UN CC:Learn
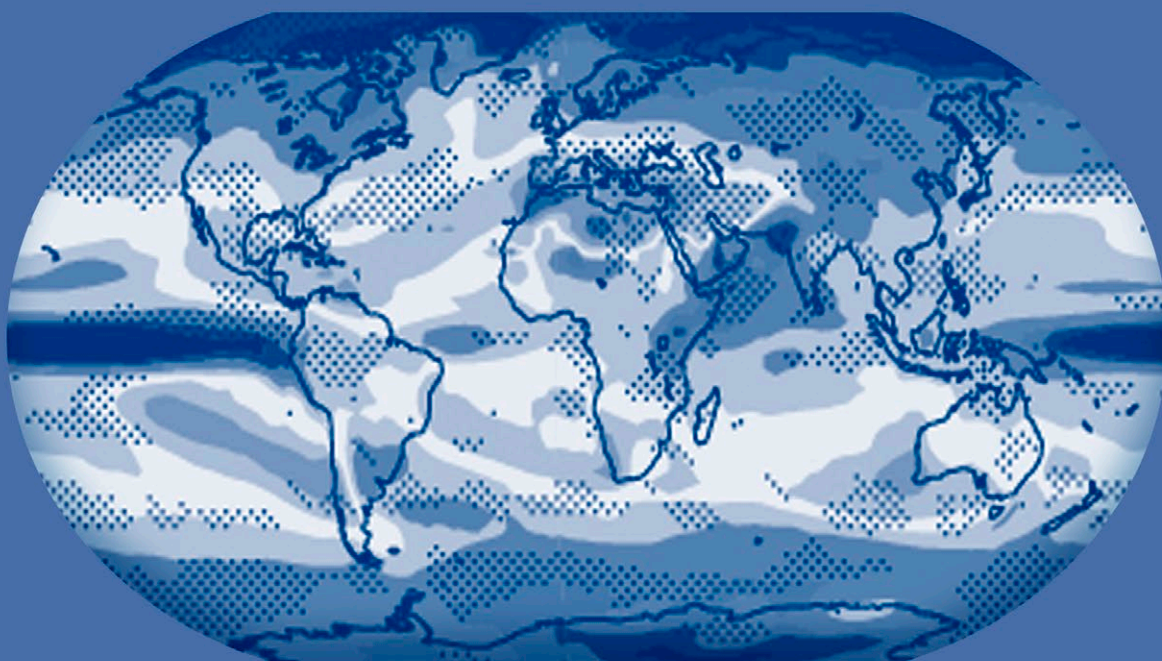
The One UN Climate Change Learning Partnership

Resource Guide for Advanced Learning on

PREDICTING AND PROJECTING CLIMATE CHANGE

Part I
Introduction

1.1 About the Series of Resource Guides for Advanced Learning

This Guide is part of a series developed through UN CC:Learn[1] 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 who perhaps understands the basics of a topic but is seeking to obtain a more advanced understanding by gaining quick access to the most relevant learning materials. The Guides cover selected climate change topics that have been identified as a priority from a country perspective.

The learning resources presented in this Guide are drawn primarily from within the UN and partners to UN CC:Learn. Learning resources published by other recognized international and other organizations are provided in the Annex. 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 Guides for Advanced Learning

This Resource Guide for Advanced Learning is organised 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, organised by learning topic. For each selected learning resource a hyperlink is provided through to Part III of the 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 for Advanced Learning

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

• Decision-makers in the public and economics sector responsible for developing and implementing policies, programmes or projects;
• 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.

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1   UN CC:Learn is a partnership of more than 30 multilateral organizations supporting countries to design and implement systematic, recurrent and results-oriented climate change learning. UN CC:Learn Partners to date include: CEB, EMG, FAO, GEF, IDB, IFAD, ILO, IMO, ITU, OCHA, UNAIDS, UNDP, UNECA, UNEP, UNESCAP, UNESCO, UNESCWA, UNFCCC, UNFPA, UNHABITAT, UNICEF, UNIDO, UNISDR, UNITAR, UNSSC, UNU, UN WOMEN, UNWTO, UPU, WFP, WHO, WMO, WTO, World Bank.

1.4 Introduction to Predicting and Projecting Climate Change

Policymakers, 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 this Resource Guide for Advanced Learning

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 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 science[2];
- 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.

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.

Go to Resources

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

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 policymaking. 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 modelling. 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.

Go to Resources

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 Hydrometeorological 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.

Go to Resources

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 Hydrometeorolgical Services (NMHSs). A WMO designated Regional Climate Center (RCC) is a multifunctional centre that fulfils 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.

Go to Resources

Learning Topic 1
Climate Prediction and Climate Change Projection
Written Resources

1
written
resources

Introduction to Climate Change: Lecture Notes for Meteorologists WMO No. 926
Go to Factsheet

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 WMO No. 100
Go to Factsheet

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 Coupled Model Intercomparison Project - Phase 5. Special issue of WCRP CLIVAR Newsletter
Go to Factsheet

General Audience(s)
Technical Staff/Practitioners
Type of Material
Other

Relevance
This document provides a "one-stop shop" through short overview articles, for information on key components of the multi-model experimental framework CMIP5. In particular, the 4th article focuses on CMIP5 near-term climate prediction. The 12th article focuses on climate projections.

