



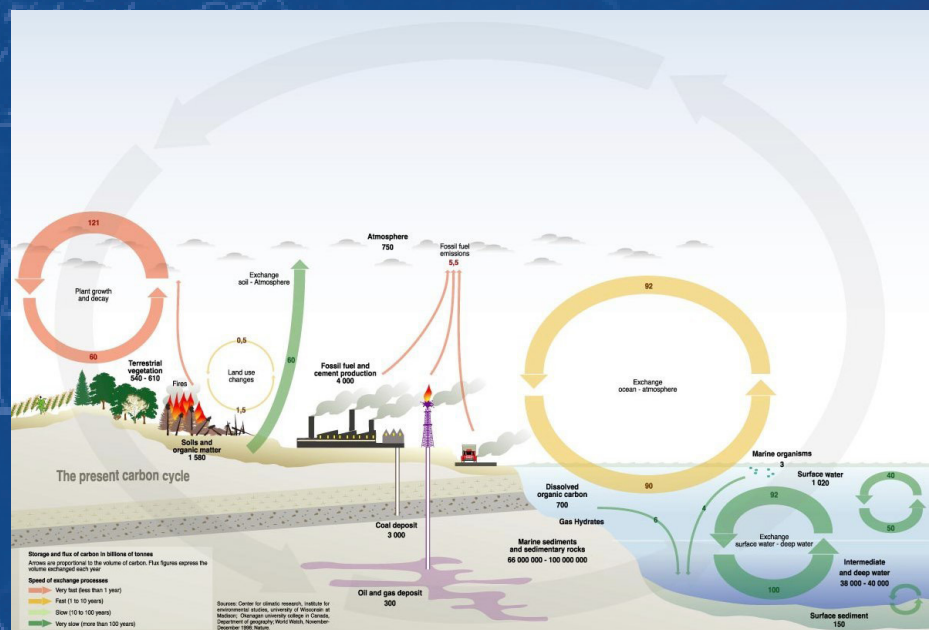
UN CC:Learn

The One UN Climate Change Learning Partnership

Resource Guide for Advanced Learning on the

Fundamentals of Climate Change Science

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Acknowledgements

This Resource Guide has been developed as part of the 2011-2013 pilot implementation phase of The One UN Climate Change Learning Partnership (UN CC:Learn). Technical leadership was provided by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) with methodological support by the UN CC:Learn Secretariat.

Specific inputs were provided by: Amir Delju, WMO; Ned Guttman, University of Tennessee; Charles Davies, UNEP; Cristina Rekakavas, Angus Mackay, Achim Halpaap, Amrei Horstbrink and Ilaria Gallo, UNITAR.

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UNEP/GRID-Arendal 2005

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 the basics of climate change:

- Decision makers in the public and economic sectors 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;

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, UNESCWA, UNFCCC, UNFPA, UNHABITAT, UNICEF, UNIDO, UNISDR, UNITAR, UNSSC, UNU, UN WOMEN, UNWTO, UPU, WFP, WHO, WMO, WTO, World Bank.

- Climate assessment and risk managers and facilitators;
- Interested citizens/youth/students.

1.4 Introduction to the Fundamentals of Climate Change Science

The climate system is a complex, interactive system consisting of the atmosphere, land surface, snow and ice, oceans and other bodies of water, and living things. The climate system evolves in time under the influence of its own internal dynamics and due to changes in external factors that are called forcings. External forcings include natural phenomena such as volcanic eruptions and solar variations, as well as human-induced changes in atmospheric composition. Solar energy powers the climate system. There are three fundamental ways to change the energy balance of the Earth: 1) by changing the incoming solar energy; 2) by changing the fraction of solar energy that is reflected; and 3) by altering the energy that returns to space from the Earth. Incoming solar energy is changed by, for example, changes in the Earth's orbit or in the sun itself. Changes in cloud cover, vegetation, and particles in the air, for example, can change reflected energy. Energy that is returned to space can be altered, for example, by changes in greenhouse gas concentrations. Climate, in turn, responds directly to such changes, as well as indirectly, through a variety of feedback mechanisms.

