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The Cryosphere Discussions

Interactive comment on "The mass and energy balance of ice within the Eisriesenwelt cave, Austria" *by* F. Obleitner and Ch. Spötl

Anonymous Referee #1

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Review of Manuscript tc-2010-72 for The Cryosphere "The mass and energy balance of ice within the Eisriesenwelt cave, Austria" F. Obleitner and Ch. Spötl

General Through the whole paper I kept asking myself "Why is this important?" The authors failed to address why I should care about ice found in caves – What percent of terrestrial ice is found in caves? What effect would it have it disappeared? I also would like to see them expand more on the seemingly major changes they made to the model SNTHERM rather than a passing sentence. Too many times I felt that the authors made statements without supporting evidence. The basic ideas may be sound, but the presentation needs help. Specific Abstract: 1. Line 1. What are "glaciological" measurements? Define. 2. Lines 2-3. Meteorological conditions can not feature anything. 3. Line 5. The energy balance is determined not predetermined by the

long-wave radiation. 4. Line 15. Do you mean the summer air temperature or cave wall temperature or both? Introduction: 1. Line 1. Define IPCC. 2. Line 1. Elaborate on terrestrial ice being a "climate indicator". 3. Paragraph 3. "show cave" is not the proper term. "tourist attraction" is better. The investigated site: 1. Line 6. Define GPR. 2. Paragraph 2, Line 3. "visitors to the" instead of "visitors of the". Measurements: 1. What is your measurement frequency? 2. Line 2. What surface? – The ice, the cave floor? 3. Paragraph 3, Line 2. What do you mean by "according logistic" efforts? 4. Paragraph 3, Line 6. What are "standard research" components? 5. Paragraph 3, Line7. What do you mean by "essential effort"? The model: 1. Paragraph 1, Line 8. The liquid water content in the rock does not change in sntherm from the initial conditions. 2. Paragraph 1, Line 11-12. Horizontal effects are not generally neglected, they are not considered in sntherm since it is a 1-D model. 3. Paragraph 2, Line 12. The precipitation is directly related to the energy balance equation through the PHF term in equation 1. 4. Paragraph 2, Line 16. A figure showing the node placements in the ice and rock would be nice. Also, why did you use so many? Did you try running the model with fewer nodes? 5. Paragraph 3. Did you measure the rock temperature and water content? If not, how did you decide on an initial profile? Did you try other ice temperature profiles besides a uniform one? 6. Paragraph 5. How different is the Yen heat conduction parameterization compared to what sntherm uses? Also, sntherm already bases the turbulent heat flux parameterization on Monin-Obukhov. Further, changing how metamorphism and water transport processes are modeled is a significant model change and warrants greater discussion. Local meteorological and glaciological conditions: 1. Paragraph 1. Why are the outside winds important? What is the orientation of the cave compared to the dominant wind direction? How do the outside winds compare to those inside the cave? 2. Paragraph 3. Line 9. Awkward wording "found also elsewhere". Please change. Why mention "Trapping. . ." unless you further expand on this idea? 3. Paragraph 5. Line 1. Again, what do you mean by "glaciological measurements"? Is it a standard set of measurements unique to glaciers? Please elaborate. Model verification: 1. Paragraph 1. Line 2.

I am not quite sure what you are trying to say in the sentence “Proper verification . . .”. 2. Paragraph 1. Line 4. Sntherm doesn’t assume constant density. Did you change this part of the code too? 3. Paragraph 1. Line 10-11. You can just say “stake” instead of “stake environment”. 4. Paragraph 1. Line 11-end. How do you know that the model is underestimating sublimation, etc.? Why are these inherent shortcomings? What time step did you run the model at? What do you mean by “There was no straightforward. . .”? If you feel that the grid resolution was to blame for the model not better fitting the measured data, did you try different node placements? It seems that you are putting all blame for the model not better matching on the model and no blame on the inaccuracies in the measurements. From figure 6 I would argue that the model does a good job replicating the data. 5. Paragraph 2. Line 8. Change “used thermometers” to “thermisters used” Energy and mass balance: 1. Paragraph 1. Line 6. By “rock dome” do you mean the cave roof? Walls? Explain. 2. Paragraph 3. Line 3. The December net radiation is nearly as low as that in March. How does this affect your analysis? 3. Paragraph 3. Line 4. Should be “events penetrate” instead of “events penetrates”. 4. Paragraph 4. The first sentence needs to be rewritten. As is I can’t tell what you are trying to say. 5. Paragraph 4, Line 3. What do you mean by “atmospheric at the surface”? 6. Paragraph 4, line 7. Change “runs off finally” to “finally runs off”. 7. Paragraph 5. What is a “constellation” of the energy balance? It is not hard for turbulent fluxes to be larger anywhere else in the cave as the modeled fluxes at the site are negligible, especially in summer. A lot of unsupported assertions are made in this paragraph. Further explanations are needed. 8. Paragraph 7. Did Ohata et al. use the sntherm to calculate the energy balance? Are your flux comparisons monthly/yearly. . .? Line 7. “We also note” should be “They also note”. 9. Paragraph 8. Line 4. Sentence starting with “Referring” needs to be reworked. 10. Paragraph 8, Line 8. Why can the turbulent fluxes be compared (not transferred) more straightforwardly than the radiative and conductive fluxes? Who assumed higher wind speeds? Higher that at EP? Effects due to uncertainties of the input data: 1. Paragraph 1, Line 5. “additionally lost” instead of “lost additionally” 2. Paragraph 1, Line 5. “as a cooling

save 4mm of ice” is confusing. Reword. Potential climate impacts: 1. Paragraph 1, Line 6. “outstanding loss” is awkward. Better wording is “additional loss”. 2. Paragraph 3, Line 3. Change “has mainly effects during the melt” to “mainly effects the melt”. 3. Paragraph 3, Line 7-8. I’m not sure what you mean by “we firstly recall the relevant environmental conditions”. Please explain. 4. Paragraph 3, Line 9. What does ZAMG stand for? Temporal and spatial representativity: 1. Representativity is not a word. 2. Paragraph 1, Line 5-6. What do you mean by “closed snow pack”? 3. Paragraph 2. I find it very hard to discern what the authors are trying to say here. Summary: 1. Paragraph 2, Line 5. Change “therof” to “therefore”. 2. Paragraph 5, Line 9-end. I don’t see from figure 8 that the multiple cold waves progressively cool below the rock-ice interface. It appears that temperatures below 0.5m are constant throughout the year. References: Listed but not cited in the paper are: âĂć De Feitas, C. and Littlejohn, R. âĂć Ford, D. and William, P. âĂć Klappacher, W. et al. âĂć Marshall, P. and Brown, M.C. âĂć Steiner, H. âĂć Trimmel, H. Figures/Tables: âĂć Figure 3. What is the “dome” – The cave walls, ceiling, both? Is the temperature at -3m the rock/ice interface temperature? âĂć Figure 7. Is the conduction through the ice to the surface or from the rock to the bottom of the ice? âĂć Figure 8. The units for liquid water content is an odd choice, i.e. as a density instead of volume/volume or mass/mass. How does this relate to the porosity of the ice? What assumptions are you making?’ âĂć Figure 9. Where do you show the reference run? âĂć Table 1. Put the units in column 1 instead of column 4. Are the radiations listed from the model or measured? Is the energy change within the ice due to temperature changes within the ice or due to changes between the two surface energies?

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