# Climate Watch System

## Early Warning against Climate Anomalies and Extremes

World Meteorological Organization

Weather • Climate • Water

## Climate watch system for efficient monitoring and warning against extreme climate events

This brochure provides a summary of the *Guidelines on Climate Watches* (WCDMP-No. 58; WMO/TD-No. 1269) of April 2005, in accordance with the climate watch definition approved by the Commission for Climatology at its fourteenth session, held in Beijing from 3 to 10 November 2005. The aim of this brochure is threefold:

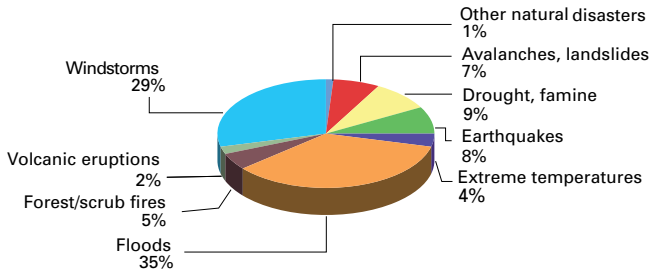
1. To provide a quick reference of common practices in implementing climate watch systems within the National Meteorological and Hydrological Services. Implementation steps are not given in detail, as they will vary according to the specific context, needs and requirements of each country;

2. To serve as material for WMO workshops dealing directly or indirectly with warning systems against severe weather and climate events;

3. To provide users with a simple description of a climate watch system.

Growing economic losses, coupled with an increase in deaths caused by extreme climate and weather events, have drawn the attention of governments, the scientific community and the public at large. In addition, it is now well established that any change in the frequency and/or severity of extreme climate events will have a negative impact on the well-being of populations and the sustainable development of societies. Therefore, adaptive measures should be taken to improve climate risk management capabilities among nations. Setting up an efficient extreme weather and climate warning system has long been a focus of WMO. The climate watch system, based on the continuous monitoring and forecasting of climate anomalies, is such a warning system. Its main governing entity should be the National Meteorological and Hydrological Services.

Although climate information plays a key role in the risk management of climate-related hazards, decision-makers often implement crisis management policy when dealing with extreme climate events.




*Global incidence of natural disasters (1991–2000) (Source: US Office of Foreign Disaster Assistance/Centre for Research on the Epidemiology of Disasters)*

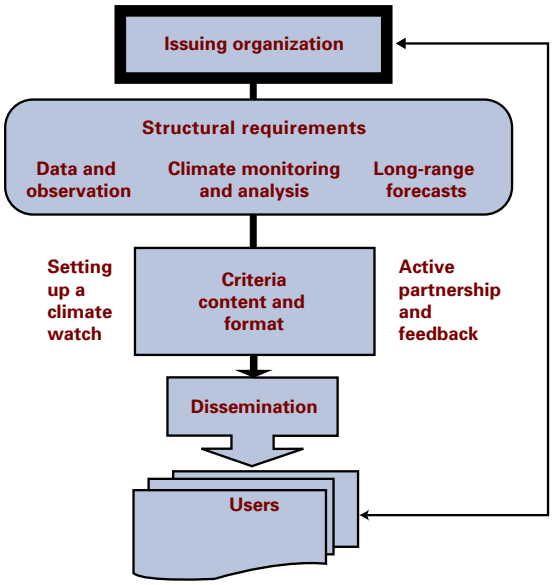
The climate watch system provides advisories and statements to inform users, particularly those involved in natural hazards preparedness, mitigation and response, about evolving or foreseen climate anomalies at the regional and national levels, thus allowing them to make informed decisions. To that effect, National Meteorological and Hydrological Services should continuously monitor and assess the status of the climate, evaluate available climate forecasts and, if warranted, issue appropriate advisories to users. The advisories should be based on all available climate information from National Meteorological and Hydrological Services, global producing centres and regional climate centres. This information includes observations on current conditions and weekly, 10-day, monthly, seasonal and annual monitoring and forecasting products.

