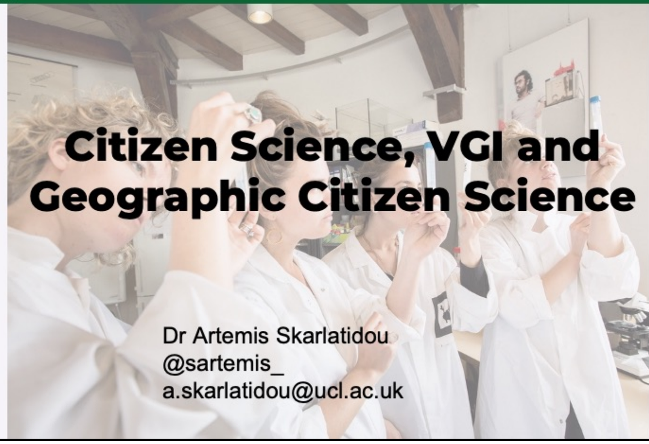

Citizen Science, VGI and Geographic Citizen Science

Dr Artemis Skarlatidou
@sartemis_
a.skarlatidou@ucl.ac.uk

ExCiteS | Extreme Citizen Science

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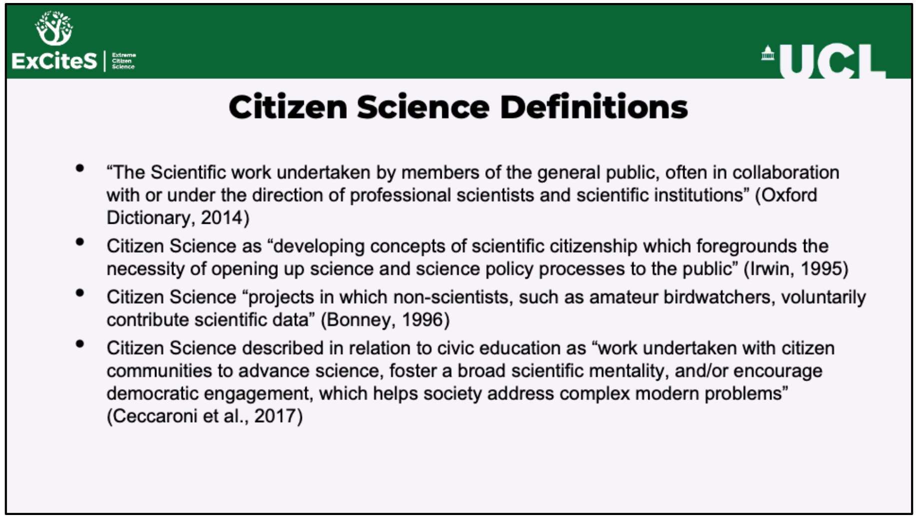
Introduction to Citizen Science

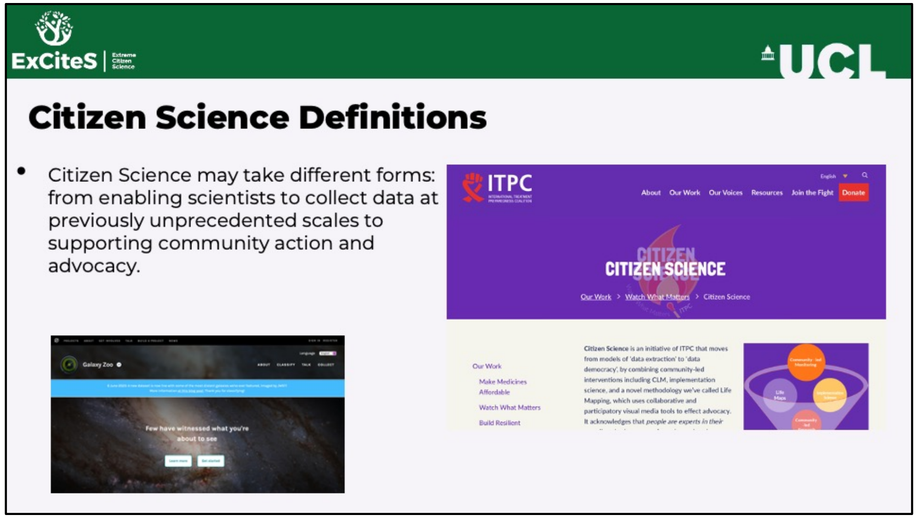
- Overview of Terminologies
- History
- Development of the field: Where are we now?
- Typologies
- Extreme Citizen Science
- Examples



Irwin, A. (1995). *Citizen Science: A Study of People, Expertise and Sustainable Development*. Routledge. ISBN 9780415130103.

Bonney, R. (1996). Citizen science: A lab tradition. *Living Bird* 15(4): 7–15.

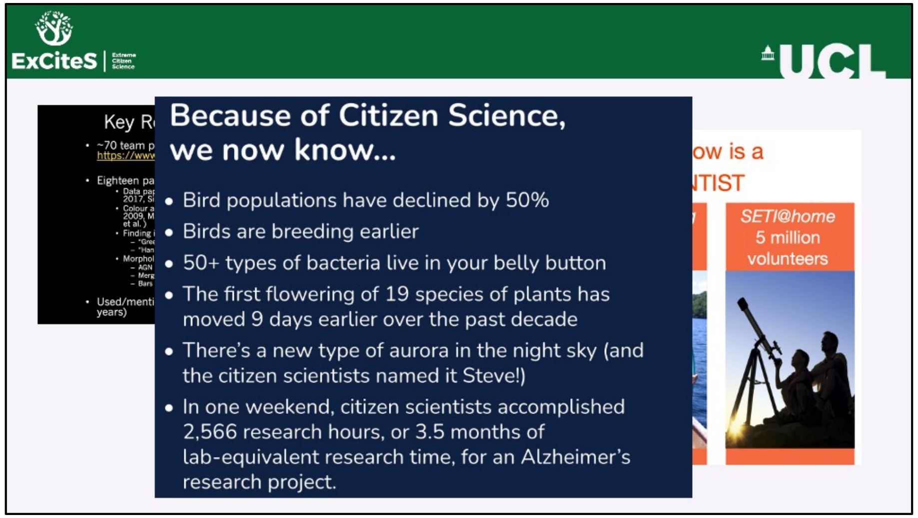
Ceccaroni, L., Bowser, A. and Brenton, P., 2017. Civic Education and Citizen Science: Definitions, Categories, Knowledge Representation. In: Ceccaroni, L. and Piera, J., (eds.), Analyzing the Role of Citizen Science in Modern Research. Hershey, PA: IGI Global, 1–23. DOI: https://doi.org/10.4018/978-1-5225-0962-2.ch001



Citizen Science may take different forms: from enabling scientists to collect data at previously unprecedented scales to community action and advocacy. Apart from popular citizen science projects in conservation and ecology such as iNaturalist, take a look at Zooniverse https://www.zooniverse.org with >1.5M volunteers. Galaxy Zoo (a project within Zooniverse) gets about 10-15K classifications daily.

To find out more about how citizen science is used watch this video here: https://www.youtube.com/watch?v=1gcrvbJipPA&list=PLUo-VNR0qe32DtWL9tTFL_XNP-4sivbw_&index=7

The International Treatment Preparedness Coalition (ITPC) is a global network of people living with HIV, community activists, and their supporters working to achieve universal access to HIV treatment and other life-saving medicines. Take a look at their website to see how they utilize citizen science for advocacy https://itpcglobal.org/blog/monitoring/citizen-science/



- 5 extraordinary Citizen Science Discoveries: https://science.nasa.gov/citizen-science/five-extraordinary-citizen-science-discoveries/
- 3 incredible examples of citizen science in action: https://www.weforum.org/agenda/2023/02/citizen-scientists-archaeology-discoveries/
- A history of the biggest discoveries by citizen scientists: https://www.australiangeographic.com.au/topics/science-environment/2018/09/a-history-of-the-biggest-discoveries-by-citizen-scientists/

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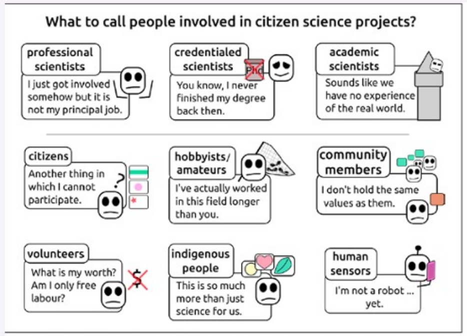
Who is involved in Citizen Science?



Source: *Eitzel, Melissa, Cappadonna, Jessica, Santos-Lang, Chris et al. (20 more authors) (2017) Citizen Science Terminology Matters: Exploring Key Terms. Citizen Science: Theory and Practice. pp. 1-20. ISSN 2057-4991*

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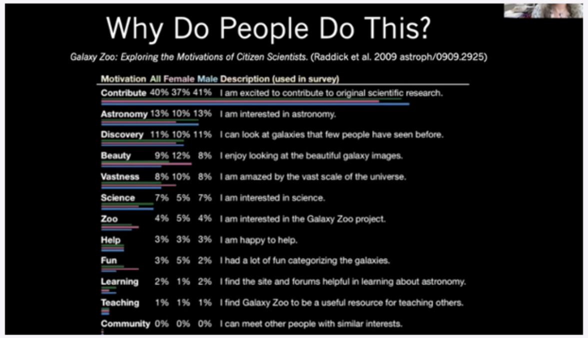
Why people participate in Citizen Science?



Why Do People Do This?

