



UKCEH at the Climate Science Showcase – Dynamic Earth, Edinburgh 6th November 2021



Jan Dick, Carole Helfter, Beth Raine, Stella White, Georgia Beel, Christine Braban and Karen Yeung

November 2021



UK-SCAPE

UK Status, Change and Projections of the Environment

Title UKCEH at the Climate Science Showcase – Dynamic Earth, Edinburgh 6th November 2021

Client UK Research and Innovation (UKRI)

Client reference UKCEH and NERC National Capability LTS-S: UK-SCAPE; NE/R016429/1

Confidentiality, copyright and reproduction ©2021 UK Centre for Ecology & Hydrology

UKCEH reference UKCEH Project: 06948

UKCEH contact details Jan Dick
UKCEH Bush Estate, Penicuik, Midlothian, EH26 0QB

t: 0131 445 8578
e: jand@ceh.ac.uk

Author Jan Dick, Carole Helfter, Beth Raine, Stella White, Georgia Beel, Christine Braban and Karen Yeung

How to cite Dick, J. Helfter, C., Raine, B., White S., Beel, G., Braban, C., Yeung, K. (2021). UK CEH at the Climate Science Showcase, UK Centre for Ecology & Hydrology (UKCEH Project: 06948; NERC National Capability LTS-S: UK-SCAPE; NE/R016429/1). 19pp

Contents

1	Introduction.....	3
1.1	Why engage?	3
1.2	Who are we targeting?	3
1.3	How to engage	3
1.4	With what impact	4
1.5	With what evidence	4
2	At the event	5
2.1	Wish tree	5
2.2	Intergenerational trend in CO ₂ concentration	7
2.3	How do scientists measure CO ₂ ?	8
3	UKCEH team and learning points.....	9
3.1	UKCEH Staff	9
3.2	UKCEH staff learning points.....	10
4	Acknowledgements	10
	Appendix 1 – Wish Tree	11
	Appendix 2 – Intergenerational trend in CO ₂ Concentration	15
	Appendix 3 – How do scientists measure CO ₂ ?	17
	Appendix 4 – Which air pollutants affect global climate warming?	18
	19

Summary

In total over 250 people engaged with the UKCEH Team at the Dynamic Earth hosted Climate Science Showcase on Saturday 6th November 2021 between 10 am and 4 pm (~40 h⁻¹).

The stand fulfilled its aim to raise awareness of publicly funded research conducted at UKCEH Edinburgh, including the national capability project UK Status, Change and Projections of the Environment (UK-SCAPE), as evidenced by the large number of people attracted into the stand, the remarks made in conversations with the team members and written in the answers to the wishing tree.

Three activities were offered to target engagement from everyone:

- **Wish tree**
 - targeted all age ranges
 - Interaction duration typically 2-5 min
 - over 100 children and adults participated
- **Intergenerational trend in CO₂ concentration**
 - targeted all age ranges
 - Interaction duration typically 1-5 min.
 - Estimated 70 children and adults participated by placing dots on the graph;
 - in addition some said they would play the game with other siblings when they got home using the handout provided.
- **How Scientists measure CO₂**
 - targeted all age ranges
 - duration typically 5-10 min
 - 55 children and adults participated.

A wide range of conversations were noted by the UKCEH team members primarily focused

- on the role of several greenhouse gasses in the environment and their link to climate change,
- the steep rise in CO₂ concentration in the lifetime of the people present
- the variety of wishes that people wrote that could improve the environment
- the comments on the wish tree showed learning

1 Introduction

Dynamic Earth hosted a Climate Science Showcase Day on 6th Nov 2021 at Dynamic Earth, Edinburgh and sent an invitation to potential participants. The email invited researchers to bring their work to up to 1000 visitors, including families and community groups, right in the middle of when COP26 was taking place in Glasgow, and during a time when engaging people with climate science could not be more important.