A climate watch system provides a proactive mechanism for interacting with users and alerting them to major climate anomalies and extremes. This mechanism adds value to existing climate monitoring and forecasting systems within the National Meteorological and Hydrological Services and should be developed with a view to fully involving users in providing the conditional elements of the system: thresholds, indices, criteria and databases. Users should also take part in crafting the format and the content of the advisories, providing timely feedback and developing operational procedures and best practices.

## Climate watch system components

**Data and observations**

Near-real-time and historical climate observations are necessary for efficient monitoring and forecasting of extreme climate events. Monitoring changes in climate




*How to develop a climate watch system*

extremes generally requires high-quality resolution data on a daily basis. National Meteorological and Hydrological Services, which are responsible for establishing and managing observation networks and performing data analyses, require reliable climate data management systems to successfully implement climate watches.

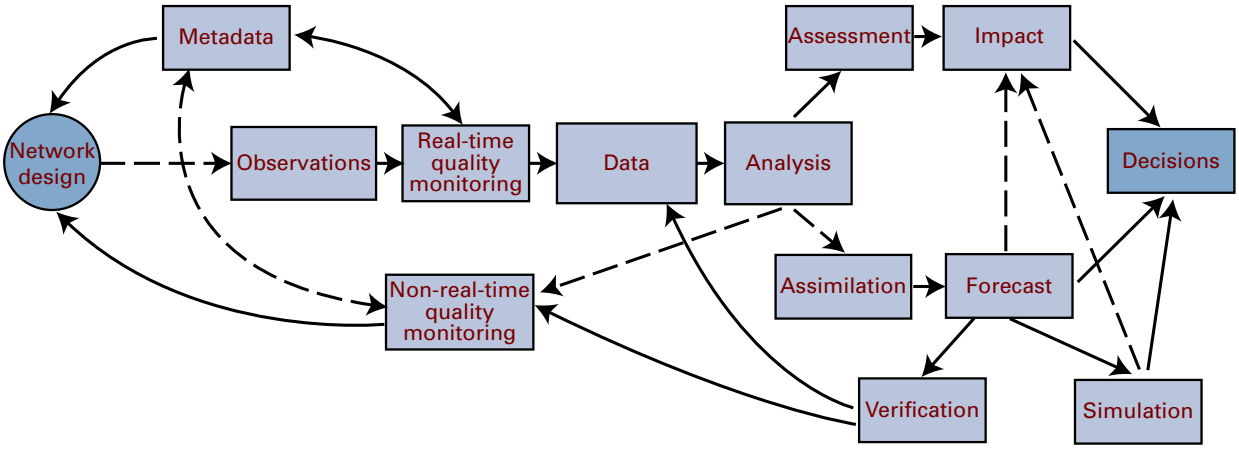
**Monitoring and analysis**

Before issuing a climate watch advisory, the current climate status and the magnitude of anomalies should be determined. During the validity period of a climate watch advisory, the issuing organization, generally a National Meteorological and Hydrological Service, must provide updated information to end-users on the evolution of climate anomalies (departures from the mean) and changes in climate outlooks. This may involve issuing a climate watch review at set stages after the initial advisory. Once the validity has expired, the potential for further climate anomalies should be monitored.

Index-based climate change analysis provides National Meteorological and Hydrological Services and users with information on changes observed in the distribution of key climate parameters. This involves statistical analyses of trends, extreme values and frequencies drawn from historical daily climate data.

