UK Centre for Ecology & Hydrology

Department for Environment Food & Rural Affairs

Welcome to the workshop on UK **A**ir **P**ollution **I**mpacts on **E**cosystems **N**etworks (UK **APIENs**)

An integrated approach to measuring UK Air Pollution Impacts on Ecosystems

08 December 2021 (10:00 – 12:00)

Workshop: UK APIENs

Time	Topic
10:00	Welcome to the workshop and policy perspective (David Vowles)
10:10	Introduction to UK APIENs and objectives (Sim Tang)
10:20	Forming Expert Work Groups and objectives (Laurence Jones)
10:30	APEG: Air Pollutants Expert Work Group (Sim Tang, Christine Braban)
10:35	VSEG: Vegetation and Soil Expert Work Group (Ed Rowe, Laurence Jones, Simon Smart, Felicity Hayes)
10:40	FWEG: Freshwater Expert Work Group (Don Monteith, Ellie Mackay, Phil Taylor)
10:45	Breakout rooms for each of the WGs (45 minutes) *Questions:* *1. Priority & optional metrics - what are these, are they measured?* *2. Methods, harmonisation?* *3. Representative coverage?* *4. Where are the (knowledge, coverage, ….) gaps?* *5. Measurement frequency feeding into reporting cycle?*
11:30	Report back from each EGs – 5 mins per group
11:45	APIENs – updating site information and data collation (Phil, Cristina and Sim) - 01/06/2022: Report APIENs sites and indicators (4-yearly cycle) - 01/06/2023: Report APIENs data (4-yearly cycle)
11:55	Wrap-up, next steps

UK APIENs – Defra policy perspective

- Assess the benefit of emission reduction policies for UK habitats
- Supports international action to reduce ecosystem impacts and restore habitats – i.e. via CLRTAP
- Data used to develop and evaluate new policies and targets – e.g. action to reduce ammonia emissions from agricultural sources.

Key targets

- Clean Air Strategy
  - Reduce deposition of damaging forms of reactive N by 17% on England's protected, priority, sensitive habitats by 2030.
- 25 Year Plan
  - Reduce UK NOx and ammonia emissions in line with NECD/Gothenburg Protocol targets
  - Restore 75% of our one million hectares of terrestrial and freshwater protected sites to favourable condition, securing their wildlife value for the long term

UK APIENs – Defra policy perspective

- Originally a requirement of NEC Directive 2016, 'Article 9' – to monitor the negative impacts air pollution has on ecosystems based on a representative network of monitoring sites and taking a cost-effective and risk-based approach – it has been transposed to UK **NEC Regs 2018, Part 5**.
- Continued integration of APIENs data will align to EU reporting on the same 4-yearly cycle.
- Now APIENS has been formed, we have an opportunity to:
  - clarify data from the different networks to improve their value, e.g. their structure, site location, interoperability, sampling frequency, methodologies, data format etc
  - better understand the synergies with other monitoring and reporting requirements, e.g. the habitats, birds and water framework directives

