Tutorial for Plant Available Water (*pawmod2*)

This plant available water model consists in a function to calculate the water that is available for crops in a given soil profile, crop evapotrasnpiration, and runoff. In order to obtain the mentioned variables the model requires the input of 14 parameters.

Files

To start you should have installed in the same folder the following files:

1) "Climate.xlsx" (file from where MatLab imports and exports data)
2) "pawmod2.fig" and "pawmod2.m" (this two files allow you run the function as a GUI)
3) "pawmod function.m" (this file allows you running the model as a function from the command window).

In this beta version, data for a sunflower crop in 2009 from OSU Research Station at Lahoma, OK is provided to compare with the model predictions.

Executing the model as a function

1- Call the function by writing in the command window ""[paw runoff etccum] = pawmodfunction (…)". You can copy what is below to save time. Then change values according to Table 1.

```
[paw runoff etccum] = pawmodfunction
(60,140,0.29,0.13,0.65,25,65,100,123,0.35,0.8,1.0,0.6,35);
```

Table 1: Parameters definitions, units, common ranges, and recommended values

Parameter	Meaning	Unit	Range	Suggested Values
a	PAW initial	mm	0-350	60
b	Soil Depth†	cm	0-300	140
c	Mean Field Capacity	$cm^3\ cm^{-3}$	0.2-0.35	0.29
d	Mean Wilting Point	$cm^3\ cm^{-3}$	0.05-0.2	0.13
e	Stress Treshold	unitless	0-1	0.5-0.65
f	DAP Kc initial	days after planting at which stage finishes		25
g	DAP Kc development			60
h	DAP Kc mid season			100
i	DAP Kc late season‡			123
j	Kc initial	unitless	0.2-0.5	0.4
k	Kc development		0.5-0.8	0.7
l	Kc mid season		0.8-1.4	1
m	Kc late season		0.5-0.8	0.6
n	Curve Number		0-100	Try 35 and then 90

† Soil depth can be the rooting zone, or any other depth that is desired in the simulation. It is recommended to use the potential rooting zone for a given soil and crop. Usually values between 1.2m and 1.8m are representative for most situations.

‡ DAP Kc late season should match the total days of the simulation. In this case should be always 123 days.

2- When you open parenthesis the function will ask you for parameters that go from “a” to “n”.
3- Once you have a set value for each of them (all separated by commas) you can press enter and run the model. You can hide results in the command window by adding a semicolon after the last parenthesis.
4- Graphs should pop up, and variables (PAW, runoff, cumulative ET) will be in the workspace.
5- At the same time, values were exported to Excel to specified cells.

Before opening the Excel file I recommend you running the GUI version, and see how the model responds by changing values. Then configure some suggested values and open the Excel file to compare the results with some real data provided.

Executing the model as a Graphical User Interface (GUI)

1-Execute the GUI by typing “pawmod2” in the windows command. The main window of the model should open (Figure 1)

