DE/NL

Memo – Intercalibration NEA 3/4 – chlorophyll a

Intercalibration of phytoplankton NEA 3/4 - class boundaries for chlorophyll-a

The main objective of the intercalibration procedure is to set harmonised ecological quality criteria to meet the protection and restoration targets for all surface waters throughout the European Union. Therefore one aim is to get comparable results of different Member States and a harmonised classification based on Ecological Quality Ratios.

European policy has consistently identified eutrophication as a priority issue for water management. The concentration of chlorophyll-a is accepted as a usefull proxy to indicate eutrophication trends and is therefore a focus of interest in meeting the requirements of the water framework directive. This statement may announce the importance of the intercalibration of the metric 'chlorophyll-a' in the water body type NEA 3/4, which is not intercalibrated by NL and DE until now.

Since 2006, a discussion exists between Germany and the Netherlands about the standards for chlorophyll-a in coastal waters of the type NEA 3/4. This paper describes the process and the results of the harmonisation process between Germany and the Netherlands as well as the agreement for intercalibration of water body type NEA 3/4 at the coastline within the geographic area from the Rhine Delta to the Eider.

The intercalibration status

The German and Dutch coastal waters are of the intercalibration types NEA1/26b, NEA1/26c and NEA 3/4. The Netherlands shares NEA 1/26b with Belgium, France and the United Kingdom, and NEA 3/4 with Germany. Germany shares NEA 1/26c with Denmark, and NEA 3/4 with the Netherlands. The NEA 3 water body 'Ems-Kust' is shared by both NL and DE. The discussion was about the values for the biological quality element phytoplankton expressed as "chlorophyll-a" in NEA 3/4. By the end of the Intercalibration Phase 1 the Commission did not accept the wide difference in boundary values at the NEA 3 water body (Ems-Kust) at the Ems Estuary which is shared by the two nations. The intercalibration of phytoplankton parameter chlorophyll-a in NEA 3/4 has to be finished in Intercalibration Phase 2.

At the moment, Germany uses the value for chlorophyll-a at 11 µg/l for the boundary Good/Moderate in NEA 3/4, whereas the Netherland puts this value at 21 µg/l (concentrations are 90 %ile values). Three water bodies are classified as type NEA 3/4 on the Dutch side, in the Wadden Sea area and on the western coastline Noordelijke Delta Kust and Hollandse Kust. The German NEA 3/4 consists of several water bodies in the mouths of the Ems, the Weser, the Elbe and the Eider. At least 14 NEA 3/4 water bodies lie in the mouth of international river basin districts from the Rhine to the Eider.

Reference setting

The difference of a factor two between the Dutch and German values originates mainly in the difference of the reference values.

For the German coastal water body type NEA 3/4 the reference value for chlorophyll-a was set to 4.8 µg/l. This value was calculated on the basis of modelling of pristine (without any human influences) nitrogen concentrations related to salinity gradients combined with the recent correlation between total nitrogen and chlorophyll-a in combination with expert judgement (Brockmann & Topcu 2010, Brockmann et al. 2007).

For the Dutch coastal water body type NEA 3/4 the reference value for chlorophyll-a was set to 9.3 µg/l (Molen & Pot, 2007). This value was deduced from the AMOEBA model (Baptist & Jagtman, 1997) and was based on hydrological models and biological growth models to convert nutrient concentrations, nutrients loads towards chlorophyll-a (Glas et al., 1989; De Vries et al., 1990). The nutrients loads to the Dutch coastal waters were based on nutrient concentration of 0.15 mgN/l in River Rhine in the 1930s, thus before industrial farming was developed. Those values are very close to reported values by Veldstra & Zuurdeeg (1989) who have reported reference values of 0,14 mgN/l with a range of 0,07-0,20 mgN/l for River Rhine, assuming 30mg/l suspended solids and 10% organic matter.

On the basis of the reference value, a simple multiplication (according to the presetting of boundary setting procedure due to IC Technical Report 2008) leads to the boundary values of High/Good and Good/Moderate.

It should be stated that both methods of reference setting are in line with the WFD, and also in line with practices in other EU member states. The method used in the Netherlands is comparable to those in France, Belgium and the United Kingdom, leading to comparable values for reference values. At the same time, the methods used in Germany and Denmark, lead to comparable reference values of DE and DK.

All methods in use have been applied for deriving the reference values and class boundaries of the subtypes 1/26b and 1/26c which already have been intercalibrated in Phase 1 of Intercalibration.

