A new attempt of 2-D numerical ice flow model to reconstruct paleoclimate from mountain glaciers

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Introduction
The aim of this study is to model paleo-glaciers in Dedegöl Mountain (SW Turkey) and simulate the paleo-climatic conditions. The first method, two-dimensional (2-D) model based on the shallow ice approximation (SIA) (Plummer and Phillips, 2003; Eaves et al., 2016), is used to compare the simulated and field observed ice extent of paleo-glaciers:

\[ \frac{\partial h(x,y,t)}{\partial t} = M(x,y) - \nabla \eta(x,y) \]

A MATLAB code is generated and finite difference method is used to solve this non-linear equation. On the other hand, Parallel Ice Sheet Model (PISM) (the PISM authors, 2016) is used to regenerate paleo-glaciers in the same area. The annual mass balance is calculated by the difference of the net accumulation and ablation of snow and (or) ice. Also, Positive Degree Day Factor is used to calculate ablation (Zweck, 2005).

Results - Ice area with PISM
Comparison of moraine proxies formed by paleo-glaciers, obtained from field studies and PISM models under different climatic conditions.

<table>
<thead>
<tr>
<th>Conditions</th>
<th>PISM Simulation</th>
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<tbody>
<tr>
<td>T-8 °C</td>
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<td>T-9 °C</td>
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<td>T-10 °C</td>
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Results - 2D flow model vs PISM
The study on two-dimensional (2-D) model based on the shallow ice approximation (SIA) is an ongoing project.

Conclusions
• Even if PISM is developed for ice sheets, using it with the 2D ice-flow model provides significant simulations for a mountain glacier.
• Simulations of nine conditions with PISM show that local air temperatures were depressed by 8-10 °C relative to present during the Last Glacial Maximum. Also, increasing of precipitation up to 1.5-2.0 times from present can be observed.

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Further information
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Literature Cited