A Geographic Framework for Identifying Hydrological and Biogeochemical Patchiness in Catenary Landscapes.

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Catenas are useful tools for understanding ecosystem structure and function—they record transport of water and nutrients in ecosystems

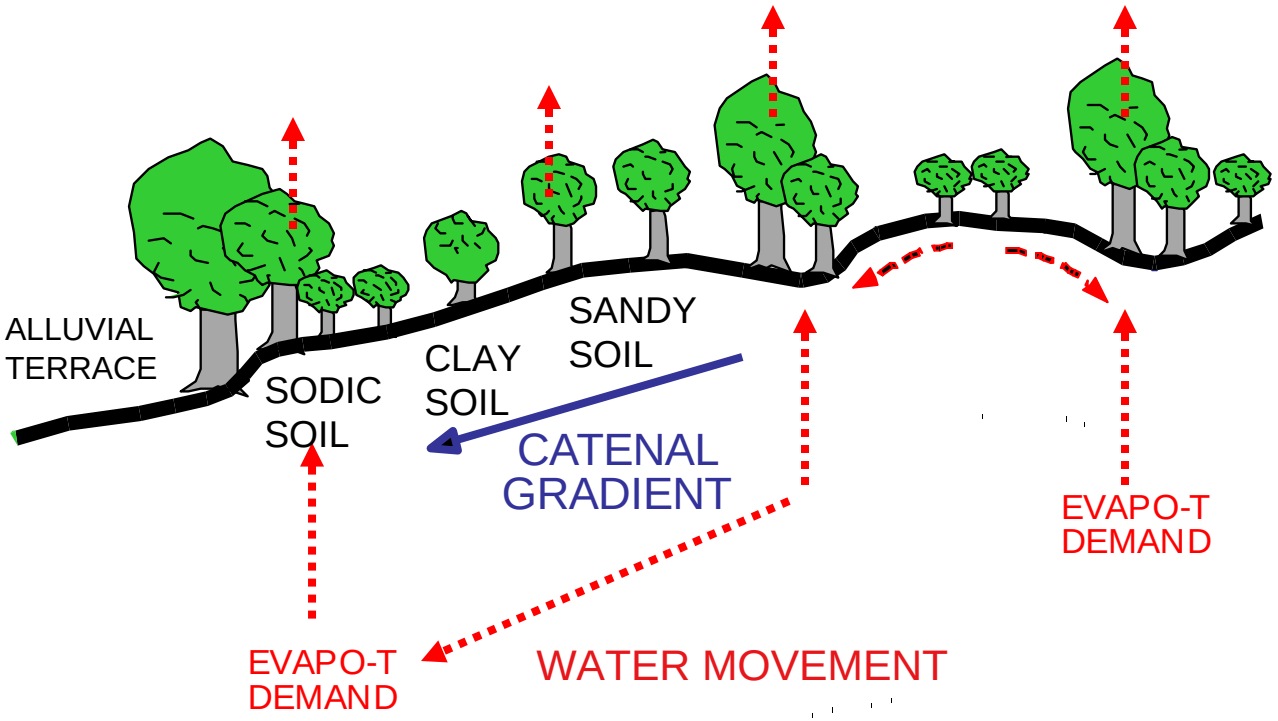
Catenas are conduits of water from hillslopes to streams

Catena processes guide differentiation of vegetation communities and soil properties and hence formation of heterogeneity

