CF Braban, A C M Stephens, YS Tang, MM Twigg, S R Leeson MR Jones, I Simmons, D Harvey, N van Dijk, K Yeung, E Nemitz, , D Leaver, C. Martin Hernandez C Andrews, R Smith, L Banin, D Sleep, HT Carter, S Thacker, M Patel, B Tanna, PO Keenan, G Pereira, A Lawlor, C Conolly, K Vincent, A Sanocka, S Richie, D Knight, D Knight, S Halser, B Donovan,E Osbourne, A Sampford and the UKEAP field team, H. Walker
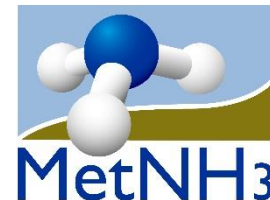
➢ human health, ecosystem health, pollution and atmospheric chemistry

  ➢ Ammonia, reactive nitrogen, particulate matter

  ➢ Ozone, emerging pollutants

➢ Environmental metrology

➢ Infrastructure and capacity building

➢ Chemical climate concept applications

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Table 1 — Summary of upper limits of NH_3 concentrations for protection of ecosystems under field conditions

Concentration ($\mu g/m^3$)	Specification	Types of locality
1	UNECE Critical Level (annual mean) for lower plants (lichens, bryophytes)	Sensitive ecosystems in which the lichens and bryophytes are important components, e.g. designated sites for nature conservation and protection of sensitive species, e.g. Natura 2000 sites
3	UNECE Critical Level (annual mean) for higher plants	Sensitive ecosystems in which the higher plants are important components, e.g. designated sites for nature conservation and protection of sensitive species, e.g. Natura 2000 sites
10	German First General Administrative Regulation Pertaining the Federal Immission Control Act Maximum near installations where ecological monitoring undertaken.	Near installations
23	UNECE critical level (monthly mean) – for peak emission periods such as in months where slurry spreading takes place.	In close proximity to emission sources

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NEN-EN 17346:2020

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM
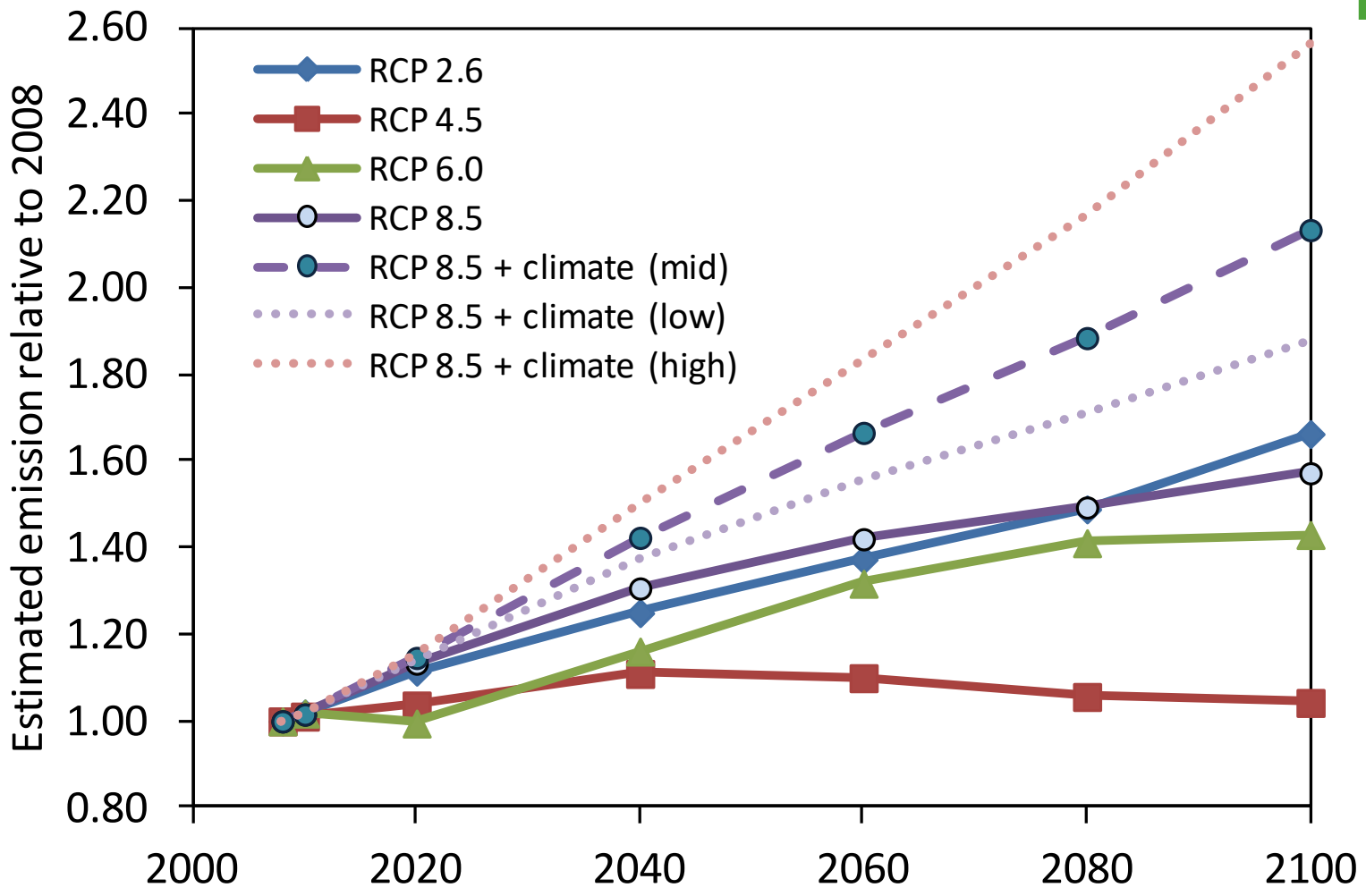
EN 17346

