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Interactive Comment

Interactive comment on "Uncertainties in selected surface water quality data" *by* M. Rode and U. Suhr

M. Rode and U. Suhr

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General comments The manuscript by Rode and Suhr has some useful information on a topic that is often inadequately addressed in the development of monitoring programs. My main suggestions are to clarify the scope of surface waters addressed in this discussion, to improve the literature review of related information, and to clarify several points. In addition, the manuscript still requires some editorial corrections which I have noted below.

Scope of paper

The title of the paper refers to "selected surface water quality data". In fact the examples come primarily from the mainstem of rivers (even excluding backwaters and tributary mouths). The title and objective statement of the paper need to be changed to reflect this, as there are many other factors affecting variability of surface water quality

EGU

data in other water body types and zones that are not discussed. It would also be useful to put the discussion into context. The implications for sampling and analytical error will vary depending on the goal of monitoring, e.g., whether one is trying to assess instantaneous water quality conditions, aggregate data to produce spatial or temporal composites, or estimate total loadings from a system (see McBride and Smith 1997)

–> the title of the manuscript has been changed according to the comments and the topic has been restricted to "river water quality data". The scope of the discussion is to assess the uncertainties of river water quality data with respect to model applications according to the aspects explained in the introduction section. Therefore a detailed discussion on implications of data uncertainties on different monitoring goals like diurnal changes of water quality constituents was not the scope of the manuscript. Recommendations on the assessment of sampling uncertainties are given in the manuscript. With respect to load calculations additional information are given on the relation of sampling frequency and associated uncertainties of load calculations.

Scope of literature review

Although sources of uncertainty in water quality measurements and analyses are often inadequately reported and dealt with in the literature, there are additional references that should be included. A quick literature review produced the following that appear to, be useful additions:

Suspended particulate matter (SPM) in rivers: empirical data and models Hakanson„L; Mikrenska, M; Petrov, K; Foster, I Department of Earth Sciences, Uppsala University„Villav. 16, 752 36 Uppsala, Sweden, [mailto:lars.hakanson@geo.uu.se] Ecological,Modelling , v 183 , n 2-3, p 251-267 , April 2005

Compared performances of different algorithms for estimating annual nutrient loads, discharged by the eutrophic River Loire Moatar, Florentina; Meybeck, Michel,Laboratoire de Geologie des Environnements Aquatiques Continentaux (UPRESEA,2100), Universite de Tours, Parc de Grandmont, 37 200 Tours,

HESSD
3, S1654–S1659, 2006
Interactive Comment

France„[mailto:florentina.moatar@univ-tours.fr] Hydrological Processes , v 19 , n 2 , p 429-444 , 2005 Publication Date: 2005

Comparison of methods for determination of total solutes in flowing waters Taylor, Barry R; Hamilton, Hal R Environmental Management Associates, Calgary, Alberta, Can Journal of Hydrology , v 154 , n 1-4 , p 291-300 , 1994

Monitoring of algae in Dutch rivers: Does it meet its goals? Ibelings, B; Admiraal, W; Bijkerk, R; Ietswaart, T; Prins, H Institute for Inland Water Management and Waste Water Treatment/RIZA, P.O. Box 17 NL 8200 AA Lelystad, The Netherlands, [mailto:B.Ibelings@RIZA.RWS.minvenw.nl] Journal of Applied Phycology , v 10 , n 2 p 171-181 , 1998

Monitoring nutrient transport in large rivers Tonderski, A; Grimvall, A; Dojlido, JR; Van Dijk, G Dep. Water Environ. Stud., Linkoeping Univ., S-581 83 Linkoeping, Sweden Environmental Monitoring and Assessment , v 34 , n 3 , p 245-269 , 1995

Pattern recognition techniques for the evaluation of spatial and temporal variations in water quality. A case study: Suquia River Basin (Cordoba-Argentina) Alberto, WD; Pilar, DMD; Valeria, AM; Fabiana, PS; Cecilia, HA; De Los Angeles, BM Universidad Nacional de Cordoba, Facultad de Ciencias Quimicas, Dto. Bioquimica. Cdad. Universitaria, 5000-Cordoba, Argentina, [mailto:dwunder@bioclin.fcq.unc.edu.ar] Water Research, v 35 , n 12 , p 2881-2894 , August 2001

Temporal and small-scale spatial variations of dissolved oxygen in the Rivers Thames, Pang and Kennet, UK Williams, RJ; White, C; Harrow, ML; Neal, C Institute of Hydrology, Wallingford, Oxon, OX10 8BB, UK Science of the Total Environment , v 251-252 , n 1-3 , p 497-510 , May 5, 2000

Stochastic theory for irregular stream modeling. II: Solute transport Li, Sh-G; Zhou, X Portland State Univ, Portland, OR, USA Journal of Hydraulic Engineering , v 123 , n 7, p 610-616 , 1997

