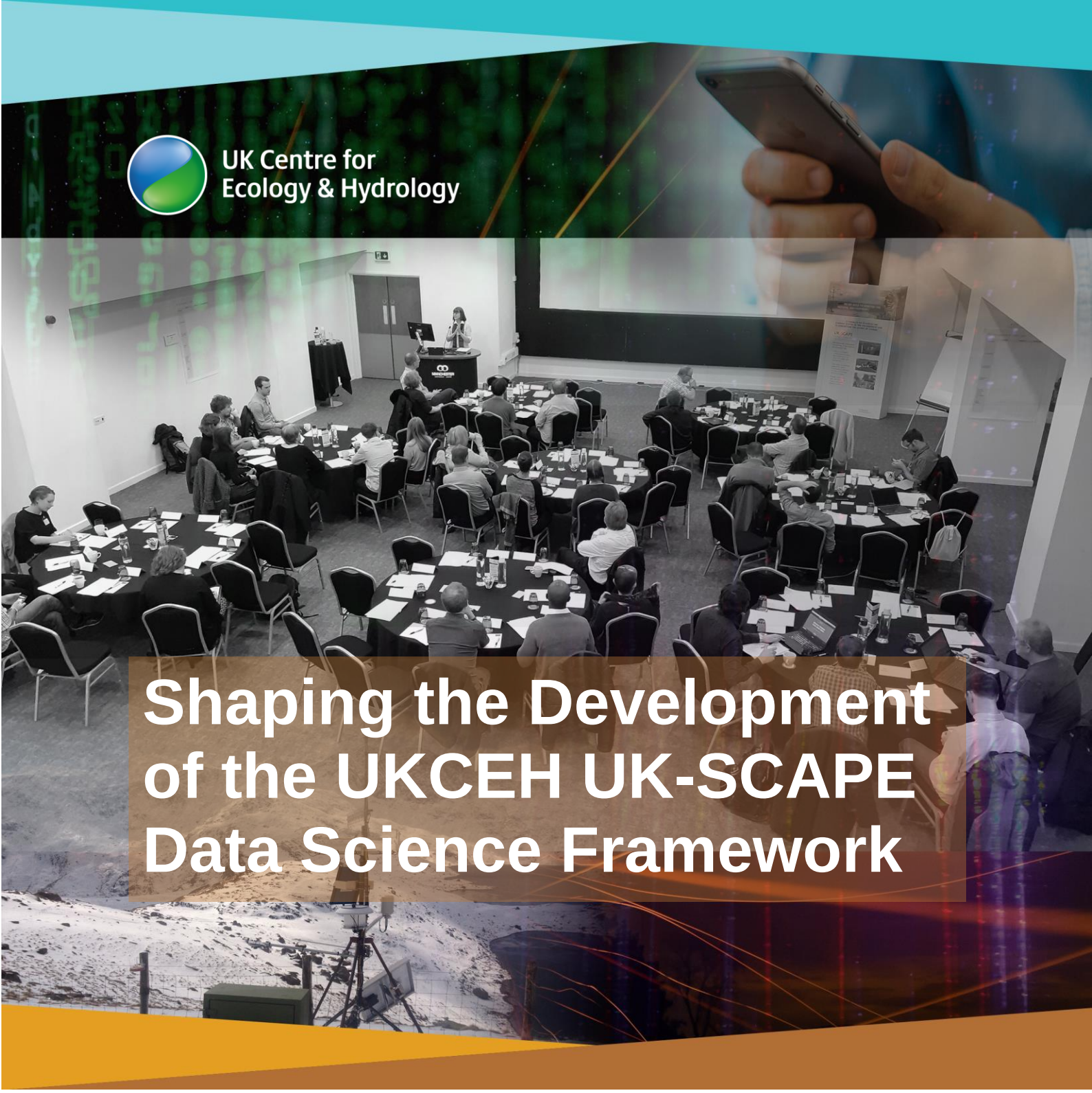

Shaping the Development of the UKCEH UK-SCAPE Data Science Framework

Workshop Report

Sue Rennie, John Watkins, Lucy Ball, Mike Brown, Matt Fry,
Pete Henrys, Mike Hollaway, Jake Quinn, Andy Sier, Jan Dick

Date 08/04/2020

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

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Title	Shaping the Development of the UKCEH UK-SCAPE Data Science Framework
Client	UK Research and Innovation (UKRI)
Client reference	NERC National Capability LTS-S: UK-SCAPE; NE/R016429/1
Confidentiality, copyright and reproduction	
UKCEH reference	UKCEH Project: 06948
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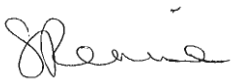
Author	Sue Rennie, John Watkins, Lucy Ball, Mike Brown, Matt Fry, Pete Henrys, Mike Hollaway, Jake Quinn, Andy Sier, Jan Dick
Approved by	Sue Rennie
Signed	
Date	08/04/2020
How to cite	Rennie, S., Watkins, J., Ball, L., Brown, M., Fry, M., Henrys, P., Hollaway, M., Quinn, J., Sier, A. and Dick, J. (2020) Shaping the Development of the UKCEH UK-SCAPE Data Science Framework: Workshop Report. UK Centre for Ecology & Hydrology (UKCEH Project: 06948; NERC National Capability LTS-S: UK-SCAPE; NE/R016429/1). 26pp

Contents

Summary

UKCEH held an event to share progress on the development of the Data Science Framework (DSF), explore community expectations for the DSF and get feedback from the participants on whether the DSF will meet their needs. Participants were able to offer feedback through interactive voting sessions, breakout groups and a feedback form. It is clear from these that the event was well-received and that the participants were positive about the DSF development. The key themes raised during the workshop that will be considered as the DSF development continues are:

- User guidance - the participants would like documentation, guidance material and other workshops to help them learn how to use the DSF. Good case study examples would be helpful.

  UKCEH will be producing a number of case study data analyses as part of user guidance materials as DSF development continues.

- Stakeholder engagement - the participants felt that the DSF would be useful for other user groups and would like further stakeholder engagement events to address their needs. The participants would also like input into which datasets are made available through the DSF.

  Further stakeholder engagement events are being discussed - UKCEH are considering the use of webinars and further face-to-face workshops.

- Plug and play methods and auditability - There was a wish to be able to explore existing methods and models and submit new ones. This would need some curation and provenance as tool sets are updated or extended.

  The DSF will enable methods to be accessed through APIs, portal and labs. Case studies within the labs will be used for more dynamic development of methods and tools using a "plug and play" concept.

- Licensing and authorisation - In order to protect IPR and sensitive data, there was a need to have controls on data access to enable some organisations to participate in co-development and contribute data.

  UKCEH is developing a range of authorisation methods to ensure data and services from the DSF are secure. These will be deployed before any commercially or personally sensitive data used in the DSF and they will be tested with those requiring these facilities.

- Co-design and development - Case studies that are co-developed with stakeholders and demonstrate the utility of the DSF need to be identified (e.g. new projects from UKRI SPF projects) and extended from existing work (e.g. within UK-SCAPE project).

