# REPORT FROM THE IASC ACTION GROUP ON CARBON FOOTPRINT

APPROVED BY IASC COUNCIL ON 30TH MARCH 2022

# TABLE OF CONTENTS

# 1. INTRODUCTION

The Action Group on Carbon Footprint (AGCF) was convened in November 2020 to advise on concrete ways to reduce IASC's carbon footprint. IASC has long recognised that global climate change is the result of anthropogenic activity. These changes have an intensified impact in the Arctic region, including destruction of plant and animal life, "loss of sea ice cover, glacier retreat and changing snow and permafrost conditions" (ICARP-III) in addition to a reduction in quality of life for Arctic communities. As the impacts of climate change become more widespread and tangible, it is becoming increasingly important for organisations like IASC to lead the way, demonstrating that it is possible to reduce environmental impact without reducing the quality of scientific activities and output.

IASC wants to ensure a full organisational response to the climate crisis. Recommendations presented here encompass secretariat activities, networking and conferencing, as well as ways in which IASC can encourage sustainability and environmental awareness in associated and funded activities. Our primary goal has been to produce recommendations that are concrete, pragmatic, realistic and impactful. With this in mind, this report's scope has been restricted to suggestions that IASC can enact directly. We do not, therefore, include specific recommendations on how to reduce the carbon footprint of field or laboratory operations.

In producing this report, we have aimed to centre the needs of the IASC community, and to ensure that we are building on existing ideas and expertise. Our approach has included open workshops, networking and a thorough review of best practice in other organisations. IASC maintains a thriving community and it is important to continue to nurture this. We have been able to adapt recommendations to benefit the community by including these consultations in our decision-making.

This report is intended to be a work-in-progress. Reducing IASC's carbon footprint and developing a sustainable approach to Arctic science will never be "complete". As society changes to meet the demands of the climate crisis, new technologies become available, and new norms and ideas are adopted, we anticipate that recommendations presented here will need to be revisited. It is important that IASC continues to work actively towards these goals and include these in its future strategic planning; this will both reinforce IASC's position at the forefront of climate change research in the Arctic and demonstrate that it is possible to develop the organisation and its community while continuing to enact climate solutions on an organisational level.

# 2. RECOMMENDATIONS FOR WAYS TO REDUCE IASC'S CARBON FOOTPRINT

Recommendations from the AGCF are outlined within the following section, and represent the culmination of the research, networking and community engagement that has been carried out as part of the AGCF's brief. A summary of our six, key recommendations is presented in 2.1. More specific recommendations targeted toward individual IASC activities are outlined in 2.2.

## 2.1 GENERAL RECOMMENDATIONS

**Recommendation 1: Create a position within IASC leadership tasked with further implementation and development of recommendations for carbon footprint reduction.** A comprehensive, organisation-wide approach to the climate crisis is a long-term task that will require regular monitoring, structural changes, updates to strategy and implementation of policy. This could be either a member of the Executive Committee or Council, or an additional role within the IASC Secretariat or a small committee. Such a "sustainability manager" would be fundamental in applying recommendations outlined in this report and keeping environmental policy updated and on-track moving into the future.

**Recommendation 2: Develop a long-term roadmap with tangible, measurable goals. It is recommended that this includes a pledge to reach carbon neutrality by 2040 or earlier.** This roadmap should include specific, measurable goals, encompassing strategies to minimise emissions, remove institutional barriers and raise awareness within the IASC community. An example of such a document from the University of Sheffield can be found at https://www.sheffield.ac.uk/sustainability/strategy. It is recommended to include such a roadmap in the IASC Strategic Plan.

**Recommendation 3: Carry out an annual assessment of IASC's carbon footprint.** This should include the systematic collection of anonymous travel data from ASSW and other conference participants (see 3.1). It is recommended that a more comprehensive overview of IASC's current and ongoing emissions is carried out than that which is within the scope of this report, including the monitoring of committee meetings, funded activities and staff travel. In the long term, it would be beneficial to monitor emissions from infrastructure and other activities.

**Recommendation 4: Agree to a travel policy for IASC events (e.g. meetings, workshops, ASSW) and Secretariat.** It is strongly recommended that air travel is discouraged for shorter distances (for example 500 km or 8 hrs) where this is possible due to available alternative means of (public) transport. It is recommended that excess funding is made available for sustainable travel options (including compensation for additional work time), and that air travel for single-day meetings be discouraged when possible. Smaller meetings (short, or with a small number of participants) should be encouraged to take place online where possible or pooled at ASSW to minimise travel of participants. We recommend investigating opportunities for an internal carbon fund, which could fund sustainable travel. It is advisable to establish good communication about the planned action and to work together with the travel agency if one is used.

**Recommendation 5: Develop opportunities and funding to encourage sustainable research and activities.** Recommendations include a sustainability award for people or projects that are leading the way with significant achievements, ring-fencing a proportion of working group funding for sustainability-focused projects, and encouraging all funding applications to outline ways in which the project's carbon footprint

will be minimised. Continued international collaboration and exchange of existing strategies is advised and the sharing of data further encouraged. We recommend that all projects seeking IASC funding include a strategy on how they will minimise carbon footprint within their project proposal.

**Recommendation 6: Where carbon emissions cannot be eliminated, use carbon offsetting schemes that comply with internationally recognised standards.** Leading carbon offset standards include the Clean Development Mechanism (CDM), the Gold Standard and the Verified Carbon Standard (VCS). Trusted organisations like myclimate.ch (https://myclimate.org/) or atmosfair (https://www.atmosfair.de/en/) conform to these standards. Local, verifiable and high-quality projects should be preferred, e.g. Iceland Carbon Fund (https://kolvidur.is/english/). It is recommended that carbon offsetting should be considered as a last resort, with other measures to reduce emissions explored first and implemented if possible.

## 2.2 RECOMMENDATIONS FOR DIFFERENT TYPES OF IASC ACTIVITIES

In order to reduce IASC's carbon footprint, a number of recommendations have been developed for different types of IASC Activities: Arctic Science Summit Weeks, IASC Committee meetings, IASC-funded projects (e.g. workshops, summer/winter schools, meetings) and the IASC Secretariat.

Recommendations outlined below represent a number of possible options that could be implemented as part of the roadmap suggested in recommendation 2. We do not envisage that every recommendation listed in 2.2 will be enacted immediately; rather, these suggestions provide possibilities that IASC may decide to pursue across the short- and longer-term.