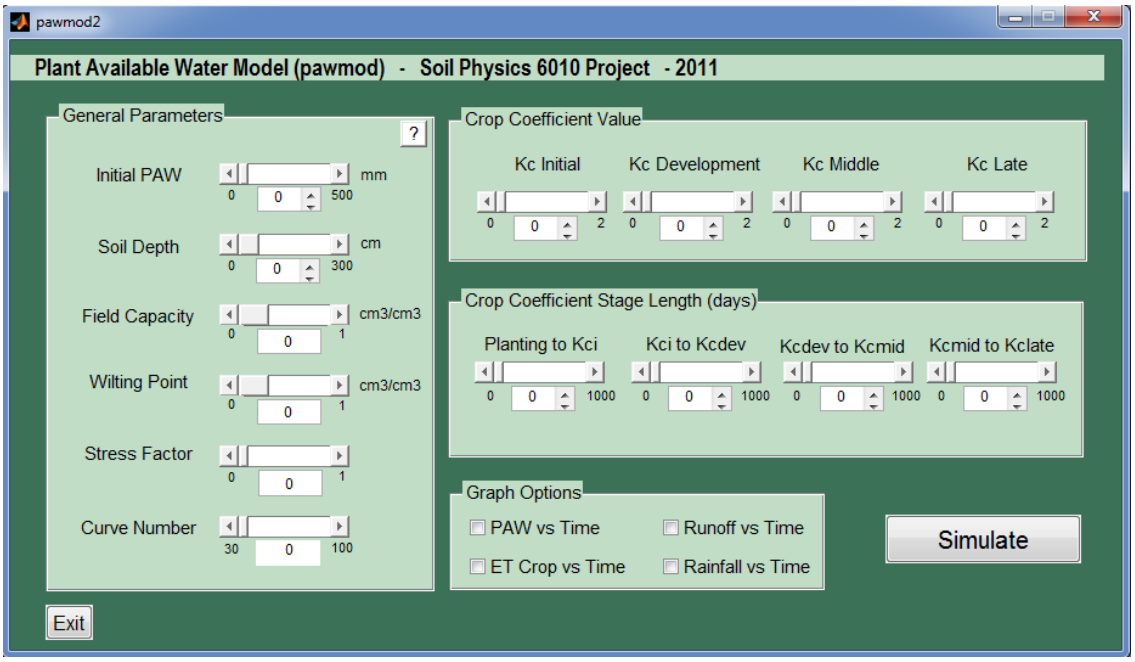

Figure 1: Example of the main screen should see when calling the model form the command window.

2- Change the parameters by sliding the buttons. The value appears in the white box immediately situated below. Again, for the crop stages insert the day after planting at which the stage finishes. As mentioned before, keep Kcmid to Kclate in 123 to ensure a proper simulation (Figure 2)

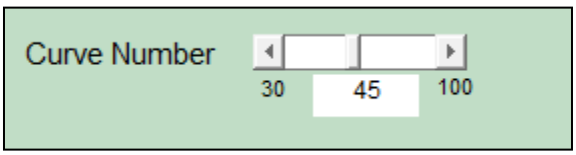

Figure 2: Detail of a slider with the display box and its range of variation.

3-Before clicking “Simulate” you can choose the graphs that you want to see by activating the checkboxes.

4-Click “Simulate”. If you close the main window, the parameter values will be lost and you will need to set them again. Results are shown in graphs as mentioned, and also recorded in the excel file (see below).

Excel File

Let’s assume that we have an experiment where we are interested in measuring PAW in a sunflower crop. For this crop we want to measure PAW on a daily basis to understand crop performance along the growing season, which starts in July and will end in late October. However, the research station is about two hours driving from where we are, and collecting daily data from several plots will result in a time consuming task.

For this reason, we decided taking PAW samples in the root-zone (about 1.4 m) in **four moments** (once a month July, August, September, and October) along the growing season with the objective of using these values to run and correct the model. The first PAWmeasured (July) value is mandatory to start the model. The rest are only to correct the model to actual values.

Steps

1-Run the model using the recommended values given in table 1 (this info is available also typing “doc pawmodfunction” in the command window).

2-Open the Excel file “Climate.xlsx”. Values in red columns are the default data. Values in the blue column are the ones you can modify to correct the model. Green columns contain the output of the last simulation.

3-The Excel file automatically updates the values in the red column to calculate the RMSE. So you can check this Excel file after each simulation to see how the curve behaves respect to the real data.

4- Lastly, try inserting a value that is highlighted in yellow in the blue column (be sure to match the date). Close the Excel file and run the model again. See how the model aligns with the new value.

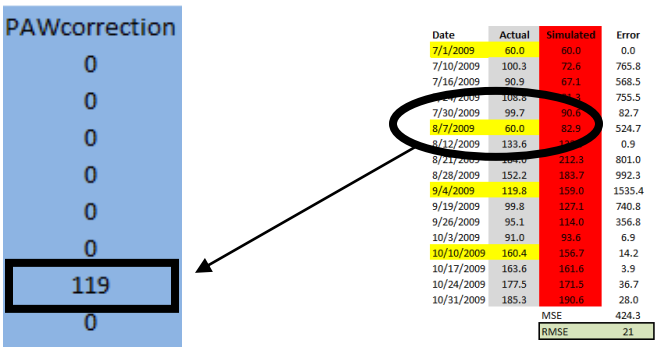

Figure 3: Inserting actual values in the PAWm column in the Excel file to align the model