

# Improving Snowpack Depletion Curves in the Precipitation-Runoff Modeling System (PRMS)

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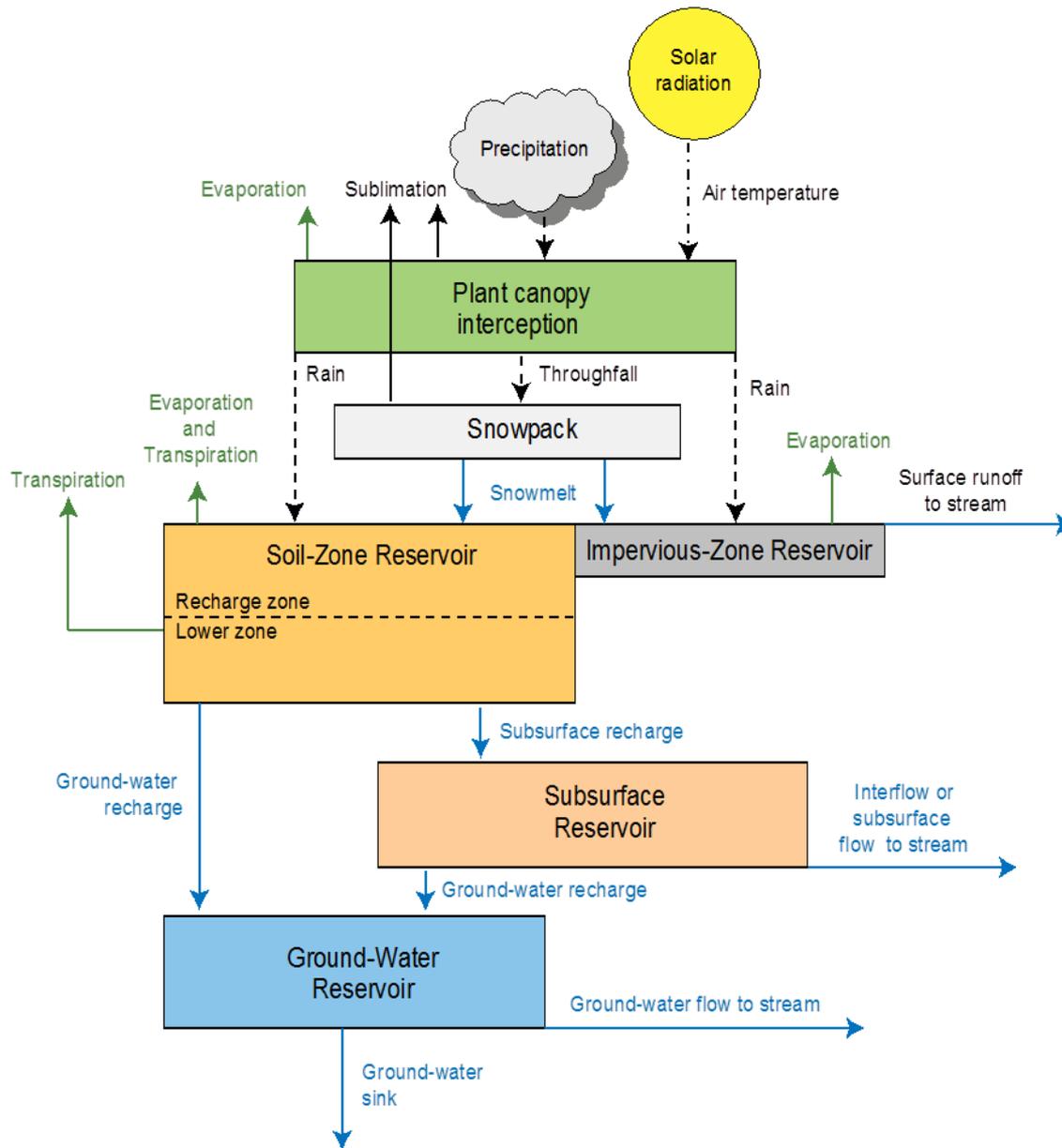


# PRMS

## Precipitation-Runoff Modeling System

- USGS watershed model developed by George Leavesley
- Operates on a daily time step
- ***Data input:***
  - Daily precipitation
  - Max/min. daily air temperature
- ***Simulated output:***

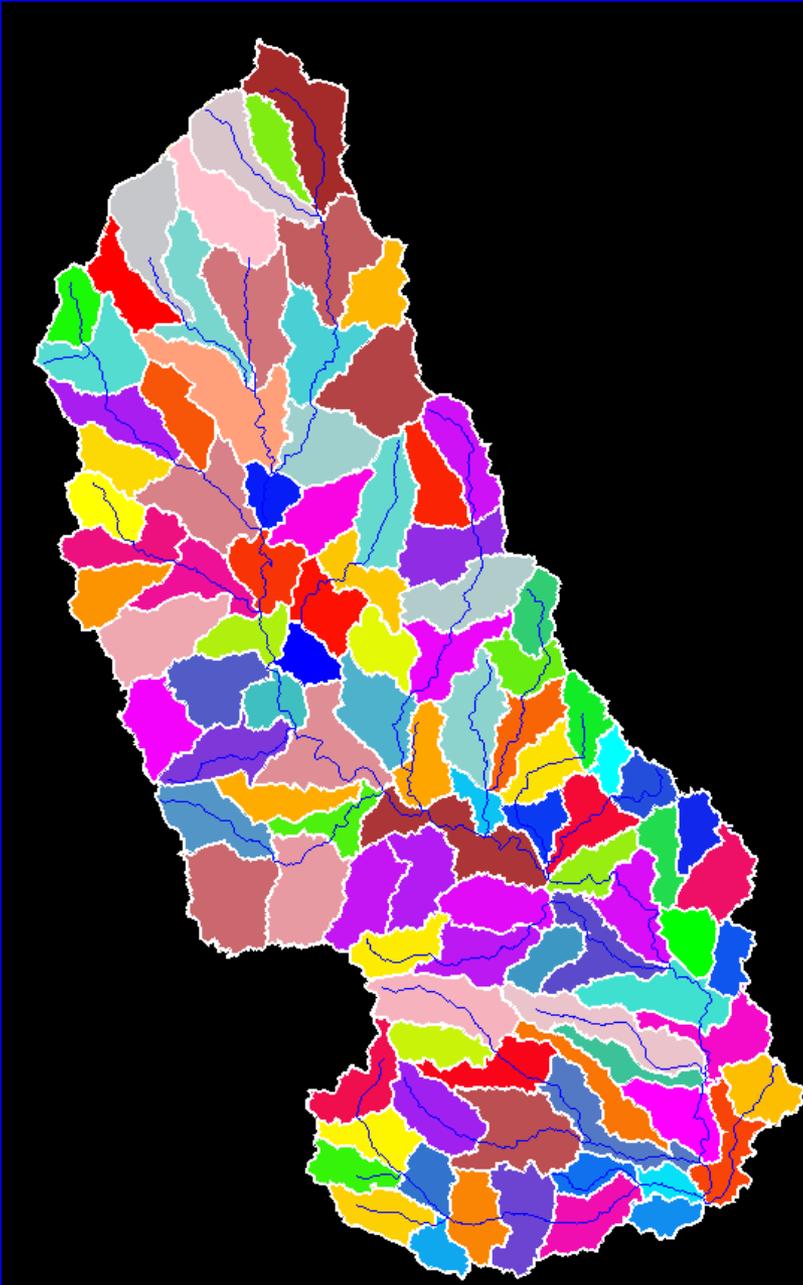
Full range of daily water budget storage/fluxes within the watershed and at the outlet



