Reply to Referee comment 2

Dear Editor and Reviewers:

We would like to thank the editor and all reviewers for their valuable suggestions and comments on the manuscript. These comments have not only improved the quality of the current manuscript, but also are beneficial to our future research in general. All point-by-point responses are presented as follows and we have carefully revised the manuscript based on these comments. For clarity, all comments are given in the original version, while responses are marked in blue.

General comments:

The omission of snow cover assimilation over the Tibetan Plateau in the ECMWF forecast system gives the authors a compelling experiment (had ECMWF really not already done that experiment in making the decision not to assimilate snow cover above 1500 m elevation?). There are few surprises in the results once we have learnt that the assimilation decreases spring snow cover, but it is still worth seeing the results.

Reply: Thanks for the positive evaluations and comments, all the comments and corrections have been addressed and incorporated into the revised manuscript. Moreover, IMS snow cover assimilation in mountainous areas is constantly evaluated to address the complex feedback between the surface and the atmosphere. Moving towards coupled assimilation ECMWF aims at enhancing the consistency between the different Earth system components, which will allow better exploitation of observations which are sensitive to the surface (such as snow cover).

Corrections:

Line 15: It would be more informative to say that IMS snow data are assimilated, but only below 1500 m elevation.

Reply: Thanks for the comment. This sentence has been rewritten: However, the SEAS5 is produced with assimilating the Interactive Multisensor Snow and Ice Mapping System (IMS) snow data, but only below 1500 m elevation which may affect the forecasting ability of SEAS5 over the region.

Line 20: “while underestimating”

Reply: Sorry for the mistake. This grammar mistake has been corrected.

Line 57: A statement of why IMS is not assimilated in IFS and hence SEAS5 is required. I think that this is not clear either here or in de Rosnay et al. (2012).

Reply: IMS snow cover assimilation improves snow and surface representation, however it has a complex impact on the atmospheric forecasts. IMS snow cover assimilation in mountainous areas is constantly evaluated to address the complex feedback between the surface and the atmosphere. Moving towards coupled assimilation ECMWF aims at enhancing the consistency between the different Earth system components, which will allow better exploitation of observations which are sensitive to the surface (such as snow cover).

Line 70: State the resolution in terms that will be comprehensible to general readers.

Reply: Thanks for the comment. The resolution has been stated in more clear terms: The configuration for these experiments was largely similar to the current SEAS5 but with lower atmospheric (~ 0.44°) and ocean (~ 1°) resolution and a newer IFS model cycle (CY45R1).

Line 95: Why is "zonal statistics" stated here? It is not just zonal averaging that is required to go from 4 km to 0.5-degree resolution.

Reply: Sorry for the confusion. The method used to obtain the 0.5° IMS snow cover fraction from 4-km IMS snow cover data has been further explained in the revised manuscript: The raw IMS snow data used in this study has a resolution of 4 km while the resolution of the reforecasts is 0.5°. The raw IMS snow data is post-processed as following steps to get the IMS snow cover fractions with the same grids of the reforecasts. Firstly, the raw IMS snow data is resampled to a resolution of 0.005° (1/100 of the resolution of the reforecasts) based on the nearest cell. Secondly, a fishnet which has a resolution of 0.5° and is coincidence with the grids of the reforecasts is produced. In each grid of the fishnet, there are 10,000 cells of the IMS snow data as the resolution of the IMS snow data after resampling is one-hundredth of that of the fishnet. The number of cells which are covered by snow is counted and then divided by 10,000 to get the ratio of the snow cover cells in each grid. Finally, the ratios of the snow cover cells in every grid of the fishnet are calculated to obtain the IMS snow cover fractions with the same grids of the reforecasts.

Section 4.1: Because only the TP is shown in Figure 2, "of the TP" does not need to be stated so many times.

Reply: We have deleted it.

Line 169: "(the DA reforecasts minus the control reforecasts)" has already appeared in this sentence.

Reply: Done.

Line 179: I don't think that snow albedo depends directly on density in IFS. The differences in albedo are clearly dominated by differences in SCF.

Reply: Sorry for the misleading. This sentence has been modified as: Since the changes of snow cover leads to changes in land surface albedo after snow assimilation, Figure 5 presents the spatial differences in land surface albedo between the two ensemble reforecasts.

Line 204: CCs used here but not explained until line 266.

Reply: The explanation of CCs has been added in Line 209 and removed from Line 273.

Line 275: The supplementary figures should either be in the main paper (which will result in there being a lot of figures) or the discussion of them should be in the supplement.

Reply: Thanks for the comment. The discussions of Fig. S1-5 have been moved to Supplementary.

Line 299: "for the two reforecasts"

Reply: Done.

A lot of the Discussion section simply restates results that will be stated again in the Conclusions.

Reply: Thanks for the comment. The Discussions section has been reorganized and condensed.

Line 440: de Rosnay et al. (2012) reference appears twice. de Rosnay et al. (2014) is missing.

Reply: Sorry for the mistakes. de Rosnay et al. (2012) has been corrected to be de Rosnay et al. (2014).

Figure 1 shows elevation; DEM is just how elevation is specified. And even common acronyms should be explained.

Reply: “DEM” in Fig. 1 has been replaced with “Elevation”, and the Figure 1 caption has been rewritten: The location and elevation of the Tibetan Plateau (TP) and the location of climate observation stations.

The Figure 2 caption should state that the difference between reforecasts is with – without.

Reply: The Figure 2 caption has been modified as: (d-f) The spatial differences in snow cover fraction between the two reforecasts (with – without snow assimilation).

The description of columns in Figures 3, 8 and 13 is actually rows.

Reply: Done.