The event plan, written prior to the event, followed the NERC Impact Development framework which focuses on five aspects of delivering impact, specifically: why, who, how, with what impact, with what evidence. The answers to these questions are detailed below.

1.1 Why engage?

What difference are we trying to make?

Increase public awareness of climate science, related UKCEH science and the UK Status, Change and Projections of the Environment (UK-SCAPE) programme of underpinning publically funded research.

1.2 Who are we targeting?

Who are we trying to engage with UKCEH and UK-SCAPE research?

The public of all ages who are attracted to the event – there was no selection process.

1.3 How to engage

What methods will we use to engage people with UK-SCAPE research and when?

Three interactive sessions displaying UKCEH science were showcased. A wish tree (Appendix 1) which encouraged conversations with the scientists.

The UK-SCAPE branded Intergenerational Game successfully trailed at the Climate Festival in Leith (Dick et al 2021 <http://nora.nerc.ac.uk/id/eprint/530922/>) was used again as it proved to be a successful way to engage people and open conversations about long-term monitoring (Appendix 2).

The third activity demonstrated how GHG fluxes might be measured in the field. A visually attention-grabbing peat core with detachable lid connected to a gas analyser and a display screen showing GHG fluxes varying depending wither the gasses were trapped in the core or vented to the room (Appendix 3).

How will we maximise involvement with the event?

- *Tweet about the forthcoming event (Appendix 4)*
- *Write a blog post after the event for UKCEH and UK-SCAPE web site was planned but the communication team decided that this was not necessary following so soon after the other public facing event (Dick et al 2021 <http://nora.nerc.ac.uk/id/eprint/530922/>).*
- *By taking a stand UKCEH and UK-SCAPE had a physical presence for visitors to look at, and interact with the physical objects as well as the scientists*
- *Attract visitors by having clear signage and a visually appealing exhibit.*
- *People engaging in longer ‘significant’ exchanges, were offered a ‘free gift’, which will be branded and thus offer further ‘advertising’.*

1.4 With what impact

What do we hope will change as a result?

Visitors leave with an increased level of knowledge of climate and CO₂ changes in the atmosphere

Increased number of people aware of UKCEH and UK-SCAPE science

1.5 With what evidence

How can I evidence that change?

- a. Number of people entering stand/booth (count button badges)*
- b. Number of people who take part in the interactive sessions*
- c. Number of people who add dot on the ‘What was the CO₂ concentration of the Earth when you were born?’ poster*
- d. Number of people who have significant engagement counted as those receiving ‘branded gift’ e.g. CEH pencil*
- e. We kept a UKCEH/ UK-SCAPE notebook and encouraged all UKCEH team members to write down interesting or funny comments or interactions in the project notebook as a means of capturing feedback.*
- f. A subset of ‘visits’ will be timed to gauge the duration of interactions.*

2 At the event

The event planner was mostly followed, however, it was not possible to calculate the total number of people taking part in each of the three activities separately as only one Button sticker (Fig 1.) was given to participants if they interacted with any of the activities rather than use three Button stickers if they took part in all three activities. If data on the number of interactions for each activity is required then distinct button badges could be used for each activity. Many groups took part in more than one activity.



Figure 1 Button stickers (UK-SCAPE logo) given to anyone engaging in one the activities or a conversation with UKCEH Team members

Some UKCEH team members took a strip of 10 button badges and recorded each strip of ten they took in the 'Team notebook'. Others preferred not to use the button badge and simply record on paper number of interactions. UKCEH team members gave out approx. 250 Button badges at the event. Surprisingly adults liked them just as much as the children did.

2.1 Wish tree

Participants were invite to share their climate-related thoughts, learning and wishes by writing on a leaf shaped post-it and sticking it to the branches of a model tree (Fig 2). The Wish Tree proved very successful to engage passer-by of all ages. Younger children were attracted by the design of the tree and the possibility of a game while adults were keen to see what others had written. The length of time people interacted with this game was very variable some adults declined to write anything and were only interested in reading the post-its already attached saying when pressed that their thoughts were already written by others. Many adults also did not write anything as they helped and encouraged their children to write. Many children required no help as they either wrote about what they had learnt at the event or knew exactly what they wanted to wish for because their schools were using the Glasgow COP26 conference in their learning activities.

