# Glossary and Acronyms

## GLOSSARY

This glossary defines some specific terms for the context of this report. Most terms below are adapted directly from definitions provided in the IPCC AR4 Glossary (IPCC 2007). Those terms not included in the IPCC report or whose definitions are not identical to the usage in the IPCC Glossary are marked with an asterisk.

**Abrupt climate change**
The non-linearity of the climate system may lead to abrupt climate change, sometimes called *rapid climate change*, *abrupt events* or even *surprises*. The term "abrupt" often refers to changes that occur on time scales faster than the typical time scale of the responsible forcing. However, abrupt climate changes need not be externally forced, and rapid transitions can result simply from physical or dynamical processes internal to the climate system.

**Aerosols**
A collection of airborne solid or liquid particles, with a typical size between 0.01 and 10 micrometers (μm) and residing in the atmosphere for at least several hours. Aerosols may be of either natural or anthropogenic origin.

**Analysis***
A detailed representation of the state of the atmosphere and, more generally, other components of the climate system, such as oceans or land surface, that is based on observations.

**Annular modes**
Preferred patterns of change in atmospheric circulation corresponding to changes in the zonally averaged midlatitude westerlies. The Northern Annular Mode has a bias to the North Atlantic and has a large correlation with the North Atlantic Oscillation. The Southern Annular Mode occurs in the Southern hemisphere.

**Anthropogenic**
Resulting from or produced by human beings.

**Attribution***
The process of establishing the most likely causes for a detected climate variation or change with some defined level of confidence.

**Climate**
The statistical description in terms of the mean and variability of relevant atmospheric variables over a period of time ranging from months out to decades, centuries, and beyond. Climate conditions are often described in terms of surface variables such as temperature, precipitation, and wind. Climate in a wider sense is a description of the full

climate system, including, the atmosphere, oceans, cryosphere, the land surface, and biosphere, including their interactions.

**Climate change**
A change in the state of the climate that can be identified (*e.g.*, using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

**Climate system**
The climate system is the highly complex system consisting of five major components: the atmosphere, the hydrosphere, the cryosphere, the land surface and the biosphere, and the interactions between them. The climate system evolves in time under the influence of its own internal dynamics and because of external forcings such as volcanic eruptions, solar variations and human-induced forcings such as the changing composition of the atmosphere and changes in land cover and land use.

**Climate variability**
Variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, *etc*.) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (*internal variability*), or to variations in natural or anthropogenic external forcing (*external variability*).

**Confidence**
The likelihood of the correctness of a result as expressed in this report, using a standard terminology defined in the preface.

**Data assimilation***
The combining of diverse observations, possibly sampled at different times and intervals and different locations, into a unified and consistent description of a physical system, such as the state of the atmosphere. This combination is obtained by integrating the observations together in a numerical prediction model that provides an initial estimate of the state of the system, or "first guess".

**Drought**
In general terms, drought is a "prolonged absence or marked deficiency of precipitation", a "deficiency that results in water shortage for some activity or for some group," or a "period of abnormally dry weather sufficiently prolonged for the lack of precipitation to cause a serious hydrological imbalance" (Heim, 2002). Drought has been defined in a number of ways. *Agricultural drought* relates to moisture deficits in the topmost meter or so of soil (the root zone) that impacts crops, *meteorological drought* is mainly a prolonged deficit of precipitation, and *hydrologic drought* is related to below normal streamflow, lake and groundwater levels.

A *megadrought* is a long-drawn out and pervasive drought, lasting much longer than normal, usually a decade or more.

**El Niño-Southern Oscillation (ENSO)**

*El Niño*, in its original sense, is a warm water current that periodically flows along the coast of Ecuador and Perú, disrupting the local fishery. It has since become identified with a basin-wide warming of the tropical Pacific east of the dateline. This oceanic event is associated with a fluctuation of a global scale tropical and subtropical surface pressure pattern, called the Southern Oscillation. This coupled atmosphere-ocean phenomenon, with preferred time scales of two to about seven years, is collectively known as El Niño-Southern Oscillation, or ENSO. ENSO is often measured by the surface pressure anomaly difference between Darwin and Tahiti and the sea surface temperatures in the central and eastern equatorial Pacific. During an ENSO event the prevailing trade winds weaken, reducing upwelling and altering ocean currents such that the sea surface temperatures warm, further weakening the trade winds. This event has great impact on the wind, sea surface temperature and precipitation patterns in the tropical Pacific. It has climatic effects throughout the Pacific region and in many other parts of the world, through global teleconnections with fluctuations elsewhere. The cold phase of ENSO is called *La Niña*.