UK APIENs: 4 year reporting cycle

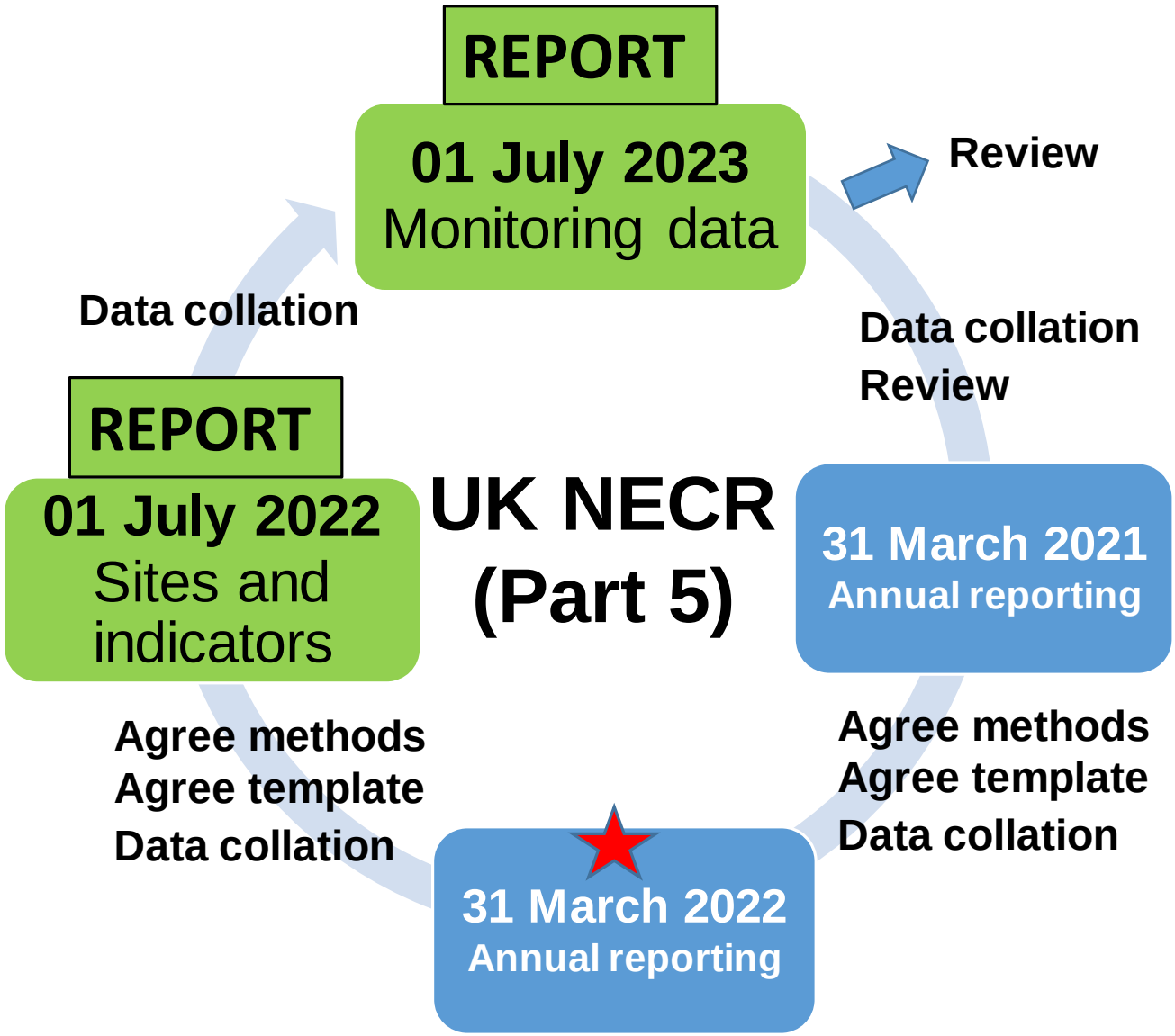
EU Eionet

https://www.eionet.europa.eu/reportnet

EU NECD
(2016/2284)
Monitoring: **Art. 9**
Reporting: **Art. 10**

01 July 2018
Monitoring sites and indicators

01 July 2019
Monitoring data



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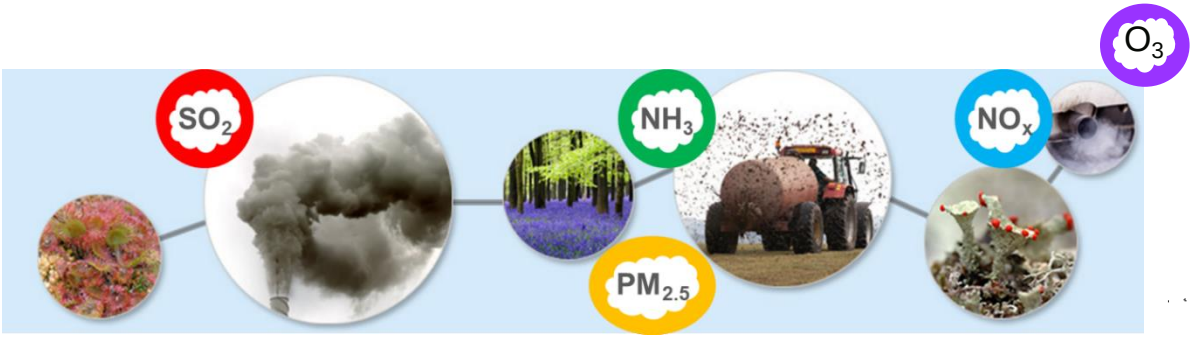
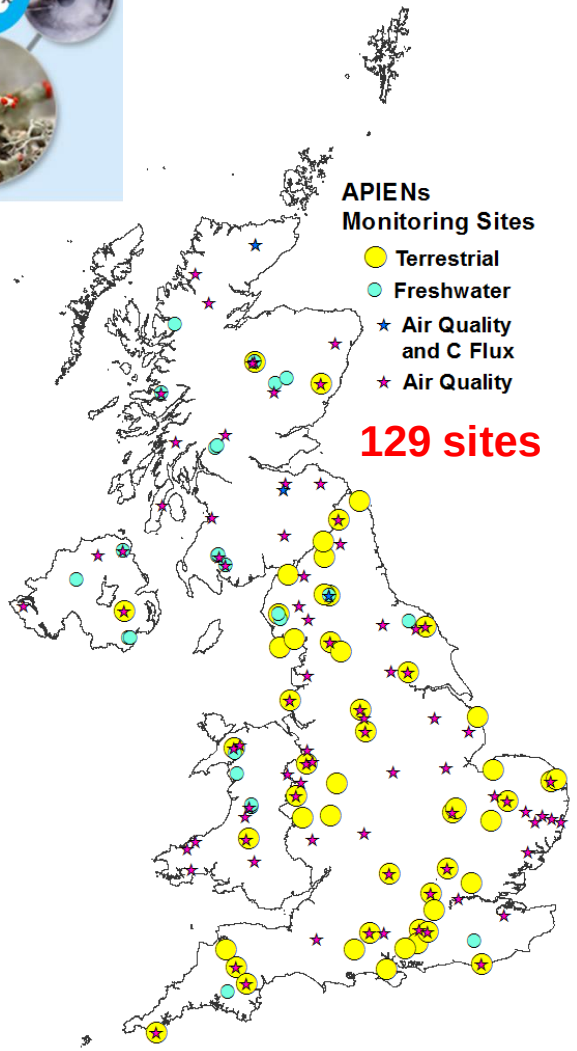
UK APIENs



