

An Automated Microlysimeter for Long-term Monitoring of Soil Evaporation

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Introduction

Microlysimeters are typically comprised of 15 to 30 cm long soil cores contained in plastic sleeves for periodic removal and weighing to track soil evaporation. In a previous study, operational life of a 30-cm microlysimeter was found to be 10 days.

Objectives

To develop and test an automated microlysimeter intended to extend the 'operational life' using longer soil columns. This technique facilitates long-term-, in situ- and real time monitoring of diurnal evaporation rates.

Column Design

The automated microlysimeter is comprised of components shown in Fig 1. The inner pipe is an acetate liner, 75 mm in dia. and 60 cm long. The bottom is closed with a 75 mm steel soil drying can lid. The outer protective housing is made of 100 mm dia. sewer pipe, 550 mm long with a 100 x 75 mm PVC reducer on top. A 100 mm sewer drain cover supports a 10 kg load cell sandwiched between aluminum plates. The top plate of the load cell is attached to an 80 mm PVC cap.

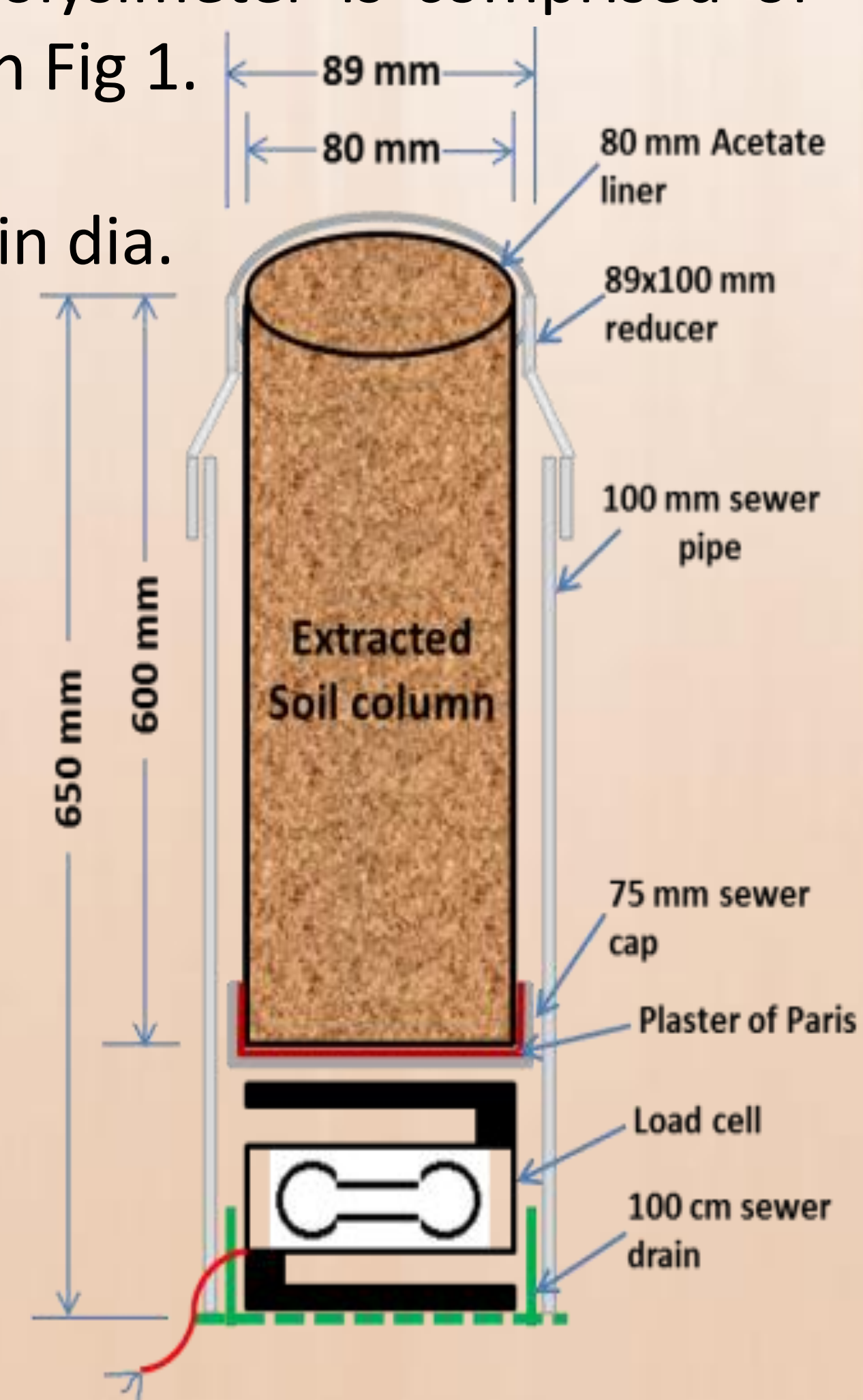


Fig 1: Sketch of the microlysimeter

Installation and Calibration

A hydraulic Giddings probe was used to extract the soil core encased with an acetate liner. A 4" auger was used to increase the hole size. The sewer pipe with base and attached load cell was then inserted into the hole. Plaster of Paris was injected into the 80 mm PVC cap to stabilize the soil column in the center of the 75 mm PVC reducer. The soil column mass was recorded every minute using a CR1000X datalogger. The evaporation rate was then calculated from mass loss of the microlysimeter.