Climate change science seeks to understand the physical, chemical, biological and geological processes, and the interactions among these processes, that produce climate. The scales of interest range from local to global and from weeks or months to millions of years. Changes in climate, both temporally and spatially, are detected by examining observational evidence from instruments and indicators such as tree rings, fossils, glaciers and sea ice, plant pollen, and sea level. Goals of the science are to predict future climates based on natural phenomena and to project future climates based on assumptions of future human activities. These predictions and projections are determined from climate models and may be used to develop strategies for mitigating the effects of climate change and for adapting to the expected changes.

1.5 Learning Topics Featured in the Guide

Many organizations have developed a number of learning materials on the theme of the fundamentals of climate change science. 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 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.

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

Learning Topic 1: Climate and the Factors Shaping the Earth's Climate

Climatology is the study of climate, its variations and extremes, and its influences on a variety of activities including (but far from limited to) human health, safety and welfare. Climate, in a narrow sense, can be defined as the average weather conditions for a particular location and period of time. Climate can be described in terms of statistical descriptions of the central tendencies and variability of relevant elements such as temperature, precipitation, atmospheric pressure, humidity and winds, or through combinations of elements, such as weather types and phenomena, that are typical of a location or region, or of the world as a whole, for any time period.

To understand climate change, it is crucial to use a scientific definition of climate, understand the difference between weather and climate, and study changes in the state of the climate that persist for an extended period. It is also important to understand how the natural factors such as latitude, altitude, reflectivity of the Earth's surface, distance from the sea and external forcing such as solar radiation, which are beyond human control, contribute to the highly complex system of the climate and lead to climate patterns.

A climate pattern is a recurring characteristic of the climate. Climate patterns exist over many time scales. For instance the glacial and interglacial periods within ice ages last tens of thousands of years, while monsoons repeat each year. They may come in the form of a regular cycle, like the diurnal cycle or the seasonal cycle, a periodic event, like El Niño, or a highly irregular event, such as a volcanic winter. Since the nineteenth century, attempts were made to classify global climates in many ways and provide atlases which showed maps of temperature and precipitation around the world. Today, some of these atlases may contain maps of atmospheric pressure, prevailing winds, ocean currents and extent of sea ice throughout the year. These atlases with more detailed classifications are used by many countries in climate sensitive sectors such as agriculture and water management.

Learning Topic 2: Historical Climate Variations

In most parts of the world there is nothing unusual about changeable weather. Seasonal contrasts, too, are perfectly usual and, indeed, to be expected. Further, no two years are alike and no two decades necessarily follow exactly the same pattern of changing weather. From the study of the factors governing climate and their expression in regional patterns we realize that there is no reason to suppose that the climate, or the characteristic regional weather, of one decade, will necessarily be the same as the climate of another decade. The likelihood of variability would be even greater if we looked at longer time spans or contrasted decades farther apart in time. Until well into the twentieth century it was widely believed that weather changes were no more than fluctuations around an average and that over a long enough time-span one could define average weather, or the 'normal' climate, for any place on Earth. This belief must now be questioned. Meteorological records of the past 150 years, for example, show that conditions characteristic of the mid-twentieth century differ noticeably from those of the mid-nineteenth century. To such data historical records and improved geological techniques must be added to provide an even clearer picture of the changing climate. These historical variations in climate may be due to natural internal processes or external forcing, or to persistent anthropogenic changes to the composition of the atmosphere or in land use.

Learning Topic 3: Meteorological Consequences of Climate Variability and Change

The viewpoint of synoptic climatology (looking at an entire weather situation in a given location) is to regard climate essentially as the product of atmospheric circulation and weather conditions. Weather

phenomena such as droughts, floods and extreme events are meteorological manifestations of climate variability and change. These are mainly caused by changes in the distribution of mean annual total precipitation, minimum and maximum temperature, humidity, evaporation and solar radiation. Variation in these parameters is a matter of great social and economic importance. How human activities are dominated by climate has driven our search for better knowledge of how it functions. It started with how daily weather events affected agriculture and has extended now to how wider features of the global climate can influence commerce and trade around the world.