**Ensemble**

A group of parallel model simulations. Typical ensemble sizes in many studies range from 10 to 100 members, although this number is often considerably smaller for long runs with the most complex climate models. Variation of the results across the ensemble members gives an estimate of uncertainty. Ensembles made with the same model but different initial conditions characterize the uncertainty associated with internal climate variability, whereas multi-model ensembles including simulations by several models also include effects of model differences. Perturbed-parameter ensembles, in which model parameters are varied in a systematic manner, aim to produce a more objective estimate of modeling uncertainty than is possible with traditional multi-model ensembles.

**Evapotranspiration**

The combined process of evaporation from the Earth's surface and transpiration from vegetation.

**Fingerprint**

The climate response pattern in space and/or time to a specific forcing. Fingerprints are used to detect the presence of this response in observations and are typically estimated using forced climate model simulations.

**Geostrophic wind (or current)**

A wind or current that represents a balance between the horizontal pressure gradient and the Coriolis force. The geostrophic wind or current flows directly parallel to isobars with a speed inversely proportional to the spacing of the isobaric contours (*i.e.*, tighter spacing implies stronger geostrophic winds). This is one example of an important balance relationship between two fundamental fields, mass (represented by pressure) and

momentum (represented by winds), and implies that information about one of those two fields also implies information on the other.

**Land use** and **Land-use change**

*Land use* refers to the total of arrangements, activities and inputs undertaken in a certain land cover type (a set of human actions). The term "land use" is also used in the sense of the social and economic purposes for which land is managed (*e.g.*, grazing, timber extraction, and conservation).

*Land-use change* refers to a change in the use or management of land by humans, which may lead to a change in land cover. Land cover and land-use change may have an impact on the surface albedo, evapotranspiration, sources and sinks of greenhouse gases, or other properties of the climate system and may thus have a radiative forcing and/or other impacts on climate, locally or globally.

**Likelihood**

The probability of an occurrence, an outcome or a result. This is expressed in this report using a standard terminology, as defined in the preface.

**Modes of climate variability**

Natural variability of the climate system, in particular on seasonal and longer timescales, predominantly occurs with preferred spatial patterns and timescales, through the dynamical characteristics of the atmospheric circulation and through interactions with the land and ocean surfaces. Such patterns are often called *regimes* or *modes* or Pacific North American pattern (PNA), the El Niño-Southern Oscillation (ENSO), the Northern Annular Mode (NAM; previously called Arctic Oscillation, AO) and the Southern Annular Mode (SAM; previously called Antarctic Oscillation, AAO). Many of the prominent modes of climate variability are discussed in chapter 2.

**Non-linearity**

A process where there is no simple proportional relation between cause and effect. The climate system contains many such non-linear processes, resulting in a system with a potentially very complex behavior. Such complexity may lead to abrupt climate change.

**North Atlantic Oscillation (NAO)**

The North Atlantic Oscillation is defined by opposing variations of barometric pressure near Iceland and near the Azores. Through the geostrophic wind relationship, it also corresponds to fluctuations in the strength of the main westerly winds across the Atlantic into Europe, and thus also influences storm tracks that influence these regions.

**Northern Annular Mode (NAM)**

A winter-time fluctuation in the amplitude of a pattern characterized by low surface pressure in the Arctic and strong middle latitude westerlies. The NAM has links with the northern polar vortex into the stratosphere. Its pattern has a bias to the North Atlantic and has a large correlation with the North Atlantic Oscillation.

**Numerical prediction model***

A model that predicts the evolution of the atmosphere (and more generally, other components of the climate system, such as the ocean) through numerical methods that represent the governing physical and dynamical equations for the system. Such approaches are fundamental to almost all dynamical weather prediction schemes, since the complexity of the governing equations do not allow exact solutions.

**Pacific Decadal Variability**
Coupled decadal-to-interdecadal variability of the atmospheric circulation and underlying ocean in the Pacific basin. It is most prominent in the North Pacific, where fluctuations in the strength of the wintertime Aleutian Low pressure system co-vary with North Pacific sea surface temperature, and are linked to decadal variations in atmospheric circulation, sea surface temperature and ocean circulation throughout the whole Pacific Basin.

**Pacific North American (PNA) pattern**
An atmospheric large-scale wave pattern featuring a sequence of tropospheric high and low pressure anomalies stretching from the subtropical west Pacific to the east coast of North America.

**Paleoclimate**
Climate during periods prior to the development of measuring instruments, including historic and geologic time, for which only proxy climate records are available.

