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How does global biogeochemical cycle become complicated by terrestrial-aquatic interactions ?

Tadanobu Nakayama and Shamil Maksyutov
Center for Global Environmental Research, National Institute for Environmental Studies, Tsukuba, Japan (nakat@nies.go.jp)

Inland water such as river and lake are now known to be important and active components of global carbon cycle though its contribution has remained uncertain due to data scarcity (Battin et al., 2009; Aufdenkampe et al., 2011). 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-global scales, and can simulate iteratively nonlinear feedback between hydrologic, geomorphic, and ecological processes. In this study, NICE was coupled with various biogeochemical models to incorporate biogeochemical cycle including reaction between inorganic and organic carbons (DOC, POC, DIC, pCO_2, etc.) in terrestrial and aquatic ecosystems including surface water and groundwater. The coupled model simulated CO_2 evasion from inland water in global scale, was relatively in good agreement in that estimated by empirical regression model (Raymond et al., 2013). In particular, the simulated result implied importance of connectivity between terrestrial and aquatic ecosystems in addition to surface and groundwater, and hillslopes and stream channels, etc. The model further improved the accuracy of CH4 flux in wetland which is sensitive to fluctuations of shallow groundwater because the original NICE incorporates 3-D groundwater sub-model and simulates lateral subsurface flow more reasonably. This simulation system would play important role in integration of greenhouse gas budget of the biosphere, quantification of hot spots in boundless biogeochemical cycle, and bridging gap between top-down and bottom-up approaches (Cole et al., 2007; Frei et al., 2012; Kiel and Cardenas, 2014).

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