Experimental Inter-comparisons of the Chemical Speciation Laboratories

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US EPA/NAREL

at the

IMPROVE Steering Committee Meeting

October 15, 2014

US EPA / NAREL

Specific QA Activities at NAREL

- PT Samples
  single-blind samples analyzed at different labs
- Laboratory TSA
  on-site inspection and interviews with lab staff
- Special Studies
  experimental investigations

Speciation Laboratories

California Air Resources Board (CARB) Sacramento, CA	Mass, Ions, Carbon, XRF
Desert Research Institute (DRI) Reno, NV	Mass, Ions, Carbon, XRF
Oregon Dept. of Environmental Quality (ODEQ) Portland, OR	Mass, Ions, XRF
Research Triangle Institute (RTI) Research Triangle Park, NC	Mass, Ions, Carbon, XRF
South Coast - Air Quality Management District (AQMD), Diamond Bar, CA	Mass, Ions, Carbon, XRF
Crocker Nuclear Lab, University of California Davis, CA (UCD)	Mass, XRF
EPA's National Air and Radiation Environmental Laboratory (NAREL), Montgomery, AL	Mass, Ions, Carbon

Collocated Met One Samplers

How good are the replicates?

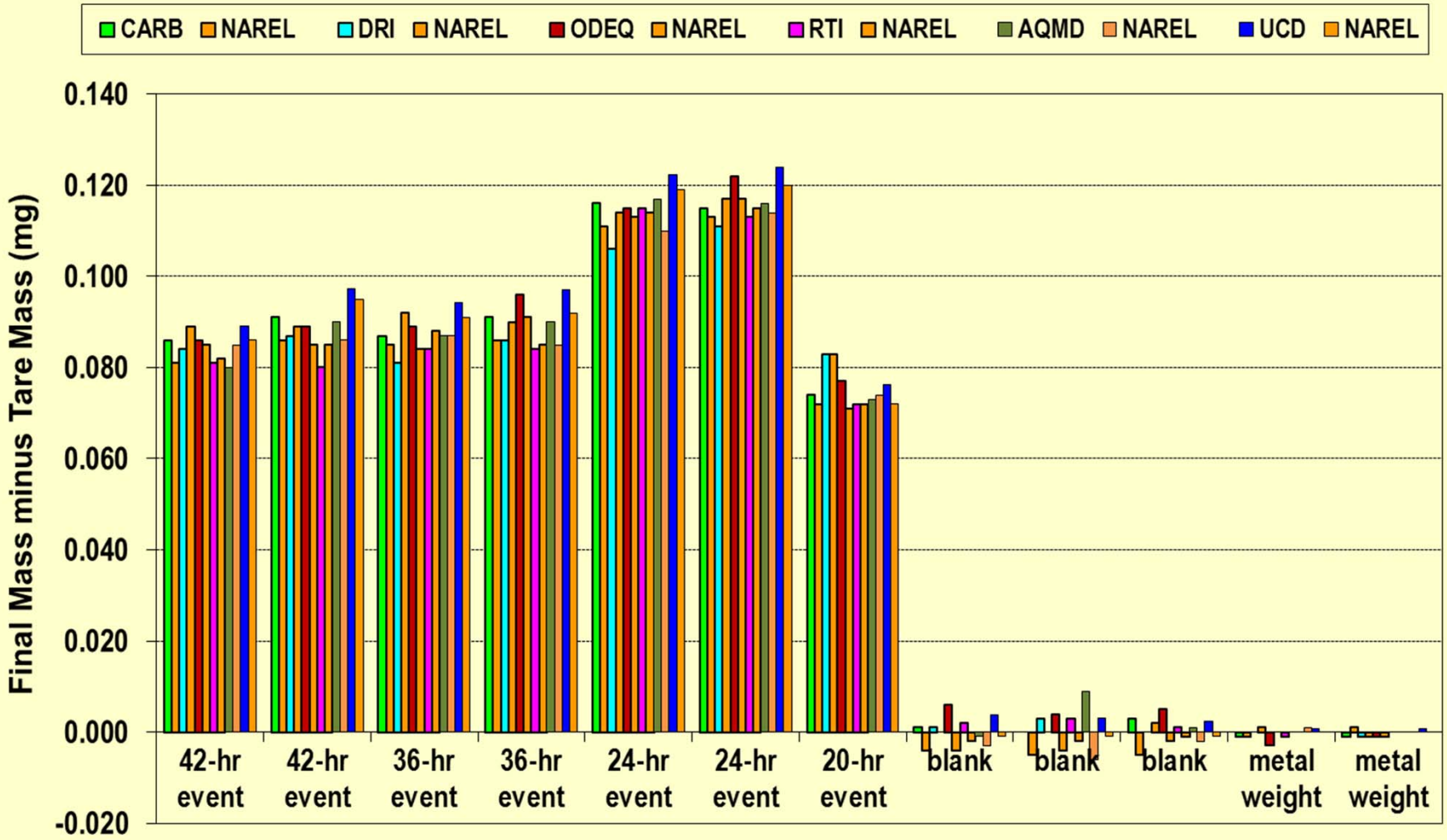
Table 8. Gravimetric Mass Analysis of the Exposed XRF Filters							
Sampling Event	**Filter Size**	**Filter ID**	**Test Lab**	**Ref. Lab**	**Filter Deposit (µg)**	**Average Deposit (µg)**	**Relative Deviation of Deposit**
152-hr event starting on 28-Jan-2013	**25-mm**	T13-14867	DRI	UCD	413	419	**-1%**
		T13-14868	DRI	UCD	437	419	**4%**
		T13-14869	RTI	UCD	407	419	**-3%**
		T13-14870	RTI	UCD	420	419	**0%**
	47-mm	T13-14857	CARB	RTI	415	419	**-1%**
		T13-14858	CARB	RTI	417	419	**0%**
		T13-14859	DRI	RTI	421	419	**0%**
		T13-14860	DRI	RTI	410	419	**-2%**
		T13-14861	ODEQ	RTI	412	419	**-2%**
		T13-14862	ODEQ	RTI	423	419	**1%**
		T13-14863	AQMD	RTI	425	419	**1%**
		T13-14864	AQMD	RTI	423	419	**1%**
162-hr event starting on 29-May-2013	**25-mm**	T13-14883	DRI	UCD	440	450	**-2%**
		T13-14884	DRI	UCD	465	450	**3%**
		T13-14885	RTI	UCD	486	450	**8%**
		T13-14886	RTI	UCD	437	450	**-3%**
	47-mm	T13-14873	CARB	RTI	439	450	**-2%**
		T13-14874	CARB	RTI	434	450	**-4%**
		T13-14875	DRI	RTI	443	450	**-2%**
		T13-14876	DRI	RTI	449	450	**0%**
		T13-14877	ODEQ	RTI	444	450	**-1%**
		T13-14878	ODEQ	RTI	469	450	**4%**
		T13-14879	AQMD	RTI	443	450	**-2%**
		T13-14880	**AQMD**	**RTI**	**447**	**450**	**-1%**

