

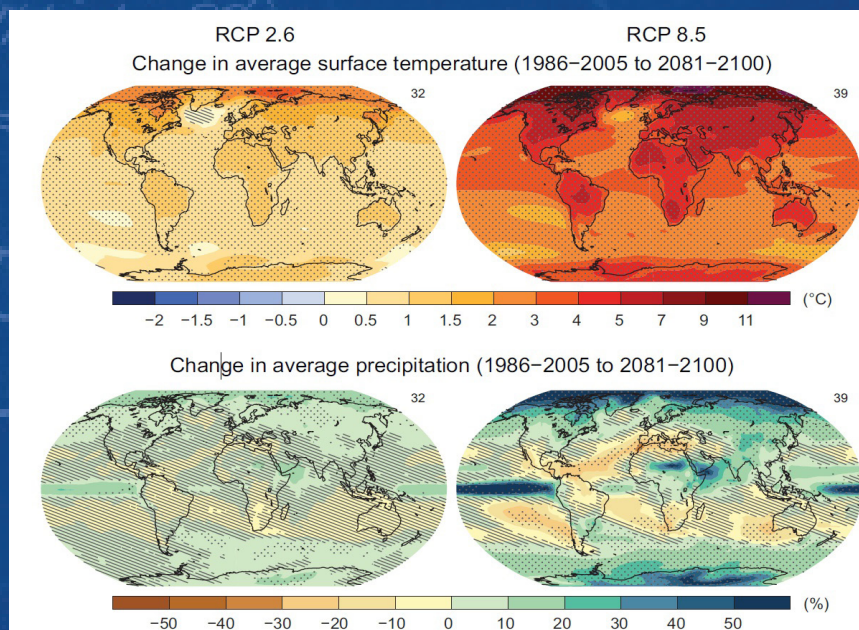


UN CC:Learn

The One UN Climate Change Learning Partnership

Resource Guide for Advanced Learning on

Predicting and Projecting Climate Change



Acknowledgements

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Layout

We Are Boq, Lda.

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Part I Introduction

1.1 About the Series of Resource Guides

This Guide is part of a series of Resource Guides developed through UN CC:Learn¹ to facilitate access to existing state-of-the-art materials relevant for climate change learning on particular topics. The Guides are written from the perspective of a learner seeking to obtain an understanding of the topic and consider use of relevant learning materials. The references cited in each Guide collectively contribute to the compilation of Advanced Learning Packages on Priority Topics of Climate Change (ALPs). ALPs compiled under UN CC:Learn cover selected climate change topics that have been identified as a priority from a country perspective. Based on an analysis of existing learning resources, development of further materials may be initiated in order to fill gaps.

The learning resources presented in this Resource Guide are drawn primarily from within the UN and partners to UN CC:Learn. Resources published by other recognized international and other organizations are provided in Annex 1. UN CC:Learn is not responsible for the content of these third-party resources and their mention does not imply that these have been endorsed or recommended by UN CC:Learn.

1.2 How to Use this Resource Guide

This Resource Guide is organized into three parts. Part I provides basic orientation for readers, including a brief introduction to the subject area and an outline of the specific learning topics to be covered. Part II lists available written learning resources as well as a number of training courses currently being offered, organized by learning topic. For each selected learning resource a hyperlink is provided through to Part III of the Resource Guide, which provides more detailed factsheets and further links to source material. Readers are advised to: (A) start by reading Part I; (B) select a preferred learning topic; (C) identify the relevant learning resources for that topic under Part II; and (D) click on the relevant hyperlinks to access the factsheets.

1.3 Target Groups for this Resource Guide

This Resource Guide has been designed to inform the following target groups interested in learning about predicting and projecting climate change:

- Decision makers in the public and economic sectors responsible for developing and implementing policies, programmes or projects;

¹ UN CC:Learn is a partnership of 33 multilateral organizations which supports Member States, UN agencies and other development partners in designing and implementing results-oriented and sustainable learning to address climate change. UN CC:Learn Partners to date include: CEB, EMG, FAO, GEF, IDB, IFAD, ILO, ITU, OCHA, UNAIDS, UNDP, UNECA, UNEP, UNESCAP, UNESCO, UNESWA, UNFCCC, UNFPA, UNHABITAT, UNICEF, UNIDO, UNISDR, UNITAR, UNSSC, UNU, UN WOMEN, UNWTO, UPU, WFP, WHO, WMO, WTO, World Bank.

- National and local government officials participating in or using climate change science;
- Non-governmental organizations (NGOs) involved in the development and implementation of climatological programmes;
- Climate assessment and risk managers and facilitators;
- Interested citizens/youth/students.

1.4 Introduction to Predicting and Projecting Climate Change

Policy makers, planners, investors and vulnerable communities need information about future climate so that they can prepare for expected trends and changes. Climate predictions are estimates of future natural conditions, while climate projections are estimates of future climates under the assumptions of future human related activities such as socioeconomic and technical developments. Because these assumptions may not be fulfilled, climate projections are subject to a high degree of uncertainty. Climate services provided by governmental and other institutions bridge the communication gap between climate scientists and user communities by explaining and interpreting climate information in a manner that can be understood by those who need the information about future climates.

National systems maintain observation programs, analyze historical data, and monitor the climate. They transform the scientific observations and analyses into products that are tailored to the needs of diverse user communities. Climate predictions and projections are interpreted and disseminated for different time periods ranging from months to decades to centuries. Regional and global support services help to improve estimates of future climates through research and modelling. They also provide climate change projections to both national services and user communities.

1.5 Learning Topics Featured in the Guide

Many organizations have developed learning materials on the theme of predicting and projecting climate change. However, given the wealth of existing resources, interested learners can face difficulties in identifying specific materials that match their needs. This Resource Guide aims at facilitating access to learning by providing a “guided tour” to materials that are already available, focusing mainly on those available from within the UN system. These have been selected according to specific learning topics identified in consultation with the UN CC:Learn partners, further refined through the application of the following criteria:

- Universality: the resources featured in this package are relevant for interested learners regardless of their specific background and experiences;
- United Nations: the resources have been produced primarily by UN agencies, especially by agencies with specific expertise in the field of climate change science²;
- Quality: the resources are comprehensive and of high quality;
- State-of-the-art: given the developments in the field, resources are recent and up-to-date;
- Learning component: the resources selected are designed to promote learning activities.

