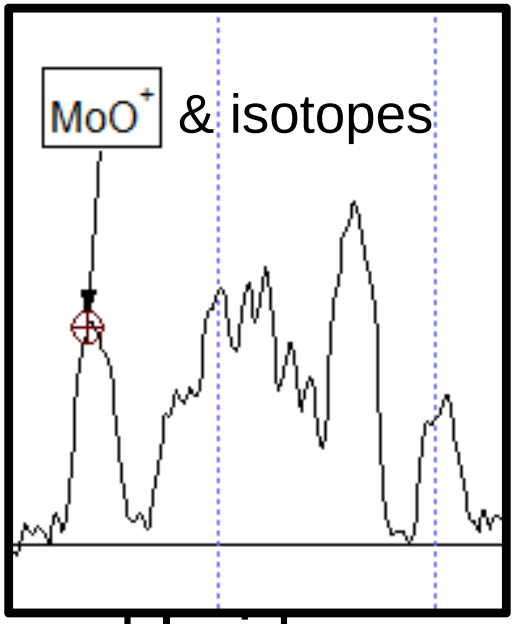
A small Pieber-style artifact for AMS Nitrate → Choride ("Hu effect")

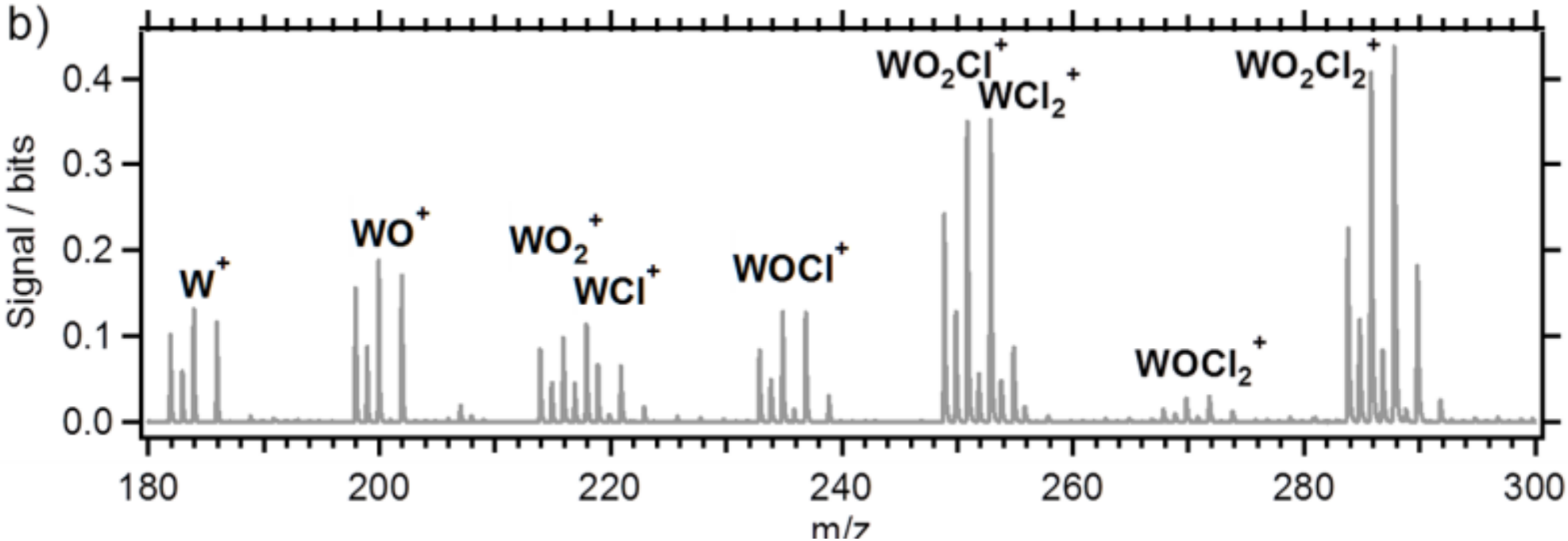
Jose-Luis Jimenez, Weiwei Hu, Jason Schroder, Benjamin Nault, Pedro Campuzano-Jost et al.
University of Colorado-Boulder