Effects of Point Source Loadings, Sub-basin Inputs and Longitudinal Variation in Material Retention on C, N and P Delivery from the Ohio River Basin Bukaveckas, PA; Guelda, DL; Jack, J; Koch, R; Sellers, T; Shostell, J Department of Biology, Center for Environmental Studies, 1000 W. Cary Street, Richmond, Virginia 23284, USA, [mailto:pabukaveckas@vcu.edu] Ecosystems , v 8 , n 7 , p 825-840 , November 2005

Suspended chlorophyll in the River Nene, a small nutrient-rich river in eastern England: long-term and spatial trends Balbi, DM Department of Biological Sciences, University of Durham, DH1 3LE, UK Science of the Total Environment , v 251-252 , n 1-3 , p 401-421 , May 5, 2000

Sampling and analytical tolerance requirements for detecting trends in water quality, McBride, GB; Smith, DG NIWA Natl. Inst. Water and Atmos. Res. Ltd., P.O. Box 11-115, Hamilton, New Zealand Water Resources Bulletin , v 33 , n 2 , p 367-373 , April 1997

Example of analysis incorporating serial autocorrelation in time series Comparison of trends in stream water quality Potts, DJM; Hirst, D; Miller, JD; Edwards, AC; Elston, DA Biomathematics and Statistics Scotland, The Macaulay Institute, Craigiebuckler, Aberdeen AB15 8QH, UK, [mailto:j.potts@bioss.ac.uk] Hydrological Processes , v 17 , n 12 , p 2449-2462 , 2003

Some of the above papers also provide information on modeling or analytical approaches to explain variability.

–> The mentioned literature has been checked and not all of them provided information on the scope of the manuscript. For instance the paper of Williams et al. (2000) deals exclusively with dissolved oxygen which is not considered in the manuscript. Other papers deal with longitudinal changes of water quality constituents but did not give any information about measurement uncertainties due to cross sectional concentration variations (Balbi, 2000, Alberto et al. 2001). A more theoretical paper analysis the impact of stream morphology of longitudinal dispersion but does not lead to general

HESSD

3, S1654–S1659, 2006

Interactive Comment

conclusions which can support the assessment of sampling uncertainties (Li and Zhou, 1997). The papers of Tonderski et al. 1995, Moatar and Meybeck (2005) revealed very useful information on the assessment of uncertainties in load calculations and these were included in the manuscript. Also additional literature of these authors has been included in the discussion on load calculation.

Specific comments: p. 3000, Line 7 Nitrate can be determined down to a level of ˇE by the cadmium reduction method. Also, with respect to interferences from sample turbidity, it is common practice to filter water samples to remove turbidity prior to measurement of solutes such as nitrate. This source of error can be avoided. (Ditto for the discussion of soluble reactive P on p. 3002)

–> The comment on the impact of sample turbidity has been included since filtering of water samples may not always totally remove turbidity (e.g. in the case of high DOC concentrations)

Following paragraph and elsewhere: The wording appears to confuse the two examples given in Standard Methods. One describes variation in the method bias as concentrations increase. Neither the absolute nor the relative bias reported change systematically with increased spikes. The second example in Standard Methods describes repeated measurements used to evaluate precision. In this example relative precision improves with increased concentration. Use of the term bias should be checked throughout the paper to ensure proper usage.

–> The two examples have been described in more detail to clearly state the difference between bias (systematic error) and precision (random error) and the text has been checked for proper use of notions.

The authors should clarify in their discussion of suspended sediment and suspended sediment loads whether they are considering bedload as well, which accounts for much of the delivery.

HESSD

3, S1654–S1659, 2006

Interactive Comment

EGU

–> Bedload is not considered in the discussion of suspended sediment and suspended sediment load calculations and this is mentioned in the manuscript

p. 3004 I'm not sure of the protocols in the European community, but in the U.S., spectrophotometric and fluorometric analyses are commonly used for chlorophyll a; HPLC is not routinely used for monitoring.

–> In Europe HPLC is more and more becoming common to be used for chlorophyll a.

p. 3005 “It was shown that the CV can give information on the general predictability of a given variable ” - circular?

–> The comment has been taken into account

Conclusions: Although the manuscript addresses several sources of uncertainty in assessing river water quality, it fails to include any recommendations for strategies to deal with these errors. There are various sampling strategies (sample compositing over time and/or space) and statistical approaches to dealing with at least some of these sources of variation. For example, there is a well-developed literature on assessing temporal autocorrelation in the analysis of trends (see Gilbert, R.O., 1987. Statistical Methods for Environmental Pollution Monitoring, Von Nostrand Reinhold, Eˇ). Continuous monitoring with real-time access of data is becoming more commonplace. In some cases, predictive models have been developed relating parameters that are continuously measured with those that are more expensive or time-consuming to monitor.

–> Additional information is given in the river load and conclusion section on optimised sampling and stochastic approaches to reduce uncertainties in river water quality sampling.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 3, 2991, 2006.

HESSD

3, S1654–S1659, 2006

Interactive Comment