Anthropogenic climate change detected in natural and human systems of the world’s mountains

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Mountains cover about a quarter of the Earth’s land surface and are home to or serve a substantial fraction of the global population with essential ecosystem services, in particular water, food, energy, and recreation. While mountain systems are expected to be highly exposed to climate change, we currently lack a comprehensive global picture of the extent to which environmental and human systems in mountain regions have been affected by recent anthropogenic climate change.

Here we undertake an unprecedented effort to detect observed impacts of climate change in mountains regions across all continents. We follow the approach implemented in the IPCC 5th Assessment Report (AR5) and follow-up research where we consider whether a natural or human system has changed beyond its baseline behavior in the absence of climate change, and then attribute the observed change to different drivers, including anthropogenic climate change. We apply an extensive review of peer-reviewed and grey literature and identify more than 300 samples of impacts (aggregate and case studies). We show that a wide range of natural and human systems in mountains have been affected by climate change, including the cryosphere, the water cycle and water resources, terrestrial and aquatic ecosystems, energy production, infrastructure, agriculture, health, migration, tourism, community and cultural values and disasters. Our assessment documents that climate change impacts are observed in mountain regions on all continents. However, the explicit distinction of different drivers contributing to or
determining an observed change is often highly challenging; particularly due to widespread data scarcity in mountain regions. In that context, we were also able to document a high amount of impacts in previously under-reported continents such as Africa and South America. In particular, we have been able to include a substantial number of place-based insights from local/indigenous communities representing important alternative worldviews.

The role of human influence in observed climate changes is evaluated using data from multiple gridded observational climate products and global climate models. We find that anthropogenic climate change has a clear and discernable fingerprint in changing natural and human mountain systems across the globe. In the cryosphere, ecosystems, water resources and tourism the contribution of anthropogenic climate change to observed changes is significant, showing the sensitivity of these systems to current and future climate change. Furthermore, our analysis reveals the need to consider the plurality of knowledge systems through which climate change impacts are being understood in mountain regions. Such attempts at inclusivity, which addresses issues of representation and justice, should be deemed necessary in exploring climate change impacts.