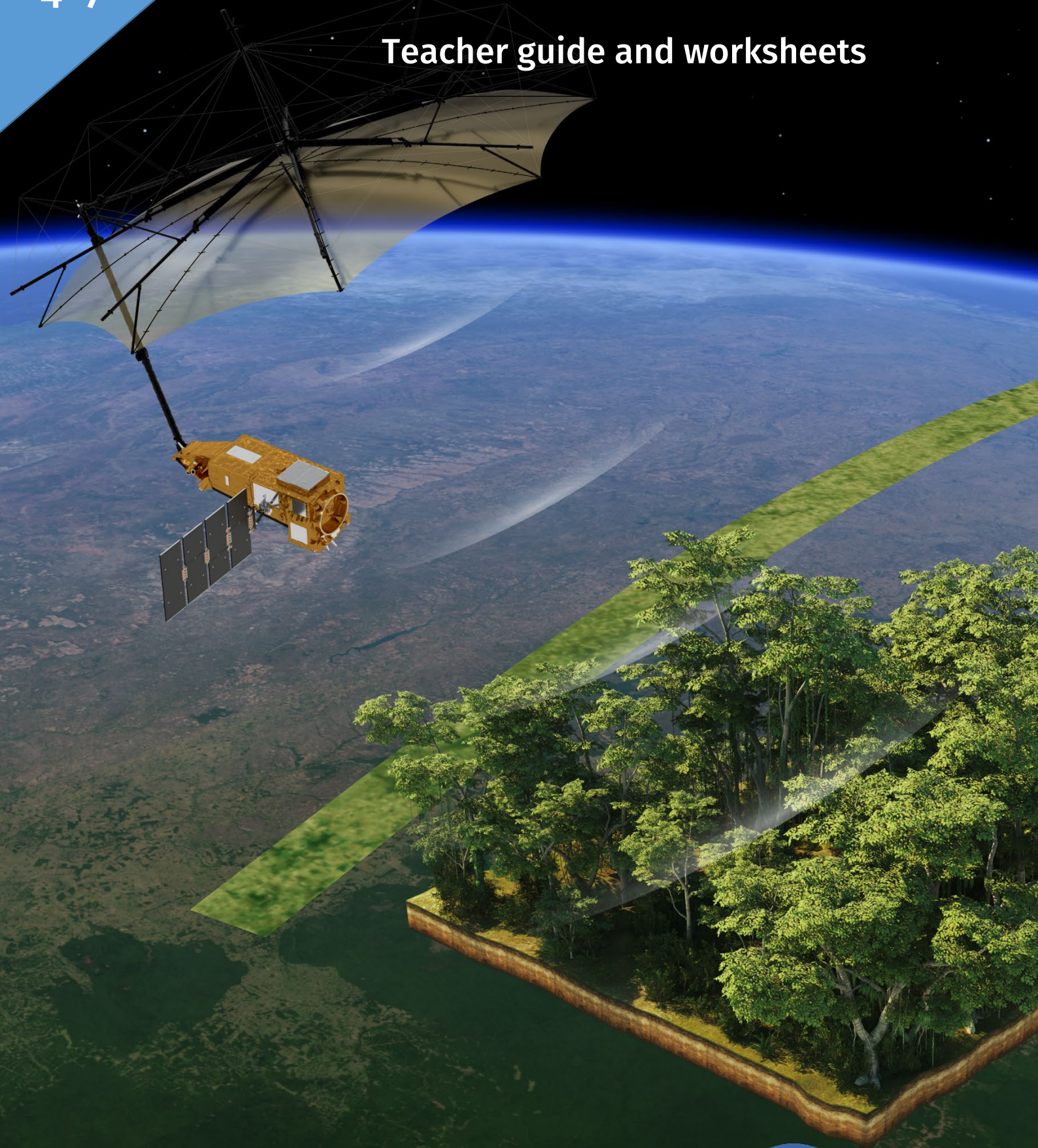# What do trees do?

Teacher guide and worksheets

**National Centre for
Earth Observation**

NATURAL ENVIRONMENT RESEARCH COUNCIL

Earth Observation science for a changing planet

esa
biomass

EODetective

Contents

> If you have any comments or questions about these materials, please email **EODetective@NCEO.ac.uk** We would love to hear about how you have used them and see what your students have produced!

