ATM 233 Final Project

Class work from March 5, 2020:

# Methods

## Second order Taylors approximation for the saturation vapor pressure

LE Equation:

Saturation Vapor Pressure Equation from Teton’s equation (PM Equation)

Where is the air temperature measured at z= 2m and is the saturation vapor pressure at the air temperature measured at z = 2m.

The first order Taylor Approximation of the saturation vapor pressure curve is:

Where is the surface temperature.

CIMIS uses the following equation for (PM Equation):

The second order Taylor’s approximation of the saturation vapor pressure for the surface temperature:

Applying this equation to the LE equation,

The energy budget equation:

Where H is the sensible heat, Rn is the net radiation, G is the ground heat flux and LE is the latent heat. Sensible heat is defiened by:

Plugging in the equation of H into the energy budget:

Substitute the previous equation for LE into the LE equation for the second order Taylor’s approximation for the saturation vapor pressure to solve for the surface temperature.

The surface temperature from this solution is applied to equation 1 in order to solve for LE using the second order Taylor’s approximation.

## CIMIS Calculated LE

CIMIS uses the Penman-Monteith for the hourly evapotranspiration with the version described in Allen, et.al, 1998. For a well-watered grass field with a height 12cm, the reference evapotranspiration from grass (ETo) is

This equation is derived from the Penman – Monteith equation for Latent heat ():

CIMIS uses the approximations:

Aerodynamic resistance:

For reference evapotranspiration for a grass with a height of h = 0.12 cm,

Bulk surface resistance:

Where is the assumed bulk stomatal resistance of a well illuminated leaf, and because approximately half of the grass is actively contributing to heat and vapor transport.

For a clipped grass, the LAI is assumed to be:

NOTE: NEED TO FIND RI FOR NIGHTTIME

For the daytime, the bulk surface resistance of the 12cm grass is approximately 70 s m-1.

Atmospheric pressure (P):

Psychrometric constant():

Slope of the saturation vapor pressure:

To go from the tradiation version of the Penman-Montieth equation to the FAO 1998 version of the equation, substidtude:

Where the virtural air temperature is

Combined the term :

Simplifying and plugging in for the constants

# References

Allen, Richard G, Luis S Pereira, Dirk Raes, and Martin Smith. “Crop Evapotranspiration - Guidelines for Computing Crop Water Requirements - FAO Irrigation and Drainage Paper 56,” n.d., 15.

Walter I. A., Allen R. G., Elliott R., Jensen M. E., Itenfisu D., Mecham B., Howell T. A., et al. “ASCE’s Standardized Reference Evapotranspiration Equation.” *Watershed Management and Operations Management 2000*, Proceedings, n.d., 1–11. <https://doi.org/10.1061/40499(2000)126>.