Determining a new dryland decomposition input term: Sediment redistribution to litter surfaces during fluvial event simulation

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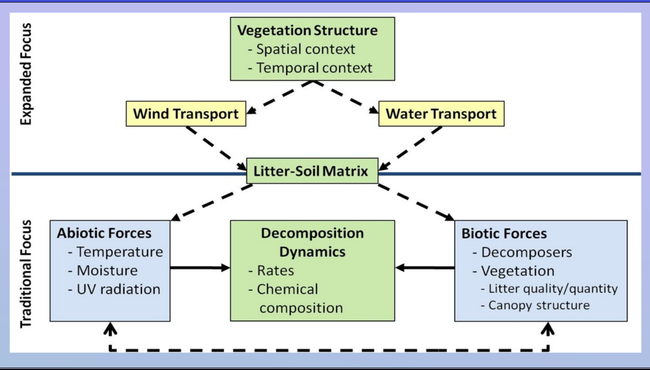
Problem Statement



- Decomposition plays an important role in the cycling of nutrients and the mineralization of organic matter
- It is believed that in arid ecosystems photodecomposition and soil-litter mixing are among the factors that accelerate the process of litter decomposition (Austin et al., 2006; Throop and Archer 2009; Hewins et al. 2013)
- Decomposition in drylands is poorly understood; however, a new conceptual model suggests soil-litter mixing might be important

Objectives

- **To examine how rain and wind events redistribute sediment to litter surfaces in arid and semiarid ecosystems**
- To compare and contrast how edaphic properties influence soil-litter mixing
- To use a rainfall simulator to examine differences in sediment capture between soil and litter types

Methods and Materials

- A set up of six aluminum trays (≈ 28 cm x 38 cm) each with 6 drainage holes on the bottom and a 2 mm mesh screen for each soil type was created for use in the field and lab
- The three soil types: **Critical Zone Observatory (CZO), Landscape Evolution Observatory (LEO), and Santa Rita Experimental Range (SRER)** were sieved (2 mm sieve) before being added to the trays
- To represent organic matter in semiarid ecosystems, litter from SRER was collected, washed in distilled water, and sorted

- Litter consisted of:
  1) Honey mesquite leaves (*Prosopis glandulosa*)
  2) Blades of Lehmann love grass (*Eragrostis lehmanniana*) ≈15 cm long
  3) Honey mesquite sticks cut into ≈10-11 cm segments
- Each tray contains ≈1 g of grass, 2 g of leaves and 20 g of woody material
- After being prepared, litter was weighed and stored in vacuum-sealed bags

Rainfall Simulation and Sample Processing Methods

Rainfall Simulator

Litter Collection

Muffle Furnace

- Rainfall simulation was performed at the USDA ARS's Walnut Gulch Rainfall Simulator with an intensity of 63.5 mm/hr (2.5 in/hr)
- Trays were exposed to 2 or 20 minute duration events
- Litter was collected and stored in cups, before being ashed with a muffle furnace so that only sediment remained

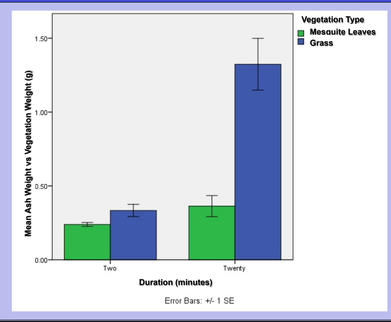
Wind Simulation and Natural Event Methods

- We developed an inexpensive, but effective wind simulation system to complement the rain simulation
- A set up consisting of three air movers was created to yield wind speeds of ≈ 6 m/s across the six trays
- Trays were exposed to 2 or 20 minute wind events of ≈ 6 m/s intensity
- Wind simulation allows us to examine differences in sediment capture between soil and litter types in a controlled environment and will complement field data

- Trays were exposed to naturally occurring windy and rainy days during the monsoon season
- Data from the field experiments will help us understand if the sediment distribution seen in the simulations seems reasonable
- Once data from the field experiment and simulations are analyzed, they may bring insight into the relative roles and importance of water and wind in soil-litter mixing in drylands

- **We developed methods that enable the study of both wind and water driven sediment deposition under both controlled and field conditions**

Results and Discussion: Vegetation



- Initial results suggest that the grass captured more sediment than the leaves, highlighting that there may be differences between litter types
- Event duration appears to have an influence on the amount of sediment redistributed to litter surfaces, with the longer duration event having greater sediment capture
- Additional sample processing is ongoing and will explore differences between herbaceous and woody litter, soil texture, duration, and event type (natural or simulated; water or wind)

Implications and Conclusions

- The influence of sediment and litter mixing with regard to decomposition rate is relatively unknown, but likely important in semiarid and arid ecosystems
- These initial measurements are among the first for the redistribution of sediment onto litter and provide insights into a key dryland decomposition input term
- Preliminary data and pilot studies suggest more sediment is captured, on a per mass basis, by herbaceous rather than woody litter
- Research of this nature has implications for soil quality, ecosystem health, biogeochemistry, hydrology, contaminant transport, and the carbon cycle

References

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