Assignment with LHS

2022-04-19

With a new group: Sensitivity Analysis

Often when we are estimating vegetation or crop water use we need to know the atmospheric conductance - which is essentially how easily water diffuses into the air and depends largely on windspeed (you get more evaporation in windier conditions) Atmospheric conductance is also influenced by the vegetation itself and the turbulence it creates

I've provided a function to compute atmospheric conductance C_{at} (how easily vapor diffuses from vegetation surfaces)

The function *Catm.R* is provided

So that you know what it does - here's some background on the function

$$C_{at} = \frac{v_m}{6.25 * ln(\frac{z_m - z_d}{z_0})^2}$$

$$z_d = k_d * h$$

$$z_0 = k_0 * h$$

z_m is the height at which windspeed is measured - must be higher than the vegetation (m), it is usually measured 2 m above the vegetation

h is vegetation height (m)

v is windspeed (m/s)

Typical values if k_d and k_o are 0.7 and 0.1 respectively (so use those as defaults)

Your task

For a given forest, you will perform a sensitivity analysis of model predictions of conductance Consider the sensitivity of your estimate to uncertainty in the following parameters and inputs

- $height$
- k_d
- k_0
- v

Windspeeds v are normally distributed with a mean of 2.5 m/s with a standard deviation of 0.3 m/s

For vegetation height assume that height is somewhere between 9.5 and 10.5 m (but any value in that range is equally likely)

For the k_d and k_0 parameters you can assume that they are normally distributed with standard deviation of 1% of their default values

a) Use the Latin hypercube approach to generate parameter values for the 4 parameters
b) Run the atmospheric conductance model for these parameters
c) Plot conductance estimates in a way that accounts for parameter uncertainty

d) Plot conductance estimates against each of your parameters
e) Estimate the Partial Rank Correlation Coefficients
f) Discuss what your results tell you about how aerodynamic conductance? What does it suggest about what you should focus on if you want to reduce uncertainty in aerodymaic conductance estimates? Does this tell you anything about the sensitivity of plant water use to climate change?

Submit the Rmarkdown (or link to git repo) as usual

Grading Rubric

- Generation of parameter values using latin hypercube sampling (10pts)
- Running model for the parameters (10pts)
- Graph of conductance uncertainty
  - meaningful graph (5pts)
  - graphing style (axis labels, legibility) (5 pts)
- Graph of conductance against parameter values
  - meaningful graph (5pts)
  - graphing style (axis labels, legibility) (5 pts)
- Correct Rank Correlation Coefficients (10 pts)
- Discussion (10pts)
  - suggestion for how to reduce uncertainty that follows from your analysis (5pts)
  - idea about how uncertainty might impact estimate of plant water use under climate change (5pts)