Working paper

The essential role of climate information systems for early action interventions and resilience-focused decision-making

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April 2024

Abstract

Small Island Developing States (SIDS) continue to face climate-related challenges and the need for effective resilience-building is critical, yet there is minimal emphasis on the underpinning role of climate information in supporting adaptation and resilience. Comprising fundamental scientific weather and climate data and/or local knowledge, climate information remains essential for targeted local decision-making as well as interventions such as early warning systems, early action infrastructure, forecast-based financing, climate finance and risk transfer. However, despite this role and implied benefit, there is still a limited focus on reducing persistent barriers and supporting enabling factors and conditions which increase the effective use of locally relevant climate information, especially in SIDS and low-income countries.

This paper encourages a discussion on the barrier and influencing factors of climate information use, as well as the related enabling and catalysing conditions towards securing a resilient future for SIDS. To do so, it first outlines the nature of climate information, including project efforts within the Caribbean, before discussing the relevance of climate information for early warning systems and early action. It then summarises key challenges and enablers for use and uptake, as offered by 26 Caribbean-focused experts. The paper ends with evidence-supported suggestions and recommendations to support essential climate information development and use, including the improvement of climate information awareness; the development of a climate information hub; the need for cohesive programmatic action; clearer international language on the role of climate information; and a drive to enhance the enabling factors that can improve and increase climate information use and uptake.

RESILIENT SUSTAINABLE ISLANDS

How to cite: Dookie, D.S. (2024) The essential role of climate information systems for early action interventions and resilience-focused decision-making. Working Paper. London: ODI (www.odi.org/en/publications/role-of-climate-information-systems)

Acknowledgements

This paper is based on findings described in, and in some parts replicated from, Dookie et al. (2023). Financial support for the research and interview process was received from the UK Economic and Social Research Council (ES/R009708/1) through the Centre for Climate Change Economics and Policy (CCCEP), as well as the Grantham Foundation for the Protection of the Environment. We remain extremely grateful for the time, consideration and perspectives of interviewees and other contacted persons, and advice from regional and international partners including Shelly-Ann Cox, Jacqueline Spence-Hemmings, Crystal Upperman, Cédric Van Meerbeeck, Ronald Jackson, Michael Hendrickson, and Ilan Kelman, in addition to comments and insights from GRI staff including Sara Mehryar, Kate Gannon, Swenja Surminski, and Timo Leiter.

About this paper

This is one of 12 papers commissioned for the Small Island Developing States (SIDS) Future Forum, co-hosted by RESI and Island Innovation, alongside partners UN-OHRLLS, UNDESA, UKAid
and AOSIS.

In each paper, a leading expert analyses one of five themes identified in the preparatory documents for the UN's Fourth International Conference on Small Island Developing States (SIDS4) which will take place in May 2024. The papers will contribute to SIDS4 as supporting material/annexes to the next 10-year roadmap for SIDS, the Antigua and Barbuda Agenda for SIDS.

This paper was commissioned under the theme of 'Resilient economies: New strategies for diversification and growth.'

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Acronyms/Glossary

BPOA	Barbados Programme of Action
CariCOF	Caribbean Climate Outlook Forum
CIMH	Caribbean Institute for Meteorology and Hydrology
CI&S	climate information and services
DRR	disaster risk reduction
ENSO	El Niño-Southern Oscillation
EWS	early warning systems
NAP	National Adaptation Plan
NMHS	National Meteorological and Hydrological Services
MSI	Mauritius Strategy of Implementation
UNFCC	United Nations Framework Convention on Climate Change
S2S	sub-seasonal to seasonal
SAMOA	SIDS Accelerated Modalities of Action
SIDS	Small Island Developing States
WMO	World Meteorological Organization

1 Introduction

Building climate resilience is noted as the ability or capacity to 'anticipate climate risks and hazards, absorb shocks and stresses, and reshape and transform development pathways in the longer term' (UNFCCC, 2020), and there are multiple actors (such as governments, communities, and organisations) as well as certain measures that can help drive climate resilience efforts and investments. For instance, some interventions which can help address climate risks and impacts across and within sectors include the development of climate risk and vulnerability assessments (as well as further reporting and monitoring); early warning systems (EWS) and early action; climate-proofing infrastructure and services; risk transfer (such as through insurance and social protection); and increasing the availability of and access to public and private finance (ibid.). The use of blockchain technology and artificial intelligence has also been mentioned within considerations of increasing the efficiency of efforts.

Within this overall discussion, however, there is perhaps an implicit assumption relating to the availability, awareness, dissemination, uptake, and use of valuable weather and climate information to contribute to measures relating to resilience decision-making and strategy. (In this paper, the reference to climate information broadly includes both weather and climate information.) At its heart, climate information is the information from scientific data and/or local knowledge that is relevant and necessary for adaptation to climate change, long-term planning, and early warning systems. More specifically, climate information largely refers to processed data, products and/or evidence-based knowledge about the historical, current, and future climate conditions in a specific location over various timescales (Lemos et al., 2012; Singh et al., 2018) which offers decision-makers an evidence-based context for strategies to respond to climate-related threats (Dinku et al., 2011).