The leaf shaped post-its were very well received but did not stick well to the tree so bluetac was used. Some visitors innovated and used the sticky button logo of UK-SCAPE to adhere their leave to the tree (Fig 2).



Figure 2 The Wish Tree used to engage participants at the event and some of the comments written

The length of time participants took to consider and write their thoughts depended on a range of factors but in general, young children took 3-5 min., while adults generally took 2-3 min. In total 103 comments were attached to the Wish Tree and 14 leaves were attached by younger children who did not write a comment but rather scribbled on the leaf or drew a tree, mountains or a river.

Approximately, a quarter of the comments related to pollution of the air, seas, water courses or environment and wishing for a better environment globally and for society was also a dominant theme (22%). The dominance of these themes reflects the

other stands at the event that included National Oceanography Centre and conservation organisations.

Great consideration of the planets flora and fauna was the third most dominant theme (17%) with planting more forests mentioned on over 10% of the posit-its Reducing the use of fossil fuels either by stopping their use or finding alternatives was also a prevailing theme (16%). Many interesting conversations on the role of science were sparked by this game, enabling staff to fulfil the aim of raising awareness of UKCEH and UK-SCAPE.

Table 1 Comments attached to Wish tree grouped by themes

Category	Number	example text
Pollution	25	
Water	9	Do not litter the sea
General	6	I wish for a cleaner world
Plastic	6	Make less plastic in the ocean
Air	2	No pollution
Litter	2	Stop littering
Global	23	
Environment	15	Look after the planet
Society	8	Priority shift away from personal wealth
Fossil fuels	21	
Transport	8	Car free roads and joined up cycle networks across Scotland
Alternatives	7	I wish that people can find a great renewable source of energy
Governance	4	That COP 26 changes things
Politicians	4	For leaders to lead by example: to be the role models we pay them to be
Extraction	2	Less oil mining
Flora and fauna	18	
Forests/plants	12	I wish I could save the rain forest
Animals	5	Think about animals more
Biodiversity	1	More biodiversity - without threatening peoples livelihoods
Miscellaneous	16	
Food	5	Go Vegan
Recycle	3	Recycle more
Personal fear	2	I'm scared
COVID	1	I want the virus to go away at China
Oceans	1	No more sea level to be high
Weather	1	I would like it to be snowing - anytime
Unreadable	3	

2.2 Intergenerational trend in CO₂ concentration

This game proved very useful to engage passing public as the opening question “Do you know the concentration in the environment the day you were born?” was personal and interesting to them (see Appendix 2 for details of the activity). A handout sheet was created following interaction with the public at the Edinburgh Climate Festival (Dick et al 2021 <http://nora.nerc.ac.uk/id/eprint/530922/>). The handout sheet fulfilled a game deficit identified at the Leith Links event i.e. a take home activity sheet to re-enforce the learning.

It was not possible to determine the exact number of people playing the game as sometimes a family would each place a sticker on the graph to represent their birth year but then were also invited by the UKCEH team member to add a grandparent who was not present. While other families only placed one dot per generation.

Placing a dot on the birth year and reading off the graph provided two useful learning points:

- (i) to emphasise the slow increase between for example a grandmother and mother and the steeper increase between the mother and child present and
- (ii) provide another opportunity for a child to improve their graph reading skills (it was invariably the child to wanted to add additional sticky dots – they often did so for the parent year of birth).