  UKCEH will use the existing case studies within UK-SCAPE e.g. on air quality modelling to demonstrate how DSF co-development will work and use further workshop contacts and outreach activities to define further case studies and DSF training events.

All the developments above will be tailored by response to community need including the discussion during this workshop. UKCEH will continue to build the foundations of the DSF as specified in the UK-SCAPE commissioning and use the case studies built on these foundations. Some case studies are in-train within the UK-SCAPE project and other potential case studies were identified during the workshop discussions. Through follow-up discussions and further outreach workshops, we will extend our co-design and development plans to ensure the DSF is a community led national capability.

1 Aims of the workshop

UKCEH is developing the Data Science Framework (DSF) within the UK-SCAPE programme, part of UKCEH's national capability portfolio funded by UKRI. It is designed to enable easier access to UKCEH environmental datasets and models by the environmental research community.

This workshop was designed to share progress on the development of the DSF, explore community expectations for the DSF and get feedback from the participants on whether the DSF will meet their needs. It was intended that this feedback will allow the participants to influence the design, and help shape the further development of the DSF.

2 Participants

UKCEH aimed to have the participation of a wide range of data providers, researchers, data scientists, statisticians and data users at the workshop. We contacted people using existing mailing lists and through targeted invitations of relevant researchers. A breakdown of the organisations of those that registered and those that attended the event is found in table 1.

Table 1 *Type of organisation that the participants work for.*

Type of organisation	Number of Registrations	Number of Attendees
University	18	8
Government	4	3
Government Agencies	10	7
Non-Governmental public body	2	1
Research Centre	18	13
Commercial	3	0
UKCEH presenters / note takers	10	10
Total	**65**	**42**

On the day 42 people attended the workshop. The list of participants is in Appendix 2. As they registered, the participants were asked how they had heard about the event. Personal contacts were key - the majority (78%) had received a personal invitation from UKCEH staff or someone else (see table 2).

Table 2 *How the participants heard about the event.*

Contact method	Number of people
Personal invite from UKCEH staff	16
Recommendation from someone else	9
Social media	2
LinkedIn	2
Twitter	1
UKCEH website	1
EA newsletter	1
Total	**32***

* UKCEH presenters (6) and note takers (4) are not included in these figures.

3 Workshop summary

The agenda can be found in appendix 1. The slides that were presented during the workshop are available at https://www.slideshare.net/secret/7RzOsiBLXeyxIM.

The workshop started with an introduction and then a presentation describing what the DSF is and how it can address key data science challenges. Following this there was the first interactive voting session of the day, which was intended to gauge existing knowledge of the DSF (see section 5 for the results). Four presentations then demonstrated key components of the DSF. After lunch, a breakout session allowed the participants to discuss the DSF components in more detail with the presenters (see section 6 for a summary of the results; more detailed notes can also be provided on request[1]). A second voting session allowed the participants to give feedback on the DSF (see section 5 for the results) and the workshop finished with a plenary session to give the participants a final opportunity to offer their feedback and suggest future events.

The workshop was designed to be interactive. The participants gained insight into what the DSF is through the presentation of components of the DSF and then had the opportunity to provide feedback in breakout sessions and in voting sessions using online polling software – Mentimeter (section 4). This is a browser-based software that allows participants to easily give feedback using their smartphones. This feedback can be visualised in real-time to provide immediate feedback for the participants and is provided in this report.

[1] Please contact Sue Rennie, srennie@ceh.ac.uk

4 Voting results

4.1 Voting session 1

This session was intended to gauge the existing knowledge the participants had about the DSF. The UKCEH presenters and note-takers were asked not to vote.

Question 1 – What type of organisation do you work in?

Responses: 34

Nearly half the participants (44%) came from Research Centres (the UKCEH staff who were not involved in presenting or facilitation are included in this figure). Mentimeter is completely anonymous so this question could be used to assess if people from different sectors responded differently in the interactive sessions if further data analysis - in conjunction with other UK-SCAPE engagement events - is undertaken.

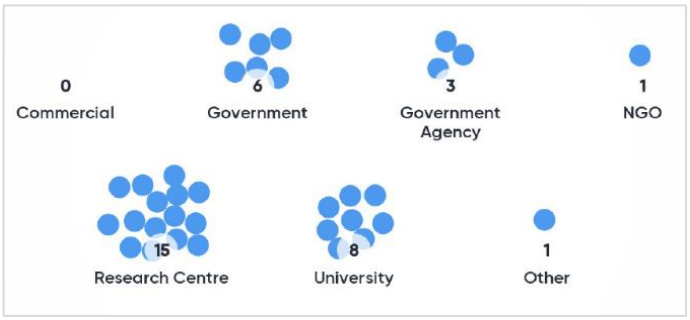


Figure 1

Question 2 – How much previous knowledge do you have about the DSF?

Responses: 34

The majority of the attendees (64%) had no previous knowledge of the DSF. Some attendees said that they were involved in DSF development so it seems likely that some presenters/note-takers participated in the online voting. Mentimeter is completely anonymous so it is impossible to check this.

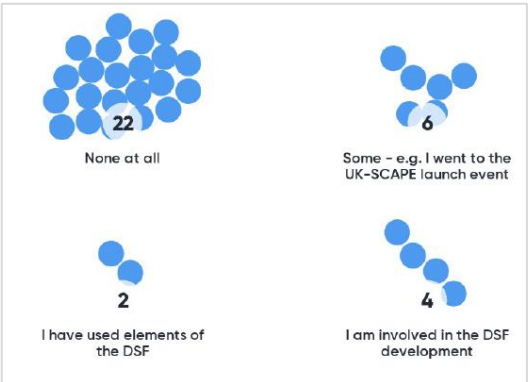


Figure 2

Question 3 – What do you think are the biggest challenges?