Learning Topic 2
Climate Change Modelling
Written Resources

Introduction to Climate Change: Lecture Notes for Meteorologists WMO No. 926

`Go to Factsheet`

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 WMO No. 100

`Go to Factsheet`

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 Fifth 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. Climate models are discussed across the entire documents, but, in particular, chapter 1.5 informs on advances in measurement and modelling capabilities and chapter 9 focuses on the evaluation of climate models. Results of these models are discussed in chapters 10 to 14.

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.

Towards New Scenarios for Analysis of Emissions, Climate Change, Impacts and Response Strategies

Go to Factsheet

General Audience(s)
Technical Staff/Practitioners
Type of Material
Analytical/Technical Document

Relevance
This document presents and reviews options for the development of benchmark emission scenarios to initiate climate model simulations for developing climate scenarios for use in a broad range of climate-change related research and assessment.

Seamless Prediction of the Earth System from Minutes to Months WMO No. 1156

Go to Factsheet

General Audience(s)
Technical Staff/Practitioners
Type of Material
Analytical/Technical Document

Relevance
This document highlights the latest advances in weather science and in the science and practice of weather prediction, including prediction models.

Guidelines on Analysis of Extremes in a Changing Climate in Support of Informed Decisions for Adaptation WMO-TD No. 1500

Go to Factsheet

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.

Evaluating and Improving Regional Climate Projections

Go to Factsheet

General Audience(s)
Technical Staff/Practitioners
Type of Material
Analytical/Technical Document

Relevance
The document discusses key points for the evaluation and improvement of regional downscaling models and methods to improve climate projections at the regional level.

Learning Topic 3
National Systems for Climate Monitoring and Predictions
Written Resources

3 written resources

Introduction to Climate Change: Lecture Notes for Meteorologists WMO No. 926

`Go to Factsheet`

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 WMO No. 100

`Go to Factsheet`

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 WMO No. 1025

`Go to Factsheet`

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 WMO No. 994

`Go to Factsheet`

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 WMO-TD No. 1562

`Go to Factsheet`

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 WMO No. 1065

`Go to Factsheet`

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 multinational, global collaboration to provide climate services and information.

Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation

`Go to Factsheet`

General Audience(s)
Decision Makers; Technical Staff/
Practitioners; General Public

Type of Material
Analytical/Technical Document

Relevance
The report focuses on the relationship between climate change and extreme weather and climate events, the impacts of such events, and the strategies to manage the associated risks. In particular, chapter 6 assesses how countries are managing current and projected disaster risks, focusing on the design of national systems for managing such risks, the roles played by actors involved in the system, and the functions they perform.

Guidelines on Analysis of Extremes in a Changing Climate in Support of Informed Decisions for Adaptation WMO-TD No. 1500

`Go to Factsheet`

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.

Climate Exchange

`Go to Factsheet`

General Audience(s)
Decision Makers; Technical Staff/
Practitioners

Type of Material
Analytical/Technical Document

Relevance
This publication provides a wealth of information on developments in the provision of climate services by WMO Members. It is an example of how the GFCS can build upon the existing efforts to advance improvements in the provision of needs based climate services.

Agriculture and Food Security
Exemplar to the User Interface Platform of the Global Framework for Climate Services

`Go to Factsheet`

General Audience(s)
Decision Makers; Technical Staff/
Practitioners

Type of Material
Other

Relevance
This document discusses incorporation of climate information into agricultural development through informed decision-making, as part of the implementation of the GFCS.

Learning Topic 4
Regional and Global Climate Support Services
Written Resources

▶ ### Introduction to Climate Change: Lecture Notes for Meteorologists WMO No. 926
`Go to Factsheet`

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 WMO No. 100
`Go to Factsheet`

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.

▶ ### Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation
`Go to Factsheet`

General Audience(s)
Decision Makers; Technical Staff/
Practitioners; General Public

Type of Material
Analytical/Technical Document

Relevance
The report focuses on the relationship between climate change and extreme weather and climate events, the impacts of such events, and the strategies to manage the associated risks. Chapter 7 assesses experience and theory in adaptation to extremes and disasters, focusing on issues and opportunities at the international scale.

▶ ### Role of NMHSs in Adaptation to Climate Variability and Change WMO-TD No. 1562
`Go to Factsheet`

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 WMO No. 1025
`Go to Factsheet`

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 WMO No. 994

Go to Factsheet

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.

Climate Knowledge for Action: A Global Framework for Climate Services - Empowering the Most Vulnerable WMO No. 1065

Go to Factsheet

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 multinational, global collaboration to provide climate services and information.

How to Establish and Run a Regional Climate Centre WMO-TD No. 1534

Go to Factsheet

General Audience(s)

Technical Staff/Practitioners

Type of Material

Guidance Document/Handbook

Relevance

This document is meant for the use of any centre or organization that might consider becoming a WMO Regional Climate Centre.

Valuing Weather and Climate: Economic Assessment of Meteorological and Hydrological Services WMO No. 1153

Go to Factsheet

General Audience(s)

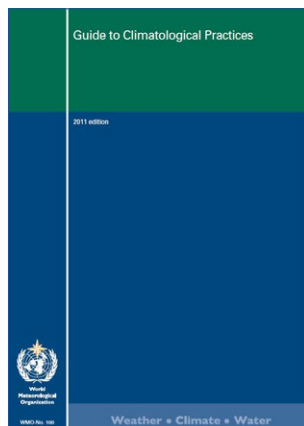Decision Makers; Technical Staff/
Practitioners

Type of Material

Guidance Document/Handbook

Relevance

This publication aims to highlights and enhance the social and economic benefits that NMHSs deliver daily to society and to help mobilize and optimize financing to ensure NMHSs can increase the effectiveness of their work.