### 2.2.1 ARCTIC SCIENCE SUMMIT WEEK

The Arctic Science Summit Week (ASSW) was initiated by IASC in 1999 to provide opportunities for coordination, cooperation and collaboration between the various scientific organisations involved in Arctic research and to economise on travel and time by providing a common meeting space and allowing participants to attend multiple meetings in one location/time. Over the years the summit evolved into the most important annual gathering of the Arctic research organisations.

A **Green Event Action Plan** has been developed for the ASSW 2022 in Tromsø. In order to organise a sustainable and environmentally friendly in-person event, the following aspects have been taken into account: Venue, Travel, Transport, Food/drinks, Single-use products, Energy use, Printed materials.

→ It is recommended to develop a **handout on "green events"** to guide organisers of future ASSW events through a checklist of carbon footprint reduction.

1. Host country and venue

    - The principles by which the conference host of ASSW is decided could be revised. Importance should be attached to continuously representing the diversity of IASC members and member countries while striving for a balance between remoteness and accessibility of location. The choice of meeting location (e.g. close to public transport) can significantly reduce emissions from participants' travel.
    - If possible, choose conference and meeting venues using sustainable energy sources for heating and electricity.

- Arrange physical meetings back-to-back with other key meetings.

2. Travel to ASSW

   - Highlight alternative transportation modes (train, bus) on the website. Use public transport and share logistics.
   - Calculate the carbon emissions from participant travel (this should be implemented for ASSW2022). A travel data questionnaire to be included in the registration form is available in chapter 3.
   - Participants are encouraged to consider if it is necessary to attend physically or if online participation, or representation by another person, is an option.

3. Online and hybrid format

   - Organise ASSW as a hybrid event in the future and always enable online participation at the conference.
     It is recommended to improve even further the possibility of joining a meeting remotely. In other words, minimise the disadvantage of not being at a meeting. Challenges and difficulties with hybrid meetings can be reduced by good technical preparation:
     - Good microphones for in-person participants and discipline to always speak into them. Otherwise it is difficult for the online people to follow, and it quickly gets frustrating.
     - Record the meeting and make recording and slides available online.
     - Provide technical support before and during the event.
     - Actively use the chat function.
     - Be conscious of time zone differences.
     - Digital training across all career-stages is key.
     - Issue guidelines for improvement of the meeting (e.g. camera on).

4. Local Logistics

   The local organisers of ASSW should work among others with the host institution(s) and their existing environmental strategies / carbon reduction action plans and in addition:

   a. Local transport

      - Enable participants to use public transport during the conference week, e.g. a bus pass.

   b. Food/Drinks

      - Buying locally produced products and food, where possible (including traditional indigenous food).
      - Buying less meat, offering vegetarian options.
      - Serving tap water, unless a proper recycling system exists.

- Providing food for the exact number of people that will be present to avoid food waste.

c. Single-use products

- Serving lunches in the main cantina and avoiding single-usage items.
- If single-use products must be used, then they should be as environmentally friendly as possible (recycled, organic, or environmentally friendly materials).

d. Energy use

While the host organisation and venue provider is mainly responsible for energy use, emphasis should be on purchasing power from renewable sources.

- Running light, video equipment, catering services with renewable energy.
- Choosing digital meeting platforms according to energy use.

e. Printed materials

- Avoiding unnecessary printing.
- Using digital format whenever possible.
- Using recycled paper when printing is necessary.
- Choosing environmentally friendly name tag (no plastics, recycled/organic/eco-friendly lanyard or other alternatives).

### 2.2.2 IASC COMMITTEE MEETINGS

IASC is engaged in all fields of Arctic research and its main scientific working bodies are the five working groups: Atmosphere, Cryosphere, Marine, Social & Human, Terrestrial, Cryosphere, Social & Human and Atmosphere. Each working group is composed of up to two scientists from each IASC member country. The IASC Council is the policy and decision-making body for IASC. It ensures an input of a wide range of scientific and technical knowledge and provides access to a large number of scientists and administrators through their national committees. Action groups are short-term expert groups that provide strategic advice to the IASC Council. ISIRA - the International Science Initiative in the Russian Arctic - is an IASC advisory body.

1. Travel

- The strategic advice outlined in 2.2.4.2 needs to be considered for all IASC committee meetings (e.g. Working Groups, Council).
- Implement a scheme of accountability for carbon footprint.
- For Working Groups: Consider only one country representative travelling for working group meetings, with others joining via a hybrid format.
- Limit the number of in-person meetings for each committee to only one a year at the ASSW. All other meetings during the year should be held in an online format.

### 2.2.3 IASC-FUNDED PROJECTS

IASC Working Groups (WGs) encourage and support science-led international programs by offering opportunities for planning and coordination, and by facilitating communication and access to facilities. They fund each year cross-cutting and WG-specific projects which include activities such as IASC-funded projects (e.g. workshops, summer/winter schools, meetings).

1. Travel
    - The strategic advice outlined in 2.2.4.2 needs to be considered for IASC-supported projects.
2. Careful planning of field schools
    - Require that IASC supported field projects such as field schools to conduct careful project planning and risk assessments. Badly planned field activities can cost carbon with potentially no scientific outputs.
3. Reporting
    - Require that projects screen activities and seek to reduce carbon footprint (and environmental impact?).
4. Funding
    - Embedding sustainability in funding applications: identify any actions taken to minimise or counteract the environmental impact of research activities.

### 2.2.4 IASC SECRETARIAT

The IASC Secretariat consists of 3 staff members and is located in Akureyri, Iceland. It manages the day-to-day operations of IASC. Secretariat travels, office space, furniture, equipment, etc. emit carbon through emissions from e.g. production of purchased goods, travel, and electricity and heat (if this is not based on sustainable energy sources).

1. Location and building
    - When choosing future office space for the IASC Secretariat consider sustainability in building materials and design.
    - Prioritise sustainable and reusable/recyclable building materials.
    - Prioritise passive house design and sufficient insulation to minimise heat loss.
    - Prioritise location close to public transport.
    - If possible, use sustainable energy sources for electricity and heating (e.g. solar cells)
    - Electricity: Turn off light and equipment when not in use, and use energy efficient equipment.
    - Heating/Cooling: Reduce room temperature when offices/rooms are not used, minimise use of air conditioner for cooling.