# PRMS is a Physical Representation of Watershed Hydrologic and Energy Processes

## Reference:

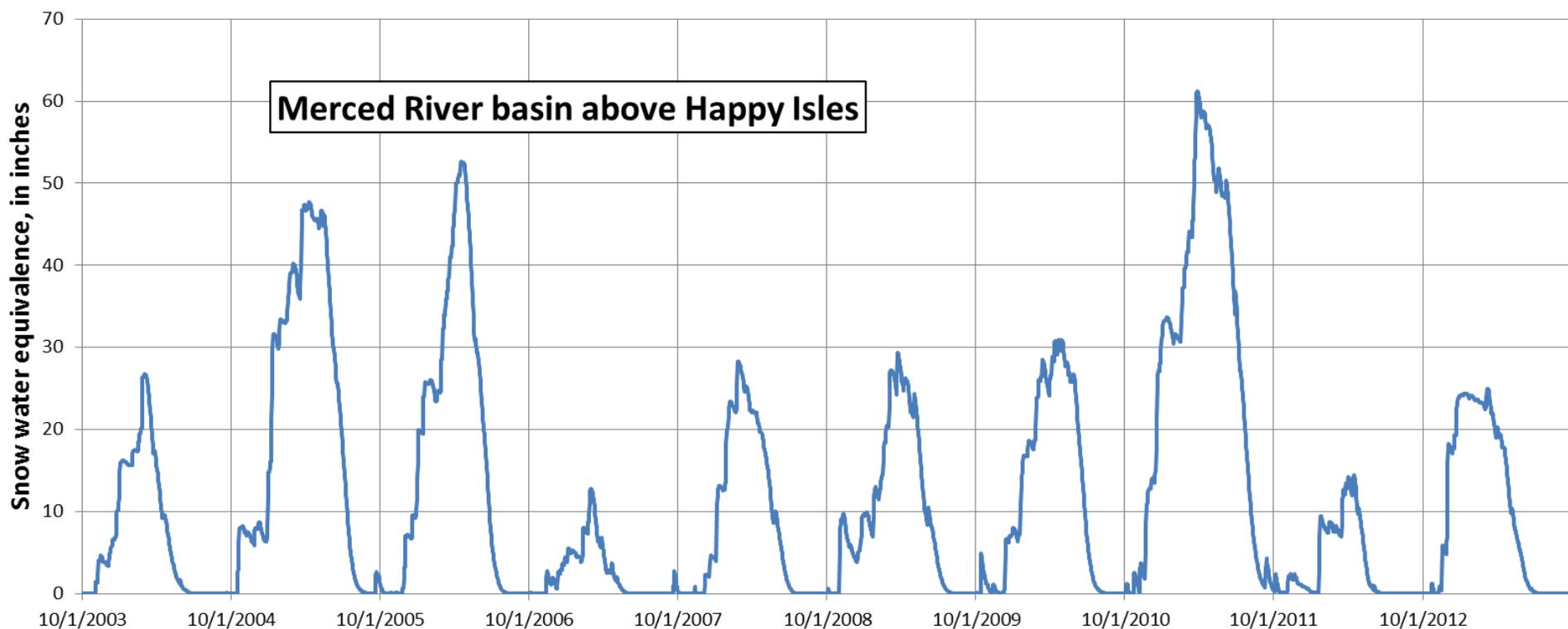
Leavesley, G.H., Lichty, R.W., Troutman, B.M., and Saindon, L.G., 1983, Precipitation-runoff modeling system—User's manual: U.S. Geological Survey Water-Resources Investigation Report 83-4238, 207 p.



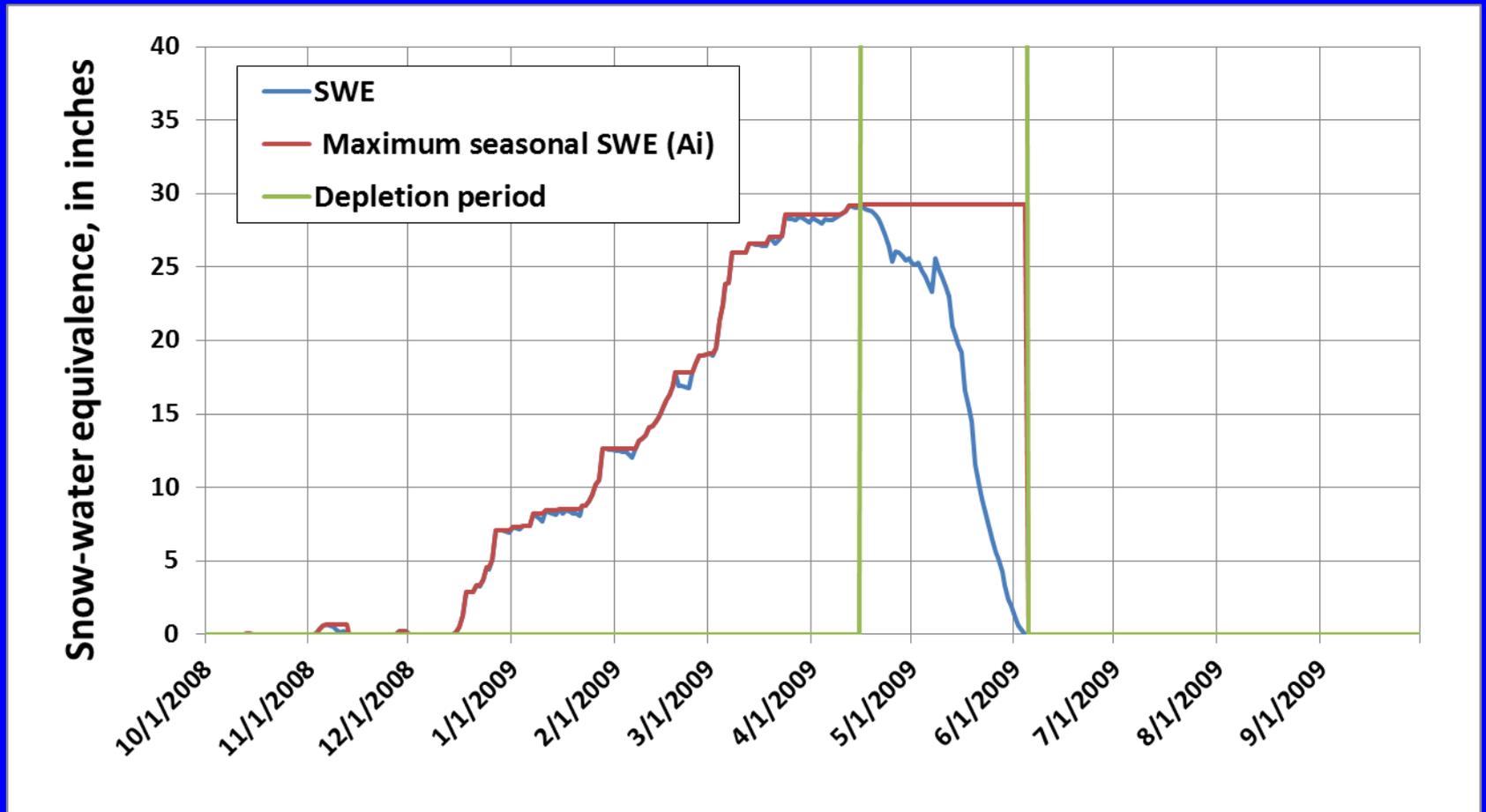
## **PRMS is a Distributed Parameter Model**

