WP3: Application of ammonia metrology

- 3.3.2: Production of instrument inlets, pre-exposed to test aerosol

J Kentisbeer, M.M. Twigg, N Mullinger & C.F. Braban

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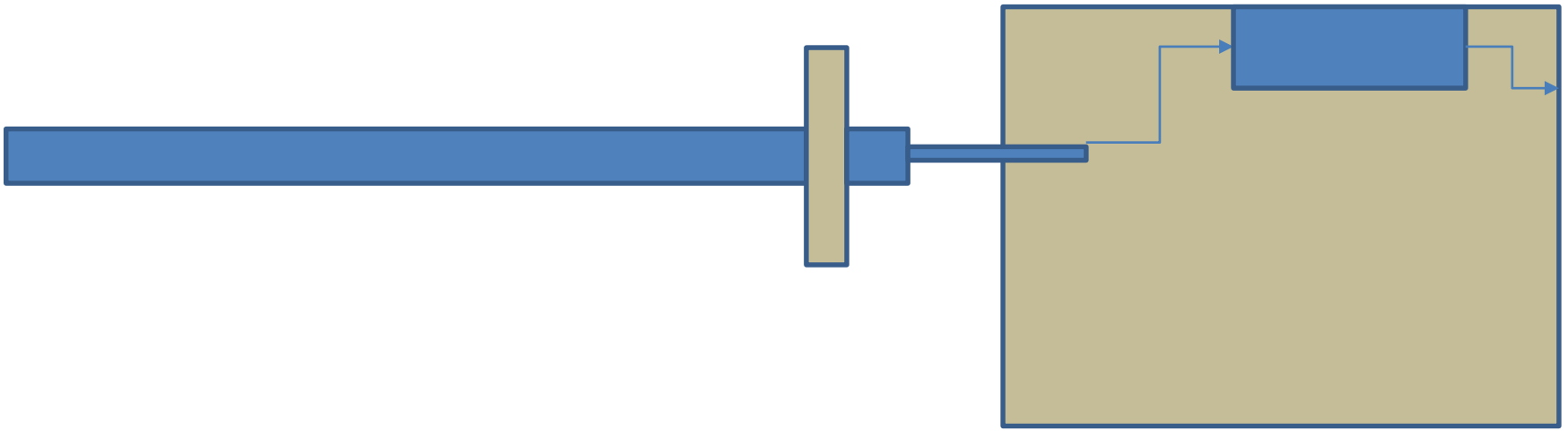
Why?

- NH_3
  - is a “sticky” molecule
  - Interacts with gas phase H_2O, any acid
  - Interacts with aerosol phase chemicals: H_2O, salts, acids
  - Can be biologically consumed



