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Increasing Si trends in the Neckar river system and implications to elemental ratios of nutrients

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Silica is one of the essential nutrients for riverine and coastal biogeochemical processes.

The Neckar river, a major tributary to the river Rhine/Germany, was analysed for trends caused by anthropogenic impact. Data of 18 monitoring stations sampled by governmental environment monitoring programmes (8 main stream stations, 1997-2002; 10 headwater stations, 1989-2001).

All stations showed a positive trend in dissolved silica concentration with time. These trends were compared with trends of PCO_2, major ions concentrations, nutrients, as well as pH, and temperature. In the main stem, the silica increase was accompanied by a negative trend in almost all other concentrations including nutrients, borate and PCO_2 and a positive trend in iron. In the headwaters, we find a contrasting pattern. The major ions mostly show positive trends but sulphate decreases. Most nutrients (NH_4^+, PO_4^-, NO_2^-) stay below the detection limits at headwater stations, except for nitrate and iron which show a mixed trend pattern (borate was not measured). PCO_2 decreases in most headwater stations, except where we find increasing nitrate trends.

Due to the differences in trends in the main ions between headwater and main stem stations, it is concluded that the monitored headwater stations do not yield a representative picture of all tributaries to the Neckar. Specifically input from some of the larger tributaries and from sewage treatment plants are missing.

The main stem data show that the nutrient ratios have been significantly shifting over at least the last decade. A decrease in NO_3^- and PO_4^-, a result of increased sewage treatment and nutrient limitation in agriculture, is accompanied by an increase in sil-

ica. The origin of this silica remains unclear. It may simply be the result from a lower photosynthetic usage (diatoms) of the silica (due to decreased nutrient availability). It also could derive from a better remineralization of silica in headwaters or sewage plants. It is further possible that increased temperature and/or changing agricultural practises led to an increase in the mobilization of amorphous soil silica and/or phytolithes. This merits further investigation in the future.