Gravimetric Mass Analysis

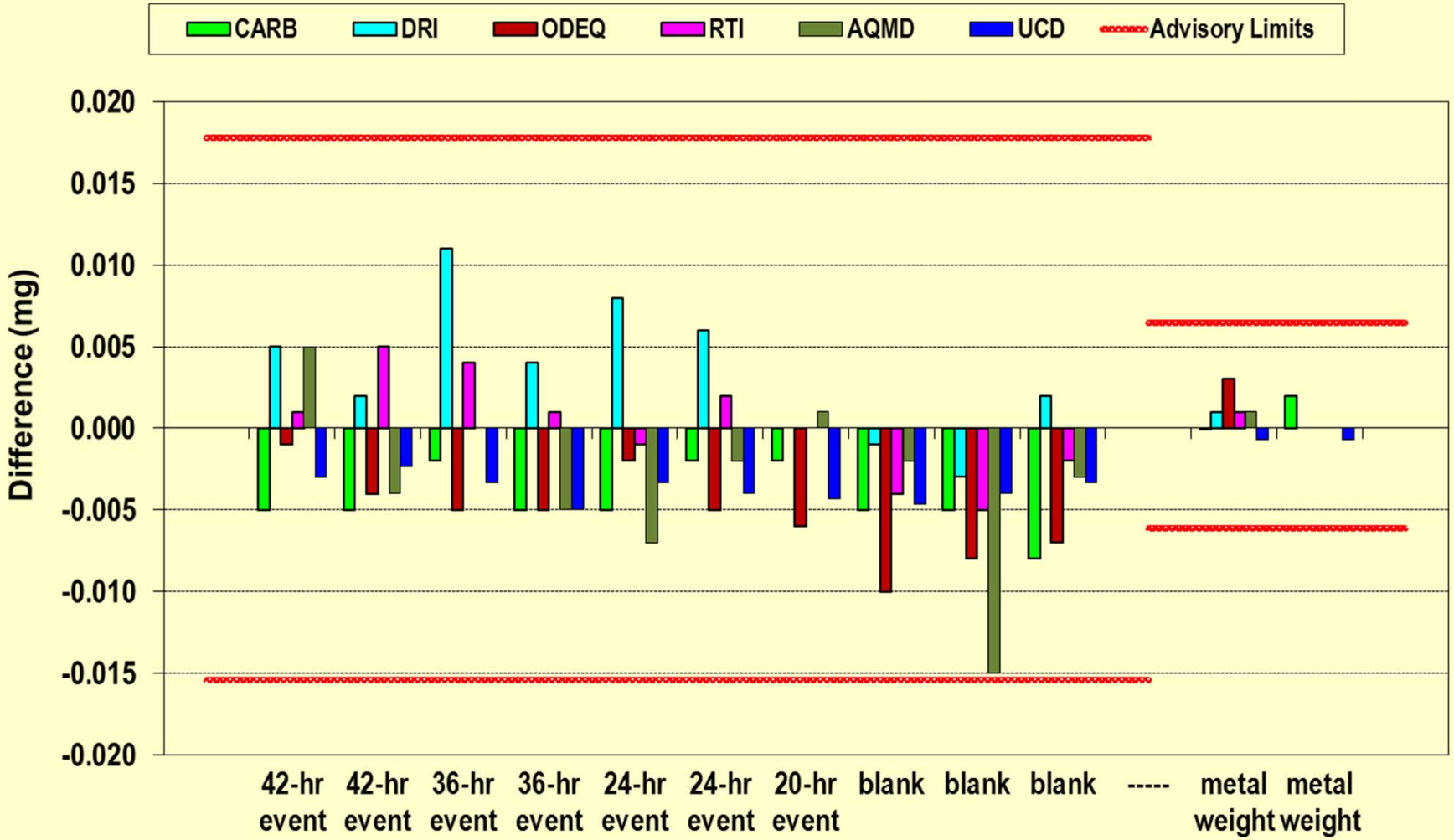
Ten teflon filters and two metallic weights were submitted to each lab for analysis.

NAREL served as reference lab

Captured PM2.5 Determined by Each Participating Lab and NAREL



PM2.5 Capture Comparisons - NAREL Value minus Participating Lab Value
(negative value indicates a smaller capture determined by NAREL)



Ion Chromatographic Analysis

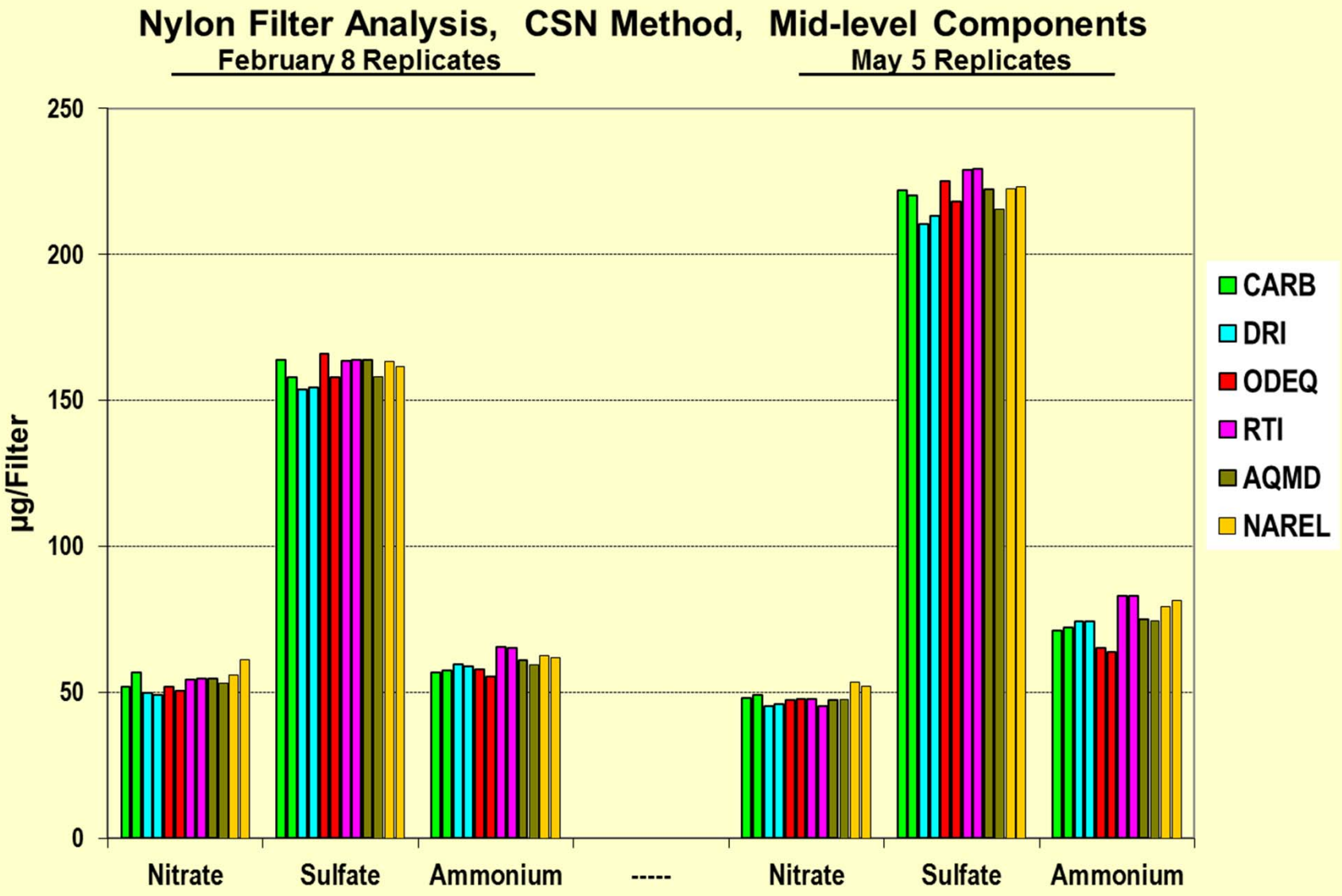
Most Labs Received Six Filters for Analysis

