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Hydrology and Earth System Sciences Discussions

Interactive comment on "Uncertainties in selected surface water quality data" *by* 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.

Specific comments

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 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)

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 (UPRES-EA 2100), Universite de Tours, Parc de Grandmont, 37 200 Tours, 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:

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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.

Specific comments

p. 3000, Line 7 Nitrate can be determined down to a level of Ě 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)

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.

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.

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

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.

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, Ě). 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.

Editorial corrections

p. 2992 line 2 form => from line 13 variability's => variability line 18 insert comma after "sampling uncertainties" line 21 considerably => considerable p. 2993 line 8 form => from line 10 reword: "has become increasingly important" line 17 reword: "are caused by airborne pollutants" line 18 cause => causes, sensible => sensitive line 22 insert comma after trends p. 2994 line 11 due => related? line 14 ph => pH line 18 predictions, e.g., scenario analyses. p. 2995 line 8 Chl a - spell out line 9 bank

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filtration - what do you mean here? Line 16 grouped in => grouped into Line 20 delete "several" Line 26 distinguished => "divided" p. 2996 Line 20 grap => grab p. 2997 Line 9 pdf: spell out Line 21: varity => variety Line 26: traces=>trace, delete "Especially" p. 2999 Line 4: then => than Line 7: delete comma Line 17: cool=> cooled Line 18: weight => weighed Line 21: duplicates=> duplicate, made=> were made Line 24: suspend => suspended p. 3000 Line 7: interfere with p. 3001 Line 20: on weekly nitrate data => to weeklyĚ Line 28: week => weak Line 29: non linear => nonlinear p. 3004 Line 4: weather => whether Line 9: allocthone => allocthonous, autochtone=> autochthonous Line 20: Chlorophyll => chlorophyll p. 3008 Line 16: can be stated well suited => is adequate Line 21: regarding => among Table 2 Sampling transport => sample transport Table 3 Need to define categories Table 5 Space => volume Time => analytical time

Various places in the paper refer to "experimental" data from the Elbe River. I would substitute "monitoring data" since this really isn't an experiment in progress.

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