

**FIFTY-SEVENTH SESSION OF THE IPCC**  
**Geneva, Switzerland, 27 – 30 September 2022**

IPCC-LVII/INF. 4, Rev.1<sup>1</sup>  
(21.IX.2022)  
Agenda Item: 7.1  
ENGLISH ONLY

## **PROGRESS REPORTS**

### **Working Group I contribution to the Sixth Assessment Report**

(Prepared by the Co-Chairs of Working Group I)

(Submitted by the Secretary of the IPCC)

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<sup>1</sup> This revised version is being submitted with the addition of Appendix 1 and some modifications to section 6, to separate out a section (6.2) focused on the chapter scientist role.

## PROGRESS REPORTS

### Working Group I contribution to the Sixth Assessment Report

This report describes key activities undertaken by the Working Group I (WGI) since the last update presented during the the 54<sup>th</sup> (bis) Session of the IPCC in December 2021. The Working Group I activities are now focused on the production and publication of the report, work on the report microsite, the implementation of FAIR<sup>2</sup> data principles, outreach and communications, and debriefing on the assessment to prepare end of cycle legacy and hand over documents.

The IPCC Special Report on Global Warming of 1.5°C is now available from Cambridge University Press [here](#).

#### 1. Finalisation of the WGI sixth assessment report

##### 1.1 Production of the Working Group I report

- The Technical Support Unit (TSU) has coordinated the different production stages following a detailed schedule with the objective of sending the report to the publisher and making it available on the microsite by the end of January/mid-February 2022. This timeline was delayed due to the heavy involvement of TSU staff in the approval sessions of Working Group III (WGIII) and Working Group II (WGII). The production of the report has reached completion at the end of April and will undergo publication in the coming month through Cambridge University Press.
- The TSU has worked with Soapbox, an external contractor on copy editing and layout of the report.
- The process includes processing references, post-editing and fine-tuning of the figures to respect, as much as possible, the recommendations of the WGI 'visual style guide', copy edit with particular attention to the syntax and vocabulary used, to standardize the style of the report in iteration with authors. A detailed copy editing style guide was prepared by the TSU. Authors have proofread the revised drafts and addressed comments from editors.
- Corrigenda, tricklebacks have been addressed and implemented with authors where relevant.
- Submissions to the Error Protocol have been addressed, documented and corrections implemented before the finalisation of the report for publishing. The submissions reflect the considerable interest in reading all report chapters. Once the report is sent for publishing, the submissions will continue to be addressed and responses/corrections will be documented in a spreadsheet available with the report.
- The layout has been completed for all report files except for Supplementary Material that is currently being finalised.
- The index has been prepared with an external supplier.
- The report has been delivered to the publisher Cambridge University Press. The total number of pages of the WGI report (master version) is 2392. For printing, it will be produced in two volumes.

##### 1.2 Working Group I report microsite

- After several months of delay in the procurement process, the IPCC Secretariat has retained the services of Istrico Productions to design a simple landing page that will be used for the initial publication of each report after its approval and the complete outline of future report microsities (design, HTML, CSS and Javascript files, etc.). The objective of these sites will be to present the complete content of each report in HTML in addition to providing access to downloadable PDFs and related documents.

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<sup>2</sup> Findable, Accessible, Interoperable, Reusable

- The TSU worked with Istrico to prepare the [WGI report homepage](#), which went live on 9 August 2021. Since then, the three TSUs meet regularly with Istrico to advance the design project for the other pages of the microsites. A revised schedule was set with the aim of finalizing design work by 5 December 2021.
- An external web developer was hired through the Secretariat in April 2022 to upgrade the microsite and to convert all the InDesign files (layout document files) into HTML.
- The WGI report microsite has been updated and a soft launch is taking place in on 5 May 2022 with the final report documents, review comments and responses, errata, and supporting outreach, communications and data resources. The microsite will be tested through a short survey.
- The development of the html version on the report is underway over a 2-3 month period. It is expected to be launched in the northern Fall. Work will be undertaken to connect report figures to the archived code on the WGI GitHub repository and the intermediate and final datasets curated by the Data Distribution Centre.

### **1.3 Translations**

- The TSU coordinates proofreading of translations produced by WMO translators with volunteer WGI experts (authors, members of the WGI Bureau and, for the first time, IPCC focal points, following a call on this subject sent by the TSU).
- The volunteers have been divided into several product/language groups and have been invited to comment on/correct the documents (posted on a common platform allowing everyone to work on the same version).
- Since WMO translators require a finalized corrected version, one person (usually a member of the Bureau) is responsible, in each group, for analyzing the comments of the volunteers and making the final decisions on the translation.
- In order to ensure consistency of translations, the Glossary was the first product translated (translators were asked to refer to the translations of the Glossaries of the Special Reports).
- At this stage, the Glossary and SPM are translated and finalised. The Technical Summary and the FAQs have been sent for translation.
- There are multiple challenges that are currently experienced in the translation process that call for improving the quality and efficacy of the current process. A note has been prepared by WGI Co-Chairs with input from WGI Vice Chairs and TSU, to give a sense of the efforts that have been implemented by volunteers, WGI bureau and WGI TSU in this process. The note was sent to the IPCC Executive Committee (ExCom) on 31 January 2022 and is available [here](#).
- Recommendations for consideration by the Informal Group on Publications has been prepared by WGI and is available [here](#).

## **2. Communications activities**

### **2.1 Climate Change Explained Video Series**

- Short videos have been produced by the TSU in collaboration with the Secretariat with WGI authors explaining climate science topics in their own words. The playlist is available [here](#) on the IPCC YouTube channel and has been distributed via the IPCC social media channels.
- The video series is now being complemented with regional videos that connect key findings of the reports, the regional Factsheets and the Interactive Atlas.

### **2.2 Climate change scenarios in the media**

- A project has been initiated with James Painter, Reuters Institute, on a media analysis of climate change scenarios-related information thanks to the generous support of the UN Foundation. This work will contribute to the development of some communications guidance for the scenarios research community that develops scenarios that are assessed by the IPCC and remain a major challenge in communications both with stakeholders and with the public.

