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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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Anonymous Referee #2

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The authors examine the MODIS daily snow cover product in an attempt to improve the monitoring of snow in the Amur River Basin. They employ a cloud free algorithm to generate complete "daily" maps of snow cover extent. They then use the product to examine snow cover within various vegetated landscapes and see how it varies spatially, seasonally and interannually from 2000-2015. This is an interesting effort that demonstrates the authors' knowledge of the MODIS product and the landscapes within the Basin.

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Discussion paper

Their cloud “removal” algorithm appears to be successful, however it is similar to Hall’s previous work, thus not all that original.

Reply: Thank you for your reviewing efforts. Yes, the cloud removal algorithm is quite efficient and improved from Hall’s previous work, which generates a cloud-gap-filled daily snow cover products using MODIS Terra MOD10C1, the daily 0.05-degree (∼5 km) product. The product applied in this study is generated by using the 500-m MODIS Terra and Aqua products (MOD10A1 and MYD10A1). It makes full use of the cloud-free observations of MODIS Terra and Aqua, thus having shorter temporal interval and higher spatial resolution than Hall’s product. It is more reliable for snow cover monitoring and the related applications.

Their evaluation of the accuracy of snow monitoring within forested areas as compared to more open locations looks to be done well, but, again, does not add greatly to what was already understood regarding the differences between snow extent monitoring over different vegetative covers.

Reply: The Amur River Basin (ARB) is special region with a large proportion of forest cover. Forests were 47% in ARB, 38% in the Chinese part and 63% in the Russian side in 2009. It is well-known that forest plays complex roles in the physical processes of snow accumulation and melting and even in satellite snow cover mapping. 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. Specifically, 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 add significant contributions to the literature.

The 14-year analysis of potential trends in snow cover extent within the basin covers too short a period to be considered a trend analysis. Rather it may be considered a

useful evaluation of extent variability within the region.

Reply: The 14-year study period is constrained by the availability of the most accurate records of satellite snow cover mapping in order to maintain the consistence of high quality satellite snow cover observations. Although the 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 dominated by the air temperature. The Amur River is the world's tenth longest river and forms the border between the Russian Far East and Northeastern China. 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 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.

Correlations with temperature and extent are as expected, but to state that increasing temperature over the past two years "projects a further decrease of snow cover extent" (line 359) is far too much of a stretch.

Reply: There is a confusion on "projects". Our analysis show that air temperature variations could explain the snow cover variations by up to 86%. The air temperature began to increase again in 2014 and 2015, accordingly the snow cover began to decrease. We want to express that the snow cover will decrease if the air temperature keeps increasing, e.g., in 2016. This sentence is changed to: "The air temperature began to increase again in 2014 and 2015, and the snow cover extent and periods are likely to decrease if air temperature keeps increasing in ARB in the coming years."

To sum up, this contribution demonstrates the firm knowledge possessed by the re-

search team with respect to MODIS snow mapping and the utility of the product in gaining improved knowledge of the distribution of snow cover within the Amur Basin. As such, it can be considered to provide an incremental improvement in our knowledge of these factors. However, in the broader scheme of things it does not provide large incremental improvements. As such, I do not recommend publication in The Cryosphere. The authors have something to contribute, however they might chose a regional or lesser-known journal for publication.

Reply: Thanks for your reviewing efforts and recognition to our work. We have done solid investigations and analysis on the snow cover variations and on the influence of forest on MODIS snow cover mapping and on snow accumulation and melting. The Amur River Basin is the largest snow distribution region of China and an important component of the global snow cover distribution. However, 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 Amur River Basin has a large forest cover. This paper quantifies the overall impacts of forest on the snow processes and discusses the impact of forest on MODIS snow cover mapping. The results presented from this study add significant contributions to the global snow cover analysis, the MODIS snow cover mapping, and the forest-snow-hydrology communities. These results deserves being published in The Cryosphere and delivered to readers worldwide.

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