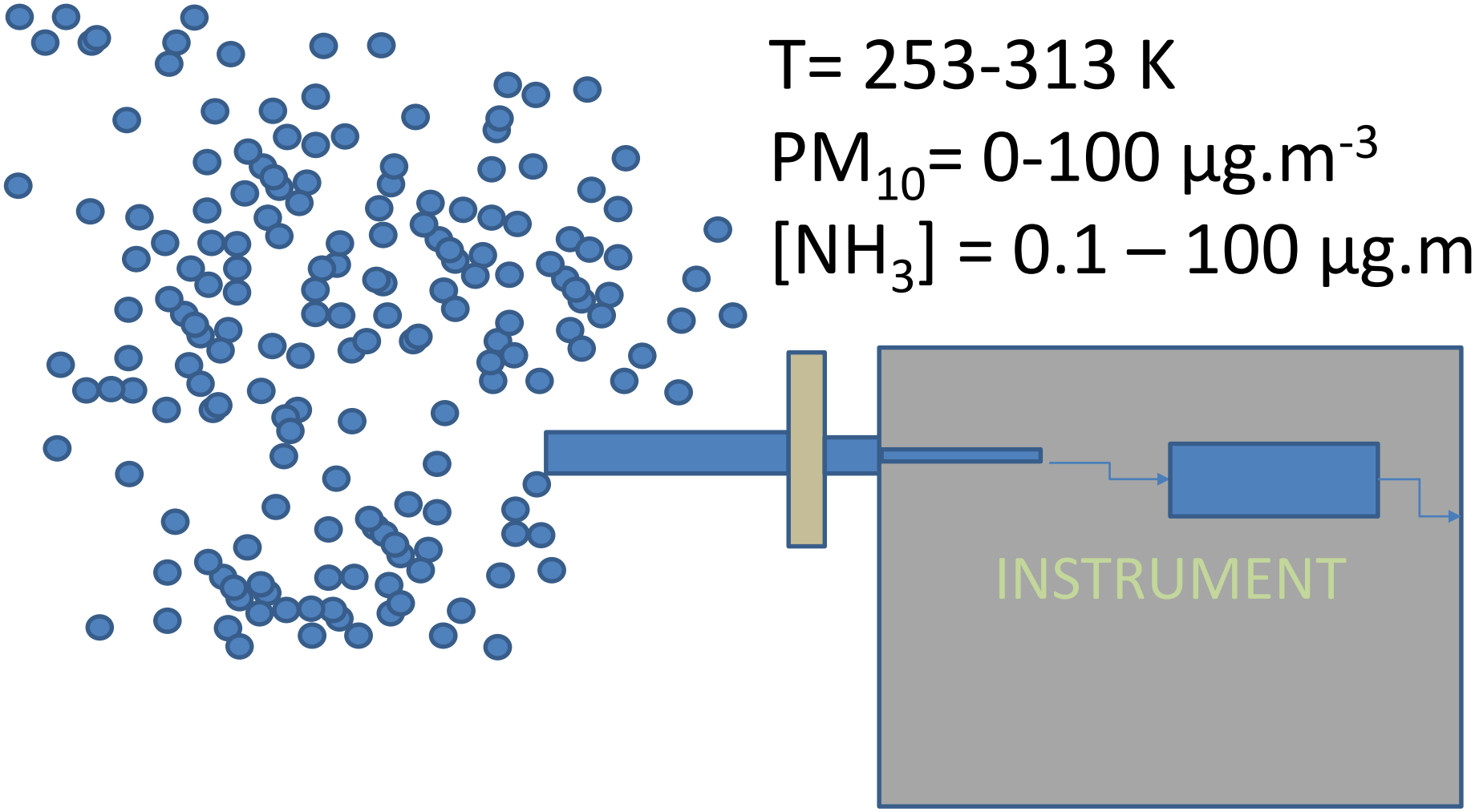
Typical measurement systems and conditions…

RH = 40-100%

T= 253-313 K

PM_{10}= 0-100 µg.m^{-3}

[NH_3] = 0.1 – 100 µg.m^{-3}



Potential effects of inlet configuration

1. Equilibration with RH and T
   - Enhanced adsorption or desorption *fn of time*
2. Aerosol impaction on walls of inlet
   - Chemical interactions change
   - Water thermodynamic equilibrium changes
3. Inlet material surface properties change with time

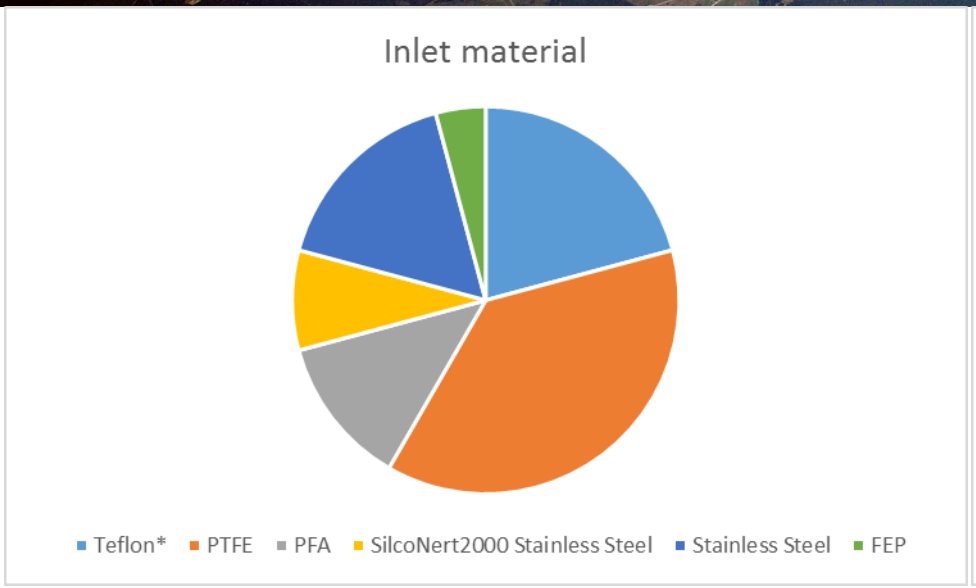
What applies to an inlet will also apply to any filter in the system

