Chapter 1
Introducing Climate Services and Their Applications

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Abstract This introductory chapter defines climate services and outlines their nature, as processes which deliver climate information to a wide range of users. It also describes some application and the barriers experienced in the dissemination of climate services, and introduces the chapters of this book.

Introduction

Knowledge about climate change plays a crucial role in guiding both, mitigation and adaptation processed. The pressures posed by climate change on the one hand, and the advancement in climate science on the other, have led to the prioritizing the development and provision of Global Climate Services by public and private organisations and specialist institutions (Jancloes et al. 2014). Climate services are defined as those related to the generation, interpretation, transmission and application of climate knowledge and information for the decision making and further planning. Climate services provide the most recent knowledge about climate science, in support of adaptation strategies for agriculture, water, health and other sectors (Climate Services Partnership 2015). The difference between climate service from climate research is that it focuses at serving user requirements which later helps in the understanding of climate systems. Apart from helping to prepare to manage the effects of climate change, one of the mains aim of climate services is to provide up to date climate-related knowledge and information which can be further used to reduce climate related disaster risks, and to improve welfare (Vaughan and Dessai 2014; WMO 2012, 2019).

One of the features of climate services is that the climate information processed is provided in a suitable format which allow it to be used by a variety of groups. These include:

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(a) policy-makers,
(b) planners,
(c) investors,
(d) other user groups (e.g. farmers).

The data required, be it in respect of temperature, rainfall, wind or soil moisture, among others, is provided in the ways required by the users. If needed, long-term historical averages of these parameters, with vulnerability maps and risk analysis may also be provided. Climate data may also be combined with non-climate data i.e. health trends, agriculture production, population distribution in high-risk areas, and other socio-economic variables, depending on users´ requirement (GFCS 2012).

The list of climate service providers, which act in the nexus climate science, policy and process. Include a variety of organisations (Vaughan and Dessai 2014) such as:

- International Service Structures—World Meteorological Organization Climate Service
- National Climate Service Providers—NOAA Climate Services, Climate Service Center, Germany
- Regional Climate Services—Australia National Climate Center
- Research Institutes—The Climate Impacts Group (CIG) of the University of Washington
- Private Sector Services—Climate Risk Analysis, Predictia, and Climpact
- Climate Services across Scales.

There are also organisations, such as meteorological services, which offer climate services. Table 1.1 shows a list of climate services around the world.

Figure 1.1 provides a framework of climate services. It shows that it consists of information provision based on the availability of good quality data, which may allow an interpretation of trends. All these elements interact. Combined, they may ultimately lead to improved decision-making.

There are many factors which speak for the use of climate services. These include:

(a) The pressures posed by a changing climate which leads to a greater demand for timely, reliable and technically sound information
(b) The multiple uses of data, from support to mitigation efforts, to a concrete use in adaptation efforts
(c) The multi-stakeholder dimension, which enables the mobilisation of a variety of users
(d) The concrete support to cope with extreme events
(e) The provision of support to administrations, enterprises and other organisations which need climate information.

One further characteristic of climate services is the existence of various modalities of applications. Figure 1.2 illustrates some of them.

Unlikely widely believed, the provision of climate services is not solely related to the availability of information on weather and climate. Rather, climate services encompass also support to the identification of possible (or likely) risks, proving

Table 1.1 Some existing climate services providers

Climate services	Country	Website
World Meteorological Organization Climate Services	International	http://www.wmo.int/pages/themes/climate/climate_services.php
Food and Agriculture Organization of United Nations—climate change resources	International	http://www.fao.org/climatechange/59898/en/
Red Cross Climate Center	International	http://climatelab.org/Red_Cross_Red_Crescent_Climate_Centre
NOAA (National Oceanic and Atmospheric Administration) Climate Services Portal	USA	http://www.ncdc.noaa.gov/oa/climate/regionalclimatecenters.html
Australia National Climate Centre	Australia	http://www.bom.gov.au/climate/
China Meteorological Administration (CMA) Climate	China	http://www.cma.gov.cn/en2014/
Caribbean Community Climate Change Centre (CCCCC)	Caribbean Community	http://www.caribbeanclimate.bz
Fiji Meteorological Services—Climate Services	Fiji	http://www.met.gov.fj/
Southern African Development Community—Climate Services Centre (SADC CSC)	South Africa	https://www.sadc.int
Climate Service Center, Germany	Germany	https://www.climate-service-center.de/
UK MET Office—Climate Services	UK	https://www.metoffice.gov.uk/services/research-consulting/climate-service
KNMI Climate Services	Netherlands	https://www.knmi.nl/research/climate_services/
Météo-France Climate Section	France	http://www.meteofrance.com/accueil

Source Modified from Medri et al. (2012)

valuable information which may be deployed in support of investment decisions or policies.