Galaxy Zoo: Exploring the Motivations of Citizen Scientists. (Raddick et al. 2009 astroph/0909.2925)

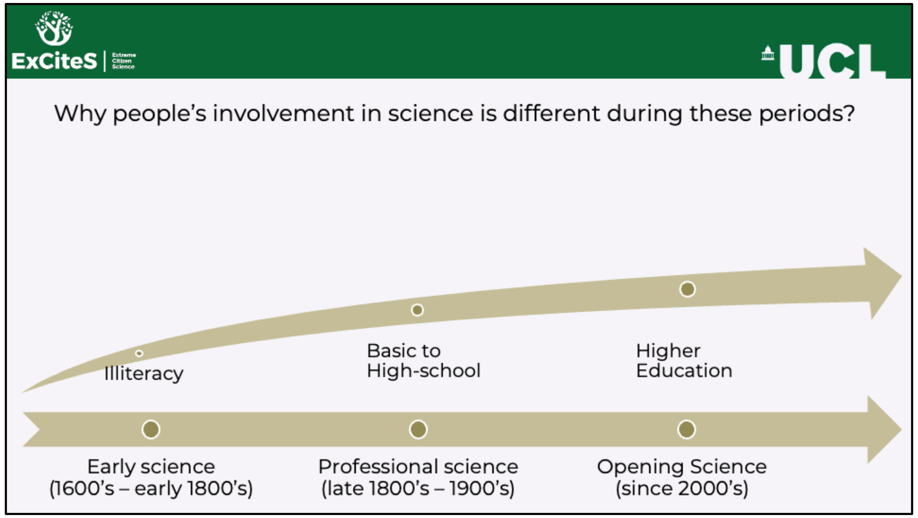
Motivation	All	Female	Male	Description (used in survey)
Contribute	40%	37%	41%	I am excited to contribute to original scientific research.
Astronomy	13%	10%	13%	I am interested in astronomy.
Discovery	11%	10%	11%	I can look at galaxies that few people have seen before.
Beauty	9%	12%	8%	I enjoy looking at the beautiful galaxy images.
Vastness	8%	10%	8%	I am amazed by the vast scale of the universe.
Science	7%	5%	7%	I am interested in science.
Zoo	4%	5%	4%	I am interested in the Galaxy Zoo project.
Help	3%	3%	3%	I am happy to help.
Fun	3%	5%	2%	I had a lot of fun categorizing the galaxies.
Learning	2%	1%	2%	I find the site and forums helpful in learning about astronomy.
Teaching	1%	1%	1%	I find Galaxy Zoo to be a useful resource for teaching others.
Community	0%	0%	0%	I can meet other people with similar interests.

Have a look at this very interesting article: "Darwin meets the citizen scientists"
https://www.nationalgeographic.com/science/article/darwin-meets-the-citizen-scientists

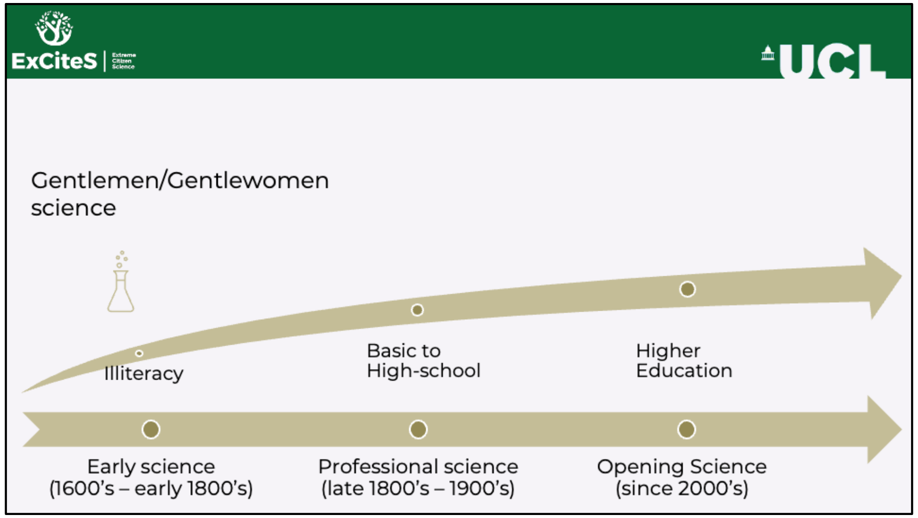
Other historic examples of Citizen Science: Recording the cherry blossom

- Cherry blossom (Sakura) – culturally significant in Japan
- Court diarists in Kyoto have been recording the blossom since 850
- The dates reveal changes in climate, with the shift to earlier dates (from about 15 April to 5 April)

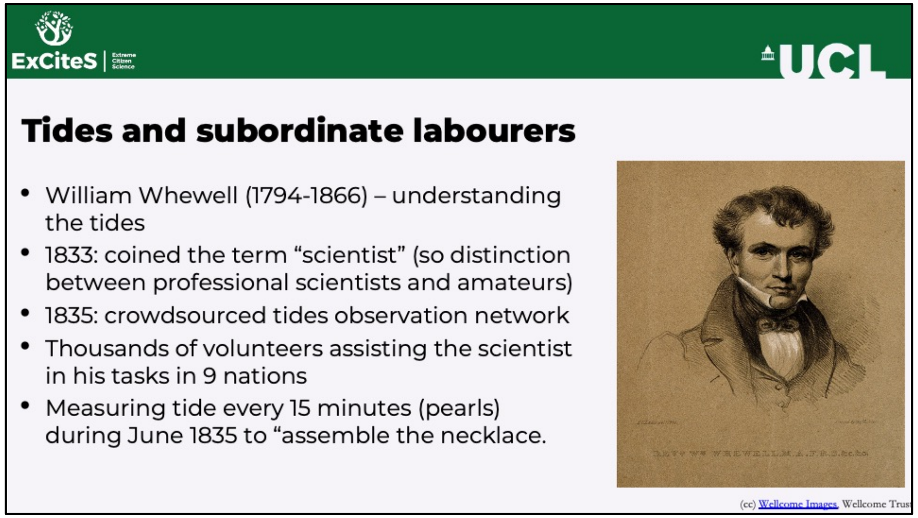
To think about the historical context of citizen science, let's consider 3 periods in the history of modern science – the early, formative period of developing methods, establishing scientific societies, etc. This was followed by a period that science became increasingly professional (especially after World War II and for the most part of the 20th century). Science is now entering a new period (Science 2.0), in which it is reopening to a wide range of people.



Because we are discussing public engagement in science, we should add to the picture the level of literacy outside scientific circles (in this case we show the in Western societies), we can see that in the wider population, when science started, it was indeed the preserve of the educated elite –no surprise that people couldn't join –most of the population was illiterate. In 1650 – 50% men, 10% women were illiterate (the Royal Society was established in 1660). As we shall see, the outside society became more educated – during the 19th and 20th century is started with basic schooling, and eventually, education for a period of 10-12 years became widespread.



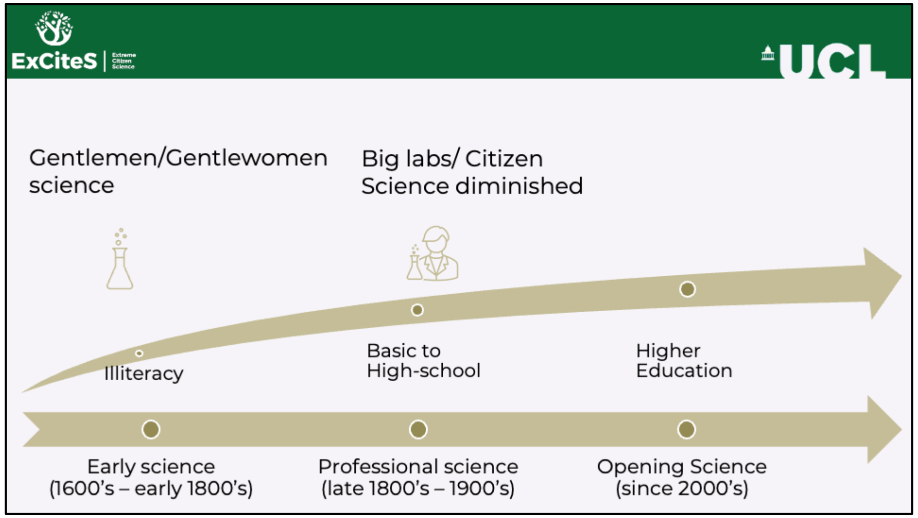
In the first period, there is lack of clarity of what is a scientist (or natural philosopher, or a gentlemen of science) is, and in a way, all scientists are citizen scientists as they operate outside scientific institutions, But some examples can help us understand the nature of citizen science during this period



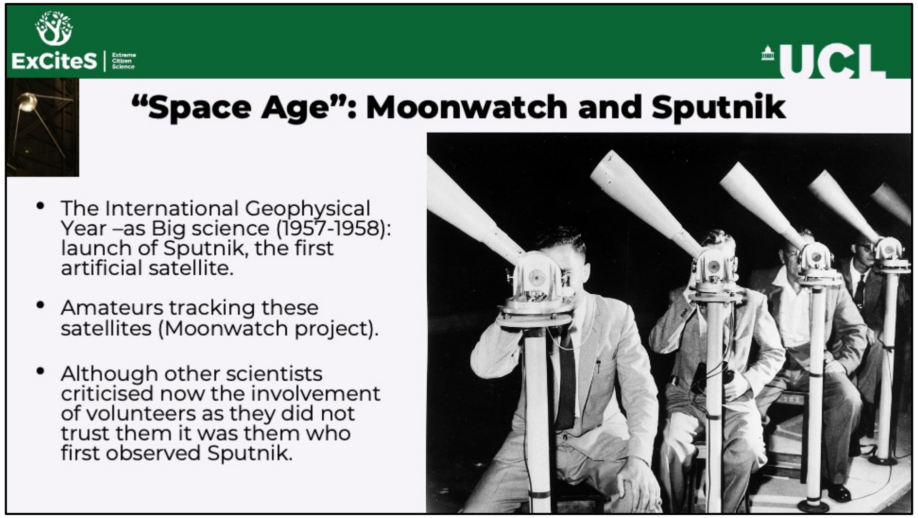
“William Whewell, an elite scholar who engaged the public to understand the tides, but in so doing helped to solidify the distinction between amateur and professional scientists. Trinity College, Cambridge

With the consent of the British Admiralty, Whewell coordinated thousands of people in nine nations and colonies on both sides of the Atlantic in the synchronized measurement of tides. At over 650 tidal stations, volunteers followed Whewell’s instructions for measuring tides every 15 minutes, around the clock, during the same two week period in June 1835. Volunteers in the “great tide experiment” included dockyard officials, sailors, harbormasters, local tide table markers, coastal surveyors, professional military men, and amateur observers. Many participants did more than measure the tides; they also tabulated, graphed, and charted the data. Whewell brought it all together into maps illustrating how the tides progressed across the Atlantic Ocean and onto shores, inlets, ports, and into rivers and estuaries. In 1837, the oldest learned society of science, the Royal Society, awarded Whewell a Royal Medal for his work on tides.