2. IASC staff travels

- Encourage and promote sustainable and low-carbon travel.
- Actively reduce travel: Move meetings online, if possible.
- Actively support the use of public transport.
- Ensure that all travel falls within the travel policy devised as part of recommendation 4. If air travel is used, ensure that carbon offsetting continues to be used as advised in recommendation 6.
- Annual assessment of carbon footprint (see chapter 3).

3. Resource use - Reduce, reuse, recycle principle

Resource use is a significant contributor of carbon emissions – from extraction/production of raw materials, production phase, transport and disposal. Anything that can be done to reduce, reuse and recycle products will help to minimise the carbon footprint of any given activity.

Below recommendations should be used by IASC internally and when dealing with external suppliers and service providers (including conference and meeting venues).

- Certified goods and services: If possible, choose goods or services certified by an accredited organisation (environmental sustainability, social sustainability, energy efficiency, etc.)
- Apply the 'Reduce, reuse, recycle' principle when buying goods and services, including computing infrastructure, by:
  - Buying green and carbon friendly.
  - Buying second hand.
  - Buying only what is needed.
  - Buying durable and reusable products.
  - Making unused and reusable products available to others or use/reuse at later meetings/conferences.
  - Sorting garbage for recycling or proper treatment.
  - Minimise printing (e.g., of IASC reports, Bulletin, advertising materials).

### 2.2.5 EQUALITY, DIVERSITY AND INCLUSION

If applied without due consideration, some recommendations included in this report have the potential to diminish opportunities for some within the IASC community (e.g. networking opportunities for early career researchers). We have sought to avoid this, by engaging with the community and outlining solutions for potential problems before they arise. We recommend remaining vigilant to ensure that, for any given project or event, carbon footprint reduction strategies are applied in a way that avoids discrimination. Recommendations for mitigating such harms are presented here.

1. Potential lost networking opportunities from a reduction in in-person meetings
    - Launch a mentoring programme for early career researchers, potentially in cooperation with the Association of Polar Early Career Scientists (APECS). Such a programme would pair individual early career researchers with more experienced Arctic researchers in their field. This would provide the opportunity to develop professionally as well as to be introduced personally to a wider network.
    - Continue to encourage early career and Indigenous participation in in-person events when they do occur.
2. Difficulties attending online conferences due to poor internet connection, time zone incompatibilities or pre-existing responsibilities at home
    - Provide funding for local internet access options where participants do not have access at home.
    - For larger meetings, consider establishing several smaller, local "hubs" that can be connected as a hybrid conference.
    - Consider providing compensation for childcare during online and hybrid meetings, especially when meetings are outside local working hours due to time zone changes.
    - Several of these suggestions are already in place in the guidelines given by IASC to funded projects.
3. General suggestions
    - It is recommended to set up small-scale focus groups for specific groups within the community, for example early career researchers and Indigenous scientists, in order to identify areas where these recommendations may cause difficulties and outline potential solutions.
    - It is important to keep the IASC community engaged in the process as sustainable policies are developed.
    - Striving for an open, critical discussion without judgement is important while developing environmental strategies and policies.

# 3. QUANTIFYING THE CARBON FOOTPRINT OF IASC ACTIVITIES

Recommendation 3 advises that a carbon footprint assessment of IASC activities is carried out annually. Here, we have developed a simple tool to estimate the travel-related carbon footprint associated with IASC activities. The work could be done annually by the "sustainability manager" (see recommendation 1) and reported to the IASC Council. As an example, an assessment of travel during 2019 has been carried out and a carbon footprint estimate presented in 3.1.

This tool provides a starting point from which to estimate the environmental impact of IASC's activities. We recommend that IASC's carbon footprint assessment capacity is developed in the future to allow the inclusion of emissions from infrastructure, goods and services, computational infrastructure, electricity, heating and other activities. This will provide a more comprehensive understanding of current emissions, which will allow areas for efficient mitigation strategies to be more easily identified and targeted.

## 3.1 ANALYSIS OF TRAVEL DATA FROM 2019

The analysis of travel data is based on the IASC funded flights in 2019. In 2019, IASC funded 257 trips by scientists. We used the International Air Transport Association (IATA) or International Civil Aviation Organisation (ICAO) codes of the departure and arrival airports to derive the coordinates of the airports to calculate the flight distance over the great circle route. This was achieved using the open source software R [1], mainly using the R package airport.r [2]. Previously we used another R package (footprint.r), but the results seem to overestimate the $CO_2$ equivalent ($CO_2e$) footprint per person.

Having the flight distance, carbon dioxide emissions per kilometre were calculated with the factor 1.891. This factor includes the direct carbon dioxide emissions as well as the radiative forcing per passenger and it is based on the method of Carbonfund.org [3,4].

Using this factor, we calculated the **total carbon footprint of all IASC funded flights in 2019 for each flight per person was in total 125.7 tons $CO_2e$** (Figure 1a). Approximately 48 % of all IASC-funded emissions in 2019 were produced by flights to attend the ASSW conference in Arkhangelsk, Russia (roughly 61 t $CO_2e$).

