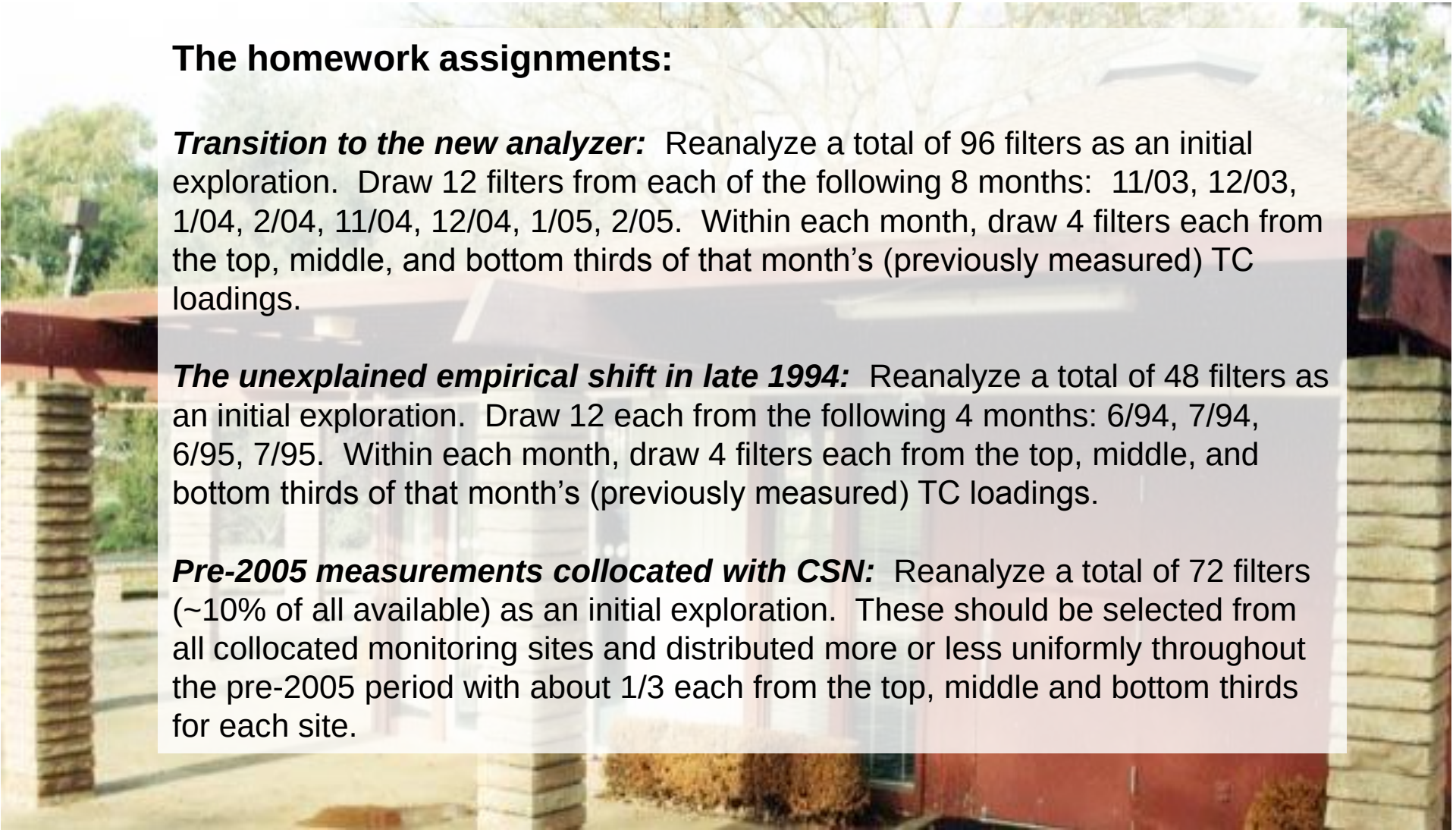
Re-analysis of IMPROVE carbon samples

Follow-up to January 2008 IMPROVE – CSN Carbon PM Monitoring Workshop

WHW, 2/4/10 – data from Dana Trimble, 9/30/09



The homework assignments:

Transition to the new analyzer: Reanalyze a total of 96 filters as an initial exploration. Draw 12 filters from each of the following 8 months: 11/03, 12/03, 1/04, 2/04, 11/04, 12/04, 1/05, 2/05. Within each month, draw 4 filters each from the top, middle, and bottom thirds of that month's (previously measured) TC loadings.

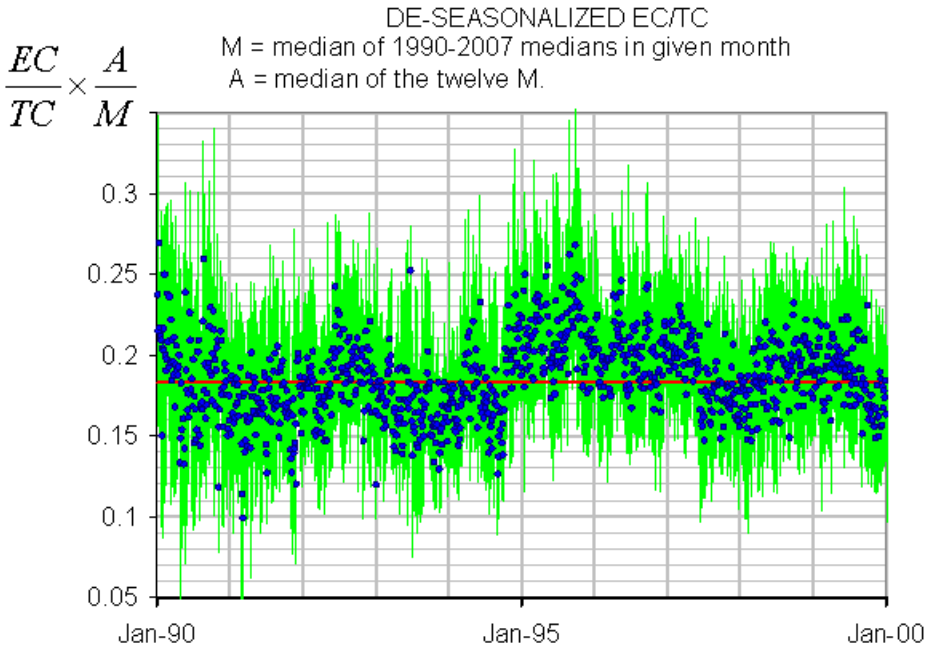
The unexplained empirical shift in late 1994: Reanalyze a total of 48 filters as an initial exploration. Draw 12 each from the following 4 months: 6/94, 7/94, 6/95, 7/95. Within each month, draw 4 filters each from the top, middle, and bottom thirds of that month's (previously measured) TC loadings.