In total 72 dots were placed on the graph and it is estimated that around 80-90 individual people took part in this activity (often for family or larger groups, they only added a couple of dots). The duration of the interaction with the UKCEH team member varied between 1 and 5 min, although subsequent conversation could last a further 5-10 min. It is interesting to note that when staff were talking with one set of parents their three children added dots on the map well below the line because they could not reach the line. Rather than remove the dots the year they would need to have been born for them to be correct was discussed. This reinforced the raise in ambient CO₂ concentration as children of their height in 1900 would have been breathing air with approximately 300 ppm compared with today's ambient concentration of over 400 ppm.

Fewer participants were interested in the main sources of the greenhouse gasses (poster placed below the activity graph) and the poster explaining the role of gasses heating the planet (Appendix 4) those who did engage, tended to spend 5-10 min reading the posters with care and asking relevant questions.

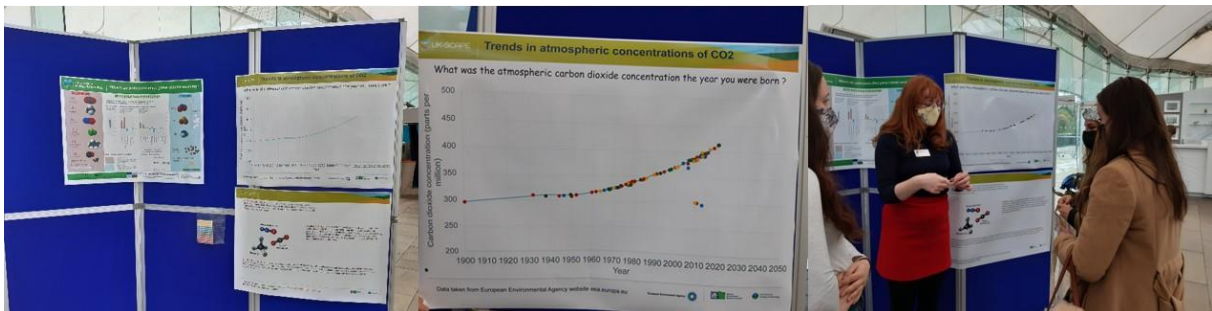


Figure 3 Adults and children playing the Intergenerational trend in CO₂ concentration activity

2.3 How do scientists measure CO₂?

The interactive demonstration of actual real time greenhouse gas measurements proved a significant attraction to both children and adults (Fig 4). Approximately 55 people were keen to learn how the Greenhouse Gas Analyser (GGA) measured CH₄ and CO₂. The system was a closed dynamic chamber system. The GGA was connected to a monitor so participants could view the measured concentrations plotted in real time.

A demonstration was set up using a peat core taken from Auchencorth Moss, Penicuik. Auchencorth Moss is a field site where the UK SCAPE research monitors exchange of CO₂ and CH₄ as part of the global network Integrated Carbon Observing Systems (<https://www.icos-cp.eu/observations/national-networks/united-kingdom>)..

During the demonstration, the core was exposed to direct light, via a lamp, to stimulate photosynthesis of the top layer of moss. When the light was switched off the CO₂ concentration increased again as respiration dominated.

Approximately half of the participants enquired about the exact method used to measure the gases. Staff explained the GGA works using cavity ring-down infrared spectroscopy. A pulse of light is emitted by a laser and is absorbed by the gas, different gases absorb at different wavelengths. The time taken for the light to be absorbed (the 'ring down' time) is an indicator of concentration. The shorter the ring down time the higher the concentration. The GGA on display had two lasers, one for CH₄ & H₂O and one for CO₂.

Staff explained the work conducted at UKCEH and that this GGA has so far been used to measure GHG fluxes from water bodies around the UK as part of the GHH Aqua project.



Figure 4 Closed dynamic chamber system to demonstrate how scientists measure CH₄ and CO₂ concentrations

3 UKCEH team and learning points

3.1 UKCEH Staff

In total six staff were involved in the event on the day and pre-post activities (Fig 5). Not all staff members stayed the whole day with a changeover occurring around mid-day.