- Integrated from existing **air quality** and **ecosystem** monitoring networks and schemes
- **Objectives:** Monitor & report negative impacts of air pollution (e.g. acidifying and eutrophying pollutants, ozone) on habitats/ecosystems representative of: **freshwater, natural and semi-natural habitats, forests in UK**



UK APIENs: structure

Representative
- Habitats
- Pollution gradient

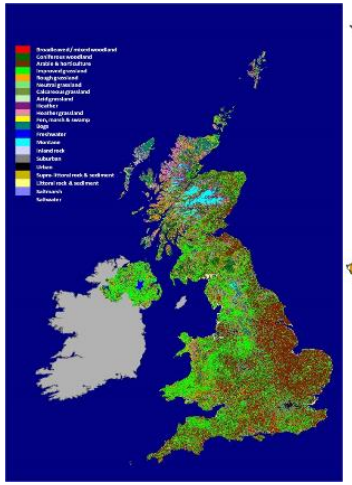
Informs Policy

Risk Based

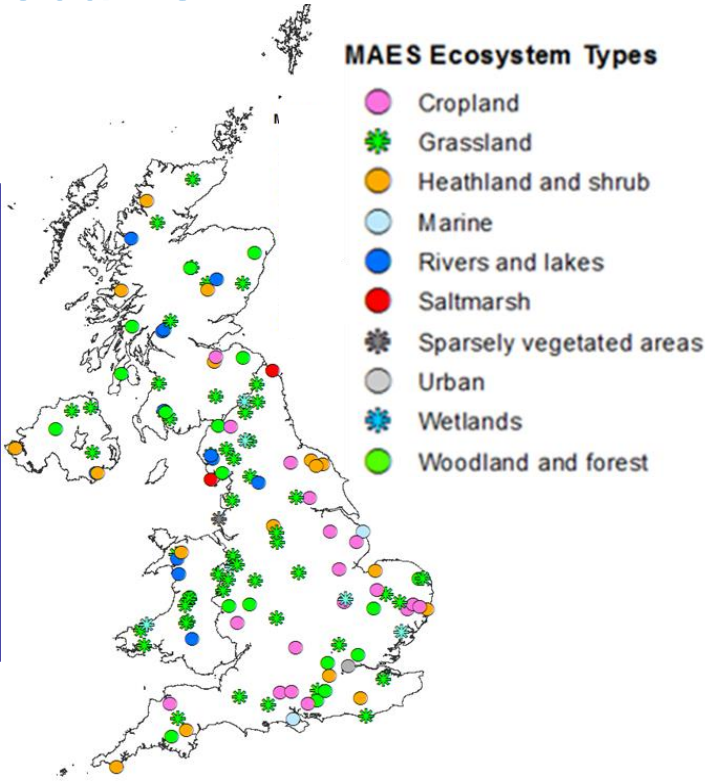
Cost Effective

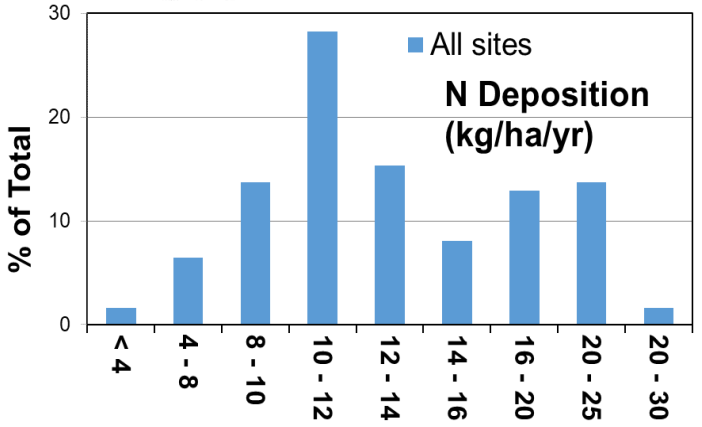
Modelling to understand "hotspots"

Data from Existing networks



UKCEH Land Cover Maps (LCM series)

