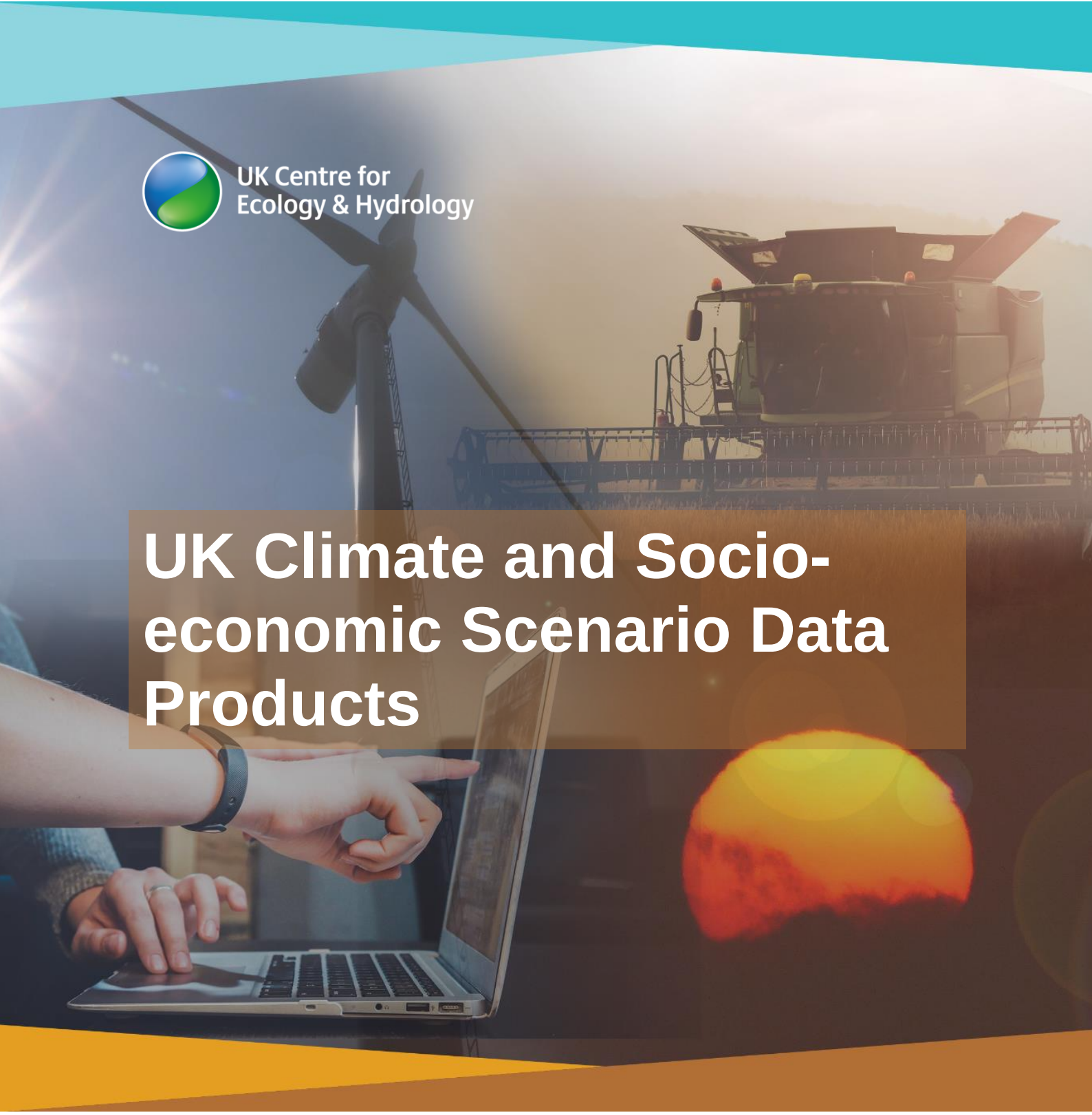

UK Centre for Ecology & Hydrology

UK Climate and Socio-economic Scenario Data Products

Workshop Report

James Bullock, Lucy Ball, Mike Brown, Sue Rennie, Emma Robinson, Paula Harrison

Date: 27/05/2021

UK-SCAPE
UK Status, Change and Projections of the Environment

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Title	UK Climate and Socio-economic Scenario Data Products
Client	UK Research and Innovation (UKRI)
Client reference	NERC National Capability LTS-S: UK-SCAPE NE/R016429/1
Confidentiality, copyright and reproduction	©2021 UK Centre for Ecology & Hydrology
UKCEH reference	UKCEH Project: 06946
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1 Aims and background of the workshop

The workshop took place to discuss some of the outputs of the UK-SCAPE (UK Status Change and Projections of the Environment) programme being undertaken by the UK Centre for Ecology & Hydrology as part of its NERC-funded National Capability portfolio. SPEED (Spatially-explicit Projections of EnvironmEntal Drivers) is a work package within UK-SCAPE, which is producing projections of key environmental variables for the UK over the 21st century, including climate, socio-economics, land use and pollution. The aim is to produce linked and consistent sets of variables that can be used by the wider community in researching future environmental change. This will ensure consistency among different projects (see https://ukscape.ceh.ac.uk/our-science/projects/SPEED for further information).

The projections are being linked to the most recent set of widely applied scenarios for investigating climate change risk and resilience - the IPCC-community Representative Concentration Pathways (RCPs) and Shared Socio-economic Pathways (SSPs). We have been working to produce downscaled and enriched RCP and SSP datasets and products specifically for the UK. We want now to share these data and products with the community, discuss how they might be used, and gather feedback on how best to make these data and products available.

