Transferring nutrient reduction requirements from German Baltic Sea coastal and marine waters to inland

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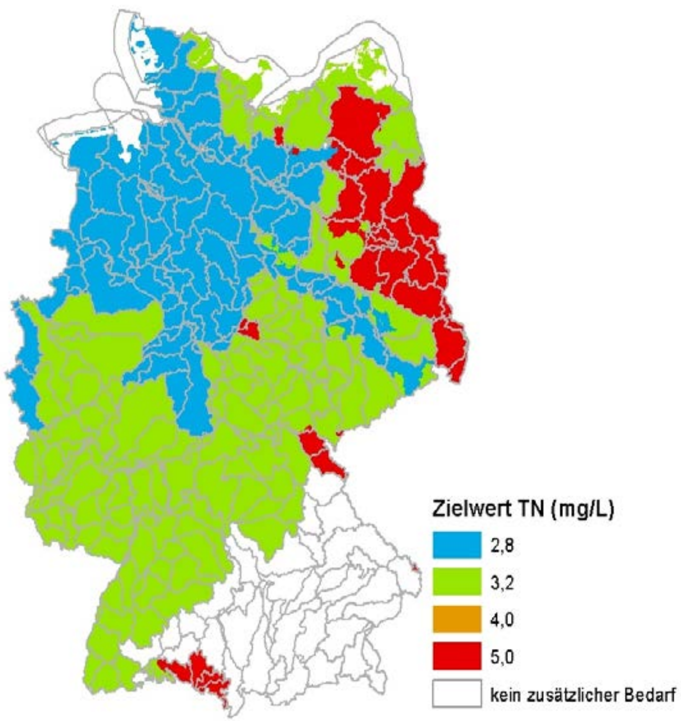


Overview

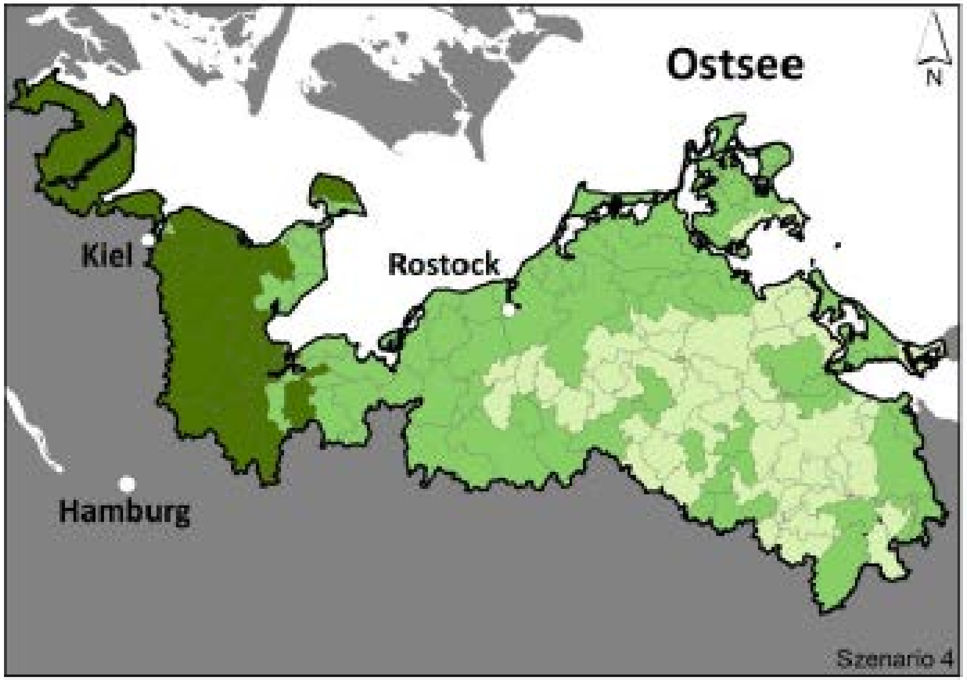
- Step 1 – Deriving reference conditions and G/M boundaries for nutrients and other eutrophication-related parameters
- Step 2 – Setting management targets for riverine nutrient concentrations at the border limnic/marine
- Step 3 – Transferring these targets inland

Step 1 – Deriving reference conditions and G/M boundaries for nutrients and other eutrophication-related parameters