² Selected publications from other relevant international and other organizations have been referenced in Annex 1.

Learning Topic 1: Climate Prediction and Climate Change Projection

A climate prediction or climate forecast is an attempt to produce an estimate of the actual evolution of the natural climate in the future, for example, at seasonal, inter-annual or long-term time scales. Since the future evolution of the climate system may be highly sensitive to initial conditions, such predictions are usually probabilistic in nature. Climate projections are distinct from climate predictions. Climate projections depend upon emission/concentration/radiative forcing scenarios, which are based on assumptions concerning, for example, future socioeconomic and technological developments that may or may not be realized and are therefore subject to substantial uncertainty.

Learning Topic 2: Climate Change Modelling

Climate models are a mathematical representation of the climate developed by scientists to understand and predict the climate system. In order to be able to do this, the models divide the earth, ocean and atmosphere into a grid. The values of the predicted variables, such as surface pressure, wind, temperature, humidity and rainfall are calculated at each grid point over time, to predict their future values. Various types of models are used to analyze different aspects of the climate. If the natural system is altered by assuming socioeconomic trends, greenhouse gas emissions, or other activities by man, the climate models project future climates. These projections are scenarios of how man's activities may affect the natural climate.

Simulating climate change at the regional and national levels is essential for policy making. However, Global Climate Models (GCMs) have a coarse spatial resolution that is not suitable to understand the climate at a smaller scale. One technique used to overcome this problem is that of nested modeling. This involves the linking of models of different scales within a global model to provide increasingly detailed analysis of local conditions while using the general analysis of the global output as a driving force for the higher resolution model. Results for a particular region from a coupled GCM are used as starting points and constraints for Regional Climate Models (RCMs). RCMs operate at much higher resolution and often, with more detailed topography and use of physical parameters. This downscaling can be extended to even finer detail in local models. This procedure is particularly attractive for mountain regions and coastal zones, as their complexity is unresolved by the coarse structure of a coupled GCM grid. However, finer detail is accompanied by higher levels of uncertainty.

Learning Topic 3: National Systems for Climate Monitoring and Predictions

To generate and deliver effective climate services, high quality observations at the national level are required not only for the physical climate system, but also for relevant socioeconomic variables. Monitoring products such as extreme value statistics derived from routine observations are of prime importance to planning decisions, for instance in disaster risk reduction through the development of climate resilient infrastructure. Existing national capabilities for climate observations and arrangements for data exchange provide the starting point for building the national infrastructure for climate services. National Meteorological or Hydro-meteorological Services (NMHSs) play a key role in this regard, working in concert with key sectors such as agriculture, water, forests, public infrastructure and local development.

Learning Topic 4: Regional and Global Climate Support Services

Climate relevant processes have strong inter-scale linkages going beyond borders of individual countries. In order to address this dimension, and to meet the needs of its Members, WMO has defined a worldwide three-level infrastructure: Global Producing Centres for Long-range Forecasts (GPCs), Regional Climate Centres (RCCs) and National Meteorological or Hydro-meteorological Services (NMHSs). A WMO designated Regional Climate Center (RCC) is a multifunctional centre that fulfills all the climate required functions for a particular region, or for a sub-region. The Global Framework for Climate Services (GFCS) is a partnership of governments and organizations that produce and use climate information and services. It seeks to enable researchers and the producers and users of information to join forces to improve the quality and quantity of climate services worldwide, particularly in developing countries.

Part II

Guide to Learning Resources and Training Courses

Learning Topic 1

Climate Prediction and Climate Change Projection

Written Resources

Introduction to Climate Change: Lecture Notes for Meteorologists

[Go to Factsheet](#)

Reference

WMO No. 926

General Audience(s)

Decision Makers; Technical Staff/Practitioners; General Public

Type of Material

Analytical/Technical Document

Relevance

These lecture notes are intended to enhance familiarity with the broad scope of topics related to climate change. In particular, chapter 5 discusses climate prediction, and chapter 7 discusses climate projection.

Guide to Climatological Practices

[Go to Factsheet](#)

Reference

WMO No. 100

General Audience(s)

Decision Makers; Technical Staff/Practitioners

Type of Material

Guidance Document/ Handbook

Relevance

This publication is designed to provide guidance and assistance to WMO Members in developing national activities linked to climate information and services. Chapter 6.7.2 discusses the difference between climate predictions and projections.

Emissions Scenarios

[Go to Factsheet](#)

General Audience(s)

Decision Makers; Technical Staff/Practitioners; General Public

Type of Material

Analytical/Technical Document

Relevance

This report describes emissions scenarios that extend to the end of the 21st century and explains how they were developed. In particular, chapter 1.2 defines scenarios (projections).

WCRP Workshop on Seasonal to Multi-Decadal Predictability of Polar Climate

[Go to Factsheet](#)

General Audience(s)

Decision Makers; Technical Staff/Practitioners; General Public

Type of Material

Analytical/Technical Document

Relevance

This report summarizes the current state of knowledge of polar climate variability and predictability and identifies concrete steps to improve predictive capability in polar regions.

Learning Topic 2

Climate Change Modelling

Written Resources

Introduction to Climate Change: Lecture Notes for Meteorologists Go to Factsheet	
Reference WMO No. 926 General Audience(s) Decision Makers; Technical Staff/Practitioners; General Public Type of Material Analytical/Technical Document	Relevance These lecture notes are intended to enhance familiarity with the broad scope of topics related to climate change. In particular, chapter 4 discusses basic climate modelling and chapter 5 discusses global and regional models.
Guide to Climatological Practices Go to Factsheet	
Reference WMO No. 100 General Audience(s) Decision Makers; Technical Staff/Practitioners Type of Material Guidance Document/ Handbook	Relevance This publication is designed to provide guidance and assistance to WMO Members in developing national activities linked to climate information and services. Chapter 6.7 discusses climate models.
The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change Go to Factsheet	
General Audience(s) Decision Makers; Technical Staff/Practitioners; General Public Type of Material Analytical/Technical Document	Relevance This document describes progress in understanding of the human and natural drivers of climate change, observed climate change, climate processes and attribution, and estimates of projected future climate change. In particular, chapter 1.5 gives an overview of the history and evolution of climate modelling. Chapters 8, 9 and 10 discuss different kinds of models, model evaluation, and model results.
Bridging the Emissions Gap Go to Factsheet	
General Audience(s) Decision Makers; Technical Staff/Practitioners Type of Material Analytical/Technical Document	Relevance This report discusses projections of temperature for varying emissions scenarios.
Emissions Scenarios Go to Factsheet	
General Audience(s) Decision Makers; Technical Staff/Practitioners; General Public Type of Material Analytical/Technical Document	Relevance This report describes emissions scenarios that extend to the end of the 21st century and explains how they were developed.

