**Climate information products**[[1]](#footnote-1)

Climate products are information packages that include data, summaries, tables, graphs, maps, reports and analyses. Spatial distributions may be shown on maps. More complex products, such as climate atlases or analyses, may combine several kinds of visualization with descriptive text (WMO, 2011). The climate service is often required to interpret the meaning of the information product to the user.

1. **Historical climate data sets**

Developing and securing basic, historical climate data sets for characterizing past climate behavior on all time and space scales is one of the key components of a Climate Services Information System. Some NMHSs include historical climatological data series in yearbooks or other annual bulletins. Historical data sets help to design groups of projects and policies. For example, the calculation of probabilities of the speed and direction of movement of tropical storms from historical storm data is strategic, meaning that aids in the general long-term planning. Historical information must be collected, subjected to quality control, archived and made accessible in a timely manner. Products concerning historical data should be of higher quality than those using very recent data. All data that contribute to the climate record should be checked for random and systematic errors, homogeneity, spatial representativeness and gaps in time series. For products such as climatic atlases or technical regulations, data should be for a standard reference period. The value of historical climatological data tables can usually be improved by the inclusion of a supporting text that serves to interpret the data to the user and to emphasize the more important climatological elements.

1. **Climatological data periodicals**

Monthly, quarterly or seasonal data periodicals can be issued to disseminate summarized seasonal data such as winter snowfall, growing-season precipitation, summer cooling degree-days and winter degree-days.

1. **Occasional publications**

Long-term, continuous and homogeneous series of data are of great value for comparative climatological studies. The collection of maps in atlas format is another valuable occasional publication.

1. **Standard products**

Standard products that can be used by a wide range of users. For example, both energy management entities and fruit growers can make use of a degree-day product. When the content, format and design of a product are carefully chosen, the development costs can be spread across many users.

1. **Specialized products**

Specialized products should be locally developed to meet the needs of groups of users. An example of an application-driven product can be found in the requirement by a fruit grower for daily degree-hour data for pesticide management of fire blight disease. Flood analysis is another example. A product that provides the probability of observed precipitation amounts is a necessary component in the development of flood frequency estimates.

1. **Climate monitoring products**

Monitoring activities require that the climate service develop expertise in analyzing the state of both past and current climate and global to regional teleconnections, and provide summarized information to both public and private sector users. Good monitoring products are essential for climate predictions and updates.

Monitoring of the climate provides information that can, for example, guide appropriate preparatory actions for mitigating the effects of extreme events. Close and meticulous monitoring also allows for detecting long-term climate change and determining its driving forces as well as its impacts around the world. Monitoring the climate at a global scale also helps improve regional and national predictions. Several countries produce national State of the Climate reports which provide a baseline for documenting ongoing climate variability and change. This baseline is useful for national reporting under environmentally-related conventions that include the UN Framework Convention on Climate Change. More frequent extreme events such as forest and grassland fires, floods, severe storms and drought are likely in a changed climate. Documenting their occurrence through special bulletins and advisory mechanisms will be critical for developing effective national early warning systems as well as appropriate mitigation and response actions.

1. **Indices**

Presentation of historical climate patterns to the user in a simple and readily understandable form may often be accomplished with indices. Climate indices are widely used to characterize features of the climate for climate prediction and to detect climate change. They may apply to individual climatological stations or describe some aspect of the climate of an area. Indices usually combine several elements into characteristics of, for example, droughts, continentality, phenological plant phases, heating degree-days, large-scale circulation patterns and teleconnections. Examples of indices are the El Niño–Southern Oscillation (ENSO) Index; the North Atlantic Oscillation Index; agrometeorological indices such as the Palmer Drought Severity Index; and the mean monsoon index, which summarizes areas of droughts and floods.

1. **Climate outlook products**

Climate outlooks are forecasts of the values of climate elements averaged over timescales of about one month to one year. The climate elements typically forecast are average surface air temperature and total precipitation for a given period. Sunshine duration, snowfall, the number of occurrences of tropical cyclones, and the onset and end of monsoons are also forecast in some centres. The WMO *El Niño/La Niña Update*, a consensus product based on inputs from a worldwide network of forecasting centres, provides an indication of the phase and strength of the El Nino–Southern Oscillation. The methods of climate forecasting can be roughly classified as empirical-statistical or dynamical. The empirical-statistical methods use relationships derived from historical data, while the dynamical methods are numerical predictions using atmospheric general circulation models or coupled ocean–atmosphere general circulation models (GCMs).

