

Interactive comment on “The Northeast Asia mountain glaciers in the near future by AOGCM scenarios” by M. D. Ananicheva et al.

Anonymous Referee #1

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GENERAL COMMENTS This paper uses GCM data to predict the response of glaciers in NE Russia to warming over the coming 60 years. The characteristics focused upon are glacier’s ELAs and terminus altitudes. ‘Modern’ and ‘future’ vertical mass balance profiles are generated, and used to estimate ELA. Future changes in the glacierised area of different regions of NE Russia are also estimated. The paper is of interest partly because of the methods employed, but also because NE Russia is a little-investigated region. The paper is original, but sometimes poorly written, making it difficult to follow, and the science difficult to comprehensively evaluate. Given some improvements to the writing and clarity (proof reading), the paper will be a valuable addition to the sparse literature focusing upon these topics in NE Russia.

SPECIFIC COMMENTS

I find the time period referred to unclear. For example, on p.414, lines 21-23, it is stated that “According to our chosen climatic scenario the mean summer temperature would increase by between 3.1° and 4.0 °C throughout the study region by 2040–2069...”. This is a long time period (30 years). Is the suggestion that temperatures increase by 3.1° and 4.0 °C, relative to present? If so, are modern temperatures compared to the mean value for the 2040–2069 period, or are temperatures predicted to increase 3.1°C by 2040, and 4.0 °C by 2069? I feel this requires clarification. This also applies to p.718, lines 14-15 (temperature increase from now until when?).

There is a need for consistency when referring to orientations, i.e. NE or northeast etc. (not a combination). For example, compare pg.714, lines 13 (northwest. . .) and 15 (NE. . .). This needs addressing throughout the paper.

‘Range’ when referring to a ‘Mountain Range’ should consistently have an uppercase ‘R’

When referring to elevation/altitude, there is a need for consistent inclusion of m ‘asl’. This needs addressing throughout the paper, including figures.

Need for consistency when refereeing to plural or singular, e.g. p.708, line 11: ‘ELA’ is singular, ‘termini’ is plural, ‘elevation’ is singular. This needs addressing throughout the paper.

p. 714, lines 8-10: It is stated that “In the mountains during cooling periods, the greatest temperature decreases occurred in autumn and spring, exacerbating and prolonging winter cooling; however, warming phases were concentrated in summer, which enhanced ablation.” However, Fig 3 appears to suggest the opposite (i.e. increased warming in winter). Perhaps Fig 3 ‘b’ and ‘c’ are incorrectly labelled? The sentence on pg.710, lines 10-16, goes on to state that “The comparison of schematic distributions of seasonal temperature trends for the past ~50 years, and the signs of these values in particular, specifies different “sources of intensification” for the winter and summer trends. The former increases from northwest to southeast, under the influ-

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ence of warming, coming from the central part of Asia; the latter increases from NE to SW, under the influence of warming of the southern part of the Sea of Okhotsk, and rapidly disappears towards the Arctic Ocean.” First, I find this sentence unclear. I’m assuming the “former” relates to winter temperature (trends), and the “latter”, summer temperature (trends)? If so, I would again question the labelling in Fig 3 (b,c). I’m unsure whether Fig 3 illustrates the “schematic distributions of seasonal temperature trends for the past ~50 years”, but if so, it appears that that winter values increase from NE to SW (“under the influence of warming, coming from the central part of Asia”), and summer values increase from NW to SE (“under the influence of warming of the southern part of the Sea of Okhotsk”) [i.e. the trends are opposite to those suggested in the text]. If Fig 3, doesn’t show “schematic distributions of seasonal temperature trends for the past ~50 years”, then might I suggest this figure be included for the purposes of clarification.

p.722-723. I feel section 5 needs rewriting to clearly emphasise that the ‘change’ in ice distribution is linear/non-linear. At present I feel that the ‘change’ element isn’t clear. This also applies to p.713, lines 9-11, where, to say: “The area share of elevation intervals occupied with ice, is assumed [...] to linearly decrease with altitude while a glacier is retreating” I feel suggests that that the surface area of the glacier decreases linearly with altitude, or that the ice surface area in the upper-reaches of a glacier diminishes relative to the total glacier area. It is my understanding that the key emphasis is this: “The temporal reduction in glacier surface area is assumed to be inversely proportional to the altitude of the elevation band considered, and that this relation is linear”. I would consider revising the relevant sections accordingly.

TECHNICAL CORRECTIONS

What follows is a list of technical corrections. These are numerous and the list is not exhaustive. The paper should be thoroughly proof-read prior to full publication.