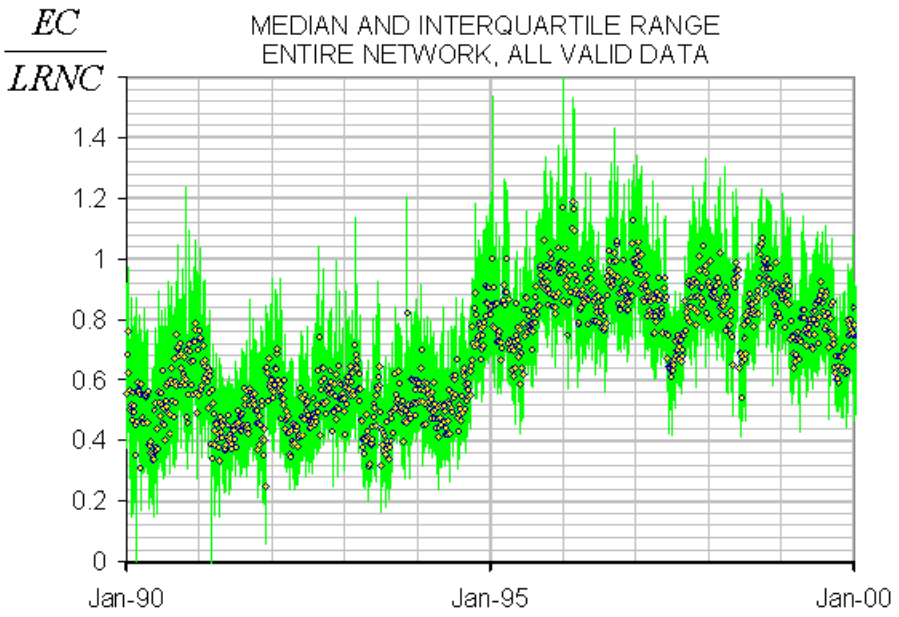
Pre-2005 measurements collocated with CSN: Reanalyze a total of 72 filters (~10% of all available) as an initial exploration. These should be selected from all collocated monitoring sites and distributed more or less uniformly throughout the pre-2005 period with about 1/3 each from the top, middle and bottom thirds for each site.

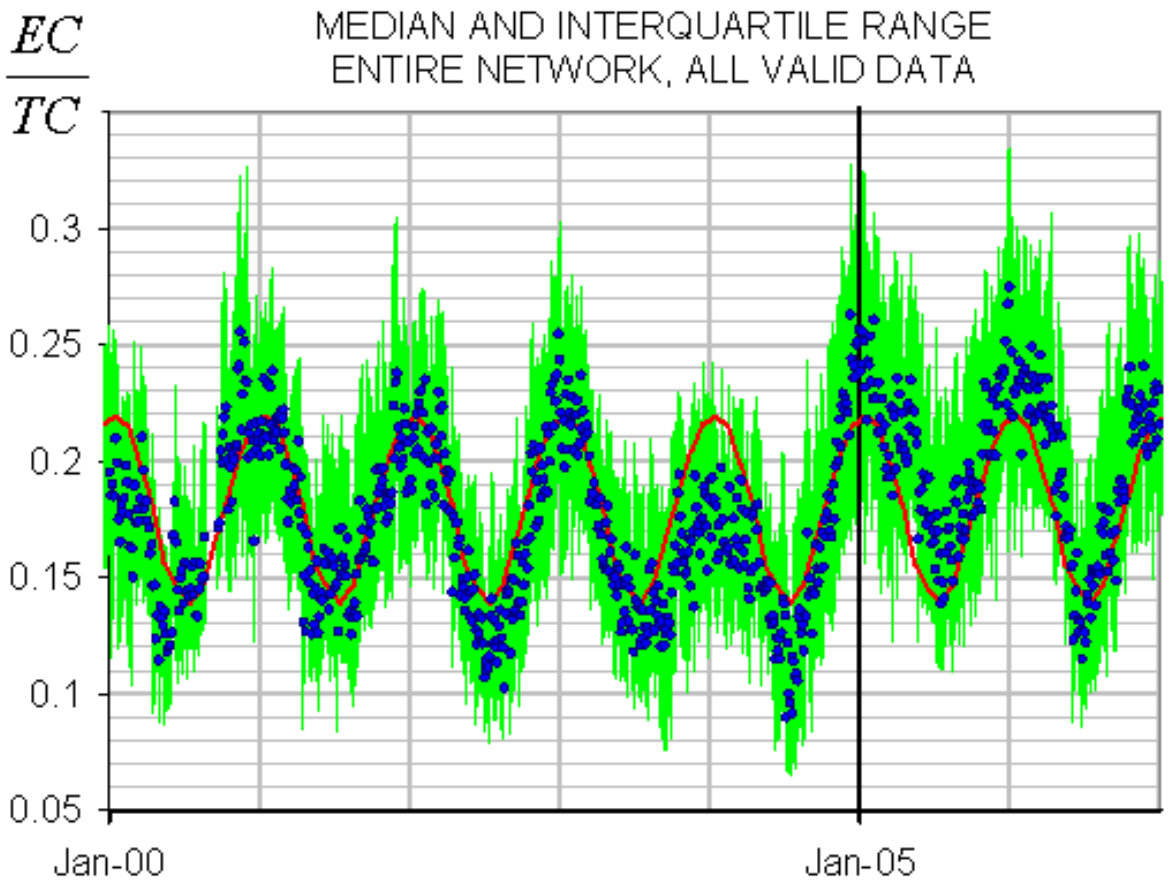
recall:

<u>1994-5 mystery:</u>

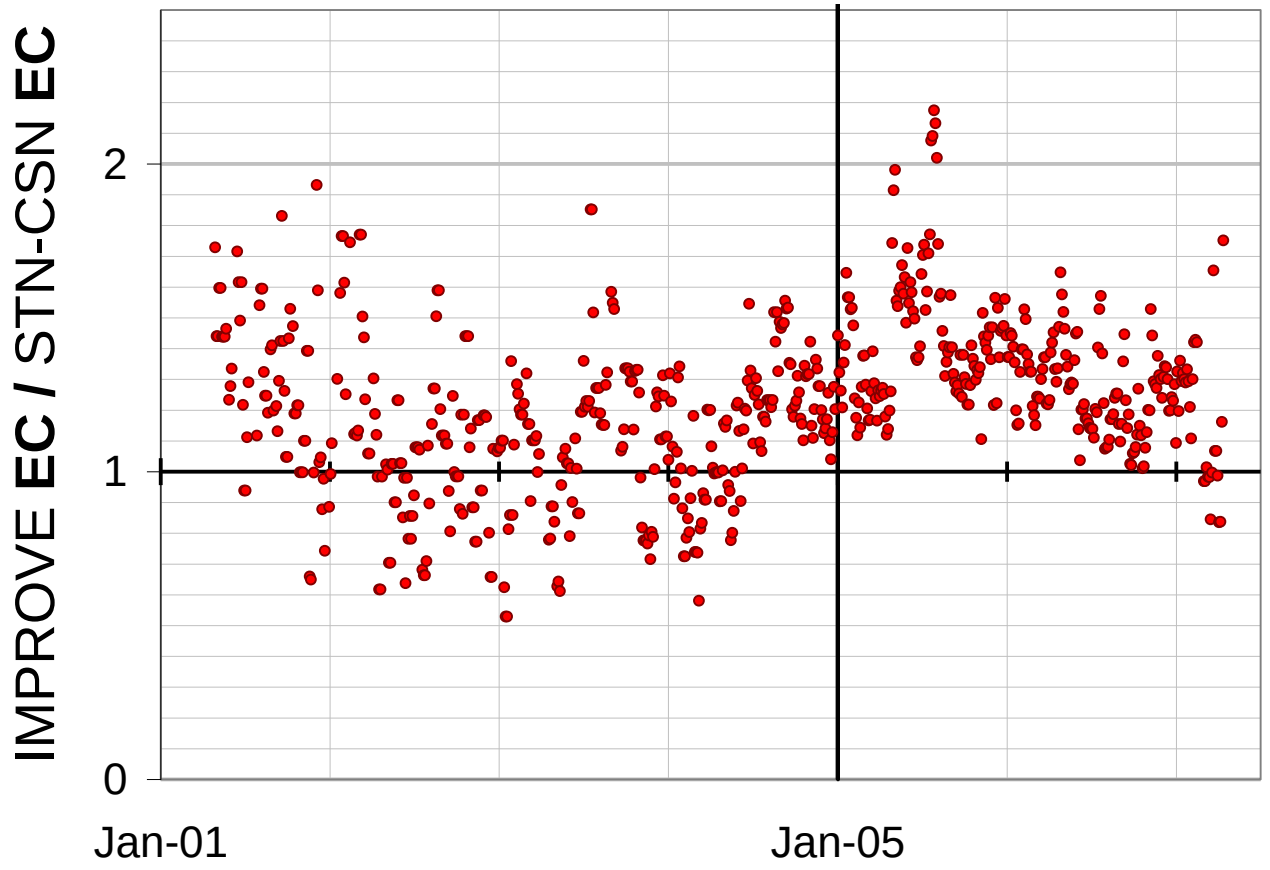
Network medians of EC as a de-seasonalized fraction of TC (top), and relative to the measured filter darkness LRNC, commonly interpreted as an optical surrogate for EC (bottom).



