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Spring Sahelian heat waves: detection, characteristics and trends

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In the Sahel very high temperatures prevail in spring, prior to the wet monsoon season, with monthly-mean minimum (maximum) temperatures typically reaching 30°C (40°C). However, little is known about heat waves in this region at that time of year. This study documents Sahelian heat waves with a new methodology that allows selecting heat waves at specific spatio-temporal scales and can be used in other parts of the world. It is applied separately to daily maximum and minimum temperatures, as they lead to the identification of distinct events.

Synoptic to intraseasonal Sahelian heat waves are characterized from March to July over the period 1950–2012 with the Berkeley Earth Surface Temperature (BEST) gridded dataset. Morphological and temperature-related characteristics of the selected heat waves are presented. From March to July, the further into the season, the shorter and the less frequent the heat waves become. From 1950 to 2012, these synoptic-to-intraseasonal heat waves do not tend to be more frequent. However, they become warmer. At first order, this warming trend follows the Sahelian climatic trend, around 0.3°C per decade. Data suggest some differences though, with a relatively stronger warming of nighttime heat waves and a relatively weaker warming of daytime heat waves. Compared to other commonly used indices, the present index tends to select heat waves with more uniform intensities. This comparison of indices also underlined the importance of the heat index definition on the estimated climatic heat wave trends in a changing climate.

Finally, heat waves were identified with data from three meteorological reanalyses: ERA-Interim, MERRA, and NCEP-2. Inherent biases between the distributions of climatological means and variances resulted in significant differences in temperature-related heat wave characteristics. This notably affects Tmin anomalies in NCEP-2 nighttime heat waves (they are 3°C higher on average) and to a lesser extent Tmax in MERRA daytime heat waves, while temperature and temperature anomalies in both heat wave types are much closer to BEST in ERA-Interim. The spread in temperature seasonal cycles and trends among reanalyses also lead to differences in the interannual variability, and climatic trends of heat waves, with fewer departures from BEST and in-situ SYNOP data for ERA-Interim.