ReadMe - V_soil_moisture_snowbed_experimental

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1 Protocol

Soil moisture is measured using TMS-4 data loggers (TOMST, Prague, Czech Republic) with a logging interval of 15 minutes following the COAT protocol
'protocol_soil_moisture_temperature_loggers_varanger'.

1.1 Timing of sampling and changes in that

Temperature loggers are usually deployed the whole year and are downloaded once a year.

1.2 Spatial layout of sampling and changes in that

The dataset covers snowbeds at the COAT intensive localities Vestre Jakobselv and Komagdalen. Only snowbeds where the herbivore exclosure experiment is conducted are included in the dataset. Two loggers were deployed in 2020 in all herbivore exclosures in snowbeds in Vestre Jakobselv. All other loggers were deployed in 2021 in Vestre Jakobselv and Komagdalen. If possible, the loggers were placed inside the all herbivore exclosures. If the soil in all herbivore exlosures was too shallow, the loggers were deployed in large herbivore exclosures. Some additional loggers were deployed in control plots.

More detailed information about which sites were included in the study design can be found in the auxialiary file 'V_soil_moisture_snowbed_experimental_aux.txt'.

2 Description of the dataset

The dataset includes four differnt types of files and all files are saved as ;-separated txt-files:

- One data file per year (`V_soil_moisture_snowbed_experimental_YEAR.txt`)
- One meatadata file per year with dates when the loggers were deployed and collected (`V_soil_moisture_temperature_snowbed_experimental_metadata_YEAR.txt`)
- One coordinate file with coordinates of all sites (`V_soil_moisture_temperature_snowbed_experimental_coordinates.txt`)
- One auxiliary file with information about which sites are included in the study design (`V_soil_moisture_temperature_snowbed_experimental_aux.txt`)

2.1 Soil moisture data files

These files contain raw soil moisture values measured every 15 minutes. The raw values can be converted to volumetric soil moisture content. However, there is no calibration for the soil types included in this dataset available. The calibrations provided by the manufacturer TOMST don't cover the whole range of this dataset and can not be applied.

Example of the first rows of the data files:

```
  sn_region      sn_locality      sn_section     sn_site
1  varanger vestre_jakobselv bearalveaijohka vj_be_sn_13
2  varanger vestre_jakobselv bearalveaijohka vj_be_sn_13
3  varanger vestre_jakobselv bearalveaijohka vj_be_sn_13
  sc_type_of_sites_ecological       sc_plot_treatment     t_date   t_time
1                    snowbed all_herbivore_exclosure 2020-08-05 00:00:00
2                    snowbed all_herbivore_exclosure 2020-08-05 00:15:00
3                    snowbed all_herbivore_exclosure 2020-08-05 00:30:00
                         v_logger_id v_soil_moisture v_comment
1 vj_be_sn_13_all_herbivore_exclosure            2484      <NA>
2 vj_be_sn_13_all_herbivore_exclosure            2485      <NA>
3 vj_be_sn_13_all_herbivore_exclosure            2485      <NA>
```

Description of the columns included in the data files:

Column name	Description	Possible values
sn_region	Study region	varanger
sn_locality	Locality (within region)	vestre_jakobselv, komagdalen
sn_section	Section (within locality)	torvhaugdalen, bearalveaijohka, kjoltindan, ruossachokka, gaasevannan, tranemyra
sn_site	Unique Site ID	e.g. vj_be_sn_13, vj_be_sn_14
sc_type_of_sites_ecological	Habitat type	snowbed
sc_plot_treatment	Plot treatment within site where the logger was deployed	all_herbivore_exclosure, large_herbivore_exclosure, control
t_date	Logging date	yyyy-mm-dd
t_time	Logging time	hh:mm:ss
v_logger_id	Logger ID	e.g. vj_be_sn_13_all_herbivore_exclosure, vj_be_sn_12_control
v_soil_moisture	Soil moisture raw values	[numeric]
v_comment	Comments	[character]

2.2 Metadata files

These annual files contain additional information for each logger, such as the dates when the loggers were deployed and downloaded.

Example of the first rows of metadata files:

```
  sn_region      sn_locality      sn_section sc_type_of_sites_ecological
1  varanger vestre_jakobselv   torvhaugdalen                     snowbed
2  varanger vestre_jakobselv bearalveaijohka                     snowbed
3  varanger       komagdalen      kjoltindan                     snowbed
      sn_site       sc_plot_treatment t_year
1  vj_to_sn_3 all_herbivore_exclosure   2020
2 vj_be_sn_13 all_herbivore_exclosure   2020
3  ko_kj_sn_5 all_herbivore_exclosure   2021
                         v_logger_id v_serial_number v_date_logger_in
1  vj_to_sn_3_all_herbivore_exclosure        94204970             <NA>
2 vj_be_sn_13_all_herbivore_exclosure        94204969             <NA>
3  ko_kj_sn_5_all_herbivore_exclosure        94213443             <NA>
  v_date_logger_out v_observer                                    v_comment
1        2020-08-04        kha logger deployed in 2020, not downloaded in 2021
2        2020-08-04         hb logger deployed in 2020, not downloaded in 2021
3        2021-07-12        mld                                          <NA>
```