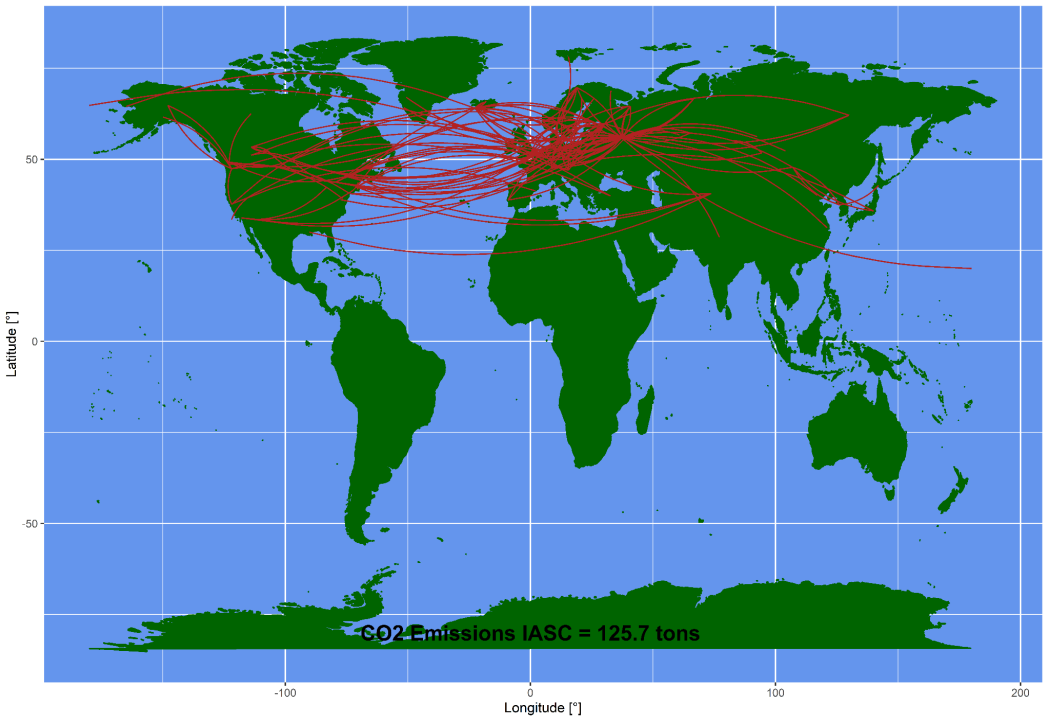
[1] https://www.rstudio.com

[2] https://cran.r-project.org/web/packages/airportr/vignettes/Introduction_to_Airportr.html

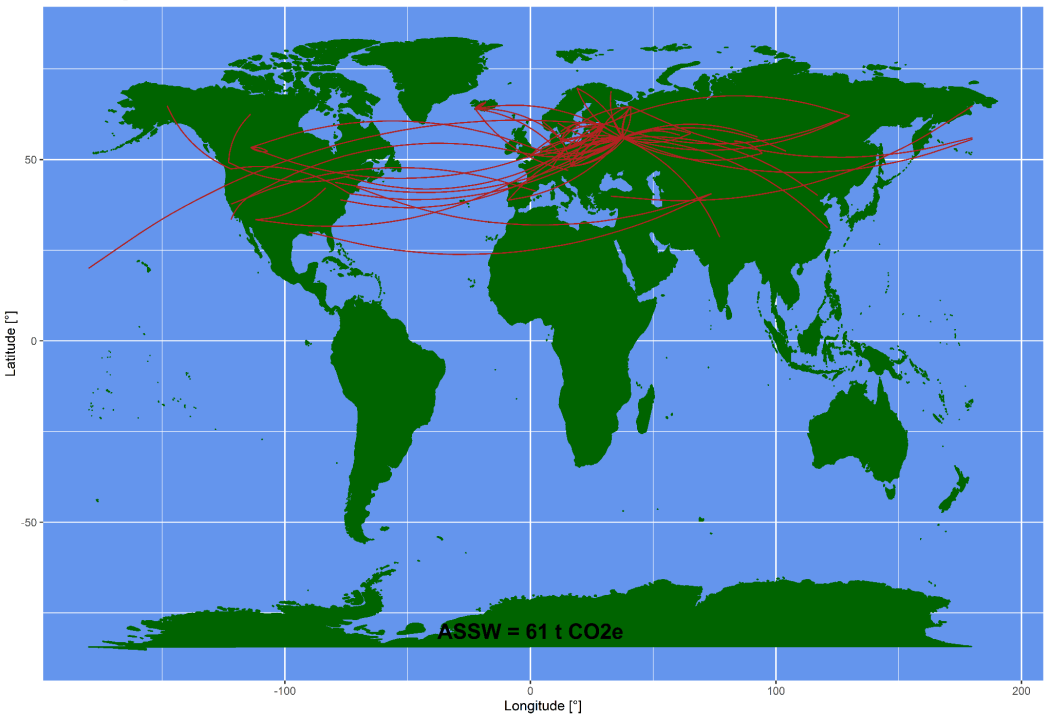
[3] https://carbonfund.org/calculation-methods/

[4] https://sheilasaia.rbind.io/post/2019-04-19-carbon-cost-calcs/

Funded Flights of IASC in 2019




Funded Flights to ASSW 2019



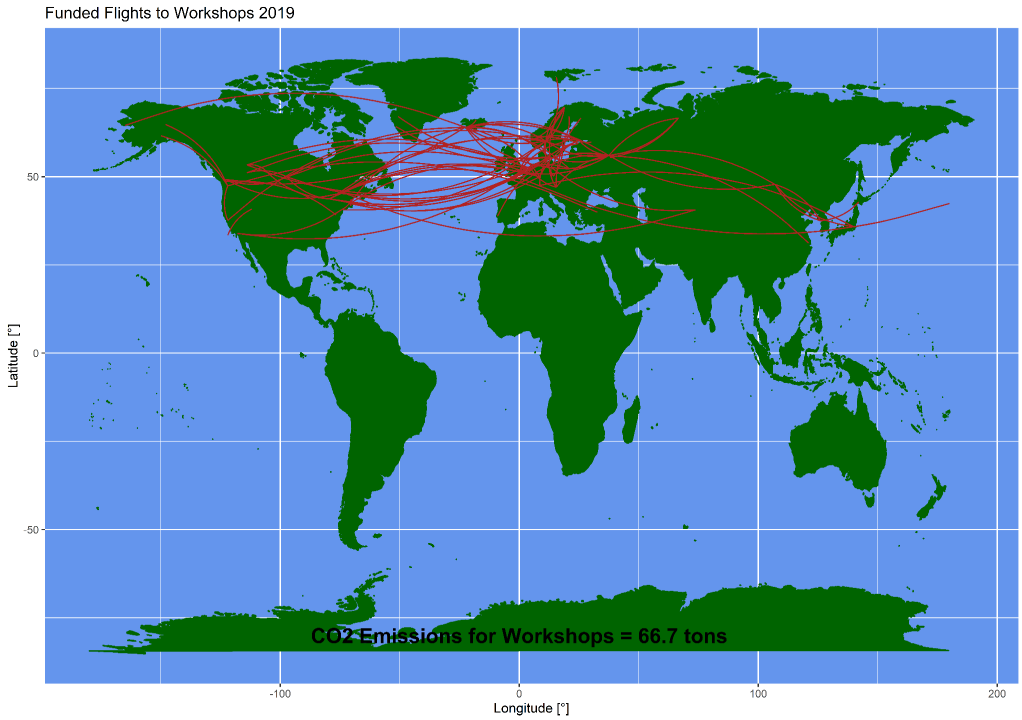



***Figure 1:*** Visualisation of IASC funded flights in 2019 and the carbon footprint in tons $CO_2$ equivalent. The upper plot shows all IASC funded flights and their carbon footprint 125 t $CO_2$, the middle plot just the flight conducted to travel to the ASSW 2019 conference (61 t $CO_2$). The IASC funded flights to workshops emitted 66.7 t $CO_2$.

