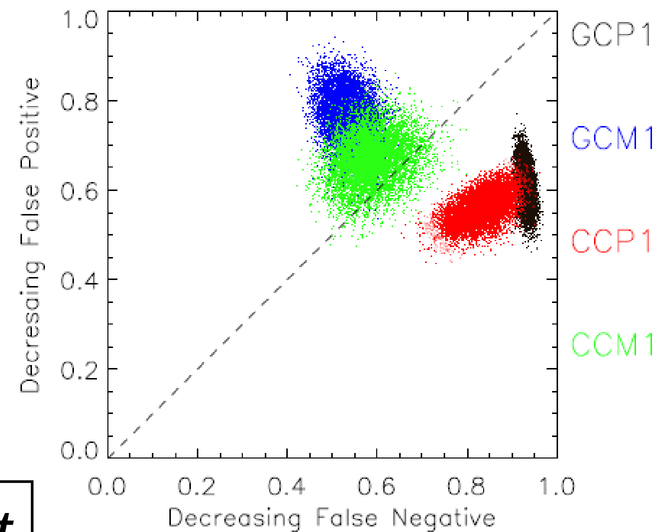
MEDOC vs PROFILE ALL for UDM Predictions

250 ppt threshold

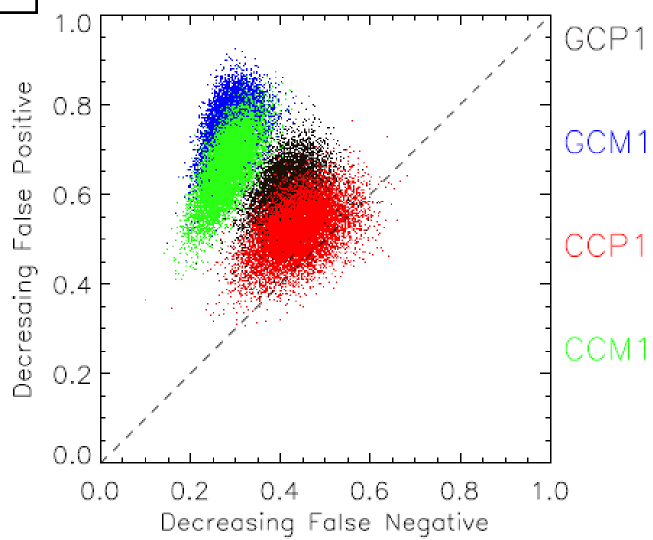
Day

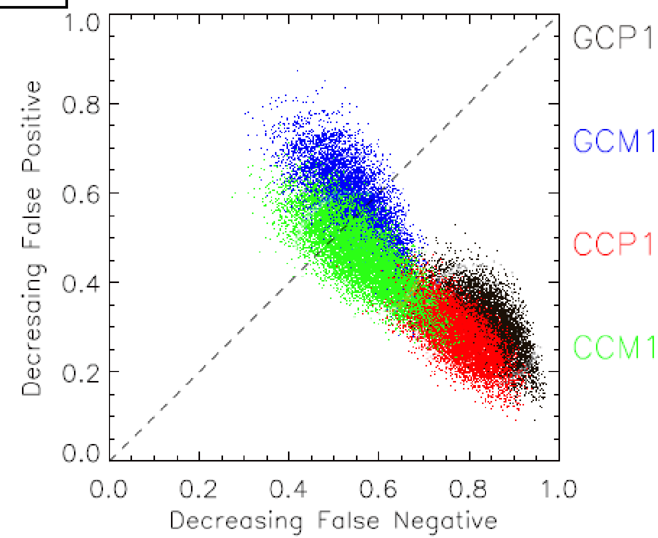


Night

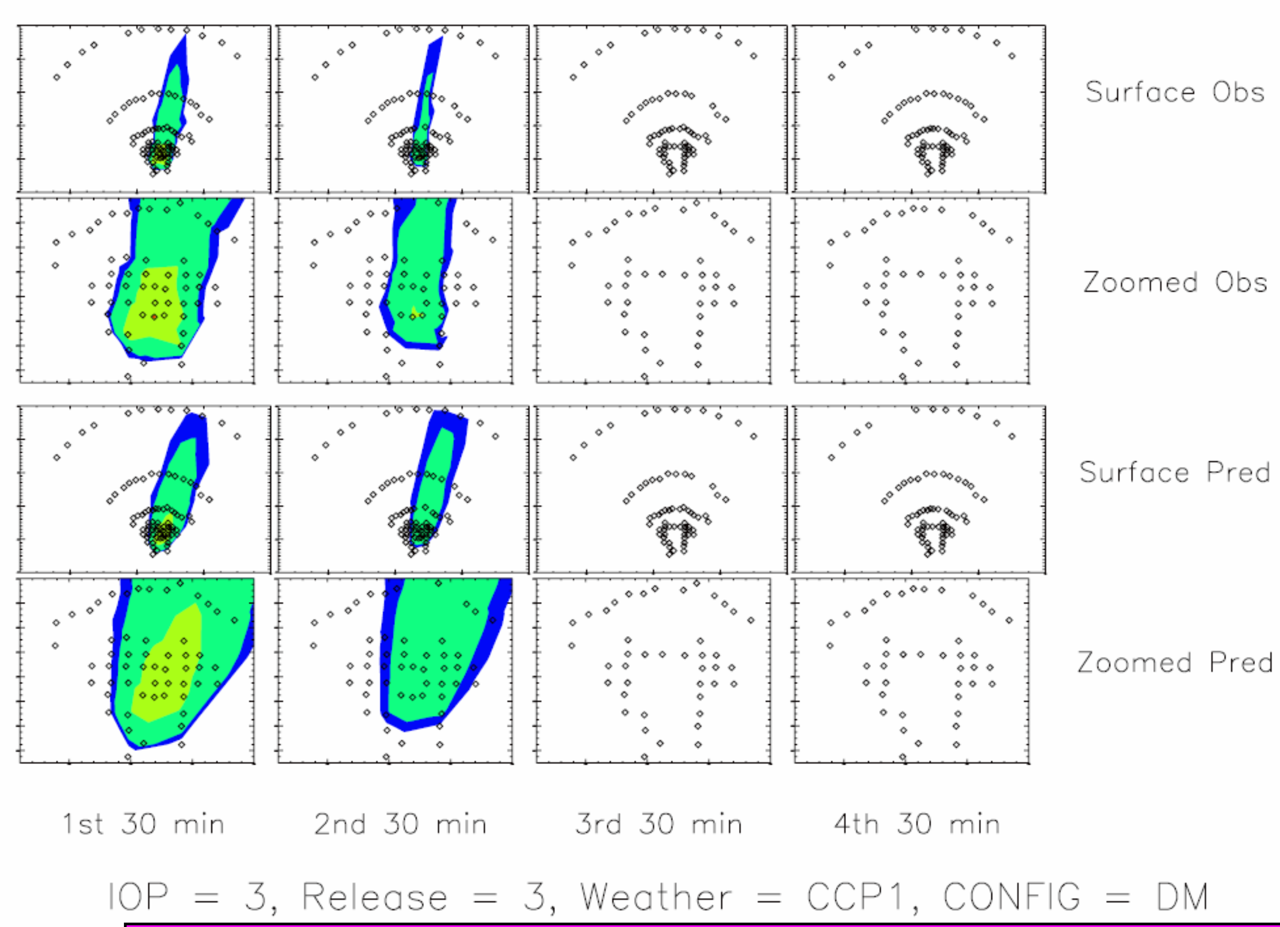