As depicted in Figure 1 (see Annex), there could be a range of timescales as well as applications which further contextualise climate information. For instance, and perhaps most familiar and longstanding to the public, there is locally relevant climate information at short timescales, which includes weather forecasts that can inform preparedness planning, early warning systems, and response and relief operations within a disaster risk reduction (DRR) remit. Those who have experienced storms would be aware of tropical storm or hurricane watches and warnings, or other alerts with similar intent, which inform of impending threat within days to hours. There could also be threat assessments which offer advice for the coming weeks.

At medium-to-longer timescales, such as at monthly, sub-seasonal to seasonal (S2S), seasonal, inter-seasonal, and inter-annual timeframes, products such as outlooks, predictions and other guidance can assist with preparedness planning. These may consider, for instance, inter-annual phenomenon such as El Niño-Southern Oscillation (ENSO) through which different phases could have different impacts depending on the location. Further, at longer timescales, on the order of decades and even centuries, climate scenarios can assist strategic planning and scenario building.

Climate information offers the potential for improved decision-making at different timescales and in different contexts. Shorter-timescale climate information offers authorities, and disaster and emergency management agencies, critical and time-sensitive information to alert the public of impending threat with the aim of minimising the risk of impact. Seasonal climate information can assist farmers in preparing for anomalies which could affect their crop and output. At longer timescales, climate scenarios can assist decision-making concerning resilience and anticipatory adaptation by identifying potential risks and guiding investment and planning decisions (Jones et al., 2017).

Within this context of benefits, however, and towards narrowing the gap between climate science and adaptation action (Kirchhoff et al., 2015), the tailoring of climate information for decision-makers has been touted as critical within a range of research (Goddard et al., 2010; Kirchhoff, 2013; Knapp and Trainor, 2013; Orlove et al., 2020; Singh et al., 2018). For climate information to be usable, it needs to be tailored to the community so that it is locally relevant and appropriate. Further, scholars highlight the framework of credibility (relating to scientific adequacy of the information and/or the credentials of the information providers), salience (referring to comprehension and access), and legitimacy (relating to perceived levels of representation, bias and/or participation in the information process) of scientific information (Cash et al., 2003; Guido et al., 2020).

These conceptual and theoretical frameworks define and, importantly, suggest the need for, usable climate information. However, in practice, it seems there remain stubborn challenges to the mobilisation and uptake of climate information, as evidenced by the limited inclusion and support for climate information within decision-making, especially in climate-vulnerable, including small and low-income, countries (Harvey et al., 2021; Jones et al., 2017, 2018; New et al., 2022). While knowledge and the context of some of these challenges have been explored in, for example, Europe (Bruno Soares et al., 2018; Porter et al., 2015) and sub-Saharan Africa (Harvey et al., 2021; Vincent et al., 2020), there is limited comparative and contextualised evidence for other lower-income countries, including the Caribbean and wider Small Island Developing States (SIDS). However, local narratives and perceptions of climate information use and uptake are essential, as such insights could better contextualise theoretical and comparative influencing factors, assist in building local awareness and ownership of knowledge, and contribute to more successful and effective decision-making and strategies.

2 Climate concern within Caribbean SIDS

It is important to note that understanding and responding to climate change and variability has largely been of critical concern to SIDS (UNFCCC, 2005). SIDS nations have been at the forefront of the impetus for climate action, noting the threat of rising sea levels and the increasing frequency and intensity of extreme weather events. As some of the countries most vulnerable to climate impacts, they battle with the devastating effects of climate change on their lives, livelihoods, and economies.

For instance, historically, Caribbean countries have been heavily impacted by short-term climate variability and extreme weather events including numerous flash floods, droughts, and tropical storms (Dookie and Osgood, 2021b; Pelling and Uitto, 2001), as well as effects of seasonal and inter-annual phenomenon such as the El Niño-Southern Oscillation (Giannini et al., 2000). Given these outcomes, the need to reduce existing and prevent new disaster risk has been and remains important in national and regional capacity-building efforts (Dookie and Osgood, 2021b), objectives which can be traditionally encapsulated within the concept of DRR (UNDRR, 2023). Further, the ongoing impacts and future threat of climate change within the region continues to drive the need for longer-term decisions and policy on adaptation (Giordono et al., 2020). Appreciating the context of these concepts (which, for brevity, are not offered within this paper), we may understand their roles in shaping approaches to resilience in the Caribbean.

Considering an estimate of the economic impact of climate change within the region as 5.6% to 34% of gross domestic product (Pulwarty et al., 2010), the Caribbean has taken formative action to understand and mainstream adaptation to climate change into national strategies and to build local adaptive capacity and resilience (Birch and Simpson, 2011; Pulwarty et al., 2010; Robinson, 2018a, 2018b; Thomas et al., 2019; Tompkins, 2005). This is reflected in a variety of regional/sub-regional donor-funded programmes and projects, as noted on the website of the CARICOM Climate Change Centre (5Cs), as well as National Communications and National Adaptation Plans to the United Nations Framework Convention on Climate Change (UNFCCC). As shown in Figure 2 (see Annex), the region has witnessed and been a part of many pivotal national, regional, and international actions, events, and milestones. This includes national actions such as submitting National Communications and a National Adaptation Plan (NAP) to the UNFCCC; regional events including the first Caribbean Climate Outlook Forum (CariCOF); SIDS-related strategies, including the Barbados Programme of Action (BPOA), the Mauritius Strategy of Implementation (MSI) and the SAMOA Pathway; and international events and reports. In addition, there have been decisive occurrences such as intense storms, hurricanes, and intense ENSO events.