Several climate indices defined by the CCI/CLIVAR/JCOMM* Expert Team on Climate Change Detection and Indices (ETCCDI) can be used to detect variability and trends in climate extremes. Some 27 core indices are based on daily temperature values and precipitation amount. Since they are computed according to fixed thresholds of relevance to particular applications or according to thresholds typically defined as a percentile of the relevant data series, the indices vary from location to location. Information on ETCCDI is available at http://www.clivar.org/organization/etccdi/etccdi.php. For a definition of the indices, see http://cccma.seos.uvic.ca/ETCCDI/. The indices computed for a given

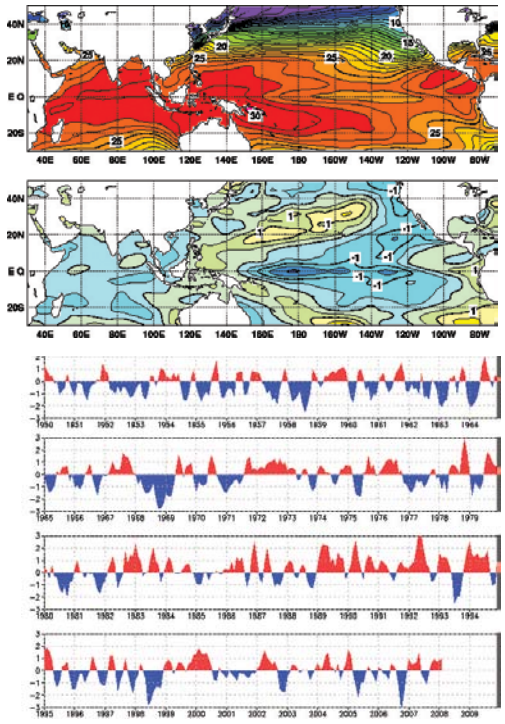
*CCI – Commission for Climatology
CLIVAR – Climate Variability and Predictability
JCOMM – Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology




*The fundamental role of observations, networks, climate data and metadata in providing climate information (Source: National Climate Centre, Bureau of Meteorology, Australia)*

(a)

(b)



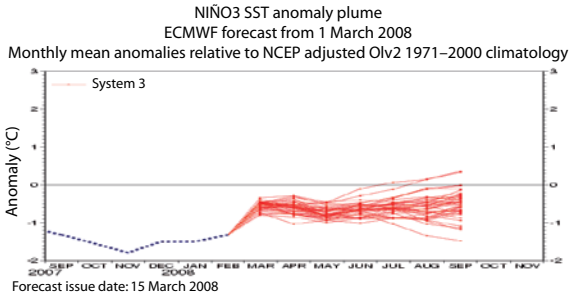
*Monthly mean sea-surface temperature and anomalies in the Pacific and Indian Oceans: (a) base period 1971–2000 (Source: Tokyo Climate Center, Japan); and (b) North Atlantic Oscillation standardized running mean through February 2008 time series (Source: Climate Prediction Center, National Centers for Environmental Prediction (NCEP), National Oceanic and Atmospheric Administration)*

country can be used to put the observed climate anomalies and extremes in a historical context for further analysis and can be useful in evaluating climate watch advisories to improve the climate watch system.

*ETCCDI workshop on exploring climate extremes and climate change indices in South-East Asia, Viet Nam, December 2007*

**Long-range forecasts**

Long-range forecasting involves the following tasks: using global and/or regional climate model outputs from the global producing centres or regional climate centres, respectively; downscaling – relating large-scale phenomena, such as the El Niño Southern Oscillation, to localized climate variability; adapting regional climate forecasts generated by the regional climate outlook forums; performing statistical analysis of historical climate data; and developing national dynamical long-range forecasting systems.




*El Niño plume*
*(Source: European Centre for Medium-Range Weather Forecasts)*

Forecasts should be verified and results made available to the user community. It is also necessary to assess the effectiveness of climate watch criteria over a period of time, which includes monitoring false alarms and hit rates.

**Outputs**

A climate watch system generates the following outputs: an initial climate watch advisory outlining the expected climate anomaly; one or more climate watch updates informing end-users of the progress of a climate watch (updates may be issued at monthly intervals or at intervals agreed upon in partnership with the end-user); and a final climate watch statement confirming that the climate watch has expired and that the likelihood of risks associated with the climate anomaly has diminished significantly.

