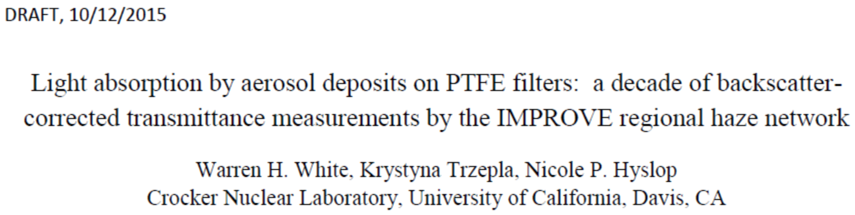
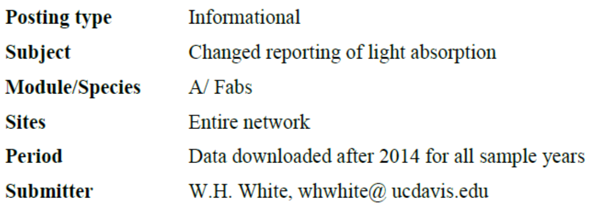
HIPS data are now reported with a consistent calibration (2003 – present)



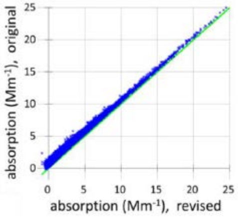
DRAFT, 10/12/2015

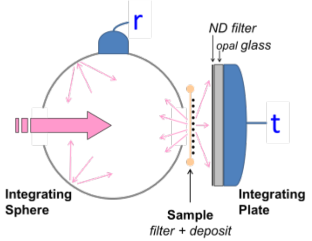
Light absorption by aerosol deposits on PTFE filters: a decade of backscatter-corrected transmittance measurements by the IMPROVE regional haze network

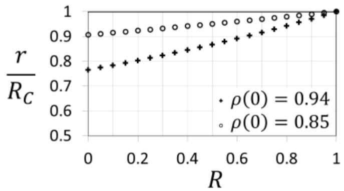
Warren H. White, Krystyna Trzepla, Nicole P. Hyslop
Crocker Nuclear Laboratory, University of California, Davis, CA

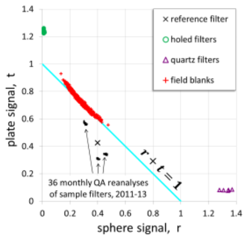


Posting type	Informational
Subject	Changed reporting of light absorption
Module/Species	A/ Fabs
Sites	Entire network
Period	Data downloaded after 2014 for all sample years
Submitter	W.H. White, whwhite@ ucdavis.edu





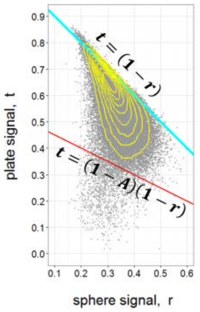


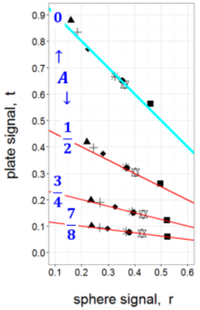


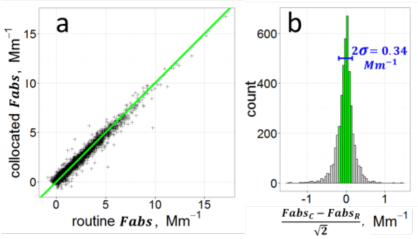
So …

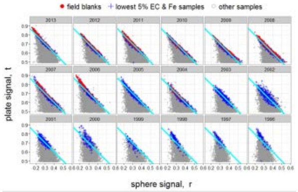
what do

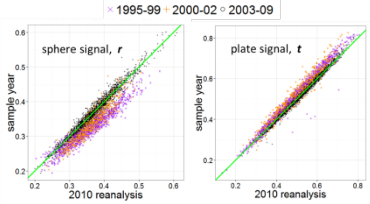
they say?





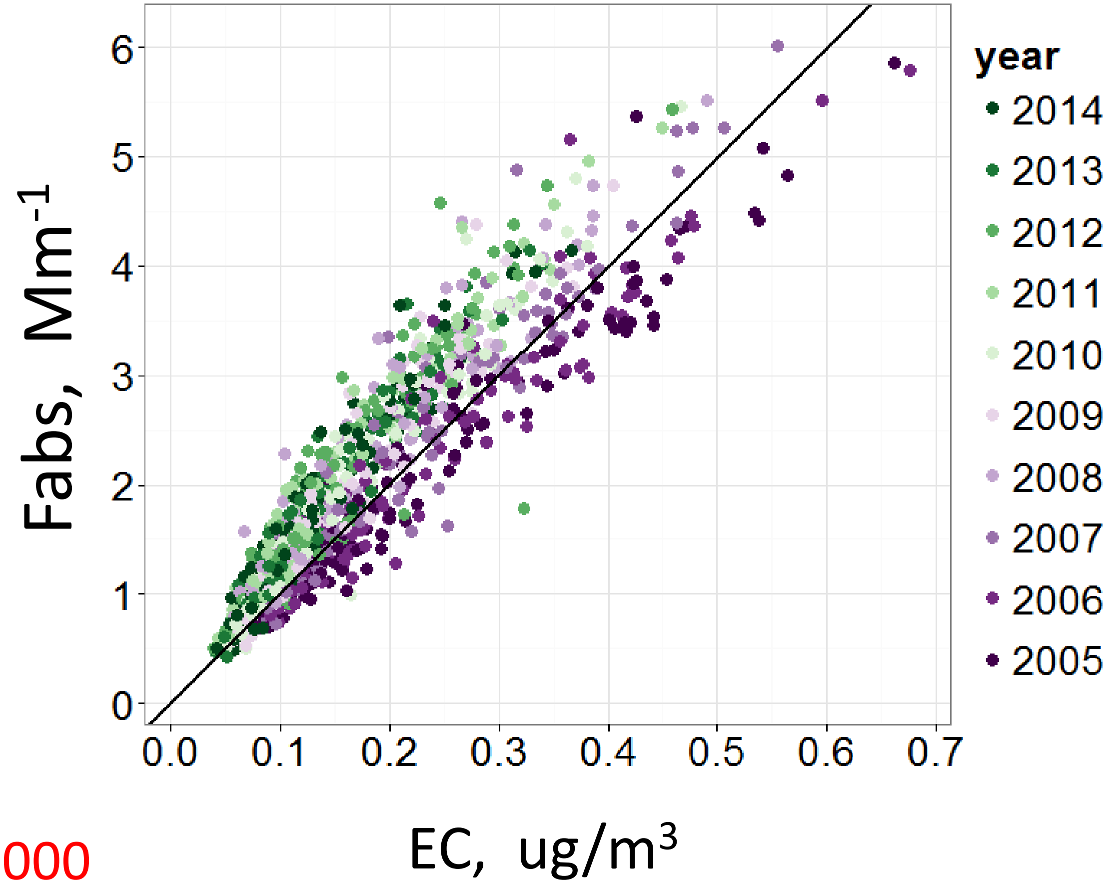






Well, *Fabs* correlates well with *EC* (!!), as seen below with site-year means. Each point shows the arithmetic means from at least 100 observations during one calendar year at one of 116 IMPROVE sites selected for data homogeneity:

- ✓ unmasked A module
- ✓ non-urban location
- ✓ -130 < longitude < -65
- ✓ |*FM*-*RM*| < 5 ug/m^3 *
- ✓ at least 1000 samples from 2005 – 2014