AMS Users Meeting
Portland, OR, 21-Oct-2016

Pre-Pieber World

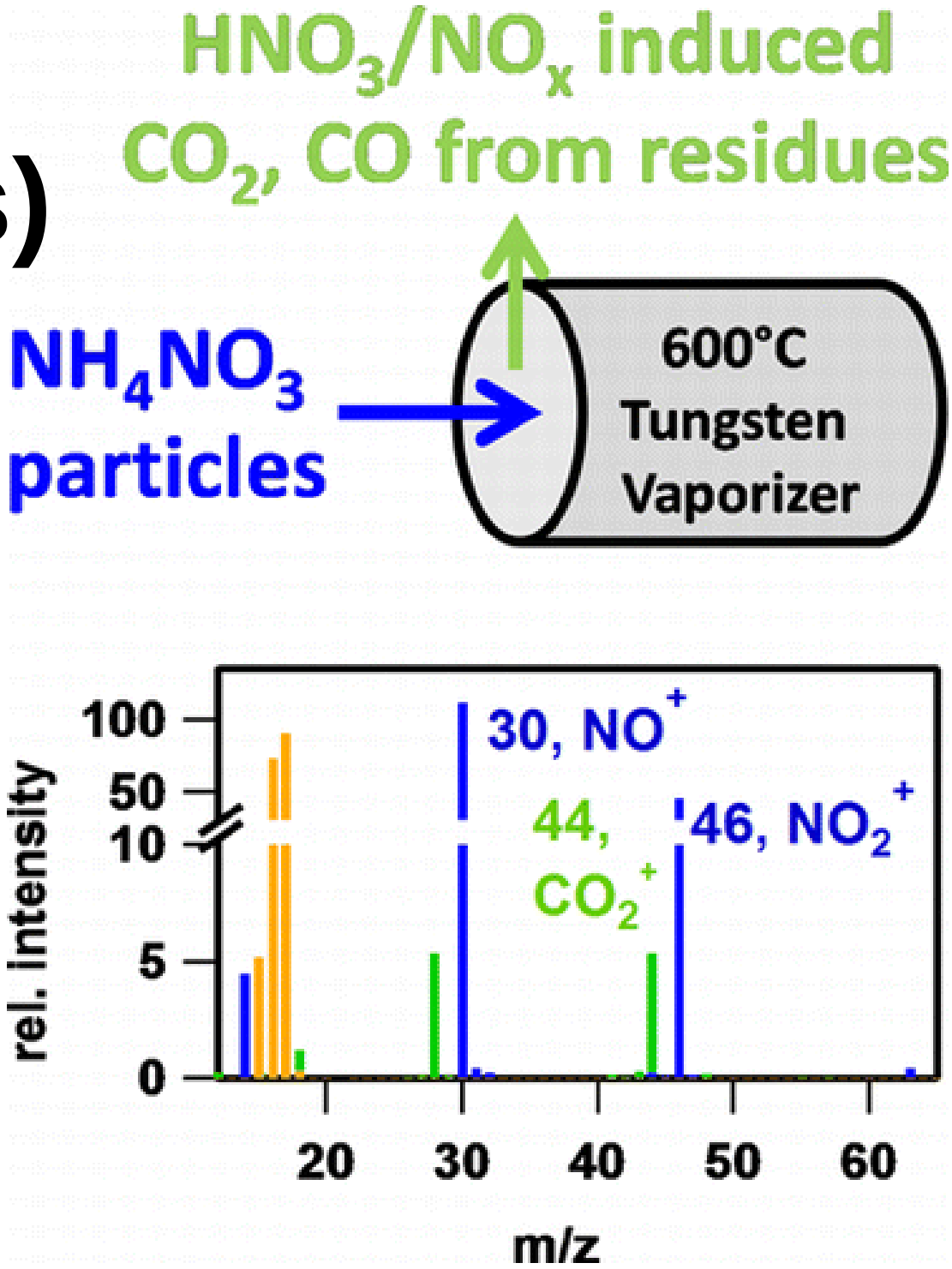


- Products of chemistry in AMS vaporizer reported before
- MoO+ and MoO_2^+ when sampling HIO_3 containing particles (Jimenez et al. 2003)
  - ~0.1% Level
- $WCl_xO_y^+$ ions when sampling NH_4Cl and other chlorides (Drewnick et al. AMT 2015)
  - ~0.1% level for NH_4Cl



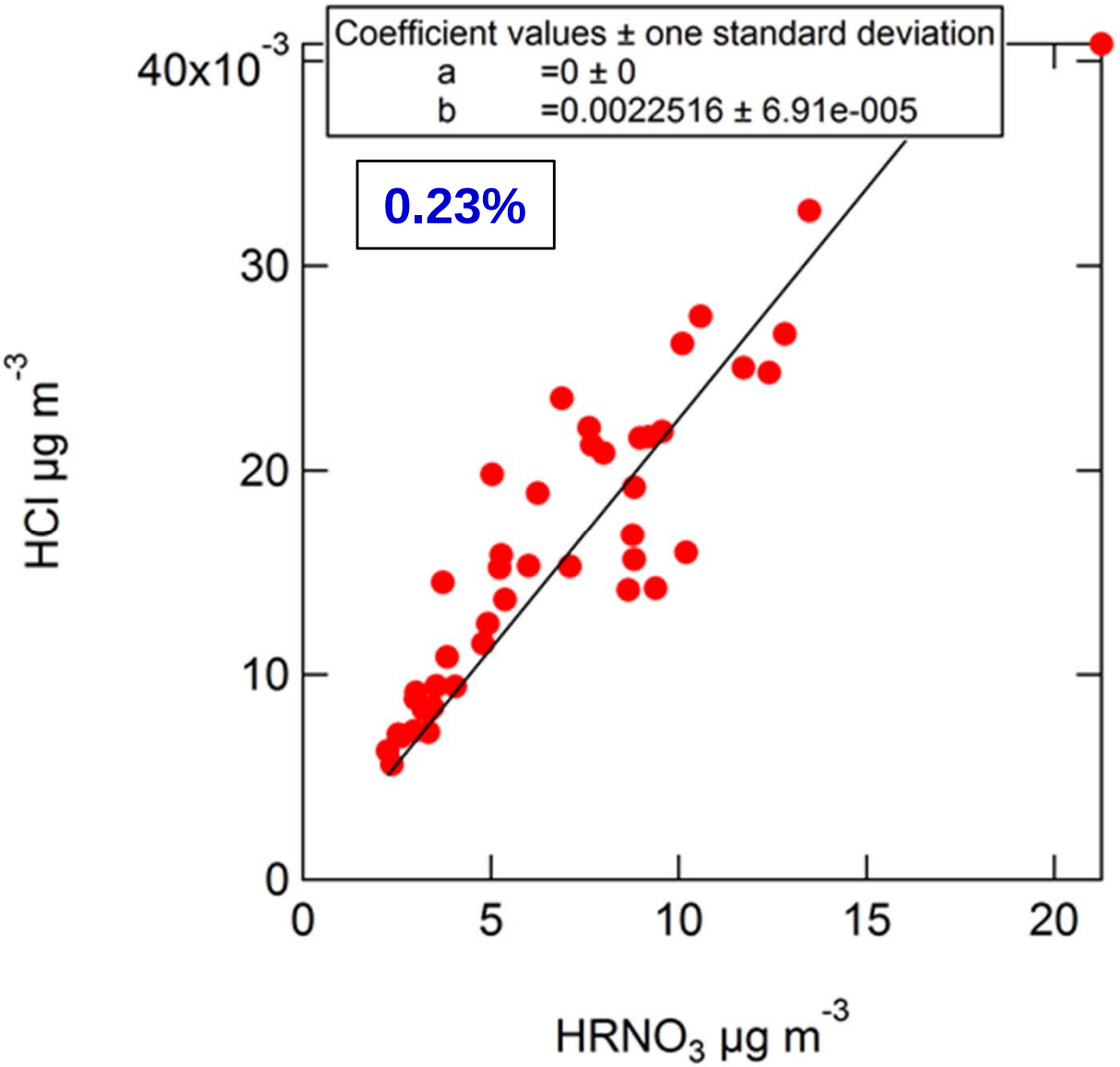
Reminder of Pieber effect(s)

