SIXTIETH SESSION OF THE IPCC
Istanbul, Türkiye, 16 – 19 January 2024

IPCC-LX/Doc. 11
(8.I.2024)
Agenda Item: 8.3
ENGLISH ONLY

MATTERS RELATED TO OTHER IPCC ACTIVITIES

Task Group on Data Support for Climate Change Assessments

(Prepared by the Co-Chairs of the Task Group on Data Support for Climate Change Assessments)

(Submitted by the Secretary of the IPCC)

MATTERS RELATED TO OTHER IPCC ACTIVITIES

Task Group on Data Support for Climate Change Assessments

1. Salient activities since last report at the 57th Session of the IPCC in September 2022

1.1 Meetings

- Fourth annual face to face (F2F) TG-Data meeting held on 12-14 October 2022 at JAMSTEC, Yokohama, Japan;
- 10th TG-Data teleconference held January 25th 2022;
- 11th TG-Data teleconference held May 19th 2022;
- 12th TG-Data teleconference held October 13th 2023;
- Fifth annual face to face TG-Data meeting held in Santiago, Chile, November 22-24 2023;
- Monthly IPCC Data Distribution Center (DDC) managers meetings;
- Bi-weekly meetings among DDC managers, Working Group II (WGII) Technical Support Unit (TSU) and Synthesis Report (SYR) TSU officers.

1.2 Outreach activities

Webinars

Five webinars discussing the content of Working Group III (WGIII) report and demoing the Scenario Explorer, an online tool facilitating the exploration of assessed Sixth Assessment Report (AR6) mitigation scenarios, were hosted on multiple continents. A synthesis of outreach activities is presented in the tables below, also including 2022 webinars on the Working Group I (WGI) Interactive Atlas.

Table 1 WGIII TG Data Scenario Explorer Webinars.

Event	Date	People registered
Europe	Jan 26th 2023	624
Oceania 1: Australia	Feb 15th 2023	189
Oceania 2: New Zealand	Feb 18th 2023	314
Latin America	Apr 17th 2023	333
Asia	Apr 20th 2023	253

Table 2 WGI TG-Data Interactive Atlas Webinars.

Event	Date	People registered
Europe	Mar 18th 2022	Over 600
Central and South America	Apr 29th 2022	690
Africa	Oct 6th 2022	Over 700

Talks and conferences

- Lecture within "Open Science for Physics" course at Utrecht Universities regarding the IPCC FAIR[1] process by Alessandro Spinuso (2023-09-15).

- The reality of implementing FAIR principles in the IPCC context to support open science and provide a citable platform to acknowledge the work of authors (2023), Charlotte Pascoe, Lina Sitz, Diego Cammarano, Anna Pirani, Martina Stockhause, Molly MacRae, Emily Anderson, EGU 2023.

- Implementation of the IPCC FAIR Guidelines into the Sixth Assessment Report (AR6): benefit, challenges and recommendations for the Seventh Assessment Report (AR7) (2023), Martina Stockhause, Anna Pirani, Lina Sitz, Beate Krüss, Charlotte Pascoe, Molly MacRae, Emily Anderson, Ellie Fisher, SciDataCon-IDW 2023.

- How to use data, video shared by the WGI IPCC in the context of the AR6 publication process, Lina Sitz.

- "GIEC l'envers du decor"; talks about FAIR application of FAIR principles and data sharing in WGI IPCC.

- FAIR data podcast (IPCC WGI FAIR application experience), Lina Sitz and Anna Pirani.

- IPCC Interactive Atlas and FAIR data lab. Workshop on Climate Information for Risk Assessment and Regional Adaptation from Global Scale Climate Projections to Local Scale Climate Hazards. Maialen Iturbide, Andres Alegria, Lina Sitz, Trieste, Italy, 2023-06-08.

- Implementing FAIR principles in the IPCC context to support open science and provide a citable platform to acknowledge the work of authors, Emily Anderson, Diego Cammarano, Molly MacRae, Charlotte Pascoe, Anna Pirani, Lina Sitz, Martina Stockhause, PV2023, 2023-05-02.

- IPCC FAIR data approach, Martina Stockhause, Lina Sitz, Charlotte Pascoe, Anna Pirani, Emily Anderson, Diego Cammarano, and Molly MacRae, Open Science and Data Help Desk, EGU2023.

1.3 Publication of AR7 recommendations

TG-Data published its recommendations regarding FAIR objectives and their implementation in AR7 last October. These recommendations were shared at the Bureau 65th Session and informally with AR7 Working Group (WG) Co-Chairs.

1.4 Final data curation

Final data refers to data underpinning figures published in IPCC reports.

The table below indicates how many final datasets are currently indexed in the DDC Catalog hosted by MetaDataWorks, and which are still being processed.

