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Interactive comment on "Monitoring water accumulation in a glacier using magnetic resonance imaging" *by* A. Legchenko et al.

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The authors present time-lapse 3-D-SNMR imaging of a small polythermal glacier in the French Alps, over the period 2009 – 2012 during which subglacial cavities were drained by pumping each fall, and subsequently re-fill naturally. They suggest that their results show both changes in cavern volume (caused by creep processes) as well as estimates of cavern re-filling rates by natural recharge. The field data and modelling work are of high quality, and represents a useful addition to the paper of Vincent et al (2012), Journal of Glaciology, Vol. 58, No. 211, 2012 doi: 10.3189/2012JoG11J179; further SNMR datasets are presented, and SNMR data interpreted as 'time-lapse' images showing changes in water volumes, which are then corroborated by comparison with pumped water volumes. However, the current manuscript is difficult to follow for

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readers unfamiliar with the abovementioned 2012 paper – this reviewer found that the 2012 paper gave a much greater insight into the nature of the glacier, the measurements taken, and the problems and issues that arise when interpreting SNMR data for glacial water content. I therefore recommend that the introduction of the submitted manuscript be rewritten, to provide a clearer picture of the previous work, and the additional contribution made here. The specific issues mentioned below concerning the interpretation of the results presented, should also be addressed.

Specific issues a) How can the use of forward modelling solve the non-uniqueness problem with SNMR interpretation (P 2124 last para, and p2126 first para)? Forward modelling in itself cannot reduce the number of potential fits.

b) Authors state that the average water content of the cavern '... is 40% rather than the 100% expected for the bulk cavern,' and explain this lower value represents averaging of liquid water and ice [P2126 last para] . The figure of 40% must depend on the volume over which averaging is conducted, and is therefore arbitrary/not meaningful?

c) Some water content remains locked within temperate ice and cannot be pumped out [p2128 line 20] – however this 'locked-in' water should still contribute to the SNMR signal for the dataset collected after pumping, and should therefore be correctly accounted for by the water budgeting conducted (Tables 1 and 2). It's presence therefore cannot explain the discrepancies between pumped and SNMR estimated water volumes (Table 2).

d) The SNMR technique detects only liquid water, so it cannot distinguish air (i.e. empty cavern) from ice. So, how can we tell that the cavern is larger is 2009-2011 than 2012, rather than simply containing more water [p2129 line 12], as indeed authors state later [p2132 line 16]? Can increased amounts of trapped air after sequential cavern drainage actually explain the water volume reductions proposed (65% in one year and 73% in two years, p2129, last para), rather than cavern closure by ice deformation?

e) '...significant deformation of the glacier surface became visible only in July 2012' [p2132 line 14]. This comment deserves more explanation. How do we know this, how much deformation and where was it, in relation to the caverns?

f) Creep deformation as the mechanism for cavern closure is mentioned [p2133 line 15]. Assuming we can believe that the caverns do reduce in size (see point d) above), are such volume reductions not more likely to arise from re-freezing processes?

Interactive comment on The Cryosphere Discuss., 7, 2119, 2013.