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Variability in methane benthic fluxes of a small lowland stream - role of hyporheic zone in total methane budget

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Methane budget for an experimental area of a small lowland stream Sitka was studied during three summer months in 2012. A simple model uses rates of inputs (benthic fluxes) and loss of dissolved CH4 through evasion to the atmosphere combined together with advection inputs and losses to yield a CH4 dynamics (budget) for any particular section of the stream. Considering that methane is produced in great amount within hyporheic zone sediments, we have expected that amount of methane released by the benthic fluxes into the overlying water should significantly affect the total methane budget of the surface stream. In order to asses this assumption, we measured simultaneously methane concentrations within vertical sediment profile of a hyporheic zone, direct benthic methane fluxes by static chambers, methane emissions into the atmosphere and both upstream and downstream methane concentrations in the surface water, respectively. While methane concentrations in an interstitial water tended sharply to increase with sediment depth, we found considerable variability in the benthic methane fluxes suggesting that there may be various factors affecting rate of the benthic fluxes icluding methanotrophy in the top sediment layers and stream flow, respectively. Generally, the contributions of benthic fluxes to methane budgets of the experimental area were negligible, however, this contribution will rapidly increase with increasing study area implying an importance of the whole stream measurements. Despite variability in benthic methane fluxes all the methane budgets computed by mass balance of the measured positive and negative fluxes into the stream experimental area showed “missing methane source”. The principal uncertainties in the simple budget models we used are probably the errors associated with individual benthic fluxes and their extrapolation for the whole experimental area. Nevertheless, this study demonstrates the importance of hyporheic sediments on the dynamics of methane in river system and its potential greenhouse effect.