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Interactive comment on "Dispersion in deep polar firn driven by synoptic-scale surface pressure variability" *by* Christo Buizert and Jeffrey P. Severinghaus

Anonymous Referee #1

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General: The authors present in a very convincing paper the influence of barometric pressure variations on the dispersive mixing of the air contained in the firn layer. Their approach leads to improved firn air models that can now explain some hitherto not understood discrepancies between data and standard models. Using 86Kr excess as a new proxy of past synoptic activity looks very promising.

Specific comments:

p. 4, l. 2:".. and flow driven by synoptic-scale surface pressure variations": I suggest that the authors distinguish here two rather different phenomena. On one hand there are the alternating pressure variations (the main topic of this paper) and on the other hand there are wind driven flows (of Colbeck type driven by Bernoulli effect). The

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latter flow can be persistent over long time, e.g. in katabatic wind regime and lead to significant advection in the upper firn layer. These air flows are thus of quite different nature compared to the pure 1 dimensional pressure pumping.

p. 5, l. 10: For completeness one could mention here that isothermal firn is assumed i.e. temperature and viscosity do not depend on depth.

p. 8, l. 10: The velocity of the back flux scales roughly with the ice accumulation rate. I.e. at a high accumulation site it is on the order of 10ˆ-8 m/s.

p. 11, l. 27: In my view the comparison with electrical current is not very instructive. An argument why AC-dispersivity is lower than DC-dispersivity would be more helpful.

p. 12, Fig. 6 caption: "The first control () is a control run -> the first scenario(?) is a control run

p. 12, Fig. 6 caption and corresponding text: "..includes convective mixing and dispersion". Please specify how convective mixing is included.

p. 13, l. 14: ".. it is thus conceivable that gravitational isotopic enrichment has stopped, while molecular diffusion is still very much active." This statement could possibly be misleading in the sense that it could suggest to the reader that this is a special case of no gravitational enrichment in a diffusive regime. But if I understand this correctly then the authors state that despite of local intermittent diffusive zones the overall regime is dominated by dispersion.

p. 15, l. 8: As the LD DE08 site is mentioned repeatedly without showing data the reader is somewhat left up in the air or forced to go to the original papers to find out whether DE08 and DSSW20K data are similar or not. So a short notice why DE08 is mentioned and how it compares to DSSW20K would be very helpful.

p. 15, l. 24: "Studies aiming to understand the glacial 15Ndata-model mismatch in East Antarctica (Landais et al., 2006; Capron et al., 2013) should take this effect into consideration." As above, a short note on that problem and how dispersion could possibly

help to solve it would be very helpful for the reader.

p. 16, l. 1: delete one "where"

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