* excludes fewer than 3 in 1000

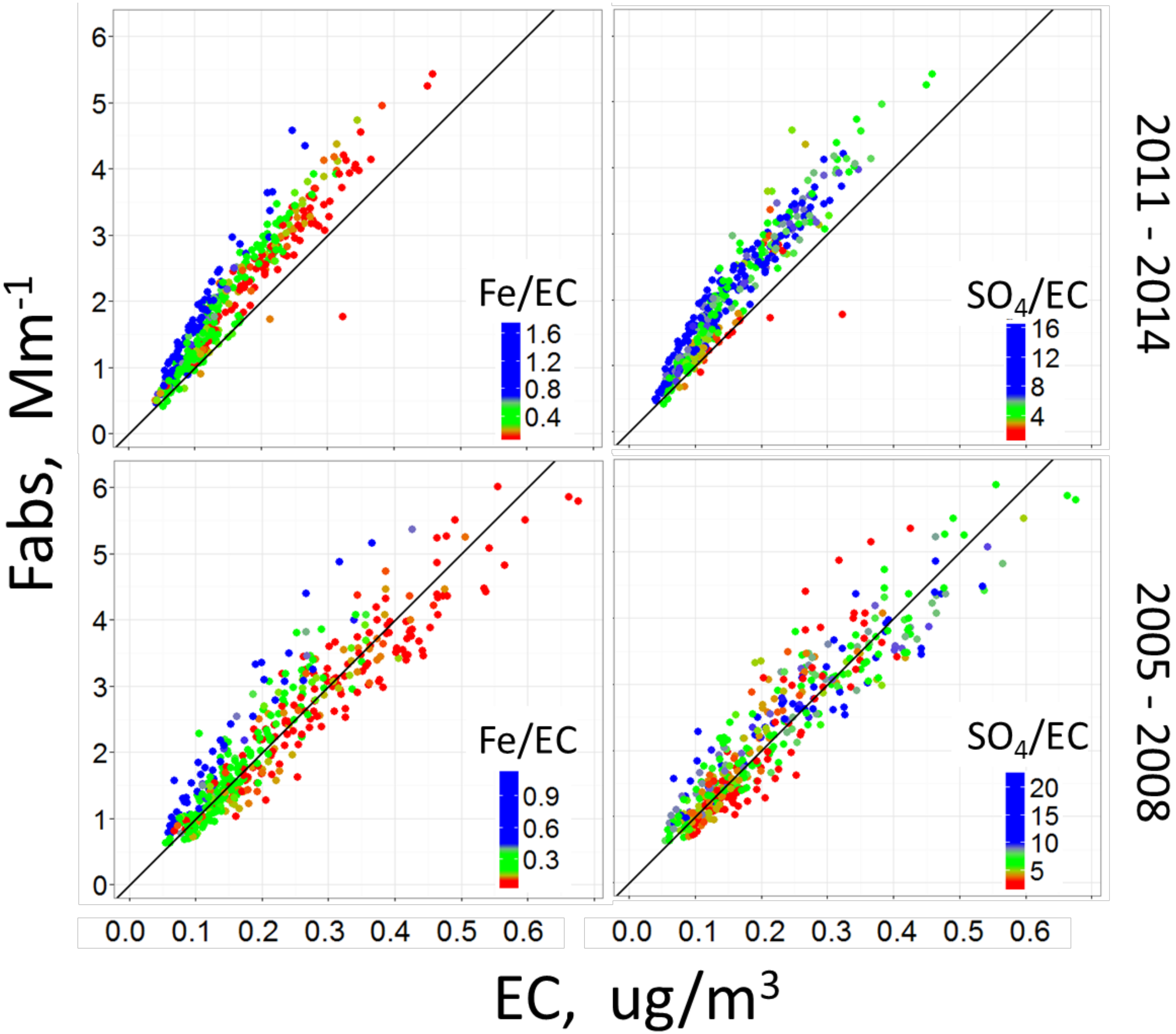
$$RM \equiv \frac{132}{96} \cdot SO_4 + \frac{80}{62} \cdot NO_3 + 1.65 \cdot Cl + EC + 1.7 \cdot OC + 20 \cdot Fe$$

Question:

Where does the scatter come from?

Partial Answer 1:

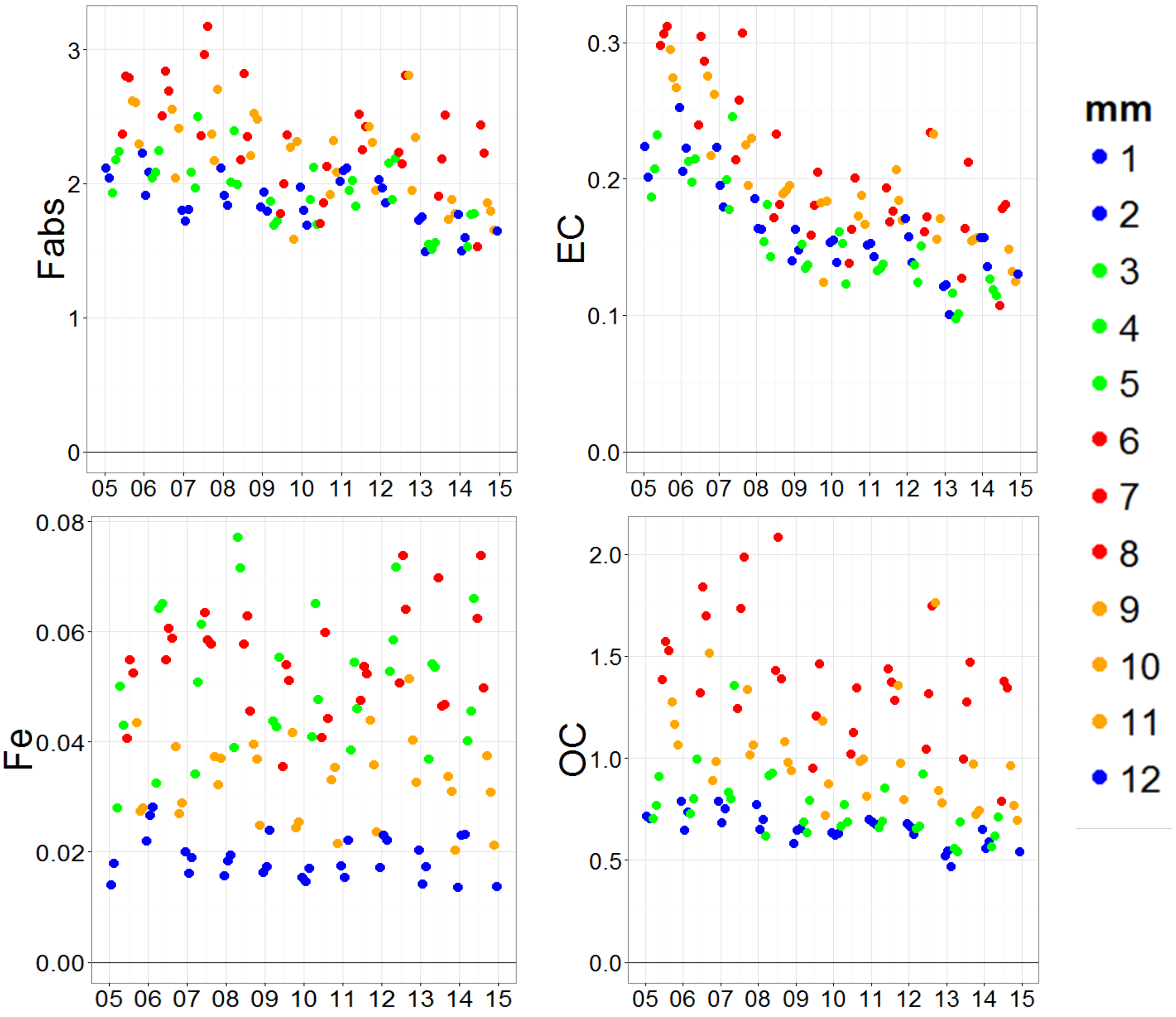
EC is not the sole absorbing species. Iron oxide minerals also absorb, for example. Sulfates don't.