The online workshop (via Zoom) targeted potential users of these datasets. The workshop aims were:

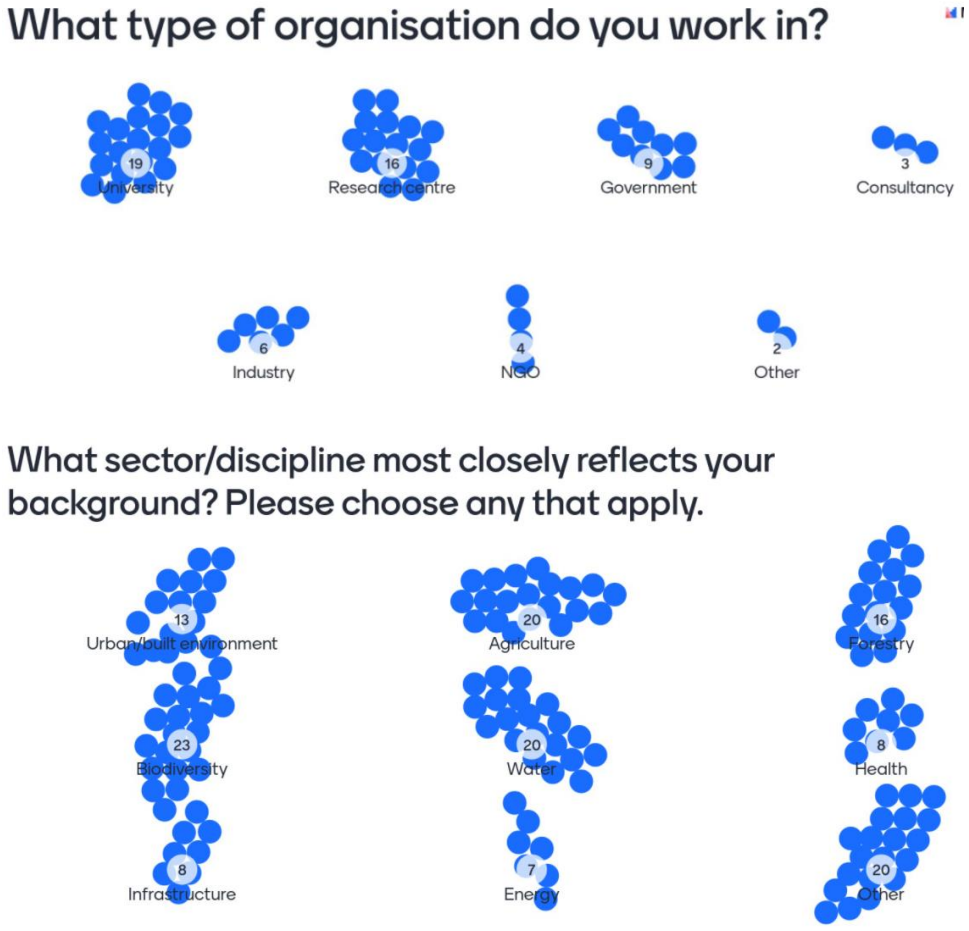
- to describe what scenario datasets and products have been created and the methods used;
- to explain and discuss the basis and potential use of these datasets and products;
- to assess how the wider community might want to use the data and products;
- to discuss the best approaches to making the RCP climate data available and usable by the community.

Recorded presentation: Introduction. Speaker: James Bullock

2 Participants

We aimed at the participation of a wide range of potential users of scenario data. We contacted people using existing mailing lists and through targeted invitations of relevant researchers, as well as more generally via Twitter. 137 participants registered for the workshop, with organisation types comprising: Commercial – 24 registered; Government – 10; Government Agency – 17; NGO or similar – 8; Research centre – 25; University – 53. On the day ca 70 people attended the workshop with the majority coming from Universities or Research Centres, but with coverage of all other organisation types.

Workshop participants covered a wide range of sectors, with fairly equal representation across agriculture, water, biodiversity, forestry and the urban/built environment, and slightly fewer from the health, energy and infrastructure sectors.



3 Workshop summary

3.1 UK Shared Socio-economic Pathways (UK-SSPs)

3.1.1 Summary of UK-SSP data products

The SSPs describe a set of alternative plausible trajectories of societal development, which are based on hypotheses about which societal elements are the most important determinants of challenges to climate change mitigation and adaptation. SPEED has been working with partners[1] to develop UK versions of the SSPs through a participatory process involving stakeholder workshops, interviews and questionnaires to extend global and European versions of the SSPs spatially, temporally and sectorally.

[1] The UK-SSPs products have been jointly developed with Cambridge Econometrics, University of Edinburgh and University of Exeter through co-funding from the Met Office as part of the UK Climate Resilience Programme (DN420214 – CR19-3).

The UK-SSP products are available from the UK-SCAPE SPEED website (https://ukscape.ceh.ac.uk/our-science/projects/SPEED/shared-socioeconomic-pathways) and the UK Climate Resilience programme website (https://www.ukclimateresilience.org/products-of-the-uk-ssps-project/). They comprise:

(i) Narratives around 5-6 pages in length that describe socio-economic developments for the UK over three time periods (present to 2040, 2040 to 2070, 2070 to 2100) as well as differences in socio-economic developments in each of the four UK nations (England, Wales, Scotland and Northern Ireland) where relevant. These are known as “Scenario Fact Sheets” on the websites.

(ii) System diagrams that visualise the interrelationships between socio-economic drivers within each UK-SSP. These are available as flat pictures within the “Scenario Fact Sheets” or as animation videos with voice-overs narrating the key relationships within the scenario.

(iii) Tables of semi-quantitative trends showing the relative directions and magnitudes of changes in 50 socio-economic variables for use by modellers. The trends are provided in seven categories (from strong decrease [- - -] to strong increase [+++]) for all five UK-SSPs and for three periods (present to 2040, 2040 to 2070, 2070 to 2100). A rationale for each trend is also provided to help understanding and interpretation by modelling teams. These will be made available on the websites by end May 2021 as a PDF and through the InsightMaker interface.

(iv) Detailed quantitative projections for 25 socio-economic variables for all five UK-SSPs at a range of spatial resolutions covering 1km, Local Authority Districts, NUTS2, NUTS3 and UK. An opensource tool for regridding data is also being developed that will provide access to essential python libraries for geospatial analysis (e.g. Geopandas, shapely, and pyproj). It will provide a workflow to take the quantified projections data and interpolate/aggregate the data to specified output grids. These data and tools will be provided via the UK Climate Resilience website by end May 2021. They can also be accessed via the InsightMaker interface on the same website.