Part III
Factsheets

▶ ## Guide to Climatological Practices WMO No. 100

Organization(s)
WMO

Language(s)
English, French, Spanish, Russian, Arabic, Chinese

General Audience(s)
Decision Makers, Technical Staff/Practitioners

Year of Publication
2011

Type of Material
Guidance Document/Handbook

Go to Document

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 WMO No. 926
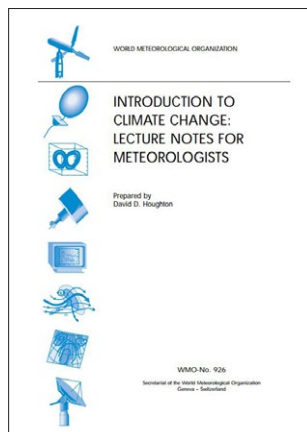
Organization(s)
WMO

Language(s)
English

General Audience(s)
Decision Makers; Technical Staff/Practitioners; General Public

Year of Publication
2002

Type of Material
Analytical/Technical Document
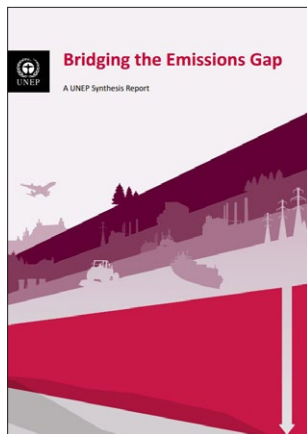
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Value of Learning Resource

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

Organization(s)
UNEP

Language(s)
English, French, Spanish, Chinese

General Audience(s)
Decision Makers; Technical Staff/Practitioners

Year of Publication
2011

Type of Material
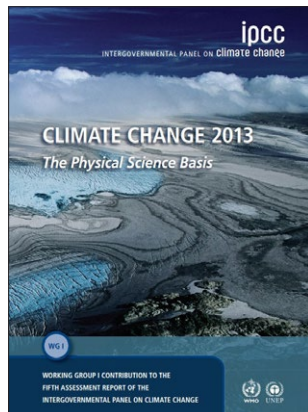Analytical/Technical Document

Go to Document

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.

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

Organization(s)
IPCC

Language(s)
Arabic, Chinese, English, French, Spanish, Russian

General Audience(s)
Decision Makers; Technical Staff/Practitioners; General Public

Year of Publication
2013

Type of Material
Analytical/Technical Document

Go to Document

Value of Learning Resource

The document provides a comprehensive and robust assessment of the physical science basis of climate change. It builds upon the Working Group I contribution to the IPCC's Fourth Assessment Report in 2007 and incorporates subsequent new findings from the "Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation", as well as from research published in the extensive scientific and technical literature. The assessment considers new evidence of past, present and projected future climate change based on many independent scientific analyses from observations of the climate system, paleoclimate archives, theoretical studies of climate processes and simulations using climate models.

Structure and Content

- **Chapter 1**
  Introduction: focuses on concepts and definitions, examines several of the key indicators for a changing climate and shows how the current knowledge of those indicators compares with the projections made in previous assessments.
- **Chapter 2**
  Observations: Atmosphere and Surface: assesses the scientific literature on atmospheric and surface observations and identifies the most likely changes in physical climate variables or climate forcing agents.
- **Chapter 3**
  Observations: Ocean: summarizes the observational evidence of change in the ocean, with an emphasis on basin- and global-scale changes relevant to climate.
- **Chapter 4**
  Observations: Cryosphere: describes the current state of the cryosphere and its individual components, with a focus on recent improvements in understanding of the observed variability, changes and trends.
- **Chapter 5**
  Information from Paleoclimate Archives: assesses the information on past climate obtained prior to the instrumental period, using data from various paleoclimatic archives and modelling of past climate.

- **Chapter 6**

  Carbon and Other Biogeochemical Cycles: summarizes the scientific understanding of atmospheric budgets, variability and trends of the three major biogeochemical greenhouse gases, CO_2, CH_4 and N_2O, their underlying source and sink processes and their perturbations caused by direct human impacts, past and present climate changes as well as future projections of climate change.

- **Chapter 7**

  Clouds and Aerosols: considers observations, theory and models to assess how clouds and aerosols contribute and respond to climate change.

- **Chapter 8**

  Anthropogenic and Natural Radiative Forcing: discusses radiative forcing from natural and anthropogenic components during the industrial period, presenting values for 2011 relative to 1750, and projected values through 2100.

- **Chapter 9**

  Evaluation of Climate Models: focuses on the climate models used in the report.

- **Chapter 10**

  Detection and Attribution of Climate Change: from Global to Regional: assesses the causes of the observed changes and uses understanding of physical processes, climate models and statistical approaches.

- **Chapter 11**

  Near-term Climate Change: Projections and Predictability: assesses the scientific literature describing expectations for near-term climate (present through mid-century) as well as atmospheric composition and air quality projections through to 2100.

- **Chapter 12**

  Long-term Climate Change: Projections, Commitments and Irreversibility: assesses long-term projections of climate change for the end of the 21st century and beyond.