Vital Climate Change Graphics for Latin America and the Caribbean Go to Factsheet	
General Audience(s) Decision Makers; Technical Staff/Practitioners; General Public Type of Material Analytical/Technical Document	Relevance This report discusses the manifestations of climate change and the effects of projected climate change in Latin America.
Guidelines on Analysis of Extremes in a Changing Climate in Support of Informed Decisions for Adaptation Go to Factsheet	
Reference WMO-TD No. 1500 General Audience(s) Technical Staff/Practitioners Type of Material Guidance Document/ Handbook	Relevance This document discusses how to account for a changing climate when assessing and estimating extremes. In particular, chapter 3 describes assumptions and methods for modelling extremes. Chapter 4 discusses predictions of extremes, and chapter 5 discusses projections of extremes.
Guidelines for Use of Climate Scenarios Developed from Statistical Downscaling Methods Go to Factsheet	
General Audience(s) Technical Staff/Practitioners Type of Material Guidance Document/ Handbook	Relevance This document describes how impact analysts should use climate scenarios. It reviews methods of regional modelling, discusses uncertainties, and presents guidelines for using models.

Learning Topic 3

National Systems for Climate Monitoring and Predictions

Written Resources

Introduction to Climate Change: Lecture Notes for Meteorologists Go to Factsheet	
Reference WMO No. 926 General Audience(s) Decision Makers; Technical Staff/ Practitioners; General Public Type of Material Analytical/Technical Document	Relevance These lecture notes are intended to enhance familiarity with the broad scope of topics related to climate change. In particular, chapter 6 discusses both point and spatial observations necessary for monitoring climate.
Guide to Climatological Practices Go to Factsheet	
Reference WMO No. 100 General Audience(s) Decision Makers; Technical Staff/Practitioners Type of Material Guidance Document/ Handbook	Relevance This publication is designed to provide guidance and assistance to WMO Members in developing national activities linked to climate information and services. Chapter 1.5 describes national climate activities. Chapter 2 discusses requirements for observations, and chapter 3 discusses responsibilities for managing the collected data. Chapter 6.6 further outlines responsibilities for climate monitoring and prediction.
Climate Information for Adaptation and Development Needs Go to Factsheet	
Reference WMO No. 1025 General Audience(s) Decision Makers; Technical Staff/ Practitioners; General Public Type of Material Other	Relevance This document describes many WMO programmes and specifically the Nairobi Work Program to adapt to climate change and variability. It includes climate monitoring, information dissemination, climate prediction and projection, and regional and global cooperation.
Climate Knowledge for Adaptation and Sustainable Development Go to Factsheet	
Reference WMO No. 994 General Audience(s) Decision Makers; Technical Staff/Practitioners Type of Material Guidance Document/ Handbook	Relevance This document describes how the international community has recognized that adaptation is a necessary strategy on all scales to complement mitigation efforts. It discusses observations and monitoring, modelling and prediction, and information dissemination.
Role of NMHSs in Adaptation to Climate Variability and Change Go to Factsheet	
Reference WMO-TD No. 1562 General Audience(s) Decision Makers; Technical Staff/Practitioners Type of Material Guidance Document/ Handbook	Relevance This analysis assesses the current and future role of NMHSs in facilitating adaptation to climate change and variability.

Climate Knowledge for Action: A Global Framework for Climate Services – Empowering the Most Vulnerable [Go to Factsheet](#)

Reference

WMO No. 1065

General Audience(s)

Decision Makers; Technical Staff/Practitioners

Type of Material

Guidance Document/
Handbook

Relevance

This High Level Taskforce proposal presents an important, cost effective opportunity to improve well being in all countries through contributions to development, disaster risk reduction and climate change adaptation. The plan advocates multi-national, global collaboration to provide climate services and information.

Role of NMHSs in Mainstreaming Climate Services for Adaptation and Sustainable Development [Go to Factsheet](#)

Reference

CCA-7

General Audience(s)

Technical Staff/Practitioners

Type of Material

Guidance Document/
Handbook

Relevance

This document discusses the Global Framework for Climate Services, facilitation of quality data and of a broader use of information, capacity building, technology, and public awareness.

Guidelines on Analysis of Extremes in a Changing Climate in Support of Informed Decisions for Adaptation [Go to Factsheet](#)

Reference

WMO-TD No. 1500

General Audience(s)

Technical Staff/Practitioners

Type of Material

Guidance Document/
Handbook

Relevance

This document discusses how to account for a changing climate when assessing and estimating extremes. In particular, chapter 6 describes national data management measures that should be considered to improve monitoring and understanding of extremes.

