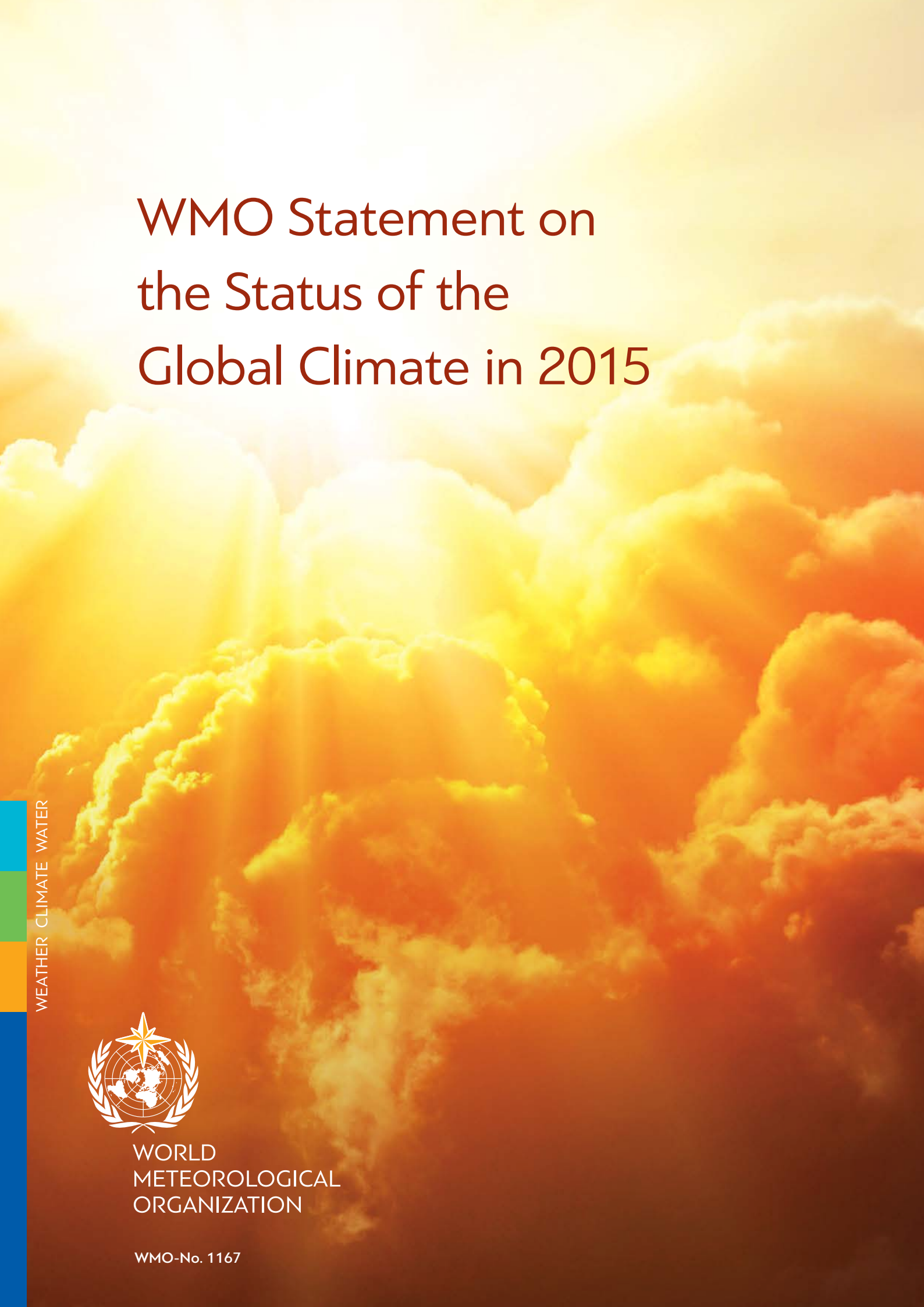
WMO Statement on the Status of the Global Climate in 2015



WEATHER CLIMATE WATER

WORLD METEOROLOGICAL ORGANIZATION

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Contents

Warmest year on record by far, 0.76 °C above 1961–1990 average

2015

1°

Increase above pre-industrial era; halfway to 2 °C limit

EL NIÑO

One of the strongest on record; combined with climate change from human activities to drive global temperatures to new peak

Heatwaves, droughts, floods, strong tropical cyclones

400 ppm

CO_2 concentrations breach symbolic benchmark in northern hemisphere spring

Excess energy from greenhouse gas emissions stored in oceans; record global ocean heat content down to 2 000 m.