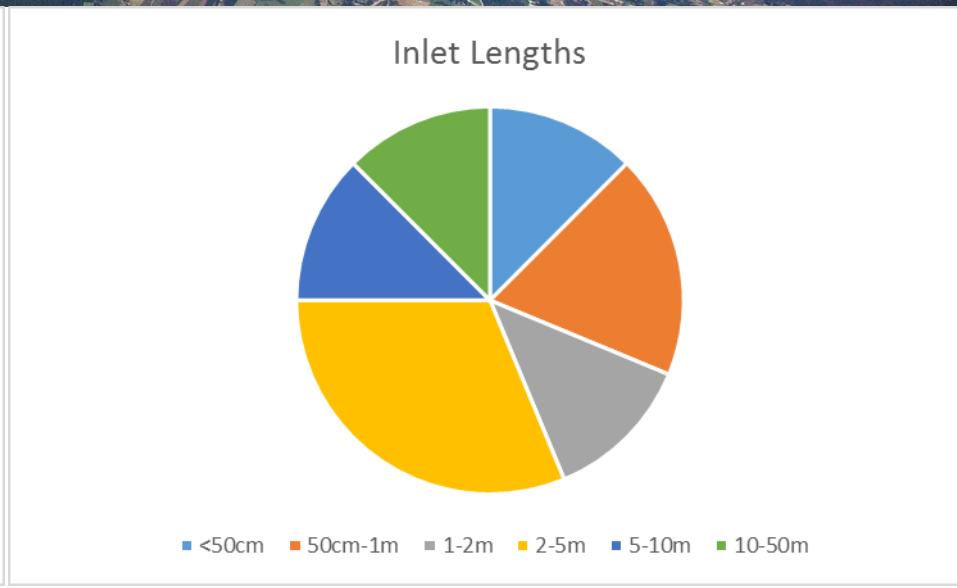
Canvassing the community

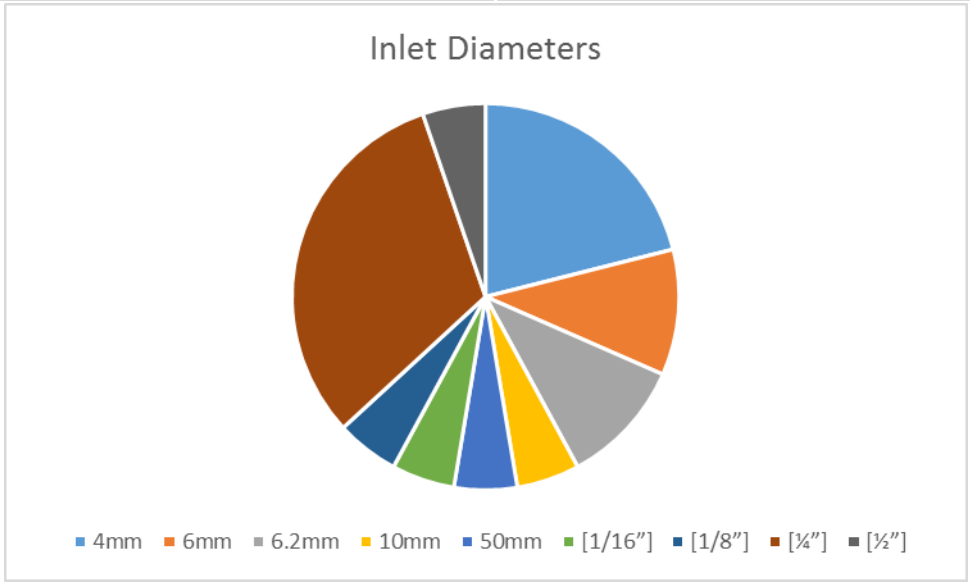
Surveymonkey – 18 respondents to 7 questions….

1. What type of ammonia analyser(s) do you use?
2. What inlet material(s) do you use?
3. What inlet length(s)?
4. What internal diameter is your sample inlet(s)? [External]
5. What sample flow rate(s) do you use?
6. Do you use an aerosol filter? If so, what type?
7. Do you heat your sample line?