Overview

Activity summary
In this classroom activity, students think about ways in which different parts of a tree are useful. They discuss why trees are important for us, other animals and plants. Finally, they use photographs alongside their own experience to consider how difficult it can be to count trees and find out how the Biomass satellite will help.

Time needed
1 hour, but can be split into two shorter sessions

Prior learning
None

Learning outcomes
- Describe some of the ways in which trees help other living things, including us.
- Match some of these ecosystem services to the part of the tree that provides them.
- Explain how we could count the trees in an area.
- Know that the Biomass satellite will help us count trees in places it is difficult to travel to or see from above.

Key words
tree, root, trunk, branches, leaves, fruit, flower, wood
(needles, cones, canopy, ecosystem services)

Curriculum coverage

England
Science
- Pupils should be taught to identify and describe the basic structure of a variety of common flowering plants, including trees. (Year 1 PoS)
- Pupils should be taught to … describe how different habitats provide for the basic needs of different kinds of animals and plants, and how they depend on each other. (Year 2 PoS)

Geography
- Pupils should be taught to use basic geographical vocabulary to refer to key physical features, including … forest … soil … vegetation … (KS1)
- Pupils should be taught to use aerial photographs … to recognise … basic human and physical features. (KS1)

Scotland
Sciences
- I have observed living things in the environment over time and am becoming aware of how they depend on each other. (SCN 0-01)
- I have helped to grow plants and can name their basic parts … (SCN 0-02)
- I can … show an appreciation of how animals and plants depend on each other for food. (SCN 1-02a)

Health and wellbeing
- I explore and discover where foods come from … (HWB 0-35a)
- I am learning about where living things come from and about how they grow, develop and are nurtured. (HWB 0-50a / HWB 1-50a)

Wales
Science and technology
- I can recognise that plants and animals are living things which grow. (PS1)
- I can recognise that what I do, and the things I use, can have an impact on my environment and on living things. (PS2)
- I can explore relationships between living things, their habitats and their life cycles. (PS2)

Humanities
- I can describe how people and the natural world may impact on each other. (PS2)
- I can describe how places, spaces, environments and landscapes are important to different people and for different reasons. (PS2)

Northern Ireland
The world around us
- Pupils should be aware of the local … environment and their place in it. (FS)
- Pupils should understand the need to respect and care for themselves, other people, plants, animals and the environment. (FS)
- Pupils should understand and use … simple maps and drawings. (FS)
- Pupils should explore how plants and animals rely on each other within the natural world. (KS1)

- Pupils should explore interdependence of people and the environment. (KS1)
- Pupils should explore interdependence of people, plants, animals and place. (KS1)

Background information for teachers

Ecosystem services provided by trees

Ecosystem services are the benefits we get from the natural world. They can be hard to recognise in an environment built and heavily managed by people. However, even in a city, it is likely that children have experience of trees and ideas about what they 'do'. A 2017 report for the Woodland Trust (see **Links**) identified well over fifty benefits of trees some of which, such as those related to mental health and wellbeing, have only relatively recently been quantified.

The benefit of trees that is perhaps most widely spoken about is their role in regulating climate. Carbon dioxide (CO_2) captured from the atmosphere is combined with water and converted into sugars during photosynthesis. Some of these sugars are broken down during respiration (so some CO_2 returns to the atmosphere) but other chemical reactions incorporate some of the sugars into the tissues of the plant (the biomass) so locking away (sequestering) CO_2 – which is, of course, a greenhouse gas that makes a major contribution to the greenhouse effect.

A plea on behalf of colleagues teaching in secondary schools

It is tempting to talk about plants 'breathing in CO_2' and 'breathing out oxygen' because comparing with animals/us makes an invisible process easier to understand. This idea is implied when forests are referred to as 'the lungs of the planet'. However, the comparison and analogy hide the facts that plants respire as well as photosynthesise, and that animals breathe in air but absorb just one gas from the mixture. They also reinforce the idea that respiration is the same as breathing. The common misconceptions and blurred everyday usage of a specialist term are things that secondary science teachers struggle to get students to 'unlearn'.

