

## **Improvement of performance and applicability of MODFLOW-2005: new NWT solver and $\chi$ MD matrix solver package**

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**Abstract** MODFLOW has been widely used for many years to investigate groundwater flow systems. In most numerical models, including MODFLOW, >80% of memory and execution time is used for the matrix solver; thus, improving matrix solver performance is a key to improve simulation performance. A  $\chi$ MD solver package was developed for higher robustness, faster execution speed, and better memory efficiency. The preconditioning module of  $\chi$ MD consists of level-based incomplete LU (ILU) factorization with a drop tolerance scheme that can reduce memory usage and lead to faster execution speed. The acceleration part consists of the conjugate gradient method, Bi-CGSTAB and ORTHOMIN. The  $\chi$ MD solver package is adapted for MODFLOW-2005 and preliminary results show that level-based ILU factorization with a drop tolerance scheme greatly reduce memory usage compared to ILU-only factorization by a factor of two or more. In addition, execution times decrease by 40% or more.

**Key words** matrix solver; numerical modelling; groundwater