Designing and launching a citizen initiative to monitor snow depth in Sierra Nevada (South Spain)

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The spatial distribution of snow thickness in extensive alpine regions can be estimated with high spatial resolution from LIDAR data capture. However, due to the significant economic cost of these activities, its application is limited, especially to cover large areas. Traditionally, snow thickness has been estimated by applying interpolation methods and/or hydrological models that approximate the distribution of snow from fieldwork data. In some places there is permanent infrastructure that facilitates the collection of data. In Spain, within the framework of the national snow depth monitoring program (ERHIN, initiated in 1981), an infrastructure consisting of a network of poles distributed over various mountain ranges was generated to obtain measurements by direct observation from helicopter flights (1-3 per year). This monitoring activity has been drastically reduced and even cancelled in some mountain ranges in recent years as a result of budget cuts. In order to maintain the observation of snow, we propose a novel approach to involve groups of volunteers to take advantage of the existing (or optimally increased) infrastructure that are underutilized or in disuse, to gather photos of poles as a means of monitoring snow thickness. The proposal is being applied in the Sierra Nevada (Southern Spain), and may be extended in the future across the whole Spain. The tasks performed to achieve the objective are: 1) Inventory of infrastructures and potential volunteer: The 23 poles installed by the ERHIN program in Sierra Nevada are being marked to facilitate their identification in photos sent in by volunteers. An inventory of potential volunteer and user groups has been compiled; 2) Optimum design of snowpole network for monitoring snow depth: The aim is to identify the optimal location of new poles in order to minimize uncertainty in estimates of snow depth. To solve this problem, we have employed a regression model that estimates the spatial distribution of snow depth and its uncertainty 3) Generation of tools to supply and display information: Mobile application and web platform. For the success of the activity, we need user-friendly applications that include relevant
local information (e.g., location of the poles) and an adequate link to the project web for supplying and storing information; 4) Maximization of participation. Program of incentives. We have involved key institutions, such as Sierra Nevada Natural Park and Andalusian Mountaineering Federation (FAM), which predict a high participation rate by its members. To encourage collaboration, participation by volunteers will be published, including ranking and honorary awards to the most active. As stated by the Andalusian Federation of Mountaineers, this ‘competition’ will be an additional incentive to increase participation by mountaineers. The task will have a significant impact with a low economic cost; 5) Dissemination and communication of relevant: It includes the design and distribution of posters and brochures to the main potential groups of volunteers.

This research has been partially supported by the SIGLO-AN project (RTI2018-101397-B-I00) from the Spanish Ministry of Science, Innovation and Universities (Programa Estatal de I+D+I orientada a los Retos de la Sociedad).