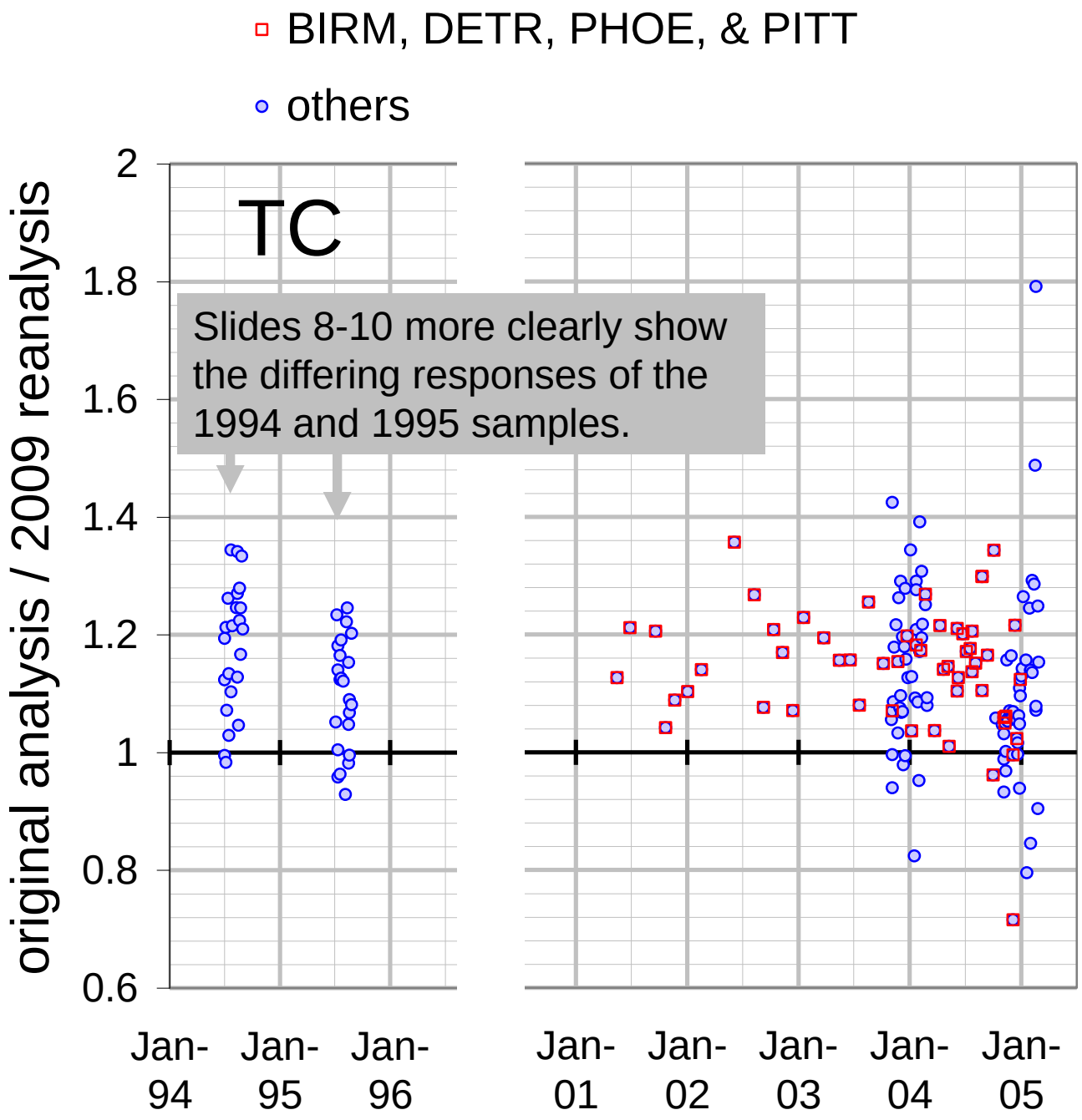




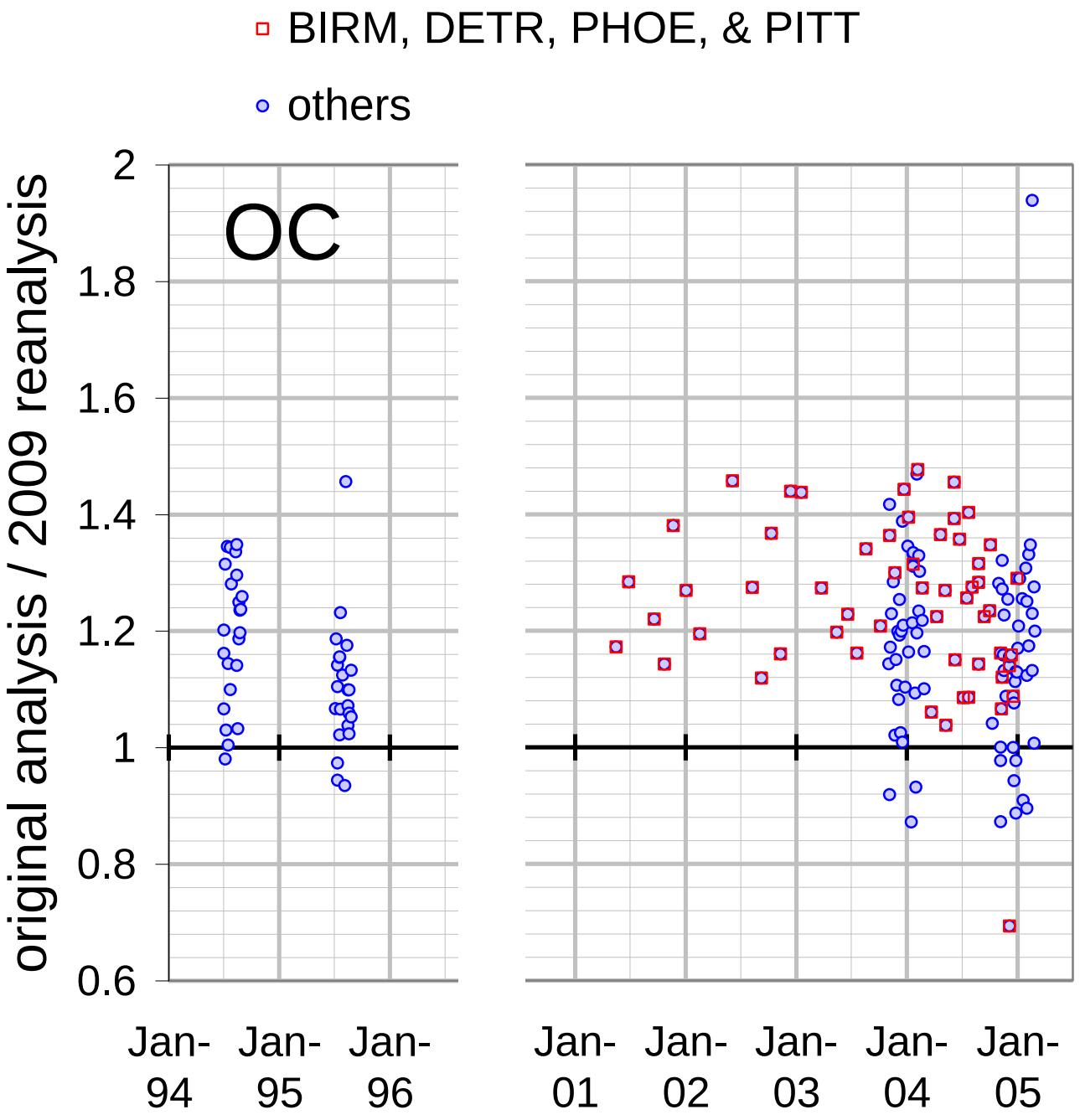
2004-5 transition: Network-median EC/TC. Each blue point shows the median of all observed ratios on the indicated day, vertical green bars show the 25th - 75th percentile range, and red curves indicate 2002-4 weekly “norms” for visual reference.



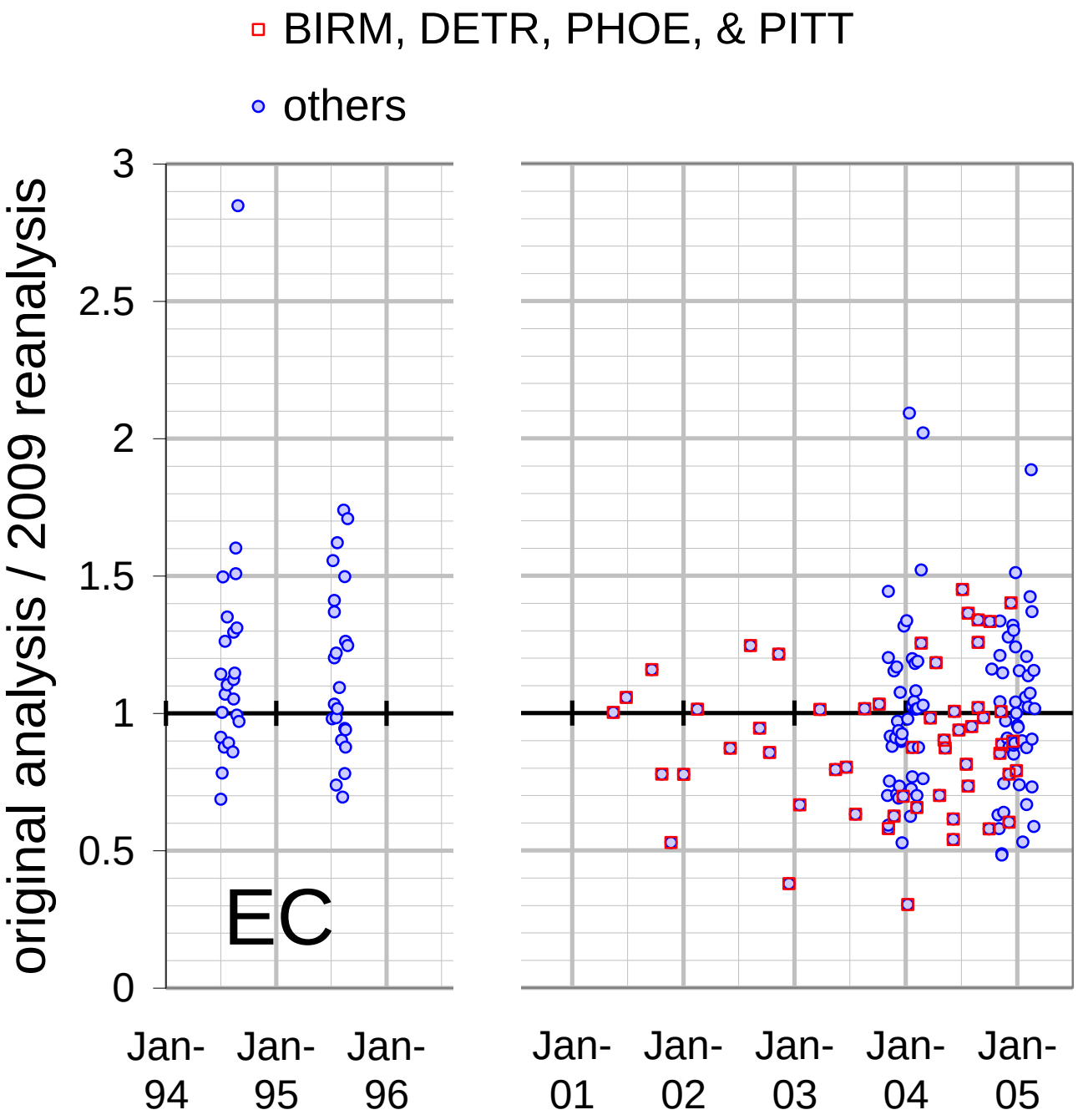
2001-4 urban collocations: Ratios of EC by IMPROVE to EC by MetOne, the predominant CSN sampler. Each point is the median from all observations on days -3, 0, +3.



