EMERGING TECHNOLOGIES:
MONITORING FOR TOMORROW

Introduction

Background & Purposes

Tech #1 – BAM 1022
   Purpose: "Standalone" cont. PM2.5 BAM unit

Tech #2 – Carbon-SASS
   Purpose: Combining SASS and URG units

Tech #3 – BC 1050
   Purpose: Turnkey/calibrate-able BC unit

Tech #4 – Neighborhood PM2.5 Monitor
   Purpose: Low-cost PM2.5 monitor

Tech #5 – Speciated-PM10 SASS
   Purpose: Collecting PM10 ion with a modified SASS

Emerging Technologies: Monitoring for Tomorrow

Tech: #1 BAM 1022

❖Similar technology to BAM 1020

❖No temperature control or roof mod needed

❖Designated EPA FEM

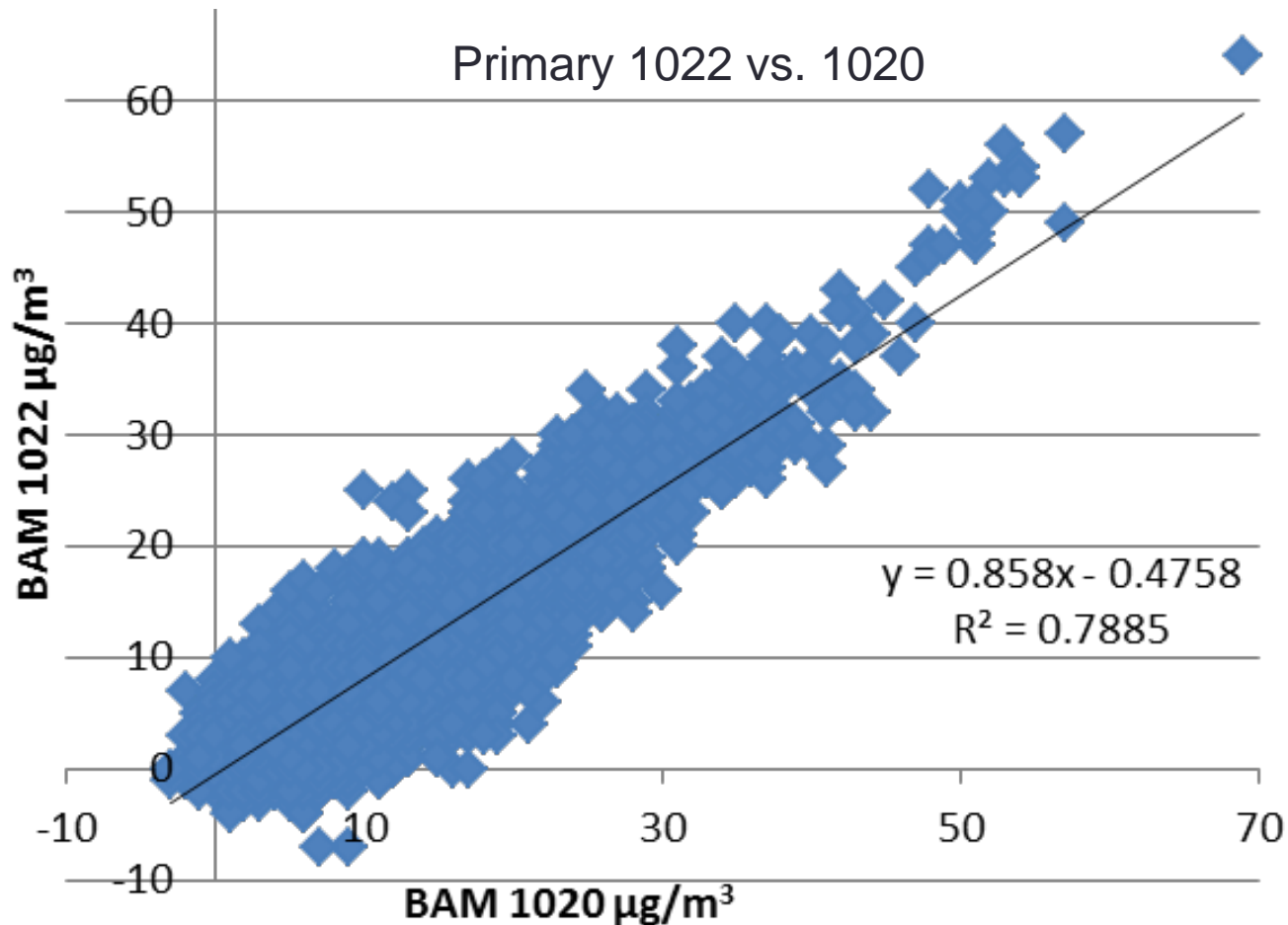❖Have lightweight shelter/detachable pump

❖Requires AC voltage
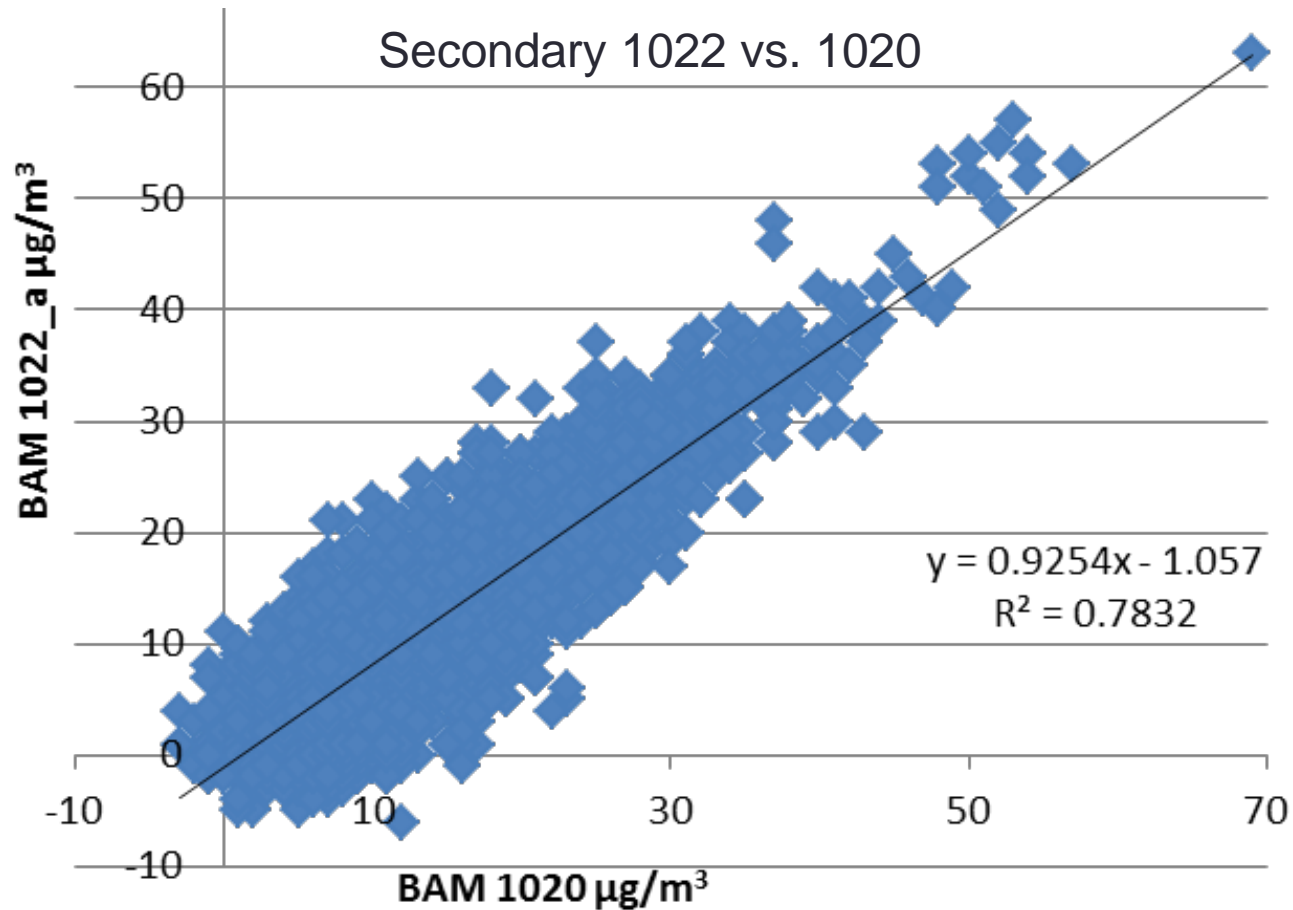
Emerging Technologies: Monitoring for Tomorrow

BAM 1022
Sac-T Station Study

❖Primary unit: Aug 2015 - April 2016

❖Secondary unit: Nov 2015 - April 2016

❖~200 days of hourly data

❖~69 24-hour averages

Emerging Technologies: Monitoring for Tomorrow

Primary BAM 1022 vs. BAM 1020 Sac-T Station Study (cont.)

Primary 1022 vs. 1020

$y = 0.858x - 0.4758$

$R^2 = 0.7885$

Emerging Technologies: Monitoring for Tomorrow

Secondary BAM 1022 vs. BAM 1020 Sac-T Station Study (cont.)

Secondary 1022 vs. 1020

$y = 0.9254x - 1.057$

$R^2 = 0.7832$

Emerging Technologies: Monitoring for Tomorrow

BAM 1022
Sac-T Station Study (cont.)

Emerging Technologies: Monitoring for Tomorrow
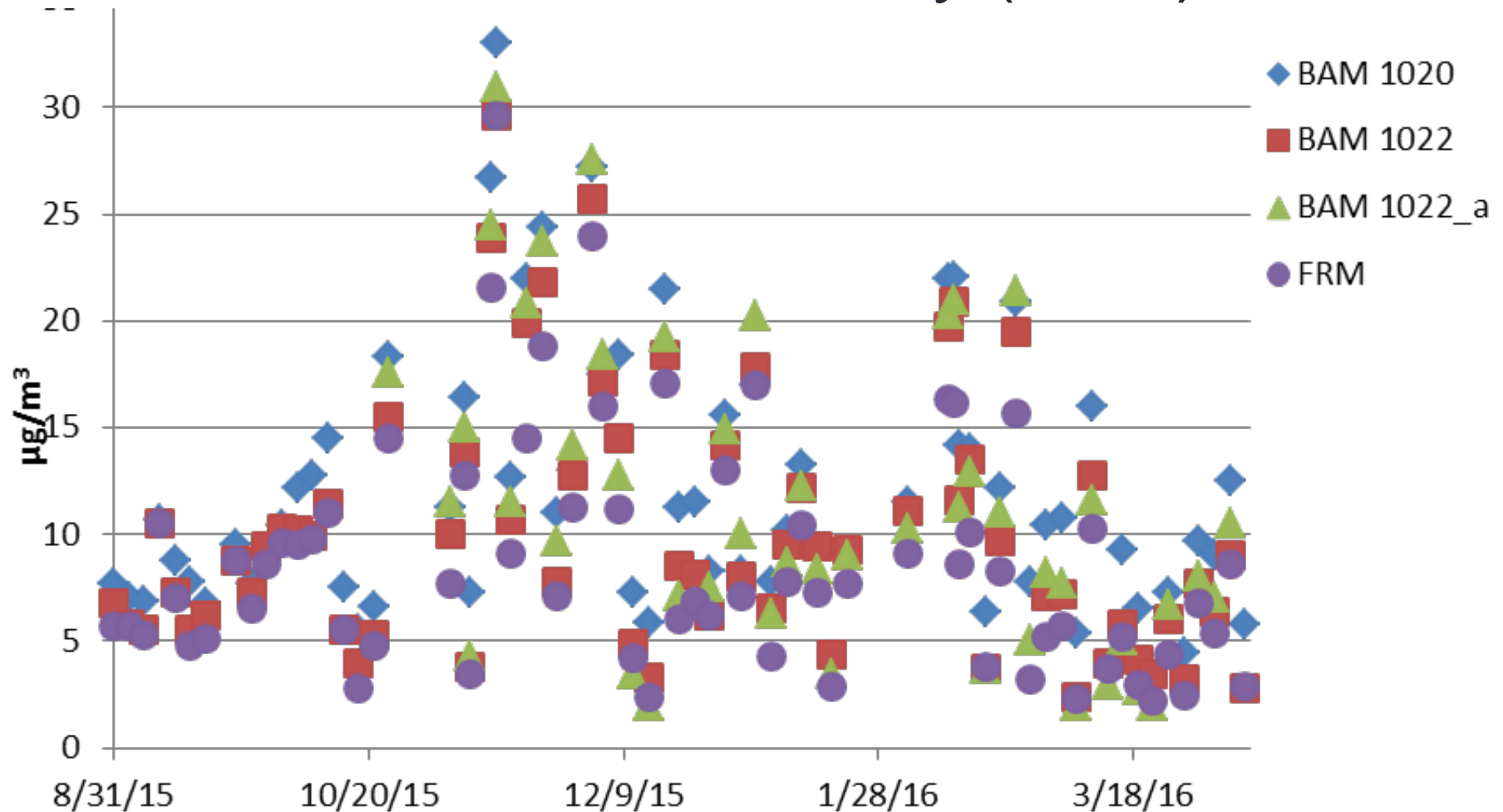
BAM 1022 vs. PM2.5 FRM
Sac-T Station Study (cont.)