Learning Topic 4: The Human Contribution to Climate Change

Continued expansion of man's activities on Earth may cause significant extended regional and even global changes of climate. In the context of climate change, global warming has been more in focus than other issues. It refers to the global-average temperature increase that has been observed over the last one hundred years or more. To many politicians and the public, the term carries the implication that mankind is responsible for that warming. In the early 1980s, international organizations called for global cooperation to explore the possible future course of global climate and to take this new understanding into account in planning for the future development of human society. Increasing concentrations of greenhouse gases were expected to cause a significant warming of the global climate in the next century. WMO-UNEP established the Intergovernmental Panel on Climate Change (IPCC) which is dedicated to identifying uncertainties and gaps in our present knowledge with regard to climate change and its potential impacts, and preparation of a plan of action over the short term to fill these gaps.

Learning Topic 5: Global Emission Scenarios and Climate Change

In order to determine the impact of climate change in the future, it is key to understand the concentrations of greenhouse gases and other pollutants in the atmosphere to which climate is sensitive, in the years to come. These concentrations depend on their emissions from various sources, natural as well as man-made. Emissions scenarios describe future releases into the atmosphere of greenhouse gases, aerosols, and other pollutants and, along with information on land use and land cover, provide inputs to climate models. They are based on assumptions about driving forces such as patterns of economic and population growth, technology development, and other factors. Levels of future emissions are highly uncertain, and so scenarios provide alternative images of how the future might unfold. They assist in climate change analysis, including climate modelling and the assessment of impacts, adaptation, and mitigation.

Part II

Guide to Learning Resources and Training Courses

Learning Topic 1

Climate and the Factors Shaping the Earth's Climate

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 1 defines climate and describes radiation processes and the climate system. It also discusses components of the climate system (atmosphere, land surface, ice, and the biosphere). Chapter 2 describes natural variability of climate, basic forcing mechanisms, and the interaction of climate system components. Both chapters describe several patterns resulting from the factors that shape the climate and the interaction of the components of the climate system.

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 defines climate and briefly describes the climate system. Chapter 4 discusses measures for describing climate (averages, variability and extremes). Chapter 6 depicts many examples of how to visually display climate patterns.

Climate Change Science Compendium [Go to Factsheet](#)

General Audience(s)

Decision Makers; Technical Staff/Practitioners; General Public

Type of Material

Analytical/Technical Document

Relevance

This document is a review of some 400 major scientific contributions to our understanding of Earth Systems and climate. The background section of chapter 1 describes interactions among the components of the climate system. Chapter 2 describes patterns of ice and glacier coverage of the Earth. Chapter 3 describes patterns of ocean circulations.

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. FAQ 1.1 briefly describes the climate system.

Learning Topic 2 Historical Climate Variations

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 2 discusses the natural temporal variability of several climate characteristics and patterns.

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 4 discusses measures used to portray historical variations of climate characteristics, and some of the problems with the data used to determine historical features. Chapter 6 depicts many examples of how to visually display historical perspectives.

Climate Change Science Compendium [Go to Factsheet](#)

General Audience(s)

Decision Makers; Technical Staff/Practitioners; General Public

Type of Material

Analytical/Technical Document

Relevance

This document is a review of some 400 major scientific contributions to our understanding of Earth Systems and climate. Chapters 2-4 show graphs of temporal trends of several climate characteristics.

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, drawing on historical analysis of variables such as temperature, precipitation and sea levels. Graphs and maps depict changes of several characteristics over time.

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, chapters 3-6 put current climate characteristics into historical perspective.

Learning Topic 3

Meteorological Consequences of Climate Variability and Change

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 2 covers natural environmental changes.

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 2 describes in detail observation practices so that users of data can better determine the impacts on the climate system of changes in characteristics and patterns. Chapters 4 and 5 discuss analysis techniques that are used to determine impacts, and chapter 6 offers many display tools.

Climate Change Science Compendium [Go to Factsheet](#)

General Audience(s)

Decision Makers; Technical Staff/
Practitioners; General Public

Type of Material

Analytical/Technical Document

Relevance

The entire document concerns impacts on the climate system of changes, both natural and anthropogenic.

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, drawing on historical analysis of variables such as temperature, precipitation and sea levels.

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, chapters 3-6 describe observed changes to the climate system, both globally and regionally.

Learning Topic 4

The Human Contribution to Climate Change

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 3 covers the human impacts on the climate system.