Catenas are sensitive to climate and landscape change

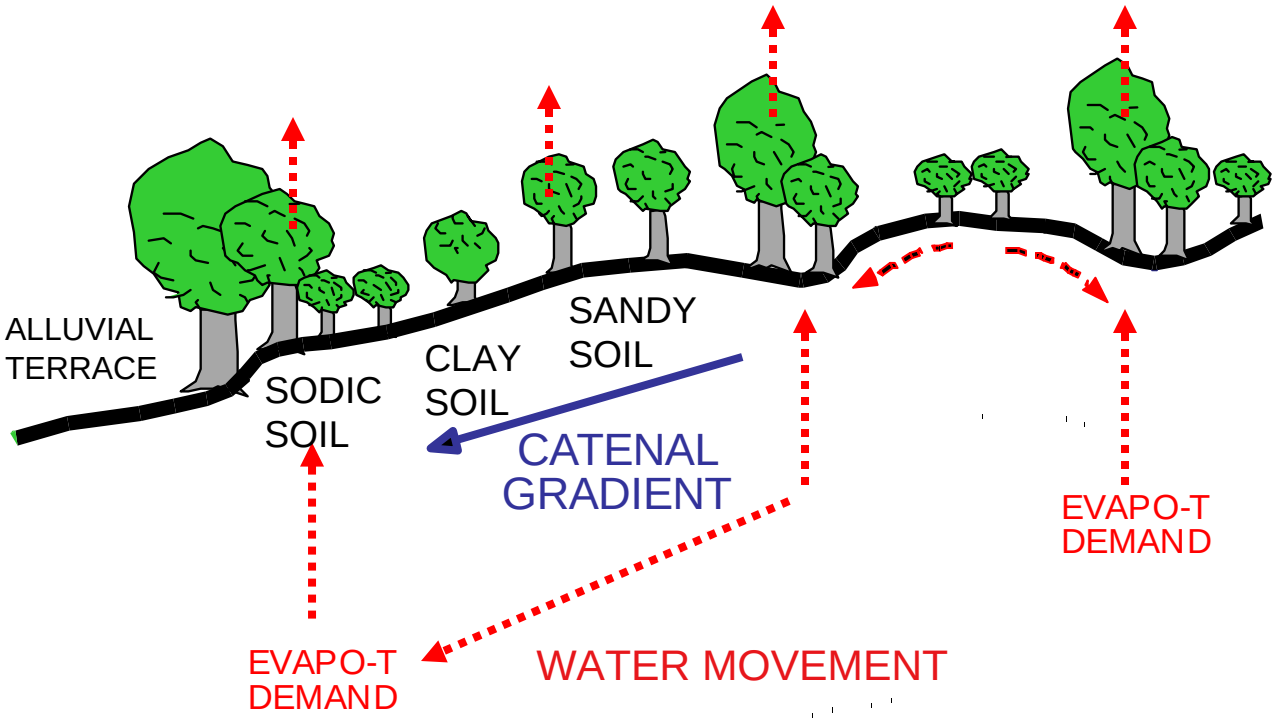
We provide a hillslope/hydrological framework within which to consider catena processes

Catenas are most strongly expressed on coarse-grained, quartz-rich rocks in subhumid environments



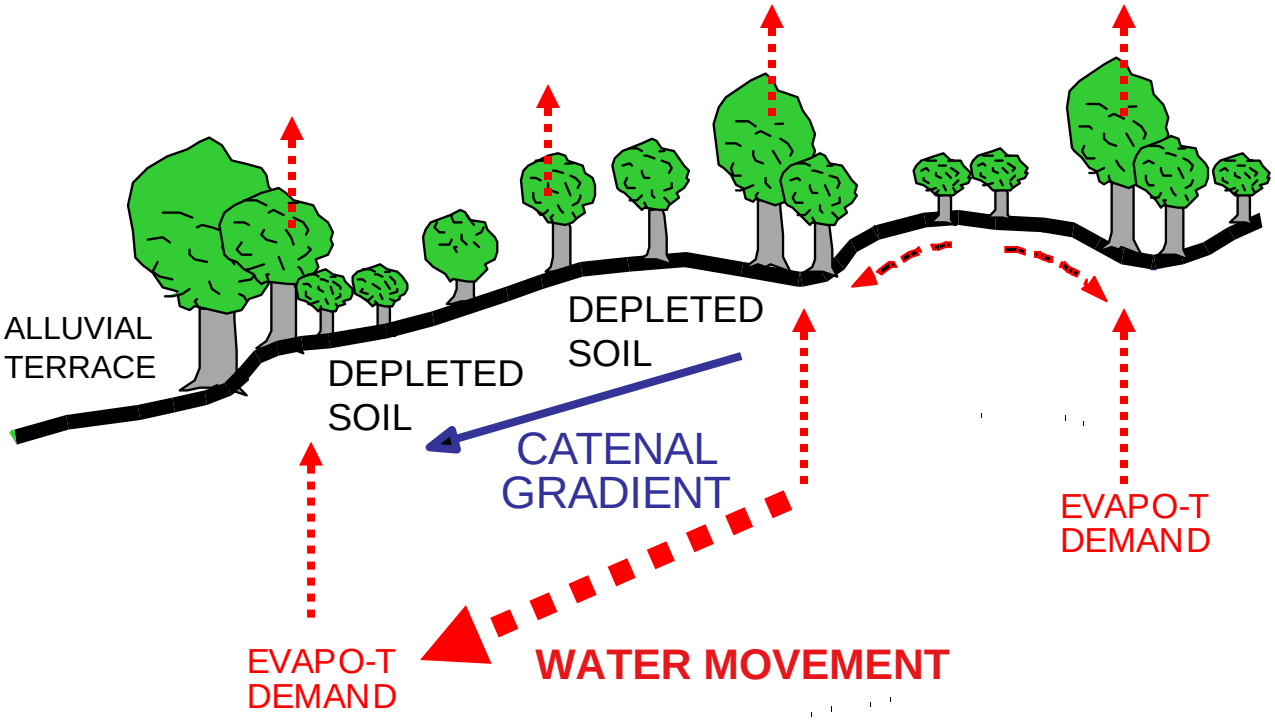
Catenas are most strongly expressed on coarse-grained, quartz-rich rocks in subhumid environments