Responses: 34

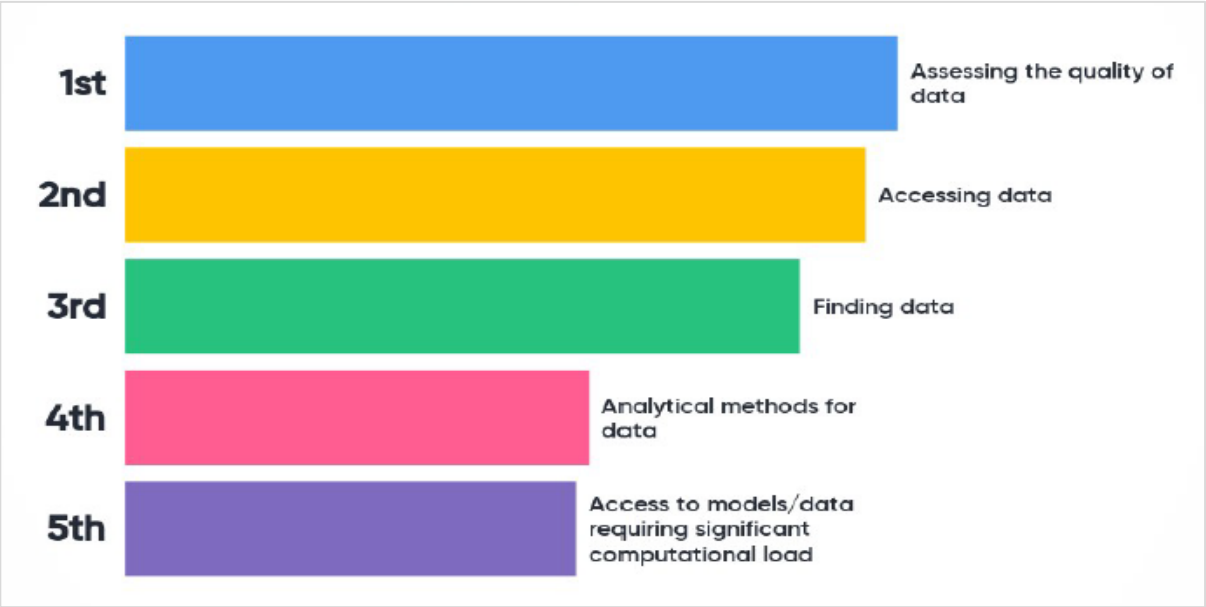


Figure 3

These five challenges were chosen by John Watkins and Sue Rennie as representative challenges based on their experience of DSF development. The participants had the opportunity to highlight other challenges in Question 4. The participants were asked to rank the challenges - with assessing the quality of data ranking first as their key challenge.

Question 4 – Are there other challenges we've missed?

Responses: 39

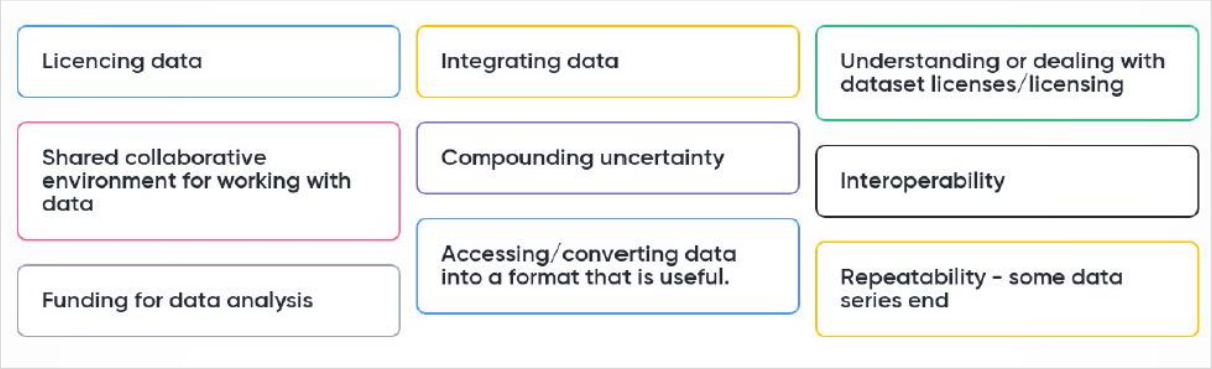
The participants had the opportunity to highlight key challenges that they faced - they could highlight more than one challenge. A summary of the key issues raised were:

Table 3

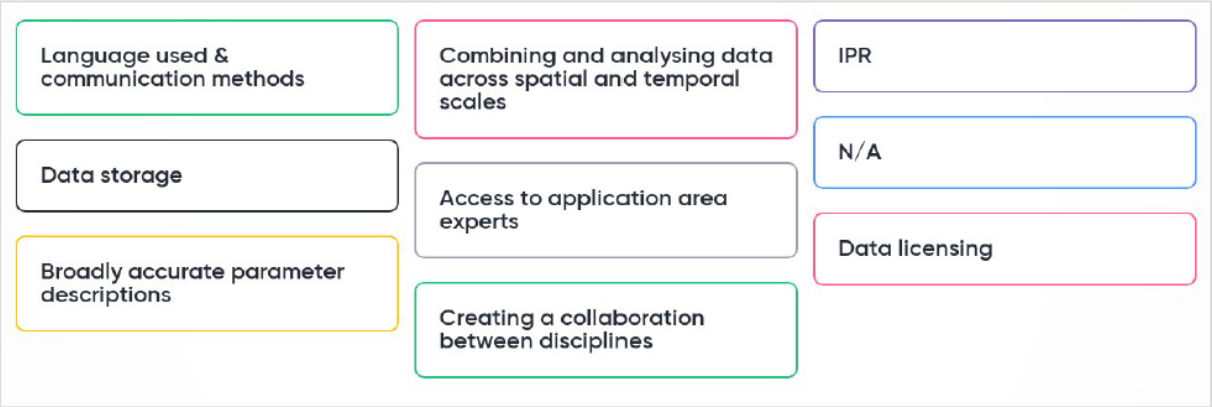
Challenge	Number of comments
Data harmonisation - i.e. combining data from different sources, standards etc.	12
Licensing and ownership	7
Cultural issues - i.e. changing new collaborative ways of working, upskilling	4
Expertise - i.e. availability of experts; different analytical techniques and coding languages used	3
Funding	2
Repeatability and reproducibility	2
Data availability - i.e. are sufficient data available, are they representative	2
Uncertainty	1
Data storage	1
Data citation	1
Obtaining geographically specific data	1

The comments provided by the participants are below in the following figure.

(a)



(b)



(c)

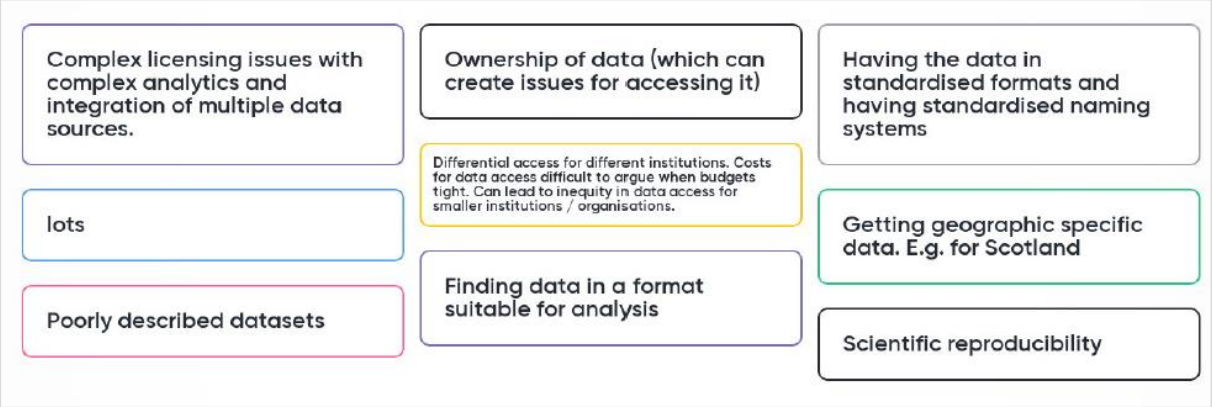


Figure 4 (a-c) *Participants' comments made during voting session 1*

Question 5 – From what you've heard of the DSF so far, how do you think it will deal with these challenges?