- NH_4NO_3 results in CO_2^+ signal
- Same with $NaNO_3$
- Smaller with $(NH_4)_2SO_4$
- Favez (this meeting): *m/z* 30 from $(NH_4)_2SO_4$



http://pubs.acs.org/doi/abs/10.1021/acs.est.6b01035

Weiwei noticed something…

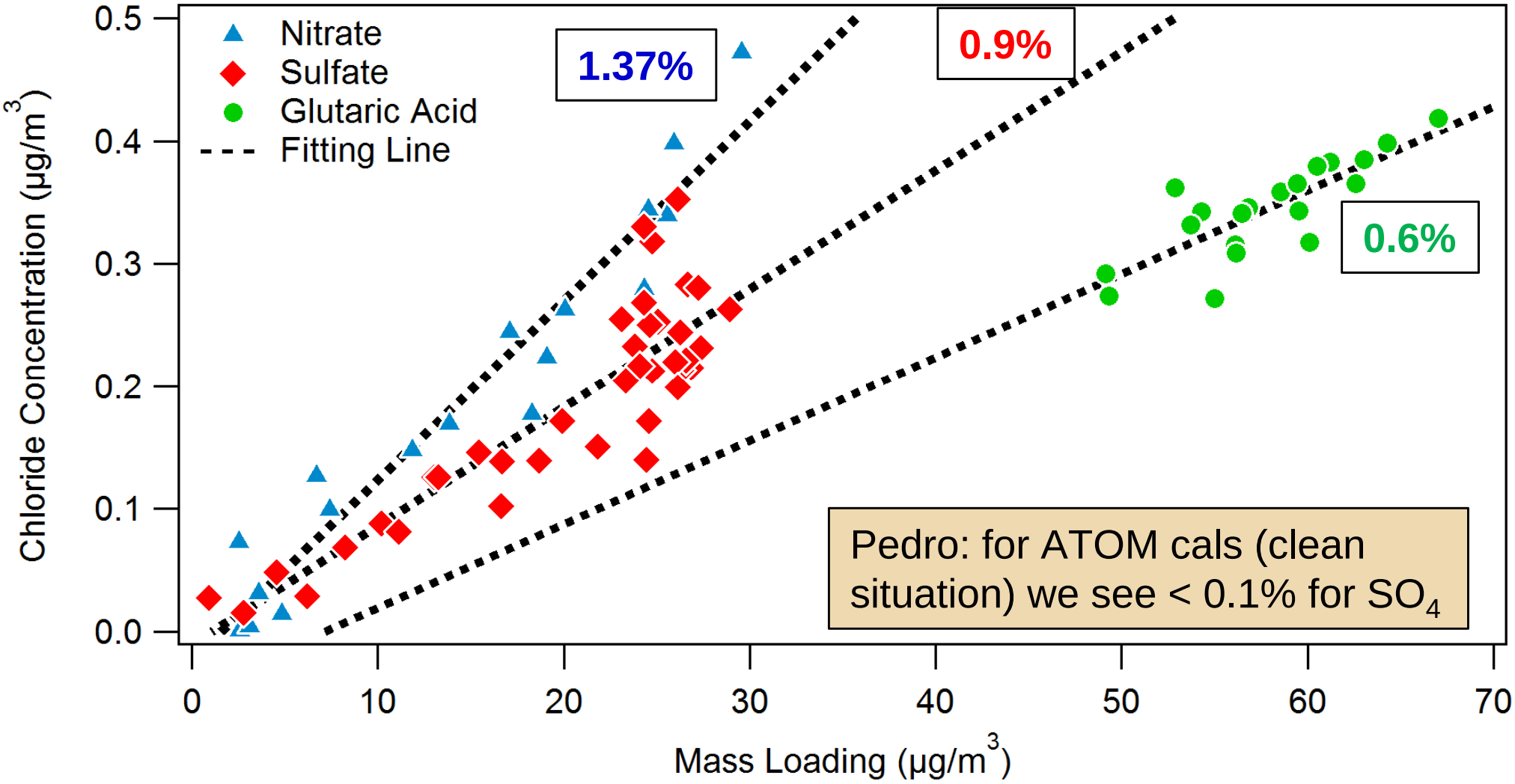


- See some HCl^+ when sampling pure NH_4NO_3
- Ratio ~0.23%
- It is not an impurity of the sample
- We see it in many datasets across the years
- Tiny effect for total mass (< 0.1%)
- Can be significant for chloride:
  - Chl/NO_3 often ~ 1%

UT Austin Group Results

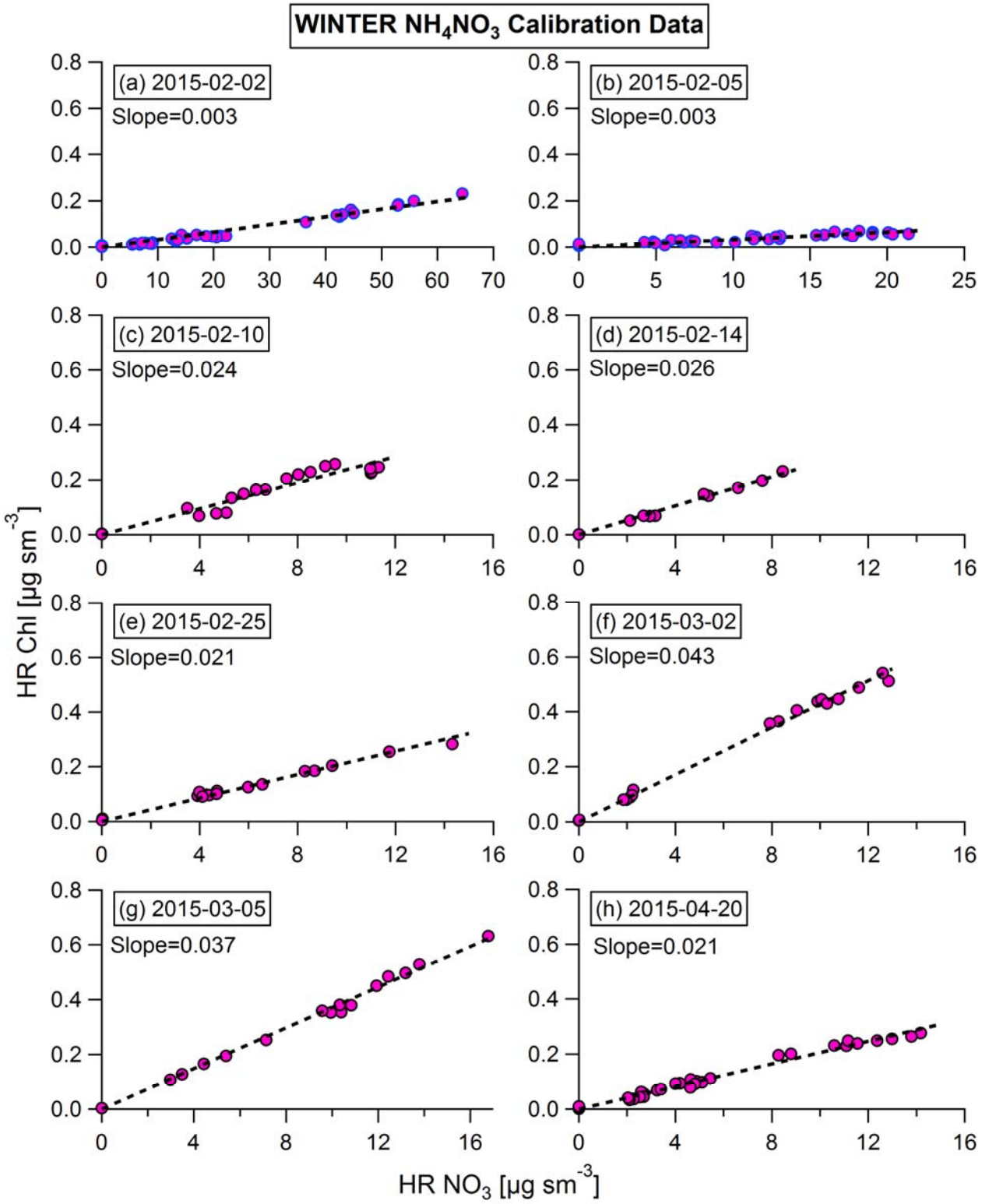
Q-ACSM [UT Austin]
Submitted by Dongyu Simon Wang and Lea Hildebrandt Ruiz