2 replicates from February 8 sampling event

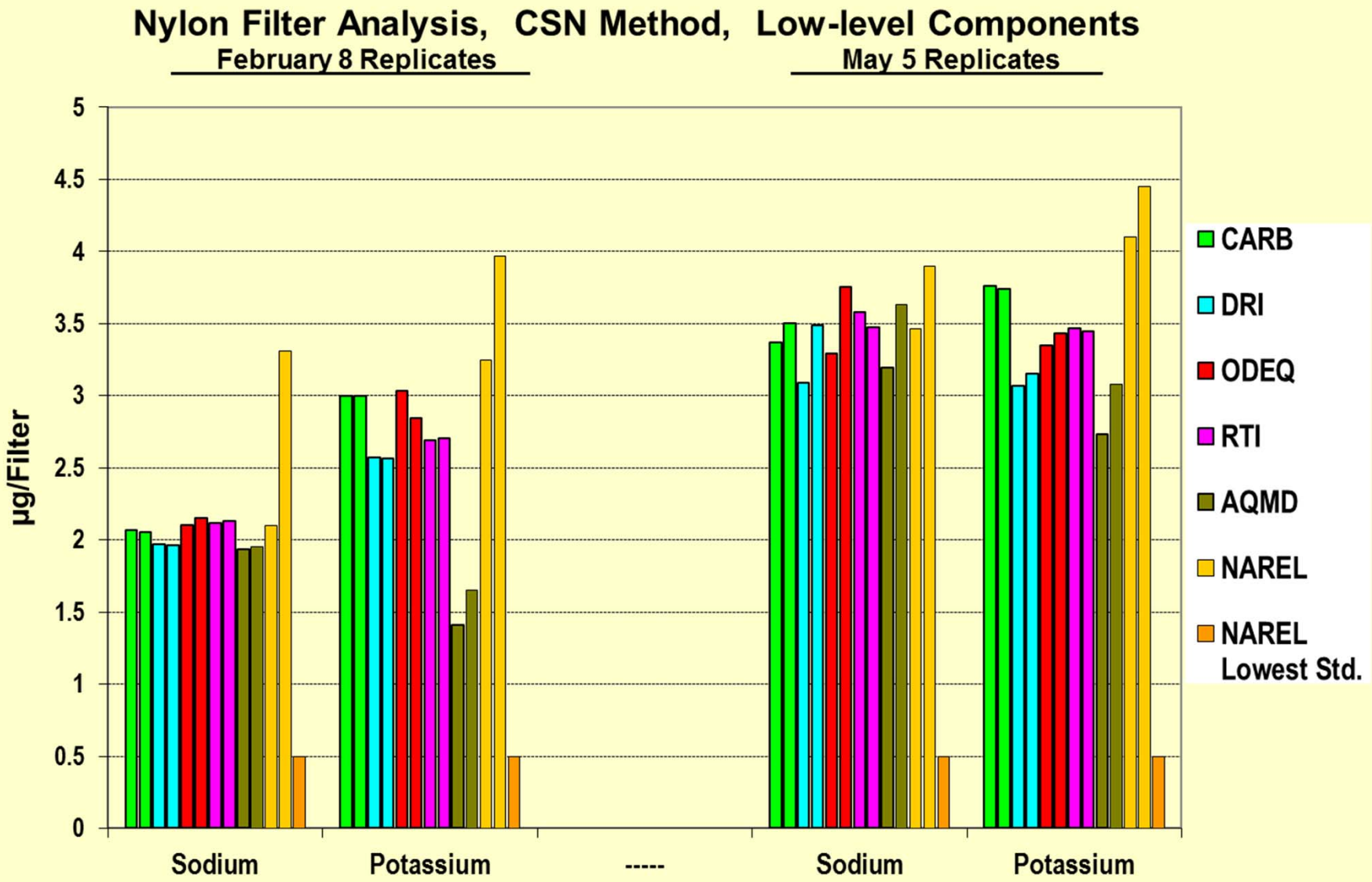
2 replicates from May 5 sampling event

2 blank filters

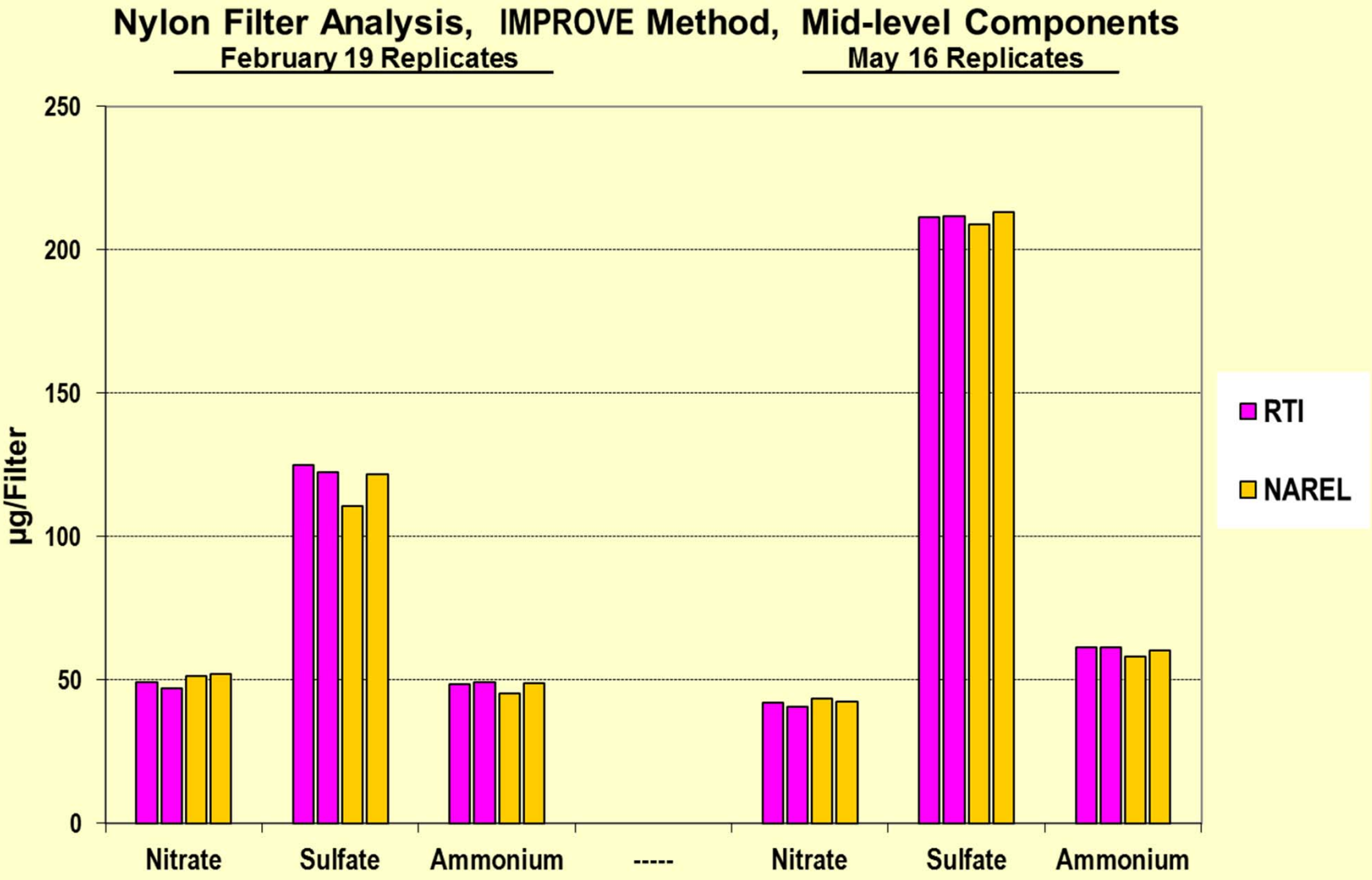
DRI and RTI received extra filters to test more than one method.