Responses: 36

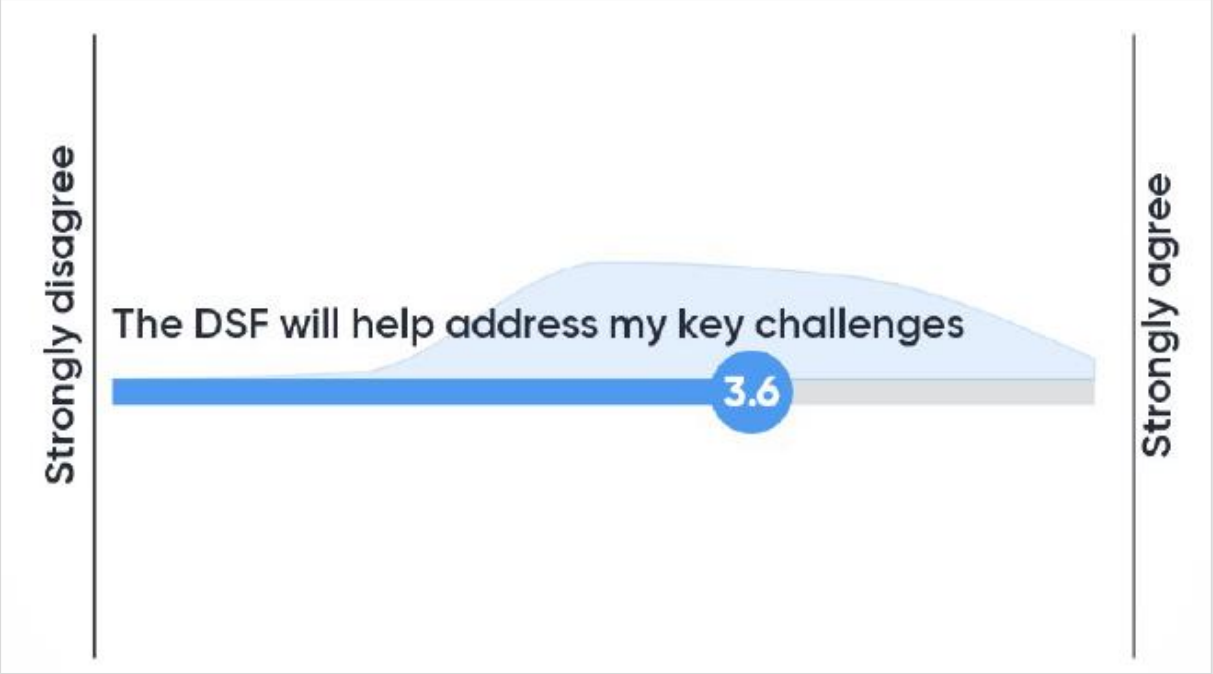


Figure 5

The majority of participants agreed that the DSF would help with the challenges highlighted in the previous questions, none of the participants strongly disagreed with the statement.

4.2 Voting Session 2

This session was designed to gauge the reaction to the DSF and get feedback on the presentations on its components - each component was voted on in turn. It should be recognised that the presentations were about components of the DSF, not the DSF as a whole, therefore they are unlikely to address all challenges equally.

This voting session also included some similar questions to the first voting session which will be used to explore if the participants had found the day useful and could see the value in the DSF development.

Question 1 – Will the DSF development of spatial scaling (DSF component 1) address these challenges?

Responses: 31

The participants felt that 'Analytical methods' and 'access to models and data requiring significant computational load' were the key challenges addressed by DSF Component 1 - Methods.

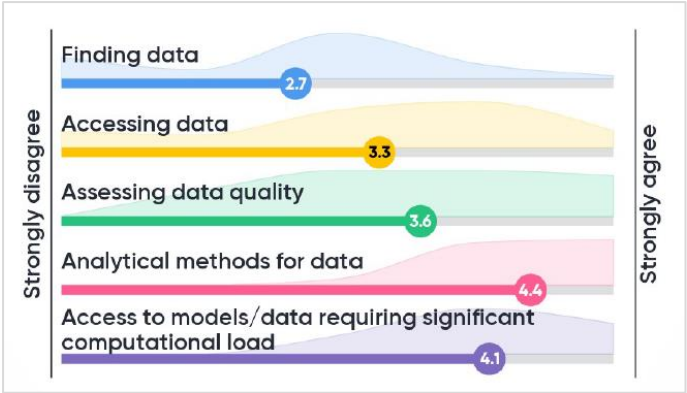


Figure 6

Question 2 – Will the DSF development of API's (DSF component 2) address these challenges?

Responses: 31

The participants felt that 'Accessing data' was the key challenge addressed by DSF Component - Portals.

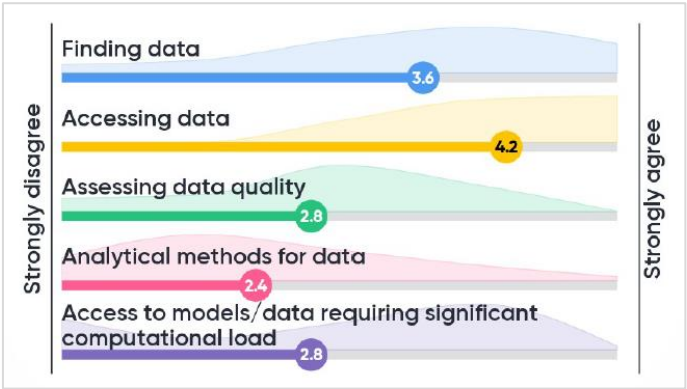


Figure 7

Question 3 – Will the DSF development of data labs (DSF component 3) address these challenges?

Responses: 30 The participants felt that 'Accessing data' was the key challenge addressed by DSF Component 3 - APIs.

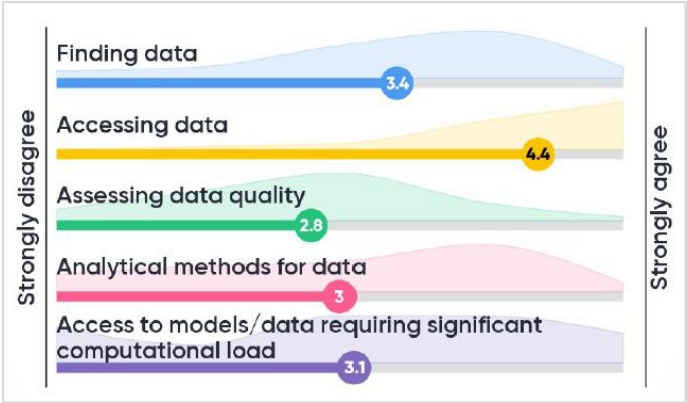


Figure 8

Question 4 – Will the DSF development of portals (DSF component 4) address these challenges?