Recorded presentation: The UK Shared Socio-economic Pathways (UK-SSPs)
Speaker: Paula Harrison

3.1.2 Q & A

Question	Response
Could you perhaps clarify which spatial projections account for future climate change? I think you mentioned land use, but what about food production?	Both land use and food production take account of climate change as they are simulated using the same CRAFTY-UK land use model.
Why did you decide not to make food production responsive to climate change impacts?	See above.
How would the SSPs be coupled with RCPs and national pathways to Net Zero	The UK-SSPs can be coupled with the RCPs in a flexible manner depending on whether your study objectives require consistency in the underlying assumptions at the global scale. This depends on if you want to assume that the rest of the world is following the same SSP as the UK. To explore national pathways to Net Zero you would need to bring in additional elements of climate policy, the robustness of which could then be tested against different UK-SSP and RCP combinations. This is equivalent to defining Shared Policy Assumptions (SPAs) in the IPCC-community scenario framework.
Does the (realistic) spatial resolution vary with time into the future?	No, the spatial resolution of the quantified projections is fixed over time at the finest resolution for which we have baseline data.
It was identified at the start that the scenarios would be used to look at projections of pollution. There did not seem to be that many pollution variables in the mapping etc	There are variables in the tables of semi-quantitative trends that can be related to pollution, such as industrial activity, fertilizer use, etc. In SPEED we are currently working with the pollution modellers to define additional variables related to heavy metal pollution. These will be released at a later date to the set of 50 variables.
You said only land use variables are responsive to climate change impacts - can you say more about this and how other 'static' variables can be interpreted considering CC impacts?	The SSPs are independent of climate change and climate policy, which means they do not consider the potential impact climate change may have on societal and economic choices. Rather the SSPs can be used to explore how economic and societal choices may affect greenhouse gas emissions and, hence climate change, and the feasibility of meeting climate targets such as the goals of the Paris Agreement. To explore how both climate change and socio-economic change effect climate impacts or risks, the SSPs need to be combined with the RCPs (as we have done for a limited number of combinations for the land use variables).

Question	Response
Are the SSPs UK wide or is there regional variation, e.g. Scotland v England following different trajectories?	Regional differences across the UK are reflected in both the narratives and spatial projections. In particular, the narratives have separate sections on England, Wales, Scotland and Northern Ireland that emphasize differences of each UK country from the full UK narrative or provide specific regional examples. Spatial variation is reflected in the projections by calculating whether trends converge or diverge spatially, e.g. if the scenario specifies the UK becomes more equitable, we assume regional differences reduce. We also account for differences between urban and rural regions from the narratives.
Has uncertainty in these projections been quantified in anyway, and if so how?	Uncertainty is only reflected in the design of the SSPs as five exploratory scenarios, which set out different plausible futures that aim to cover the possibility space in relation to challenges to climate change adaptation and mitigation. We haven't had time or resources in this project to include quantification of uncertainty in the spatial projections, but this could be done in follow-up work by the community.
It can be expected that the working class and the underclass will be most at risk of negative climate change impacts (e.g. presumably in the Life expectancy slide that was shown): 1. Were these demographics represented in the stakeholder workshops? 2. Consequently, are these demographics explicitly included in the analyses and products? 3. In the System Diagrams, the Social Structure and the Demography drivers look a bit isolated? Is that the case, and what are the reasons for this?	The stakeholder engagement aimed to involve a representative coverage of a broad range of expertise and viewpoints across the UK climate resilience community. A detailed stakeholder mapping and identification process took place to support this, but we were limited in engaging with approx. 50-60 stakeholders in total, so there will inevitably be some biases in representation as in all participatory research. The working class and social structure is represented in all five narratives. They may dominate in some UK-SSPs more than others, such as UK-SSP4 (the Inequality scenario). In the systems diagrams the position of the nodes (representing the key drivers) and the connections between them vary by UK-SSP, so social structure and demography are more central in some than others.
Are the downscaled products spatially coherent?	Yes to the degree we are able to check this. The system diagrams were created to help ensure internal consistency between variables within each UK-SSP. We then iterate several times between the narratives, system diagrams, semi-quantitative trends and spatial projections to ensure consistency and spatial coherence is maintained between all products.
Do you think the timing of the second workshop (May 2020) affected the types of drivers identified as important? (e.g. did global shocks	Yes, response to global shocks emerged as a new driver from the online workshop held in 2020 and was a direct result of participant's experiences with the coronavirus pandemic. The key dimensions for this driver were defined as

Question	Response
come out more strongly than during first workshop?)	whether recovery after a global shock was persistent or transformative. This is discussed in this paper in Nature Climate Change (see Box 3 on “Scenarios and COVID-19”).
Have you produced user examples that show how the SSPs can be used, for example, for regional economic strategy?	No, there hasn’t been time to do this yet, but in SPEED we will demonstrate how the SSPs can be used in examples related to land use, pollution and biodiversity. We hope the wider research community will provide further use cases.
Could you please comment on how the product could be of use for looking at potential changes in food production and consumption patterns in future? (I believe that the IPCC has looked at a range of patterns and the CCC has suggested 20% less meat and dairy)	Each of the UK-SSPs has different assumptions about production and consumption, ranging from a highly individualistic and high consuming society in UK-SSP5, to an egalitarian and co-operative society with healthier lifestyles, improved well-being and sustainable use of natural resources in UK-SSP1. Each scenario therefore has very different trends in production and consumption that can be used to explore implications on land use, health, etc. The projections of land use and food production will take account of these, but studies can undertake their own analyses using the richer narratives or the large range of variables for which we have produced semi-quantitative trends, e.g. overall consumption levels, consumption source/proximity, meat consumption.

3.1.3 Participants' planned use for UK-SSP data and products

3.2 UK Climate scenarios

3.2.1 Summary of climate data

SPEED has developed the CHESS-SCAPE future climate data set to provide UK climate change data that have high temporal and spatial resolution, are consistent with historical observations and demonstrate a range of possible climate change scenarios. The data set is derived directly from climate model output provided by UK Climate Projections 2018 (UKCP18), but extends it by: (i) downscaling to 1 km resolution based on physical and empirical relationships; (ii) bias-correcting to the CHESS-met observation-based data set; and (iii) developing alternative RCP scenarios, derived from the original RCP8.5 scenario provided by UKCP18. CHESS-SCAPE provides several physical climate variables to 2080 at 1 km spatial resolution and time steps ranging from daily to decadal averages.

The CHESS-SCAPE data set comprises a four-member ensemble of daily climate variables for 1980-2080 at 1 km resolution, based on four members of the UKCP18 12

km Regional Climate Model (RCM) ensemble. For each ensemble member we provide a) downscaled 1 km resolution climate data and b) downscaled and bias-corrected 1 km climate data. We provide both of these for four IPCC RCPs: 2.6, 4.5, 60 and 8.5. We also provide the data averaged to monthly, seasonal and annual means, and provide 20-year mean monthly climatologies.

