Database containing harmonized data sets

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Harmonized data sets were prepared for water quality monitoring of drinking water resources, and a readily usable database was developed from them.

Development of the database was mainly driven by existing data sets coming from most of the 13 FAIRWAY case studies, as well as various other data sets at national or EU level that could be found online. Mining of monitoring data on agricultural pressure and drinking water quality resources and most other site-specific data was conducted with the support of the partners involved in the case studies. The resulting database contains near 390,000 rows of data from the 13 case study sites, about more than 65 parameters and 500 sub-parameters.

One of the challenges throughout the task of database development was to find ways to harmonize as much as possible the heterogeneous data sets obtained from those various sources.

Some major challenges identified throughout this work are that:

1) Definitions of a 'boundary' are different from the pressure and state perspectives. The catchment area defines the hydrogeological boundary, but the agricultural boundary is an administrative boundary (at least are displayed as that). Moreover, there is generally a lag time (delay) between pressure and state indicators. Consequently, agricultural pressure data and hydrogeological state data often do not coincide well neither in space nor in time, and thus they cannot be linked directly.

2) Because of the difference in those definitions, the spatial scale of the collected data is also different. The state data (mainly hydrogeochemical data on water quality) can be at point scale or at the catchment scale, while the pressure data, which ideally should be at the field plot scale, is in fact most often at administrative levels (i.e., municipal, regional, or even national level).

3) Therefore, it is time-consuming to collect these large sets of data and then process the data to a comparable form between state and pressure for a case study site and among the case study sites.

4) It was difficult to collect exploitable pairs of pressure and state data. In some case studies the collected data include several state time series, but no usable pressure time series. In addition, even in the cases where a logical pair of pressure and state time series is available, its exploitability is often limited by the too short duration of one or both of the time series.

The main objective FAIRWAY's Monitoring and Indicators research theme was to identify, select and prioritize transparent and data-driven indicators for monitoring of the impacts of agriculture activities on drinking water quality, referred as Agri-Drinking Water Indicators (ADWIs). Our hypothesis was that the best pressure indicators should a priori be related (linked) to contaminant concentration in water (state indicators) and thus be useful and straightforward. The database

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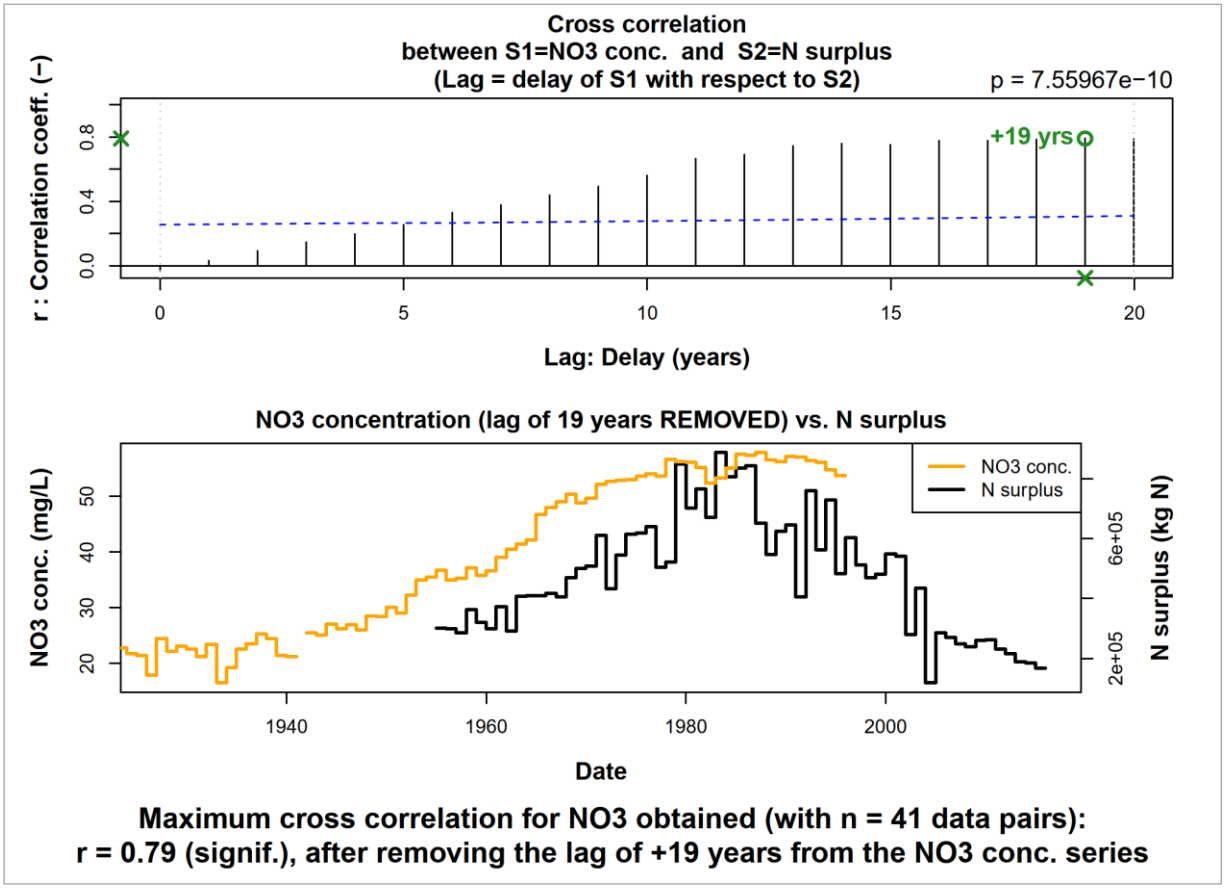
allowed an efficient exploration of statistical relationships between pairs of pressure and state time series, which provided answers to the question “How long may we have to wait to see the impacts of changes in agricultural practices?”

This question was investigated through cross-correlation analyses of the aggregated data series (by year, for the whole catchment) in the case studies where data were available. These analyses produced “lag time” quantitative information. The main conclusions of these investigations were published in Kim et al, 2020[1].



Cross-correlation analysis results for nitrate and superimposed pressure and state curves after removing the lag time of +19 years from the ‘NO_3 conc.’ (state) time-series, for bottom spring of Case Study #4

[1] Kim, H.; Surdyk, N.; Møller, I.; Graversgaard, M.; Blicher-Mathiesen, G.; Henriot, A.; Dalgaard, T.; Hansen, B. Lag Time as an Indicator of the Link between Agricultural Pressure and Drinking Water Quality State. *Water* **2020**, *12*, 2385. https://doi.org/10.3390/w12092385