Their properties are affected by differences in effective moisture, soil length and slope angle



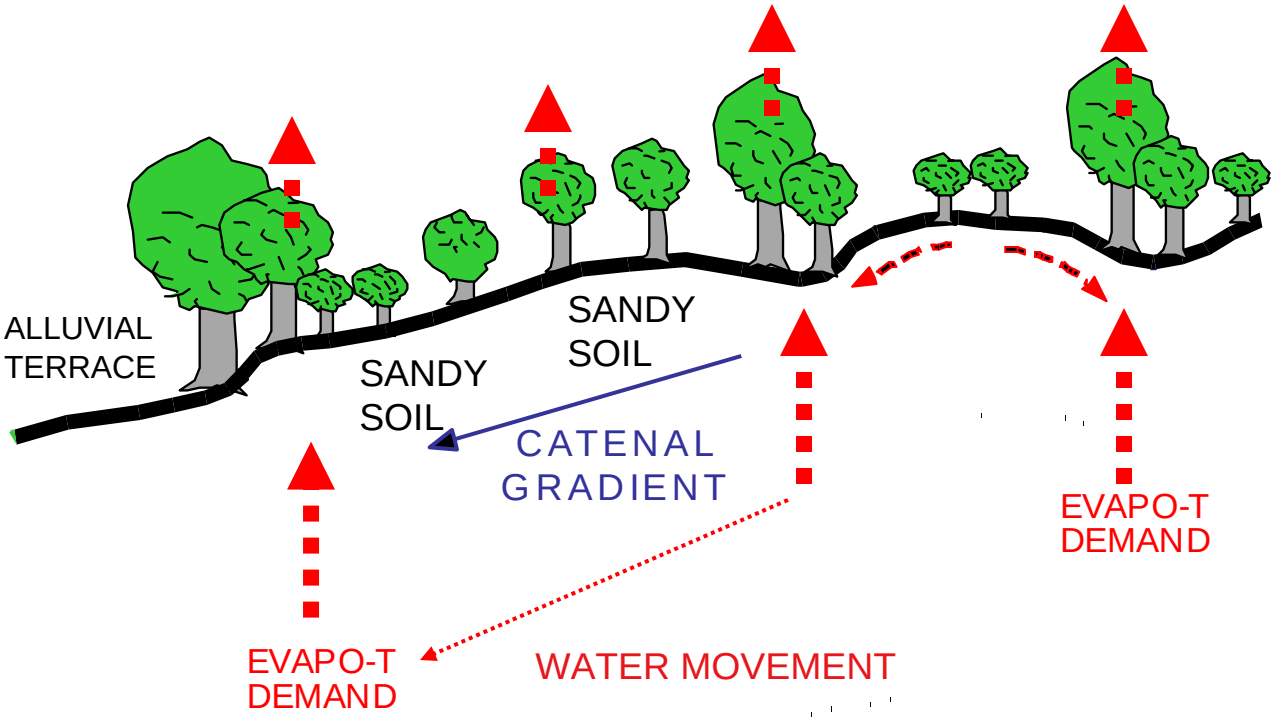
Humid Environment Catenas

High levels of effective moisture remove soil components from hillslopes leaving soils that are depleted in nutrients everywhere