May 2020

English Version

Ambient air - Standard method for the determination of the concentration of ammonia using diffusive samplers
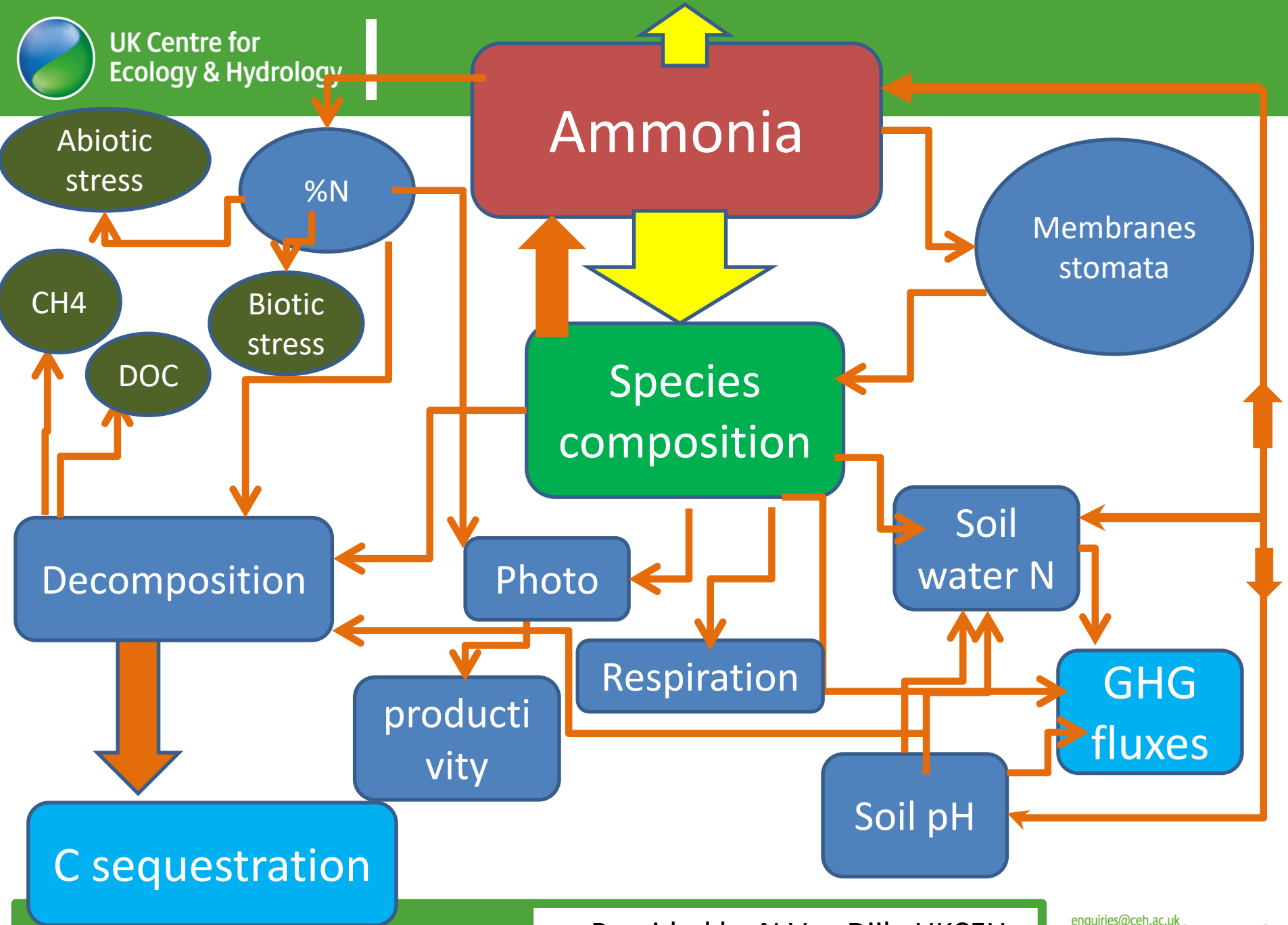
Air ambiant - Méthode normalisée pour la détermination de la concentration en ammoniac au moyen d'échantillonneurs par diffusion
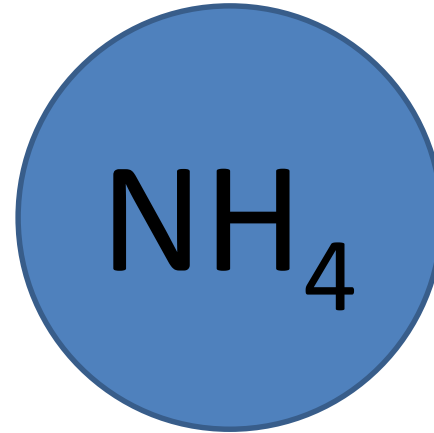
Außenluft - Messverfahren zur Bestimmung der Konzentration von Ammoniak mit Passivsammlern

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Sutton et al. Phil Trans. Roy. Soc., 2013

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Abiotic stress

%N

Ammonia

Membranes stomata

CH4

Biotic stress

DOC

Species composition

Decomposition

Photo

Soil water N

Respiration

GHG fluxes

productivity

Soil pH

C sequestration

Provided by N Van Dijk, UKCEH

NH_3 ⟷ NH_4

- ➤ Amines
- ➤ Co-emitted
   organics

- ➤ Reaction
- ➤ Precipitation
- ➤ consumption
- ➤ Re-emission

More obvious air pollution impacts on variations in bacteria than fungi and their co-occurrences with ammonia-oxidizing microorganisms in PM$_{2.5}$☆

Xiao-Yan Fan, Jing-Feng Gao*, Kai-Ling Pan, Ding-Chang Li, Hui-Hui Dai, Xing Li

ξ Laboratory for Advanced Municipal Wastewater Treatment and Reuse Technology, Beijing University of Technology, Beijing, 100124,

SCIENTIFIC REPORTS

OPEN Diversity, abundance and activity of ammonia-oxidizing microorganisms in fine particula matter

Jing-Feng Gao, Xiao-Yan Fan, Kai-Ling Pan, Hong-Yu Li & Li-Xin Sun

Atmospheric Chemistry and Physics

Modeling reactive ammonia uptake by secondary organic aerosol in CMAQ: application to the continental US

Shupeng Zhu[1], Jeremy R. Horne[1], Julia Montoya-Aguilera[2], Mallory L. Hinks[2], Sergey A. Nizkorodov[2], and Donald Dabdub[1]

[1]Computational Environmental Sciences Laboratory, Department of Mechanical and Aerospace Engineering, University of California, Irvine, Irvine, CA, 92697-3975, USA
[2]Department of Chemistry, University of California, Irvine, Irvine, CA, 92697-3975, USA

Correspondence: Donald Dabdub (ddabdub@uci.edu)

