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Cenozoic ice volume and temperature simulations with a 1-D ice-sheet model

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Ice volume and temperature for the past 35 Million years is investigated with a 1-D ice-sheet model, simulating ice-sheets on both hemispheres. The simulations include two continental Northern Hemisphere (NH) ice-sheets representative for glaciation on the two major continents, i.e. Eurasia (EAZ) and North America (NAM). Antarctic glaciation is simulated with two separate ice-sheets, respectively for West and East Antarctica. The surface air temperature is reconstructed with an inventive inverse procedure, forced with benthic δ^{18}O data. The procedure linearly relates the temperature to the difference between the modelled and observed marine δ^{18}O 100 years later. The derived temperature, representative for the NH, is used to run the ice-sheet model over 100 years, to obtain a mutually consistent record of marine δ^{18}O, sea level and temperature for the last 35 Ma of the Cenozoic. For Northern Hemispheric glaciations results are good compared to similar simulations performed with a much more comprehensive 3-D ice-sheet model. On average, differences are only 1.9 ˚C for temperature and 6.1 m for sea level. Results with ice-sheets on both hemispheres are very similar. Most notably, the reconstructed ice volume as function of temperature shows a transition from climate dominated by Antarctic ice volume variation towards NH ice-sheets controlled climate. The transition period falls within the range of interglacials (about -2 to +8 ˚C with respect to present day) and is thus characterized by lower ice volume changes per ˚C. The relationship between temperature, sea level and δ^{18}O input is tested with an equilibrium experiment, which results in a linear and symmetric relationship for both temperature and total sea level, providing limited evidence for hysteresis, though transient behaviour is still important. Furthermore results show a rather good comparison with other simulations of Antarctic ice volume and observed sea level and deep-sea temperature.