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[1] Findable, accessible, interoperable and reusable

Table 3 Number of AR6 final datasets available from the DDC Catalog, and number of outstanding datasets yet to be included. Source: MetaDataWorks.

Group	In DDC catalog	Outstanding
AR6 WGI	101	120 (published at CEDA)
AR6 WGII	40	3
AR6 WGIII	39	0
AR6 SYR	16	2

At the end of the process, over 300 datasets from IPCC authors will have been archived and made available publicly. For WGI, scripts and code used to generate some of those figures are also available publicly on a code sharing platform.

1.5 Intermediate data curation

Intermediate data refer to processed data that is generated in the production of the IPCC report. The curation and archival of intermediate datasets used in WGI has been completed by DDC. The following datasets are now available publicly:

- Gridded monthly climate projection dataset underpinning the IPCC AR6 Interactive Atlas for the impact-relevant variables and indices. The collection includes datasets with CMIP6, CMIP5 and the Coordinated Regional Climate Downscaling Experiment (CORDEX) model outputs.The data have been prepared by the Consejo Superior de Investigaciones Científicas (CSIC) and are hosted on DIGITAL.CSIC (long-term) and the Copernicus Climate Data Store (CDS).

- Datasets of the assessed Global Surface Air Temperature (GSAT) projections and all input data and instructions necessary to reproduce the assessed GSAT projections in the Figure 4.11 of IPCC AR6 WGI. The datasets are hosted at the German Climate Computing Center (DKRZ), see Milinski, Sebastian; Marotzke, Jochem (2023).

- Datasets of sea level projections associated with the IPCC AR6. The dataset groups contain the full set of samples for the global projections as well as summary relative sea level projections. The datasets are hosted at the DKRZ, see Garner, Gregory et al. (2023).

Note that plans to archive ocean heat content data have been abandoned due to difficulties converting original files in proprietary data format to an open data format better suited for public dissemination.

1.6 Input data curation

Input data refer to source material used by IPCC authors. The following datasets and databases were recently published by DDC:

- The IPCC AR6 Risk Assessment Database, a collection of 13 datasets containing data for all "burning embers" figures in the WGII AR6, WGI Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC) and Special Report Global Warming of 1.5°C (SR15). Archived at the Center for International Earth Science Information Network (CIESIN).

- The Observed and Projected Impact Assessment Database, a collection of 30 datasets containing data from all observed and projected impacts figures in the AR6 WGII. Archived at CIESIN.

- The data subset of the climate model simulations from [Coupled Model Intercomparison Project Phase 6 (CMIP6)](#) used in AR6 are archived at DKRZ (134 TB / 65 118 datasets / 730 DOIs).

- The data of the climate model simulations from [HAPPI-MIP](#)[2] underpinning the SR15 are archived at DKRZ (35 TB / 149 173 datasets / 5 DOIs).

2. DDC funding status and funds allocation

As has been highlighted in previous TG-Data progress reports there is an ongoing concern on DDC funding status. In an endeavor to mobilize additional funds to support DDC activities, pursuant of Paragraph 28 of [Decision IPCC-LVII-4](#), letters were sent to IPCC Focal Points, Observer Organizations and six potential donors. In response to these letters, donations so far to the IPCC Trust Fund in support of the IPCC DDC include CAN 100,000 from the Trottier Family Foundation, AUD 100,000 from Australia, and EUR 100,000 from France. No expense so far has been billed.

We expect those funds will be needed to complete the curation of AR6 datasets, maintain the DDC web site operational and respond to user queries regarding IPCC data over the coming year. It would not however be sufficient to fully prepare and plan for AR7.

TG-Data has asked DDC partners to submit a funding proposal that would allow it to complete the AR6 data curation work and maintain key DDC services in operation for 12 months. The cash expenses should not exceed the amount donated to the Trust Fund for DDC activities. This proposal is included below. Note that the proposal does not cover activities for the IPCC Special Report on Climate Change and Cities, and the next section discusses DDC funding for AR7 activities.