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 2 describes in detail observation practices so that users of data can better determine the impacts on the climate system of changes in characteristics and patterns. Chapters 4 and 5 discuss analysis techniques that are used to determine impacts, and chapter 6 offers many display tools.

Climate Change Science Compendium [Go to Factsheet](#)

General Audience(s)

Decision Makers; Technical Staff/Practitioners; General Public

Type of Material

Analytical/Technical Document

Relevance

The entire document concerns impacts on the climate system of changes, both natural and anthropogenic.

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, drawing on historical analysis of variables such as temperature, precipitation and sea levels.

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, chapters 7 and 9 concern the relationships between human activity and climate.

Learning Topic 5

Global Emission Scenarios and Climate Change

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 7 covers scenarios.

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 and outlooks from the perspectives of servicing user needs and of information management by meteorological services.

Climate Change Science Compendium [Go to Factsheet](#)

General Audience(s)

Decision Makers; Technical Staff/
Practitioners; General Public

Type of Material

Analytical/Technical Document

Relevance

The entire document concerns impacts on the climate system of changes, both natural and anthropogenic.

Bridging the Emissions Gap [Go to Factsheet](#)

General Audience(s)

Decision Makers; Technical Staff/
Practitioners

Type of Material

Analytical/Technical Document

Relevance

This report examines the gap between expected greenhouse gas emissions in 2020 according to country pledges and the reductions needed to limit temperature rise and climate change.

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 8 describes climate models and their evaluation. Model results are presented both globally and regionally.

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.

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 National Meteorological or Hydro-meteorological Services (NMHS) 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

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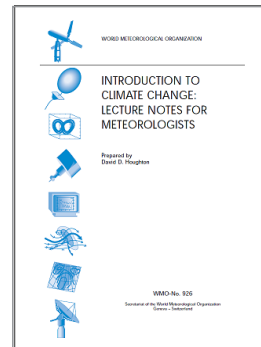
Organization(s)	Reference	Type of Material
WMO	WMO-No. 926	Analytical/Technical Document
Year of Publication	Language	General Audiences
2002	English	Decision Makers; Technical Staff/Practitioners; General Public

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.



Climate Change Science Compendium

[Go to Document](#)

Organization(s)	Language	Type of Material:
UNEP	English	Analytical/Technical Document
Year of Publication		General Audiences
2009		Decision Makers; Technical Staff/Practitioners; General Public

Value of Learning Resource

This document is a review of some 400 major scientific contributions to our understanding of Earth Systems and climate that have been released through peer-reviewed literature or from research institutions since the close of research for consideration by the IPCC Fourth Assessment Report.

Structure and Content

Earth Systems	Stresses that the Earth System behaves as a single, self-regulating system comprised of physical, chemical, biological, and human components;
Earth's Ice	Describes the trends of ice coverage on the Earth and the impacts of these trends;
Earth's Oceans	Describes the relationships among increased temperature, sea level rise, increased acidification, and changing oceanic circulation and nutrient supplies;
Earth's Ecosystems	Reports on the increasing confidence and better quantification of the impacts of climate change on the marine and terrestrial ecosystems;
Systems Management	Describes possible ways of mitigating the effects of climate change.



Bridging the Emissions Gap

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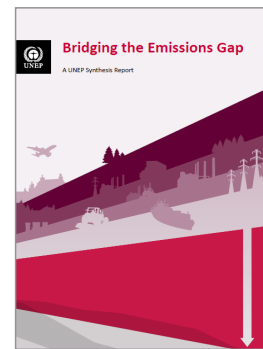
Organization(s)	Language	Type of Material
UNEP	English	Analytical/Technical Document
Year of Publication	General Audiences	
2011	Decision Makers; Technical Staff/Practitioners	

Value of Learning Resource

This report examines the gap between expected greenhouse gas emissions in 2020 according to country pledges and the reductions needed to limit temperature rise 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