Responses: 31

The participants felt that 'Analytical methods' and 'access to models and data requiring significant computational load' were the key challenges addressed by DSF Component 1 - Methods.

The participants felt that 'Analytical methods' and 'access to models and data requiring significant computational load' were the key challenges addressed by DSF Component 4 - Data Labs (shown).

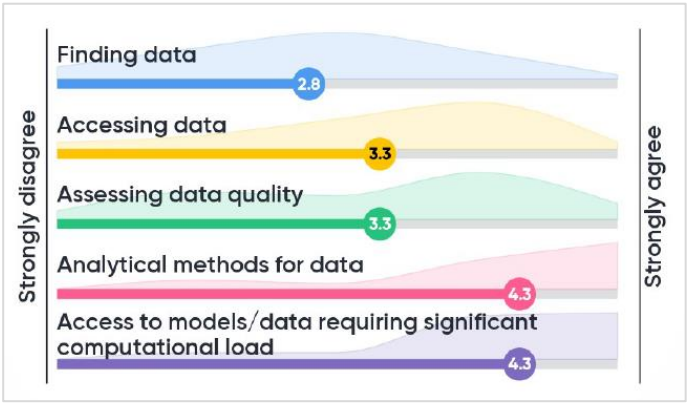


Figure 9

Question 5 – What type of organisation do you work in?

Responses: 31

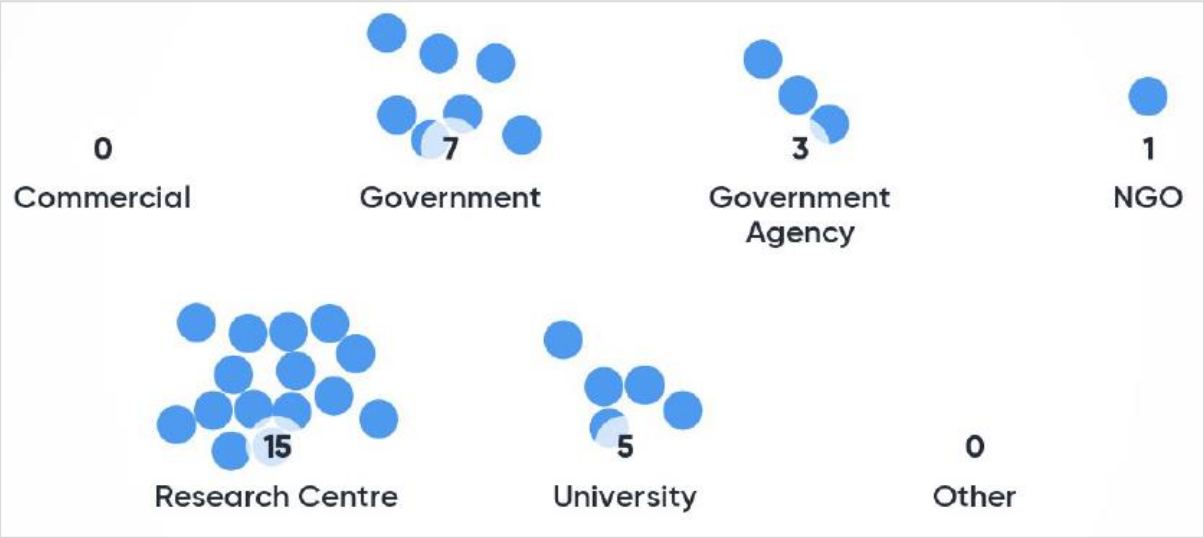


Figure 10

This was a repeat of the question asked in voting session 1. Mentimeter is completely anonymous so this question could be used to assess if people from different sectors responded differently in the interactive sessions if further data analysis - in conjunction with other UK-SCAPE engagement events - is undertaken.

Question 6 – After today how do you feel about UKCEH's approach to DSF development?

Responses: 31

The majority of the participants felt that the DSF addressed their challenges - 2 participants disagreed with this statement. All the participants said that they would also use it in the future and recommend it to colleagues - no participant disagreed with either of these statements.

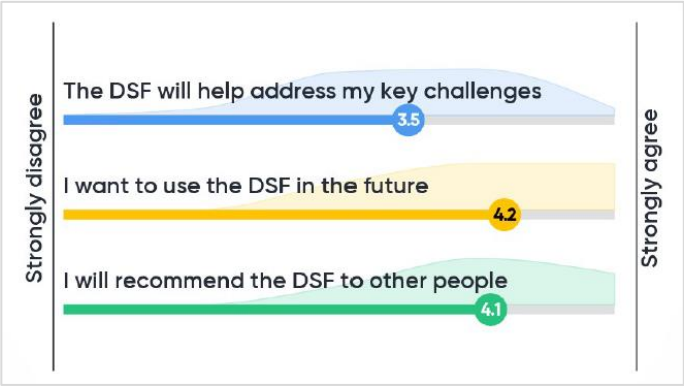


Figure 11

Question 7 – Please let us know if you have any feedback about the DSF or this event.

The participants had this final opportunity to provide feedback - they could make more than one comment. A summary of the comments raised were:

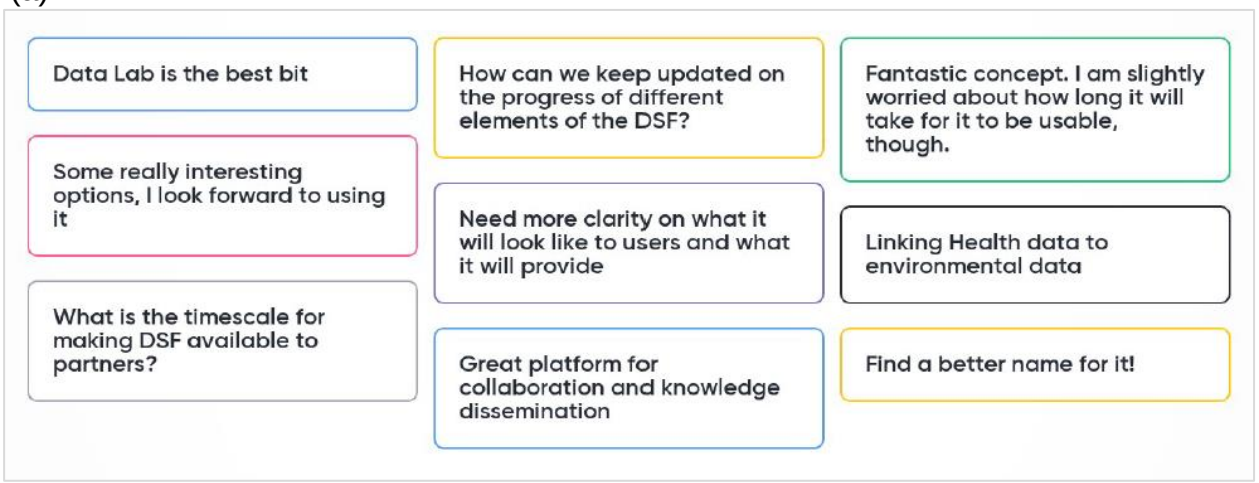
Table 4

Theme/issue	Number of comments
Timescale for making the DSF available?*	6
A number of participants thought it was a good platform and would be useful for collaboration	4
Documentation and user guidance are needed	3
Information about licensing and citation is a key requirement	2
Access to data labs and HPC was a benefit	2
It has applicability beyond the environmental sciences	2
Further stakeholder engagement needed to cover other user groups	2
It needs to be accessible by a number of user groups e.g. policy makers	2
More information on how to harmonise data	1
Integration of the 4 components needed	1
Access to 3rd party data needed	1
It needs a better name	1

*The DSF is being developed as part of the UK-SCAPE programme, part of UKCEH's national capability portfolio funded by UKRI. This is a 5 year programme which started in 2018.