- They found this independently, contacted me when they saw title of this users meeting presentation



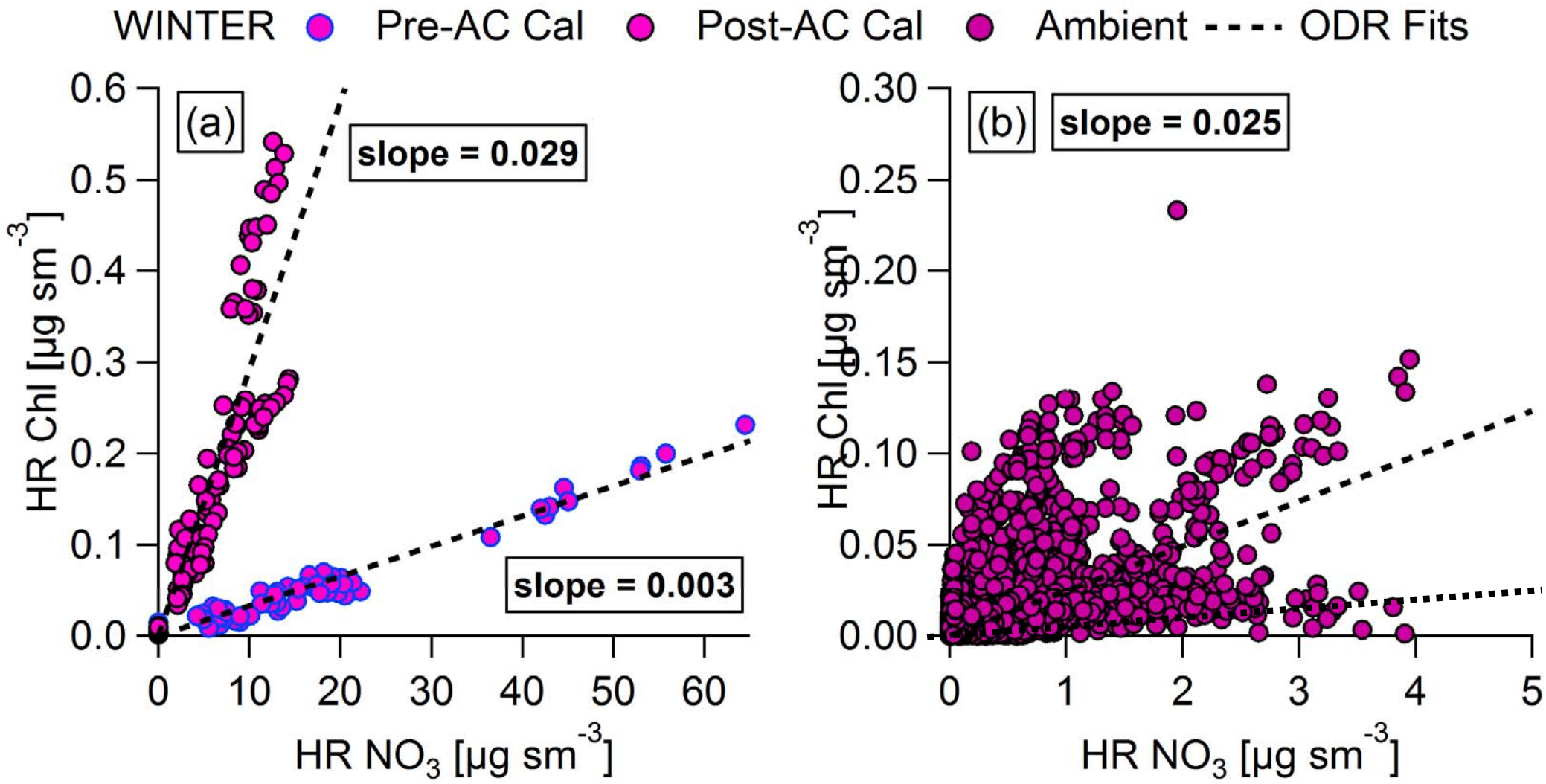
It can vary in time for 1 instrument

- Slope went from 0.3% to 2-4%
- “Regular Pieber” (NO_3 → CO_2 did not change)



Jason Schroeder et al.
WINTER 2015 campaign

Fractional Impact on Ambient Data (WINTER)