Emerging Technologies: Monitoring for Tomorrow
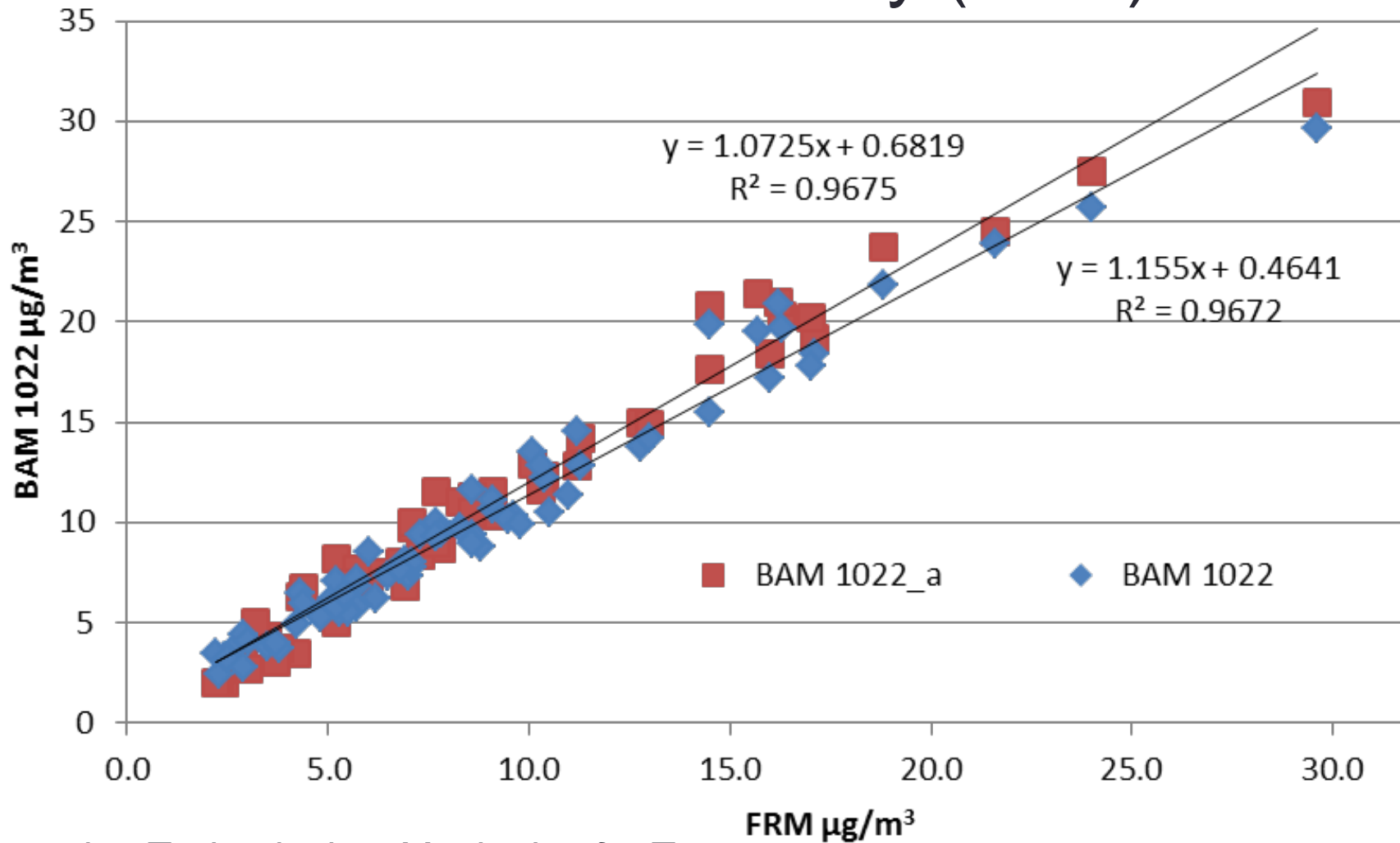
BAM 1022 SUMMARY

❖ Good data correlations between BAM 1022, BAM 1020 and PM2.5 FRM

❖ Pinholes were observed but issue is fixed now

❖ ARB ordered BAM 1022s to add to its network

Emerging Technologies: Monitoring for Tomorrow

Tech: #2 Carbon-SASS

❖At CSN sites: carbon (EC and OC) is collected on a filter with URG 3000-N

❖This requires CSN stations to operate both a SASS and an URG
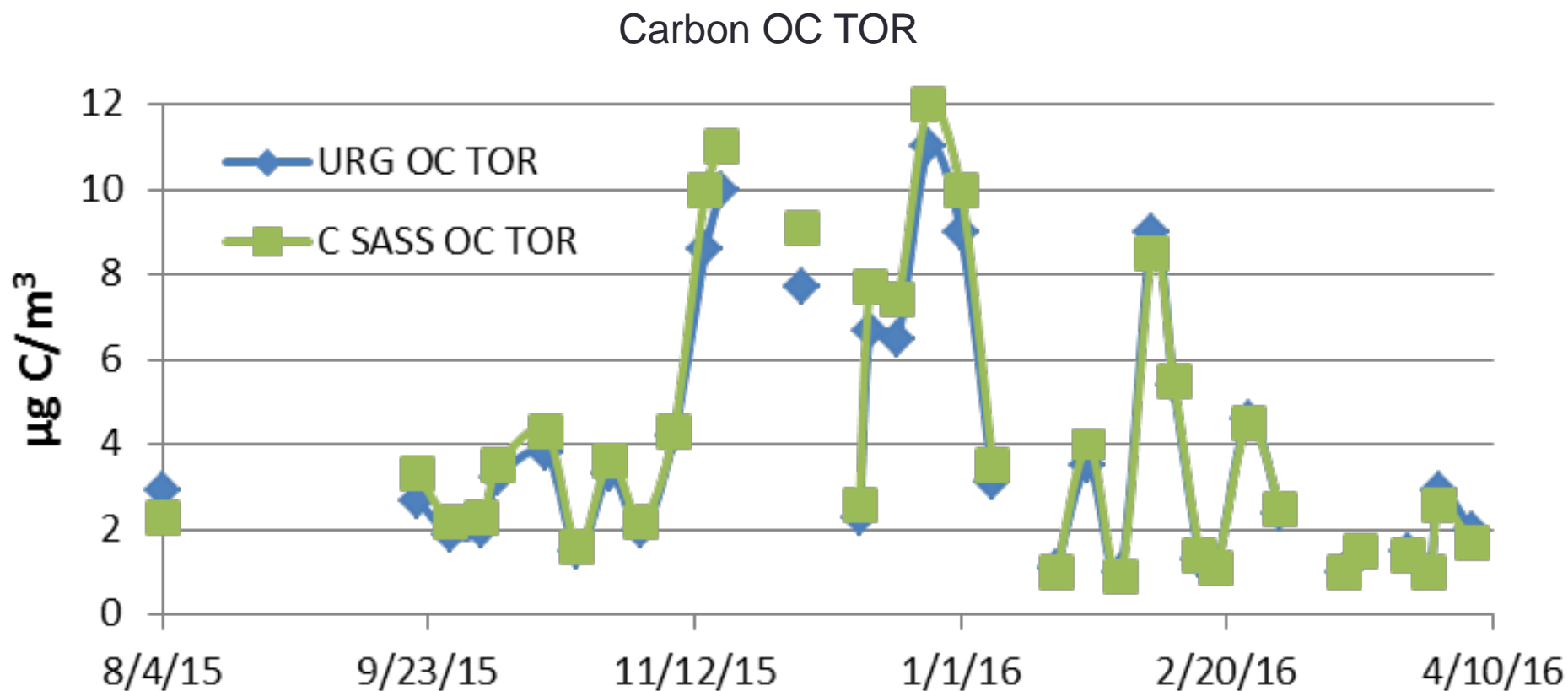
❖Carbon-SASS (prototype) captures carbon data

Emerging Technologies: Monitoring for Tomorrow

Carbon-SASS
Chico-East Station Study

❖ ~August 2015 through April 2016

❖ 34 sample pairs for carbon analysis

❖ 30 sample pairs for PM2.5 mass analysis

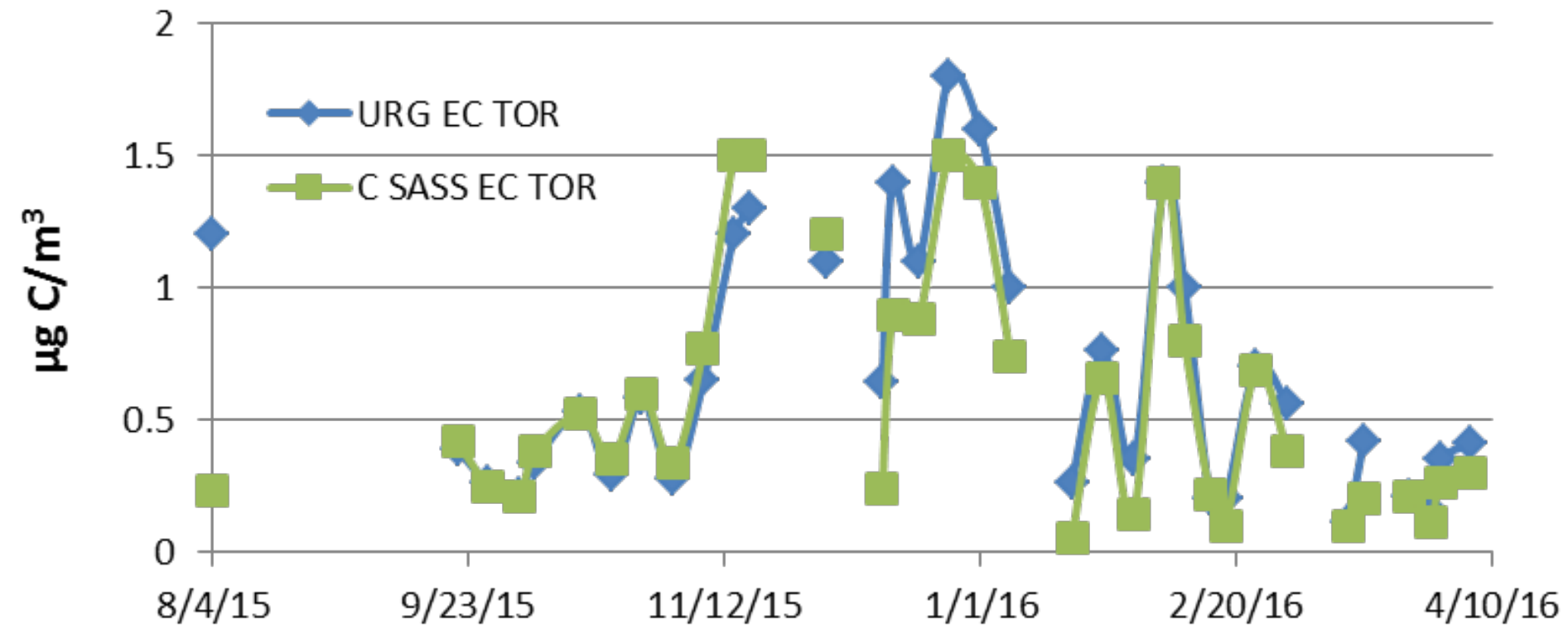*Emerging Technologies: Monitoring for Tomorrow*

Carbon-SASS
Chico-East Station Study (cont.)