The content and the format of climate watch advisories and statements should be developed in conjunction with the appropriate user intermediaries based on user needs and requirements. The format generally includes the following details: heading, name of issuing organization, type of warning, area affected by the climate watch, date and time issued, validity period, general climate watch statement, update advice, contact details of the issuing organization and a list of attachments.

A dissemination plan is drawn up by the National Meteorological and Hydrological Service concerned and its partner intermediaries, including members of the media. Advisories should be issued in a timely manner so that the end-user can benefit from their early warning aspect.

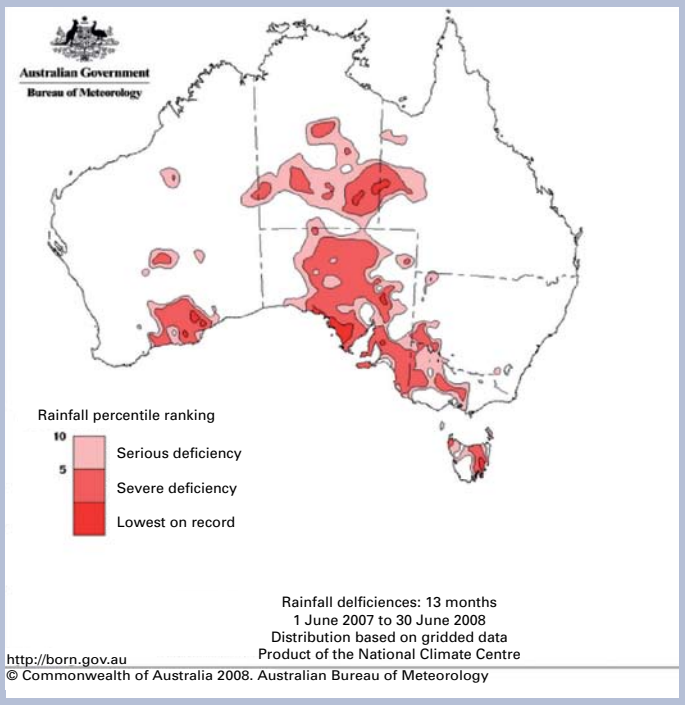
**Example of format and content of a climate watch advisory**

Australian Government
Bureau of Meteorology

INITIAL CLIMATE WATCH
Bureau of Meteorology National Climate Centre

CLIMATE WATCH FOR RAINFALL DEFICIENCY Climate watch valid for South Australia and western Victoria.
Issued on 3rd July 2008
Valid until 4th August 2008

Areas of serious to severe rainfall deficiencies across South Australia and western Victoria are likely to persist during the coming season. Most of SA and western Victoria have recorded rainfall totals in the lowest decile range for the thirteen-month period from 1st June 2007 to 30th June 2008. The outlook for the next three months, July to September, derived from the Bureau of Meteorology's statistical forecast model, shows that the chance of exceeding the median rainfall is only between 30 and 40% for these areas affected by rainfall deficits. Outlook confidence for this forecast is moderate over northern and central SA, with a skill level of around 60%. The confidence level for western Victoria is low, although in several areas the July to September rainfall total would need to be decile 8 or higher for the deficits to be removed.




These figures meet or exceed the criteria for a rainfall deficit climate watch for this region, being:

- Rainfall for the past three or more months: decile one or lower
- Chance of rainfall being greater than the median: 40% or lower
- Forecast skill score: 55% or greater

Climate situation: Sea-surface temperatures in the central equatorial Pacific have gradually increased over the previous two months and are now generally close to average. The final remnants of the 2007/08 La Niña event continue to linger in the western Pacific, although the overall ENSO state is rated as neutral. A majority of computer models in a recent survey indicated that neutral conditions are likely to persist for the next three to six months. However, these same models show that a positive dipole of Indian Ocean temperatures (IOD) may persist for a few more months. This phase of the IOD has been linked with reduced rainfall over central and south-eastern Australia.