### **2.3 Communicating the key messages of the WGI SPM Figures**

- A project is underway to develop resources to support non-expert users in navigating and understanding the key messages of the Summary for Policymakers (SPM) visuals and also support authors in using the visuals for communication and outreach. The goals are (1) to design a visual storyline to communicate the key messages of the SPM figures effectively to non-specialist audiences via a web-based platform and (2) to design PowerPoint presentations and (3) prepare video explainers. The project is supported by the Norwegian Environment Agency (NEA) with Information Design Lab.

## **3. Outreach activities**

### **3.1 Bureau outreach activities**

- Bureau members continue to be actively involved with outreach activities across regions including at national press conferences, parliamentary bodies, academies of sciences, public and private sectors, and academic audiences.
- Ministerial briefings, briefings with local governments, and outreach related to extreme events grounded in the context of human-induced climate change, previous attribution studies, and future climate projections.
- The [twitter thread on the WGI report in French](#) by Valérie Masson-Delmotte has had 1 million views.
- Jan Fuglestad and Anna Pirani convened a session on the use of scenarios in the IPCC at the 2022 Scenarios Forum on the 20<sup>th</sup> June 2022. A summary of the session discussion is available [here](#).

### **3.2 Fact sheets of physical climate information relevant for sectors update**

- A set of fact sheets has been prepared on climate information relevant for sectors (Cities-Buildings-Transport, Energy, Health, Tourism, Agriculture, Fisheries, Forestry, Water, Ecosystems conservation, Risk Management, and Insurance). The fact sheets unpack the assessment outcomes of physical climate indicators and climatic-impact drivers. The format is similar to that of the regional factsheets and the objective is again to highlight for users the type of information that has been assessed, and to guide them to the more detailed information in the report.
- A consultation with users from different sectors in different regions, as well as IPCC Focal Points was carried out through a questionnaire during COP26 with close to 400 participants. The survey has been particularly insightful to know more about the potential users of these factsheets and what climate information they are most interested in. Two consultation meetings with stakeholders from various countries and sectors were held on 6 December 2021 and 18 January 2022. Representatives of Working Group II (WGII) and Working Group III (WGIII) were invited to participate in preparatory meetings and an internal review of the fact sheets. The final drafts were made available to Focal Points, WGII and WGIII, and users more broadly by means of a second survey that has been running during 10 April - 08 May 2022.
- The fact sheets will be finalised by October 2022.

### **3.3 Summary for Actuaries**

- “Climate Science: A Summary for Actuaries” has been prepared in collaboration with the International Actuarial Association. The Summary is based on the Working Group I report and is tailored to provide helpful insights into what the IPCC report means for the Actuarial profession. The document focuses on observed and projected extreme events, sea level rise, air pollution and the long-term effects of climate change. Two annexes are dedicated to data, regional specificities and a glossary.

- To launch this summary, a webinar was held on 13 April 2022. Over 400 individuals participated in the webinar from 51 countries. A video and slides from the webinar, can be found [here](#).
- The Summary for Actuaries can be downloaded [here](#).

### 3.4 WGI-TG-Data-DDC Interactive Atlas Regional Outreach Events

- The Task Group on Data Support for Climate Change Assessments (TG-Data), WGI TSU and Data Distribution Centre (DDC) are organizing an online webinar series focused on using the WGI Interactive Atlas. The webinars are aimed at researchers and practitioners, and will be interactive sessions highlighting the data aspects of using the Interactive Atlas, including data availability and FAIR data principles, how to access and terms of use of data.
- The Europe event took place on [18 March 2022](#) and the Central and South America event took place on [29 April 2022](#).
- The objectives of these events are:
  - Present the main results of the Working Group I contribution to the IPCC Sixth Assessment Report.
  - Engage with the regional research practitioner community over specific regional domains.
  - Present the data availability with special emphasis on the Interactive Atlas (IA) providing regional information and synthesis (from the Technical Summary and the regional chapters 10-11-12-Atlas Chapters).

## 4. WGI contribution to TG-Data and the implementation of FAIR data principles

- The WGI TSU data team continues archive data and code that underpins the assessment findings, in particular the report figures. Intermediate “Final data” are data from report tables, maps or graphics, and intermediate included in the assessment reports. It is usually the result of an analysis drawing on one or multiple ancillary datasets. A workflow is being implemented by the TSU in close collaboration with CEDA<sup>3</sup> and DKRZ<sup>4</sup> DDC representatives. Once all checks are completed code and data are published.
- The WGI GitHub repository is available [here](#).
- WGI is working with the Data Distribution Centre to document and curate datasets that underpin the report figures, including a meticulous process of quality control. The data of the SPM figures was made available with the report publication on the 9 August (<https://catalogue.ceda.ac.uk/uuid/ae4f1eb6fce24adcb92ddca1a7838a5c>).
- A TG-Data guidance document has been published on implementation of FAIR (Findable, Accessible, Interoperable, Reusable) data principles in the IPCC AR6 assessment process ([Pirani, et al., 2022](#)). The motivation to implement FAIR in the IPCC is to increase transparency and accessibility of the assessment, the implementation of the IPCC Error Protocol, and the long-term curation of the assessed digital information. The document introduces the implementation of FAIR data principles into the IPCC process and reflects the four elements of FAIR to find the data, produce and reproduce figures and, finally, to document the provenance for reusability. It presents standard (basic) measures that are recommended for all digital data that is assessed, intermediate measures that achieve reproducibility of assessed digital information, for example through the use of collaborative platforms for figure development, and also full (advanced) measures to achieve reusability of digital products with complete provenance documentation.
- A paper has been prepared on the full implementation of FAIR principles by the WGI AR6 Atlas and Interactive Atlas, including the challenges faced during its implementation, and those that remain for the future ([Iturbide et al., 2022, under review](#)).

<sup>3</sup> Center for Environmental Data Analysis

<sup>4</sup> Deutsches Klimarechenzentrum

- Work has started on a briefing process to develop lessons learned and recommendations for Seventh Assessment Report (AR7) on the implementation of FAIR data principles in the IPCC process. A summary has been compiled ([Pirani et al., 2022](#)) with input from the TSU data team and representatives of the DDC.

