To Editor:

We greatly appreciate the reviewers taking the time to provide constructive feedback and valuable suggestions. The implementation of these suggestions has greatly improved the quality of the manuscript, enabling us to make significant improvements. Every revision suggestion and opinion proposed by the reviewer has been carefully considered. Of course, there are also some parts that we do not agree with, and we will annotate them in segments.

We have also prepared and supplemented the documents one by one according to your six requirements. Original comments and suggestions quoted from this decision letter highlighted in black italics, and our response is in blue. The revised content is marked in red text in the manuscript.

Response to the Reviewer comments

1 One minor comment: it is usually recommended to avoid, whenever possible, using a large number of abbreviations in the abstract. I suggest revising the abstract to reduce the number of abbreviations (see the example copied below).

Reply: We would like to thank you for taking the time to read our manuscript and give us your feedback. We really appreciate your helpful comment about the shortened words in the summary. We have carefully checked the abstract to make it shorter and less full of abbreviations, as you suggested. We have expanded SD, PMW, QTP, AutoML, BT, and SCE, among others, to their full terms throughout the abstract. This change makes it easier to understand while keeping all the original meanings and key scientific findings of the study.The updated abstract is attached below.

Abstract: Snow depth is a crucial parameter for describing the spatiotemporal variations of snow cover, and passive microwave snow depth products (10–25 km) are widely used for monitoring snow depth changes. However, as one of the three major snow-covered regions in China, the Qinghai-Tibet Plateau has complex terrain and rapid changes in snow cover with strong spatial heterogeneity, making it difficult for coarse-resolution snow depth products to accurately describe its spatiotemporal characteristics. This study proposes a high spatial resolution (500 m) snow depth estimation method based on the Advanced Microwave Scanning Radiometer 2 (AMSR-2) brightness temperature data and Automated Machine Learning. Firstly, using Pearson correlation coefficients, 19 key factors influencing snow depth, including AMSR-2 brightness temperature, slope, and surface roughness, were selected as input data (independent variables) for Automated Machine Learning. Meanwhile, passive microwave downscaled snow depth data and ground-based snow depth measurements were introduced as dependent variables for Automated Machine Learning. The Automated Machine Learning model was then trained separately for four different types of snow cover surfaces (forest, grassland, water, and bare land). Finally, through ten-fold cross-validation, the optimal machine learning model for snow depth estimation under each type of underlying surface coverage was selected, thus generating sequential snow depth datasets for the ten-year snow cover period of the Qinghai-Tibet Plateau from 2012 to 2021. Results show that (1) the estimated snow depth values well with ground-based observations, yielding a coefficient of determination (R^2) of 0.71 and a root mean square error (RMSE) of 3.64 cm, indicating high estimation accuracy. (2) Snow depth estimation demonstrates the highest accuracy in unused land (CatBoost, R^2=0.82), followed by grassland (CatBoost, R^2=0.77, RMSE=3.11 cm), water (ET, R^2=0.75, RMSE=2.20 cm), and forest (XGBoost, R^2=0.71, RMSE=3.30 cm). (3) A comparison with snow cover extent derived from Landsat-8 optical imagery reveals that the estimated snow depth spatial distribution is consistent with snow cover extent, providing reliable data for monitoring snow cover changes in mountainous regions.