1. **Climate predictions**

A climate prediction is a probabilistic statement about the future climate on timescales ranging from years to decades. It is based on conditions that are known at present and assumptions about the physical processes that will determine future changes. A prediction generally assumes that factors beyond what is explicitly or implicitly included in the prediction model will not have a significant influence on what is to happen. For example, a weather prediction that a major snowstorm will develop over the next few days is mostly determined by the state of the atmosphere as observed (and its conditions in the recent past). The small changes that may occur over the next few days in other factors that are potentially influential on longer timescales, such as ocean temperatures or human activities are likely to be less important to the weather forecast.

1. **Climate projections**

A climate projection is usually a statement about the likelihood that something will happen several decades to centuries in the future if certain influential conditions develop. In contrast to a prediction, a projection specifically allows for significant changes in the set of boundary conditions, such as an increase in greenhouse gases, which might influence the future climate. As a result, what emerges are conditional expectations (if this happens, then that is what is expected). For projections extending well out into the future, scenarios are developed of what could happen given various assumptions and judgments. Projections are neither a prediction nor a forecast of what will or is likely to happen. For decision-makers, they indicate the likely outcomes resulting in part from the adoption of specified policy-driven actions.

1. **Climate scenarios**

A major use of global climate models is the generation of climate scenarios. A climate scenario refers to a plausible future climate constructed for investigating the potential consequences of human-induced climate change, but should also represent future conditions that account for natural climate variability. The IPCC reports and publications for example, provide a good source of information about climate scenarios.

1. **Global climate models**

Global climate models are designed mainly for representing climate processes on a global scale. They provide the essential means to study climate variability for the past, present and future. They are based upon the physical laws governing the climate processes and interactions of all of the components of the climate system, expressed in the form of mathematical equations in three dimensions. Initially, GCMs were directed at coupling the atmosphere and ocean; most state-of-the-art GCMs now include representations of the cryosphere, biosphere, land surface and land chemistry in increasingly complex integrated models that are sometimes called climate system models. These GCMs have formed the basis for the climate projections in IPCC assessments and contribute substantially to seasonal forecasting in climate outlook forums. There is considerable interest in refining global climate modelling in order to simulate climate on smaller scales, where most impacts are felt and adaptive capacity exists. Smaller-scale climates are determined by an interaction of forcings and circulations on global, large-area and local spatial scales and on sub-daily to multi-decadal temporal scales.

1. **Downscaling products: Regional climate models**

Models cannot provide direct information for scales smaller than their own resolution. A process known as downscaling relates the properties of a large-scale model to smaller-scale regions. The approach can be either dynamical or statistical, or a combination of the two. The dynamical approach involves nesting limited area high-resolution models within a coarser global model. Tools used in this process are known as regional climate models (RCMs). Since the RCM is essentially driven by the GCM, good performance of the GCM is of prime importance for the smaller-scale modelling. Statistical downscaling involves the application of statistical relationships between the large and smaller scales that have been identified in the observed climate. Features of the large scale, such as averages, variability and time dependencies, are functionally related to the smaller regional scale. The most severe limitation of statistical downscaling is the necessity for adequate historical observations upon which the statistical relationships are based. Both methods are prone to uncertainties caused by lack of knowledge of the Earth system, model parameter and structure approximations, randomness, and human actions.

1. **Local climate models**

Local climate models attempt to simulate microscale climate over a limited area of a few square meters to a square kilometer for a short time. Local climate modelling is used for a range of purposes, such as planning for potentially hazardous industrial plants; planning for outdoor and noise emissions from industrial and agricultural plants and roads; urban planning of, for example, ventilation, cold air flow and heat stress in single buildings or housing and industrial areas; warning and emergency services relating to local concerns that may include air quality and pollutant threshold levels; and managing the spread of hazards.

1. The list stems from an interpolation of WMO Climatological Guidelines (2011) and the Global Framework for Climate Services Brief on Climate Services Information System (2014). [↑](#footnote-ref-1)