**Figure 2** displays the distribution of total flown kilometres per conference or workshop in 2019, and **Figure 3** the carbon footprint per activity.


**Figure 2:** Flown kilometres per IASC funded activity in 2019

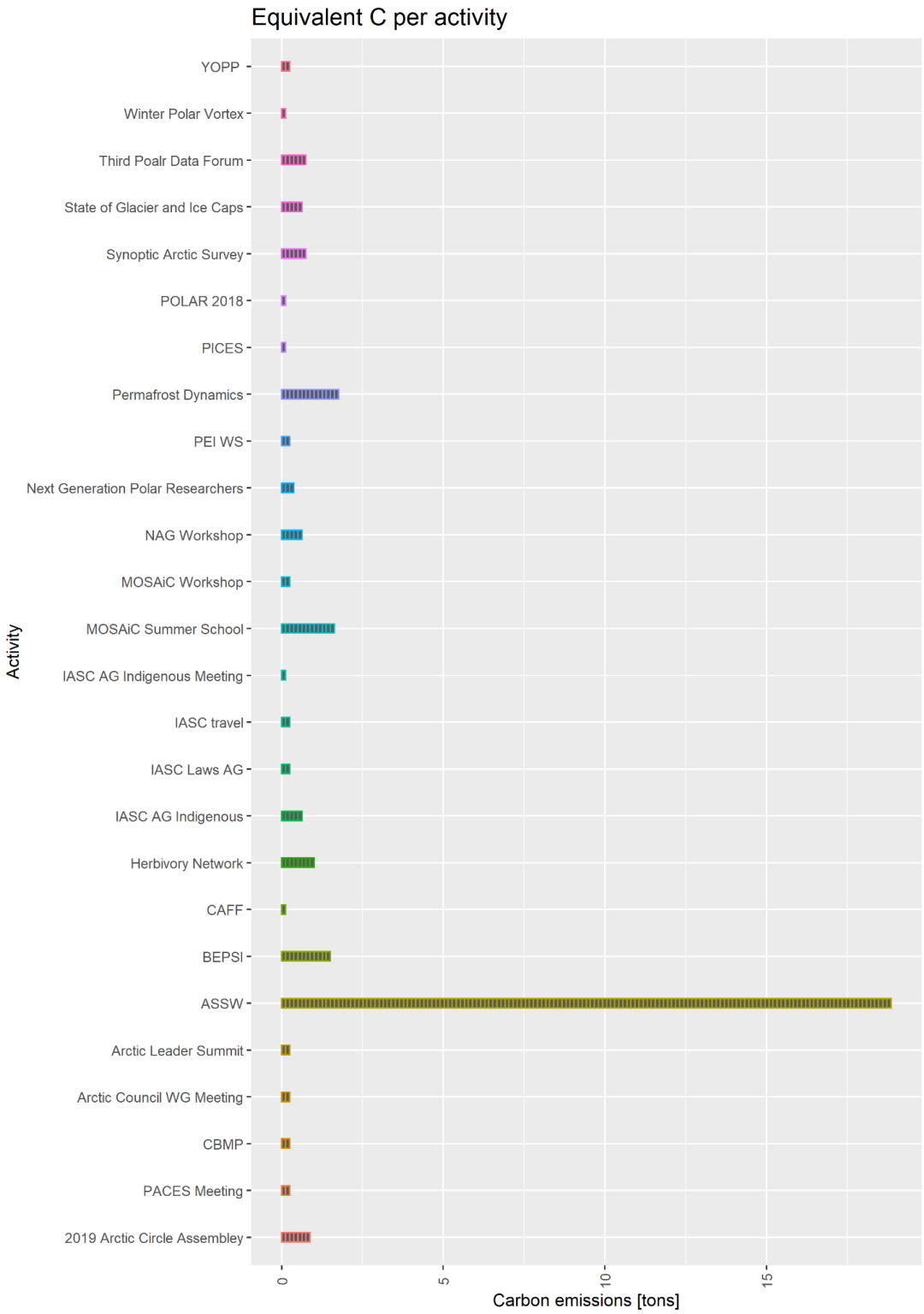



**Figure 3:** Carbon dioxide equivalent emissions assigned to the IASC funded flights in 2019.

## 3.2 DEVELOPING A TOOL FOR ASSESSING CARBON FOOTPRINT ANNUALLY

During the data analysis of the funded flights of 2019 a fundamental code was set up, which is capable of assessing the carbon footprint of IASC annually. This is based on the R Studio Software and uses multiple additional packages.

The code needs just basic information (IATA or ICAO codes), which will not create problems with the data privacy policy of IASC.

To continuously assess the carbon footprint a basic analysis should be conducted annually. This implies repeating the carbon footprint calculation in this initial phase every year. Additionally, improvements in the method should be included and reviewed to continuously reduce the errors of carbon footprint assessment.

We evaluated several factors which can be requested during conferences and workshops organised by IASC, to enhance the carbon footprint computation and extend the carbon footprint calculation to all participants, not just to those who are IASC funded. Our recommendations to improve the carbon footprint assessment are based on more information about travel and are summarised in the table below.

Crucial information: IATA or ICAO Code of departure and arrival airport.
Additional information: Aircraft Type, Class, potential carbon compensation.

| Travel data questionnaire | |
|---|---|
| Mode of Travel | Plane / Train / Car / Bus |
| From / To (involve stopovers) | IATA or ICAO Code for Flights |
| Class | Economy / Business / First / Second |
| Did you compensate for your travel using carbon offsetting? | Yes / No |

Table 1: Summary of the information that can be used in the assessment of the carbon footprint.

# 4. REVIEWING DEVELOPMENT AND BEST PRACTICES WITHIN OTHER ORGANISATIONS

## Bottom-up or top-down approach

Reviewing different approaches adopted by multiple institutions and organisations, we occasionally found very detailed documents, which denote a thoughtful approach towards sustainability, including a precise strategy and action-plan, e.g. University of Sheffield[5]. This implies commitments to become a carbon neutral university campus, use of renewable energy only, reduction of academic flights, stimulation of low-carbon opportunities for any catering and events, and a responsible waste management pathway.

