

Overview of snow measurement practices and purposes in Europe based on the questionnaire

Includes the following deliverables of COST ES1404 (HarmoSnow):

- D1** Review report on identifying and assessing the essential snow variables.
- D2** Summary of physical characterization and harmonized definition of snow variables.
- D3** Priority assessment of snow characteristics for various applications.

Description

The questionnaire, *European survey on snow measurement practices and applied instrumentation*, was prepared and conducted together by Working Group 1 (WG1) and WG2. The questionnaire was open from December 2015 to November 2017 and it was answered by 125 participants from 99 operational and research institutions from 38 European countries. Responses from operational oriented institutions (71 responses) were more numerous than the responses from the research only institutions (54 responses), but 55% of them had also research objectives. On the contrary, research institutions generally did not have any operational purposes. The typologies of environments where the snow measurements are performed range from mountain to low elevated plains, including forests, bogs, tundra, urban areas, glaciers, lake ice, and sea ice. The results of the questionnaire are presented in the attached paper *European in-situ snow measurements: practices and purposes*.

The questionnaire addressed the general information on snow measurement practices and purposes, and most of the questions were formulated as multiple choices. Snow properties were grouped into five categories: snow macrophysical properties, snow microphysical properties, snow electromagnetic properties, precipitating and suspended snow, and snow composition. The questions mostly concentrated to measured parameters and measurement methods. This required an investigation on the existing measurable snow properties and instruments, which are described in the Appendix of the attached paper.

The essential snow variables are identified by the questionnaire. 93% of the respondents measure snow macrophysical parameters, such as snow presence, snow depth (HS), snow water equivalent (SWE), and snow density. These describe the bulk characteristics of the whole snowpack or of a snow layer, and they are the primary snow properties that are needed for most operational applications (such as hydrological monitoring, avalanche forecast, and weather forecast). In most cases, these measurements are done with manual methods. Parameters characterizing precipitating and suspended snow, some of which are crucial for the operational services, are measured by 74% of the respondents. Parameters characterizing the snow microstructural properties, the snow electromagnetic properties, and the snow composition are measured by 41%, 26%, and 13% of the respondents, respectively, mostly for research applications. Information concerning assessing of the snow variables is collected in the survey. Snow information is used mainly for hydrological (65%), meteorological (67%) and climatological purposes (69%).

Attachments

Pirazzini R, Leppänen L, Picard G, Lopez Moreno J I, Marty C, Macelloni G, Anna Kontu A, von Lerber A, Tanis C M, Schneebeli M, de Rosnay P, Arslan A N, **European in-situ snow measurements: practices and purposes**, *Sensors*, 18(7), 2016.

<https://www.mdpi.com/1424-8220/18/7/2016/htm>