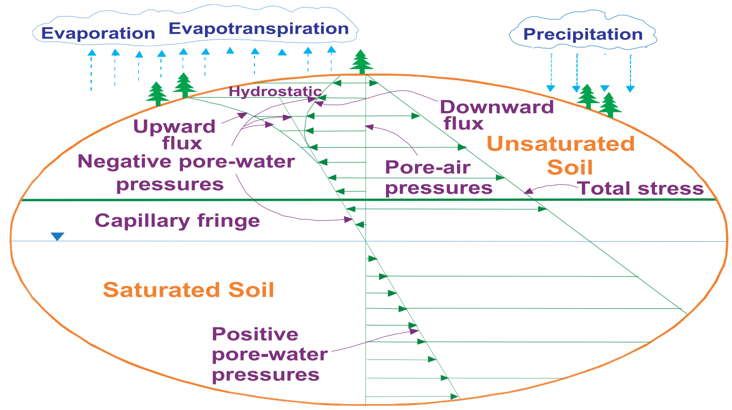
SVFLUX VERSION 5

Evaporation Simulation

SVFlux version 5 implements several significant new features including:



Evaporative Flux Boundaries

Stochastic Analysis

Improved Mass - Balance Calculations

The implementation of evaporative boundary conditions in SVFlux 5 is designed around a new philosophy and provides several advanatges

1) Simple to use
2) Versatile
3) Speed of solution
4) 2D, Plan, Axisymmetric, or 3D analysis

1) SIMPLE TO USE: Most evaporative seepage modeling is not performed due to the complexity of currently available software. Climate data such as temperature data, relative humidity, and net radiation is often collected at varying timestep intervals. SVFlux 5 allows tables of climate data to be pasted in seprately and with individual timesteps. This feature greatly reduces the amount of data reduction needed prior to analysis.

2) VERSATILE: The common problem with evaporative analysis is that there are so many climate parameters that it is difficult to determine the influence of one particular climate parameter. SVFlux 5 allows each climate parameter to be represented as a constant, an equation or a table of data. This means that the user can quickly answer the question "What happens if we make the temperature a constant of 21 degrees Celsius?"

3) SPEED OF SOLUTION: SVFlux 5 also utilizes the following advanced features of the finite element solver to speed solution times

Automatic mesh generation
Fully automatic mesh refinement
Fully automatic time-step refinement
Support for parallel processing

The current formulation of SVFlux does not solve heat transport. This simplification improves solution times as the influence of thermal gradients in the soil mass is often negligible.

4) 2D, PLAN, AXISYMMETRIC, OR 3D: The evaporative boundary condition may be applied to a 2D, Plan, Axisymmetric, or 3D analysis in SVFlux. The dimensional variability passes enhanced flexibility on to the user.

APPLICATIONS

The evaporative formulation implemented in SVFlux uses the Modified Penman equation or a user-defined equation. Analysis performed using the Modified Penman equation is applicable to the caculation of evaporative flux in dry or semi - arid regions where evaporative flux represents a significant influence on the problem. Long term performance of earth covers is one of the common applications.

INPUT REQUIRED

The implementation of the Modified Penman method in SVFlux considers the following general input if an evaporative analysis is performed:

* Temperature data
* Net radiation data
* Windspeed data
* Precipitation data (storm intensity can be specified)
* Relative humidity data

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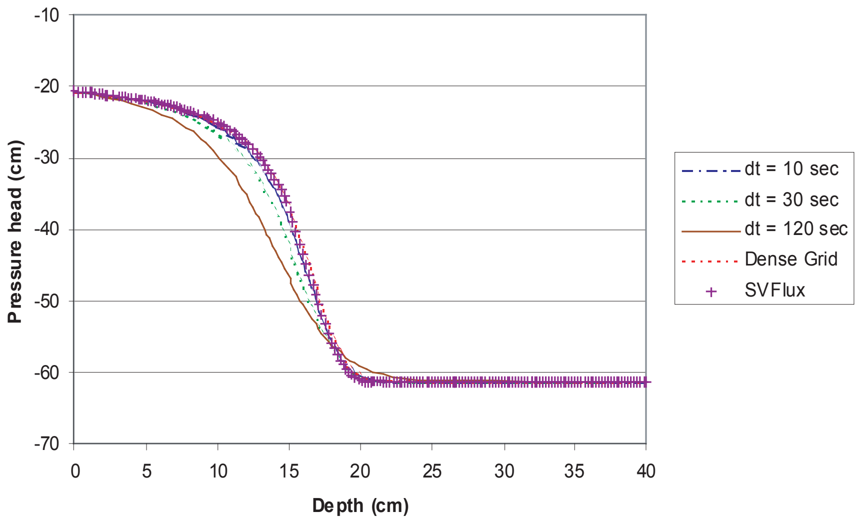
Verification