93%

Foreword

As part of its mandate to provide authoritative information about weather, climate and water, the World Meteorological Organization (WMO) conducts annual assessments of the state of the global climate. For over two decades, those assessments have been published in the six official languages of the United Nations in order to inform governments, international agencies and other WMO partners about global climate trends, and extreme and notable weather and climate events at the national and regional levels.

The year 2015 will stand out in the historical record of the global climate in many ways. Modern records for heat were broken: 2015 was a record warm year both globally and in many individual countries. Heatwaves were extremely intense in various part of the world, leading to thousands of deaths in India and Pakistan. Record extreme precipitation led to flooding that affected tens of thousands of people across South America, West Africa and Europe. Dry conditions in southern Africa and Brazil exacerbated multi-year droughts. The influence of the strong El Niño that developed in the later part of 2015 can be discerned in many of the year's weather and climate events. While much work remains to be done, advances in international collaboration, the near-real-time sharing of data, and progress in attribution science are starting to make it possible to disentangle the respective roles played by El Niño, other natural climate variations and human-induced climate change.

On a more positive note, the Parties to the United Nations Framework Convention on Climate Change adopted the groundbreaking Paris Agreement in December. The world's governments unanimously agreed to take action in order to reduce global emissions of greenhouse gases into the atmosphere. They will aim to hold the increase in the global average temperature to well below 2 °C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5 °C. The Paris Agreement raises hope that international efforts to safeguard our planet will be accelerated in order to avoid reaching a point of no return for the climate system. However, the warming trend and an increasing number of disasters are expected to continue for several decades. That emphasizes the need to invest in adaptation as well as mitigation. One of the most powerful ways to adapt to the consequences of climate change is to strengthen disaster early warning and climate services.

WMO is committed to further enhancing weather and climate services and related research. But in addition to promoting scientific progress, WMO recognizes the need to build operational climate services that support climate resilience and adaptation. Some 70 countries around the world do not have the capabilities they need to generate and apply climate information and forecasts with the required timeliness and quality of service. The Global Framework for Climate Services is assisting least developed countries, small island developing States and other vulnerable countries to strengthen their national climate and meteorological capabilities. WMO is also working with its partners to help countries protect themselves from climate risks through multi-hazard early warning systems, impact-based forecasts and risk-informed warnings.

I would like to take this opportunity to express my gratitude to the National Meteorological and Hydrological Services of the WMO Members, to international and regional data centres and institutions, and to climate experts from around the world: they have all contributed to developing this annual statement according to the highest scientific standards.

WMO welcomes suggestions from its Members on how to further improve the Statement on the Status of the Global Climate, including in light of new requirements arising from the Paris Agreement, the Sendai Framework for Disaster Risk Reduction 2015–2030, and the United Nations Sustainable Development Goals.

(P. Taalas)
Secretary-General

Introduction

The *WMO Statement on the Status of the Global Climate in 2015* covers many aspects of the climate system, including atmospheric and ocean conditions, El Niño, the cryosphere, greenhouse gas concentrations, regional extremes, tropical cyclones and ozone depletion. The Statement draws on in situ and space-based observations collected through various WMO and co-sponsored programmes. It also draws on numerical objective analyses. These observations are the Essential Climate Variables that have been defined by the Global Climate Observing System.

The international datasets underpinning this assessment are maintained by advanced climate data, monitoring and research centres that collaborate with WMO. In addition, data and climate information has been collected directly from WMO Members through a special WMO survey. The global temperature analysis combines three international datasets: the first (HadCRUT) is maintained by the Met Office Hadley Centre in collaboration with the Climatic Research Unit at the University of East Anglia (both in the United Kingdom of Great Britain and Northern Ireland); the second is kept by the National Oceanic and Atmospheric Administration National Centers for Environmental Information (United States of America); and the third is maintained by the National Aeronautics and Space Administration, Goddard Institute for Space Studies (United States). The WMO analysis also incorporates reanalysis data maintained by the European Centre for Medium-Range Weather Forecasts and by the Japanese Meteorological Agency. Global precipitation information is provided by the Global Precipitation Climatology Centre (Germany).

The assessment of national temperature anomalies uses data collected directly from Members through a WMO survey. Data used in this publication relating to socioeconomic impacts are based on reports provided directly by Members or are taken from authoritative United Nations sources. The peer-review process involves international climate experts, regional institutions dealing with climate products and experts from the National Meteorological and Hydrological Services. In some cases, it was necessary to cross-check with national focal points in order to validate or update information available from global sources.