But despite the relevance of and the need for climate services, there are some barriers which hinder their deployment. These are described in Table 1.2.

This list is by no means exhaustive. Other barriers which may be added include possible problems related to the lack of quality regarding the information offered by the scientific community, as cross-checked against the needs of diverse potential users (Brasseur and Gallardo 2018). In some developing countries, up to date weather information may not be available, which would make it difficult to deploy climate

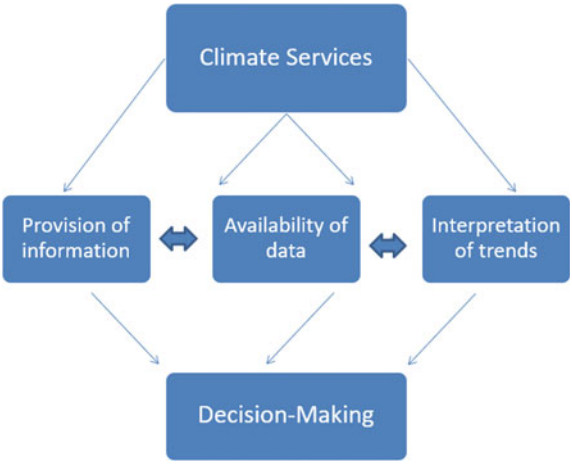

Fig. 1.1 Framework of climate services

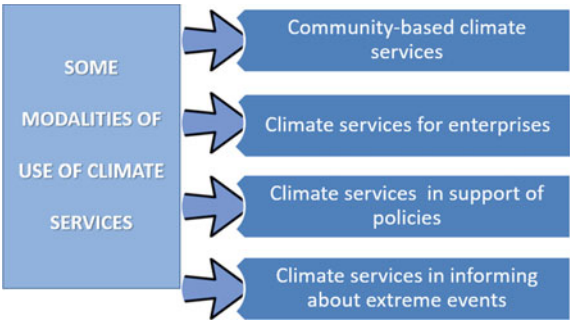

Fig. 1.2 Some modalities of climate services

Table 1.2 Some of the barriers to the dissemination of climate services

Barrier	Impact
Limited access to technology	Limits the options and access to up to date information in some contexts (e.g. developing countries)
Low levels of awareness	Limited information about the benefits of climate services
Restricted data availability	Reduces the scope of use of climate services
Need for multi-stakeholder engagement	Adds complexity to the design and use of climate services
Lack of frameworks	Unsystematic use of climate services

services. Moreover, the key issue in integrating climate services is budgeting should be mentioned, since government budgets are usually assigned sectorally (Bettencourt 2015), which may make inhibit the allocation of specific funding for climate services.

But despite the barriers, climate services do offer various benefits at the community level, at the individual level, and to the environment as well. For instance, in agriculture, climate services can enhance awareness regarding the possible climate risks and help farmers in deciding on particular crops, plantation timing, and fertilizers' application to mitigate the impact of climate risk on agriculture (Vaughan and Dessai 2014). Moreover, disaster risk reduction can be pursued, by prior information obtained from climate services. The broadcasting of warnings related to hazards can help appropriate preparedness measures, and ultimately protect lives. In addition, data observation on extreme weather events can help increase livelihood's security (Dutton 2002; WMO 2012). Moreover, climate services may be used to raise awareness regarding the patterns and burdens of many diseases related to the environment, which may prevent the population from getting infected (Global Framework for Climate Services 2012). Indeed, the inclusion of climate information in health planning is one of the promising areas of climate services, which may assist the health community (Shafer 2008).

