Monitoring of snow cover in Skalnatá valley (High Tatras) using time-lapse photography

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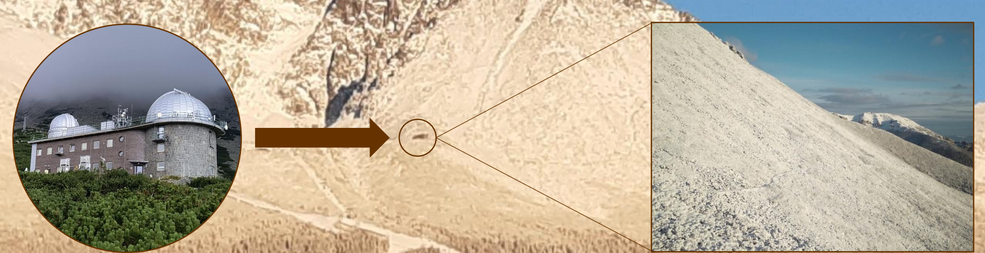
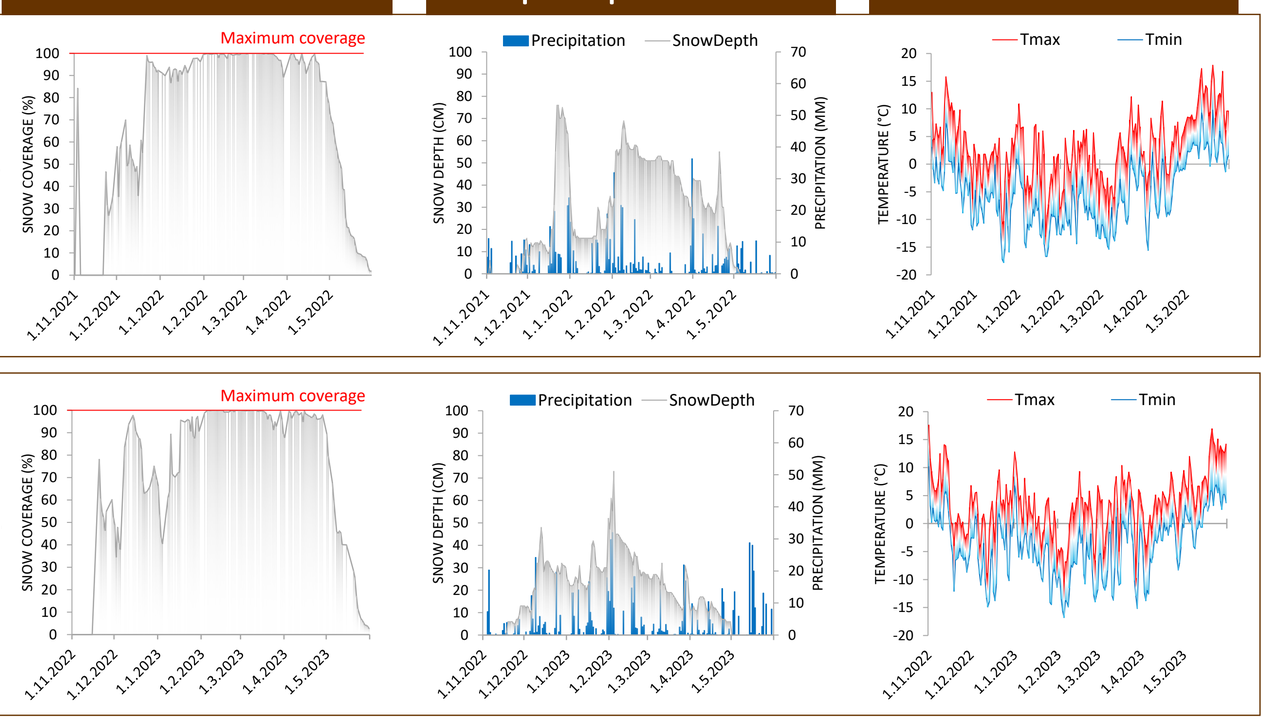


1 Snow cover on time-lapse photography over four winter seasons (November-May) in 2021/22-2024/25

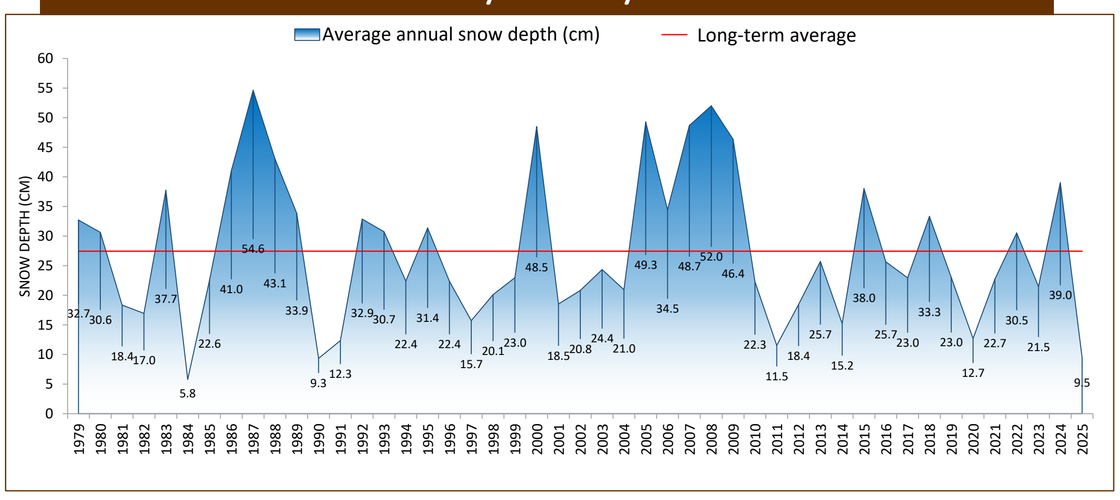
2 Snow coverage

Snow depth and precipitation

Temperature



3 Average annual snow depth measured at Skalnaté Pleso Observatory in the years 1979-2025



Summary

1 Snow cover is a critical component of the hydrological cycle in mountain regions. Monitoring it has become increasingly urgent in recent years due to climate warming. To analyse snow cover dynamics, we complemented manual point measurements using a snow stake at the Skalnaté Pleso Observatory (SPO, 1778 m a.s.l.) with a trail camera equipped with a time-lapse function and image transmission. We compared data from four winter seasons, spanning 2021/22 to 2024/25.

2 During the 2021/22, 2022/23, and 2023/24 seasons, snow coverage reached 100 %, meaning the entire environment, including vegetation canopies, was completely covered with snow. In contrast, during the 2024/25 winter, coverage remained low, fluctuating around 50% throughout the season.

3 The average snow depth in the 2024/25 was only 9.5 cm, while in the other monitored years the values were several times higher. In the context of long-term measurements (1979–2025), this value is extreme, as it falls below the 5th percentile of all analysed data.

Such low snow cover in high mountain areas can have a wide range of consequences across ecological, hydrological, and geomorphological systems. Low snow cover reduces the insulating effect of snow, leaving vegetation exposed to sub-zero air temperatures, which can result in frost damage, winter desiccation, or abrasion by windblown ice.

Acknowledgement

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