As early as 1833, Whewell coined the term scientist: before it caught on, such an individual was called “man of science” or “natural philosopher” and they were more likely pursuing science in their leisure, not as a profession. Whewell viewed observations as pearls, and induction as the rational mental processes by which minds can string the pearls together to form a necklace. In the context of Whewell’s citizen science project, thousands gathered the pearls (he referred to the thousands of collaborators as his “subordinate labourers”), and he, the scientist, assembled the necklace. His choice of the words “subordinate labourers” illustrates the class systems which structured his thinking.”



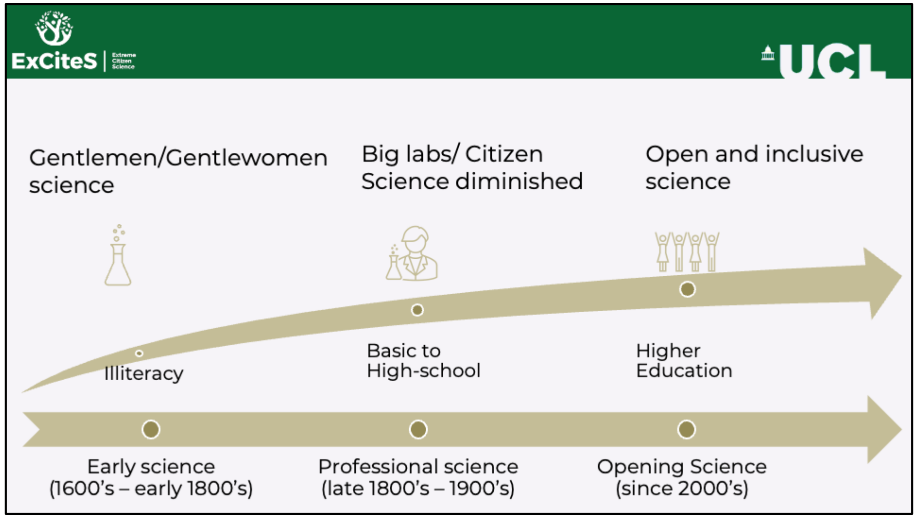
During the late 19th century, science became professionalised. This accelerated especially after the World Wars, as the investment in science was seen as part of economic and military development. After the Second World War, from the 1940s onward, started an era of “Big Science” – major projects, with significant financial investment, running in research institutes and research universities. Science became more professional, with specialised skills, laboratories, methodologies, and tools (that were usually expensive because they were produced in small batches or aimed at bodies that can afford the costs). As a result, the ability of non-professionals to participate in scientific research has been diminished and while it survived in certain areas, as we will see soon, in many parts of science they all but disappear.



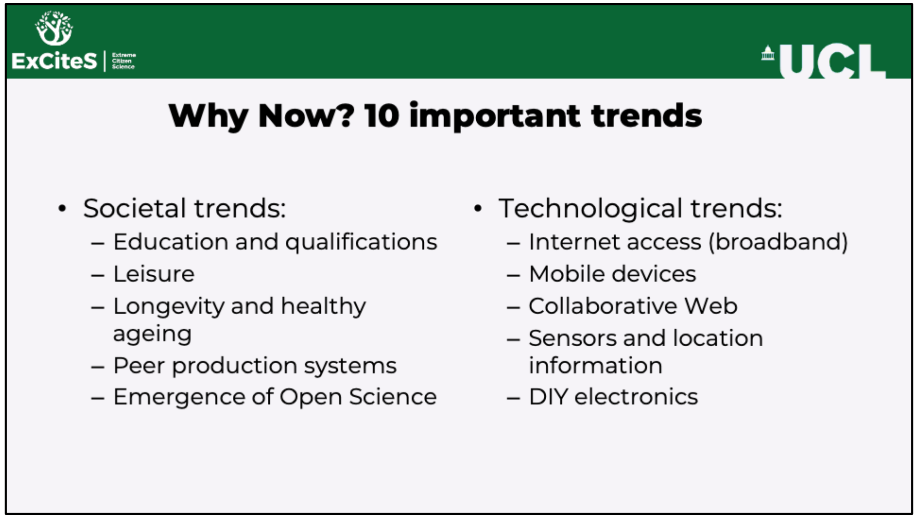
The International Geophysical Year (IGY 1957–1958) is Big Science as it get – it included many activities that set in motion geosciences and other areas. The IGY saw the launch of Sputnik, the first human-made satellite, and the opening of the 'Space Age'.

Thousands of amateur scientists participated in tracking these very early satellites (McCray 2006). Under the leadership of Fred Whipple, the then head of the Smithsonian Astrophysical Observatory, amateurs were engaged in identifying satellite locations in close collaboration with professional scientists. The Moonwatch project, which continued to run until 1975, involved participants in optical observation of satellites as they orbit the Earth. The programme faced obstacles and scepticism from other scientists and administrators of the IGY, as they did not trust the volunteers to provide sufficiently high-quality information and observations. Eventually, though, it was a group of Moonwatch volunteers who first observed the Sputnik

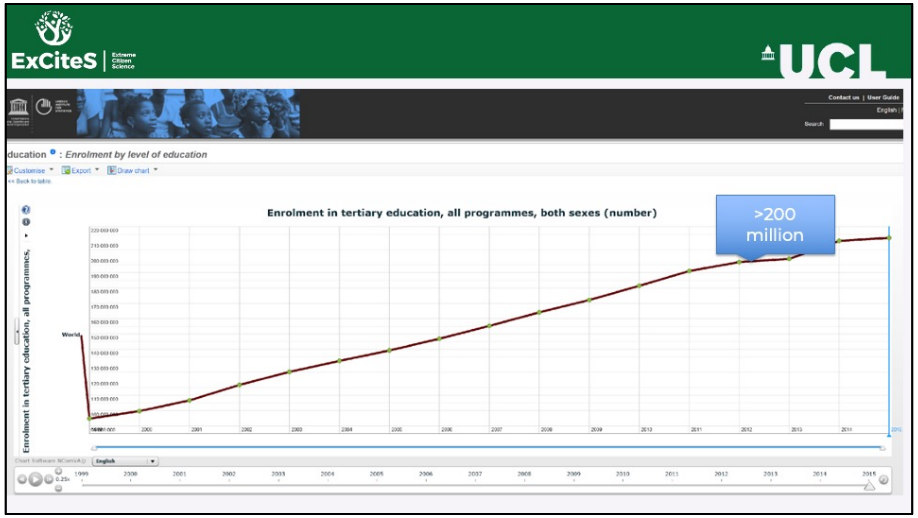
(McCray 2006).



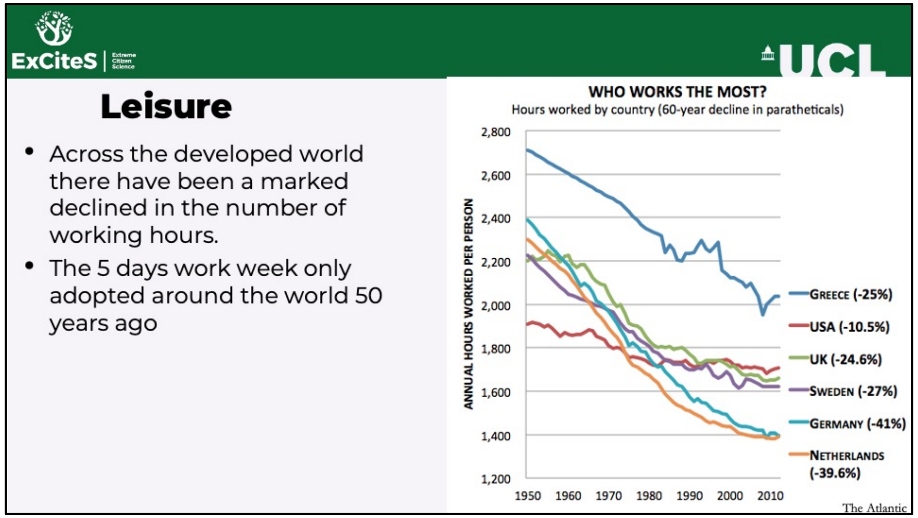
We are now entering the current state of science and citizen science, in which we're seeing citizen science gain recognition in research and policy, and we also see growth in organisations and activities – we will cover them soon. However, the question that we will explore is why do we see it now?



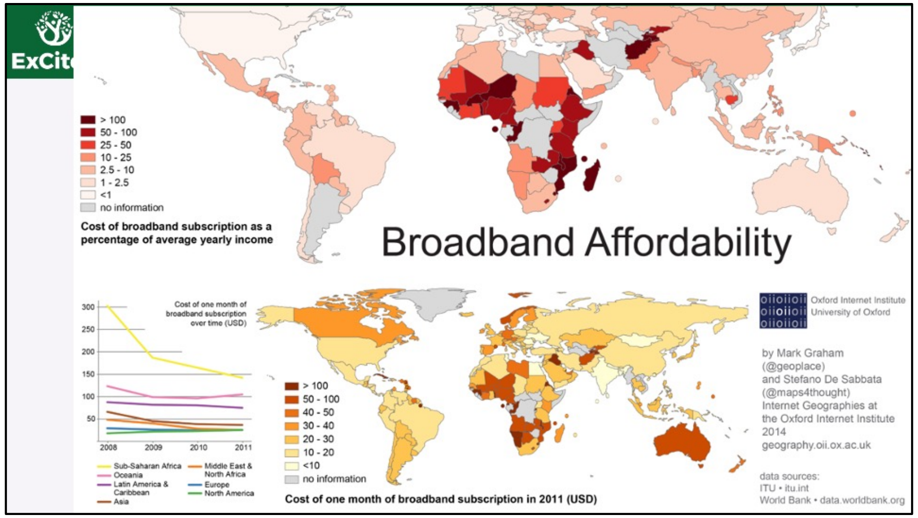
Trends are a valuable way to consider what were the social and technological process that led to the change that we see now. From looking at the range of activities in citizen science, I would like to suggest that the following 10 trends are the most relevant. We will look at 5 trends that are happening in society, and 5 trends that are happening in technology. We look at them in more or less chronological order. Let's start with the first one, the education transition.