Figure 5 UKCEH team at the event

3.2 UKCEH staff learning points

The team learnt a great deal by interacting with the public including:

- The need to enable children time to collect their thoughts to ask question or write on the post-its (silence when interacting was not bad).
- The accuracy of learning in schools around the COP26 issues.
- The value of different stands at the exhibition telling the 'same story' which re-enforced learning as demonstrated by the wishes expressed on the Wishing Tree.

4 Acknowledgements

The authors are grateful to all the people who took the time to visit the stand and take part in the activities and shared their knowledge with the team. We are also indebted to all the adults, parents and children who allowed their photographs to be taken and gave permission for them to be included in this public report. Every photograph was shown to the individuals and all remarked that they were happy for their faces to be shown. All photographs would have been immediately deleted if permission was not granted do avoid mistakes.

Appendix 1 – Wish Tree

- A model tree was placed at the front of the stand and members of the public were encouraged to write their climate-related thoughts, learning and wishes wish for the planet.
- The wishes or thoughts were written in leaf shaped post-its.
- The post-it's were collected at the end of the day and comments reviewed.



Table 2 Wish tree comments by category

Category	Sub-heading	Text written on leaf post-it
Biodiversity	animals	Save animals
Biodiversity	animals	save birds
Biodiversity	animals	think about animals more
Biodiversity	animals	tigers to stop getting hunted
Biodiversity	animals	protect the animals
Biodiversity	biodiversity	more biodiversity - without threatening peoples livelihoods
Biodiversity	more forests/plants	I wish ... that more forests are planted
Biodiversity	more forests/plants	Return/restore previous ancient woodlands sites
Biodiversity	more forests/plants	Stop cutting down trees
Biodiversity	more forests/plants	I wish I could save the rain forest
Biodiversity	more forests/plants	Plant for plants!!
Biodiversity	more forests/plants	I wish for more trees
Biodiversity	more forests/plants	more trees please
Biodiversity	more forests/plants	grow more plants
Biodiversity	more forests/plants	stop cutting down our trees
Biodiversity	more forests/plants	plant more trees
Biodiversity	more forests/plants	less deforestation
Biodiversity	more forests/plants	no more cutting trees
Fossil fuels	alternatives	More solutions for home heating
Fossil fuels	alternatives	A carbon neutral future
Fossil fuels	alternatives	Less fossil fuel
Fossil fuels	alternatives	Stop using fossil fuels
Fossil fuels	alternatives	No CO2
Fossil fuels	alternatives	carbon dioxide (with down arrow drawn)
Fossil fuels	alternatives	I wish that people can find a great renewable source of energy
Fossil fuels	extraction	less oil mining
Fossil fuels	extraction	Cut out coal production
Fossil fuels	transport	use less fuel cars
Fossil fuels	transport	stop buying diesel cars
Fossil fuels	transport	Car free roads and joined up cycle networks across Scotland
Fossil fuels	transport	I want people not using cars and busses
Fossil fuels	transport	More bike/scooter parking places to use them more often thanks
Fossil fuels	transport	more electric cars and less CO2
Fossil fuels	transport	Better cleaner public transport
Fossil fuels	transport	Stop using cars and bus's walk more
Global	environment	I hope the earth won't always be too hot
Global	environment	We only have one Earth, one plant and one live
Global	environment	I hope the earth stays health