Carbon OC TOR

Emerging Technologies: Monitoring for Tomorrow

Carbon-SASS
Chico-East Station Study (cont.)

Carbon EC TOR

Emerging Technologies: Monitoring for Tomorrow

Carbon-SASS
Chico-East Station Study (cont.)

PM2.5 Mass

Emerging Technologies: Monitoring for Tomorrow

Carbon-SASS
Chico-East Station Study (cont.)

PM2.5 Mass

$y = 1.0401x + 0.3778$
$R^2 = 0.9711$

Emerging Technologies: Monitoring for Tomorrow
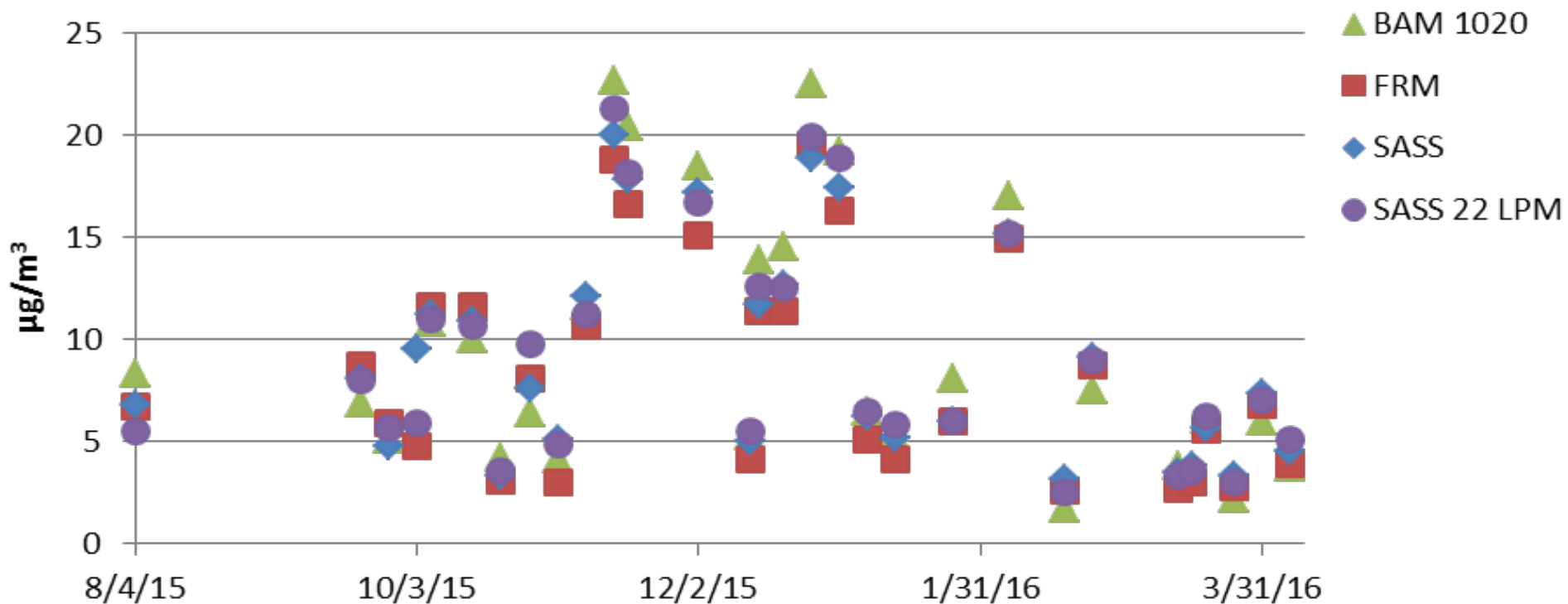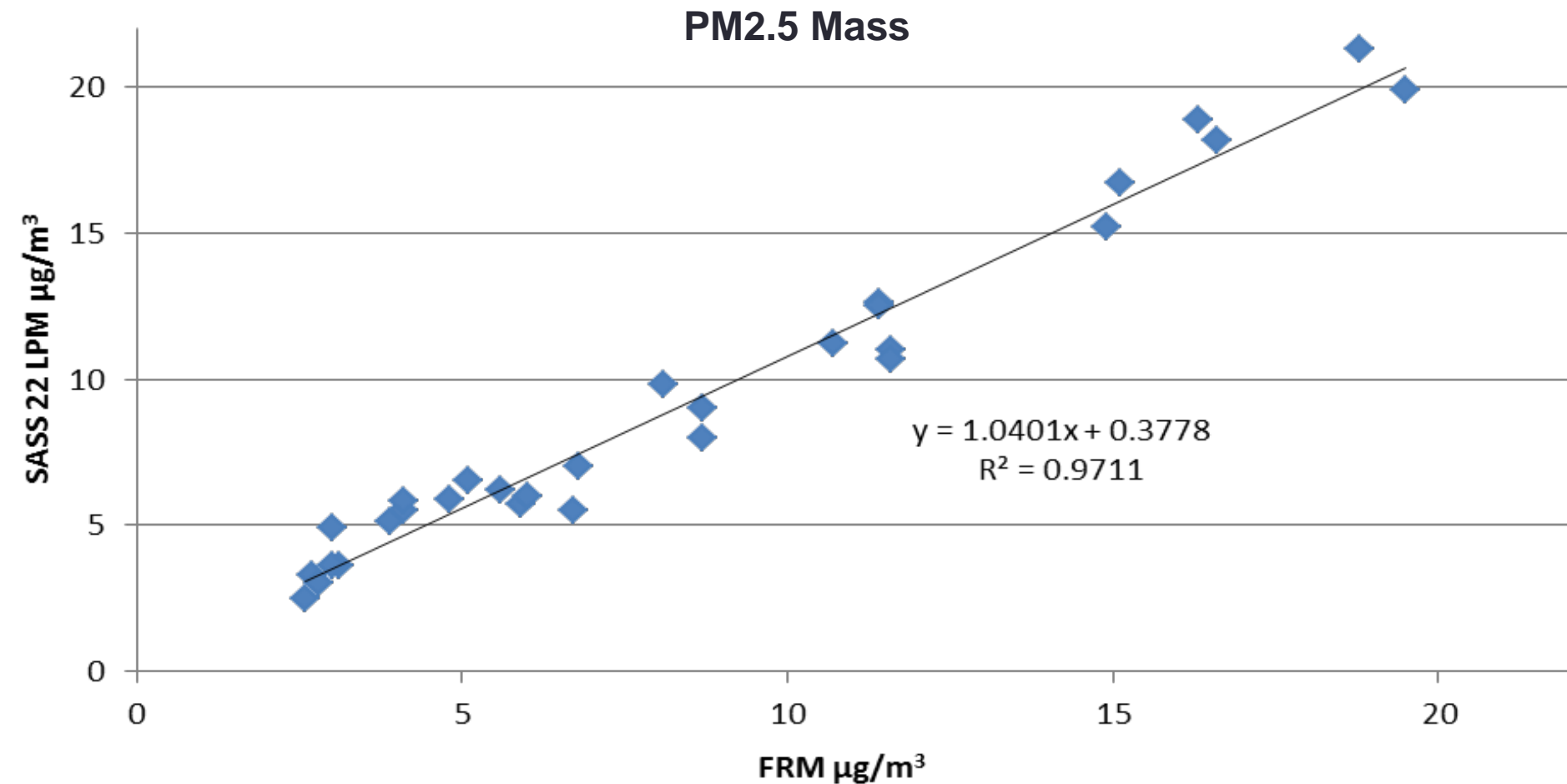
Carbon-SASS SUMMARY

❖Good carbon & mass data correlations between Carbon-SASS, URG and PM2.5 FRM

❖Smaller monitoring "foot print"

❖CSN sites operate Carbon-SASS now!