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Auchencorth Moss

$[NH_3]$ = 1 µg.m^{-3}

EMEP sites are "background" sites however background varies significantly

$[NH_3]$ = 5.5 µg.m^{-3}
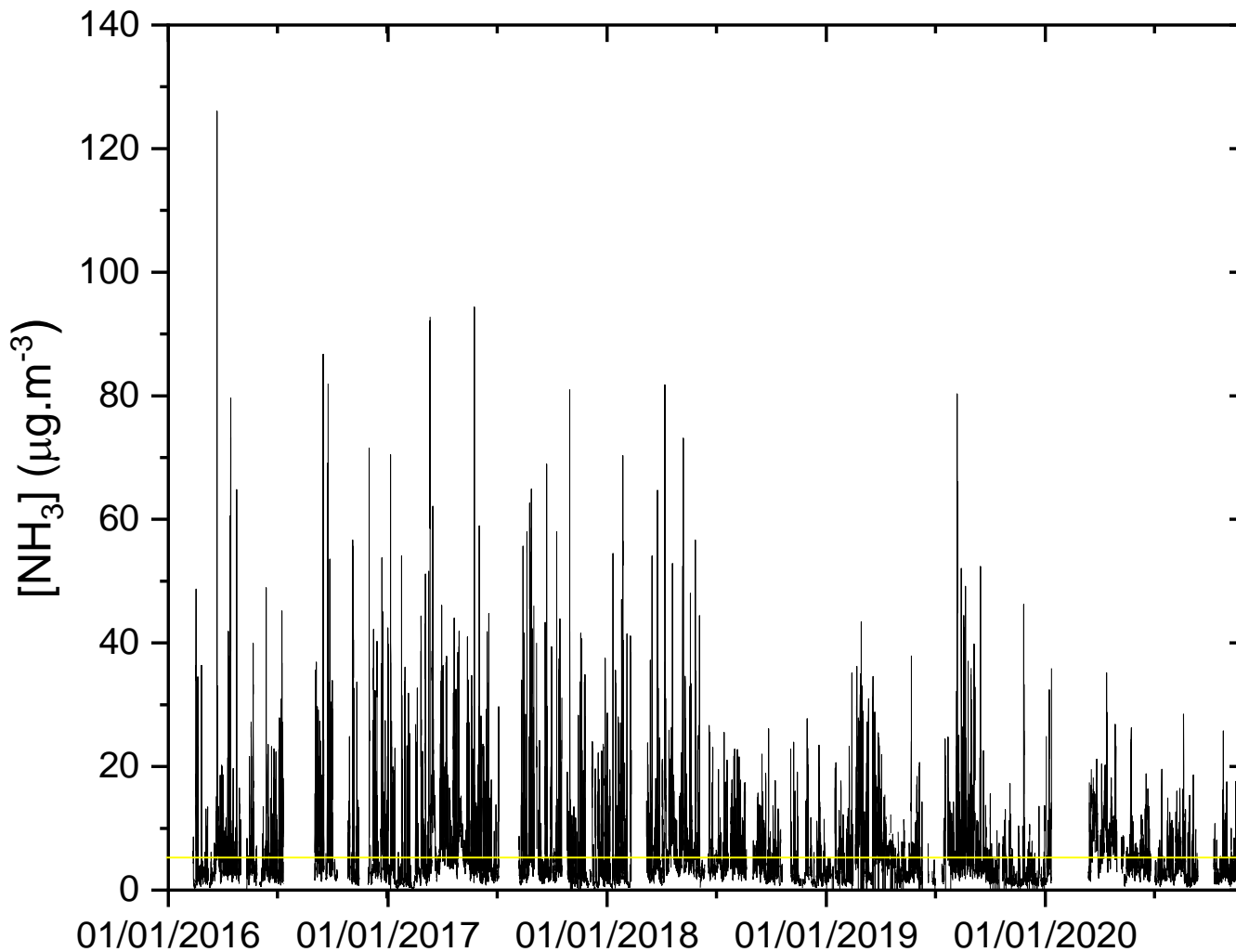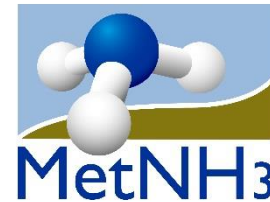
Cottonworth   SSSI   Chilbolton

Fullerton

SSSI

Chilbolton Observatory

Leckford

Google

UK Centre for
Ecology & Hydrology

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UK Centre for Ecology & Hydrology

MetNH₃

NEN-EN 17346:2020

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 17346

May 2020

ICS 13.040.20

English Version

Ambient air - Standard method for the determination of
the concentration of ammonia using diffusive samplers

Air ambiant - Méthode normalisée pour la
détermination de la concentration en ammoniac au
moyen d'échantillonneurs par diffusion

Außenluft - Messverfahren zur Bestimmung der
Konzentration von Ammoniak mit Passivsammlern

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enquiries@ceh.ac.uk
www.ceh.ac.uk

4 Description of samplers

4.1 Principle

The diffusive sampler is exposed in air for a measured time period. NH_3 migrates through the sampler along a diffusion path of defined dimensions and is collected by reaction onto an acid sorbent.

Determining the sampling rate is essential when deploying diffusive NH_3 samplers in the field, either by:

— calculation based on Fick's first law of diffusion (see EN 13528-3 [35] and Annex E),

— calibration by exposure to standard atmospheres, or

— co-located calibration studies against another well characterized NH_3 measurement method in the field.

NOTE   Denuders can be used as a cost effective surrogate reference method until there are improvements in the continuous optical methods.

Details of these approaches shall be documented.

Samplers can be provided with manufacturer measured sampling rates. Samplers in networks often have on-going measurements of sampling rates. Users can calculate a locally derived sampling rate. Sampling rates are also documented in literature [see [36], and Annex D].

The sampling rate in the field is a function of local meteorology. Samplers can be deployed with protective shelters to minimize meteorological influences. When doing so, the user shall apply a suitable protocol to ensure a consistent approach for all samplers. Ideally, the effect of the shelter on the sampler performance should be characterized.

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Laboratory calibration to calculate

