ipcc

INTERGOVERNMENTAL PANEL ON climate change

FORTY-THIRD SESSION OF THE IPCC
Nairobi, Kenya, 11 - 13 April 2016

IPCC-XLIII/INF. 16
(15.III.2016)
Agenda Item: 10
ENGLISH ONLY

FUTURE OF THE TASK GROUP ON DATA AND SCENARIO SUPPORT FOR IMPACT AND CLIMATE ANALYSIS (TGICA)

An Institutional Analysis of TGICA

(Submitted by the Acting Secretary the IPCC)

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Executive Summary

*S*ince its inception in 1997, the TGICA[1] has worked to provide climate change data and guidance to the impacts, adaptation, vulnerability, and mitigation communities.

As part of this, the TGICA has focused its energies on three main tasks: data provision, primarily through the Data Distribution Centre (DDC); technical capacity building, including the development of guidance documents; and community engagement. In doing so, the Task Group has used its unique position within the Intergovernmental Panel on Climate Change (IPCC) to curate assessed science and provide objective comment on the issues of concern to the research community. In this way, the TGICA has served to facilitate exchange of information, support research, and improve the quality of information that ultimately feeds into IPCC assessment reports.

While these contributions of the TGICA have been significant, the Task Group has also faced a number of challenges that have limited its capacity to capitalize on its unique position and deliver on its mandate. Aware of such challenges, and in preparation for the next assessment cycle, the TGICA developed a vision document for the 41st Session of the IPCC. The document proposed three possible futures for the Task Group: (1) discontinue or severely curtail the TGICA and discontinue the DDC; (2) maintain the status quo; or (3) strengthen the TGICA and upgrade the DDC.

More than a simple accounting of the past accomplishments of the TGICA / DDC, weighing these possible futures requires consideration of the unique role the TGICA plays in the evolving landscape, including an analysis of emerging needs and opportunities associated with the provision of relevant data and guidance. Weighing the future of the TGICA also requires a reckoning of the missed opportunities associated with eliminating a group whose cross-Working Group position allows it to credibly and legitimately communicate with a number of communities whose full capacity and participation are essential to improving both the quality and relevance of IPCC assessment reports, and our collective understanding of the potential impacts of climate change more broadly.

To facilitate a discussion on the future of the TGICA, this paper takes stock of the main contributions of the Task Group and crystallizes some of the persistent challenges that have limited its efficacy. The paper also reviews four broad trends that have shaped the environment in which the TGICA operates and considers the several opportunities for a better-resourced TGICA to contribute in a unique way within this new environment.

While the paper does not advocate for a particular path for the TGICA, it warns against curtailing or eliminating the group without a full consideration of the unique potential of the Task Group to advance access and the appropriate use of climate change information across a broad range of user groups; build technical and human capacity within these groups; and facilitate communication that can improve knowledge and decision-making in both research and operational contexts. The paper also argues that a decision to strengthen the TGICA should be matched with a sharpened mandate, a clear set of specific goals that capital on the unique role of the TGICA, and a realistic sense of the resources needed to achieve those goals.

[1] Originally called the Task Group on Scenarios for Climate Impact Assessment (TGCIA), the Task Group changed its name in 2003.

Accomplishments & Persistent Challenges

A permanent body made up of representatives from each of the three Working Groups (WGs), the TGICA engages assessed science, provides curatorship for the data and information included in the Assessment Reports (ARs), and offers objective comment on issues of concern to the research community. Managed jointly by organizations in three countries, the DDC has been TGICA's primary vehicle for data provision. The DDC currently provides climate observations, climate model data, socioeconomic baseline and scenarios, and other environmental data assessed in documents that have been "approved," "adopted," or "accepted," by the IPCC.

The TGICA has sought to build technical capacity with regards to access, interpretation, and application of data. Among other activities, this has involved the development of technical guidelines that describe the use of scenario data for climate impacts and adaptation assessment (1999/2007); the use of climate scenarios developed from regional climate model experiments and from downscaling methods (2003 and 2004, respectively), and the construction of sea level scenarios for impact and adaptation assessment of coastal areas (2011).

Finally, the Task Group has worked to build human capacity through community engagement – collecting input to inform the scenario development process, coordinating information use, and facilitating communication between and among IPCC WGs and the diverse communities that these groups represent, including through two regional expert meetings (2007, 2015). Many current and past TGICA members cite its role in facilitating informal communication between WGs that does not have many other avenues for exchange as critically important.

While these contributions have been significant, the Task Group has consistently struggled with insufficient resources. With only intermittent support from an IPCC Technical Support Unit (TSU), TGICA's Co-chairs are often left on their own to plan and coordinate meetings, follow up on planned activities, and reach out to potential partners; the volunteer nature of the group also means that some members are more active than others. This has delayed the timely provision of guidance documents, among other things. The DDC managers also report operating more or less at capacity, with a range of upgrade tasks they cannot accomplish without additional resources.

Evolving Landscape & Emerging Opportunities

More recently, the Task Group has found itself challenged by a series of ongoing developments within the wider community; these include changes in the governance of relevant data sets, a proliferation of climate information portals and providers, and a relative explosion in both the number and diversity of actors seeking to employ climate change information in their own analyses. Greater interest in climate change has also brought increased scrutiny to the IPCC, leading the Inter Academy Council (IAC) to recommend that the IPCC improve transparency, particularly with regards to the data and information assessed (IAC, 2010).

Many current and past members of the TGICA see these developments as creating new opportunities for the TGICA to engage in meaningful work associated with ongoing tasks of data provision, capacity building, and community engagement. While these activities would require new resources, additional support would allow the group to capitalize on the Task Group's unique position within the IPCC to improve access and use of data and scenarios, support research and decision-making, and improve the quality of information that ultimately feeds into IPCC assessment reports.

Potential activities for a better-resourced TGICA are many; those described in the report include the development of a meta-database; helping to harmonize top-down and bottom up approaches to understanding the potential threats and opportunities associated with climate change; evaluating

the science of decision support; co-developing capacity development activities; and better engaging the UNFCCC[2] process, particularly through the Least Developed Countries Expert Group (LEG), the Consultative Group for National Communications from non-Annex I (NAI) Parties, and the Group Support Programme for National Adaptation Plans.

Defining Next Steps

Were the TGICA to be strengthened, including a sharpened mandate, the clear identification of specific goals, and a realistic sense of the resources needed to accomplish these goals, the Task Group would be able to contribute in new ways to improve the access and use of climate data and scenarios for research and decision making. In the event that the IPCC is not able to sharpen the TGICA mandate, identify clear goals, and obtain the resources needed to support those goals, the Task Group may need to adjust its mandate to more narrowly focus on the provision of data through the DDC.

[2] United Nations Framework Convention on Climate Change

Introduction

The Task Group on Scenarios for Climate Impact Assessment (TGCIA), now the Task Group on Data and Scenario Support for Impacts and Climate Analysis (TGICA), was founded nearly two decades ago by the IPCC. Since its inception, the Task Group has sought to provide data support and guidance to the impacts, adaptation, vulnerability and mitigation communities as a mean to advance collective understanding of the threats and opportunities associated with climate change. It has made significant contributions with respect to this mandate, contributing to improvements in both climate change research and the IPCC assessment process.

While the contributions of the Task Group have been significant, it has been frustrated by persistent lack of resources, which affect its ability to achieve its mandate. In addition, recent years have seen the landscape in which the TGICA operates change substantially – requiring the Task Group to take stock of current conditions, and its own strengths, in order to carve a path that allows itself to contribute most significantly to the next IPCC assessment cycle.

In order to inform discussions about the future of the TGICA, this paper presents the Task Group's main areas of work, identifies persistent and evolving challenges, and calls out a series of potential new activities through which the TGICA could achieve its mandate in the current environment. While the paper does not argue for a particular course of action, it warns against curtailing the TGICA / DDC without a full accounting of its current and potential value, and suggests that a strengthened TGICA should be matched with a sharpened mandate, a clear set of specific goals, and a realistic sense of the resources needed to achieve those goals.