Jason Schroeder et al.
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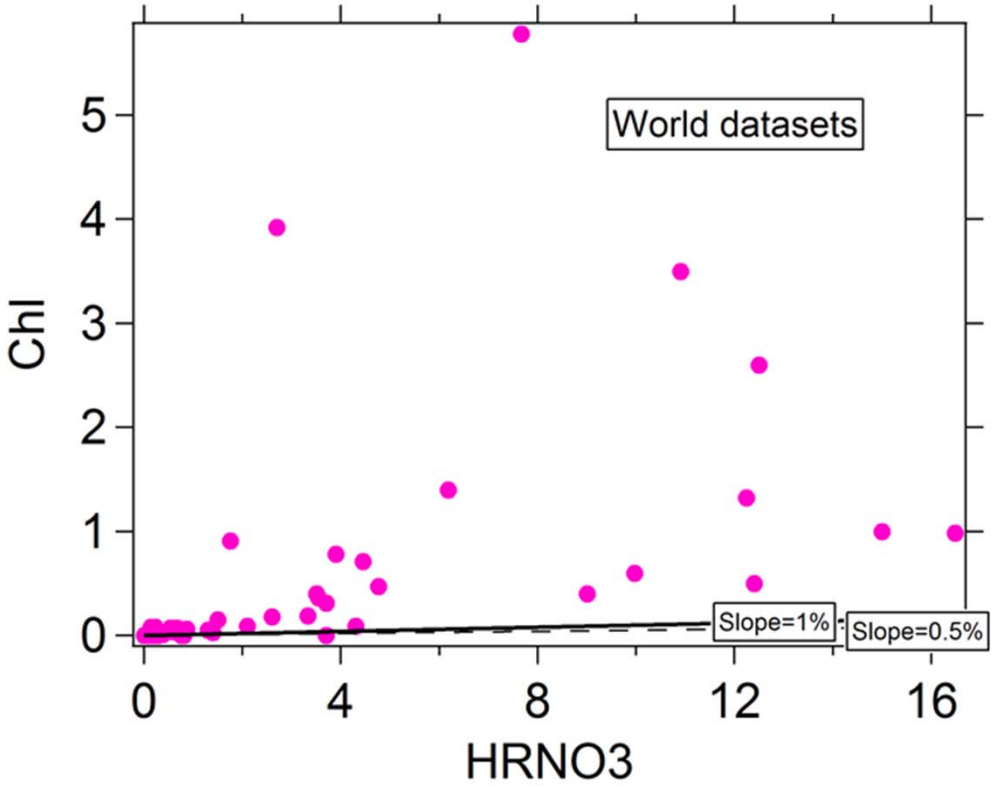
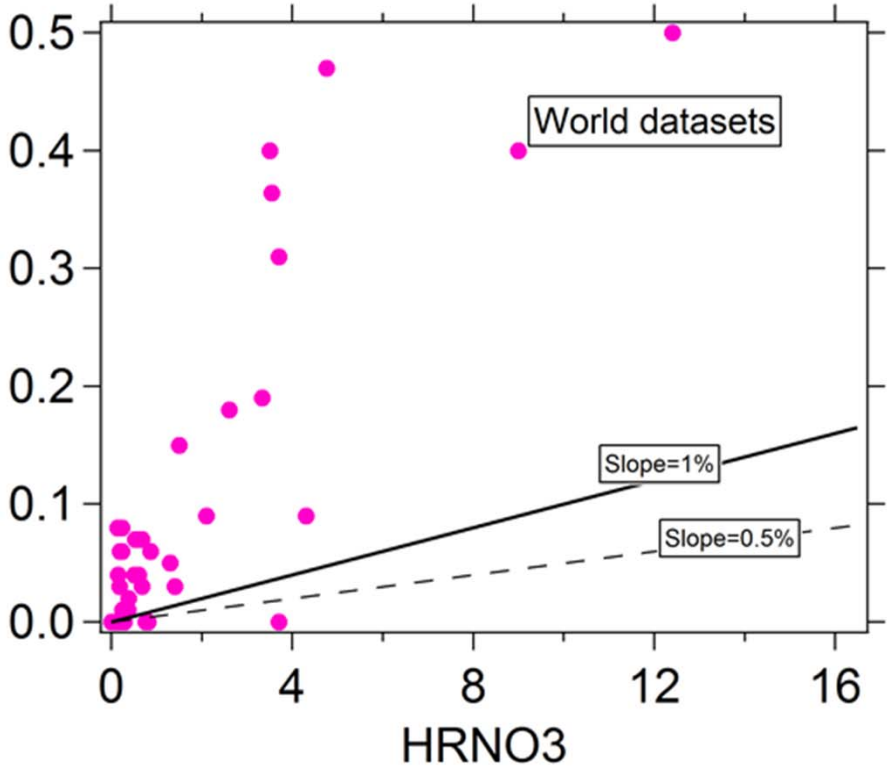
How important is this for AMS Chloride Worldwide?

- Weiwei: datasets from AMS Worldwide database (mostly quadrupoles, some HR)