2.1 Proposal for the completion of AR6 data curation

Tasks (March 2024 - March 2025)		Cost (USD)	Cost (CHF)	Lead
- Maintain the DDC Catalog until March 2025 - Ingest remaining AR6 datasets prepared by AR6 TSUs - Update to DDC Catalog web pages - Operate Catalog help desk until March 2025		58,000	49,880	MDW
- Regional CMIP6 data subset archival in support of developing countries (ca. 300 GByte and 12,000 datasets) - Publish the DDC CMIP6 input data subset archive in and make the data accessible through the Earth System Grid Federation (ESGF), the CMIP6 data infrastructure (similar to the CMIP5 data snapshot) Note: DDC Operations are covered by DKRZ's in-kind contribution of 0.5 FTE.		14,575	12,535	DKRZ

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[2] Half a degree Additional warming, Prognosis and Projected Impacts - Model Intercomparison Project

			56,486	48,578	CIESIN

• AR6 Adaptation Feasibility Database retrieval and archival (a collection of ten individual data sets)
 • AR6 Scenarios Database (1.0, 1.1) archival
 • AR6 WGII Input data sets retrieval and archival:
   1. Supplementary materials and annexes from the International Water Management Institute for WGII Chapter 4
 	
   2. WorldRiskIndex (WRI) data from University of Stuttgart for WGII Chapter 8
 	
 Note: NASA SEDAC contract has ~1 FTE covering maintenance of the CIESIN DDC archive and the operations for the AR7.					

• Update to the DDC catalog records for AR6 WGI data sets • AR6-CMIP6 provenance connection.			7,000	6,020	CEDA
• AR6 data status and gap report (WGI, WGII, WGIII, SYR) • FAIR Guidelines training material • Update to IPCC data curation workflow • Update to IPCC metadata schema • Metadata forms and templates for authors • Annual budget reports on use of the DDC fund			40,000	34,400	All ($10,000 each to above four centers)
• DDC-TSU Training workshop (travel costs to DDC managers) • Outreach activities (travel costs to DDC managers)			20,000	17,200	All ($4000 each to all of the five centers)
Total			**198,861**	**171,020**	

(Total current available: CHF **177,381**; balance: CHF **6,331**)

2.2 Options for DDC funding over AR7

The IPCC relies on DDC for the curation and long-term archival of assessed datasets, as well as of the final data underpinning graphics from the IPCC reports. In AR6, TG-Data and TSUs had to deal with uncertainties regarding DDC funding resources, and eventually a decrease in the in-kind contribution provided by DDC. One key recommendation from the AR6 experience is for the IPCC to ensure predictable funding for DDC support over the full AR7 cycle. During the 66th Session of the IPCC Bureau (BUR-64), the Secretary of the IPCC acknowledged the suggestions to request the Panel to consider funding of the DDC activities from the IPCC Trust Fund. The budgeted amount of support should be proportionate with the level of ambition in making IPCC data findable, accessible, interoperable and reusable, as laid out in the options paper (see Annex I to Document IPCC-LVII/INF. 7, Rev. 1).

DDC activities for AR7 include the continued preservation of datasets from past cycles, the curation and archival of new datasets generated during the seventh cycle, coordination with the scientific community, as well as contribution to the development of tools and documentation to onboard IPCC authors. This exceeds the in-kind contribution offered by current DDC members.

As outlined in the document prepared by DDC members[3] fully funding DDC activities would require a cash contribution of around 700,000 CHF per year. Note that TG-Data is willing to pursue efforts to collect funds, with the understanding that this is not the core strength of the group.

Whatever the amount budgeted by the IPCC for DDC activities, a mechanism will need to be put in place to allocate those funds. TG-Data proposes two options for the allocation of DDC funds:

- Option 1: Ask current TG-Data members (DKRZ, CIESIN, CEDA, MetaDataWorks, CSIC) to jointly submit a bid for the executive committee to evaluate.

- Option 2: Publish an open call for proposals, seeking paid and in-kind contributions both from current DDC members and other institutions willing to contribute to the IPCC data curation activities. Those bids would be evaluated by the executive committee to find a combination maximizing the value for the IPCC.

TG-Data requests the Panel to consider these options and/or provide guidance on additional elements required to inform its decision on the disbursement of funding for DDC activities from the IPCC Trust Fund.

3.   Preparing for AR7

Taking advantage of the experience carried over from the AR6 cycle, over the next year, TG-Data plans to conduct activities to communicate its recommendations to facilitate the implementation of FAIR guidelines in AR7. This includes holding joint discussions with WG Co-Chairs, past and current TSUs and the Secretariat regarding figure management software, preparing tools and training materials for AR7 TSUs and authors, and liaising with institutions to facilitate access to data and compute resources. For example, TG-Data members have ties to IIASA, which oversees the Scenario Database, to the CORDEX Flagship Pilot Study *URBan environments and Regional Climate Change* (URB-RCC), which is expected to contribute data for the Special Report on Cities, as well as to CMIP, which coordinates global climate modeling experiments.

A recommendation worth highlighting at this time is the importance of including scientists with data management expertise both within TSUs, author teams and chapter scientists. This will avoid overwhelming too few knowledgeable individuals with all data preparation responsibilities.

Below are plans and ideas for upcoming activities to prepare for AR7.