1.1 Background

The TGCIA grew from a recommendation, made at the IPCC Workshop on Regional Climate Change Projections for Impact Assessment (London, 24-26 September 1996), that the IPCC "establish a Task Group to focus on the provision of the necessary data to the impacts community in time for the Third Assessment Report (TAR) and on capacity building for future assessments" (IPCC-XXI/Doc. 13).

The recommendation, which came on the heels of the Second Assessment Report (SAR), acknowledged a need to engage the increasingly diverse impacts, adaptation, and vulnerability research community in exploring the value of newly developed climate scenarios. It also recognized a need to coordinate with the mitigation community, whose work was also based on scenarios. The recommendation was considered by the IPCC Bureau in November 1996, and the TGCIA was established the following month.

After initial consultations in January, the TGCIA held its first meeting in Washington, DC in May 1997; the meeting identified a number of priorities for action, including the inventory of impact studies and climate model runs, the provision of climate data runs through the DDC, and the production of guidance materials to facilitate the use of scenarios (TGICA-1 minutes).

1.2 Data Distribution Centre

In July 1997, governments were invited to nominate institutions to act as the DDC. Based on recommendations made later that year by the Ad Committee on the Data Distribution Centre, the Panel agreed that Germany and the United Kingdom would co-host the DDC – at the German Climate Computer Center's World Data Center for Climate (DKRZ-WDCC) and the Climatic Research Unit (CRU) of the University of East Anglia, respectively.

The DDC was designed to archive climate and scenario information underlying the ARs and to serve as a resource for the research community. Indeed, when the DDC was launched in 1998, it was the only place the research community could access the 1992 IPCC Six Alternative (IS92)

scenarios that were included in the SAR; it also made available climate model projections and observed climate data included in that report.

The DDC has continued to evolve over time. For example, in 2002, the Center for International Earth Science Information Network (CIESIN) at Columbia University joined the team to provide socioeconomic data and scenarios. Later, the CRU was replaced by the British Atmospheric Data Center (BADC), which now serves at the main coordinating unit of the DDC. Starting in 2014, Representative Concentration Pathways (RCPs) and Shared Socio-Economic Pathways (SSPs) have been hosted at the International Institute for Applied Systems Analysis (IIASA) and linked to through the DDC.

The DDC currently provides climate observations, climate model data, socioeconomic baseline and scenarios, and other environmental data included in documents that are "approved," "adopted," "accepted," by the IPCC.

1.3 Task Group

TGICA took up a supervisory role with respect to the DDC and worked to facilitate cooperation and communication between the modeling and impacts communities, particularly with respect to the availability and accessibility of data. The Terms of Reference that guided the Task Group's early years also set out for it a series of specific tasks that grew from the 1996 Workshop on Regional Climate Change Projections, referenced above. These included:

- Undertaking and disseminating an inventory of studies from Atmosphere-Ocean General Circulation Models (AOGCMs) and regional modeling centers;
- Considering requirements for a standard set of climate projections for use in impact assessment;
- Recommending particular regions for regional and model inter-comparison studies;
- Recommending time windows for particular studies using time-slice experiments;
- Preparing guidance materials on the use of climate projections in impact assessment; and
- Considering the requirement for AOGCM centers to carry out one or two stabilization projections (ToR 1999).

The group worked with this ToR, addressing much of its attention to particular concerns articulated after the SAR, until a contact group at the 20th Session of the IPCC (Paris, 19-21 February 2003) developed a draft mandate early in 2003. This mandate was reviewed at TGCIA-8 (Boulder, 30 June – 2 July 2003), where a few changes were introduced, including an update to the group's name. Newly dubbed the Task Group on Data and Scenario Support for Impacts and Climate Analysis (TGICA), the group's new mandate articulated an ambition "to facilitate wide availability of climate change related data and scenarios to enable research and sharing of information across the three IPCC working groups" (TGICA Mandate 2003).
The mandate also identified four core activities for the TGICA:

- Coordinate the Data Distribution Centre, which provides data sets, climate and other scenarios, and other materials (e.g., technical guidelines on use of scenarios);
- Identify information needs in support of IPCC work, facilitate research on climate impacts, adaptation, and mitigation, and make related recommendations on cross-cutting issues;
- Contribute to building capacity in the use of data and scenarios for climate-related research in developing and transition-economy regions and countries; and
- Convene expert meetings on an as-needed basis.

This relatively more open mandate has allowed the TGICA to evolve with the climate change research and policy-oriented communities, engaging in a range of activities described in brief below. The mandate of the TGICA, and its position within the IPCC system, distinguishes it from other climate information providers, particularly with regards to the neutral, authoritative nature of its guidance and its role as a repository of records for the IPCC.

2 Main Areas of Work

The TGICA has focused on three areas of work to deliver its mandate: data provision; guidance and capacity building; and community engagement.

2.1 Data Provision

When it was first launched, the DDC broke new ground in making socioeconomic, emissions, and climate information used by the IPCC available. This includes: climate estimates from observations, data from Coupled Global Circulation Models, and socioeconomic data and scenarios, as well as data and scenarios from other environmental changes. More information on each category of data is below.

- ***Climate estimates from observations*** available through the DDC include the CRU Global Climate Dataset, eventually superseded by a high-resolution data set prepared by the CRU, and a low-resolution CRU dataset included in the AR4[3].

  The DDC also links to a number of external climatological datasets produced by organizations including the BADC, the US National Center for Atmospheric Research, the Global Precipitation Climatology Center, the Climate Research Unit, the US National Oceanic and Atmospheric Administration, and the International Research Institute for Climate & Society (links are available at: http://www.ipcc-data.org/observ/clim/index.html)

- ***Global Circulation Model (GCM) output***. Setting broad criteria about what should qualify for distribution (particularly with respect to climate variables, GCMs, time steps, and spatial resolution) the DDC has also made available data from Coupled Global Circulation Models, starting in 1998 with results from just a handful of modeling groups.

  The DDC now hosts global model outputs used in all assessment reports, at a range of frequencies and as climatologies. Most recently, this includes WG I and DDC Snapshots of data from the Coupled Model Inter-comparison Project, Phase 5 (CMIP5) used in the AR5[4]. The DDC also links to the CMIP archive in the Earth System Grid Federation (ESGF).

- ***Socioeconomic data and scenarios*** provide plausible descriptions of how the future may evolve with respect to a range of variables; they are used as input for climate model runs and as a basis for the assessment of possible climate impacts and mitigation options. Originally, the DDC provided scenarios developed within the IPCC process – the IS92 used in the SAR and the Special Report on Emissions Scenarios (SRES) used in the TAR and the AR4.

  More recently, it has also linked to scenario information developed outside the IPCC. Indeed, for the AR5, the IPCC limited its role to catalyzing and assessing scenarios developed by the research community – including the Shared Socio-Economic Pathways (SSPs) and Representative Concentration Pathways (RCPs) which are currently available through IIASA.

- ***Data and scenarios for other environmental changes*** are useful for helping to understand and gauge the impact of climate change. The DDC provides data on global mean CO_2 concentration, global and regional sea-level rise, regional ground-level ozone concentration, sulfate aerosol concentration and sulfur deposition. All of these scenarios were developed for the IPCC TAR based on the SRES emissions scenarios, though some are in the process of being updated based on Annex II of the AR5 WG I report.

[3] Fourth Assessment Report

[4] Fifth Assessment Report

As the authoritative source of information included in documents that have been "approved," "adopted," and "accepted," by the IPCC, the TGICA has strived to ensure that information in the DDC is relevant and up to date. This involves liaising with WGs to identify and request relevant data sources in the Assessment Reports and coordinating with external bodies (PCMDI[5], IIASA, etc.) to ensure links when appropriate. Several examples that deserve particular mention are:

- ***Socioeconomic data***. In 2003, the DDC distributed downscaled population and GDP data that were seen as useful for impact analysis. These data were removed later that year when concerns were raised regarding the projection and downscaling methods used. The data were later reinstated, but relabeled to better reflect their utility and limitations.

