Linking soils and streams during events: response of stream water K+ concentration to soil exchangeable K^+ concentration in small catchments with fragipan soils (Carpathian Foothills, Poland)

Joanna Siwek[1], Wojciech Szymański[1], Janusz Siwek[1], Mirosław Żelazny[2], and Mariusz Klimek[1]

[1]Jagiellonian University in Kraków, Institute of Geography and Spatial Management
[2]Jagiellonian University, Institute of Geography and Spatial Management

May 5, 2020

Abstract

The study aimed to determine the linkage between soil exchangeable potassium (K^+) concentration and stream water K^+ concentration during rainfall and snowmelt events. The research was performed in small catchments with different land use (i.e. woodland, traditional agriculture, experimental agriculture, mixed-use) in the Carpathian Foothills (Poland). All of the studied catchments whose hillslopes were covered with fragipan soils had a markedly lower hydraulic conductivity (K_{sat}) in the fragipan (Btx) than in the horizons lying above (A and E). These highly permeable horizons determine the K^+ influx to streams during most event types except snowmelts with frozen soil. In the woodland catchment, stream water K^+ concentrations during events are determined by a high vertical variability in Ksat and exchangeable K^+ concentrations in soil profiles. Rapid flushing of K^+ from the topsoil Ah horizon with higher K_{sat} and higher exchangeable K^+ concentrations than in the lying lower E horizon resulted in a clockwise hysteresis of K^+ in stream water during most events. In the agricultural catchments, changes in stream water K^+ concentration during events were determined by distinct differences between soil exchangeable K^+ concentrations on hillslopes and in riparian areas. For example, during rainfall events under dry antecedent conditions, exchangeable K^+ concentrations in topsoil horizons on hillslopes were distinctly higher than concentrations of exchangeable K^+ in riparian area soils. The inflow of alluvial water with a low dose of K^+ before the inflow of throughflow from hillslopes with a high dose of K^+ thus resulted in wide counterclockwise hystereses for streamwater K^+.

Hosted file

`Main Document.doc` available at https://authorea.com/users/295042/articles/423619-linking-soils-and-streams-during-events-response-of-stream-water-k-concentration-to-soil-exchangeable-k-concentration-in-small-catchments-with-fragipan-soils-carpathian-foothills-poland

Hosted file

`Table 1.docx` available at https://authorea.com/users/295042/articles/423619-linking-soils-and-streams-during-events-response-of-stream-water-k-concentration-to-soil-exchangeable-k-concentration-in-small-catchments-with-fragipan-soils-carpathian-foothills-poland

Hosted file

`Table 2.doc` available at https://authorea.com/users/295042/articles/423619-linking-soils-and-streams-during-events-response-of-stream-water-k-concentration-to-soil-exchangeable-k-concentration-in-small-catchments-with-fragipan-soils-carpathian-foothills-poland

Hosted file

Table 3.doc available at https://authorea.com/users/295042/articles/423619-linking-soils-and-streams-during-events-response-of-stream-water-k-concentration-to-soil-exchangeable-k-concentration-in-small-catchments-with-fragipan-soils-carpathian-foothills-poland

Hosted file

Table 4.docx available at https://authorea.com/users/295042/articles/423619-linking-soils-and-streams-during-events-response-of-stream-water-k-concentration-to-soil-exchangeable-k-concentration-in-small-catchments-with-fragipan-soils-carpathian-foothills-poland

Hosted file

Table 5.docx available at https://authorea.com/users/295042/articles/423619-linking-soils-and-streams-during-events-response-of-stream-water-k-concentration-to-soil-exchangeable-k-concentration-in-small-catchments-with-fragipan-soils-carpathian-foothills-poland