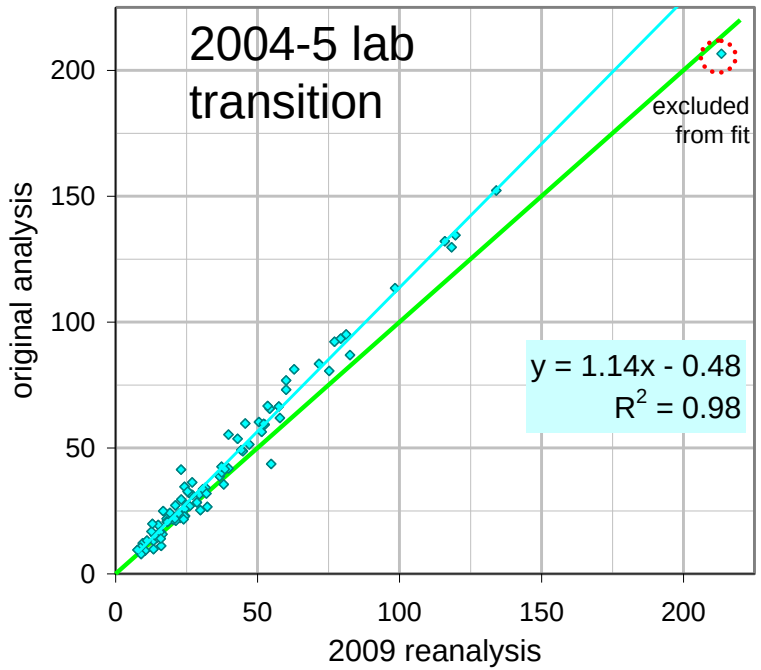
All samples with original and 2009 TC both > 10xMDL_{DRI}

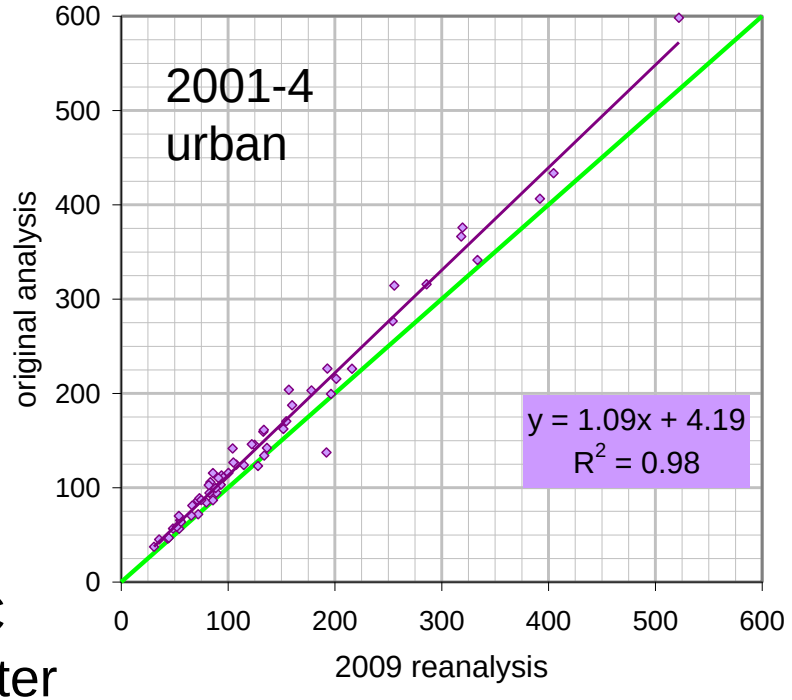


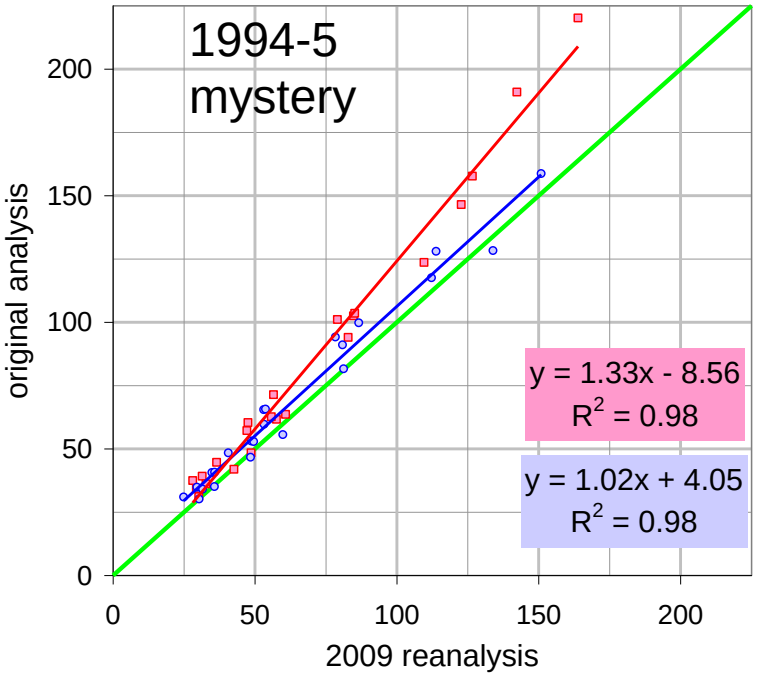
All samples with original and 2009 OC both > 10xMDL_{DRI}



