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Testing and out-scaling in situ water harvesting approaches in Palestine

Workshop I: Training of trainers on in-situ WH functionality and soil water process monitoring

Surface runoff processes modeling

Training of trainers / workshop

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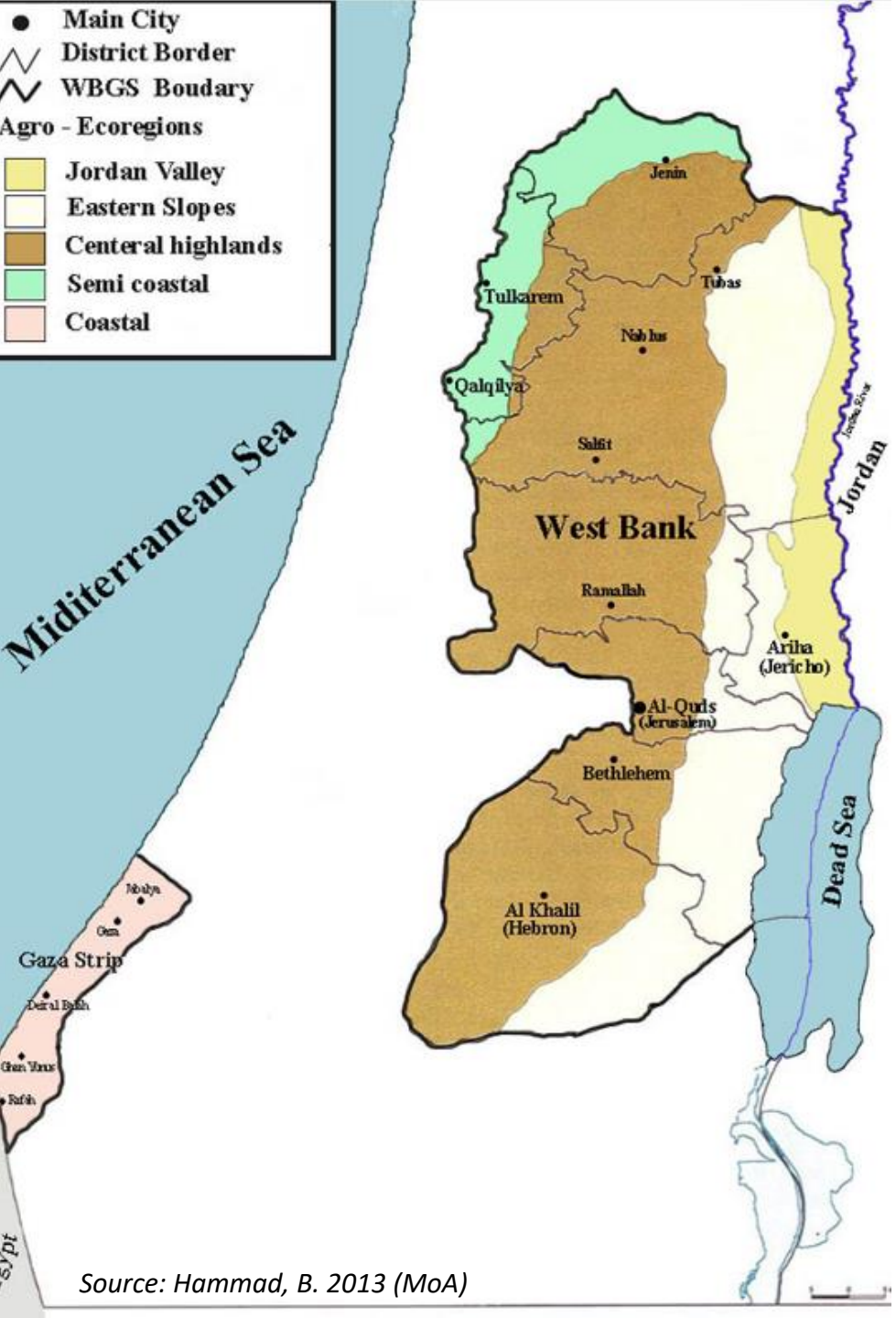
What is RHEM?

Rangeland Hydrology and Erosion Model

- estimates runoff, erosion, and sediment delivery rates at the spatial scale of the ***hillslope***.
- designed to be used as a runoff and erosion calculator, or "**engine**", within a **web-based interface** or within another model that works on the **watershed scale**, such as AGWA/KINEROS2.
- is a vehicle for incorporating new scientific findings from rangeland infiltration, runoff, erosion and water quality studies.
- Address on-site erosion, sediment yield, and salinity transport (Total Dissolved Solids) in runoff water.



