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Sensitivity of large-basin hydrological response to changes of climate parameters: an analysis on the basis of delta-change approach.

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The fundamentally complex nature of hydrological systems limits our ability for accurate prediction of their responses to the inherently uncertain climate change. In this context, hydrological climate impact studies can be focused more on "what might change and why, rather than on the exact magnitude of any change" (Peel, Blöschl, 2011). Sensitivity analysis provides opportunities to offer explanation for physical mechanisms and indicate main drivers of possible changes of hydrological systems.
Sensitivity analysis was performed through numerical experiments with the physically-based regional hydrological models developed on the ground of the ECOMAG (ECOlogical Model for Applied Geophysics) hydrological modeling platform for 4 large river basins located in the different physiographic and climatic zones: Lena, Mackenzie, Amur, and Selenga River basins. Being driven by the data of meteorological observations or reanalysis, the regional hydrological models demonstrated good performance in reproducing the long-term historical streamflow data recorded in the listed basins. A delta-change approach was used for construction from the observation data the synthetic series of meteorological data. The latter were transformed by small constant perturbations and, as a result, the constructed synthetic series were characterized by the changed multi-year mean of climatic variables (air temperature and precipitation) in comparison with historical data. The artificial series were used as the inputs into the hydrological model whose responses may be interpreted in terms of sensitivity of the basins' water regime to the pre-determined changes of climatic norms. The elasticity (sensitivity) indexes showing changes of water regime characteristics (mean and variances of annual and seasonal flow) to small changes in climatic norms were determined from the simulated responses. Physical mechanisms of influences of different physiographic conditions on hydrologic sensitivity indexes were analyzed.