- ***Observed impact data***. In 2006, the DDC made available a database on observed impacts that was developed by the authors of AR4 WGII Chapter 1, assessed as part of the assessment report process, and found to be useful to a variety of researchers. The DDC is currently working to make additional observed impact data from AR5 accessible, though these data have not yet been uploaded.

- ***Regional information***. The group has long been aware of the utility of regional information to the research community, but has struggled to find an appropriate way to make this sort of data available, particularly given the volume of regional climate data, the poor coordination of its archiving, and requirements to distribute data that have been approved or assessed through the IPCC system. While there has been little information directly assessed through the IPCC process since the 1997 report on Regional Impacts of Climate Change (IPCC 1997), CORDEX[6] data are now more easily accessible through the ESGF and their linking to them are currently under consideration.

The TGICA has also paid special attention to the data needs of researchers in developing and economy-in-transition countries.

Initial efforts included the distribution of data on CD-ROMs, and more recently, USB devices, to researchers for whom internet connectivity may be a problem. Server-side processing of storage devices has also been investigated, as the variable selection on existing media does not serve all scientists, though financial constraints have prevented its implementation. Financial constraints also curtailed mirror sites in Brazil, China and Canada – designed to make data more accessible, but ultimately deemed to resource-intensive to maintain.

The Task Group has also put together an internal report on Data Needs for Developing Country Actors. This report, finalized in 2014, synthesizes conclusions from three workshops on data needs for the IAV[7] community, and suggests that the TGICA could help develop consensus around priorities for data which can improve research and decision-making. The document also suggests that TGICA could build better links with existing data providers and provide more tangible guidance regarding the use and application of relevant data (Data Needs 2014).

The TGICA/DDC has had to tackle a number of technical and management issues to be able to provide data on this scale. This includes syncing webpages that are built and maintained by three organizations, ensuring that the look and feel is consistent with other IPCC pages, establishing procedures for registration, distributing and analyzing user feedback surveys, collecting site statistics, and answering user queries. The Task Group has also had to establish procedures to govern the review and formatting of data and the criteria for linking to datasets and other data portals.

[5] Program for Climate Model Diagnosis and Intercomparison
[6] Coordinated Regional Climate Downscaling Experiment
[7] Impacts, Adaptation and Vulnerability

2.2 Guidance and Capacity Building

While capacity building was not included in the original Terms of Reference, it has been an explicit goal since the TGCIA's first meeting in 1997. This was reaffirmed in the more recent mandate, which tasks the TGICA with "building capacity in the use of data and scenarios for climate-related research in developing and transition-economy regions and countries," and the DDC with providing, among other things, "technical guidelines on the use of scenarios." While the group's first efforts in this regard were substantial, more recent efforts have struggled in the face of resource constraints.

Orienting users to the DDC. The TGICA has produced several materials geared toward orienting users to the DDC itself. In 2002, for instance, a short note describing the material available in the DDC was published in *Global Environmental Change* (Parry 2002). More recently, the TGICA has produced a number of explanatory web pages (see for instance here and here), a flyer, a glossary of terms specific to the DDC, and a video, guiding users in how to navigate to the resources they are interested in.

Guidance documents. The Task Group has also produced a number of documents designed to help scientists use and apply the information they find on the DDC. This includes the "Guidelines on the Use of Scenario Data for Climate Impacts and Adaptation Assessment" first produced in 1999. Discussions for revising this document were broached around the time of the TAR, with the next version approved in 2007. A third version, under consideration for several years, is in preparation.

The Task Group has also made more specific technical guidelines available. This includes documents that discuss the use of climate scenarios developed from regional climate model experiments and from downscaling methods, produced in 2003 and 2004, respectively.

In 2011, the TGICA released a third detailed guidance note: "Constructing Sea Level Scenarios for Impact and Adaptation Assessment of Coastal Areas: A Guidance Document." This document provided guidance on how AR4 sea-level-rise projections could be used in constructing scenarios for impacts and adaptation analysis. A related document was published in *WIRES Climate Change* in 2014; Google Scholar indicates this paper has since been cited 23 times as of January 5, 2016.

In addition to these five published documents, the TGICA has explored and/or begun developing a number of other technical guidelines and fact sheets. (Separate documents provide direction to authors regarding the production of technical guidelines and of fact sheets.) For instance, a document that details approaches for developing and applying socioeconomic data in impacts and adaptation assessments was first proposed in 2004, for instance; it was reconsidered in 2010, but has not yet been completed. The Task Group has also begun work on documents that explore downscaling, extremes, the use of technology for adaptation, and the limits of CMIP data in informing IAV studies.

As recently as 2014, the group produced an informal list of priorities for future guidance documents; this includes uncertainty, a comparison of SRES and RCPs scenarios, bias adjustment, near-term (decadal) forecasting, and the nature of climate models. As of the time of this writing, resource constraints have prevented work on these documents.

Capacity building. The Task Group has always been interested in making larger contributions to capacity building, particularly by creating experiential learning opportunities for scientists from developing and economy-in-transition countries. Discussion regarding appropriate partnerships to facilitate this kind of capacity building began as early as TGICA-2 in 1998, though well-funded partners that could support the TGICA in this work have failed to emerge.

The conversation progressed in 2005, when the TGICA produced a "Framework to facilitate the development of appropriate data products and research and capacity in developing and transition-economy countries." The framework highlighted several key issues, including a need to facilitate

mentoring between scientists in developed, developing and economies-in-transition countries; a need to facilitate data access and assist in data rescue; and the production and use of tailored products which would preclude the need for raw data where appropriate (Framework Doc 2005).

In 2007, and again in 2015, the TGICA held Regional Expert Meetings, described in more detail in the next section, that have built capacity, particularly by exposing scientists to existing data and methodologies that could be used in their own research.

As mentioned earlier, the group has also produced an internal document on data needs, which articulates a number of actions that could be taken to build capacity among IAV researchers to use and apply climate and related information (Data Needs 2014). More recently, the group explored the possibility of offering online course modules to communicate how climate model outputs are translated into impact and adaptation assessments (TGICA 19, 2013). In both cases, however, resources were not forthcoming to support these activities.

At present, the TGICA seeks to contribute to capacity building by using its finite resources to "grease the wheels" of community initiatives and activities, though this has not always resulted in TGICA-branded activities (TGICA 16, 2010).

2.3 Community Engagement

In addition to these efforts to provide data, to develop guidance materials and to build capacity, the TGICA has engaged the research community on a number of fronts. This includes contributing to the scenario development process, coordinating the use of information, hosting regional expert meetings, and otherwise facilitating communication between the various and diverse groups engaged in activities relevant to the group's mandate.

Scenario development. While the TGICA has never been responsible for scenario development, it has used its experience and network to solicit and contribute to both the SRES and the RCP process. In particular, the DDC hosted a set of pages on the parallel scenario process developed by the community in coordination with the IPCC in support of AR5. It also participated in and/or coordinated several scenario task groups set up by the IPCC to organize specific IPCC workshops and expert meetings on scenarios.

The TGICA also supported earlier versions of CMIP in suggesting criteria for climate model simulations and in selecting standard variable datasets for downloading and storage. While this job was taken over entirely by the CMIP committee for CMIP6, the DDC managers and several TGICA members are very heavily involved in this process.

Coordinating information use. The TGICA has made strong contributions in organizing and structuring the use of scenario and other types of information in climate impact assessment. This was particularly important before the advent of large-scale model intercomparison projects: If different model groups around the world were to use different metrics and make different assumptions about baselines and starting points, it would have been very difficult to compare one study to another, or to validate models against each other.

In this context, the original ToR spelled out specific tasks for the TGCIA to accomplish with regards to coordinating information use; this included identifying requirements for a standard set of climate projections for use in impact assessment and the development of recommendations for CGCMs centers carrying out stabilization projections.