- Not enough historic in-situ data
- Anecdotal evidence that around 1880 macrophytes were still abundant in coastal waters and water transparency was high
- For 1880 good data availability from statistical year books – hardly any use of mineral fertiliser, low numbers of livestock, few sewer systems, extensive agriculture
- Model MONERIS (model for the quantification of nutrient emissions from point and diffuse sources in river catchments) used to estimate riverine nutrient inputs around 1880 (based on today‘s hydrology)

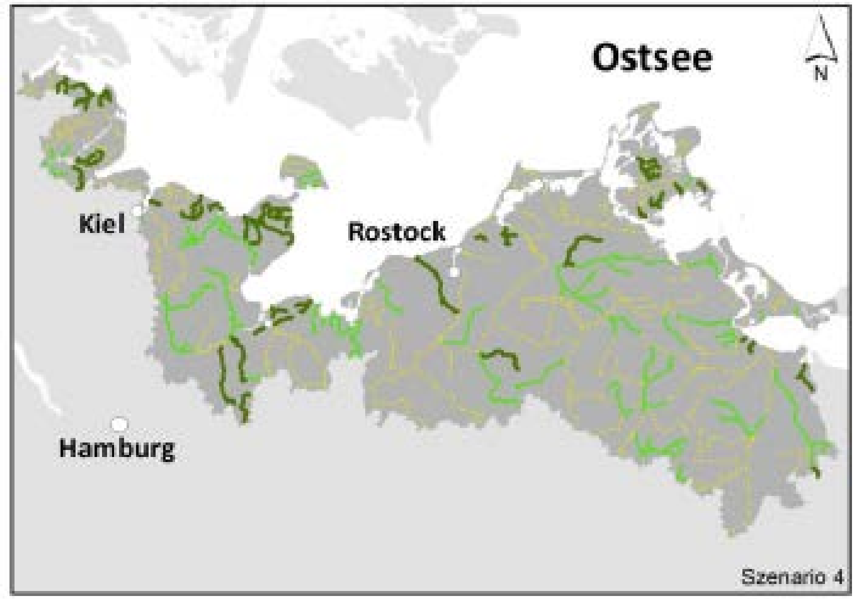
Model output

TN inputs



TN Eintrag in kg ha^{-1} a^{-1} < 1 > 1 - 3 > 3

TN Concentrations



TN Konzentration in mg/l < 0,5 > 0,5 - 1 > 1

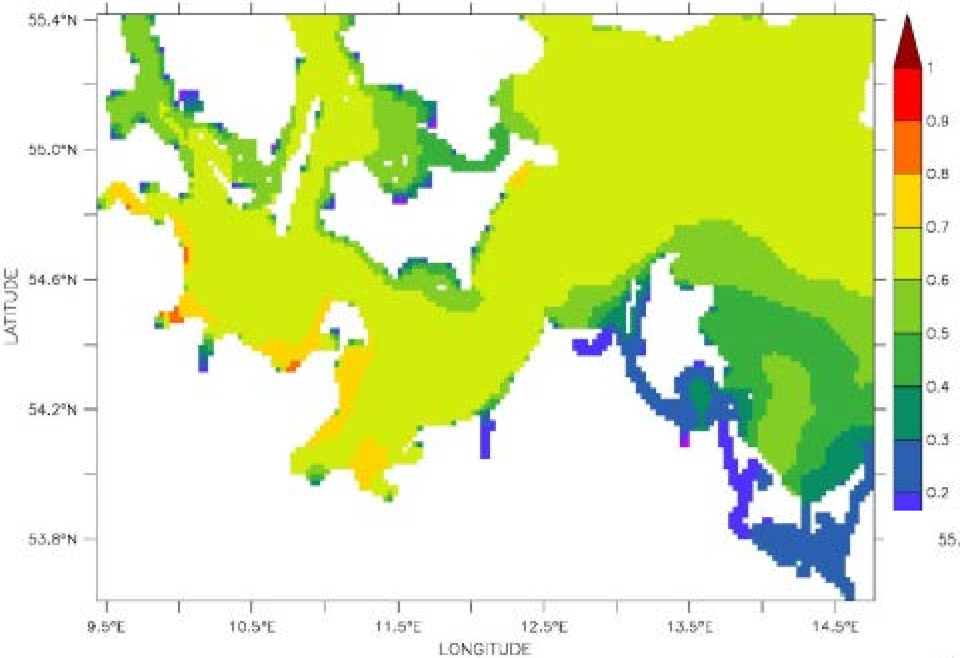
Average TN-concentration was <1mg/l; TP concentration <0,05mg/l

