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Evaluation of Future Climate Change Impact on Aquatic Ecosystem and Health using LM3-TAN Model in South Korea

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Abstract: Climate change could be one of the main threats faced by aquatic ecosystems and freshwater biodiversity. Recently, LM3-TAN (Land Model 3 Terrestrial and Aquatic Nitrogen) land-based physical, biological, chemical processes model for South Korea was developed to assess the combined effects of direct human influences and future climate change on Aquatic Nitrogen cycling by Korea NIEL (National Institute of Environmental Research). The objective of this study is to analyse the relationship between stream water quality, water temperature, and Trophic Diatom Index (TDI) and Benthic Macroinvertebrate Index (BMI) determined by stream water quality factors. The TDI and BMI monitored 2 times in May and September during 2008-2014 at 67 sites had high correlations with phosphate (PO₄³⁻) and nitrate (NO₃⁻). Based on the HadGEM3-RA RCP (Representative Concentration Pathway) 2.6 and 8.5 emission scenarios, the LM3-TAN model projected up to 2.3 °C and 9.6 m³/s increases of stream water temperature and flow under 2080s (2060~2099) RCP 2.6 scenario and up to 3.1 °C and 275.6 m³/s increases under 2080s RCP 8.5 scenario respectively based on the baseline period (1975-2005). For the representative basin, Han River (34,148 km²) in South Korea, the RCP 2.6 scenario showed that the present (2010) class D (the lowest grade) TDI and BMI increased by 94.0% and 82.4% respectively in 2080s, and increased by 71.0% and 88.2% respectively in 2080s RCP 8.5 scenario.

Keywords: Climate Change, RCP, TDI (Trophic Diatom Index), BMI (Benthic Macroinvertebrate Index), LM3-TAN

Acknowledgement
This research was supported by a Grant (11-TIC06) from Advanced Water Management Research Program funded by Ministry of Land, Infrastructure and Transport of Korean government.