To create CHESS-SCAPE we selected four members from the UKCP18 12km RCM ensemble. The members were selected based on the change in air temperature and precipitation from the start to the end of the century, such that we span the range of the underlying ensemble. Each of the ensemble members was downscaled to 1 km resolution, using an adapted version of the CHESS-met methodology, which interpolates and uses a combination of physical and empirical relationships to adjust for local topography, including elevation, aspect and slope.

After downscaling, we bias-corrected the projections by comparing each of the CHESS-SCAPE downscaled ensemble members to the existing CHESS-met historical data set. Correction factors were calculated for each season of the overlap period 1980-2015, then applied to the full extent of the CHESS-SCAPE data.

Finally, as UKCP18 only produced climate model output for RCP8.5, we created the other RCPs (2.6, 4.5, and 6) by applying time shifting and pattern scaling to the CHESS-SCAPE RCP8.5 data. Both approaches rely on the assumption that the impact of a given amount of global warming on UK climate variables is linear and does not depend on the trajectory taken. Time shifting involves substituting years from RCP8.5 which have the similar global warming as the target RCP. Pattern scaling involves adjusting the UK climate variables by an amount that depends on the difference between the given global warming and a target global warming. For CHESS-SCAPE, we use selected members of the CMIP5 ensemble as a reference. We first apply time shifting to the CHESS-SCAPE ensemble members. This gives a new time series that has too high a variability compared to the target RCP, so we then apply pattern scaling to adjust the climate variables closer to the target RCP. The pattern scaling is calculated by linear regression of the seasonal mean of the climate variables in each 1 km pixel to the global annual mean air temperature.

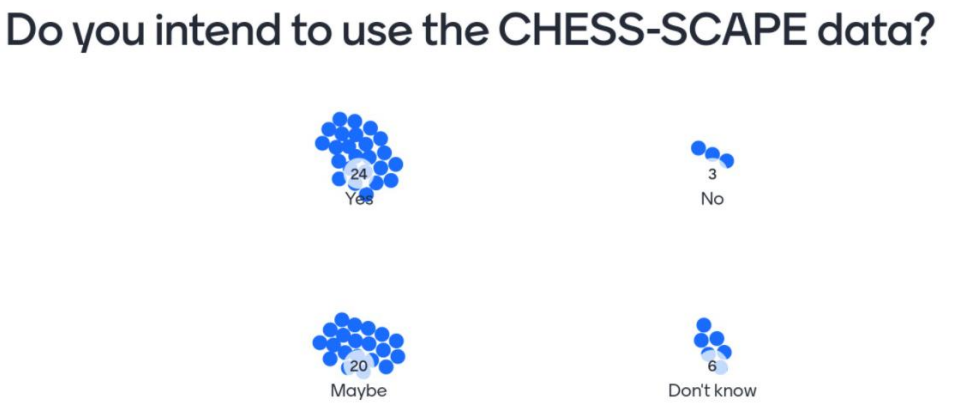
Recorded presentation: A new high resolution data set for modelling climate change impacts. Speaker: Emma Robinson

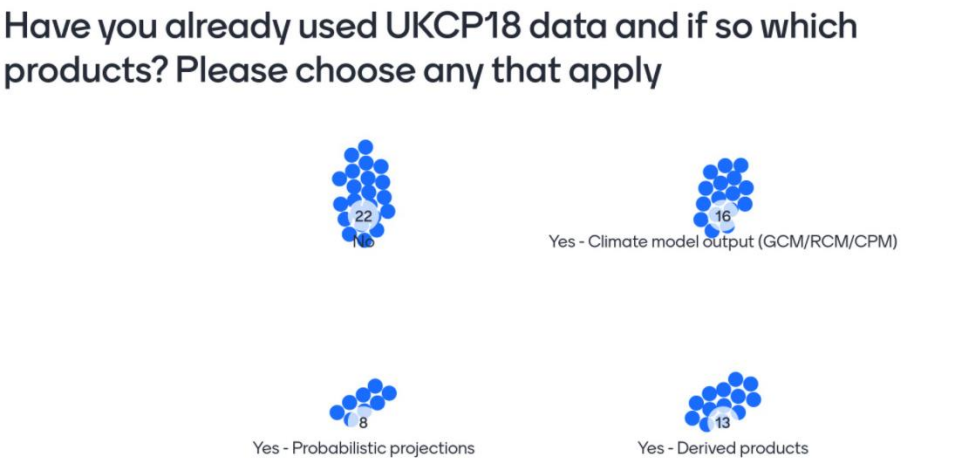
3.2.2 Q & A

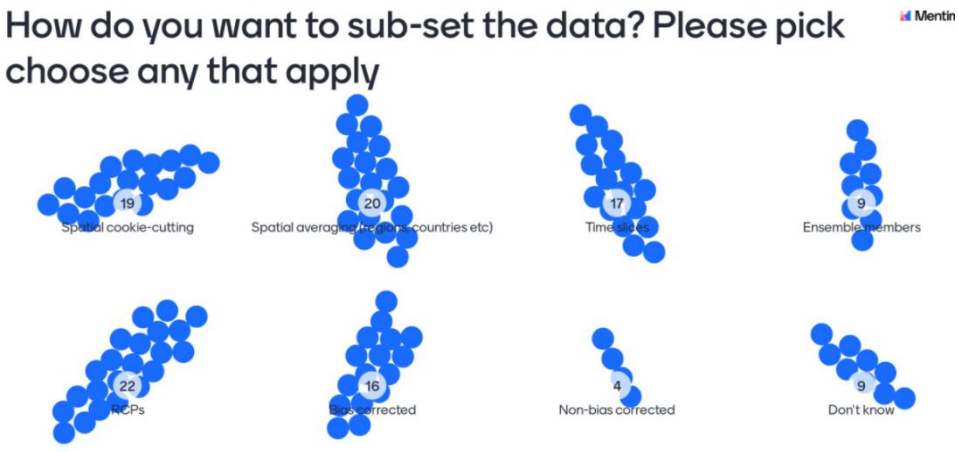
Question	Response
With monthly and seasonal bias correction, do you still just get drizzle or realistic daily rainfall intensities?	We are not doing anything to the distribution of rainfall, we are just scaling it so we will preserve the same rainfall intensity and the same distribution of rainfall intensities that are in the 12 km RCM. This is less drizzly than the Global Climate Model because it is a finer resolution and is better parameterised for Europe, but it won't be as realistic as the convection permitting model, because this has more realistic atmospheric physics and gets higher intensity rainfall more accurately.
Are there consistencies between variables and is the bias correction applied to the original daily data?	Yes, there is consistency between variables. Some are downscaled and are kept consistent with other variables, and some of them are preserved in terms of the rate, so the rainfall is consistent between CHESS-SCAPE and UKCP18. The bias correction is applied to the daily downscaled CHESS-SCAPE data – it isn't applied to the 12 km UKCP18 RCM data.
How would increased treescapes and larger areas of protected land be factored in?	Because we are not running a climate model we are not able to change the land use that is going into the climate modelling. When the Met Office ran their climate model to produce UKCP18 they had a specific land cover dataset and the model would respond appropriately for that land cover. The land use change modelling in SPEED would then affect how the climate interacts with the land surface so it could have an effect on modelling of hydrology for example but it wouldn't change the climate data. The protected areas will come from the SSP part of the dataset, and the narratives will provide a guide on whether that society is looking to reforest or not – this is moving more into impacts assessments and land use change modelling.
Can you confirm that the final product will cover NI? Some of the maps you showed looked like GB only.	The downscaled data will cover Northern Ireland, however we didn't have the data to do the bias correction for Northern Ireland, so the bias corrected data will be GB only.
Is there any intention to produce a similar set of projections for climate extremes (that would in some cases require higher temporal resolutions to be captured)?	Short answer is no. At extremes, particularly at sub-daily time-steps the convection permitting model is what would produce those kinds of numbers. Because we're at the daily time-step we wouldn't be able to tell you anything about sub-daily extremes.
With regards to CHESS-SCAPE: What are the differences between this	MO SPF UKCEH eFLAG is a project some of our UKCEH colleagues are involved in - which is