A1, continued:

Fabs has not declined as fast as EC has because other absorbers are not declining as fast as EC, …

month-mean 116-site concentrations, Mm^{-1} or $\mathrm{ug/m}^3$



sample date, yy

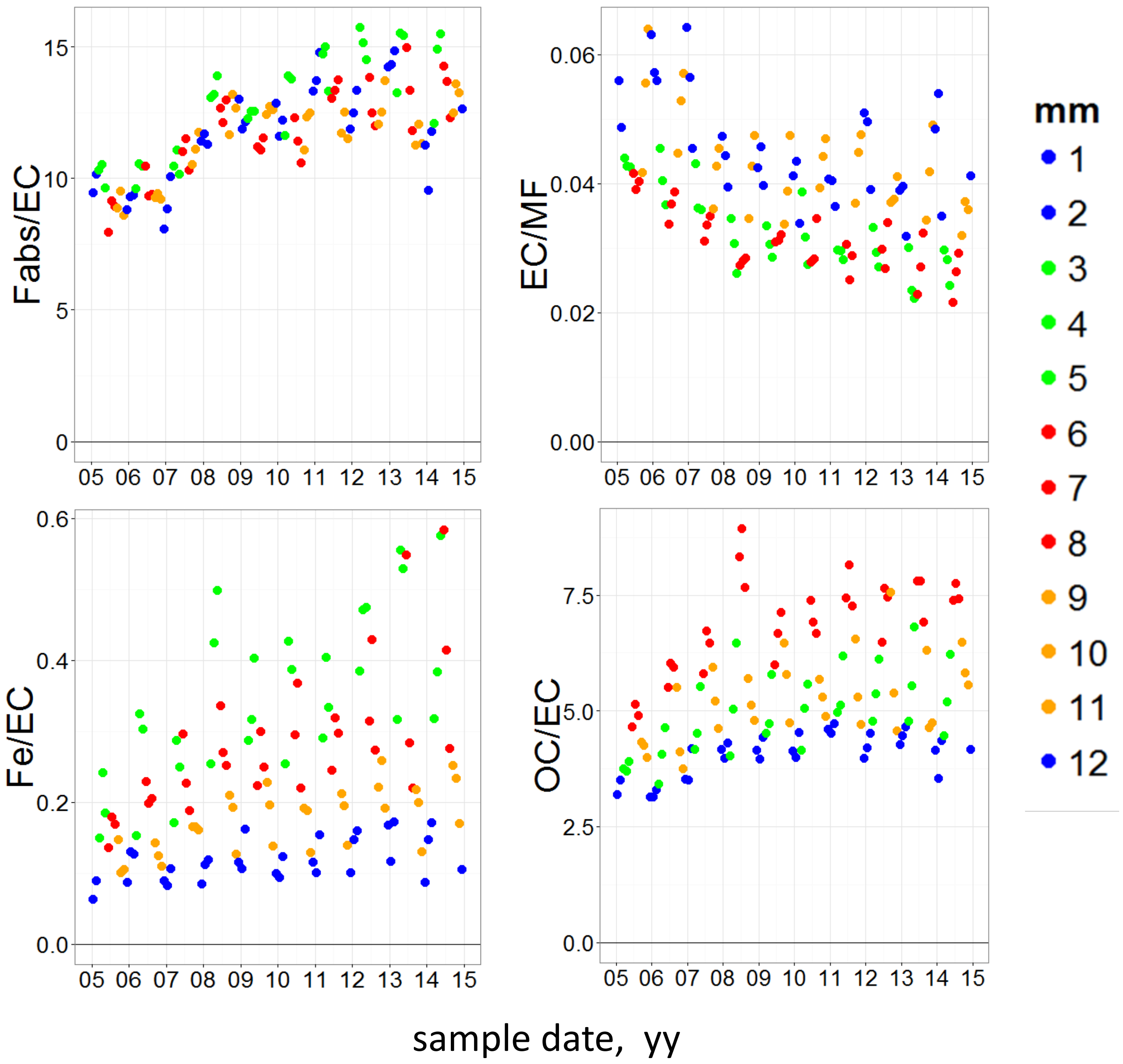
A1, continued:

… so total absorption increasingly reflects dust and other species. *But this is only part of what is changing.*

Partial answer 2:

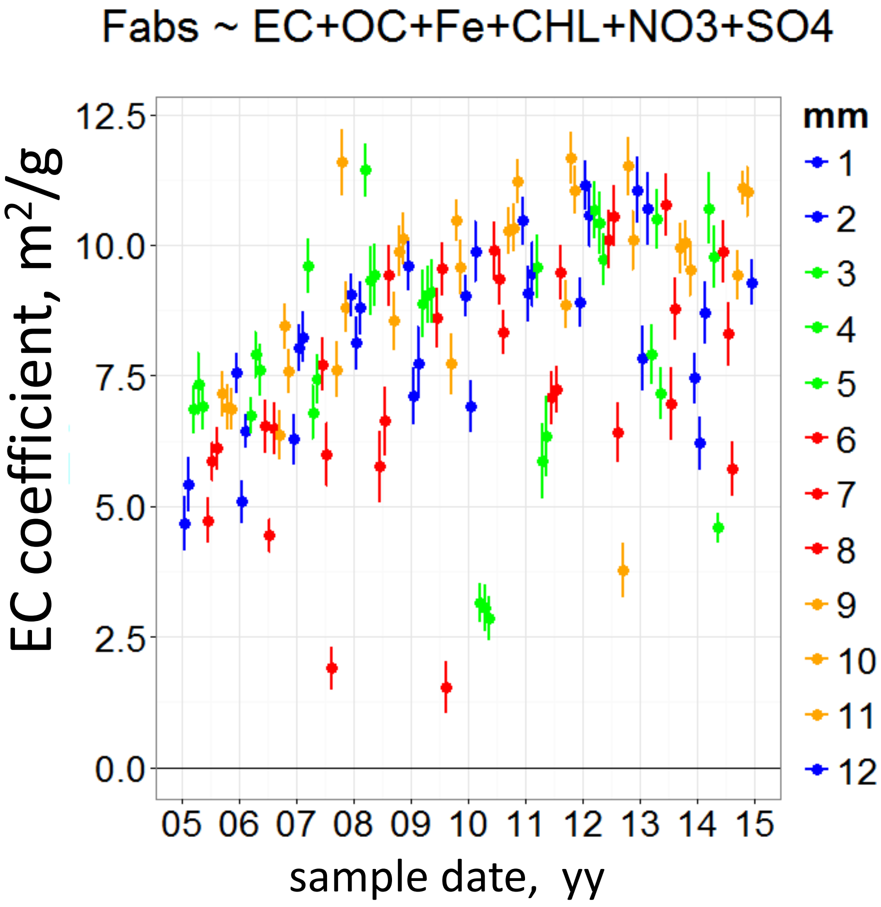
LAC is itself complex and evolving.

ratios of month-mean concentrations, m^2/h or g/g

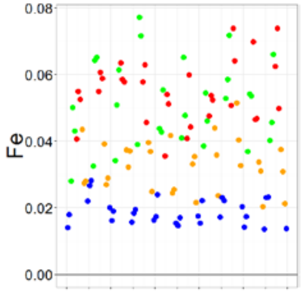


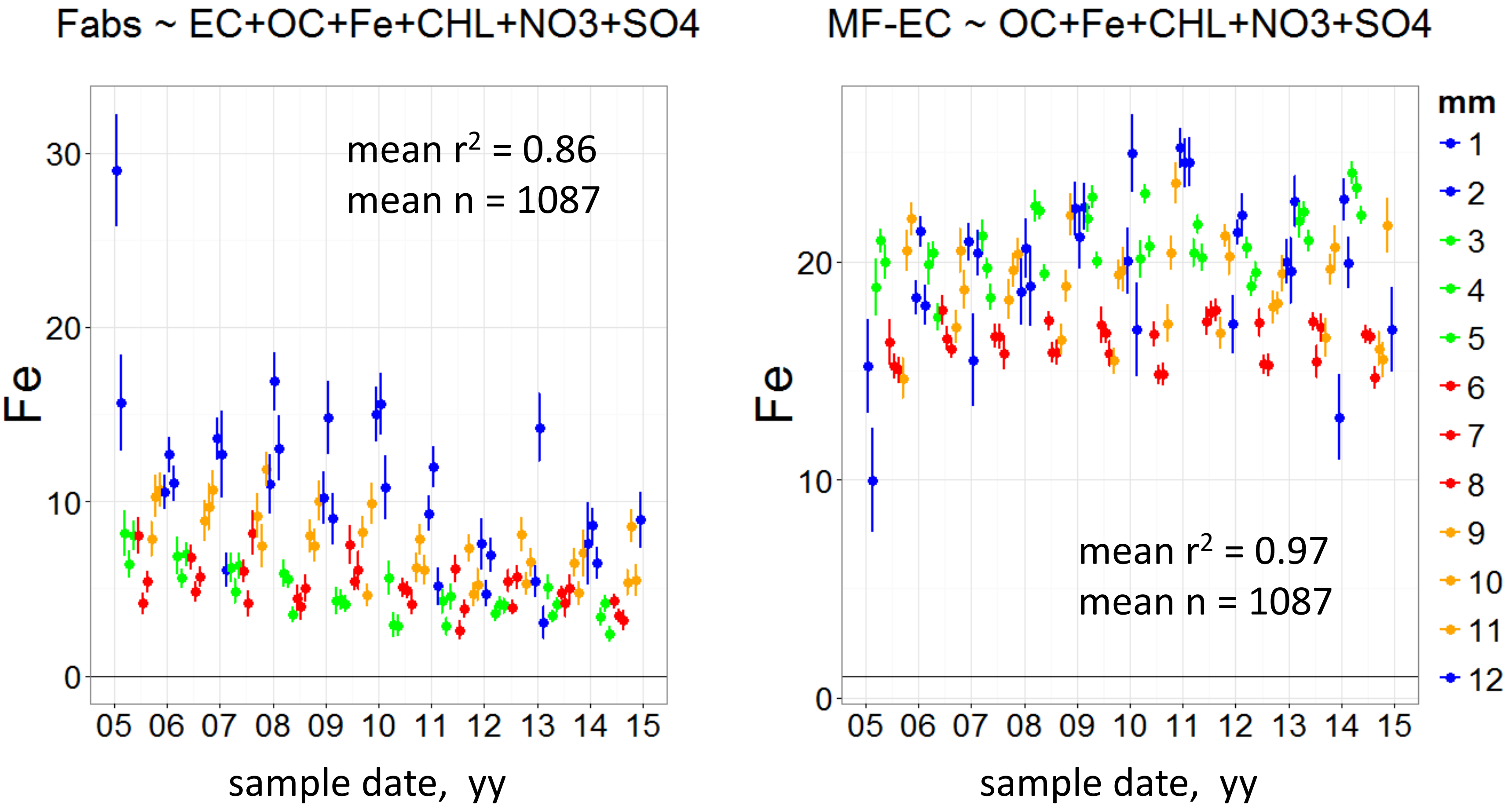
Multiple linear regression analysis is a convenient approach to assess the sensitivity of total absorption to individual chemical species. It provides only a statistical model, not a causal relationship, as the contributions of different species need not be additive (e.g., Fuller, Malm and Kreidenweis, 1999).

