

Dear Dr Reinhard Drews,

Please find attached a list of changes introduced in the revised version of the manuscript titled *Unlocking archival maps of the Hornsund fjord area for monitoring glaciers of the Sørkapp Land peninsula, Svalbard*.

Kind regards,

Justyna Dudek

1. Introduction

In the introduction we have made all changes as suggested by both reviewers.

We removed word glacier after all glacier names. We also merged some paragraphs as suggested by the second reviewer.

We rephrased the first paragraph and added relevant references (Nordli et al., 2014; Isaksen et al., 2016, Nuth et al. 2010; Morris et al., 2020; Schuler et al. 2020).

We merged the second and the third paragraph and added references supporting our statements (Jakob et al, 2012; Nuth et al. 2013; Martín-Moreno et al., 2017). We also rephrased some sentences as per suggestion of the second reviewer.

In the fourth paragraph of the reviewed version (which was merged from the sixth and seventh paragraphs of the preprint) we corrected two sentences as suggested by the second reviewer (line 44 and 47 of the preprint).

In the sixth paragraph of the reviewed version we rephrased first two sentences and added one citation (Kolondra 2005). We also rephrased the last sentence according to the suggestions of the first reviewer.

In the first table we added a third column with references to the published works from the overflights carried out by the NPI (over 40 citations). We also added one figure showing a series of 9 maps of Sorkapp Land lined up side by side showing the regions covered by each photogrammetric mapping campaign.

In the last paragraph we introduced some changes as suggested by the second reviewer (line 68, 69, 73, and 74 of the preprint).

2. Study area

In the beginning we added two paragraphs with general information about Svalbard, the influence of the sea currents, strong climate gradients, ice cover of the archipelago. We also introduced the concept of surging glaciers. We added some information about climate (temp. and precipitation change) in southern Spitsbergen. We supported this section with 8 additional citations including one suggested by the reviewer (Hagen et al., 1993; Eckerstorfer and Christiansen, 2011; Farnsworth et al., 2016 ; Sund et al., 2009; Ziaja and Ostafin 2015; Pälli et al., 2003; Grabiec et al., 2017; Isachsen et al 2016, Forland et al., 2011; Osuch I Wawrzyński 2017).

In the next paragraphs we introduced all corrections suggested by both reviewers (lines 76-79, 85, 88) while also updating the information so that it refers to the larger research area and more glaciers included in the reviewed version of the manuscript.

The figure 2 (previously 1) is now updated covering larger area, and having an additional map showing Svalbard's location in the North Atlantic.

3. Source material

Instead of dividing this chapter into two sections describing the data representing a specific period (1961, 1990), we decided to change its order and divide this chapter by data type (maps, images, dems), which we then ordered from the oldest to the newest.

In the first section (3.1. Maps) we introduced most of the suggested changes referring to the data from 1961. The corrected text from section “3.1. 1961 data” (lines 95-139 of the preprint) is now in the section “3.1.1 IGF PAN topographic map series”. From the 1961 cartographic data series we added 3 more map sheets representing glaciers and overlapping with the elevation data from 2010. We show their position on the figure 3.

Both figures 2 and 3 in the preprint showing the original IGF PAN maps are now merged and their content is shown on the figure 3 of the reviewed version of the manuscript.

We added the section “3.1.2 NPI map” detailing the specification of the online map released by NPI and representing the year 1990 which we used in our research (lines 175 to 182). In this section we also added Figure 4 showing the extent of the data for 1990 and 1961 on this map.

We added the section “3.2. Imagery” in which we described data from 3 photogrammetric campaigns (1961, 1990, and 2010) and Landsat 5 TM scenes used in our research. Figure 5, added to reviewed version is showing their spatial coverage.

The last section of this chapter “3.3. Dems” added to the corrected manuscript contains information about elevation datasets released by NPI. Added figure 6. shows their extent. Important change in this section: four research we added data from 2010 which constituted our baseline dataset throughout the study.

4. Methods

The most important change in this chapter refers to the data extent and the tables with coordinates of the topographic points. As mentioned above we decided to add more map sheets, and in order to avoid having too many tables in the text we decided to merge the information from the tables 2-4 together with the same information for additional map sheets and add it to the manuscript as a supplement. In this chapter we decided to keep mostly the information regarding the processing of the maps while the description of the changes in glacier extent was moved to added chapter “ 5. Results”. We also changed the division into sections in this chapter and in the reviewed manuscript some of the sections has different names and content. In the corrected version of the manuscript we have 4 sections:

4.1 Source data processing and evaluation of output data accuracy (previously in the preprint 4. Methods of source-data processing and evaluation of output data accuracy and 4.1 Verification of source data accuracy);

The biggest change described in this section is the work flow for processing the scanned maps. In the corrected version we decided to do the data processing using only the tools available in Arc Scan extension of ArcGIS software. For the standardization of data processing methods we also repeated the processing for the data presented in the preprint. In this section we also added Figure 7 showing our initial work flow.

Figure 8. (previously 4) shows larger study area.

In this section there is also the description of the three additional maps sheets. All maps sheets are presented on the figures 9-14 (previously 5,6, and 8). Although previously we planned to plot vector arrows pointing in the direction of the dx, dy offset to the NPI reference map we didn't manage to do it efficiently because they were not clearly visible in the adopted scale.

4.2 Fitting data from 1961 and 2010 (previously in the preprint it was the same title)

We updated the section with regards to comparison of 1961 data against 2010 NPI model.

4.3 Final elevation model for 1961

We introduced some corrections suggested by reviewers (lines 228, 230, 231, 242 of the preprint). We updated all values relevant bigger study area. Both figures 16 (previously 9) and 20 (previously 14) were updated with new dataset for larger area compared against the data for 2010.

4.4 1961–1990–2010 changes in glacier geometries

We left in this section only 3 phrases referring to methods for determining glaciers geometry changes.

5. Results

In this chapter we included 2 tables with data about surface area and surface area change of each analysed glacier in the periods 1961-1990, 1990-2010, and 1961-2010. We also introduced all changes suggested by the reviewers (lines of the preprint: 251, 255, 256, 257-258, 258-262, 268, 273, 281, 286-287, 289, 290, 292, 297, 298, 299, 300). We removed fig 16 of the preprint. We described the results adding information about glacier changes in the period 1990- 2010 (or updating the values for the period 1961-2010). The figure 21 (previously 15) was updated showing larger area extent and additional research periods.

6. Discussion

We updated the research periods in the text, added references as suggested by the reviewers, and make all corrections as per line by line comments.