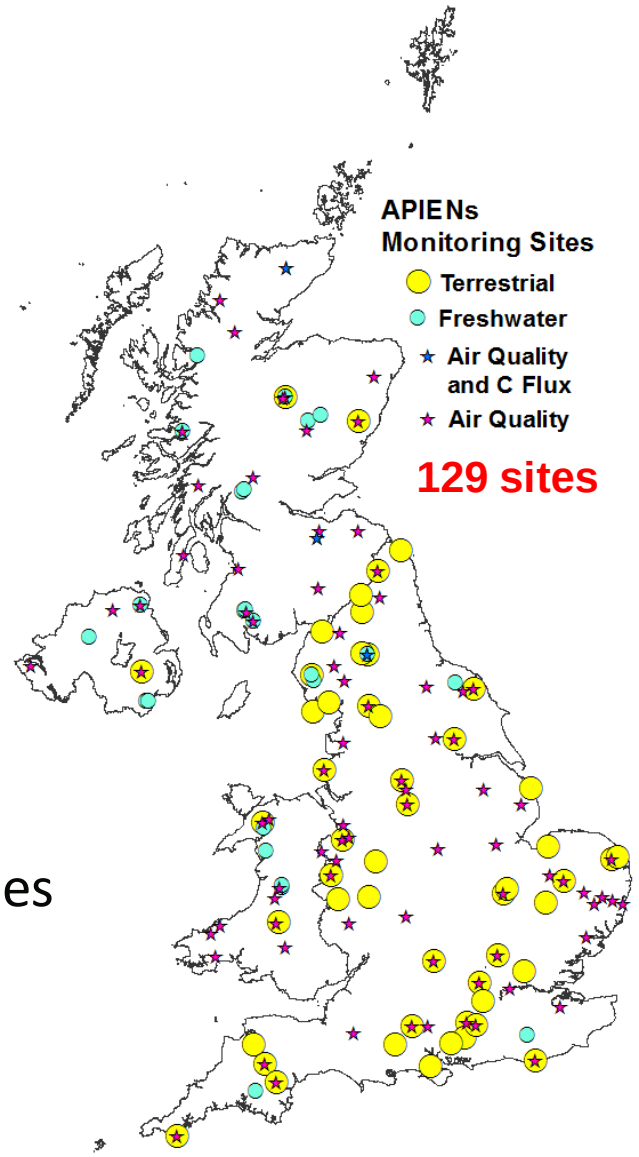




UK APIENs

Aim:

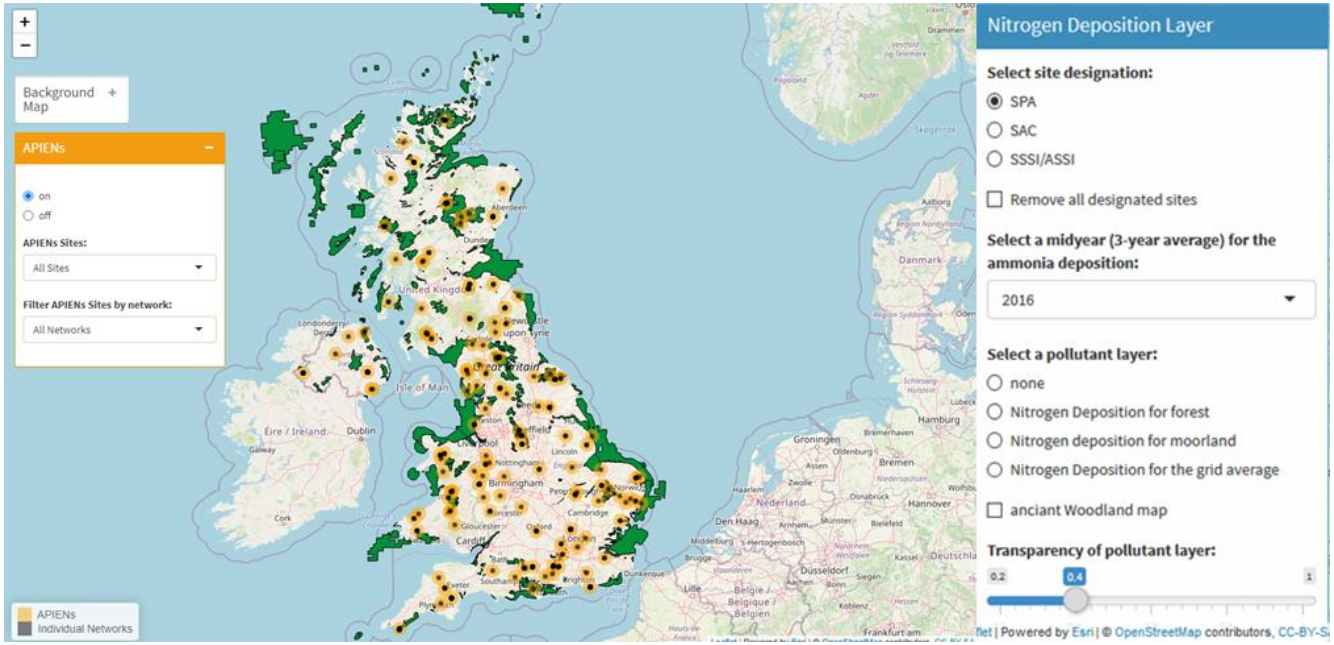
- Incremental improvement to network
- Improve reporting template
- Harmonised protocols



- **Drivers/Pressures**: air pollutants
- **Response/Effect**: vegetation, soil and freshwater indicators
- **Monitor** change and improvement
- Assess **benefit** of emission reduction policies

