

Response to Referee #2 comments:

Review of “Multi-year analysis of distributed glacier mass balance modelling and equilibrium line altitude on King George Island, Antarctic Peninsula”, by Falk *et al.* (tc-2017-232)

Response to major (structural) points:

We thank the reviewer for the careful evaluation of our manuscript. The paper includes complex data sets and analysis, that unfortunately has affected the structure of the paper. We acknowledge the comments and will straighten the manuscript to improve its structural integrity and readability.

To include future climate change scenarios as proposed would, in our opinion, result in a second paper that would deal with a sensitivity analysis of the modelling results. To our understanding, the presented research is already comprehensive and adding further elements would result in a too broad and diffuse paper.

Specific comments

abstract

line 5 "distinct spatial heterogeneity reflecting the impact of synoptic[...]" I dont understand what you mean

The rugged topography leads to a distinctly different extent of terrain exposure to the impact of the synoptic weather patterns. This then leads to a heterogeneous spatial pattern of ablation and accumulation areas of the glacier surface (more details in Falk et al. 2016).

line 6 "moist air with high temperatures and rain, and leads to melt conditions on the ice cap, fixating surface air temperatures to the melting point[...]" I believe you mean melting surface temperature? please rephrase

The melting point of a solid, in this case ice, is the temperature at which it changes state from solid to liquid at atmospheric pressure.

Introduction

line 1 "a large fraction" how much? page 3 line 16: add a point 6? projection?

The peripheral glaciers and icecaps of Antarctica represent ca. 18% of the global total. We changed the manuscript accordingly.

Study area

p3 line 32 "rarely absent" -> "frequent" ? p3-4: "all year round" -> you said "rarely absent" just before so that is confusing p4 line 3: link that with the changes in the climatic systems evoked in the introduction

“In general, days with temperatures above freezing are rarely absent in winter and are frequent in summer.” This means, that air temperatures above freezing are present all year round, meaning also in winter, but more frequent of course during summer. This is recorded by the ice lenses in the snow pack of the accumulation zone.

Datas and glaciological datasets

line 15 p4: are the radiation shield aspirated artificially? you should discuss if there's an impact of the radiation on the air temperature measurements.

The radiation shields are not aspirated. This is a valid technique that assumes that wind speeds are high enough to ensure a natural ventilation. The location of the South Shetland in the Antarctic circumpolar low pressure through, as well as katabatic wind systems, leads to high wind speeds throughout the year. Ventilation is not an issue at the AWS due the high average wind speeds.

p4 line 26: the nationality has no scientific significance

The nationality of the scientific support is important for international collaboration and was added here for reasons of completeness.

p6 line 9-11: might be moved to "methods"

The reference to the glaciological model will be added to the model description section as part of the restructuring of the manuscript.

p6 line 28: so what do you do in that case? could you explain?

The battery voltage was logged with the meteorological data, so that we can differentiate between real features (like a frontal system) and fake sensor readings due to power failure. In the first case, we take the data as it is, of course. In the second case, we apply despiking routines.

p9 line 11-22: could you explain more precisely how you use your density measurement to interpret your snow height changes in terms of swe?

We are not sure if we understand the comment correctly. We use the snow density as a conversion factor to obtain the surface elevation changes in water equivalent.

p10-11, until 3.4: that mixes results/methods, please clarify.

In agreement with the comment of referee #1, the part p11 lines 9 to 17 will be moved to results.

p12 line 12: can you provide an estimate of the uncertainties on discharge outputs resulting from all the unknowns such as, for example, the bedrock topography? do you have any discharge measurements?

The discharge measurements were part of the hydrological research carried out by our Argentinean colleague, and is underway to being published. The values compare well for the time periods of hydrological observations, but these data cannot be used here in this manuscript. There is so far no information on bedrock topography. The basal melt is thus not included in the discharge that includes the spatially integrated melt and rain.

p12 line 30: how much that would impact further predictions (such as those made with the AAR)

Choosing higher values for the roughness length leads to higher calculated melt, and mostly to an overestimation of the calculated melt and discharge. We will add a short comment on this in the manuscript.

p14 line 24: coverage

This was a mistake and we corrected it. Thanks!

p15 line 2: to methods

We will move this part to the methods section as part of the restructuring of the manuscript. Thanks!

p15 lines 6-10: to methods

This is better located in the methods section, model description. Thanks for the comment!

line 21: ?

We are not quite sure, what the question mark refers to. p15 line 21: "The high variability of ablation and accumulation reflects the very high inter- and intra-annual variability of the meteorological boundary conditions (Falk and Sala, 2015)." This statement refers to the high inter- and intra-annual variability of accumulation and ablation observations as seen in Fig. 8 to 13. It is driven by the variability of the meteorological boundary conditions as discussed by Falk & Sala (2015).

line 26 - onwards: to methods

We do not agree with this comment. The correlation of the simulated discharge to positive degree days is clearly a result.

p17: the AAR method should be described in a methods section

The AAR is a standard index describing the health/status of a glacier. It is a simple definition as the ratio of accumulation area to total glacier area. We discuss here the results of analysis of our field data and modelling efforts by this index.

p18 line 19: See general comments: what would be the impact on micro biota of these changes (make links to the introduction)

We thank the author for this comment and will include a paragraph on the impact on biota to link with the introduction.