3.1 TSU training workshop

TSUs play a critical role in the implementation of the FAIR guidelines. Our objective for 2024 is first to contact TSUs as early as possible and start preparing training material for their activities during AR7. TG-Data proposes to present these training material during a workshop including TSU staff, DDC and TG-Data members. This material could then be used later by TSUs to train authors on the FAIR guidelines. Ideally, training material should be ready in time for the Special Report on Cities first Lead Author Meeting. Together with TSUs TG-Data will prepare a more concrete plan including activities for the Second Lead Author meeting (LAM2) when figure preparation becomes more evident.

Training material would include diagrams of data life-cycle, from author's ideation to long-term archival, with the different requirements and reviews required at various milestones during the assessment report (AR), tools to facilitate the management of figure data for authors and TSUs, FAQs for authors, data and code templates, etc. The training will build on existing content prepared for AR6 to demonstrate the steps leading to data publication. Note that exchanges between the DDC and the Secretariat have already taken place regarding the Figure Manager and its use in AR7.

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[3] The document was presented at the 57th Session of the IPCC IPCC-57; Geneva, Switzerland, 27 – 30 September 2022 (see Annex I to Document IPCC-LVII/INF. 7, Rev. 1).

3.2 Potential use of artificial intelligence for FAIR guidelines

A TG-Data subgroup has started discussions on the implications of recent progress in generative artificial intelligence (AI) capabilities for data support in the AR. We anticipate that a number of new AI-related opportunities and risks will need to be accounted for by AR7. TG-Data will consult experts to better understand implications for data access, provenance tracking, and any other relevant issue identified by WG Co-Chairs and the Bureau. Understanding that use of AI tools will be a critical element during AR7 we expect that this topic could be included at an overarching IPCC level AI discussion. TG-Data is organizing a webinar regarding AI within IPCC.

3.3 Contact input data providers

The AR relies on many sources of data, some of which require special MoU that grant IPCC authors access to restricted data. We plan to work with Co-Chairs to start identifying key data providers and hold talks to clarify how their data will be made available to authors and under which licenses, in order to streamline both access and the curation of derivative products. These talks will also aim to secure accounts and resources needed by some authors for data processing.

3.4 Expert Meeting on probabilistic scenarios

TG-Data members combine experience from all three WGs. Sharing ideas and challenges across WGs over the last years, we realized there is a gap in the data and science required to perform probabilistic climate risk analysis. Adaptation and mitigation decisions would benefit from a clear methodology and data requirements to make evidence-based probabilistic statements regarding future climate hazards. We suggest the need for a cross-WG activity in the form of an Expert meeting to achieve progress on this area. TG-Data would welcome the opportunity to be involved. The estimated budget for an Expert Meeting on probabilistic scenarios to preferably be held late in 2024 or perhaps early in 2025 is CHF 100,000.

A detailed proposal for the Expert Meeting is attached as Annex 1.

3.5 TG Data Web page

The implementation of the new TG-Data webpage is going through a final review process by IPCC Secretariat.

3.6 TG-Data membership

Article 4.1 of the TG-Data Terms of Reference states that "The term of membership on the TG-Data is to be linked to the assessment cycle of the IPCC and be refreshed at latest with the author selection process of a new comprehensive assessment, though with contingency for members to serve shorter terms". Accordingly, the current membership of the TG-Data is continuing until the time when the IPCC Bureau will select authors of the comprehensive AR7. The renewal of the membership of the TG-Data should be coordinated by the IPCC Secretariat that will invite governments, IPCC Observer Organizations and Bureau members to nominate experts.

4. Expected Panel Decisions

The Panel is invited to:

1. Consider the funding needs for the sustainability of the DDC work and allocate the appropriate budget from the IPCC Trust Fund for the year 2024, and subsequently. Furthermore, pursuant of Paragraphs 28 and 29 of Decision IPCC-LVII-4, urge the TG-Data Co-Chairs continue with the efforts of mobilizing resources, including in-kind contributions, for the Task Group's activities and for the Data Distribution Centre (DDC).

2. Establish the mechanism for allocating funds for the Data Distribution Centre funds from the IPCC Trust Fund.
3. Allocate funds for the proposed TG-Data Expert Meeting on Probabilistic Scenarios.

Appendix A: DDC Reports

This appendix includes additional information regarding DDC activities.

A.1 DKRZ

DKRZ is responsible for the long-term archival of WGI input and intermediate datasets.

