We thank for this review and all valuable comments and suggestions which will improve the paper remarkably. The comments really help in removing confusion at some parts and to clarification. In this text, we repeat at first the questions and comments by the reviewer and then reply, indicating how we would like to react in a revised version of the manuscript. Reviewer's comments are written in italics to make them clearly distinguishable from our reply.

General comment:

- *This paper estimates the gravity effect of glacial ablation in the Eastern Alps by comparing an observed absolute gravity time series with the modeled gravitational effect of changes to glacier mass. This is an interesting use of these datasets, and it will continue to have impact as the gravity and glacier data sets continue over time. I am not very familiar with this region of the Alps, so this likely contributes to my expressed confusion. But the work performed seems well done and the methods are appropriate. This paper is appropriate for publication in The Cryosphere.*
- *I have several suggestions that will hopefully improve the clarity and impact of this work after revision. My main concern with this work is that many places in the text are unclear because they are too brief. The paper would be more clear if more de-tail/explanation was added. I felt I needed several reads through the paper before I understood the differences between the regions and glacier datasets. I have tried to note in my comments below where I was confused and think more detail is needed. Since the paper is on the shorter side, space should not be a concern when adding more detail. Hopefully this will make the paper more accessible to a wider audience. I think these changes are important to the paper, however they should also be easy to address. So I would say they are "moderate" revisions.*

We agree and will follow these suggestions. Both chapters 3 and 4 will be re-structured; more detailed explanations will be given where requested.

Main comments:

- *p4979 line 18: "This is quite surprising. . ." I found this statement confusing. First, uplift could mean several things when I think the authors mean 'rise of mean elevations'. Just say that instead. Second, it would help if there was a phrase like "a negative absolute gravity trend is expected, due mainly to the rise in elevation at the station." Often the GIA literature shows positive gravity trends from rebound because they have been corrected for elevation change, but you are looking at absolute gravity so you don't do that. Noting that difference would be more clear.*

Yes, we addressed the geometrical aspect and the expected gravity change. We will change the wording as proposed.

- *p4979 line 3: This paper cites several non-English references which I cannot read. It would be very helpful if when you cite these papers in the text there could be more detail on what the paper shows. For example on this line, I was wondering what technique do these two citations use to measure the uplift at the station?*

These citations used classical leveling techniques performed during the past decades in Austria. We will add clarifying statements.

- *Figure 1: These figures were modified from the Wikimedia Commons, and are not really the quality I would expect for a journal article. I would expect the authors to produce these maps themselves from the topo data using some freely available software (such as Generic Mapping Tools). Also, the Creative Commons license for the figures requires derivative figures to be "shared alike" with the same license. I will guess that this conflicts with the journal policy since they have their own license and copyright permissions cannot be transferred.*

We will exchange the figures and produce a new Fig. 1. At this occasion, the map of Austria will be replaced by a local map displaying the glacier inventory area used in the paper for better referencing in the re-structured section 3. This new map can be clearly related to Fig. 4.

- *Section 3: You need to be more clear in this section that you will discuss 3 main areas and that they have different datasets. For example, p4981 line 15-18 about the photogrammetry and lidar. Does this statement apply to all 3 regions, because later in p4982 line 16-18 you make the same statement for just the Stubai Alps? Continuing in the first paragraph of sec 3, you next discuss volume change in p4981 line 19-22. Where is this volume change from? Is it just the Otztal area, like the Abermann (2009) citation suggests, or is it all three areas? You should start with a paragraph that says what is common to all regions. (e.g. We have 3 years, all same months, all 2006 data is lidar, we determine boundaries from roughness, etc. etc.) Then have a paragraph for each region that describes that specific dataset. (e.g. Otztal is 5m resolution. Ubeltalferner is 20m resolution.) Is the Ubeltalferner DEM also from lidar?*

We completely re-structure chapter 3 according to your recommendations. Only one DEM has been acquired for the Übeltalferner, thus no digital elevation changes could be determined. Thus, we assumed to have the same average ice loss as observed for the Ötztal area. The DEM was only used to properly locate the approximating rectangular prisms in terms of horizontal and vertical coordinates. We make this clear in the text. We also answer the other questions raised above. The new Fig. 1 will additionally clarify the confusion.

- *Section 4: This section is better because the 3 regions are more clearly separated. It could use a small starting paragraph saying: we have the glacier outlines and the elevation changes, and since we have small resolution in general we use this prism approach to calculate the gravity. Then the specifics of each region would have more context.*

  p4983 line 5-10: Does this mean that you are interpolating the DEMs onto uniform grids? If so, then say that. Why does the later time period (97-06) have a larger grid size than the earlier period, when the later data has a smaller resolution?