Arid Environment Catenas

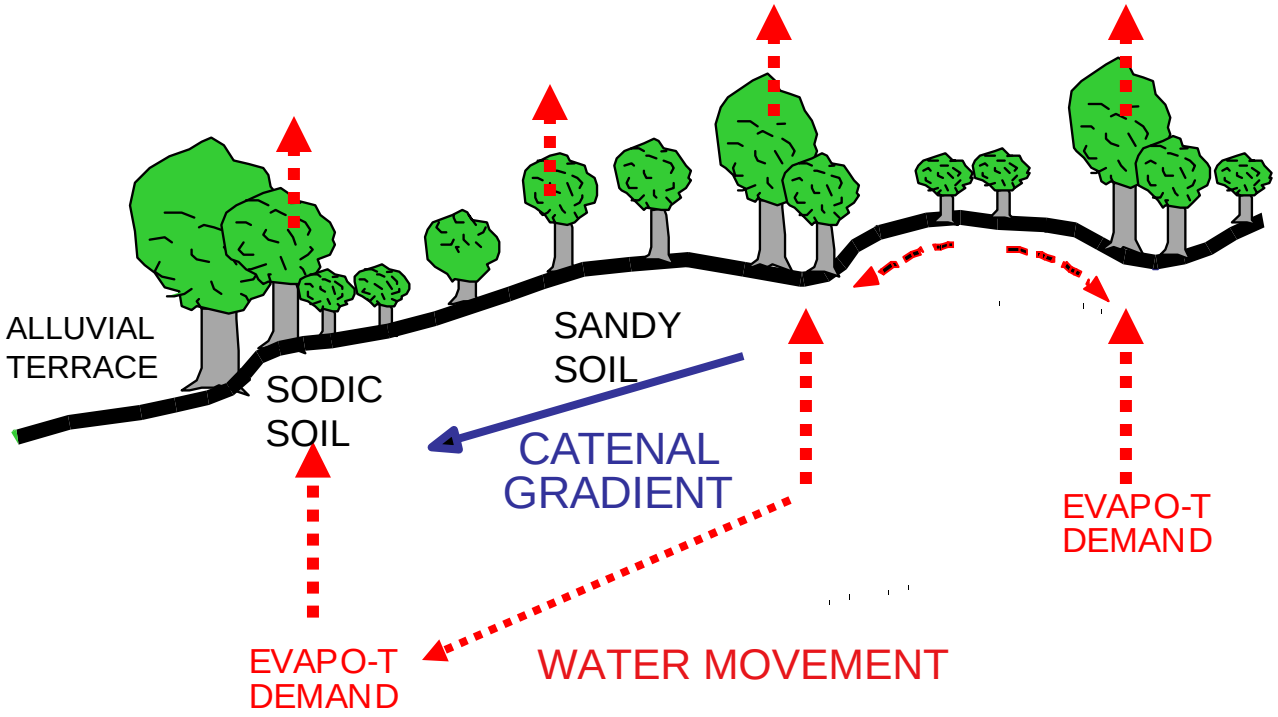
When plants remove all rainwater by ET there is no excess moisture to drive differentiation along hillslopes



Kruger Park Catenas

As rainfall increases, plant needs are met leaving progressively greater moisture to drive downslope differentiation