What to test?







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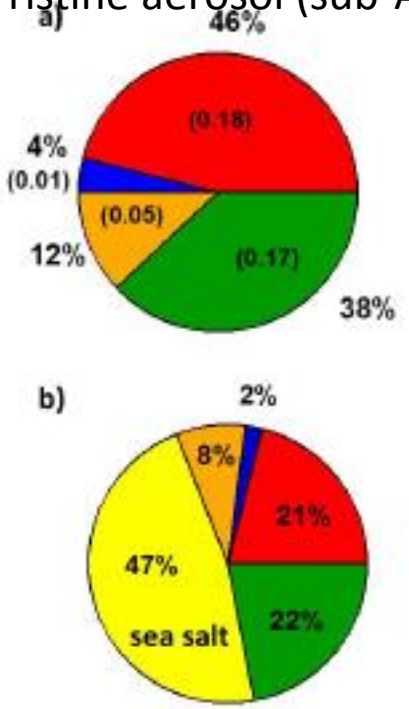
Selecting Test Parameters

Inlet	
Material	PTFE, PFA, SilcoNert 2000 SS, LDPE
Length	2m
Diameter	¼”

Aerosols
Ammonium Sulphate
Ammonium Nitrate
Sodium Chloride
Humic Acid Sodium Salt

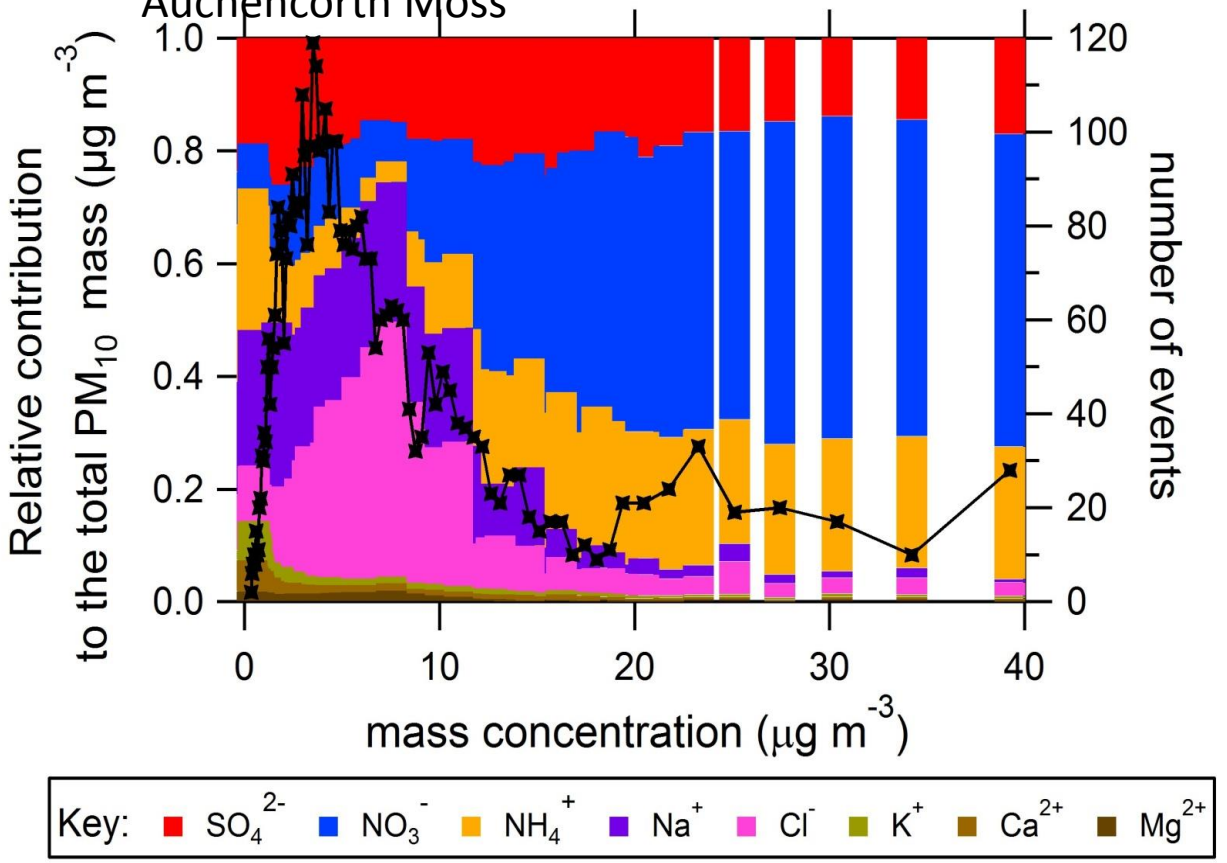
Why these salts?