Across the years, there is a range of regional projects in the Caribbean which broadly focus on adaptation, as highlighted in the top portion of Figure 2, with a subset of these offering some

scope of climate information and services (denoted by orange bullets). However, despite regional and national attention to the broader concern of climate change and variability, as well as localised measures to improve resilience to impacts and potential threats, there is yet limited focus on the role of and increased need for locally relevant climate information within wider resilience-building measures. While Figure 2 shows that there has been a range of regional donor-funded efforts across the years, with more than 40% of these including a focus on climate information, these initiatives are often disjointed and carried out by different donors over time. Such projects, though relevantly designed, can tend to be limited in approach due to challenges of sustainability of efforts over time and difficulties fostering momentum for concern and action.

3 Climate information within early warning systems and early action

It is essential to note that building resilience to climate impacts fundamentally requires improving the availability, accessibility, and use of climate information. Much of the range of suggested resilience-building interventions (such as detailed climate risk and vulnerability assessments, early warning systems, climate-proofing infrastructure, index-based insurance and climate finance) in some way hinges on the availability, awareness, dissemination, uptake, and use of valuable weather and climate information.

For instance, much is expected of EWS and related infrastructure, as these are considered to be key elements of adaptation and disaster risk reduction. These systems, which detect and warn of potentially threatening climate-related hazards and resulting risk, naturally rely on appropriate and reliable scientific and technical data to make relevant time – and location-sensitive decisions. For hazards such as tropical cyclones, floods, storms, tsunamis, extreme heat or cold, fires, drought, and the like, this may be represented by informed weather and climate information running the gamut from shorter-term observations on weather as well as storm watches and warnings, to medium-term forecasts including seasonal outlooks, to longer-term climate scenarios, guidance and predictions.

While climate information is at the heart of early warning systems, an effective early action infrastructure also depends on an integrated communication system. This includes the active involvement of at-risk people and communities to create awareness of risks and threats, a thorough understanding of the threat and appropriate related measures, and the effective and efficient communication of warnings and advice to ensure preparedness (ClimateADAPT, 2019). Further, as noted by the European Climate Adaptation Platform, Climate-ADAPT, which has an aim to share adaptation knowledge for a climate-resilient Europe, for an early warning system to be effective and complete, it 'needs to comprise four interacting elements namely: (i) risk knowledge, (ii) monitoring and warning services, (iii) dissemination and communication and (iv) response capability' (ClimateADAPT, 2019).

Beyond the building of effective early warning systems, there is much discussion of the role of early action, which broadly refers to actions taken before crises develop. It is also sometimes interchanged with the term anticipatory action, which refers to actions 'aimed at reducing or mitigating the impact of disasters and enhancing post-disaster response, using forecasts or early warnings of imminent shock or stress' (Wilkinson et al., 2021), including actions triggered by forecasts of a shock. More specifically, much is written about forecast-based early action, which are actions triggered by the forecast of the shock, and mostly used in relation to forecasts of extreme weather events. Associated with forecast-based early action is the concept of forecast-

based financing, which refers to 'specific funding modalities set up in response to the difficulties humanitarian actors have frequently faced in obtaining resources to act before a shock or crisis has occurred. These enable quicker release of funds based on a forecast' (Wilkinson et al., 2021).

With the power to enhance existing early warning and preparedness mechanisms by improving decision-making, early action – more specifically, forecast-based early action – is touted as critical to increase resilience and minimise disaster and climate risk. However, it must be noted that underlying these concepts and their effective implementation is the assumption of the existence and use of locally appropriate and reliable climate information.

4 Caribbean-focused barriers and enablers of climate information use

Towards developing and improving an understanding of the context of climate information uptake and use in SIDS, we review perspectives and narratives of current influencing factors (barriers and enablers), as ascertained through thematic analysis of insights from 26 Caribbean-focused experts, as shown in Tables 1 and 2 and as adapted from Dookie et al. (2023).