average concentration



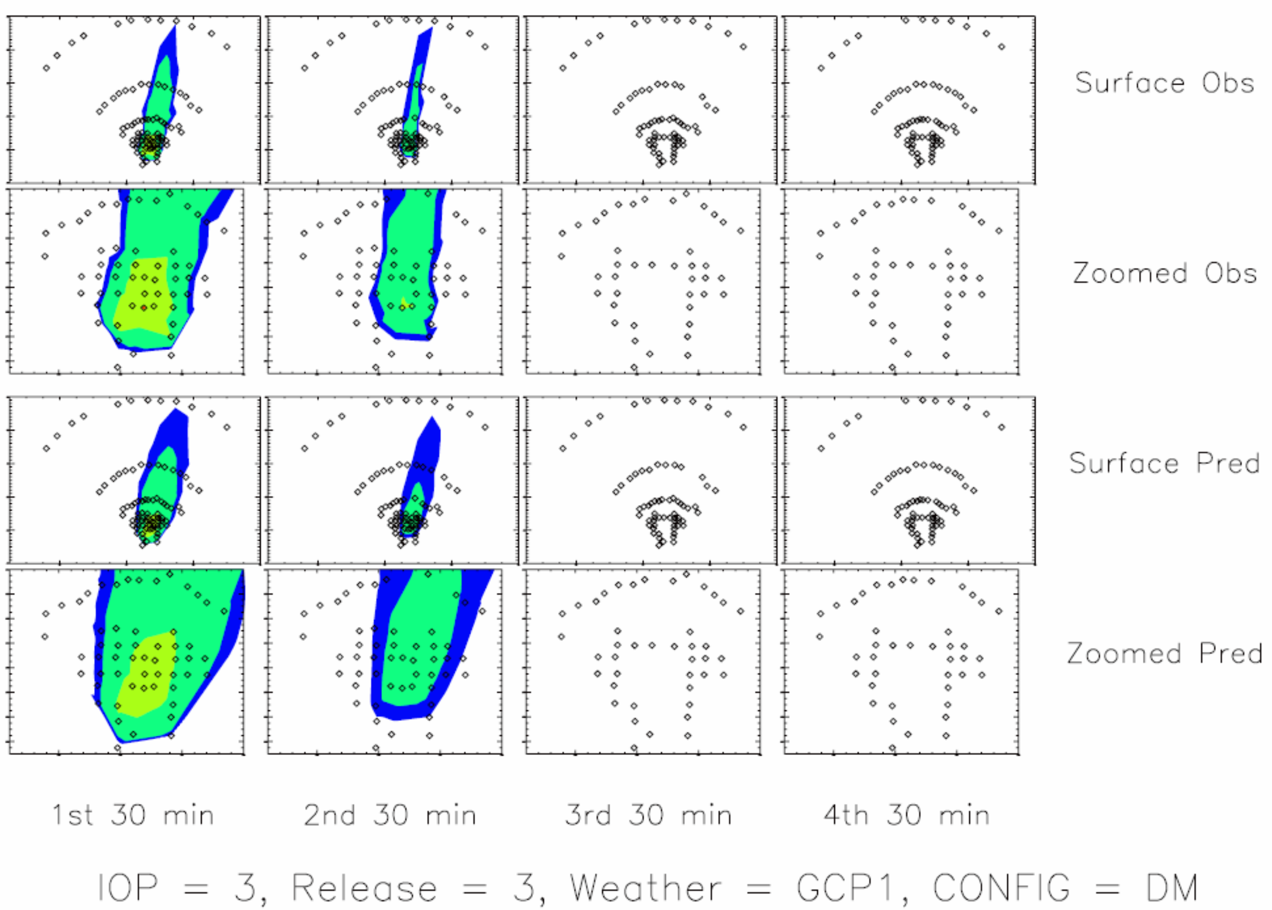


CCAM PROFILE ALL Predictions vs Observations