UK APIENs: integrating data

Long-Term UK National Networks			Broad-scale
Air quality	Terrestrial Ecosystems	Freshwater	National surveys
UKEAP, AURN https://uk-air.defra.gov.uk/	**ECN** www.ecn.ac.uk	**ECN** www.ecn.ac.uk	**CS** https://countrysidesurvey.org.uk/
GHG-Flux www.ceh.ac.uk/carbon-catchment-sites	**LTMN** http://publications.naturalengland.org.uk/	**UWMN** www.ecn.ac.uk	**NPMS** www.npms.org.uk/
COSMOS https://cosmos.ceh.ac.uk/	**ICP-Forests** www.icp-forests.org/		**ICP-F Biosoil** www.forestresearch.gov.uk/



http://www.apis.ac.uk/app

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Old NECD Art. 9 template (2019)

(1) Monitoring sites	• Coordinates • MAES ecosystem type, other metadata
(2) Vegetation and Soil	• Indicators for terrestrial vegetation and soil characteristics
(3a, 3b) Terrestrial ecosystems: Vegetation and Soil	• Indicators for acidification and eutrophication
(4) Terrestrial ecosystems: Liquid	• Indicators for acidification, eutrophication • Deposition and soil liquid phase
(5) O_3-air quality-carbon flux	• Ozone, NH_3, SO_2, NO_2, carbon net flux
(6) Freshwater ecosystems	• Indicators: freshwater chemistry

NECD Guidance: monitoring sites

Sites	Parameters	Remarks
Level I	Minimum monitoring	• Core parameters = low-cost and easier to collect. • Extra 'breadth' to spatial coverage, whilst being cost effective.
Level II	Core	• Core parameters - most important to collect • Fulfil Level II criteria (includes all Level I parameters).
Level II	Non-core	• Extra 'depth', i.e. scientifically more robust data, but are generally more time consuming or more expensive to collect data on.
Sites under other programmes	As available	• Supplementary information (any parameter type available: Level I, core or non-core). • Note: urban locations are normally not advisable to use for monitoring purposes.

Your contribution

As experts:

1. To provide specific expertise on networks, monitoring, policy perspectives, …
2. To help shape and review the proposals which underpin development of APIENS
3. To exchange information and ensure cooperation among experts, policy makers, network managers and data users

The process

- Introductory workshop (8 Dec 2021)
  - Outlining the task
  - Establishing the principles
- Core team produce drafts, circulate for comment
- 2nd workshop to review drafts and agree final changes (Feb 2022)
- If you want to be part of the teams writing the drafts, please get in touch

Principles

- Establishing the principles, for example …
  - … around metrics (key types to include & justification for inclusion)
  - … rule base for prioritisation ?
  - … key considerations / constraints, quick win decisions
  - … what type of sites/networks to include
  - … what is a ‘site’ ? (with a view to how represented in the database)

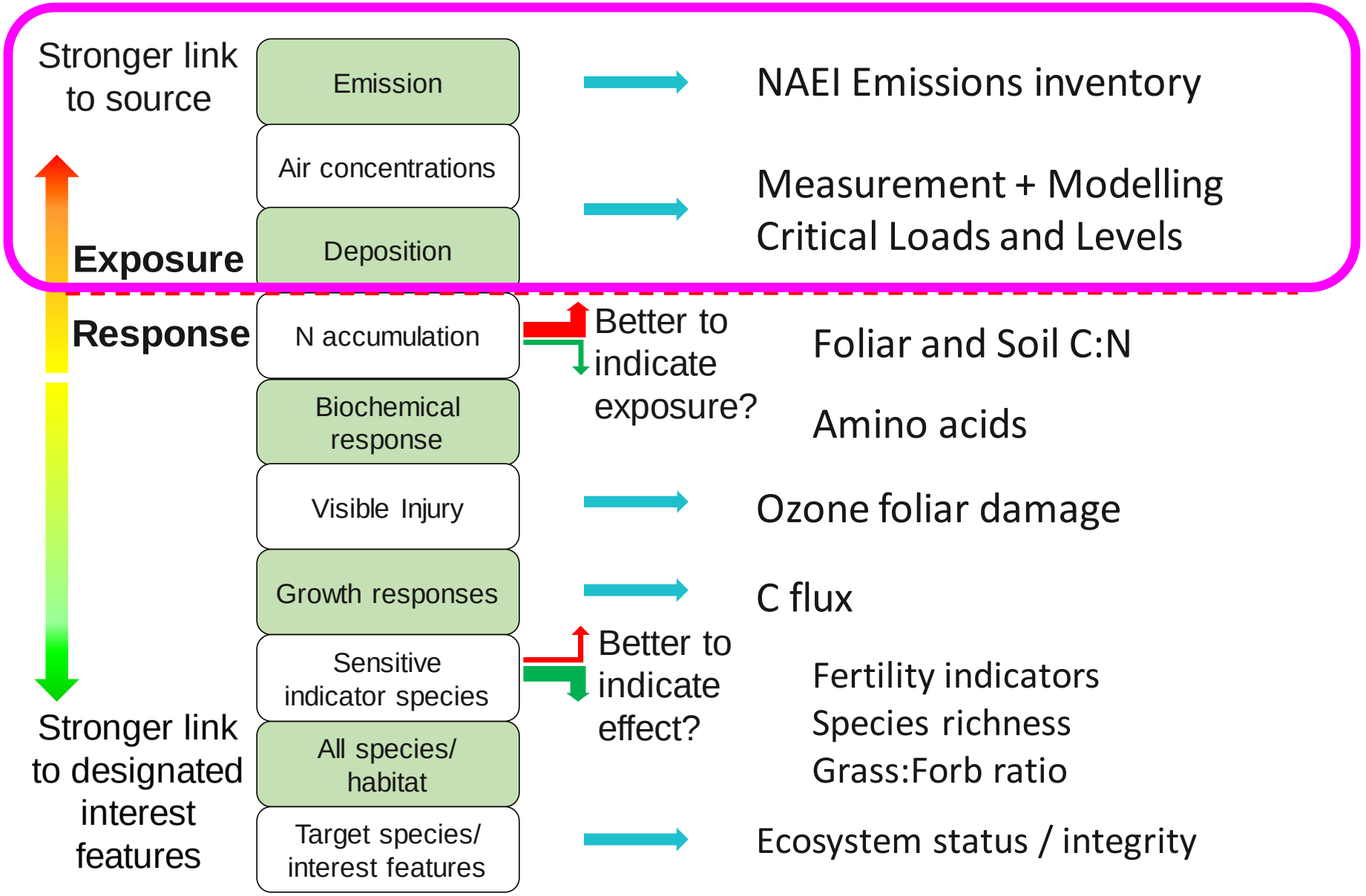
Reporting sections:

1. Metrics
2. Protocols
3. Network review

UK APIENs: parallel sessions

Group	Rooms
Impacts: VSEG Vegetation and Soils Expert Working Group	**Breakout room 1** Ed Rowe (Lead) Laurence Jones Felicity Hayes Simon Smart
Impacts: FWEG Freshwater Expert Working Group	**Breakout room 2** Don Monteith (Lead) Phil Taylor
Pressures: APEG Air Pollutants Expert Working Group	**Breakout room 3** Sim Tang (Lead) Christine Braban

DPSIR (Driver, Pressure, State/Condition, Impact, Response)

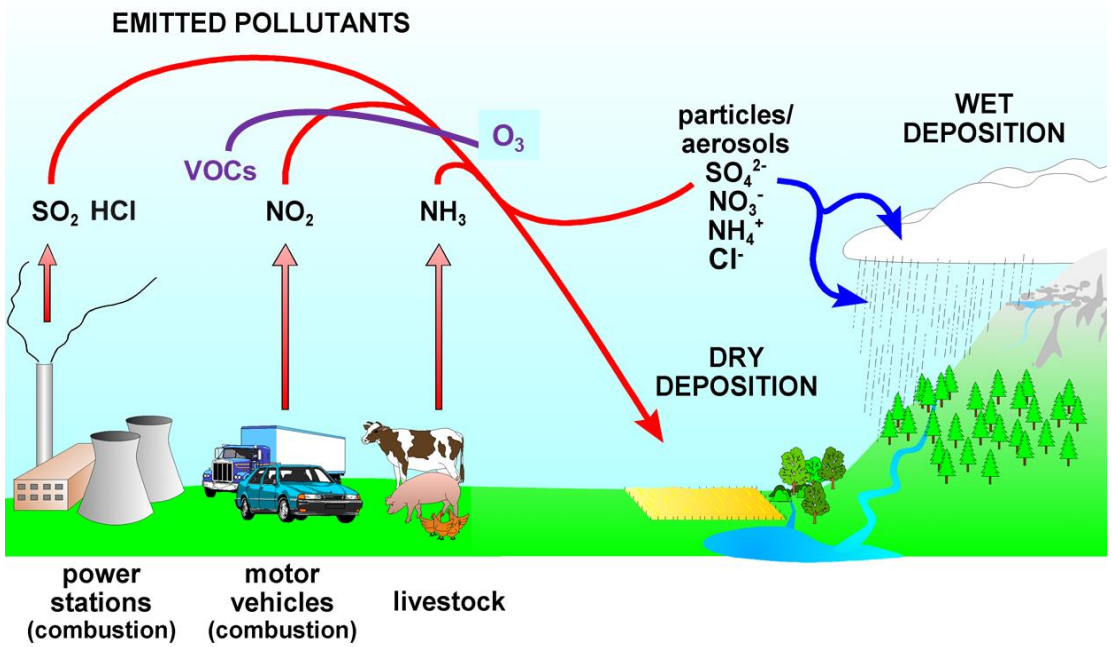


(Sutton et al. 2011)

REQUIREMENT

Monitor and report on negative impacts of air pollution

Acidification, eutrophication, ozone damage & biodiversity loss



- **Long-term** measurement and deposition data for **key pollutants** to assess **Pressures**.
- Captures spatial and temporal variation.
- **Evidence** to assess **changing emissions** and **concentrations** relationship.

