As climate changes, several direct influences alter precipitation intensity, frequency and type. Warming accelerates the rate of evaporation and the atmosphere can hold more water. Moisture stored in the oceans is gradually taken up by the atmosphere, which in turn acts to moisten the air rather than warm it. An observed consequence of increased heating from the human-induced greenhouse effect is increased evaporation, provided by the oceans and other wet surfaces. Hence, changes in the ocean and other wet conditions, together with increased evaporation caused by increased temperatures, has generally increased atmospheric moisture. The Clausius-Clapeyron relation (the Clausius-Clapeyron relation) determines that the water-holding capacity of the atmosphere increases by about 7% for every 1°C rise in temperature. Observations of trends in relative humidity have been made in many places over the 20th century, based on changes in sea surface temperature. The distribution and timing of floods and droughts is most profoundly affected by the interplay of El Niño events, particularly in the tropics and over much of the mid-latitudes of Pacific-rim countries. Consequently, with the increased availability of atmospheric moisture, increased temperatures will have resulted in increased water-vapour uptake, colder air pushing under warmer air (cold front), convection from local heating of the surface, and other weather and cloud systems. Hence, changes in the timing and intensity of storms are also reflected in the distribution of precipitation, with heavy precipitation becoming more common. In areas where aerosol pollution masks the ground from direct sunlight, enhanced greenhouse effect is increased evaporation, providing a measure of changes in evaporation. As precipitation increases, the supply to the atmosphere increases, as does the potential for heavier precipitation events. The warmer climate therefore increases risks of both drought and flooding. Observations show that changes are occurring in the amount, intensity, frequency and type of precipitation. These aspects of precipitation generally exhibit large annual variability, and El Niño events have been observed in precipitation changes in some places. Spatial patterns of precipitation changes are characteristic of changes in atmospheric circulation patterns such as the Pacific Decadal Oscillation and the Atlantic Oscillation. Over northern continents in winter, temperature changes are associated with climate change. An associated shift in the storm track makes some regions wetter and some − often nearby − drier, making for complex patterns of precipitation: the general term for rainfall, snowfall and other forms of liquid water falling from clouds. Precipitation is the result of increased heating from the human-induced greenhouse effect, increased evaporation, and changes in atmospheric circulation patterns such as the Pacific Decadal Oscillation and the Atlantic Oscillation. Over northern continents in winter, temperature changes are associated with climate change. An associated shift in the storm track makes some regions wetter and some − often nearby − drier, making for complex patterns of precipitation. Observations show that changes are occurring in the amount, intensity, frequency and type of precipitation. These aspects of precipitation generally exhibit large annual variability, and El Niño events have been observed in precipitation changes in some places. Spatial patterns of precipitation changes are characteristic of changes in atmospheric circulation patterns such as the Pacific Decadal Oscillation and the Atlantic Oscillation.
continues although it is not quite as intense as it was; it has been linked, through changes in atmospheric circulation, to changes in tropical sea surface temperature patterns in the Pacific, Indian and Atlantic Basins. Drought has become widespread throughout much of Africa and more common in the tropics and subtropics.

As temperatures rise, the likelihood of precipitation falling as rain rather than snow increases, especially in autumn and spring at the beginning and end of the snow season, and in areas where temperatures are near freezing. Such changes are observed in many places, especially over land in middle and high latitudes of the Northern Hemisphere, leading to increased rains but reduced snowpacks, and consequently diminished water resources in summer, when they are most needed. Nevertheless, the often spotty and intermittent nature of precipitation means observed patterns of change are complex. The long-term record emphasizes that patterns of precipitation vary somewhat from year to year, and even prolonged multi-year droughts are usually punctuated by a year of heavy rains; for instance as El Niño influences are felt. An example may be the wet winter of 2004–2005 in the southwestern USA following a six-year drought and below-normal snowpack.

**FAQ 3.2, Figure 1.** The most important spatial pattern (top) of the monthly Palmer Drought Severity Index (PDSI) for 1900 to 2002. The PDSI is a prominent index of drought and measures the cumulative deficit (relative to local mean conditions) in surface land moisture by incorporating previous precipitation and estimates of moisture drawn into the atmosphere (based on atmospheric temperatures) into a hydrological accounting system. The lower panel shows how the sign and strength of this pattern has changed since 1900. Red and orange areas are drier (wetter) than average and blue and green areas are wetter (drier) than average when the values shown in the lower plot are positive (negative). The smooth black curve shows decadal variations. The time series approximately corresponds to a trend, and this pattern and its variations account for 67% of the linear trend of PDSI from 1900 to 2002 over the global land area. It therefore features widespread increasing African drought, especially in the Sahel, for instance. Note also the wetter areas, especially in eastern North and South America and northern Eurasia. Adapted from Dai et al. (2004b).
From the report accepted by Working Group I of the Intergovernmental Panel on Climate Change but not approved in detail

Frequently Asked Questions

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