## 5. WGI contribution to cross-WG activities

- WGI Bureau members, authors and TSU have continued to support cross-WGI coordination activities on topics such as overshoot, future global surface temperature estimates, regional information, carbon cycle feedbacks and processes, short lived climate forcers, remaining carbon budgets, future climate pathways, net-zero, carbon dioxide removal, climate velocities, sea level rise.
- WGI representatives have provided detailed reviews of the Final Government Distribution (FGD) WGII and WGIII SPMs, focusing on consistency checks across the WGI assessment findings.
- WGI provided support to draft Box SPM.1 AR6 Common Climate Dimensions, Global Warming Levels and Reference Periods of the WGII SPM and supported scenarios-related content in the WGIII SPM.
- WGI representatives provided support to the approval sessions of the WGII and WGIII reports on aspects ranging from consistency in the substance to the technical, logistical and communications aspects of the sessions.
- WGI contributed to the IPCC-IPBES<sup>5</sup> workshop and report, including Edvin Aldrian as an SSC member and Valérie Masson-Delmotte as an active reviewer.
- WGI is actively involved in the preparation of the summary for urban policy makers with authors bringing expertise on regional climate, short lived climate forcers and pollution, climate information relevant for sectors and risk assessment.
- WGI will support the preparations for the cross-WG IPCC Expert Meeting on Scenarios.

## 6. De-briefing of the preparation of the Working Group I Report

### 6.1 Survey of the WGI assessment process

- A detailed survey of authors' views of the assessment process has been undertaken. 151 authors have responded.
- The aim of this survey is to unpack how the assessment unfolded in practice and to take stock of the lessons learned for the next assessment cycle. Question topics include the structure of the report, the chapter assessment process, cross-chapter and cross-WG aspects, the preparation of different parts of the report (FAQs, Glossary, Technical Summary, Summary for Policymakers), communications activities, the COVID-19 context and virtual working practices, and reflections for the AR7 WGI assessment. A report will be prepared on the survey outcomes.
- This process has been undertaken alongside reflections within the broader climate sciences community, in a coordinated activity with WCRP<sup>6</sup>, including CMIP<sup>7</sup>. CMIP has also run a consultation and some common issues have been addressed with identical questions. This exercise is relevant for developments in the scientific community, including future coordinated efforts, and the next IPCC assessment cycle.

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<sup>5</sup> Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

<sup>6</sup> World Climate Research Programme

<sup>7</sup> Coupled Model Intercomparison Project



## **6.2 Chapter Scientists**

- A survey has been sent to Chapter Scientists and Coordinating Lead Authors to gather an understanding of their experiences and recommendations for future IPCC cycles. The survey questions covered topics such as the tasks they were involved with, how demanding were these tasks, whether they worked beyond the stated terms of reference among others.
- A report has been prepared and includes recommendations for future IPCC cycles to improve the role within the Working Group I assessment process, including updated Terms of References on the role and its expectations - [See Appendix 1](#).
- Chapter Scientists contribute an essential role in the IPCC report drafting process. In a time of ever increasing literature and the need for data transparency and documentation, the need for technical support for author teams increases. This needs attention by the IPCC, through the Bureau, careful management by CLAs and support by the TSU as it can otherwise lead to an unsustainable burden on CSs.
- A cross-WG discussion is recommended on improving the role of Chapter Scientists. The report is available in Appendix 1 of this report.

## **6.3 Inclusive practices and diversity in the assessment process**

- From the outset of AR6, WGI has prioritized diversity and inclusivity in the participation of authors in the assessment process. Efforts included setting a welcoming and supportive environment for new authors, introducing a Code of Conduct at the first lead author meeting (LAM1), running post-LAM surveys with authors that included a range of questions about participation and inclusion, and working with SHIFT<sup>8</sup> Collaborative, and external experts, from LAM2 to provide additional support for creating an inclusive and participatory culture. Together with the Bureau and TSU, SHIFT designed resources and facilitated a series of activities for authors in the time surrounding LAM2, 3 and 4.
- A report has been prepared by SHIFT Collaborative with input from Bureau and TSU representatives to summarise the activities that have been undertaken and the author feedback that was gathered during the assessment process. The aim has been to identify what has changed and what works to create an inclusive, participatory culture in this kind of global, scientific setting. The report is available [here](#). This first debriefing phase has identified themes for a second phase of information gathering.
- A survey for authors was launched on the 28<sup>th</sup> June as a second phase of the debriefing process. The analysis will inform a deeper understanding of impacts and strategies to strengthen diversity and collaboration. The survey addresses individual practices and experiences, inclusive practices in the chapter teams and the inclusive environment in WGI, and the Coordinating Lead Author (CLA) experience.
- The WGI TSU will contribute relevant information to the Gender Action Team.

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<sup>8</sup> SHIFT Collaborative (<https://shiftcollaborative.ca/>)

## Appendix 1

### AR6 WGI Chapter Scientists Feedback Survey Report

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*Suggestions from the CSs on how to improve the role in the future*

*Feedback and recommendations from CLAs*

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Recommendations

Updated Terms of Reference

*Improving the CS role more widely in the IPCC*

### Summary

Chapter Scientists (CS) play essential roles in the IPCC report drafting process. The CS role is usually undertaken by an early career scientist who supports a specific chapter, assisting on more technical tasks such as document and citation management and figure development. The Working Group I Technical Support Unit (WGI TSU) undertook a short feedback survey to gather the views and experiences from the WGI AR6 CSs. The survey responses show that the CS role is a unique opportunity for early career scientists to gain experience and knowledge of the IPCC process and of the latest climate change research, however the workload is often overburdened with junior scientists taking on more responsibilities than previously expected and sometimes with resulting ethics of authorship / acknowledgement issues in the author team. In this report, the WGI TSU and Bureau provides some recommendations for future IPCC cycles to improve the CS role within the Working Group I assessment process, including updated Terms of References on the role and its expectations. A unified approach to this role across the Working Groups is recommended to the IPCC.

### Introduction to the Chapter Scientist role

Chapter Scientists (CS) are usually early career scientists that support a chapter's development during the IPCC report writing process. They aid in the more technical and logistical tasks, such as managing the chapter reference database, technical editing of the chapter drafts, or supporting figure development. The names of chapter scientists are listed on the front page of chapters but, as for Contributing Authors and Review Editors, they are not included in chapter citations that includes only the Coordinating Lead Authors and Lead Authors.

