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A conceptual model to quantify plant root induced changes in soil hydraulic conductivity and water retention

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The root systems of plants modify the physical properties of the soil they occupy, which can lead to a change in soil hydraulic conductivity and water retention. We developed a conceptual model that partitions the soil volume into soil with and soil without roots. Using the capillary bundle approach the effects of roots are then modeled. In soil where roots are present we assume that pores are cylindrical and that roots are also cylinders that lie concentrically within these pores. We determine the capillary pressure saturation relationship and water flux within the annulus to model the hydraulic properties of soil with roots present. The hydraulic properties of the combination of soil with and soil without roots present were found by summing the two.

Preliminary results show that the greatest effect of plant roots on the hydraulic properties of soil is in the near to saturated range. In this range hydraulic conductivity and water content both decrease as the amount of live root mass increased, and vice versa. Other preliminary results show that amount of change in the modeled hydraulic properties is sensitive to root radii distribution and soil texture. This suggests that different vegetation types will affect soil hydraulic properties differently during there growth. We will discuss the implications of these changes in soil hydraulic properties on water fluxes in the root zone with its potential feedbacks to biomass production.