Flow correction of AB: finding flow offset

Suzane S. de Sá, Douglas A. Day

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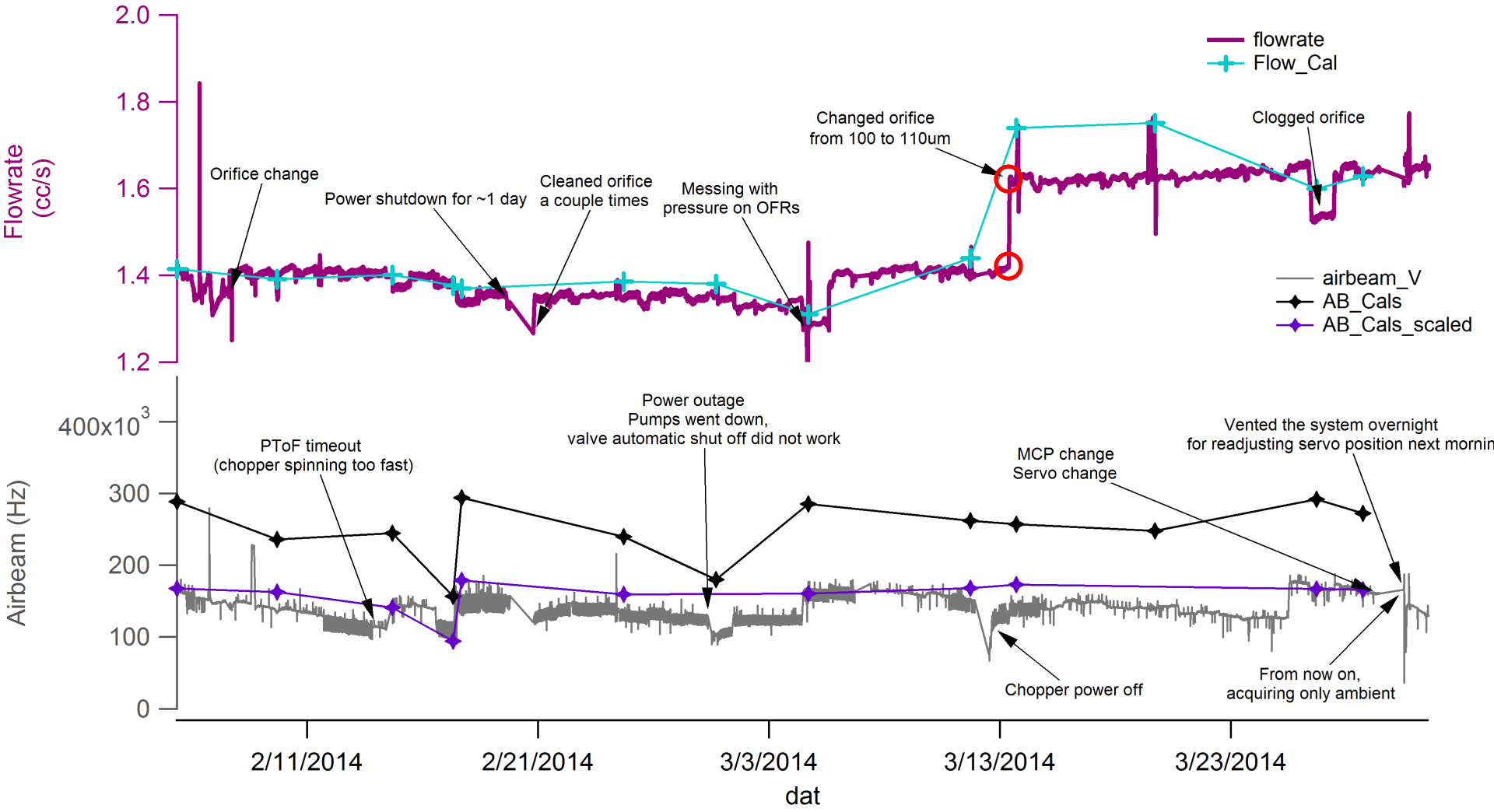
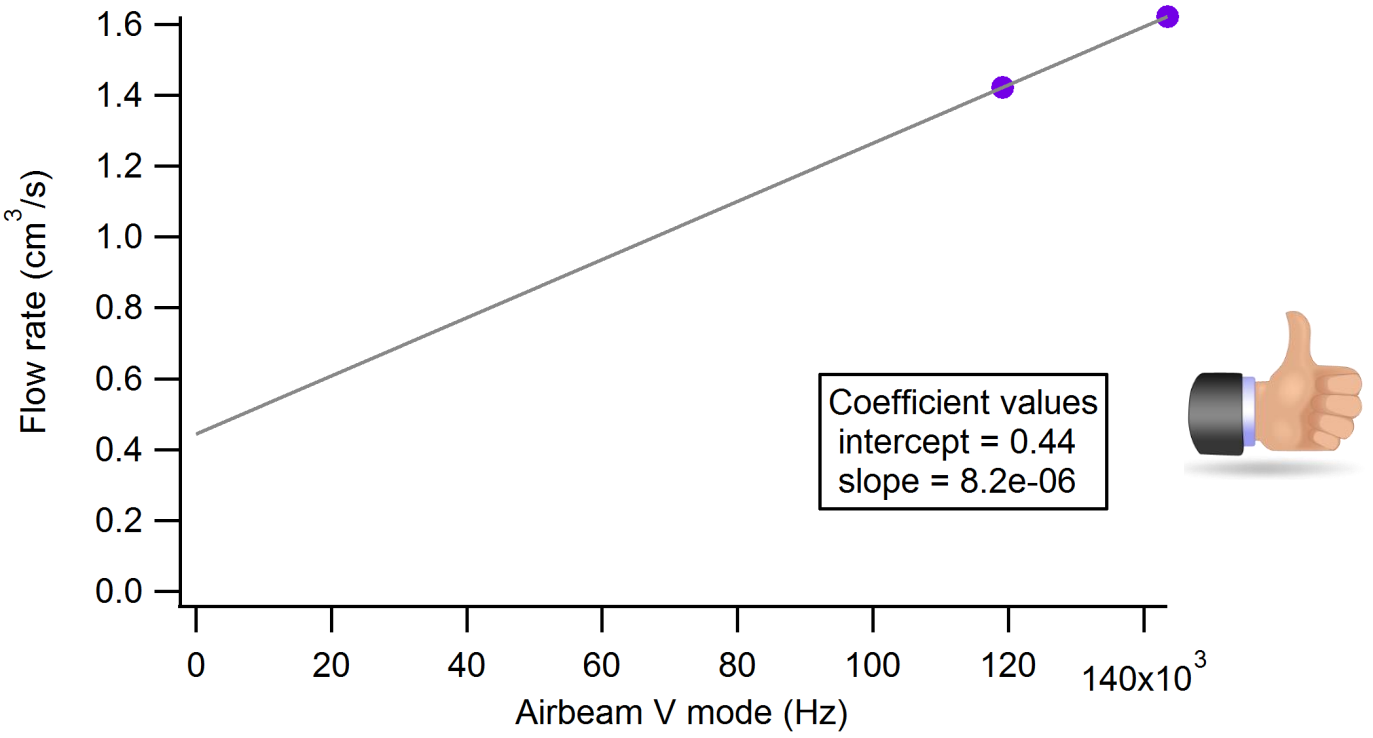
Flow correction: finding flow offset