Description of the columns included in the metadata files:

Column name	Description	Possible values
sn_region	Study region	varanger
sn_locality	Locality (within region)	vestre_jakobselv, komagdalen
sn_section	Section (within locality)	torvhaugdalen, bearalveaijohka, kjoltindan, ruossachokka, gaasevannan, tranemyra
sc_type_of_sites_ecological	Habitat type	snowbed
sn_site	Unique Site ID	e.g. vj_to_sn_3, vj_tr_sn_2
sc_plot_treatment	Plot treatment within site where the logger was deployed	
t_year	Year in which loggers were downloaded	e.g. 2005
v_logger_id	Logger ID	e.g. vj_to_sn_3_all_herbivore_exclosure, vj_tr_sn_2_all_herbivore_exclosure
v_serial_number	Serial number of the logger	e.g. 94204970, 94213404
v_date_logger_in	Date when the logger was collected/downloaded	yyyy-mm-dd
v_date_logger_out	Date when the logger was deployed/downloaded	yyyy-mm-dd
v_observer	Date when the logger was started	e.g. es (Eeva Soininen)
v_comment	Comments	[character]

2.3 Coordinate file

This file contains the coordinates of all sites included in the study design. Coordinates are given in decimal degrees and UTM 33 (WGS 84).

Example of the first rows of coordinate files:

```
      sn_site     e_dd     n_dd e_utm33 n_utm33
1  vj_to_sn_3 29.11003 70.29710 1026762 7860451
2  vj_to_sn_6 29.08956 70.30502 1025806 7861136
3 vj_to_sn_13 29.07985 70.31023 1025315 7861619
```

2.4 Auxiliary file

This file contains further information about the dataset such as the years when sites were first included in the study design and when sites were excluded from the study design as well as site specific information about soil type and vegetation.

Example of the first rows of auxiliary-files:

```
  sn_region sn_locality sn_section sc_type_of_sites_ecological     sn_site
1  varanger  komagdalen kjoltindan                     snowbed ko_kj_sn_10
2  varanger  komagdalen kjoltindan                     snowbed ko_kj_sn_13
3  varanger  komagdalen kjoltindan                     snowbed ko_kj_sn_14
        sc_plot_treatment year_first year_last     t_date t_time
1 all_herbivore_exclosure       2021        NA 15/07/2021  15:00
2 all_herbivore_exclosure       2021        NA 15/07/2021  12:00
3 all_herbivore_exclosure       2021        NA 13/07/2021  14:30
  v_serial_number v_vegetation_height_cm v_moss_depth_cm
1        94213446                    1.0             2.0
2        94213441                    0.5             0.3
3        94213442                    1.0             0.5
  v_organic_layer_depth_cm v_sand_percent v_silt_percent v_clay_percent
1                      1.0            10             35             45
2                      1.5            30             30             30
3                      2.0             5             NA             NA
  v_comment_soil_type v_soil_type_calibration v_certainty_soil_type_calibration
1             mineral                    loam                  relative certain
2             mineral                    loam                  relative certain
3             mineral               silt_loam                  relative certain
  v_observer                                 v_comment
1        mld difficult to measure % of sand, silt, clay
2        mld difficult to measure % of sand, silt, clay
3         es                    unsure of clay vs silt
```

3 Data cleaning and formatting

Raw metdata (entered in an excel-template) and data downloaded from the loggers are cleaned and formatted using the scripts `01_clean_and_reformat_metadata.R` and `02_process_data_tomst_loggers.R` .

1. Metadata: The scripts checks all variables for correct spelling and correct formatting. Errors will be corrected in the script and the data will be reformatted according to the requirements of the COAT data portal. The file will be saved as a ;-separated txt-file and uploaded to to COAT data portal. In particular, the script checks for:

- **sn_site:** Correct spelling of all variables.
- **t_date:** Correct format (yyyy-mm-dd), dates in other formats are reformatted.
- **v_logger_id:** Missing observations. Are all loggers included in the metadata?
- **v_observer:** Correct format (initials and lowercase letters), observer is reformatted e.g. if full names were used.
- **v_comment:** Correct spelling and format (lowercase letters and english). Comments are edited or translated if necessary.

All corrections that lead to differences between rawdata and cleaned data are double-checked in the fieldbooks and a comment is added.

2. Temperature data: The script removes the days when the logger was not deployed in the field , reformats the data according to the requirements of the COAT data portal and saves the data as ;-separated txt-tiles which can be uploaded to the COAT data portal. In particular, the script includes the following steps:

- Removing days when the logger was not deployed (based on t_date_logger_in and t_date_logger_out in the metadata).
- Reformatting the columns t_date and t_time.
- Checking the recorded temperature values.
- Adding all other necessary columns such as spatial variables and loggerID.