Pristine aerosol (sub-Antarctic)



Schmale et al. (2013)

Auchencorth Moss



Twigg et al. ACP, 2015

Seasalt, organics, ammonium-nitrate-sulphate

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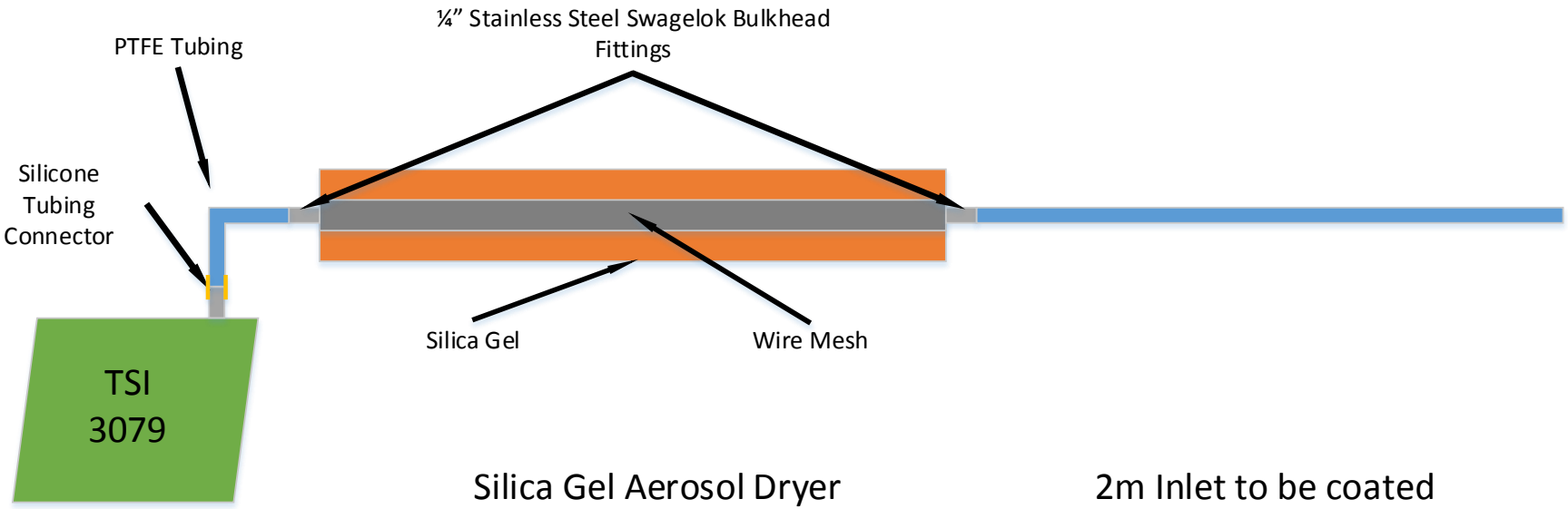
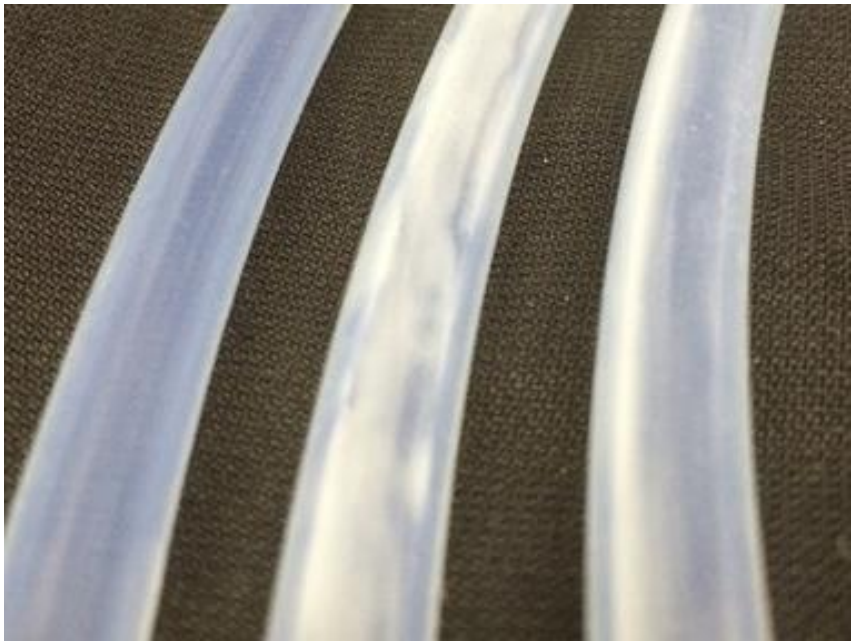
Coating the inlets



