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Decision support systems (DSS) for offshore windfarm siting

For the evaluation of coastal and offshore geological resources in the Belgian part of the North Sea, RBINS-GSB uses a DSS that builds upon a subsurface voxel model (200mx200mx1m of the upper 65m below seabed; Hademenos et al., 2019) comprising lithology, lithostratigraphy and sediment composition (TILES DSS, Van Lancker et al., 2019). The TILES DSS incorporates multiple IT components to support data integration from multiple databases and other data sources and comprises both a DST and a visualisation tool (De Tré et al., 2018). These tools are essential for understanding geological risks and informing marine spatial planning (MSP). The system also includes methods for evaluating uncertainty in geological data by providing confidence scores to help users assess the reliability of the information, as described by Kint et al. (2021).

Geographic Multi-Criteria Decision Making (MCDM) tools were employed to query the voxel models. The tools created suitability models that help decision-makers evaluate different scenarios. The MCDM approach involves an Extract, Transform, and Load (ETL) process to integrate data from multiple sources, ensuring that the system provides accurate and up-to-date information (De Tré et al., 2018). Kint et al. (2021) highlighted the importance of standardising lithological data to improve the quality and reliability of the outputs.

The output of the DSS are 3D suitability models that aggregate suitability degrees of individual geological parameters, such as lithology, bathymetry, and sediment composition.

The DSS and DST applications are evaluated based on several criteria, including ease of use, accuracy, and adaptability. Additionally, RBINS-GSB has explored the use of Bayesian Networks to incorporate probabilistic reasoning into offshore windfarm siting, as discussed by De Mol et al. (2019).

Input parameters mentioned in the figure may comprise multiple sub-parameters. For more information on the input parameters see Larsen et al. (2025; Table 3, p 27).

Further reading

De Mol, R., De Tré, G., Pelta, D. A., Cabrera, I. P., Verdegay, J. L., Yager, R. R., Ojeda-Aciego, M., Medina, J., Bouchon-Meunier, B., Cabrera, I. P., Yager, R. R., & Pelta, D. A. (2018). Applying suitability distributions in a geological context. In *Information Processing and Management of Uncertainty in Knowledge-Based Systems. Theory and Foundations* (Vol. 853, pp. 278–288). Springer International Publishing AG. https://doi.org/10.1007/978-3-319-91473-2_24

De Tré, G., De Mol, R., van Heteren, S., Stafleu, J., Chademenos, V., Missiaen, T., Kint, L., Terseleer, N., Van Lancker, V., Carrara, P., & Bordogna, G. (2018). Data quality assessment in volunteered geographic decision support. In *Mobile Information Systems: Leveraging Volunteered Geographic Information for Earth Observation* (Vol. 4, pp. 173–192). Springer International Publishing AG. https://doi.org/10.1007/978-3-319-70878-2_9

Hademenos, V., Stafleu, J., Missiaen, T., Kint, L., & Van Lancker, V. R. M. (2019). 3D subsurface characterisation of the Belgian Continental Shelf: A new voxel modelling approach. *Netherlands Journal of Geosciences*, 98. <https://doi.org/10.1017/njg.2018.18>

Kint, L., Hademenos, V., De Mol, R., Stafleu, J., van Heteren, S., & Van Lancker, V. (2021). Uncertainty assessment applied to marine subsurface datasets. *Quarterly Journal of Engineering Geology and Hydrogeology*, 54(1), 1–. <https://doi.org/10.1144/qjgegh2020-028>

Larsen, I. R., Ernsten, V. B., Maspatud, A., Dakin, N., van Heteren, S., Koutroulli, A., Poyiadji, E. & the GSEU T5.4 Consortium (2025). EGDI multifunctional 2D/3D decision-support module v1. GSEU Report on Deliverable 5.7, 165 pp.

Van Lancker V, Francken F, Kapel M, Kint L, Terseleer N, Van den Eynde D, Hademenos V, Missiaen T, De Mol R, De Tré G, Appleton R, van Heteren S, van Maanen PP, Stafleu J, Stam J, Degrendele K, Roche M. (2018). Transnational and Integrated Long-term Marine Exploitation Strategies (TILES). Final Report. Brussels: Belgian Science Policy 2018 – 82 p. (BRAIN-be - Belgian Research Action through Interdisciplinary Networks). http://www.belspo.be/belspo/brain-be/projects/FinalReports/TILES_FinRep_AD.pdf