Emerging Technologies: Monitoring for Tomorrow

Tech: #3   BC 1050

❖Increased interest in black carbon research

❖Limited to aethalometers

❖Limited to lab methods: TOR/TOT

❖Like to have a turnkey and "calibrate-able" BC unit

Emerging Technologies: Monitoring for Tomorrow

BC 1050
Bakersfield/Fresno Studies

❖ <u>Bakersfield</u>

- ~July 2015 through December 2015
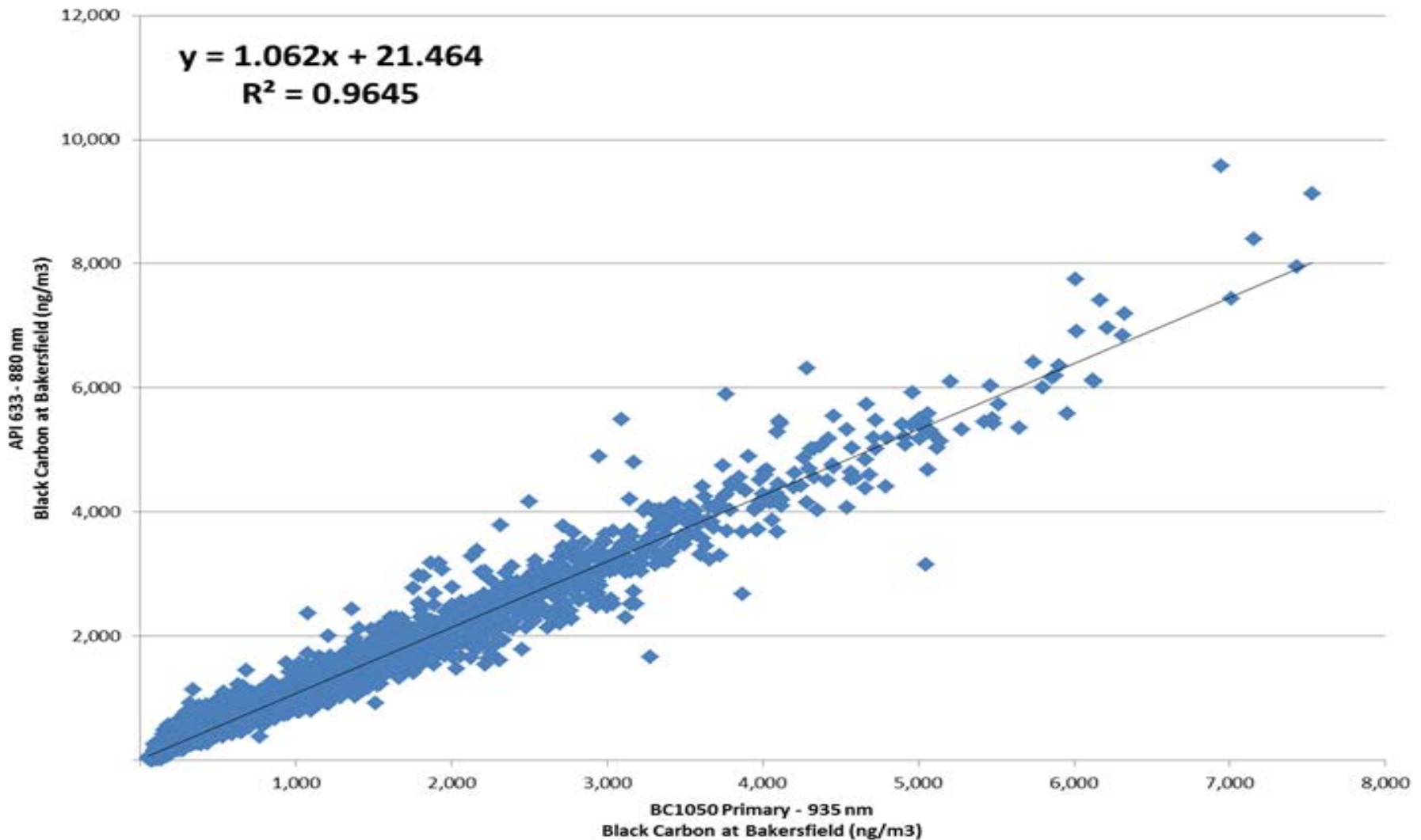- Ran BC 1050s alongside an TAPI 633
- URG in operation since 2003

❖ <u>Fresno</u>

- ~July 2015 through February 2016
- Ran BC 1050s alongside an Magee AE33
- URG in operation since 2004

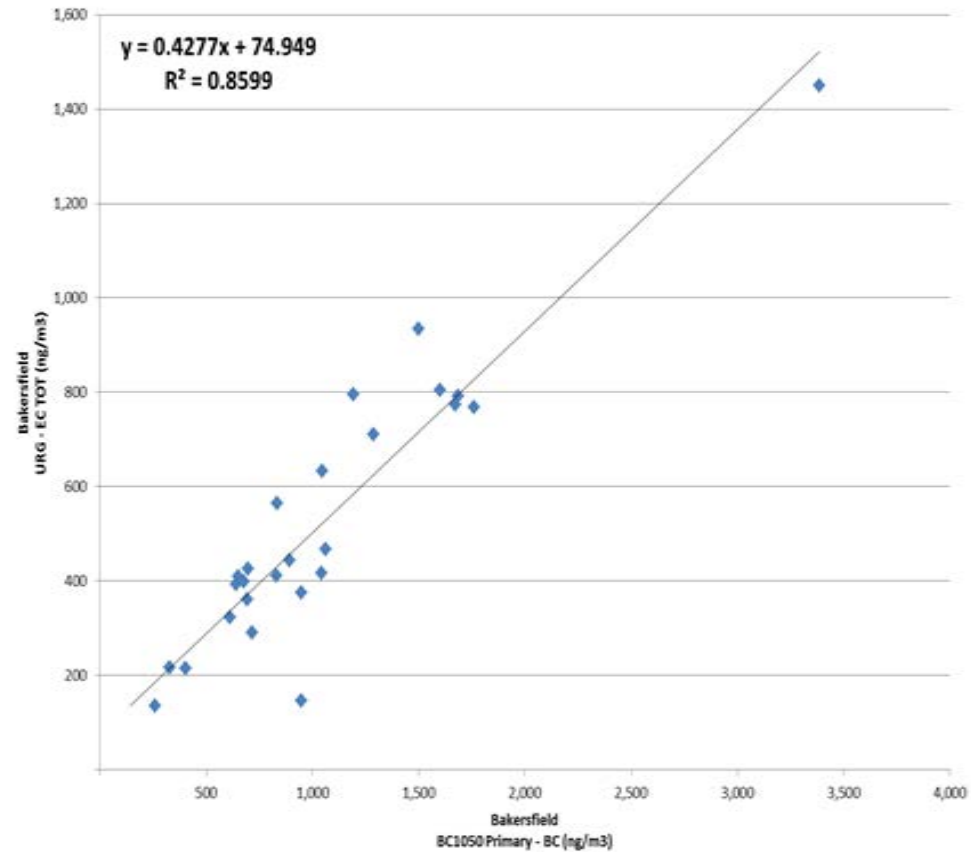*Emerging Technologies: Monitoring for Tomorrow*

