## Sergio Villamaring assignment 3

### Osmotic potential

Using van’ Hoff equation of osmotic potential given

And since all the quantities provided are already per unit of cubic centimeter, i.e. then the formula resolves to

Finally, considering that and plugging and approximate of the molar gas constant we get the potential

### Soil resistance

Before I break up into each case I will consider the general situation a bit to avoid repetition. The value for specific water (at 20C) . Additionally, the hydraulic conductivity function for loamy sand for a given saturation can be expressed using the provided empirical coefficients as

In particular we care about the following 2 scenarios: full saturation , and 30% saturation , so

The difference in scale of the hydraulic conductivity already hints that the difference between these two scenarios is massive. Also, since none of the other values involved have time units, and day is a time scale more significant for water moving through the membrane (the scale of the numbers become even smaller if made into seconds) then I decided to keep these units.

Lastly, we will use the notation from Manzoni 2013 for the characteristic length of water to travel from the soil to the inside of the roots, and we will assume (couldn’t find the Porporato 2022 ref) that we can use in the equation

(This is probably either a 75% percentile of the root lengths which may be a good representative value for the root depth horizon?) and substituted the root diameter

#### sclerophyll, shrubs and trees

In this scenario the characteristic length of water

Now soil conductance is

And so each scenario for we get

And finally for the corresponding soil resistances we get

#### tropical evergreen forest

In this scenario the characteristic length of water

Soil conductance is again

And so each scenario for we get

And finally for the corresponding soil resistances we get

### Water potential of air

Recalling the formulation for the water potential of the environment as a function of humidity and the gravitational potential we can stablish the water potential of air at a given elevation

Assuming the partial molar volume of water into the atmosphere is , and If we plug in for the density of water at 20C , the gas constant , the temperature , and the gravity the formula becomes

We additionally remove a term so units are .

We can now make a table with the different humidities and elevations

|  |  |  |  |
| --- | --- | --- | --- |
| Humidities \ elevation | 0m | 20m | 828m |
| 20% | -225.321 MPa | -225.126 MPa | -217.222 MPa |
| 40% | -128.281 MPa | -128.085 MPa | -120.181 MPa |
| 90% | -14.7505 MPa | -14.5548 MPa | -6.65098 MPa |

From the results it is easy to see that changes on the relative humidity have greater impact on the water potential of the air and only when the humidity is high enough does it compare in a significant way to the gravitational potential. This is consistent with the formulation as changes in the relative humidity are inside a logarithm on the range (0,1] and gravitational potential is linear on and has a significant smaller order of magnitude.