Source: Hammad, B. 2013 (MoA)

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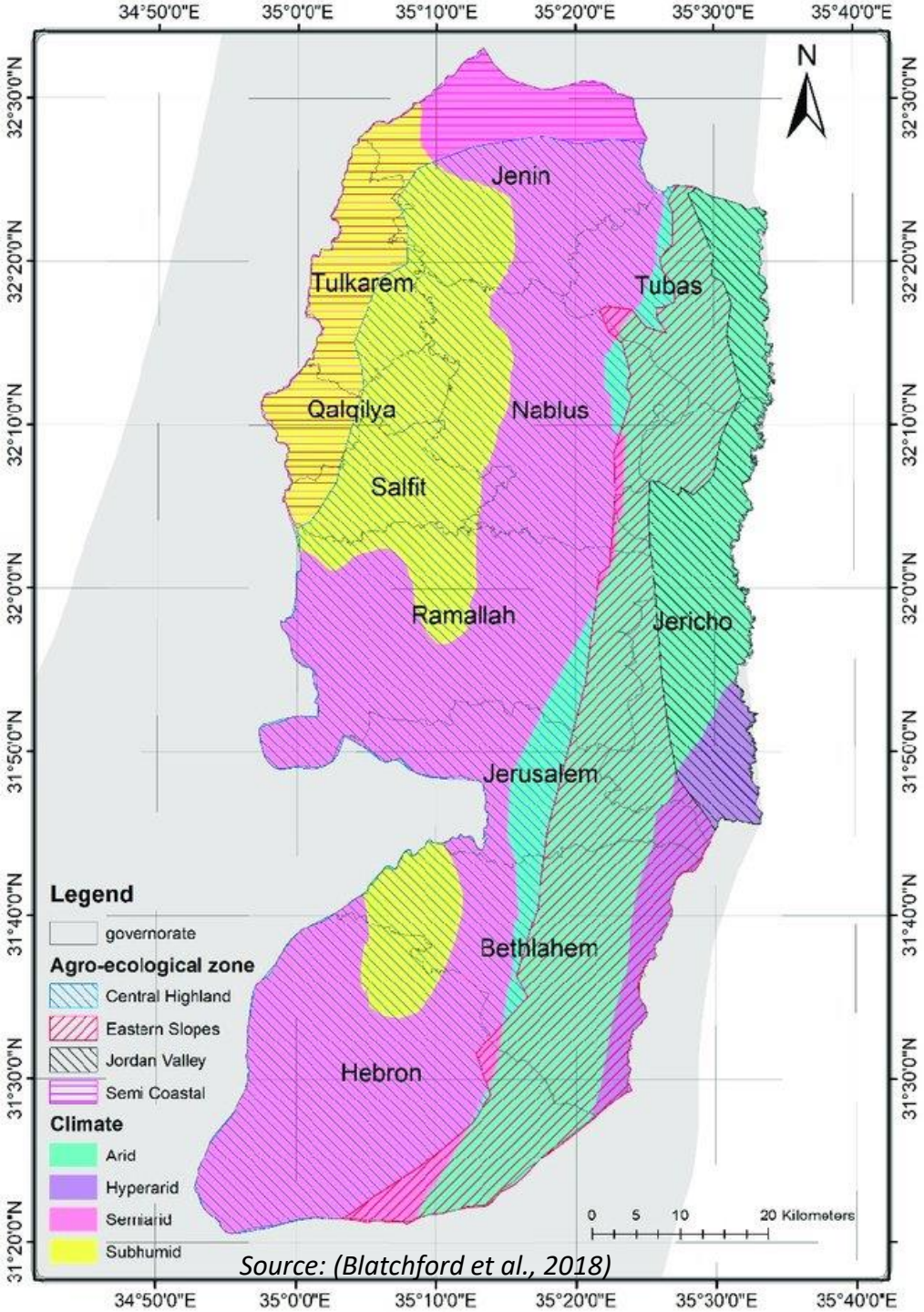
Why RHEM?

- RHEM is designed for government agencies, land managers and conservationists who need sound, science-based technology to model, assess, and predict runoff, water quality, and erosion rates on rangelands and to assist in evaluating rangeland conservation practices effects and sustainability of current and proposed management.

Scientific publications on the development and use of RHEM are available at: https://apps.tucson.ars.ag.gov/rhem/docs



Source: (Blatchford et al., 2018)

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Development of RHEM

RHEM is developed based on a large set of rangeland experimental data.
RHEM was first developed based on the WEPP-IRWET dataset: 204 plots, 49 sites, 15 western states.

