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Conceptual model for improving nitrogen load estimates using event response reconstruction approach

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For surface water quality evaluation, it is well known that the grab sampling could not capture the dynamical behaviour of solute concentration and only provides a general overview due to the lack of detailed information. Thus, recently there has been an increased interest in high-resolution water quality monitoring temporally and spatially. This study aimed at improving the nitrogen (NO_3) load estimates using nitrogen event reconstruction approach based on high frequency measurements. This approach was developed at the intensively agriculture Weida catchment (99.5 km2) located in central Germany. In-stream 1 year (1.10.2005-1.10.2006) of semi-continuous (15 min interval) measurements of nitrogen concentrations and discharge were conducted at the catchment outlet. Also, hourly precipitation measurements at a station close to the catchment outlet were used. The event response of NO_3 concentration, discharge and precipitation were analysed through a set of event-responses characteristics. To achieve our goals, 14 events were used for calibration. While, two periods of continuous 9 and 5 events in winter and summer, respectively were used for validation of the method.
Results showed that three multiple linear regression models were needed to reproduce the relative nitrogen change (rdN), the time to maximum relative change (TdN) and the nitrogen recovery time (TNrec) during each event. These three nitrogen characteristics were reconstructed only based on the discharge and precipitation features. This approach was applied to reconstruct the nitrogen patterns during the gaps of the grab sampling measurements. Results revealed that this new approach significantly improve nitrogen load estimates compared with the traditional grab-sampling moving average method (error was reduced from 10 to 1% for a period of 2 weeks). These findings revealed the beneficial of using commonly available hydrological data for the interpretation of surface water pollution. Here, it has been confirmed, at least for the catchment characterized by consistent and repetitive NO_3 concentration-discharge relationships, that an accurate estimates of nitrogen requires a period of high resolution measurements and a conceptual model relating the nitrogen response to the quantitative hydrological changes.