**Areas in a watershed  
having similar  
hydrologic processes  
are delineated as  
Hydrologic Response  
Units (HRUs)**

# Snow-Water Equivalence Simulated on a Daily Time Step in PRMS

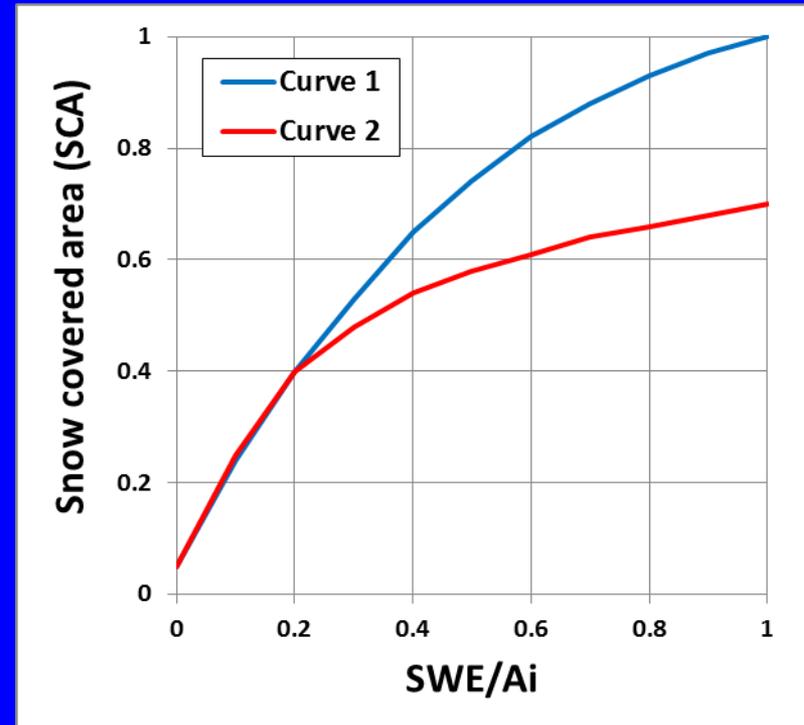


# Snowpack Depletion Period



# Current PRMS Snow Depletion Curves

- Curves are defined as the ratio of snow-water equivalence (SWE) divided by the maximum seasonal snow-water equivalence ( $A_i$ ) (**X axis**) versus the percent snow cover area (SCA) (**y axis**).
- Lower elevation forested HRUs generally use (**Curve 1**) and windy sparsely vegetated higher elevation HRUs use (**Curve 2**).

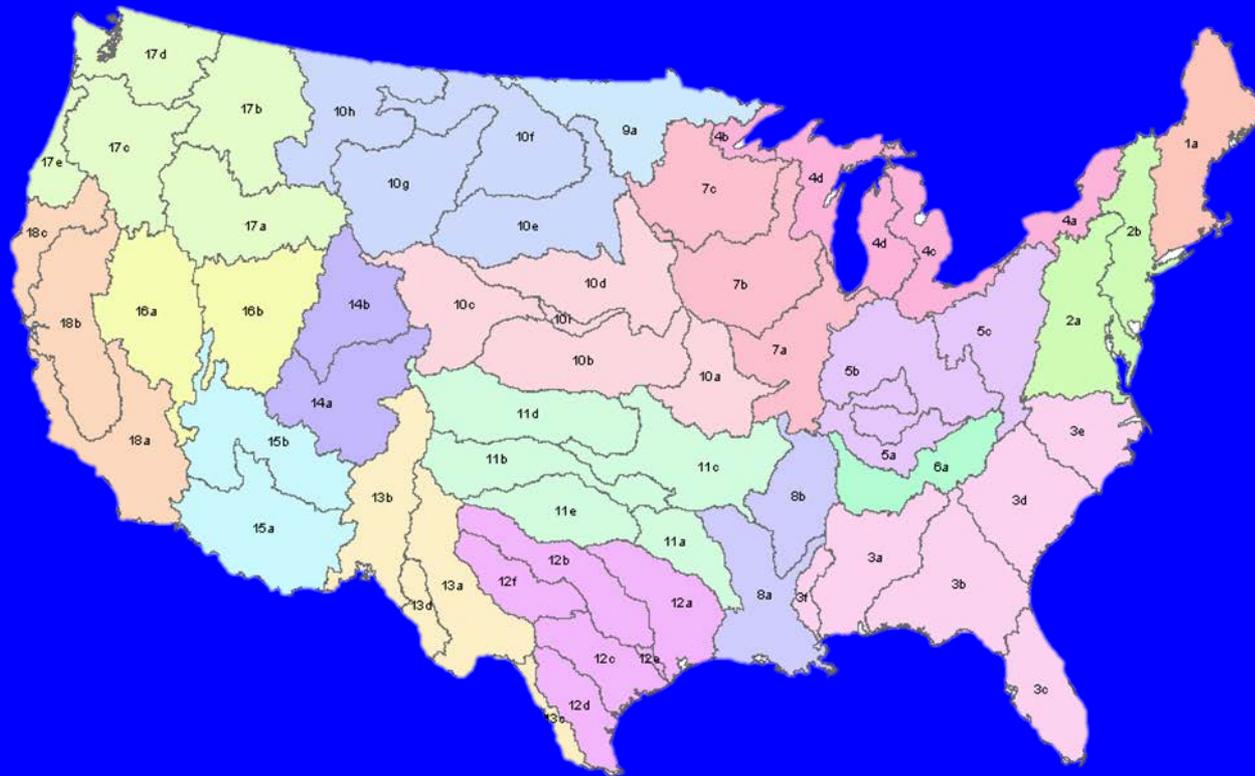


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# USGS National Hydrologic Model (NHM)