Question	Response
and what the MO SPF UKCEH eFlag project are doing?	really to do with hydrological modelling. As far as I understand, they are using 12 km RCM data as it is, and they downscale at the point of doing their hydrological modelling. They are doing bias correction but they are doing it with different reference data. I think they're only doing it for precipitation but I'm not completely sure. They do it at a monthly timescale, but the bias correction factors are very similar between ours and theirs. We are providing a comprehensive dataset that other people will be able to use, and they are doing it as part of their project to produce projections of flooding. There are similarities, but ultimately we are ending up with different datasets at different resolutions.
Will you provide PET (potential evapotranspiration) under different land use assumptions?	The original CHESS-met data we used to produce a CHESS-PET which was Penman Monteith assuming short-grass land cover. Thus far we have carried out the same calculations internally for our SPEED work. In the longer term I've been working with UKCEH colleagues to update and improve the Penman-Monteith calculations so that they're more appropriate and a better representation of PET, and so that we have consistent PET products. We've started off with just short grass land use but we are looking at the possibility of doing that with different land use assumptions. However, this won't be a part of the initial release.
Did you attempt any cold air drainage adjustments or feedback between land use and albedo etc, (or are these things we would potentially incorporate separately in statistical models)?	Short answer is no. We mostly don't account for land use in the downscaling. We do have albedo because we are converting from net radiation to downward radiation, but we haven't done any of the things mentioned in your question. If you're proposing to incorporate these in statistical models, we would have to rerun the land surface model and see what effect that will have on the land surface but it wouldn't have a feedback into the atmosphere.
*Was bias correction done based on daily/ monthly/ annual?**	*The bias correction was calculated using seasonal metrics calculated from daily values. It was applied to the daily data, then the daily bias-corrected data have been averaged to monthly, seasonal and annual means.*
*The original UKCP18 12 km data has some large errors - particularly precipitation in upland areas - will these biases be propagated through the bias-correction process?**	*The bias correction will correct these errors.*
** Not answered in the meeting*	

3.2.3 Participants' planned use for SSP data and products







3.3 Options for accessing the climate data

3.3.1 Summary of climate data

Access to the outputs of UK-SCAPE is one of the key deliverables of the programme. The CHESS-SCAPE data will be available from the CEDA archive as a set of downloadable files organised into a number of time averages (daily, monthly, annual, seasonal and 20-year mean-monthly climatologies) for each variable, ensemble member and RCP and for bias-corrected and non-bias-corrected data. However, the data set is still large, consists of many files and the only way to analyse and use it would be to download it to your computer.

In this presentation we introduced some novel methods of data access that could be developed in partnership with UKCEH.

Recorded presentation: Data Access Tools. Speaker: Mike Brown

Web Portals

These are user-friendly interfaces to visualise, interrogate and access data products through online web-based portals. Typically, we can provide tools for spatial cookie cutting for user defined areas as well as time slices of the data. These tools provide users with the ability to explore the data and download only the area of interest through a bespoke interface.

Application Programming Interfaces (APIs)

APIs provide a dedicated set of URLs (web links) that return a data response if you use the correct call. In this way you can access the data from your favourite coding platform, e.g. R or Python, etc. This means they can provide timely access to quality-assured data in appropriate formats and through standards-based services open for use by the community. Since you have a standardised way of accessing the data through a programming interface, this means you can build your own custom applications on top of the API we can provide.

Virtual Collaborative environments (DataLabs)