In 2000, a meeting was held to facilitate the inter-comparison of regional studies – and at its third meeting in 2001, the TGCIA sent a letter to the modeling groups to encourage experiments for the 6 SRES scenarios (TGICA 4, 2001). The group also recommended to the Bureau and the research community that, where resources were short, impact assessments should focus on 4 scenarios (A1FI, A2, B1 and B2) for 3 time periods 2020s, 2050s and 2080s.

Facilitating communication. The group has been conscious of the need to facilitate communication between the modeling, mitigation and impact communities – encouraging researchers to provide feedback to the modelers, with the goal that models and model outputs will ultimately be more relevant to research needs. Indeed, while there is generally some communication between these groups at national levels, there are very few forums outside of the TGICA for bringing actors together to foster sustainable interactions of this nature.

In addition, the TGICA's unique mandate, which spans the interest areas of the IPCC's three WGs, has allowed it to facilitate and sustain communication between these groups over years and between assessment cycles.

The TGICA has also opened lines of communication with a range of different groups, including CORDEX, the Global Climate Observing System (GCOS), the WCRP[8] Working Group on Regional Climate, the Integrated Assessment Modeling Community (IAMC), the Climate Services Partnership (CSP), the Global Framework for Climate Services (GFCS), and the Asian Development Bank. The TGICA Co-Chairs contribute formally to the new CMIP6 Vulnerability, Impacts, Adaptation and Climate Services Advisory Board (CMIP VIACS-AB).
The TGICA has made special efforts to coordinate with the Global Programme of Research on Climate Change Vulnerability, Impacts, and Adaptation (PROVIA), a global initiative which aims to provide direction and coherence at the international level for research on vulnerability, impacts and adaptation.

Expert meetings. The group also held two Regional Expert Meetings, both of which allowed it to better engage with the community regarding current needs and opportunities in the use of scenarios for impact, adaptation and vulnerability assessment. As mentioned above, these meetings also contributed to capacity building, particularly by making researchers and decision makers aware of available information and contexts in which that information can be best used.

- ***Integrating Analysis of Regional Climate Change and Response Options, Nadi, Fiji***
  In June of 2007, TGICA convened an international meeting of researchers, policymakers, and practitioners to explore needs for and innovative approaches to interdisciplinary research targeted at regional and local information needs for managing climate risks.

  More than 40 people attended the meeting, which sought to identify innovative research applications for dealing with multi-scale issues and cross-system processes relevant to climate change impacts, vulnerability and mitigation. It also fostered dialogue among a host of different climate change experts and engaged a growing community to explore complexities associated with the combination of climate and non-climate stressors.

  The meeting also explicitly sought to identify ways the TGICA could facilitate research advances, including the greater access to data, and to recognize and prepare for future needs of the IPCC, the DDC and related entities within the community (Fiji Workshop Report 2007). The meeting resulted in a special issue of *Climate Research*.

- ***Decision-Centered Approaches to the Use Of Climate Information, Palisades NY***
  In July 2015, the TGICA convened a meeting to guide and promote the appropriate application of AR5 information in developing and economy-in-transition countries. To do this, the meeting linked experts with operational decision makers at major regional and international science, funding, and development assistance agencies engaged in climate response activities.

  The meeting especially sought to support research integration by sharing the latest science of relevance across diverse communities; provide a space for learning and developing a common

[8] World Climate Research Programme

understanding of the use, strengths, weaknesses, gaps and limitations of climate data and information in the context of IAV assessment; to identify and prioritize needs for information, knowledge products, and guidance; and to build capacity for accessing, selecting, compiling, interpreting and applying regional climate information.

3 Persistent Challenges

While these contributions have been significant, the progress of the TGICA has been hampered by several persistent challenges that limit the ability of the TGICA to capitalize on its unique role in the community. These include resource constraints, a lack of necessary technical support, and limitations with regards to the TGICA membership.

3.1 Resource constraints

Resource constraints have made it difficult for the TGICA to complete guidance materials, even after certain topics have been identified as important priorities for the group. Resources constraints also limit the ability of the TGICA to contribute to larger capacity building efforts, despite ongoing conversations regarding the potential to join efforts with external organizations in this regard. Finally, resource constraints make it difficult to engage the IAV research and policy/decision making communities, both of which are more fragmented than the climate science and energy-emissions modeling communities, and so require more time-consuming engagement. Full-time support for these activities, ideally in the form of the TGICA's own TSU[9], would allow the group to be much more productive and deliver on the goals it identifies for itself.

3.2 Technical support

The DDC is maintained by the three organizations that it comprises. Support includes the data infrastructure of each institution as well as the support of individuals to develop and maintain the site (0.5 FTE[10] DKRZ, 1 FTE BADC, 1 FTE CIESIN); while DKRZ is able to access core support for the task, the BADC must apply for core funding from the UK Department of Energy and Climate Change. Similarly, CIESIN's support for the DDC is provided through its contract to operate the NASA[11] Socioeconomic Data and Applications Center (SEDAC), which is funded on a 5-year cycle, and is subject to review by SEDAC's User Working Group and NASA management.

IIASA has also bolstered the DDC by providing links to the new scenario data, which were produced through in-kind support to WGIII (0.5-1 FTE across the AR5).

This support has been sufficient to conduct site development and maintenance, the provision of data, and the answering of user queries. However, there are many tasks that the TGICA has identified as of interest for the DDC, that current resources are not able to address. Priorities for future action cluster around (1) services for data access, such as server-side processing (automated and individual) to reduce download volume and for format conversions and (2) services for data storage, such as individual assistance of data managers in data delivery or support in data processing and replication; linking to additional data-related information and archival of additional data, e.g. IPCC AR6 Atlas data.

The TGICA also receives support from the WG TSUs, though this has varied over time – with one TSU providing support in one assessment cycle and another taking on the role the next time around. In this context, the person assigned to support the TGICA has changed frequently, making it difficult for that person to develop an understanding of the work of the group or to make

[9] Technical Support Unit
[10] Full-time equivalent
[11] National Aeronautics and Space Administration

substantial contributions. As a result, it has been difficult for the TGICA to rely on TSUs to perform important coordination activities, assisting in the development of guidance materials and tracking progress on DDC improvements.

There is no continuity in support from well qualified (PhD level) and experienced professionals able to develop meeting agendas, draft minutes, prepare operational and scientific documents and correspond with the membership, liaise with IPCC WGs and Secretariat, and outside organizations. Thus, the main burden of these jobs falls on the Co-chairs of the Task Group. The TSU has also sometimes withdrawn support for the TGICA during intense periods before the ARs are released.

3.3 Activity of the TGICA Membership

The roughly 20 members of the TGICA are nominated by their governments and serve on a voluntary basis. Members come from developed, economy-in-transition, and developing countries; they represent a diverse array of expertise, including climatology, climate modeling (both global and regional); physical, social and economic impacts; adaptation; emissions modeling, and integrated assessment, which are specifically mentioned in the mandate.

Although the TGICA maintains a membership of ~20 people, there is a general perception that only a limited number of people on the Task Group spend time on the work of the group outside of meetings. As a result, much of the work of the group falls to the Co-chairs, the DDC Managers, and a handful of TGICA members, which limits the effectiveness of the group as a whole. There have also been some challenges in replacing members who step down during an assessment cycle and in maintaining a group with an appropriate array of expertise, plus the time available to contribute.

The IPCC provides travel support for members from developing and transition-economy countries, and for the convening of approved expert meetings and workshops. Members from developed countries generally must apply to their governments or host organizations for travel funding for each TGICA meeting or event, which has in many cases inhibited participation.

4 Evolving Landscape

When it was founded in 1997, the TGCIA was tasked with “providing the necessary data to the impacts community.” In the past nearly 20 years, however, many things have changed – including the data under discussion, the impacts community, and the institutional and governance structures that organize and connect them, all of which pose challenges to the existing systems. Four large-scale trends affecting the governance, volume, and interest in / scrutiny paid to climate data are described below.