In a review of the top barriers, or factors which may likely hinder the ability of local agencies to use climate information, three themes were of key concern: political/policy concerns, application and usability, and awareness – see Table 1. Political or policy-related concerns were the most cited, with challenges including a changing government alignment (due to shifts in political/ministerial regime), an 'inability to involve politicians', and limited political mandate to encourage climate information (e.g. 'minimal mandate' and 'doing as in the past'). Other barriers that were mentioned include a general 'siloed approach' to focusing on priorities within the region (e.g. 'gap between knowledge and implementation', 'hard to connect impact and climate information', communication problems, and competition with other priorities (e.g. 'climate not seen as economic', '[perception of more pressing] development concerns'). Application/usability-related barriers broadly included limitations related to the format in which the data is presented for analysis or interpretation (e.g. 'how do you use that data for your purposes', '[need] form that is applicable,' 'format not understandable'), as well as the need for better interpreting of the data (based on respondent references including 'translating this raw information' and '[challenge to] interpret the messages'). Specific factors relating to the challenges of 'visualisation', 'real-time availability' and 'certainty' of data were also mentioned, and through discussion the appropriateness or relevance of the data for the small islands of the region (e.g. 'limited output from region') was also mentioned.

A low level of awareness of climate information in the region was also deemed a significant barrier. This included speculation that local agency officials may not know that data exists (e.g. '[limited] awareness of what is available', and 'lack of awareness'), or, if they did, they would not know where to access it (e.g. 'where to go for climate information', '[need readily] identifiable data', 'limited dissemination and outreach'). Respondents stressed access problems; challenges with data management and sharing, nationally and at the regional level, were also stated as barriers. These concerns related to institutional reluctance to share data (e.g. 'challenge of sharing data', 'difficulty with national data'), possible 'institutional jealousy', and lack of legislation to encourage sharing and ease of management. Connecting climate information with other data was also found to be difficult due to different platforms and the associated challenges of multi-disciplinary datasets (e.g. 'different info platforms' and 'limited availability of other data').

Additional barriers included the concern of resource constraints, mostly referring to human resource capacity concerns (respondents referenced elements such as 'human capacity constraints', 'capacity to utilise', 'training needs', and 'education system'). Financial and technical constraints (e.g. 'data and analysis skills' and 'adaptation to new technologies') were also specifically mentioned.

Reviewing the key enablers, or factors which respondents believed may likely encourage the ability of local agencies to use climate information for climate-related decisions, most of the factors suggested by respondents focused on the need for improved local and sectoral contextual relevance – see Table 2. Related narratives included the need for data that is of relevance to a small-island setting (e.g. 'need to work within small island needs', and '[make] relevant at local scale'). In addition, a better understanding of the direct utility, as well as the economic bottom line/costs and benefits, of climate information was also highlighted (with respondent comments such as 'need quantifiable impact', 'connecting data and economy', 'connecting to socio-economic data and impacts', 'understanding associated risk', 'direct utility', 'illustrating value', 'impacting pockets', 'impacts cost money', and '[need to] relate to costs'). Respondents mentioned having climate information as well as key partners and stakeholders associated with such information engaged and included at early (or 'integral') stages of decision-making processes. In addition, 'making climate information a requirement' in certain decisions and the project process could be helpful.

Respondents also mentioned the influencing nature of improved climate information application, translation, and training. Importantly, perspectives included the need for improved awareness of how to apply the available climate information (e.g. 'knowing how to apply'), as well as the need for improvements in the formatting and presentation of information so it could be more widely and better understood, including by policymakers (e.g. 'translating scientific knowledge', 'need simplified version').

Several enabling factors were awareness-related, including improved 'awareness of the existence' of relevant types of data, 'knowing where to go' and having 'official/verified sources', 'access to timely data', and, as well, the need for 'dissemination and outreach', perhaps through social media or civil society.

Enablers related to recent events were also mentioned, with respondents suggesting that a renewed attention to climate information usually occurs just after extreme weather events (with a lack of interest at other times). Specific motivations relating to funding, including the option to 'incentivise resilience building', were also suggested as enabling factors.

5 From research to recommendations

Such narratives of current barrier and enabling factors of climate information use (as shown in Tables 1 and 2) highlight a range of enabling and catalysing conditions helpful for the use and utility of climate information for decision-making. Research of this kind, which showcases the importance of climate information, provides governments, communities, and organisations with the context and knowledge of why climate information systems should be developed and nurtured and is thereby instrumental in empowering them in the decision-making process. Further, these perceptions offer a localised understanding of Caribbean-centric issues which can specifically assist climate adaptation and resilience processes within the region, as well as providing a foundation and template for discussion by other SIDS.

Importantly, this research helps provide evidence-based concerns, suggestions and/or recommendations which could better inform policy pathways for SIDS for improving the use and uptake of climate information. This includes:

5.1 Creating awareness of the relevance of climate information

While many respondents mentioned that they had been aware of the term 'climate information', not all professed to using it within daily efforts, not even within sectors that could benefit from it for decision-making. As such, there is a need to create an awareness of climate information at various scales, including to a broad range of stakeholders across different sectors, and including line ministers and permanent secretaries. Such an awareness would include knowledge of what climate information means, what it includes, how it is created and stored, and how it could be used for resilience-building.

There are several ways in which awareness could be increased. One suggestion is to improve the showcasing of climate information by publicising 'success stories' of climate information use. This could utilise different media (articles, illustrations, and video) to highlight examples of when climate information successfully triggered early warning systems; for example, in the Bog Walk Gorge, Jamaica in April 2019 (Dookie and Spence-Hemmings, 2022). Another suggestion might be to hold an awareness-raising forum on climate information use for non-technical persons who have a decision-making interest. While Climate Outlook Forums have been at the helm of disseminating climate information knowledge to meteorological offices and disaster/emergency management agencies, as well as climate-relevant sectors including water and coastal resources, a policy-maker-focused session could be of use.