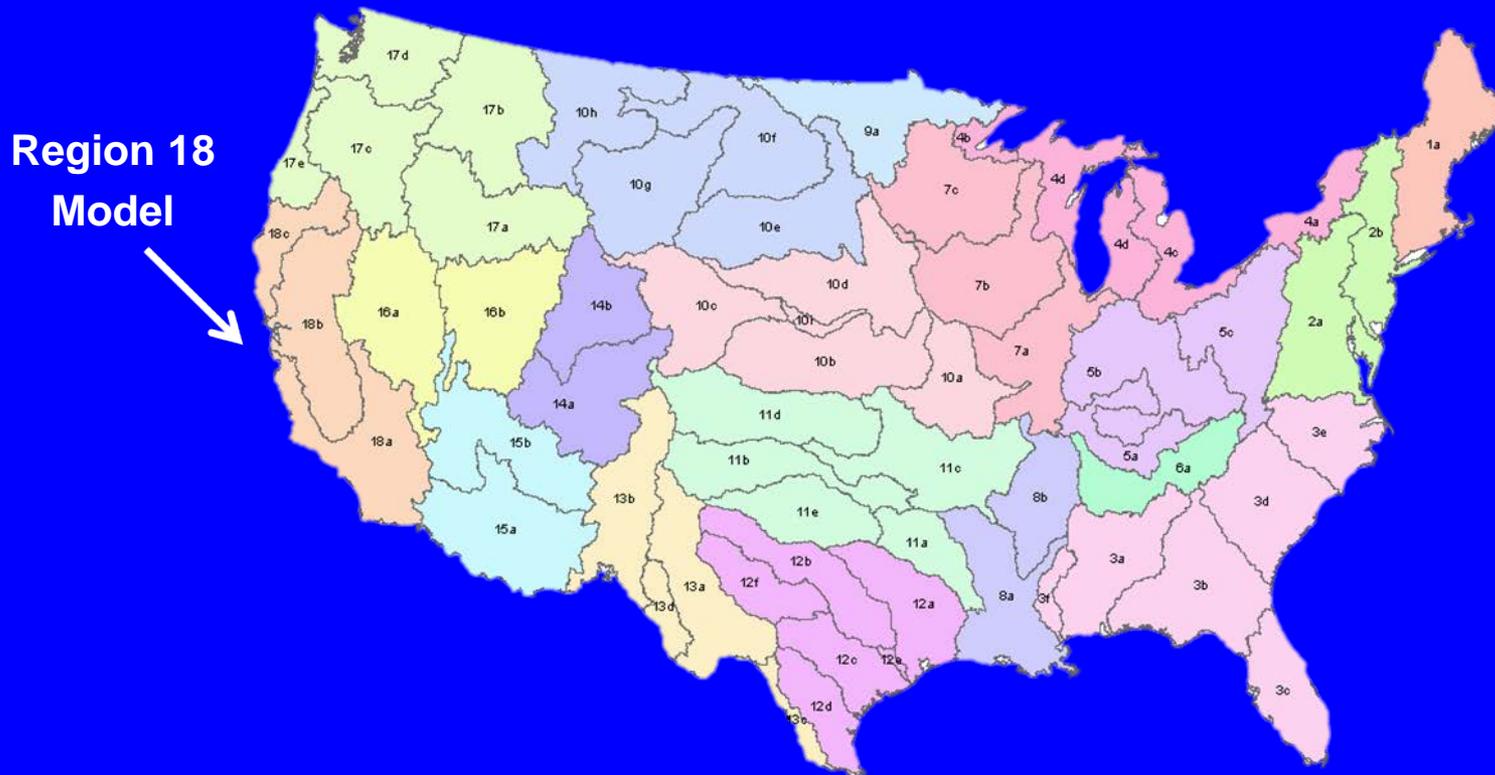
New PRMS model with pre-calibrated HRUs currently in development (Lauren Hay, USGS National Research Program)



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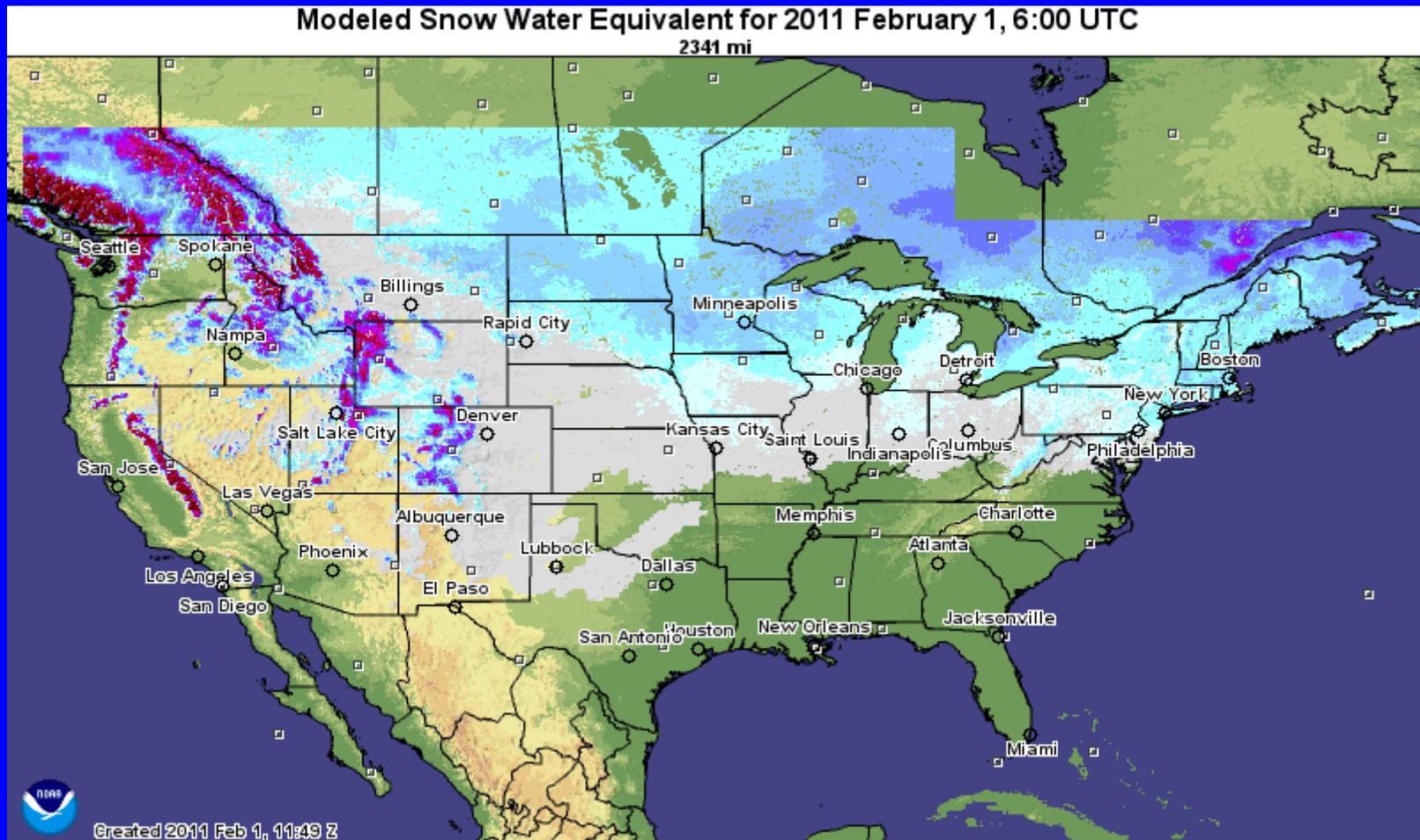
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# Snow Depletion Curve Analysis