The comments provided by the participants are provided in the figure below.

(a)



(b)

(c)

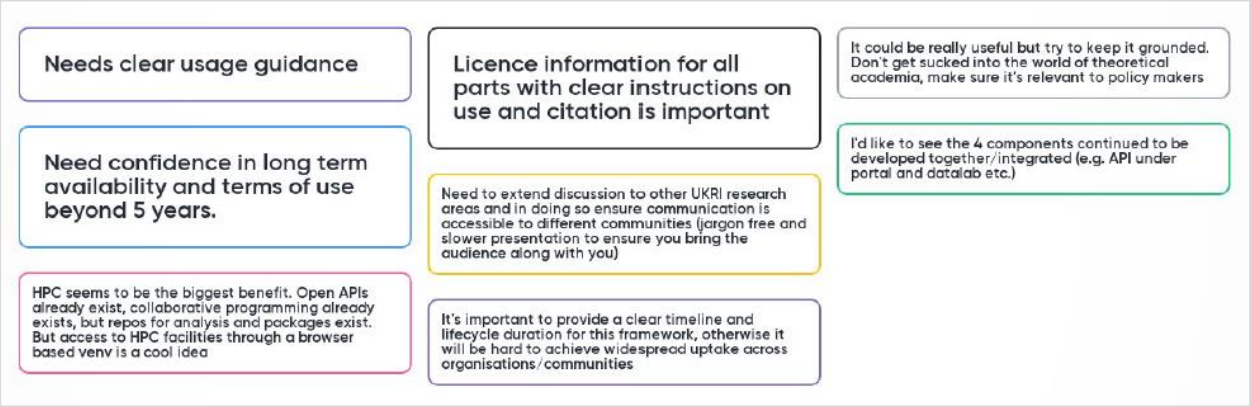


Figure 12 *Participants' comments made during voting session 2*

5 Summary of the breakout session feedback

Detailed notes from breakout session are available separately on request[2].

5.1 Methods

Key themes that were identified during the session were:

1. The ability to upload and contribute new methods and to obtain metrics about their use for impact assessment. This is important for developers.
2. The ability to plug and play different methods in an analysis provides a mechanism to test for robustness and sensitivity of overall analytical workflow. This will also enable a comparative assessment of the different methods.

[2] Please contact Sue Rennie, srennie@ceh.ac.uk

3. There is some need for curation of methods across providers. How can this be done? Perhaps consider existing avenue of methods/app publications such as Method in Ecology and Evolution's application section.
4. Need to consider the use of the DSF environment and whether it is for research or for policy and hence an operational interface.
5. It is important to consider the Terms and Conditions attached to the infrastructure and any licensing restrictions on use or on outputs.
6. The DSF and platform provides the opportunity for assessing models that feed into models and including the uncertainty. Therefore providing the potential for a giant meta- model exploring uncertainty.
7. For the DSF to be successful, training and good case study examples are critical.

5.2 Portals

Key themes that were identified during the session were:

1. The ability to represent the provenance and the quality of the data that is being accessed through the portal.
2. The ability to represent the uncertainty of the portal outputs especially when it is showing an integrated data product.
3. The ability to display clear licencing and IPR restrictions associated with the outputs of the portal.
4. It was clear from the feedback that the portals should be aimed at a number of different stakeholder groups, e.g. public, policy makers, researchers, students etc. and that we need to engage with these different groups to customise the experience.
5. The stakeholders also made it clear that they would like to input into setting the priorities of the datasets being delivered by the portals.
6. Stakeholders would like the ability to integrate third party datasets into the portal.
7. It would be useful if these portal developments could be catalogued to make them easier to find and to provide information on how to use them (as in the different stakeholder groups see 4 above). UKCEH are thinking about webinars, videos, social media to present this information.

5.3 APIs

Key themes that were identified during the session were:

1. APIs would be useful for integration of a range of data sources
2. Different data licences may make things complex, so starting with datasets that are open would be sensible
3. Data provenance is very important, both for understanding where a dataset has come from and what it is, and also which version it is, for the sake of

repeatability. It would make sense to start with datasets within CEH's EIDC which will not change and are already well documented.
4. Metadata will be key to understanding important aspects of the data, e.g. sensitivities of instruments, etc., and this metadata should be available with the data from the API
5. It will be very important to make this easy for less technical users - with guidance but also by making the APIs simple and clear
6. An end-to-end worked example would be ideal, showing data available through an API, used by, for example, an R package within a Data Lab, to produce some outputs that could be visualised, potentially through a portal.

5.4 Data Labs

Key themes that were identified during this session were:

1. Training - to help users understand how to use data labs. Videos and worked case studies were thought useful
2. Data access/integration - what data and methods will be available within the data labs?
3. Licensing - this is a common issue not unique to data labs
4. Versioning - GitHub will be used to document and publish different versions of methods
5. Management - how will the data lab projects and related content be maintained? Who will have oversight? How will the need for reproducibility and traceability work within this environment?

6 Feedback Form

The participants completed a feedback form. This was presented in the 'Introduction to workshop' session and placed on the tables at the start of the event. The form was anonymous and sought the participants opinion on the content of the meeting, the, facilities and ideas for future events to co-develop the DSF. The scoring system of the form consisted of a 6 point Likert Scale (table 3). Participants were asked to score each session. In addition, an open space invited participants to share their opinion in narrative form.

Table 5 *The 6 point Likert Scale used in the workshop feedback form.*

1	2	3	4	5	6
Unsatisfactory	Very Poor	Poor	Good	Very Good	Excellent

In total, 25 participants returned fully or partially completed forms. Overall the feedback was positive (all sessions were scored between good and excellent) and provided the organizers with suggestions for future events. The scores for each session are presented as percentage of those responding (figures 13-16).