Nylon Filter Analysis, CSN Method, Mid-level Components
February 8 Replicates
May 5 Replicates
µg/Filter
250
200
150
100
50
0
Nitrate
Sulfate
Ammonium

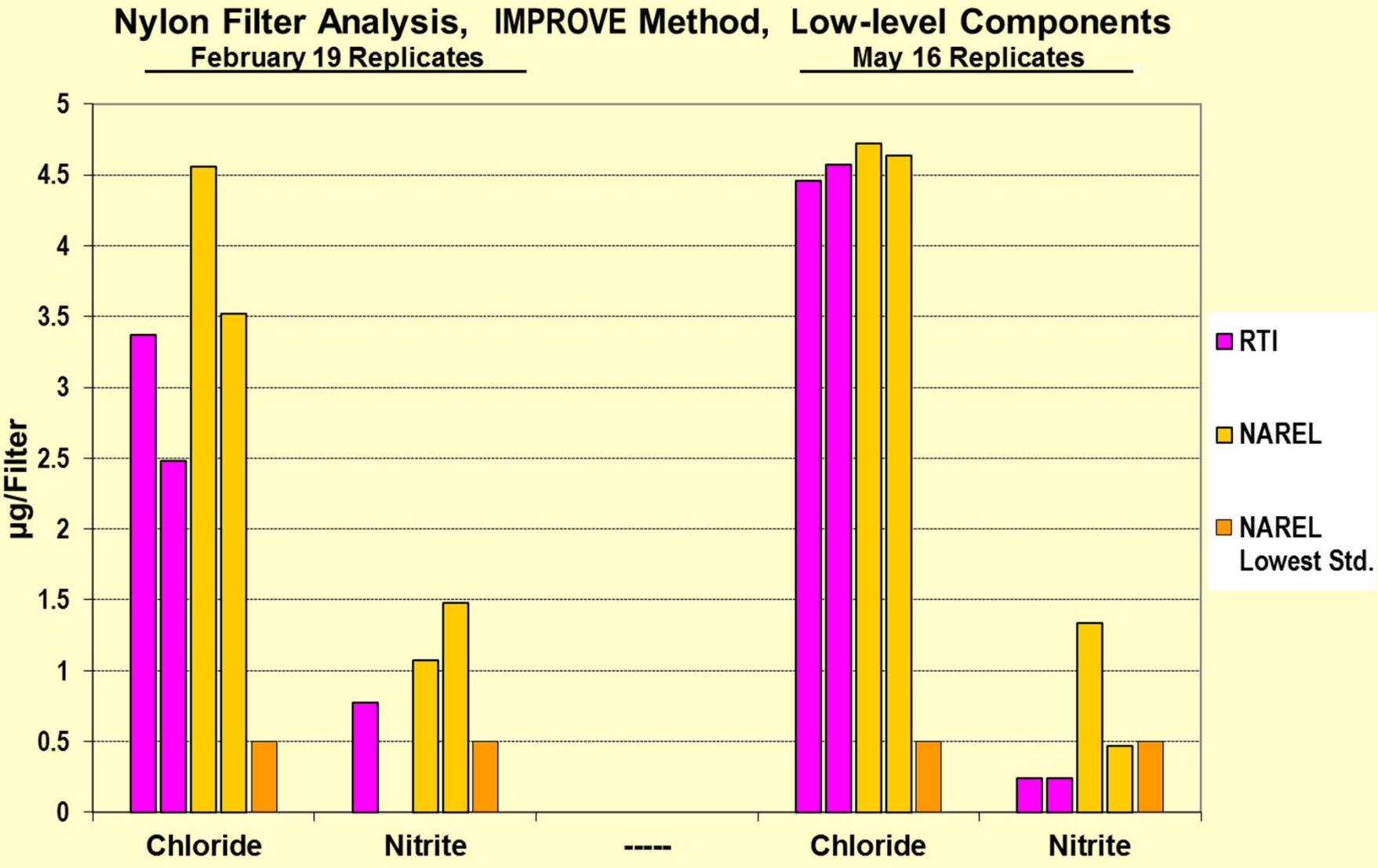
Nitrate
Sulfate
Ammonium
CARB
DRI
ODEQ
RTI
AQMD
NAREL


Nylon Filter Analysis, CSN Method, Low-level Components
February 8 Replicates
May 5 Replicates
µg/Filter
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Sodium
Potassium

