

Review of “Strong ELA increase causes fast mass loss of glaciers in central Spitsbergen” by J. Małecki.

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Overview

This rewritten paper analyzes decadal scale glacier change in central Spitsbergen. The manuscript is greatly improved over the first version, but I still have one minor complaint, as well as a number of corrections. My main objection is that there is still an attempt to make more out of the story than is strictly justified. The work in Dickson Land (DL) is carefully performed, and now well presented, for the most part. But the specific balance found in DL is then extrapolated outside of that area to selected parts of central Spitsbergen (areas containing valley glaciers, which are deemed similar to DL), to estimate the contribution of this extended region to sea-level rise. The exercise seems unwarranted given that there are no elevation change data presented outside of DL. It is straightforward to multiply any given glacier area by some assumed value of specific balance; what we really need are concrete data. The results presented here for DL are valuable in of themselves; increasing the total number of gigatons per year by extrapolating the balance outside the area considered is not necessary.

Specific comments

P01L07: Rewrite to “Dickson Land (DL), in the central part of the largest island, Spitsbergen, is relatively arid, and as a result, glaciers there are relatively small and restricted mostly to valleys and cirques. This study presents a comprehensive analysis of glacier changes in DL, based on...”

P01L12: “Total glacier area decreased by ~38% since the LIA maximum, and front retreat gas increased over the study period.

P01L15: “...bands, in contrast...”

P01L17: “Its application...” As noted above, this should not be highlighted as a main conclusion.

P01L36: “...Current, and ice masses there are considered to be sensitive to changes in climate and ocean circulation (Hagen et al, 2003).”

P01L48: “In contrast, the interior of Spitsbergen, the largest island of the archipelago, receives relatively low amounts of precipitation, due to its distance to the open ocean, and to the surrounding rugged terrain of Svalbard; both factors act to limit moisture transport into the interior. As a result, this area has fewer and smaller glaciers than the adjoining areas. Lower snow amounts means earlier exposure of low albedo surfaces, a more continental climate, with higher summer temperatures (Hagen...”

P02L08: “...since they surround the main settlements of Svalbard.”

P02L09: “Their retreat may...”

P02L13: “...is the sparsely glacier-covered...”

P02L14: “In this paper I present an inventory of the ice masses in DL, and quantify...”

P02L16: “...fluctuations, using...”

P02L19: “...in central Spitsbergen to sea level rise.” Although, as per the comment above, I think you should stick to the region in which you have done the work i.e. DL.

P02L38: “...near Longyearbyen.”

P02L40: “...mean of 4.9 °C.” There isn’t much of a basis for saying this is “high for Svalbard”, given that there are only a few meteorological stations there.

P03L09: “...landscape evolution.”

P03L15: “...and their fronts are retreating (...”

P03L18: “DL glaciers are mostly small, and only...”

P03L19: “...radar data). As a result, ice velocities are low; the maximum measured on the largest glaciers is less than 12 ma⁻¹ (Rachlewicz, 2009b), while...”

P03L22: “...surge-type glaciers are to be found.”

P03L22: “Also, 2009/11 aerial imagery acquired by the Norwegian Polar Institute shows that...”

P04L01; “...indicate older surges.”

P04L09: The glacier inventory should be referenced by König et al. (2013) and Nuth et al. (2013), and it should be referred to consistently as “glacier inventory”.

P04L11: “First, glaciers smaller...” There are no glaciers smaller than 1 km² in our glacier inventory; that was our cut-off size.

P04L11: “...than 1 km² are not...”

P04L13: Delete entire sentence “Lastly...snowpatches.” The glacier inventory (König et al. 2013; Nuth et al. 2013) does not “tend to” contain transient snowpatches. That was the entire point with making simpler (i.e. coarser) boundaries, we were eliminating as much as possible these areas. You might say “some glacier boundaries in the glacier inventory (König et al. 2013) include transient snowpatches”, but I disagree that this is a widespread problem. In addition, there is still confusion about the data sources (see comment below).

