Temperature profiling device and related monitoring system

Abstract

The patented invention relates to a device for detecting temperature profiles and a related monitoring system of small dimensions autonomously operating and capable of remotely measuring the temperature profile of the thickness of the hydrogeological mantle to be kept under observation in all those areas where there is a need for pervasive multi-sensor profile detection in ice, snow and/or water, at high frequency, in adverse geological situations and at different depths.

State of the art

For security and/or study reasons - in fields such as scientific research, rescue, transport, military and so on - it is important to have information both for the analysis of the stability of a hydrogeological mantle, and for the analysis of chemical/biological processes existing in that mantle. At present, the surveys that provide such information are carried out very infrequently and require the intervention of an on-site operator. However, weather conditions and the associated high risk may prevent personnel from taking the required measurements, thus making surveys discontinuous. The systems that currently allow the production of such information, besides having limitations in measuring at different depths, are not equipped with features that make them easy to retrieve in the event of loss or drift, and do not ensure high reliability in the temporary storage and transmission of the data, even in real time, in adverse transmission conditions (such as malfunctioning, isolation and the like).

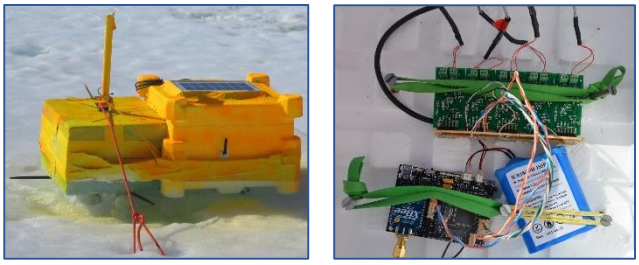

Figure no. 1 – Prototype system operating in the Antarctic and thermally insulated component parts.

Figure no. 2 – preparation for installation of the multisensory probe

Invention description

The patented system can be used in all those areas where a pervasive detection of temperature profiles in ice, snow, and similar matrices (e.g. permafrost) is required, at high frequency in adverse geological situations, and concerns a device for the detection of temperature profiles and a monitoring system comprising:

- at least one container, thermally insulated and tightly sealed, containing at least one CPU, wireless communication means of the *multi-hop* type, and means for the detection of a global positioning signal (GPS with at least one antenna);
- at least one means for external sensors including one or more temperature sensors;
- at least one battery and means for recharging said battery which include a photovoltaic panel;
- a flotation system for the device, arranged to hold it in a predetermined position.

Industrial Property

Italian Patent granted with No. 102019000003391 on 04/02/2021 and filed on 08/03/2019

International Patent Application No. PCT/EP200/056091 of 06/03/2020 filed with priority

Applicant

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Advantages

The patented system:

- enables an autonomous operation within a network of coagent devices and, thanks to the possibility of equipping it with internal utilities that allow its use in difficult conditions and an easy recovery in case of loss, it minimises the chances of losing both device and data;
- is easily transportable thanks to its small size;
- guarantees remote measurement, with modular and flexible spatial density and therefore pervasive measurements, of the hydrological mantle thickness temperature profile to be kept under observation (i.e., an ice cap), at different depths;
- is equipped with multi-sensor detection capability and redundancy, to ensure high reliability and the possibility to quickly identify any anomalies;
- guarantees reliable data transmission even at distances of more than one kilometre;
- requires a low investment.

Applications

The patented system finds application in the scientific research, rescue, transport and military fields, in all cases where it is required to detect, with the same space-time characteristics, a temperature gradient across the thickness of the snowpack and/or monitor the temperature profile of the ice with high frequency. In general, the system finds application:

- in the areas of safety and tourism (e.g. for avalanche prevention and for the monitoring of snowpack metamorphism on ski slopes in tourist resorts);
- in the field of ice transport (i.e. in the case of airstrips or road routes built on frozen surfaces).

Development stage

Current TRL: 7

Prototype realised and used, with demonstrable results, in an operational environment

Perspective TRL: 9

Actual system tested in operating environment

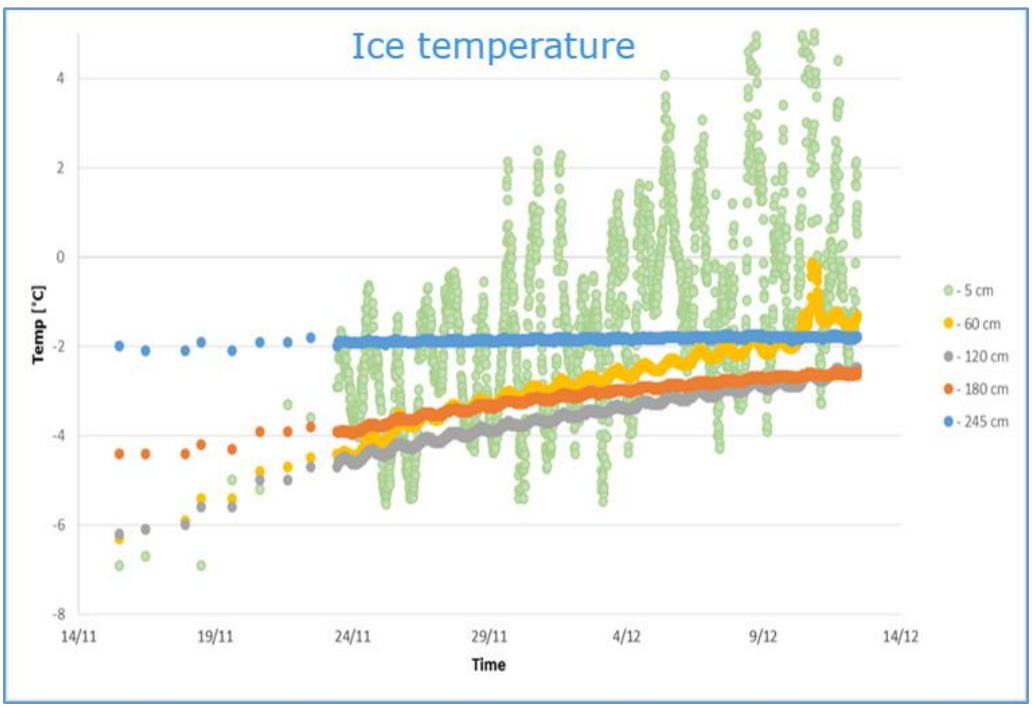

Figure no. 3 – Graph showing the results of measuring ice temperature profiles at different depths

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