Intercalibration Phase 2

From the Dutch to the Schleswig-Holstein coast a natural gradient can be recognized due to the input and influence of fresh water from rivers. The NEA 3 water bodies on the Dutch western coast are highly influenced from riverine input from river Rhine, which comprises a very large international catchment. This so-called ‘coast river’ enters the moderately exposed Wadden Sea (NEA 4). There is thus a gradient of salinity, caused by different freshwater influence, resulting in higher levels of nutrients and consequently higher levels of chlorophyll-a.

From the Ems in eastern direction the relative influence of riverine input diminishes due to the smaller catchment of the discharging rivers with less pronounced nutrient input. This allows lower reference and class boundaries compared to the western NEA 3/4 water bodies.

In the Netherlands the nutrient input at the coast is mainly derived from riverine input from the river Rhine. During the last decades nutrient levels in the North Sea have decreased clearly in general. In geographical context nutrient values show a clear pattern and diminish from west to east along the Wadden coast. This declining pattern is mainly due to the dilution process following the water flow patterns in the North Sea and along the coast (figure 1).

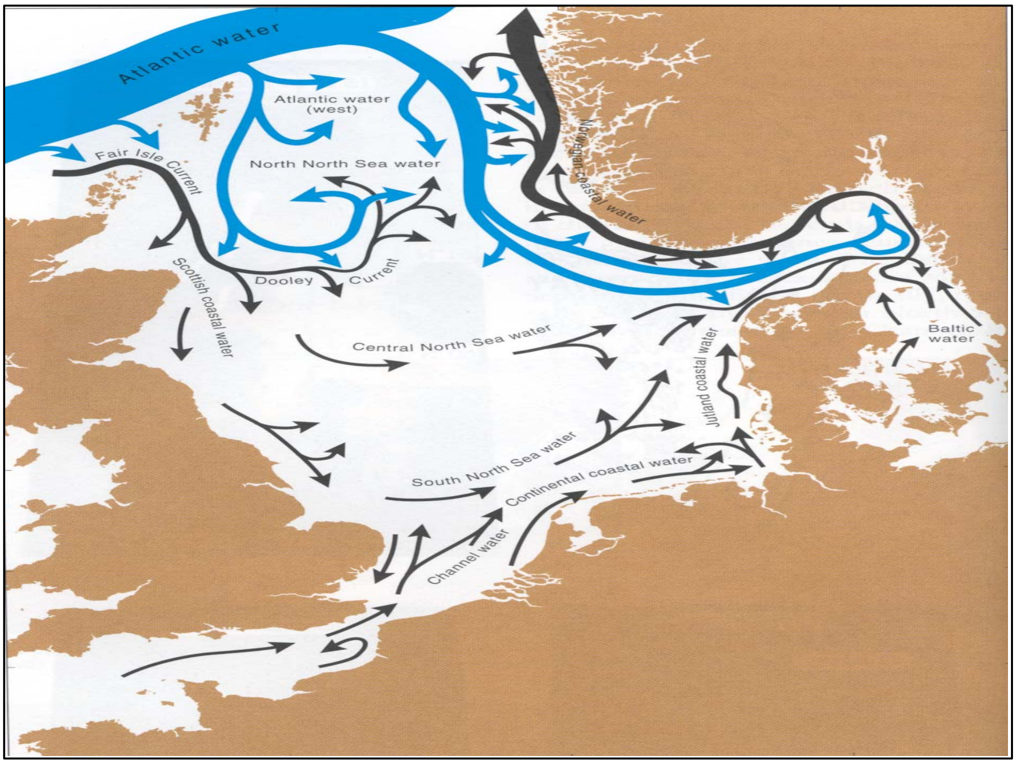

Fig. 1: Water flow patters at the North Sea.

While nutrient levels decrease in eastern direction, salinity levels increase. The influence of the river Rhine is enormous compared to that of the river Elbe (Fig. 2). To that effect the influence of the river Rhine is still traceable at the Isle of Norderney with declining effects eastward. Dutch 2D hydrodynamical model study shows that the Dutch nutrient input, mainly Rhine and its tributes, in the Northern Dutch waters constitutes 60-90% of total nutrient over the last decades. For Ems coastal waters, including its estuary, this is estimated at 20-60% (Blauw et al. 2006).