**Parameterization**
The technique of representing processes that cannot be explicitly resolved at the spatial or temporal resolution of the model (sub-grid scale processes), by relationships between model-resolved larger scale flow and the area or time averaged effect of such sub-grid scale processes.

**Patterns of climate variability**
Natural variability of the climate system, in particular on seasonal and longer time-scales, predominantly occurs with preferred spatial patterns and timescales, through the dynamical characteristics of the atmospheric circulation and through interactions with the land and ocean surfaces. Such patterns are often called regimes, modes or teleconnections. Examples are the North Atlantic Oscillation (NAO), the Pacific-North American pattern (PNA), the El Niño-Southern Oscillation (ENSO), and the Northern and Southern Annual Mode (NAM and SAM). Many of the prominent modes of climate variability are discussed in chapter 2.

**Predictability**
The extent to which future states of a system may be predicted based on knowledge of current and past states of the system.

**Probability Density Function (PDF)**
A probability density function is a function that indicates the relative chances of occurrence of different outcomes of a variable.

**Reanalysis***
An objective, quantitative method for representing past weather and climate conditions and, more generally, conditions of other components of the Earth's climate system such as the oceans or land surface. An important goal of most reanalysis efforts to date has been to reconstruct a detailed, accurate, and continuous record of past global atmospheric conditions, typically at time intervals of every six to 12 hours, over periods of decades or longer. This reconstruction is accomplished by integrating observations obtained from numerous data sources together within a numerical prediction model through a process called data assimilation.

**Sea-surface temperature**
The bulk temperature in the top few meters of the ocean. Measurements are made by ships, buoys and drifters.

**Storm tracks**
Originally a term referring to the tracks of individual cyclonic weather systems, but now often generalized to refer to the regions where the main tracks of extratropical disturbances occur as sequences of low (cyclonic) and high (anticyclonic) pressure systems.

**Stratosphere**
The highly stratified region of the atmosphere above the troposphere extending from about 10 km (ranging from 9 km in high latitudes to 16 km in the tropics on average) to about 50 km altitude.

**Teleconnection**
A connection between climate variations over widely separated parts of the world. In physical terms, teleconnections are often a consequence of large-scale wave motions, whereby energy is dispersed from source regions along preferred paths in the atmosphere.

**Troposphere**
The lowest part of the atmosphere from the surface to about 10 km in altitude in mid-latitudes (ranging from 9 km in high latitudes to 16 km in the tropics on average) where clouds and weather phenomena occur. In the troposphere temperatures generally decrease with height.

# ACRONYMS

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|---|---|
| **AGCM** | Atmospheric General Circulation Model |
| **AMIP** | Atmospheric Model Intercomparison Project |
| **AMO** | Atlantic Multi-decadal Oscillation |
| **AMS** | American Meteorological Society |
| **AR4** | IPCC Fourth Assessment Report |
| **BC** | black carbon |
| **CCCma-CGCM3.1(T47)** | a Canadian Centre for Climate Modelling and Analysis model |
| **CCSM3** | a National Center for Atmospheric Research model |
| **CCSP** | Climate Change Science Program |
| **CFS** | Climate Forecast System |
| **CFSRR** | Climate Forecast System Reanalysis and Reforecast Project |
| **CMIP** | Coupled Model Intercomparison Project |
| **CNRM-CM3** | a Météo-France/Centre National de Recherches Météorologiques model |
| **CRU** | Climate Research Unit |
| **CRUTEM** | Climate Research Unit Land Temperature Record |
| **CSIRO** | Commonwealth Scientific and Industrial Organization |
| **CSIRO-Mk3.0** | a CSIRO Marine and Atmospheric Research model |
| **CTD** | Conductivity Temperature Depth |
| **DJF** | December-January-February |
| **DOE** | Department of Energy |
| **ECHAM5/MPI-OM** | a Max-Planck Institute for Meteorology model |
| **ECMWF** | European Center for Medium-Range Weather Forecasting |
| **ENSO** | El Niño-Southern Oscillation |
| **ESMF** | Earth System Modeling Framework |
| **EU** | European Union |
| **FAR** | fraction of attributable risk |
| **FGGE** | First GARP Global Experiment |
| **FGOALS-g1.0** | an Institute for Atmospheric Physics model |
| **GARP** | GEMPAK Analysis and Rendering Program |
| **GCHN** | Global Historical Climatology Network |
| **GCM** | Global Circulation Model |
| **GCOS** | Global Climate Observing System |
| **GEMPAK** | General Meteorology Package |
| **GEMS** | Global Environment Monitoring System |
| **GEOS** | Goddard Earth Observing System |
| **GEOSS** | Global Earth Observing System of Systems |
| **GFDL** | Geophysical Fluid Dynamics Laboratory |
| **GFDL-CM2.0** | a Geophysical Fluid Dynamics Laboratory model |
| **GFDL-CM2.1** | a Geophysical Fluid Dynamics Laboratory model |
| **GISS** | Goddard Institute for Space Studies |
| **GISS-EH** | a Goddard Institute for Space Studies model |
| **GISS-ER** | a Goddard Institute for Space Studies model |
| **GMAO** | Global Modeling and Assimilation Office |
| **GODAR** | Global Oceanographic Data Archaeology and Rescue |
| **GPCC** | Global Precipitation Climatology Project |
| **GRIPS** | GCM-Reality Intercomparison Project for SPARC |
| **GSI** | grid-point statistical interpolation |
| **HIRS** | High-resolution Infrared Radiation Sounder |

