

Publication

High temporal resolution of ion fluxes in semi-natural ecosystems : gain of information or waste of resources?

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Author(s) Alewell, C; Lischeid, G; Hell, U; Manderscheid, B

Author(s) at UniBasel [Alewell, Christine](#) ;

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Monitoring programs of ion concentrations and fluxes in semi-natural ecosystems are confronted with the task to gain as much information as possible with simultaneously minimizing costs and efforts. The aim of this study was (i) to assess how much of the heterogeneity of solution concentrations is lost because of temporal integration of measurements and (ii) to estimate the error in ion fluxes due to temporal integration. High resolution measurements (daily interval) of ion concentrations (sulfate, nitrate, chloride, pH and EC) in throughfall, soil solutions and runoff at the catchment Lehstenbach (Fichtelgebirge, Northeast Bavaria, Germany) were compared over a two year period with the reference monitoring program (biweekly measurement interval). Evaluation of the maximum temporal heterogeneity of ion concentrations in throughfall, soil solution and runoff (expressed as minimum, maximum, median and 25-75% percentile) did not result in an overall higher heterogeneity of the high resolution measurements compared to the reference program. The calculation of runoff fluxes from the reference data (biweekly concentration) resulted in significant errors of up to 25% for time periods <1 year (high resolution data was considered the "true" value and set as 100%). However, errors became minor (<10%) if longer time periods were considered. The suitability of different interpolation methods to up-scale biweekly concentration data for the calculation of runoff fluxes was evaluated in this study. We concluded for the monitoring programs at the Lehstenbach catchment that a biweekly measurement interval seemed to be suitable to capture the heterogeneity of ion concentrations and fluxes (and thus temporal trends). In comparison, high resolution measurements with a daily measurement interval were higher in cost, work and time resources and had a relatively low information gain. While the introduced methods are applicable in all monitoring programs, conclusions on temporal resolution of measurements are most likely not valid for systems where ion concentrations have a low autocorrelation length (e. g., agricultural or urban systems with nitrate or pesticide treatment; tropical systems with extreme temperature or hydrological events).

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