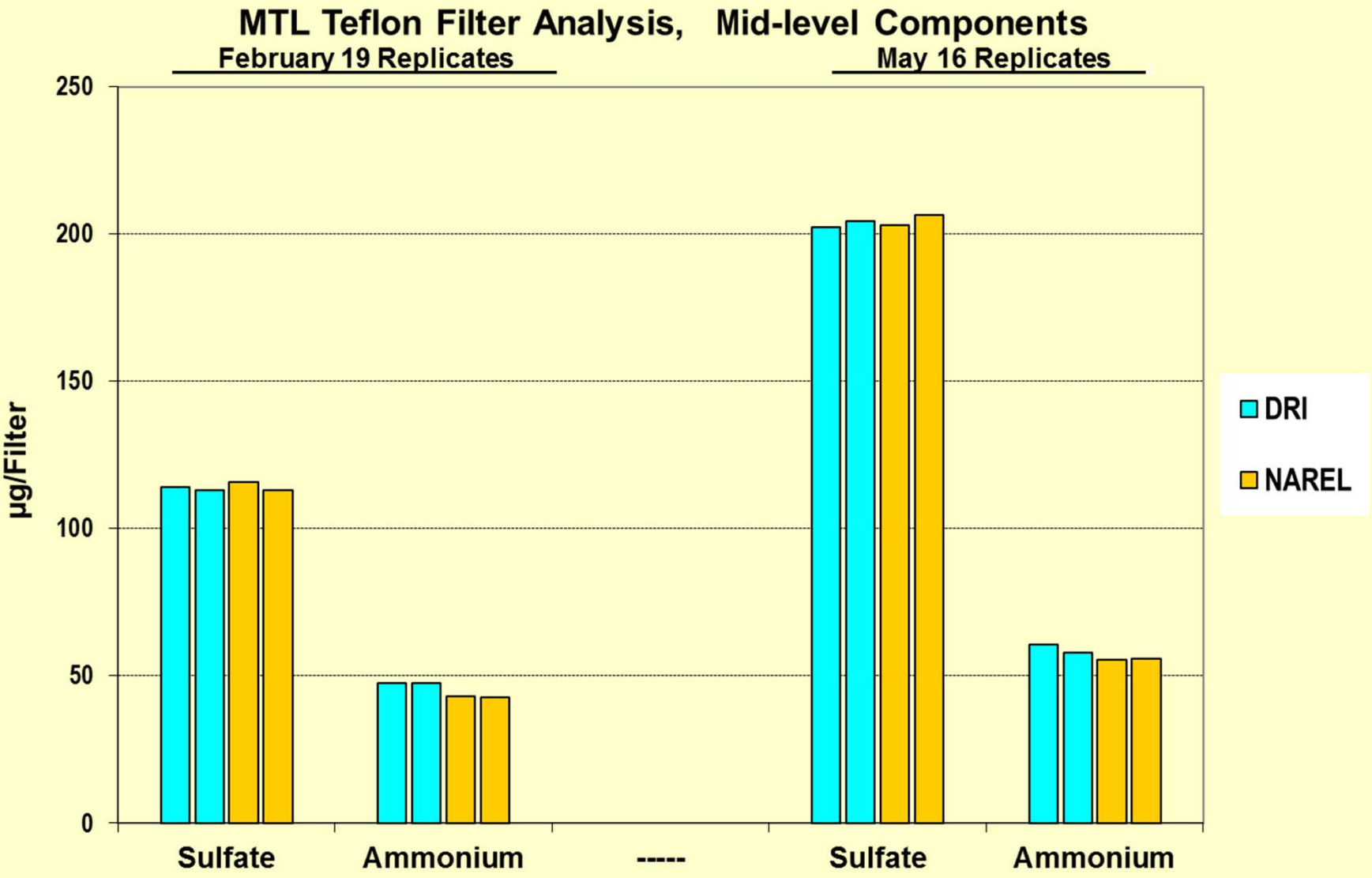
Sodium
Potassium
CARB
DRI
ODEQ
RTI
AQMD
NAREL
NAREL Lowest Std.


Nylon Filter Analysis, IMPROVE Method, Mid-level Components
February 19 Replicates
May 16 Replicates
µg/Filter
250
200
150
100
50
0
Nitrate
Sulfate
Ammonium

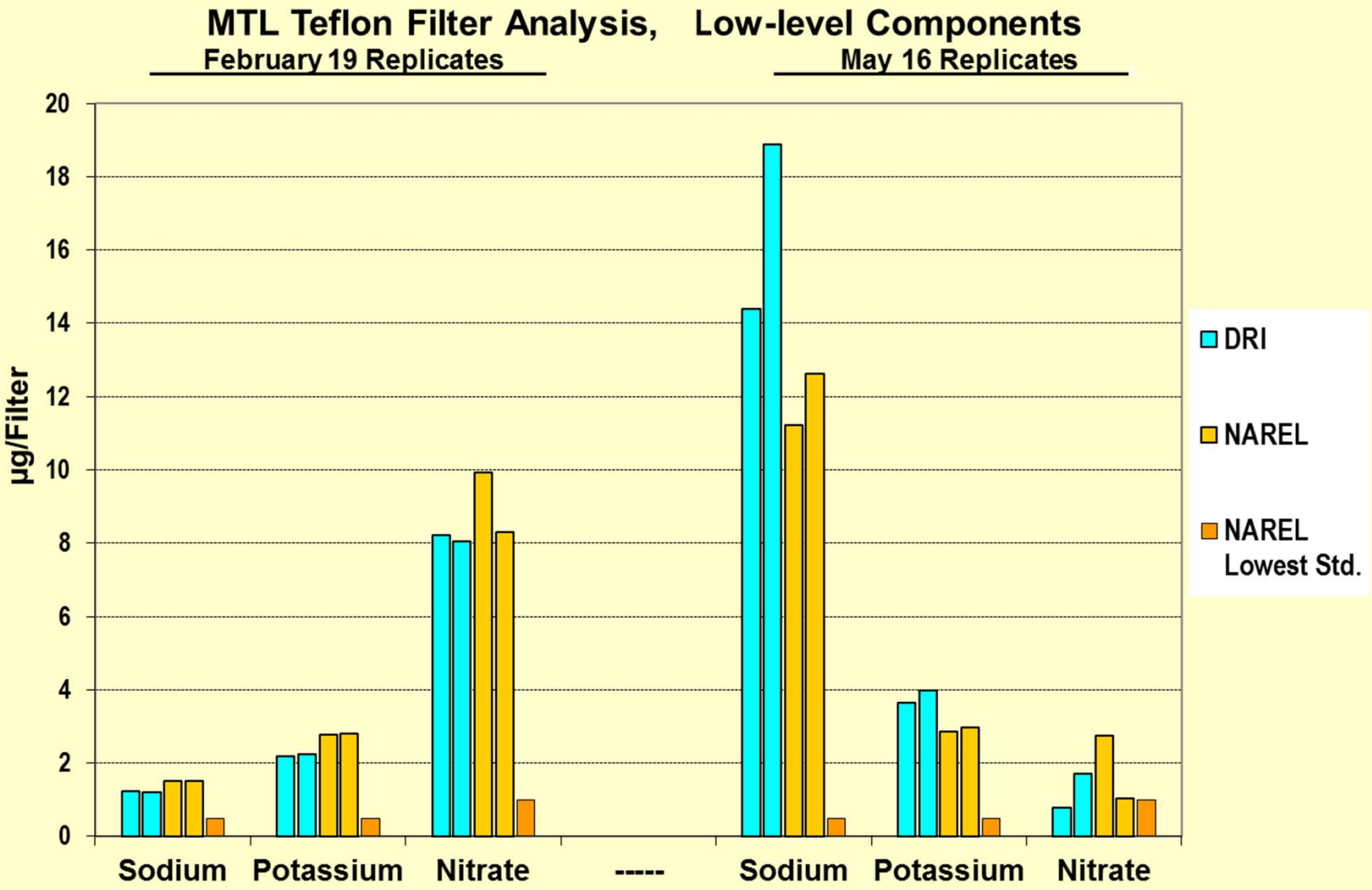
Nitrate
Sulfate
Ammonium
RTI
NAREL


Nylon Filter Analysis, IMPROVE Method, Low-level Components
February 19 Replicates
May 16 Replicates
µg/Filter
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
Chloride
Nitrite

Chloride
Nitrite
RTI
NAREL
NAREL Lowest Std.


MTL Teflon Filter Analysis, Mid-level Components
February 19 Replicates
May 16 Replicates
µg/Filter
250
200
150
100
50
0
Sulfate
Ammonium

Sulfate
Ammonium
DRI
NAREL


MTL Teflon Filter Analysis, Low-level Components
February 19 Replicates
May 16 Replicates
µg/Filter
20
18
16
14
12
10
8
6
4
2
0
Sodium
Potassium
Nitrate

Sodium
Potassium
Nitrate
DRI
NAREL
NAREL Lowest Std.

