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Comparison of three models of gas exchange to describe the degassing of ^{222}Rn in a first-order stream on Huewelerbaach catchment (Luxembourg)

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Field experiments have been performed in order to obtain the needed parameters to model the degassing of ^{222}Rn (radon) in a headwater stream. An attempt was done to determine a reliable expression for the gas exchange rate constant (time^{-1}) of ^{222}Rn. For this purpose the studied stream has been intensively sampled for ^{222}Rn, major ions, T, EC, and pH. A continuous NaCl injection has been performed to obtain the amount and the location of lateral inflows to the creek. These data were supported by discharge and rain data. The results show an exponential decrease in ^{222}Rn concentration along the flow path, highly correlated to the morphology of the creek. Three models have been tested: the thin film model and two approaches of the surface renewal model, one for isotropic and one for non-isotropic conditions. The results show that, in the range of water heights and flow velocity of the study case, gas exchange rate constants obtained by the thin film model are comparable with the experimental values at low water heights while the ones obtained by the surface renewal model (non-isotropic) are comparable with the experimental values at relatively higher water heights.