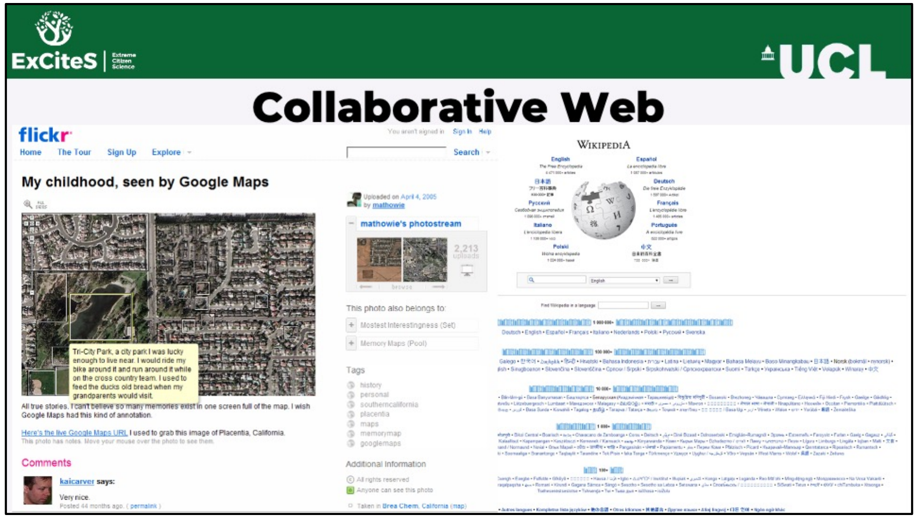
We can see it in worldwide statistics that show that over 200m people are in higher education – and the growth in it is faster than population growth.



We need to also consider that people need free time – citizen science falls into the area of "serious leisure". It is done by volunteers in their free time, so patterns of work do make an impact. We now have a very common pattern across the world of 5 days working week, with a very significant reduction of official working time. Of course, this is not true for everyone especially lower down on the earning scale, and not in all life stages, and there is also a gender difference in terms of housework, but the increase in free time open up more time for different activities – including observing nature.



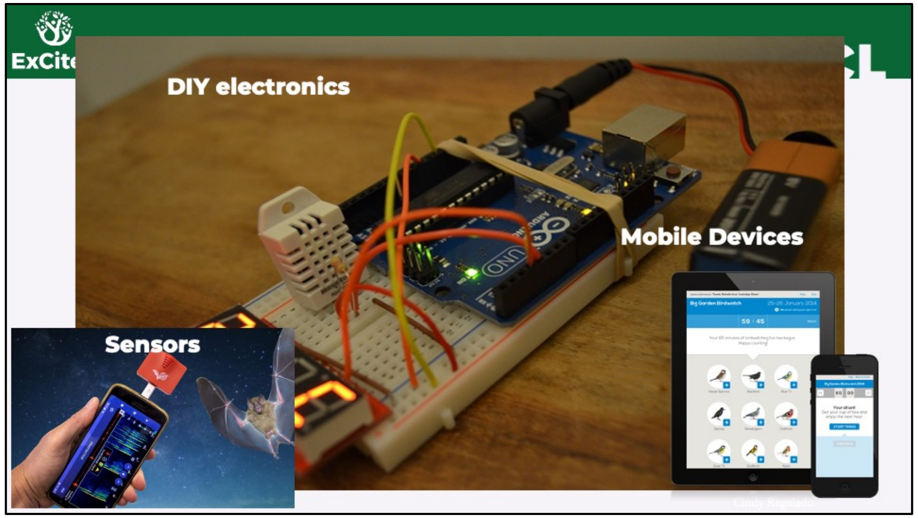
Now we can look at the technological aspects that enabled citizen science. As with the last two socio-technical trends, we can see the technical-social impact of increased connectivity. This is a map from Mark Graham, from the Oxford Internet Institute, which shows the costs of broadband internet subscription. You can see that in many parts of the world, the costs of accessing the internet are very low. We can also see an aspect that is called "Digital Divide" in which parts of the world have cheap and easy access to information, while for others it is expensive. There are further obstacles in terms of access to devices, knowledge of language to access different services, etc.



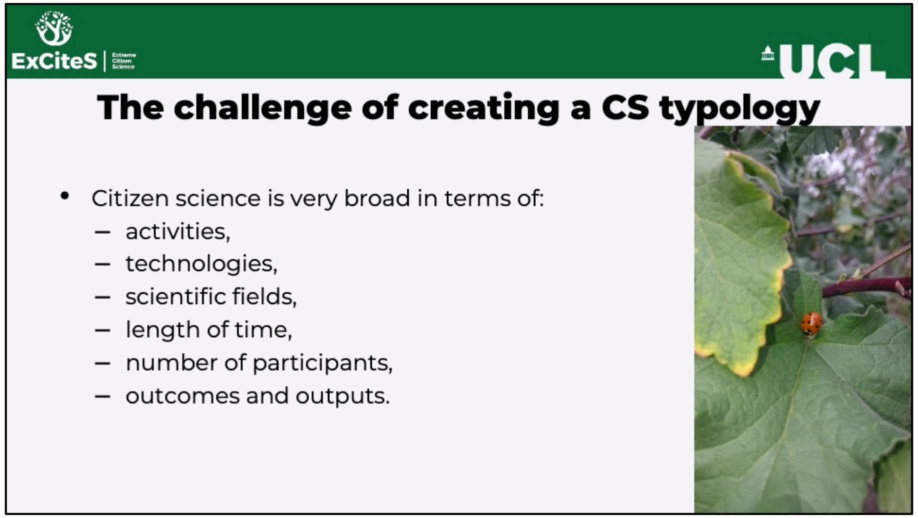
The technical side of peer-production system is the emergence of the collaborative web about 15 years ago (Web 2.0) – with the increase in access to broadband, it became possible for people to share information on websites. In April 2005, Flickr added the ability to annotate photos by marking rectangular areas on them. The designers created this functionality probably to allow the system users to annotate photos by indicating names of those who appear in the photograph or note specific features. However, one of the users of Flickr, Matt Haughey, who also blogs (thus, is among the few who are actively contributing to online systems), realised that he could take a screenshot of satellite imagery of the area in which he grew up in Google Maps, upload the image to Flickr (somewhat disregarding copyright issues) and use the annotation tools to mark specific locations on the image, attaching to them personal memories such as:

'My first girlfriend lived here ("Lisa"). I met her the summer between 7th and 8th grade when she moved in. We never kissed, and when school started I ignored her because she was in 7th and I was in 8th. I was an ass.'.

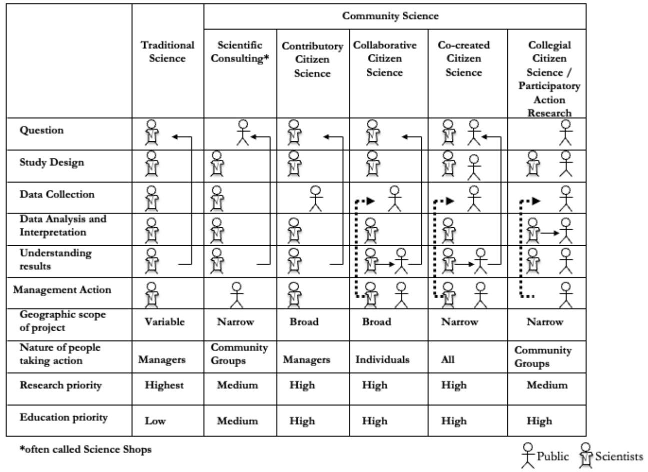
He was quickly followed by other Flickr users and there were over 650 memory maps on Flickr within a short period.



Finally, with the advancement of ideas about open source, and open science, new forms of open hardware started to emerge – for example, Arduino and Raspberry Pi, which allowed people to start creating their own sensing devices, 3D printers, and other technical and scientific instruments. The set of trends – societal and technical, influence the practice of citizen science, and you will be able to spot many of them in the different examples that we will cover.



Once you open the box and look at all the things that people call citizen science, you start noticing, even at this early stage, that there is a very broad range of activities – from taking a photo of a ladybird in my garden with my phone to building new scientific instruments in a makerspace. In technologies, from using pen and paper as the main technology to building scientific instruments to sequence DNA. In the scientific fields, we've seen that it applies to many areas of science (arguably all of them). There are also big differences In the length of time – from an occasional image taking to regular observations of the weather every day. Projects can include one participant dedicated to chasing tiger beetles to something that millions participate in, and projects can yield a community report or a scientific paper in a top academic journal.
How do you capture all of that in one classification?



	Traditional Science	Community Science: Scientific Consulting*	Community Science: Contributory Citizen Science	Community Science: Collaborative Citizen Science	Community Science: Co-created Citizen Science	Community Science: Collegial Citizen Science / Participatory Action Research
Question						
Study Design						
Data Collection						
Data Analysis and Interpretation						
Understanding results						
Management Action						
Geographic scope of project	Variable	Narrow	Broad	Broad	Narrow	Narrow
Nature of people taking action	Managers	Community Groups	Managers	Individuals	All	Community Groups
Research priority	Highest	Medium	High	High	High	Medium
Education priority	Low	Medium	High	High	High	High

*often called Science Shops

After Cooper, Dickinson, Phillips & Bonney (2007) Citizen Science as tool for conservation in residential ecosystems. *Ecology and Society* 12(2)

Although the original paper from 2007 used other terms, here we changed the titles to match the 5C's model. So now we can look in details at each of these models, and see how citizen science change it. First, let's look at the typical scientific process on the left. In this process, setting the question, methodology, data collection, analysis, interpretation (and in the case of environmental management, action or can be a publication) there are all done by scientists. The public is out of the process. Under the description of the process, you see four aspects – geographic scope, who is taking action, and the degree of balancing education and outreach with producing research outcomes. In the typical scientific case, education is a low priority while producing research outcomes is high.

