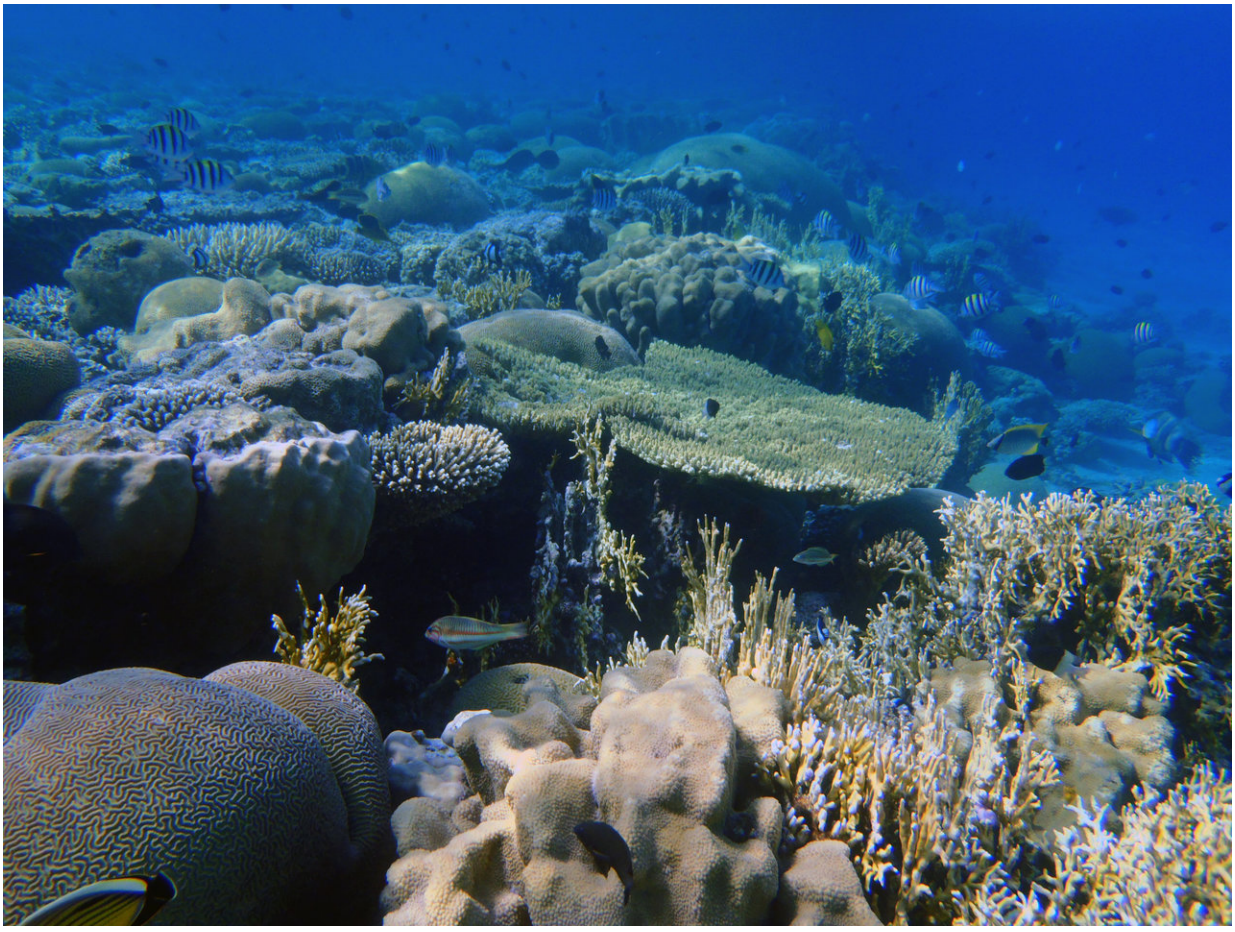
Coral skeletons act as archive of desert conditions from Little Ice Age

September 19 2018, by Kathryn Cawdrey



A coral reef in the northern Red Sea has massive colonies that are used in paleoclimatic research. Credit: Thomas Felis, MARUM, University of Bremen

The Sahara and Arabian deserts did not cool as much as the rest of the Northern Hemisphere during the Little Ice Age, but in fact were drier 200 years ago than they are today, according to a new study.