BC 1050 vs. API 633
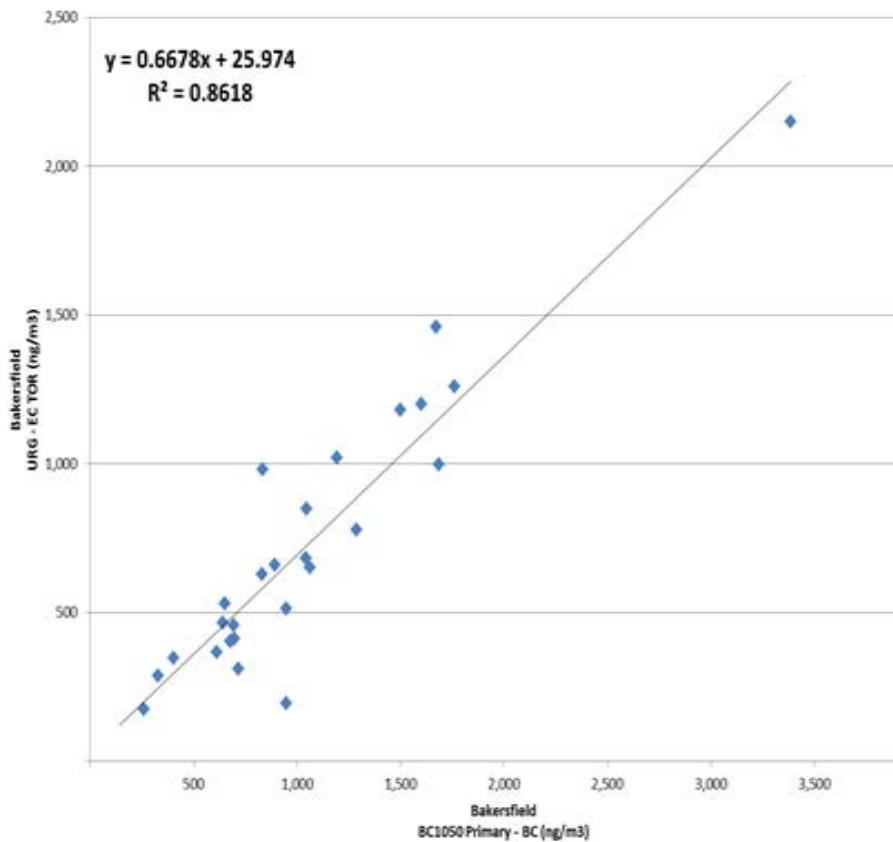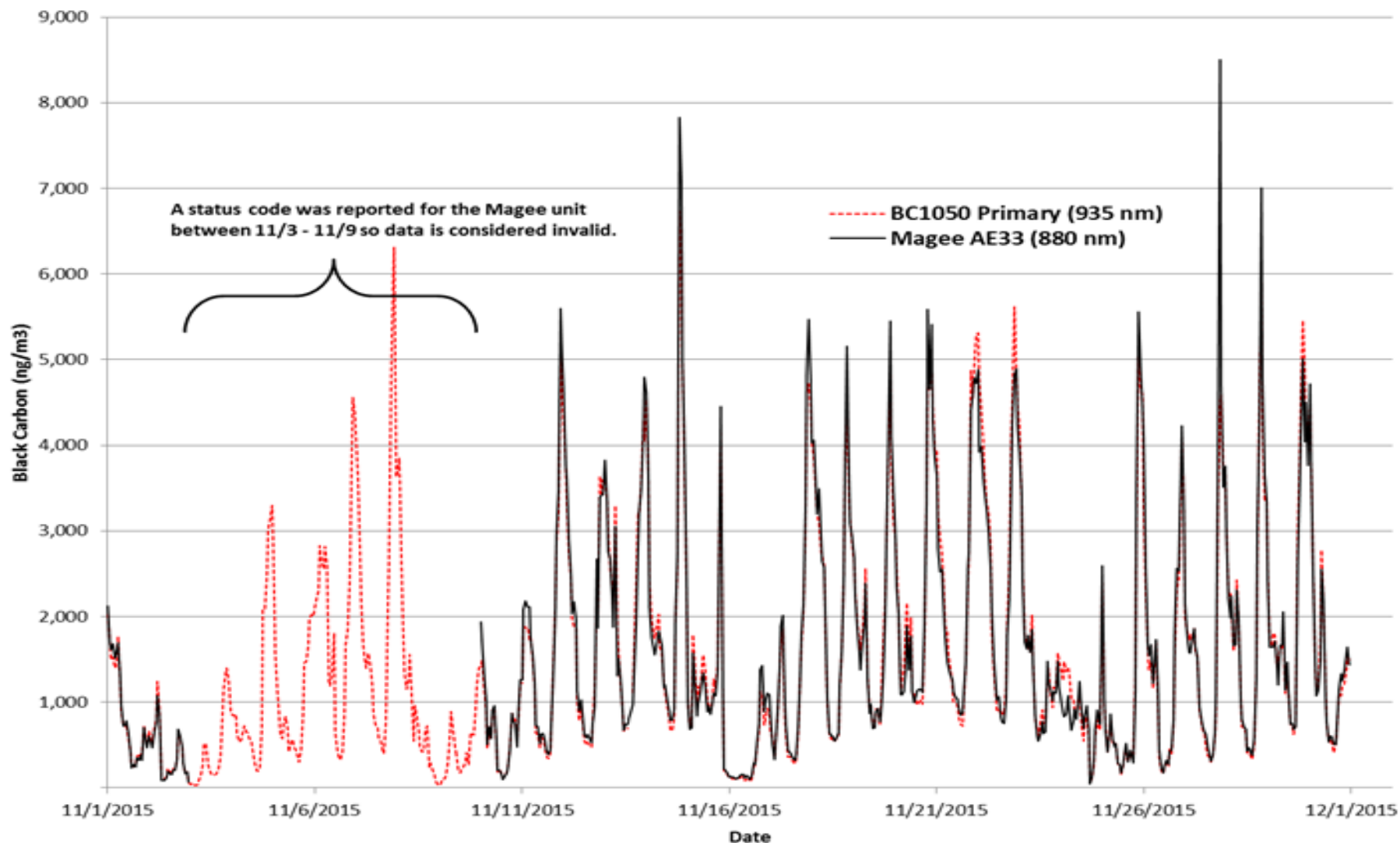# Bakersfield Study
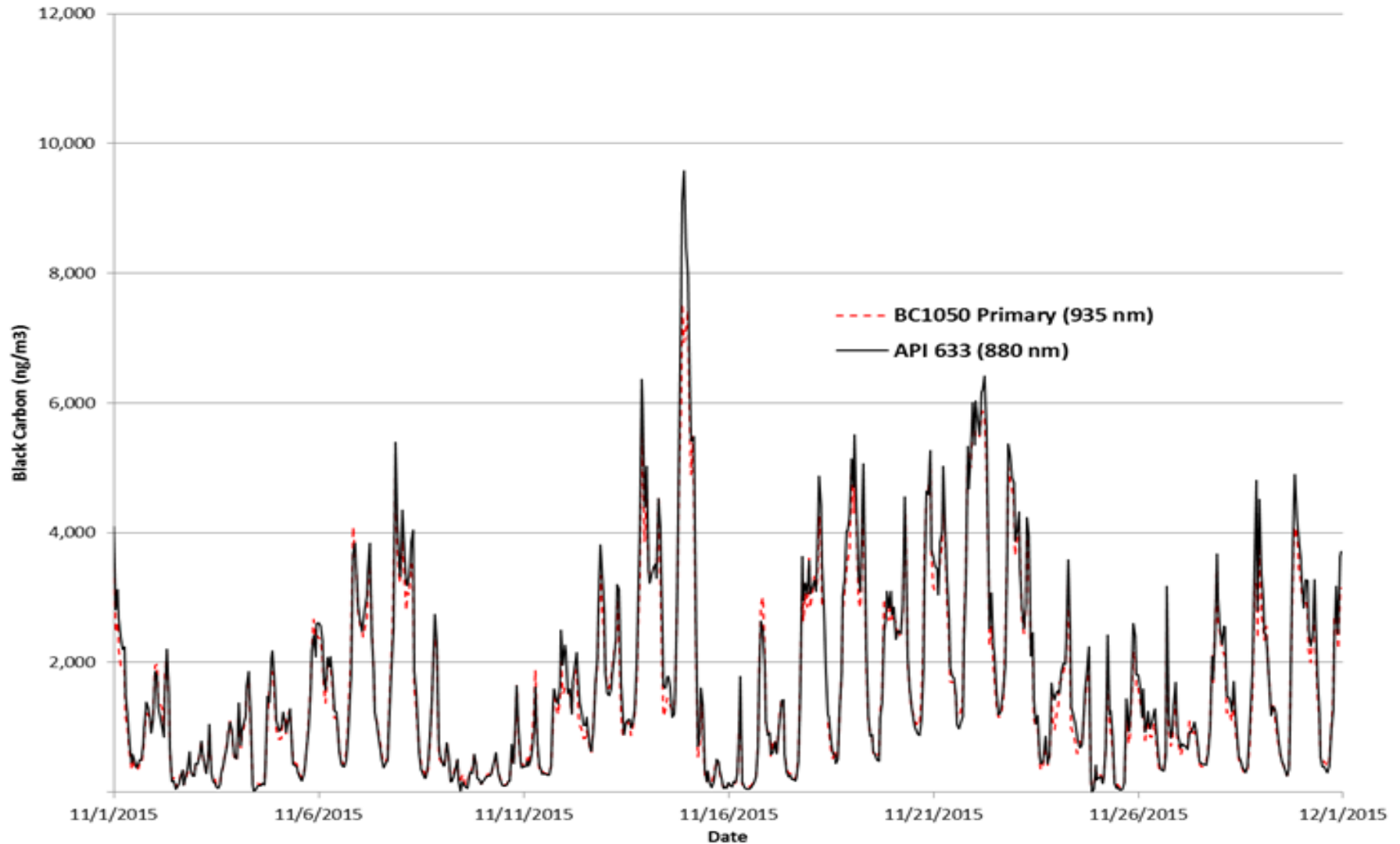
BC 1050 vs. API 633
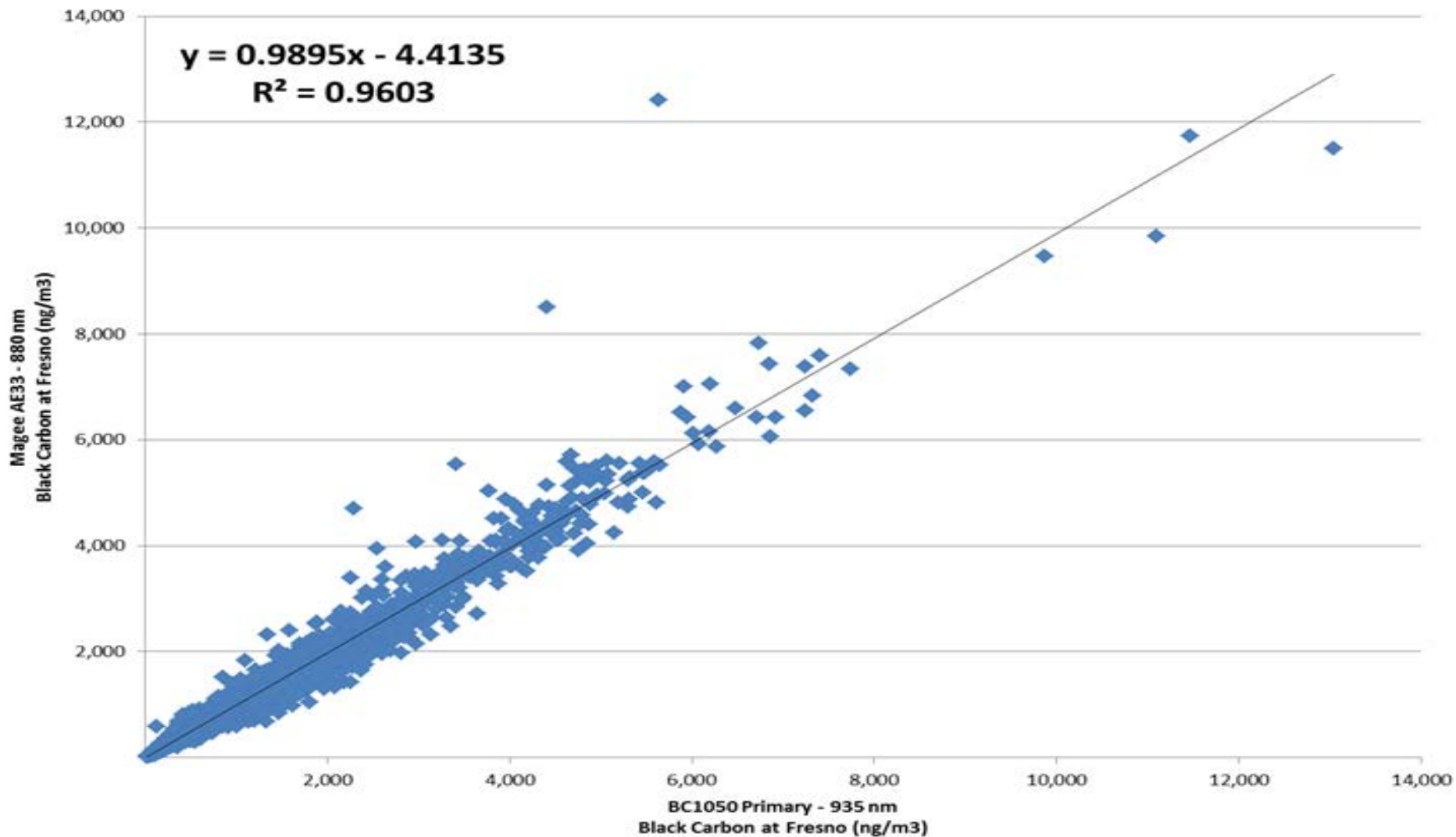# Bakersfield Study

BC 1050 vs TOR/TOT Bakersfield

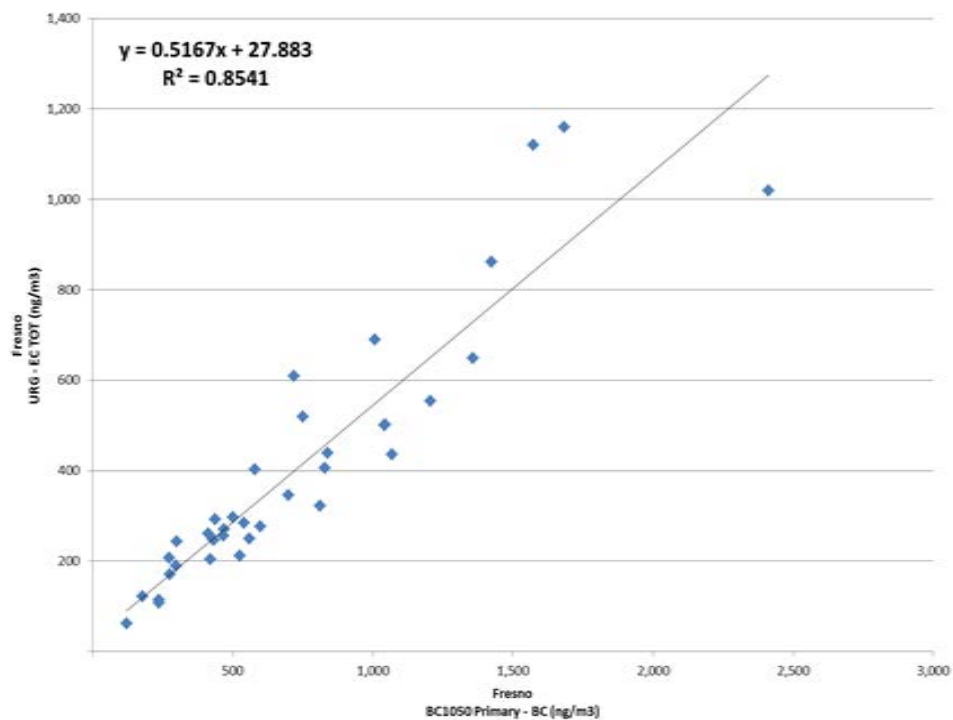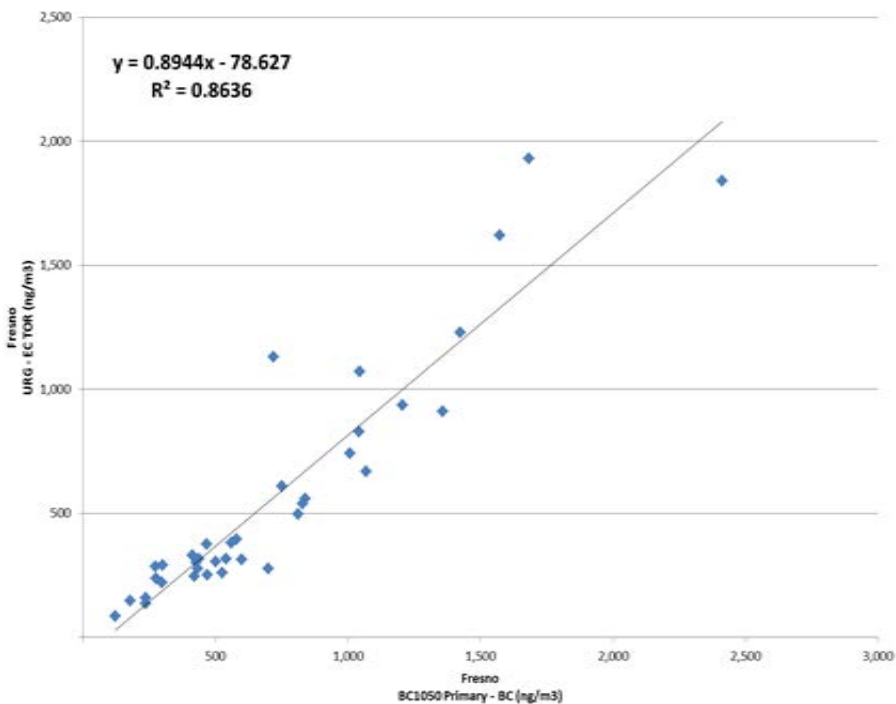# BC 1050 vs. Magee AE33 Fresno Study