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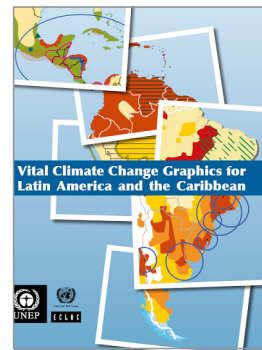
Organization(s)	Year of Publication	Type of Material
UNEP, ECLAC, UNEP/GRID- Arendal	2010	Analytical/Technical Document
	Language	General Audiences
	English, Spanish	Decision Makers; Technical Staff/Practitioners; General Public

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 times 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

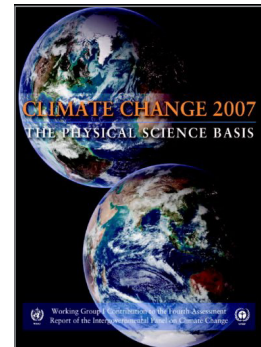
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[Go to New 5th Assessment Report](#)

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.

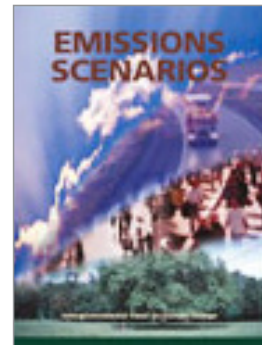
Emissions Scenarios

[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: 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 IPCC scenarios and the underlying literature.

ANNEX 1

Selected Non UN Written Resources and Training Courses

Learning Topic 1

Climate and the Factors Shaping the Earth's Climate

Introduction to Climatology

COMET Program, University Corporation for Atmospheric Research (UCAR) and National Oceanic and Atmospheric Administration – National Weather Service (NOAA NWS), United States, 2008

This module provides an overview of climatology, the study of climate. It is intended for a wide range of users, from forecasters and scientists to those in business and government as well as the general public—in short, anyone interested in learning about climatology. Chapter 1 discusses the difference between weather and climate and defines climatology. Chapters 2 through 5 examine the drivers that combine to create the climate regions of the world—from those at the mesoscale (local) level to those at the synoptic-scale (continental) and global-scale levels. Examples include locally dominant winds, air masses, fronts, ocean currents, Earth's rotation around the sun, and latitude. Each discussion of a climate driver has an 'example/exploration' segment, where the information is applied to several cities. Chapter 6 examines climate zones and classifications of the world's climate. The module also discusses the sources and uses of climate information, and some of the limitations of this information. Some familiarity with basic meteorology is useful although not required. The material is available in English both 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=499

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 first section describes some of the natural influences of climate. Included are descriptions of orbital mechanics, continental drift, ocean currents, greenhouse gases, and the carbon cycle. Some familiarity with basic meteorology is useful although not required. The material is available both in English and in Spanish both 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

The Science of Global Climate Change and Human Influences

COMET Program, University Corporation for Atmospheric Research (UCAR) and National Oceanic and Atmospheric Administration – National Weather Service (NOAA NWS), United States, 2004

This webcast, recorded in 2003, is an expert lecture by Dr. Kevin Trenberth of NCAR's Climate and Global Dynamics division. The presentation includes evidence that the atmosphere is changing, discussions on global energy flows and human factors contributing to change, and concludes with predictions for the future. It is intended for anyone interested in learning about climatology. Section 2 defines the greenhouse effect and describes the components of the effect. Section 4 describes global heat flows, energy from the sun, and radiative forcing of climate. The presentation has enhanced graphics and links to additional resources. The material is available in English and Russian online, and the webcast can be downloaded for local viewing; registration is required.

https://www.meted.ucar.edu/training_module.php?id=147

Learning Topic 2

Historical Climate Variations

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 about future changes, and what can be done to minimize the effects. It is intended for anyone interested in learning about climatology. The first section describes some of the natural influences of climate. Included are graphics of historical patterns of carbon dioxide, and temperature. The second section presents historical changes of temperature, sea level, snow and ice, rain and drought, and ecosystems. Some familiarity with basic meteorology is useful although not required. The material is available both in English and in 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

The Science of Global Climate Change and Human Influences

COMET Program, University Corporation for Atmospheric Research (UCAR) and National Oceanic and Atmospheric Administration – National Weather Service (NOAA NWS), United States, 2004

