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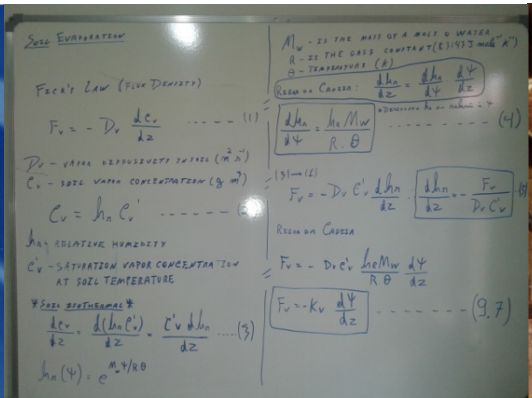
**Article:**

# AN EMPIRIC MODEL FOR PREDICTING SOIL DAILY EVAPORATIONS: SOIL AND ATMOSPHERIC VARIABLES

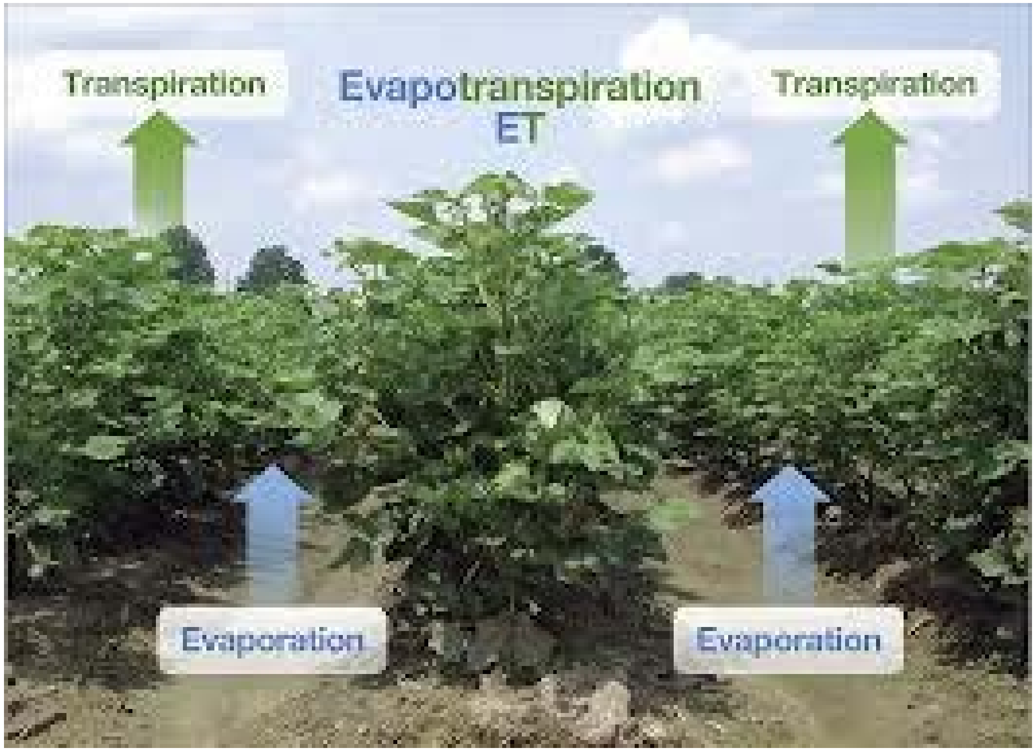
Isaac M. Ponciano, Jarbas H. de Miranda, Marcos A. dos Santos, Quirijn J. Van Lier, Vanessa F. Grah

Professor at University of Rio Verde
PhD candidate at: Agricultural Systems Engineering
ESALQ/USP



# INTRODUCTION

The evaporation of soil water ($E_s$) affects water availability for crop transpiration which is directly related to crop growth and yield.



# INTRODUCTION

Generally, $E_S$ represents 10% of evapotranspiration, being more important under sparse vegetation, especially in dryland ecosystems where it can accounts for 30 to 90% of evapotranspiration.