Learning Topic 4

Regional and Global Climate Support Services

Written Resources

Introduction to Climate Change: Lecture Notes for Meteorologists Go to Factsheet	
Reference WMO No. 926 General Audience(s) Decision Makers; Technical Staff/Practitioners; General Public Type of Material Analytical/Technical Document	Relevance These lecture notes are intended to enhance familiarity with the broad scope of topics related to climate change. In particular, chapter 6 discusses both point and spatial observations necessary for monitoring climate.
Guide to Climatological Practices Go to Factsheet	
Reference WMO No. 100 General Audience(s) Decision Makers; Technical Staff/Practitioners Type of Material Guidance Document/ Handbook	Relevance This publication is designed to provide guidance and assistance to WMO Members in developing national activities linked to climate information and services. Chapters 1.3 and 1.4 describe global and regional climate activities. Chapter 2.5 and 2.6 discuss the design and operation of climatological networks. Chapters 6.6, 6.7 and 6.8 discuss products.
Vital Climate Change Graphics for Latin America and the Caribbean Go to Factsheet	
General Audience(s) Decision Makers; Technical Staff/Practitioners; General Public Type of Material Analytical/Technical Document	Relevance The document describes the ways in which climate change manifests itself in Latin America, drawing on historical analysis of variables such as temperature, precipitation and sea levels.
Role of NMHSs in Adaptation to Climate Variability and Change Go to Factsheet	
Reference WMO-TD No. 1562 General Audience(s) Decision Makers; Technical Staff/Practitioners Type of Material Guidance Document/ Handbook	Relevance This analysis assesses the current and future role of NMHSs in facilitating adaptation to climate change and variability. It outlines the need for regional and global cooperation.
Climate Information for Adaptation and Development Needs Go to Factsheet	
Reference WMO No. 1025 General Audience(s) Decision Makers; Technical Staff/Practitioners; General Public Type of Material Other	Relevance This document describes many WMO programmes and specifically the Nairobi Work Program to adapt to climate change and variability. It includes climate monitoring, information dissemination, climate prediction and projection, and regional and global cooperation.

<h2>Climate Knowledge for Adaptation and Sustainable Development Go to Factsheet</h2>	
<p>Reference</p> <p>WMO No. 994</p> <p>General Audience(s)</p> <p>Decision Makers; Technical Staff/Practitioners</p> <p>Type of Material</p> <p>Guidance Document/ Handbook</p>	<p>Relevance</p> <p>This document describes how the international community has recognized that adaptation is a necessary strategy on all scales to complement mitigation efforts. It discusses observations and monitoring, modelling and prediction, and information dissemination.</p>
<h2>Climate Knowledge for Action: A Global Framework for Climate Services – Empowering the Most Vulnerable Go to Factsheet</h2>	
<p>Reference</p> <p>WMO No. 1065</p> <p>General Audience(s)</p> <p>Decision Makers; Technical Staff/Practitioners</p> <p>Type of Material</p> <p>Guidance Document/ Handbook</p>	<p>Relevance</p> <p>This High Level Taskforce proposal presents an important, cost effective opportunity to improve well being in all countries through contributions to development, disaster risk reduction and climate change adaptation. The plan advocates multi-national, global collaboration to provide climate services and information.</p>
<h2>How to Establish and Run a Regional Climate Centre Go to Factsheet</h2>	
<p>Reference</p> <p>WMO-TD No. 1534</p> <p>General Audience(s)</p> <p>Technical Staff/Practitioners</p> <p>Type of Material</p> <p>Guidance Document/ Handbook</p>	<p>Relevance</p> <p>This document is meant for the use of any centre or organization that might consider becoming a WMO Regional Climate Centre.</p>

Part III

Factsheets

Guide to Climatological Practices

Go to Document

Organization(s)	Reference	Type of Material
WMO	WMO No. 100	Guidance Document/Handbook
Year of Publication	Language	General Audiences
2011	English	Decision Makers; Technical Staff/Practitioners

Value of Learning Resource

This guide provides, in a convenient form for all concerned with the practice of climatology, information about those practices and procedures that are of the greatest importance for the successful implementation of their work. It describes basic principles and modern practices important in the development and implementation of all climate services, and outlines methods of best practice in climatology. It is intended to describe concepts and considerations, and provides references to other technical guidance and information sources, rather than attempting to be all-inclusive in the guidance presented.



Structure and Content

- Chapter 1 States the purpose and the scope of this guide. The publication is primarily designed to provide guidance and assistance to World Meteorological Organization (WMO) members in developing national activities to promote climate information and services. This first chapter includes information on climatology and its scope, the organization and functions of a national climate service, and international climate programmes;
- Chapter 2 This chapter on observations follows the sequence of specifying the elements needed to describe the climate and the stations at which these elements are measured, instrumentation, siting of stations, network design and network operations;
- Chapter 3 Looks at the importance, purpose and practices of managing data;
- Chapter 4 Concentrates on descriptive statistics, the tool used to reduce to a comprehensible form the properties of an otherwise large amount of data;
- Chapter 5 Concentrates on statistical methods and should be used in conjunction with chapter 4. Both chapters are intended to describe basic concepts rather than to provide detailed specifics of complex subjects;
- Chapter 6 Describes the dissemination of climate information to the public or a specific user. This involves strong partnerships among NMHSs and stakeholders, including government agencies, private interests and academia, for the purpose of interpreting and applying past climate information for decision-making, for sustainable development, and for the improvement of climate information products, predictions and outlooks.

Introduction to Climate Change: Lecture Notes for Meteorologists

[Go to Document](#)

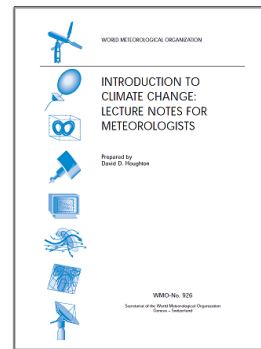
Organization(s)	Reference	Type of Material
WMO	WMO-No. 926	Analytical/Technical Document
Year of Publication	Language	General Audiences
2002	English	Decision Makers; Technical Staff/Practitioners; General Public

Value of Learning Resource

These lecture notes are intended to enhance familiarity with the broad scope of topics related to climate change. They provide material on the science of climate change assuming that the users already have a basic understanding of atmospheric processes, the hydrological cycle, and cloud physics along with some understanding of air chemistry, hydrology, and oceanography.

Structure and Content

- Chapter 1 Reviews the characteristics and physical processes of the climate system;
- Chapter 2 Discusses climate variability from natural causes;
- Chapter 3 Discusses climate variability from human activity;
- Chapter 4 Describes numerical climate models;
- Chapter 5 Focuses on climate predictability;
- Chapter 6 Presents important requirements for observations needed to identify and understand climate change;
- Chapter 7 Describes progress in the isolation and analysis of recent climate change;
- Chapter 8 Gives examples of climate change impacts.