If you talk instead of plants taking in/absorbing *more* CO_2 than they give out to the air, or that they store some of the CO_2 they take in, and avoid comparisons with what animals do, you will make it easier for your students to understand more complex topics they meet later.

Biomass and Geo-trees

The European Space Agency (ESA) Biomass satellite mission is the brainchild of science lead Shaun Quegan (NCEO, University of Sheffield). The satellite was built by Airbus in the UK and, at the time of writing, was due to be launched on 29 April 2025 from Kourou in French Guiana. It will orbit the Earth and send down radar pulses that can pass through clouds and the canopy of a forest. The trunks and branches of trees reflect these pulses back up to the satellite. Scientists can use the reflected pulses to gradually build a 3D model of the forest. This will allow us to better understand the amount of carbon captured and stored in tropical forests.

Meanwhile, scientists across the world – such as Mat Disney (NCEO, UCL) – are involved in a programme called Geo-trees. They collect information using instruments on planes and drones. In forests that are easier to get to and into, they can measure and count trees directly or use a technique called lidar that makes 3D pictures like those that will come from the Biomass satellite.

Comparing information about the same forests from Geo-trees and Biomass will give scientists confidence that results from places where only one programme works are correct.

Practical notes

- Worksheets are designed for single use and can be copied in black and white.
- Resource sheets may contain larger images for you to insert into your classroom presentations or print for display, additional information for students, or data for them to work with. These are best printed or copied in colour but may be reused.
- Students may need a pen/pencil and their exercise book or paper as well as the materials listed for each activity.
- You will need to print sufficient copies of any worksheets and resource sheets you plan to use in advance and, in some cases laminate or/and cut into separate cards. If any additional preparation is required, it is described below the resources list.
- The presentation to go with this activity can be downloaded, along with any additional supporting files, by following the links to this pack on **STEM Learning** or the **NCEO website**. As well as the slides referenced in the activity, it may include additional slides that may be useful such as one listing the learning outcomes that you can edit as required.
- Suggestions for differentiation, home learning and assessment are included at appropriate points in the description of each activity.

Health and safety

In all activities, we have assumed you will continue to follow your usual procedures relating to, for example, movement within the learning environment, use of equipment, trips and spills, first aid and online safety. Since the details of these vary, even within an individual school, we have not listed them every time. However, we have highlighted any additional specific hazards to inform your risk assessment.

What do trees do?

Resources

- Slide pack: What do trees do?
- Tree picture (see Resource sheet 1) – one A3 copy per group.
- Ecosystem services cards (Resource sheet 2) – one set per group.
  A set does not need to include all the cards: choose those that are best-suited to your class, or to different groups within it.

Suggested sequence

1. Show pictures of trees at different times of year (slides 4–8). Ask students to name the parts of the tree they can see (trunk, branches, leaves, flowers, fruit) and the parts they cannot see (roots) in each picture. Depending on the age of the class, you may want to discuss the evergreen tree on slide 8 as well as the cherry tree: the needles are tiny tough leaves and the cones, although they are not flowers, do a similar job.

2. Ask the students to share some ideas about what we get from trees and why trees are useful.

3. Give each table a large tree picture and a set of cards.
   Explain that the picture is split into three: roots, trunk and the rest of the tree (canopy). Also explain that the cards show different things we get from trees or things that trees do, some of which they may have already mentioned and some of which they may not have thought about. There is also a blank card they can use to include another idea of their own.

4. Ask the students to work in groups to place each card on the picture to show the part of the tree that does this job. They could take turns, or talk about each card and decide together where to put it. You might need to explain what some cards represent (see Answers, below).

5. Go through the answers (slides 10–24) or, if you plan to assess the work more formally, ask each group or individual to record their answers in a way appropriate to their age and ability (e.g. stick the cards to the picture, make a copy of the picture using words instead of smaller pictures, make a table in their exercise books). You could also ask them to add any other ideas they can think of or/and use this as a homework exercise.