RHEM's Limitations

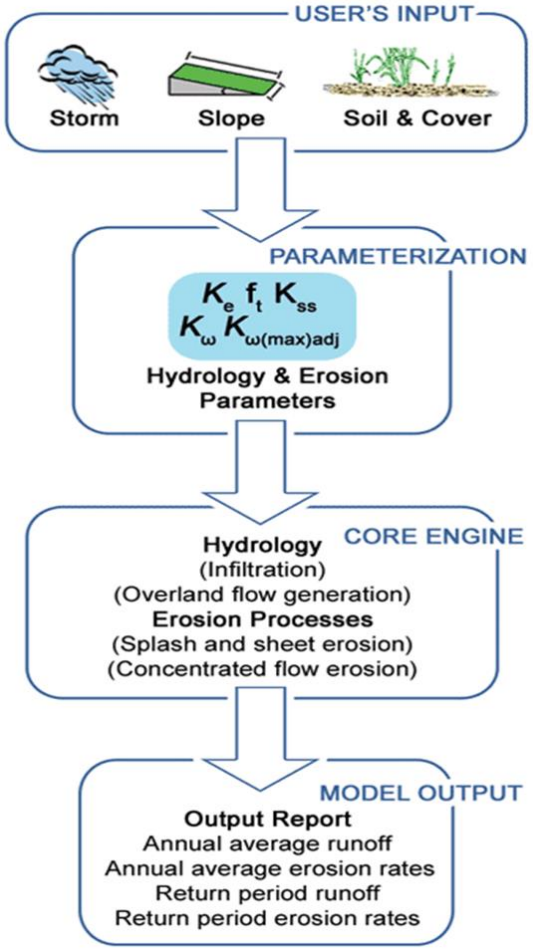
The RHEM model is a single event hillslope scale prediction tool and therefore does not address channel, gulley, side-bank sloughing, head cutting, rain-on-snow, and/or seep induced soil erosion processes

How Does RHEM Work?

USER'S INPUT

RHEM requires:

1. Climate Station from Interface
2. Slope Gradient and Shape
3. Soil (Texture and Chemical Content) and Ground Cover



How Does RHEM Work?

USER'S INPUT

1. Storm Characteristics:

Rainfall data are entered as time-accumulated depth or time-intensity breakpoint pairs.

OR

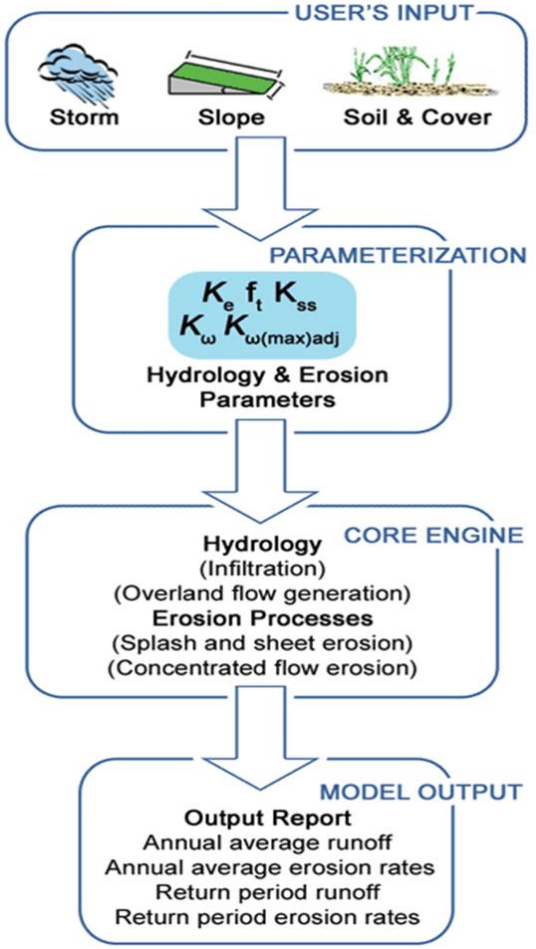
Output from CLIGEN

- Total storm amount
- Duration
- Peak intensity
- Time to peak intensity

Climate – CLIGEN Model

- Generates a 300-year representative climate sequence. Climate is supplied by RHEM after choosing climate station in the interface
- Develops disaggregation time intensity curves for each storm simulated
- NOT to be viewed as a sequence over time, but as a statistical representation of the specified climate at the site evaluated under current vegetation expression