HAWAII, UNITED STATES

A powerful El Niño combined with rising temperatures is destroying the world's coral reefs, causing the longest die-off event on record.

NOAA

Key findings

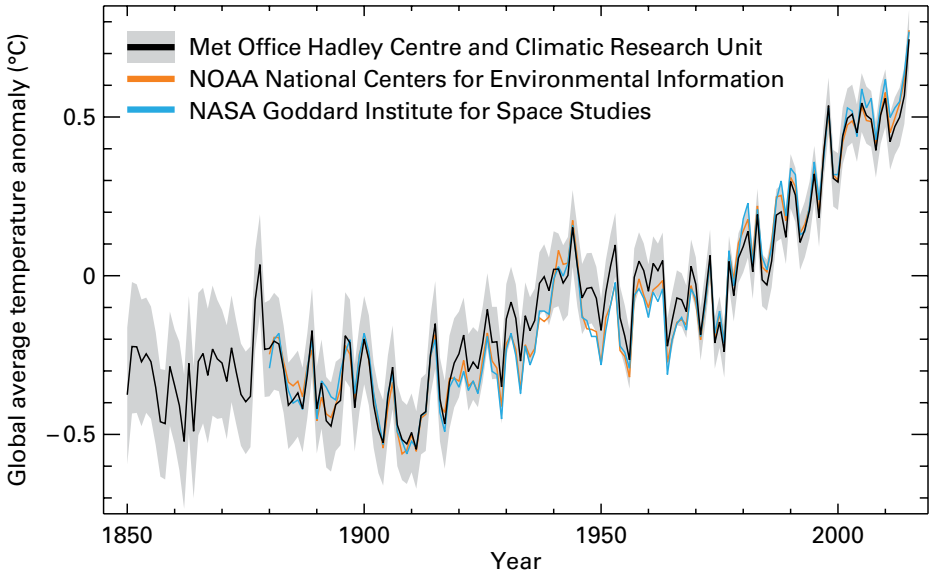


Figure 1. Global annual average temperature anomalies (relative to 1961–1990) for 1850–2015. The black line and grey shading are from the HadCRUT4 analysis produced by the Met Office Hadley Centre in collaboration with the Climatic Research Unit at the University of East Anglia. The grey shading indicates the 95% confidence interval of the estimates. The orange line is the NOAAGlobalTemp dataset produced by the National Oceanic and Atmospheric Administration National Centers for Environmental Information (NOAA NCEI). The blue line is the GISTEMP dataset produced by the National Aeronautics and Space Administration, Goddard Institute for Space Studies (NASA GISS). *(Source: Met Office Hadley Centre, United Kingdom, and Climatic Research Unit, University of East Anglia, United Kingdom)*

TEMPERATURE

In 2015, global warmth reached record levels as a result of the long-term rise in global temperatures (caused mostly by humanity's emissions of greenhouse gases) combined with the effects of a developing El Niño.

The global average near-surface temperature for 2015 was the warmest on record by a clear margin, according to data sources[1] analysed by WMO (Figure 1). The global average temperature for the year was about 0.76 ± 0.09 °C above the 1961–1990 average, and approximately 1 °C above the 1850–1900 average. Uncertainties relative to the period 1850–1900 are larger and more difficult to estimate.

These estimates are based on air-temperature data gathered at meteorological stations over land, and sea-surface temperatures measured at sea, both by ships in the voluntary observing fleet and by drifting and moored buoys. The estimates are corroborated by an analysis produced by the Japan Meteorological Agency.

Global average temperatures can also be estimated using output from reanalyses. In a reanalysis, historical observations from many different instruments are combined using a modern weather forecasting system, in order to give a comprehensive record of weather and climate. Two long-term reanalyses were surveyed: the ERA-Interim reanalysis, produced by the European Centre for Medium-Range Weather Forecasts, and the JRA-55 reanalysis, produced by the Japan Meteorological Agency. The central estimates for both of those reanalyses indicate that 2015 was the warmest year on record near the surface.

The global average of temperatures over land areas shows that 2015 was the joint warmest year on record over land: 2005, 2007 and 2010 are comparable. The global average temperature over the sea surface in 2015 was equal to the 2014 record. The combination of high land and sea temperatures made 2015 a record year overall.