Awareness by students, staff and employees at universities and organisations is important for a top-down approach towards a low-carbon teaching and research environment. Good examples are suggested:

1) best practice for laboratories, such as optimising cold storage, reducing the use of single-use plastic, saving energy and using common lab equipment[6];

2) creation of groups like "Scientists4Future", supporting the global climate movement by providing facts and materials based upon reliable and accepted scientific data to activists, politicians, decision makers, educators and the general public[7];

3) representations like the "Flight decision", which consist of a simple, but effective visualisation to minimise emissions[8].

4) open provision of data, knowledge and information, plus science communication and transfer should be encouraged.

Generally, moving toward a sustainable world requires both research on what is happening and how different problems could be solved, together with concrete action and behaviour change - both knowledge and action being indispensable parts of sustainability[9].

## How to stimulate and encourage sustainability?

A crucial point of our discussion was: "How can sustainability be stimulated by institutions and organisations?". Searching for answers, several good ones were identified:

1) Awards for sustainability to people, projects and organisations that are leading the way with significant achievements in sustainable building design, development and management[10].

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[5] https://www.sheffield.ac.uk/sustainability/strategy

[6] https://www.ed.ac.uk/sustainability/what-we-do/laboratories

[7] https://scientists4future.org/

[8] https://ethz.ch/content/dam/ethz/associates/services/organisation/Schulleitung/mobilitaetsplattform/images/Decision%20Tree_eng%20copy.png

[9] https://www.awi.de/en/about-us/organisation/sustainability/awi-sustainability-guideline.html

[10] https://www.breeam.com/awards/

2) Advice for embedding sustainability in research grant applications: scientists could identify and clearly articulate any actions taken to minimise, or counteract, the environmental impacts of their research activities, as well as describe such actions explicitly in theses, dissertations, and journal article publications arising from the associated research[11].

3) Encouragement of low-emission individual transport and public transport use; e.g. for all the destinations that can be reached within 6 hours by train and/or are within a distance of 500 km, you may only travel by train[12].

4) Similarly, prioritise, wherever possible, travel-free meetings and telephone/video conferences over physical travel, and collective ground (train or bus) over air travel[13].

5) Bike-scheme. For example, purchase of your own bicycle plus accessories and insurance and claim the costs back up to a maximum of € 1000[14].

6) Generally, remove institutional barriers to change.

Social and environmental aspects, and not only economic efficiency, should be taken into consideration when addressing sustainability issues.

### How to calculate carbon footprint?

Literature about this point is less prolific, but some good tools are available:

- An open-source tool to assess the carbon footprint of research[15]
- A travel decision tool, to sort travel options according to time, cost, or $CO_2$ emissions[16]
- A prototype tool to support more sustainable decision-making around air travel[17]
- A smart lab toolkit[18].

### What did Covid-19 teach us?

Covid-19 had (and still has) a big impact on travelling, including participation in field work and international conferences. Nevertheless, we have learned that virtual and/or hybrid meetings are

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[11] https://esajournals.onlinelibrary.wiley.com/doi/10.1002/fee.2326

[12] https://www.rug.nl/about-ug/profile/facts-and-figures/duurzaamheid/projecten/nieuw-zakelijk-reisbeleid

[13] https://www.lucsus.lu.se/sites/lucsus.lu.se/files/lucsus_travel_policy.pdf

[14] https://www.rug.nl/about-ug/profile/facts-and-figures/duurzaamheid/nieuws/gouden-certificaat-rug-voor-fietsvriendelijkheid?lang=en

[15] https://www.biorxiv.org/content/10.1101/2021.01.14.426384v1

[16] https://ethz.ch/services/en/organisation/executive-board/vice-president-infrastructure/mobilitaetsplattform/air-travel/routerank.html

[17] https://www.sei.org/projects-and-tools/projects/tr2ail/

[18] https://www.i2sl.org/

possible. Sometimes the online format has even increased total registration numbers[19]. This could well be because online meetings are providing an alternative for those who (for whatever reason) cannot travel. On the other hand, caregivers, or others in situations not conducive to focusing on online meetings, could be disadvantaged[20]. However, as long as recordings are available, virtual meetings can be watched at a more convenient time, also helping people with weak or unstable internet connections. While these solutions may not always be ideal as participants are unable to participate in live discussion, they show that alternatives, though imperfect, do exist. Furthermore, to facilitate remote participation, a few guidelines might help, such as:

1) provide multiple meeting times, to accommodate different time zones;

2) communicate clearly to all participants through emails and websites, especially when and where new calendar / scheduling / agenda information would be provided;

3) in addition to recordings, the desirability of holding multiple iterations of certain discussions should be considered[15].

The best way forwards, once the downsides have been identified, is to search for solutions to fix them, for example following the indications offered by Bonifati et al. (2020)[21] or Raby and Madden (2021)[22].

We acknowledge that online meetings do not replace personal interactions and that it is difficult to establish new collaborations, but while some participants felt feedback and reactions were more challenging during online meetings, others report an increased personal engagement (people who are usually shy in public, Early Career Scientists (ECS) who hesitate to ask questions to senior researchers, time constraints / limits for questions during live conferences).

Undoubtedly, online meetings have a positive impact on reducing carbon emission and cost savings over an in-person meeting (when considering rental of a venue, registration fees, travel and accommodation), but also intermediate options are available: hybrid conferences (though costs for organising the correct technology for these should not be underestimated) or development of new measures for conferences, like the three suggested by Klöwer et al. [23], i.e.

1) choose accessible venues,

2) increase virtual attendance, and

3) switch to biennial, rather than annual.

