

RC2:'Comment on egusphere-2024-3154', *Anonymous Referee #2*, 06 May 2025

The overall organization of the article is clear and meets the requirements for writing scientific papers. Off-road conditions and snowpack strata data are traditionally acquired with Cone penetrometer and Ramsonde Rod to assess trafficability and snow stability. On this basis, the author designed a new Snow and Terrain Mobility Evaluation Tool (STMET) and applied it. I believe that this article can be accepted after providing additional technical details and revisions.

Response to Referee 2:

The authors sincerely thank the referee for the positive and encouraging comments. The newly developed STMET instrument offers several advantages over existing tools, such as the cone penetrometer (used in soil analysis) and the Ramsonde rod (used in snowpack evaluation). In addition to the functionalities of these instruments, STMET is equipped with additional features, including the capability to measure temperature profiles and moisture content-features absent in both traditional tools.

They have carefully reviewed and revised the manuscript by incorporating all feedback and suggestions provided by the esteemed referees. The updated manuscript is submitted with the hope that it meets the standards for publication.

Point-wise responses to the referee's comments are as follows:

1.What is the condition of the new Snow and Terrain Mobility Evaluation Tool (STMET) battery and how long can it be used in the field?

Response 1: The STMET is powered by a 6000 mAh lithium-ion cylindrical battery, which is housed within the handle of the device. Under standard operating conditions, the battery provides a backup of approximately 4 hours.

2. The author mentioned the Inertial Measurement Unit (IMU), how do they work, and what contribution do they make to the final measurement results?

Response 2: The IMU comprises an accelerometer, gyroscope, and magnetometer. It measures the acceleration, velocity, and orientation (pitch, roll, and yaw) of the device. This information is used to determine the penetration rate of STMET for optimal operation. Additionally, the orientation data is integrated into an algorithm that computes terrain area and slope, contributing to a better understanding of terrain features.

3. The article discusses the measurement results of temperature and humidity, but lacks modeling based on these parameters and terrain passability. How will these measurement results be applied?

Response 3: The authors thank the referee for this valuable observation. The STMET includes temperature and humidity sensors mounted on the electronic enclosure to monitor ambient environmental conditions. In emergencies, this data can be transmitted to a base station upon activation of a panic button.

To evaluate terrain trafficability (passability), additional temperature and moisture sensors are embedded at the rod's tip to measure subsurface conditions. Soil strength is influenced by its

moisture content and is quantified using the cone index. This is compared with the Vehicle Cone Index (VCI) of a specific vehicle to determine the feasibility of terrain traversal. The methodology has been elaborated in the revised manuscript.

4. The article mentions The Decision Support System (DSS), which decisions can ultimately be made by the system, and the decision-making process should be supplemented and explained.

Response 4: Authors appreciate the referee's insightful suggestion. The DSS integrated with STMET aids users in decision-making across the following applications:

1. **Weak Layer Identification:** Based on the measured strength profile, users can detect weak layers within the snowpack, which are potential triggers for snow avalanches.
2. **Terrain Slope Assessment:** The instrument measures terrain slope, which is essential for classifying avalanche-prone zones—formation, middle, and runout.
3. **Trafficability Assessment:** An algorithm uses measured soil strength and cone index data to determine whether a specific vehicle can traverse a given terrain and estimate the number of feasible passes.
4. **Victim Detection and Rescue Support:** In the event of an accident, STMET can send an alert signal containing GPS coordinates and ambient temperature to facilitate timely rescue operations.

These details have been included in the revised manuscript.

5. The references should be further supplemented.

Response 5: The reference list has been reviewed and updated. Duplicate entries have been removed, and additional relevant references have been included to support the discussion.