- Using only two points, immediately before and after the orifice change

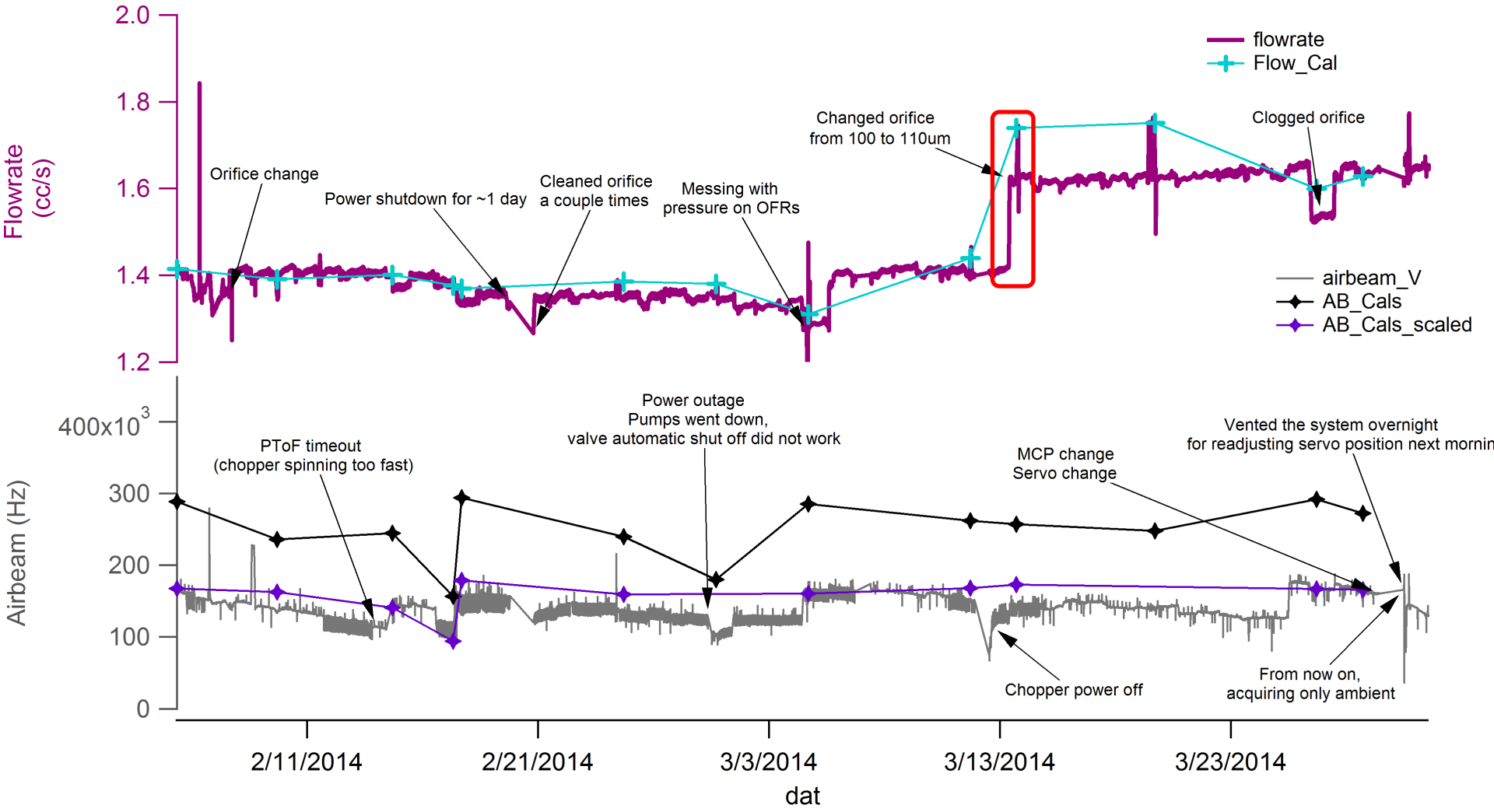
Flow correction: finding flow offset



- Using only two points, immediately before and after the orifice change

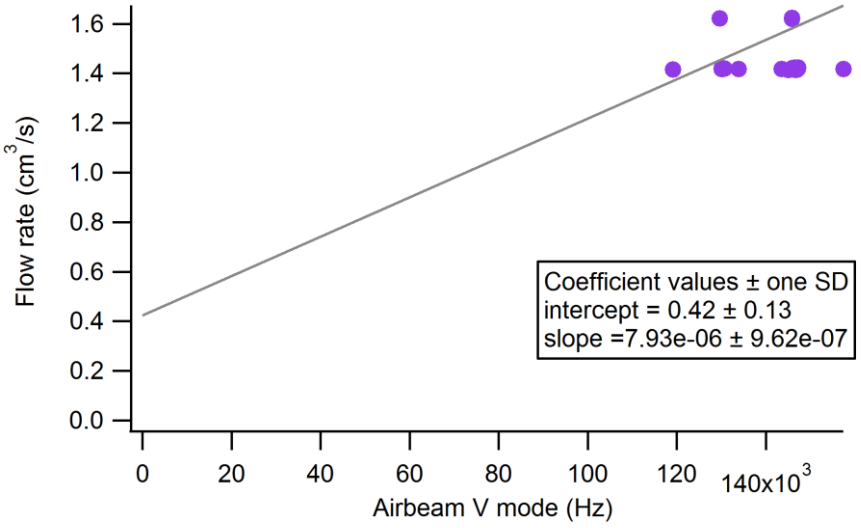
→ Obtain reasonable offset value (cf. wiki: 0.5 cc/s)