Field calibration to calculate

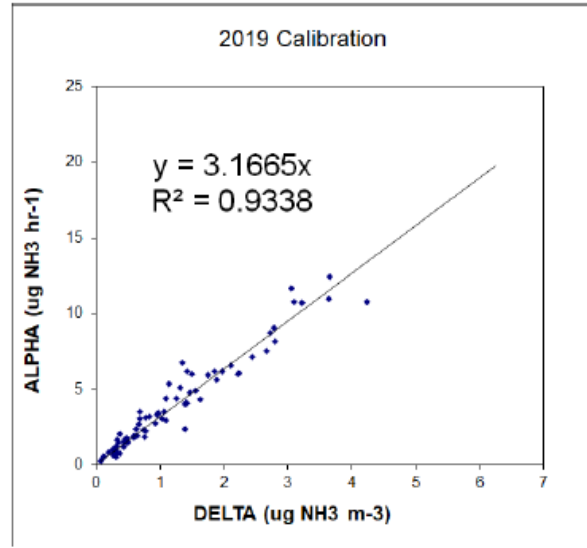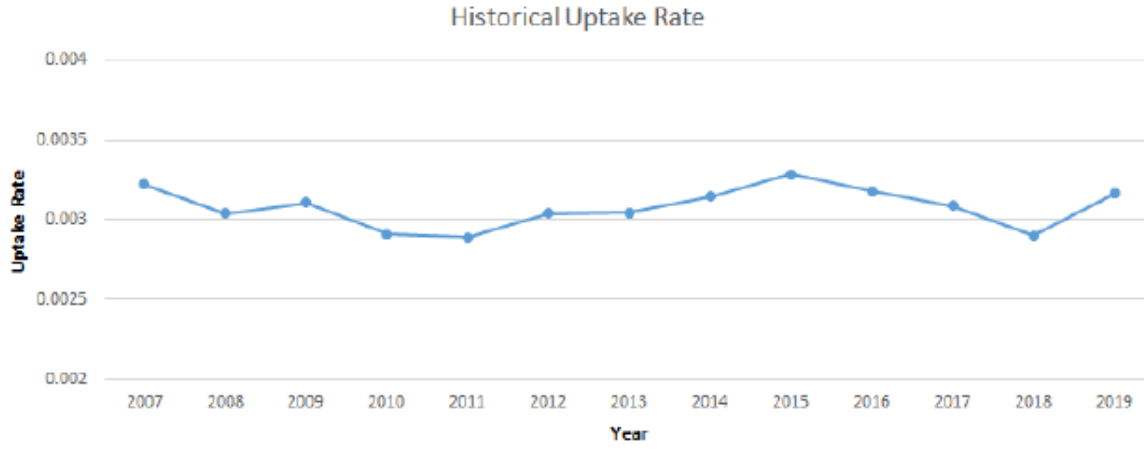2019 Calibration

$y = 3.1665x$
$R^2 = 0.9338$
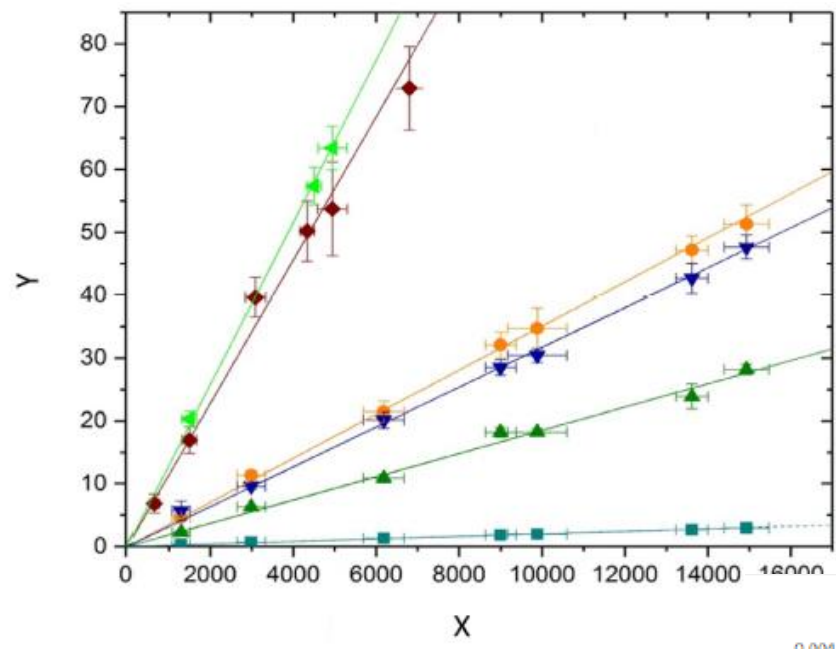
Figure 39 Historical UKEAP uptake rate for ALPHA samplers.

Historical Uptake Rate

Data quality objective CV <15%

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Syringe drives for liquid flow control

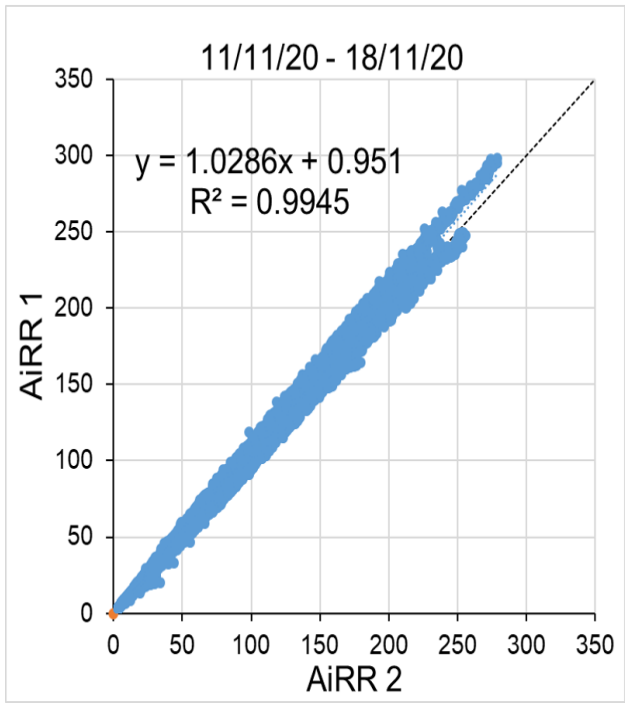Mass flow controller

Fan

Air pump
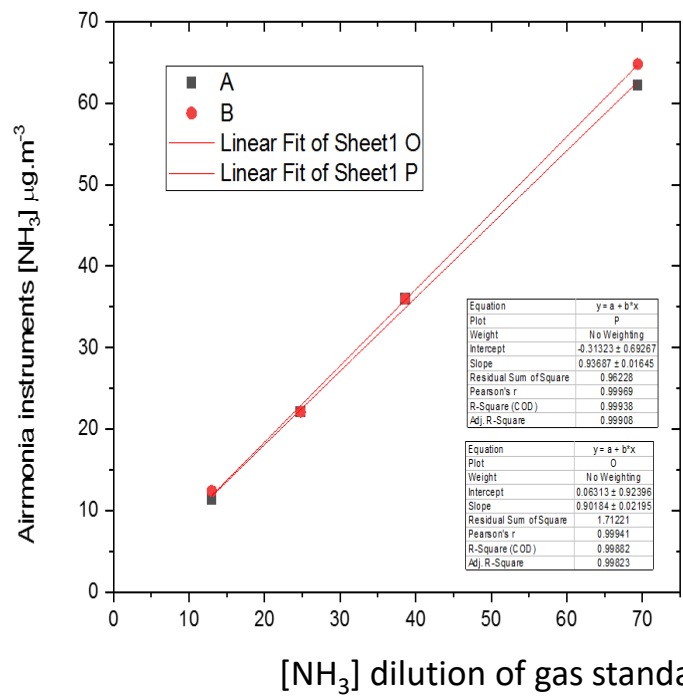
Air inlet

Sample Block

Conductivity detector block

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Calibration (Airrmonia)