UK APIENs: networks contributing data

Networks/surveys	Air pollutants	Soil	Vegetation	Freshwater
CORE sites: ALL sites included in APIENs				
ECN	Y (NO_2, wet dep)	Y	Y	Y
LTMN	-	Y	Y	-
ICP Forest Level II	-	Y	Y	
UKEAP: NAMN, AGANet, NO_2-Net, Precip-Net	Y (inorganic gas and aerosols, wet dep)	-	-	-
UWMN	-	-	-	Y
EMEP supersites	Y (as above + O_3)	Y (infrequent)	Y (infrequent)	-
SUB-SET of sites (co-located with CORE sites above) included in APIENs				
AURN	Y (NO_x, SO_2, O_3)	-	-	-
GHG Flux	Y (C flux)	-	-	-
COSMOS-UK	-	(Y – not used)		
Countryside Survey	-	Y	Y	-
NPMS	-	-	Y	-
ICP Forest Biosoil	-	Y	-	-

New NECD template (2021-provisional)

(3) Reporting Vegetation

- Exceedance flux-based CLe of ozone – POD_Y
- Atm. concentration of pollutants (eutrophication/acidification)
- Carbon flux

Exceedance flux-based critical levels of ozone – POD_Y

• Vegetation type	Eunis class
• Species	Latin name
• Exceedance of flux-based CLe of ozone based on site-specific calculation	mmol / m^2 projected leaf area
• Exceedance of flux-based CLe of ozone based on modelled gridded data	
• Calculated ozone flux based on site specific calculation	
• Calculated ozone flux based on modelled gridded data	
• Reference date	DD.MM.YYYY

Protocol: ICP Vegetation manual

Atmospheric concentration of pollutants (eutrophication/ acidification)

• NH3 concentration	µg/m3
• NO2 concentration	µg/m3
• SO2 concentration	µg/m3
• O3 concentration	µg/m3
• AOT40	ppm.h

Protocol: ICP Forests manual

Reference date	DD.MM.YYYY
Vegetation type	Eunis class
Net carbon uptake	g C/m^2*yr

Wet deposition data not in template?

Key questions for breakout discussions

Drivers / pressures for air pollution impacts
(Acidification, eutrophication, ozone damage)

Questions	Discussions / recommendations?
Priority & optional metrics - what are these, are they measured?	**KEY** and **OPTIONAL** parameters to be measured at each site. Use of measurement and modelled data.
Methods, harmonisation?	Replication, frequency, data ratification and reporting.
Measurement frequency and reporting cycle?	AQ data on annual cycles
Representative coverage?	Are key habitats represented? Are the major pollution gradients covered?
How can we improve?	On-site monitoring (co-location with ecosystem plots)? Other drivers and information, e.g. climate data?

VSEG: Vegetation and Soils Expert Group **Evidence needs: Terrestrial impacts/recovery**

Feedback on 1st round of Article 9 reporting (Best *et al*. 2020)

- Under-represented habitats (semi-natural grassland, heathland, bog)
- Infrequent reporting of biodiversity parameters e.g. plant species

Evidence needs differ

Freshwater chemistry
Atmospheric chemistry

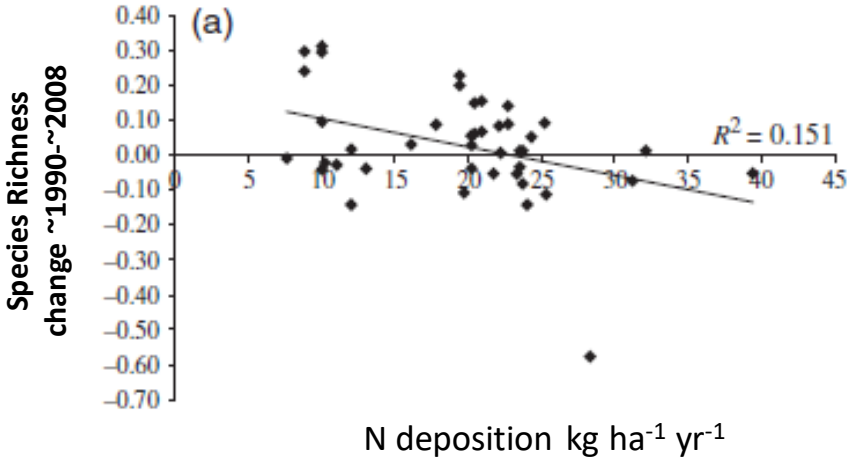
Short-term: measure hourly to monthly

Plant occurrence
Soil organic matter

Long-term: measure every ~ 4 years

Evidence needs (terrestrial impacts)

- Sufficient replication
- *n* = 10-20 per habitat
- Across the risk gradient



van den Berg et al. (2011) *Global Change Biology* 17, 1871-1883

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Best et al. 2020. https://ec.europa.eu/environment/air/pdf/reduction_reports/NECD-ecosystem-monitoring_2020-07-31-FINAL-REPORT.pdf

New NECD template (2021-provisional)

(1)
Reporting **Sites**

- Coordinates
- MAES classification, EUNIS (optional)

New: WFD site code /water body code

(3)
Reporting **Vegetation**

- Physical and Site Parameters
- Soil horizon profile and description
- Soil acidity/eutrophication: i) soil, ii) soil porewater
- Nitrate Leaching
- Vegetation Parameters
- Ozone foliar damage
- Exceedance flux-based CLe of ozone – PODY
- Atm concn pollutants (eutrophication/ acidification)
- Carbon flux

New: (non-woodland) Species richness, % cover

- The database needs to manage data from different plots within a site
- Needs data dictionaries for species names, management codes, etc.
- We are feeding back to the EC via Felicity Hayes (ICP-Vegetation), and the Irish NEMN project
- We will aim to meet the evidence need, even if this is not possible within the current template.