5.2 Fostering an 'economic bottom line'

Connected to building a general awareness of climate information, several respondents to our survey were concerned that the direct utility and 'economic bottom line' of climate information

was not well understood. As such, there is a need to improve research to better understand the utility of climate information and how improvements to climate information and its use could benefit and impact countries. One relevant working paper cites that the timely use of climate information could be associated with a reduction in the number of people affected by storms, as well as related macroeconomic effects (Dookie and Osgood, 2021a) – further research along these lines could assist countries with similar economic insights that support the decision-making process.

Moreover, there is a general need to better understand the relevance of climate information within the sustainable finance architecture that is needed to support the transition to a climate-sustainable economy, and to address the need for information on climate-related risks. As mentioned within an IMF Staff Note, '[s]trengthening the climate information architecture is paramount to promote transparency and global comparability of data and thus improve market confidence, safeguard financial stability, and foster sustainable finance' (Ferreira et al., 2021). Further, the note outlines that '[p]rogress and convergence are required on the three building blocks of a climate information architecture: (1) high-quality, reliable, and comparable data; (2) a globally harmonized and consistent set of climate disclosure standards; and (3) a globally agreed upon set of principles for climate finance taxonomies. A decisive, globally coordinated effort is needed to move forward on all three fronts'.

As SIDS move forward on development pathways within a competitive global market, it will be essential to understand the role of climate information architecture and to develop an improved iteration of it.

5.3 Developing a hub for localised climate information

Many responses within our semi-structured interviews mention the need to have ready access to locally appropriate climate information, i.e. at the small-island level. It is indeed important to enable timely access to salient, credible, and legitimate climate information which is locally appropriate and relevant to decisions along different timescales and in different locales, and which can be referenced by an inclusive range of stakeholders. In this regard, a regional and/or SIDS-focused hub with a mandate to assist countries to access and utilise climate information at various timescales would be of great assistance.

Such efforts could be the specific result of a boundary organisation, such as the Caribbean Institute for Meteorology and Hydrology (CIMH) in the Caribbean, which has a current mandate to provide climate services to support all required areas of disaster risk reduction including damage and loss for the Caribbean as a WMO Regional Climate Centre. Complementary to the ongoing role of the CIMH, the development of a SIDS Centre of Excellence and Data Hub could have a key role in consolidating, disseminating, and enabling practical action on climate

information. A key concern/caveat, however, would be the need for enhanced data management as well as data-sharing and coordination between agencies, since different entities are often responsible for different aspects of capturing climate information (see Figure 1 in Annex).

5.4 Translating science for action

Further to the need for a hub for localised climate information, there also exists a need to review the role of climate translators, as well as increasing training and human capacity for this within the regions of interest. While scientists have done a great job of improving the methods and science to better understand the climate problem, there remains a challenge of translating such scientific knowledge into actionable elements. Perhaps a key strength of the data hub could be the provision of a facility to help train decision-makers on how to access and utilise available climate information for different purposes and decisions, and how to understand what further climate information may be needed for other outcomes, including in terms of gender and inclusion. The creation of a space or platform for dialogue between users (and their needs and options) and climate service providers could encourage the development of climate information that is useful, usable, and fit for purpose.

5.5 Highlighting the need for improved human and technological capacity

As mentioned by interviewees, the challenge of human resources has been a key concern for many persons, noting high levels of attrition. There remains a need to encourage degree, technical/vocational and other education programmes, as well as learning exchanges between inter-regional and international agencies, to better develop, access and use climate information. Importance should also be placed on building behavioural-based modalities of efforts towards improving the understanding of local challenges and how climate information might assist. Within this, there is value in underscoring a SIDS-focused narrative and encouraging bottom-up approaches towards solutions, which might help build more sustainable efforts towards achieving resilience. This aspect requires further discussion and directive on the likely pathways through which it could be encouraged.

5.6 Supporting cohesive programmes focused on climate information

Despite a range of donor-funded efforts which include a focus on climate information within the region, as shown in Figure 2, there is still a generally disconnected approach to improving efforts on assimilating and using climate information for decision-making. Designing longer-term inter-agency programmatic work on building climate information expertise and technical capacity, and on encouraging climate information use within island regions, could, however, enable a more comprehensive and sustainable approach to resilience-focused action. This would need to include the creation of a strategic national focus on encouraging climate information awareness and use, and, in the process, using user-led service design to underscore localised stakeholder and sectoral inputs on climate information needs, uses and goals, and highlighting obvious gaps in current local

climate service provision. Through this process, evidence-based knowledge can offer impetus to donor agencies to support and co-design better comprehensive, inter-sectoral and longer-term strategies and assist the channelling of appropriate and efficient financing.