This report focuses solely on the AR6 WGI practices and experiences of the CS role, but the CS role has been present in [AR5](#), as well as the AR6, across all three Working Groups (WGs). There is no standardised approach to CS recruitment or to their Terms of Reference across the three WGs. More often, as was the case in the WGI AR6, CSs are recruited by chapter Coordinating Lead Authors (CLAs), either with a specific working contract or as part of an already contracted postdoc, PhD or masters position. The WGI TSU covered funding to support the travel of Chapter Scientists when needed.

Terms of reference (TOR) for the CS role were given to CLAs at the beginning of the assessment process to aid their recruitment efforts. For WGI AR6, CLAs appointed chapter scientists from their own funding sources.

The WGI AR6 assessment lists 29 CSs across its 13 chapters. On average, each chapter was supported by 2 CS, however the maximum number of CSs reached per chapter was 5 (Chapter 9) and the minimum was 1 (Chapters 5, 6, 10). All 29 CSs were based at the same institution as one of the CLAs but only 6 of the 29 CS

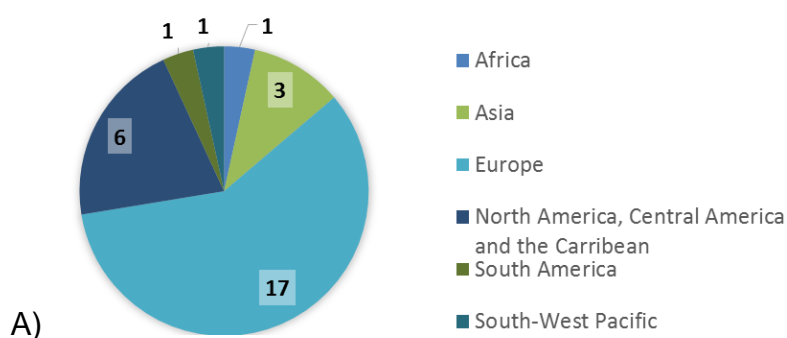


(21%) were based in a developing country institution. **Figure 1 Panel A** shows the regional distribution of all 29 CS as defined by the WMO regions. 17 CS (59%) were based in Europe, 6 (21%) within North America, Central America and the Caribbean, 3 (10%) in Asia, and only 1 CS (3%) was based in Africa, South America, and the South West Pacific region, respectively<sup>9</sup>. There was no standardized start date for CS across the chapters and as such CS started throughout the WGI AR6 drafting process. **Figure 1 Panel B** shows the number of CS attending their first WGI AR6 meeting along the drafting process. No CS had started by the first Lead Author Meeting (LAM1) in June 2018 but 10 joined by LAM2 (January 2019) and another 10 by LAM3 (August 2019). A further 7 joined by the virtual 'pre-LAM4 activities' (June-September 2020) sessions and 2 final CS joined by the virtual LAM4 (January 2021). CS end dates were also not standardized. Many CS continued to work during the lead up to the WGI approval of the Summary for Policymakers (SPM) and contributed to data and code archival tasks after the approval however end dates were not well documented by the WGI TSU and no overview can be provided.

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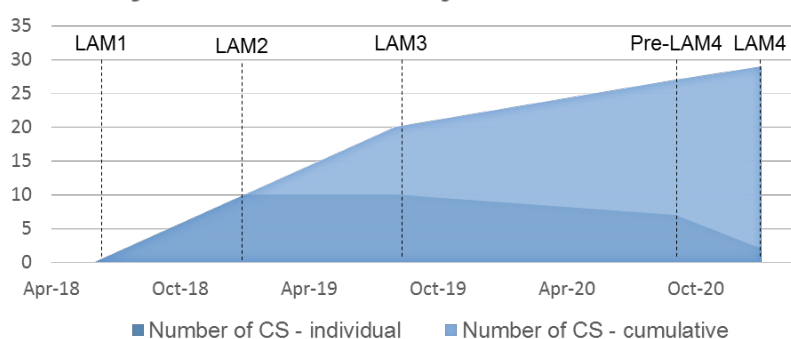
<sup>9</sup> 99% due to rounding.

## In which region were the WGI AR6 CS based?



A)

## By when did the CS join the WGI AR6?



B)

**Figure 1:** Statistical of the WGI AR6 Chapter scientists. A) The geographical regions of the host country in which the CS are based. Regions are based on the WMO regional classification<sup>10</sup> what the IPCC follows. B) Approximate start dates of the CS throughout the WGI AR6 process. LAM = Lead author meeting. The pre-LAM4 was a series of virtual events that concluded in September 2020. N=29

### The survey

After the WGI report was released, CSs were sent a short feedback survey, comprising 15 questions to gather an understanding of their experiences and recommendations for future IPCC cycles. The survey was sent for responses between 14 to 28 March 2022, roughly 9 months after the Summary for Policymakers was approved and as the production of the report's chapters was coming to an end. The survey was intentionally designed to be anonymous to encourage as honest feedback as possible. It therefore did not contain any questions asking for personal data, for example name, nationality etc., nor did it ask in which chapter they were based. The survey questions covered topics such as the tasks CSs were involved with, how demanding were these tasks, whether they worked beyond the stated terms of CS - reference among others.

### Survey analysis

Of the 29 CSs, 15 (52%) responded to the survey. This is a small sample size and as such it may not be appropriate to extrapolate these results to represent the range of views across all CSs, however the responses still offer insight into what just over half of the WGI CSs experienced.

### Contract type

To the question 'What type of contract was your chapter scientist role?', nine (60%) responded that they were working part time while undergoing a full time postdoctoral research contract. Other contract / employment types included part time while studying for a PhD or masters (7%), part time as part of a full time employment position (14%), part time self-employed (7%). One person responded that they worked as part of a full time employed role as a senior scientist. Only one person responded that they were contracted as a full time CS. The survey did not ask how workload changed across the WGI timeline, but it can be noted that there were often periods

<sup>10</sup> <https://community.wmo.int/governance/regional-association>

of more intense workload, for example leading up to chapter draft submission deadlines, compared to other periods where workload was more balanced, of example during reviews of the drafts. This imbalanced distribution of work would have affected CS who were not on full time contract.