4.1 Evolving Governance of Relevant Data Sets

The evolving governance of datasets has impacted the DDC in several ways. First, while both the IS92 and SRES scenarios were developed by the IPCC and made available predominantly through the DDC, later scenarios were developed outside of the IPCC, coordinated by the International Committee on New Integrated Climate Change Assessment Scenarios (ICONICS). As a result, the SSPs, SPAs[12], and RCPs were made available directly through IIASA – though they were linked to the DDC as well. While it is not clear if another set of scenarios will be developed, it is unlikely they would be developed through the IPCC if they were. In this context, those interested in accessing scenario data are no longer required to visit the DDC in order to do so.

[12] Shared Policy Assumptions

A second change has to do with the governance of GCM data. For instance, when the TGCIA was created, it coordinated with only a handful of modeling organizations to make this data available through the DDC. Today, however, the number of modeling groups contributing to the CMIP project is much larger, resulting in a number of challenges: time-consuming replication, more effort in quality assurance and storage of data, and greater hardware expenses. The increased heterogeneity of data coming from the federation of CMIP5 data centers also increases the effort involved in replication, storage, and quality assurance.

Finally, an increase in the number and diversity of projects and organizations providing data relevant to the impacts, adaptation, vulnerability, and mitigation communities has also complicated matters, as the DDC must decide how and whether to make information from activities such as AgMIP[13] and ISIMIP[14] available when they engage with ARs.

While the governance of data sets has changed, making more data available from different sources, it is important to note that the DDC's role in archiving assessed information has not, thus retaining its position as the official source of information included in IPCC reports, despite the fact that some information is available elsewhere. In many cases, this is not a trivial matter of providing a one-stop repository – CMIP, for instance, often makes upgrades and corrections to data in ways that are not transparent, so researchers relying on that source to access information used in ARs may find themselves unable to locate the original data.

4.2 Advances in Volume & Accessibility of Data and Information

A related challenge stems from an increase in the volume and accessibly of climate change data and information. Indeed, the world has witnessed an increase in all kinds of climate data: instrumental data, data from space-borne instruments, data from model-based re-analyses, and data from climate model simulations. The archiving and sharing of output from climate models, particularly those run with a common experimental framework, has also grown; while results from only four CGCM modeling organizations were included in the DDC when it was founded, it now stores output from 60 models from 28 institutions.

As the volume of data has increased, so has the ability of organizations to store, manage, and transfer data. The ESGF, for instance, manages a decentralized database for handling climate science data, with multiple petabytes of data at dozens of federated sites worldwide. The ESGF is an international collaboration for software that underpins most global climate change research; it is recognized as the leading infrastructure for the management and access of large distributed data volumes for climate change research, supporting CMIP among other projects. Another source of information is an increasing number of "climate service" providers, described in more detail below.

4.2.1 Climate Service Providers

Touted as an important part of the adaptation agenda, climate services – which involve the provision, translation, transfer, and use of climate information for decision making – have garnered a great deal of attention, particularly since the concept of the GFCS was endorsed at the third World Climate Conference in 2009. Implemented in 2012, the GFCS provides a worldwide mechanism for coordinated actions to enhance the quality, quantity and application of climate services, particularly with respect to seasonal to decadal information.

[13] Agricultural Model Intercomparison and Improvement Project
[14] Intersectoral Impact Model Intercomparison Project

While a full review of climate service providers is beyond the scope of this paper, a general overview of the institutional arrangements that support them is included below:

International Service Structures: A number of organizations with global reach have begun to offer global services, including the Red Cross Climate Centre, the Food and Agricultural Organization (FAO), World Food Programme, Oxfam, and the World Health Organization.

National Climate Service Providers: Many state meteorological agencies provide climate services, particularly to the water and agriculture sectors. In recent years, a number of countries have consolidated these capacities into national climate service centers, including in Australia, Austria, China, Finland, Germany, the Netherlands, and the United Kingdom.

Regional Climate Services: Regional climate services are offered at sub- and supranational scales:

- Sub-national services include: US Regional Climate Centers, the Northern German Climate Office, and the Pacific Climate Impacts Consortium, which provides information on the impacts of climate change in the Pacific and Yukon Region of Canada.
- Supra-national services include: the Copernicus Climate Change Service, the African Centre for Meteorological Applications for Development (ACMAD), the AGRHYMET[15] Regional Centre, the Caribbean Institute for Meteorology and Hydrology (CIMH), the International Centre for Research on the El Niño Phenomena (CIIFEN), the IGAD (Intergovernmental Authority on Development) Climate Prediction and Applications Centre (ICPAC), and the Latin American Observatory of Extraordinary Events (OLE2).

Research Institutes: While the universities engaged in climate research and service development are too many to mention, a few examples include the University of Cape Town's Climate Systems and Analysis Group (CSAG) Climate Information Portal and the Climate Impacts Group (CIG) of the University of Washington.

Private Sector Services. To inform long-term planning, private companies in the energy and insurance fields have created their own climate risk management teams; a number of private companies develop relevant tools.

More information on climate service providers is available in Vaughan and Dessai (2014) and in Medri et al (2012).

4.2.2 Climate Information Portals

This growth in information providers has been matched by a broad array of information portals and platforms, providing both climate and adaptation services (EEA 2015). While a comprehensive review of these portals is beyond the scope of this paper, a general overview is included below.

- The **Climate Knowledge Brokers' Knowledge Navigator**, an online compendium of climate change platforms, directs to 105 different sites. Portals that appear in the navigator engage both adaptation and mitigation and a range of different sectoral (e.g., energy, ecosystems, community-based adaptation) and geographic foci [e.g., South America (17), Central America (15), Caribbean (14) and Australiasia (9) showing the most portals] (accessed January 10, 2015).

  Forty-three of the sites included in the Navigator include numerical data, though their holdings and focus vary quite a bit: the World Bank's Climate Change Knowledge Portal, NASA's Global

[15] Agriculture, Hydrology, Meteorology

Climate Change, Local Governments for Sustainability, the Climate Smart Planning, the Africa Climate Exchange, the Virtual Climate Change Center for Mexico City, and FAO's Climate Impact on Agriculture, among others.

- A 2015 review of climate change adaptation portals in Europe conducted by the **European Environment Agency** includes 19 sites, though the content provided by the sites varies considerably. Portal in this study include: the European Environment Agency's Climate-ADAPT, Austria's Klimawandelanpassung.at, Denmark's Klimatilpasning.dk, Ireland's Climate Ireland, and Baltic Window, among others.

  The report concludes that all the portals in the study strive to provide access to scientifically sound, high-quality, relevant, reliable and usable information. Among other things, these portals struggle with the fact that information and knowledge available on climate change and adaptation is constantly growing. At the same time, the needs of stakeholders are evolving over time while they are progressing in the adaptation policy process. Involving researchers and providers of adaptation information into the development of the adaptation platforms is also reported as a primary challenge (EEA, 2015).

- An ongoing analysis of 42 climate information portals conducted by the **Climate Systems Analysis Group**, reveals a mix of information: Portals are provided by a full range of information providers (e.g., international bodies, regional centers, national agencies, etc.); they also target a wide range of different kinds of actors (e.g., researchers, government officials, development practitioners). Four report targeting the IAV research community; roughly half include associated information for the IAV community.

  Just short of half of these portals provide global information, most of this in the form of GCM outputs and associated downscaling. While raw data is accessible on many of the sites, many also provide processed and/or targeted information. Initial analysis finds that more than half of the portals make it difficult for decision makers to navigate the portal to access information they would need (Hewitson and Waagsaether, in prep).

A more complete list of climate information portals is included in Annex 3.

While it is important to consider the changing landscape of information providers and portals, it is equally important to consider the unique role of the DDC is serving as a repository of record for the data associated with the ARs, which no other providers or portals do.