This climate watch is expected to be updated on or before 4th August 2008

## User aspects

The National Meteorological and Hydrological Service identifies critical sets of prospective end-users and appropriate intermediaries. Users of climate information are individuals or organizations whose interests are affected by climate anomalies and who consider climate information when making decisions. The most vulnerable users are those involved in health, agriculture, food security, water resources, energy and transport. Climate and user databases need to be used together to analyse climate hazards and related impacts. The output will provide the geographical and historical references to monitor climate anomalies and extremes. By using the geographic information system, both databases can be integrated readily.

User intermediaries are individuals or organizations – governmental or others – responsible for providing guidance to climate-sensitive sectors to enable informed decision-making.

User stakeholders are organizations that have user interests at heart and a stake in the effectiveness of the processes aimed at meeting those interests. They include aid agencies, international organizations involved in development or governance, non-governmental organizations and community-based organizations.

| Sectors | Climate-related risks | Impacts |
|---|---|---|
| Health | Heatwave/cold wave | Cardiovascular, respiratory and heatstroke mortality |
| | Flood, landslide, windstorm | Deaths and injuries, infectious diseases and mental disorders |
| | Drought | Starvation, malnutrition and diarrhoea and respiratory diseases; strain on health due to poorer drinking water quality and availability |
| | Extreme temperature and excess of rainfall | Mosquito-borne and tick-borne diseases; rodent-borne, waterborne and food-borne diseases |
| Agriculture | Flood, heavy rainfall, hailstorm | Effects on early seedlings, damage to crops and submergence, inefficiency of applied fertilizers; damage to food and shelter for livestock; diseases such as cholera, worm infestation |
| | Drought | Early establishment in high lands, low plant stand, damage to crops; outbreak of diseases such as black quarter, anthrax in cattle |
| | High/low temperature | Yield reduction; diseases such as foot-and-mouth disease, peste des petits ruminants in cattle, heatstroke and production loss, cold stress and production loss |
| Tourism | High/low temperature | Travellers may be subject to sudden changes in temperature and the body requires time to adjust |
| | Radiation | Harmful to skin and eyes |
| | Wind | Adds to the discomfort of people, especially when laden with moisture |
| | High humidity and temperature | May lead to dehydratation and even fatality |
| Transport | Flood, heavy precipitation | Flooding of roadways, rail lines, subterranean tunnels and runways, road washout, damage to rail-bed support structures, damage to pipelines |
| | Heatwave | Compromised pavement integrity, deformation of rail lines, thermal expansion of bridge joints, heat buckling of runways |
| | Drought | Increased risk of wildfires, decreased visibility at airports in drought-prone areas |
| Water resources | Heavy rainfall | Increased river discharge, inundation, dam management |
| | Dry spell | Poor water quality, reduced water resources, effect on reservoir management and freshwater distribution in urban areas |
| Energy | Heatwave/cold wave | Increased demand for heating or cooling, reduced energy supply, affects gas and fuel pipelines |
| | Precipitation deficiency | Reduced hydropower energy production |

## Climate watch requirements

National Meteorological and Hydrological Services should assess their capabilities and needs to establish an effective climate watch production and dissemination system meeting the following requirements:

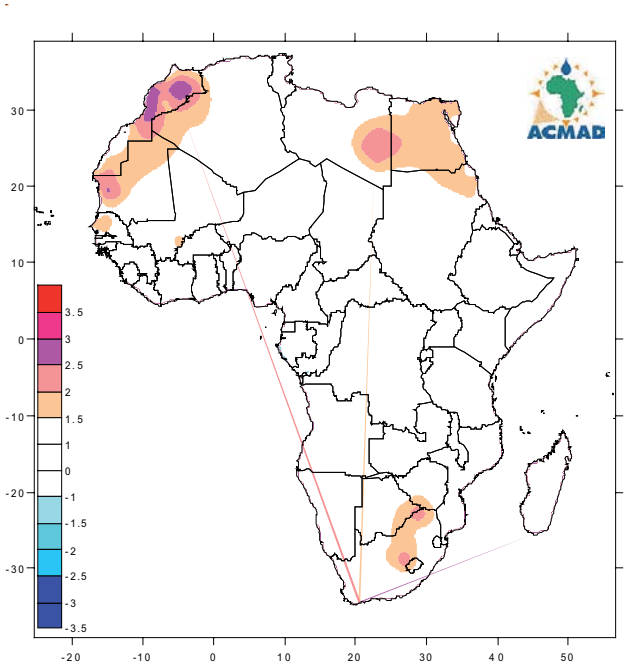
- Provide timely observations of current climate conditions for their areas of responsibility and adequate historical climate data;
- Perform timely monitoring and analyses of current climate anomalies;
- Enjoy access to current global climate forecasts and possess the technical capabilities to interpret and downscale them to their region;
- Deliver probabilistic climate forecast products that the user community can understand;
- Regularly update records of past forecasts and analyses of past forecast performance;
- Employ effective methods for the routine dissemination of climate information to user groups and sectors;
- Develop active partnerships with the user community and feedback mechanisms to provide guidance for the design of climate watches and evaluate their effectiveness.

If some aspects of required capacities are lacking, they will need to be developed. There are two points to consider when planning to build climate watch system capacity: activities that are necessary to ensure that National Meteorological and Hydrological Service staff have the skills to operate a climate watch system, and the need to build user capacity, requiring dedicated and sustained efforts best achieved by regular interaction and partnership. To that end, an outreach programme is necessary to ensure adequate use of system outputs and an understanding of its limitations and problem areas so that improvements can be made.

## Worldwide climate watch-related activities and examples

At the global level, the World Climate Data and Monitoring Programme (WCDMP) coordinates and facilitates international climate data and climate monitoring activities. It produces the annual WMO *Statement on the Status of the Global Climate* highlighting major global and regional climate anomalies that have occurred during the year. These and other publications provide users operating at the global, regional and national levels with useful information on the geographical extent and time scope of climate extremes such as drought, heatwaves, flooding, heavy precipitations and tropical cyclones. At the same time, efforts have been made to boost the capacities of National Meteorological and Hydrological Services in climate data management, data rescue and currently in climate watch implementation in the developing and least developed countries.

Since 1997, WMO and the International Research Institute for Climate and Society have issued the El Niño Update, with contributions from many meteorological services, regional centres and organizations. These updates are coordinated by the WMO World Climate Applications and Services Programme (WCASP).




*Example of monthly temperature anomalies provided by the* Climate Watch Africa Bulletin *(Source: ACMAD)*

At the regional level, the monthly *Climate Watch Africa Bulletin* is produced by the African Centre of Meteorological Applications for Development (ACMAD). The bulletin provides comprehensive analyses of the current status of the African climate, including the inter-tropical convergence zone, winds, rainfall, temperature and soil moisture. It also describes seasonal climate

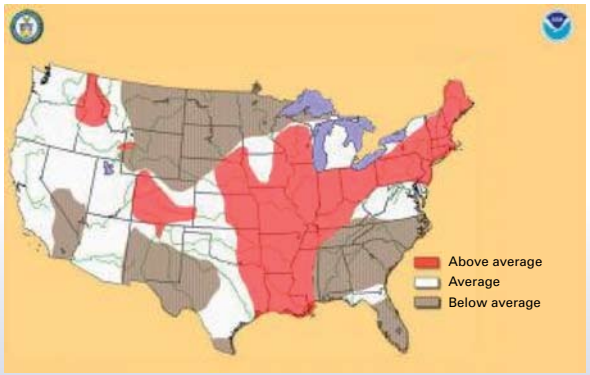

*Forecasted soil moisture anomaly for Europe*
*(Source: LISFLOOD output based on ECMWF-ERA40)*

outlooks and possible related impacts on continental and subregional scales.