Bridging the Emissions Gap

[Go to Document](#)

Organization(s)

UNEP

Language

English

Type of Material

Analytical/Technical Document

Year of Publication

2011

General Audiences

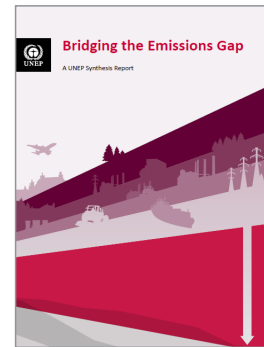
Decision Makers; Technical Staff/Practitioners

Value of Learning Resource

This report examines the gap between pledged greenhouse gas emissions and the reductions needed to limit temperature increase and climate change. It answers the questions 1) Is it possible to bridge the emissions gap by 2020?, 2) What is the emissions gap in 2020?, and 3) How can the gap be bridged?

Structure and Content

- Chapter 1 Reviews and summarizes the latest studies of the gap;
- Chapter 2 Provides updated emissions, scenarios consistent with temperature targets, national emission reduction pledges, and the estimated gap;
- Chapter 3 Presents results from global mitigation scenarios, and options and emission reduction potentials by sector;
- Chapter 4 Describes international baseline emissions and projections; targets, goals, measures, and abatement potential; and policies.



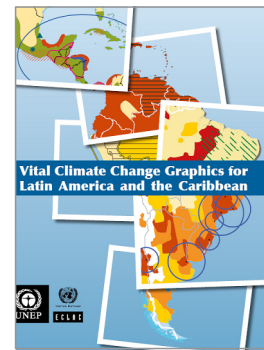
Vital Climate Change Graphics for Latin America and the Caribbean

[Go to Document](#)

Organization(s)	Year of Publication	Type of Material
UNEP, ECLAC, UNEP/GRID- Arendal	2010	Analytical/Technical Document
	Language	General Audiences
	English, Spanish	Decision Makers; Technical Staff/Practitioners; General Public

Value of Learning Resource

The document describes the ways in which climate change manifests itself, drawing on historical analysis of variables such as temperature, precipitation and sea levels. In addition, it details the effects of climate change on ecosystem services, human health and the region's vulnerability to extreme events. Lastly, it provides an analysis of global and regional greenhouse gas emissions and identifies possible options in the region for mitigating the impact of climate change.



Structure and Content

- Chapter 1 Manifestations of Climate Change: presents time series evidence of changes in temperature, precipitation, sea level, ice cover, and hydrometeorological events;
- Chapter 2 Effects of Climate Change: describes the effects of climate change on agriculture, health, water resources, urban infrastructure, tourism, biodiversity, and other sectors;
- Chapter 3 Emissions and Mitigation Processes: focuses on mitigation and adaptation strategies primarily in the energy and forestry sectors.

The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change

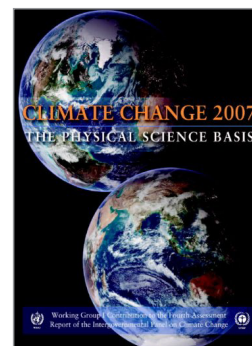
[Go to Document](#)

[Go to New 5th Assessment Report](#)

Organization(s)	Language	Type of Material
IPCC	English, French,	Analytical/Technical Document
Year of Publication	Spanish, Russian,	General Audiences
2007	Chinese, Arabic	Decision Makers; Technical Staff/Practitioners; General Public

Value of Learning Resource

The document describes progress in understanding of the human and natural drivers of climate change, observed climate change, climate processes and attribution, and estimates of projected future climate change. It builds upon past IPCC assessments and incorporates new findings from the past six years of research. Scientific progress since the Third Assessment Report (TAR) is based upon large amounts of new and more comprehensive data, more sophisticated analyses of data, improvements in understanding of processes and their simulation in models and more extensive exploration of uncertainty ranges.



Structure and Content

- Chapter 1 Historical Overview of Climate Change Science: starts by describing the fundamental nature of earth science. It then describes the history of climate change science using a wide-ranging subset of examples, and ends with a history of the IPCC;
- Chapter 2 Changes in Atmospheric Constituents and Radiative Forcing: concerns trends in forcing agents and their precursors since 1750, and estimates their contribution to the radiative forcing (RF) of the climate system. The chapter assesses anthropogenic greenhouse gas changes, aerosol changes and their impact on clouds, aviation-induced contrails and cirrus changes, surface albedo changes and natural solar and volcanic mechanisms;
- Chapter 3 Observations: Atmospheric Surface and Climate Change: assesses the observed changes in surface and atmospheric climate;
- Chapter 4 Observations: Changes in Snow, Ice and Frozen Ground: concerns the main components of the cryosphere (snow, river and lake ice, sea ice, glaciers and ice caps, ice shelves, ice sheets, and frozen ground) and its relevance to climate variability and change;
- Chapter 5 Observations: Ocean Climate Change and Sea Level: focuses on observed changes in the global ocean basins, provides updated estimates of temperature changes for the oceans, and discusses new evidence for changes in the ocean freshwater budget and the ocean circulation;
- Chapter 6 Palaeoclimate: assesses palaeoclimatic data and knowledge of how the climate system changes over interannual to millennial time scales, and how well these variations can be simulated with climate models;
- Chapter 7 Coupling Between Changes in the Climate System and Biogeochemistry: identifies the major biogeochemical feedbacks of significance to the climate system, and to assesses current knowledge of their magnitudes and trends;
- Chapter 8 Climate Models and their Evaluation: evaluates the capabilities and limitations of the global climate models used elsewhere in the report. A number of model evaluation activities are described in various chapters of this report. This section provides a context for those studies and a guide to direct the reader to the appropriate chapters;

- Chapter 9 Understanding and Attributing Climate Change: assesses scientific understanding about the extent to which the observed climate changes that are reported in chapters 3 to 6 are expressions of natural internal climate variability and/or externally forced climate change;
- Chapter 10 Global Climate Projections: assesses future global and large-scale climate change projected from models;
- Chapter 11 Regional Climate Projections: assesses future regional climate change projected from models.