5.7 Encouraging clearer language in international and regional documentation

Thus far, there has been relatively limited regional and national action towards improving use of climate information, perhaps in part due to its limited focus within international policies and programmes of action. For instance, in reviewing the outcome document for the SIDS Accelerated Modalities of Action (SAMOA) Pathway (A/RES/69/15), while the role of data and statistics in development planning are recognised and reaffirmed, and there is commitment to strengthening the availability and accessibility of data and statistical systems, there is no obvious specific concern about climate information. As such, concerted efforts to improve the language used in international discussions regarding the on-the-ground concerns of climate information could bring the requisite focus to the topic and encourage the building of programmatic efforts concerning climate information in SIDS-focused resilience-building.

6 Conclusion

This contribution on the role and nature of climate information as it relates to resilience-building initiatives and interventions – as well as the specifically Caribbean narratives of climate information-use enablers and hindrances, illustrated through the thematic analysis of insights from 26 Caribbean-focused experts – highlights a range of the enabling and catalysing conditions necessary to encourage the use and utility of climate information for decision-making.

Research of this kind can be instrumental in the decision-making processes of governments, communities, and organisations, as well as encouraging wider inter-governmental and donor efforts in this field. Although the narratives and perceptions shared within this paper offer a localised understanding of Caribbean-centric issues towards assisting climate adaptation and resilience processes within the region, this knowledge could also serve as a foundation or template for discussion by other SIDS.

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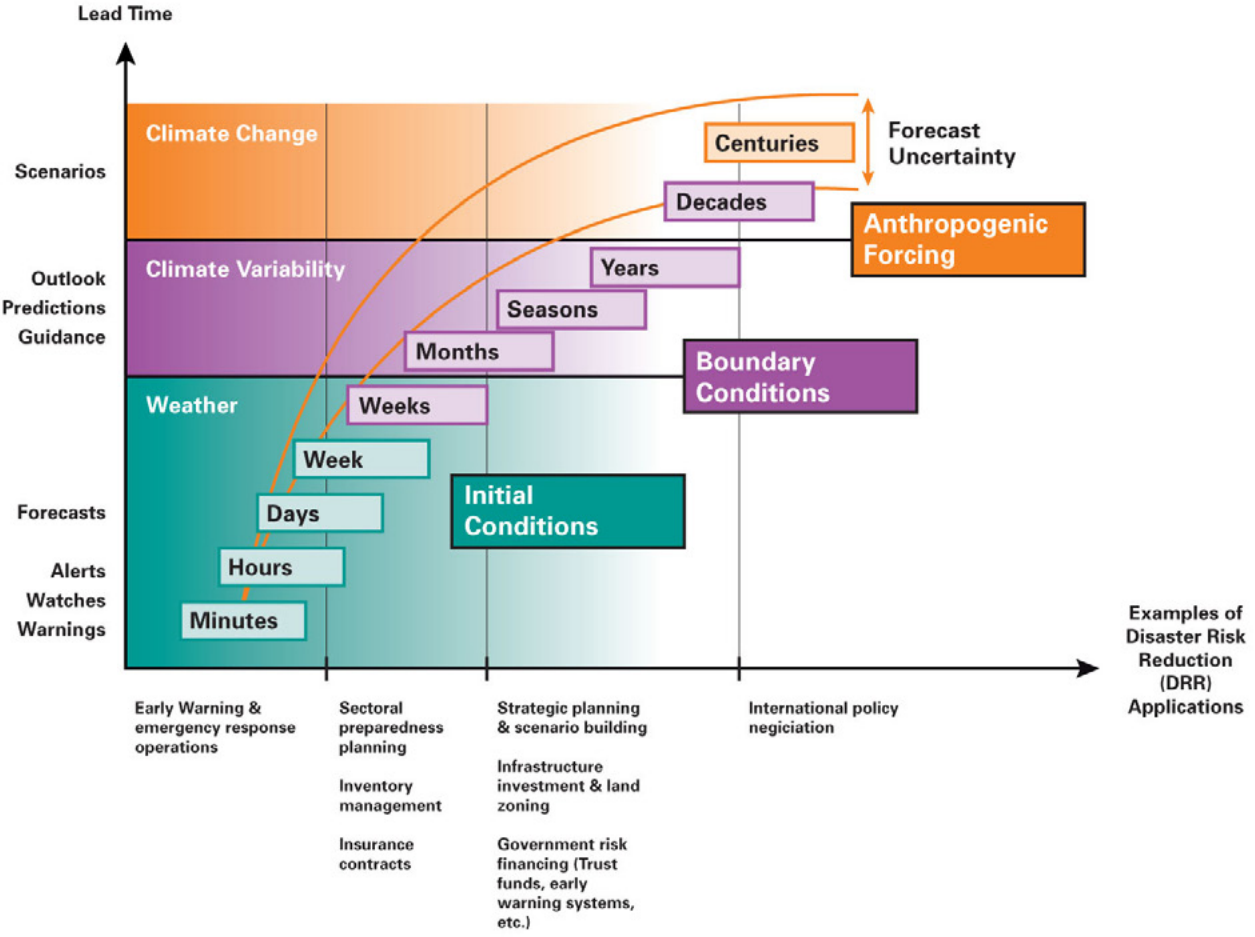
Annex