The initial registration, introduction to the workshop and the presentation on the Data Science Framework was scored by participants as good to excellent:

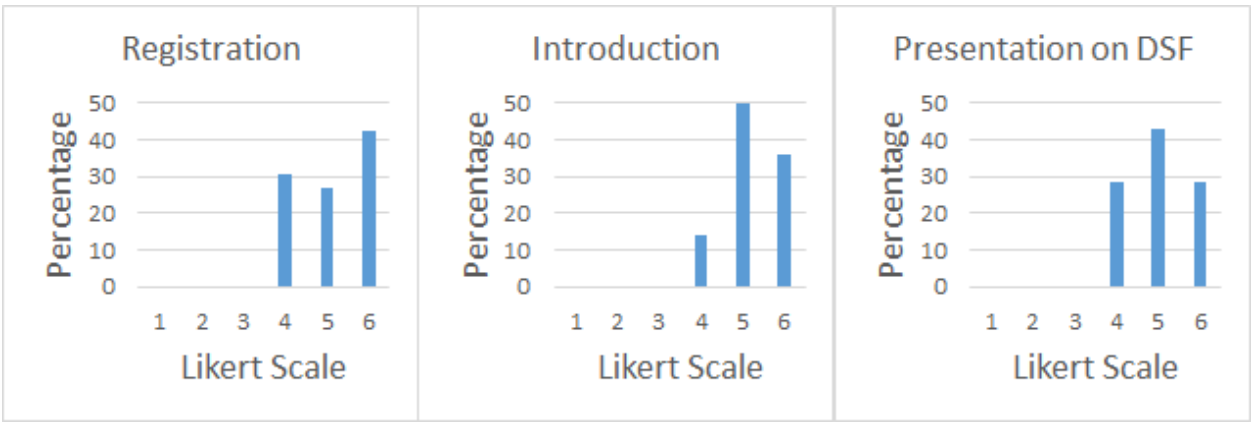


Figure 13 *Percentage of respondents selecting one of 6 Likert scores for the initial three sessions of the program (6 = excellent and 1 = unsatisfactory)*

The four components of the DSF presented also scored highly:

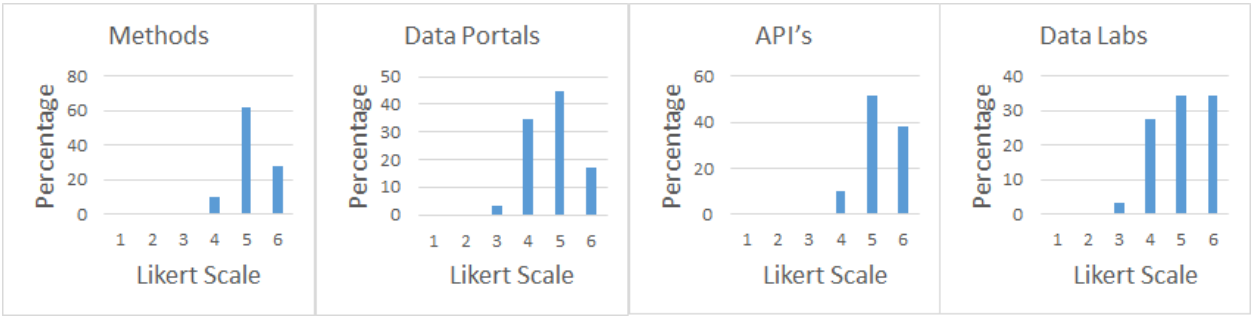


Figure 14 *Percentage of respondents selecting one of 6 Likert scores for the presentation of each of the four elements of the Data Science Framework*

The participants generally appreciated the interactive voting and the flexible breakout session:

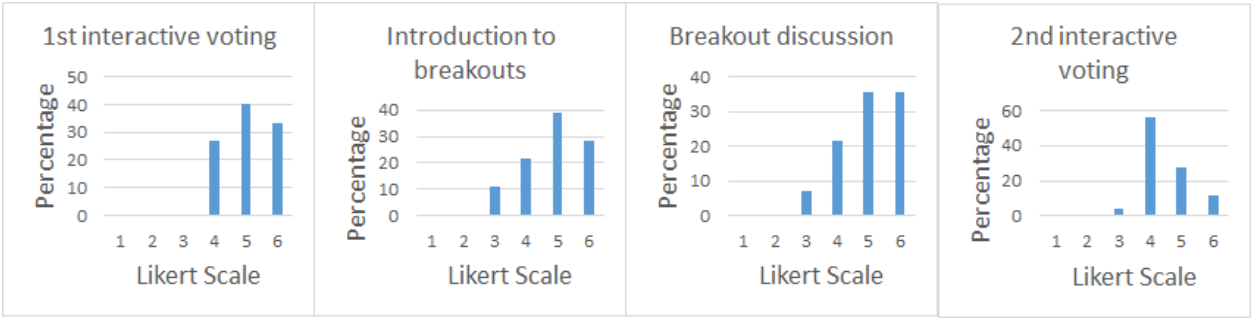


Figure 15 *Percentage of respondents selecting one of 6 Likert scores for the interactive sessions*

The participants were most critical of the facilities (figure 4) especially the catering with several commenting negatively "r*an out of reusable mugs*" "*NO DESERT*" and "*Lunch choice for vegetarians not very good too little choice -> there could have been less meat options and instead more variety for vegetarians*":

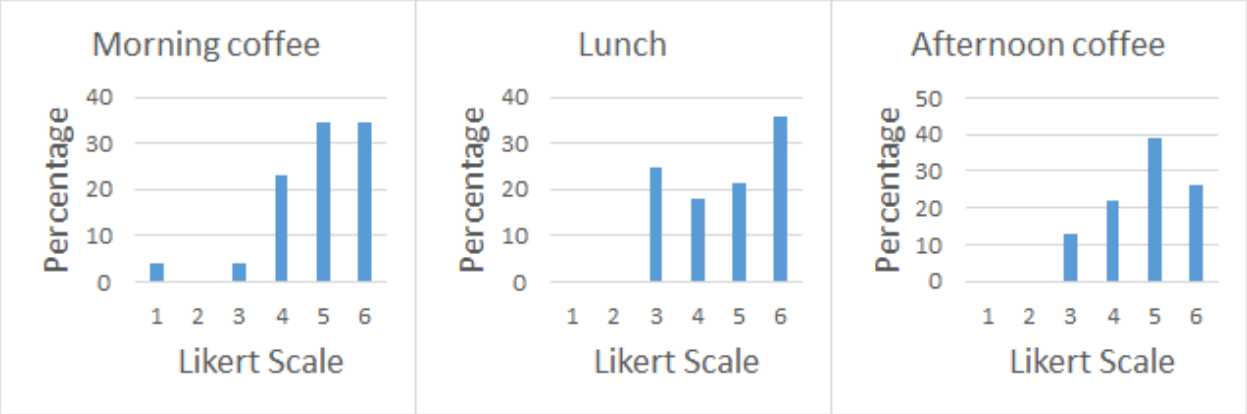


Figure 16 *Percentage of respondents selecting one of 6 Likert scores for the catering at the workshop*

Over half of the respondents (n=15; 60%) wrote in the space provided for narrative responses. The comments were generally positive and constructive (the detailed comments are available on request[3]). Several respondents were keen to understand more about how the DSF would be developed, for example one participant requested "*a clear statement about where this DSF fits into the wider ecosystem of data centres and computing resources in the UK*" and another requested "*better explanation of which APIs are being developed*" and *"clearer explanation of how open/external database are planning on being integrated*".