Fig 2: (a) The automated microlysimeter is a 60 mm long soil column housed in an acetate liner and placed on a 10 kg load cell. (b) Field site where microlysimeters were installed.

Microlysimeter Calibration

The microlysimeter load cells were field-calibrated two times – at the beginning and towards the end of the evaporation experiment using standard weights. A requirement for accurate evaporation measurements is that the soil column does not touch the walls of the housing, which was verified periodically.

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Results

- Continuous measurements of soil evaporation were carried out from Sept. to early Oct. (≈ 35 days) in two phases.
- After initial extraction at field capacity water content (phase-1), the soil columns were rewetted by adding the amount of water lost during phase-1; hence, resetting the process.
- Mass loss with time for the microlysimeters (ML-1,2,3) was recorded in two phases as shown in Fig 3.

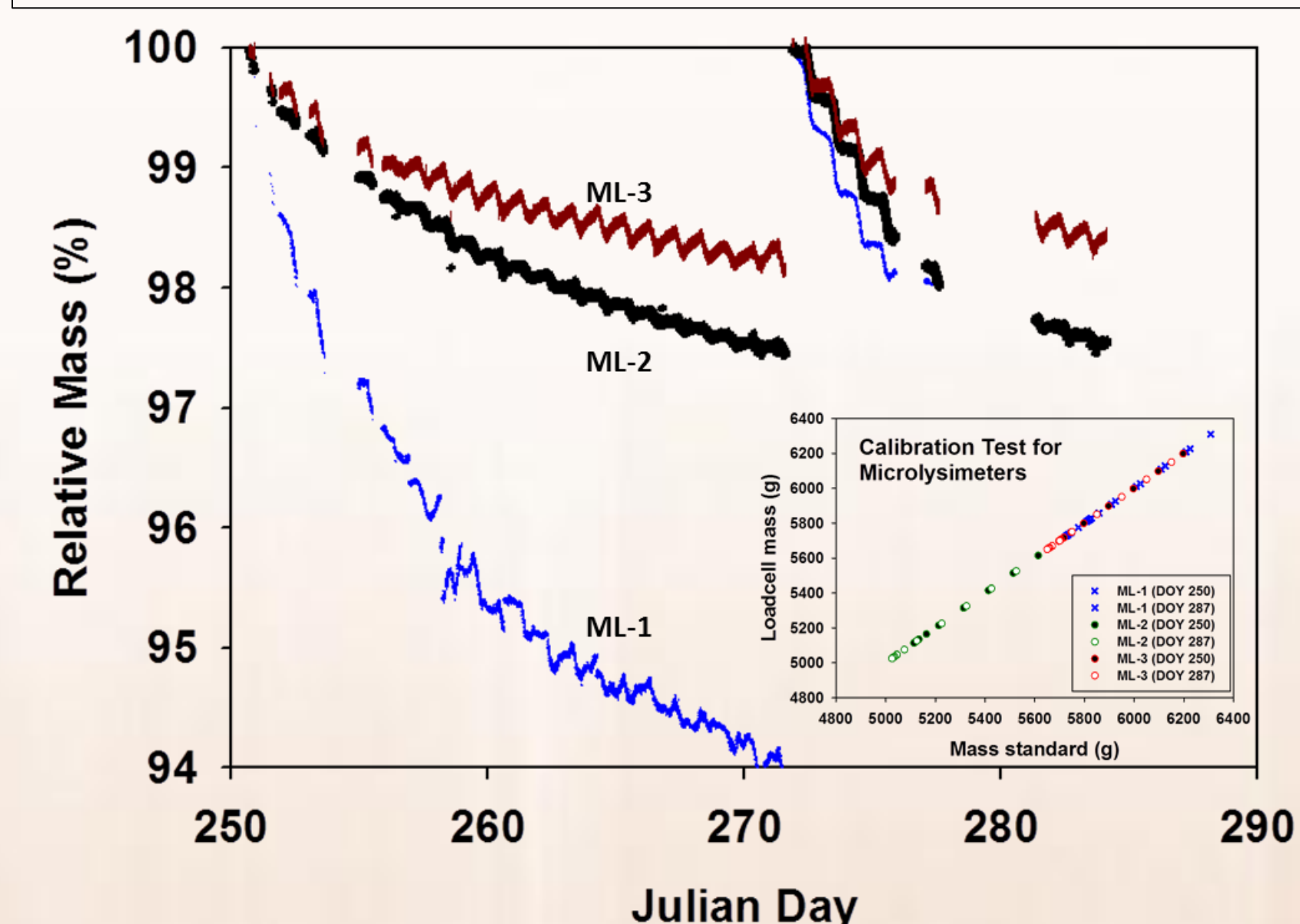


Fig 3: Mass loss from microlysimeters (ML-1,2,3) recorded with time for two phases (before and after resetting the process). Inset figure shows calibration results for ML-1,2 and 3 in the field experiment.