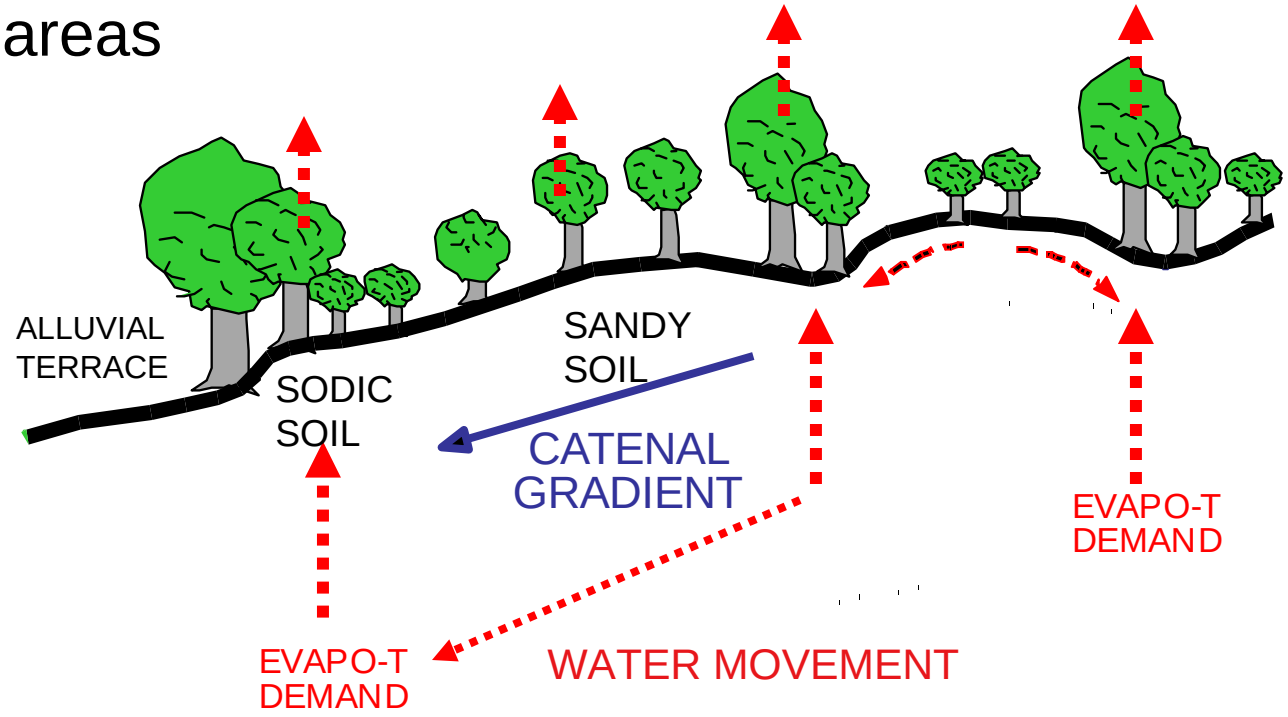
Starting with redistribution of salts in the driest areas of the park



Kruger Park Catenas

As rainfall increases, plant needs are met leaving progressively greater moisture to drive downslope differentiation

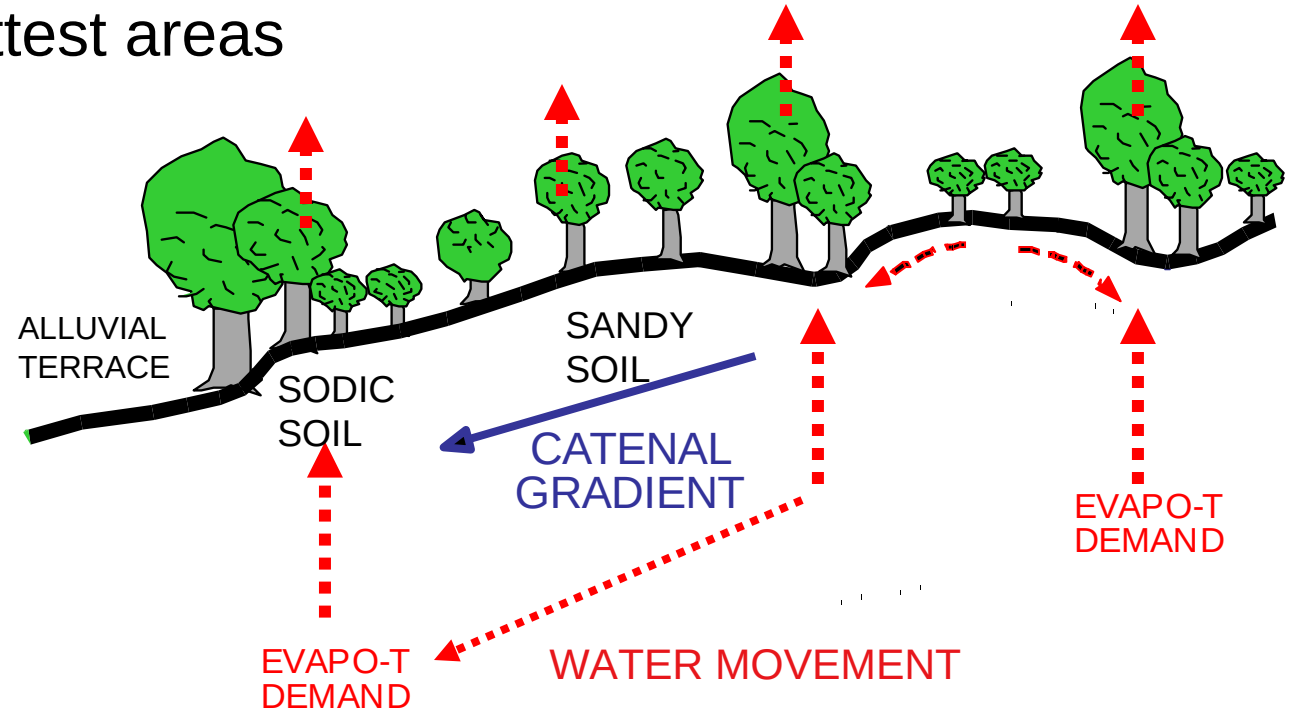
Effecting redistribution of salts and clays in intermediate rainfall areas



