Clim. Past Discuss.,
doi:10.5194/cp-2016-1-RC2, 2016

Climate of the Past Discussions

Interactive comment on "The Last Glacial Maximum in central North Island, New Zealand: palaeoclimate inferences from glacier modelling" *by* Shaun R. Eaves et al.

S. Mills (Referee)

stephanie.mills@plymouth.ac.uk

Received and published: 11 February 2016

General comments

This paper uses a 2D glacier modelling approach to determine likely temperature and precipitation changes during LGM in central North Island, New Zealand, based on mapped moraine limits. The paper uses a step change in temperature and variations in precipitation in order to determine the most likely ice extent during the LGM, as well as studying the sensitivity of secondary parameters such as albedo. The paper also takes into account changes in the topography of the study area, as a result of post-glacial lava flows that have built up cones or infilled glacial troughs. It is concluded that temperatures during the LGM would have been in the order of 4-7 °C colder during the

LGM, with no change in precipitation, which is in accordance with other proxy records. This study improves understanding of past temperature change during the LGM in this relatively understudied region of North Island. The paper is well written and suggested changes are relatively few, although I do have a couple of recommendations.

Specific comments

1.) The paper would benefit from an explanation of the geomorphology of the area in more detail, including a geomorphological map outlining the key geomorphological features for each volcano. The prominent moraines are illustrated in Figure 1A, but it's very difficult to see how they relate to the topography, and their altitudinal range.

2.) The model has been run for present-day conditions with T and P =0. The authors mention that there is overestimation of ice in some of the catchments, however it would be useful if this were explored in more detail. Figure 2 seems to represent mass balance, although the figure caption suggests that this is also ice extent, however this isn't really clear. It would be useful to include a figure with modelled ice extent/thickness under present-day conditions. The authors use ice thickness from Keys (1988) to remove the ice, but how do the present-day simulations of ice thickness compare with this data? Are simulated ice thicknesses comparable to those measured? The areas where the model overestimates ice under present conditions are also where ice overspills during the temperature steps, which suggests that a more comprehensive model validation is needed. What does it take to get a better fit in the Whangaehu and Whakapapa catchments? E.g. variations in precipitation? I appreciate that the authors note the effect of Crater Lake and that modelled ice extent is better aligned in catchments that do not receive ice from this area, however this could be explored in more detail.

3.) It would be useful to look at precipitation in more detail. How many climate stations have been used in the creation of the precipitation grids and over what altitudinal range do the climate stations occur? It is later mentioned that there are no climate stations on the Tongariro massif therefore there is potentially a large uncertainty in precipitation

in these areas. I think that variations in precipitation between the two volcanoes needs to be explored in more detail or at least acknowledged much more effectively, although I note that this is mentioned briefly in page 14 lines 13-22. There also appears to potentially be asymmetry in the distribution of the moraines on Tongariro. Is this correct? It's difficult to tell without knowledge of the altitude at which these occur but it may also be something to explore in more detail.

Technical corrections

Page 4 line 21 rephrase 'moraines present outboard of these positions'.

Page 4 line 22 . . .are also supported by recent. . .

Page 7 line 1. What is the original resolution of the dem?

Page 7 line 4 How does Keys (1988) determine the ice thickness? It would be useful to give a little more information here.

Page 7 (model assessment) and reference to Figure 2. Figure caption says that the figure shows modelled steady state ice extent and mass balance but it only seems to show mass balance. It would be useful to have another figure specifically showing ice extent and thickness.

Page 10 line 35. Fig. 6a, b?

Page 14 line 6. The authors mention that there is good agreement between observed ice distribution on Mt. Ruapehu and simulations using the 30-year data set but I'm not sure that I agree with this. If figure 2 is showing the ice extent then as stated previously, it overestimates ice extent of the Whangaehu and Whakapapa glaciers and this needs to be addressed more effectively.

Figure 1. It would be really useful to know the altitudinal range of the moraines and I would suggest also including these on 1B.

Figure 4. It would be really useful to have some idea of the topography / elevation on

this figure, whether this is as a shaded dem surface or contours.

Table 1. Wahianoa should be WAH. Also, how was the ELA derived in Keys (1988)?

Table 2 Changes in lapse rates could be explored in more detail given the uncertainty in lapse rates during the LGM. What is the seasonality that has been applied? What seasonal lapse rate was originally applied and what is the justification for running the model for -0.006 °C m-1 across all months? What are contemporary lapse rates?

Interactive comment on Clim. Past Discuss., doi:10.5194/cp-2016-1, 2016.