OLS (classical) regressions were performed a month at a time, in 120 separate calculations. Coefficients are plotted with 95% confidence intervals. The regression model is indicated above the plot, using conventions of the R language.



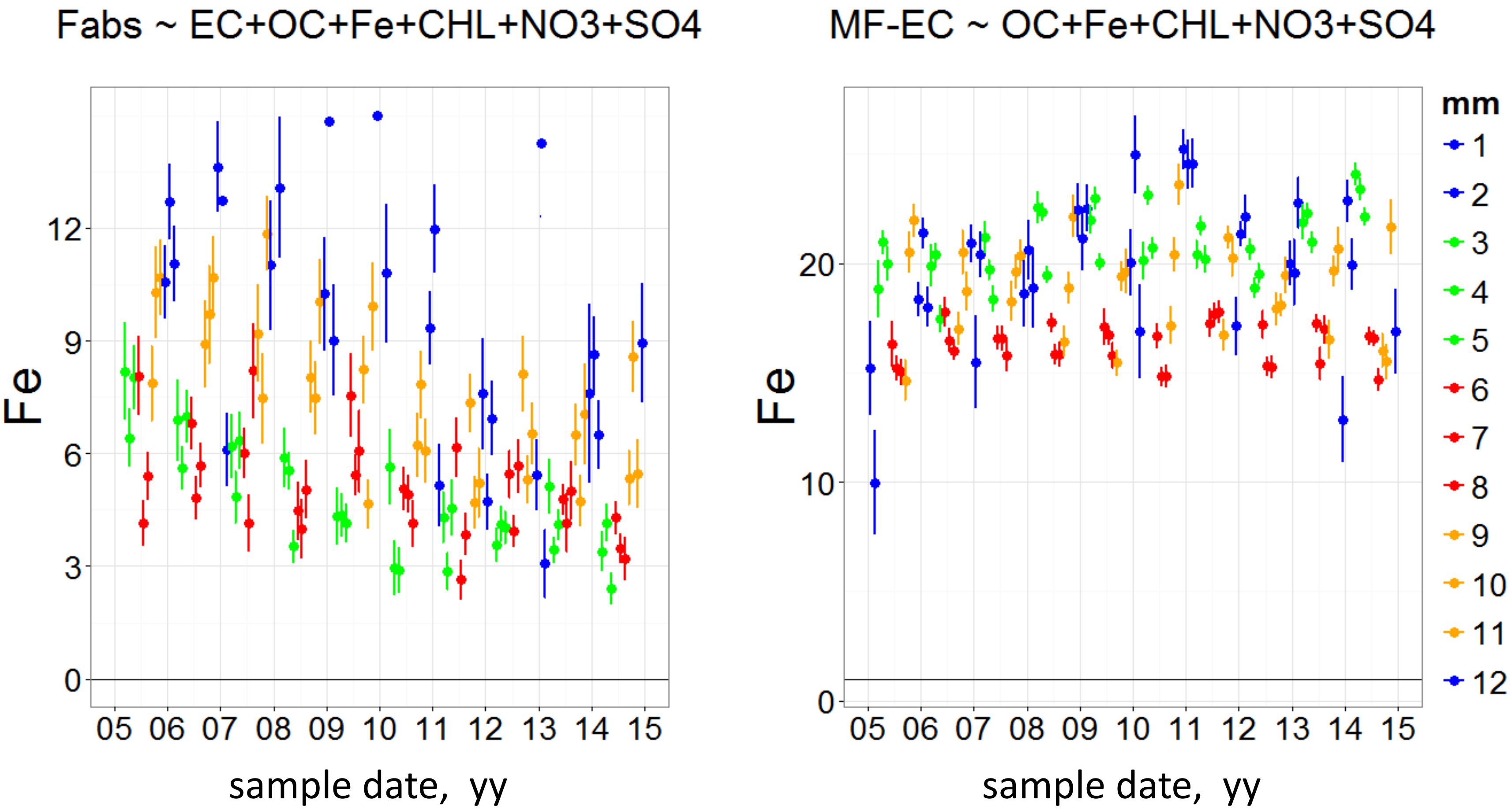
Before digging into LAC, we'll first "calibrate" the regression approach on other species.
Recall the seasonality of Fe concentrations →





OLS coefficients from monthly regressions, m^2/g or g/g

The coefficients for the winter months are poorly determined, suggesting that the absorption plot be re-scaled for better visibility.