BC 1050 vs. Magee AE33
Fresno Study

BC 1050 vs TOR/TOT

Fresno

BC 1050 SUMMARY

❖Good data correlation between BC1050 & aethalometers

❖Decent data correlation between BC1050 & TOR/TOT

❖ARB plans to expand black carbon monitoring

Emerging Technologies: Monitoring for Tomorrow

Tech: #4   Neighborhood PM2.5 Monitor
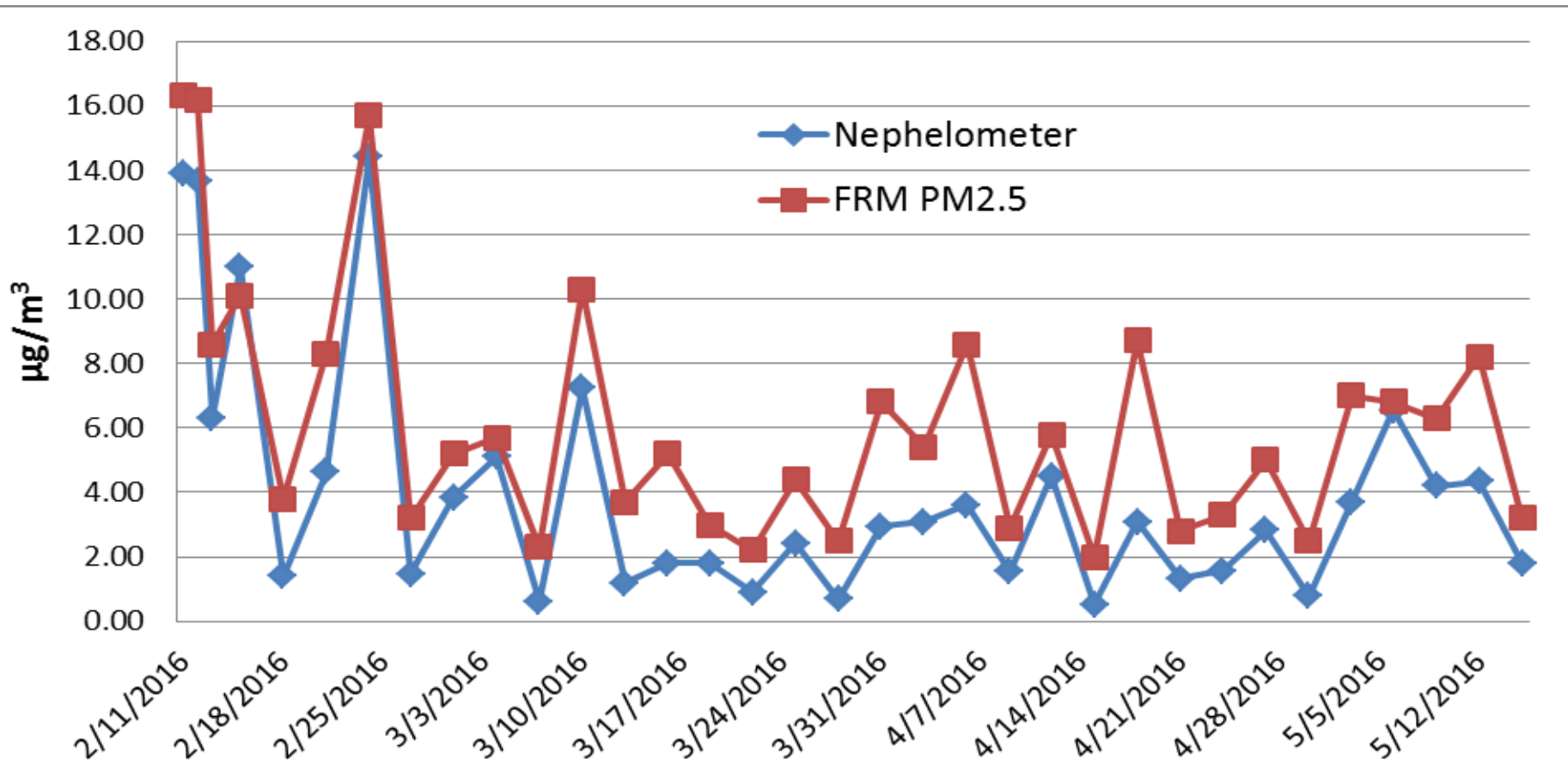
❖Exploring low cost PM2.5 monitors (~2K)

❖Easily deploy around neighborhoods

❖Non-regulatory data

❖Provide useful real-time PM2.5 info
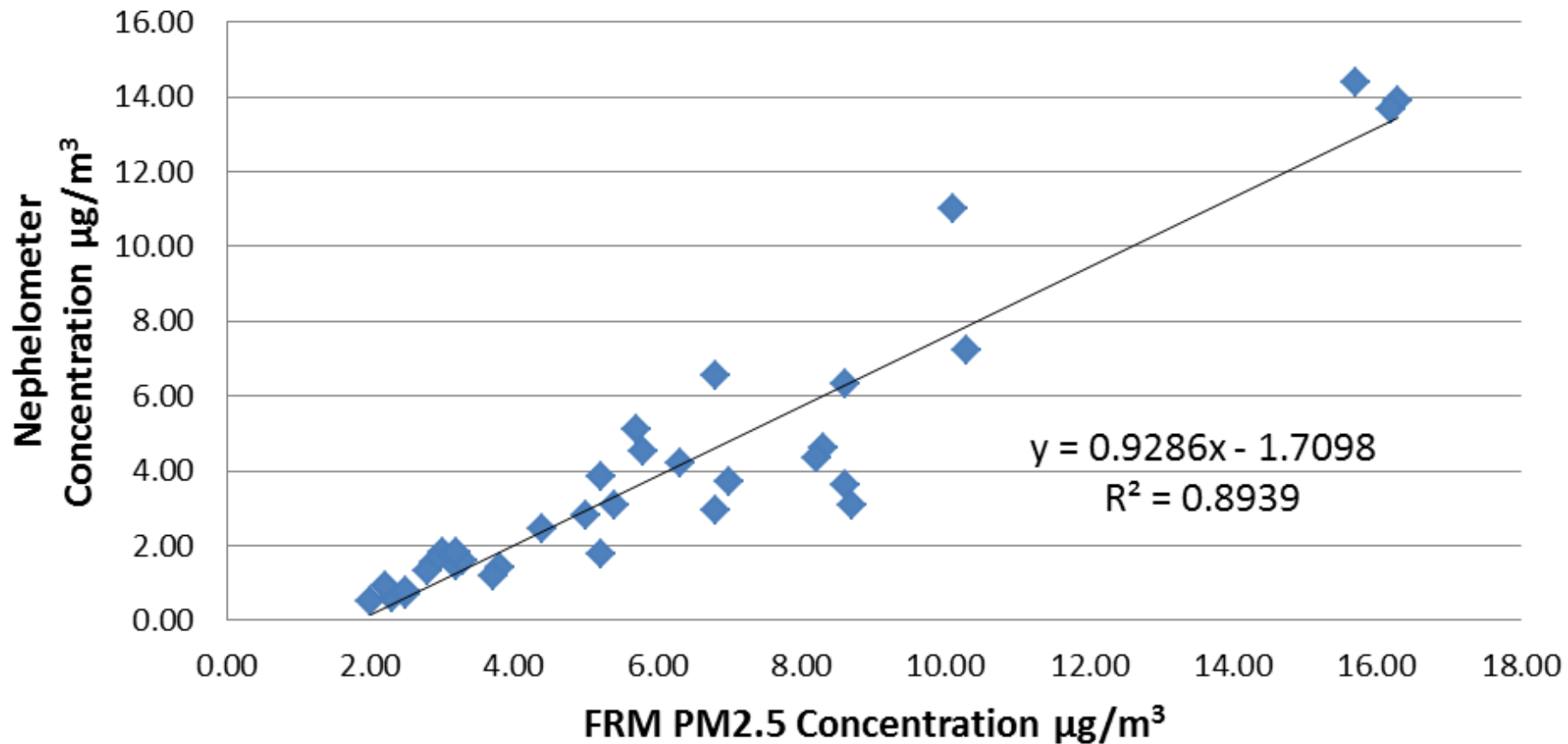
Emerging Technologies: Monitoring for Tomorrow

Neighborhood PM2.5 Monitor Sac-T Station Study

❖ Light scatter principle of operation

❖ Range of 0 – 100,000 ug/m3 & resolution is 1 ug/m3

❖ Has GPS and cellular modem capabilities

❖ Webpage/software interface

❖ Study: ~February through May 2016

Emerging Technologies: Monitoring for Tomorrow

Neighborhood PM2.5 Monitor Sac-T Station Study (cont.)

Emerging Technologies: Monitoring for Tomorrow

Neighborhood PM2.5 Monitor Sac-T Station Study (cont.)

$y = 0.9286x - 1.7098$

$R^2 = 0.8939$

Emerging Technologies: Monitoring for Tomorrow

Neighborhood PM2.5 Monitor SUMMARY

❖Decent data correlation between Neighborhood & PM2.5 FRM monitor

❖Potentially could be used in saturation studies

❖Compliment e-BAMs in wildfire responses

Emerging Technologies: Monitoring for Tomorrow

Tech: #5 Speciated-PM10 SASS

❖PM10 ion collected via the PM10 HiVol Sampler

❖Other monitoring methods to collect PM10 ions?

