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Development of advanced process-based model towards evaluation of boundless biogeochemical cycles in terrestrial-aquatic continuum

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Recent research shows inland water may play some role in continental biogeochemical cycling though its contribution has remained uncertain due to a paucity of data (Battin et al. 2009). The author has developed process-based National Integrated Catchment-based Eco-hydrology (NICE) model (Nakayama, 2008a-b, 2010, 2011a-b, 2012a-c, 2013; Nakayama and Fujita, 2010; Nakayama and Hashimoto, 2011; Nakayama and Shankman, 2013a-b; Nakayama and Watanabe, 2004, 2006, 2008a-b; Nakayama et al., 2006, 2007, 2010, 2012), which incorporates surface-groundwater interactions, includes up- and down-scaling processes between local, regional and global scales, and can simulate iteratively nonlinear feedback between hydrologic, geomorphic, and ecological processes. In this study, NICE was extended to evaluate global hydrologic cycle by using various global datasets. The simulated result agreed reasonably with that in the previous research (Fan et al., 2013) and extended to clarify further eco-hydrological process in global scale. Then, NICE was further developed to incorporate the biogeochemical cycle including the reaction between inorganic and organic carbons (DOC, POC, DIC, pCO_2, etc.) in the biosphere (terrestrial and aquatic ecosystems including surface water and groundwater). The model simulated the carbon cycle, for example, CO_2 evasion from inland water in global scale, which is relatively in good agreement in that estimated by empirical relation using the previous pCO_2 data (Aufdenkampe et al., 2011; Global River Chemistry Database, 2013). This simulation system would play important role in identification of full greenhouse gas balance of the biosphere and spatio-temporal hot spots in boundless biogeochemical cycle (Cole et al. 2007; Frei et al. 2012).

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