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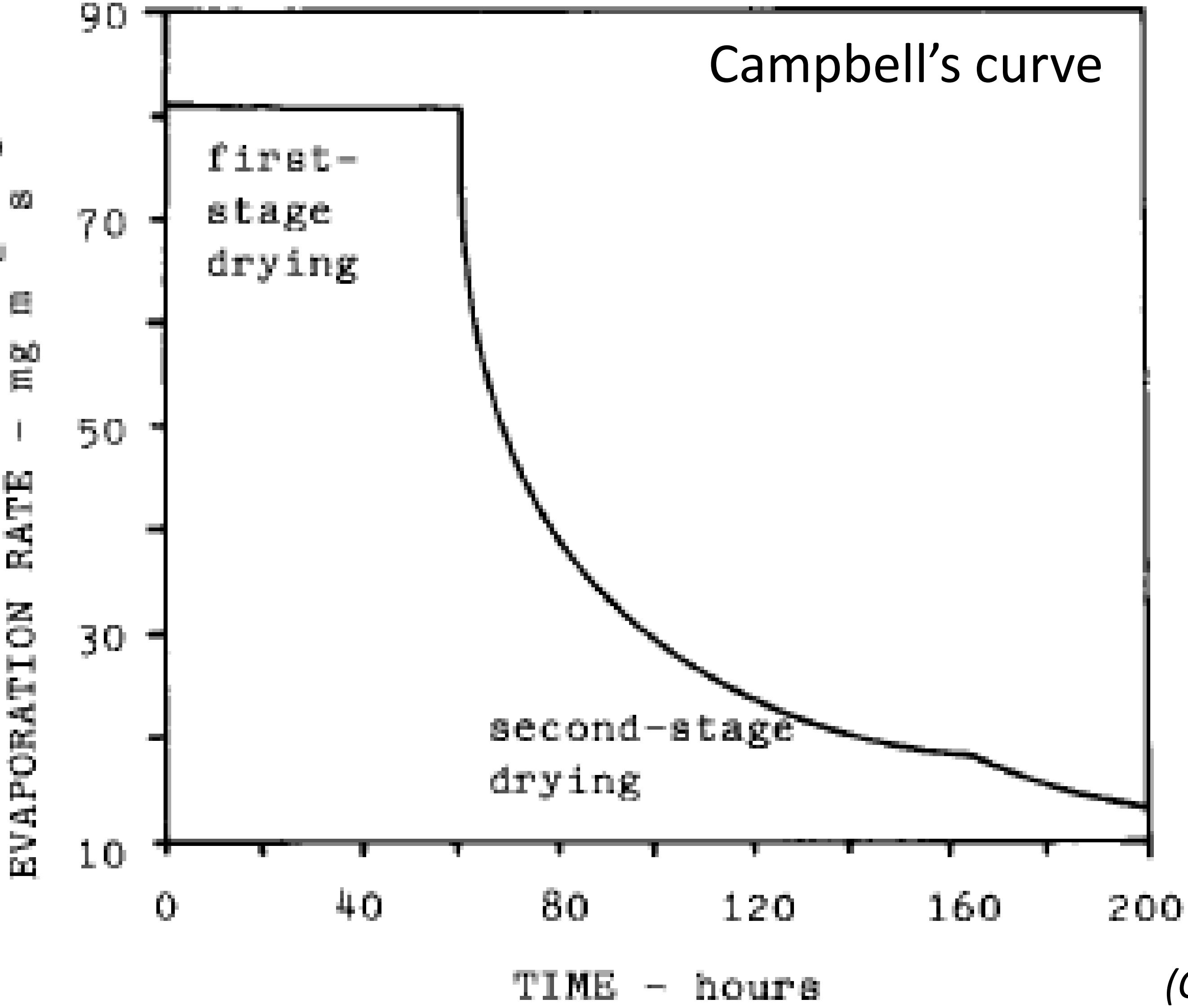
(BALWINDER-SINGH et al., 2014; *CAMPBELL, 1985;* STROOSNIJDER, 1987)

# INTRODUCTION




(CAMPBELL, 1985)

# GOALS

In order to contribute to the prediction of evaporation we aimed to propose a new empirical daily model considering the three evaporative stages based on commonly measured quantities: the 0.05 cm depth **soil water content** and the **class A pan evaporation**.