6. Since trees are so important, we need to keep track of where they are and how we are looking after them.
   a. Show slide 27 and ask how we could count trees in a place like this. (Walk along and count!)
   b. Show slide 28 and ask if their method would work here. (Yes, but they might want to split the area between them because there are so many trees.)
   c. Continue like this through slides 29 to 32 asking:
      - What we could do if the trees are not in a line or regular pattern. (They might do something to mark the trees they've counted like tie some string on them.)
      - What if we can't get to the trees because they're in someone's garden? (Ask the owner to do it, or for permission.)
      - What if there's too much stuff growing between the trees? (Take a picture from above using a drone or an aircraft or a satellite – see slide 32.)
      - What if the picture we take has clouds in it? Or the trees are so tightly packed we can't tell where one starts and another ends? (Need a special satellite that can see

through clouds and leaves to make out the trunks. Slide 34 shows a computer image of the Biomass satellite which will be able to do this job.)

Make clear that the simplest method that works in each case is the best: using an aircraft or a satellite to get a picture when we can count trees ourselves wastes lots of energy and money.

7. Scientists and engineers from ESA countries (see flags on patch on slide 34) have been working on the Biomass mission since 2005, and the programme will cost millions of pounds. To elicit what students have learnt from the lesson, ask them why this mission matters: why have so many people from so many countries been working together for so long (and governments spending so much money) to find out more about trees on our planet?

Answers

Canopy	Trunk	Roots
Home for birds/fosters biodiversity Chocolate (from cocoa beans) Home for/food for bees/pollinators Fruit Clouds and rain[2] Nuts Cleans air/absorbs pollution/CO_2	Maple syrup Home for people[1] Paper Places to play[1] Logs/planks/timber	Home for earthworms/healthy soil Cleans/filters water Hold soil in place/prevent landslips and slides

[1]Not the trunk as such, but space beneath the canopy – although can also play, build houses or sleep in the canopy, so this answer is flexible.
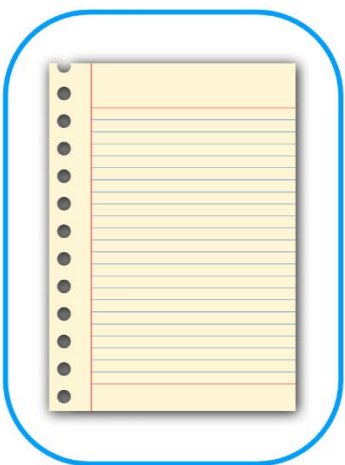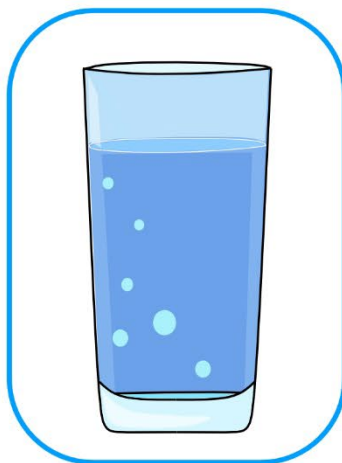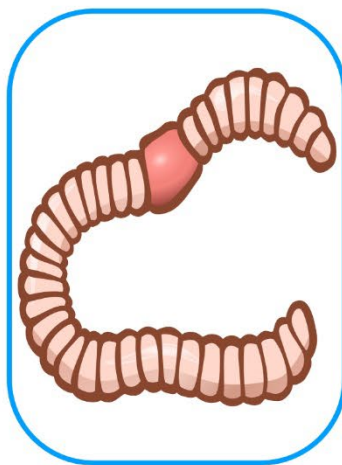[2]Through evapotranspiration: trees take water from the soil through roots and it evaporates from leaves into the air.