DKRZ handover to TSU AR7 WGI

The first meeting with the Head of TSU AR7 WGI included, among other topics information on the following important AR6 activities:

- Intermediate dataset archival process: http://bit.ly/IPCC_DKRZ_Virtual_Workspace
- Introduction to the CMIP6 input data archival process and its documentation including a tabular overview over all archived datasets (intermediate and input data) as part of the IPCC WGI github repository: https://github.com/IPCC-WG1/DDC-AR6-CMIP6-Data-Archival
- Virtual Workspace activity in support of the authors providing a collaboration platform with access to requested datasets and common software tools (including ESMValtool): https://bit.ly/IPCC_DKRZ_Virtual_Workspace

DKRZ continues to act as the liaison with CMIP. One area of activity is improving how provenance information is recorded by IPCC authors. Storing this information provides transparency and visibility on how climate models are used across the report. CMIP6 data usage in IPCC AR6 has been made accessible as part of the CMIP6 Citation Service at https://bit.ly/CMIP6_in_IPCC. How CMIP6 data was used in IPCC AR6 WGI is also proving useful to make decisions on variable selection for CMIP7.

In addition, DKRZ held discussions on IPCC data and infrastructure requirements with the CMIP-WGCM Infrastructure Panel. DKRZ also consulted with the Secretariat regarding AR7 recommendation on CMIP provenance records within the IPCC's Figure Manager.

Input and intermediate data curation

DKRZ completely archived all input and intermediate datasets for AR6 by the end of August 2023 (see Figure 1). All are included in DDC's joint catalog. The archived total data volume for AR6 is 169 TB. References to the AR6 figure page and the final datasets were added for CMIP6 input datasets. **The DDC's long-term archive has reached a size of approximately 2 PB.**
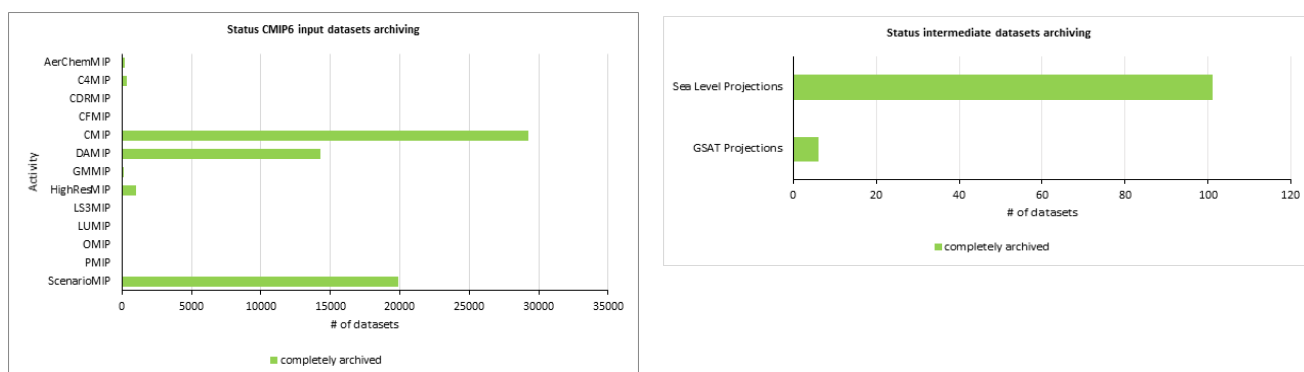

Figure 1 Number of input (left) and intermediate datasets (right) archived by DKRZ. Source: DKRZ.

Help Desk

User requests are directed to the DDC Partner DKRZ and for AR5 and AR6 input data partly to the ESGF support. A separation of user requests on IPCC DDC issues is not possible. Two requests were forwarded from DKRZ to the responsible DDC Partners.
In parallel to the regular user support channels, additional requests were sent to individuals at the modeling centers or at the data centers.

Data Usage

Preliminary information on data downloads from 20230-01-01 until 2023-11-28 is shown in .
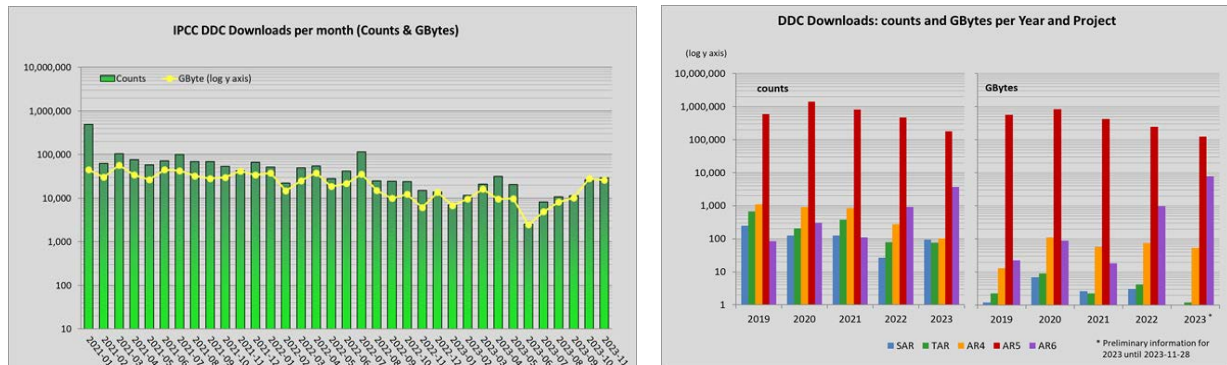

Figure 2 Monthly downloads (preliminary) over the last three years (left), and downloads per AR over the last five years (right). Source: DKRZ.