- **Chapter 13**

  Sea Level Change: considers changes in global mean sea level, regional sea level, sea level extremes, and waves.

- **Chapter 14**

  Climate Phenomena and their Relevance for Future Regional Climate Change: assesses the scientific literature on projected changes in major climate phenomena and more specifically their relevance for future change in regional climates, contingent on global mean temperatures continue to rise.
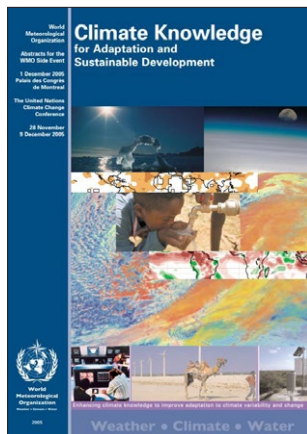
Climate Knowledge for Adaptation and Sustainable Development WMO No. 994

Organization(s)
WMO

Language(s)
English

General Audience(s)
Decision Makers; Technical Staff/Practitioners

Year of Publication
2005

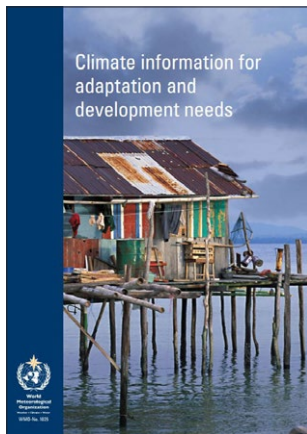**Type of Material**
Guidance Document/Handbook

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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

- **Introduction**
  Provides the rationale for the document.
- **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.
- **Integrated Observing System**
  Describes the observing systems needed to monitor the climate.
- **Climate Data and Monitoring**
  Describes the sustained development of comprehensive, dedicated global observing and data management.
- **Climate Research, Modelling and Prediction**
  Discusses a multidisciplinary approach to organizing research, modelling and prediction activities.
- **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 developmentž
- **Capacity Building**
  Discusses the need for global partnerships.
- **Climate Applications, Information and Prediction Services for Decision-making**
  Discusses the use of climate information for decision making.
- **Future Development/Strategies**
  Recognizes the need to promote climate awareness, especially for decision makers.

Climate Information for Adaptation and Development Needs WMO No. 1025

Organization(s)
WMO

Language(s)
English, French

General Audience(s)
Decision Makers; Technical Staff/Practitioners; General Public

Year of Publication
2007

Type of Material
Other

Go to Document

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

- **Introduction**
  Provides an overview of the need to adapt to climate change.
- **The Roles of the World Meteorological Organization and the National Meteorological and Hydrological Services**
  Describes the historical roles and the need for these roles.
- **World Meteorological Organization Programmes and the Nairobi Work Programme**
  Describes and discusses specific activities of the Nairobi Work Programme.
- **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 WMO-TD No. 1500

Organization(s)
WMO

Language(s)
English

General Audience(s)
Technical Staff/Practitioners

Year of Publication
2009

Type of Material
Guidance Document/Handbook

Go to Document

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, 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 observed changes in extremes in the past in the analysis; 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.

Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation - Special Report of the Intergovernmental Panel on Climate Change
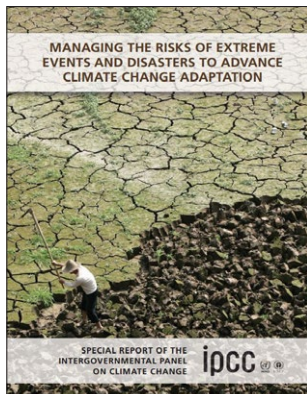
Organization(s)
IPCC

Language(s)
English

General Audience(s)
Decision Makers; Technical Staff/Practitioners; General Public

Year of Publication
2012

Type of Material
Analytical/Technical Document

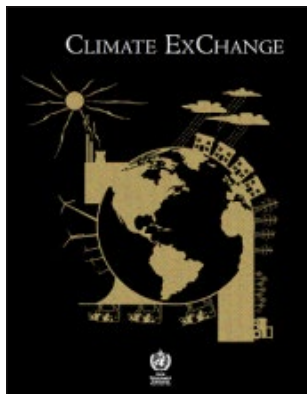**Go to Document**

Value of Learning Resource

The report focuses on the relationship between climate change and extreme weather and climate events, the impacts of such events, and the strategies to manage the associated risks. In particular, it contributes to frame the challenge of dealing with extreme weather and climate events as an issue in decision making under uncertainty, analyzing response in the context of risk management.

Structure and Content

- **Chapter 1**
  Frames the issue of extreme weather and climate events as a challenge in understanding and managing risk. It characterizes risk as emerging from the overlap of a triggering physical event with exposure of people and assets and their vulnerability.
- **Chapter 2**
  Explores the determinants of exposure and vulnerability in detail, concluding that every disaster has social as well as physical dimensions.
- **Chapter 3**
  Provides an assessment of the scientific literature on observed and projected changes in extreme weather and climate events, and, where possible, their attribution to causes.
- **Chapter 4**
  Assesses observed and projected impacts, considering patterns by sector as well as region.
- **Chapter 5**
  Assess experience and theory in adaptation to extremes and disasters, focusing on issues and opportunities at the local scale.
- **Chapter 6**
  Assess experience and theory in adaptation to extremes and disasters, focusing on issues and opportunities at the national scale.
- **Chapter 7**
  Assess experience and theory in adaptation to extremes and disasters, focusing on issues and opportunities at international scale.