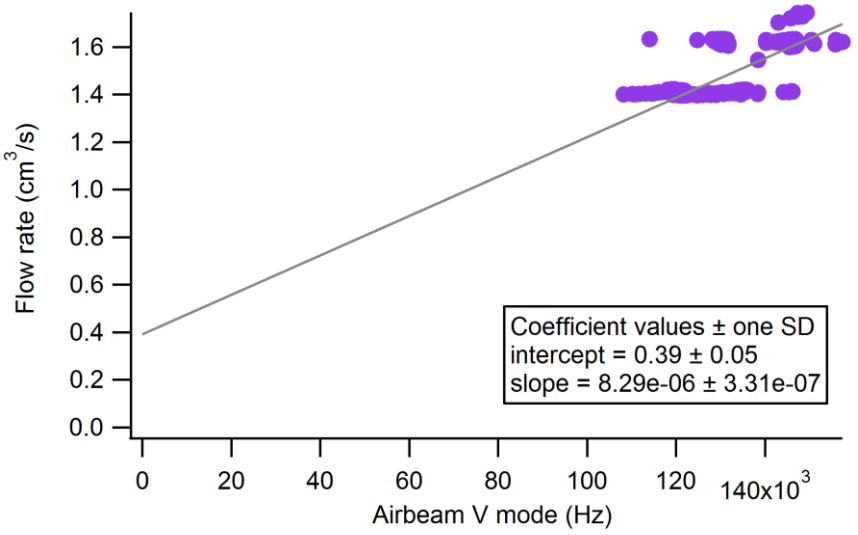
Flow correction: finding flow offset



- Using a larger set of points, before and after the orifice change

Flow correction: finding flow offset



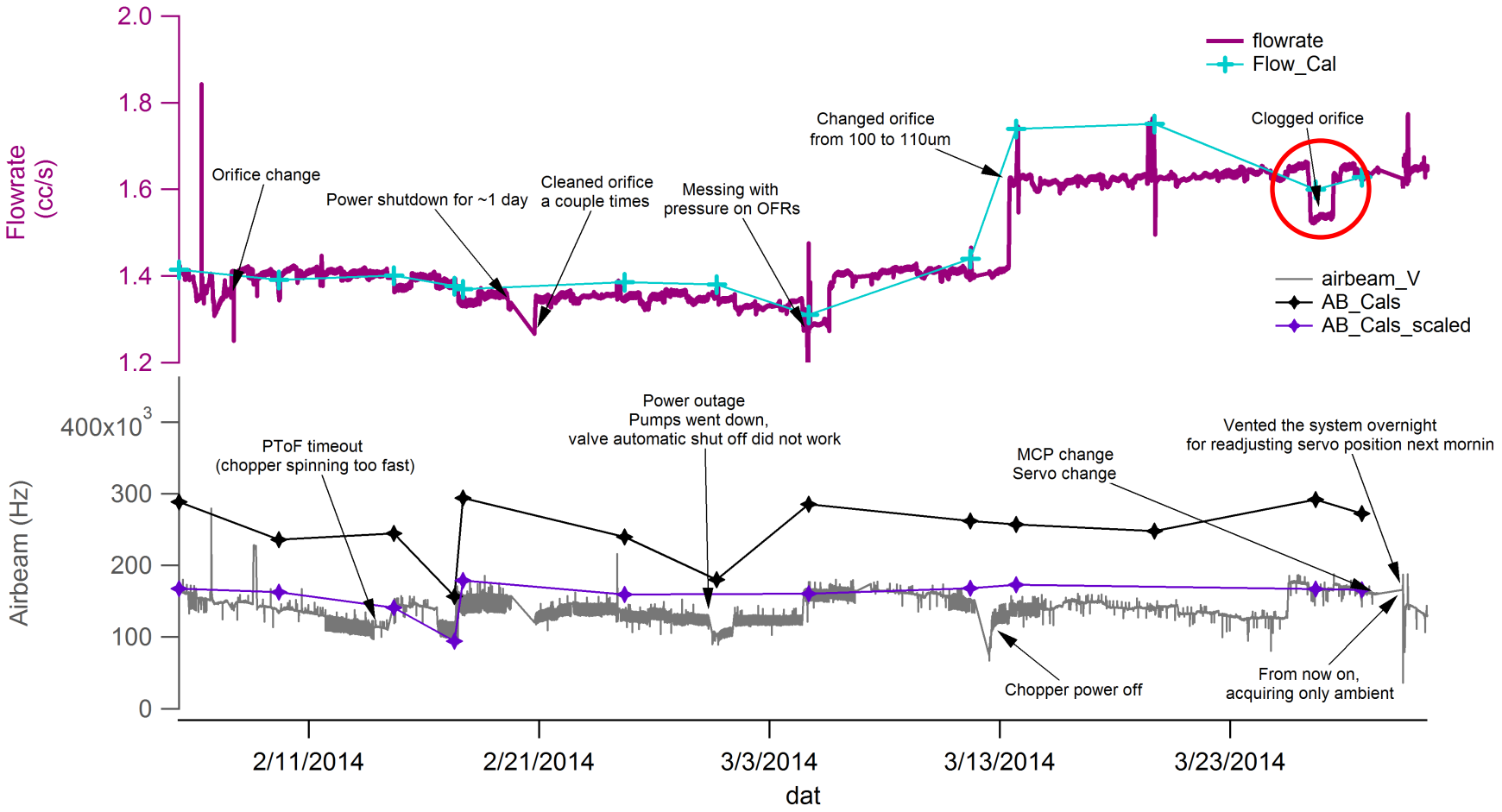


- Using a progressively larger set of points, before and after the orifice change

→ Obtain still reasonable offset values, although points seem to indicate that AB is being affected by factors (changes in sensitivity) other than flow rate