Side by side calibration
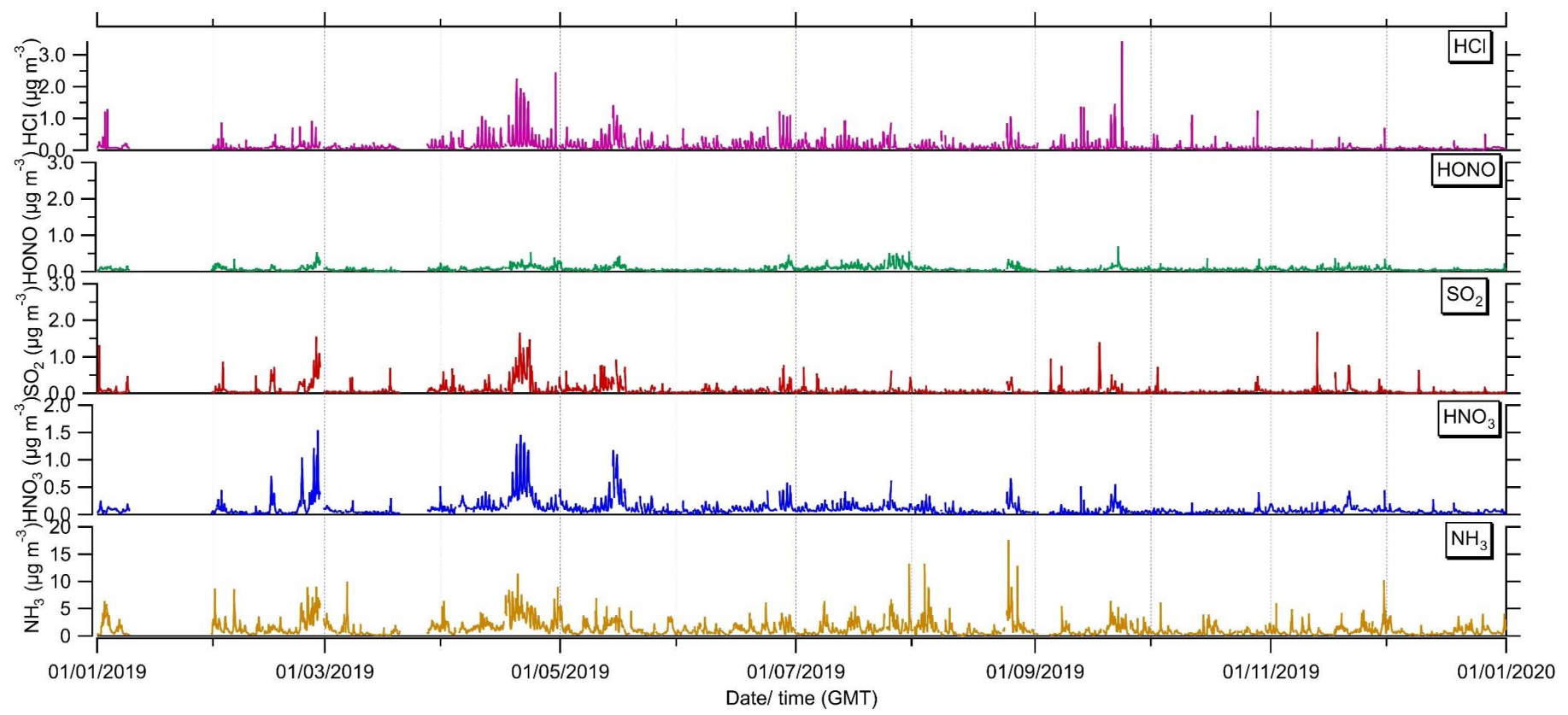

Side by side calibration: Gas standard

- No inlet
- Still needs T stabilisation

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change every:	1	2	1	2	3	4	6	1	2
component	week	week	month	month	month	month	month	year	Years
Clean cyclone and PM$_{10}$ head			x						
Replace air tubing					X	X			
Carry out a blank			x						
Take a subsample of internal standard for analysis					x				
2x absorbance liquid 20 Litre (with 1ml 30-35% H2O2)	x								
2x eluent (anion and cation, both 8 Litre)	x								
Internal standard LiBr 4 (or 5) Litre				x					
suppressor liquid 5 Litre 0.35M phosphoric acid (H3PO4)		x							
2x empty waste container 30 Litre and add approximately 30 grams of NaHCO$_3$	x								
2x sample filters behind SJAC		x							
2x sample filters behind WRD			x						
2x aspiration filters anion/cation			x						
2x inline eluent filter behind pump before pulsation dampener			x						
2x inline liquid filter behind suppressor pump			x						
2x suppressor pump tubing								x	
4x WRD seals located inside WRD heads								X	
4x WRD seals on outer tubing located against WRD heads								x	
2x IC pump seals								x	
2x IC pump check inlet valves								x	
2x IC pump check outlet valves								x	
2x membrane of gas sampling vacuum pump								x	
2x clean SJAC in 1% H$_2$O$_2$ for 10 minute in an ultrasonic bath **							x		
2x clean WRD **							x		
clean or change all Teflon tubing 1/16" boxes**								x	
2x change guard column: 1 anion, 1 cation (+filters if dirty)			x						
1x change anion IC column if necessary ****				x		x			
1x change cation IC column if necessary ****						x			
1 x change cation pre-concentration column if necessary							x		
1 x change anion pre-concentration column if necessary						x			

(*) preventive replacement frequency based on local experience. Prevent filter blockage. Indicators of blocked filters: significant phosphate peak around 6 min; (**) Frequency depends on location of instrument, clean when visibly dirty; (***) Frequency depends on location of instrument, exchange when blocked/ together with 1/16" tubing. Exchange at least every 2 years (wear); (***) Frequency depends on local conditions (quality of solutions; for anion column: concentration of peroxide); (*****) Pump tubing including connectors