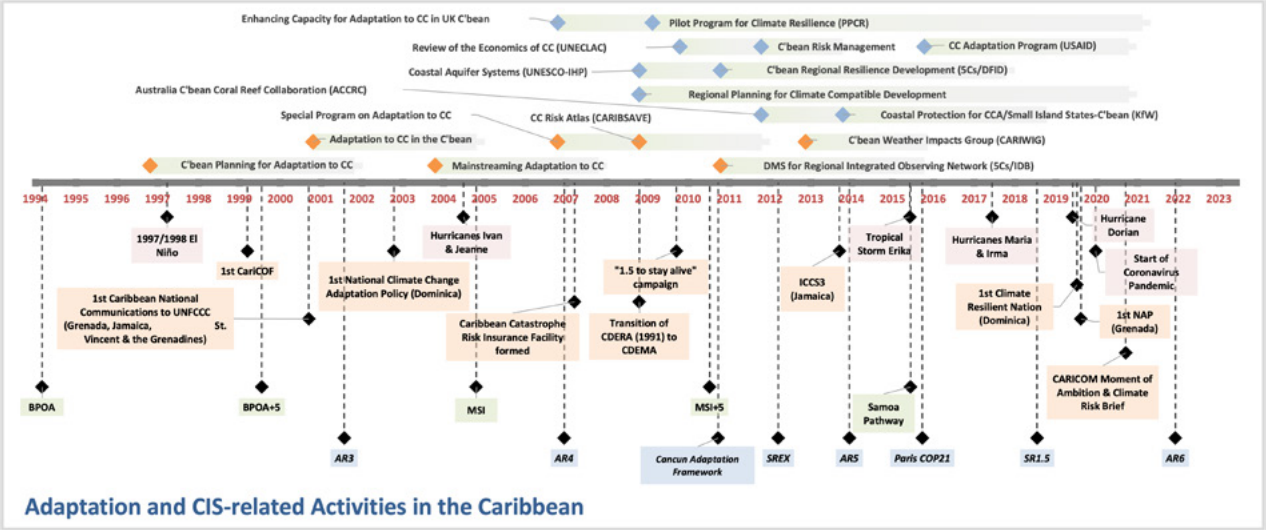
Figure 1 Illustration of types of climate information and Caribbean sources across weather to climate timescales, and likely applications



Source: Dookie et al. (2023). Adapted from Mason et al. (2015), based on WMO (2018).

Notes: CI&S refers to climate information and services; NMHSs are the National Meteorological and Hydrological Services (which include national weather services); WMO is the World Meteorological Organization.

Figure 2 Timeline of major Caribbean projects relating to adaptation, and climate information and services, 1994–2022



Source: Dookie et al. (2023).

Notes: The top portion of this timeline highlights the periods of adaptation-related Caribbean programmes and projects, as found on the Caribbean Community Climate Change Centre (5Cs) website (www.caribbeanclimate.bz/) as of 4 January 2021, with projects offering scope climate information and services denoted with orange bullets. The bottom portion indicates a range of pivotal events and key milestones, such as: national actions (including the submissions of the first National Communications and National Adaptation Plan (NAP) to the United Nations Framework Convention on Climate Change (UNFCCC); regional events (including the first Caribbean Climate Outlook Forum (CariCOF); SIDS-related strategies (including the Barbados Programme of Action (BPOA) and Mauritius Strategy of Implementation (MSI)); and international events and reports featuring SIDS (including the Intergovernmental Panel on Climate Change (IPCC) Assessment Reports, Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX), and Special Report on Global Warming of 1.5°C (SR15)).

Table 1 Selection of narratives on the barriers to climate information use

Summary factor	Description	Selection of narratives
Challenges of climate information usability and applicability	Respondents mentioned challenges relating to the limited usability and applicability of available climate information due to presentation and available formats, as well as the need for translating or interpreting the data.	*It's one thing that you're in a sector that rainfall patterns can change, and you see a graph, but how do you use that data for your purposes? Having the capacity to not only receive* [*climate information*] *but move beyond this* *Presented in technical and scientific language... is how it applies to me easily identifiable?* [*Need*] *capacity to understand information* [*Need for*] *training the trainers...* [*Need*] *to make people more skilled to understand and interpret the messages providing the key information* *Climate information needs to be presented in ways that relate to their imperatives* *Need something easy to refer to...* [*problem is that climate information is*] *collected for different reasons, difficult for comparisons* [*Climate information is*] *specialised information not readily consumed by everyone... Not everyone in research and ministries can use... needs expertise* [*for*] *translating this raw information* *Still some* [*areas*] *where research has not yet been done. The less information that comes from your regions the less contributions that will be included in international reports. The Caribbean is under-represented in papers that IPCC reviews*
Challenges of climate information awareness, availability, and access	Respondents mentioned challenges relating to not being aware of what climate information is available, or not sure where to look, or not having access to information. Problems of data-sharing and compatibility across differentiated data platforms, the challenge of understanding uncertainty, as well as the need for dissemination and outreach were also mentioned.	*Not knowing where to go for information; challenge of hunting down information... Poor culture of sharing information across agencies, ministries. If they know there's information readily available then will seek out. A lot of work being done to collect interesting information, but not packaged to be easily shared to end users, and little investment of wanting to share* *Sometimes you have too much information, not sure what to believe... we don't dedicate people to dissemination and outreach* *Lots of information out there; what information is being used, is it usable? ... Challenges of data gaps and data access* *Challenges of data sharing... in Europe there is a public value of databases* *Misinterpretation of uncertainty and understanding what it means within context*