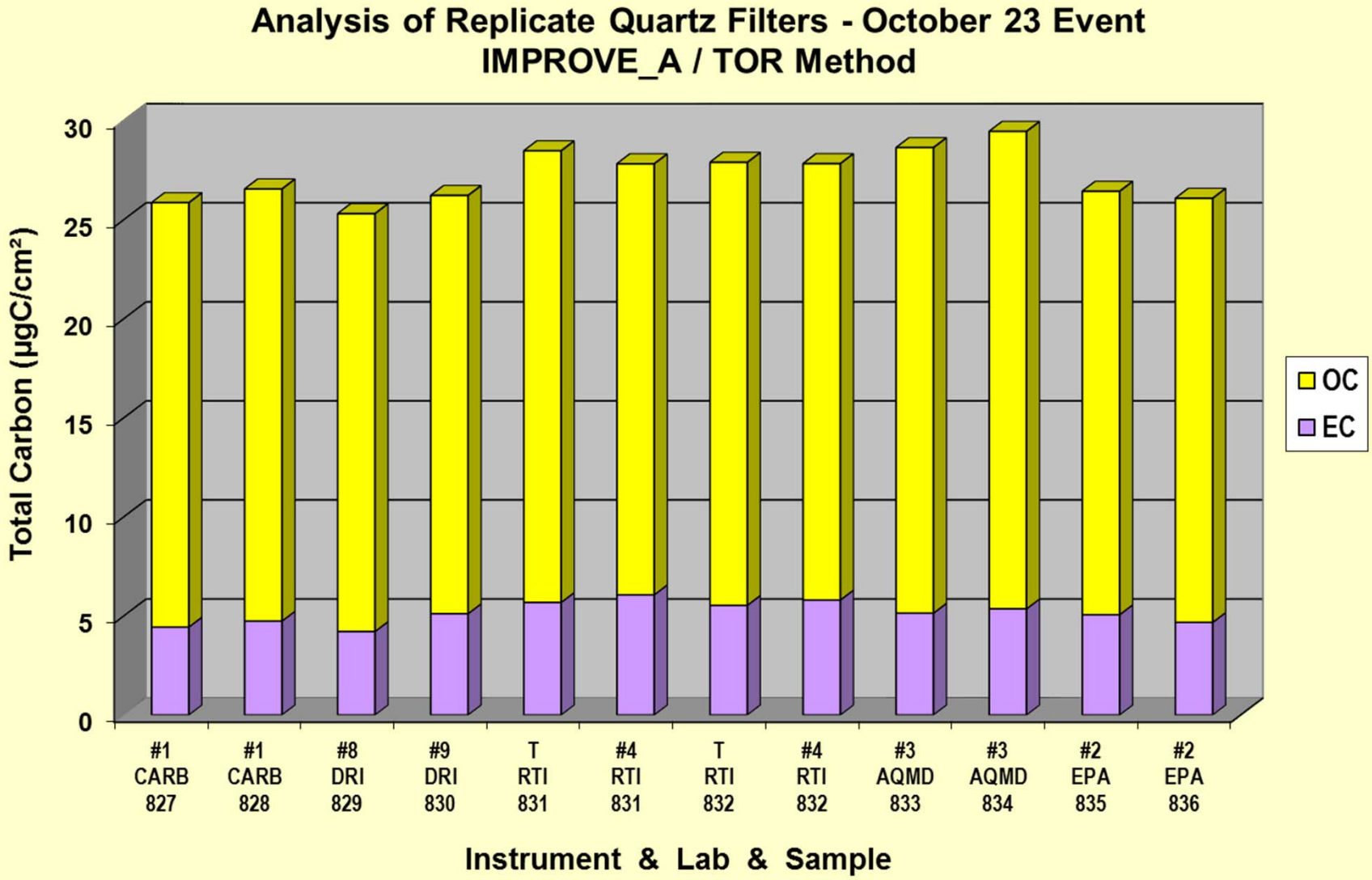
TOA Carbon Analysis

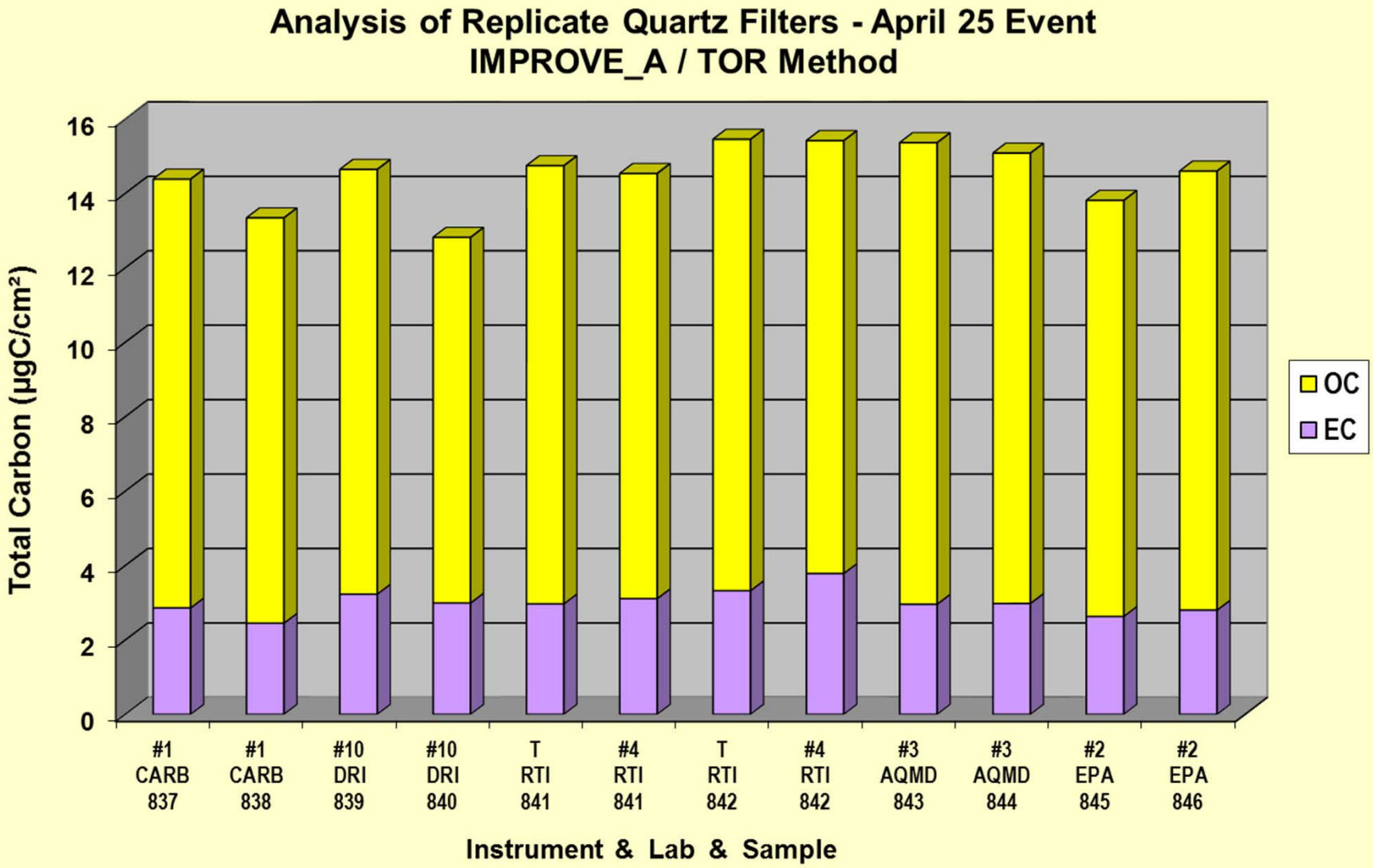
Each Lab Received Six Filters for Analysis

