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Geometrical model of the Baltic artesian basin

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Baltic artesian basin (BAB) is a multi-layer sedimentary basin spanning around 480'000 km2. BAB is located in the territory of Latvia, Lithuania and Estonia, parts of Poland, Russia, Belarus and large area of the Baltic Sea, including island of Gotland. The thickness of sedimentary cover is about 5000 m in the south-western part. Crystalline bedding reaches the surface in the northern and north-western parts. The aim of the present work is development of the model of geometric structure and three dimensional finite element mesh for the hydrogeological model of the whole BAB.

The information that is used to build the geometrical structure includes:

(1) Stratigraphic information from boreholes in Latvia and Estonia
(2) Maps of height isolines of geological layers for Latvia and Lithuania
(3) Maps of sub-quaternary deposits in Latvia and Lithuania
(4) Maps of fault lines on the crystalline basement surface in Latvia, Lithuania and Estonia
(5) Buried valley data from Latvia and Estonia
(6) Earth topography data
(7) Baltic sea depth data
(8) Data from published geological cross-sections, information from books and other sources.

Unification of the heterogeneous information from different sources, which are employed for building of the geometrical structure of the model are performed. Special algorithms are developed for this purpose considering the priority, importance and plausibility of each of the data sources. Pre-processing of the borehole information to screen out the outlying borehole data has been performed.

Model of geological structure contains 42 layers. It includes aquifers and aquitards from Cambrian up to the Quaternary deposits. Fault displacements are incorporated into the model taking into account data from the published structural maps. Four reconstructed regional erosion surfaces (upper Ordovician, Devonian, Permian and Quaternary) are included into the model

Three dimensional mesh of the geological structure is constructed layer-wise. The triangular mesh in horizontal plane is constructed including characteristic lines such as rivers, borders of countries and areas of presence of geological layers. Mesh consists of triangular prisms, pyramids and tetrahedrons.

The construction of the geometric mesh is implemented by specially developed script in Python. Such approach has several advantages: (1) flexibility in choosing ways to build the structure; (2) parallelization of workload in developing/updating of different structure elements; (3) documentation and maintenance of repeatable structure building path; (4) opportunity to rebuild the structure with slight or significant modifications at any time; (5) possibility to build, and maintain several structures of different complexity simultaneously.

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