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Climate of the Past Discussions

Interactive comment on "Inferring paleo-accumulation records from ice-core data by an adjoint method: application to James Ross Island's ice core" *by* C. Martín et al.

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This manuscript present a novel method to infer paleo-accumulations from age-depth observations in an ice core. It is based on control theory. It is the first time, to my knowledge, that control theory is used for this problem. For this reason, I think this manuscript is important.

My biggest question is however: does this manuscript really belong to CP? This is really a methodological paper, the application of the method to James Ross Island is anecdotic. Therefore, I would rather see this manuscript in Geoscientific Model Development. But I leave this question up to the editor and I will continue my review.

A further important remark concerns the introduction of the control theory concepts in the manuscript. CP's reader will not be familiar with them so they should be carefully explained. First, in equation (3), J is a function of (a, m, A0; A). A is separated by a ";" from the other variables. It is not clear what that means. A itself is a function of (a, m, A0) so at first glance, one does not understand why A is also part of the variables. Second, it is not obvious at all why the optimization problem in eqs (1) and (3) is equivalent to the optimization problem in eq. (5). The reference (Tröltzsch, 2010) is cited so I imagine one can find the answer to this question in this reference. But a general qualitative explanation would be helpful here. Third, it is not clear how one goes from eq. (5) to eqs. (6) and (7). Again, this should be more carefully explained.

In the discussion, the authors might also want to compare their new control based method, with inverse problems based methods like the ones presented in Lemieux-Dudon et al. (QSR, 2010) or Fudge et al. (CP, 2014, based on Waddington et al., 2003). A review of pros and cons of the different methods would be helpful.

Also in the discussion, it would be interesting to know if this method can be extended to more realistic ice flow models. The model described here is 1D and has a steady velocity profile which is quite a strong assumption.

Concerning the applications of the method, I think they are not very well chosen. Indeed, in both applications, melting is zero and in this case, there is no need of a langrangian model. Indeed, in this case, age can be given by (see Parrenin et al., CP, 2007): A=\int_0^z \frac{dz'}{a \eta(z')} So with respect to methods like Lemieux-Dudon et al. (QSR, 2010) or Fudge et al. (CP, 2014), the method really shows its power when there is a basal melting (and therefore there is no explicit solution for A).

In the first application, it is not explained how the age observations are sampled.

Other minors remarks below: - p. 3827, l. 11: remove "the" before L - p. 3829, l. 1: replace "are" by "and" - p. 3832, l. 7: "the recovered accumulation ONLY loses..." - p. 3833, l. 1: I think this analytical profile first appeared in Lliboutry (1979) - p. 3833,

l. 2: add subscript "l" to \eta - p. 3834, l. 26: remove "the" - p. 3835, l. 19: "paleo-accumulation" - p. 3836, l. 1: "paleo-accumulation" - p. 3836, l. 4: "largest" - fig. 3: what is the horizontal dashed line? - fig. 6, legend: "a normal distribution"

Interactive comment on Clim. Past Discuss., 10, 3821, 2014.