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EDITORIAL
EXPLORING THE PAST FORCE OF WATER

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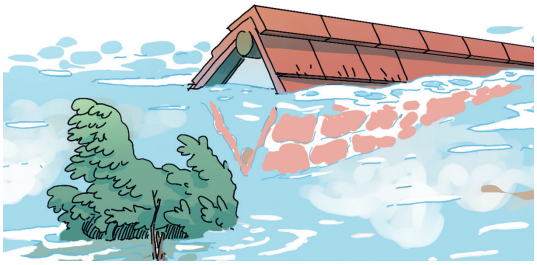
Dear Readers

Water, in all its forms, has the potential to shape the Earth's landscape over extended periods of time. For example, the formation of rivers which cut through the landscape, or larger (and rare) episodes such as the melting of ice sheets and mountain glaciers (which occurs over tens of thousands of years).

Water can also shape the landscape in the short term, following rare, extreme events (for example, from 100-year floods or droughts). These events can greatly impact the environment, including plants and animals (i.e. ecosystems), and people (such as farming and infrastructure). In recent decades it has become clear that global warming is changing the frequency and magnitude of heavy rainfall, flooding and drought events.

According to the latest Intergovernmental Report on Climate Change (Intergovernmental body of the United Nations; IPCC report, AR6), rising temperatures caused by climate change are intensifying wet and dry periods. Catastrophic floods are becoming more common, driven by changes in the frequency of extreme rainfall events, as well as by land degradation due to severe heatwaves and droughts, and/or deforestation by humans. Floods are also becoming more common in some regions because of increasing temperatures, which leads to the melting of glaciers and permafrost. Much of these changes in rainfall, flood and drought frequency, due to a warming climate, are particularly relevant in tropical regions, some of which are densely populated. There is an urgent need for people and communities to adapt to, and mitigate, such extreme climate events in the near future.



However, to do this, we need to understand the history of these extreme events, but our records are short – beginning only when people started measuring and recording them. In most world regions, instrumental measurements began less than 200 years ago. As such, we need a longer-term perspective, and this is where paleoscience – the study of climatic and environmental processes before there were instrumental records – can help us.

Paleoscience offers a better understanding of extreme floods by extending the instrumental record to hundreds, or even thousands, of years. When floods occur, rivers carry large amounts of sediment, move large boulders and cause land degradation. Extreme rainfall also infiltrates caves, flooding underground galleries. These sediments end up in the alluvial plains of the rivers and along rocky canyons, even reaching lakes and marine coastal areas. In the same way, droughts reduce infiltration into caves, and affect vegetation physiology. Every time an area is flooded or suffers a drought, a different kind of sediment layer, or ecological evidence, is produced. All this information forms the pages of a book that details the "history" of the past climate. The role of paleoscience is to help read the "pages" found in stratigraphic layers of sediments, tree rings, speleothems in caves, and sediments of lakes and marine basins.

We use paleorecords to learn how, for example, extreme wet and dry events have changed over time, and across the world. These long-term hydrologic histories help contextualize the magnitude of modern extreme events, their occurrence, impacts and trigger mechanisms. This information is essential to understanding the future trajectories of extreme wet and dry events under global warming, as well as to test hypotheses in hydrological sciences. What's more, we know that these rare but big events disrupted the functioning of past societies. Therefore, information from the paleosciences provide lessons from the past to help communities better prepare for extreme events and contribute to our sustainable development.

It is our pleasure to present this third volume of PAGES Horizons, dedicated to studying wet and dry using paleorecords. The volume contains a total of eight contributions which reveal, in a relaxed, fun, and visually appealing way, how scientists work with different archives, including speleothems, tree-rings, historical records, and sediments, and in various environments, such as volcanic, fluvial, cave and mountain regions. The research presented here covers the study of speleothems from caves in alpine and tropical environments; the impact of glacier retreat on the generation of massive floods in high mountain regions; the effect of volcanic eruptions triggering large floods due to changes in climatic and meteorological conditions; and changes in the precipitation and hurricane passages using isotopes and tree-ring records, among others. The value of paleoscience in analyzing hydrological-extreme events is illustrated using a variety of formats, including photo reports, comics and images.

We hope that readers will enjoy the stories told by different scientists and gain insight into how paleoscience can be used to inform a safe and sustainable future.