Title: I would suggest the title be changed, from: “The Northeast Asia mountain glaciers

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in the near future by AOGCM scenarios” to something like: “The mountain glaciers of Northeast Asia in the near future by AOGCM scenarios”.

p.708, lines 1-2: parentheses are opened, but not closed.

p.708, lines 1-3: sentence lacks clarity and should be rewritten.

p.708, line 18: the dates included here are “2049-60”, should this read 2040-60?

p.708, line 23: rather than “termini level”, try “terminus altitude/elevation”

p.709, line 20: remove “The” from “The NE Siberia”

p.709, lines 24: change to past tense, e.g. “Significant warming has also been observed...”

p.710, line 2: should read either: “Glacierised regions” or “Glacier Systems”, not “Glacier regions (systems)”.

p.710, line 16: “NE 66 Siberia” – unclear what the “66” denotes.

p.710, line 18: “(ELA) 68” – unclear what the “68” denotes.

p.710, line 23: “Mapped” by (include a reference)

p.711, line 13: “Kamchatka glaciers” = plural, “lies” = singular

p.711, lines 15-16: “Upon” rather than “within” the Kamchatka Peninsula

p.712, line 6: define “GCM”

p.712, line 16: for numbers (7) and (10) in parentheses, include (n = 7), (n = 10) to improve clarity.

p.712, line 24: delete “the” from “the NE Asia”

p.713, line 8: Braithwaite and Raper (2007) speak of the median glacier altitude (i.e. AAR = 0.5), but this is distinctly different from the arithmetic mean elevation, and I would

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therefore question the use of this reference in support of the use of the Gefer/Kurowski method.

p.713, line 22: references need to be included here to support the preceding statement that “Comparison of data obtained between the late 1950s and 2001 about the glaciers of northeast Asia and their regimes, shows they have undergone appreciable changes – as revealed through retreat of their termini, surface lowering, formation of new morainic deposits, etc.”

p.716, line 14: are the lapse rates, adopted for Kamchatka, “summer” lapse rates (as used for NE Siberia). If so, I would suggest referring to these as summer lapse rates.

p.716, line 19-20: change from “defined basing on its...” to something like “defined on the basis of its...”

p.717, line 7: not clear what “latter” here refers to.

p.717, line 15: Needs short explanation of what the coefficient of concentration relates to.

p.717, line 20: states “we introduced the concentration coefficient for snow drift...” Introduced in what way? To what? In which equation? More detail is needed.

p.718, line 20: remove “involved”

p.718, lines 225-26: would be interesting to know modern coefficient values in these regions.

p.719, lines 1-3: this sentence is unclear. Particularly use of the word “unity”.

p.720, line 15: remove “altitude” from “ELA altitude”. The ‘A’ in ELA is altitude.

p.720, lines 22-26: “glaciers will not be present...” by when? Including a specific year/time period would be useful.

P.721: a number of accumulation and ablation estimates (in mm) are included on this

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page. I assume many of these are in mm per year, and should be recorded as such.

P.721, line 13: “attain negative A-, C-values” should read “attain negative ΔA -, C-values)

P.721, lines 17-22: The section starting “Under constant...” and ending “consistent with climate”, tells us little, and I would suggest its removal.

P.721, line 29: consider replacing “consistent” with “in equilibrium”.

p.722, line 5: “Verification of the results” appears to be italicised.

p.722, lines 5-8: it is stated that “Verification of the results was done by comparing the calculation of parameters (ELA, glacier termini and glacier areas) projected for the period of the 1957 International Geophysical Year (IGY) until the modeled period 2010–2039 with data of actual glacier changes obtained based on Landsat satellite imagery (Ananicheva at al., 2006)”. I would suggest revising the sentence, as it appears to suggest 2010-2039 data were compared to observations for this period.

p.723, lines 4-8: I would consider using ‘%’ in each example, rather than referring to an ‘x-fold’ change (this also applies to p.723, line 23).

p.723, line 20: it is unclear what is meant by “safe”.

p.723, line 26: change “till” to “to”.

p.724, line 22: I would suggest changing “consists” to “lies”.

p. 285, Table 1, Column 2: “The shift of ΔH_{ela} ” suggests a shift in the change in ELA. This should be altered to something like: “Shift in ELA” or “change in ELA”.

p. 285, Table 1, Column 6-7: are ablation and accumulation in mm yr⁻¹? (this also applies to tables 2 & 3).

Table 1 shows balance in mm yr⁻¹. Tables 2 & 3 show balance mm/year. There should be consistency, either use -1 or /year.

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p.734, Fig 4: each of the lines in these figures needs to be identified in figure caption, i.e. it is stated that “Solid lines – baseline period, broken line – projection by ECHAM4”, but there are four lines in each figure.

p.734, Fig 4: I would remove “directed in oppositional way” from the figure caption as its meaning is unclear.

p.735, Fig 5: The figure caption should tell us what ‘S’ (i.e. the x-axis) represents. There also needs to be more information in this caption generally, i.e. what 30-year period? Which glaciers?

Interactive comment on The Cryosphere Discuss., 4, 707, 2010.

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