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Biogeosciences Discussions

Interactive comment on "Regional hydrology controls stream microbial biofilms: evidence from a glacial catchment" *by* T. J. Battin et al.

Anonymous Referee #2

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This paper summarizes a study of microbial biofilms in an alpine glacial catchment in the Austrian Alps. Overall the paper is well written and makes a contribution to our understanding of lower trophic levels in alpine glacial catchments, an area which has been little studied. I cannot comment on the methodology related to bacterial secondary production, microbial exopolysaccharides or whole-cell in situ hybridization as it is outside my realm of experience. Consequently my comments are restricted to the paper's contribution to our understanding of the ecology and functioning of alpine glacial streams.

The abstract states "rithral with more constant and favourable habitats" but there are fluctuating habitat variables in Figure 3 when compared to the krenal - not very constant.

The introduction is comprehensive and includes most of the key literature - however one key paper has been omitted (Brown et al 2003) which examines the role of different water sources in alpine streams and therefore is a key reference that should

be addressed. This paper talks about the temporal nature of runoff sources in alpine catchments and the likely consequences to ecological communities. This is particularly relevant to the aims of this paper (line 25). Brittain and Milner (2001) did not propose a conceptual model of longitudinal gradients in the macroinvertebrate community - it was Milner et al (2001) in the same special issue of Freshwater Biology. The same applies to the term “windows of opportunity” - the alternative term “hot moments” is appropriate even in reference to a cold environment. There should be more discussion on the link of DOC to biofilm.

In Study sites - need a reference for the rate of retreat and glacial history. This is one problem with the paper - the lack of replication of sites. The conclusions are based upon one metakryal and one hypokryal site and thus cannot be widely attributed to regional controls with no replication. This should be addressed as it does not relate to the title of “regional”.

Also the lower stream site is classified as “kryal” - but the temperature reaches 8 oC which is above the threshold of 4 oC as defined by Ward for hypokryal.

In flow gauging - do not need slope for regression model. Change L to m3/s.

Fulvic Acid techniques not discussed in the Methods.

On the whole statistical analyses seem appropriate but why do a PCA to reduce 4 variables to three for the bacteria morphology data.

In results suggest using $P < 0.05$ rather than give an actual value.

P 507 - Calcium and electrical conductivity are stated to be significantly elevated during snowmelt but graphs indicate they were elevated up to the onset of snowmelt and then decreased rapidly in the glacial stream (Fig. 3).

Line 12 - the statement “metacarbonate outcropĚimparted distinct signatures to the rithral stream” suggests that maybe the rock, not the snow, is influencing the hydro-chemical signature. The snow may be infiltrating the ground, recharging groundwater

BGD

1, S273–S276, 2004

sources that then feed the tributary stream. This would account for the upward trend in concentrations of conductivity and calcium over time probably further assisted by decreasing discharge of this stream over the melt season. It could be the wrong conclusion to attribute the biofilm in this stream to snowmelt without considering how it could be modified en-route.

Would like to see more reference of actual values reached for chlorophyll a and bacterial biomass. For example reference the 0.07 mg reached and put in perspective of other values for other systems..how hot is this 'hot moment'? Right now the discussion is just about the significant differences seasonally - would benefit from some real values on this.

Results (p 509) talk about bacterial carbon production having a "peak at the onset of the snowmelt in the hypokryal site (Fig. 5)" when it looks like the peak is after the onset of snowmelt judging from the arrow. Figure 5 also needs a legend for the krenal stream.

In the discussion can you elaborate on the reason why the glacier constitutes a major DOC source to the stream in winter..will not glacial flow be at a minimum?

Also terrestrial/aquatic linkage is suddenly introduced without context or introduction

Could you also elaborate on the source of the increasing nitrate-N during the further hot moment of the recession period?

I think you have to be careful of this separation of glacial melt and snowmelt - some glacial melt can include snowmelt. Snow and glacier melt from the surface of a glacier is different from water that comes from within and below the glacier and this can include snowmelt that percolates downwards. This water will have higher sulfate, magnesium and conductivity compared to the quickflow water from the glacier surface.

Are chemical variables the main influence on biofilms? What about water temperature? - there is no discussion of this variable as temperature data is presented but not taken

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1, S273–S276, 2004

Interactive Comment

further, nor is suspended sediment.

Good points with regard the role of microbial biofilms in the carbon fluxes of high-alpine streams with otherwise low retention capacity and of hot moments in an otherwise ‘cold’ landscape.

Could the similarity in flow pathways account for the similarity of the bacterial cells in the two streams in Figure 7.

Smith et al. (2001) did not predict macroinvertebrate communities in glacial streams.

Table 3 P should be italics

Table 4 maybe include range of values for the 4 sites rather than mean.

Figure 3 very difficult to read.

Interactive comment on Biogeosciences Discussions, 1, 497, 2004.