Average nutrient inputs are for TN 80% lower than today and for TP 70% lower

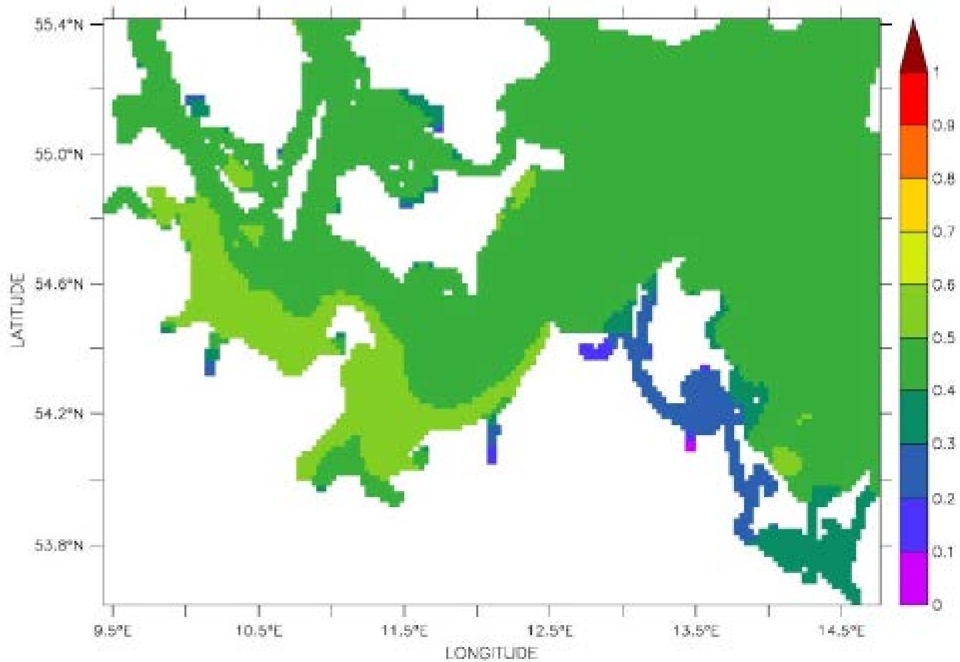
Extrapolation of the nutrient concentrations into the sea using a modelling approach

- Modelling with ERGOM-MOM model (3D ecosystem model of the Baltic Sea)
- 1880 nutrient loads used as a basis to simulate the resulting nutrient (and chl-a, secchi, oxygen) concentrations
- Relative difference between ERGOM-MOM simulations of the present situation and 1880 was calculated and then multiplied with recent monitoring data
- To set G/M boundaries a 50% deviation from reference conditions (1880) was allowed

Model output for relative change



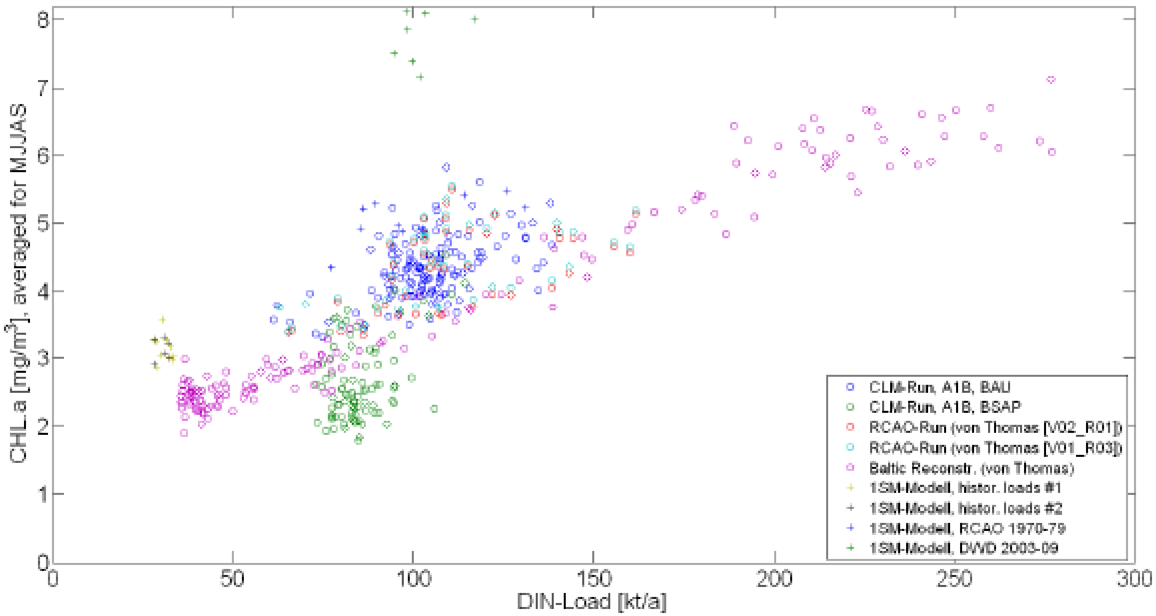
Relative change between 1880 and today (2000-2008) for TN