1

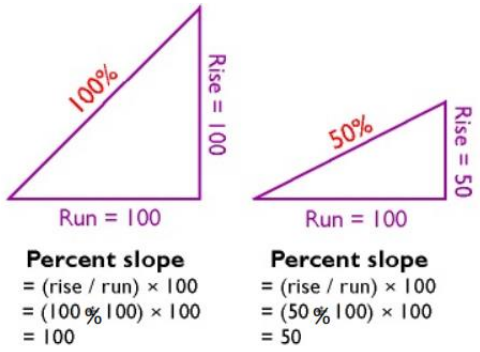


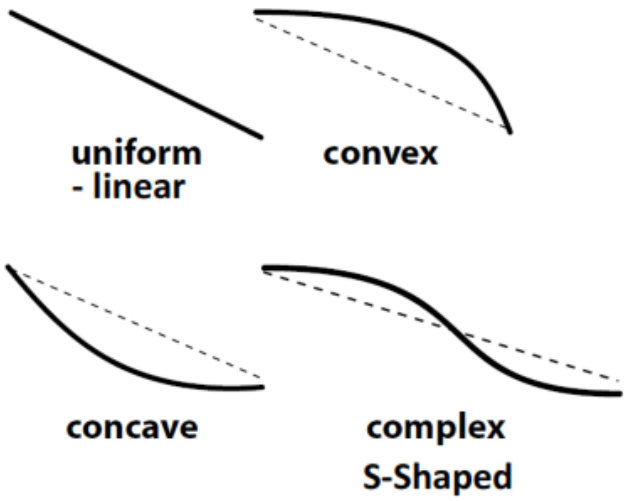
How Does RHEM Work?

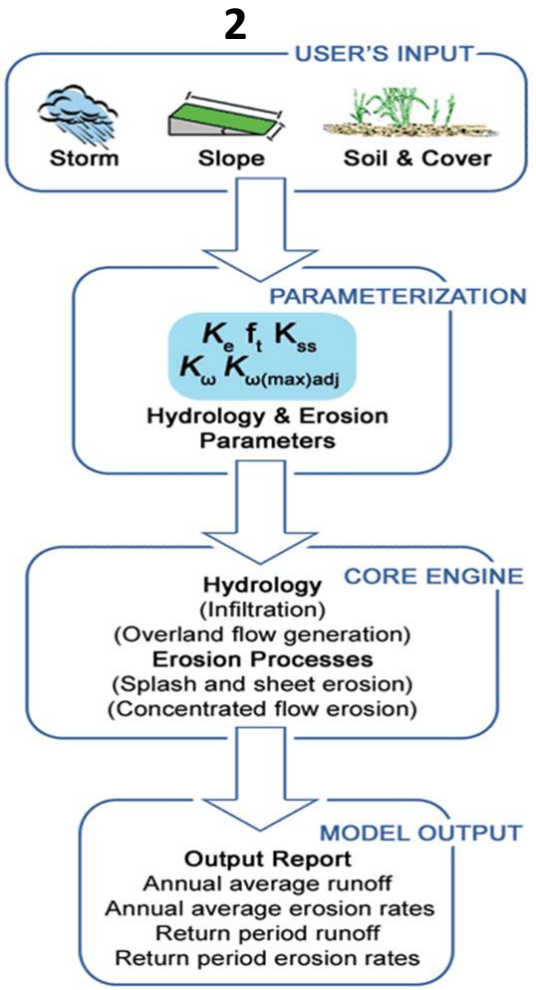
USER'S INPUT

2. Hillslope Characteristics:

- Slope steepness: is defined as rise over run of the hillslope
- Slope length: RHEM default is 50 m in interface
- Slope shape: is defined by the curvature of the hillslope.







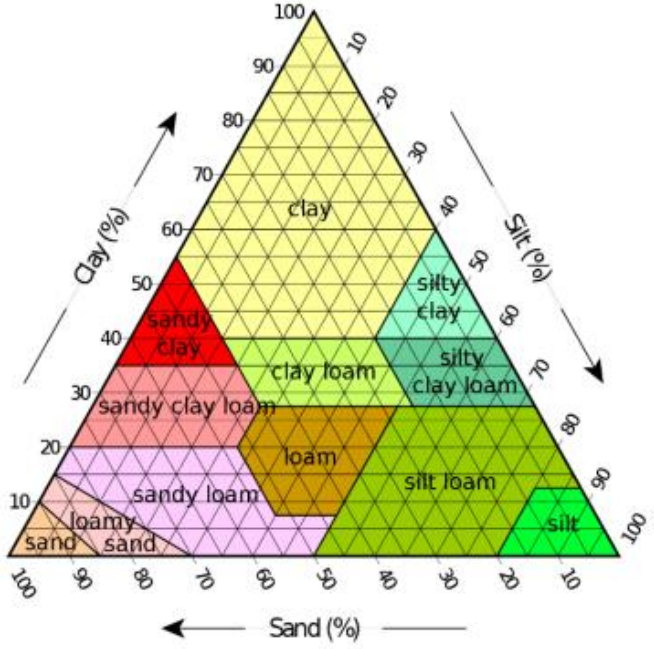
How Does RHEM Work?