Silica Gel Aerosol Dryer

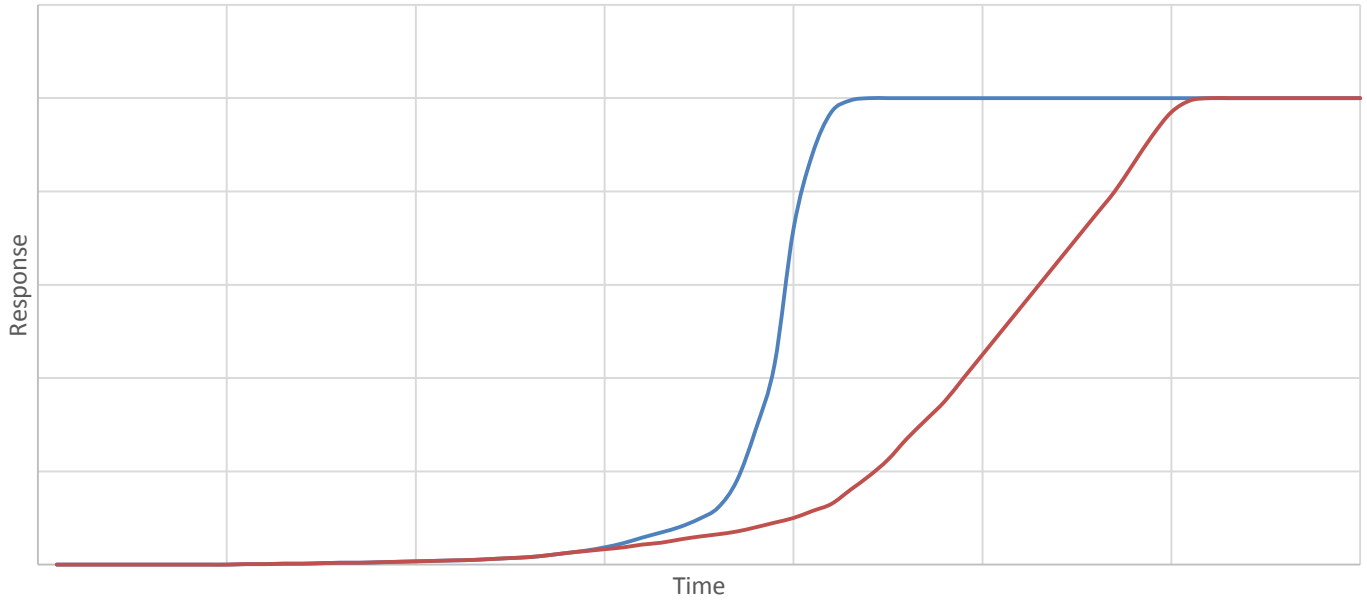
2m Inlet to be coated

Coating the inlets



Chemical	% wt.	Concentration
Sodium Chloride	15%	3.02M
Ammonium Nitrate	15%	2.20M
Ammonium Sulphate	15%	1.34M
Humic Acid Sodium Salt	5%	0.28M

