

Numerical Modelling Sediment-Bacteria Interaction Processes in the Severn Estuary

PDF (Size: 333KB) PP. 22-31 DOI: 10.4236/jwarp.2011.31003

Author(s)

Guanghai Gao, Roger A. Falconer, Binliang Lin

ABSTRACT

Faecal bacteria exist in both free-living and attached forms in estuarine waters. The deposition of sediments can take faecal bacteria out of the water column and to the bed. The sediments can subsequently be re-suspended to the water column, which can then lead to re-suspension of the faecal bacteria of the attached forms back to the water column. Therefore, the fate and transport of faecal bacteria is highly related to the governing sediment transport processes, particularly where these processes are significant, such as the Severn Estuary, UK. However, little attempt has been made to model such processes in terms of predicting the impact of the sediment fluxes on faecal bacteria levels. Details are given of the refinement of a numerical model of faecal bacteria transport, where the sediment transport processes are significant. After testing the sediment-bacteria interaction model favourably against known results in previous study, the model was applied to the Severn Estuary and Bristol Channel, UK, to investigate the impact of suspended sediment fluxes on the corresponding faecal bacteria transport processes. The model predictions have proved to be encouraging, with the results being compared to a traditional faecal bacteria modelling approach, where sediment bacteria interactions were not included. The new model provides improved predictions of faecal bacteria concentrations when sediment transport is included and for the Bristol Channel Severn Estuary it can be seen that the effects of the sediments on the bacterial levels in the water column can be significant.

KEYWORDS

Numerical Modelling, Faecal Bacteria, Sediment Transport, Enterococci

Cite this paper

G. Gao, R. Falconer and B. Lin, "Numerical Modelling Sediment-Bacteria Interaction Processes in the Severn Estuary," *Journal of Water Resource and Protection*, Vol. 3 No. 1, 2011, pp. 22-31. doi: 10.4236/jwarp.2011.31003.

References

- [1] R. C. Jamieson, R. Gordon, D. Joy and H. Lee, " Assessing Microbial Pollution of Rural Surface Waters a Review of Current Watershed Scale Modeling Approaches," *Agricultural Water Management*, Vol. 70, No. 1, 2004. pp. 1-17. doi:10.1016/j.agwat.2004.05.006
- [2] J. S. Fries, G. W. Characklis and R. T. Noble, " Attachment of Fecal Indicator Bacteria to Particles in the Neuse River Estuary, N. C.," *Journal of Environmental Engineering*, Vol. 132, No. 10, 2006, pp. 1338-1345. doi:10.1061/(ASCE)0733-9372(2006)132:10(1338)
- [3] G. W. Characklis, et al., " Microbial Partitioning to Settleable Particles in Stormwater," *Water Research*, Vol. 39, No. 9, 2005, pp. 1773-1782. doi: 10.1016/j.watres.2005.03.004
- [4] R. C. Jamieson, D. Joy, H. Lee, R. Kostaschuk and R. Gordon, " Resuspension of Sediment-associated Escher- icheia in a Natural Stream," *Journal of Environmental Qu- ality*, Vol. 34, No. 2, 2005, pp. 581-589. doi:10.2134/jeq2005.0581
- [5] L. Yang, B. Lin and R. A. Falconer, " Modelling Enteric Bacteria Levels in Coastal and Estuarine Waters," *Proceedings of Institution of Civil Engineers, Engineering and Computational Mechanics*, Vol. 161, No. EM4, 2008, pp. 179-186.

- [Open Special Issues](#)
- [Published Special Issues](#)
- [Special Issues Guideline](#)

[JWARP Subscription](#)[Most popular papers in JWARP](#)[About JWARP News](#)[Frequently Asked Questions](#)[Recommend to Peers](#)[Recommend to Library](#)[Contact Us](#)

Downloads: 402,256

Visits: 1,010,160

[Sponsors, Associates, and Links >>](#)

- [6] C. M. Stapleton, M. D. Wyer, D. Kay, M. Bradford, N. Humphrey, J. Wilkinson, B. Lin, Y. Yang, R. A. Falconer, J. Watkins, C. A. Francis, J. Crowther, N. D. Paul, K. Jones and A. T. McDonald, " Fate and Transport of Particles in Estuaries," Volume I, II, III, IV, Environment Agency Science Report SC000002/SR1-4, 2007.
- [7] R. A. Falconer, " An Introduction to Nearly Horizontal Flows," In: M. B. Abbott and W. A. Price, Eds., Coastal Estuarial and Harbour Engineers, Reference Book, E and F. N. Spon Ltd., London, 1993, pp. 27-36.
- [8] Y. Wu, R. A. Falconer and B. Lin, " Modelling Trace Metal Concentration Distributions in Estuarine Waters," Estuarine, Coastal and Shelf Science, Vol. 64, No. 4, 2005, pp. 699-709. doi:10.1016/j.ecss.2005.04.005
- [9] L. C. Van Rijn, " Sediment Transport, Part I: Bed Load Transport," Journal of Hydraulic Engineering, ASCE, Vol. 110, No. 10, 1984, pp. 1431-1457. doi:10.1061/(ASCE)0733-9429(1984)110:10(1431)
- [10] L. C. Van Rijn, " Sediment Transport, Part II: Suspended Load Transport," Journal of Hydraulic Engineering, ASCE, 1984. Vol. 110, No. 11, pp. 1613-1641. doi:10.1061/(ASCE)0733-9429(1984)110:11(1613)
- [11] L. C. Van Rijn, " Principles of Sediment Transport in Rivers, Estuaries and Coastal Seas," Aqua Publications, Netherlands, 1993.
- [12] R. A. Falconer and Y. Chen, " Modeling Sediment Transport and Water Quality Processes on Tidal Floodplains," In: M. G. Anderson, D. E. Walling, P. D. Bates, Eds., Floodplain Processes, Wiley,