Application of a second-order approach for evaluating chemical compounds runoff at the small river catchment using daily water discharge data

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INTRODUCTION

Together with regular atmospheric pollution monitoring and assessment, catchment analysis studies are performed for selected areas within region of EANET (Acid Deposition Network in East Asia). These researches include an evaluation of datasets on measurement of pollutants and nutrients in all environmental media within small watersheds. Precise estimation of chemical compound runoff is one of the crucial factors for the adequate evaluation of nutrient/pollutant budgets of small river catchments affected by atmospheric pollution transport or regional climate change. Yet most of monitoring programs based on extensive networks do not allow performing long-term intensive sampling and chemical analyses due to cost effective constrains.

The regular sampling of river water for chemical composition is conducted at one of EANET monitoring sites, Primorskaya, mere five times per year, corresponding to main hydrological regime phases. This sampling protocol was established based on international recommendations, and adopted in manual in for inland aquatic monitoring of streams or small rivers in temperate humid climate. Such temporally sparse data is subsequently processed for pollutant runoff estimation using the direct interpolation scheme, but correspondent results provided with a rather low degree of accuracy are often not appropriate enough for catchment budget calculations.

We present the comparison of estimates of sulfur and nitrogen compounds runoff (fluxes with the stream water discharge) by two methods for years of 2005, 2010 and 2015 with the use of stream water discharge and surface water chemistry data for Komarovka river at the Primorskaya EANET site (Russian Far East region).