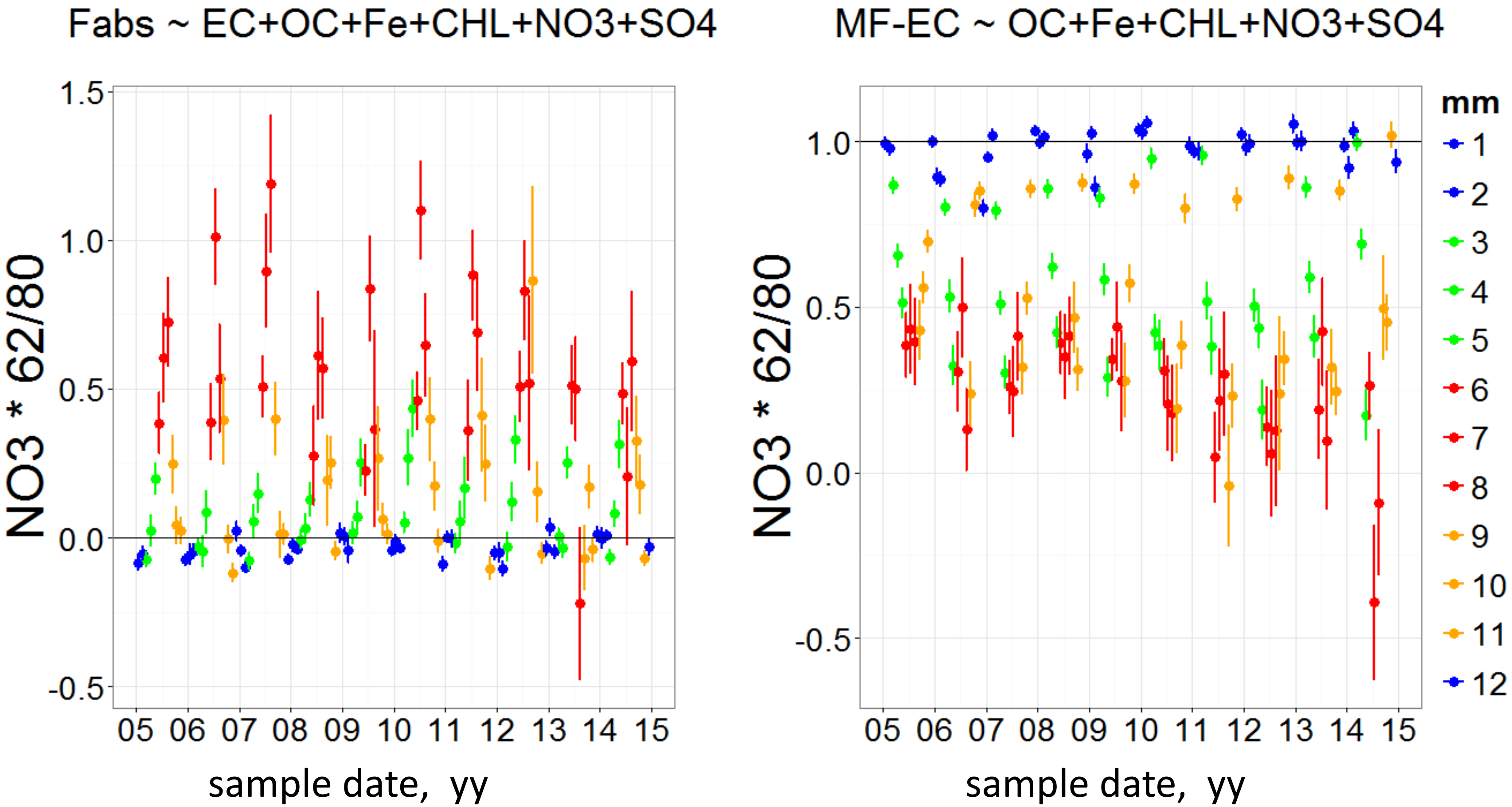


Fabs ~ EC+OC+Fe+CHL+NO3+SO4

MF-EC ~ OC+Fe+CHL+NO3+SO4

OLS coefficients from monthly regressions, m^2/g or g/g

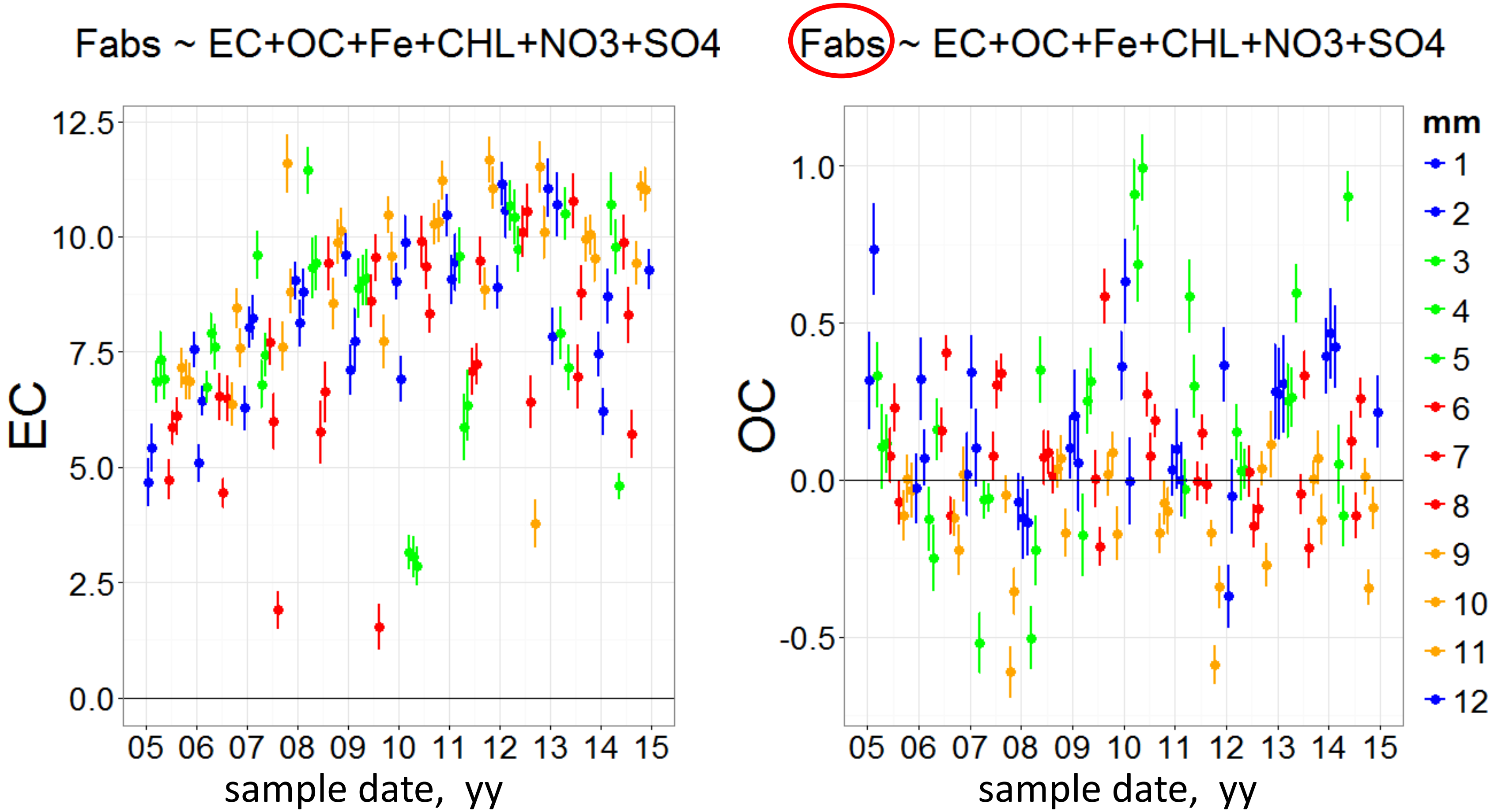
The coefficients for nitrate are well determined for the winter months and behave as expected for ammonium nitrate. In the summer months, ammonium nitrate is lost from the PTFE filters.


Fabs ~ EC+OC+Fe+CHL+NO3+SO4

MF-EC ~ OC+Fe+CHL+NO3+SO4

OLS coefficients from monthly regressions, m^2/g or g/g

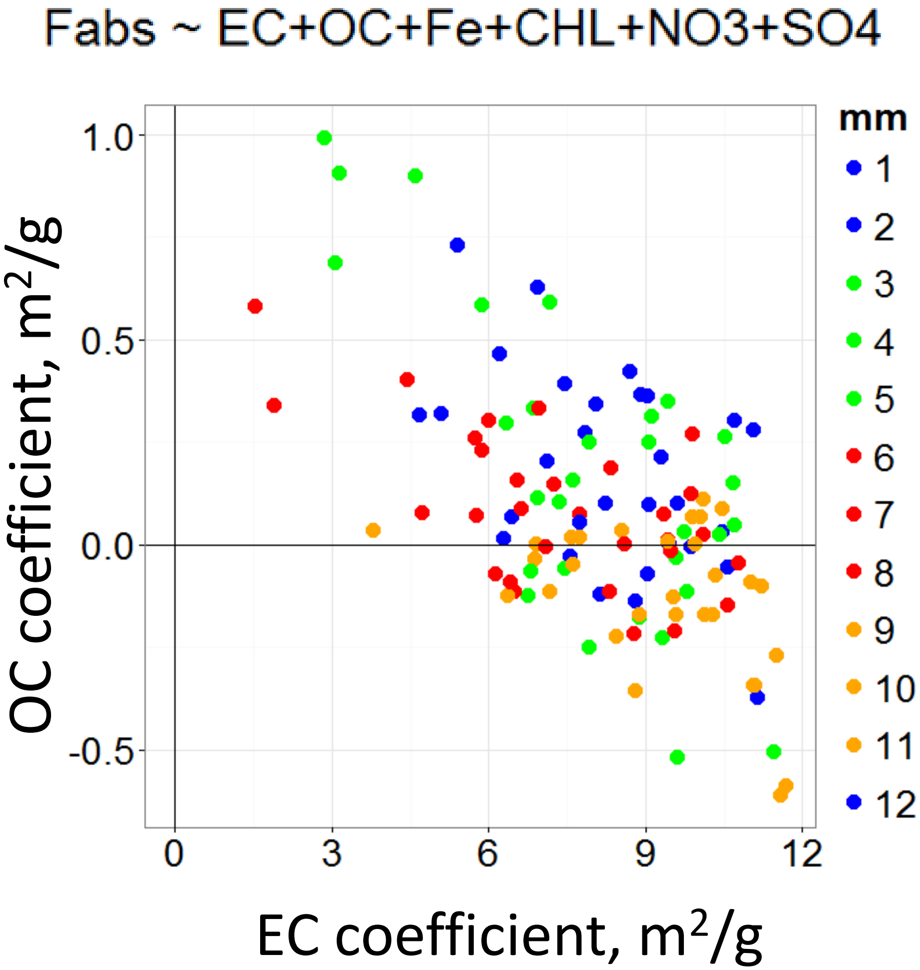
Regression does not yield stable mass coefficients for EC. The absorption coefficients for EC are accordingly paired below with those for OC, instead. These have not increased noticeably.