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19 https://static1.squarespace.com/static/5c7db94f77b90397ce872711/t/5eb9510995662464af185020/1589203260786/Report_ASSW2020+Online2020Final.pdf

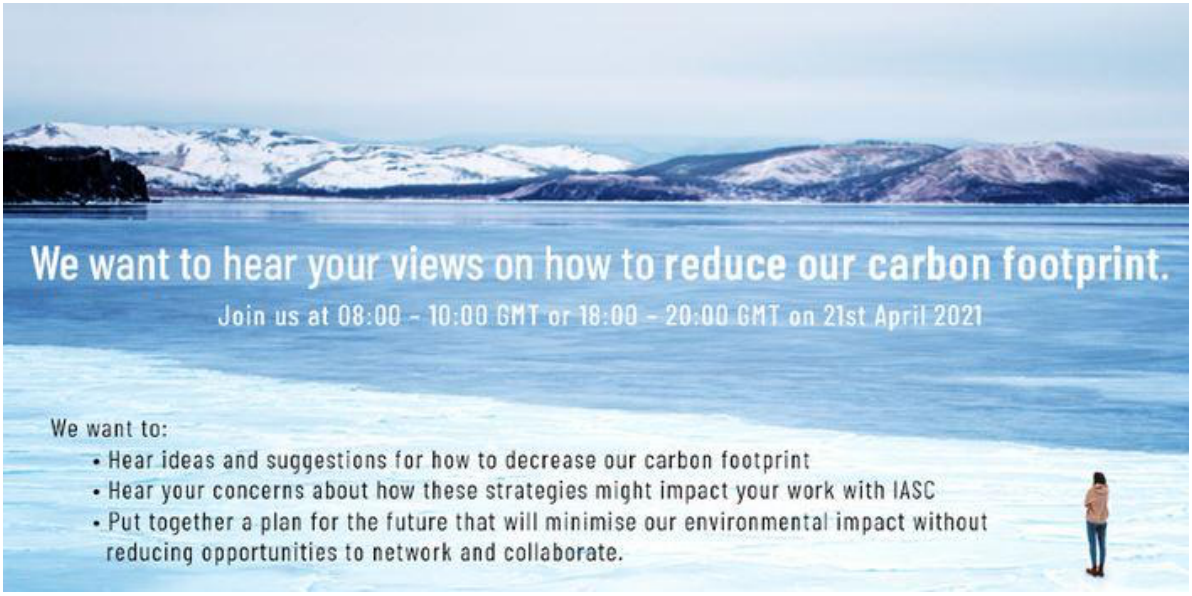
20 Angela Bonifati, Giovanna Guerrini, Carsten Lutz, Wim Martens, Lara Mazilu, Norman W. Paton, Marcos Antonio Vaz Salles, Marc H. Scholl, and Yongluan Zhou. 2021. Holding a Conference Online and Live due to Covid-19: Experiences and Lessons Learned from EDBT / ICDT 2020. *SIGMOD Rec.* 49, 4 (December 2020), 28–32. DOI:https://doi.org/10.1145/3456859.3456866

21 Angela Bonifati, Giovanna Guerrini, Carsten Lutz, Wim Martens, Lara Mazilu, Norman W. Paton, Marcos Antonio Vaz Salles, Marc H. Scholl, and Yongluan Zhou. 2021. Holding a Conference Online and Live due to Covid-19: Experiences and Lessons Learned from EDBT / ICDT 2020. *SIGMOD Rec.* 49, 4 (December 2020), 28–32. DOI:https://doi.org/10.1145/3456859.3456866

22 Raby CL, Madden JR. Moving academic conferences online: Aids and barriers to delegate participation. Ecol Evol. 2021;11:3646– 3655. https://doi.org/10.1002/ece3.7376

23 https://www.nature.com/articles/d41586-020-02057-2

## 5. AGCF WORKSHOP ON "HOW TO REDUCE OUR CARBON FOOTPRINT"




One of the best resources available to us as an action group is the wealth of collective experience and knowledge within the IASC community itself. In addition, this is the community that will be most directly influenced by any changes to policy or procedure that may come about in response to AGCF recommendations. With this in mind, we hosted two open, online workshops to engage the IASC community in discussion around how to reduce our carbon footprint on 21st April 2021.

The primary aims for these workshops were:

- To elicit suggestions and recommendations from a large and diverse group on the most effective approach to reducing our carbon footprint;
- To understand the potential negative impacts that recommendations could have on some parts of the community, and to discuss ways to minimise these;
- To encourage general awareness and discussion of sustainability within the IASC community.

The workshops attracted approximately 60 attendees in total. They were held over Zoom at 08:00 GMT and 18:00 GMT to enable attendance from a range of time zones. During the workshops, participants were divided into smaller groups to discuss specific questions, with conclusions being fed back to the whole group after each session. Questions were broadly phrased (eg "What do you think are the most important things to focus on in trying to reduce IASC's carbon footprint?"), yet many different discussions focused on the same themes, indicating that these may be constructive topics for the AGCF to prioritise.

Key topics raised during the workshops include the following:

- Travel. Suggestions included minimising trips where possible, encouraging low-emissions travel, thinking carefully about when and where to host meetings and who ought to attend in-person, and carbon offsetting. A number of potential challenges and pitfalls were presented, including changing procedures and the expectations of employers, and maintaining strong international networks.

- Online/hybrid meetings. These were often suggested as an alternative to in-person meetings. However, a number of associated challenges were raised. These included making it harder for certain groups (early career researchers, indigenous researchers etc) to expand their networks, a potential lack of productivity, the loss of informal networking, technological and access problems, and challenges associated with work/life balance and time zones.
- Reducing the carbon footprint of in-person meetings. Participants emphasised that sustainability guidelines for in-person meetings should be clear, practical and ambitious. Suggestions included a ban on single-use plastics and providing locally sourced and vegetarian food options.
- Other topics. Further discussion focused on the role of the international community and the challenges involved in institutional change, alongside a number of other topics.

A more detailed summary of recommendations and potential challenges raised during these workshops can be found in Appendix 7.1. Suggestions and opinions expressed here and, in the appendix, reflect ideas discussed and raised during the workshops; they do not represent recommendations from the AGCF.

# 6. AGCF MEMBERSHIP

The members of the IASC Action Group on Carbon Footprint were:

- Sophie Haslett (Co-Chair), Sweden
- Svenja Holste (Co-Chair), Germany
- Carlo Barbante, Italy
- Philip Wookey, United Kingdom
- Christian Rixen, Switzerland
- Elmer Topp-Jørgensen, Denmark
- Sergi Pla-Rabes, Spain
- Deborah Bozzato, Netherlands
- Magnus Ole Asmussen, Germany
- Ulrike Grote, Norway
- Robert Baxter, United Kingdom
- Helen Wheeler, United Kingdom
- Gwenaëlle (Gwen) Gremion, Canada/France
- Malgorzata (Gosia) Smieszek, Norway
- Pjotr Elshout, Netherlands
- Gerlis Fugmann (ex-officio), Iceland

The Action Group would also like to thank all participants involved in the workshops for important and fruitful discussions and Kolbrún Reynisdóttir/the IASC Secretariat for providing travel data and organisation.