DATA AVAILABLE

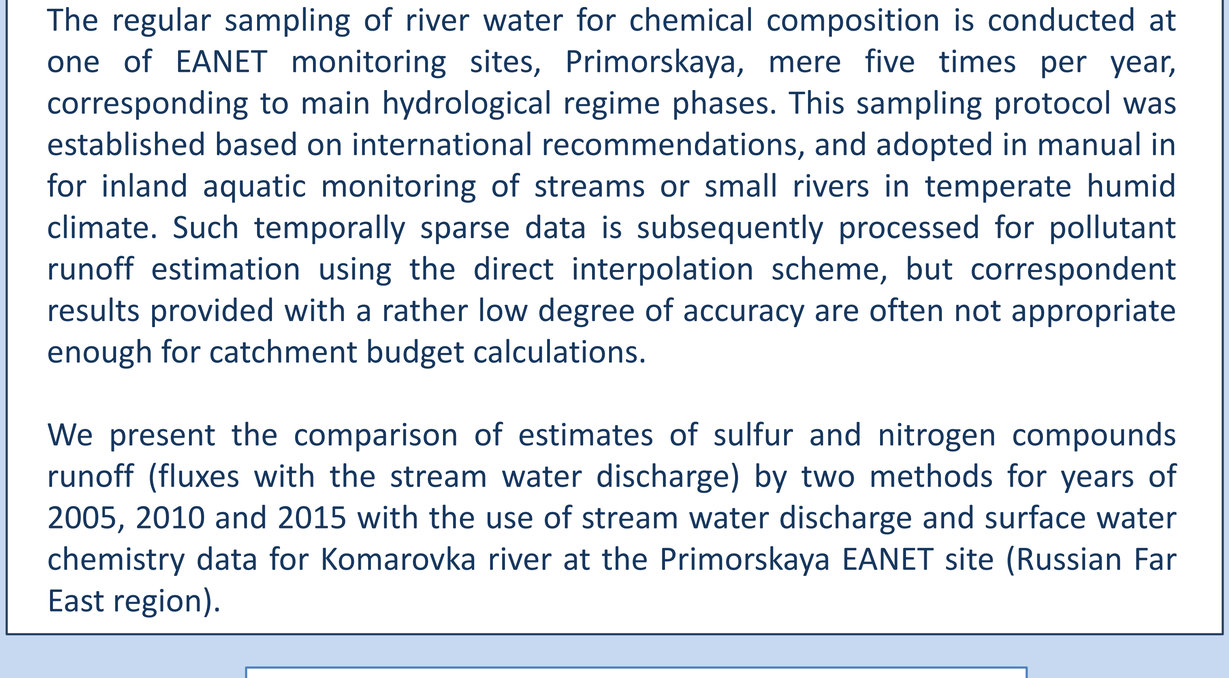


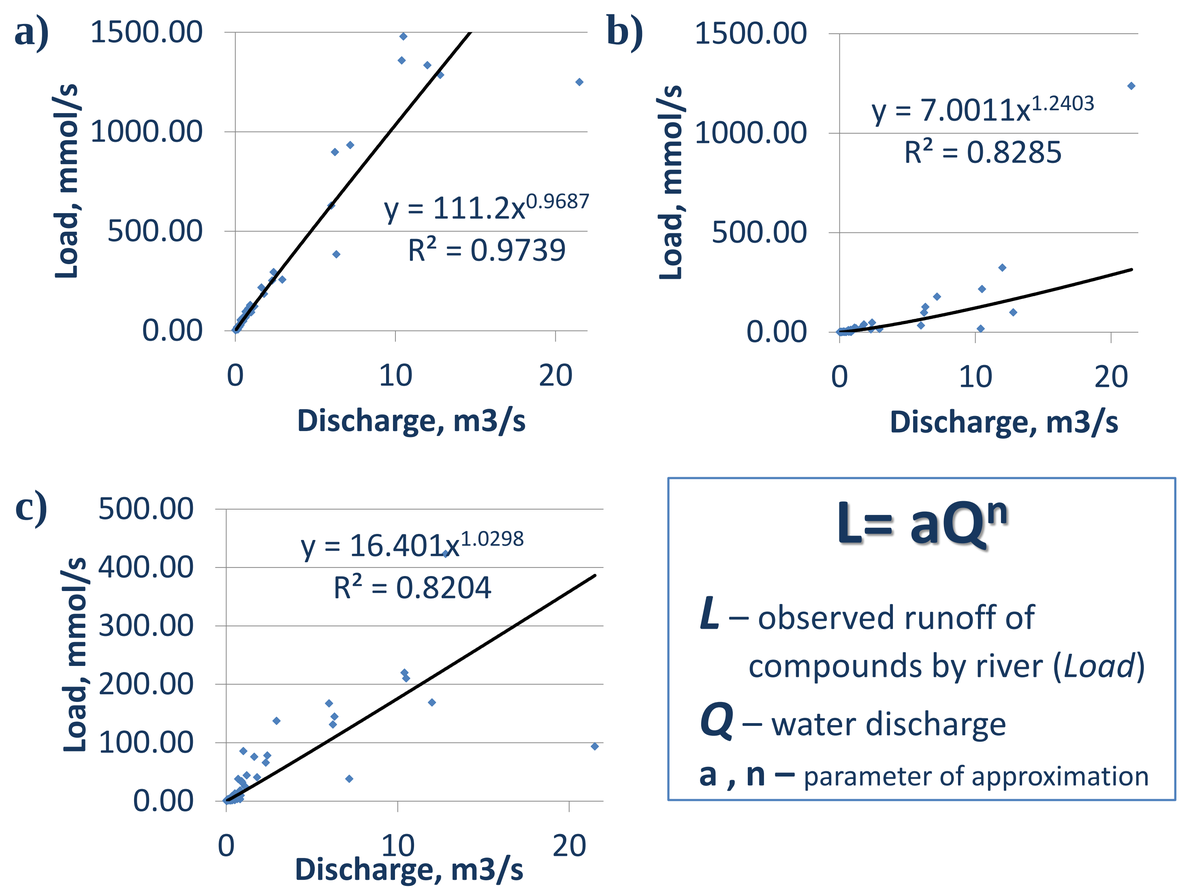
Fig. 1 Concentration of sulfur and nitrogen compounds in Komarovka river water for years 2005-2015

DATA AND METHODS

Interpolation method	L-Q method
Concentrations and water discharge data from EANET site Primorskaya in sampling days - 5 times/year	The same measurement data Additionally: daily data on water discharge from regular hydrometry point (RHP)
Daily runoff flux was calculated directly for days of sampling	Graphs of daily runoff – water discharge dependence were plotted using whole sets data for years 2005-2015
Interpolation (or mean values) of runoff for intermediate periods from nearby sampling days	Retrieval of every day runoff values from graphs using daily measurements of water discharge from RHP
Summing of interpolated values (or mean values for defined periods)	Summing daily runoff values for whole year

Runoff ("*Load*") was calculated as compound concentration (*mmol/m³*) multiplied to the stream water discharge (*m³/s*)