## Tasks, responsibilities and workload

### *Terms of Reference*

CSs were asked which roles listed in the original TOR were they involved with and to list other roles, if any, they performed outside of these TORs. Of the listed TORs, the most widespread task conducted was managing content on the Document Management System (14 responses, 93%), followed by assisting the author team in compiling, revising and organising chapter contributions (11 responses, 73%).

There is a diversity of roles for a CS, as it shows not all CSs took part in all roles, for example, under half of the respondents mentioned that they undertook monitoring overlaps or inconsistencies across chapters or organising of chapter teleconferences.

### **Initial terms of reference with the number of associated responses**

n=15 for all options

- Managing content on the Document Management system (14 responses, 93%)
- Assisting the author team in compiling, revising and organising chapter contributions (11 responses, 73%)
- Maintaining a complete set of references, checking references in the chapter and reference management with Mendeley (10 responses, 67%)
- Assisting in the design and development of figures and tables (10 responses, 67%)
- Technical editing (e.g., edits for consistency in your chapter) (10 responses, 67%)
- Keeping records of review responses up to date and accurate in formal reporting (10 responses, 67%)
- Assisting CLAs during online meetings and at Lead Author Meetings, e.g. note taking, coordinating correspondence between authors, coordinating online meeting times (10 responses, 67%)
- Assisting with quality control in relation to the application of the style guide, chapter formatting and glossary (10 responses, 67%)
- Identification and compilation of references related to the objectives of the report (8 responses, 53%)
- Assisting with traceability checking (8 responses, 53%)
- Monitoring overlaps or inconsistencies across chapters (7 responses, 47%)
- Organisation of chapter teleconferences (7 responses, 47%)

These initial TORs were drafted at the beginning of the WGI report drafting process. Most tasks listed were carried out by half of the responses and so generally captured what was needed from CSs. The survey shows that CS also undertook several other additional tasks that were not listed in the TORs. These included tasks that are normally expected of chapter authors like replying to review comments, helping to draft FAQs, taking part in the chapter assessment. If CS make these contributions, they need to be recognised as Contributing Authors. For example, one specific response to this question was being the “main responsible author for one topic and heavily involved in writing one subchapter [section]”, which is a major concern since this is the role expected of a LA.

CS also completed a wider range of technical tasks including writing code to produce figures and analysis, and data documentation for archival. The development of figures, supporting metadata and the data archival tasks were projects that evolved during the drafting process in particular related to a new effort undertaken by WGI to the implementation of the FAIR principles. This was expected to be a chapter-wide responsibility, but all chapters allocated a CS as the point of contact for this task (only two chapters listed an additional author as another point of contact. This implies that much of the coordination work of this task fell on their shoulders.

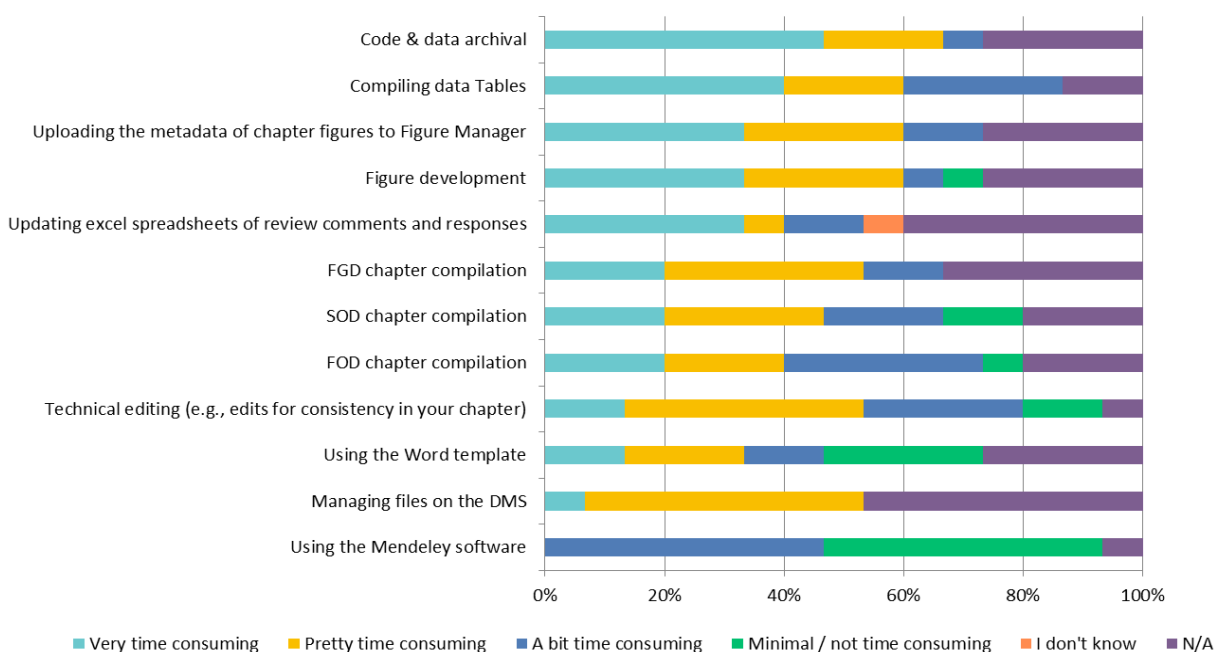
### *Contributing Authors*

What is not considered part of the CS remit is to take part in the chapter assessment. The published WGI AR6 report shows that 20 out of the 29 CS became CAs on their chapters (69%). All chapter scientists and CAs are also listed on their chapter’s Supplementary Material (additional, online only documents that support the chapter assessment). One CS is listed as the coordinator of one of the Chapter’s Supplementary Material. 13 CS (45%) are listed as CAs to either other chapters (8, 28%) or to report Annexes (8, 28%). Six CSs (21%) are listed purely as a CS role. On average, a CS is listed as a contributing author to two documents (chapters, supplementary materials or annexes). The highest number of documents to which a CS contributed was six (four chapters, one annex and the coordinator of the chapter supplementary material).