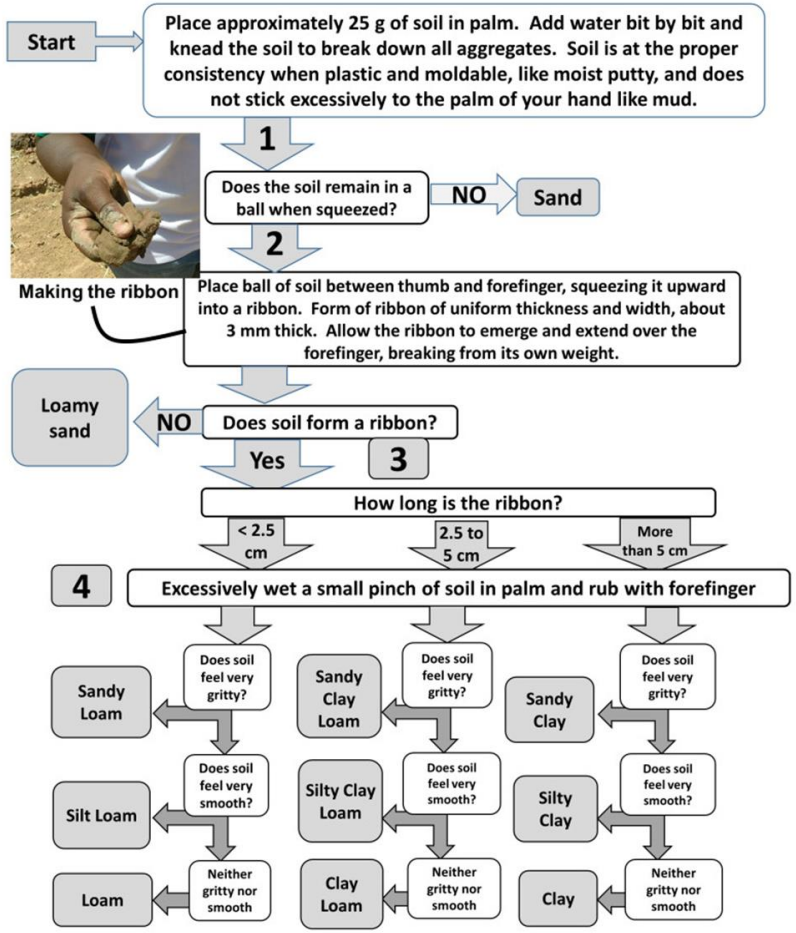
USER'S INPUT

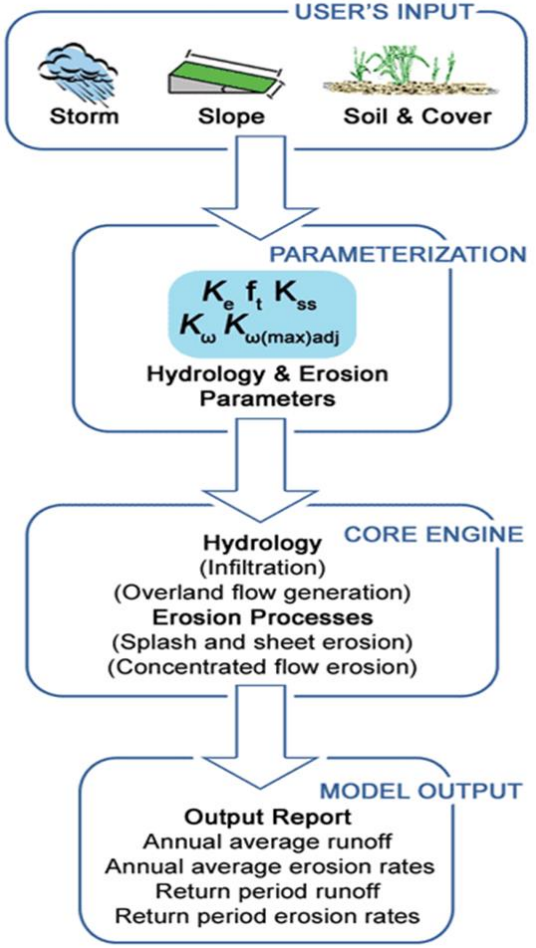
3. Soil and Cover Characteristics:

3.1 Soil Characteristics:

- Soil texture class of the upper 4 cm of the soil profile







How Does RHEM Work?