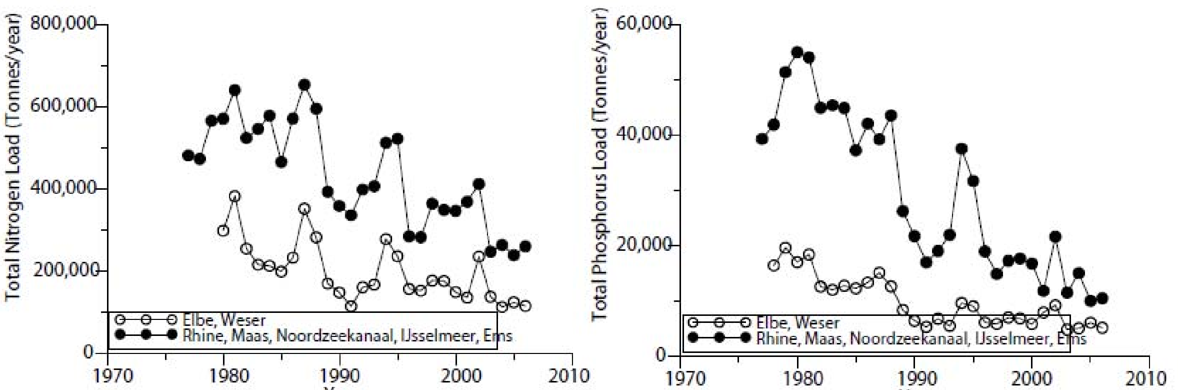

Fig. 2: Major riverine TP and TN loads to the Southern Wadden Sea (Rhine, Meuse, Noordzeekanaal, Ijsselmeer and Ems) and to the Central and Northern Wadden Sea (Weser, Elbe). – QSR CWSS 2009, Thematic Report No. 6

It is important to realize that background concentration of nutrients in rivers are not measured and, thus, are estimations. The relative low N background concentration for River Rhine as compared e.g. to Elbe (20 µm vs. 39 µM N) (Behrendt et al., 2003) may suggest that the impact of river Rhine is not so big in natural conditions for the Waddensea. The models used by Behrendt et al. 2003, however, show that River Rhine background emission is almost threefold higher than that of Elbe or Weser.

Van Beusekom et al. (2005) show a historical difference of chlorophyll concentrations between the Southern and the Northern Wadden Sea (Fig. 3).

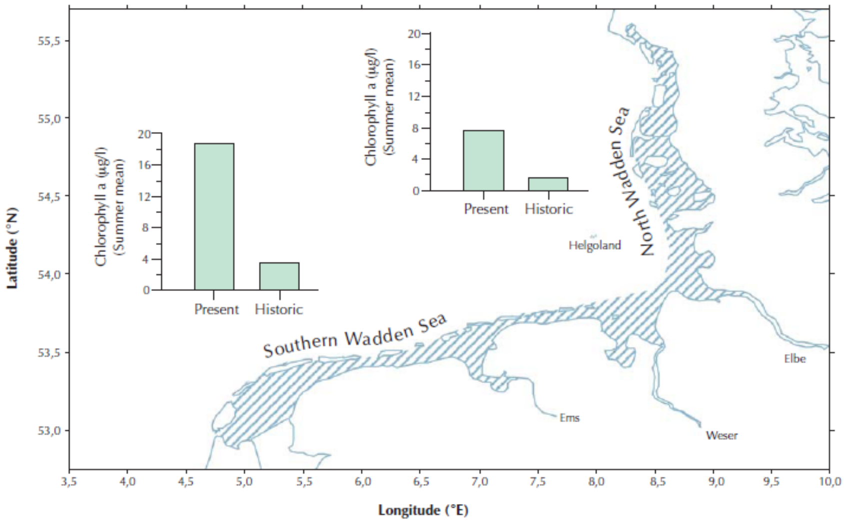

Fig. 3: Mean summer-biomass phytoplankton (Chlorophyll a) in the Wadden Sea (~1985–2002) in comparison with historic estimations (van Beusekom et al. 2005)

The current concentration of the Rhine Delta is about 35 µg/l 90%ile (2005-2008) and the current concentration of Norderney is about 16 µg/l 90%ile (2007-2009).

Concerning the influence of the Rhine plume towards the German coast van Beusekom (2008) show the result of a tracer model. It illustrates that the influence of the Rhine is observable approximately beyond the mouth of the Ems. The influence of the Rhine decreases eastwards. Even the open North Sea is on a big scale influenced by the Rhine plume (Fig. 4). The Ems-Dollard thresholds mark a transition area with a boundary setting basing on bilateral agreement.