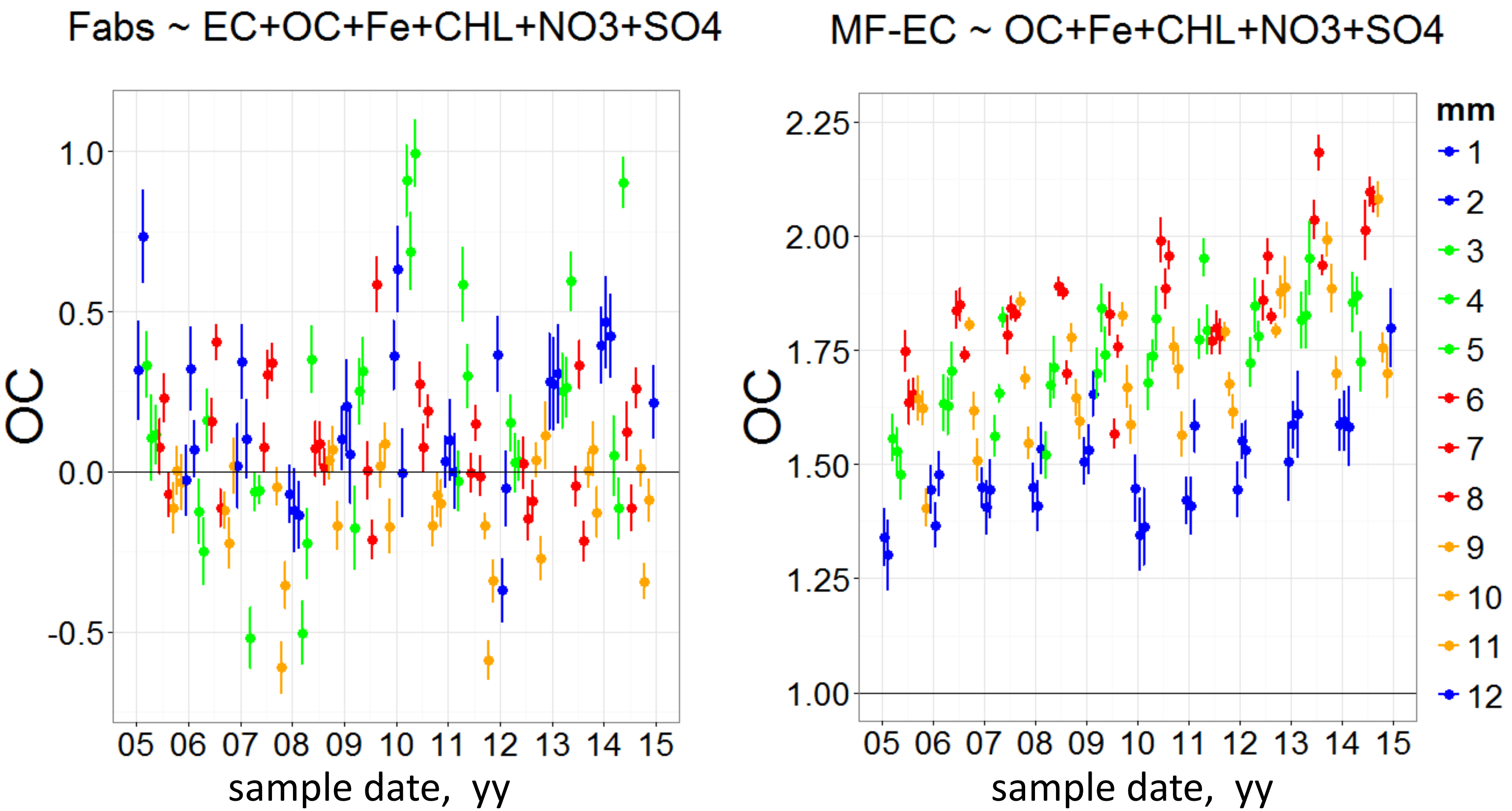
OLS coefficients from monthly regressions, m^2/g

Interestingly, there is some anti-correlation (in all seasons) between the absorption coefficients attributed to EC and OC.

This coupling suggests uncertainty in the division of absorption between OC and EC, which could reflect statistical as well as measurement issues.

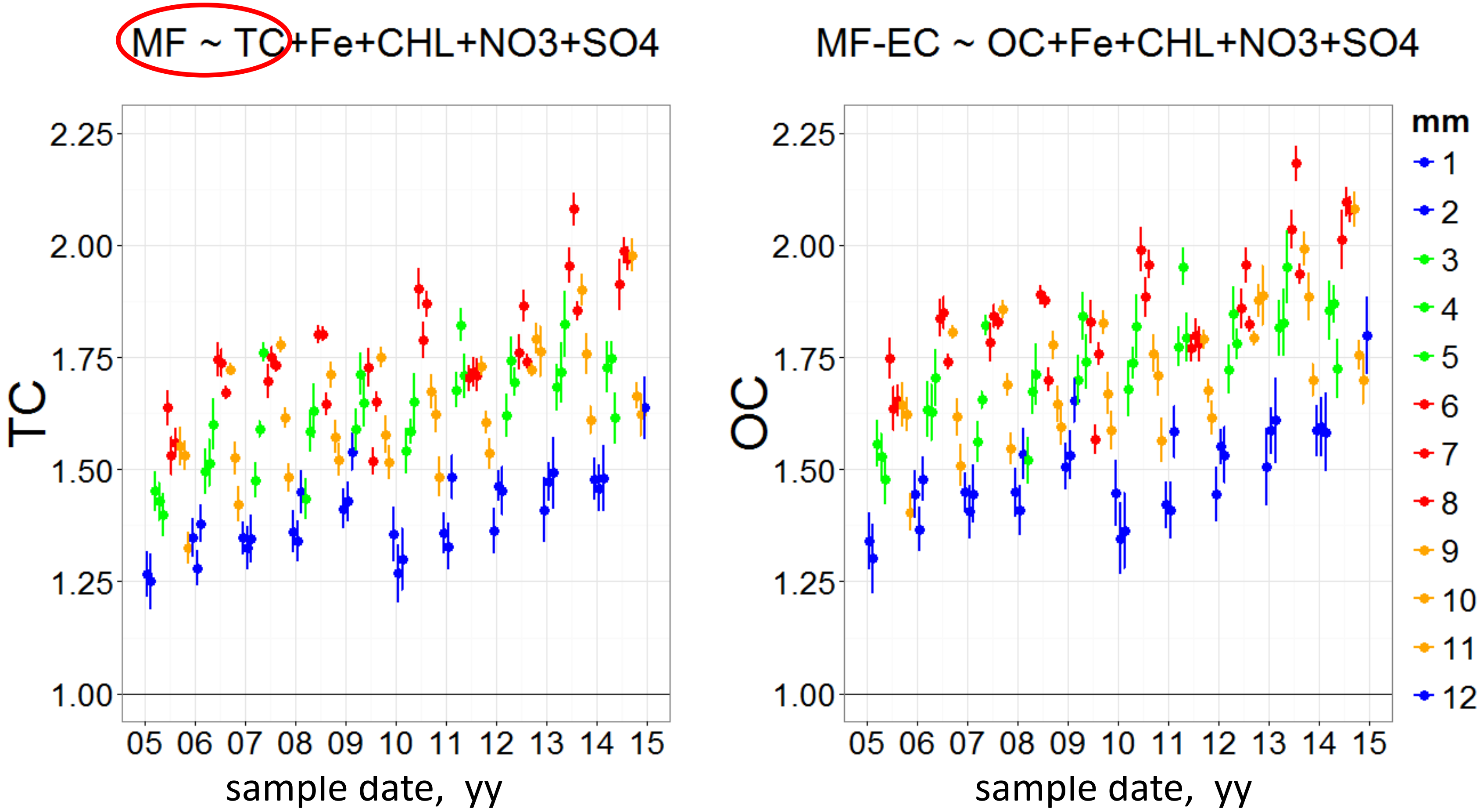


Mass-specific absorption by OC (m^2/g) is small, and may represent nothing more than statistical and analytical uncertainty in the OC-EC split. But note the clear trend in the mass ratio OM/OC (g/g)!