All samples with original and 2009 EC both > 10xMDL_{DRI}





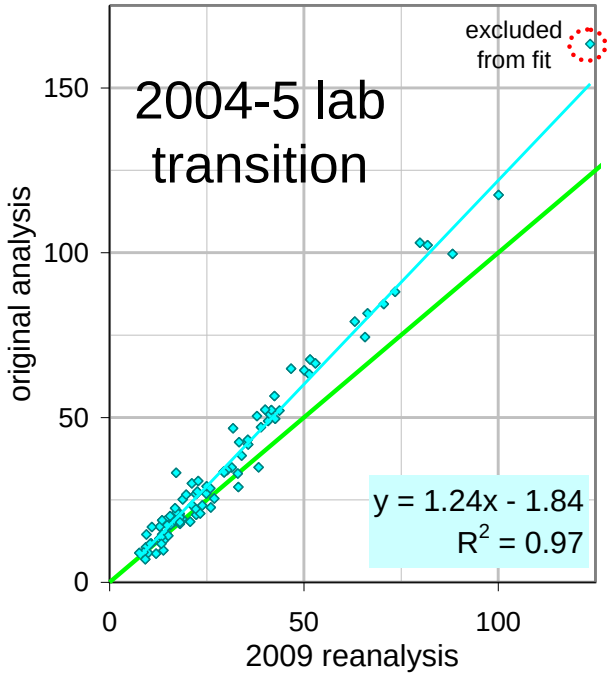


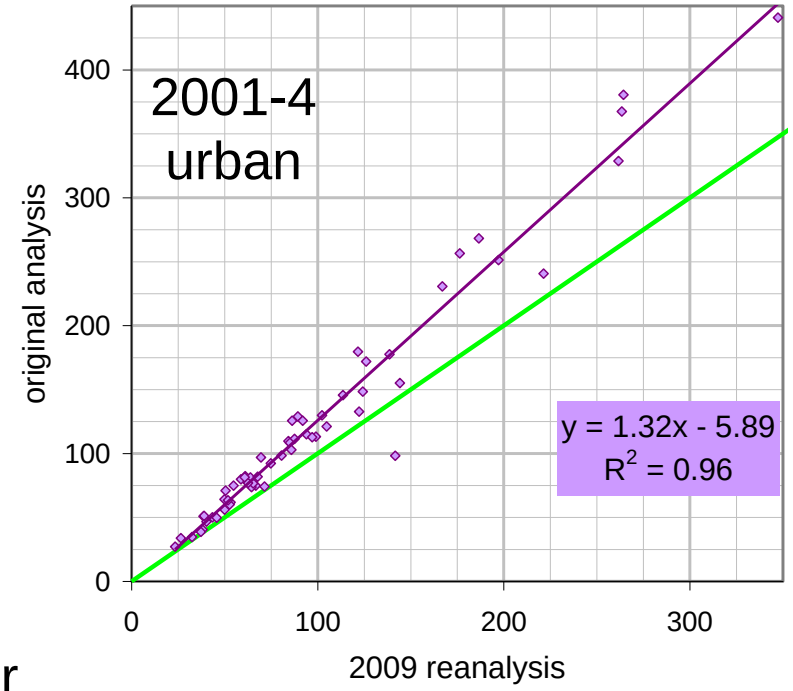
TC ug/filter

- JUL-AUG 1994
- JUL-AUG 1995
- replication

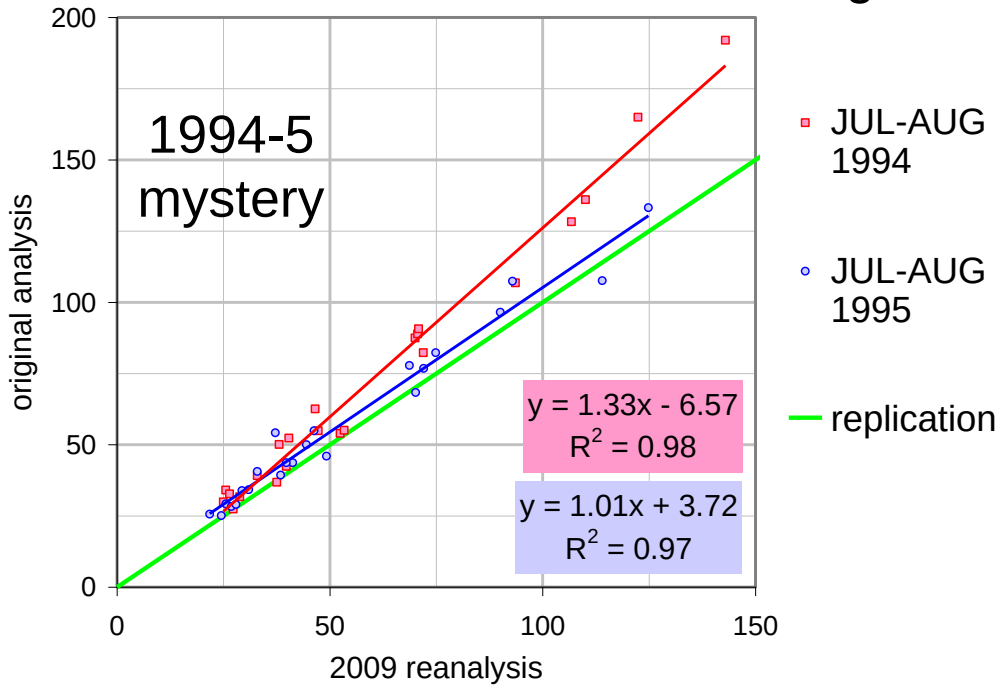
For $TC_{original}$ > 50 ug/filter (> ~1.5 ug/m^3 ~ 34xMDL_{DRI}), reanalysis almost always gave lower TC values.

← Curiously, this apparent loss was considerably greater from samples collected ***15*** rather than ***14*** years earlier.