Additional activities and questions

- Students could count trees in the school grounds, in their street or a local park and identify the main 'job' each tree does. Some may also be able to use a field guide (such as those from the **Woodland Trust 'Tree ID for kids' series**) to identify the types of trees.
- As a class or group project, or individual homework, recycle materials and objects to make a model tree and 'baubles' showing the different jobs trees do to hang from the branches. Discuss the best way to make sure it can stand up.
- Tie in to reading or telling stories set in woods or forests. There may be legends connected with local places or individual trees (e.g. the Major Oak in Sherwood Forest) as well as folk tales and myths from many cultures (see, for example, **worldstories.org**). For book suggestions see, for example, **bestbooksforschools.com/collections/pack-plants-and-trees**.
- Ask students to imagine a particular place with and without trees. This might be a location they know that would benefit from increased tree cover or a local place where there are lots of trees. Given what they have learned today, how would it be different? How would people living, playing, working or visit the area feel? They could write about this (perhaps as a letter to whoever owns or manages the area) or draw pictures to show the differences.
- There are a multitude of ideas online for art and poetry based on trees …

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Resource sheet 1

Resource sheet 2
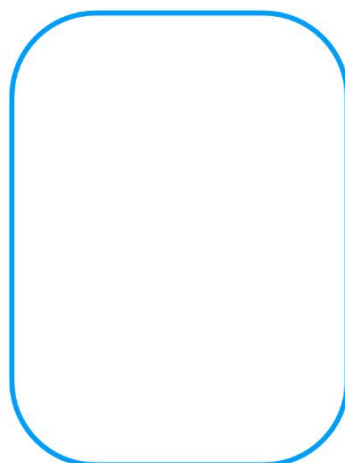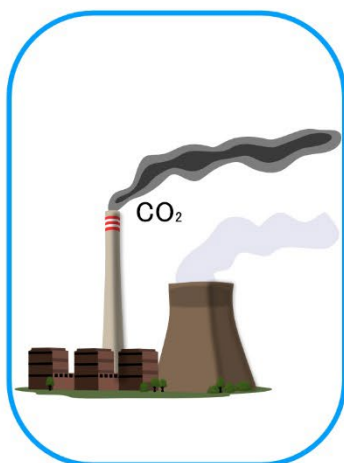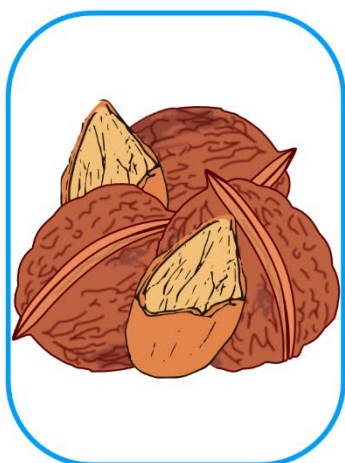
Links

Teaching packs

More teaching materials related to Earth observation can be downloaded from the **NCEO website**, **EO Detective on STEM Learning** and **ESA Education Teachers corner** (although most of these are aimed at ages 8–11). Of particular relevance are:

- **Colour in the Earth with Tim Peake**
- From the ground and from the sky
  (**simple version on STEM Learning** /**more complex version from ESA**)
- Counting trees (Biomass 7–11), which follows on from this activity
- **Papercraft satellites** from Dynamic Earth on STEM Learning

Earth observation

On YouTube, **Satellite – What are Earth observation satellites?** from Airbus is an animated introduction to some of the roles EO satellites play.

On the **NCEO website** there is an **About EO** page in the education section that gives an overview aimed at teachers and older pupils. Other pages and news items give more detail about specific areas.

Ecosystem services of trees

Table 1 in the Woodland Trust report, **The benefits to people of trees outside woods**, lists a multitude of ecosystem services trees provide – without considering the additional benefits of woods and forests.

Trees | Educational video for kids from Happy Learning English is one of many tree videos on YouTube. It covers the material in this pack well but does have some more complex vocabulary.

Biomass and Geo-trees

More detailed information about the Biomass mission, and links to key papers, can be found on the **Space4Climate Biomass** page and the explainer you can download from it. There are links to the latest news and pictures at the bottom of the page on the ESA website about the mission, and there is a **Biomass playlist** on the ESA YouTube channel. Although the methods used are quite complex, you may want to show students excerpts from some of the animations showing how the satellite travels around the Earth, or films of people working on the satellite.

More information about **terrestrial laser scanning (TLS)**, the ground-based method used to build 3D images of trees, can be found in an NCEO news article from November 2023, which links through to the **home page of the Geo-trees project**.

Acknowledgements

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The pack was written by Catherine Fitzsimons (NCEO, University of Leicester).

Image credits