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Versatility of marine geological databases *in view of MSFD related assessments*

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Introduction

Mapping seabed substrates is under continuous development, both from a methodological as database perspective. Throughout the years, procedures have changed, e.g., related to navigation, sampling and analyses, as well as to classification and interpretation. But how do we deal with such differences through time? And how do we handle the associated uncertainties? Dealing with **harmonisation and standardisation** has become a critical component of any seabed mapping initiative. Hence, marine geological databases should be versatile in many ways…

Versatility of (meta)data, data uncertainty and data products

Within the framework of marine resource management, a common geological knowledge base is being developed on the distribution, composition and dynamics of various geological resources. Sediment and lithological data from the entire Belgian part of the North Sea are compiled and joined with marine geological data from the adjacent Dutch part. Thereby **two main databases**, one with lithological descriptions and numerical values and one with grain-size distributions, are being compiled.

Table 1. Uncertainties associated with sediment data and data products (van Heteren and Van Lancker; 2015).

Step	Causes of Uncertainty	Actions Needed for Harmonization
Remote sensing	Survey design, method of acquisition (incl. calibration) and data processing, vintage, timing	Filtering data on the basis of methods and vintage
X Sampling	Survey design, method of acquisition (incl. calibration) and data processing, vintage, timing	Filtering data on the basis of methods and vintage
Subsampling	Representativeness	Adherence to minimum sample sizes for sediments of different grain size
X Description	Subjectivity, gross simplification	Description of standard parameters
X Analysis	Pre-treatment, systematic error due to particle properties and imperfect conversion models, simplification	Intercalibration of granulometry methods and protocols, inclusion of methods and protocols in metadata
X Classification	Simplification, inconsistency of standards, definition of class breaks, poor metadata	Development of mapping protocols for translating between standards, inclusion of standards in metadata
Interpolation	Spatial heterogeneity, temporal variability, poor system knowledge, validity of statistics, imperfect relation with external-drift variable	Use of standard methods, calculation of uncertainty
Interpretation	Subjectivity, poorly known surrogacy, poor system knowledge	Multidisciplinary and transnational collaboration and knowledge exchange

Quantification
Harmonisation
Quantification
Harmonisation

Since we are dealing with data over a wide time span (1900-2016), there is increasing need for **harmonisation and standardisation**. We anticipate through:

- Coding lithological data towards the most common classification systems: Wentworth and Folk.
- Parameterising in high detail grain-size distribution data (1/4 phi Krumbein scale).
- Describing metadata according to INSPIRE-compliant international standards and use these to quantify data uncertainties (Table 1).

Flexible and tailor-made data products are being produced, comprising seabed substrate maps (Figure 2) (EMODnet-Geology, EU DG Mare), as well as 3D geological voxel models (TILES, Belspo Brain-be). Within these products, conflicts on data uncertainty and harmonisation issues are unavoidable and need solving.

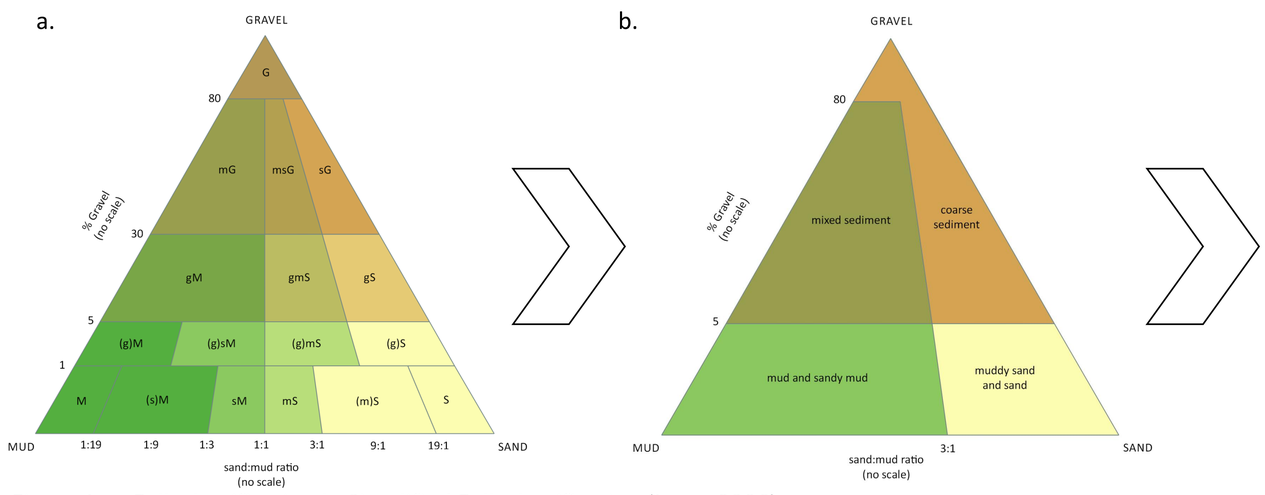
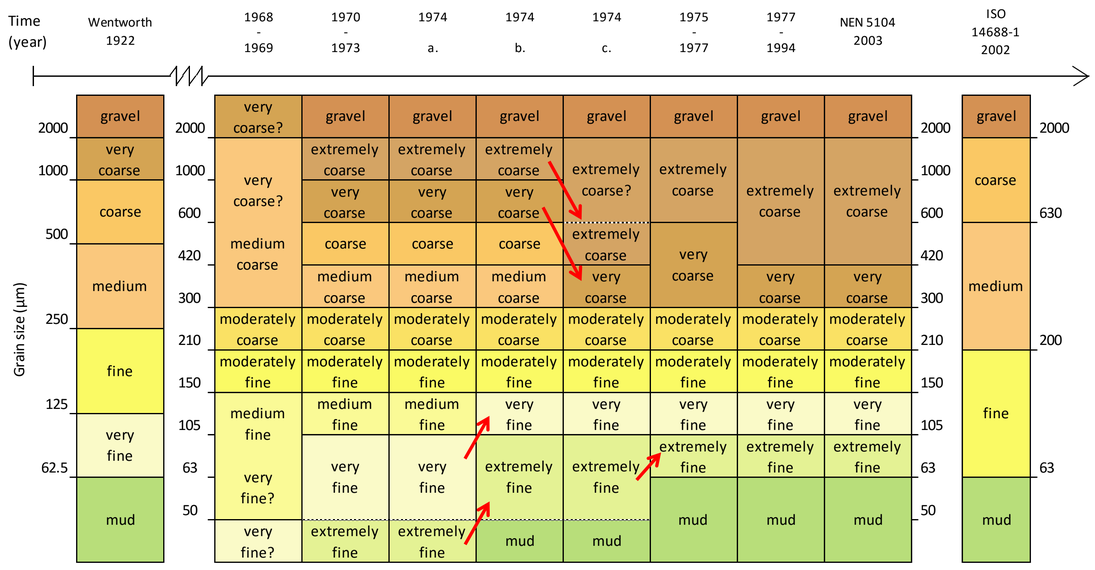