- PM removed for separate analysis
- High flow inlet (<1 s)
- Regular maintenance
- Internal standard
- Monthly blanks
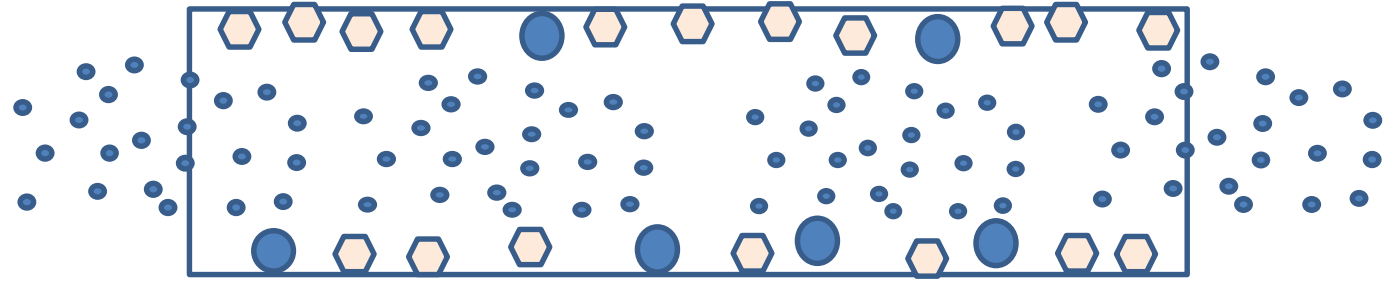- QA QC on quarterly and annual basis

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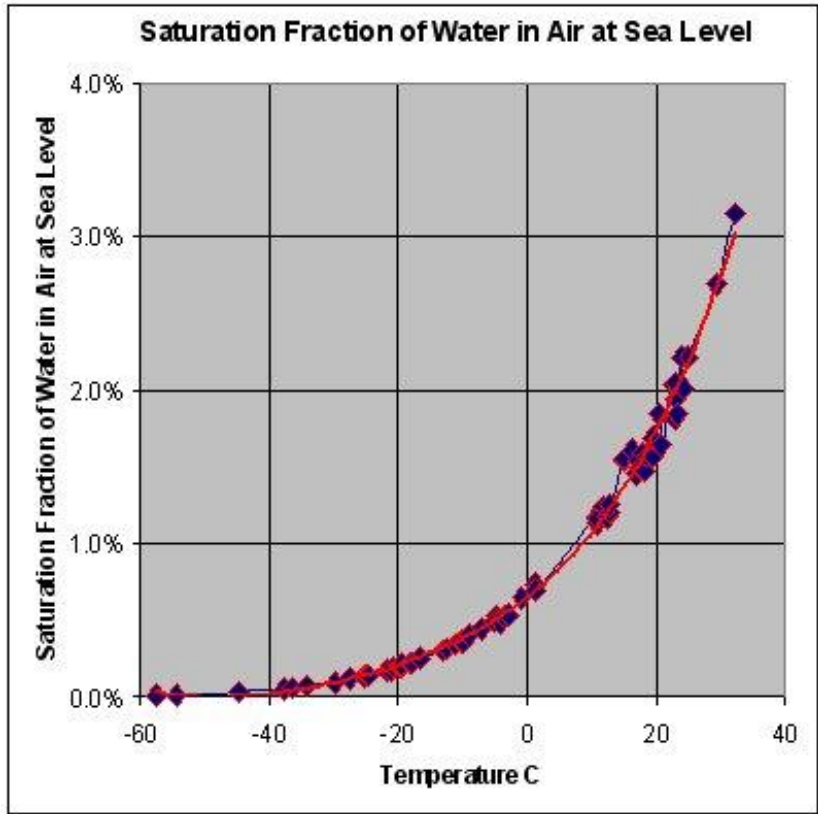# Auchencorth Moss NH$_3$ (and other analytes)

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$f(t)$
$f(T, RH)$
$f(air\ mass)$

Saturation Fraction of Water in Air at Sea Level

- 3 sites in the UK are using an LGR NH_3 analyser
- Much less maintenance
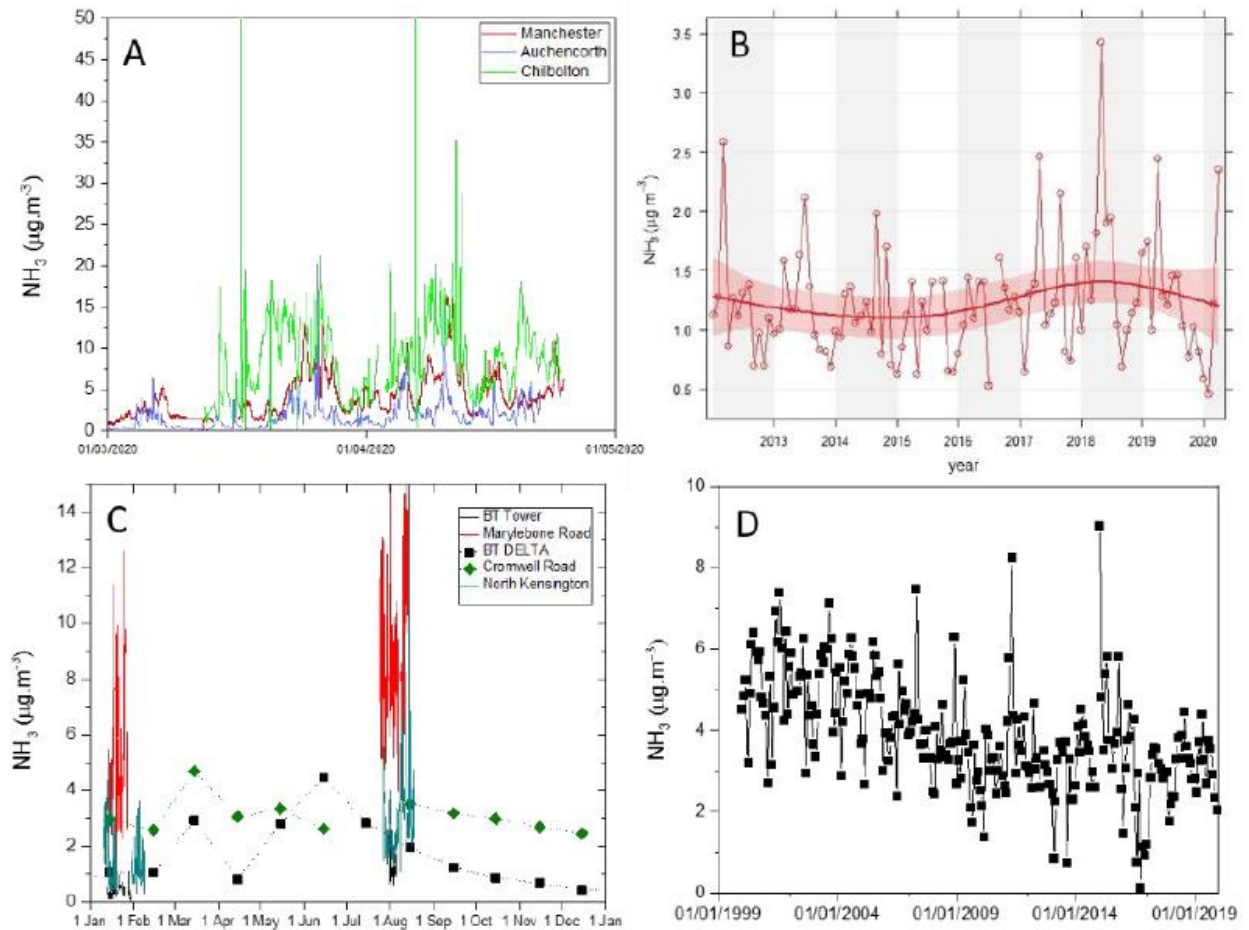- Attention to data quality is required

