

UnsatFreezeThaw example problem

The UnsatFreezeThaw example problem is a two-dimensional (2D), saturated-unsaturated problem that simulates freezing and thawing of water in a hypothetical laboratory experiment conducted on a column of partially saturated soil. Part A simulates freezing due to a temperature decrease imposed at the top of the column. Part B simulates subsequent thawing of frozen water due to inflow of warmer water at the bottom of the column. The problem setup is described in detail in the SUTRA 4.0.0 documentation:

Voss, C.I., Provost, A.M., McKenzie, J.M. and Kurylyk, B.L., 2024, SUTRA—A code for simulation of saturated-unsaturated, variable-density groundwater flow with solute or energy transport—Documentation of the version 4.0 enhancements—freeze-thaw capability, saturation and relative-permeability relations, spatially varying properties, and enhanced budget and velocity outputs: U.S. Geological Survey Techniques and Methods, book 6, chap. A63, 91 p., <https://doi.org/10.3133/tm6A63>.

Input files

Complete sets of input files for Parts A and B of the example problem are provided.

The input files for Part A are:

- SUTRA.FIL – Contains file assignments for the remaining input and output files.
- UnsatFreezeThawA.inp – Main input (INP) file.
- UnsatFreezeThawA.inp8D – Contains INP dataset 8D (observations) and is referenced in the INP file using the “INSERT” command.
- UnsatFreezeThawA.ics – Initial conditions (ICS) file.

The input files for Part B are:

- SUTRA.FIL – Contains file assignments for the remaining input and output files.
- UnsatFreezeThawB.inp – Main input (INP) file.
- UnsatFreezeThawB.inp8D – Contains INP dataset 8D (observations) and is referenced in the INP file using the “INSERT” command.
- UnsatFreezeThawA.rst – A copy of the restart (RST) file output by Part A of the simulation, which serves as the initial conditions (ICS) file for Part B.

Output files

The output files generated by Part A of this example problem are listed below:

- UnsatFreezeThawA.lst – Main output (LST) file.

- UnsatFreezeThawA.nod – Nodewise results output (NOD) file.
- UnsatFreezeThawA.ele – Elementwise results output (ELE) file.
- UnsatFreezeThawA.rst – Restart output (RST) file.
- UnsatFreezeThawA_Timed_Obs.obc – Observations output (OBC) file.
- UnsatFreezeThawA.smy – Summary output (SMY) file.

The output files generated by Part B have identical filenames except that “B” replaces “A” in each filename in which “A” appears.

Execution

Before running the example problem, you may wish to save the existing output files for later comparison with your new results. To run Part A of the simulation, run the batch file “RUNSUTRA.BAT” (which calls the SUTRA executable in the “SUTRA_4_0/bin” subdirectory) in the folder (subdirectory) that contains the input files for Part A. To run Part B of the simulation, run the batch file “RUNSUTRA.BAT” (which calls the SUTRA executable in the “SUTRA_4_0/bin” subdirectory) in the folder (subdirectory) that contains the input files for Part B.