Big Picture

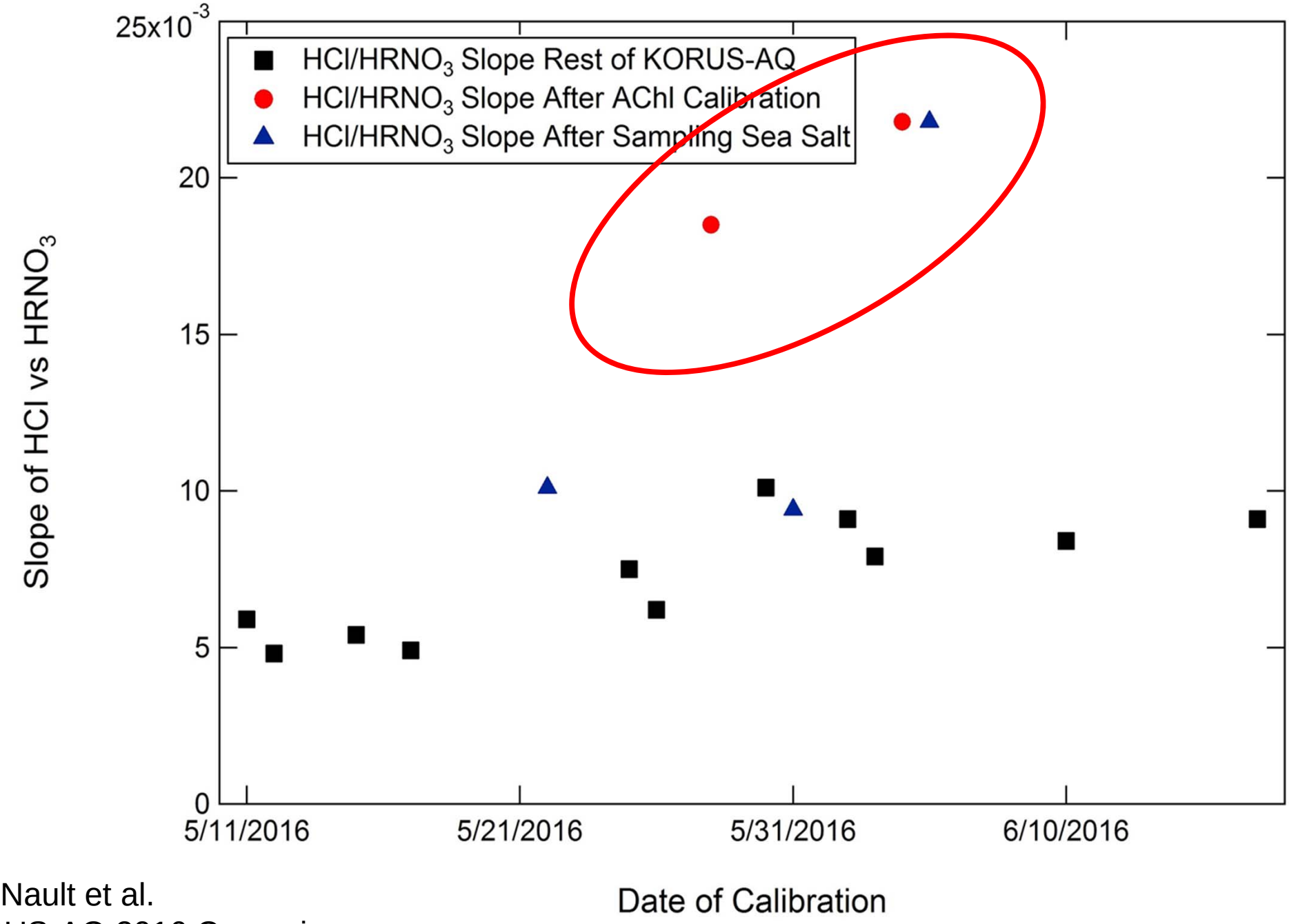


Zoomed version



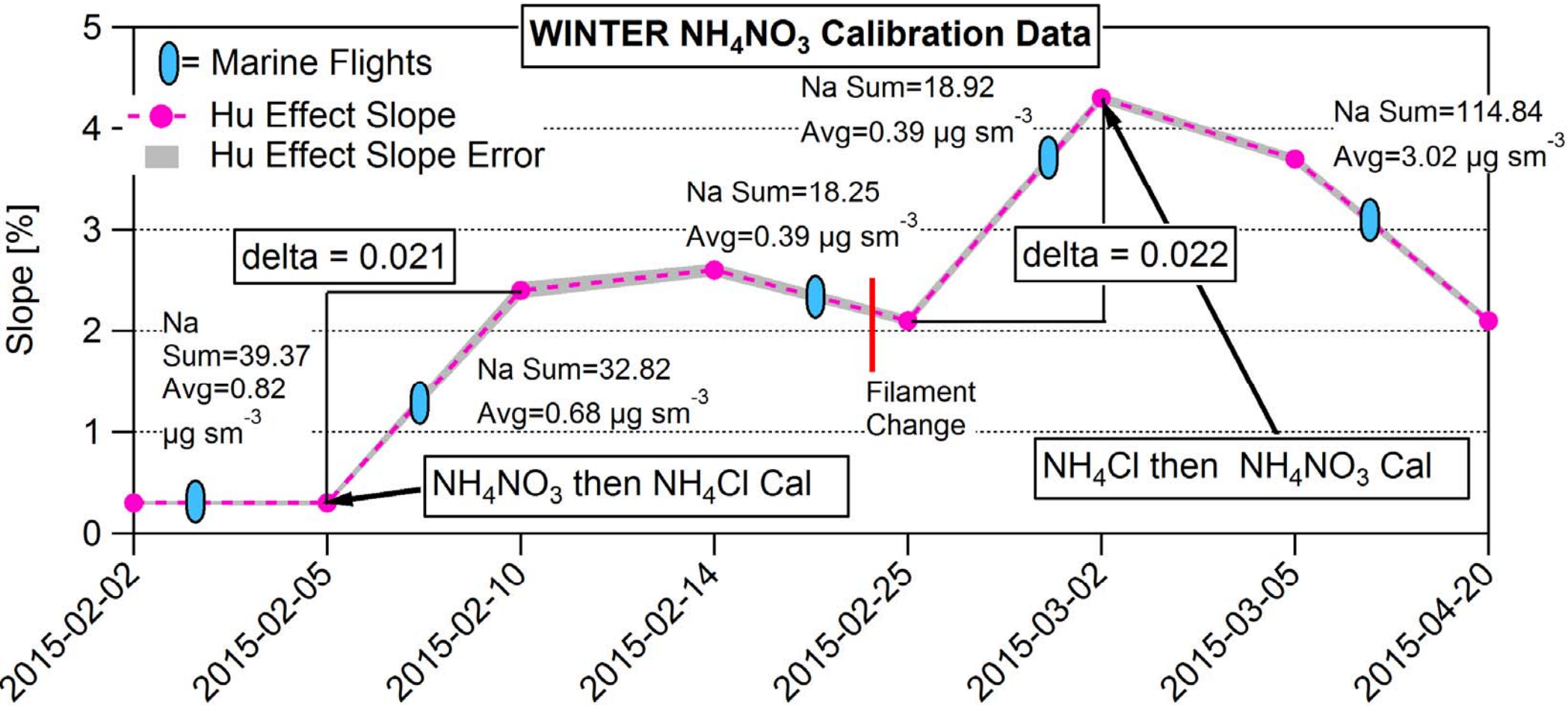
- Generally small effect, but often not negligible
- For some datasets it could be e.g. ½ of (small) reported AMS chloride

