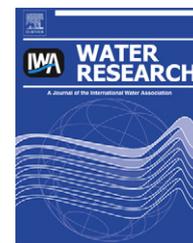


Available online at www.sciencedirect.com

SciVerse ScienceDirect

journal homepage: www.elsevier.com/locate/watres

The modified SWAT model for predicting fecal coliforms in the Wachusett Reservoir Watershed, USA

Kyung Hwa Cho^a, Yakov A. Pachepsky^b, Joon Ha Kim^c, Jung-Woo Kim^d, Mi-Hyun Park^{a,*}

^a Department of Civil and Environmental Engineering, University of Massachusetts, 130 Natural Resources Road, Amherst, MA 01003, USA

^b USDA-ARS, Environmental Microbial and Food Safety Laboratory, 10300 Baltimore Avenue, Building 173, BARC-East, Beltsville, MD 20705, USA

^c School of Environmental Science and Engineering, Gwangju Institute of Science and Technology (GIST), 261 Cheomdan-gwagiro, Buk-gu, Gwangju 500-712, South Korea

^d Radioactive Waste Technology Development Division, Korea Atomic Energy Research Institute, 1045 Daedeok-daero, Yuseong-gu, Daejeon 305-353, Republic of Korea

ARTICLE INFO

Article history:

Received 22 November 2011

Received in revised form

18 May 2012

Accepted 27 May 2012

Available online 28 June 2012

Keywords:

Fecal coliform

SWAT model

Solar intensity

Wildlife

ABSTRACT

This study assessed fecal coliform contamination in the Wachusett Reservoir Watershed in Massachusetts, USA using Soil and Water Assessment Tool (SWAT) because bacteria are one of the major water quality parameters of concern. The bacteria subroutine in SWAT, considering in-stream bacteria die-off only, was modified in this study to include solar radiation-associated die-off and the contribution of wildlife. The result of sensitivity analysis demonstrates that solar radiation is one of the most significant fate factors of fecal coliform. A water temperature-associated function to represent the contribution of beaver activity in the watershed to fecal contamination improved prediction accuracy. The modified SWAT model provides an improved estimate of bacteria from the watershed. Our approach will be useful for simulating bacterial concentrations to provide predictive and reliable information of fecal contamination thus facilitating the implementation of effective watershed management.

© 2012 Elsevier Ltd. All rights reserved.

1. Introduction

Freshwater resources are susceptible to various fecal contaminations. Fecal coliform, also known as thermotolerant coliforms (Ashbolt et al., 2001), are a subgroup of total coliforms associated with fecal contamination. Most fecal coliform bacteria are not pathogenic, but they indicate the possibility of the presence of microbial pathogens, which are detrimental to public health (Noble et al., 2003). Fecal coliform sources include: agricultural runoff, sewage, and wild and domestic animal feces (Howell et al., 1995; Alderisio and

DeLuca, 1999; Gerba, 2000; Guber et al., 2006; Servais et al., 2007; Cho et al., 2010a). Another potential source of fecal contamination is the release of fecal coliform from streambeds. Previous studies have demonstrated that sediments can contain one to three orders of magnitude more fecal coliform than the overlying water column (Goyal et al., 1977; Doyle et al., 1992; Buckley et al., 1998; Crabill et al., 1999; Smith et al., 2008; Rehmann and Soupier, 2009; Cho et al., 2010a; Pachepsky and Shelton, in press).

Several studies found that the levels of fecal coliform are substantially affected by meteorological conditions (Gannon

* Corresponding author. Tel.: +1 413 545 5390.

E-mail address: mpark@ecs.umass.edu (M.-H. Park).

0043-1354/\$ – see front matter © 2012 Elsevier Ltd. All rights reserved.

<http://dx.doi.org/10.1016/j.watres.2012.05.057>