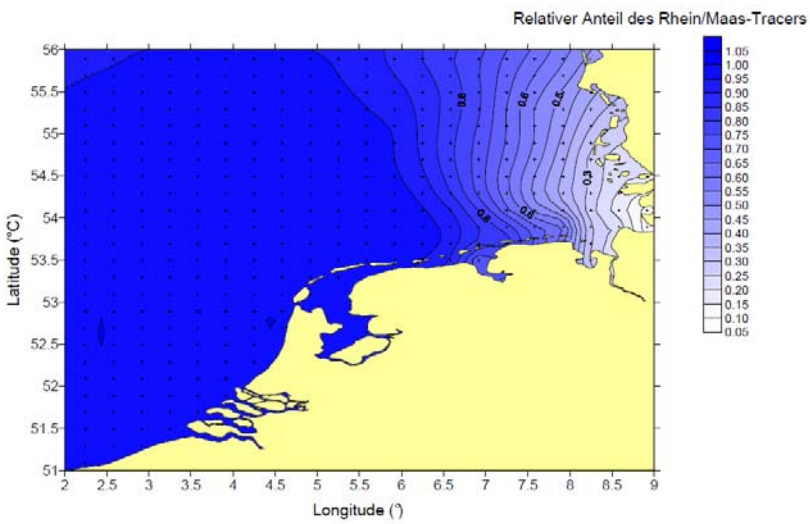

Fig. 4: Relative discharge of Rhine-/Maas-Estuary to total discharge (van Beusekom 2008)

Concerning the intercalibration process there exist the acceptance between NL and DE to sustain one water body type NEA 3/4 from the Rhine Delta to the Eider with a gradient of references and class boundaries and to add adjusted values in Ems Dollard as connecting link between the eastern and western part of the intercalibration area. The influence of the River Ems on its coastal area is because of its small run off restricted.

Concerning the range of references and class boundaries for chlorophyll-a the Ems estuary NEA 3 marks a transition region between the easterly and westerly coastal waters. In agreement between NL and DE a fitted reference value for chlorophyll-a is set in this water body. The chlorophyll-a class boundaries for the NEA 3 Ems-Dollard water body are harmonized to 10 µg/l for the boundary Very Good/Good and 15 µg/l for the boundary Good/Moderate (parameter values are expressed in µg/l as the 90 % percentile value calculated over the defined growing season in a six years period). This procedure implies in NEA 3 Ems Kust a reduction of threshold values from Dutch side and an increase on German side. The further national thresholds remain unchanged in the other water bodies NEA 3/4 (Fig. 5).

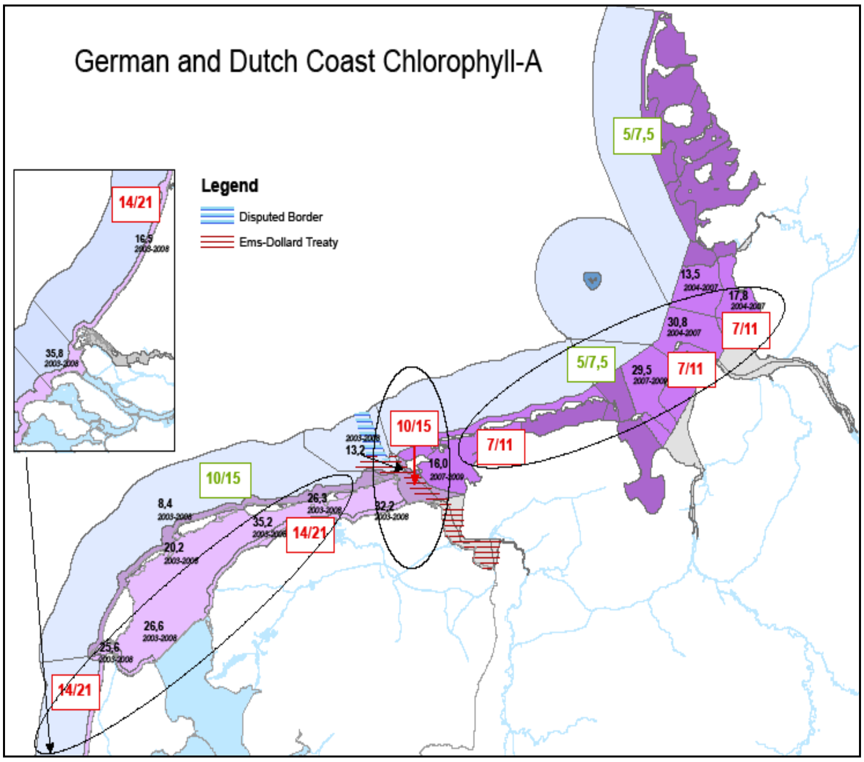

Fig. 5: Intercalibration geographic area NEA 3/4 NL and DE with class boundaries 'Very Good/Good' and 'Good/Moderate' representing a gradient due to hydrological circumstances (please double click figure for pdf file)

Therefore it is stated to have reference values in a range of 4.8 to 9.3 µg/l chlorophyll-a and the deduction of class boundaries Very Good/Good from 7 to 14 µg/l chlorophyll-a and Good/Moderate from 11 to 21 µg/l chlorophyll-a (all concentrations are 90 %ile values) (Fig. 6).