Figure 1 A: NH_3 concentrations over March and April 2020 for Chilbolton, Auchencorth Moss and Manchester OSCA Observatory (note all data provisional and unratified), B: Trend in ammonia concentration at Auchencorth Moss 2012-2020; C: 2012 NER Clearflo (BT Tower, Marylebone Road and N Kensington) and UKEAP NAMN London Cromwell Rd NH_3 data; D Defra/EA National Ammonia Monitoring Network site London Cromwell Road 1999-2019 monthly passive (ALPHA© sampler) data

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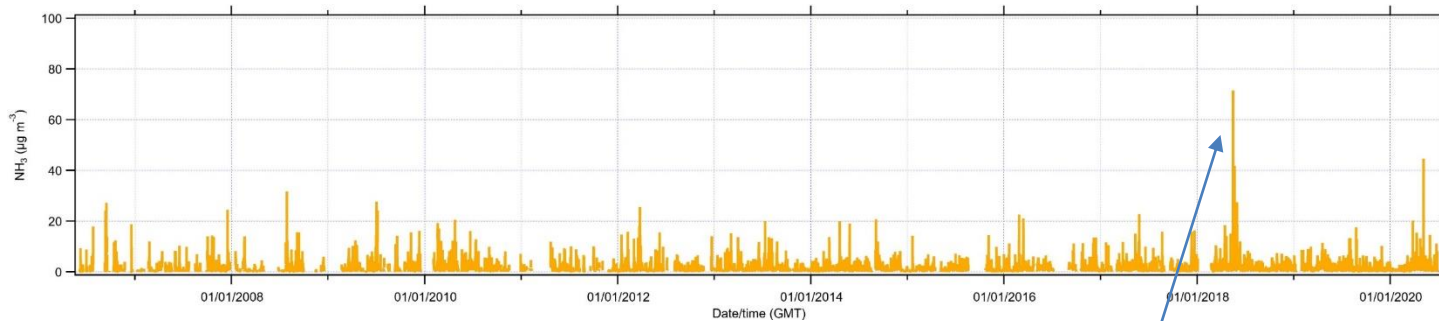
Unexpected local manure heap!
(discussions were had)

- Significant evidence fro UKCEH Met NH$_3$ field intercomparison that lots of automatic instruments on the market which have the potential to measure NH$_3$ accurately
- **However**, SOP for long term operation needed.
- Inlet, filter changing, internal mirror and surface cleaning protocols for easy and regular maintenance needed to make sure quantitative long term data available
- Similar protocols as the ACTRIS NO$_2$ SOP will be needed to ensure baseline and span drift is monitoring and corrected in a timely way.
- UKCEH undertaking laboratory tests with both a permeation based calibration and a gas dilution- humidied gas stream calibration systems in order to begin to establish "gold standard" and "field" standard protocols
- Field tests to follow

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Ecology & Hydrology
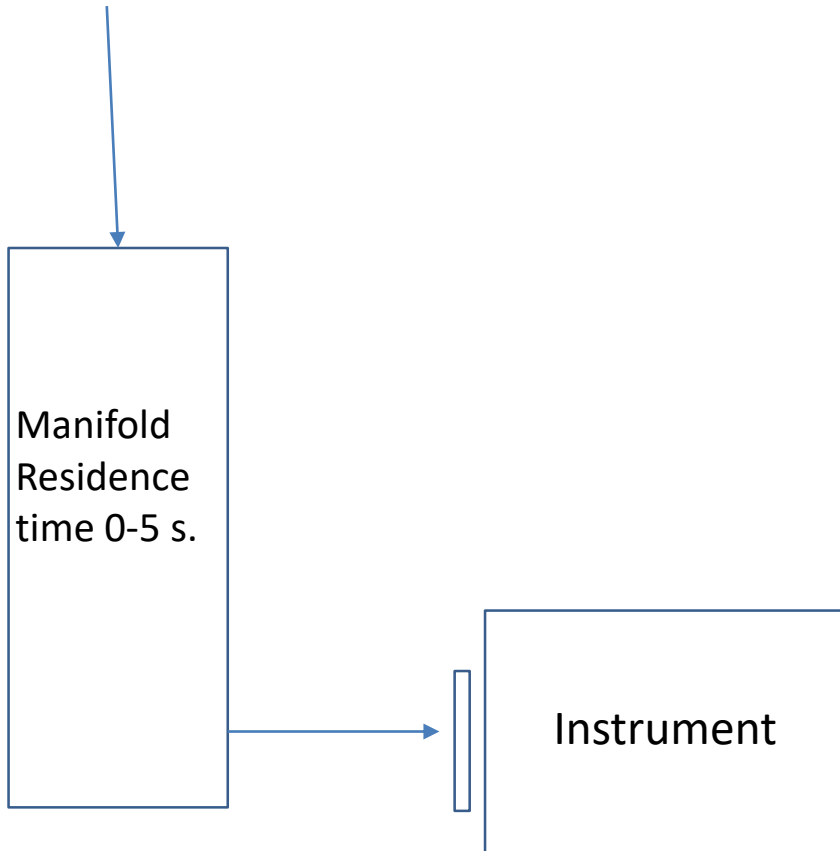
Calibration

- Need accurate cylinder or permeation source
- Need to add in H_2O
- Need to have a blank with H_2O vapour present

Manifold
Residence
time 0-5 s.

Instrument

Changeable filter?

Thankyou!

