Monitoring and understanding the ongoing evolution of global mountain systems: Hotspots of snow cover change and other examples

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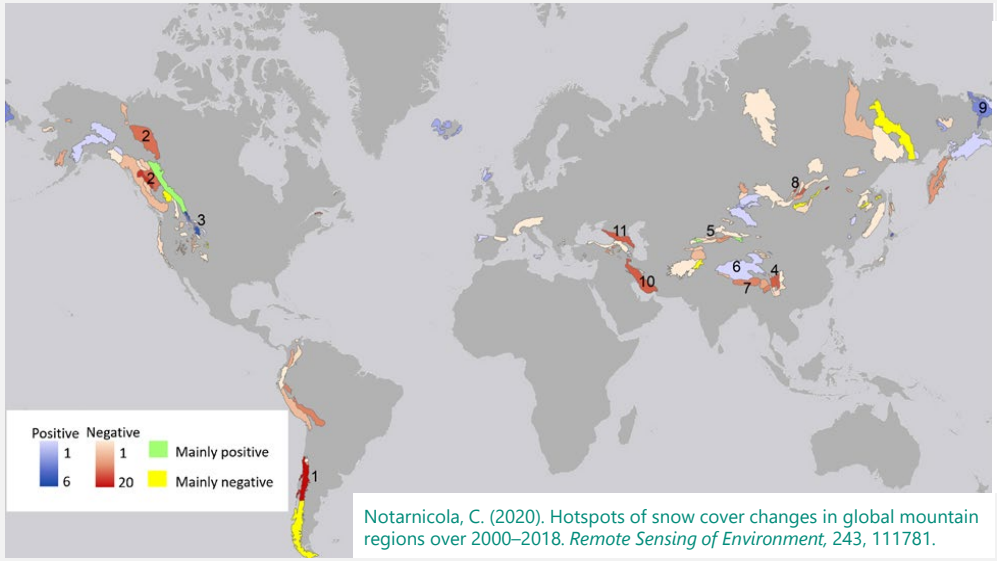
EURAC Research is a private research center with researchers from a wide variety of scientific fields and across the globe. It is one of several organizations involved in GEO Mountains.

GEO Mountains is a Group on Earth Observations (GEO) Work Programme Initiative that is co-led by the Mountain Research Initiative and ISAC-CNR, and is supported by the Adaptation at Altitude Programme. It seeks to coordinate activities to improve the access and use of data and information on mountain regions globally.

Hotspots of snow cover changes over 2000-2018

Using MODIS images from 2000 to 2018, variations in snow cover and snow phenology (duration, onset and melt) were assessed in global mountain ranges. Considering different elevation belts and seasons, 42 parameters were analysed. The main findings are that:

- Around 78% of the areas with significant changes indicate a snow decline
- Snow cover duration decreases up to 43 days and snow cover area decreases up to 13% are observed
- The change in snow accumulation onset (days/y) is smaller than that in snow melt onset (days/y)
- A few areas show positive changes with increases in snow cover duration of up to 32 days and snow cover area of up to 11%, mainly during winter in Northern Hemisphere
- From 4000 m upwards, only negative changes are detected in the analysed parameters



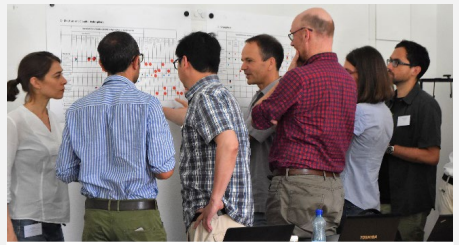
1: SouthAmerica-02
2: Skeena Mountains, Omineca Mountains, and Mackenzie Mountains
3: Flathead Range and Lewis Range
4: Daxue Shan and Shaluli Shan
5: TienShan
6: Tibetan Plateau
7: Nyainquentanglha Mountains
8: Baykal'skly Khrebet, Tungirskly Khrebet and Ikatskly Khrebet
9: Chukotskly (Anadyrslky) Khrebet
10: Zagros Mountain
11: Greater Caucasus

Notarnicola, C. (2020). Hotspots of snow cover changes in global mountain regions over 2000–2018. *Remote Sensing of Environment,* 243, 111781.

Hotspots of snow cover changes in global mountain ranges. The map illustrates the direction of change in the snow parameters analysed across the global mountain regions considered. In the legend, six indicates the maximum number of positive trends and 20 the maximum number of negative trends found in the observed regions.

Towards a definition of Essential Mountain Climate Variables

- Little consensus exists regarding which variables should be considered absolute observation priorities for monitoring and understanding the drivers, responses, and impacts of ongoing change in global mountains
- As a first step, we identified 25 key processes and ranked over 80 corresponding variables according to their perceived importance
- Defining corresponding observation requirements (e.g. spatial resolution etc.) in mountain areas is an important task that requires further work
- Establishing better mountain observatories, making use of Data Cube technologies, and integrating in situ and remotely sensed data alongside numerical models may further improve the situation



Thornton, J.M. et al., Towards a definition of Essential Mountain Climate Variables, under revision, *One Earth*

Using Artificial Intelligence to validate and downscale ecosystem-related Essential Biodiversity Variables in mountain environments

AI4EBV
https://ai4ebv.eurac.edu/

Sayre, R. et al. (2020). An assessment of the representation of ecosystems in global protected areas using new maps of World Climate Regions and World Ecosystems. *Global Ecology and Conservation*, 21.

- In this new project, we will derive accurate, high-resolution maps of mountain ecosystem extents by exploiting the advanced feature extraction capabilities provided by AI-based algorithms and the computational power of cloud-based platforms
- Specifically, for two study regions – the Central European Alps and the Himalayas – we will assess the accuracy of the World Terrestrial Ecosystems (WTE) map (Sayre et al., 2020; left) and explore whether Earth Observation data can be used to improve its spatial resolution and thematic content