Significant warmth was recorded over the majority of observed land areas (Figure 2). Particularly warm were large areas of South

[1] **HadCRUT4.4.0.0** produced by the Met Office Hadley Centre in collaboration with the Climatic Research Unit at the University of East Anglia (both in the United Kingdom); **GISTEMP** produced by the National Aeronautics and Space Administration, Goddard Institute for Space Studies (United States); and **NOAAGlobalTemp** produced by the National Oceanic and Atmospheric Administration National Centers for Environmental Information (United States). The number quoted is an average of those three datasets. Its uncertainty is taken from the HadCRUT4 dataset.

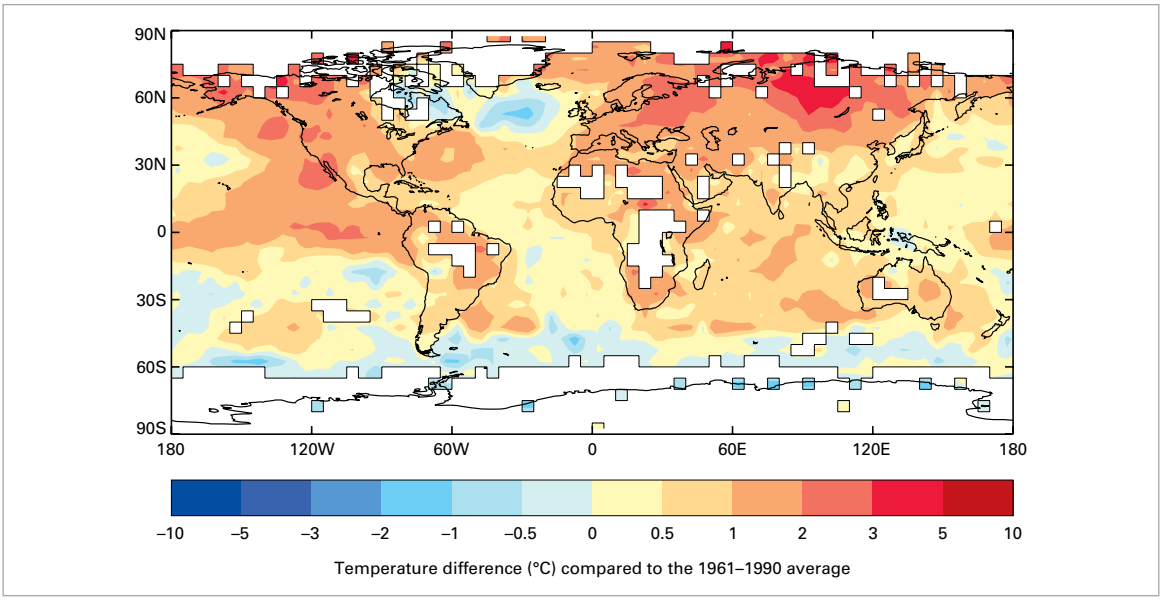
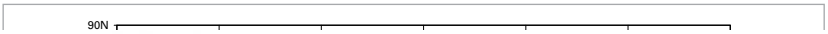


Figure 2. Annual average near-surface temperature anomalies (temperature difference from the 1961–1990 average) for 2015 from the HadCRUT4 dataset *(Source: Met Office Hadley Centre, United Kingdom)*

America, Africa, much of Europe, North-East Eurasia, the Middle East and western parts of North America. Continental temperature records were set for Asia and South America. The Russian Federation had its warmest year on record, at 2.16 °C above the 1961–1990 average. China also had its warmest year on record (since at least 1961) and 10 of its provinces experienced record warmth. Europe experienced either its second-warmest year (after 2014) or its warmest, and 2015 was either the warmest year in a number of countries (Estonia, Finland, Spain) or was one of the top three warmest years (Germany, France, Slovenia, Republic of Moldova, Hungary, Serbia). Africa and Oceania each experienced their second-warmest year on record.

Few land areas experienced significant cold conditions when averaged over the year. One notably colder-than-average area was the Antarctic, where the positive phase of the Southern Annular Mode (SAM) persisted for several months. In the positive phase of SAM, westerly winds strengthen and contract towards Antarctica. That induces cooling over most of East Antarctica and warming over the Antarctic Peninsula. October saw a change to less extreme values of the SAM index through to the end of the year and a warming relative to average over the continent. Some north-eastern areas of North America were colder than average during the year.

Figure 3. Annual total precipitation expressed as a percentile of the 1951–2010 reference period for areas that would have been in the driest 20% (brown) and wettest 20% (green) of years during the reference period, with darker shades of brown and green indicating the driest and wettest 10%, respectively *(Source: Global Precipitation Climatology Centre, Deutscher Wetterdienst, Germany)*



PRECIPITATION AND SNOW COVER