# 7. APPENDIX

## 7.1 A SUMMARY OF DISCUSSIONS AND SUGGESTIONS RAISED AT THE COMMUNITY WORKSHOPS ON 21ST APRIL 2020

### Travel

Reducing the amount of travel – and in particular air travel – carried out in association with IASC activities was one of the most recurrent themes raised in the workshops. Common solutions recommended during the workshops included:

- Minimising travel wherever possible, by
    - Carefully considering which trips are truly necessary,
    - Grouping meetings, which will allow several to be attended on the same trip,
    - Encouraging online and hybrid meetings where possible;
- Compensating individuals for choosing low-emissions transport (eg taking the train instead of flying), and encouraging them to do so;
- Including carbon offsetting within the IASC budget;
- Reducing the number of meetings and the number of people attending each meeting;
- Making practical choices for meeting locations, for example, in a regional hub, near main airports and railways.

These suggestions raised a number of challenges and opportunities during discussion. A large number of challenges and opportunities raised were specifically related to online and hybrid meetings and as such, these are outlined in a separate section below.

| Challenges | Associated opportunities and potential solutions |
|---|---|
| • A key challenge can be the expectation of institutions and employers, who may not consider "slow travel" a worthwhile use of funding or work time<br>• Existing infrastructure within institutions (e.g. travel agents) do not often make it easy to book train or bus travel | • There may be more acceptance of and willingness to take part in remote meetings after experiences during the COVID-19 pandemic<br>• Encourage individuals to lobby their institutions and employers to change existing systems |
| • Carbon offsetting is not an ideal solution as it doesn't actually reduce carbon input into the atmosphere<br>• It can be difficult to verify carbon offsetting companies | • Carbon offsetting should not be the first solution<br>• Ensure that offsetting companies can show genuine, verifiable certificates |

| | |
|---|---|
| • There is a need to strike a balance between carbon footprint considerations and maintaining the international nature of conferences and research | |

**Challenges and opportunities associated with online/hybrid meetings**

These challenges are specifically related to online/hybrid meetings.

| Challenge | Associated opportunities and potential solutions |
|---|---|
| • Online meetings can reduce opportunities for early career researchers (ECRs), who often rely on physical conferences to form collaborations and build networks<br>• Inclusivity: e.g. indigenous involvement, ECRs etc. | • Mentorship to help ECRs and others to develop their network if attending meetings virtually<br>• There were several suggestions that online meetings could in fact increase participation for marginalised communities, who may have been unable to attend in-person<br>• Online meetings could attract larger numbers of attendees |
| • Online meetings can be unproductive and lead to "Zoom fatigue," which makes it difficult to focus<br>• How can the high quality of meetings be assured? | • Develop capacity to ensure the platforms and resources being used for online meetings are successful in achieving the goals aimed for by participants<br>• Divert funding towards developing infrastructure for holding online and hybrid meetings<br>• Digital training is important<br>• Issue guidelines in advance for expectations during meetings (e.g. camera on) |
| • Online meetings rarely give the same opportunity for networking as in-person meetings<br>• How can we avoid a "two-tier" system, where the experience of those able to attend in person is better than those who are not?<br>• Gauging feedback and reactions is challenging in an online format | • Change the format of sharing science: more discussion, fewer presentations<br>• Include "speed dating" events in conference programmes<br>• Promote holding social events online after or during conference<br>• Include some kind of reminder within the conference platform and advertisement to let participants know how much carbon is being saved |

| | |
|---|---|
| • Even online meetings will have some kind of carbon footprint attached | |
| • Online attendance could be more difficult for those without reliable high-speed internet access at home<br>• Technical problems: it is not possible to control access and quality for every attendee<br>• Accessibility issues | |
| • Different time zones are likely to be a significant challenge<br>• Family duties may make it difficult to dedicate time to networking during a virtual conference<br>• Employers' expectations: employers may not respect the time spent at a virtual conference in the same way as for an in-person conference<br>• There is a prestige in attending an in-person conference that may not be achieved when it is virtual | |

### Reducing the carbon footprint of in-person conferences and workshops

In addition to changing travel habits and reducing the number of in-person meetings, a number of suggestions were raised around how to reduce the carbon footprint of an in-person meeting when it does take place. Key suggestions included the following:

- Developing clear, practical guidelines and procedures to ensure that the carbon footprint is considered and reduced where possible;
- Sourcing food locally and encouraging vegetarian catering;
- Banning single-use plastics and encouraging circularity and recycling;
- Using renewable energy to power conferences;
- Quantifying the carbon footprint of each meeting, and providing guidelines to make it easier to do so;
- Encouraging individuals to apply pressure on their own institution/employer.

### International collaboration

International collaboration was raised as an important way to increase the sustainability of Arctic science. While some of these suggestions lay outside the remit of the AGCF, many are actionable, at least in part, by IASC.

- IASC should push to increase the availability and openness of Arctic datasets;
- International coordination between Arctic operations to reduce emissions;
- Pushing for exchange services between researchers, and include this in the Arctic roadmap so these services can be relied on – the Barter system in the Antarctic Peninsula was raised as a good example;
- Sharing/exchanging experiences between organisations.

### Conducting Arctic science

- Increasing the use of automation and robotics in Arctic research, and funding the development of these techniques;
- Working with local and Indigenous communities to coproduce research, allowing data collection by local people;
- Being more aware of sustainability in research: adding a section about resources used to conduct research to journal articles, for example, to become more aware of consumption;
- Requiring carbon emissions to be quantified and methods of reduction to be outlined in applications to funding agencies;
- Adding a platform to discuss carbon footprints and sustainability at international conferences.

### Challenges associated with institutional change

- Getting institutions on board in considering this a valuable use of money and employees' time;
- Creating a general atmosphere in which individuals are comfortable proposing ideas to reduce their carbon footprints;
- Existing infrastructure does not encourage this kind of change
- How to change funding agencies so they are flexible towards this approach?
- Change the organisation and structure of working groups, excom, council etc to reduce the footprint.