- **Chapter 8**

  Assesses the interactions among sustainable development, vulnerability reduction, and disaster risk, considering both opportunities and constraints, as well as the kinds of transformations relevant to overcoming the constraints.
- **Chapter 9**

  Includes a series of case studies.

Climate Exchange

Organization(s)
WMO

Language(s)
English

General Audience(s)
Decision Makers; Technical Staff/Practitioners

Year of Publication
2012

Type of Material
Analytical/Technical Document

Go to Document

Value of Learning Resource

This book provides an important contribution to illustrate the benefits of, and promote good practices in, climate services, highlighting that risks of climate variability and change and adaptation to climate change can be better understood and managed through the development and application of the science and knowledge of climate information and prediction. The book includes an extensive list of articles from over 100 authors working in weather, climate and water services at international, regional, national and local levels. These articles present a variety of experiences on how people are using climate information to improve their lives and highlight progress and challenges in a wide variety of societies and disciplines.

Structure and Content

- **Section I**
  Includes 17 articles focusing on the production and delivery of climate services in the area of agriculture.
- **Section II**
  Includes 7 articles focusing on the production and delivery of climate services in the water sector.
- **Section III**
  Includes 6 articles focusing on the production and delivery of climate services in the area of health.
- **Section IV**
  Includes 9 articles focusing on the production and delivery of climate services for disaster risk reduction.
- **Section V**
  Includes 4 articles focusing on the production and delivery of climate services in the energy sector.
- **Section VI**
  Includes 5 articles focusing on the production and delivery of climate services in the area of transport and infrastructure.
- **Section VII**
  Includes 4 articles focusing on the production and delivery of climate services related to ecosystems.
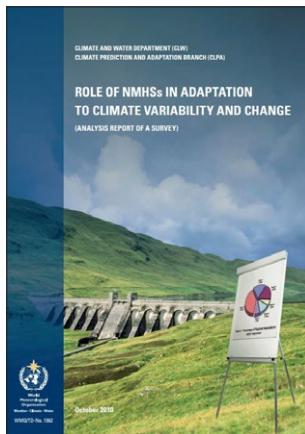
- **Section VIII**

  Includes 4 articles focusing on the production and delivery of climate services for urban Issues.
- **Section IX**

  Includes 6 articles focusing on the production and delivery of climate services for communities.
- **Section X**

  Concludes with 10 articles on capacity development.

Role of NMHSs in Adaptation to Climate Variability and Change _{WMO-TD No. 1562}

Organization(s)
WMO

Language(s)
English

General Audience(s)
Decision Makers; Technical Staff/Practitioners

Year of Publication
2010

Type of Material
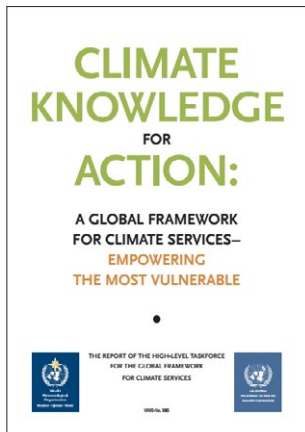Guidance Document/Handbook

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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 is elaborated in this report.

Structure and Content

- **I. Introduction**
  Provides the rationale for the survey.
- **II. The 2008 Survey**
  Describes the survey and analyzes the responses.
- **III. Policy Role of NMHSs**
  Discusses the preparation of documents for policy makers.
- **IV. Role of NMHSs in Adaptation**
  Discusses organizational issues, roles in national adaptation strategies, provision of sector specific services, and contributions to technical areas.
- **V. End User Feedback**
  Discusses the degree of feedback mechanisms.
- **VI. Gaps and Needs**
  Discusses the factors limiting contributions of NMHSs, resource limitations, and the need for global and region coordination.
- **VII. 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 WMO No. 1065

Organization(s)
WMO

Language(s)
English, French, Spanish, Russian, Chinese, Arabic

General Audience(s)
Decision Makers; Technical Staff/Practitioners

Year of Publication
2011

Type of Material
Guidance Document/Handbook

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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

- **Part 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.
- **Part 2: Needs and Opportunities for Climate Services**
  Describes experiences of climate sensitive sectors, the needs of international policy, and experiences at the national level.
- **Part 3: Establishing the Global Framework for Climate Services**
  Describes gaps and opportunities, an implementation plan, and governance arrangements.

WCRP Couple Model Intercomparison Project – Phase 5 – CMIP5

Special Issue of the WCRP CLIVAR Newsletter
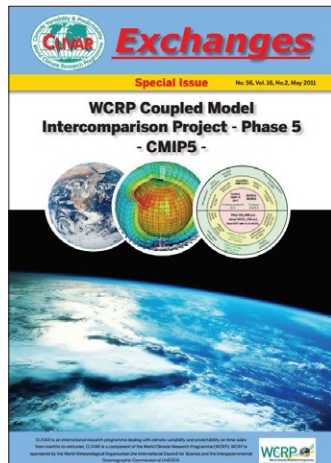
Organization(s)
WMO, UNESCO's Intergovernmental Oceanographic Commission, International Council for Science

Language(s)
English

General Audience(s)
Technical Staff/Practitioners

Year of Publication
2011

Type of Material
Other

Go to Document

Value of Learning Resource

Through short overview articles, this newsletter issue provides a "one-stop shop" for information on key components of the Coupled Model Intercomparison Project Phase 5 (CMIP5). About 20 modeling groups from around the world are currently running the CMIP5 experiments that represent the most ambitious multi-model intercomparison and analysis project attempted so far.

