The Effect of Soil Moisture Dynamics on Stream Discharge

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Background:

Soils are physically connected with streams and have the potential to regulate flow, playing an important role in controlling how water inputs are stored and released.

Storm precipitation and spring snowmelt can increase soil moisture levels to saturation, activating surface and shallow subsurface flow paths to streams, significantly increasing stream discharge.

Soil moisture dynamics and its relationship to catchment scale hydrology have so far been studied at daily or longer time scales. The examination of sub-daily data will allow us to quantify water flux from soils to streams and may play a key role in understanding solute transport dynamics.

Research Question:

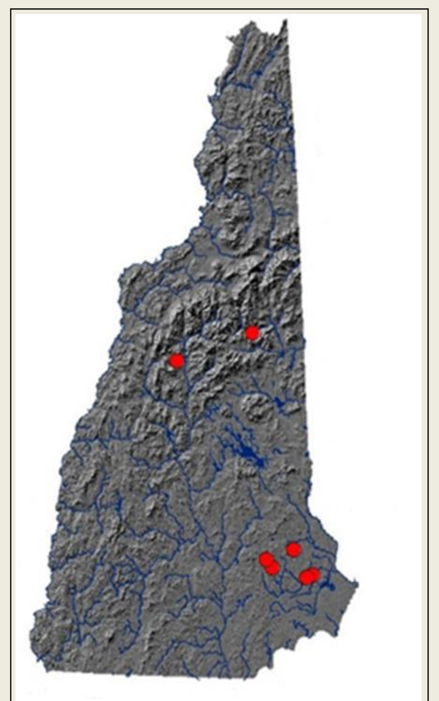
How is soil moisture related to stream discharge?

H1. Stream flow (Q) and soil moisture (S) relate to each other with a power law equation of the form $Q = x(s)^{\alpha}$

H2: Catchment characteristics, soil type, storm intensity, and seasonal variation will influence the relationship between soil moisture and stream discharge

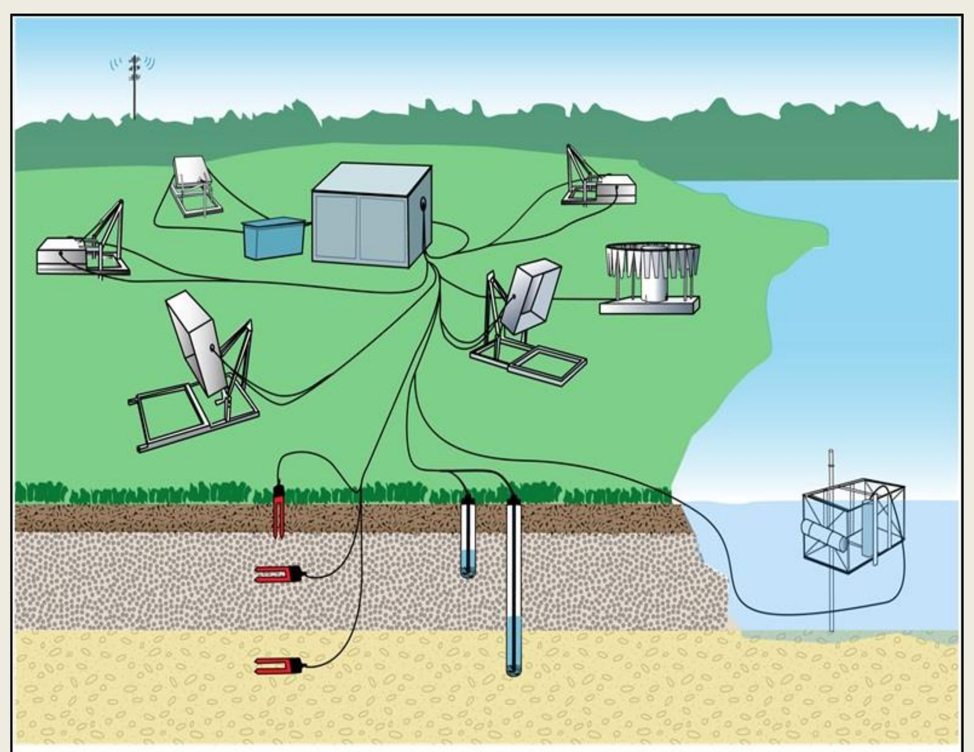
Method:

To capture this coupled terrestrial and aquatic system response, we are utilizing data from the NHEPSCoR *in situ* soil and stream sensor network that is deployed across the state collecting data every hour. The three sites targeted for this preliminary analysis are Saddleback Mountain, Dowst Cate Town Forest, and Burley DeMerritt Farm, which are all located within the Lamprey River Watershed.



