

## ***Interactive comment on “Response of the ice cap Hardangerjøkulen in southern Norway to the 20th and 21st century climates” by R. H. Giesen and J. Oerlemans***

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Giesen and Oerlemans (2009) provide a detailed reconstruction of the past and future Hardangerjøkulen Ice Cap using a combined surface mass balance and ice flow model. The input data, model derivation and output results are appropriate and well documented. The paper is written with exceptional clarity. I have just one comment that will further help document the robustness of the mass balance model.

Because the mass balance and ice flow model are coupled at an annual time step, it is at this time step that the mass balance model must be accurate. The mass balance model is tested against the mean annual balance record of the Rembesdalsskaka

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and the correlation is good. Of equal importance is the ability of the model to reconstruct the ELA accurately, particularly during negative balance years, given the future reconstructions of ELA discussed. The ELA is a good measure of the mass balance elevation distribution and represents a key input for the ice flow model. Examining the 1990–2008 mass balance record of the Rembesdalsskaka there have been three years with the ELA above the ice cap summit 1996, 2003 and 2006, all featured limited winter balances. There have been three particularly high ablation years 1997, 2002 and 2006 with summer balances losses exceeding 3 m, and ELA's ranging from 1700 to 1860. For Hardangerjøkulen to survive the ELA must be consistently below 1800 m. Thus, it is at this upper range of ELA observations that the mass balance model must be particularly accurate in replicating both the mean mass balance and ELA. How good is the mass balance model at reconstructing the ELA, particularly during the highly negative years noted? A satellite image or aerial photograph of the ice cap would also be useful.

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