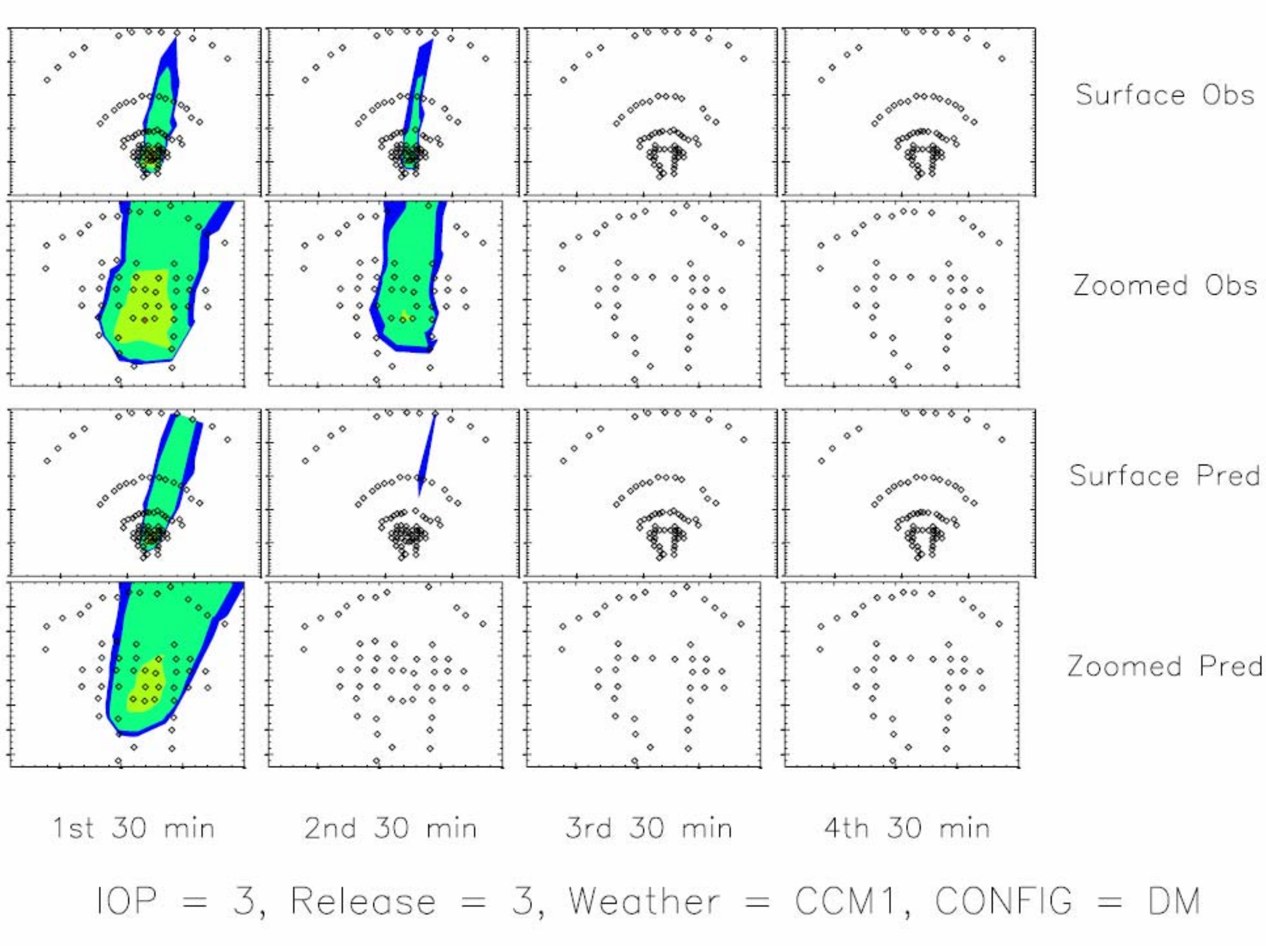
Predictions seems to be in-sync (30 minute interval) with observations