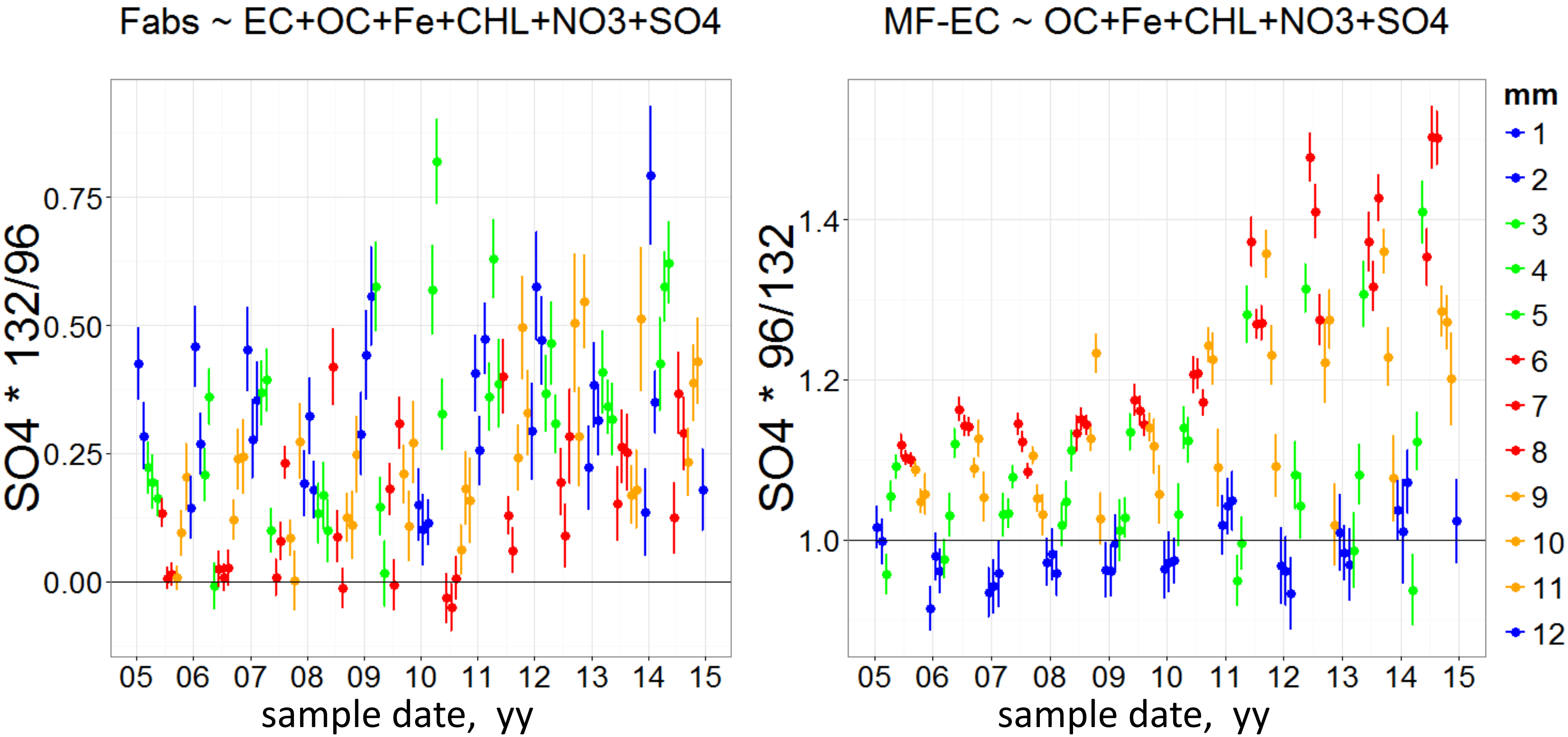
OLS coefficients from monthly regressions, m^2/g or g/g

The trend in OM/OC has nothing to do with the OC-EC split. Is the composition of the carbonaceous haze fraction evolving? Are there implications for the scattering attributed to OC in RHR tracking?



OLS coefficients from monthly regressions, g/g

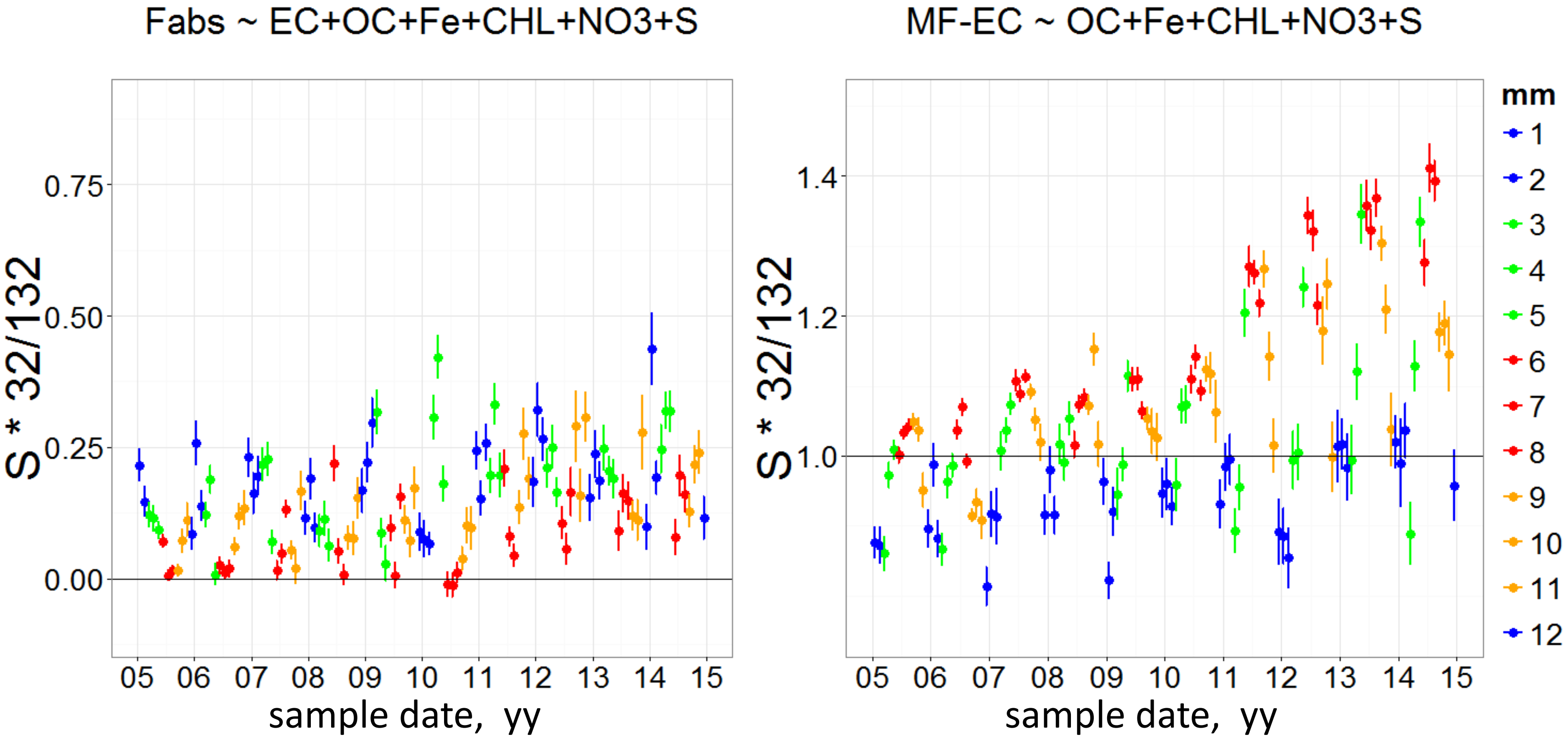
A potential advisory/*caveat*: summer and late spring regression coefficients for hygroscopic salts increased starting in 2011, when sample handling and weighing were moved to a new lab space.