# MATERIALS AND METHODS

Soil Evaporation rate (mm d$^{-1}$)

$E_0$ - is the potential evaporation (mm d$^{-1}$)

$$E_s = \frac{E_0}{a + b\left[\ln\left(\frac{\theta_i}{\theta_s}\right)\right]^2}$$

$\theta_i$ - is the daily early morning (initial) soil water content (m$^3$ m$^{-3}$)

$\theta_S$ - is the saturated soil water content (m$^3$ m$^{-3}$)

*a* and *b* are empirical parameters (-)

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# MATERIALS AND METHODS


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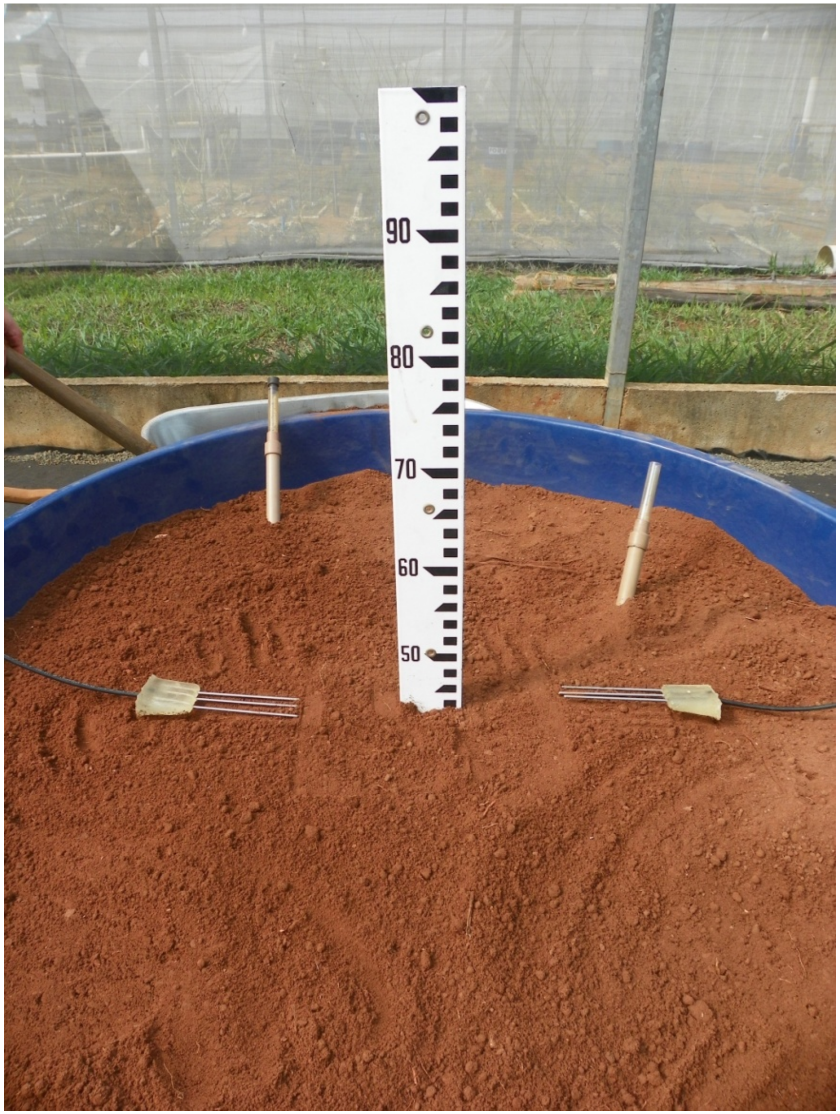