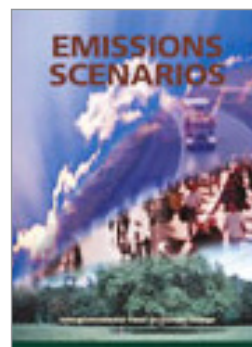
Emissions Scenarios

[Go to Document](#)

Organization(s)	Language	Type of Material
IPCC	English, French,	Analytical/Technical Document
Year of Publication	Spanish, Russian,	General Audiences
2000	Chinese, Arabic	Decision Makers; Technical Staff/Practitioners; General Public

Value of Learning Resource

The long-term nature and uncertainty of climate change and its driving forces require scenarios that extend to the end of the 21st century. This report describes the new scenarios and how they were developed. The scenarios cover a wide range of the main driving forces of future emissions, from demographic to technological and economic developments. The set of emissions scenarios is based on an extensive assessment of the literature, six alternative modelling approaches, and an “open process” that solicited wide participation and feedback from many groups and individuals. The scenarios include the range of emissions of all relevant species of greenhouse gases (GHGs) and sulfur, and their driving forces.



Structure and Content

- Chapter 1 Background and Overview: provides an overview of the process and scenarios;
- Chapter 2 An Overview of the Scenario Literature: presents the assessment of more than 400 global and regional greenhouse gas (GHG) emissions scenarios based on an extensive literature review;
- Chapter 3 Scenario Driving Forces: some of the major driving forces of past and future anthropogenic greenhouse gas (GHG) emissions, which include demographics, economics, resources, technology, and (non-climate) policies, are reviewed in this chapter;
- Chapter 4 An Overview of Scenarios: the main characteristics of the scenarios are presented;
- Chapter 5 Emission Scenarios: emission estimates for radiatively important gases generated in 40 scenarios are presented;
- Chapter 6 Summary Discussions and Recommendations: provides a summary of the emissions scenarios and compares them with the previous set of Intergovernmental Panel on Climate Change (IPCC) scenarios and the underlying literature.

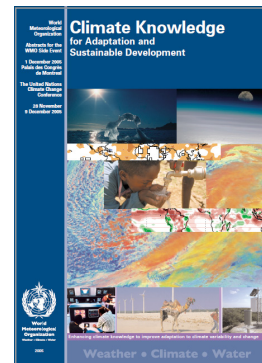
Climate Knowledge for Adaptation and Sustainable Development

Go to Document

Organization(s)	Reference	Type of Material
WMO	WMO No. 994	Guidance Document/Handbook
Year of Publication	Language	General Audiences
2005	English	Decision Makers; Technical Staff/Practitioners

Value of Learning Resource

The aim of this document is to contribute to the emerging debate on adaptation to climate variability and change and sustainable development. Specifically, the brochure provides information on the activities carried out by WMO, NMHSs and partners to mainstream climate knowledge into adaptation and sustainable development decision-making. It also contributes to ongoing efforts to foster a common, coordinated response by the United Nations system to climate variability and change.



Structure and Content

- 1 Introduction: provides the rationale for the document;
- 2 WMO, NMHSs and the United Nations Climate Change Conference: fosters global cooperation in providing an authoritative international scientific voice on climate variability and change, and assists societies in the application of climate information and knowledge to national sustainable development;
- 3 Integrated Observing System: describes the observing systems needed to monitor the climate;
- 4 Climate Data and Monitoring: describes the sustained development of comprehensive, dedicated global observing and data management;
- 5 Climate Research, Modelling and Prediction: discusses a multidisciplinary approach to organizing research, modelling and prediction activities;
- 6 Climate Knowledge for Adaptation and Sustainable Development: discusses the use and application of climate knowledge and services to maintain public safety, health and welfare, to alleviate poverty and to promote sustainable development;
- 7 Capacity Building: discusses the need for global partnerships;
- 8 Climate Applications, Information and Prediction Services for Decision-making: discusses the use of climate information for decision making;
- 9 Future Development/Strategies: recognizes the need to promote climate awareness, especially for decision makers.

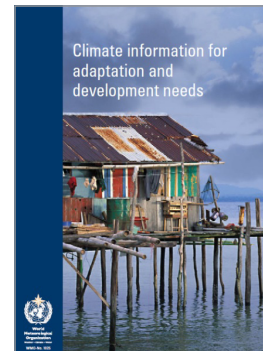
Climate Information for Adaptation and Development Needs

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Organization(s)	Reference	Type of Material
WMO	WMO No. 1025	Other
Year of Publication	Language	General Audiences
2007	English, French	Decision Makers; Technical Staff/Practitioners; General Public

Value of Learning Resource

This document describes WMO programs and specifically the Nairobi Work Program to adapt to climate change and variability. It provides updated information on how climate science and services can enhance adaptation to climate variability and change, especially for development needs. Highlighted are a few examples from the experience of National Meteorological and Hydrological Services and collaborating organizations, to give an idea of real-life experience in utilizing climate knowledge to formulate and implement appropriate adaptive policies and strategies.



Structure and Content

- 1 Introduction: provides an overview of the need to adapt to climate change;
- 2 The Roles of the World Meteorological Organization and the National Meteorological and Hydrological Services: describes the historical roles and the need for these roles;
- 3 World Meteorological Organization Programmes and the Nairobi Work Programme: describes and discussed specific activities of the Nairobi Work Programme;
- 4 Future Development and Strategies: recognizes the need for continuing regional and national capacity building.

Guidelines on Analysis of Extremes in a Changing Climate in Support of Informed Decisions for Adaptation

[Go to Document](#)

Organization(s)	Reference	Type of Material
WMO	WMO-TD No. 1500	Guidance Document/Handbook
Year of Publication	Language	General Audiences
2009	English	Technical Staff/Practitioners

Value of Learning Resource

The demand for information services on weather and climate extremes is growing. The sustainability of economic development and living conditions depends on our ability to manage the risks associated with extreme events, in particular the infrastructures we depend upon for food and water. The overall question addressed in these guidelines document is how we should account for a changing climate when assessing and estimating extremes. Pertinent points include how to incorporate in the analysis the observed changes in extremes in the past; and determining the best way to deal with available future climate model projections. Energy, shelter and transportation are sensitive to high or low values of meteorological variables.