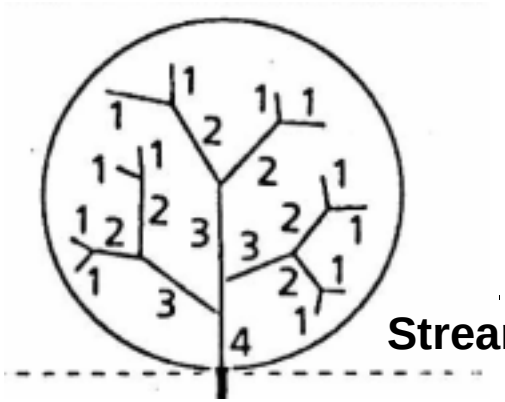
Kruger Park Catenas

As rainfall increases, plant needs are met leaving progressively greater moisture to drive downslope differentiation

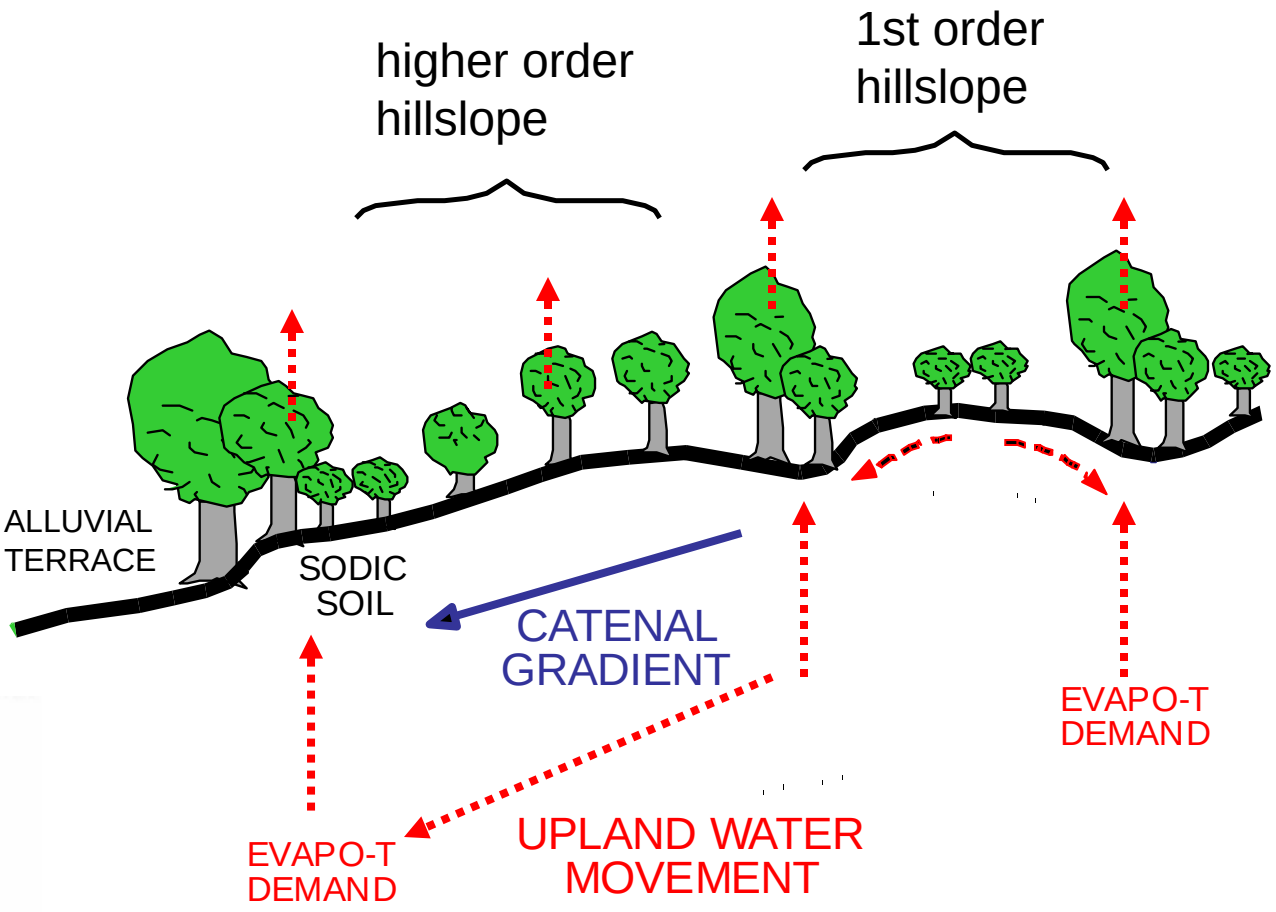
And finally driving losses of salts but redistribution clays in the wettest areas



Hillslope length and slope act to modify water relations with shorter slopes (lower stream order) showing less differentiation than longer slopes (higher stream order)