# MATERIALS AND METHODS

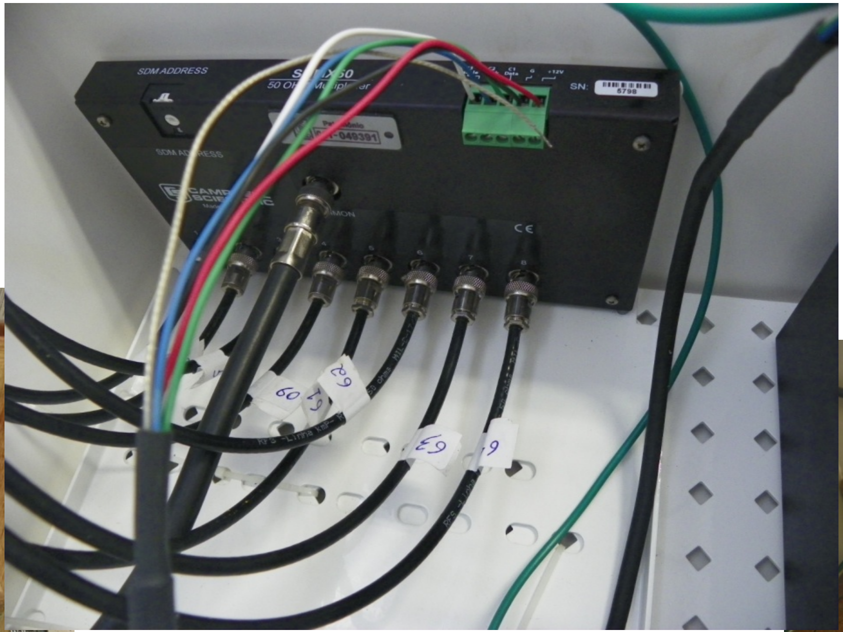
**Table 1.** Final soil bulk density (average and standard deviation) per depth in the lysimeters

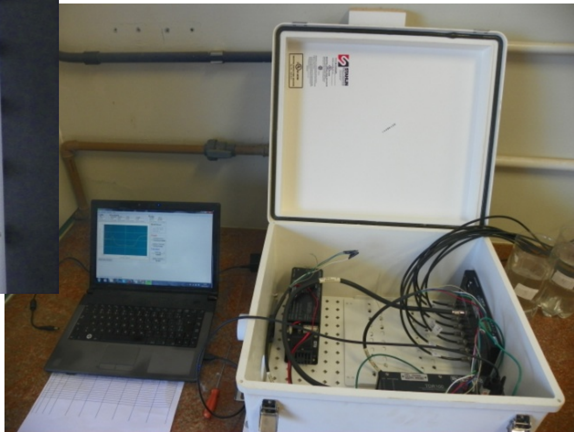
| Depth (m) | Soil Density (g cm$^{-3}$) | Standard Deviation (g cm$^{-3}$) |
|---|---|---|
| **0.0 - 0.1** | 1.2857 | 0.0234 |
| **0.1 - 0.2** | 1.4898 | 0.0178 |
| **0.2 - 0.3** | 1.5867 | 0.0474 |
| **0.3 - 0.4** | 1.5655 | 0.0312 |

# MATERIALS AND METHODS

**Table 2. Estimate soil water contents (θ) from the dielectric permittivity (Ka):**

$$\theta = 0.0146 + 0.0395\,Ka - 0.0016\,Ka^2 + 2.6953 \times 10^{-5}\,Ka^3 \qquad R^2 = 0.9923$$



# MATERIALS AND METHODS

### *Evaporation rate and monitoring of variables*

**Figure 1.** Experimental setup to measure surface (0.05 m) dielectric permittivity (Ka) using TDR, lysimeter and auxiliary column used to monitor the water level inside the lysimeters (A); Class A pan used to measure atmospheric demand (B)

# MATERIALS AND METHODS

Soil Evaporation rate (mm d-1)

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$$E_s = \frac{E_0}{a + b\left[\ln\left(\frac{\theta_i}{\theta_s}\right)\right]^2}$$

$\theta_i$ - is the daily early morning (initial) soil water content ($m^3\ m^{-3}$)

$\theta_S$ - is the saturated soil water content ($m^3\ m^{-3}$)

*a* and *b* are empirical parameters (-)