To improve PRMS accuracy at ungaged watersheds, individual snow cover areal depletion curves will be created for all snow significant hydrologic response units (HRU) in the National Hydrologic Model (NHM) using weighted-mean daily time series (2003-2014) of:

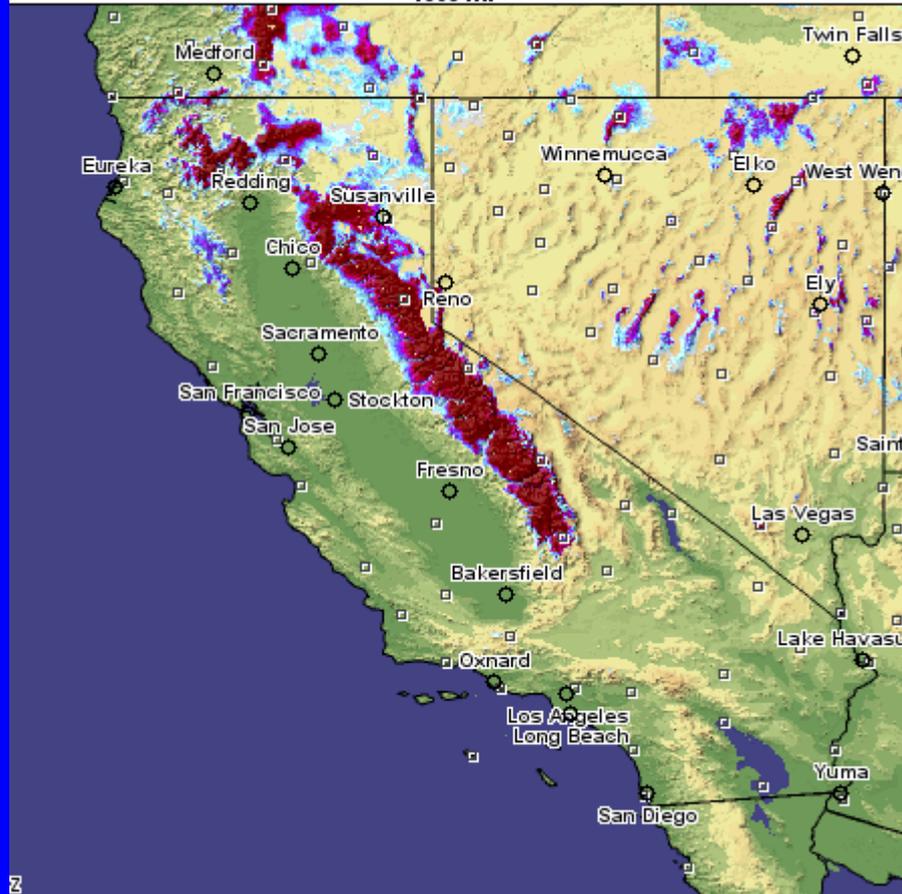
- (1) 1-kilometer gridded SWE, from U.S. National Weather Service Snow Data Assimilation System (**SNODAS**), and
- (2) 500-meter gridded SCA, from NASA Moderate Resolution Imaging Spectroradiometer (**MODIS**).