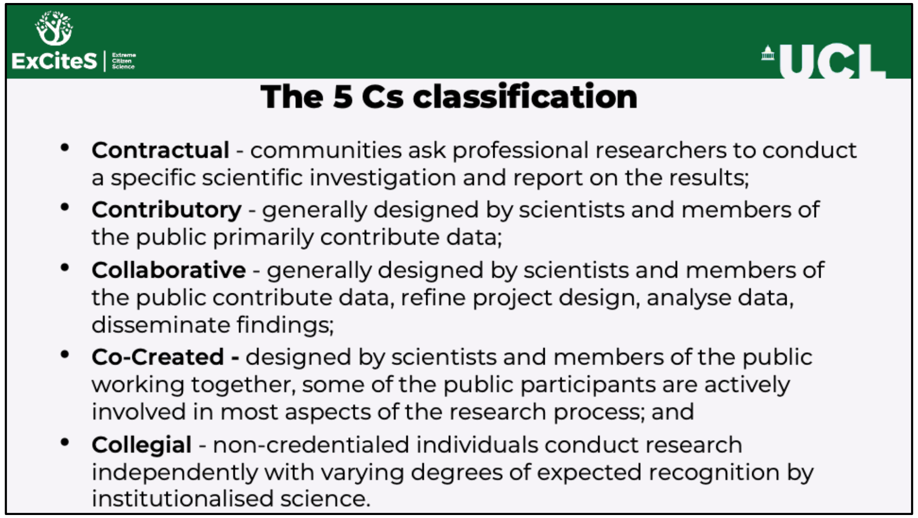
The second column explains the **Consulting** model – this is something that can happen when a community group engage scientists (either paid or pro-bono) in doing some work with them on an issue that concerns them. For example, local concern about what pollution is being emitted from a combined heat and power plant locally. The area is usually narrow, and there are mechanisms such as science shops – in which universities create an office where community members can come and ask a question, and the university will recruit student volunteers to work on the issue with some supervision from an experienced scientist. At UCL, we have the Engineering Exchange that follows this model. Notice that the research and education elements are both at the medium level, and therefore limited.

The **contributory** model is the most common in citizen science, although we already have seen that participants don't only participate in data collection, but also in basic analysis (e.g. the micro-tasks in Galaxy Zoo). In the area of ecology, indeed data collection is the most common. Notice that both the research and education are a priority here and the coverage can be extensive. Also notice that in terms of the results, they are mostly shared with other scientists (so scientific outputs are the priority here).

The relationships in the next model, the **collaborative** model is more complex. The scientists are setting the question, and most of the time design the study. Participants are involved not only in data collection but also in understanding the results, which might lead to refining the research questions. There is also collaboration on the use of the results, with participants also expected to be involved in taking an action.

In **co-created** projects, the participants are involved in setting the questions and also in some cases, they are engaged in the data analysis, in most cases this is the role of scientists in the project. The **Collegial** which can be carried out without scientists, require that all the research process is done by participants. Although the scientists are appearing, they are providing advice and facilitating the process more than driving it.

Notice that the scientific output is taking second place, because the community goals are the most important, but there is a very high education aspect.



Here are the 5 categories that they have identified – as the paper point: "We divide PPSR projects into five models based on degree of participation:

Contractual projects, where communities ask professional researchers to conduct a specific scientific investigation and report on the results;

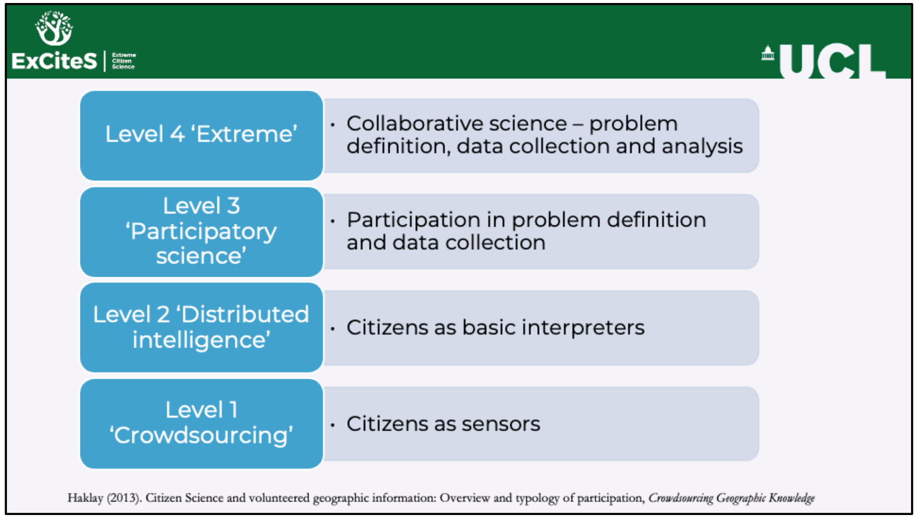
Contributory projects, which are generally designed by scientists and for which members of the public primarily contribute data;

Collaborative projects, which are generally designed by scientists and for which members of the public contribute data but also help to refine project design, analyze data, and/or disseminate findings;

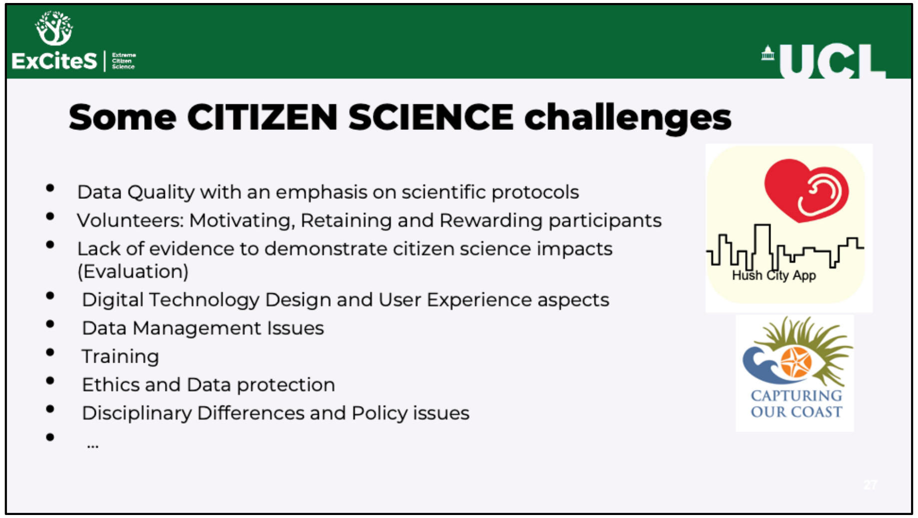
Co-Created projects, which are designed by scientists and members of the public working together and for which at least some of the public participants are actively involved in most or all aspects of the research process; and

Collegial contributions, where non-credentialed individuals conduct research independently with varying degrees of expected recognition by institutionalized science and/or professionals."

Notice that in all these cases there is a degree of participation, but the main attention is on the role of project designers and owners.



This version of this put four levels of participation – crowdsourcing, distributed intelligence, participatory science, and extreme citizen science. Let's look at the different levels.



Here we will briefly review some citizen science challenges. Unfortunately we do not have the space to discuss all citizen science challenges, but some of the most common challenges include data quality issues – and these are very similar to the data quality issues, which I mentioned in the previous lecture for example there is a lot of discussion around coverage or participation inequality challenges as well as data and individuals' privacy.

Particular attention scholars pay here in the development and use of suitable, scientific rigorous and volunteer-friendly protocols which assist the data collection process. Some times there are sacrifices scientists have to make, for example with the hush city app which is used to collect data about quiet areas all over the world the questionnaire initially designed which users had to answer while contributing data was extremely long (volunteers have to answer 20 questions for each data item they submit). Volunteers gave feedback and they explained they didn't like this feature and the fact that they couldn't skip questions – yet the project operator decided to keep it that way so that the data collected actually contributes to scientific research around noise pollution and the soundscape concept.

In another project, called Capturing our Coast, which aimed at training volunteers to carry out transect surveys of marine species on UK rocky shores, the scientists had to redesign the whole data collection protocol and experiments, to make them better fit the needs of volunteers as it was clear during the first months of the project implementation that the initial experimental design was very complicated and they run the risk of either having very low participation rates or participants would end up collecting accidentally incorrect data.

Regardless of how obvious this sounds many scientists think that any protocol could work, which of course it is not the case, and this has a direct impact in the quality of the data that the project generates.

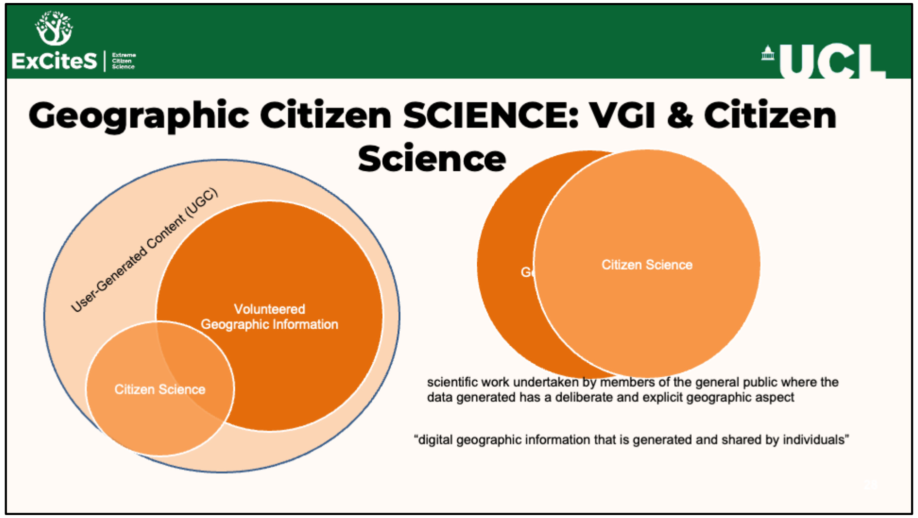
This brings us nicely to the second challenge – which is related to motivation aspects which would eventually encourage participation in a citizen science project. Citizen science projects need to answer questions about what will motivate volunteers to participate in a particular project? How to retain volunteers over the duration of the project and beyond it? How participants should be rewarded for their contributions and similar questions. Although there is some research which provides some insights I found that the most valuable lessons learned come from the experiences of the people who work in a specific project and which unfortunately remain mostly anecdotal, as the focus of the researchers working on a project is mostly on publishing scientific outputs from the analysis of the data rather than the methodological insights and experiences from the implementation of their citizen science science approach.

This brings us to the third challenge which concerns the lack of evaluation materials and studies which provide the necessary evidence to demonstrate that citizen science projects actually achieve their anticipated impacts. For example, Citizen science projects may play an important role in terms of improving scientific literacy, imporving others skills of volunteers (such as technological skills, or environmental knowledge skills), in terms of connecting people with nature and in terms of being a brilliant way to have fun, cultivating a more environmental friendly attitude and behaviour, achieving some form of social innovation, or contributing positively to climate change, and so on and so forth. However, citizen science projects rarely provide the evidence that it is usually required to demonstrate that these impacts in the short, medium and long term are indeed achieved.

