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Interactive comment on "The impact of a seasonally ice free Arctic Ocean on the climate and surface mass balance of Svalbard" *by* J. J. Day et al.

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Day et al. (2011) present a well designed and highly valuable study on the impacts of declining sea ice around Svalbard on the mass balance of the archipelago's ice caps. However and probably due to limited data availability, their model shows a weak performance over Nordaustlandet. Especially for Vestfonna modelled mass balances show extremely high deviations from ice core records.

This comment is meant to contribute additional insights into the mass balance situation on Nordaustlandet. New results and data analysis are presented in some recently accepted papers. These might a) contribute to better understand the driving forces

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behind the weak model performance at Vestfonna and b) strengthen one of the key findings of Day et al. (2011) regarding sea ice-mass balance interaction.

A spatiotemporal analysis of various snow-pit data from all over Vestfonna from the period 2007-2010 is presented by Möller et al. (2011b). Among other results, we find that accumulation on the ice cap is almost exclusively controlled by altitude. No significant correlations with other spatial parameters are obtained. This indicates that surface elevation has to be regarded as a crucial factor for accumulation modelling. The low resolution of the Day et al. (2011) RCM surface topography (Fig. 5c) might thus represent a serious drawback for the accuracy of precipitation modelling and thus for mass-balance estimation. Surface elevations are frequently underestimated over large parts of the glacierized areas in eastern Svalbard (Fig. 5c).

For Vestfonna, a modelled 9-year climatic mass balance time series (2000-2009) is presented by Möller et al. (2011a). The mass balance model employs an accumulation scheme that was calibrated from a relation between ERA-Interim data and in situ snow water equivalent measurements on the ice cap. Calibration results show that winter accumulation on Vestfonna increases by a factor of more than nine from the lowermost parts of the ice cap to its summit ridges. This strong increase with terrain elevation could by now means be reproduced by a 25 km resolution RCM. It could thus be regarded as an explanation for the extremely high deviation of modelled and measured accumulation on Vestfonna (Fig. 5b). In the same study (Möller et al., 2011a) the dependency of Vestfonna's mass balance on the North Atlantic Oscillation (NAO) is analysed. We find that winter balances, i.e. accumulation, are significantly correlated with the mean winter NAO. Positive NAO conditions usually coincide with reduced sea-ice cover on the Barents Sea (Yamamoto et al., 2006) and a resulting increase of precipitation over Svalbard (Rogers et al., 2001). Taken together, this supports the finding of Day et al. (2011) that a future sea-ice decline will probably result in increased precipitation and thus accumulation over Svalbard ice caps (page 1904, lines 2-4). It provides a present day evidence for this relationship.

Day et al. (2011) state that future changes in DJF precipitation are modelled to more than 400% over Nordaustlandet compared to present conditions (page 1899, lines 24-25). When taking together this statement with the considerable underestimation of accumulation on Vestfonna (Fig. 5b), it can be argued that the future accumulation over Nordaustlandet might be even higher. Therefore, the statement that increased accumulation might compensate only parts of the melt driven future mass loss (page 1902, lines 5-8) should be reconsidered. At least for the coming decades, where temperature increase is still moderate, it should be discussed that a distinctly higher net accumulation might temporarily balance the effects of increased surface melt on Nordaustlandet.

References:

Möller, M., Finkelnburg, R., Braun, M., Hock, R., Jonsell, U., Pohjola, V. A., Scherer, D., and Schneider, C.: Climatic mass balance of the ice cap Vestfonna, Svalbard: A spatially distributed assessment using ERA-Interim and MODIS data, J. Geophys. Res., doi:10.1029/2010JF001905, in press, 2011a.

Möller, M., Möller, R., Beaudon, É., Mattila, O.-P., Finkelnburg, R., Braun, M., Grabiec, M., Jonsell, U., Luks, B., Puczko, D., Scherer, D., and Schneider, C.: Snowpack characteristics of Vestfonna and De Geerfonna (Nordaustlandet, Svalbard) – a spatiotemporal analysis based on multiyear snow-pit data, Geogr. Ann., accepted, 2011b.

Rogers, A. N., Bromwich, D. H., Sinclair, E. N., and Cullather, R. I.: The atmospheric hydrological cycle over the Arctic Basin from reanalysis. Part II: Interannual variability, J. Climate, 14, 2414-2429, 2001.

Yamamoto, K., Tachibana, Y., Honda, M., and Ukita, J.: Intra-seasonal relationship between the Northern Hemisphere sea ice variability and the North Atlantic Oscillation, Geophys. Res. Lett., 33, L14711, doi:10.1029/2006GL026286, 2006.

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