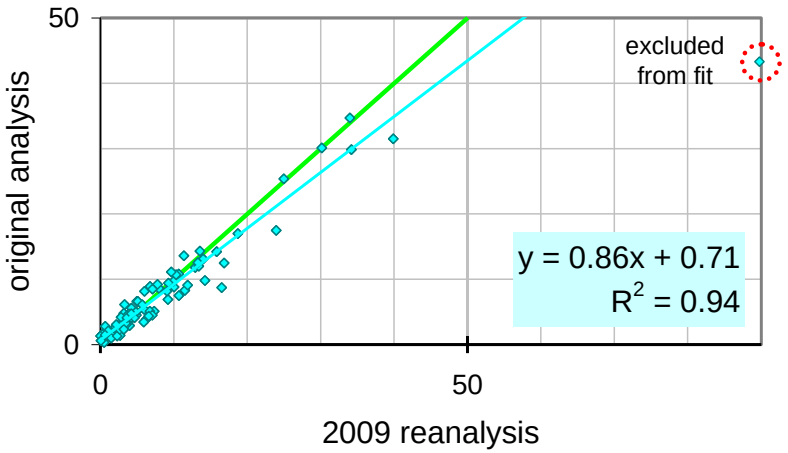


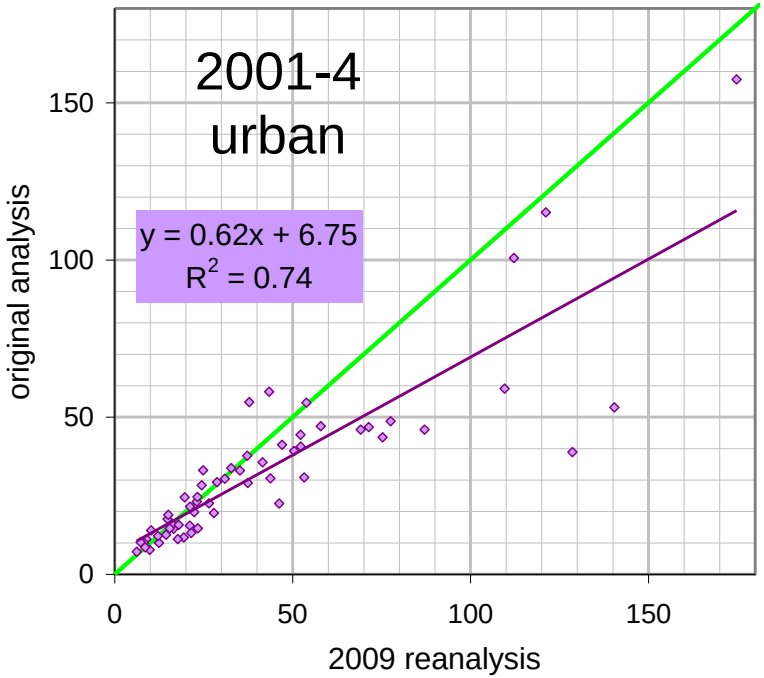


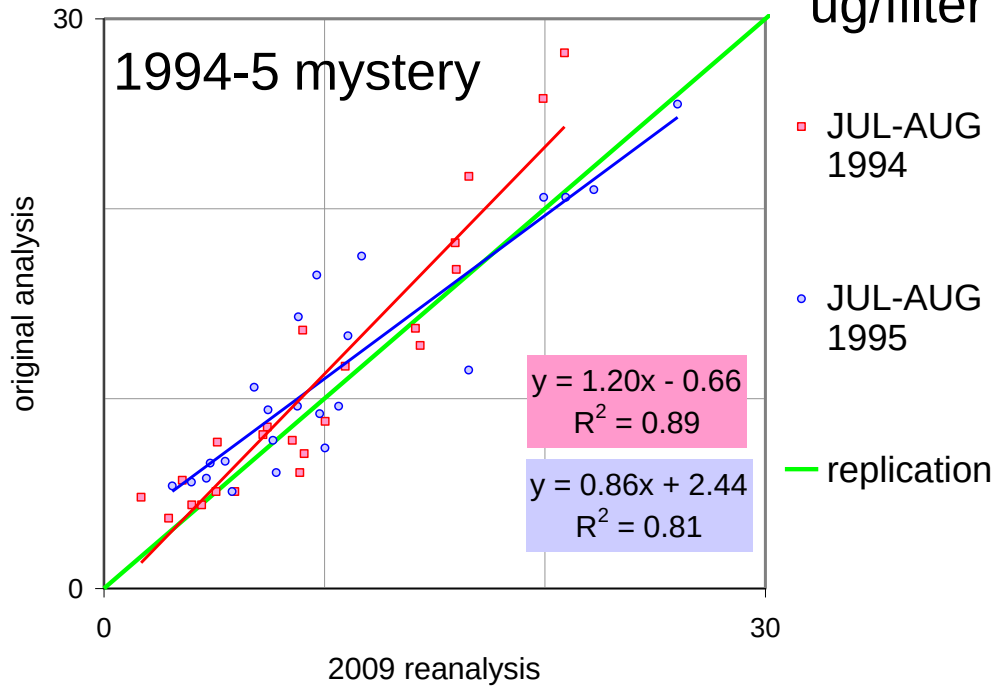
OC ug/filter



Samples collected before and after 2000 show different changes in their EC – OC splits. For the younger samples, the TC decrease reflects a larger decrease in OC, often offset by an *increase* in EC. →



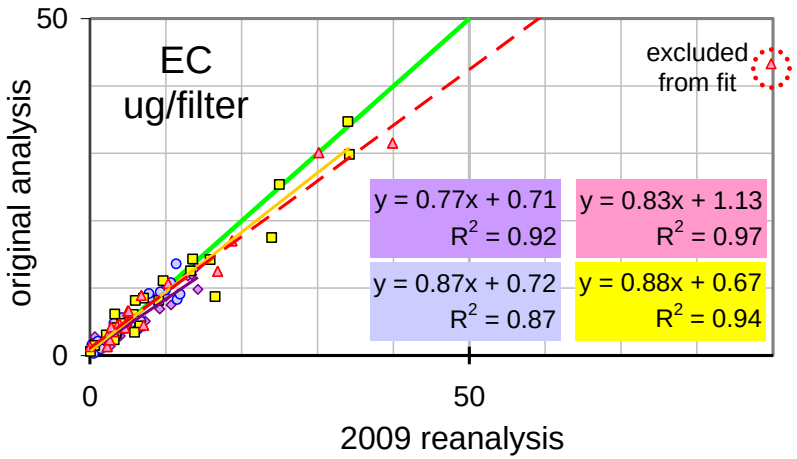


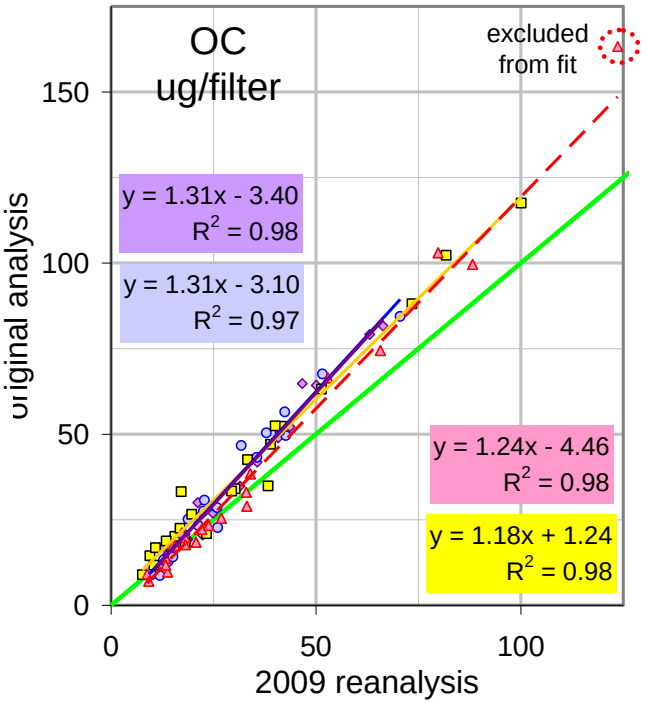


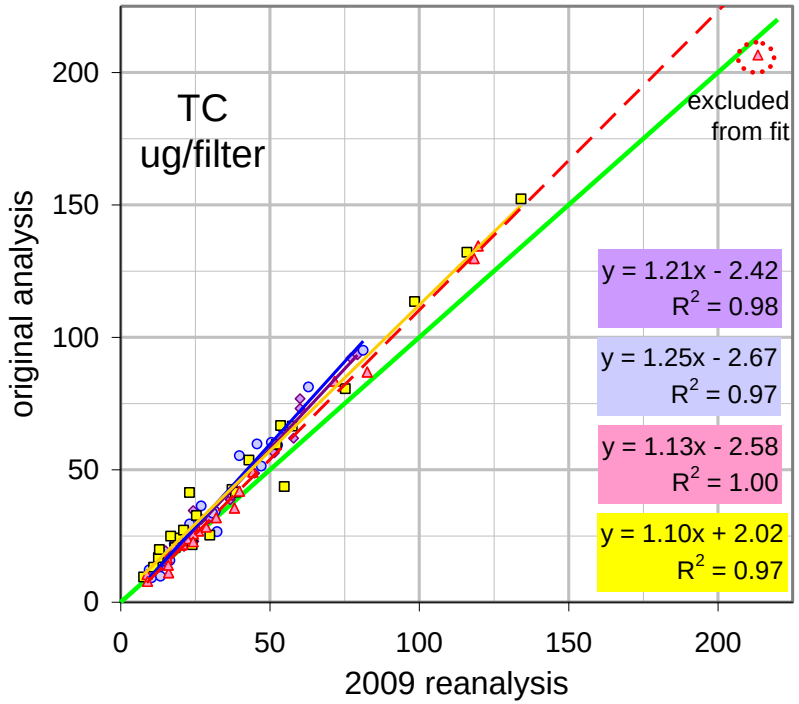
EC ug/filter

- JUL-AUG 1994
- JUL-AUG 1995
- replication

← For the older samples, reanalysis more often gave lower values for EC as well as OC.