CSIC
CSIC operates and maintains the AR6 WGI Interactive Atlas on behalf of the IPCC.

Sessions and downloads

CSIC recorded over one million Atlas sessions from over 750,000 users since its launch in August 2021. below displays the number of users each week during the last six months of activity, showing a steady activity of over 200 users per week.
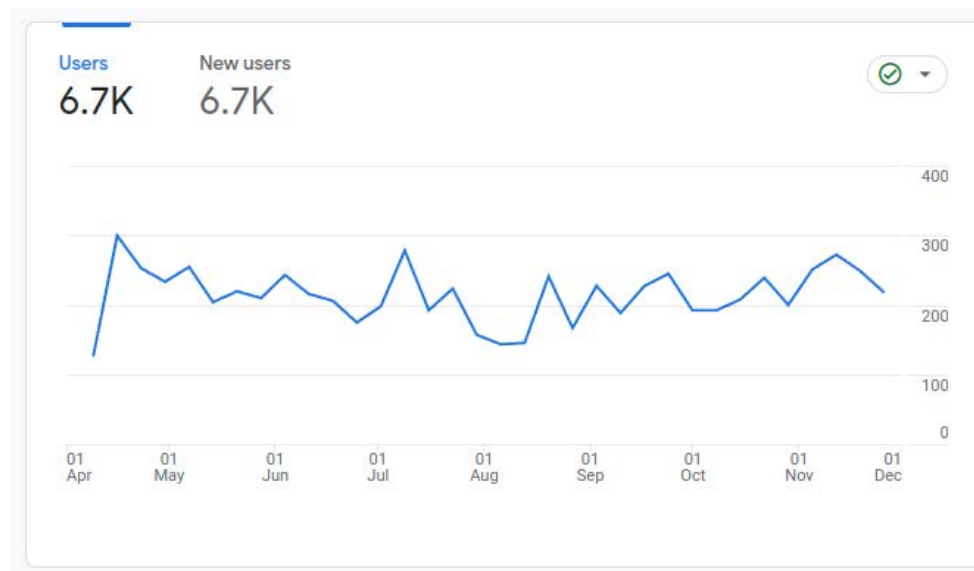

Figure 3 Weekly Interactive Atlas users during the last 6 months. Source: CSIC.

There have been 2,070 downloads of the Intermediate data underpinning the Atlas (stored at digital.csic), from 620 users. The code for the Atlas, available on GitHub and stored on Zenodo, has been downloaded 267 times.

Help desk

The Interactive Atlas help desk answers around 5-10 questions per month, mostly related to technical/scientific topics, as well as with technical issues using the Atlas.

CIESIN

CIESIN is responsible for the long-term archival of socio-economic data and scenarios from WGII and WGIII, as well as the integrated databases of observed and projected climate change impacts, risk assessments, and adaptation feasibility from across Working Groups.

CIESIN and MetaDataWorks (MDW) have worked together with TSUs of WGII, WGIII, and SYR, as well as with chapter authors on AR6 final data curation. The data sets have been included in the DDC Catalog. The downloads and user statistics are also included in the report of MDW.

MetaDataWorks

MetaDataWorks (MDW) is responsible for archiving final data from WGII and III, as well as developing, maintaining and operating the DDC Catalog.