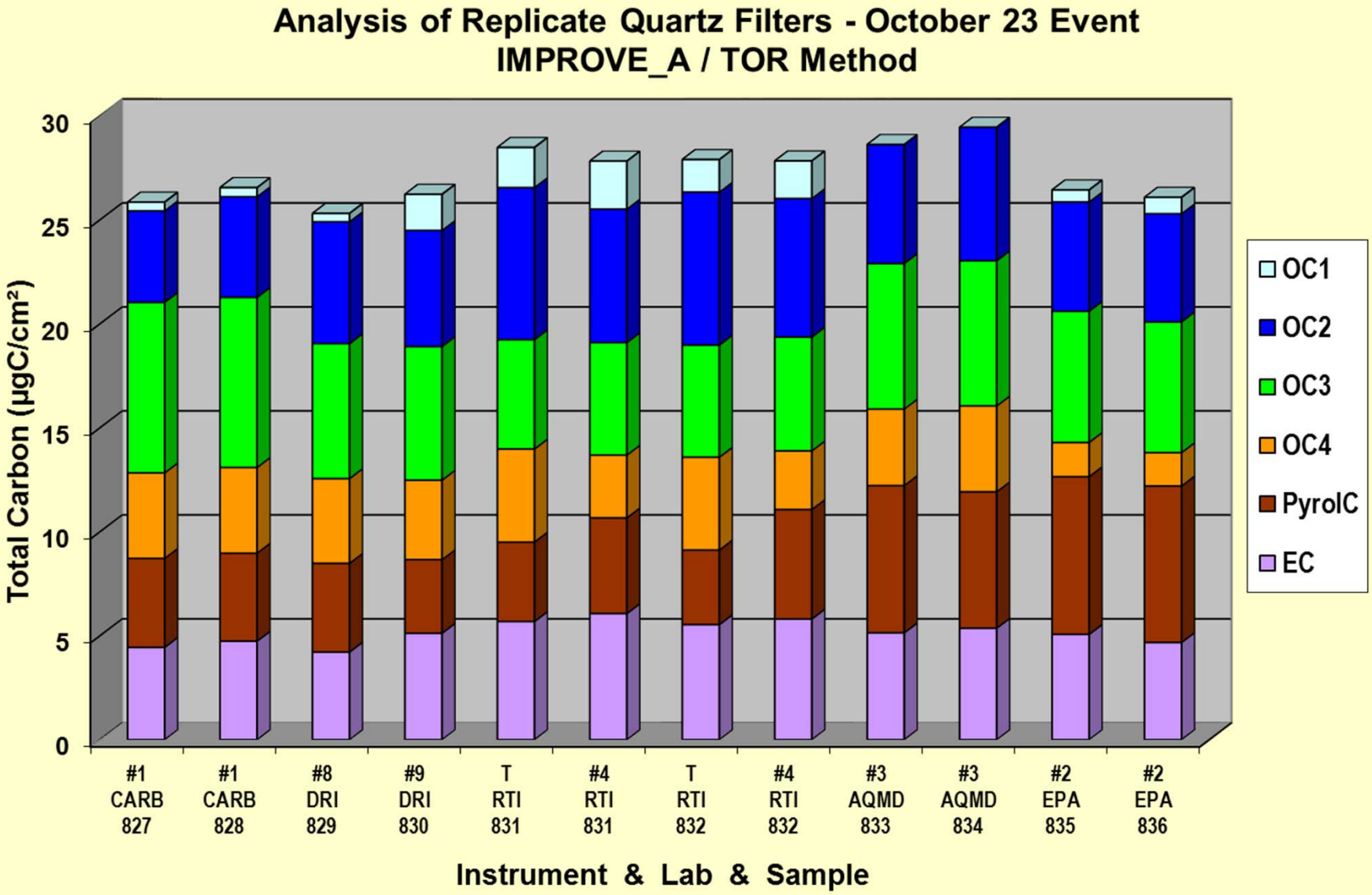
2 replicates from October 23 sampling event

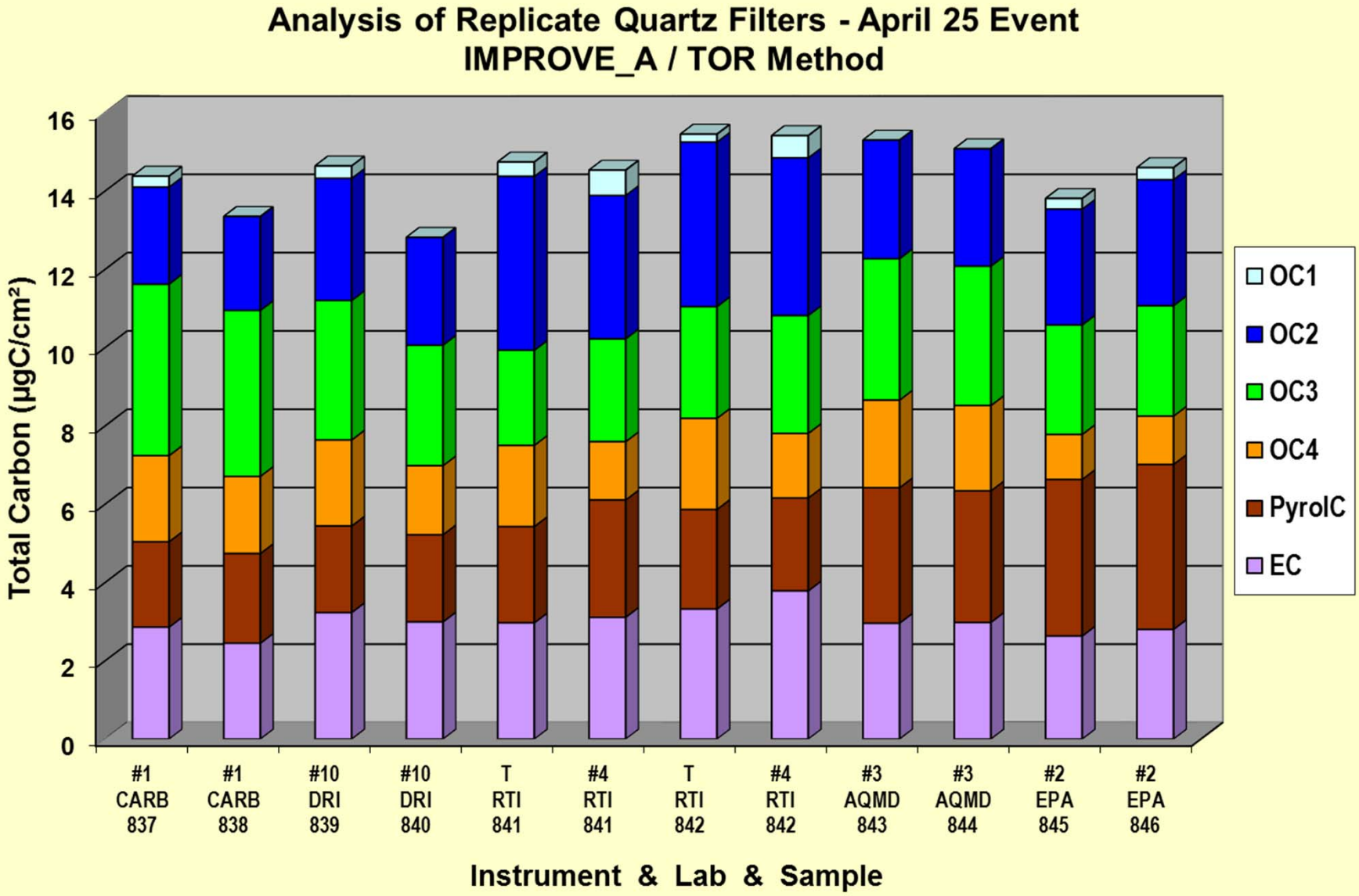
2 replicates from April 25 sampling event