If CS make contributions to the substance of the chapter (e.g., responding to review comments, producing figures, drafting parts of text), then they should be recognised as a Contributing Author (CA) to that chapter. The survey asked for those who contributed to the chapter assessment whether they were recognised as CAs for this additional commitment. Of the 10 that responded, all said that they had been accredited as a CA. On a related topic of having recognition for their contributions, it should be noted that in another survey question response, one participant mentioned that they helped to draft an Annex but was not listed as a CS for that document. This raises the important issues of ethics of authorship (see Recommendations section).

### Workload of tasks

CSs were asked how time consuming their main tasks were relative to each other. For this question, tasks that were not listed in the initial TOR but were known responsibilities often carried out by CS were included, such as code & data archival, data tables, and storing metadata on figure manager. **Figure 2** shows the relative workload distributions of the tasks. Tasks most often stated as 'very time consuming' were code & data archival, compiling data tables, tasks related to figures and handling excel files to deal with review comments. The least time consuming task was reported to be using Mendeley to handle chapter references, followed by managing the document manager system and the word template.

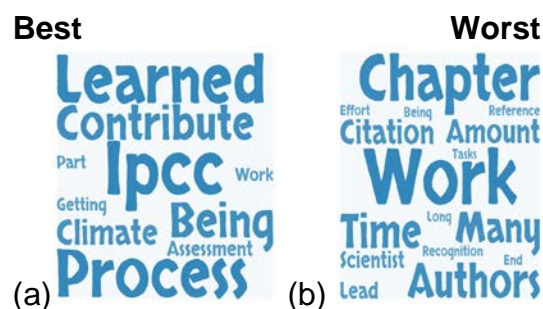


**Figure 2:** Time-consuming tasks with respect to the Chapter Scientist role overall as a percentage. n=15 for all options. Colour-coding refers to the relative amount of time spent on each task, in decreasing demand: Very time consuming, Pretty timing consuming, A bit time consuming, Minimal/not time consuming, I don't know, Not Applicable.

### Best and worst aspects of the role

CSs were asked to explain the 'best' and 'worst' parts of doing the role. These questions were open ended text box questions. 13 and 14 responses were collected for the 'best' and 'worst' questions, respectively.

Word clouds showing the most common words that occurred in these responses are found in **Figure 3**. The most common words for the 'best' answers were 'IPCC' (6 times), followed by 'learned' and 'process' (5 times each) reflecting the knowledge learnt from the experience and being part of the IPCC process. The most common words for the 'worst' answers were 'work' (13 times), 'chapter' (9 times), 'authors' (5 times) and 'time' (5 times) reflecting the workload in relation to the authors' and also their interaction with the authors.



**Figure 3:** Word cloud from respondents' answers on the 'best' (a) and 'worst' (b) parts of the CS role. Text size reflects the number of times the word was used in the responses. The max number of occurrences was 6 and 13 for (a) and (b), respectively, whereas the minimum number of occurrences was 3 for both word clouds.

Responses to the best parts of being a CS included networking and building more contacts, learning about new science, and being able to contribute to the IPCC process, for example:

- “Knowledge gained. I learned so much about the IPCC process. I also expanded my knowledge of the subject matter and found listening to the authors discuss the assessment and assignment of confidence to be really helpful.”
- “Networking opportunities, a sort of pride in being involved with the IPCC and contributing to something important”
- “Access to the latest literature, participating in the IPCC process. Building science contacts.”
- “Aside from getting one's name in the Chapter (!), the best part is getting to work with the world's leading climate scientists in the world's most important climate assessment publication.”
- “Very interesting and exciting experience, also a very fulfilling and useful thing to work on! Made some good connections with more senior scientists and had some opportunities to be a coauthor on some papers directly related to the IPCC work.”

The worst part of being a CS is also clearly shown in the survey responses: the workload and the lack of perceived recognition or credit for doing the work. A couple of the responses mentioned specific tasks such as managing the references in Mendeley or creating the data tables but the main focus of the responses here was on workload and stress. For example:

- “No recognition and enormous workload under low guidance. Since starting in June 2020 until the end, I was working crazy hours (10am-10pm), from January to March even working 12-14 hours/day over the weekends without doing anything outside the chapter preparation, and at the end not being included into [the] citation. At the same time, it was hard to understand certain points since I joined so late in the process, and it was incredibly hard to find some guidelines or information.”
- “The type of work I did for the report and the amount of effort I put into it only barely resembled the Terms of Reference for a chapter scientist. There were many long days and nights trying to stay caught up that it took a severe toll on my physical and mental health.”
- “The amount of time and energy consumed. High stress levels for long periods of time and lack of proper recognition. The work comes on top of a research position which suffered in a part of our career where building your CV is essential. Many CSs are also young adults with small kids. Balancing IPCC, day job and family was nearly impossible. Years of effort with little to show for it. Put as much, if not more, time and effort into this as lead authors, but all we get in return is our name printed on the front page in a role that reads like assistant.”

Some responses also talked about a lack of respect between them as CS and some of the chapter authors. A few responses touch on the difficulty of interacting with more ‘senior’ scientists, requesting them for information for tasks such as figure metadata documentation.

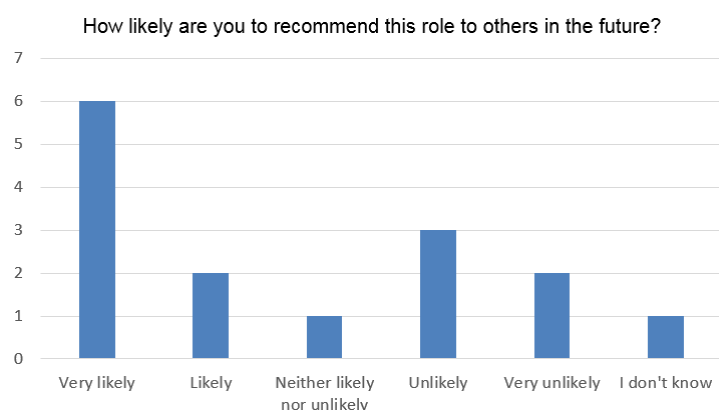
- “The last point was an extremely not caring attitude of some figure developers with regards to metadata and datasets submission.”
- “Sometimes being treated like a student rather than a colleague”
- “Non-leading CLAs”
- “Sometimes I was not completely sure about how far I could go in organizing the work in my chapter. Since I'm a junior scientist from a minority group I needed CLA's encouragement to keep track of the chapter's work (insisting by email and during the LAM).”
- “The stress, the effect it had on my health and relationships, the lack of recognition, feeling that many tasks were pointless and unmotivating, being castigated by LAs of other chapters.”

