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Discussions

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Interactive comment on "The increasing snow cover in the Amur River Basin from MODIS observations during 2000–2014" *by* X. Wang et al.

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Reply to Interactive comment on "The increasing snow cover in the Amur River Basin from MODIS observations during 2000–2014" by X. Wang et al.

Anonymous Referee #1

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This is an interesting analysis for the specific area analyzed in China, and certainly important for the regional hydrological applications (water resource management).

Mainly, this paper has 3 objectives: 1) To validate the MODIS daily cloud-free snow cover product developed by Wang et al (2014): interesting for the region analyzed, but relative limited contribution for the scientific knowledge (regional validation of an

already published study).

Reply: Thanks for your comments. It is critical to know the accuracy of the improved daily cloud-free snow cover product in a large region since it is used to investigate the spatiotemporal variations of snow cover. The high agreements of snow cover with ground snow depth measurement in a large region verify the reliability and usefulness of this product.

2) To apply this cloud-free snow cover product to study the spatiotemporal variations of the snow cover extent in the entire Amur River Basin. Even if this is a very large area, this remains a particular region (comparing to global snow cover analysis), and this analysis is over a relatively short time period (14 years). The observed trend analyzed against temperature variation over such a short period does not really bring new insights in the snow process evolution knowledge. The observed variations are very specific to the interannual regional variations of the meteorology. I do not contest the results (link between temperature and snow cover), but, again, the contribution to new science knowledge on the climate-snow interactions is weak.

Reply: This is one of the main objectives in this study. The Amur River is the world's tenth longest river and forms the border between the Russian Far East and Northeastern China. This study area of the Amur River Basin is over two million square kilometer. It is the largest snow distribution region of China and an important component of the global snow cover distribution, whereas few studies investigate the snow cover variation in this region. Our results show that the snow processes in this region behave differently from global snow cover variations. The snow cover shows an increase trend during the study period during 2000-2014, which is constrained by the availability of the most accurate records of satellite snow cover mapping. Although study period (14 years) is relatively short in the context of global and climatic investigations, our results display a clear change trend and an evolution pattern, which is dominated by the air temperature. The variations of the snow cover in this large region result in complex feedbacks and impacts on the regional agriculture, water resource, natural ecosystem,

regional and global energy balance, climate and meteorology. The results from this study provide significant contribution to the global snow cover analysis.

3) To evaluate the influence of forest on snow cover mapping and variations. This is the most interesting part for a general contribution to the snow cover processes. But, the results obtained in this study are in fact already known: weaker agreement in snow cover estimates at forested stations compared to non-forested stations (known problem, but any improvement method is proposed here); and snow cover duration shorter in forest areas compared to open areas (due to lower accumulation in forest area, even compensated by the canopy shadowing effects). This last problem is also known, even if the forest snow evolution is a very complex process, including several aspects that induce opposite impacts (trapping effects, sublimation of intercepted snow, decrease shortwave radiation, increase long wave radiation.). This paper does not try to investigate these different processes (this is not the objective of this paper).

Reply: This is another main objective of this study. Forests were 47% in ARB, 38% in China and 63% in Russia in 2009, and mainly distributes in the northern ARB and in mountains. It is well-known that forest plays complex roles in satellite snow cover mapping and in the physical processes of snow accumulation and melting. This study quantifies the influence of forest stands on MODIS snow cover mapping and on the snow accumulation and melting as the first time in this large region. The forest snow evolution is a very complex process and is not the objective of this paper. Meanwhile, this paper quantify the overall impacts of forest on the snow processes, e.g., the snow cover duration, the snow cover onset dates and end dates. Moreover, this paper also quantifies and discusses the impact of forest on MODIS snow cover mapping and its agreement/disagreement with ground snow depth measurements. Those results are significant contributions to the literature as well.

Thus, I suggest to the author to publish this paper in a regional application-oriented journal, because this study is interesting for the particular analyzed region, done with adequate methodology and is well presented (but maybe too long).

Reply: Thanks for your recognition to our analysis. I do not agree with your suggestion "publish this paper in a regional application-oriented journal, because this study is interesting for the particular analyzed region". First of all, this large area of the Amur River Basin is an important components of global snow cover distribution, whereas few studies investigate the snow cover variation in this region, especially to quantify the influence of forest stands on MODIS snow cover mapping and on the snow accumulation and melting. This study is a significant contribution to the literature of global snow cover analysis. Secondly, the Earth consists of different continents and regions, and the global study is composed of detailed and solid analysis from regional analysis. Generic global snow cover analysis often skip the regional features. Finally, as you commented, this study has done adequate methodology/analysis and is well presented, and it is unsuitable not to suggest it for publication in The Cryosphere just because its study area is a regional large river basin. Actually, any river basin/region is a regional case, and together they form the global snow cover analysis.