Testing the Inlets



WP3: Deliverable 3.3.3

- 3.3.3: Construction of mixing system for aerosol and humidity

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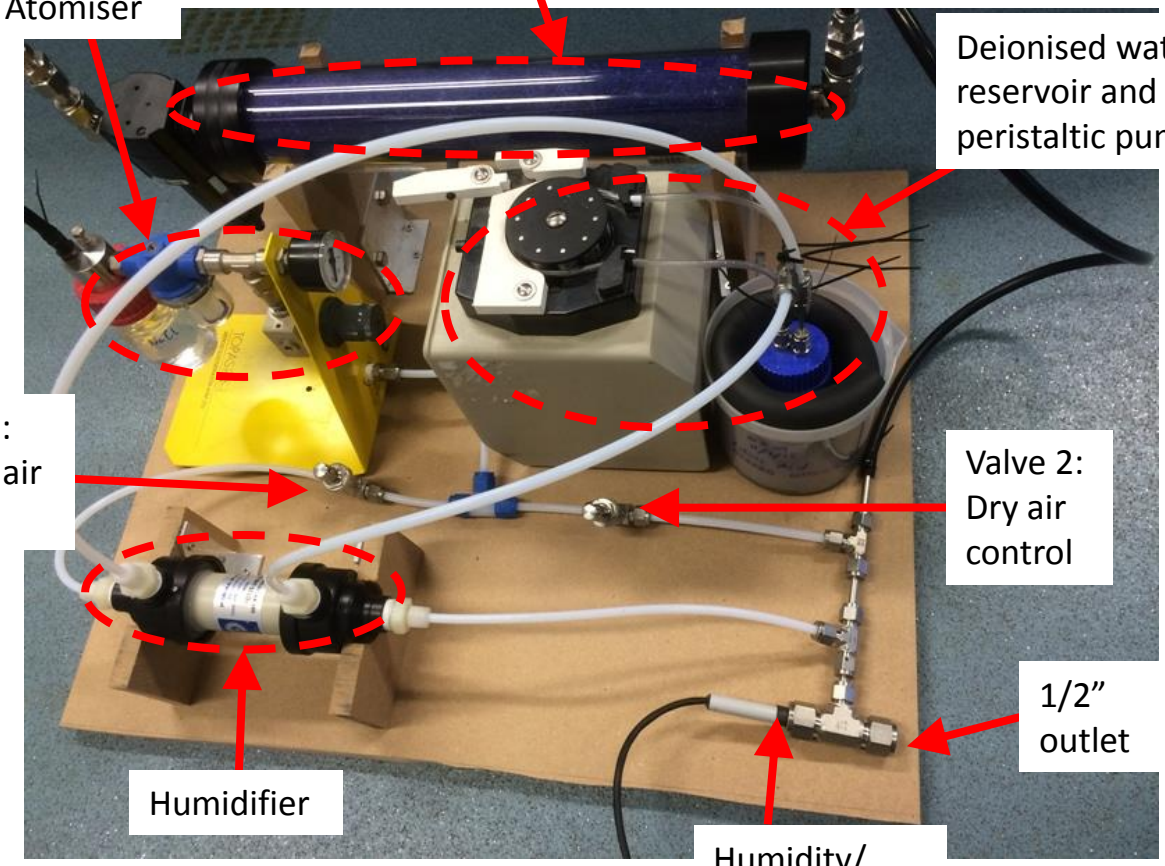
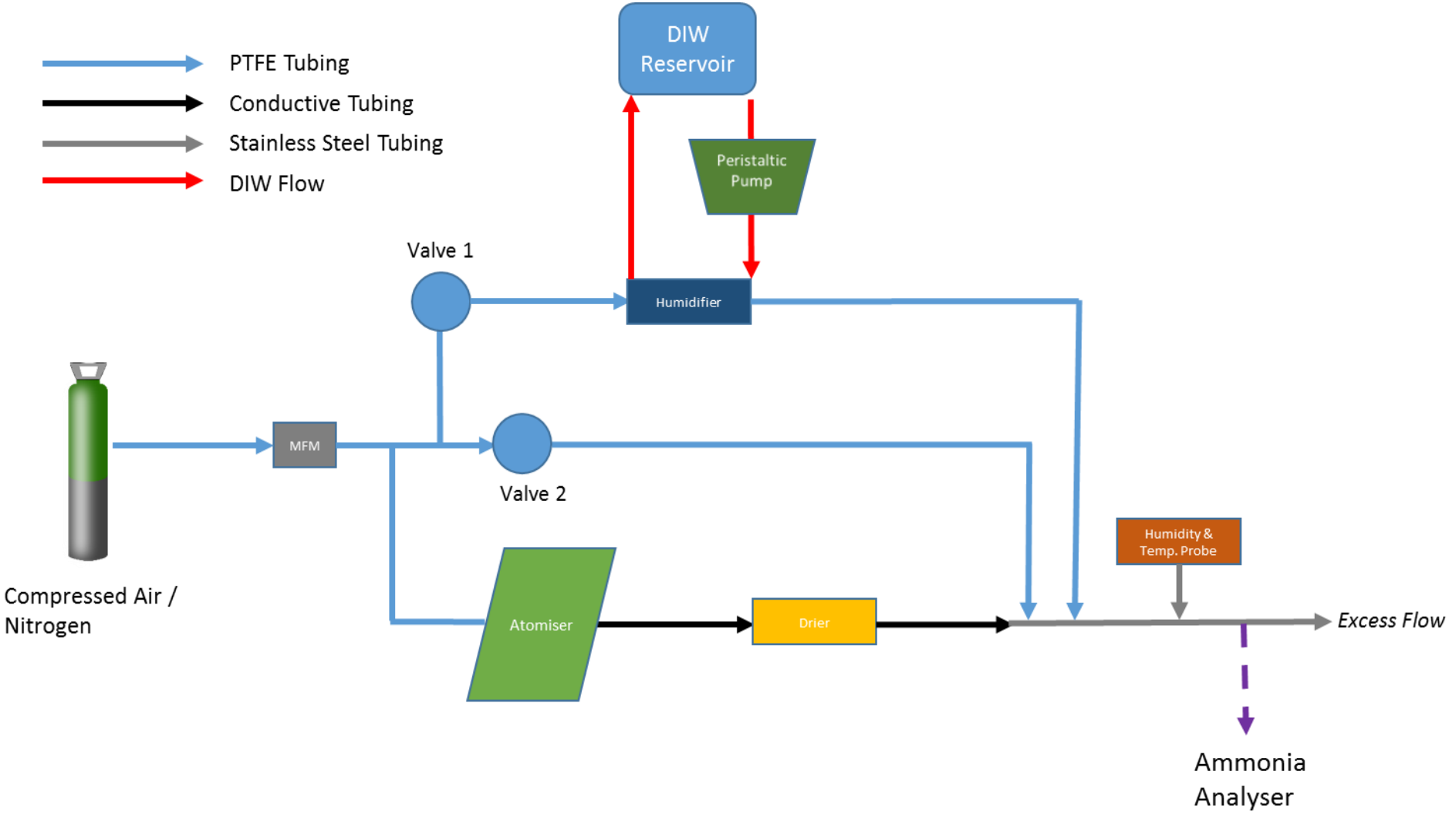
PReHAGS

