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Holocene evolution of Hans Tausen Iskappe (Greenland): merging constraints and models

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In this study the Holocene evolution of Hans Tausen Iskappe (western Peary Land, Greenland) is investigated. Constraints on the ice cap evolution are combined with climatic records in a numerical ice flow – surface mass balance (SMB) model to better understand the palaeoenvironmental and climatic evolution of this region. Our simulations suggest that after disconnecting from the Greenland Ice Sheet (GrIS) the ice cap had roughly its present-day size and geometry around 8.5-9 ka ago. An ice core drilled to the bed indicates that the southern part of the ice cap subsequently disappeared during the Holocene Thermal Maximum (HTM) and this collapse can be reproduced, but the model suggests that the northern part of the ice cap most likely survived this warmer period. The late Holocene growth of the ice cap to its Little Ice Age (LIA) maximum neoglacial extent can be reproduced from the temperature reconstruction. The simulations suggest that over the last millennia the local precipitation may have been up to 70-80% higher than at present. By coupling the pre-industrial temperature forcing to a post-LIA warming trend, it is concluded that the warming between the end of the LIA and the period 1961-1990 was between 1 and 2°C. In all experiments the ice flow model complexity and horizontal resolution have only a minor effect on the long-term evolution of the ice cap, which is largely driven by SMB changes. On the other hand the glacial isostatic adjustments (GIA) need to be accounted for in a detailed manner, as this has a large impact on the modelled Holocene ice cap evolution.