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A national model concept for estimating freshwater discharge, 1990-2008.
- Assessment of freshwater discharge to coastal waters round Denmark using a meta DK_Q model combining measured and modelled discharges.

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Abstract

A new harmonised modelling tool (DKQ) has been developed for the estimation of monthly freshwater runoff to coastal waters around Denmark for the period 1990-2008.
DKQ is based on results from 179 gauging stations covering 57% of the ca. 43,100 km Danish land area in a combination with modelled runoff for ungauged coastal areas utilising the hydrological DK-model. For 99 of the gauging stations unbroken time series of measurements are available for the period 1990-2008. However, for 80 of the gauging stations there's no unbroken time series of daily discharge measurements. Hence, at technique for both interpolation and extrapolation has been developed to generate estimated station specific monthly runoff in periods with no measurements. This technique use a combination of measured monthly runoff from reference gauging stations in coastal catchments and modelled monthly runoff for specific catchments lacking an unbroken time series of measurements. The modelled runoff is derived from the MIKE SHE model (DK-model), where results from 1 km$\times$1 km grid's has been available at the time of meta model development. The modelled runoff was shown to have general station specific bias as well as seasonal bias when comparing model estimates with measurements. Station specific model corrections for these bias's have been made and the adjusted modelled runoff has then been used for periods with no measurements from the 80 stations. For periods with no modelled runoff available (2006-2008), results from a set of reference gauging stations holding full time series of measurement have been used in the inter- and extrapolation procedures.

For land areas being ungauged areas in the period 1990-2008 (43% of the Danish land area) the DKQ meta-model utilises monthly empirical relationships developed between a set of reference gauging stations and the DK-modelled monthly runoff for 320 smaller ungauged coastal watersheds. Hence, within each of nine major Georegions bias correction factors have been calculated as the average ratio between observed monthly runoff at the gauging stations and the monthly runoff simulated with the DK-model for the same gauging stations. These bias correction factors have been applied for the ungauged coastal watersheds lying within each Georegion. For periods with no modelled runoff (period 2006-2008) results from a set of reference gauging stations holding full time series of measurement have been used for extrapolation. Hence, each coastal watershed is linked to one or several reference gauging stations and empirical monthly relationships between simulated and bias corrected monthly runoff as calculated with the DK-model for the ungauged area within the coastal watershed and the reference station(s) have been developed. These monthly relationships are then utilised to calculate the runoff from the ungauged part of the coastal watershed after having accessed to the monthly runoff data from the reference station.

The DKQ meta model described above has been developed in a collaboration between the National Geological Survey of Denmark (GEUS) and the National Environmental Research Institute (NERI), Aarhus University. Experiences gained will be used in the ongoing updating of the hydrological DK-model (www.vandmodel.dk). The discharges estimated by the procedure described have been used in the reporting of results from the national environmental monitoring programme including calculations of regional and temporal distributed nutrient loadings to coastal waters (NP_DK model).