The Little Ice Age was a cool period from around 1450 to 1850. During this time, Europe was very cool and even experienced a "year without a summer" in 1816 due to the 1815 eruption of Mount Tambora, a volcano in Indonesia. Scientists knew Europe experienced significant cooling during the Little Ice Age because of historical data but were unsure how other parts of the world were affected, such as the Sahara and Arabian deserts.

Humans began installing weather stations around the globe around 1850, which means there were no instruments for scientists to use to analyze climate prior to that time. In the desert, natural archives, like trees that are used to detect historical climate changes, were not available.

In a new study, researchers analyzed a coral from the Red Sea, which lies between the Sahara and Arabian deserts, to reconstruct temperatures and aridity in the two deserts from 1750 to 1850.

Corals offer a natural archive in the surface ocean that documents climate variability, said Thomas Felis, a marine geologist at MARUM, the Center for Marine Environmental Sciences at the University of Bremen, Germany, and lead author of the new study in *Geophysical Research Letters*, a journal of the American Geophysical Union.

An X-ray image of northern Red Sea coral slab. The skeletal density banding pattern of alternating bands of high (dark color) and low density (light color) are visible. One year is represented by a low and high density-band pair. Core diameter is 3.5 cm. Credit: Thomas Felis, MARUM, University of Bremen

The new study finds the Sahara and Arabian deserts did not cool as much as Europe during this period and the deserts were drier than they are today.

Understanding natural climate variability in the past may improve projections of future climate change, especially in the subtropics, according to the study's authors. Past climate information can give insight into responses of the climate system to large events, such as volcanic eruptions. This insight may aid in producing a more-reliable projection of future climate changes.

Tracking climate

In the new study, the researchers sampled an annually-banded coral of the northern Red Sea, which provides a unique archive of temperature and aridity beyond the observational record.

These stony corals' skeletons are made of calcium carbonate, which allows them to build annual bands and incorporate geochemical tracers as they grow. The process is like how trees develop rings as they age. X-rays of coral skeleton slabs show alternating light and dark layers, which are the result of changes in growth rate and differences in skeletal density, according to the U.S. Geological Survey. Larger living corals show continuous records of the past 100 to 400 years, and reflect

changes in environmental factors.

Credit: Thomas Felis, MARUM, University of Bremen

"These annual bands give us a sort of calendar, so we can count back in time," Felis said. Analyzing the geochemistry of the bands allows scientists to reconstruct past ocean temperatures and salinity changes, he said.

The new study provided two major findings: The eastern Sahara and

Arabian deserts did not cool when most of the Northern Hemisphere did during the Little Ice Age and the deserts were more arid than they are today. The mild temperatures the two deserts experienced were likely a result of changes to atmospheric circulation, according to the authors.

"The corals' geochemistry is an archive for sea surface salinity, and therefore a proxy for evaporation and atmospheric circulation changes," Felis said. "This paper, and hopefully more papers, will contribute to a tropical network of coral records of temperature and sea surface salinity going back into the Little Ice Age."

The absence of pronounced cooling in the eastern parts of the Sahara and Arabian deserts during the late Little Ice Age—as indicated by the results of the study—has implications for the detection of the onset of industrial-era warming across these large continental areas, which did not commence prior to the early 20th century, according to the study's authors.

"Slight changes in climate variability … effects millions of people in the tropics to subtropics," Felis said. "Therefore, it's important to really understand more about climate dynamics in timescales which are very relevant for societies."

More information: Thomas Felis et al. Mild and Arid Climate in the Eastern Sahara-Arabian Desert During the Late Little Ice Age, *Geophysical Research Letters* (2018). DOI: 10.1029/2018GL078617