- The linearity of mass calibration (Inset fig 3) was excellent indicating that the columns were free-standing inside the housing and yielding reliable mass measurements.

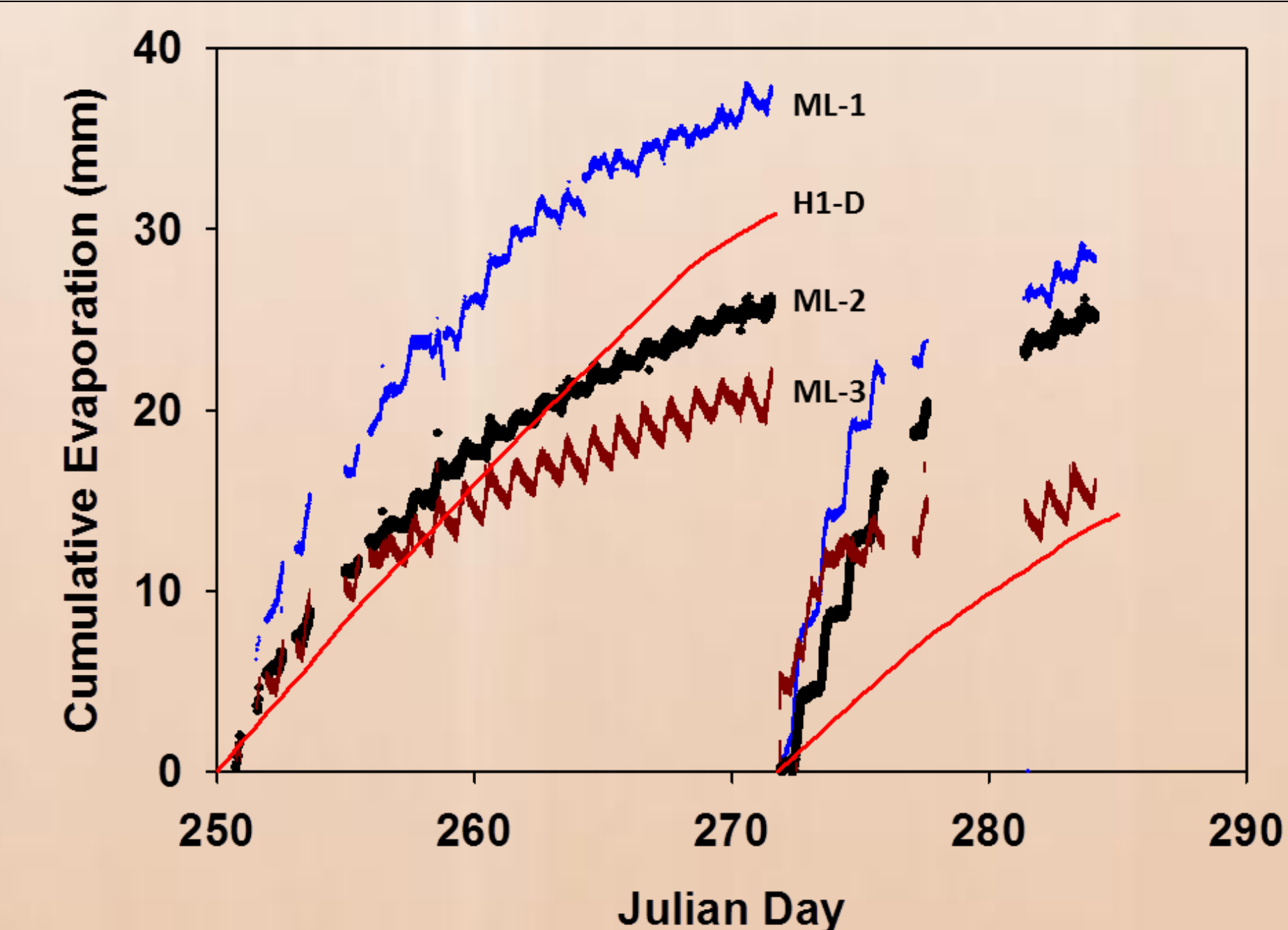


Fig 4: Comparison of cumulative evaporation estimates from Hydrus 1-D (H1-D) model and microlysimeter results. The results are separated into two drying phases.

- The automated microlysimeter shows promise for extending the 'operational life', likely to be a function of forcing conditions and column depth.
- The diurnally oscillating mass is likely condensation and evaporation from the lysimeter wall possibly requiring a vapor barrier at the bottom to minimize condensation.
- Future efforts will look at end-of-life comparisons with surrounding soil and longer columns.