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Ground temperature data from an ice-free area at mid-range of Yukidori Zawa, Langhovde, East Antarctica during January 2010–January 2012

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Abstract: Ground (soil) temperature data recorded by temperature data recorders buried in 1 cm and 10 cm depths of the ground surface at the mid-range of Yukidori Zawa during the JARE-51 and 53 (2010–2012) are summarized in a table. Almost 2-year data of the ground temperature at two discrete depths were compiled in a text file from each recorder at the 1-hr interval. Using the present data with air temperature and solar radiation data from neighborhood automatic weather station reported previously, we have shown timing and period of soil thawing graphically.

1. Background & Summary

This report presents ground temperature data recorded by two temperature recorders buried in two discrete depths (1 and 10 cm) at the mid-range of Yukidori Zawa (Yukidori Valley), Langhovde, East Antarctica, between the Japanese Antarctic Research Expedition 51st (JARE-51) in January 2010 and JARE-53 in January 2012. This study, part of the National Institute of Polar Research (NIPR) projects, “Studies on fluctuations of the environment and ecosystem in ice-free areas on Sôya Coast (general research project)” and “Monitoring of terrestrial ecosystems (Mission code,

AMB)" had recorded several environmental conditions for terrestrial organisms in major ice-free areas of Syowa Oasis since 2009. Previously we reported the meteorological data obtained from automatic weather stations in JARE Data Reports[1,2,3] and in Polar Data Journal[4]. This observation was aimed to monitor temporal, seasonal, and annual fluctuation pattern of ground temperature where most of the Antarctic terrestrial organisms such as mosses, lichens, soil algae, fungi, bacteria, and invertebrates were thought to be actively inhabitant.

2. Locations

Yukidori Zawa, a valley in central Langhovde, is Antarctic Specially Protected Area No. 141, where relatively fertile vegetation of mosses and lichens distributes on rocks and ground surfaces along a seasonal stream in Syowa Oasis[3]. Two temperature recorders were set at an automatic weather station (AWS) site and buried at two discrete depths (1 cm and 10 cm) of a flat sandy bank at 69º14.47′S, 39º44.37′E as determined by a handy GPS (GPS Map 62, Garmin), approximately 53 m above sea level (Fig. 1a, b). The AWS site was a typical floodplain at the mid-range of the valley where sands and gravels accumulated among rocks (Fig. 1c). Previously our reports had described that air temperature fluctuated between −35°C and 8°C, the annual average was −9.5°C (2010–2014)[1], and it was ca.2°C higher than that of recorded at Syowa Station[5]. Based on the previous studies conducted near Syowa Station, the permafrost table was expected to position at 70–100 cm depth[6] exact thickness of active layer still needs confirmation to monitor[7]. There are no ground temperature data reported from this valley but few trials to record the temperature throughout a year in some vegetation[3,8,9]. According to these vegetation temperature data, a period of snow cover prevailed during April to October in the valley[3]. However, it should be varied depending on seasonal, annual conditions of snowfall, solar radiation, wind, air temperature, and so on.

3. Methods

The temperature recorder used was a data logger (HOBO Tidbit V2 model UTBI-001, Onset) with a temperature sensor, clock, processor, memory, and battery. This logger can record the temperature from −40 to 70°C, however, the accuracy is ±0.2°C within the range between 0 and 50°C as in the specification in the manual from manufactures. The recorders were buried in sandy soil without gravels. However, the exact measurement of grain size had not been checked at two discrete depths (1 cm and 10 cm) on 3 January 2010; and started logging the ground temperature at 1-hour interval. The recorders were removed from the ground, and data were collected in January 2012.

4. Data Records

Every 1 hour, the logger stored a single temperate data with a time stamp. For this report, data from 2 loggers were combined in a file. From noon on 3 January 2010 to noon on 2 January 2012, all recorded temperature data were stored without error.