Category	Sub-heading	Text written on leaf post-it
Global	environment	Reduce emissions
Global	environment	For a clean healthy environment for all
Global	environment	Be kind to the planet
Global	environment	Stop producing greenhouse gasses
Global	environment	enjoy your planet, its nature and creatures
Global	environment	wishing for a clean environment for everyone to enjoy
Global	environment	look after the planet
Global	environment	Everyone to love the earth - we are part of it
Global	environment	respect the world
Global	environment	stop climate change now
Global	environment	I wish people with stop being butheads and help the plant
Global	environment	I want the environment to be fresh
Global	society	That my granddaughters have a future on a good earth
Global	society	I wish to have a sustainable and safe planet in the future for all the generations behind us
Global	society	I wish they would stop putting profit before people
Global	society	reduce the level of GHG save for planet for the future kids
Global	society	I hope everyone plays a part
Global	society	Priority shift away from personal wealth
Global	society	Help at risk communities around the world
Global	society	for all nations to act as one to save our planet
Governance	policy	that COP 26 changes things
Governance	policy	Vote out the Tories
Governance	Politicians	For leaders to lead by example: to be the role models we pay them to be
Governance	Politicians	I wish politicians would stop using COP as a tick box and start using it to make <u>REAL</u> commitments for the climate
miscellaneous	COVID	I want the virus to go away at China
miscellaneous	food	go vegan
miscellaneous	food	Go vegan
miscellaneous	French	je souhaite un moyen de transport plus ecologique
miscellaneous	miscellaneous	Lava bread
miscellaneous	miscellaneous	the see was warm
miscellaneous	miscellaneous	more blue - carbon solutions # listen to the ocean
miscellaneous	Oceans	No more sea level to be high
miscellaneous	Personal fear	I'm scared
miscellaneous	Personal fear	me too :D
miscellaneous	recycle	recycle
miscellaneous	recycle	recycle more
miscellaneous	recycle	recycle more
miscellaneous	Unreadable	
miscellaneous	Unreadable	

Category	Sub-heading	Text written on leaf post-it
miscellaneous	weather	I would like it to be snowing - anytime
Pollution	air	less pollution clean air all nations working together
Pollution	air	no more pollution by 2030 Carbon - neutral futures
Pollution	general	I wish for a cleaner world
Pollution	general	No pollution
Pollution	general	No Pollution please
Pollution	general	I wish for pollution to disappear by 2030
Pollution	general	Less pollution
Pollution	general	we stop polluting
Pollution	litter	stop littering
Pollution	litter	no litter
Pollution	plastic	use less plastic
Pollution	plastic	make less plastic in the ocean
Pollution	plastic	less plastic
Pollution	plastic	Reduce the use of plastics
Pollution	plastic	Use less plastic
Pollution	plastic	less plastic and more trees
Pollution	water	I wish for more investment in clean technologies so we can clean the ocean and help our planet
Pollution	water	Please stop polluting the seas, rivers and lakes and be especially helpful to turtles and dolphins
Pollution	water	I wish the oceans stay clean
Pollution	water	Getting all the rubbish out of the water
Pollution	water	do not litter the sea
Pollution	water	I wish for the sea to be clean
Pollution	water	Clean rivers
Pollution	water	stop polluting the oceans and seas
Pollution	water	cleaner water for fish

Appendix 2 – Intergenerational trend in CO₂ Concentration

Game created to engage all ages and sexes at the Edinburgh Climate Festival, 14th Aug 2021.

Aim

- engage visitors in participatory game and subsequent conversation about the science conducted at UKCEH and within the UK-SCAPE program
- highlight the rise in atmospheric CO₂ in the time frame relevant to their family
- educate them on the sources of the main greenhouse gases
- Additional educational aspects - Learn how to read a graph

Rules of the game

Approach visitors and ask them to take a small sticker and write the concentration of CO₂ in the atmosphere the year they were born. Only help if they do not know how to read a graph.

If appropriate, ask also to estimate from the graph the year their mother or grandmother or father or grandfather was born.

If a sticker is already on the 'spot' on the graph they want to use line up above on the correct year but wrong concentration (concentration is already written on the sticky dot).

In order to comply with social distancing rules - have an A4 copy of the poster to hand so it is possible to explain at a distance from the poster the rules of the game. Participants can calculate the CO₂ concentration they need to write on the sticky dot and where on the poster they should put it when it is safe to approach the poster.

Have one colour if the person present and another if they are adding someone who is not present.