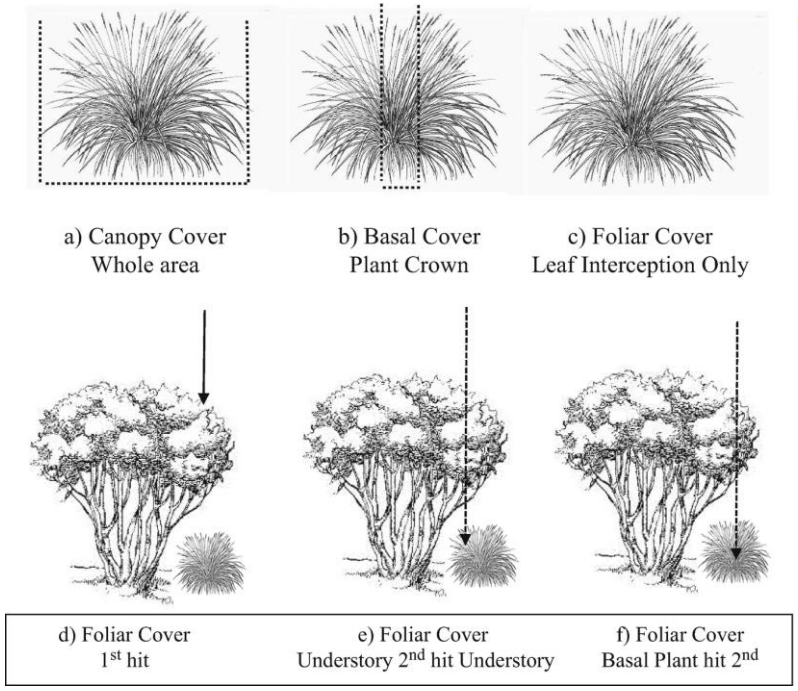
USER'S INPUT

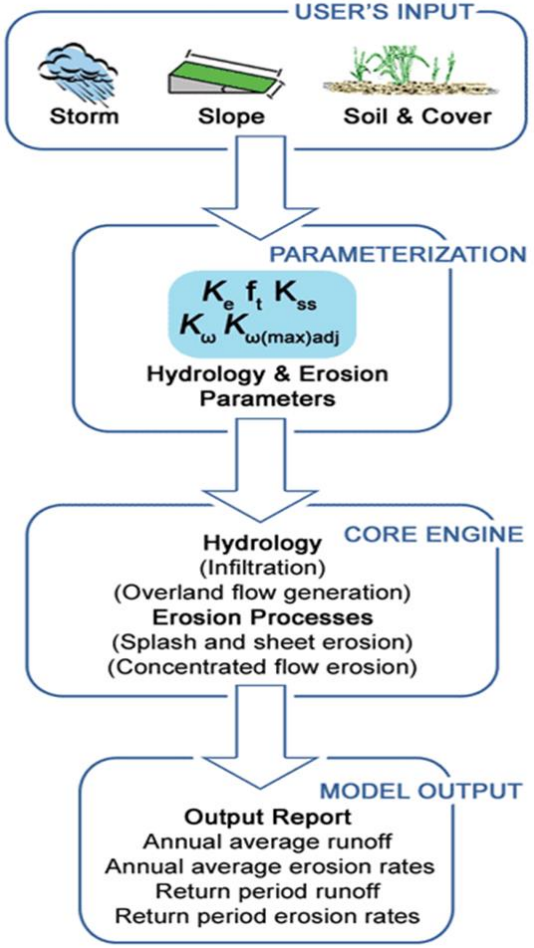
3. Soil and Cover Characteristics:

3.2 Cover Characteristics:

1. Vegetative foliar canopy cover by plant life forms: shrub, bunch grass, sodgrass and forbs.
   - Foliar cover is first hit on any plant
   - Basal area is defined as plant stems emanating directly from the soil surface

2. Ground cover by component: rock, litter, basal area, and cryptogam





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What data can be used to check/validate the model?