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| 1 | **ICOADS** | International Comprehensive Ocean-Atmosphere Data Set |
| 2 | **IDAG** | International Ad Hoc Detection and Attribution Group |
| 3 | **IESA** | integrated Earth system analysis |
| 4 | **INM-CM3.0** | an Institute for Numerical Mathematics model |
| 5 | **IPCC** | Intergovernmental Panel on Climate Change |
| 6 | **IPSL-CM4** | Institute Pierre Simon Laplace model |
| 7 | **ITCZ** | Intertropical Convergence Zone |
| 8 | **JAMSTEC** | Frontier Research Center for Global Change in Japan |
| 9 | **JJA** | June-July-August |
| 10 | **LDAS** | Land Data Assimilation System |
| 11 | **LLJ** | low-level jet |
| 12 | **MERRA** | Modern Era Retrospective-Analysis for Research and Applications |
| 13 | **MIROC3.2(medres)** | a Center for Climate System Research model |
| 14 | **MIROC3.2(hires)** | a Center for Climate System Research model |
| 15 | **MJO** | Madden-Julian Oscillation |
| 16 | **MRI** | Meteorological Research Institute |
| 17 | **MRI-CGCM2.3.2** | a Meteorological Research Institute model |
| 18 | **MSU** | Microwave Sounding Unit |
| 19 | **NAM** | Northern Annular Mode |
| 20 | **NAMS** | North American Monsoon System |
| 21 | **NAO** | North Atlantic Oscillation |
| 22 | **NARR** | North American Regional Reanalysis |
| 23 | **NASA** | National Aeronautics and Space Administration |
| 24 | **NCAR** | National Center for Atmospheric Research |
| 25 | **NCDC** | National Climatic Data Center |
| 26 | **NCEP** | National Centers for Environmental Prediction |
| 27 | **NIDIS** | National Integrated Drought Information System |
| 28 | **NIES** | National Institute for Environmental Studies |
| 29 | **NOAA** | National Oceanic and Atmospheric Administration |
| 30 | **NRC** | National Research Council |
| 31 | **NSIPP** | NASA Seasonal-to-Interannual Prediction Project |
| 32 | **OSE** | Observing System Experiments |
| 33 | **PCM** | National Center for Atmospheric Research model |
| 34 | **PCMDI** | Program for Climate Model Diagnosis and Intercomparison |
| 35 | **PDO** | Pacific Decadal Oscillation |
| 36 | **PDSI** | Palmer Drought Severity Index |
| 37 | **PIRATA** | Pilot Research Moored Array in the Atlantic |
| 38 | **PNA** | Pacific North American Pattern |
| 39 | **PRISM** | Precipitation-elevation Regressions on Independent Slopes Model |
| 40 | **QBO** | Quasi-Biennial Oscillation |
| 41 | **SAP** | Synthesis and Assessment Product |
| 42 | **SNOTEL** | Snowpack Telemetry |
| 43 | **SODA** | Simple Ocean Data Assimilation |
| 44 | **SPARC** | Stratospheric Processes and their Role in Climate |
| 45 | **SRES** | (IPCC) Special Emissions Scenario |
| 46 | **SST** | sea surface temperature |
| 47 | **SSU** | Stratospheric Sounding Unit |
| 48 | **TAO** | Tropical Atmosphere Ocean |
| 49 | **TAR** | IPCC Third Assessment Report |
| 50 | **T2M** | two meter height temperature |
| 51 | **UKMO-HadCM3** | a Hadley Centre for Climate Prediction and Research model |

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| **UKMO-HadGEM1** | a Hadley Centre for Climate Prediction and Research model |
| **WCRP** | World Climate Research Programme |
| **WOAP** | WCRP Observations and Assimilation Panel |
| **WOD** | World Ocean Database |
| **XBT** | expendable bathythermograph |