Structure and Content

- **Editorial**
  Provides an introduction to the newsletter.
- **Article 1**
  Introduces the World Climate Research Programme (WCRP) Modelling Council.
- **Article 2**
  Provides a brief background and introduction, as well as some updates on CMIP5 activities.
- **Article 3**
  Presents the CMIP5 long-term experimental design.
- **Article 4**
  Focuses on CMIP5 near-term climate prediction up to 2035.
- **Article 5**
  Focuses on Representative Concentration Pathways (RCPs) and the coordination between different modelling communities.
- **Article 6**
  Focuses on paleoclimate modelling in CMIP5.
- **Article 7**
  Discusses strategies for a better evaluation and understanding of clouds and cloud feedbacks in CMIP5 models.
- **Article 8**
  Analyses climate response to aerosol forcings in CMIP5.
- **Article 9**
  Addresses climate-carbon interactions in the CMIP5 Earth System models.
- **Article 10**
  Highlights stratosphere-resolving models in CMIP5.

- **Article 11**

  Discusses physical ocean fields in CMIP5.

- **Article 12**

  Presents the Coordinated Regional Downscaling Experiment (CORDEX), which provides an international downscaling link to CMIP5.

- **Article 13**

  Introduces the Earth System Grid Federation, which provides software framework supporting CMIP5 data analysis and dissemination.

- **Article 14**

  Discusses the CMIP5 model and simulation documentation.

- **Article 15**

  Focuses on the provision of satellite observations for CMIP5 simulations.

- **Article 16**

  Presents an initiative for processing satellite data to produce climate observation.

- **Article 17**

  Provides an update from the Climate and Ocean: Variability, Predictability and Change (CLIVAR) project global modeling working groups.

How to Establish and Run a WMO Regional Climate Centre WMO-TD No. 1534

Organization(s)
WMO

Language(s)
English, French

General Audience(s)
Technical Staff/Practitioners

Year of Publication
2011

Type of Material
Guidance Document/Handbook

Go to Document

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

- **General Information**
  Briefly describes Regional Climate Centres.
- **Definitions**
  Defines a Centre, network and node.
- **Mandatory Functions**
  Lists operational activities for long range forecasting, climate monitoring, data services and training.

Towards New Scenarios for Analysis of Emissions, Climate Change, Impacts and Response Strategies
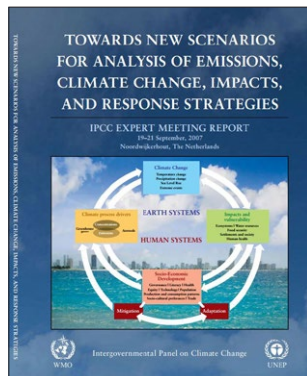
Organization(s)
IPCC

Language(s)
English

General Audience(s)
Technical Staff/Practitioners

Year of Publication
2008

Type of Material
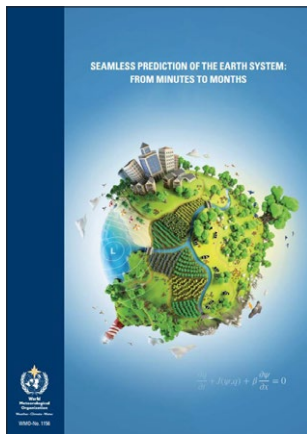Analytical/Technical Document

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Value of Learning Resource

The report provides information on the latest state of planning by the scientific community for preparation of new scenarios for analysis of emissions, climate change, impacts and response strategies. It identifies a set of benchmark emissions scenarios, referred to as "Representative Concentration Pathways" (RCPs), as supporting materials for consideration by the Intergovernmental Panel on Climate Change (IPCC).

Structure and Content

- **Chapter 1: Introduction**
  Provides the context and background information concerning the development of new scenarios.
- **Chapter 2: An Overview of Integrated Scenario Development, Application, and Synthesis**
  Describes a new parallel scenario development process.
- **Chapter 3: Representative Concentration Pathways (RCPs)**
  Focuses on the RCPs, how they will be prepared, and how they will subsequently be used throughout the broad user communities.
- **Chapter 4: Institutional and Coordination Issues**
  Addresses institutional and coordination issues among various relevant stakeholders along with a list of proposed next steps for the various research communities.
- **Chapter 5: Increasing Developing Country Participation**
  Provides a discussion of the need for participation of developing countries and economies in transition, and outlines a series of fundable opportunities at the regional scale for ensuring a new level of balance.
- **Chapter 6: Conclusion**
  Reflects on the development of new scenarios described in this report through the analysis of key cross-cutting questions.