## RESULTS AND DISCUSSION

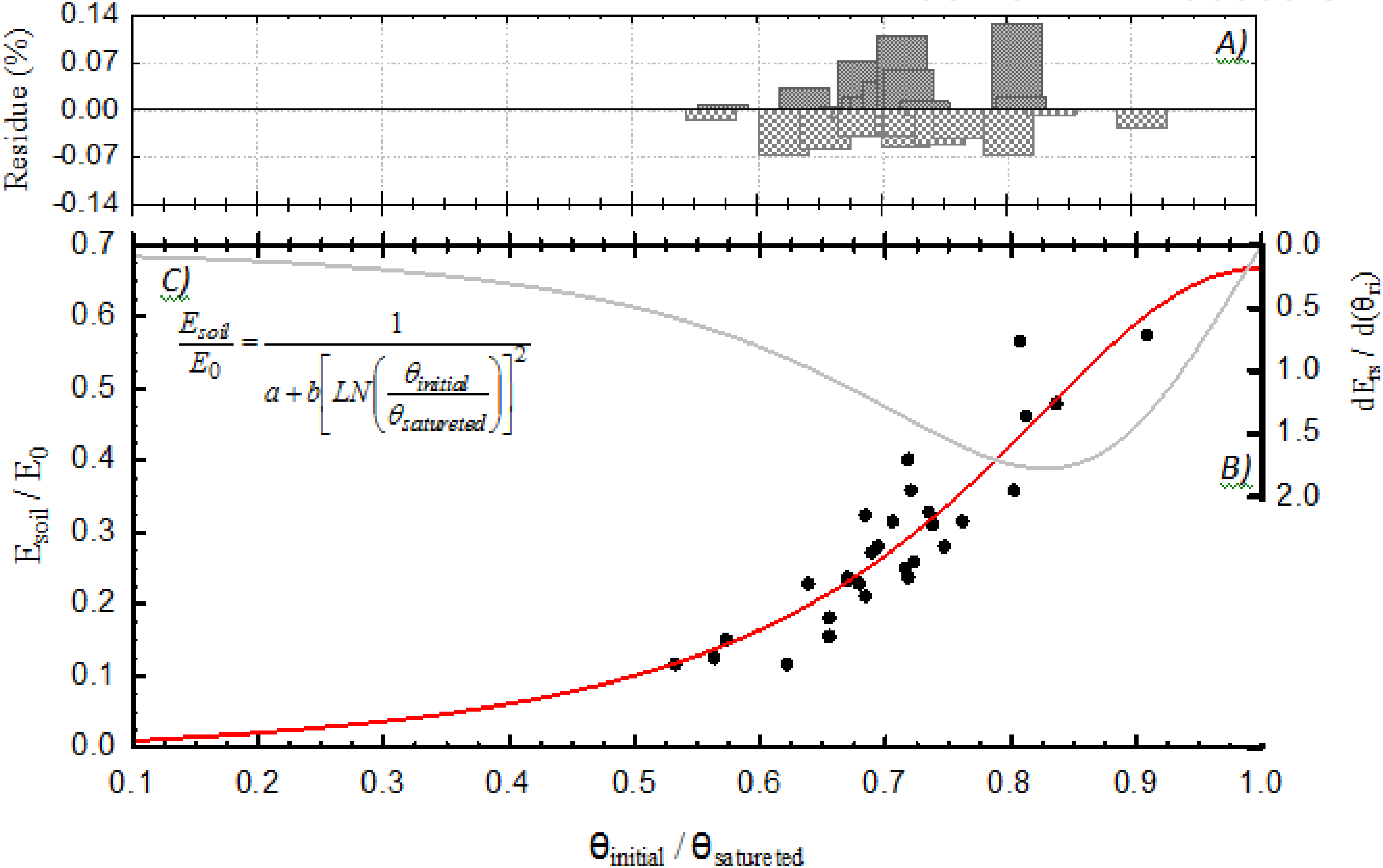


**Figure 2.** (A) model residual error; (B) first derivative of relative soil evaporation rate $E_{rs}$ ($E_{soil}$ $E_0^{-1}$) as a function of relative soil water content $\theta_{ri}$ ($\theta_{initial}$ $\theta_{saturated}^{-1}$); and (C) model fit to evaporation data measured in the lysimeter

