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Realistic Forcing Simulations for 1D Richards Simulations

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Description:

Attached is a MATLAB code that simulates realistic forcings for us in 1D Richards Equation simulations. The code generates rainfall timing and amounts with an exponential distribution governed by the Lamba and alpha parameters (arrival rate of rainfall and rainfall depth). The process is referred to as a marked Poisson Process and is a good model for daily rainfall generation. The Potential evapotranspiration is based off reasonable PET values for Neb. during the growing season. It simulates PET values based on a mean and std. When rainfall occurs PET is set to 0, which is a reasonable assumption. The PET is further partitioned into Evaporation and Transpiration (root water uptake and defined by ratio parameter). The boundary condition and sink term for evaporation and transpiration are different in Richards Eqn. Evaporation is a negative flux at surface and transpiration is a sink term integrated over root zone. The code will generate a matrix called “Forcing”. The first column is the IDs (1 to season length), 2nd column is rainfall depth (mm/day), 3rd Column is PET (mm/day), 4th column is Evaporation (mm/day, it is a negative flux at surface, opposite of rainfall BC!!!!), 5th column is transpiration amount (mm/day), this is a sink term. You can remove this amount uniformly over root zone, here we will it is 0-50 cm.

Top BC: This will switch from a constant flux of positive values for rainfall and negative values for evaporation. You can uniformly distribute across time steps as only daily data provided.

Lower BC: Use the unit gradient concept. Use Buckingham Darcy equation for last node and BC where q = K(th)\*(dh/dz+1) with information from last node. This will be a constant flux.

IC: You can set this to field capacity, which a tension value of -33kPa. This would be typically following a wet spring. Also could set a uniform value of say 0.2 m^3/m^3 for a water content.

Depth: Use a 2 meter column.

Data assimilation with soil moisture data to look at:

Point sensors with information at nodes 5, 10, 25, 50, 100 cm. These are standard depths for data monitoring networks. Time information would vary between 1, 5, 30, 60 minutes, or 24 hours. Typically data is collected/reported every 30 or 60 minutes.

Remote Sensing: Information is collected from 0-5 cm (integrated value) every 1, 2, 3 days depending on satellite overpass.

Cosmic-ray neutron sensor: Information is collected from 0-30 cm (integrated value) every 30 or 60 minutes in most cases. You could also look at 2, 6, 12, 24 hours.