Seamless Prediction of the Earth System from Minutes to Months WMO No. 1156

Organization(s)
WMO

Language(s)
English

General Audience(s)
Technical Staff/Practitioners

Year of Publication
2015

Type of Material
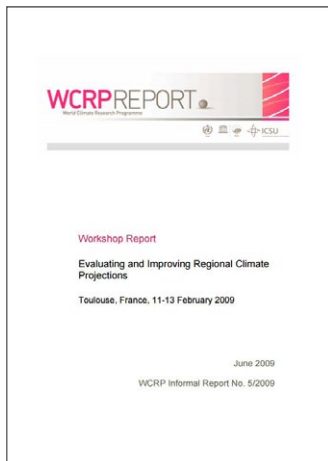Analytical/Technical Document

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Value of Learning Resource

This book provides a collection of white papers that have been written to describe the state of the weather science and to discuss the major challenges for making further advances. It is intended to be a valuable resource for anyone dealing with environmental prediction matters, providing new perspectives for planning and guiding future research programmes.

Structure and Content

- **Section 1**
  Provides an introduction, outlining challenges and priorities for weather science as well as for user, application and social sciences.
- **Section 2**
  Provides papers focusing on observations and data assimilation for improving observational capability and ensuring it is used optimally for forecasting high-impact weather.
- **Section 3**
  Includes research in the area of predictability, processes and interaction between prediction subsystems.
- **Section 4**
  Covers research on numerical prediction of the Earth System, including at different level (global, regional, urban-scale, polar, season and sub-seasonal).
- **Section 5**
  Provides analysis for increasing understanding of weather-related hazards and impacts.
- **Section 6**
  Concludes and stresses the need to tackle the weather and environmental prediction research challenges highlighted in the book.

Evaluating and Improving Regional Climate Projections

Organization(s)
WMO, UNESCO's Intergovernmental Oceanographic Commission, International Council for Science

Language(s)
English

General Audience(s)
Technical Staff/Practitioners

Year of Publication
2009

Type of Material
Analytical/Technical Document
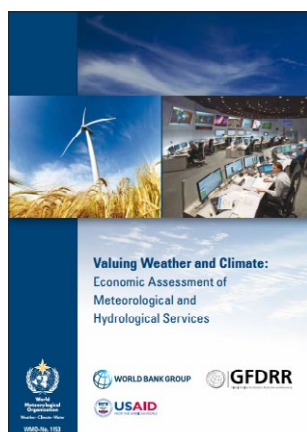
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Value of Learning Resource

Highlighting the increasing need for precise regional information regarding future climate, this report summarizes the main points addressed during a workshop on evaluating and improving regional climate projections, discussing the details for the design of a regional projection experiment framework.

Structure and Content

- **Context and Main Objectives**
  Provides background information on the workshop and on the development of a regional projection experiment framework.
- **General Framework**
  Provides a few points on modelling and on regional climate.
- **Regional Climate Downscaling Techniques**
  Summarizes presentations on the status and open issues regarding regional climate modelling and statistical downscaling, and on the use of variable resolution global climate models.
- **Specific Applications**
  Summarizes presentations on the use of climate information for impact and adaptation applications, on the use of regional climate models for seasonal prediction, on downscaling activities in developing countries, and on the climate and impact information needs in developing countries.
- **Technical Issues**
  Summarizes presentations focusing on specific global and regional climate model output databases;
- **Discussion on a Coordinated International Activity**
  Reports on discussions on a regional climate projection experiment framework, including on involving end users and developing country scientists, definition of regions, selecting emissions scenarios, and decadal prediction.

Valuing Weather and Climate: Economic Assessment of Meteorological and Hydrological Services WMO No. 1153

Organization(s)
WMO, World Bank, GFDDR

Language(s)
English

General Audience(s)
Decision Makers; Technical Staff/Practitioners

Year of Publication
2015

Type of Material
Guidance Document/Handbook

Go to Document

Value of Learning Resource

This publication is intended to help National Meteorological and Hydrological Services (NMHSs) and other providers of met/hydro services to develop a basic understanding of economic valuation methods to enable them to design and commission socioeconomic benefit (SEB) studies. It further provides support on the utilization of the results to improve service delivery through business optimization and communication with decision-makers, users and the public.

Structure and Content

- **Chapter 1: Introduction**
  Introduces some basic concepts in meteorological and hydrological service provision, identify the challenges facing the major national organizations responsible for these services, and recall earlier work on economic valuation.
- **Chapter 2: The Production, Delivery and Use of Met/Hydro Services**
  Provides a brief introduction to the production and delivery of met/hydro services and the mechanisms through which they generate economic value for their user communities.
- **Chapter 3: The Purposes of Socioeconomic Benefit Assessment of Met/Hydro Services**
  Explains the purpose of conducting SEB studies for met/hydro services and identifies the audiences interested in these results.
- **Chapter 4: Designing and Commissioning Socioeconomic Benefit Studies**
  Presents a five-step process for framing and commissioning an assessment.
- **Chapter 5: Economic Essentials**
  Provides a summary of the economic essentials relevant to valuation studies and benefit-cost analysis.
- **Chapter 6: Defining and Measuring Benefits**
  Defines and characterizes the benefits achievable from the use of met/hydro services, describes the various methodologies already used and potentially available for their valuation, and provides case study examples.
- **Chapter 7: Defining and Measuring Costs**
  Explains concepts and methodologies used to define and measure costs incurred at different stages in the service production and delivery chain and by users of these services.