Structure and Content

- Chapter 1 Introduction: details the objective and scope;
- Chapter 2 Data Preparation: describes data preparation and quality control;
- Chapter 3 Analysing Extremes: explains the basic concept of extremes indices and the traditional approach of statistical modelling of extremes;
- Chapter 4 Assessing Changes in Extremes: describes methods to assess changes in extremes;
- Chapter 5 Future Extremes: provides an overview of reported changes in observations and climate model projections;
- Chapter 6 Measures to Further Improve our Understanding: highlights data rescue, and climate change detection and attribution;
- Chapter 7 Wider Societal Benefits: societal benefits of extremes analysis are presented.

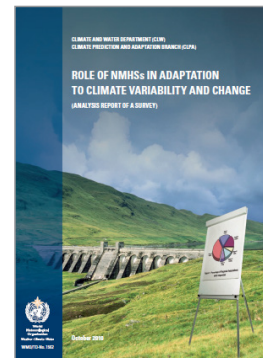
Role of NMHSs in Adaptation to Climate Variability and Change

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Organization(s)	Reference	Type of Material
WMO	WMO-TD No. 1562	Guidance Document/Handbook
Year of Publication	Language	General Audiences
2010	English	Decision Makers; Technical Staff/Practitioners

Value of Learning Resource

In order to assess the current and potential future role of NMHSs in facilitating adaptation to climate variability and change in their respective countries, WMO Secretariat conducted an on-line survey on the “Role of NMHSs in Adaptation to Climate Variability and Change”, to gather information on ways that NMHSs are contributing to the national climate change response both directly and indirectly, as well as potential gaps that NMHSs could fill if appropriate resources and planning are provided. The analysis and findings of the Survey are elaborated in this report.



Structure and Content

- 1 Introduction: provides the rationale for the survey;
- 2 The 2008 Survey: describes the survey and analyzes the responses;
- 3 Policy Role of NMHSs: discusses the preparation of documents for policy makers;
- 4 Role of NMHSs in Adaptation: discusses organizational issues, roles in national adaptation strategies, provision of sector specific services, and contributions to technical areas;
- 5 End User Feedback: discusses the degree of feedback mechanisms;
- 6 Gaps and Needs: discusses the factors limiting contributions of NMHSs, resource limitations, and the need for global and region coordination;
- 7 Linking the Survey to Subsequent Development-GFCS and EX-LXI: discusses the role and programs of the WMO and the coordination between NMHSs and the WMO.

Climate Knowledge for Action: A Global Framework for Climate Services - Empowering the Most Vulnerable

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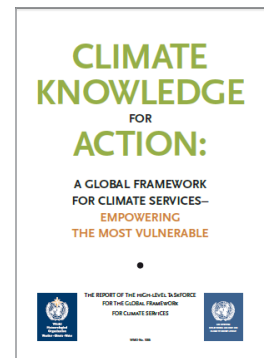
Organization(s)	Reference	Type of Material
WMO	WMO No. 1065	Guidance Document/Handbook
Year of Publication	Language	General Audiences
2011	English, French, Spanish, Russian, Chinese, Arabic	Decision Makers; Technical Staff/Practitioners

Value of Learning Resource

This High Level Taskforce proposal presents an important, cost effective opportunity to improve well being in all countries through contributions to development, disaster risk reduction and climate change adaptation. The plan advocates multinational, global collaboration to provide climate services and information. It describes components of a global framework; national, regional and global roles and responsibilities; implementation objectives and principles.

Structure and Content

- 1 Current Capabilities of Climate Services: describes the main categories of users of climate services and the ways they use and benefit from climate information, observing systems and data exchange, research supporting climate services, and capacity building;
- 2 Needs and Opportunities for Climate Services: describes experiences of climate sensitive sectors, the needs of international policy, and experiences at the national level;
- 3 Establishing the Global Framework for Climate Services: describes gaps and opportunities, an implementation plan, and governance arrangements.



WCRP Workshop on Seasonal to Multi-Decadal Predictability of Polar Climate (WCRP Informal report 2/2011)

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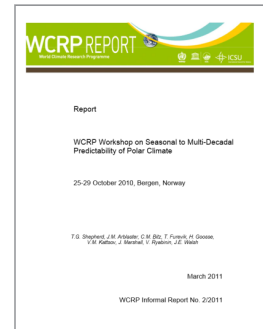
Organization(s)	Reference	Type of Material
WMO	WMO No. 1065	Analytical/Technical Document
Year of Publication	Language	General Audiences
2011	English	Decision Makers; Technical Staff/Practitioners; General Public

Value of Learning Resource

Over the last few decades, the polar regions have exhibited some of the most striking changes in the observed climate record. The observed and predicted changes in polar regions have significant implications to climate. This report summarizes the current state of knowledge and identifies concrete steps to improve our predictive capability in polar regions.

Structure and Content

- 1 Background and Purpose of the Workshop: describes the scientific motivation for the workshop;
- 2 Report on Scientific Sessions: describes the research of the participants;
- 3 Synthesis: summarizes the predictability of the polar regions;
- 4 Next Steps: identifies gaps in international cooperation.



How to Establish and Run a Regional Climate Centre

Go to Document

Organization(s)	Reference	Type of Material
WMO	WMO-TD No. 1534	Guidance Document/Handbook
Year of Publication	Language	General Audiences
2011	English, French	Technical Staff/Practitioners

Value of Learning Resource

This document is meant for the use of any centre or organization that might consider becoming a WMO Regional Climate Centre. It contains brief general information about the concept, scope and organization of a Regional Climate Centre and detailed information about mandatory functions.

Structure and Content

- 1 General Information: briefly describes Regional Climate Centres;
- 2 Definitions: defines a Centre, network and node;
- 3 Mandatory Functions: lists operational activities for long range forecasting, climate monitoring, data services and training.



Role of NMHSs in Mainstreaming Climate Services for Adaptation and Sustainable Development

[Go to Document](#)

Organization(s)	Reference	Type of Material
WMO	CCA-7	Guidance Document/Handbook
Year of Publication	Language	General Audiences
2011	English	Technical Staff/Practitioners

Value of Learning Resource

This paper provides guidance to senior managers from National Meteorological and Hydrological Services (NMHSs) on the role of NMHSs for climate services for adaptation and sustainable development.

