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Two-dimensional numerical ice flow modelling of an empirically reconstructed martian glacier-like form

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Although a substantial reservoir of glacier ice has been identified in the mid-latitudes of Mars, debate still persists regarding the formation, current and former extent, and dynamic evolution of these ice masses. Here we present initial results from a higher-order, two-dimensional (2D) numerical model of ice flow for an empirically reconstructed glacier-like form (GLF), a distinctive ice related landform, similar in planform appearance to valley or debris-covered glaciers on Earth, in eastern Hellas Planitia, Mars ($\sim$38.65 ^{o}S and 113.16 ^{o}E). The main aim of this study is to investigate the long-term temperature requirement to yield surface ice flow rates consistent with those recently reconstructed from boulder trails observed in a comparable GLF. We apply our numerical model to the GLF's central flowline under steady-state conditions and vary the viscosity related rate factor parameter, A, for a range of temperatures from 0 to -100 ^{o}C for our three reconstruction scenarios (lower [12 kPa], mean [22 kPa] and upper [38 kPa]; Karlsson et al. [2015] *Geophys. Res. Lett.*, 42[8]). The model converges for all realistic temperatures yielding a range of 2D stress and strain configurations for our reconstructed GLF. The mean annual surface velocities across the three reconstruction scenarios show a similar pattern, with motion recorded at temperatures ranging from 0 ^{o}C to $\sim$ -70 ^{o}C, below which motion reduces to $<$10-5 m a^{-1}. In order to simulate flow rates to 7.5 mm a^{-1} (Hubbard et al. [2014] *The Cryosphere*, 8), as determined for other martian GLFs, the model experiments reveal a required ice temperature for the GLF of between $\sim$ -7.5 and -27 ^{o}C.