1. Site name	2. Country	3. Do you measure jNO2
Hohenpeißenberg	Germany	Yes with a filter radiometer
Mt. Cimone	Italy	No
PUY	France	No
Jungfraujoch	Switzerland	No
Beromuenster	Switzerland	No
Seoul	South Korea	No
All Norwegian sites..	Norway	No
Cape Verde Atmospheric Observatory (CVO)	Cape Verde	Yes with a spectroradiometer
Hohenpeissenberg Meteorological Observatory	Germany	Yes with a filter radiometer
Jungfraujoch	Switzerland	No
Rigi	Switzerland	No
Leba (PL0004R), Jarczew (PL0002R), Sniezka (PL0003R)	Poland	No
National Atmospheric Observatory Košetice	Czech Republic	No
Lampedusa	Italy	Yes with a spectroradiometer

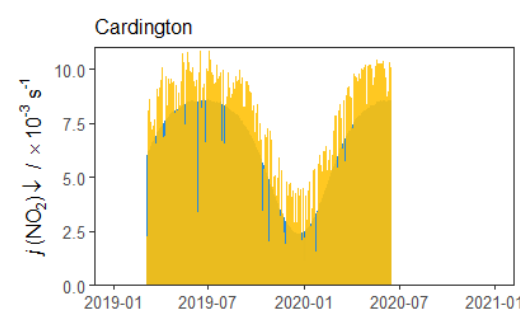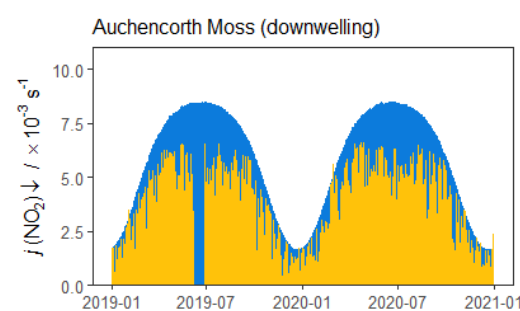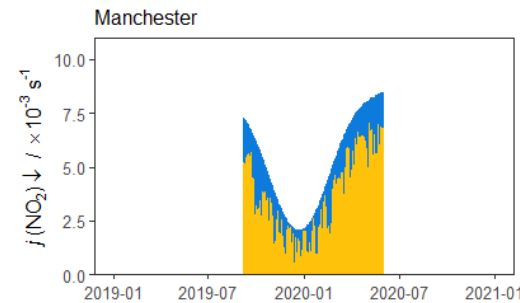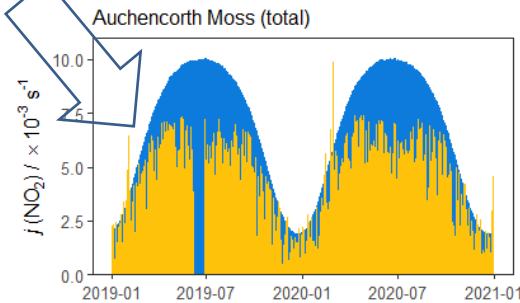## Atmospheric chemistry is largely driven by solar radiation!

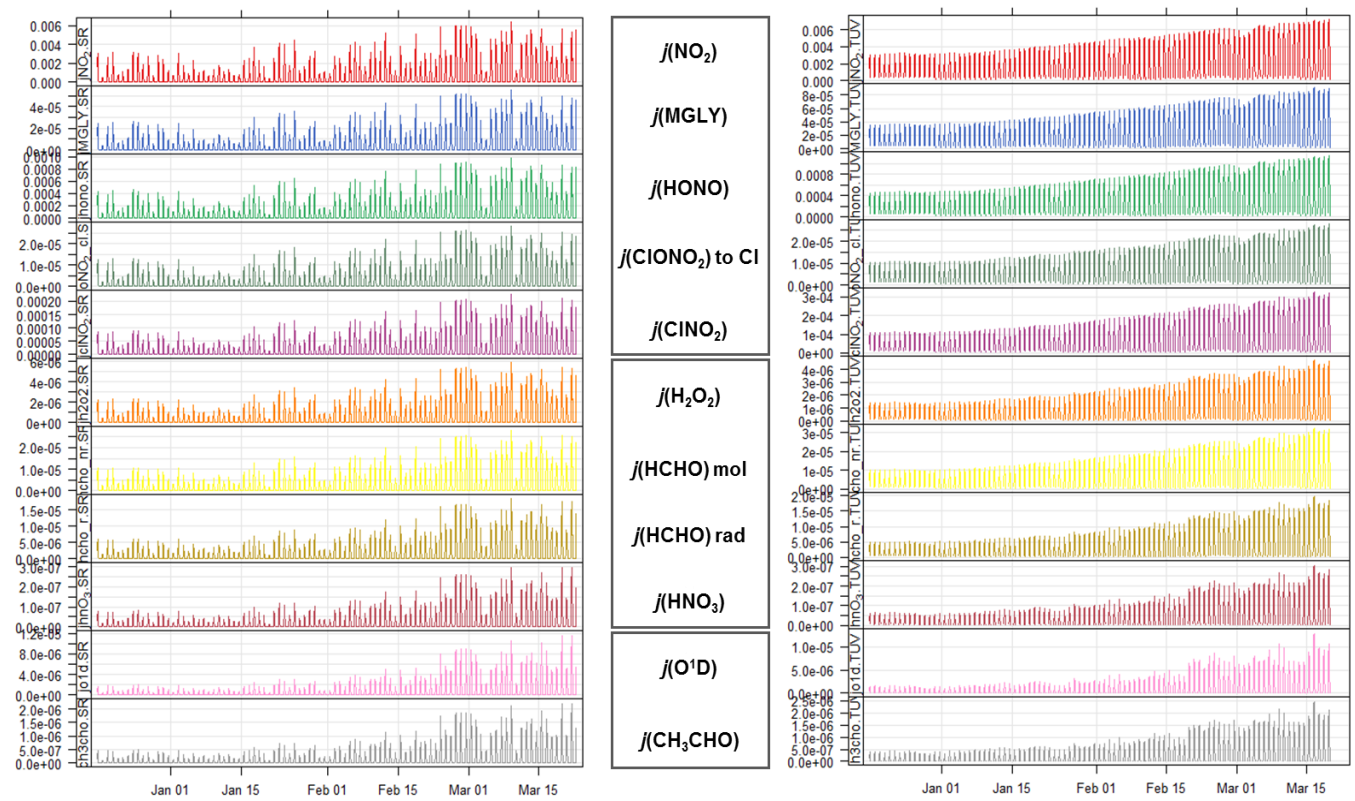*Hannah Walker, U. of Edinburgh/UKCEH, PhD research*

13th Feb

$$j(NO_2) = \int_{\lambda_1}^{\lambda_2} \sigma_{NO_2}(\lambda) \times \phi_{O(^3P)}(\lambda) \times F(\lambda) \ d\lambda$$

local conditions can mean that j is quite different at different locations for the same day (due to cloud cover, snow/frost on the ground, etc.)

Hannah Walker, U. of Edinburgh/UKCEH, PhD research

*Time series of hourly averaged photodissociation rate constants at Chilbolton Observatory, **(left)** measured by spectral radiometer with 2-π optic head and **(right)** modelled by TUV v5.3, for the full duration of measurements in this study.*

- Research on-going however there is an opportunity and need to understand atmospheric chemistry better
- Long term improvement of model performance for air pollution needed

Hannah Walker, U. of Edinburgh/UKCEH, PhD research