Chapter 9

Summary

Heat waves and cold waves are extreme temperature events that occur due to anomalies in the atmospheric circulation on a planetary scale and are supported by local factors. It is well known that global warming triggers extreme temperature events like heat waves all over the world.

In India, a heat wave is declared by the India Meteorological Department (IMD) when the maximum temperature is above 40 degrees Celsius and 4.5 degrees above normal. A severe heat wave is declared when the temperature is above 40 degrees Celsius and 6.5 degrees above normal. Heatwaves usually occur in the period from March to June in central and north-western India (heatwave zone) and in the coastal areas of Andhra Pradesh and Odisha. In this region, the frequency of heat waves is slightly lower than in northern India.

On average, heat wave areas experience two heat waves during the season, lasting between five and seven days. However, the frequency of heatwaves, their duration and their maximum duration are increasing, which is due to global warming. In the heat wave areas of India, the total duration of heat waves has increased by about 2.5 days in the last 30 years. The Intergovernmental Panel on Climate Change (IPCC) projections indicate an increase of about two heat waves (12-18 days) by 2060. Heat waves could also spread to southern India, where no heat waves are currently reported.

A cold wave is said to occur when the normal minimum temperature at the stations is 100 C or more and is at least 50 C below normal. If the normal minimum temperature at stations is below 100 C, the deviation should be at least 30C to be called a cold wave. Cold waves are generally observed over central and north-western India during the winter season from December to February. Previous observations suggest that the frequency and duration of cold waves over India is decreasing, possibly due to the increase in minimum temperatures. There are two types of cold waves in India. One

is associated with La Nina, with central and northwest India affected by cold waves. The second type occurs during the El Nino phase, but such cold waves are generally confined to the extreme northern parts of India.

The physical mechanisms of heat and cold waves are well studied and understood. Heat and cold waves are caused by large-scale anomalies in atmospheric circulation and are exacerbated by local effects such as land surface processes that affect soil moisture. Studies suggest that heat and cold waves are also predictable. On a short- to medium-term time scale, they are predictable up to 5-7 days in advance. Predicting heat waves on longer time scales (at least up to two weeks) and on seasonal time scales is very possible.

With unchecked global warming, the probability of compound extremes such as the simultaneous occurrence of droughts and heat waves is also likely to increase. Until we have studied the causes in depth, it is difficult to attribute a heatwave to human influence. However, the 2003 heatwave in Europe and the 2010 Russian heatwave were clearly attributed to human influence. The recent heatwaves in March and April 2022 in northern India are also consistent with IPCC projections.

Thanks to the efforts of the Ministry of Earth Sciences, Government of India, there is now a reliable heat wave warning system in India that provides vital information at least a week in advance. There is also good synergy between the Meteorological Department of India and the central and state disaster management agencies, which has led to the development of heatwave action plans in some states. The report by NDMA (2020) illustrate how India successfully reduced mortality due to heat waves by adopting heat wave action plans and effective and coordinated implementation. However, there is a need for greater inter-agency collaboration on heatwave impacts and adaptation.

It is high time that the India Meteorological Department (IMD) starts systematic research into the health implications of the rise in temperatures and humidity for Indian

conditions. In the meantime, the IMD can use available indices such as HI, as used by Jaswal et al. (2017), for daily monitoring and forecasting of heat waves.

We need to establish evidence-based thresholds to develop and activate different responses to heat and cold waves. For example, we need to develop strategies to educate and sensitize the public, improve energy efficiency to reduce stress on electrical systems to avoid power outages and reduce the heat island effect, build cool shades and shelters (such as cyclone shelters), and develop evidence-based advance warning systems to reduce crop damage. A long road lies ahead!