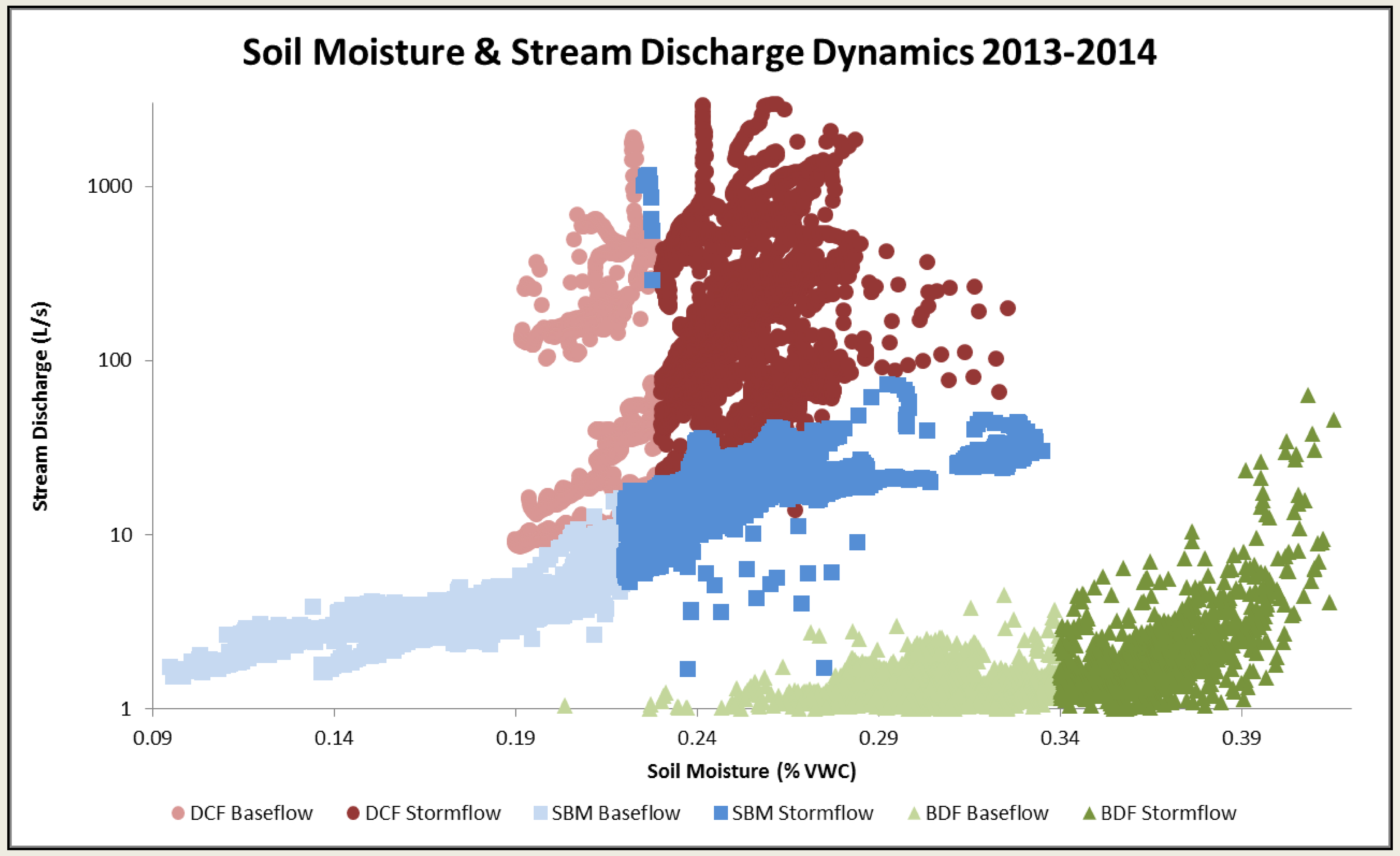
Map of EPSCoR soil sensor network sites around the state of New Hampshire