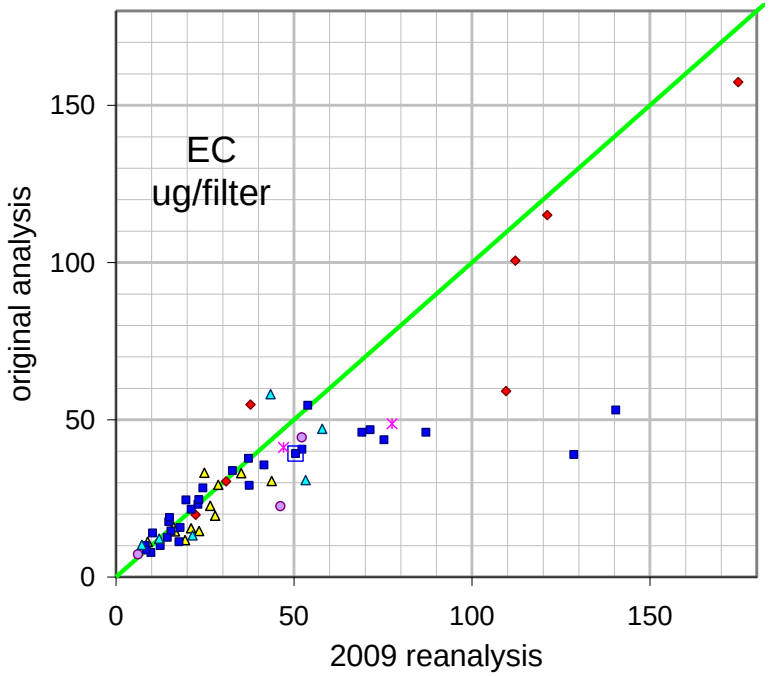


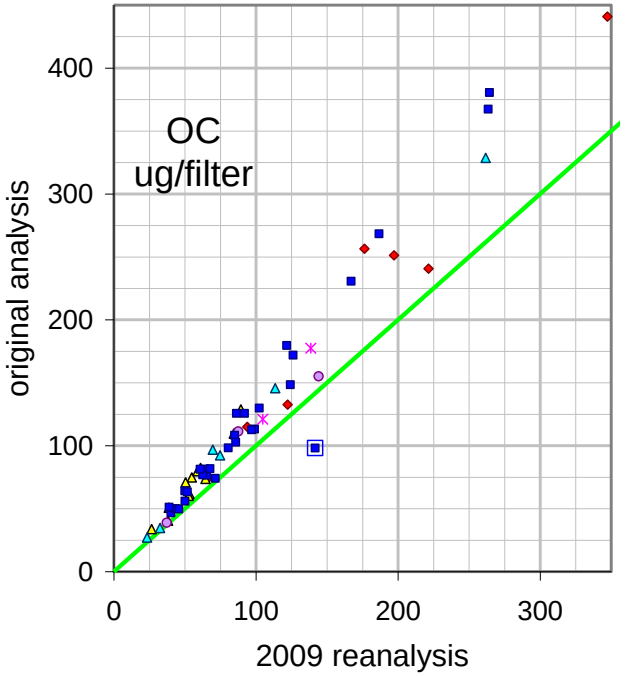


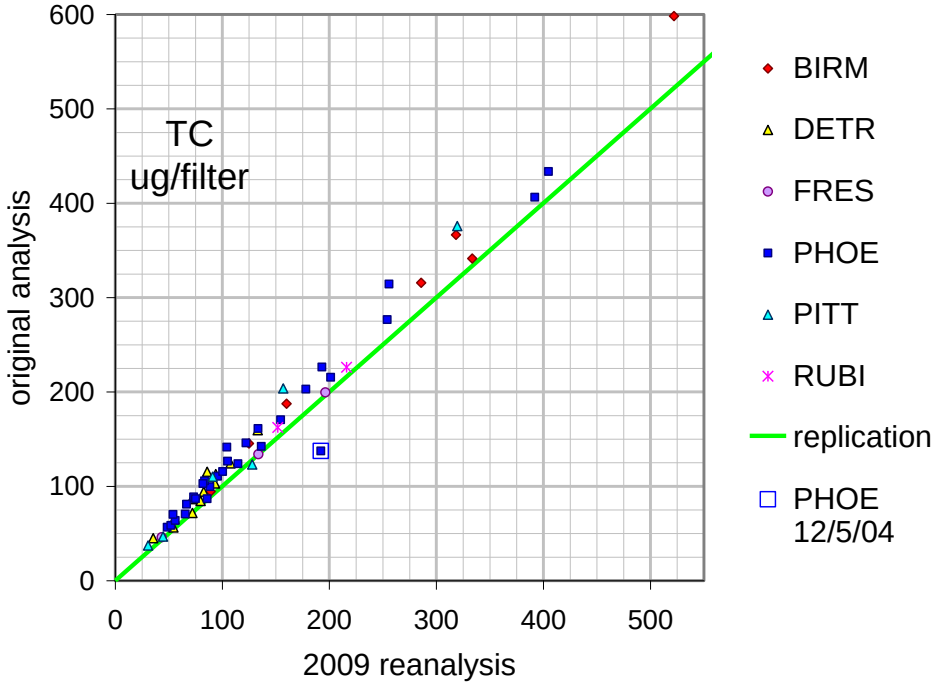
NOV-DEC 2003
JAN-FEB 2004
replication
NOV-DEC 2004
JAN-FEB 2005

2004-5 lab transition

The historical EC – OC split differed from the current split *throughout* the lab transition period, even in 2005 – when the original analyses were done with the generation of instruments in current use.







2001-4 urban

Many samples from the urban collocations with CSN showed substantial changes in the EC – OC split when reanalyzed.

Summary: geometric-mean difference, original – 2009 reanalysis, by epoch or group

	geomean(original/2009) -1		
	OC	**EC**	**TC**
JUL-AUG 1994	**19%**	**8%**	**16%**
95% confidence, original/2009	*(1.152 - 1.239)*	*(0.963 - 1.202)*	*(1.125 - 1.199)*
JUL-AUG 1995	**10%**	**13%**	**9%**
95% confidence, original/2009	*(1.054 - 1.14)*	*(1.007 - 1.26)*	*(1.056 - 1.136)*
NOV '03 - FEB '04	**18%**	**-3%**	**14%**
95% confidence, original/2009	*(1.132 - 1.227)*	*(0.882 - 1.063)*	*(1.097 - 1.184)*
NOV '04 - FEB '05	**14%**	**-3%**	**10%**
95% confidence, original/2009	*(1.085 - 1.206)*	*(0.887 - 1.069)*	*(1.05 - 1.156)*
2001-4 URBAN	**23%**	**-15%**	**13%**
95% confidence, original/2009	*(1.192 - 1.27)*	*(0.785 - 0.927)*	*(1.1 - 1.158)*

If these differences are viewed as uncertainties in the original data, then we need to see changes over time of ~ 20% before we can confidently report a change in the atmosphere, particularly for EC. Alternatively, are we fooling ourselves about the stability our samples under refrigeration? That's a question for DRI.