One participant expressed uncertainty about the future of the DSF i.e. "*I found it hard to see whether this 5 yr project will create [substantial?] new and long-term infrastructure or remain a 5 yrish case study/proof of concept*". While other participants were more positive and understood the vision and suggested that "*When the DSF is more developed, a hands-on-workshop would be very useful. A number of case studies with work through of the entire DSF would be useful, highlighting what elements would be most useful for individual users e.g. researchers, policy makers*" and another "*It is necessary to organise webinar type of workshop*".

In terms of the engagement process, the high Likert scores for all sessions were encouraging and a few participants specifically commented positively on the interactive voting sessions e.g. "*Mentimeter was good*" although one participant remarked that they considered "*Mentimeter was good but sometimes too long waiting for all answers*". (Test runs had shown that immediately displaying the answers on screen as participants were answering the question had the tendency to influence the answers given. Therefore the organisers chose to wait to reveal the results only after all participants had answered.)

Similarly guarded positive opinions were recorded for the breakout session for example "*Breakouts - this was a great, only given 4 because it should have been longer!*" and "*Really useful individual sessions could use some structure*".

[3] Please contact Sue Rennie, srennie@ceh.ac.uk

The location of the venue was considered practical with one participant noting "*Location good, bad luck with the weather / trains*".

7 Wrap-up and Next Steps

It is clear from the voting sessions and feedback form data that the event was well-received and that the participants are positive about the DSF development. The key themes raised during the workshop that will be considered as the DSF development continues are:

- User guidance - the participants would like documentation, guidance material and other workshops to help them learn how to use the DSF. Good case study examples would be helpful.

  UKCEH will be producing a number of case study data analyses as part of user guidance materials as DSF development continues.

- Stakeholder engagement - the participants felt that the DSF would be useful for other user groups and would like further stakeholder engagement events to address their needs. The participants would also like input into which datasets are made available through the DSF.

  Further stakeholder engagement events are being discussed - UKCEH are considering the use of webinars and further face-to-face workshops.

- Plug and play methods and auditability - There was a wish to be able to explore existing methods and models and submit new ones. This would need some curation and provenance as tool sets are updated or extended.

  The DSF will enable methods to be accessed through APIs, portal and labs. Case studies within the labs will be used for more dynamic development of methods and tools using a "plug and play" concept.

- Licensing and authorisation - In order to protect IPR and sensitive data, there was a need to have controls on data access to enable some organisations to participate in co-development and contribute data.

  UKCEH is developing a range of authorisation methods to ensure data and services from the DSF are secure. These will be deployed before any commercially or personally sensitive data used in the DSF and they will be tested with those requiring these facilities.

- Co-design and development - Case studies that are co-developed with stakeholders and demonstrate the utility of the DSF need to be identified (e.g. new projects from UKRI SPF projects) and extended from existing work (e.g. within UK-SCAPE project).

UKCEH will use the existing case studies within UK-SCAPE e.g. on air quality modelling to demonstrate how DSF co-development will work and use further workshop contacts and outreach activities to define further case studies and DSF training events.

All the developments above will be tailored by response to community need including the discussion during this workshop. UKCEH will continue to build the foundations of the DSF as specified in the UK-SCAPE commissioning and use the case studies built on these foundations. Some case studies are in-train within the UK-SCAPE project and other potential case studies were identified during the workshop discussions. Through follow-up discussions and further outreach workshops, we will extend our co-design and development plans to ensure the DSF is a community led national capability.

Appendix 1 – Agenda

Start	Activity
10:00	**Coffee and registration**
10:30	**Introduction to workshop** *Jan Dick & Sue Rennie*
10:45	**Presentation on DSF - what is it and how does it address key science challenges** *John Watkins*
11:05	**What do you think so far? First interactive voting session** *Sue Rennie & John Watkins*
11:30	**Coffee**
11:45	**Presentations demonstrating components of the DSF in action:** ● **Methods** – *Pete Henrys* ● **Data Portals** – *Mike Brown* ● **API's** – *Matt Fry* ● **Data Labs** – *Mike Hollaway*
12:45	**Introduction to post-lunch breakout session** *John Watkins*
13:00	Lunch

14:00	**Breakout** An opportunity to discuss the presentations of the DSF components in more detail.
14:50	Coffee
15:00	**What do you think now? Feedback from breakouts and second interactive voting session** *Pete Henrys, Matt Fry, Mike Brown, Mike Hollaway, Sue Rennie & John Watkins*
16:00	**Final discussion & summary** *Jan Dick & John Watkins*
16:30	**End**

Appendix 2 - Participants

Name	Organisation
David Amankwaah	Public Health England
Claire Anderson	Health and Safety Executive
Tim Ashelford	DEFRA
Lucy Ball	Centre for Ecology and Hydrology
Philipp Boersch-Supan	British Trust for Ornithology
Mark Brewer	Biomathematics and Statistics Scotland
Mike Brown	Centre for Ecology and Hydrology
Adam Butler	Biomathematics and Statistics Scotland
Marie Christine Henniges	RBG Kew, QMUL
Peter Coleman	BEIS
Jan Dick	Centre for Ecology and Hydrology
Rich Ellis	Centre for Ecology and Hydrology
Ed Fawcett-Taylor	DEFRA
Matt Fry	Centre for Ecology and Hydrology
Alessandro Gimona	The James Hutton Institute
Yaqing Gou	University of Leicester
Emily Grace Simmonds	Norwegian University of Science and Technology (NTNU)
Laura Graham	University of Southampton
Paul Harris	Rothamsted Research
Sam Harrison	Centre for Ecology and Hydrology
Pete Henrys	Centre for Ecology and Hydrology
Mike Hollaway	Centre for Ecology and Hydrology
Gillian Isherwood	Environment Agency
Caroline Keay	Cranfield University

Name	Organisation
Ben Marchant	British Geological Survey
Zak Mitchell	Centre for Ecology and Hydrology
Shamal Mohammed	Agri-EPI Centre
Michelle Morris	Health and Safety Executive
Sarah Nichols	University College London
Andy Nisbet	Natural England
David O'Brien	Scottish Natural Heritage
Brenda Phillips	University of Leeds
Amanda Porter	Health and Safety Executive
Jake Quinn	Centre for Ecology and Hydrology
Sue Rennie	Centre for Ecology and Hydrology
Hannah Risser	Centre for Ecology and Hydrology
Andy Sier	Centre for Ecology and Hydrology
Chris Skinner	University of Hull
Isaac Squires	Connected Places Catapult
Ruth Swetnam	Staffordshire University
Jennifer Taylor	Environment Agency
John Watkins	Centre for Ecology and Hydrology

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