This is a shortcoming widely addressed in the literature and there is now often a requirement by funders to address this gap and provide extensive evaluation materials as part of the project's reporting to the funder. Also this brings us back to the motivations - if people for example in the capturing our coast programme are motivated to participate by a desire to improve their knowledge around marine science or just exploring the seashore and connecting with nature, the project operators need early enough to evaluate their programme and see if indeed it addresses these motivations, or they run the risk that participants will lose interest and stop being involved.

Another challenge that commonly people ask me, is about what digital technology platform better suits their needs or in general what combination of technological tools is the most appropriate for them to use. There is no short answer to this but there is a growing body of research which evaluates applications to see how well they address user needs and how easy they are to use and hence there is some insight – although much more is needed – to answer these questions.

Other challenges include: data management issues, training the volunteers, ethics and data protection, policy issues and so on. These and others are covered in more detail by the optional module 'Introduction to Citizen Science and Scientific crowdsourcing" in the next next term, and in the new MSc course on citizen science which will start running in 2021.



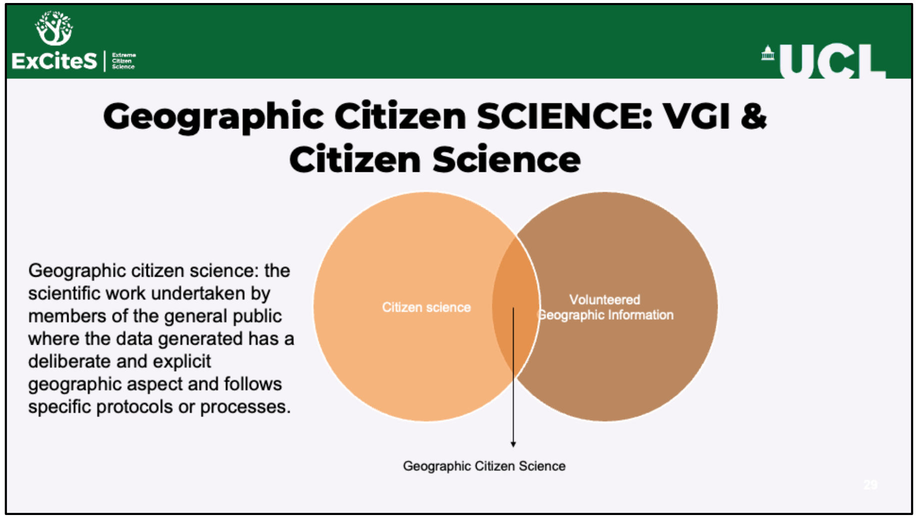
So last week we explored the concepts of crowdsourcing and Volunteered Geographic Information. One question we need to answer is where do we position citizen science in this context?

1. We saw that VGI is defined as digital geographic information that is generated and shared by individuals. Cliock 2

Click 3: We also saw earlier in this lecture that Citizen science, is the 'scientific work undertaken by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions.

Click 4: Citizen science, when recorded using computers, is also a type of UGC and here the content is scientific facts, observations or analysis.

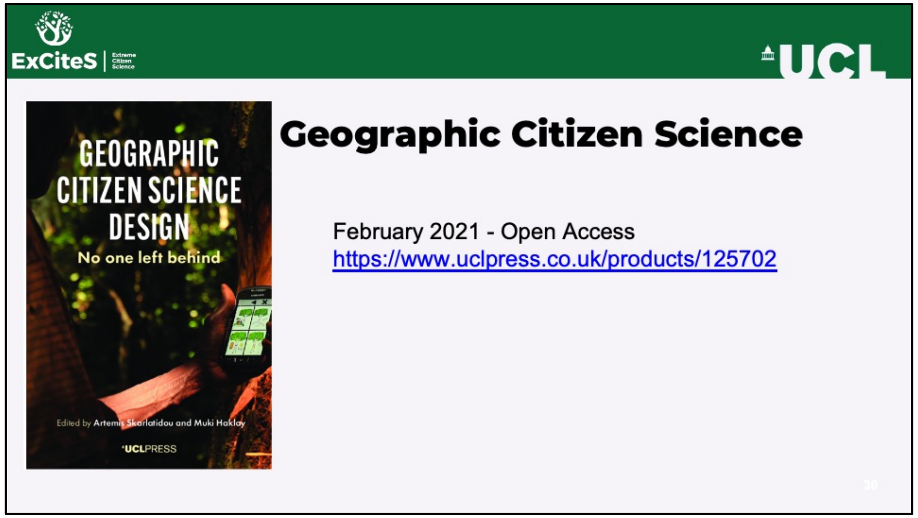
Where VGI and citizen science intersect we have geographic citizen science: and it is defined as scientific work undertaken by members of the general public where the data generated has a deliberate and explicit geographic aspect



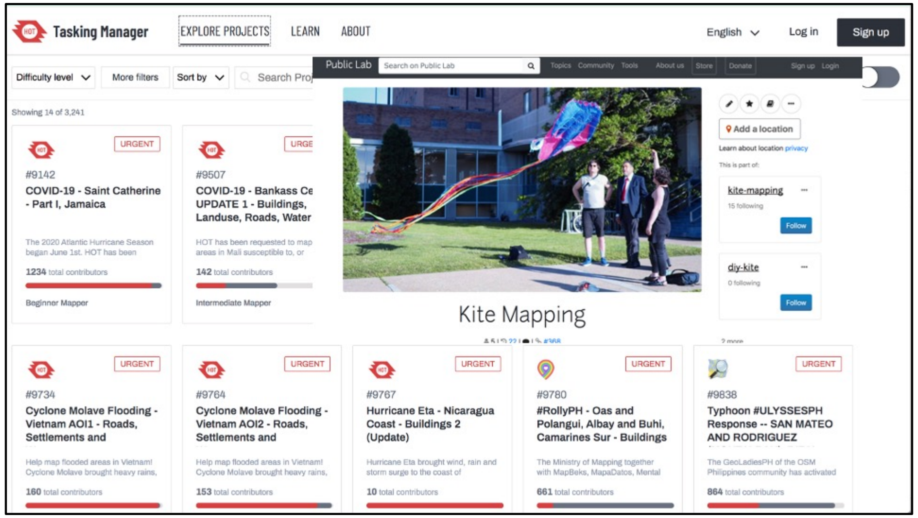
not all VGI is geographic citizen science, and not all citizen science is geographic.

A citizen science project that is concerned with recording an environmental observation by taking a geotagged picture with a smartphone is clearly producing VGI – this is one of the most common examples of geographic citizen science. Also a project that engages volunteers to map the location of all water sources in an informal settlement in the open digital database of OpenStreetMap is carrying out a systematic collection of facts, and therefore it can be considered as citizen science (and therefore geographic citizen science). On the other hand, we have activities which clearly fall outside the conditions of geographic citizen science – such as when VGI is not concerned with recording information in a systematic and objective way – for example, Opinions regarding a restaurant that are recorded in TripAdvisor cannot be considered citizen science.

In addition, VGI that is done without an intention of producing scientific outcomes or purpose falls outside geographic citizen science. Finally, when a citizen science project is not concerned with the geographic location of the observations, it will not be classed as VGI. For example, a Zooniverse citizen science activity which involves classifying galaxies is not geographic citizen science.



wE HAVE recently published with Muki the first book on the topic of geographic citizen science. You can find in this link. it contains several examples from the global north and south, theoretical materials and the emphasis is on how to design more effective interfaces which users can actually use and which create a nice user experience.



As you all know an increasing number of citizen science projects use location-based mobile apps to collect, view, share and analyse data. We saw some in the previous lecture but I would also like to refer to some of the most popular ones here.

1. Examples include inaturalist (and several other similar citizen science portals) which allows people to run their own projects and contribute biodiversity and conservation data in one place.

2. Obviously open street map which is a geographic citizen science project which actually contributes to the discipline of geography and spatial data science.

3. As well as the humanitarian open street map – where you can select a task – specify its difficulty- and start contributing data.

4. Apart from web based and mobile based apps we do also have other ways of contributing data in citizen science. Another example is the DIY Kite mapping instructions provided by Public Lab. Similarly drones are used to collect high quality satellite imagery in other contexts which can then be used for background maps or other mapping activities for contributing data - we did that in the Congo Basin where the background satellite imagery available was of very poor quality. Also generally DIY devices can be affordable versions of commercial off-the-shelf (COTS) hardware for multiple purposes without necessarily compromising geographical accuracy and reliability

5. Of course there are sensors and the more recent developments in AI and machine learning. In that context If there is one technological breakthrough that needs attention when looking at the future of technology and geographic citizen science, it is the combination of the two. In almost

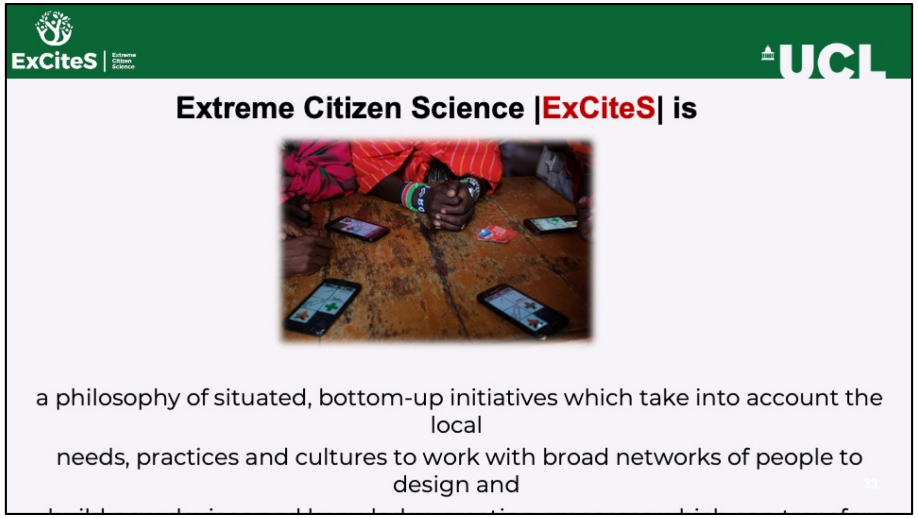
every known domain, AI and ML are breaking ground and providing solutions to all sorts of challenges that were either extremely difficult or unimaginable to cope with before. It is just a matter of time before AI and ML are being used extensively in geographic citizen science projects. For example, it would become easy to automatically classify photos of species uploaded by users to the correct class or to spot outliers in existing data sets with extreme accuracy. Land use and land cover maps which currently require huge amounts of work and *in situ* input from citizens, would be straightforward to produce through satellite or drone imagery classification with AI.