L-Q EQUATION



$$L = aQ^n$$

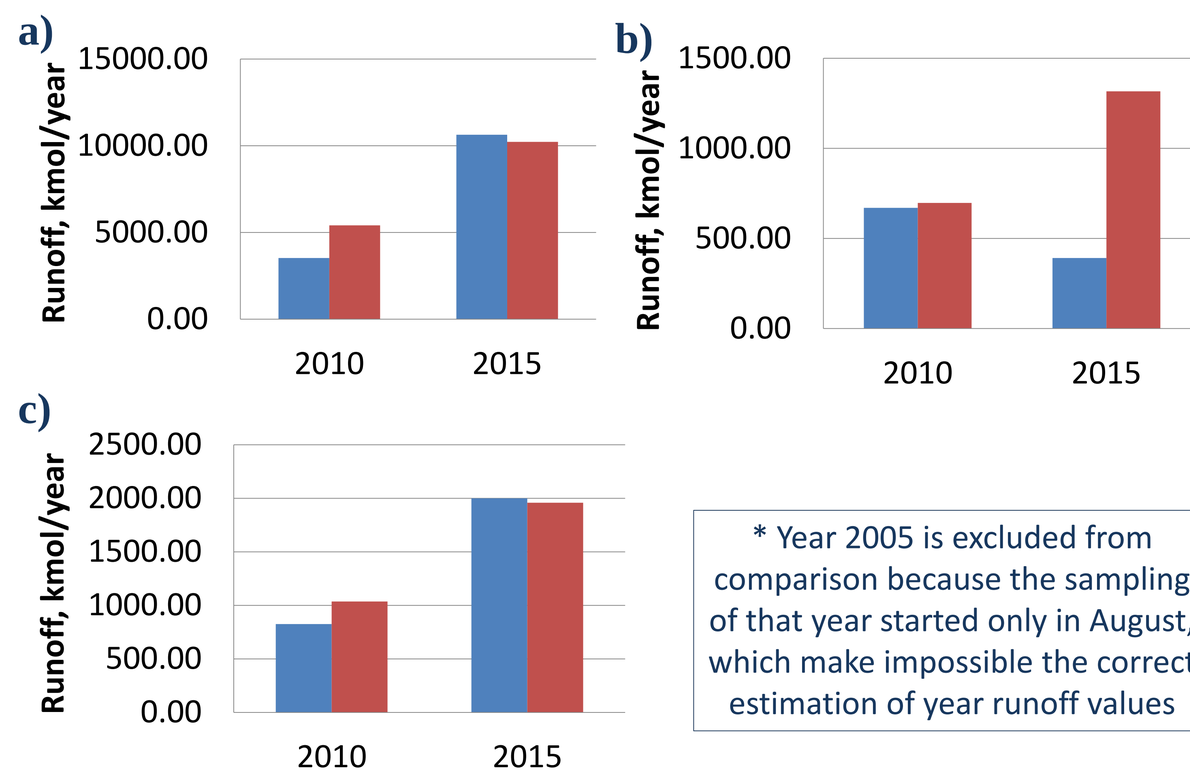
L – observed runoff of compounds by river (*Load*)

Q – water discharge

a , n – parameter of approximation

Fig. 2 Dependence of runoff on discharge for : a) SO_4^{2-} ; b) NH_4^+ ; c) NO_3^-

COMPARISON OF METHOD RESULTS



* Year 2005 is excluded from comparison because the sampling of that year started only in August, which make impossible the correct estimation of year runoff values

Fig. 3 Comparison of annual runoff values obtained by Interpolation (blue) and L-Q (red) methods for a) SO_4^{2-} ; b) NH_4^+ ; c) NO_3^-

CONCLUSIONS

Sampling protocol with five times per year is insufficient for inland aquatic monitoring to estimate annual runoff of measured compounds from watershed of small river

Application of L-Q method can provide more accurate results of total annual runoff due to taking runoff variations throughout a year into consideration

Unlike with other studies [1] it is impossible yet to determine one of two methods which provides higher total runoff values in calculations for every years

Further calculation would be done for other years using long-term EANET monitoring data from 2005 up to now.

REFERENCES

1. J. Ide, O. Nagafuchi, A. Kume, K. Otsuki, S. Ogawa, 2003. Runoff nutrients from an afforested watershed of Chamaecyparis obtusa during rain events. Proceedings of 7th International Conference Diffuse Pollution and Basin Management, Dublin Ireland, U.K., 5B, 30-34.