Relative change between 1880 and today (2000-2008) for TP

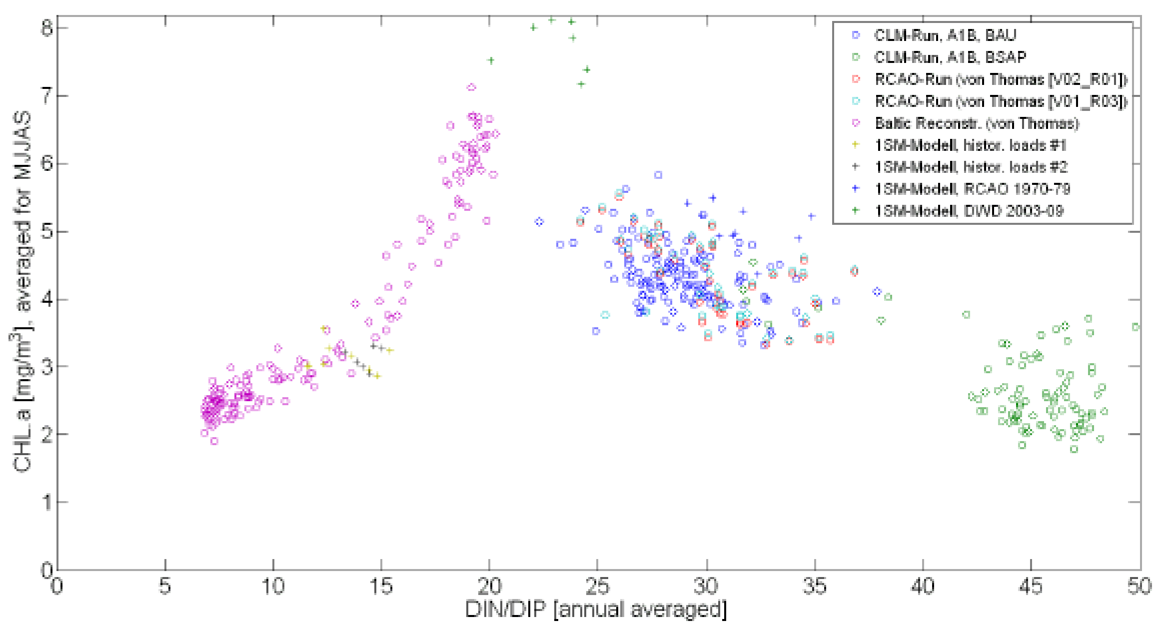
Step 2 – Setting management targets for riverine nutrient concentrations at the border limnic/marine

- Average chla-concentration of the south-western Balic Sea was calculated (3,6µg/l)
- Statistical model was derived based on the relationship between Chla and nitrogen loads and N:P ratios



linear relationship between Chla concentrations and DIN load

Non-linear relationship between chla-concentrations and DIN/DIP ratio – Chla peaks at the Redfield ratio