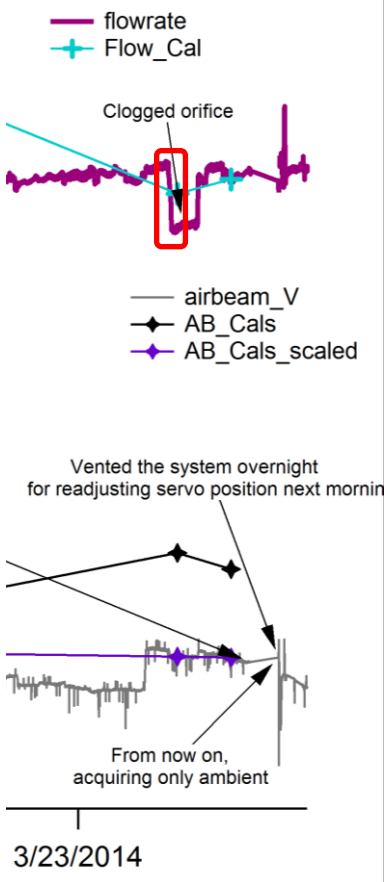
Flow correction: finding flow offset

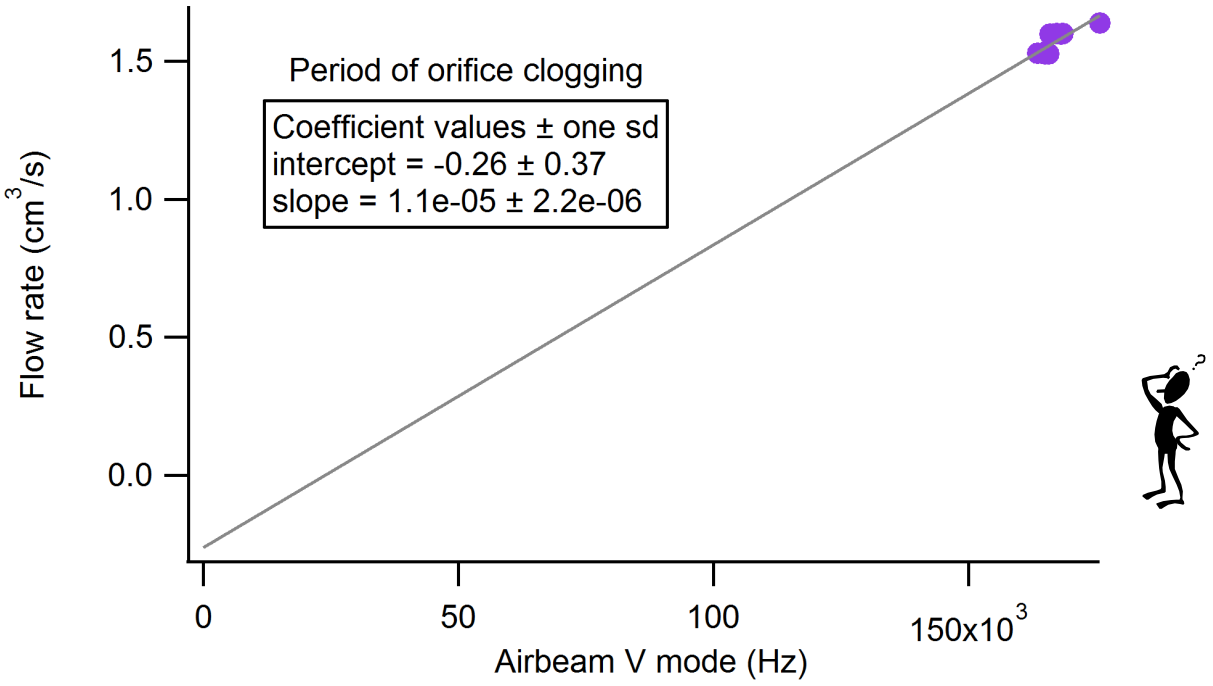
Now, looking at other intervals to try and confirm offset value for the whole time series