Evolution during Aircraft Campaign



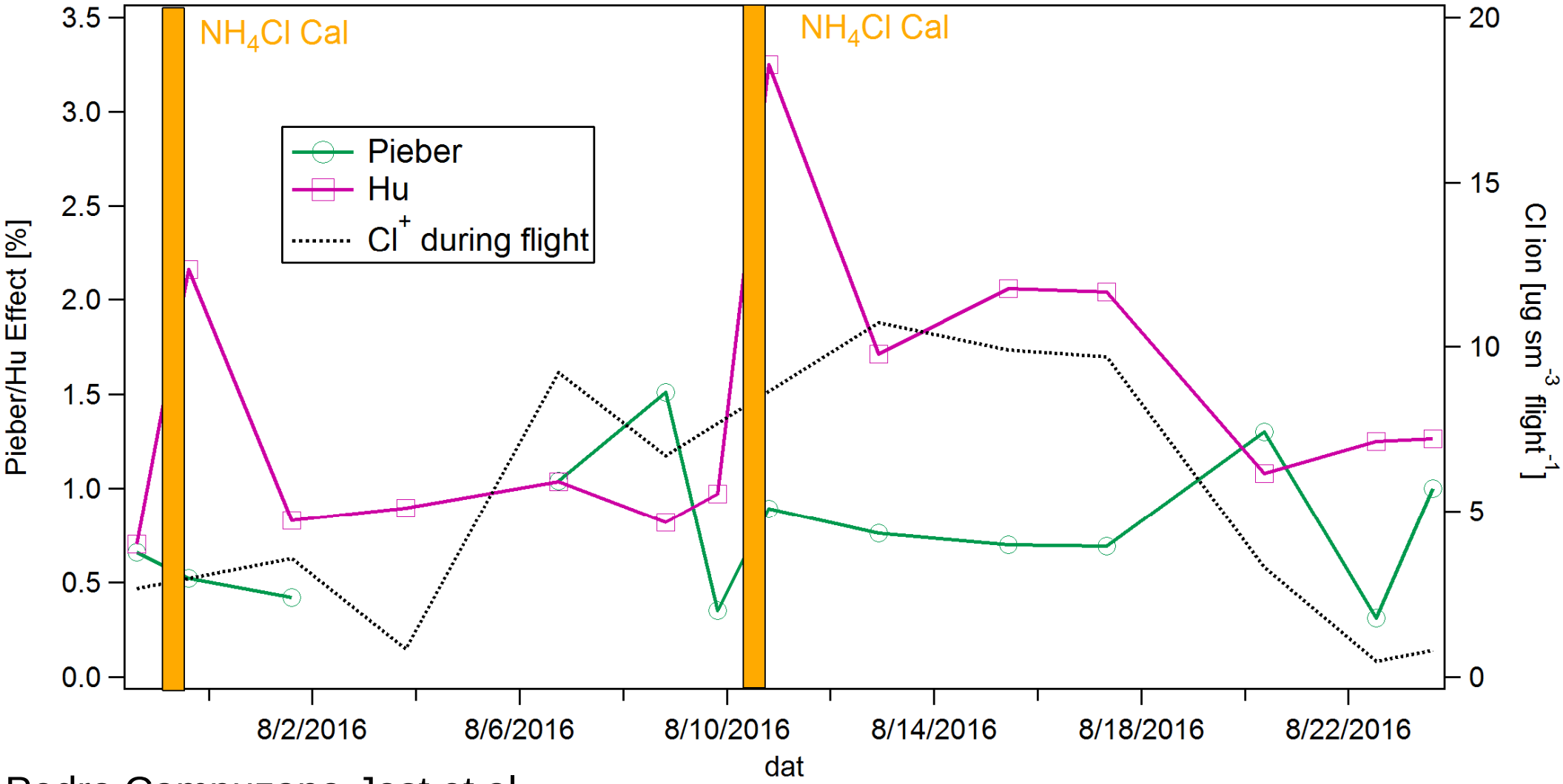
Ben Nault et al.
KORUS-AQ 2016 Campaign

Instrument history for WINTER Aircraft Campaign



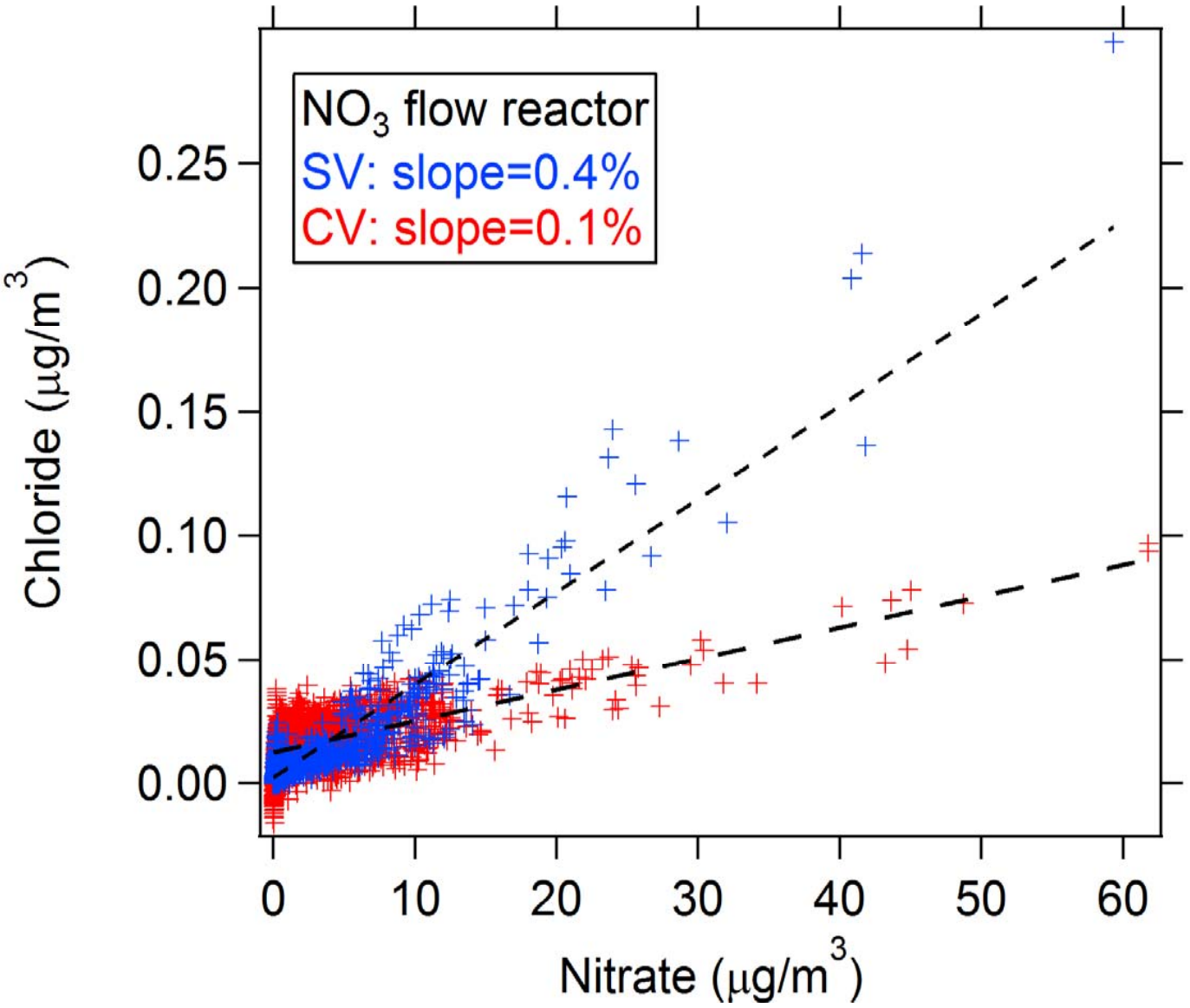
Jason Schroeder et al.
WINTER 2015 campaign