1. Name of the ground temperature data

G-temp_Yukidori_Zawa2010J-2012J.csv

5. Technical Validation

We checked the recorders when they were retrieved and noticed no serious damages on sensors or housings, and no erratic records of the data were uploaded.

Examples of quick look as a result of temporal changes in ground temperature for nearly two years are shown in Figure 2, and an example of the format of data files in Table 1. Figure 2 also contains a graph of air temperature, which was recorded by the AWS[2] for checking and comparing the annual trend of the fluctuation pattern. Ground temperature at 1 cm showed rather wider fluctuation annually, between ca.−30°C and 20 °C, while that at 10 cm fluctuated between ca.−30°C and 12°C. An annual trend such as cold winter (2010) or warm winter (2011) was well reflected with the trend seen in air temperature. The annual minimum of the ground temperature occurred in August (2010) and in June (2011) were 5–10°C warmer than the air temperature of the same time (Fig. 2a, b, c). Comparing the ground surface (1 cm) with the air temperature, the ground surface was warmer and the diel fluctuation was less variable in winter, especially in the 2011 winter season (Fig. 2a, c). It might indicated the site was covered by snow in winter, probably heavier snow covered in 2011 than 2010.

The ground temperatures rose beyond 0°C during November to early March, indicated the occurrence of thawing of the ground surface in this period. The ground of 1 cm and 10 cm depths were sometimes warmed over 20°C and 10°C in summer, respectively.

The fluctuation of the ground temperature during the initial phase of thawing in early November, early December, and around the summer solstice was graphically shown in Figure 3, with the available data of air temperature and solar radiation from neighborhood AWS[2]. In early November, both ground temperatures showed a gradual increase from <−10°C toward −8°C, while air temperature showed larger diurnal fluctuation between −15°C and 0°C (Fig. 3a). The air temperature was still recorded below 0°C, but the ground temperatures kept nearly 0°C, sometimes rose >0°C in the afternoon; suggested solar radiation reached to the ground surface was absorbed, and diurnal freeze-thaw occurred to a depth of at least 10 cm in early December (Fig. 3b). Around

the summer solstice, the ground temperatures kept over 0°C, showed large diurnal fluctuations between 0 and 16°C. The daily maximum ground temperature appeared in the late afternoon, several hours after the daily maximum solar radiation recorded when sufficient solar radiation reached and was absorbed by the ground surface (Fig. 3c).

6. Usage Notes

Before using the data for publication or presentation in any media, please request permission in writing. Inquiries should be addressed to:

