Global-scale analysis on future changes in flow regimes using Gini and Lorenz asymmetry coefficients

Yoshimitsu Masaki, Naota Hanasaki, Kiyoshi Takahashi and Yasuaki Hijioka
National Institute for Environmental Studies (NIES)

Abstract

By introducing the Gini and Lorenz asymmetry coefficients, which are two scalar quantities characteristically representing the shape of a flow-duration curve, we quantitatively analyzed future changes in river discharge at a global scale. We evaluated the seasonal inequality in the discharge (i.e., the unevenness of the temporal distribution of river discharge) of major global rivers using the global hydrological model H08 for the historical period 1960-2005 and the future period 2006-2099 under four climate-change scenarios. To obtain a reliable projection, we used ensembles of hydrological simulation results with five general circulation models. From the analysis of the Gini coefficient, future changes in seasonal inequality show a contrasting geographical pattern: a decreasing trend at high northern latitudes and an increasing trend in most other areas. A large increase in seasonal inequality is observed around the Mediterranean sea and in central North America. On the other hand, from the analysis of the Lorenz asymmetry coefficient, changes in seasonal inequality at high northern latitudes are attributable to transitions in flow-duration curves. Although a flow-duration curve is a pictorial representation of river discharge suitable for one specific site, by depicting the geographical distribution of these two coefficients along river channels, different characteristics of flow-duration curves at different sites can be detected, even within the same river basin.