❖Speciated-PM10 SASS
  ▪ creation of a PM10 SASS cyclone
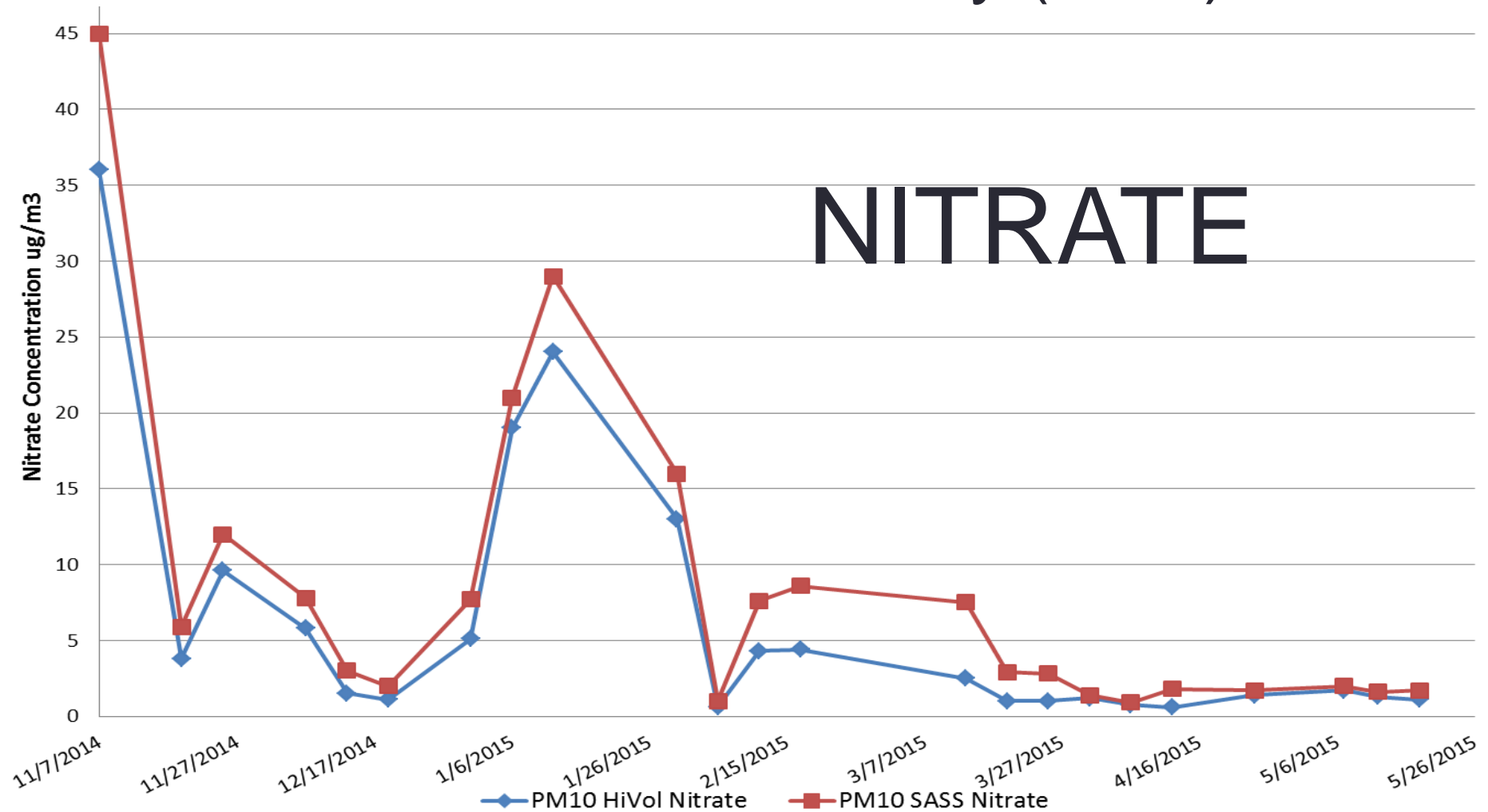
Emerging Technologies: Monitoring for Tomorrow
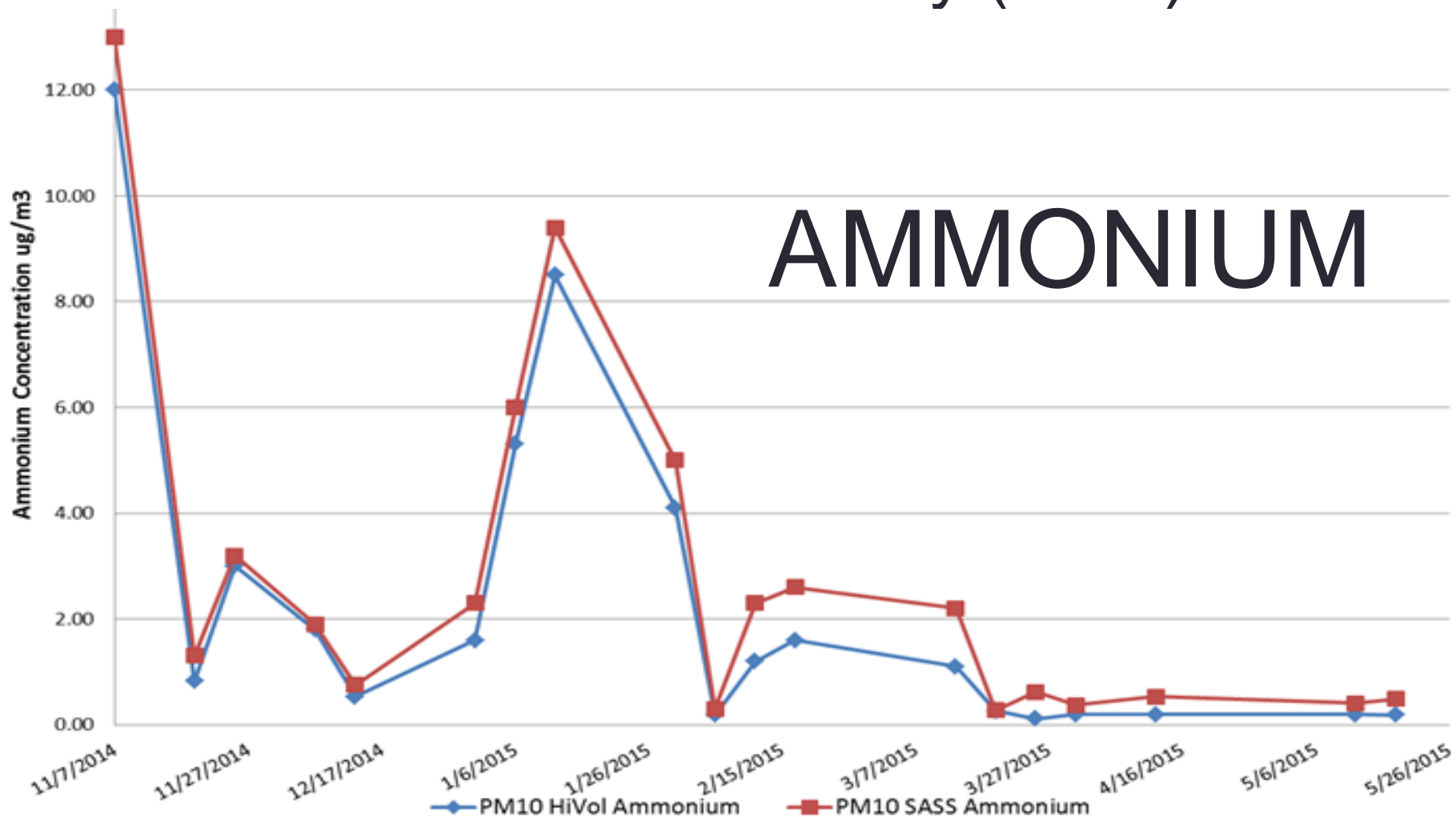
Speciated-PM10 SASS Fresno Station Study

❖ Compare ion/mass data between SASS, PM10 HiVol and Speciated-PM10 SASS

❖ Ran between Nov 2014 – May 2015

❖ Ion comparative analyses:

- Nitrate, Ammonium, Potassium & Sulfate

❖ PM10 Mass analysis

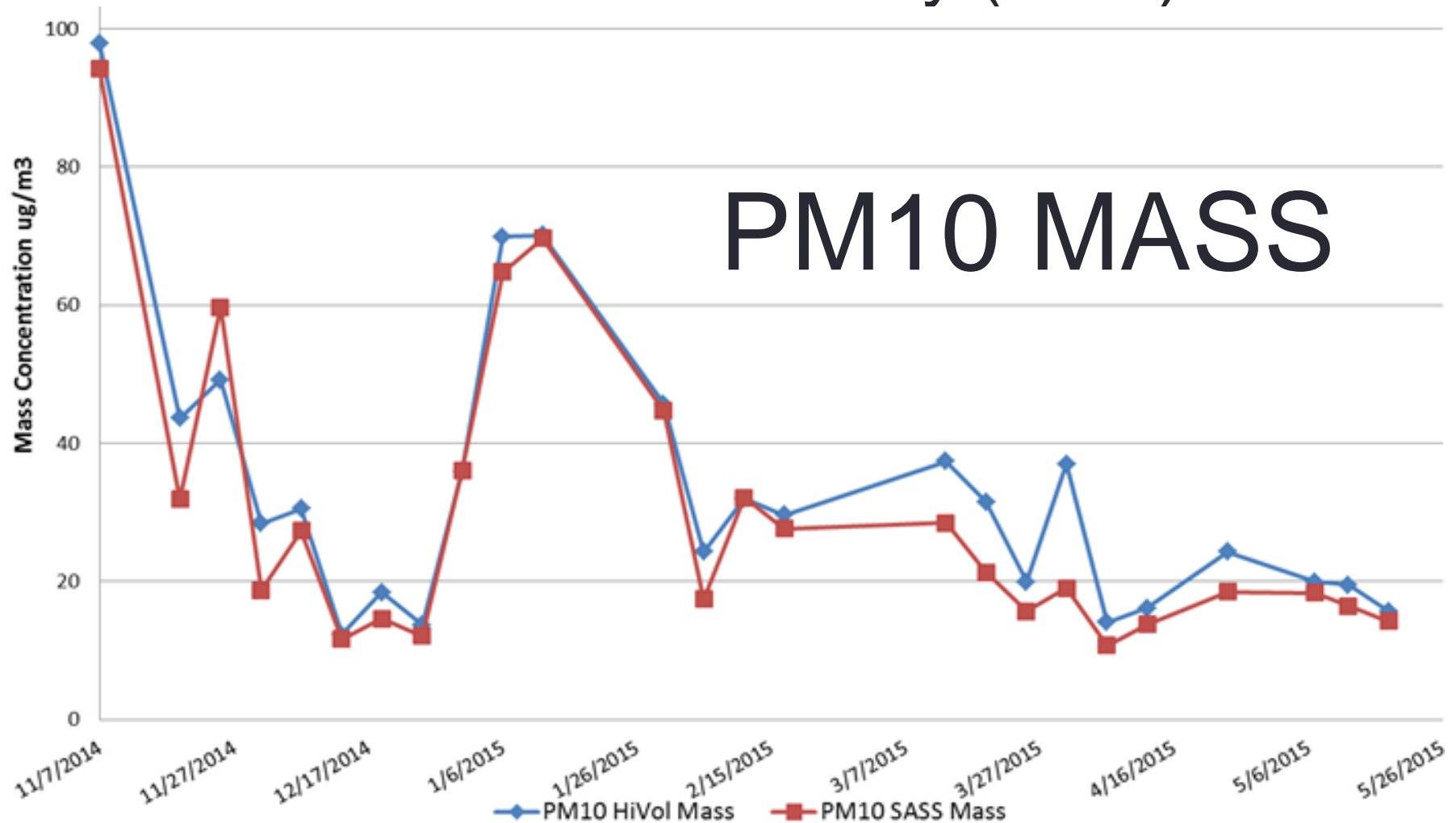*(Note: trends/precision graphs are shown only for Mass, Ammonium and Nitrate)*

Emerging Technologies: Monitoring for Tomorrow

Speciated-PM10 SASS
Fresno Station Study (cont.)

Emerging Technologies: Monitoring for Tomorrow

Speciated-PM10 SASS
Fresno Station Study (cont.)

AMMONIUM

Emerging Technologies: Monitoring for Tomorrow

Speciated-PM10 SASS
Fresno Station Study (cont.)

Emerging Technologies: Monitoring for Tomorrow

Speciated-PM10 SASS
Fresno Station Study (cont.)

NITRATE

$y = 1.1842x + 1.0533$
$R^2 = 0.9855$

Emerging Technologies: Monitoring for Tomorrow

Speciated-PM10 SASS
Fresno Station Study (cont.)

AMMONIUM

$y = 1.0598x + 0.3961$
$R^2 = 0.991$

Emerging Technologies: Monitoring for Tomorrow

Speciated-PM10 SASS
Fresno Station Study (cont.)