4.3 Growing Community of Information Users

The increase in the volume and diversity of climate information portals and providers has tracked growing interest of a large and diverse community of users eager to employ climate data to their own research and decision-making contexts. A brief discussion of the evolving needs of three communities within this evolving community of users is included below:

4.3.1 IPCC Working Groups

The IPCC WGs have always been an intended audience for the DDC. But while the DDC hosts data and scenario information critical to the WGs, the WGs have not always relied on the DDC for the provision of data; they may even look to it less frequently as other avenues of accessing data become available. On the other hand, the DDC remains a repository of record for the IPCC ARs, storing the data and associated metadata from each assessment cycle in a way that can serve as a reference point for current and incoming WGs. The DDC is also responsible for quality control of the data.

The TGICA has also served an important facilitation role between the WGs. Indeed, given its role in facilitating the flow of scientific information across the domain covered by the three WGs, the TGICA serves as a natural place to facilitate this kind of interaction.

Facilitating this kind of communication was particularly important in the early years of the TGICA when the communication between the groups was not very good and information appeared in ARs that seemed to contradict each other – and while there is some uncertainty regarding how IPCC work will be structured in future assessment cycles, the importance that the IPCC Ad Hoc Group on Future Work has given to cross-disciplinary work suggests that facilitating this kind of communication could continue to be an important role for the TGICA (Future Work 2015).

A large number of past and present TGICA members cite the fostering of information communication between WGs as a critical contribution of the Task Group, though many also agree it could improve its work in this realm, including by focusing on specific topics and/or suggesting the development of cross-disciplinary special reports.

4.3.2 IAV Research Community

The IAV community now includes a wide array of different kinds of scientists, including empiricists, impact modelers, experimentalists, vulnerability assessors, adaptation researchers, and adaptation policy analysts, among others. Researchers are also drawn from sectoral communities, including agriculture, health, water, disasters, fisheries, ecosystems, urban planning and forestry, among others.

This heterogeneity has led to the creation of a great deal of information regarding impacts, vulnerability and adaptation, advancing our understanding of climate change and ultimately feeds into the IPCC ARs.

It has also brought a lot of new researchers to the field. These researchers have a variety of needs that may be different to those of climate scientists. For instance, many report having difficulty navigating the ESGF to find the information they want, or even confusion about what information would be most useful to the studies they are conducting. In this context, many researchers are happy to rely on the authoritative information that has already been assessed by the IPCC. They are also keen to access guidance documents explaining how other scientists have used the information to do their own analyses.

In some cases, IAV researchers may also like information products rather than the raw data products that are more widely available. This could include value-added metrics (e.g., potential evapotranspiration) or more complicated variables (e.g., the Palmer Severity Drought Index, growing degree days, etc.).

Through the DDC, the IPCC has already established an infrastructure that, with appropriate resourcing, can make data and supporting information from the ARs available in a comprehensive manner (Vision Doc 2015). Properly resourced, the TGICA could also provide guidance on best practice and/or appropriate methodologies to arrive at relevant variables. This sort of activity would require further collaboration with existing actors in the field, including Future Earth, UNEP's PROVIA, the World Data System of the International Council for Science (ICSU-WDS), the VIACS-AB for CMIP6, and the WCRP Working Group on Regional Climate, among others.

4.3.3 Policy- and Other Decision-Makers

Climate and scenario outputs are no longer of interest to the research community alone. Indeed, a range of organizations – including government offices, humanitarian organizations, and the private sector – have focused attention on climate information as a way to improve climate risk

management and increase resilience. As a result, climate services currently exist at local, national, regional, and international scales and in a range of different sectors such as agriculture, health, forestry, fisheries, transport, tourism, disaster risk reduction, water resources management, and energy.

This new and increasing diverse user group puts new demands on the variety, scale, and availability of climate and related data, and the guidance to support its use. At the same time, particularly after the recent agreements at COP21[16] in Paris, research to inform adaptation-related decision-making will need to come under greater scrutiny as ever-larger investment decisions are made on the basis of such work.

Given its role in facilitating access to data and scenarios used to explore impacts, vulnerability and adaptation, there may be an important role for the TGICA in serving this community. Doing so is not something that can be undertaken lightly, however – given the diverse nature of the decision-making community, and the ever-widening landscape of actors designed to serve their needs, appropriate entry points for the TGICA must be carefully considered.

While a full description of the needs of these communities is beyond the scope of this paper, a brief overview of key user groups drawn from a review of case studies collected by the GFCS and the Climate Services Partnership (Vaughan et al in prep) is included below. It is important to remember that the climate-related decisions facing each group may be quite diverse, and that the dichotomy between information users and providers is not always a clear one: Some organizations access climate and other types of information, in order to analyze and package that information for users further down the line.

- **Government agencies** include federal and state agencies engaged in sectoral and/or national planning (ministries of agriculture, water, energy, natural resources, etc.; national planning departments; national disaster preparedness and response agencies; public utilities; urban and coastal planning departments; development agencies; national meteorological services). In some cases, intergovernmental bodies (e.g, African Union, ECOWAS[17], ASEAN[18], etc.) are also instrumental in using, interpreting, and passing along climate information.

- **Humanitarian organizations** include local (e.g., Relief Society of Tigray, Ethiopia) and international NGOs (e.g, International Federation of Red Cross Red Crescent Societies, World Vision, Oxfam, etc.), intergovernmental agencies (e.g., World Food Programme, FAO, etc.), bilateral development agencies (DfID[19], AusAID[20], USAID[21], CIDA[22], etc.), and development banks (World Bank, the InterAmerican Development Bank, the African Development Bank, etc.).

- **Private sector actors** are also increasingly interested in accessing and employing climate information. This includes consulting companies involved in environmental planning and management, insurance and reinsurance agencies and other actors in the financial services sector, private utilities, energy and/or transportation companies. In some cases, industry associations and/or local chambers of commerce may take an interest in accessing, analyzing, and distributing information among members.

[16] 21st Session of the Conference of the Parties to the UNFCCC
[17] Economic Community Of West African States
[18] Association of Southeast Asian Nations
[19] Department for International Development
[20] Australian Agency for International Development
[21] United States Agency for International Development
[22] Canadian International Development Agency

4.4 Increased Scrutiny of the IPCC

A fourth development that has changed the landscape in which the TGICA operates involves heightened scrutiny of the IPCC, which has tracked interest in climate change. Amid increasingly intense public debate over the science, impacts, and costs of climate change, the IPCC has had to answer questions about its impartiality with respect to climate policy and about the accuracy and balance of its reports. This scrutiny was exacerbated by the ClimateGate episode and by the exposure of a small number of errors in the AR4 (Hulme, 2012; Schiermeier, 2010; PBL, 2010).

In response to these challenges, the IPCC commissioned the InterAcademy Council (IAC) to convene a committee to review the process and procedures of the IPCC. The resulting report stressed that the intense scrutiny from policymakers and the public is likely to continue – and that as a result, the IPCC needs to be as transparent as possible in detailing its processes, particularly regarding the types of information assessed (IAC, 2010).

Given its role in making data available, and in providing guidance regarding its use, the TGICA clearly has an important role to play in fostering transparency, though transparency itself is not explicitly mentioned in the TGICA mandate. On the other hand, TGICA and the DDC recognize recent efforts by the scientific data management community to improve the openness, traceability, and transparency of scientific data through mechanisms including digital object identifiers, data citation practices, and improved data documentation and metadata standards.

A related concern for the IAC is the need to improve the way that IPCC data and findings are used by the national and subnational actors (IAC 2010). In this context, the 2015 IPCC Decision on Future Work states an intention to develop "other methodological reports or good practice guidance reports, for example, to facilitate preparation of regional and/or national scientific assessments" (Future Work 2015). Scrutiny of the IPCC, and particularly of research traditionally associated with WGs II and III, may also increase in the wake of the COP21 Paris agreement, in which countries are now called on to deliver real results in terms of adaptation and mitigation.

While the TGICA is clearly able to help improve the transparency of the IPCC, transparency is not explicitly mentioned in the TGICA mandate, nor are sufficient resources available to provide a thorough accounting of all the data included in the ARs without further support.