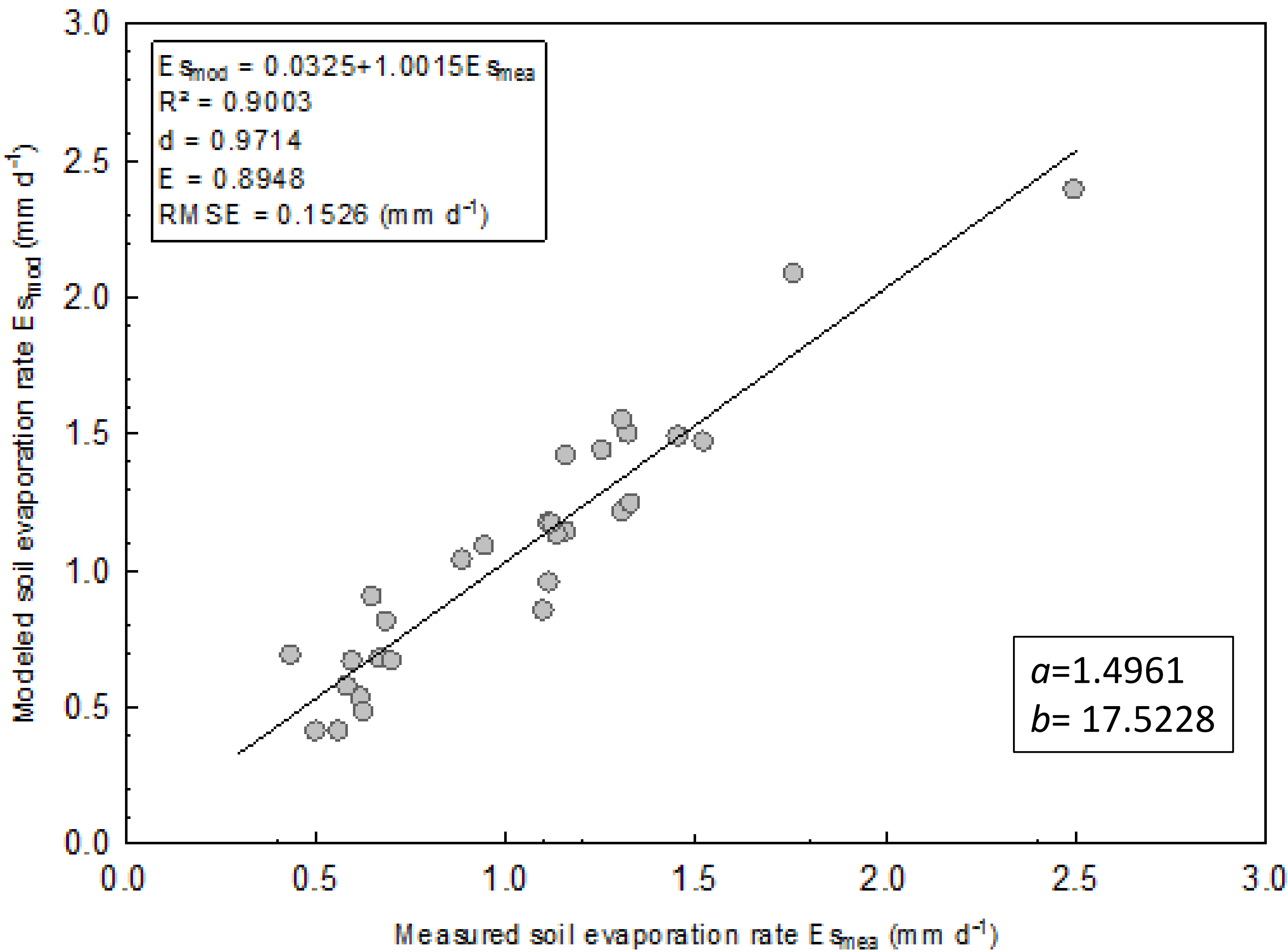


**Figure 3.** Comparison of experimental and modeled values of soil evaporation rate and associated statistical parameters