Figure 1. a. Folk classification b. Simplified Folk classification (Long, 2006).

All data are classified to **Wentworth**, based on the lithological descriptions. Conversion to grain-sizes is handled with care, since lithological terms and their respective grain-size ranges changed with time (Table 2).

Table 2. Different grain-size classifications (Wentworth, NEN 5104 and derivatives, ISO 14688-1) through time, as applied in Belgium and in the Netherlands. All were reclassified to Wentworth, being mostly used in Europe (after Van der Meulen et al., 2003; van Heteren and Van Lancker; 2015).



Grain-size data were also converted to the **Folk** classification (Figure 1a), using the secondary constituents (ISO 14688-1) in lithological descriptions, and based on percentages of sand, silt and gravel, as estimated from the descriptions and as derived from grain-size distributions. Differences in the way these are obtained, are quantified in an **uncertainty parameter**.

All of these processes are critical when attempting studying habitat changes through time, being a key element within Europe's Marine Strategy Framework Directive (MSFD).

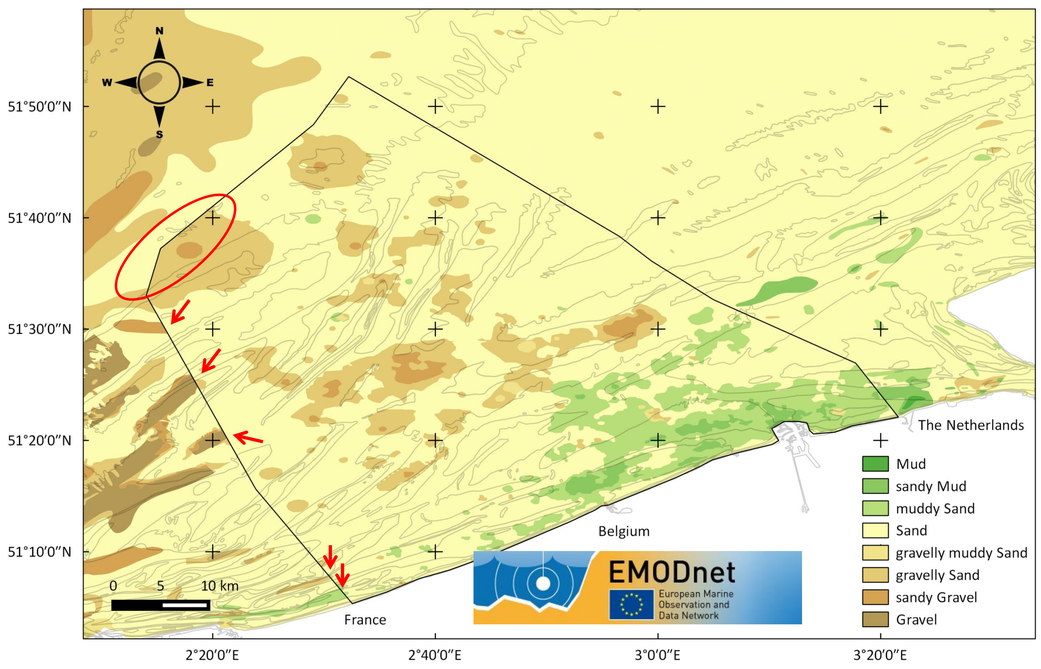


Figure 2. Recent seabed substrate map for the southern part of the North Sea representing the (simplified) Folk classification (red arrows indicate harmonisation issues). However, the database allows mapping of any desired parameter or class, depending on user requirements.

Conclusion

- Versatile marine geological databases are key to cope with increasing needs of stakeholders and to allow for adequate seabed or habitat assessments (MSFD).
- They incorporate data at the highest possible resolution and coding is done via standardised procedures. This allows solving cross-border harmonization issues.
- Metadata are critical to assess uncertainty in the data and interpretation process. Uncertainty should be propagated in the derivative data products (Future work).

References

Long, D. (2006). MESH Guide to Marine Habitat Mapping; Van der Meulen, M.J. et al. (2003). Publicatiereeks Grondstoffen, 2003/16; van Heteren, S. & Van Lancker, V. (2015). In: Diviacco, P., Fox, P., Pshenichny, C. & Leadbetter, A. (eds.). IGI Global.

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