- Using intervals of points related to the time of clogged orifice

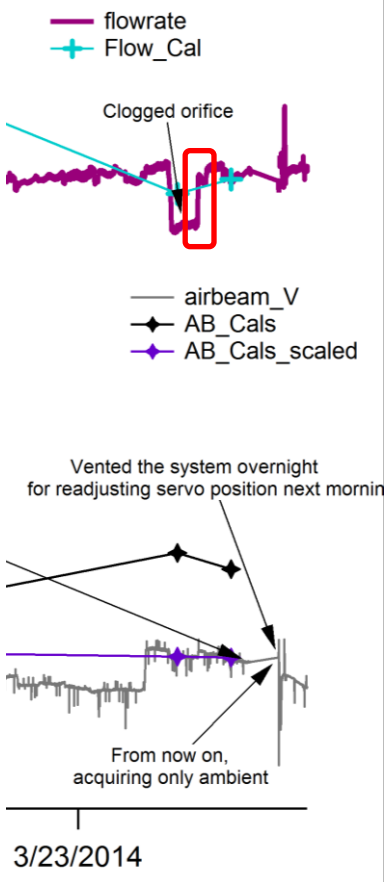
Flow correction: finding flow offset

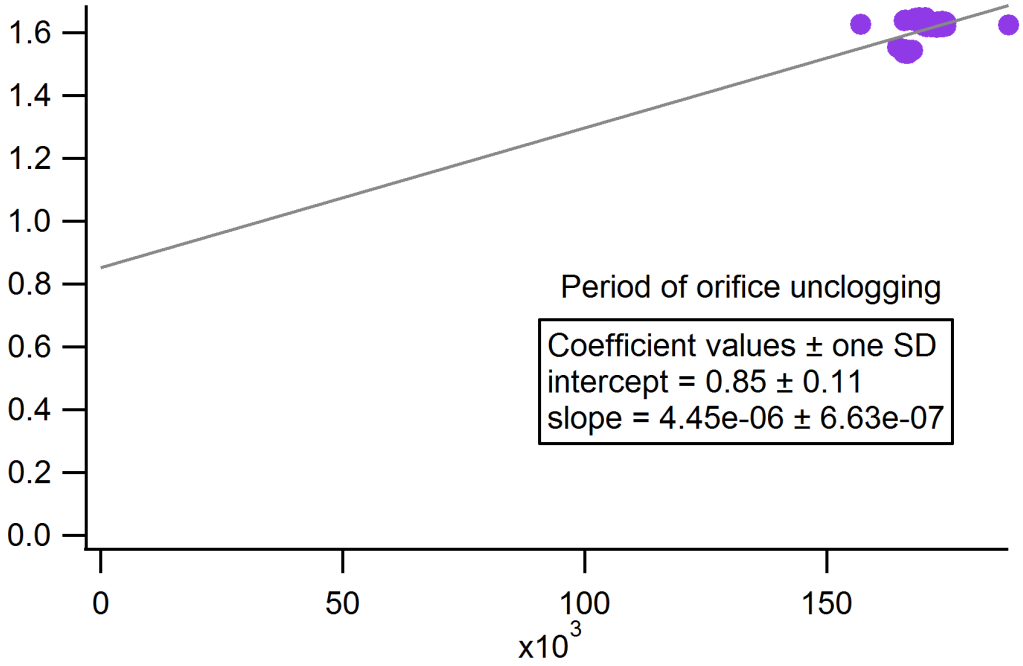




- Period of orifice clogging

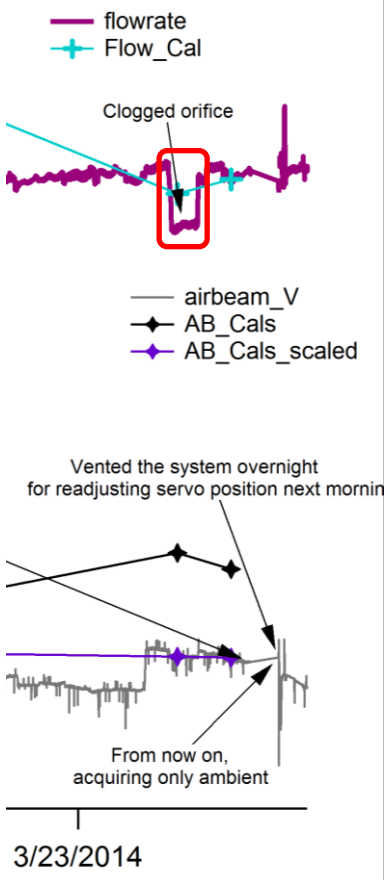
Flow correction: finding flow offset

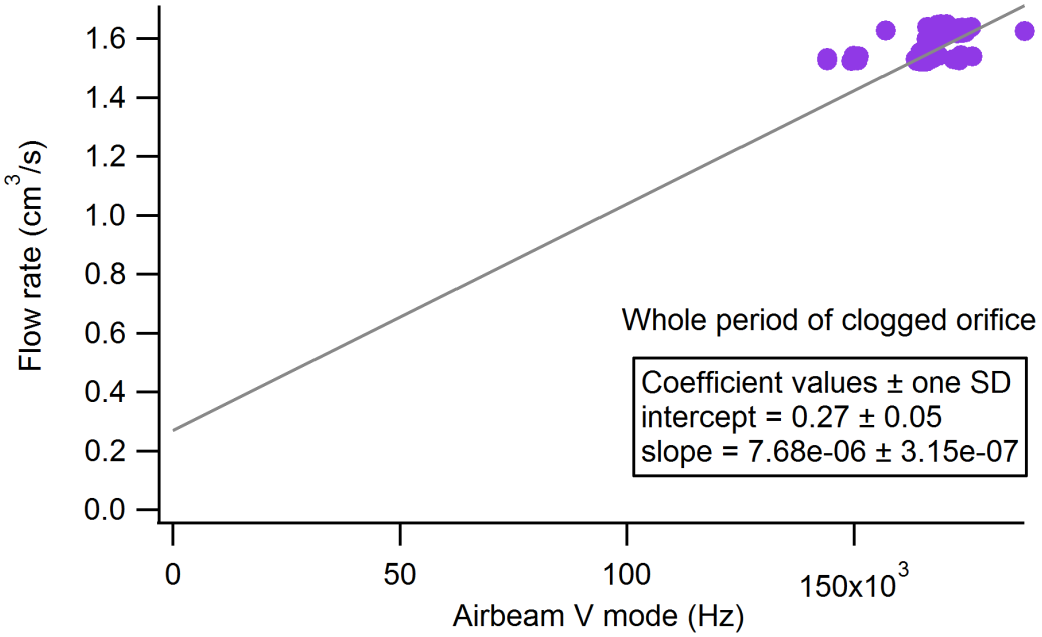




- Period of orifice unclogging

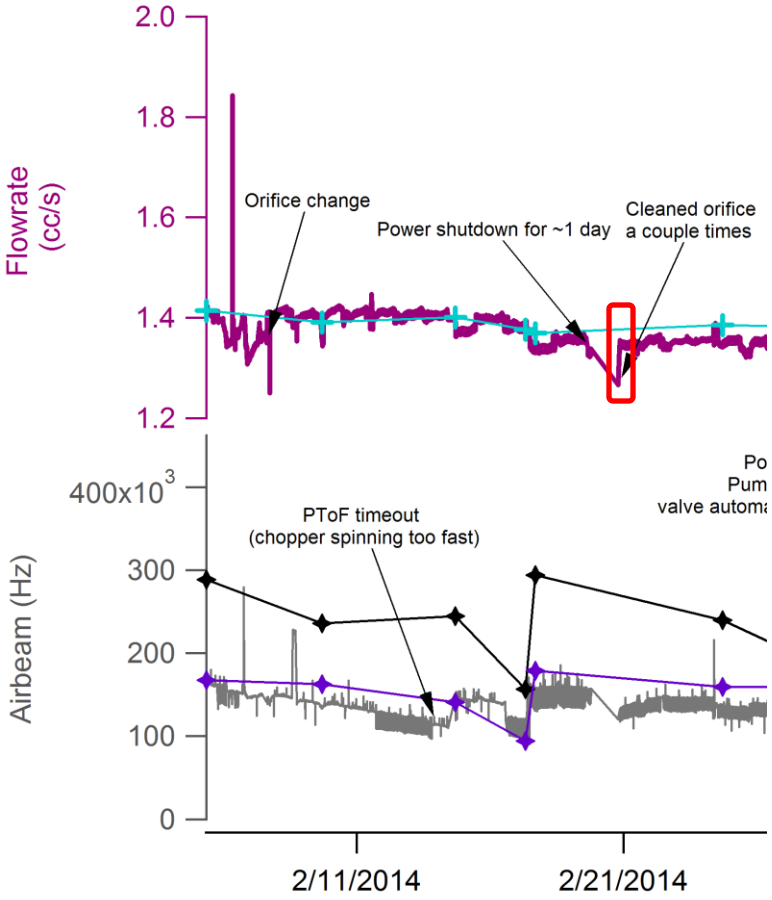
Flow correction: finding flow offset

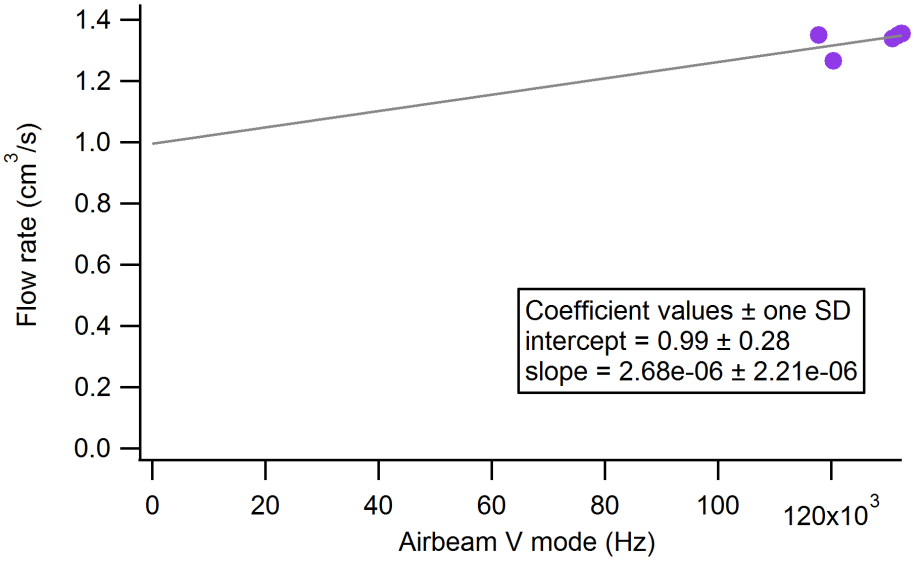




- Period including orifice clogging and unclogging

Flow correction: finding flow offset

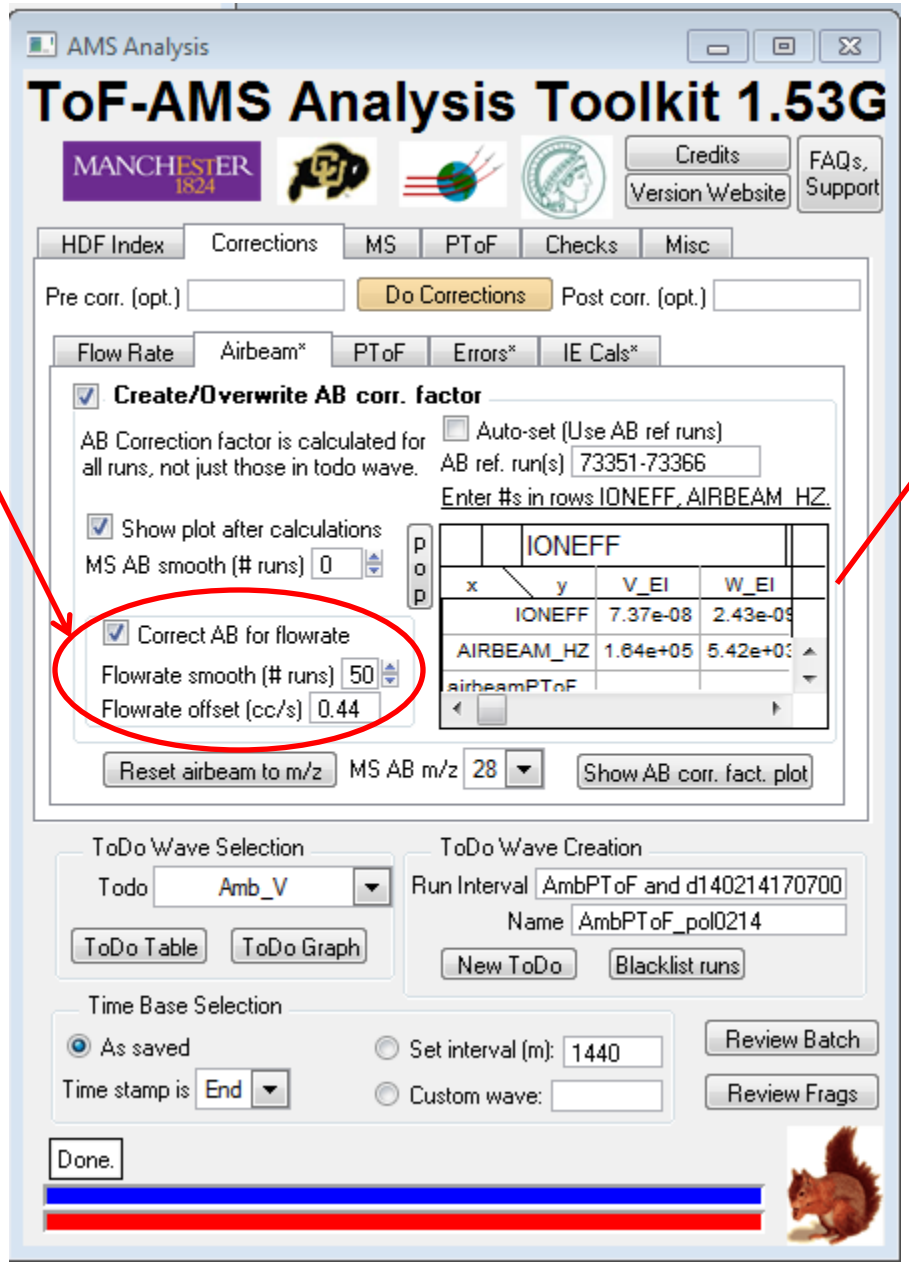


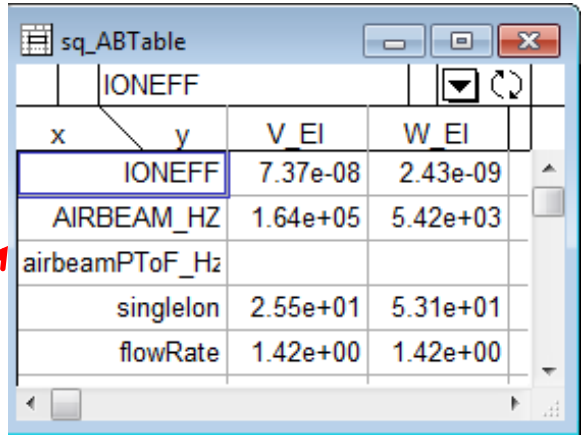


- Using interval of points from another period of orifice cleaning (probably a not very good comparison point b/c it was right after a long shutdown)

Flow-AB correction => AB corrections tab

- Enter flow offset here
- Smoothing may be useful to remove high-frequency noise, but not too much that real variability is smoothed out.