This webcast, recorded in 2003, is an expert lecture by Dr. Kevin Trenberth of NCAR's Climate and Global Dynamics division. The presentation includes evidence that the atmosphere is changing, discussions on global energy flows and human factors contributing to change, and concludes with predictions for the future. It is intended for anyone interested in learning about climatology. Section 3 shows historical changes in temperature, snow cover, freeze dates, sea ice and glaciations. The presentation has enhanced graphics and links to additional resources. The material is available in English and Russian online, and the webcast can be downloaded for local viewing; registration is required.

https://www.meted.ucar.edu/training_module.php?id=147

Learning Topic 3

Meteorological Consequences of Climate Variability and Change

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. Section 4 discusses global and regional effects of climate change on weather, temperature, precipitation, sea level rise, and extreme weather. Some familiarity with basic meteorology is useful although not required. The material is available both in English and in 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

The Science of Global Climate Change and Human Influences

COMET Program, University Corporation for Atmospheric Research (UCAR) and National Oceanic and Atmospheric Administration – National Weather Service (NOAA NWS), United States, 2004

This webcast, recorded in 2003, is an expert lecture by Dr. Kevin Trenberth of NCAR's Climate and Global Dynamics division. The presentation includes evidence that the atmosphere is changing, discussions on global energy flows and human factors contributing to change, and concludes with predictions for the future. It is intended for anyone interested in learning about climatology. Section 6 describes changes to the hydrologic cycle and temperature. The presentation has enhanced graphics and links to additional resources. The material is available in English and Russian online, and the webcast can be downloaded for local viewing; registration is required.

https://www.meted.ucar.edu/training_module.php?id=147

Learning Topic 4

The Human Contribution to Climate Change

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. Section 2 discusses the human contribution to climate change in terms of carbon dioxide, methane, nitrous oxide, and fluorinated gases. The last section discusses adaptation and mitigation strategies. Some familiarity with basic meteorology is useful although not required. The material is available both in English and in 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

The Science of Global Climate Change and Human Influences

COMET Program, University Corporation for Atmospheric Research (UCAR) and National Oceanic and Atmospheric Administration – National Weather Service (NOAA NWS), United States, 2004

This webcast, recorded in 2003, is an expert lecture by Dr. Kevin Trenberth of NCAR's Climate and Global Dynamics division. The presentation includes evidence that the atmosphere is changing, discussions on global energy flows and human factors contributing to change, and concludes with predictions for the future. It is intended for anyone interested in learning about climatology. Section 3 discusses indicators of the human influence on the atmosphere, and section 5 discusses the consequences of human influences on the global climate. The presentation has enhanced graphics and links to additional resources. The material is available in English and Russian online, and the webcast can be downloaded for local viewing; registration is required.

https://www.meted.ucar.edu/training_module.php?id=147

Learning Topic 5

Global Emission Scenarios and Climate Change

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. Sections 3 and 5 discuss climate models, future projections and scenarios, and future impacts. Some familiarity with basic meteorology is useful although not required. The material is available both in English and in 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

The Science of Global Climate Change and Human Influences

COMET Program, University Corporation for Atmospheric Research (UCAR) and National Oceanic and Atmospheric Administration – National Weather Service (NOAA NWS), United States, 2004

This webcast, recorded in 2003, is an expert lecture by Dr. Kevin Trenberth of NCAR's Climate and Global Dynamics division. The presentation includes evidence that the atmosphere is changing, discussions on global energy flows and human factors contributing to change, and concludes with predictions for the future. It is intended for anyone interested in learning about climatology. Section 6 discusses projections for the future and considerations for taking action to mitigate the effects of global warming. The presentation has enhanced graphics and links to additional resources. The material is available in English and Russian online, and the webcast can be downloaded for local viewing; registration is required.

https://www.meted.ucar.edu/training_module.php?id=147

Regional and Global Climate

U.S. Geological Survey (USGS), United States, 2012

This Global Climate Change Viewer web application provides basic visualization of climate change scenario data sets. It is a user-friendly, interactive interface that summarizes simulated future changes in temperature and precipitation for each country. Users can visualize global and country-specific spatial patterns of change, compare present-day simulations with observations, and display the distribution of climate change for a given country. The application web page includes documentation for describing in detail the methods and data sets used to create the data displayed.

<http://regclim.coas.oregonstate.edu/>

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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