Portable Relative Humidity and Aerosol Generator System



Schematic


PTFE Tubing
Conductive Tubing
Stainless Steel Tubing
DIW Flow
DIW Reservoir
Peristaltic Pump
Valve 1
Humidifier
MFM
Valve 2
Compressed Air / Nitrogen
Atomiser
Drier
Humidity & Temp. Probe
Excess Flow
Ammonia Analyser

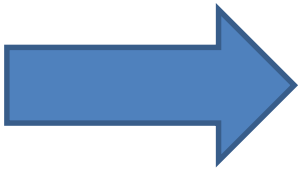
Specification & Testing

- Sample flow range: 0-15 slpm
- Relative humidity range: 10-90 %
- Sample delivery temperature: 20 ± 1 °C
- Aerosol mass delivery: 0-100 µg m^{-3}

NaCl solution concentration (ppm)	Median particle size (nm)	Mean particle size (nm)		Total aerosol mass (µg m^{-3}) at				
			Atomiser outlet pressure (bar)	2.0	2.5	3.0	3.5	4.0
100	35.2-37.4	40.7-44.7		2.0-2.5	4.0-4.5	6.0-6.6	7.3-7.7	8.7-10.9
500	39.8-42.0	49.5-51.6		9.6-12.0	17.2-18.7	28.2-29.6	38.2-39.8	44.6-45.6
1000	42.7-45.1	55.0-57.5		28.9-30.2	47.0-53.5	54.1-59.6	73.2-79.4	89.7-101.1

Plans for next 6 months

- Test pre-coated inlets systematically
- Demonstrate areas of key concern
- Make recommendations for manufacturers and end users to consider when setting up measurements in the field
- Test and make PReHAGS fully portable
- Demonstrate use in the laboratory and field
- Applicability for atmospheric chemistry expts



Improve understanding and of metrological issues with ambient NH_3 metrology