If you take the citizen science module next week we will talk more about geographic citizen science there.

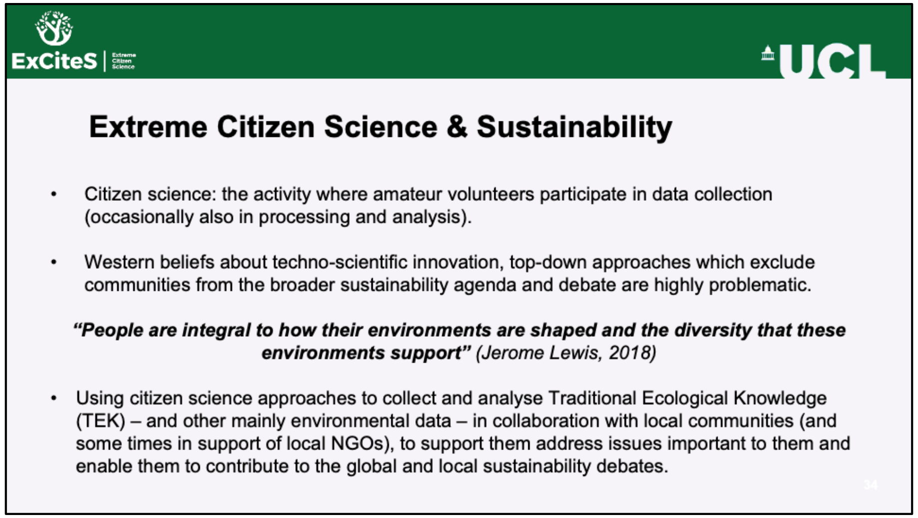
ExCiteS | Extreme Citizen Science

UCL

Extreme Citizen science



We have defined Extreme Citizen Science (ExCiteS in short which is also how our group is called) as a philosophy of situated, bottom-up initiatives which take into account the local needs, practices and cultures to work with broad networks of people to design and build new devices and knowledge creation processes which can transform the world.

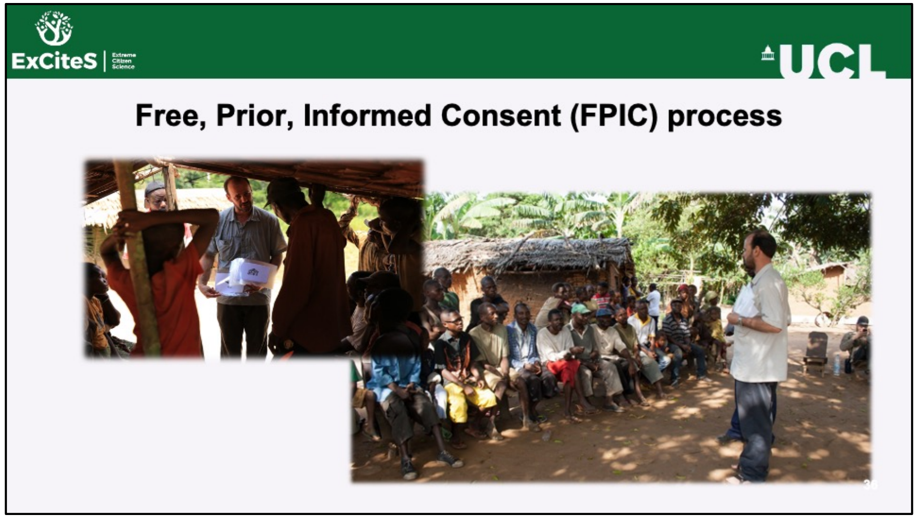


- We saw Citizen science before and explained that it is the activity where non-professional scientists participate in data collection (occasionally also in processing and analysis) which follows scientific protocols and contributes towards advancing science, supporting advocacy purposes and taking local action to address issues of concern.

- We also saw how citizen science evolved through the centuries and it now takes place in a climate where we started to come to the realisation that western beliefs about techno-scientific innovation, top-down approaches and excluding communities from the broader sustainability agenda and debate is highly problematic.

- Our failures and this realisation, resulted in citizen science getting increased attention for the purposes of collecting and analysing TEK, which is recognised within indigenous communities for millennia; as well as other types of environmental data. This is is very much in line with the type of work we carry out in extreme citizen science. We capture, collect and analyse with local people, their communities – occasionally with support or not of local NGOs – local traditional ecological knowledge and help them identify solutions to issues that really matter to them. Our vision is to empower communities and individuals in every part of the world, no matter their background, literacy skills, expertise when it comes to technology-use and so on.

- Extreme citizen science initiatives rely on communities identifying and defining the initial problem themselves. Two are the two key components of the extreme citizen science methodology and our approach to engaging indigenous communities, which always initiate a participatory design process: i.e., negotiating a Free, Prior and Informed Consent (FPIC) process and establishing an open and iterative community protocol.



- The FPIC process aims **to inform "the affected persons about planned activities and their impacts – both positive and negative"**
- **verify "that the information provided has been understood, before explicit consent can be negotiated"** [25].
- The consent **is free and informed highlighting the importance of free will and the ability of communities to refuse an intervention.**
- The consent should be also negotiated **prior to them being affected by any external actions** [25].

- This is a challenging and long process, which further sets the foundations for local capacity building [25, 34].

Establishing a Community Protocol

- To sustain the project over its lifetime, we always work towards establishing a community protocol that formalizes the solutions collectively agreed by the community participating in the work.

  - The first part of the protocol consists of questions and answers about the functioning of the project such as:
  Who collects the data?
  When will they go to collect data?
  How will they collect the data?
  How will they check the data?
  With whom will they share their data?
  Who is responsible for the equipment?
  What risks are there when collecting data?
- This is then followed by a session on the technical and methodological support, another about the logistics support and, finally, one on the data sharing protocols.

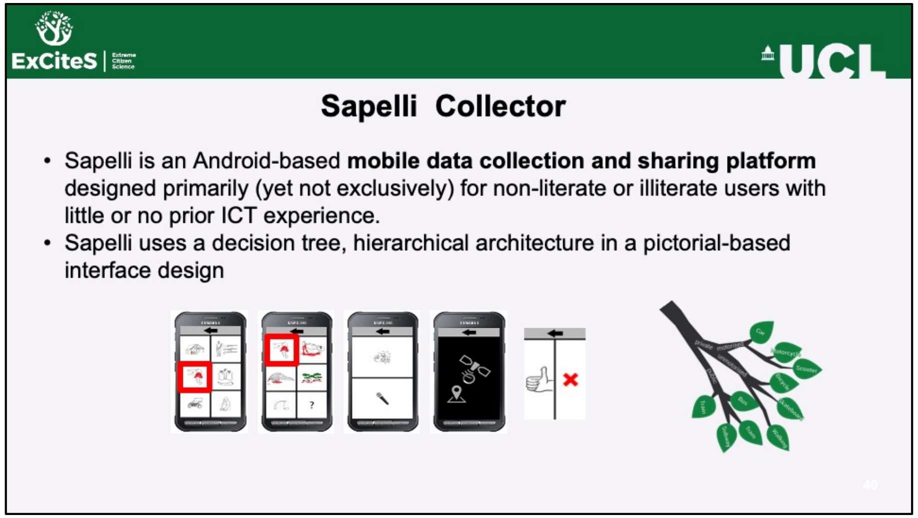
  - *It is important to understand that* the CP itself is a changing and iterative process defined by the local team. Further changes, such as inviting new members and defining their roles, are decided by the local team and need to be documented in the CP.

- Community engagement does not stop with the FPIC and community protocols. Most of the people we work with are very different from the average smartphone - or any technology really user - in the western world. People are low or even non-literate, they don't know how to draw or write, they never used a map before, perhaps they have never owned a smartphone or other cell phone (although mobile use development is driven by developing countries), perhaps they do not have electricity to charge the equipment, they have never had any experience having to all of sudden deal with multiple devices, multiple chargers and I can keep going on and on.

- To lower or eliminate any usability barriers we follow also a participatory design for the interface design and the evaluation of the proposed technological intervention. In this context we also build on knowledge from the fields of HCI4D and ICT4D.

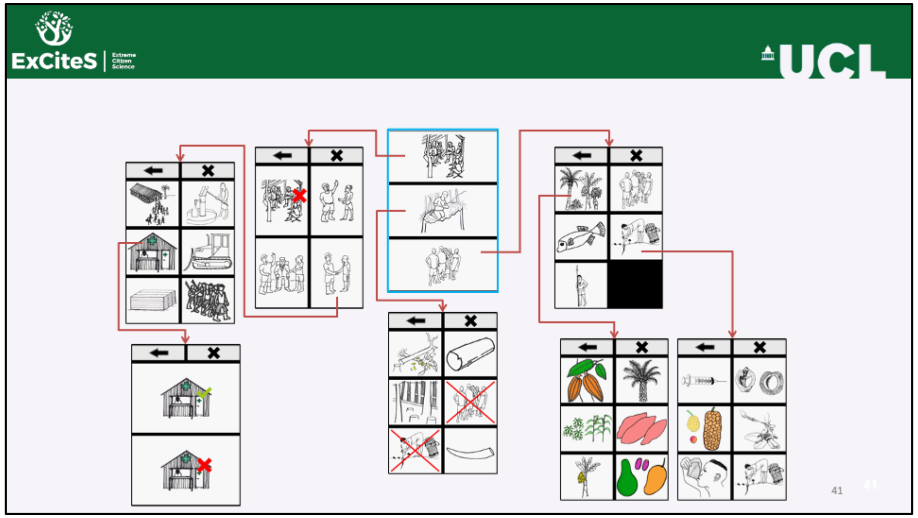
- One example to demonstrate how this process starts, is for the development of the pictograms which are then used to collect the data. Depending on their educational background and other skills these may be codesigned with the community and the research team or may be developed by the researcher and then they are shown to the community to check whether they understand what each icon means (without us telling them what each icon is of course).
- Apart from designing the pictograms, we test our interfaces with local communities, and we invest a lot of energy and time in working with them to evaluate the whole intervention.

- In the next couple of slides will briefly show you the tools we are using in excites, although a more detailed description of those will happen in this week's seminar with Marcos Moreu.