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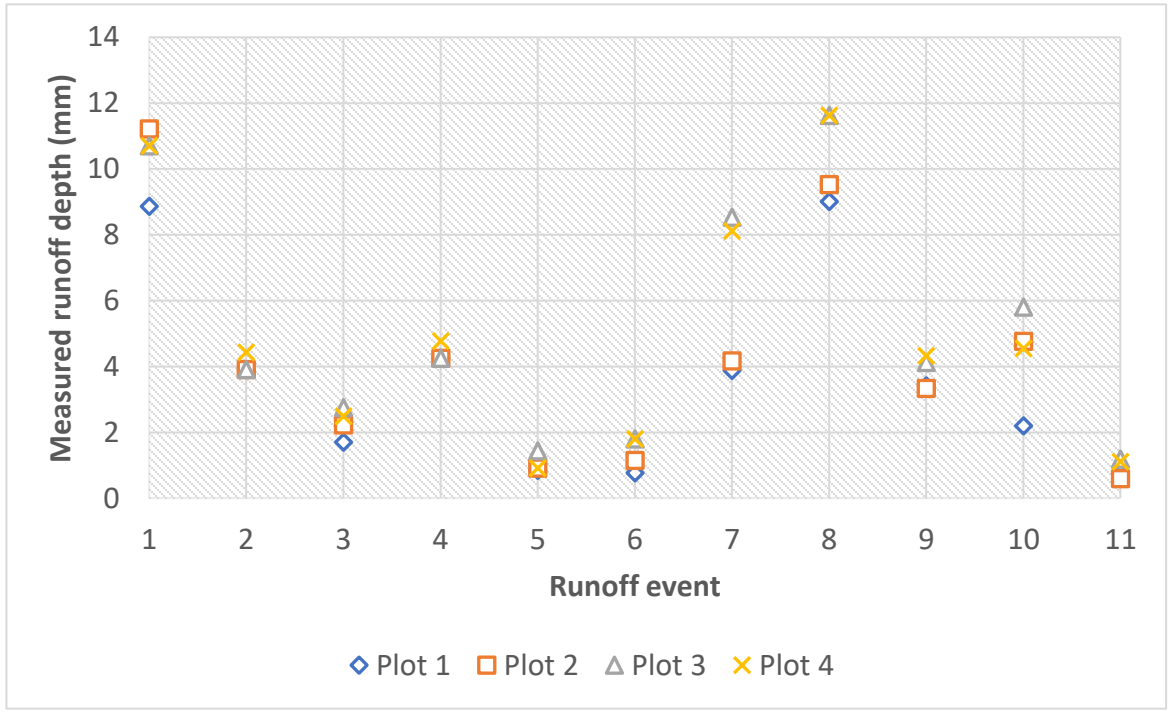
Runoff Plot
runoff and soil erosion data (per event)



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Runoff Plot
Soil and Cover Characteristics

Runoff Plot number	1		2		3		4	
Time	Period 1	Period 2	Period 1	Period 2	Period 1	Period 2	Period 1	Period 2
Slope steepness %	3.95	3.95	3.95	3.95	5.26	5.26	5.26	5.26
Bunch grass foliar cover %	0	0	0	0	0	0	0	0
Forbs and/or annual grasses foliar cover %	2.25	15	1.8	12	0.45	3	0.9	6
Shrubs foliar cover %	0	0	0	0	0	0	0	0
Sod grass foliar cover %	0	0	0	0	0	0	0	0
Total foliar cover %	2.25	15	1.8	12	0.45	3	0.9	6
Basal cover %	0	0	0	0	0	0	0	0
Rock cover %	10	10	10	10	3	3	5	5
Litter cover %	0.9	6	0.9	6	0.45	3	0.45	3
Biological crusts cover %	0	0	0	0	0	0	0	0
Total ground cover %	10.9	16	10.9	16	3.45	6	5.45	8

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Storm event data

Season	Runoff reading date	Date of rainfall	Number of storms	Rainfall amount per storm (mm)	Observed Runoff (mm)			
					Plot 1	Plot 2	Plot 3	Plot 4
A. Season (2016/2017)	18-Dec-16	15-Dec-16	3	4.25	8.87	11.22	10.70	10.70
				1.68				
				2.62				
		18-Dec-16	1	20.06				
	22-Dec-16	20-Dec-16	2	5.80	3.91	3.91	3.91	4.43
				2.39				
	28-Dec-16	25-Dec-16	2	3.33	1.71	2.23	2.75	2.49
				1.02				
		28-Dec-16	1	0.59				
	30-Jan-17	28-Jan-17	2	9.01	4.26	4.26	4.26	4.78
				5.21				
		29-Jan-17	2	10.30				
				1.50				
	19-Feb-17	2-Feb-17	1	3.11	0.85	0.92	1.44	0.92
		14-Feb-17	2	4.91				
				2.11				
		16-Feb-17	1	3.31				
		17-Feb-17	1	5.20				