The IPCC DDC Catalog saw over 11,400 new users in 2023. Together, users ran close to 11,000 catalog searches. More than 3,000 datasets were downloaded directly from the Catalog. Figure 4 shows the geographical distribution of users between May 1st and November 30th 2023, accompanied by weekly downloads in 2023. From Oct 4th to Dec 3rd, the five most downloaded datasets were SYR SPM5 (71), WGIII SPM7 (43), SYR SPM7 (25), WGIII SPM1 (24) and SROCC SPM1 (16).
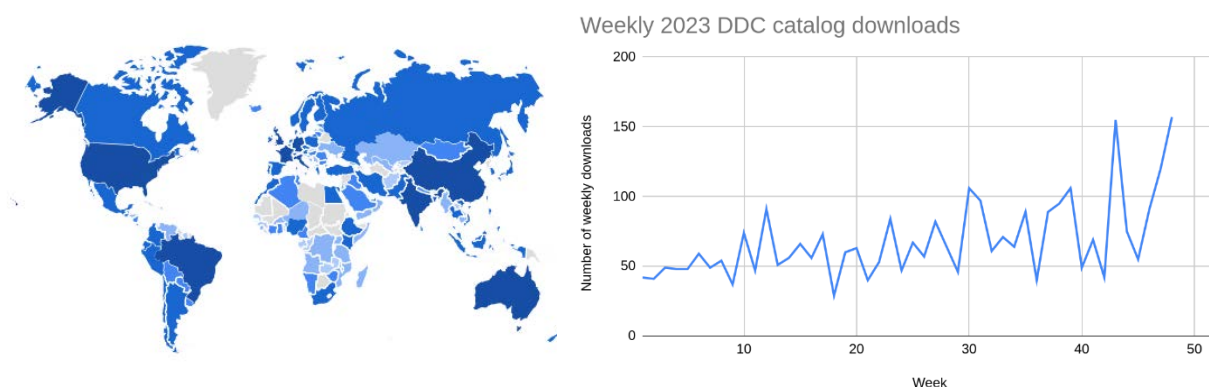

Figure 4 Number of DDC Catalog users by country, from 2023-05-01 to 2023-11-30 (left), and time series of DDC Catalog downloads per week in 2023. Source: MetaDataWorks.

Help desk

The MetaDataWorks help desk answers on average 1-2 requests per week. Most of these are requests for assistance finding data or troubleshooting issues with downloading data, and generally require back and forth with the requester.

CEDA

The Center for Environmental Data Analysis (CEDA, UK) stores final datasets for WGI.

Users and downloads

A total of 216 final WGI datasets are archived at CEDA. Since August 2021, close to 6,000 users have accessed the CEDA WGI catalog 35,000 times, and downloaded over 13 Gb of data. The five most accessed datasets are WGI SPM figures 8, 1, 2, 10 and 4.

Proposal for an IPCC Expert Meeting on Probabilistic Risk Assessments of Climate Hazards

(Prepared by TG-Data Co-Chairs to be discussed as a joint activity with Co-Chairs of Working Group II)

Background

The IPCC Task Group on Data Support for Climate Change Assessments (TG-Data) is, *inter alia,* mandated to:

- Provide expert information on data and scenarios in support of the implementation of the work programme of the IPCC.
- In cooperation with the Co-Chairs or their representatives of the three WGs, develop and update good practice guidance materials related to data and scenarios, targeting IPCC authors who lack familiarity with the IPCC process and/or the relevant data and scenarios.
- Contribute to building capacity in the use of data and scenarios for climate-related research, particularly in developing and transition-economy regions and countries e.g. through encouraging activities such as expert meetings and liaison with relevant academic institutions to address the requirements of developing countries. To achieve this, TG-Data may work with organizations and activities that have training as their core mandate but would not develop training programmes on their own.

The IPCC Bureau at its 64th Session (Geneva, Switzerland, 16 – 17 February 2023), suggested that TG-Data should consider proposing an Expert Meeting within a wider portfolio of propositions in collaboration with the Working Groups.

Context

Physical climate risks are the expectation of losses and damages caused by climate events or long-term shifts in climate patterns. Those losses may affect lives, health, infrastructures, cultural assets, services or ecosystems. As the climate shifts, risk assessments based on historical records become less reliable, and climate model projections are increasingly being used by decision makers to assess hazards. Professionals from various sectors, including public safety, insurance, service utilities, health, defense and supply-chain management, are essentially being asked to include climate science in their decisions.

The current state of climate science however raises many obstacles for doing this. Indeed, the large-scale climate modeling experiments run by the international climate modeling community are all conditional on GHG and aerosol concentrations that have no assigned probabilities. Climate model simulations can inform us of what hazards are likely given a GHG concentration scenario, but without the scenario probability, it's difficult to use this information in a risk analysis.

Use of risk-based assessments considering scenarios, probabilities and consequences are a common practice on many decision-making processes. One example of this practice is the economic assessment of engineering design of infrastructure. Another example is the evaluation of environmental risks associated with investment projects. In both cases there are clear connections of the expected outcomes of the process (value of infrastructure or impacts of investment project) and potential changes in climate conditions. The lack of probabilistic assessment of future climate scenarios has been acknowledged as a preoccupation in the design of infrastructure (Shortridge and Camp, 2019; Underwood et al., 2020; Lai et al., 2022; Helmrich and Chester, 2022). Following similar procedures as suggested in one of the latest IPCC reports (New et al. 2022), the prevalence of deep uncertainty suggests the use of robust and adaptive methods for infrastructure design. However, strict budgetary constraints and rigid decision-making process, complexity in modularity

design in some type of infrastructure inhibits this type of deliberative and exploratory approaches. In the case of environmental impact assessment process where typically a single version of an investment project is assessed on its potential environmental impacts, knowing the probabilities of future climate scenarios that might change baseline conditions and potential risks to projects, is highly desired.