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7. Figures

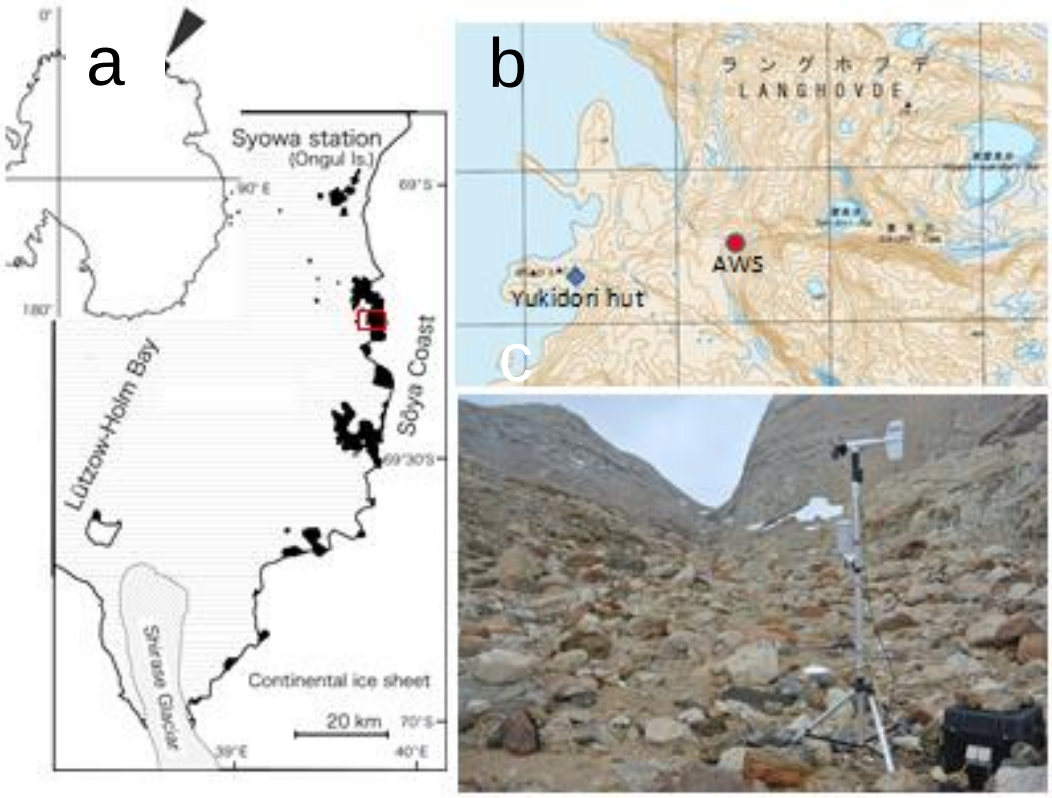

Fig. 1. Maps and a photograph of Yukidori Zawa AWS site.
The line drawing is a location map of Syowa Oasis (ice-free areas shown in black) on the Sôya Coast, East Antarctica (a). The positions of Yukidori Zawa AWS (red circle) are marked in a map (b). Yukidori Zawa AWS was installed at a typical floodplain of where sands and gravels accumulated among rocks(c). The Location of the map of (b) is shown in a red square (a).

