This manuscript evaluates the performance of three acknowledged by the community satellite-based precipitation products in the area of complex terrain in Ethiopia. The performance is evaluated via a comparison of the satellite-based rainfall estimates (SRE) with rain gauge ground observations.

The study concentrates on six areas in Ethiopia where the large part is mountainous. That is an important aspect for SRE validation since rainfall in the mountainous regions is difficult to observe and little ground observations are produced. This manuscript contains a good overview of the previous SRE performance evaluations and gives a clear picture of the Ethiopian regional landscape properties. A number of relevant previous works is mentioned. The manuscript is written in a clear and an easy to understand manner.

[Author's Response] Thank you.

The major problem of the manuscript is that there are very little interpretations for the obtained results, and that significantly reduces manuscript's value since as in this manuscript as it is there are very few new obvious findings comparing to the previous studies.

The major difference of this article from the previous study by Hirpa et al (2009) is in the enlarged study area (six river basins against one) but without findings interpretations the value of this manuscript is rather low.

[Author's Response] Please see our responses below.

Specific comments:

It is found by the authors that SRE performance decreases with the elevation and these findings are consistent with the previous studies. However it is not clear what is the value of these findings, since authors present their results in the numerical form but do not try to interpret them. Also very similar studies have been performed recently (see Hirpa et al. 2009*) and authors could try to employ those earlier findings to explain their results.

In the current manuscript a larger area of 6 river basins is analyzed and so the differences in SRE's performance in the northwestern and southeastern parts of the country are. However the manuscript lacks an explanation for this differences. It looks to me like PERSIANN comparing to CMORPH and TMPA produces lower rainfall volume for all areas, thus the reason for the smaller bias in the northwest where the TMPA and CMORPH overestimate rainfall volume significantly. This difference needs to be explained.

The nature of the rainfall during Kiremt and Belg season is essentially the same, it is mostly a convective rainfall but with different spatial distribution. It is not clear whether these two different precipitation seasons contribute to the differences in SREs performance or not.

[Author's Response] We have the following paragraphs within Section 3.3 that provide an explanation for the physical mechanisms that could possibly cause the differences.

"The physical mechanisms or processes that could potentially cause a relationship between elevation and precipitation could be explained by the fact that the precipitation in the highlands of Ethiopia (Northwest) is strongly influenced by the ITCZ, whereas the precipitation in the lowlands of Ethiopia (Southeast) is influenced more by the southerly winds than the ITCZ.

In the highlands of Ethiopia (Northwest), one hypothesis for the overestimation exhibited by CMORPH and TMPA 3B42RT could be associated with the deep convection of the ITCZ in the lower elevations leading to an increase in ice aloft, which is perceived by the MW sensors to be precipitation. Segele et al (2008) showed that the ITCZ, which is the major rain producing mechanism during the Kiremt, is centered to the North of Ethiopia and extends into the Blue Nile River basin. The overestimation of precipitation by CMORPH within deep convective systems has been shown by Nesbitt et al. (2008). The observance that PERSIANN is closer to the rain gauge data at these lower elevations could possibly be that the ice that is aloft is sufficient to bring the cloud top temperature within a range for the IR sensor to associate it with a precipitation intensity closer to the rain gauge data. The decrease in the bias ratio when moving from the lower elevations to the higher elevations for CMORPH and TMPA 3B42RT could be attributed to shallow convective systems. Nesbitt et al. (2008) showed that there is an underestimation of precipitation by MW products, such as CMORPH and TMPA 3B42RT, within shallow convective system because there is not enough ice aloft for the MW sensors to detect. In the case of PERSIANN, the underestimation could be due to poor detection of light rain events, consistent with the findings of Hong et al. (2007).

In the lowlands of Ethiopia (Southeast) the underestimation over regions such as the Rift Valley, Genale Dawa and Wabi Shebele River basins could be attributed to the southerly winds (Segele et al. 2008) not producing sufficient ice aloft (MW sensors) or having warmer cloud top temperatures (IR sensors)."

A good agreement of CMORPH and TMPA can be at least partially connected to the fact that MW precipitation estimates they both use come from the same data and partially the same retrieval algorithm since CMORPH utilizes GPROF precipitation estimates for TMI sensor (see Joyce et al, 2004). That is not mentioned.

[Author's Response] This very excellent point, which was not included in the paper, has been added to the conclusions section (Section 4).

Authors acknowledge the uncertainty in the rain gauge measurements. Is it possible to quantify? That might give a clue how much the performance of the satellite-based precipitation products is affected by this uncertainty, that is not clear at the moment.

[Author's Response] To minimize the point-pixel discrepancy we have averaged the rain gauge data at each point over a 5 year period.

Technical comments:

Introduction chapter does not include content description of the following chapters. Such description helps the reader a lot to orient in the article, consider adding it to the end of the introduction.

[Author's Response] Thank you for this comment. A brief description of the paper's content has been appended to the final paragraph of the introduction.

p. 7671/26: CCS acronym (in PERSIANN-CCS) is not explained

[Author's Response] The acronym CCS has been identified in the manuscript as Cloud Classification System.

p. 7672/10. Consider mentioning Table 1 with datasets comparisons apart from the study aim

[Author's Response] We have changed the wording within this section to read "This study aims to evaluate the accuracy of three widely used SREs across Ethiopia…".

p. 7677/11: Since Goddard Profiling Algorithm is mentioned provide a direct reference to the algorithm description

[Author's Response] Reference to Kummerow et al. (1996) and Olson et al. (1999), both identified in Huffman et al. (2007), have been added to the list of references as well as the following the mention of Goddard Profiling Algorithm within the manuscript.

p. 7677/12: IR data was calibrated to the TMI measurements, that is not mentioned

[Author's Response] This has been added to the manuscript.

p. 7680/17,18: bias term is used inconsistently, it's bias ratio throughout the chapter

[Author's Response] This has been corrected. The term bias <u>ratio</u> is consistent throughout.

p. 7692/fig.4 : The values show "bias ratio", the caption and legend say "bias" only

[Author's Response] This has been corrected. The term bias <u>ratio</u> is consistent throughout.

* Article of Hirpa et al (2009) was actually published in 2010, see here: http://journals.ametsoc.org/doi/full/10.1175/2009JAMC2298.1 The reference in the manuscript shall be changed.

[Author's Response] Thank you for this comment, and our apologies. This has been corrected.