Summary factor	Description	Selection of narratives
Challenges related to political and policy issues	Respondents mentioned challenges relating to the changing alignment of the relevant organisations and/or government in terms of political cycles, challenges related to the framing of climate information/climate change within the context of other societal issues, and the siloed nature of responding to climate change.	*Changing head of government and organisation not always good Changing alignment* *If… there is a way to do things differently from in the past* *How is climate [change/] information different from other social issues, poverty and development? Climate change is crosscutting, but it can't be distracted by something difficult to understand* *Siloed policymakers… Don't bring them in at the end, should be there at the start* *Until the environment becomes an important issue, then people in government will pay less attention to it… Climate doesn't move until it becomes an economic issue* *Politicians are afraid of the impact of science on their bottom line, likely the next election*
Need for additional resources	Respondents mentioned challenges related to insufficient resources and capacity to use/ support climate information (i.e. human capacity, financial and technical/technological limitations).	*[Need] financial resources to support staff. Downloading data needs technology and hard resources* *Capacity constraints, planning. Not using information and data in planning. Not technical, but human capacity. People not having time to have proper planning* *[Challenges of] cost, maintenance, lack of human capacity… how to do the analysis and have that training* *Capacity constraints [related to] translating raw information*

Notes: The table offers a selection of narratives relating to the posed question: 'What are the barriers, i.e. factors which may likely hinder the ability of local agencies to use climate information?' Of 26 interviewees, 24 offered a response. Respondents were able to suggest more than one factor, if necessary.

Table 2 Selection of narratives on the enablers of climate information use

Summary factor	Description	Selection of narratives
Improved contextual importance	Respondents described the need to have better context for the climate information available, in terms of localised and sectoral importance.	*Talking or working between stakeholders and provider to build trust and language, and filter out what is not usable to make sector relevant* *[If you can show] how it impacts their pockets and safeguarding investments* *Not enough localised information... [need to be] relevant at local scale and used to connect to adaptation response* *Proof of the pudding. Need to show that the utilisation of this information can impact institutional bottom line. Need to convince minister of X, or funding agency to use it. Being able to show direct utility* *Policy platforms need to have a real space for scientists to get climate information on the agenda... [use of] ministerial councils* *Scenario planning. When they are setting their budgets, thinking of which programmes they want to continue with, to show them an approach to planning that will highlight scenarios. And show impacts... people have a lot of experience and tacit knowledge of how to do things, [but need to] make it more tangible for them* *Requirement of climate information is a major factor*
Improved application, translation, and training	Respondents described the benefit of knowing how to apply climate information, as well as its presentation in less scientific and more usable formats. Training to use this information was also important.	*Knowing how to apply [climate information], [need] level of how to use this* *Need for scientists to show information presentable to non-scientists... how do we bring [it] across in a way to be accepted?* *Translating scientific knowledge [into something] that politicians can understand... fancy technical words difficult for policymakers* *Format and how the message is formulated. Climate providers and intermediaries need to make more efforts to adapt the message and the format to the sectors that they are trained to reach* *Climate and its impacts still an optional study area, when it should be compulsory*

Summary factor	Description	Selection of narratives
Improved basic knowledge and access	Respondents mentioned the need to at least be aware/know that the data existed, and to know where to look for the data. In addition, having ready access to climate information was important.	Knowing that the data exists If you want to plan and make informed decisions, need data to help them do that Access to… information on a regular and timely basis Making it extremely easy to access data, something that they can do Social media and digital media can assist, search for something and you can find; Youth and community organisations [offer] wider acceptance of climate information at societal level [allowing that a] basic knowledge level of climate change is met So much information, some are very different sometimes, information sharing is a challenge. Question of how we as a country do data generation, collation and access is a key pathway to more effective use of climate information and its application Data policy… look for this to see how it hinders accessibility and sharing Awareness at highest political agency… [need] massive increase in public awareness, needs to be a demand from a public
Other	Additional enablers included the motivation to use climate information due to the recency of need (there may be upticks in use immediately following climate events), and funding would be a motivating factor for use.	We have a tendency to be driven by events Stakeholders have indicated a lack of interest in climate information except weather reports during the Atlantic Hurricane Season Build financial structures to build this up without a need for external funds

Notes: The table offers a selection of narratives relating to the posed question: 'What are the enablers, i.e. factors which may likely enable the ability of local agencies to use climate information?' Of 26 interviewees, 25 offered a response. Respondents were able to suggest more than one factor, if necessary.