SoilVision Systems Ltd. is continuously and actively involved in the verification of our software. The verification of the Modified Penman method as implemented in SVFlux 5 is no different. Solutions to benchmarked problems and comparisons to other software packages are ongoing. Benchmarking efforts to date have involved the following efforts.

PROFESSOR WILSON THESIS VERIFICATION PROBLEM
A comparison was performed to the Modified Penman problem as described in the thesis of Dr. Ward Wilson (1990). The problem involved solution of a 1D problem involving data collected from the site.

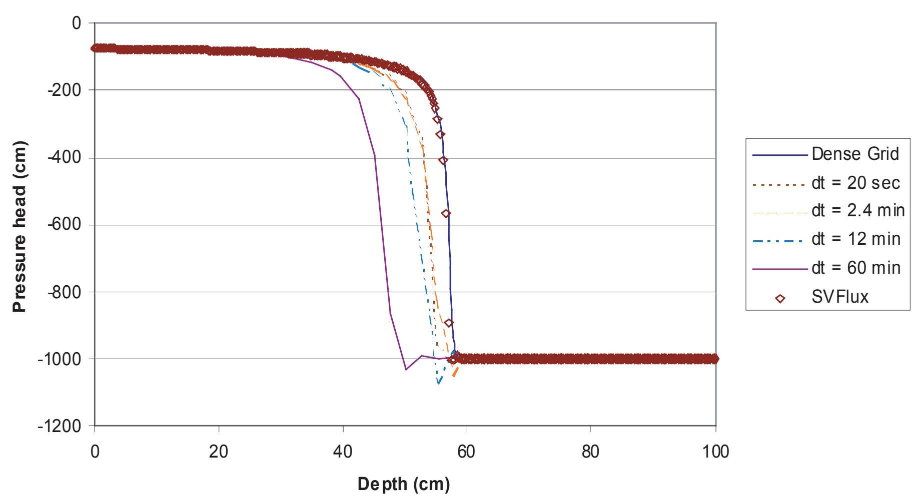
INFILTRATION
Solution of the Modified Penman evaporative boundary condition primarily involves proper solutions of infiltration problems. To verify that the code is providing correct solutions to infiltration problems, SVFlux was compared to the classic infiltration problems presented by Havercamp (1977) and Celia (1990).

The result of these infiltration comparisons may be seen in the following figures. Haverkamp presented a study of the influence of mesh density and timestep resolution on the results. It was found that concern regarding mesh density and timestep resolution are rendered irrelevant in SVFlux due to the automatic mesh refinement and automatic timestep refinement features.



What is the value of automatic mesh refinement?
"Critical cases of water flow such as evaporation near the soil surface and infiltration into initially dry soil profiles typically create local mobile regions with large gradients of water head. Highly nonlinear relationships between hydraulic conductivity and pressure head contribute to very steep wetting fronts during infiltration into initially dry soil. In the vicinity of the wetting front for the initially dry soil, small values of hydraulic conductivity require very large gradients to move even a small amount of water (Pan and Wierenga, 1995). A short distance behind the wetting front, water content increases providing a much higher conductivity and much smaller head gradients. Insufficient local resolution for such cases of water flow can result in numerical oscillation and numerical smearing." (Mansell et al., 2002)

Comparison between SVFlux and Haverkamp (1977) as presented by Celia (1990) in Fig. 1b



Comparison between SVFlux and results presented by Celia (1990)