Fabs ~ EC+OC+Fe+CHL+NO3+SO4

MF-EC ~ OC+Fe+CHL+NO3+SO4

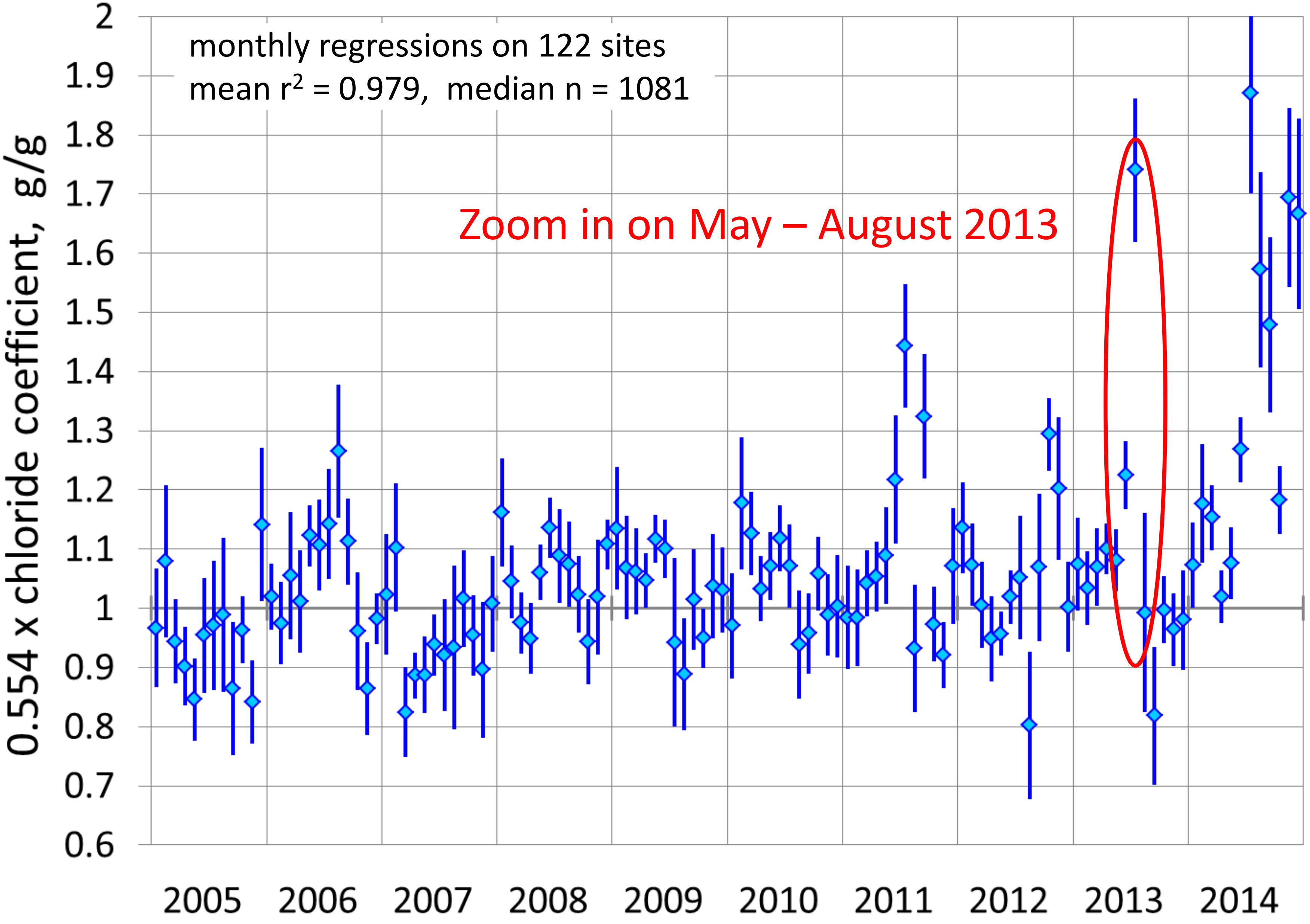
OLS coefficients from monthly regressions, m^2/g or g/g

Data for XRF sulfur (below) and chloride ion (not shown) show the same behavior. A review of the new lab's environmental logs is in its early stages.



OLS coefficients from monthly regressions, m^2/g or g/g

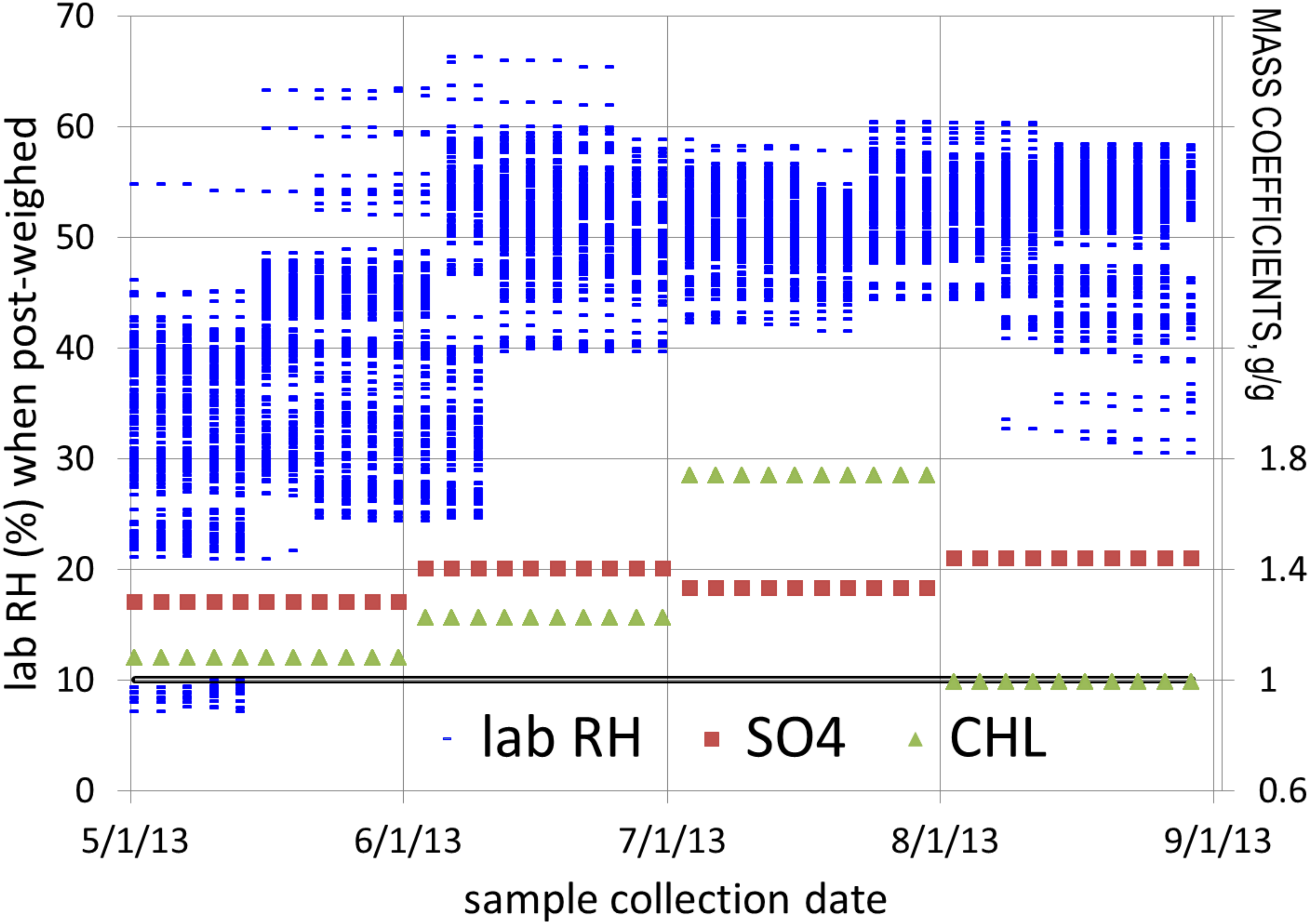
$$MF - EC \sim OC + soil + CHL + NO3 + SO4$$



monthly regressions on 122 sites

mean $r^2 = 0.979$, median $n = 1081$

Zoom in on May – August 2013


70
60
50
40
30
20
10
0
lab RH (%) when post-weighed
MASS COEFFICIENTS, g/g
1.8
1.4
1
0.6
lab RH
SO4
CHL
5/1/13
6/1/13
7/1/13
8/1/13
9/1/13
sample collection date