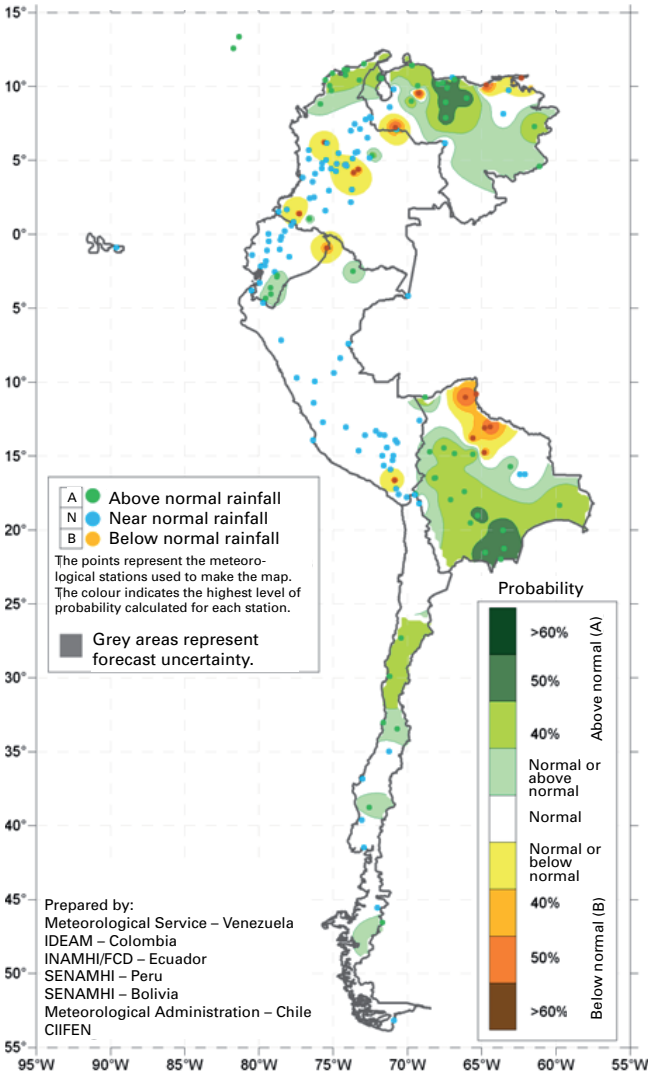
The International Research Centre on El Niño (*Centro Internacional para la Investigación del Fenómeno El Niño*, or CIIFEN) in Guayaquil, Ecuador, uses climate information from the global producing centres as the basis for El Niño outlooks for South America. The Centre also contributes to the regional climate outlook forums in that part of the world.

At the national level, the Hydrologic Information Center of the National Oceanic and Atmospheric Administration (NOAA) National Weather Service regularly monitors climate conditions, assesses flood risk and issues warnings in the United States.

The Institute for Environment and Sustainability of the Joint Research Centre of the European Commission develops methodologies and information systems for the prevention and prediction of weather-driven natural hazards throughout the European Union to complement national initiatives. It issues European flood alert bulletins and provides real-time flood-related information.




*United States spring flood risk as of 14 March 2008*
*(Source: NOAA)*




IDEAM – Institute of Hydrology, Meteorology and Environmental Studies
INAMHI – National Institute of Meteorology and Hydrology
FCD – Charles Darwin Foundation
SENAMHI – National Meteorological and Hydrological Service
CIIFEN – International Research Centre on El Niño

*Seasonal forecast for western South America, rainfall probability, June–August 2008*

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