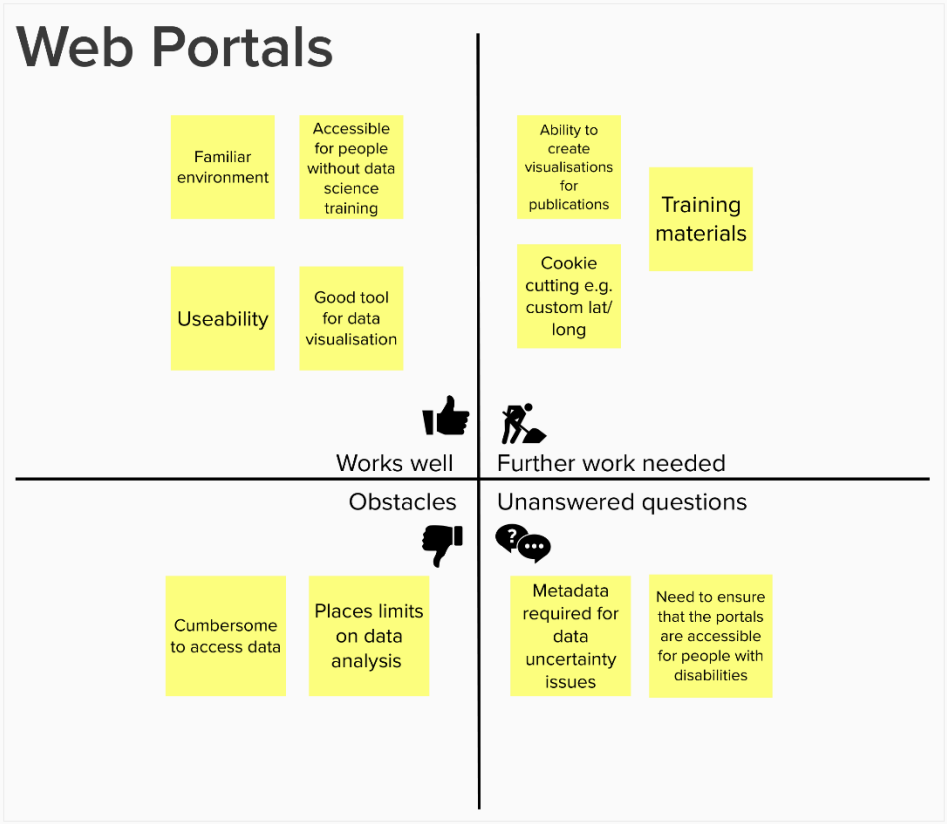
These are cloud-based collaborative research environments based on notebooks technology, e.g. RStudio, JupyterLabs, that are accessible through a web browser. The data is available in the DataLabs environment so as to enable a co-design approach in developing new analytics capabilities for a range of complex environmental research questions.

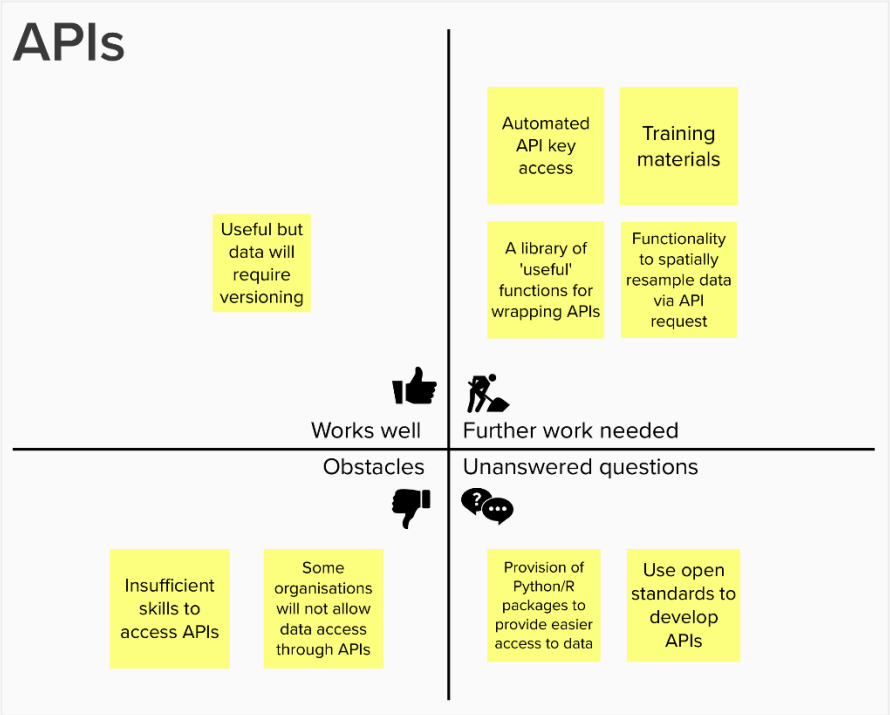
In summary these tools can provide:

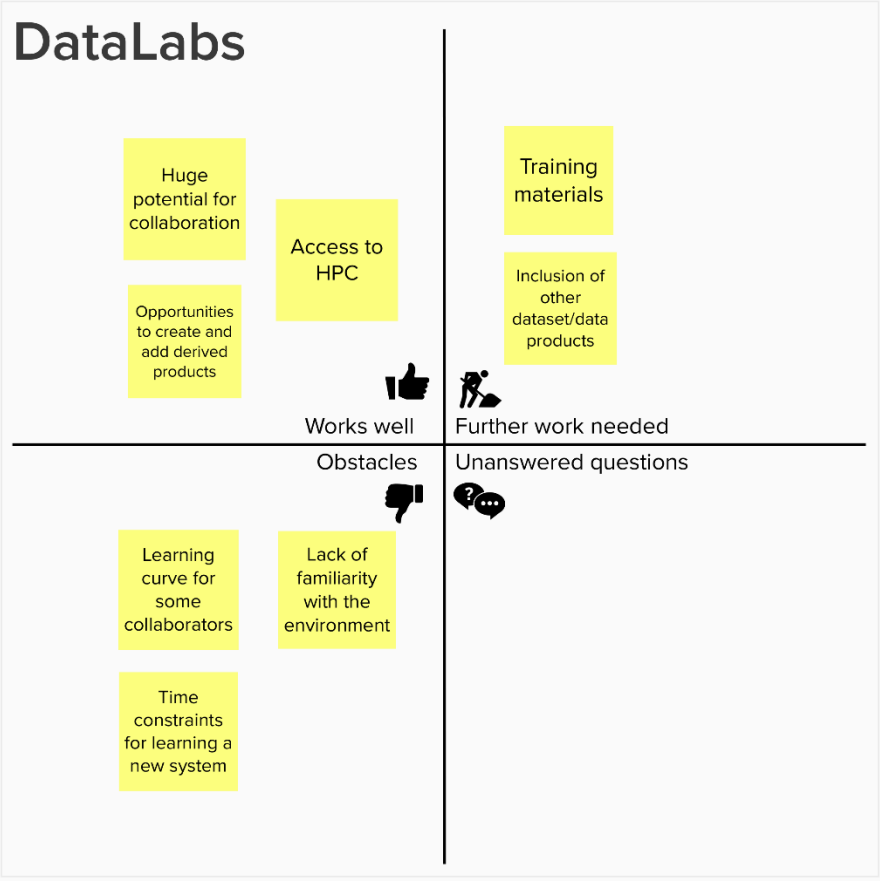
- Easier access to data;
- Simpler integration of data from different sources;
- Virtual Collaborative Environments in a cloud based computational infrastructure.