Instrument Variability During ATOM-1 (also aircraft)



Pedro Campuzano-Jost et al.
ATOM-1 2016 Campaign

Effect smaller in CapVap

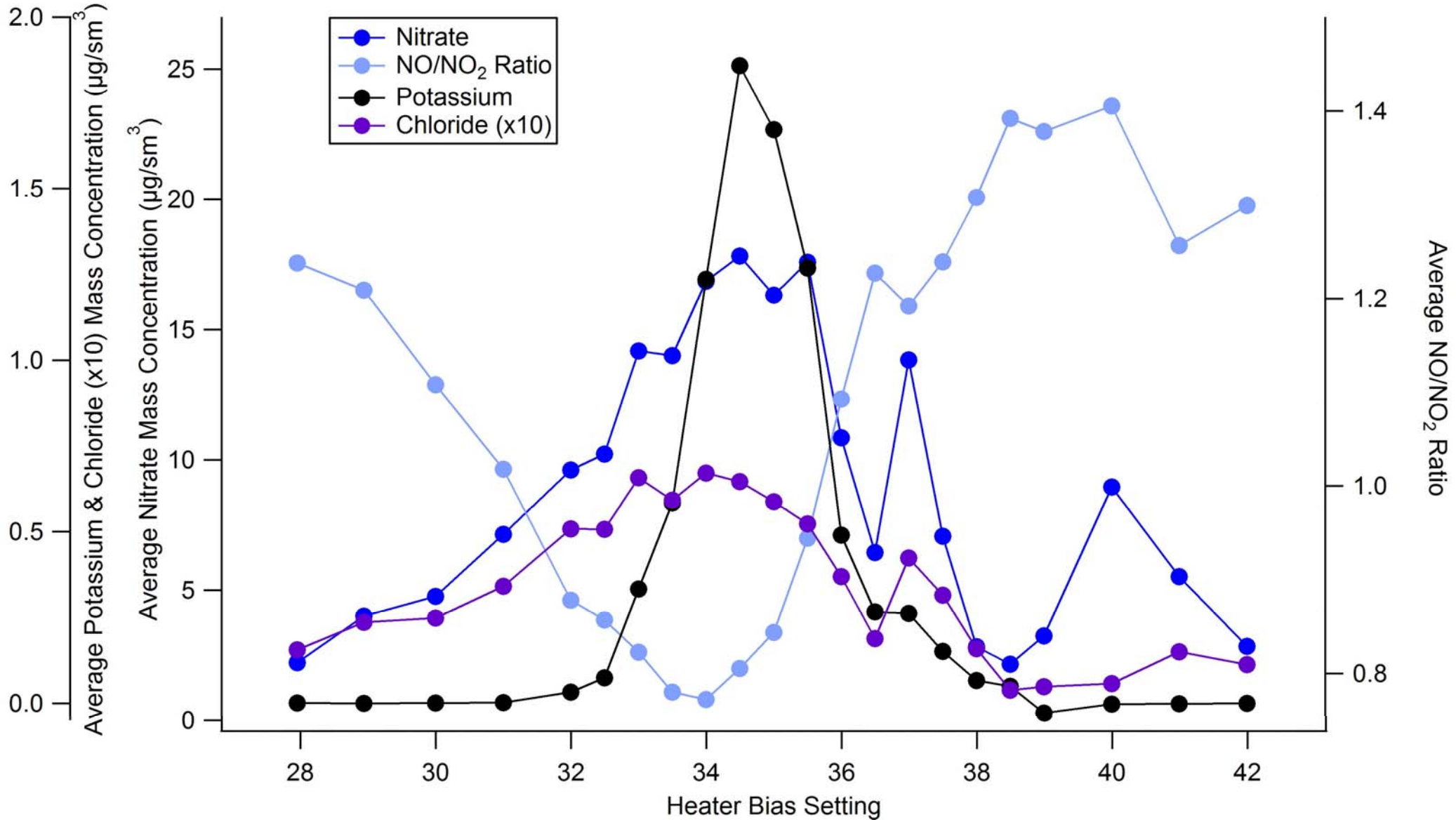


- Effect is ~ x4 smaller for CapVap

Hu et al., in preparation

Follows NO_3 vs Heater Bias

- Does not seem to track with the NO/NO_2 Ratio
- Data from Ben and Pedro during KORUS 2016



Summary

- Small 0.1% vaporizer effects had been reported a few times before Pieber
- Pieber is the first one that can matter for the major AMS species
- NO_3 results in artifact Chl signal ~ 1%
  - See it for multiple instruments and campaigns
  - Probably never important for total mass
  - At times could be tens of % of the chloride
  - x4 smaller in CapVap vs StdVap
- SO_4 shows an effect in one case and not in another
- OOA may also cause this
- Instruments vary in time
  - NH_4Cl calibrations at ~10 ug m^{-3} for 30 min. enhance the effect
  - Instrument self-cleans quickly afterwards
  - Sampling marine air with sea salt does not have a clear effect
  - NO_3 → Chl effect appears uncorrelated w/ Pieber (NO_3 → CO_2)