# U.S. National Weather Service SNODAS SWE

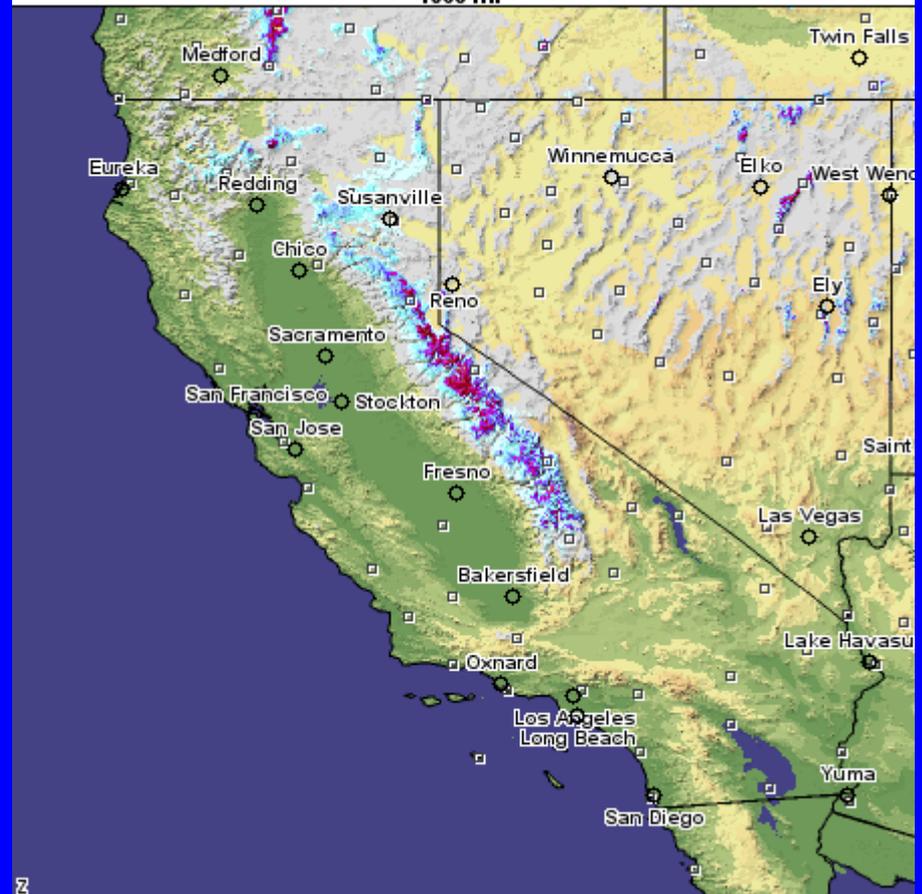


# U.S. National Weather Service SNODAS SWE

Modeled Snow Water Equivalent for 2011 April 1, 6:00 UTC  
1068 mi



Modeled Snow Water Equivalent for 2014 April 1, 6:00 UTC  
1068 mi

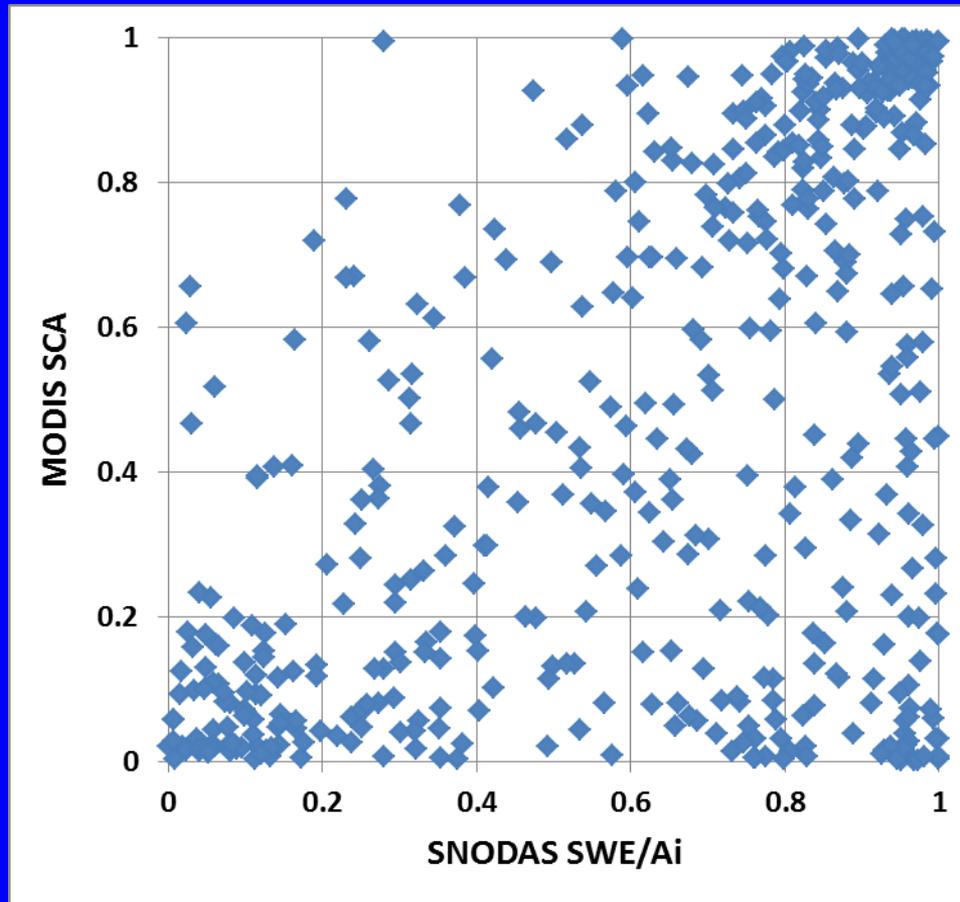


Source: U.S. National Weather Service

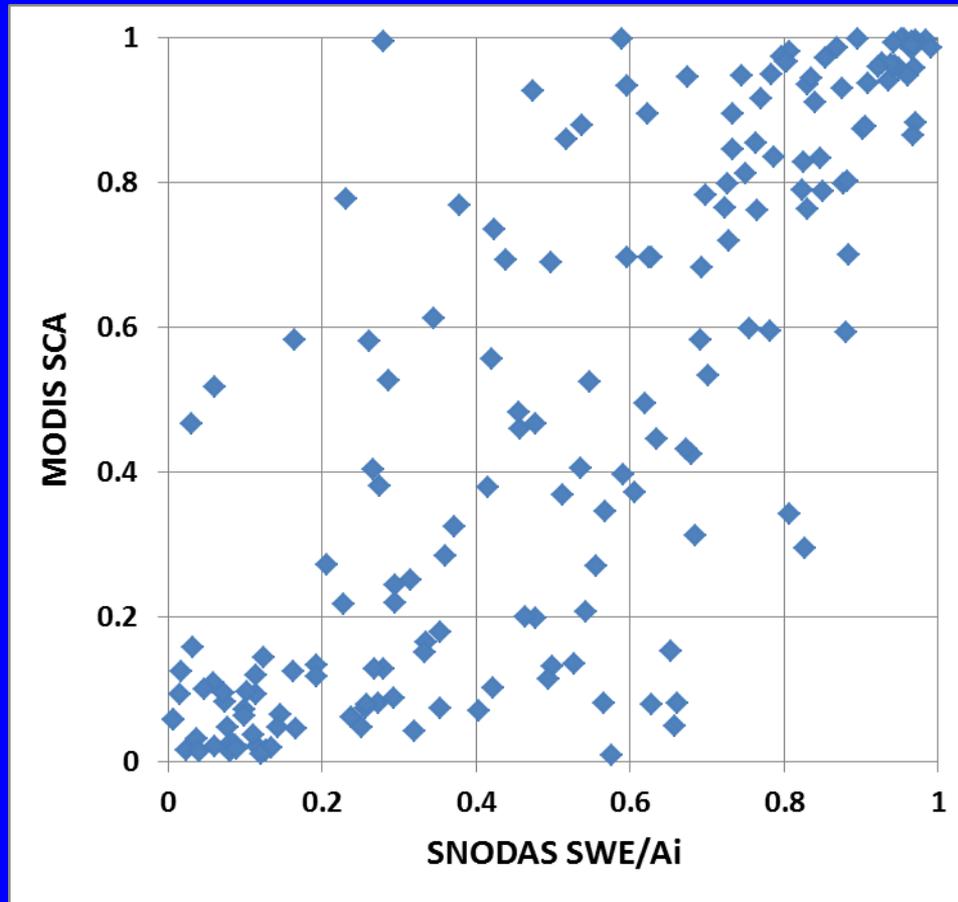
# Approach:

SWE/Ai and SCA values are paired in each HRU

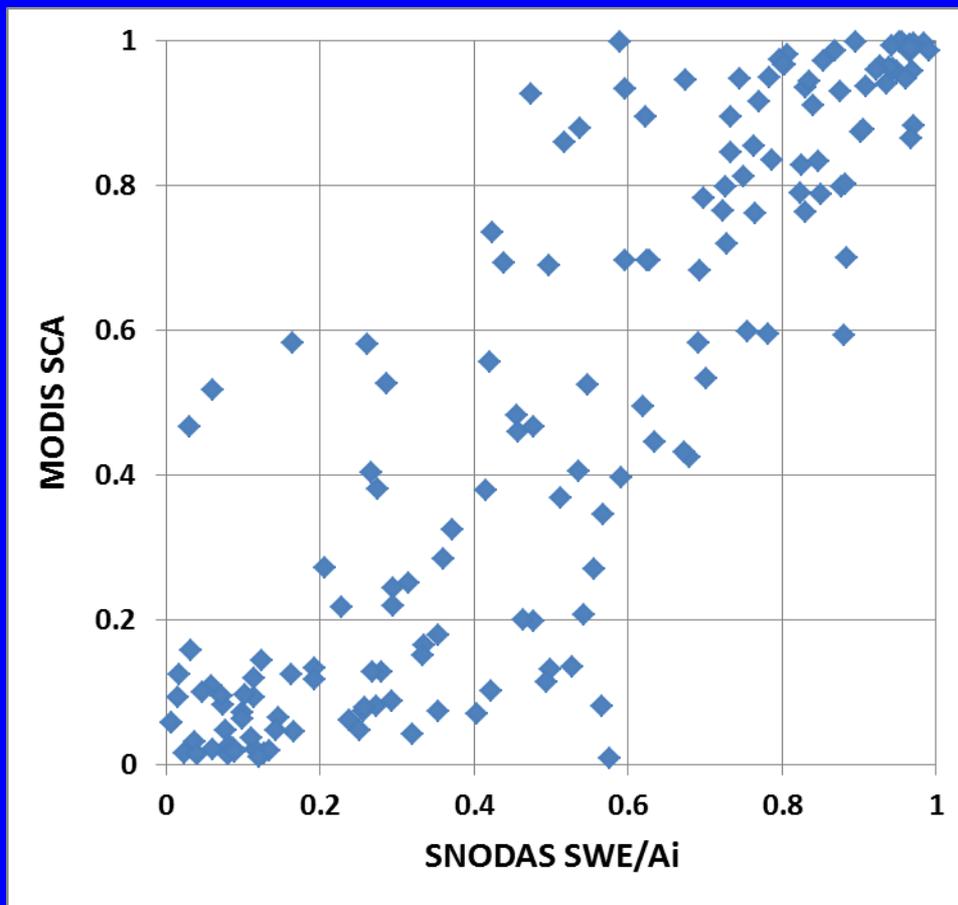
*Ebbetts Pass, California, 8,765 feet*



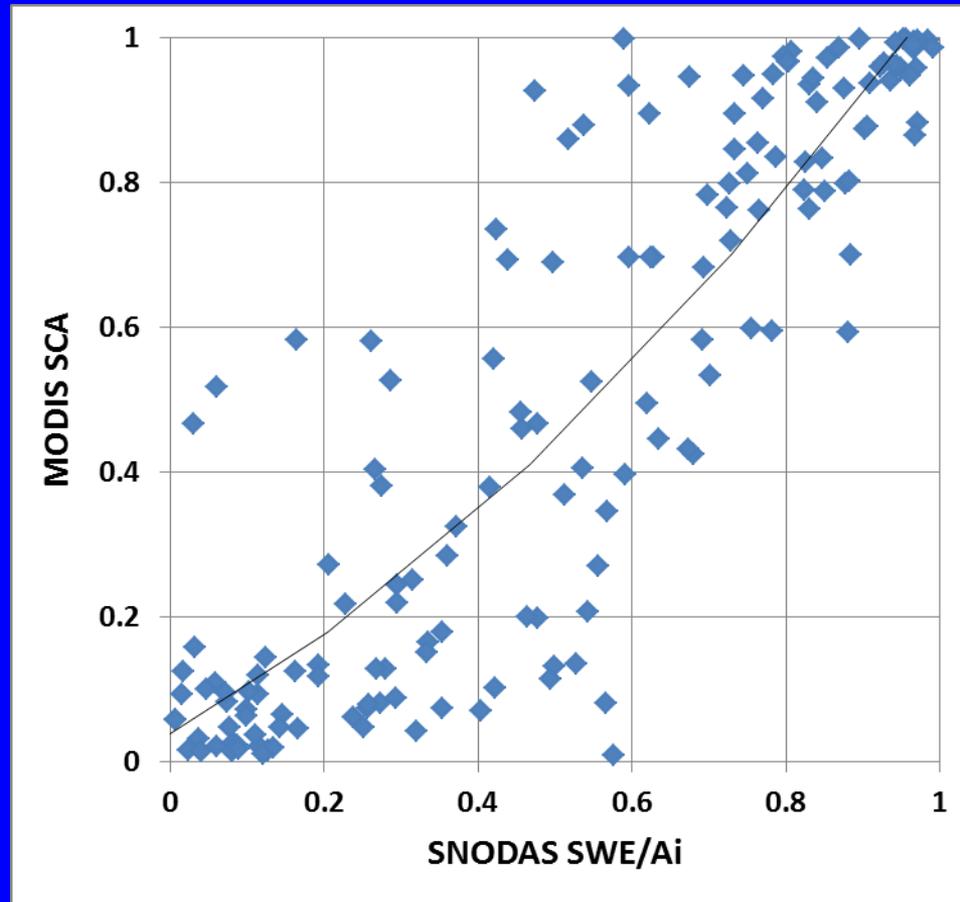
# SCA values below a cloud cover threshold are filtered out