Structure and Content

- 1 Introduction: briefly describes the purpose of the paper;
- 2 Global Framework for Climate Services: describes the concept and components of the framework;
- 3 Climate Change Adaptation: describes NMHS responsibilities;
- 4 Capacity Building in Developing Countries: outlines needs to build capacity;
- 5 Technology: outlines WMO technology programs;
- 6 Public Awareness Raising: discusses information dissemination;
- 7 Conclusions and Recommendations: summarizes the guidance.



Guidelines for Use of Climate Scenarios Developed from Statistical Downscaling Methods

[Go to Document](#)

Organization(s)	Reference	Type of Material
IPCC	CCA-7	Guidance Document/Handbook
Year of Publication	Language	General Audiences
2004	English	Technical Staff/Practitioners

Value of Learning Resource

This paper provides guidance to impact analysts on the use of climate scenarios. It reviews methods of regional modelling, discusses uncertainties, and presents guidelines for using models.

Structure and Content

- 1 Introduction: describes statistical downscaling and the structure of the article;
- 2 Review of Methods of Statistical Downscaling: outlines the main techniques;
- 3 Guidelines: assists in deciding whether the time and resources of statistical downscaling justify the added value of the information;
- 4 Case Study: an example of the use of statistical downscaling;
- 5 Summary Recommendations: provides the essence of the guidance in list format.



ANNEX 1

Selected Non UN Written Resources and Training Courses

Learning Topic 1

Climate Prediction and Climate Change Projection

Prediction or Projection: The Nomenclature of Climate Science

Academia.edu, 2009

Both terms, prediction and projections, are common in conventional scientific discourse as well as in common speech. They are subject to different interpretations and connotations. Thus, the use, if not explicitly specified, has the potential to cause problems not only in the communication of climate science in the broader scientific realm and in the understanding of the public at large, but also for policy decisions, policy design, and policy implementation and for public perceptions of climate change. This academic article examines the use of both terms.

http://www.academia.edu/1812111/Prediction_or_projection_The_nomenclature_of_climate_science

Climate Change: Fitting the Pieces Together

COMET Program, University Corporation for Atmospheric Research (UCAR) and National Oceanic and Atmospheric Administration – National Weather Service (NOAA NWS), United States, 2012

This module discusses climate change, particularly as it is currently being affected by increasing concentrations of greenhouse gases emitted by human activities. It also covers signs of climate change, how scientists study climate, the current thinking on future changes, and what can be done to minimize the effects. It is intended for anyone interested in learning about climatology. The third section discusses climate model predictions and projections. Some familiarity with basic meteorology is useful although not required. The material is available both in English and Spanish as a print version and as an audio/visual online web-based interactive format; registration is required.

https://www.meted.ucar.edu/training_module.php?id=522

Introduction to Climate Models

COMET Program, University Corporation for Atmospheric Research (UCAR) and National Oceanic and Atmospheric Administration – National Weather Service (NOAA NWS), United States, 2012

This module discusses atmospheric predictability on both long and short time scales and a variety of spatial scales. It explains similarities and differences between climate and weather models, describes how models are tested and evaluated, and lists model strengths and weaknesses. The module is intended for anyone interested in learning about climatology. The second section discusses the difference between prediction and projection. Some familiarity with basic meteorology is useful although not required. The material is available as a print version and as an audio/visual online web-based interactive format; registration is required.

https://www.meted.ucar.edu/training_module.php?id=913

Learning Topic 2

Climate Change Modelling

Climate Change: Fitting the Pieces Together

COMET Program, University Corporation for Atmospheric Research (UCAR) and National Oceanic and Atmospheric Administration – National Weather Service (NOAA NWS), United States, 2012

This module discusses climate change, particularly as it is currently being affected by increasing concentrations of greenhouse gases emitted by human activities. It also covers signs of climate change, how scientists study climate, the current thinking on future changes, and what can be done to minimize the effects. It is intended for anyone interested in learning about climatology. The third section describes climate models. Included are descriptions of different kinds of models, model uncertainties, and downscaling. Some familiarity with basic meteorology is useful although not required. The material is available both in English and Spanish as a print version and as an audio/visual online web-based interactive format; registration is required.

https://www.meted.ucar.edu/training_module.php?id=522

Introduction to Climate Models

COMET Program, University Corporation for Atmospheric Research (UCAR) and National Oceanic and Atmospheric Administration – National Weather Service (NOAA NWS), United States, 2012

This module discusses atmospheric predictability on both long and short time scales and a variety of spatial scales. It explains similarities and differences between climate and weather models, describes how models are evaluated, and lists model strengths and weaknesses. Included are discussions about building, tuning, and testing models, as well as future directions in modelling. The module is intended for anyone interested in learning about climatology. Some familiarity with basic meteorology is useful although not required. The material is available as a print version and as an audio/visual online web-based interactive format; registration is required.

https://www.meted.ucar.edu/training_module.php?id=913

Climate Change and Regional Impacts

COMET Program, University Corporation for Atmospheric Research (UCAR) and National Oceanic and Atmospheric Administration – National Weather Service (NOAA NWS), United States, 2012

This short module is an overview of the different effects climate change produces in different regions of the United States. In addition to discussing impacts already being experienced, the module presents information on how climate scientists use specialized models and statistical techniques to estimate how regional climates are likely to change in the future. The module is intended for anyone interested in learning about climatology. Some familiarity with basic meteorology is useful although not required. The material is available both in English and Spanish as a print version and as an audio/visual online web-based interactive format; registration is required.

https://www.meted.ucar.edu/training_module.php?id=972

About UN CC:Learn

UN CC:Learn is a partnership of 33 multilateral organizations which supports Member States in designing and implementing results-oriented and sustainable learning to address climate change. The Secretariat for UN CC:Learn is provided by the UN Institute for Training and Research (UNITAR). One of the objectives of UN CC:Learn is to facilitate access to existing climate change learning materials and to support the development of complementary learning resources, as appropriate. The publication of Advanced Learning Packages on Priority Topics of Climate Change (ALPs) contributes to this objective. ALPs are compiled for selected topics of climate change that have been identified as important topics from a country perspective. Core funding for the 2011-2013 implementation phase of UN CC:Learn is provided by the Swiss Government. For further information please contact: uncclearn@unitar.org

www.uncclearn.org

Funding for the 2011-2013 UN CC:Learn pilot implementation phase is provided by the Government of Switzerland.



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and Cooperation SDC