Map By: Lucie Lepine

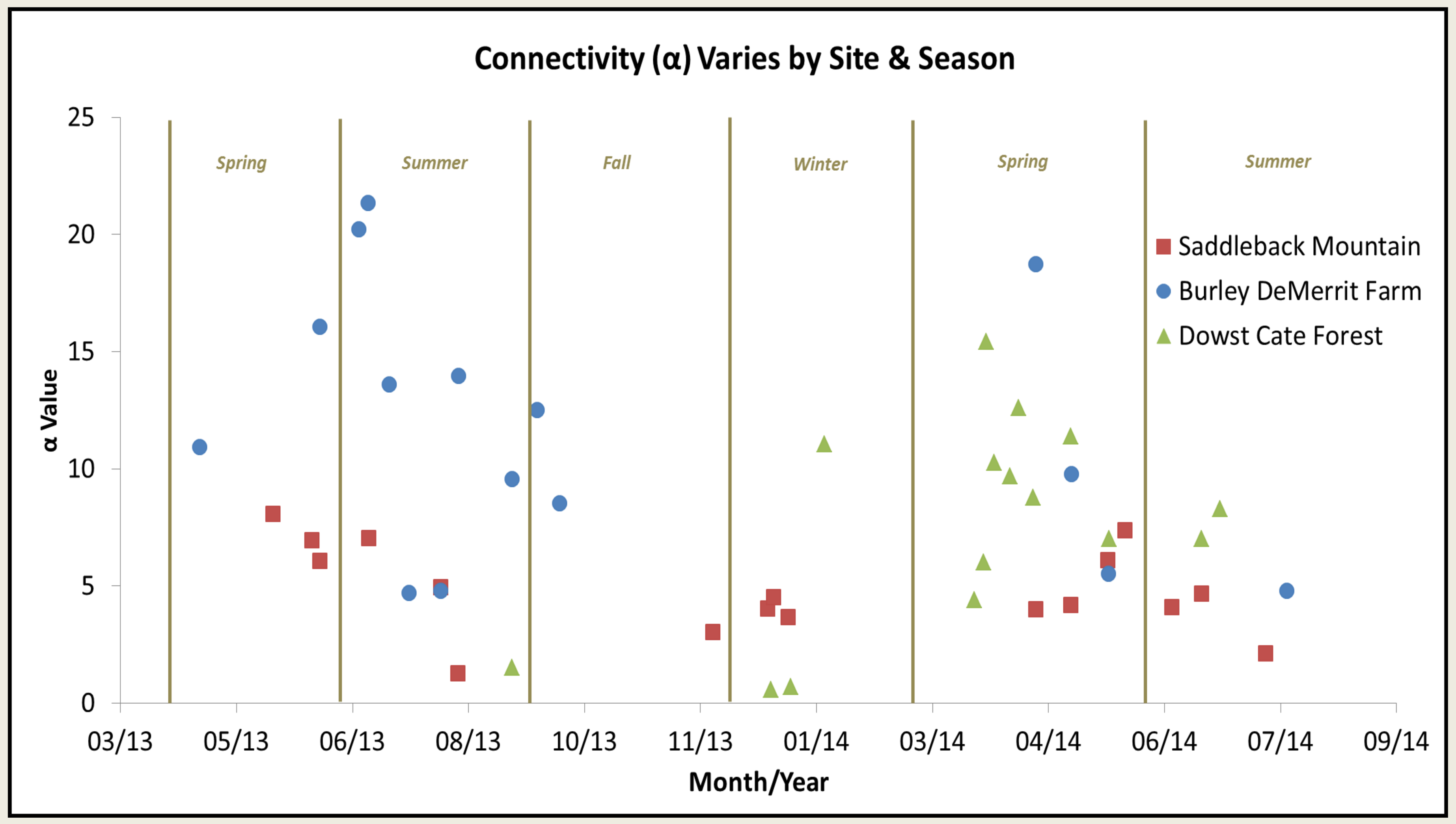


Conceptual Diagram of Coupled Terrestrial & Aquatic Sensor Network

An hourly time series was used to examine the relationship between soil moisture and stream discharge on sub-daily and seasonal timescales. Individual storm events were isolated and fit to the power law equation in **H1** ($Q = x(s)^{\alpha}$). The alpha values (exponent) in the power law equation serve as a connectivity metric between soils and streams.



The relationships fit the power law equation hypothesized, following a similar trend while having distinctly different behaviors. These differences can be attributed to location within the catchment, topography, soil type, and vegetative water demand.



Connectivity between soils and streams during storm events can vary from site to site depending on catchment characteristics (e.g. topography), soil type, storm intensity and season (e.g. vegetative water demand) .

Support for this project was provided by NH EPSCoR with support from the National Science Foundation's Research Infrastructure Improvement Award # EPS 1101245.