Another advantage of climate services is the support of sustainable tourism development, and adaptation to climate change as a whole. The use of historical climate information can be beneficial for infrastructure planning for tourism, location analysis for new resorts, architectural and landscape designs (Scott et al. 2011). Overall, climate services may be helpful tools to climate change resilience (Leal Filho 2019) and may contribute towards achieving it.

Experiences from This Book

This book encompasses a set of papers, which explore the different dimensions of climate services. Saleem Khan and Amsad Ibrahim Khan for instance, introduce "BASIEC", a coastal climate service framework for community-based adaptation to rising sea-levels. Abbadi Girmay Reda describes some methods for geospatial climate change detection and resilience through nature conservation in Ethiopia. Jahir Anicama Diaz discusses a state of the art socio-economic valuation tools for climate services.

Haile Arefayne Shishaye provides an overview of nitrous oxide emissions from agricultural farms and how this contributes to global warming.

Markus Groth outlines some business strategies and climate change, with a prototype development, as well as testing of a user specific climate service product for companies, whereas Steffen Bender describes why there is more to adaptation than creating a strategy.

Saleem Khan tackles, with the paper "COREDAR: A coastal climate service framework on sea-level rise risk communication for adaptation policy planning", issues related to climate change services focusing on sea-level rise.

Esther Hoffmann provides an overview of what users expect from climate adaptation services, whereas Karianne de Bruin outlines the links between physical climate risks and the financial sector. Åshild Hauge discusses the role of public-private cooperation for climate adaptation, providing insurance loss data to the municipalities. The need to assess climate services was analysed by Maida Zahid, who looked at how to enable users to assess the quality of multi-model climate projections and derived products. Marcela Scarpellini outlines the need for science-based information, describing a requirement for top-down and bottom-up decision-making processes, whereas Hannah Helmke describes the provision of climate services and the XDC Model.

At a case study level, Busuttil and Galdies describes a climatological global solar UV index, with a measurement and link with health issues in Malta, whereas Michael Addaney outlines climate change risk and insurance as an adaptation strategy, with an inquiry into the regulatory framework of Ghana and South Africa.

Sajal Roy writes on the impacts of climatic disasters in the coastal area of Bangladesh, using 'Climate Services' as a way-forward. Andrea Rossa, in turn, outlines trends towards more resilient food systems for smallholder farmers in the Peruvian Altiplano. Perdinan, on the other hand, outlines how weather services are used for forecast based early actions in Indonesia. Other case studies are from:

(a) Uganda: appraising climate services and impacts on adaptation and mitigation to climate change (Mwangu Alex Ronald)
(b) Bangladesh: climate information services and their potential on adaptation and mitigation (Muhammad Abdur Rahaman)
(c) Nigeria: communicating Climate Change impacts as manifested in extreme weather (Ayansina Ayanlae)
(d) Sri Lanka: climate-indexed insurance as a climate service to drought-prone farmers (Pahan Prasada)
(e) Ethiopia: Geospatial Climate Change Detection and Resilience through Nature Conservation in Ethiopia (Abbadi Girmay Reda) and Food security in the face of a climate change at Kafa Biosphere Reserve (Teowdroes Kassahun)
(f) Zimbabwe: A participatory approach to developing community based climate services (Juliet Gwenzi)
(g) Serbia: Climate services for climate resilient planning of natural and cultural heritage (Tijana Crnčević).

Both, individually and combined, the experiences from the authors illustrate the fact that engagement and collaboration are very useful on how to best prepare for and provide climate services.

Conclusions

Climate services offer reliable support in efforts towards climate change mitigation and adaptation. As the subsequent chapters of this book show, climate services can

offer effective support to decisions which can increase the resilience of sites, cities or regions, making them better prepared to manage the effects of climate change and extreme events.

But in order to yield maximum benefits, climate services should ideally follow the principle of co-production, meaning that apart from weather and climate data, they need to also take into account traditional and local knowledge, hence providing a basis for climate smart practices, from agriculture to pastoralism, especially in the developing world.

Apart from the key role they can play in decision-making, one of the major advantages of climate services is their proven support in the better understanding—and often anticipation—of disaster and risks, helping to reduce the uncertainties related to climate change.

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