One comment reflects a misunderstanding or miscommunication, possibly with their chapter CLAs, with respect to being included in the chapter citation: “We were promised that we would be cited, and therefore have many citation numbers associated with us”. Chapter citations only include the CLAs and LAs as they are selected through an open and transparent process including agreement from the IPCC Panel and who have responsibility for the scientific quality of the chapter. Contributing Authors and Chapter Scientists are not listed in the citation. While the Terms of Reference indicate clearly, “The contribution of Chapter Scientists is acknowledged and their names are listed as Chapter Scientists on the first page of the corresponding report chapter”, this may be misunderstood and this ambiguity could be avoided by stating more explicitly that chapter scientists are not included in chapter citations.

### Recommending the CS role to others

There was a split in the answers to the survey question How likely are you to recommend this role to others in the future? Of the 15 responses, nine (60%) stated that they were either likely or very likely to recommend the role. Five of the responses (33%) said they were either unlikely or very unlikely to recommend the role. There was one response (7%) that stated they were neither likely nor unlikely and one response (7%) that said they didn't know (**Figure 4**).

When comparing these responses to a question that asked whether CS worked beyond the original Terms of Reference (TOR), there were five responses who clearly stated they did more than the TOR. Of these five, four of them stated they were either unlikely or very unlikely to recommend the role (one said they were very likely). Of the 10 responses who said they worked within the TOR or left the question blank, seven stated that they were either likely or very likely to recommend the role (one said I don't know, one stated neither likely nor unlikely). Although this is a very small sample size, it could be said that CS who had a more restricted and contained workload that was consistent with the TORs are more likely to recommend the role to others.



**Figure 4:** Survey responses to the question How likely are you to recommend this role to others in the future? n=15

### ***Suggestions from the CSs on how to improve the role in the future***

The survey asked CSs for recommendations for improving both the role in general, as well as the individual tasks going forwards. To improve the role in general, or to reduce the negative experiences, the responses from the survey suggested:

- The CS role be more clearly defined at the start of the process (what is expected and what is not expected)
- Have more than one CS per chapter to share the workload
- Ensure CSs are all early career scientists
- Include CS in the chapter citation
- Provide training to all authors on the role of the CS
- Organise the process, timeline and deliverables for tasks earlier and more clearly

The role of the TSU is fundamental to supporting CSs. Overall, CSs appreciated the TSU guidance resources and the CS meetings held at lead author meetings. 14 out of 15 responses said that the tools, guidance, training were between somewhat and extremely helpful (one response said not helpful) however comments stated that further support would have been appreciated, particularly for CSs that joined later on in the process. Another comment stated that “more regular meetings (virtual or otherwise) would help with cohesion and collegiality, and identify any problems early in the process”. The TSU could have supported the CS as a group more to help them learn from each other, as stated by another comment “A close communication among CSs would be very



helpful to know how each team works, as well as how we can adjust our working routines and make it more efficient.”

Suggestions from CSs in the survey for improving the workload and efficiency of specific tasks are summarised below.

#### **Word template**

- Style guidance that includes code to automatically edit issues of consistency
- Enable hyperlinks for callouts and referencing
- More guidance on appropriate place names (e.g, in regions of political sensitivity)

#### **Comment spreadsheets**

- Provide macros and code for compiling spreadsheets and checking comment responses
- Provide an online system to have centralised comment responses.

#### **Figure development including metadata**

- Have Figure Manager available at the beginning of the process along with clear guidance
- Be more selective on what metadata is needed, if possible
- Allow for coding scripts to be uploadable to the document manager system

#### **Data tables, code and data archival**

- Clearer instructions available at the beginning of the process
- Provide examples of code
- Further training to authors on requirements and principles to avoid an over-reliance on CSs
- Avoid duplicating the information on different archives (GitHub, DMS, figures and data manager)
- Note that one comment suggested to drop data tables in AR7

#### **Feedback and recommendations from CLAs**

After doing an initial analysis of the CS survey responses, the TSU sent 9 follow up questions to all Coordinating Lead Authors (CLAs), asking them to provide details on the CS role. The TSU received 22 responses, representing 12 of the 13 chapters.

When asked how their CS were recruited, 80% of the responses indicated that either current or former students/colleagues were hired who worked at the same institution of a CLA. Only 16% of responses stated that they formally announced/advertised for positions. One responses stated that a CS was recruited who was a post-doc based at an LA institution.

Most CS were recruited to work part-time while either researching (46%) or studying (11%). 25% were hired as full-time positions. Other responses included working part-time while being retired, or working flexibly so was only full time for specific parts of the process due to other commitments.

Funding for CS positions was wide ranging, with responses including:

- Being fully covered by existing grants
- Being topped-up with existing grants
- Through additionally sourced funds from ministries / other funding agencies
- Through overhead allocations of other grant types.
- Half-paid, half voluntary.
- Not funded.

When asked about the skills looked for when recruiting CS, two types of profiles were sought. The first was to have high organizational skills, attention to detail, good communication skills, the other profile also included data handling and analysis skills and the ability to do figure creation. **Figure 5** shows a word cloud of the responses to the question ‘What were the main skills you looked for in recruiting a chapter scientist?’. A special note should be mentioned for the Atlas chapter, where three CS roles were recruited with specific profiles to aid the development of the Interactive Atlas (<https://interactive-atlas.ipcc.ch/>). These profiles included skills to handle specific datasets and website development.