P04L17: “...by the author using original NPI...”

P04L27: The most recent outlines do not come from the “official NPI inventory.” The glacier inventory (König et al. 2013; Nuth et al. 2013) does not yet contain data from the 2009-11 campaigns. You are referring to NPI shapefiles based on 200/11 aerial photography (available at data.npolar.no), which are used in the S100 map series.

P04L45: “The 1990 DEM, which was constructed from 1:15,000 aerial photographs, does not...”

P04L45: “...do elevation changes...”

P04L47: “...DL-C, the latter which comprise 16.6 %...”

P04L49: “0.5 m resolution”. To be consistent with the reference to the (1:15,000) 1990 photographs, it would be useful perhaps to give the scale for the 2009 photographs.

P05L01: “...fit onto a common grid.”

P05L02: “...(2011) was used to accurately align the datasets.”

P05L26: “...subtracting the 1990 DEM from the 2009/11 DEM. This is an accurate method for determining mass change over long time-scales...” Also, this is in general true, but the time scale is not the most important factor, it is rather the mass change itself. So if that is a large number, the time scale need not be long to get an “accurate” result.

P05L29: “...points, as is the case with stakes used...”

P05L35: “The mean...”

P05L47: “...(2007) found a good...”

P06L10: “...horizontal glacier polygon digitizing error.”

P06L33: “Since glacier surface slopes in DL are relatively gentle, mountain slopes...”

P07L22: “...on land, and...”

P08L01: “...greatest glacier coverage (26% or 117 km²), compared to only 8% (39 km²) and 10% (51 km²) in DL-S and DL-N, respectively.” Note that the significant digits might be reduced in other places in the paper.

P08L04: “Glacier maximum and median elevation increases moving from south to north. DL-N contains most of the high-elevation glacier area in DL, with a median elevation of 614 m.”

P08L07 (and all occurrences): “high-elevation” rather than “high-elevated”

P08L07: “The median elevation of...subregions is 520 m...”

P08L19: “Excluding known and probable surge-type glaciers, whose areal extent can change due to internal dynamic instability rather than in direct response to climate, shows that increasing area loss rates are related to climate forcing rather than to ice dynamics. The larger error bars of dA/dt preclude identification of any trends in that signal.”

P0L25: In figures 4a and 4b, add text to say “All glaciers” and “Non-surging glaciers,” makes it easier to quickly see what the figure is about without having to glance down at the figure caption.

P09L01: Two significant digits unnecessary given the quoted uncertainties.

P09L05: “... dL/dt have smaller uncertainties.”

P09L06: “...no front advances were detected...occurred in the first period (...”

P09L10: “...periods with...”

P09L11: “...of the latter cases...”

P09L11: “...short-term increase in dL/dt ...”

P09L22: “...observed above ca. 1000 masl, mostly in DL-N.”

P09L29: “...mass balance are found in DL-C...”

P11L02: “(a) 1990-2009 elevation ...”

P11L09: “...rates decrease with...”

P11L10: “... highest elevation glaciers, mainly in DL-N, have been thinning the least...”

P11L11: “...low elevation ice...”

P11L12: “Length changes are correlated...”

P11L12: “...low elevation fronts...”

P11L20: “...aspects, compared to...”

P12L17: “However, the clear...”

P13L34: “...of glacier-wide thinning...”

P14L07: “...for SVL (...”

P14L08: “...could also explain changes...but there are too few data to test this idea.”

P14L10: “...the minimal importance...”

P14L24: “...low-elevation...”

P14L34: "...James et al (2012) and this study."

P14L42: "...researchers to be relatively..."

P15L15: "...average ELA has increased..."

P15L31: "This shift..." I don't see any justification for this sentence.

P15L33: "low-elevation"

P15L34: "...at the fastest rates."

P15L35: "Application..." As noted above, I wouldn't highlight this as a main conclusion.