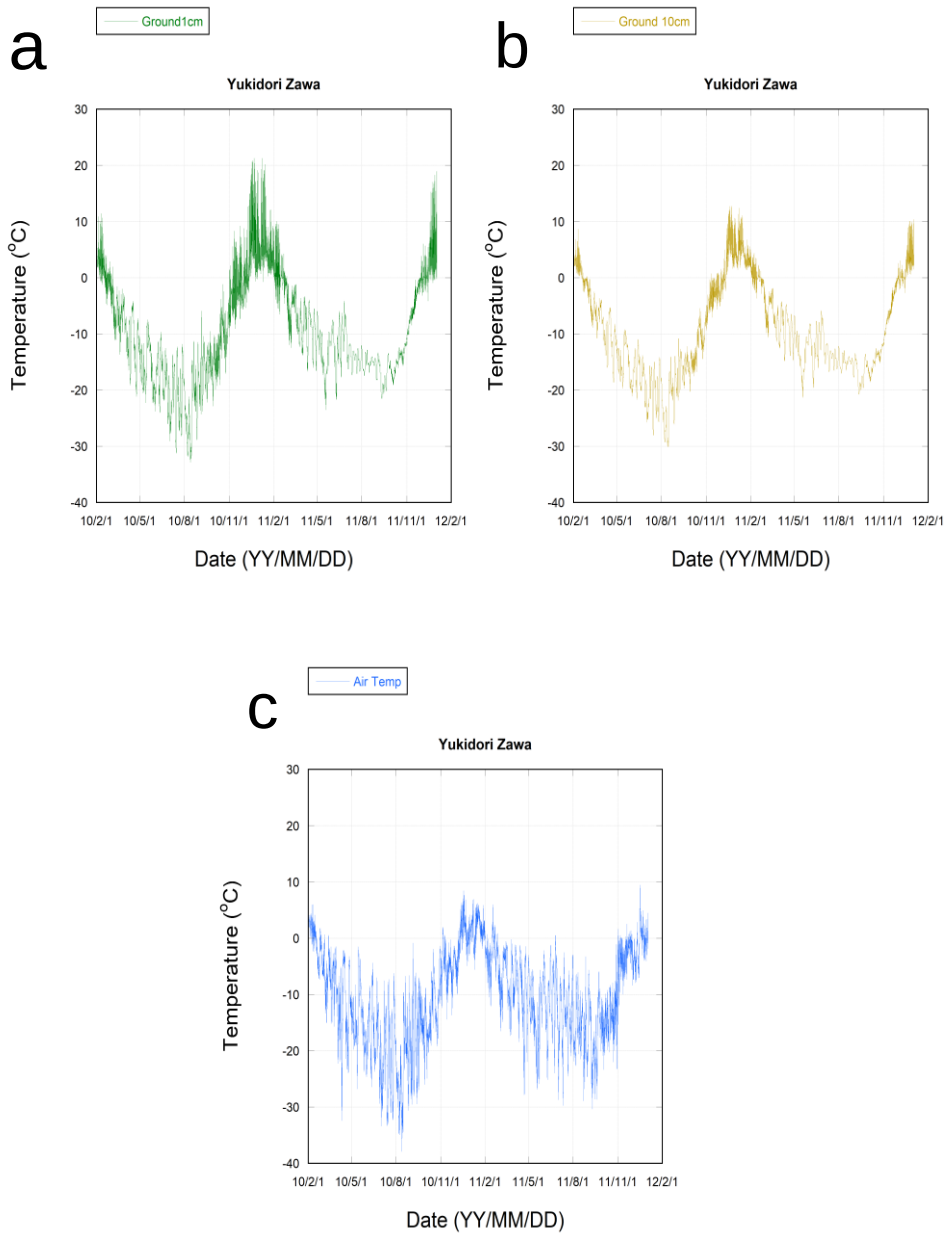

Fig. 2. Examples of graphical expressions of ground temperature at 1cm depth (a), at 10 cm depth (b), and air temperature (c) recorded at mid-range of Yukidori Zawa from 1 February 2010 to 2 January 2012.

The air temperature data by Kudoh *et al.* (2015b)[2] is used for comparison to the present ground temperature data. X-axis indicate the date (yy/mm/dd or yy/m/d) when temperature recorded.