47% of responses stated that the Terms of Reference (TOR) were helpful or sufficient when recruiting CS positions however 43% of responses stated they do not recall receiving the TORs. This could be due to the length of time since the CLAs could have received the document, or could imply the CLAs did not use the TOR when recruiting their CS. Other responses pointed out that metadata collection was not included in the TOR despite this being a large requirement of CSs.



- “Comparing AR6 with previous reports, the need to archive all the code and data to produce all the figures introduced a lot of extra work compared to previous reports. This also meant most figures had to be made by the chapter scientists themselves, with assistance from LAs, CAs. This was 80-90% of the work of our chapter scientists. This was a big difference compared to AR4, AR5. Technical editing, references etc were only a relatively small amount of work for the chapter scientists.”
- “I think we shouldn't underestimate the importance of these roles. 5 chapter scientists might sound excessive but we would have struggled without each of them. I am immensely grateful to all of them. I wonder if chapter scientists could be paid positions as part of the TSU that early career scientists apply for.”

## **WGI Bureau and TSU recommendations**

Chapter Scientists contribute an essential role in the IPCC report drafting process. In a time of ever increasing literature and the need for data transparency and documentation, the need for technical support for author teams increases. This needs attention by the IPCC, through the Bureau, careful management by CLAs and support by the TSU as it can otherwise lead to an unsustainable burden on CSs.

The responses to this survey provide unique insights into the experiences of the WGI AR6 CS and gives the WGI Bureau/TSU information to make recommendations for future IPCC cycles, as well as suggest updates to the Terms of Reference to better define the role.

### Recommendations

- To the greatest extent possible, the TSU should provide all guidance and timelines for the report preparation along with required deliverables at the start of the process. Information is needed for CS to be able to plan ahead tasks to avoid a pile up against key deadlines and prepare for times when there is a peak work load. Recognising that some changes to the timeline may sometimes be inevitable, for example, COVID-19 caused delays and rescheduling of the timeline of AR6.
- Terms of reference (TORs) should be given to chapter CLAs and LAs with an accompanying guidance document that explains the role of the CS, its boundaries and some lessons learned from the AR6 experiences.
  - If the work requested of a CS goes beyond the TORs, this should be agreed to with the CLAs. CS can also consult a Bureau member or TSU if they have concerns that their work is overstepping the TORs to ensure that their workload remains manageable.
- Collectively, efforts should be made to hire CS early in the process (by LAM2) to allow for better integration into the chapter teams. If CS are hired later then the TSU should provide support to familiarize them with the process and expectations more efficiently.
- CLAs should provide the TSU with information on the arrangements they have made for the CS working with them so that there is a clear, shared understanding of the time availability and tasks expected of the CS.
- TSU should provide regular meeting and training opportunities for the CSs as a group throughout the process so that a stronger network is build amongst the CS, also with the TSU. This can include regular opportunities to collect feedback and status checks on CSs to ensure workload is kept to an appropriate level. A TSU member should be identified as the liaison / point of contact for CS with whom they can consult and request support and guidance.
- Recognising the essential role the CSs play, the IPCC should establish a fund to support this role in AR7 and make sure the role can be consistently applied across all three WGs. The IPCC should consider funding the equivalent of *at least* one full-time position per chapter of each Working Group Report. It is recommended that these funds be flexibly applied (i.e. full time or part-time) to support individual situations. These funds can be used to allow CLAs to recruit CS(s) with the necessary skills to complete the TORs.
- The implementation of FAIR principles as part of the IPCC assessment in terms of code and data management, documentation, provision of access and curation needs to be part of the author role when producing figures, instead of a reliance on CS. To support this. It would be an asset if CS had data science and management expertise, in addition to the TSU team including this expertise.
- Bureau and TSU should brief CLAs at the start of the process of the different authorship roles for the report in the context of the Chapter Scientist role and the ethics of authorship guidance provided to authors.
  - Chapter scientist ToRs do not include authorship of the chapter. If Chapter Scientists make substantive contributions to the report based on their area of expertise, e.g. responding to review comments, drafting text, developing figures, they must be included in the chapter list of Contributing Authors (CAs).

- Contributions that go beyond a CA role, e.g. being heavily involved in a chapter sub-section, providing missing expertise in the chapter team, thus fulfilling a LA role, this needs to be flagged to the Bureau by CLAs in advance to be appropriately managed, including consideration of whether the CS should be confirmed as a LA. Selection as a LA should be undertaken by the Bureau, in the context of expertise, geographical and gender balance, before a substantial contribution is made.

### Updated Terms of Reference

The experience of CS during the AR6 WGI experience included working with the TSU on the implementation of FAIR data principles. These tasks [in blue](#) have been added as an update to the TORs:

- Managing content on the Document Management system
- Assisting the author team in compiling, revising and organising chapter contributions
- Maintaining a complete set of references, checking references in the chapter and reference management with Mendeley
- Assisting in the design and development of figures and tables
- [Overseeing the provision of metadata of chapter figures to Figure Manager](#)
- [Supporting authors to compile figure data tables](#)
- [Preparation of data and code for publication, supporting authors where relevant](#)
- Technical editing (e.g., edits for consistency in your chapter)
- Keeping records of review responses up to date and accurate in formal reporting
- Assisting CLAs during online meetings and at Lead Author Meetings, e.g. note taking, coordinating correspondence between authors, coordinating online meeting times
- Assisting with quality control in relation to the application of the style guide, chapter formatting and glossary
- Identification and compilation of references related to the objectives of the report
- Assisting with traceability checking
- Monitoring overlaps or inconsistencies across chapters
- Organisation of chapter teleconferences

### ***Improving the CS role more widely in the IPCC***

Reflecting on the feedback from both CS and CLAs in these surveys, it is clear that the CS role is a necessary role that fundamentally supports the development of each chapter in IPCC reports. The CS role exists in all WGs with some common approaches but also some strikingly different ones, including how CS are recruited and paid. Issues to address may include:

- CLA support needs
- Terms of reference
- Funding and remuneration
- Recognition of the CS role in the preparation of IPCC reports
- Regional representation
- Capacity building in the IPCC process

Care is recommended not to confuse the capacity building aspect with the need for CLA support in general. A dedicated discussion is needed across the IPCC to establish a common framework and/or a more systematic mechanism to support these roles as core parts of the IPCC process.