- **Chapter 8: Benefit-Cost Analysis**
  Provides a simple workbook approach to the conduct of benefit-cost analyses for met/hydro services.
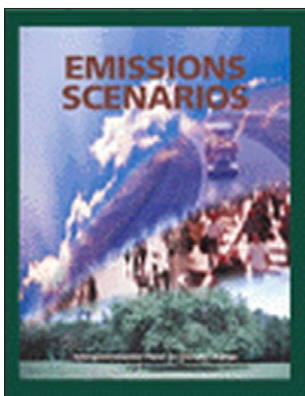- **Chapter 9: Socioeconomic Benefits Study Step 10**
  Communicating the Results of Socioeconomic Benefit Studies: deals with communicating the results of an SEB study to governments and other stakeholders.
- **Chapter 10: Looking Forward**
  Provides summary conclusions, actions to take and goals for the future.

Emission Scenarios

Organization(s)
IPCC

Language(s)
English, French, Spanish, Russian, Chinese, Arabic

General Audience(s)
Decision Makers; Technical Staff/Practitioners; General Public

Year of Publication
2000

Type of Material
Analytical/Technical Document

Go to Document

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.

Agriculture and Food Security - Exemplar to the User Interface Platform of the Global Framework for Climate Services
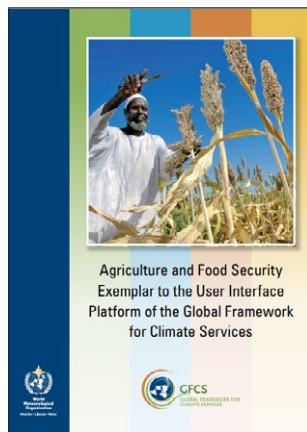
Organization(s)
WMO, FAO, WFP, International Federation of Red Cross and Red Crescent Societies, IRI, GEO

Language(s)
English, French, Spanish, Russian, Arabic, Chinese

General Audience(s)
Decision Makers; Technical Staff/Practitioners

Year of Publication
2014

Type of Material
Other

Go to Document

Value of Learning Resource

This document is an Exemplar part of the Implementation Plan of the Global Framework for Climate Services (GFCS). It describes implementation of the "User Interface Platform" – a GFCS pillar promoting effective decision-making with respect to climate considerations by making sure that the right information, at the right time and in the right amount, is delivered, understood, and used – in the agriculture and food security sectors. More specifically, the document provides an example of climate services in these sectors, which in turns identifies needs, characterizes abilities in climate services, and suggests ways to improve performance and management of agriculture and food security systems from global to local levels using climate information.

Structure and Content

- **Introduction**
  Provides background and context as well as existing activities, and gaps.
- **Implementation of Agriculture and Food Security Activities**
  Focuses on activity implementation, highlighting conditions for success, partnerships at global, national and regional levels, and criteria for the identification of the activities.
- **Work Plan for Priority Activities for Agriculture and Food Security**
  Outlines proposed activities in four priority areas and considers the approach for implementation, monitoring and evaluation and risk management.
- **Enabling Mechanisms**
  Mentions synergies with existing activities, partnerships and reviews mechanisms.
- **Resource Mobilization**
  Addresses funding for supporting the activities.

Additional Information

The GFCS Implementation Plan includes other three Exemplars on 1) Health, 2) Disaster risk reduction, and 3) Water.

These resources are available at: http://www.gfcs-climate.org/implementation-plan

1

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

2 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

Climatology for the Operational Forecaster

(COMET Program, University Corporation for Atmospheric Research (UCAR) and National Oceanic and Atmospheric Administration – National Weather Service (NOAA NWS), United States, 2013)

This module summarizes the Climate Analysis Process, a series of steps for determining which climatological products and data will be most useful for a specified application. The Climate Analysis Process is followed in the context of preparing a climatological brief for a ship deployment across multiple ocean basins. Products from various sources are used to assemble a final climatological brief relevant to naval operations. The module includes a section on climate predictions. The material is available in English 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=1028

An Introduction to the Downscaled Climate and Hydrology Projections Website

(COMET Program, University Corporation for Atmospheric Research (UCAR) and National Oceanic and Atmospheric Administration – National Weather Service (NOAA NWS), Bureau of Reclamation, United States, 2014)

These two videos serve as an introduction to the Downscaled Climate and Hydrology Projections website. This website provides access to downscaled climate and hydrology projections for the contiguous United States and parts of Canada and Mexico, derived from contemporary global climate models. In the first video, Dr. Subhrendu Gangopadhyay, hydrologic engineer at the Bureau of Reclamation's Technical Service Center in Denver, introduces the website and provides necessary background information needed to use the projections site effectively to retrieve climate and hydrology projections data for impacts analysis. In the second video, he steps through the process of retrieving projections data using the website.

https://www.meted.ucar.edu/training_module.php?id=1104#.VYGHJlWqpBc

About UN CC:Learn

UN CC:Learn is a partnership of more than 30 multilateral organizations supporting countries to design and implement systematic, recurrent and results-oriented climate change learning. At the global level, the partnership supports knowledge-sharing, promotes the development of common climate change learning materials, and coordinates learning interventions through a collaboration of UN agencies and other partners. At the national level, UN CC:Learn supports countries in developing and implementing national climate change learning strategies. Through its engagement at the national and global levels, UN CC:Learn contributes to the implementation of Article 6 of the UNFCCC on training, education and public awareness-raising, and the 2012-2020 Doha Work Programme. Funding for UN CC:Learn is provided by the Swiss Government and UN partners. The Secretariat for UN CC:Learn is hosted by the UN Institute for Training and Research (UNITAR). For further information please contact: uncclearn@unitar.org.

www.uncclearn.org