Mass balance modeling and Pleistocene paleo-climate of the central European uplands

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The central European uplands include minor mountain ranges north of the Alps with maximum altitudes of about 1500 m a.s.l.. Several of these ranges show evidence for local mountain glacier development during periods of Pleistocene glaciation. Located between the former Scandinavian ice sheet and the extended Alps ice-field, these uplands form a glacial spatial link between the major European ice masses. We have used a high resolution mass balance model for four different mountain peak regions of the central European uplands that have well-mapped extents for past glaciation; the Vosges (France), the Black Forest (Germany), the Bavarian Forest (Germany/Czech Republic), and the Giant Mountains (Czech Republic/Poland). The mass balance model was tested for the Swiss Alps and predicted positive mass balances for present-day glaciers with present-day climate input. To evaluate the paleo-climate of the central European uplands we ran the model with stepwise perturbations of the present-day climate for the four mountain peak regions, and the goal was to constrain conditions that would produce minor accumulation areas and thus local mountain glaciers. Assuming a temperature/precipitation relationship based on a specific humidity/temperature relationship, the modeling indicates cooling of 9-12°C in this area would have been required to trigger glaciation of the four regions. Somewhat stronger cooling is required for the two western regions than for the two eastern regions. This might be an effect of stronger precipitation reduction in the eastern, more continental, regions of the European uplands. The central European mass balance modeling also demonstrates how paleo-climate information, including regional trends, can be drawn from terrestrial regions with past local mountain glaciers using a simple (easily executed) numerical model.