2 blank filters


Analysis of Replicate Quartz Filters - October 23 Event
IMPROVE_A / TOR Method
Total Carbon (µgC/cm²)
30
25
20
15
10
5
0
OC
EC
#1 CARB 827
#1 CARB 828
#8 DRI 829
#9 DRI 830
T RTI 831
#4 RTI 831
T RTI 832
#4 RTI 832
#3 AQMD 833
#3 AQMD 834
#2 EPA 835
#2 EPA 836
Instrument & Lab & Sample


Analysis of Replicate Quartz Filters - April 25 Event
IMPROVE_A / TOR Method
Total Carbon (µgC/cm²)
0
2
4
6
8
10
12
14
16
OC
EC
#1 CARB 837
#1 CARB 838
#10 DRI 839
#10 DRI 840
T RTI 841
#4 RTI 841
T RTI 842
#4 RTI 842
#3 AQMD 843
#3 AQMD 844
#2 EPA 845
#2 EPA 846
Instrument & Lab & Sample


Analysis of Replicate Quartz Filters - October 23 Event
IMPROVE_A / TOR Method
Total Carbon (µgC/cm²)
30
25
20
15
10
5
0
OC1
OC2
OC3
OC4
PyrolC
EC
#1 CARB 827
#1 CARB 828
#8 DRI 829
#9 DRI 830
T RTI 831
#4 RTI 831
T RTI 832
#4 RTI 832
#3 AQMD 833
#3 AQMD 834
#2 EPA 835
#2 EPA 836
Instrument & Lab & Sample


Analysis of Replicate Quartz Filters - April 25 Event
IMPROVE_A / TOR Method
Total Carbon (µgC/cm²)
0
2
4
6
8
10
12
14
16
#1 CARB 837
#1 CARB 838
#10 DRI 839
#10 DRI 840
T RTI 841
#4 RTI 841
T RTI 842
#4 RTI 842
#3 AQMD 843
#3 AQMD 844
#2 EPA 845
#2 EPA 846
Instrument & Lab & Sample
OC1
OC2
OC3
OC4
PyrolC
EC

XRF Analysis

Twenty-six 47-mm filters analyzed at 5 Labs

RTI served as reference lab

Fourteen 25-mm filters analyzed at 3 Labs

UC Davis served as reference lab

How good are the replicates?

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		T13-14858	CARB	RTI	417	419	**0%**
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		T13-14861	ODEQ	RTI	412	419	**-2%**
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		T13-14874	CARB	RTI	434	450	**-4%**
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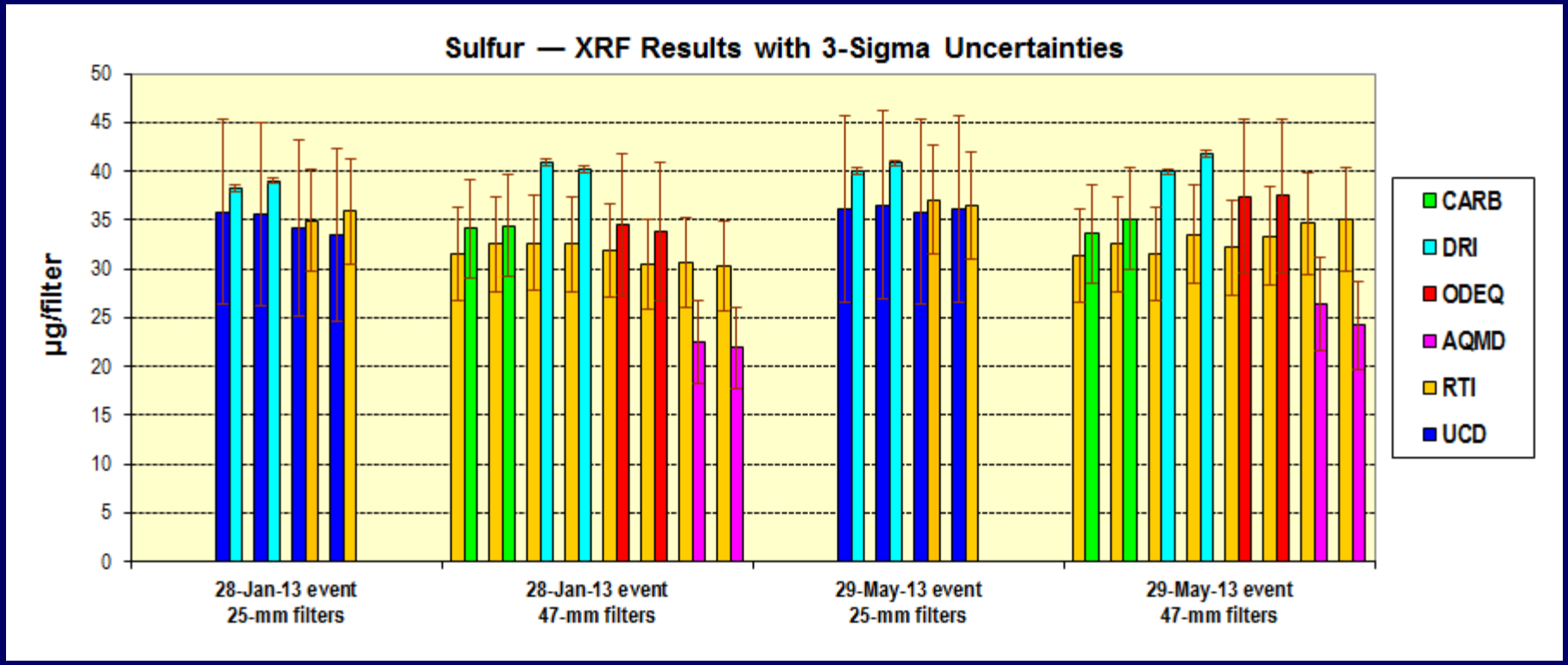
		T13-14876	DRI	RTI	449	450	**0%**
		T13-14877	ODEQ	RTI	444	450	**-1%**
		T13-14878	ODEQ	RTI	469	450	**4%**
		T13-14879	AQMD	RTI	443	450	**-2%**
		T13-14880	**AQMD**	**RTI**	**447**	**450**	**-1%**

XRF Results for Replicates
Prepared During Two Different Sampling Events



XRF Analysis

- XRF results produced by a variety of instruments and methods
- Two different sizes of filters
  - Different filter face velocity during sampling
  - Different thickness of filter deposit …
  - Different thickness of filter membrane …
  - Different sensitivity for elements w/ cal stds based on ug/cm^2

Questions?