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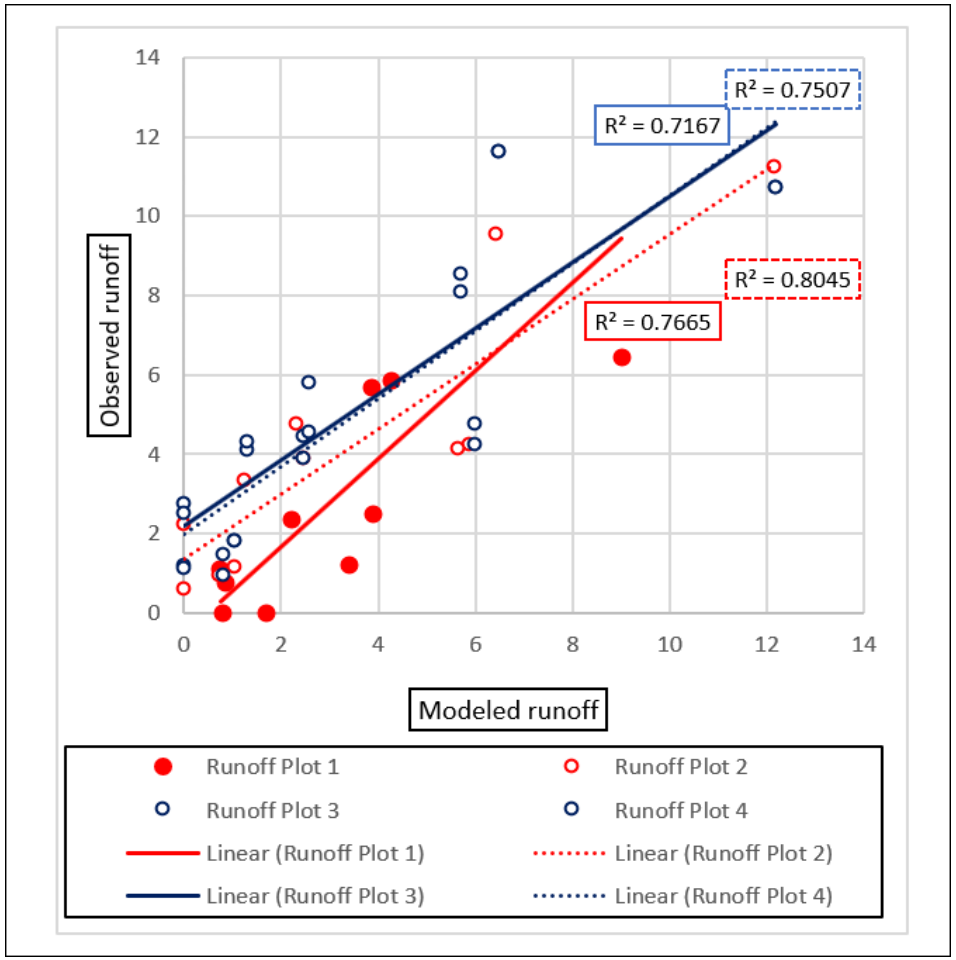
RHEM output



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RHEM web tool

Step 1: Register for free at: http://dss.tucson.ars.ag.gov/rhem/

Step 2: Login in with unique username and password

Step 3: Create a new scenario within the Define Scenario box by typing a name that identifies the situation you want to evaluate. A scenario is defined as a unique set of input parameters needed to run RHEM. Select the units (English or metric) to be used.

Step 4: Select climate station of interest from map or dropdown list.

Step 5: Define the soil texture of the upper 4 cm of the soil profile. Soil texture is input as a class name from the USDA soil textural triangle and selected from a drop down menu. Soil maps and texture information can be obtained at NRCS Web Soil Survey at: http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

Step 6: Enter the slope length (m), slope shape, and slope steepness (%). Slope length in RHEM is defined as the length of the path that water flows down a slope as sheet and rill flow until it reaches an area where flow begins to concentrate in a major channel, or to the point where the slope flattens resulting in deposition.

Step7: User defines both foliar canopy cover and ground cover by percent.

Step 8: Run the model and generate output that can be viewed in tables or graphical form. Output is saved and can be retrieved and viewed when you next login into RHEM.