1688 - Transnational Belgian-Dutch geological knowledge base on marine aggregates. From 3D voxel modelling to 4D cross-border environmental assessments

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Mineral and geological resources are non-renewable on time scales relevant for decision makers. Once exhausted by humans, they are not replenished rapidly enough by nature, meaning that truly sustainable resource exploitation is not possible. Comprehensive knowledge on the distribution, composition and dynamics of geological resources and on the environmental impact of extraction is therefore critical. Anticipating on this, a geological knowledge base has been developed as a platform for resource management (Belspo Brain-be TILES, 2014-2018).

Backbone of the knowledge base is a 3D voxel model (volume pixels) of the surface and subsurface of the Belgian and southern part of the North Sea. Standardized and harmonized databases have been created and a methodological workflow for the 3D modelling of offshore aggregates published. Data were added to the highest detail as to maximize their classification to any application (e.g., aggregate industry). Metadata were carefully added to estimate data-related uncertainty.

The 3D geological models were further coupled to 4D numerical environmental impact models as to quantify environmental impact under various scenarios of exploitation. Furthermore, the voxels were filled with decadal sediment transport calculations allowing assessing seabed recovery estimations after extraction, an important asset in many environment-related European Directives.

Data, models, and their uncertainties, are embedded in an end-user driven decision support system (DSS) that uniquely allows querying the full 3D resource volume, and integrating it with any third-party data. Visualization is an inherent part of the DSS, but to maximize impact towards a broader user community, a virtual reality application has been built too.

From a management perspective, the DSS allows long-term resource predictions, balancing aggregate quality and quantity against various applications, and whilst minimizing environmental impact. Finally, a vision will be presented on how incorporating the geological knowledge base into a future national seabed mapping programme.