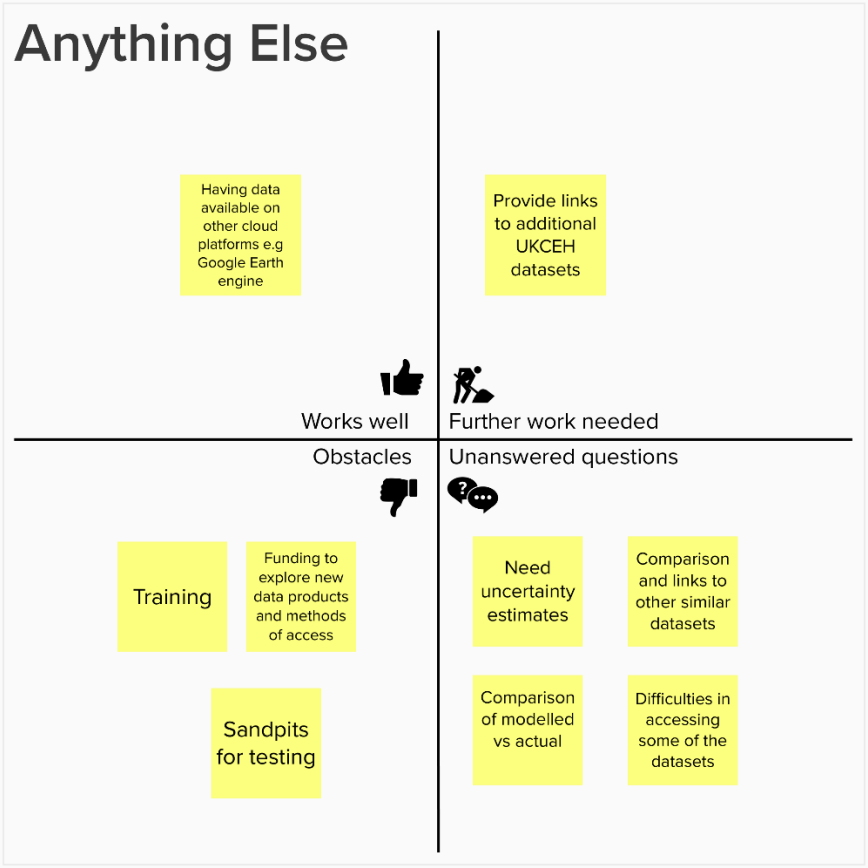
15 Summary of the Mural session feedback

The participants were able to provide feedback using Mural – a virtual whiteboard tool. The complete Mural board is available in Annex A but these graphics summarise the main issues highlighted by the participants:




APIs
Automated API key access
Training materials
Useful but data will require versioning
A library of 'useful' functions for wrapping APIs
Functionality to spatially resample data via API request
Works well
Further work needed
Obstacles
Unanswered questions
Insufficient skills to access APIs
Some organisations will not allow data access through APIs
Provision of Python/R packages to provide easier access to data
Use open standards to develop APIs


DataLabs
Huge potential for collaboration
Access to HPC
Training materials
Opportunities to create and add derived products
Inclusion of other dataset/data products
Works well
Further work needed
Obstacles
Unanswered questions
Learning curve for some collaborators
Lack of familiarity with the environment
Time constraints for learning a new system



More general comments from the 'Parking Place'

- Risk that this is all interesting research that does not get used
- "Interoperability" - making sure we can make this data talk to other data by including as many geotags/spatial aggregation units etc as possible, so easier to cut in different ways
- How do you see the Narratives themselves being used as research resources?
- Whichever way you go, ongoing support / updating / Q&A email address will be important. So many portals that are no longer maintained.
- How to do evaluate the usefulness to people - is there something going on in the background?
- Would be great if any web portal included both climate projections and spatial SSP projections
- Need the ability to download so can combine with other data/models
- How to promote collaboration with the private sector?
- For report: just very clear information on what they have (and haven't) included, and how, so that we know what's in there already and what else we might think about including separately.

Notes about 'What aspects of the data are of most interest'

- Data values, at original 1 km resolution but probably summarised across monthly time-slices.
- Daily high-spatial resolution for calculating population exposure for health impact assessment.

- Ability to extract data for multiple cells or areas (e.g. river basins).
- Potential of co-creating products for commercial use.
- Ease of access for teams with some python expertise but not their core day job.
- Data values for UK regions; data values for specific locations; daily data for both of these.
- How to better integrate climate projections with inflection points in the narratives - i.e. extremes changing the basis for the narratives.
- How to make the SSPs responsive (dynamic) to climate change impacts - so as to incorporate feedbacks between climate and temporal development of the SSP as currently static (except land use).