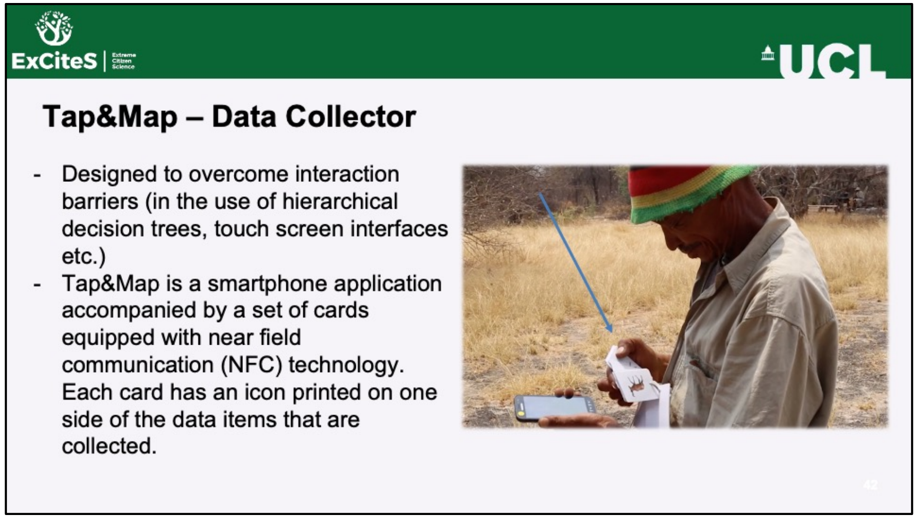
The main data collection application that we are using in all thee cases it is called Sapelli, and we named it after the endangered sapelli tree which grows in the Congo Basin rainforest a valuable source for food and lucrative timber.

The Sapelli data collection app is Android based and it is based on a hierarchical structure and it uses a pictorial-based interface design as you will see in the next slide.

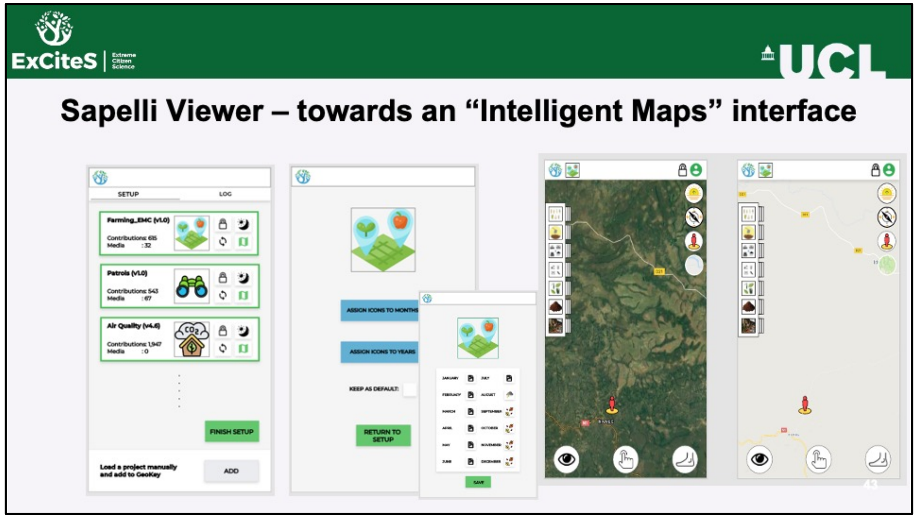


We use in the beginning categorical icons. These are icons that are used to group similar items so that when you have to collect data about let's 70 items you can somehow navigate to find the one you want to map.

From any category you select you get to access a set if more specific icons until you reach the data item (in the leaf node of the decision tree) for which information is collected.



- T&M was Designed to overcome interaction barriers (in the use of hierarchical decision trees, touch screen interfaces etc.)
- And it is a smartphone application accompanied by a set of cards – as shown in the picture – which are equipped with near field communication (or NFC) technology. Each card has an icon printed on one side to show the data item for which data are being collected
- in this process of tapping&mapping, it is essential that the user stands as close as possible to the actual location of the physical object being mapped, so that the device reads and records its accurate location through its GPS sensor.



This is our next big project and very much work in progress at the moment.

So far people to view the data they are collecting had to rely on the research team extracting the data from the phones and creating maps using specialized software.

Most people asked us to view the data as they are being collected (whenever this is possible of course due to Internet access issues) and for this purpose we are designing Sapelli Viewer. As you can see from the screenshots Sapelli Viewer will allow people initially to set up their own Sapelli Viewer project loading the images that are relevant to that project, the base maps, setting up filters that make sense (e.g. for one project people might want to view data monthly bit for another they might need to see it in seasons and so on). Then they will see the map with the data layers on the left and a set of navigation panels on the right which we very much still research now, as the people we work with do not for example use a compass or north/south to navigate (they mostly use each and west where the rises and sets).

The vision for Sapelli viewer is that in the future will also be integrated with scientific models which will help local people make more “intelligent” decisions about their local environments.

ExCiteS | Extreme Citizen Science

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Extreme Citizen Science Case Studies

- Mbendjele Yaka Pygmies of northern Congo-Brazzaville experience for years an unprecedented exploitation of their local forest and natural resources, in ways which are clearly juxtaposed with the indigenous ways of interacting with them.

- For these egalitarian communities of hunter-gatherers, the forest is not only a source of livelihood, but it is important for their traditions and its spiritual role
- In order to support local communities and in collaboration with local Non-Governmental Organizations (NGOs) Sapelli was developed in 2013, and it is used since then with non-literate people, to collect data about illegal logging and poaching in the area

- The vision of local organizations which collaborated in the project is that data collected would provide the necessary evidence to report logging companies' behavior and which would subsequently inform new EU FLEGT (Forest Law Enforcement Governance and Trade) legislation.

- The Ashaninka live in the Peruvian and Brazilian Amazon rainforest.
- They number more than 100,000 people and are probably the biggest indigenous population of lowland Amazonia.
- they fight illegal activities in their territory, but often struggle to be heard by governmental enforcement agencies, therefore they monitor their land mostly themselves.

- To give you an example at the beginning of the 2000s, their land suffered a serious logging invasion from Peru, leading to issues of hunger. The loggers were both consuming animals and scaring them away, and community members feared meeting an invader if they went hunting and fishing.

- The Ashaninka were interested in collecting geographic data using extreme citizen science processes, as they thought that by improving their monitoring strategies, refining the quality of the evidence they collected and speeding up the communication with enforcement institutions with the use of digital technologies they could get a more effective responses from authorities.

The Pantanal is the largest wetland in the world; it boasts a wide and unique biodiversity. Local fishers are directly dependent on it for their daily livelihood.

However, Current legislation for resource management and consumption in the area follow the scientific recommendations of conservation biologists, which assume that people are fixed in time and space [3]. This gradually led into people’s physical and economic displacement of indigenous peoples.

Local communities, which are dependent on the sustainable exploitation of natural resources follow practices which are mostly dynamic and flexible, taking into account periods of intensive use and seasonal abundance of livelihood.

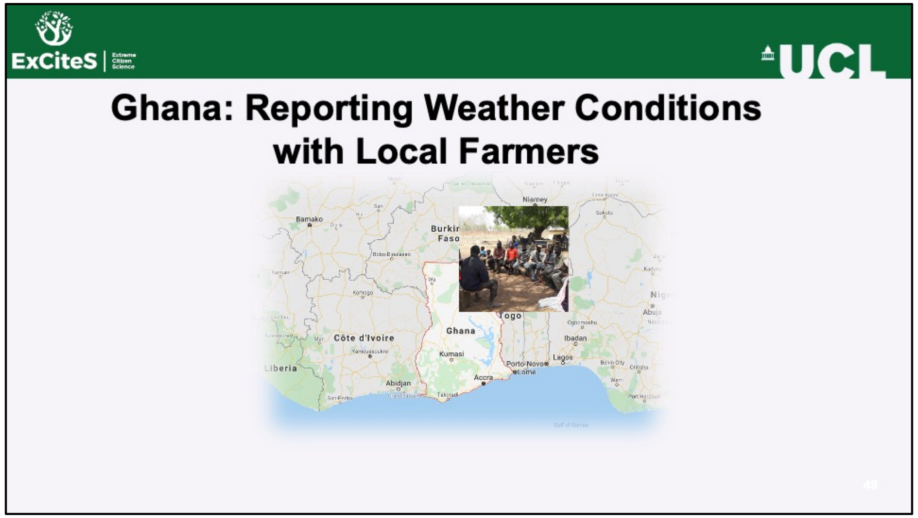
Sapelli is being used with local communities in this area since 2014, who collect data about the use of natural resources and their strategies. The data collected provided evidence that indigenous practices are indeed sustainable and as a result local people have been officially recognized as a traditional community and this provided them the right to use their traditional practices in the ways they rely on natural resources for their daily livelihood.

The Nyae Nyae Conservancy in Namibia officially registered in 1998 in an area where the Ju'hoansi community has hunted and gathered for over 25,000 years.

The area came under threat since local communities have come into contact with agricultural economies and especially due to extensive cattle farming in the traditional hunting and gathering grounds.

As the primary custodians of the Nyae Nyae conservancy the Ju|'hoansi asked for support to enable them collect data which can help fight illegal cattle invasion in their territory.

A first Sapelli implementation for this purpose was deployed in 2015, while since 2018 the communities use also Sapelli to collect data for management and use of the local community forest resources.



Agriculture in Ghana is highly influenced by extreme weather conditions and climate variability.
Due to lack of scientific data, the national meteorological agency cannot always provide reliable information for weather conditions.
Therefore, local farmers rely heavily on their own experiences and intuition, to plan and manage farming activities.
They use Sapelli to report weather conditions and share the knowledge between them as for how their predictions structure their daily activities.
The data collected has the potential to further improve scientific weather prediction models in the area.

- In Kenya, Sapelli is being utilized since early 2019,

- in Narok county it is used with Maasai warrior communities. One of the greatest threats they face is the loss of their TEK and the increased deforestation in the Maasai Mara National Reserve. Sapelli is therefore used to assist them in collecting and recording TEK related to indigenous plants. Within a few hours after the initiative was launched individuals gathered over a hundred data items and since then they've collected thousands of points with information about the medicinal and other properties of local indigenous flora.

Cameroon: Supporting Baka communities Tackle Illegal Wildlife Crime and Animal Monitoring

We have already discussed this in the previous lecture, so have a look there for more information.

Seminar this week

Dr Simon Hoyte - Extreme Citizen Science with Baka communities Tackle Illegal Wildlife Crime and Animal Monitoring in Cameroon.