This kind of intercalibration process representing geographic areas within one water body type has also been applied by other European countries and other water body types and is in accordance with the EU practice.

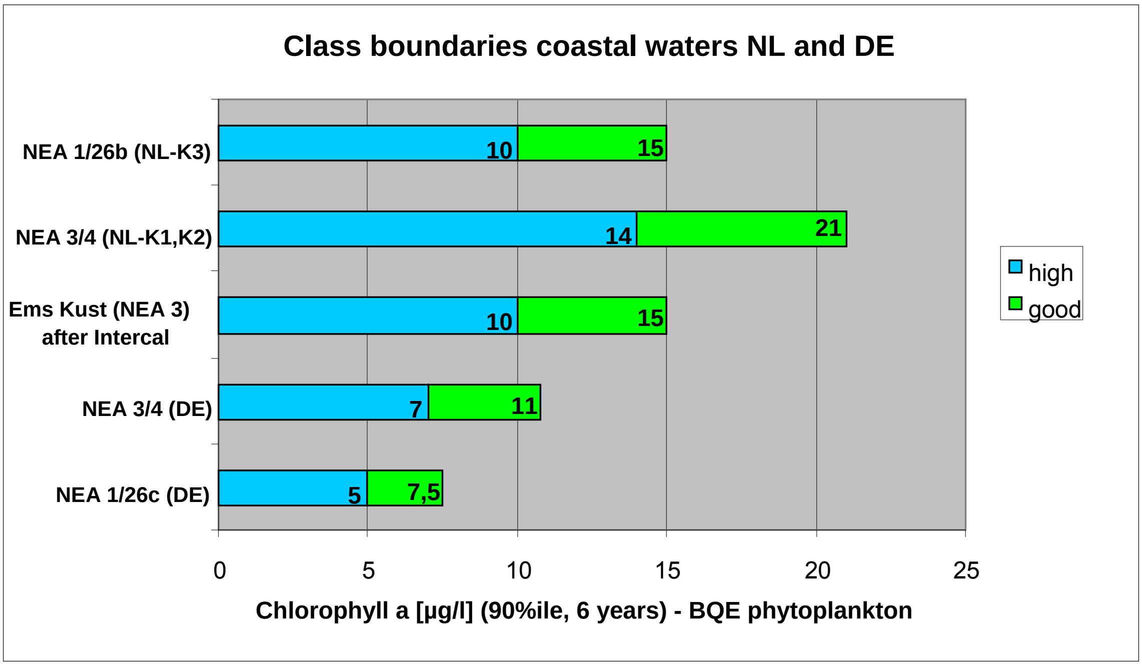

Fig. 6: Range of class-boundaries for chlorophyll-a in coastal waters NL and DE - NEA 3/4 and NEA 1/26

Scientists and policy makers of both Germany and The Netherlands have considered a number of possible ways and decided in agreement this approach as a result of intercalibration Phase 2. The two Member States agree on the continuance of one coastal water body type NEA 3/4 located in separate areas along the coast line from the Rhine Delta to the Eider. Further there exist an agreement on the harmonization of class boundaries for chlorophyll-a in the water body NEA 3 Ems Kust.

Conclusion

After consideration of the variation of reference conditions and salinity gradients at the NEA 3/4 at NL DE coast, as best approach was agreed to present a range for class boundary values for intercalibration. The States of The Netherlands and Germany agree upon the intercalibration of the quality element ‘Phytoplankton’ metric ‘Chlorophyll-a’ within the water body type NEA 3/4 with the class boundaries for ‘Very Good/Good’ in the range of 7 - 14 µg/l and for ‘Good/Moderate’ in the range of 11 - 21 µg/l (90 % percentile). The geographical distribution of the precise class boundaries is shown in Fig. 3.The range is mandatory due to a gradient of hydrological circumstances within the intercalibration area. The two Member States regard this way of agreement to be in compliance with the intercalibration requirements according to key principle 9. For the assessment method cannot be intercalibrated by one of the other options provided in the IC guidance the two member states The Netherland and Germany agreed to use this alternate intercalibration approach.

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Annex

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