Actually, the final used grid sizes result from the interpolation scheme and procedure related requirements. Important is, that the grid size is extremely small compared to the distance to the gravity station. Thus, the chosen vertical prism approach is well justified and by far sufficiently accurate. We will follow your suggestion and additionally add more details on handling the inventory grids for elevation change determination. This clarifies also the grid size issue.

- *p4983 line 16-23: I do not understand this paragraph. You said earlier that the data from the Stubai Alps is from both photogrammetry and lidar. So are you describing what Seiser (2010) did to make the DEMs of the glacier models? OR are you describing what you did because this data is not in DEM form? Did you just get glacier outlines and volume changes? When you say you calculated mean elevation changes, does that mean you divided the volume estimate numbers by the areas? It is not clear a) if this is unique to the Stubai data and b) why that is the case.*

  p4984 line 1: Is this back to Stubai data? If so, then move it up after the class 4 Stubai paragraph.

Indeed, the glacier areas are handled differently according to accuracy needs. As all parts of the Stubai Alps glaciers are more distant to the gravity station than the Ötztal glaciers, we applied a simpler approach here without losing significant accuracy in order to save time-consuming processing efforts. Analogous to chapter 3 we will also re-structure chapter 4 making all these questions clear.

- *Section 5 p4985 line 4-15: This is the first mention of the melting scenarios and the description is quite abrupt. There should be a sentence or two explaining why you are using these different scenarios. For example starting p4984 line 26: "Calculating the gravity effect from digital glacier models at three dates (1969, 1997, 2006) gives the total estimated change in absolute gravity between these years. Table 1 summarizes the gravity effect caused by ice loss during the two evaluation periods and clearly shows the dominant influence of the Otztal glaciers. In order to compare the totals to the measured time series at Obergurgl we must decide how much of this melt occurred prior to 1985 and we therefore investigate 3 possibilities on how the ice melting rate changed over time. As shown in Figs. 2 and 3…."*

You are right. Your proposal exactly describes the problem. We follow your suggestion and make use of your text proposal accordingly.

- *p 4985 line 10: This directly compares with the trend from p4981 of 14 nm sˆ-2 yrˆ-1, correct? So you can say the glacier correction explains 59% of the observations (8.2/14)?*
- *p4985 line 24: Where does this 75% number come from? Also where does the 70% number come from on p4986 line 9? Then how is the 2/3rd value gotten on p4987 line 4? They all seem to be the glacier correction, which I think is 59% above?*

2/3 or 70% are the rough estimates taking the uncertainties into account. You are right; we should report only one number. We change this in the text. We also clarify the discrepancy w.r.t. to your 59% estimate. Actually, our wording was confusing and we change this as well. In Fig. 2, the time series is not yet corrected for man-made gravity variations, which would increase the trend of 14 nms^{-2} yr^{-1} slightly, while Fig. 6 does include this correction. We will make this clear in the text, which was missing before. Your remark is certainly important.

- *p4986 line 21: In the introduction you mention that one of the gravity stations has uplift of 1mm/yr. Was this for a different station, and the uplift at Obergurgl is unknown?*

The numbers reported in the discussion section refer to estimates of the elastic response due to glacier shrinkage modeled by Barletta et al. (2006). The numbers given in the introduction are estimates of geometrical uplift based on observations. At Obergurgl, no direct observables are available; the numbers are derived from interpolating the information gained on nearby leveling lines or GPS sites.

Minor notes:

- *p4979 line 21: This last sentence is passive voice and should be changed. The paragraph could end with something like "Here we calculate the associated gravity response of these nearby ice mass losses to explain the observed gravity trend."*

We correct accordingly.

- *p4979 line 25: "under best control" Do you mean well constrained?*

The performance of an absolute gravity meter and its uncertainty can only be controlled by participating at intercomparison campaigns. „best control“ means, that the instrument took part of all these international experiments.

- *p4981 line 23: Should be ". . . decrease of -9.5 m and -8.2 m, respectively."*
  p4981 line 26: ". . .glaciers in the surrounding area of Obergurgl. . ."

We correct accordingly.

- *p4982 line 25: What is the meaning of this value of -7441 mm w. e.? Is that per square meter, so that it is an average value of the glacier mass loss? Otherwise how is it mass if you just have a length (mm) times a density (water equivalent)?*

  Figure 2: Same as last comment. The axis on the right hand side, is this the mean surface density for each glacier? m water equivalent is a surface density unit.

We will insert „specific“ before „mass balance“ to make it clear, both in text and in Figs. 2 and 3.

- *Figure 4: Do these changes in ice thickness correspond to the glacier areas in Table 1? Could the regions be labeled Otztal, Stubai, etc., be labeled on this map? Also, do the eastings and northings belong to a certain UTM zone? If so, the caption should mention that.*

We will provide a new Fig. 1, where the glacier areas are displayed. Fig. 4 shows the ice thickness change for the Ötztal Alps only. We will explain the axis labels and coordinates in the caption.