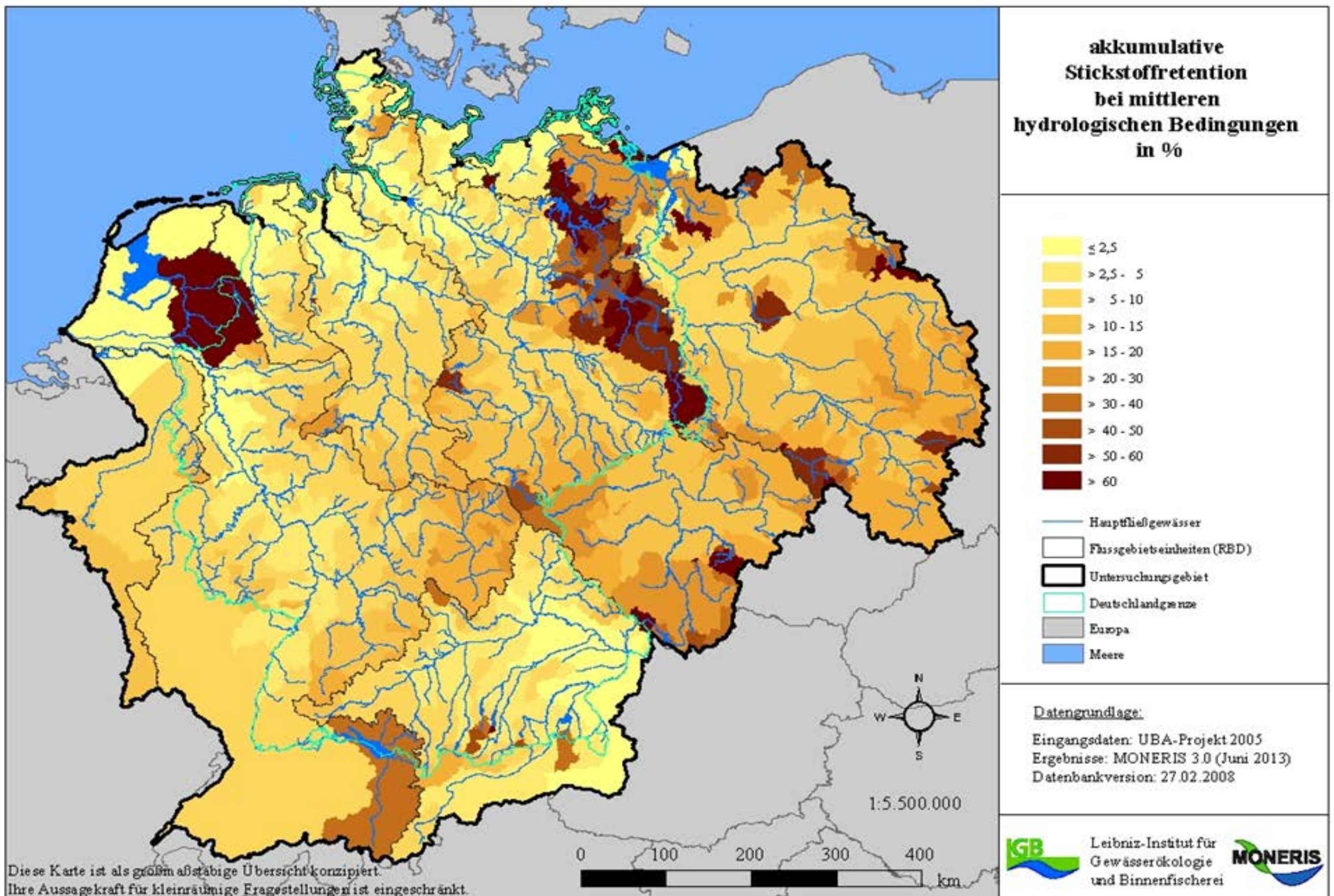


Determining required nutrient reductions

- Based on the statistical model the riverine nutrient load reduction required to achieve the mean chla-concentrations was calculated
- It was asssumed that atmospheric deposition is reduced by 20% according to the Gothenburg Protocol
- TN loads need to be reduced by 34% to 21.500 t/a; this is equivalent to a target concentration of **2,6mg/l TN** in the rivers
- This target concentration is used for management purposes, it is not legally binding
- This target will also ensure that the nutrient reduction requirements of the BSAP are met!
- For TP concentrations it was demonstrated that the G/M boundaries set for rivers (0.1 to 0.15mg/l) are sufficient to achieve the chla target concentrations and also the requirements of the BSAP