GCAT PROFILE ALL Predictions vs Observations



Predictions seems to be in-sync (30 minute interval) with observations

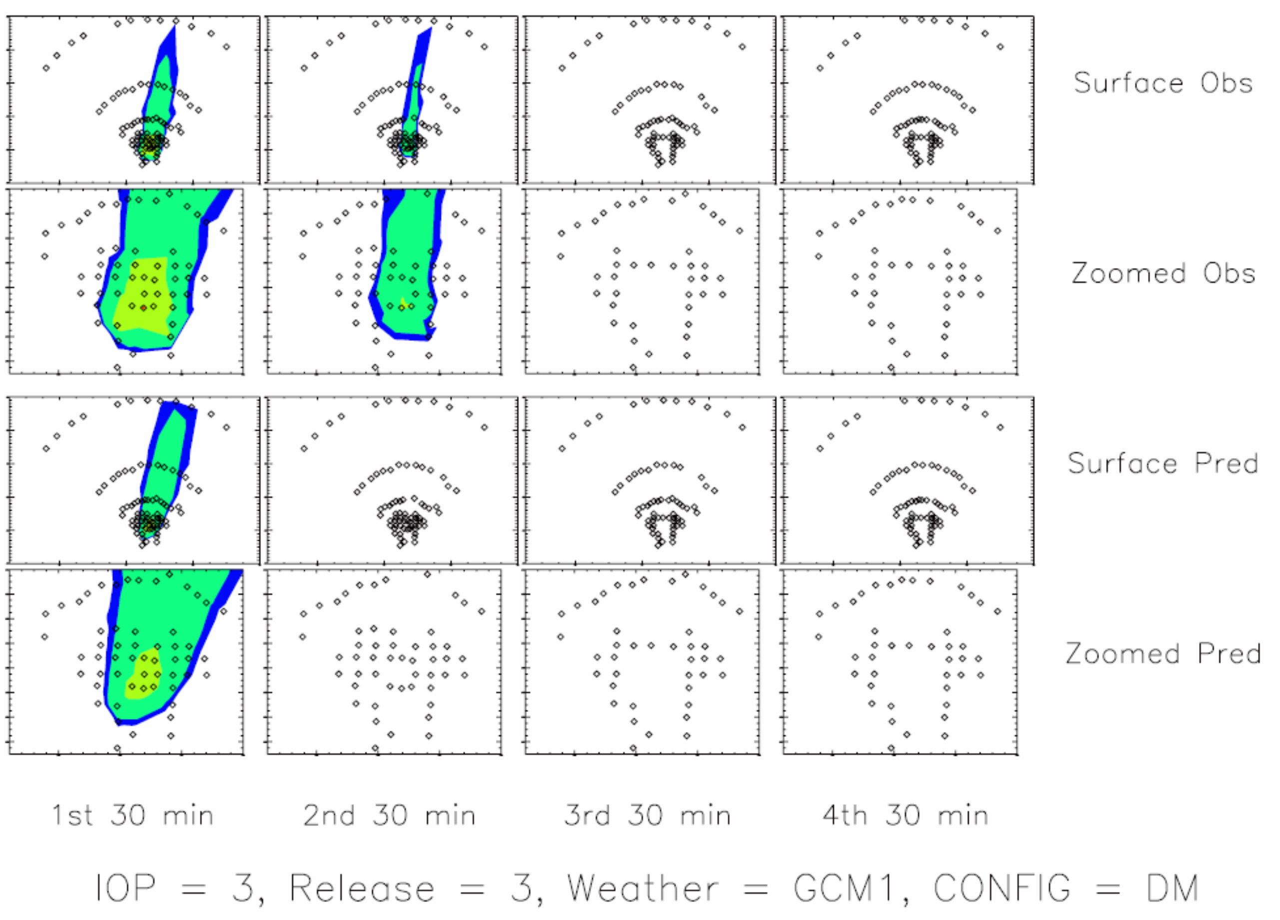
CCAM MEDOC Predictions vs Observations



This is not as noticeable with UC or at night, but since HPAC generally over-predicts significantly at night, we suspect that double-wrong makes it look OK

CCAM MEDOC predictions seem to push clouds too fast

GCAT MEDOC Predictions vs Observations



This is not as noticeable with UC or at night, but since HPAC generally over-predicts significantly at night, we suspect that double-wrong makes it look OK

GCAT MEDOC predictions seem to push clouds too fast

Conclusions and Future Work

- **CCAM MEDOC and GCAT MEDOC winds seems to push clouds too fast**
  - Compared to SWIFT and MC-SCIPUFF processed MET
  - Some indications that this is also true for comparison with observations
    - » Daytime seems to show for 30-minute averaged concentrations
    - » Nighttime is harder to see, but it might be due to compensating errors
      - Over-prediction followed by faster “removal”
- **GCAT and CCAM MEDOC and GCAT and CCAM PROFILE ALL MET input options produce significantly different predictions**
  - We really need to understand why this is happening
    - » Does MEDOC MET always have this “problem” that might lead to seemingly better predictions at night because of compensating errors?
    - » MEDOC MET runs much faster on HPAC, thus there is a great interest in using this MET for real-time hazard prediction
    - » What does SWIFT (or MC-SCIPUFF) do to slow down T&D?
  - Similarly, need to understand differences between SWIFT and MC-SCIPUFF
    - » MC-SCIPUFF is much faster running than SWIFT making it attractive to real-time hazard prediction
    - » Incidentally, we run “low-resolution” WM and DW configuration for Post Office rooftop met with MC-SCIPUFF instead of SWIFT, and we were quite “surprised” by the results which we speculate were resulting from compensating errors