5 Emerging Opportunities

While the TGICA has been able to make significant contributions with regards to data provision, technical capacity building, and community engagement, several challenges have limited its ability to deliver on its mandate. Alleviating constraints associated with resources and technical support would allow the Task Group to better deliver on its mandate in the Sixth Assessment cycle, enabling it to use its unique cross-Working Group position to meet the emerging challenges associated with today's evolving landscape.

To that end, five broad activities are presented below. While these activities are by no means the only options for the TGICA, they offer a sense of the sorts of activities that may form the backbone of a practical and forward-looking consideration of TGICA's future; similarly, they provide context on missed opportunities associated with curtailing the group.

5.1 Develop a Meta-Database

The IPCC ARs rely heavily on references to data resources, which readers both in and outside of the WGs may like to engage well after the Assessment Cycle is complete. As described in TGICA-21 Annex 2: Dataset Index, many visitors to the IPCC DDC web site are disappointed to find that data products cited by IPCC representatives are neither available nor discoverable through the DDC. To accommodate this, the DDC has recently focused on making available or discoverable data that are included in the reports but held elsewhere.

Moving forward, the DDC could advance in this regard by developing a cross-Working Group dataset index, which would exploit the DDC to consistently and comprehensively capture references to the data in future ARs. The index would gather information from authors as they prepare the report. The information required to fill the index would be similar to what authors would ordinarily be expected to record for their own use: where the data came from, an appropriate citation and possibly some keywords. The precise formulation of the questions to be answered would be agreed across WG TSUs (TGICA-21, Annex 2, 2014).
The objective would be to reach an agreement on a level of information which is consistent with good practice and which can be recorded without disrupting the review process. The added value of the index would come not from any additional assessment but from being able to share information in a searchable form across WGs during report preparation and externally after publication (TGICA-21, Annex 2, 2014). This sort of index could also be used to feed into the ARs themselves, making data sources easily discoverable through links in the AR text, as with the latest version of the US National Climate Assessment (US NCA).

5.2 Harmonize Research Strategies

The TGICA might turn its attention to helping to reconcile top-down and bottom-up strategies to understanding the potential threats and opportunities associated with climate change. Whereas the dominant paradigm has assumed the need to improve our ability to predict multi-decadal climate change as a prerequisite for effective planning, a second strand of work has focused on the need to improve our understanding of regional and sectoral climate-related vulnerabilities, and the cognitive, social and institutional context within which these will be managed, in light of the deep uncertainties associated with climate change and its possible impacts (Weaver, 2013).

Bringing these communities together will advance the quality and relevance of IAV research; it would also require expanding our conception of climate models – using them not simply as “prediction machines” but to explore a range of plausible futures, providing insight into complex system behavior and support for critical thinking within so-call robust decision frameworks (Brown and Wilby, 2012).

Located at the intersection of the climate and IAV communities, the TGICA is uniquely placed to facilitate communication that could lead to significant advances in the way that climate models are used and to foster a wider conversation on the types of information that users ultimately need from these models. With shifts in the TGICA membership to engage a wider community of bottom-up researchers, the group could foster a discussion around a new emphasis in climate modeling that could increase both the richness of our understanding of the climate system and the value of this richer understanding (Howden and Jacobs, 2015).

5.3 Evaluate the Science of Decision Support

The TGICA might also engage the issue of informed decision-making more broadly. This could take the form of a guidance note regarding the ways that long-term information might be useful in decision contexts, and the hallmarks of credible service providers. More ambitiously, the TGICA could lead an effort to evaluate the science of decision support as part of the IPCC’s Sixth Assessment Report.

The range of tools and products currently described as “climate change decision support” perform a variety of tasks: mapping climate stressors and their impacts; providing expert judgment about impact-relevant variables; estimating past and potential carbon storage; and delivering geospatial analysis of floods, droughts, heat waves, and other stressors on particular areas, among others (Moss, 2015). When these tools are not evaluated or assessed, the community is left without guidance regarding the relative contribution of various approaches to decision support. In this context, decision makers are left with very little information regarding the value of these tools to their own decision processes.

With its position at the intersection of the research communities represented by the three WGs, the TGICA is uniquely suited to beginning a process to assess the value of such tools for decision-making. Of course, the TGICA could not progress beyond the state of the art – and given that the evaluation of climate data and information for decision making is still in its infancy, the TGICA would have to content itself with assessing the state of knowledge and practice of decision support in different sectors and regions, providing information about good practices that would assist both users and developers of decision-support tools and systems in a way similar to the chapter on decision support in the US National Climate Assessment.

The goals of such an activity would be to: (1) improve understanding of the effectiveness of current decision-support methods; (2) coordinate collection of data and methods for evaluation and research; (3) advance understanding of the needs of information users and the sources that are useful for informing different types of decisions; and (4) enhance recognition of the importance of evaluating and assessing the information content as well as interfaces and communication of decision-support systems (Moss, 2015). Such an activity would move the IPCC closer to assessing the costs and benefits of various impacts and response strategies (Liverman, 2015).

On the other hand, one potential challenge associated with this type of an activity might be whether the TGICA would be able to usefully engage decision makers themselves in this activity.

5.4 Co-develop Capacity Building Activities

In the wake of the COP 21 Paris agreement, research traditionally associated with WGs II and III is likely to gain new prominence – and particularly as large investments are made based on IAV and mitigation research, the ability of TGICA to provide concrete guidance on the use of IPCC information for research and decision-making may be more important than in the past.

In this context, the TGICA might renew its focus on capacity building, potentially by working together with organizations such as PROVIA and/or the VIACS-AB to hold regional training workshops on the use of RCPs and SSPs in impacts, adaptation, vulnerability and mitigation research. These workshops could provide scientists in developing countries with hands-on experience accessing and using scenarios, exposing scientists to good practice and improving the ability of such scientists to contribute relevant research to the next assessment cycle.

This idea is consistent with recent statements made by the new IPCC chair, who has suggested that tapping into a number of experts in developing regions will be a priority for the next assessment cycle – and, in particular, that regional workshops would be a valuable tool, not only to enrich the AR6 documents but also to invite and recruit scientists in developing regions in a meaningful way (Malakoff, 2015).

A related idea with respect to the development of guidance material would be to perform a review of existing guidance materials – pointing researchers to existing resources that have already been produced by the range of organizations engaged in building capacity of developing country scientists and decision makers to access, analyze and interpret climate change information. In addition to providing perspective on existing resources, and avoiding the duplication of efforts, this kind of effort would identify a clear list of priorities for future guidance efforts of the TGICA itself.

5.5 Engage the UNFCCC Process

A related capacity building activity would be to better engage with the UNFCCC process, including by serving as a resource to the Least Developed Countries Expert Group (LEG), the Consultative Group for National Communications from NAI Parties (CGE), and/or the Group Support Programme for National Adaptation Plans.

These groups are responsible for informing national-level decisions regarding climate change – in some cases, these decisions take place with only limited understanding of how to access, apply, and interpret relevant climate and scenario information. Each group has its own work plan, available online, which includes a variety of regional activities the TGICA might engage with; were TGICA to hold its annual meetings in conjunction with some of these activities, the Task Group might be better able to understand specific needs of these communities and/or address specific capacity building gaps.

This sort of a relationship would require additional resources to support engagement between the TGICA and these experts groups. It would also require the establishment of a formal communication channel between the IPCC Secretariat, the Co-chairs of the TGICA and the Co-chairs of these expert groups. TGICA members would also be required to attend and help shape some of the activities of each group.

6 Defining Next Steps

The process of defining next steps for the TGICA should take into account the contributions of the Task Group in the nearly 20 years since it was founded. It should also account for fact that the Task Group has consistently operated without sufficient funding, and consider the possibility of a well-resourced TGICA to contribute more broadly to the archiving and provision of data, the development of technical capacity, and community engagement.

Indeed, while climate and scenario information is more plentiful and more easily accessed than it was when the TGICA was founded, the TGICA still serves the unique role of serving as a data repository for the ARs. An increase in potential users of information, both within the IAV community and from the larger group of decision- and policy-makers, has been matched by an increase in information providers – but of course none of these providers carry the authoritative weight and neutral mandate of the IPCC.