Emerging Technologies: Monitoring for Tomorrow
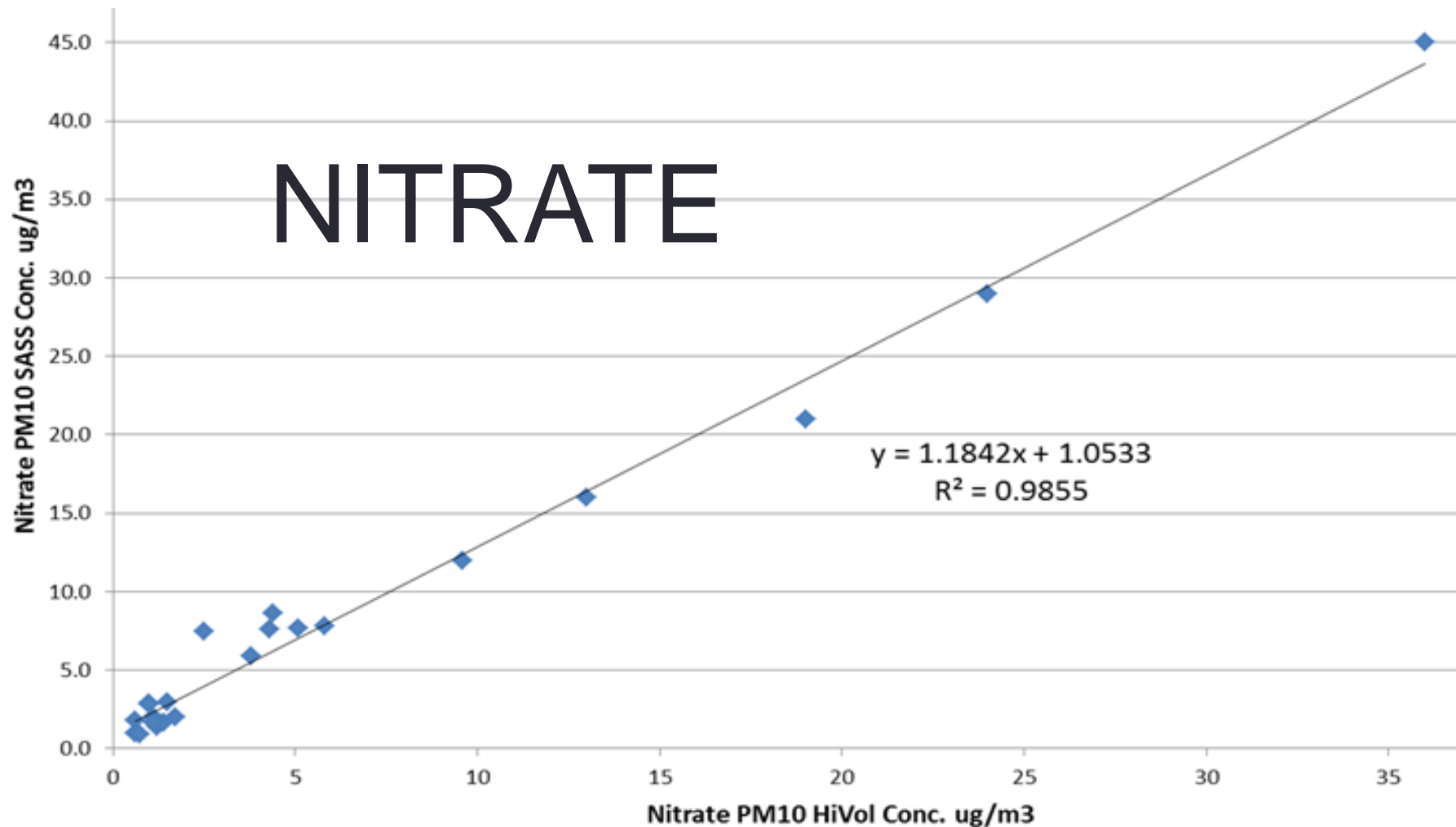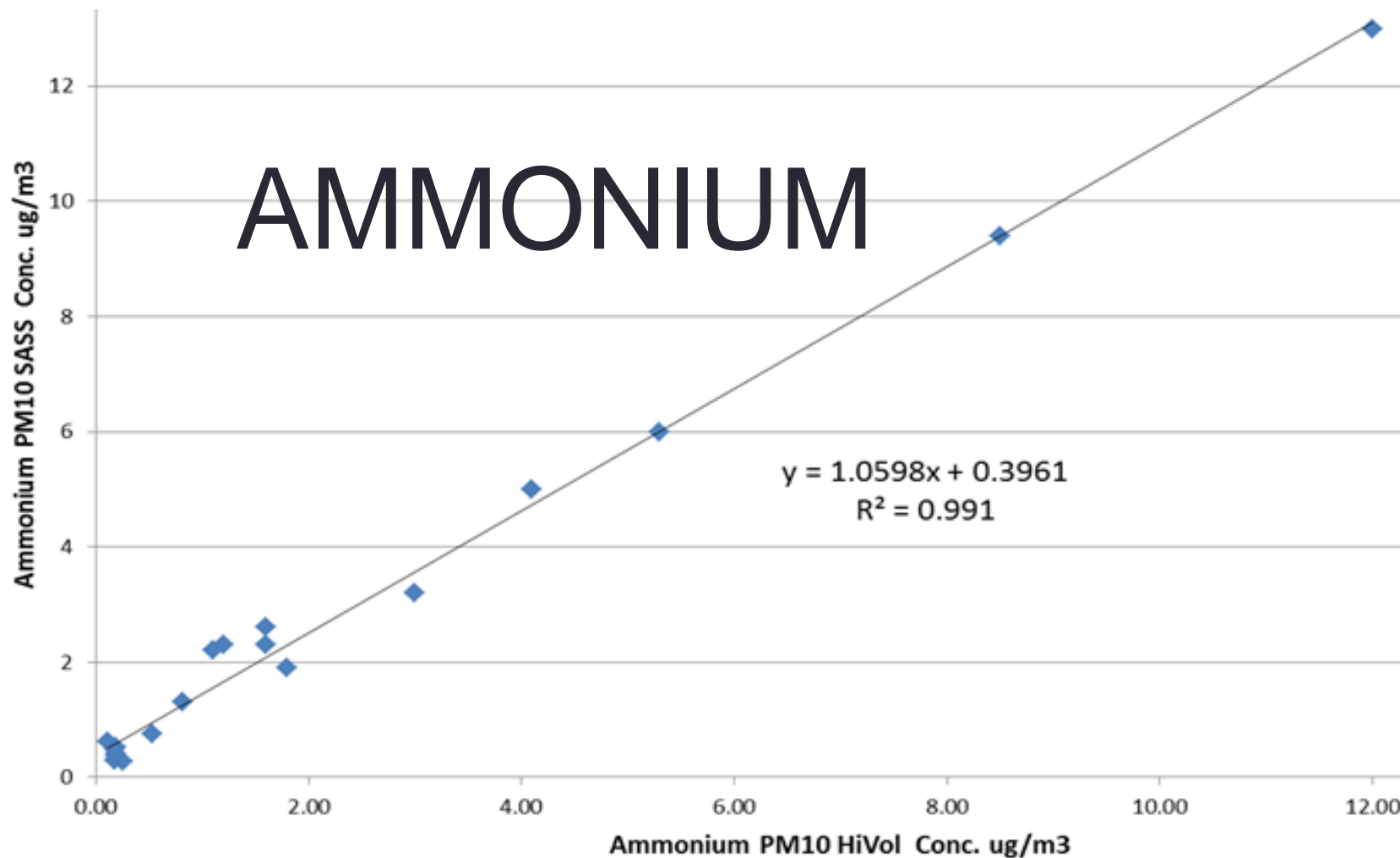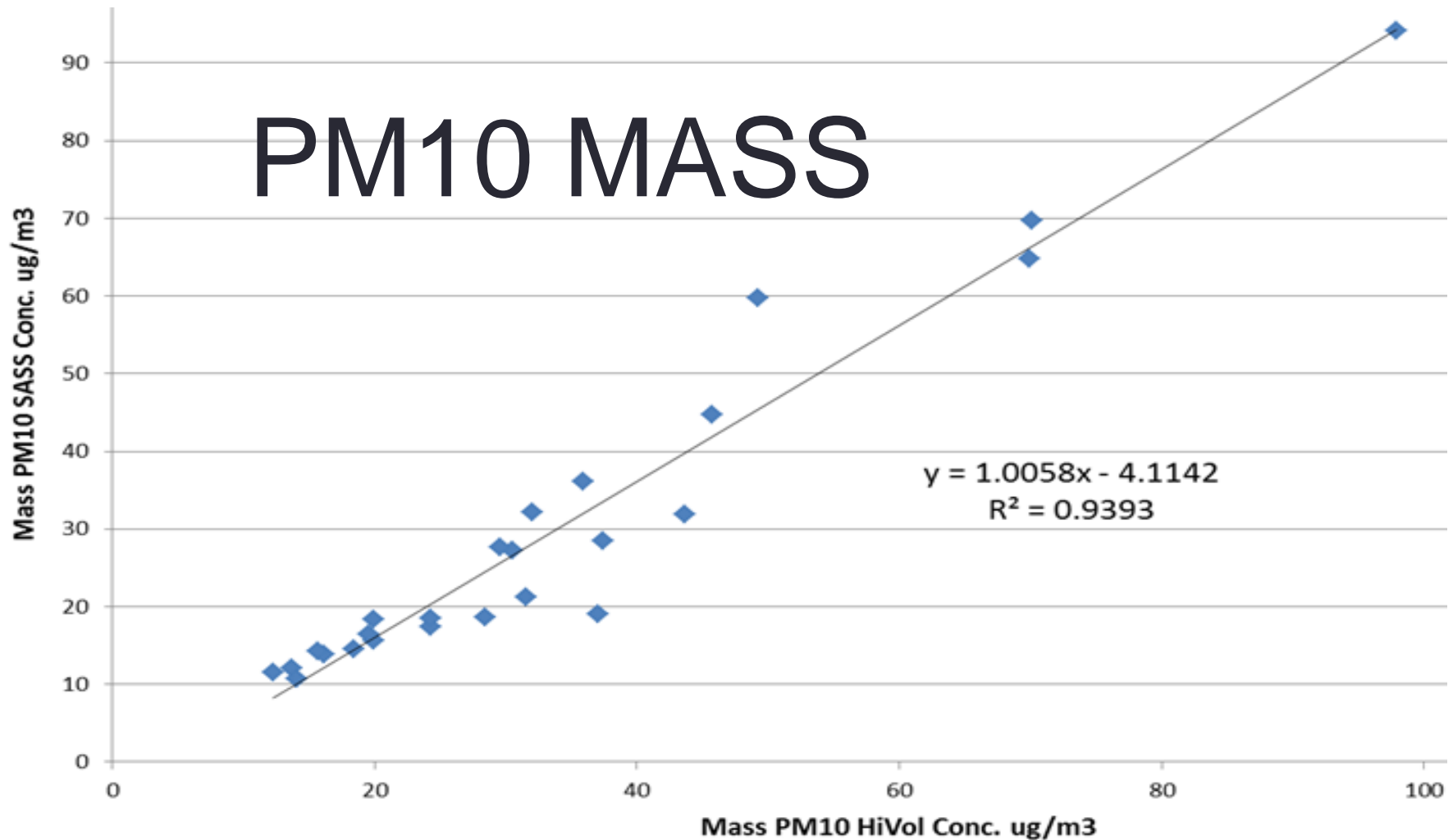
Speciated-PM10 SASS SUMMARY

❖Good ion/mass data correlations between PM10 HiVol, SASS and Speciated-PM10 SASS

❖Speciated-PM10 SASS could be used in lieu of a PM10 HiVol sampler for ion measurements

Emerging Technologies: Monitoring for Tomorrow

EMERGING TECHNOLOGIES:
MONITORING FOR TOMORROW

QUESTIONS???

Pheng Lee
pheng.lee@arb.ca.gov
Special Purpose Monitoring
California Air Resources Board
916-323-3231