

Interactive comment on “Double diffusion in meromictic lakes of the temperate climate zone” by C. von Rohden et al.

Anonymous Referee #1

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General Comments

The authors present observations and analysis of double diffusive processes in two small mining lakes from the perspective of the annual cycle. They present bathymetry and CTD data. From this they derive calculated parameters associated with likely double diffusive response. The paper concludes that the seasonal cycle, through its influence on surface layer T, can modulate vertical mixing through turning diffusive-convective effects on and off.

Specific Comments

The question of transport and diffusion in such systems is important and falls within the

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scope of HESS. The data are new as far as I'm aware although treatment for other purposes of some of the data has appeared elsewhere (Boehrer et al 2009; von Rhoden et al. 2009). It would have been good to have the present work placed in the context of these published studies.

In terms of a title I think “lakes of the temperate climate zone” is a little general as they are presenting data from small mining void lakes and so a little idiosyncratic. In fact one of them is about the smallest water body I've seen referred to as a lake. In reality they have a very coarse sampling of conditions over a year and a couple of very intriguing and promising snapshots.

The paper needs to pose some questions or aims. As it is, the reader has to guess what they are specifically going to look at. The first half of the abstract is introductory material and inappropriate for a short synopsis of a paper aimed at experts. The remainder of the abstract could do with some quantitative information.

The methods are straightforward enough although the authors steer clear of determining density from conductivity (Pieters et al 2009) and instead choose a completely empirical method. How uniform is the distribution of their salts? Do they know what they likely diffusivity of their “salty water” is as this is implicit in understanding double diffusion.

The results appear to be sufficient to support the interpretations and conclusions. However, it would have been nice to have seen some data recorded at higher spatio-temporal frequency – perhaps a transect along the lake? Also simply having step structure in density doesn't necessarily mean there is double diffusion. Treatment of double diffusion in such systems has been considered elsewhere (Hamblin et al 1999). Are the smoothed interfaces seen in Fig. 6 instrumental or real? They appear thicker than the 2cm quoted resolution of the instrument yet one would expect very thin interfaces in actively driven diffusive-convective layering.

As I'm sure the authors are aware, double diffusive parameterization involves dividing

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one gradient operator by another. This is a recipe for noise. Furthermore, conductivity spiking whereby the temperature sensor is likely not collocated exactly with the conductivity sensor nor does it have the same temporal characteristics. These are all minor issues at the large scale but when it comes to looking at layers a few 10's of cm thick and their isolation using derivative operators it becomes more difficult. A few more details on their errors and accuracy would help.

Why two lakes? Do we gain anything from them both appearing? It would be useful to understand more clearly the similarities and differences in response. The smaller lake's response on the whole will have a seasonal cycle but surely must be highly driven by local weather? Is it truly meromictic?

Could the authors not have demonstrated their point by picking a monimolomnion T and S then considered a seasonally cycling surface alayer above and calculated propensity for double diffusion? Given that double diffusion is potentially climatically modulated, what are the implications for vertical transport?

Technical

Pg 7484 line 26 – “lesser extent”?

Pg 7486 line 2 – do the authors mean iron or ion?

Pg 7489 line 10 “exemplary shows late year” – not quite sure what this means.

Pg 7490 line 27 – “(weak) internal waves” – weak in the sense of small amplitude or small potential energy variation?

References

Hamblin, P.F., C.L. Stevens and G.A. Lawrence 1999 Simulation of vertical transport in a mining pit lake, ASCE J.Hyd. Eng. Vol. 125 (10), 1029-1038.

Pieters, R. and Lawrence, G.A. 2009. Effect of Salt Exclusion from Lake Ice on Seasonal Circulation. Limnology and Oceanography, 54(2): 401-412.

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