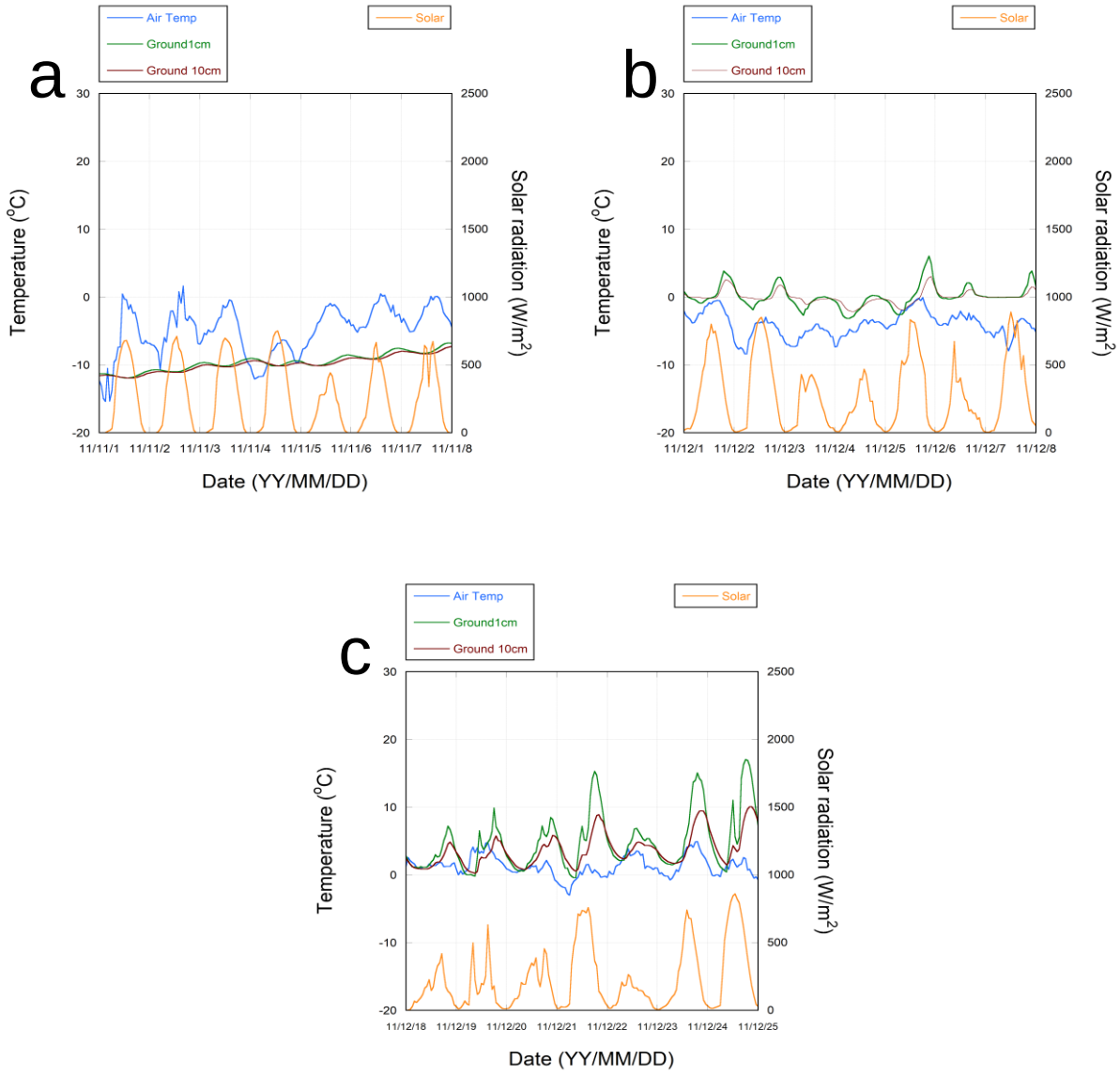

Fig. 3. Graphical expressions of ground temperature data in early November 2011 (a), in early December 2011 (b), and around the summer solstice in 2011 (c) with air temperature and solar radiation data reported in Kudoh *et al.* (2015b)[2].
X-axis indicate the date (yy/mm/dd or yy/m/d) when temperature recorded.

8. Table

Table 1. An example of the data format of the CSV file.
It contains three columns with three header lines and 17,497 data lines. Column 1 is time stamp yyyy/mm/dd hh:mm, local time), column 2 is ground temperature (°C) at 1 cm depth, and column 3 is ground temperature (°C) at 10 cm depth. Timestamps in column 1 are expressed in the format of yyyy/mm/dd hh:mm, but in case of the month, date and time were able to express in single digit, we expressed as yyyy/m/d h:mm in the CSV file.

Yukidori Zawa Mid-range, Ground temperatures		
Time	Ground 1 cm	Ground 10 cm
yyyy/mm/dd hh:mm	Degree C	Degree C
2010/1/3 12:00	10.86	6.23
2010/1/3 13:00	13.57	7.32
2010/1/3 14:00	14.24	8.25
2010/1/3 15:00	13.83	8.57
2010/1/3 16:00	15.22	9.31
2012/1/2 12:00	11.30	4.12

Members who carried out the field study

The AWS of Yukidori Zawa and the ground temperature sensor were installed by Sakae Kudoh, Yukiko Tanabe, Masaki Uchida, and Takashi Osono (JARE-51 summer). Data acquisition was made by Yukiko Tanabe, Makoto Hori, Hideo Akiyoshi (JARE-53 summer).

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Data Citation

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