Terrestrial impacts: measurements & metrics

Most useful:

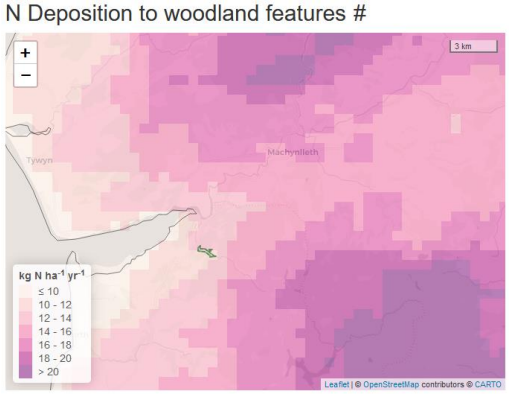
- Floristic data from permanent plots, every ca. 4 years
- Floristics → **biodiversity** & **trait-based** metrics
- Synlocated sampling of soil & moss for chemical analyses
- Ozone damage

Relating to pressures

10-20 sites per habitat needed for statistical power

Most **impacts** monitoring sites will need to use modelled data

All **pressure** monitoring sites could have impacts monitoring



Tiered network

Pressure monitoring core sites

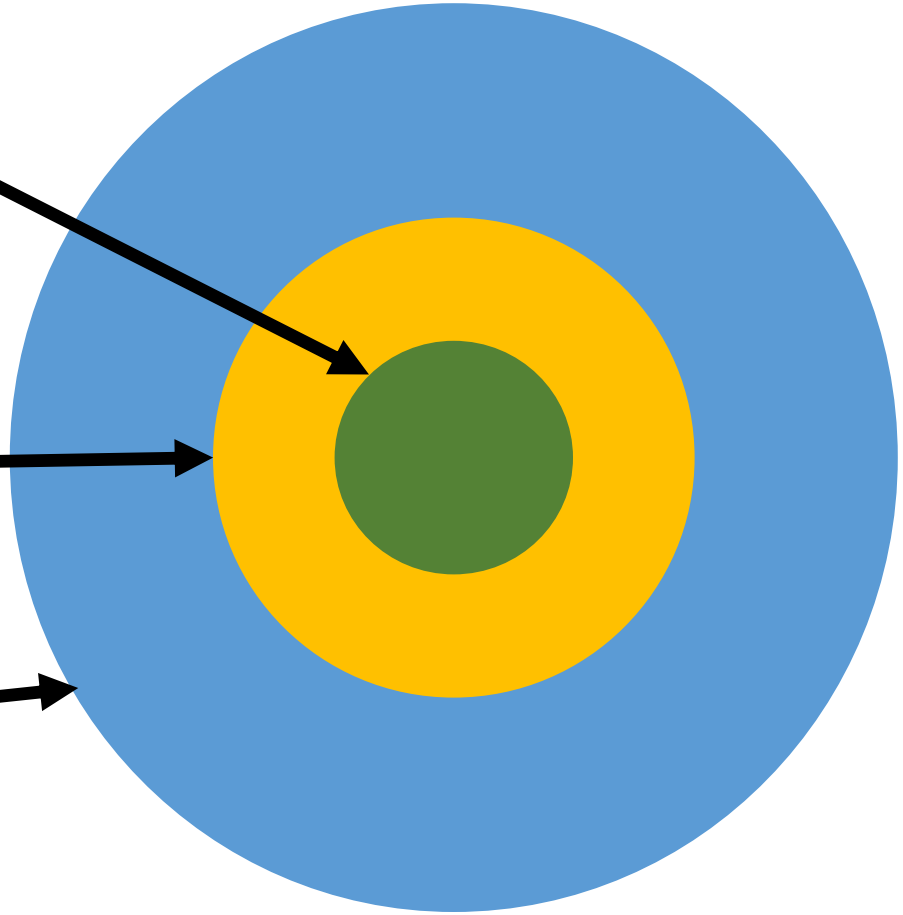
- wet & dry chemistry, meteorology
- ~ weekly visits

Ammonia monitoring only

- passive samplers
- ~ monthly visits

Impacts monitoring (all sites)

- Floristics and soil, **harmonised methods**
- ~4-yearly visits



Progress and ambition

Assess evidence needs

Define measurements, metrics & statistical design required

Select sites and measurements needed from current networks

Identify gaps

Harmonise measurement and analysis methods

Add new sites to fill gaps for key pollution-sensitive habitats

Add other important habitats

This project

In future