Were the TGICA to be strengthened, including a sharpening of its mandate, with a clear identification of specific goals and a realistic sense of the resources needed to accomplish these goals, the Task Group would be able to contribute in new ways, developing a dataset set index, reconciling different research strategies, leading capacity building efforts, or engaging expert groups within the UNFCCC.

In the event that the IPCC is not able to sharpen the TGICA mandate, identify clear goals, and obtain the resources needed to support those goals, the Task Group may need to adjust its mandate to more narrowly focus on the provision of data through the DDC. This activity would continue to rely on the DDC managers, but require a smaller Task Group, potentially complemented by the TSUs of the three WGs, to manage and curate data so the basic resources used in the IPCC reports can be identified and accessed.

Annex 1: List of documents referenced in the report

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Annex 2: Interviewees

Ana Bucher	World Bank
Timothy Carter	Finnish Environment Institute
Robert Chen	Center for International Earth Science Information Network, Columbia University
Stewart Cohen	Environment and Climate Change Canada
Seita Emori	National Institute for Environmental Studies, Japan
Bruce Hewitson	Climate Systems Analysis Group, University of Cape Town
Saleemul Huq	ICCCAD, IIED
Mike Hulme	King's College London
Gregory Insarov	Institute of Geography, Russian Academy of Sciences
Martin Juckes	British Atmospheric Data Centre
Volker Krey	International Institute for Applied Systems Analysis
Michael Lautenschlager	German Climate Computing Center
Xianfu Lu	UNFCCC
Filipe Lucio	Global Framework for Climate Services
Jose Marengo	Centro Nacional de Monitoramento e Alertas de Desastres Naturais
Richard Moss	Joint Global Change Research Institute
Martin Parry	Imperial College London
Charlotte Pascoe	British Atmospheric Data Centre
Jean Palutikof	National Climate Change Adaptation Research Facility (NCCARF), Griffith University
Gian-Kasper Plattner	WG I TSU (AR5)
Cynthia Rosenzweig	NASA GISS
Alex Ruane	NASA GISS
Sergey Semenov	Institute of Global Climate and Ecology
Martina Stockhause	German Climate Computing Center

Annex 3: List of climate information portals

AdapteCCa.es	http://www.adaptecca.es
Alpine Region Klimaportal Alpenkonvention	http://www.alpconv.org/de/climateportal/default.html
Artic Climate Research at the University of Illinois	http://arctic.atmos.uiuc.edu/
Austria Klimawandelanpassung.at	http://www.klimawandelanpassung.at
aWhere	http://www.awhere.com/
Baltic Window Baltic Sea Region (BSR)	http://climate-adapt.eea.europa.eu/transnational-regions/balticsea/general
Canada Centre for Climate Modelling and Analysis	http://www.cccma.ec.gc.ca/
CCAFS Downscaled GCM Data Portal	http://ccafs-climate.org/
Centre for Climate Change Research	http://www.ccrc.unsw.edu.au/
CI: GRASP	http://pik-potsdam.de/cigrasp-2/
Climate Adaptation Platform for the Alps (CAPA)	http://www.c3alps.eu/kip
Climate Change in Australia	http://www.climatechangeinaustralia.gov.au/en/
Climate Change Knowledge Portal	http://sdwebx.worldbank.org/climateportal
Climate CHIP	http://www.climatechip.org/
Climate Data Online	https://www.ncdc.noaa.gov/cdo-web/
Climate Information Portal	http://www.clipc.eu/
Climate Wizard	http://www.climatewizard.org/
Climate.gov	https://www.climate.gov
Climate4impact portal	http://climate4impact.eu/impactportal/general/index.jsp
Climatic Research Unit	http://www.cru.uea.ac.uk/
CliMond	https://www.climond.org/
Committee on Earth Observation Satellites	http://ceos.org/data-tools/
CORDEX East Asia	https://cordex-ea.climate.go.kr/
Data.gov	www.data.gov
Denmark Klimatilpasning.dk	http://www.klimatilpasning.dk
Downscaled CMIP3 and CMIP5 Climate & Hydrological Projections	http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/dcpInterface.html
Earth System Grid Federation	https://www.earthsystemgrid.org/home.html
EDENext Data Portal	http://www.edenextdata.com/
ESA Climate Change Initiative	http://cci.esa.int/content/access-key-cci-data-products
European Climate Assessment & Dataset (ECA&D)	www.ecad.eu
European Environment Agency and the European Commission	Climate-ADAPT http://climate-adapt.eea.europa.eu
Finland ClimateGuide (climate change portal)	http://www.climateguide.fi
France Observatoire National sur les Effets du Réchauffement Climatique (ONERC)	http://www.developpement-durable.gouv.fr/-Impacts-etadaptation-ONERC-.html
Germany KomPass — Climate	http://www.anpassung.net and

Impacts and Adaptation in Germany (German NationalAdaptation Platform)	http://www.umweltbundesamt.net
Giovanni	http://gdata1.sci.gsfc.nasa.gov/daac-bin/G3/gui.cgi?instance_id=DICCE-G_Basic
Global Observing Systems Information Center (GOSIC)	http://www.wmo.int/pages/prog/gcos/index.php?name=ObservingSystemsandData
Hole-filled SRTM 90 m resolution elevation dataset	http://srtm.csi.cgiar.org/
Hungary Climate Dialogue Forum	http://klimadialogus.mfgi.hu
International Partnership on Mitigation of MRV	http://mitigationpartnership.net/
Ireland Climate Ireland	http://www.climateireland.ie
IRI Columbia	iridl.ldeo.columbia.edu
KLIMADA Adaptation Platform	http://klimada.mos.gov.pl/en/
KlimafolgenOnline	http://www.klimafolgenonline.com/
KNMI Climate Explorer	https://climexp.knmi.nl/start.cgi?id=someone@somewhere
Med CORDEX	https://www.medcordex.eu/
NCAR Community Data Portal	http://cdp.ucar.edu/
NCAR's GIS Program Climate Change Scenarios GIS data portal	https://gisclimatechange.ucar.edu/
Netherlands Dutch Adaptation Knowledge/Spatial Adaptation Portal	http://www.ruimtelijkeadaptatie.nl/en/
Nevada Climate Change Portal	sensor.**nevada**.edu
NOAA Geophysical Fluid Dynamics Laboratory	http://www.gfdl.noaa.gov/
Norway Klimatilpasning.no (Norwegian Climate Adaptation Portal)	http://www.klimatilpasning.no
Ontario Climate Change Data Portal	www.**ontario**ccdp.ca/
Pacific Climate Change Portal	http://www.pacificclimatechange.net/
Program for Climate Model Diagnosis and Intercomparison	www-pcmdi.llnl.gov
Pyrenees Observatoire Pyrénéen du Changement Climatique	http://www.opcc-ctp.org
Caribbean Regional Clearinghouse Database	http://www.caribbeanclimate.bz/general/clearinghouse-search-tool.html
SA Risk & Vulnerability Atlas	http://rava.qsens.net/
Satellite Application Facility on Climate Monitoring	http://www.cmsaf.eu/EN/Home/home_node.html
SERVIR	http://www.nasa.gov/mission_pages/servir/index.html
Sweden Klimatanpassning.se	http://www.klimatanpassning.se
Switzerland BAFU Thema Anpassung an den Klimawandel	http://www.bafu.admin.ch/klima
UKCIP	http://www.ukcip.org.uk/
UK Climate Ready Support Service	https://www.gov.uk/government/policies/climate-change-adaptation
UNDP Climate Profiles	http://www.geog.ox.ac.uk/research/climate/projects/undp-cp/

University of East Anglia CRU	http://www.cru.uea.ac.uk/data
USGS Geo Data Portal	http://cida.usgs.gov/gdp/
Wisconsin Initiative on Climate Change Impacts	http://www.wicci.wisc.edu/
WoodForTrees.org	WoodForTrees.org
WorldClim dataset	http://www.worldclim.org/CMIP5