# RESULTS AND DISCUSSION

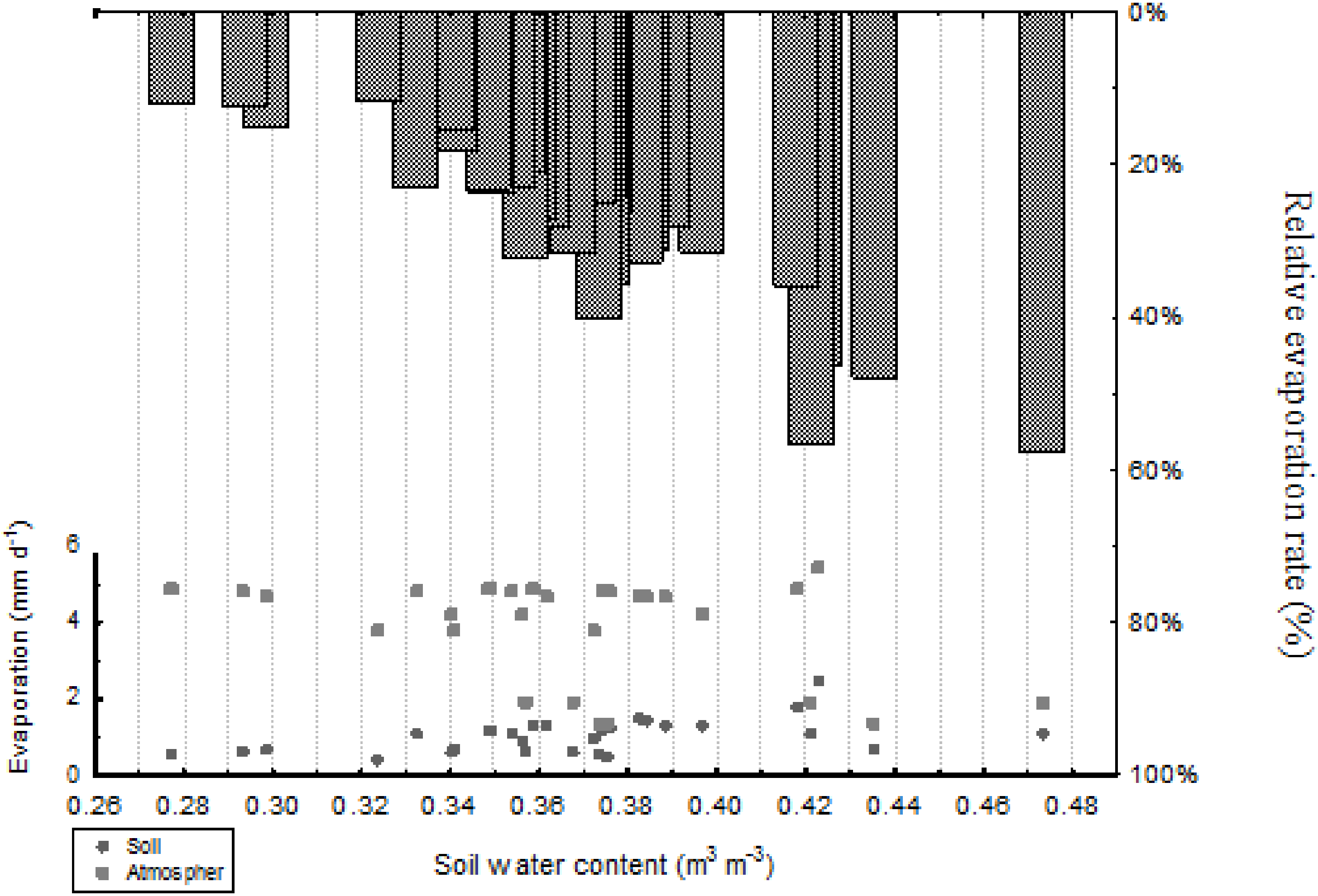


**Figure 4.** Evaporation demand from water surface ($E_0$) and soil surface (Es), and their ratio as a function of initial water content level

# CONCLUSIONS

The results indicated that the proposed model can reasonably well estimate the daily soil evaporation rate.

The experimental data indicate that the atmospheric demand can significantly influence the evaporation rate even under low soil water contents.

The direct measurement of soil evaporation rate under uncontrolled condition remains difficult, costly, time consuming and usually impractical. Nevertheless, the presented model is an easy and relatively accurate method that can be tested in irrigated areas in order to aid irrigation water management.

# ACKNOWLEDGEMENTS:

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# THANK YOU!!!

Ms. Isaac de Matos Ponciano
Professor at University of Rio Verde

**isaacponciano@usp.br**
***isaac.matos@unirv.edu.br***

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