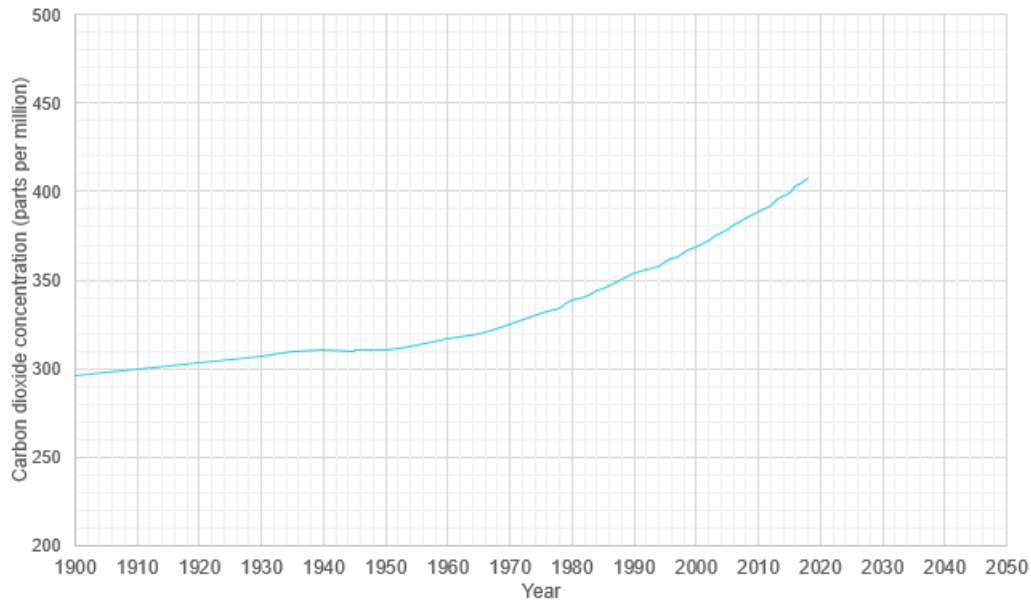
Note the x-axis of poster taken to 2050 on purpose. No predictions have been added to enable conversation – i.e. participants think the concentration might be in 2050 and what would be the consequences and what would have to be done to change the 'direction' of the line.

Evaluation

Photograph final poster and count the dots of those present to calculate the total number of participants taking part.

UK-SCAPE Resume Slide Show
Trends in atmospheric concentrations of CO₂

What was the atmospheric carbon dioxide concentration the year you were born ?

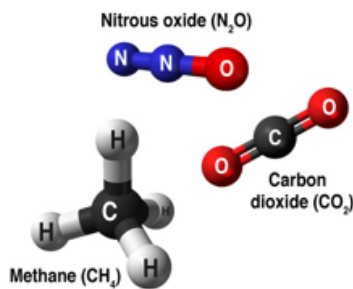


Data taken from European Environmental Agency website eea.europa.eu



UK-SCAPE

Carbon dioxide (CO₂): is the primary greenhouse gas, responsible for about **75% of emissions**. It can linger in the atmosphere for 1000s of years. Carbon dioxide emissions mainly come from burning organic materials: coal, oil, gas, wood, and solid waste.



Methane (CH₄): is released from landfills, natural gas and petroleum industries, and agriculture (especially from the digestive systems of grazing animals). A molecule of methane doesn't stay in the atmosphere as long as a molecule of carbon dioxide—about 12 years—but it is at least 84 times more potent over two decades. It accounts for about **16% of all greenhouse gas emissions**.

Nitrous Oxide (N₂O): Nitrous oxide occupies a relatively small share of global greenhouse gas emissions—about **6% of emissions**—but it is 264 times more powerful than carbon dioxide over 20 years, and its lifetime in the atmosphere exceeds a century, according to the IPCC. Agriculture and livestock, including fertilizer, manure, and burning of agricultural residues, along with burning fuel, are the biggest sources.

Images of greenhouse gas molecules courtesy of <https://climate.nasa.gov/>
 Text from National Geographic article



Appendix 3 – How do scientists measure CO₂?