16 Conclusions

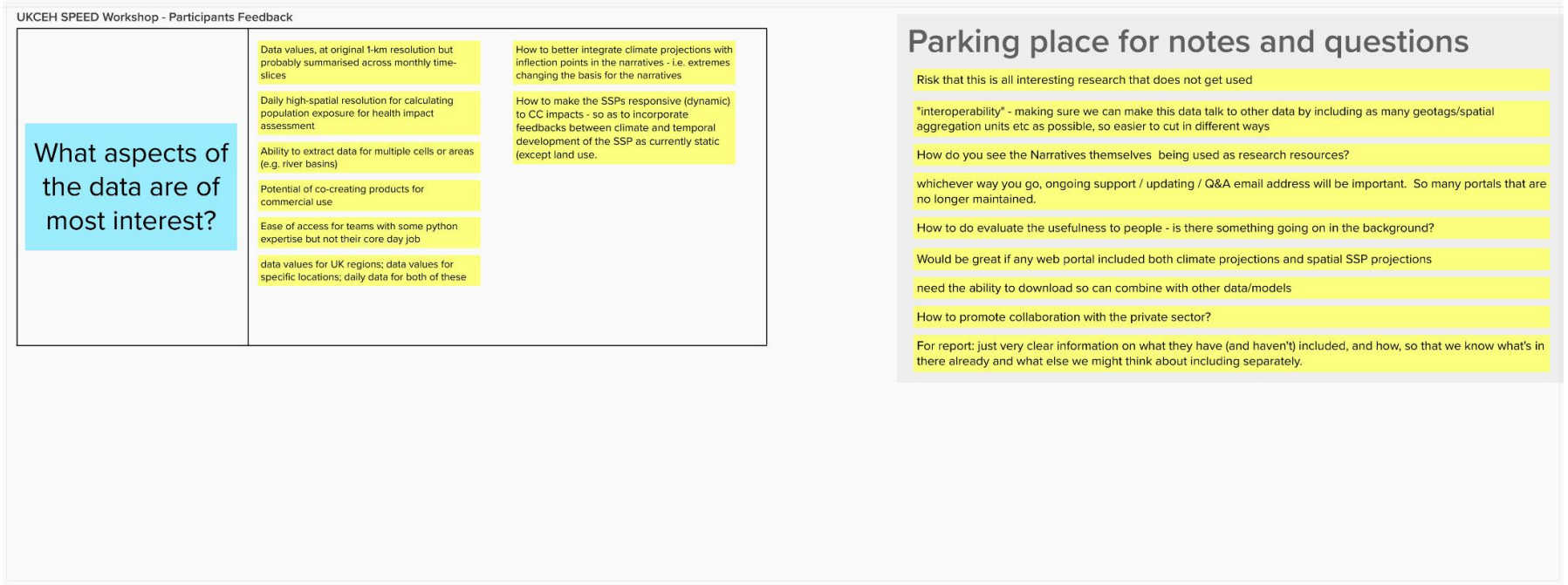
A vast majority of attendees at the workshop said they expect to or may use the data. Most other responses were ‘don’t know’. We take these responses as suggesting a wide desire and need for the climate and SSP data and products SPEED is providing. The feedback sessions illustrated a variety of potential data users from a range of sectors. Equally, there was great variety among attendees in which aspects of the SSP or climate data they plan to use, how they would want to sub-set the data and how they would like to access the climate data. On the last point, attendees expressed different opinions on web portals vs APIs vs DataLabs. Issues raised concerned ease of use, training requirements, flexibility in accessing data, and the ability to link to other data sets. These points suggest that there is not a ‘one size fits all’ solution to data access. The transferring of the climate data to the CEDA archive is progressing and we will continue to explore other data access options.

As SPEED progresses, we will be producing maps and data sets of land use, heavy metal pollution and biodiversity responses to scenarios that use realistic combinations of RCPs and SSPs. These will be made available to the wider community and publicised through further workshops. We will contact all those registered for this workshop as these future events are organised.

Annex A

UKCEH SPEED Workshop - Participants feedback

	What do you like about this approach?	What are the obstacles to you using it?	What additional functionality is needed?	Anything else?
Web Portals	Accessible to people without data science training "Lay friendly" Clear outputs for non data people Familiar environment - wide usability Visualising Probably the most flexible way of getting data for most workflows. Allows easily transferable code (e.g. in MS supplement) Seems flexible - useful to be able to visualise data before downloading	Few obsticles Slow and cumbersome to access data Often detail/specifics on data used or extracted can be limited for further analysis.	To save visualisinations in peer-review publication quality Upvote for saving visualisations for papers cookie-cutting - ability to set custom longitude and latitude Important to make simple key stroke video so folk can learn/understand	Need for metadata and additiona linformation about data uncertainty issues Do you have plans to make suitable for disabled people visually and audio? I wasn't totally sure how APIs differ from web portals
APIs	Would need to provide versioning for publication. Presumably the API would enable data to be used in interfaces that offer more experiential approaches eg sound-based? Getting the most upto date data is great but need to come with version data	As a government agency we have some issues with connecting externally through ftp, API, etc. due to corporate ICT, so we have usually downloaded the data locally and use from there, but it's a bit unweildy! programming skills haven't used these before so would need to get trained up!	Python library to make using API easy e.g. getting specific data, load with xarray etc Implementation of summary functions and spatial and tsemporal subsetting over time series of 'images' How about the functionality to spatially resample data via the API request, e.g. request data at 10x10 km resolution, rather than having to pull data at the native resolution and resampling yourself. "How to use the API" tutorial on the website would be nice Automated API key access (cf. IUCN Red List where you have to wait ages for keys), e.g. if .ac.uk or other edu email addresses?	How about providing Python/R/etc packages to wrap around the API to provide easier access to data without having to dig into the API. These could offer "extra" functionality over the API, e.g. plotting utilities. R package talking to a back end Open innovation framework around AIs?
Data labs	access to powerful computing directly from R Huge potential for collaboration COLLABORATION Opportunities to create and add derived products Great idea to work as community Possibility of collaborating with partners.	Some partners may find the resource overwhelming to use. Steep learning curve - hard to tell if it fits my specific use-case, thus hard to justify investing the time harder to get into if you are not familiar with the data? Little known in many parts of the biodiveristy sector Lack of big data staff resources in environmental consultancy as others sectors pay double for python/R coders Learning curve for some potential collaborators Staff time constraints make this difficult but it is interesting	Are you interested in adding 'added value' products? We have a suite of c.30 agrometeorological indicators? Combining with other datasets, e.g. population mapping to generate exposure estimates Easy access to help and support. Often I prefer to download data to analyse in software where it is accessible to ask questions/watch tutorials.	We have time series animations of different ypes of indicators derived from BC'd UKCP18 - would be good to see time series of your data as well
Anything else?	Having data on other cloud computing platforms (E.G. Google Earth Engine) could be nice too Would be useful to have some part of the dataset in the google earth environment - would be a road in for some to use the data.	Awareness acroiss a wider range of potential users Need for 1. much more interactive introductions that are less technical/jargon based to enable creative practitioners to engage... 2. experimental spaces where playful approaches could be tested and prototyped collaboratively 3. funding to support novel approaches to the data sets 4. engagement with cultural sector organisations to explore how these experiments can be contextualised into programmable activities 5. thinking about ways that specific communities of interest and or geography can engage with data sets c.fremantle@rgu.ac.uk	Depending on what is decided you need to either include other CEH etc. datasets or point to them.	x4 ensemble members misses a lot of the variability within the the full x12 ensemble Need for additional information - i.e. from UKCP18 on data use caveats, particulalry addressing areas of uncertainty Comparison with and links to other data available i.e. EURO-CORDEX Clear description of the uncertainties - needed so we can clearly communicate this to stakeholders. Evidence of testing of BC products agains observations - need to build credibility in utility of data How do you think that the datasets could be utilised to help inform food systems changes in the UK from both a production and consumption perspective? As an NGO we have had difficulties in the past getting access to datasets.



All feedback from the participants has been included in the Mural board. Please note these notes have been organised and made consistent to aid readability

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