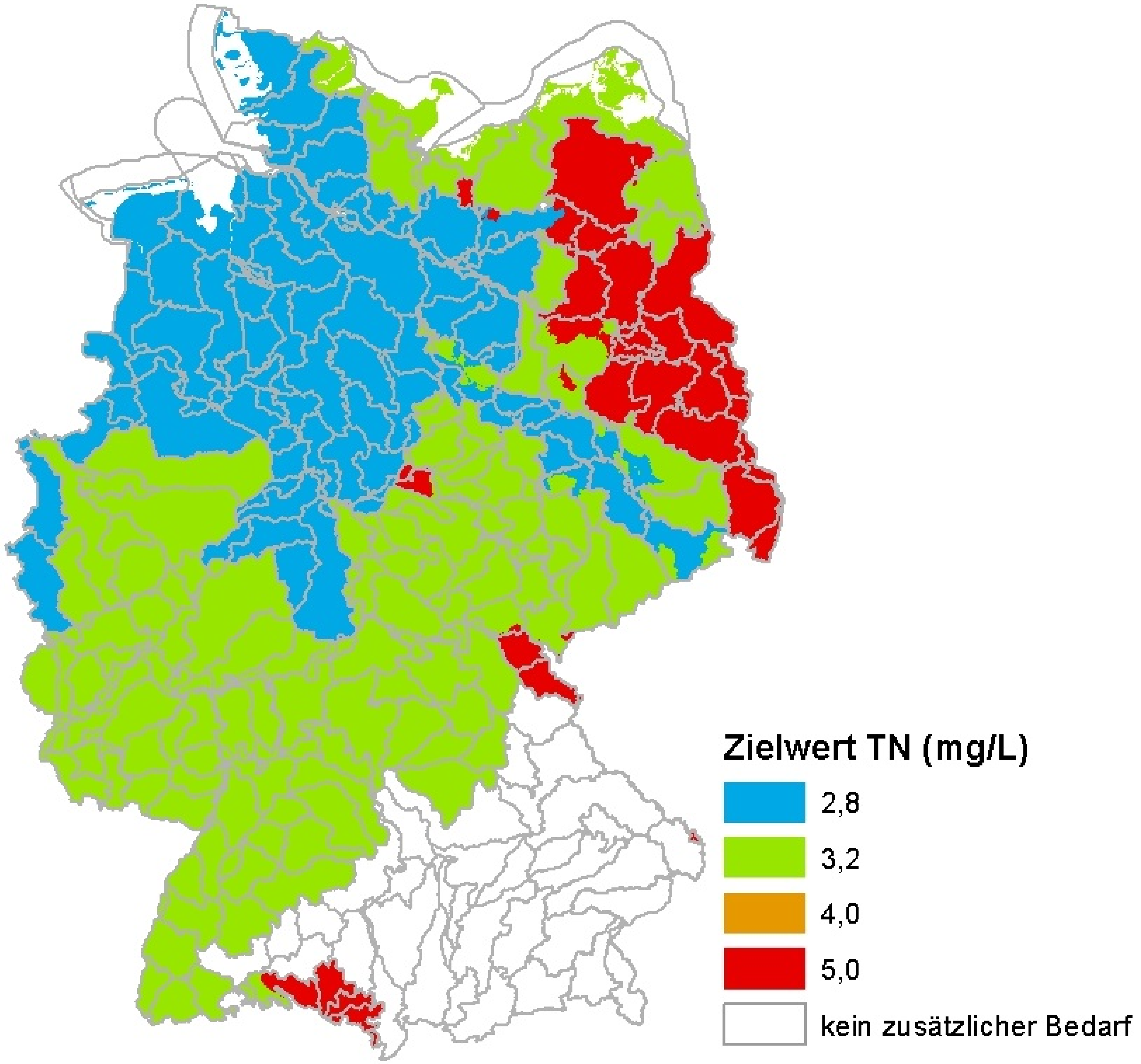
Step 3 – Transferring the nitrogen target concentration inland

- Model MONERIS was used
- Nutrient retention was considered
- Calculation of regionally differentiated nitrogen target concentrations



Cumulative nitrogen retention under average hydrological conditions in %

Average annual TN concentrations required to achieve good status in the German Baltic and North Sea



References

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Thank you for your attention