According to Morgan and Keith (2008):"If judgments about likelihood are not supplied with the scenarios, they will be assumed by the users either explicitly or implicitly. The convention of not communicating information about the relative likelihood of scenarios therefore muddies communication between analysts and users." In practice, this leaves decision makers, with no special expertise in climate science or GHG scenarios, effectively responsible for assigning implicit or explicit likelihoods to future scenarios to craft high-cost, high-consequence adaptation plans (Ho et al., 2019).

Beyond the question of scenario probability, there is also a lack of consensus on how to combine results from multiple climate model simulations into a probability distribution fit for risk assessments. While there is a considerable body of work related to model weighting, it hasn't been distilled in clear guidance that can be readily applied by the impacts and adaptation community.

Science gaps

Some of the science gaps that need to be addressed to meet the needs of risk analysts relate to:

- How to assign probabilities to future emission and concentration scenarios, where probabilities are understood as subjective degrees of belief (WGIII);
- How to analyze climate simulation ensembles to assess climate hazards conditional to a GHG scenario, region and time frame (WGI);
- How to assess probabilities for low-likelihood high-impact scenarios;
- How to build parsimonious ensembles to limit the strain on downstream impact modelers (WGII);
- What IAM and climate modeling experiments would generate valuable data for climate risk assessments (WGI, WGII, WGIII).

Some of the questions related to scenario likelihood were discussed at the IPCC Workshop on the Use of Scenarios in the Sixth Assessment Report and Subsequent Assessments (Bangkok, Thailand, 25 – 27 April 2023). The participants agreed that "the IPCC risk framing should be more prominent upfront in reports since the risk framing in relation to hazards, socio-economic aspects, make the assessment more policy-relevant".

Scenario likelihood was also discussed at the ScenarioMIP workshop (van Vuuren, 2023): "It would be helpful to provide clear narratives on what the scenarios represent in terms of policy choices and their likelihood." Another recommendation is "to run (most) simulations in emission driven mode – in contrast to the use of a concentration-driven approach in CMIP6. The former leads to a wider range of model outcomes, but that is more representative of the real uncertainty range." Having ESM driven directly by emissions scenarios with probabilistic interpretations has the potential to drastically simplify the risk assessment methodology.

Aims of the Expert Meeting

This EM seeks to answer a couple of questions:
1. Which type of adaptation decision frameworks need the use of probabilistic climate risk assessments?
2. How can the data, science and tools currently available be used to inform probabilistic climate risk assessments today?
3. What new science, modeling experiments, data and tools are needed to enable state-of-the-art probabilistic climate risk assessments by practitioners?

Outcomes

There are two key tangible outcomes expected out of the EM, related to each of the questions above.

The main outcome, related to the first two questions, is a technical report, intended for practitioners and the climate services community, regarding scientific best practices to conduct climate risk analyses with data and methods currently available, and the limitations of those analyses.

The second outcome is a white paper mapping a path to a future where climate risk analyses are credible, robust and actionable. The paper would highlight scientific gaps, make suggestions regarding the design of modeling experiments (IAM and ESM), and suggest actions the IPCC could take to support the process.

Intangible outcomes include stimulating interdisciplinary research activity across working groups, giving legitimacy to stakeholders requests regarding climate research programs, and boosting the profile of activities generating data in support of probabilistic risk analyses.

Participation

We envision a meeting with around 40 participants.

The EM would engage communities working on
- Probabilistic GHG emission modeling (WGIII)
- Climate impact, adaptation and vulnerability (WGII)
- Climate modeling (WGI)
- Risk assessments
- Uncertainty analysis

And could include representatives from
- CMIP7
- Regional Information for Society
- Stakeholders (climate services, insurers, …)

Timeline

We propose to hold the EM over four days preferably in the fall of 2024.

January - Panel decision
February – Discuss idea with WG Co-Chairs
March - Form a Scientific Steering Committee (SSC)
April - Identify location and supporting organization
May - Send invitations to participants identified by the SSC
May - Draft scientific program
June - Plan social activities and meeting logistics
June - Prepare and send travel information
August - Final scientific program
Fall 2024 - EM

Financial resources

We estimate a budget of about CHF 100,000. This would include travel expenses for 20 participants from developing countries and EITs.

Scientific Steering Committee

The SSC will be appointed by TG-Data and WG Co-Chairs following consultations with stakeholders.

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