Using the LGR GGA Microportable Greenhouse Gas Analyser

What are we doing?

We hope to demonstrate how GHG fluxes may be measured in the field. The GGA will be measuring CH₄ and CO₂ from a peat core taken from Auchencorth Moss, in a closed dynamic chamber system. Measured concentrations will be plotted in real time and displayed on a monitor.

The core will be exposed to direct light to stimulate photosynthesis of the top layer of moss. When the light is switched off the CO₂ concentration should be seen to increase again as respiration dominates.

The GGA has so far been used to measure GHG fluxes from water bodies around the UK as part of the GHH Aqua project.

How does it work?

The GGA works using cavity ring-down spectroscopy. A pulse of light is emitted by a laser and is absorbed by the gas, different gases absorb at different wavelengths. The time taken for the light to be absorbed (the 'ring down' time) is an indicator of concentration. The shorter the ring down time the higher the concentration.

The GGA has two lasers, one for CH₄ & H₂O and one for CO₂.

It has a measurement frequency of 1 Hz (measuring every second).

The GGA is portable and can measure fluxes in real time (in comparison to closed static chambers, from which samples are manually taken at given intervals – at a much lower frequency).

How to operate ?

The GGA will be connected to a monitor, keyboard and mouse. It will be plugged in to a power supply during operation (rather than running on battery). There is a simple on/off switch on the case. Please don't leave the GGA plugged in to the socket when turned off.

When running, you can switch between multiple display screens.

Display 1 shows the wavelength scan; the absorbance peak and signal peak can be seen on separate plots.

Display 2 plots a running concentration (right to left), and automatically scales itself relative to measured concentrations. The plots can be refreshed to clear past data.

Display 3 shows settings and parameters.

Appendix 4 – Which air pollutants affect global climate warming?

UK Centre for Ecology & Hydrology
Which air pollutants affect global climate warming?

WARMING

CO₂
carbon dioxide

CH₄
methane

N₂O
nitrous oxide

CF₃Cl
example halogenated gas (CFCs)

C₅H₈
isoprene, example volatile organic compound

CO
carbon monoxide

Black carbon

Aviation contrails

IPCC DIAGRAM EXPLANATION

Observed warming is driven by emissions from human activities, with greenhouse gas warming partly masked by aerosol cooling

What is climate warming or cooling?
 Climate warming
 Sun's energy absorbed into part of the atmosphere where climate is and affects life
 Climate cooling
 Sun's energy scattered or reflected from part of the atmosphere where climate is and affects life

Uncertainty of our knowledge
 ———— Could be as big as
 ———— **Best estimate** ————
 ———— Could be as small as

COOLING

Chemical reactions

NO₂

SO₂

NH₃

Organic carbon

Land use reflectance and irrigation

IPCC report

https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf

UKCEH air pollution monitoring in Scotland

<http://www.auchencorth.ceh.ac.uk/>

enquiries@ceh.ac.uk

www.ceh.ac.uk



BANGOR
UK Centre for Ecology & Hydrology
Environment Centre Wales
Deiniol Road
Bangor
Gwynedd
LL57 2UW
United Kingdom
T: +44 (0)1248 374500
F: +44 (0)1248 362133

EDINBURGH
UK Centre for Ecology & Hydrology
Bush Estate
Penicuik
Midlothian
EH26 0QB
United Kingdom
T: +44 (0)131 4454343
F: +44 (0)131 4453943

LANCASTER
UK Centre for Ecology & Hydrology
Lancaster Environment Centre
Library Avenue
Bailrigg
Lancaster
LA1 4AP
United Kingdom
T: +44 (0)1524 595800
F: +44 (0)1524 61536

WALLINGFORD (Headquarters)
UK Centre for Ecology & Hydrology
Maclean Building
Benson Lane
Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB
United Kingdom
T: +44 (0)1491 838800
F: +44 (0)1491 692424

enquiries@ceh.ac.uk

www.ceh.ac.uk