- Be sure to add flow reference value
- If using auto-set for ref runs, this value will be automatically loaded, but always worth checking that it is correct.

Notes/Conclusions

- Ideally, we want to calculate the offset for a period when changes in AB are only associated with changes in flow rate, i.e. no other (sensitivity) factors playing a role
- Because of that, long periods are avoided; also, the trend of SI values was checked for these periods and seemed stable (see campaign diagnostic plot)
- For the first case shown (2 points only, before and after orifice change), the offset found (0.44 cc/s) seems reasonable; when increasing the number of points around that, offset value still seems ok, but AB clearly is being affected by other factors
- From the examples shown here, there is a large range of offset values that can be obtained depending on the period chosen, even negative ones (?), so we have to be very careful in choosing the most appropriate period

→ I am inclined to assume that 0.44 (or some value in between 0.39 - 0.44) is our best bet for offset. The other periods with orifice clogging appear to not have enough range in flows to calculate a good offset. Likely other factors are affecting the AB to isolate the flow vs AB relationship.

→ One can measure the flow offset much better by putting a needle valve in front of the inlet and decreasing the flow while recording the AB (e.g. during a flow calibration if the MS is on)

→ Also, note that for flow changes on the order of 10-20% typically observed during a campaign, knowing the flow offset perfectly may not be critical yet the correction still gets it right, to first order. See explanation on next page.

In terms of getting the offset better than 0.1 cc/s, consider that:

- A flow drop in of 0.1 cc/s will cause a lowering of the AB of ~10% (1.5 cc/s - 0.5 cc/s offset => 1.0 cc/s per full AB). If this is not accounted for, the AB correction is off by 10% (since aerosol mass entering the AMS is not affected, to first order). However if your offset was off by 0.1 cc/s (0.4 or 0.6 cc/s instead) that would result in a ~10% error in your flowrate correction of the AB which is then only 1% overall error in quantification, so no big deal.
- As the flowrate drop gets bigger (as you approach zero), then the relative error introduced by error in the offset will increase (and eventually blow up). Ideally, you're only correcting for flow changes that are >10-20% otherwise knowing the offset will matter more. But generally when flow drops by a lot more, the data is not reliable (aerosol losses on a clogged orifice, etc). And, of course if one really wants to know it better, you can measure the relationship over a wider range with a needle valve in front of the inlet (can do this during the flow calibration by having the mass spec on, if you're careful).