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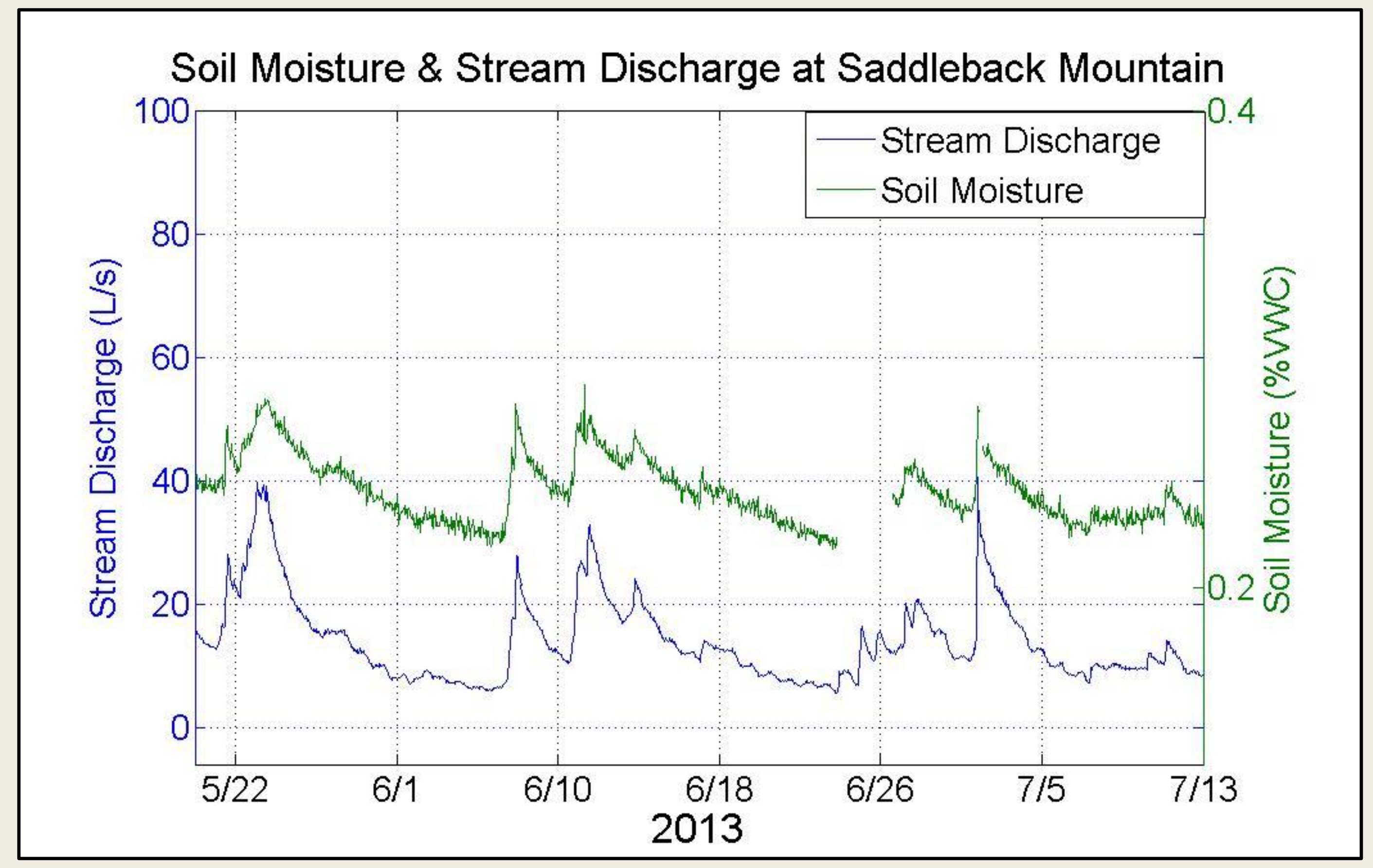
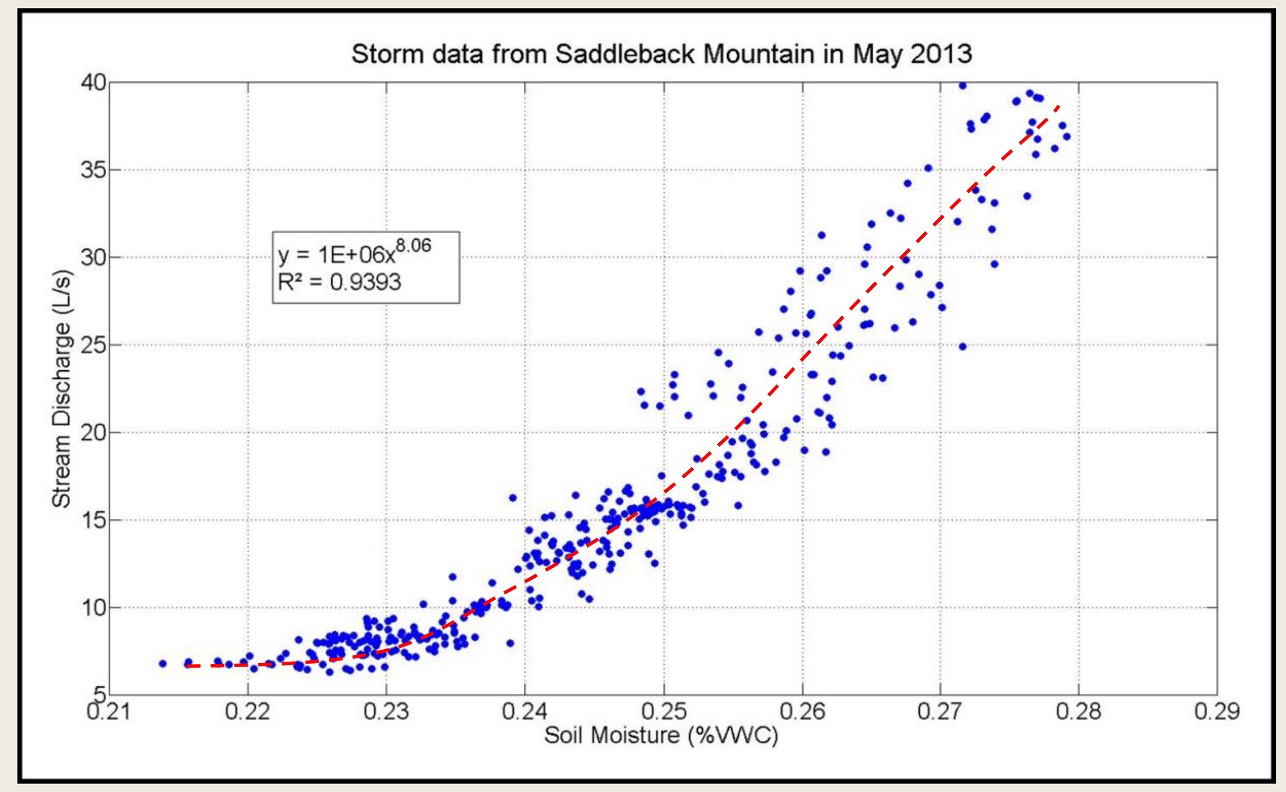
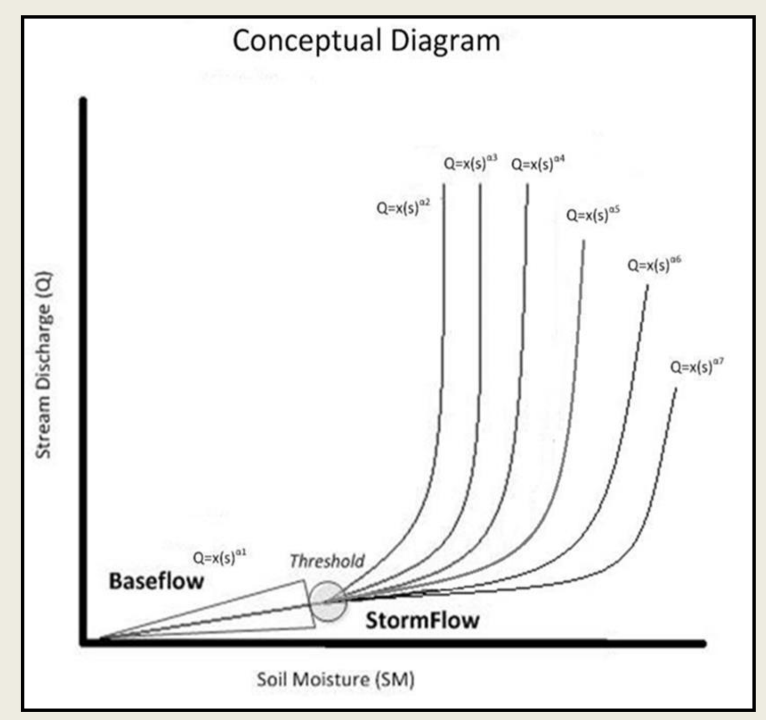


A snapshot of the time series used to isolate individual storm events to fit to the power law equation. This data is representative of the entire time series.



Data from one storm event which represents a point on the Connectivity figure.



Next Steps:

1. Examination of connectivity metric (alpha) during storm events with a distinction between the rising and falling limb of the hydrograph
2. Analyze data from two remaining sites
3. Update datasets through 2014