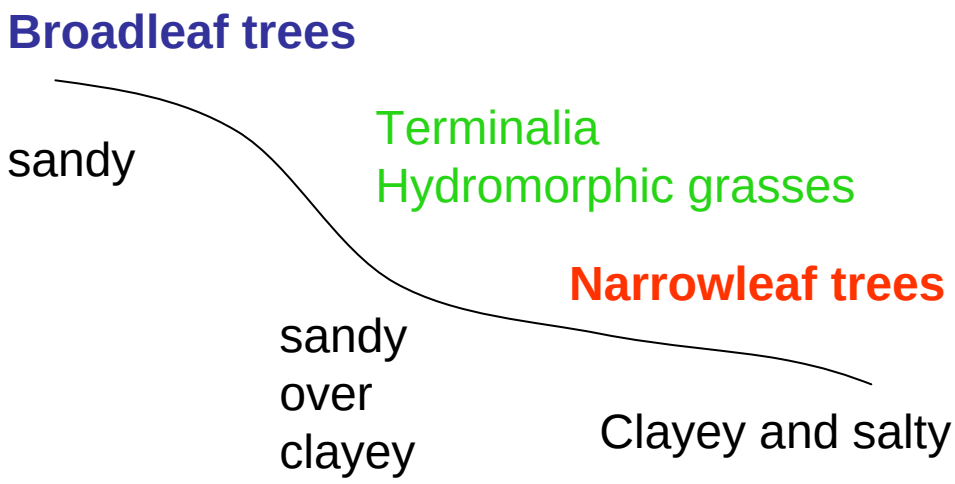


Stream order (“age”)



We conclude that:

1) Heterogeneity in savanna ecosystems derives, in part, from a delicate balance among effective rainfall, slope length and slope angle



2) Catena - climate relationships can be modeled and thresholds quantified

Catena Properties =>

f(PPT/ET)(Infiltration Rate)(K_{sat})(Slope Angle)
(Cumulative Contributing Area)