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The Cryosphere Discussions

Interactive comment on "Surface energy budget on Larsen and Wilkins ice shelves in the Antarctic Peninsula: results based on reanalyses in 1989–2010" *by* I. Välisuo et al.

Anonymous Referee #2

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General comments:

The authors are analysing time series of several meteorological variables (at surface) and of radiative and turbulent surface fluxes at two locations on the Antarctic Peninsula (on east and west coast) on order learn about the role of atmospheric contributions in recent ice shelf disintegration events. A critical issue for such an investigation is the suitability of the selected data base to correctly represent the conditions at the study sites. This is challenging in this region due to its complex topography. Even on Larsen-C Ice Shelf considerable spatial variability of surface has to be expected, concluding e.g. from melt pattern apparent in satellite radar images.

In the first part of the paper the authors compare meteorological variables and energy fluxes from three different reanalysis sources. The comparison with – rather limited – in situ data (single station, no fluxes) does not provide a definite answer on the best reanalysis for the given application. The authors decide to use ERA-Interim for the analysis of time series and inter-annual variations, because it is the time series showing highest interannual variability (p. 1280, line 14 ff.; p. 1283, line 12). This is not a sound scientific selection criterion, in particular taking into account that this model has some of the largest biases in air temperature and E-W wind data (Table 1). This questions the significance of the time series analysis.

A main deficiency of the presented material is the lack of proper validation. The authors are aware of the importance of validation, but they use only data from a single station. More is feasible in this respect. Kuipers Munneke et al. (2012), for example, report on two additional AWS on Larsen-C, and present also energy fluxes. Although running only during 2 years, these data should be quite valuable for validation. There are further stations operating in this region since a few years within the NSF LARISSA project, and several stations on the west coast (although not on Wilkins ice shelf, they could be used for some basic validation of reanalysis data).

For checking the relevance of deduced interannual variations, satellite data can be used. In particular for melt duration, multi-annual time series are available. (Satellite analysis on surface melt, Ant. Peninsula: Fahnestock et al., Ann. Glaciol. 2002 show time series 1978-2000 for Larsen-B, Larsen-C, Wilkins. More recent data: Liu et al., JGR 2006, doi:10.1029/2005; Trusel at al., JGR 2012, doi:10.1029 /2011JF002126: Barrand et al., JGR 2013). These data sets show that the melt time series calculated from ERA-Interim data (Fig. 12) misses some summers with long melt duration, e.g. 97/98 on Larsen-C and on Wilkins; 01/02, 05/06 and 06/07 on Larsen-C; 99/00 and 06/07 on Wilkins. The reasons for this mismatch need to be investigated (incorrect interannual variability of driving data for computing melt and/or the procedure for computing summertime melt?).

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Interactive Discussion

Discussion Paper

The problems addressed above indicate that the selected procedures for deriving energy fluxes are not yet at the level to deduce consolidated estimates of climate variability at local scale, at least in this region. The work presented in the manuscript is of interest as it reveals the problem of applying presently available reanalysis data sources in such a context. However, in order to achieve substantial and consolidated conclusions, major validation activities and critical assessment need to be performed.

Further Issues:

- P. 1275, line 8ff: The data base used for this work should be completely specified. (Which variables and fluxes are coming from each of the 3 basic reanalysis data sets, from forecast models, computed from these data by the authors,. . . .)

- P. 1275, line 25-28: "Despite the good parameterisations, ERAI and CFSR disagree with observations of surface ïňĆuxes and atmospheric boundary-layer variables in polar regions." This is a contradiction. Disagreement with observations questions the quality of the parameterisation algorithm or the driving data. Any conclusions from this statement regarding the work presented here?

- P. 1276, line 12; specify the elevations of the grid points.

- P. 1277, line 9 and Table 1: Explain the impact of large bias in temperature on computed fluxes and melt.

- P. 1278, line 20: In order to understand the rather large differences in net solar radiation the assumptions on surface albedo need to be specified.

- P. 1279, line 22: Which test of significance was applied?

- P. 1281, line 17 ff: Are the statements on "lack of northerly wind component on the eastern side of the PI" and " wind speed was almost uniformly from the west" based open monthly means or daily values. Monthly means of u and v may tell little about the actual wind conditions. For example, data of Kuipers Munneke et al. (2012) show clear dominance of S wind direction at their Larsen-C stations. Does not fit with the reanalysis data.

- P. 1282, line 26ff: "(Table 5) . . ... On LCIS the wind speed, either of the wind components, and air temperature together explained 58 to 80 % ". Cannot see temperature in the regression equations in Table 5.

- P. 1283, line 19 ff: Negative surface fluxes are not unlikely during summer for 3 hour periods, e.g. on clear days during night hours with very low sun angle, or during periods with cold air advection. Fluxes should be checked with station data.

- P. 1285, line 8 ff: "The validation against the AWS observations on LCIS demonstrated that ERAI can reasonably well reproduce the observed inter-annual variations of seasonal mean air temperature for winter, spring and summer, whereas CFSR is good for summer and spring, and JRA for summer." Considering the rather high bias and RMSE values (Table 1) this statement would not hold for requirements of climate data sets . - P. 1287, line 12ff: " . . .. summertime surface net heat ïňĆux on LCIS was exceptionally high (1992–1993), ... The warm-air advection together with strong solar insolation under reduced cloud cover contributed to the high air and snow surface temperatures on LCIS." Contradicts to the data shown in Fig. 6: Higher cloud cover at Larsen-C in 1992-93 than in the average summer (if the spatial scale is sufficient to resolve the strong gradients in this region at all).

- Table 1: Should add here the mean values of the variables measured at AWS, and also wind speed (which is a main parameter for computing turbulent fluxes).

- Table 3: Wind speed (magnitude of wind vector) to be added.

Interactive comment on The Cryosphere Discuss., 7, 1269, 2013.