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Application of the Integrated Finite Difference Method in groundwater flow

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The massive introduction of computer facilities to hydrogeology has rendered the use of numerical methods for solving partial differential equations applicable to operational problems. The dominant methods used today are the Finite Difference Method (FDM), the Finite Element Method (FEM), the Finite Volume Method (FVM) and the Boundary Element Method (BEM) with FDM and FEM being the most widely used in hydrogeologic modelling. FDM appears to have greater applicability maybe as a result of the simplicity of discretisation grid construction and of solution procedure that it uses. On the other hand, the poor capacity of FDM in representation of complex geometry due to prescript use of rectangular discretisation makes in some cases inevitable the application of FDM or BEM. The FVM is very similar to FDM and has the same advantages and disadvantages. When hydrogeologic simulation is embedded in optimisation, such as in water resource management problems or in parameter estimation (inverse) problems, all these methods are extremely time consuming due to the required many repetitions. In such cases, the so called Integrated Finite Difference Method (IFDM) that appeared earlier in the bibliography and shares the same theory with FVM may be a better candidate. This method can be applied successfully with non rectangular discretisation with a small number of cells. A set of theoretical studies that demonstrates that IFDM can achieve reliable solutions even with a very spare discretisation is presented.