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Interactive comment on "Estimating spatial distribution of daily snow depth with kriging methods: combination of MODIS snow cover area data and ground-based observations" *by* C. L. Huang et al.

Anonymous Referee #1

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The paper focuses on an important issue of continuous characterization of the snow depth spatial distribution using spatially distribute ground-based station data. It is proposed applying a krigging technique to interpolate the data. To improve characterization of the snow depth distribution the authors complement station data with information on the snow cover extent inferred from combined MODIS and AMSR-E observations and on the correlation of the snow depth with the surface elevation. The technique has been applied over a relatively large area in China and demonstrated a robust performance during one winter season. In the beginning of the winter season the best

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accuracy of the reproduced snow depth of 1-3 cm was obtained with the ordinary krigging technique. Towards the end of the winter season errors increased to about 10 cm and the most effective interpolation technique was the universal co-krigging. Although the results of application of the developed technique look quite promising, the practical value of the paper appears to be limited. First, the description of the algorithm provided in the paper is not sufficient to reproduce it independently. Particularly important is the selection of "virtual stations" which are assigned zero snow depth values. The paper only mentions that these locations are selected randomly. How the number of these stations was determined ? Was it constant or varied from day to day ? Was the surface elevation accounted for when selecting these virtual stations ? Did the number of virtual stations depend upon the cloud coverage of the study region and hence on the particular type of satellite observations (MODIS or AMSR-E) that was predominantly used to identify snow-free portions of the land surface. Given that microwave observations are not quite sensitive to shallow and melting snow, delineation of the snow cover boundary with AMSR-E data is not that accurate as with MODIS and hence the placement of these "virtual stations" may present a problem if the region was mostly covered with clouds. Furthermore, it is not clear why the particular winter season of 2004-2005 was selected for testing and evaluation of the algorithm. Was it a typical winter season for this region with close to average snow accumulation or anomalous in any way ? It is stated that the region is the snowiest in China with the average snow accumulation of 60 cm. In the same time graphs and charts in the paper indicate that the snow depths in the region were mostly within 10-25 cm. Does the fact that a relatively dry winter season was selected for the algorithm development and validation has an effect on the estimated algorithm accuracy ? How would the accuracy change if the same experiment is conducted for a normal winter season with snow accumulation close to 60 cm ? All these issues should be addressed. Second, it would be good to repeat at least the basic idea of how the blended MODIS and AMSR-E snow cover product is derived and to provide the properties of the blended product (spatial resolution, accuracy, etc.). How accurately can it reproduce the actual location of the snow cover boundary ? This

information would also help others to test your algorithm over other areas to better assess its efficiency. Third, it also appears important to include in the paper at least a brief discussion of whether and how this technique can be transferred to other regions and what particular limitations/constrains for doing this are.

Interactive comment on The Cryosphere Discuss., 9, 4997, 2015.