

Interactive comment on “Soil weathering rates in 21 catchments of the Canadian Shield” by D. Houle et al.

Anonymous Referee #2

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Soil weathering is a very important process which strongly influences the chemistry of ground and surface waters, rivers and lakes and is a major source of nutrients for these ecosystems. It is also associated to a release of base cations which contributes to the buffering power of soils and surface waters against acidification. Hence, calculating proper weathering rates to quantify the magnitude of this process is of prime importance.

The development of models such as PROFILE provides useful tools to evaluate weathering rates. However, due to the natural heterogeneity of soils, these rates can strongly vary locally and only a large number of stations within a given region allows to properly validate to efficiency of such models.

C5159

In this manuscript “Soil weathering rates in 21 catchments of the Canadian Shield” by D. Houle et al., a selection of 21 forested river catchment on the Canadian Shield of Quebec was used to study the release of base cations through weathering and investigate to robustness of the PROFILE model.

I believe this study could be a valuable contribution to HESS. I have, however a few comments that need to be answered before this manuscript is considered suitable for publication. If the recommendations of reviewer #1 are also properly taken into account, addressing my comments should only require minor revisions.

Major comments: - My biggest concern about this manuscript is the lack of proper description and information about the study sites. The section “2.1 Sites description” is very brief and refers to the LRTAP-Quebec network for more details. I believe this is not enough. With the sole information contained in the manuscript, it is often difficult to properly follow the discussion of the results and the authors often compare the stations to one another on the basis of data which are not available to the reader. A more detailed description of the different kind of vegetation found in the study area as well as complementary information about the structure of the river network should be added to the first section of the “Methods”. Sampling and studying a collection 21 sites adds a lot of value to this work but not even knowing the exact location of each of the sites takes away a great deal of this value. For instance, in the section “3.2 Modeled weathering rates”, most of the discussion refers to spatial variations that require knowledge of the geographic distribution of each station and it is difficult to really understand the analysis of the authors without prior knowledge of the region. For this reason, I believe it essential to update the map (Figure 1) with the number of each study site associated to its exact location. Moreover, I believe the manuscript would benefit for an additional table listing some basic parameters for each location (for example information about the hydrology, vegetation coverage and physical conditions). This would be most helpful, for example, in the result section (page 5754) when one of the explanations proposed by the authors for the decrease in weathering rates from the southwest to the northeast

C5160

is the influence of a latitudinal gradient in annual temperature. Would it be possible to provide the reader with measured average temperature for each station for instance?

- My second major comment regarding this manuscript is related to the section "3.3 Comparison of the modeled BC weathering rates with BC concentrations in lakes and BC watershed exports" and the Conclusions of the manuscript. One of the main outcomes of this manuscript appears to be the inability of PROFILE to predict weathering rates for sodium (Na). With such a strong conclusion and a final statement saying about the model that: "its capability to provide reliable Na WRs must be questioned", I miss at least a paragraph in the discussion, discussing potential ways to address this issue. What, in your opinion should be done to improve PROFILE and which kind of field investigation would help providing the necessary information to do so?

The following comments are minor: - All along the manuscript, the different cations studied are referred to as Ca, Mg, K or Na when mentioned individually (BC for all the base cations). But these are the chemical elements themselves and not the cations. Wouldn't it make more sense to call the cations Ca²⁺, Mg²⁺, K⁺, Na⁺?

- Page 5747, line 13: A brief definition of podzol or harplotod according to the Canadian and American soil classification would be welcome, especially for readers unfamiliar with the field.

- Page 5747, line 14: The Saguenay River is mentioned in the text followed by a reference to Figure 1 but that river's location is not on the map.

- Page 5748, line 22. The manuscript says that the UPSALA model used in this study is "based on assumptions of the stoichiometric composition" of the minerals in soils of granitic origin (Precambrian Shield of Sweden)". A sentence explaining why this assumption is valid for the studied region would be useful in this paragraph to justify the use of this model. It's only later, at the beginning of the result section, that the authors specify that the soil composition is "typical of Precambrian Shield geologies".

C5161

- Page 5750, line 19: The units should be listed with the parameters of the equation describing the calculation of the weathering rate of the soil horizon.

- Page 5751, line 8: The citation "Houle, 2011" does not correspond to any entry in the list of references.

- Page 5753, line 10: The citation "Hock, 1994" does not correspond to any entry in the list of references.

- Page 5754, line 5: I find the term "annual temperature" a bit vague. If the authors meant annually averaged temperature, I would suggest using that expression instead.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 5743, 2011.

C5162