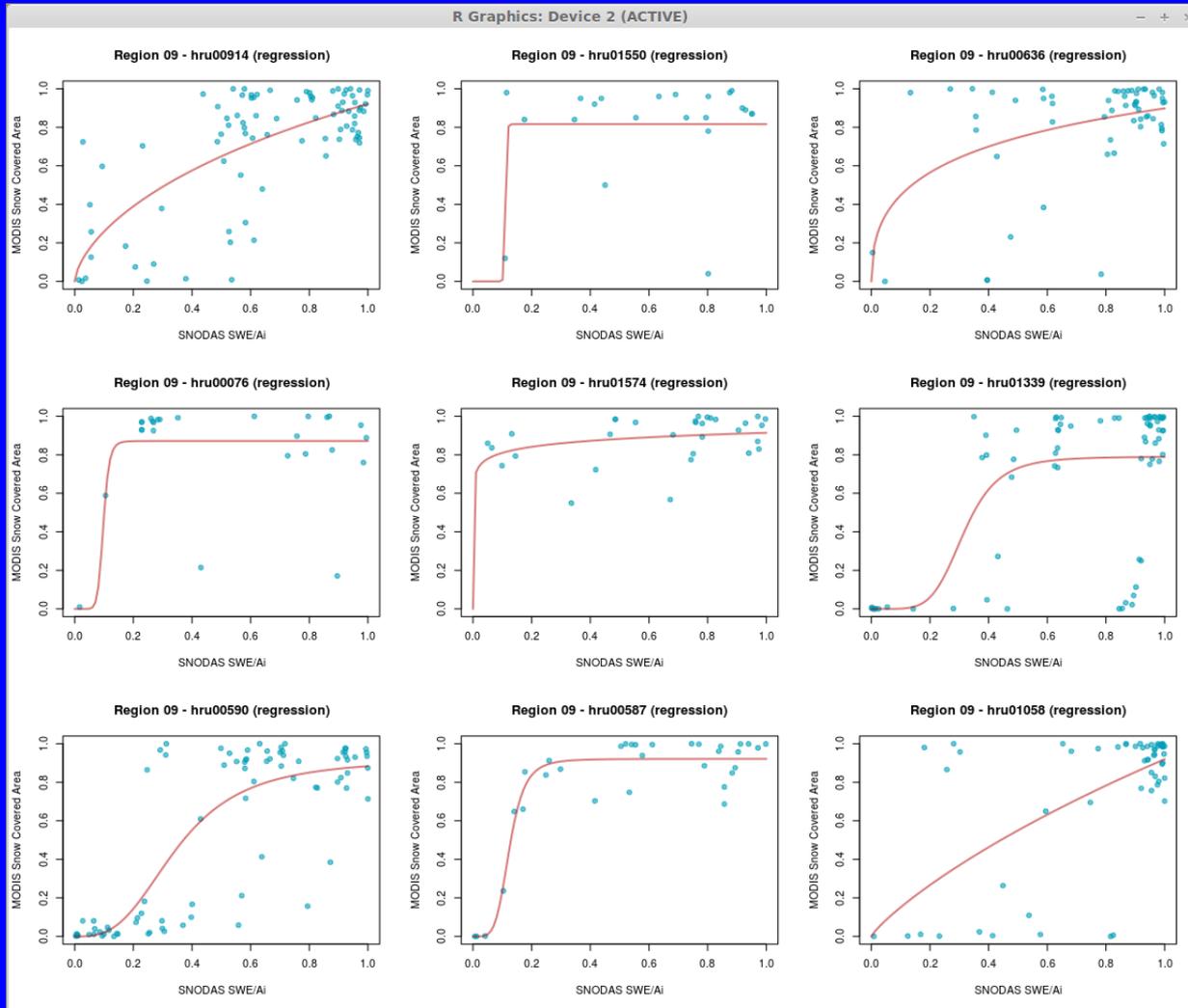
# Unrealistically low and high values of SCA and SWE/Ai are filtered out



# A non-linear regression is fit to remaining SWE/A<sub>i</sub> and SCA pairs to create a unique curve for each HRU

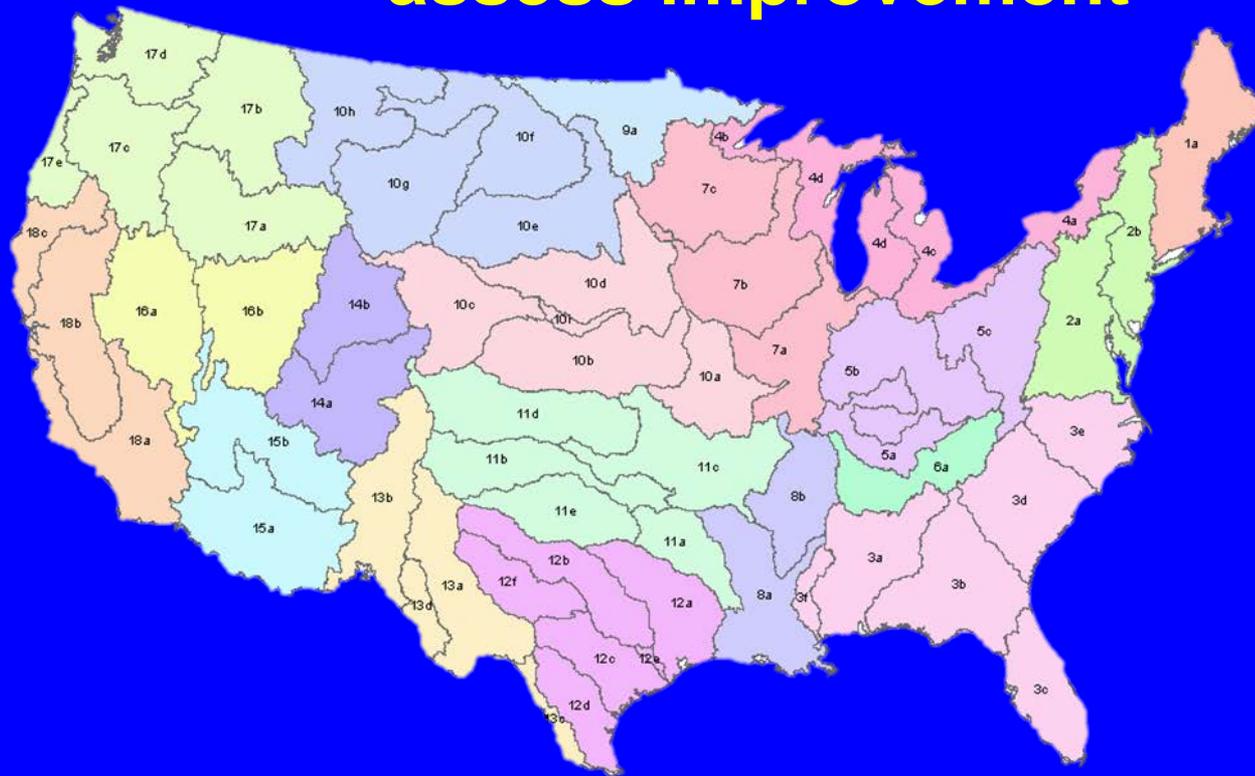


# Non-Linear Regression Equation Fits for Test HRUs



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**PRMS simulated streamflows with new snow depletion curve equations will be compared with baseline simulated streamflows to assess improvement**



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# **Preliminary results will be presented at the American Geophysical Union Conference in December**

**H43I-1082 Poster Session**

**Using Gridded Snow Covered Area and Snow-Water Equivalence Spatial  
Data Sets to Improve Snowpack Depletion Simulation in a Continental  
Scale Hydrologic Model**

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**Thank you**