



Observed hotspots of changing snow depth and snowfall in European mountain regions

Micu, Dana-Magdalena; Amihaesei, Vlad-Alexandru; Quinti, Gabriele; Halsnæs, Kirsten; Some, Shreya; Paraschiv, Monica-Gabriela; Dumitrescu, Alexandru; Cheval, Sorin

Published in:
Book of abstract of EGU General Assembly 2025

Link to article, DOI:
[10.5194/egusphere-egu25-15922](https://doi.org/10.5194/egusphere-egu25-15922)

Publication date:
2025

Document Version
Early version, also known as pre-print

[Link back to DTU Orbit](#)

Citation (APA):
Micu, D.-M., Amihaesei, V.-A., Quinti, G., Halsnæs, K., Some, S., Paraschiv, M.-G., Dumitrescu, A., & Cheval, S. (2025). Observed hotspots of changing snow depth and snowfall in European mountain regions. Manuscript submitted for publication. In *Book of abstract of EGU General Assembly 2025* Article EGU25-15922 <https://doi.org/10.5194/egusphere-egu25-15922>

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.



Observed hotspots of changing snow depth and snowfall in European mountain regions

Dana-Magdalena Micu¹, **Vlad-Alexandru Amihaesei**¹, Gabriele Quinti², Kirsten Halsnæs³, Shreya Some³, Monica-Gabriela Paraschiv¹, Alexandru Dumitrescu¹, and Sorin Cheval¹

¹National Meteorological Administration, Climatology, Bucharest, Romania (dana.micu@meteoromania.ro)

²Conoscenza e Innovazione, Roma, Italy (quinti@knowledge-innovation.org)

³Danmarks Tekniske Universitet, Copenhagen, Denmark (khal@dtu.dk)

Mountain regions are particularly vulnerable to natural hazards, such as snow avalanches, landslides, or flash-flooding, which are increasingly exacerbated by climate warming and changing climate patterns. This paper leverages the Copernicus Regional ReAnalysis for Europe (CERRA) dataset, with 5 km x 5 km spatial resolution, from the Copernicus Climate Change Service (C3S), covering the period 1985–2020, to analyse the changing of the seasonal patterns of snow depth and snowfall in two major European mountain ranges: the Alps and the Carpathians. More specifically, the study aims to identify the mountain areas with persistent and statistically significant increases or declines in snowfall and snow depth, referred to as "hotspots". The focus of the study is on four key snow depth and snowfall-related indicators including (i) total snow depth, (ii) number of snow cover days, (iii) days with snow depth exceeding 30 cm, and (iv) snowfall water equivalent. The hotspots are identified based on local spatial auto-correlation methods (the Getis and Ord G statistic), using the estimated Mann-Kendall trends of the four snow indicators as inputs. A positive G_i value signifies that a feature and its surrounding neighbours exhibit high values, whereas a negative G_i value indicates low values in the feature and its neighbours. The magnitude of the G_i value reflects the intensity of the clustering.

The results indicate widespread hotspots characterised by significant declines in both snow depth and snowfall indicators, in all seasons, especially at low and mid-elevations in both mountain regions. The observed shifts are particularly pronounced during winter (December-January-February) and spring (March-April-May). The location of identified hotspots carries multiple implications for the distribution and availability of water resources, ecosystem services, infrastructure and tourism activities, and so for the livelihood of mountain communities. These findings provide critical insights into the shifting snow avalanche hazard and their socio-economic impacts at NUTS3 level and in specific areas where historical snow avalanche events have significantly impacted three key socio-economic sectors—tourism, infrastructures, and forestry. They also could underscore the ongoing challenges in the mountain risk management under a changing climate.

This research received funds from the project "Cross-sectoral Framework for Socio-Economic Resilience to Climate Change and Extreme Events in Europe (CROSSEU)" funded by the European Union Horizon Europe Programme, under Grant agreement n° 101081377.

