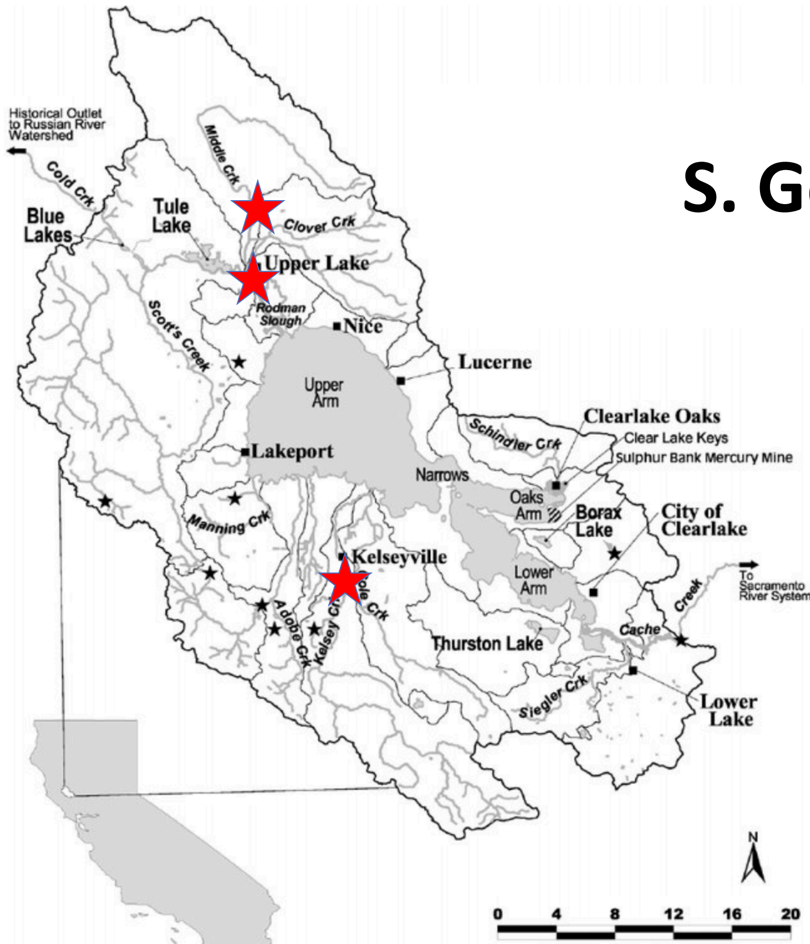
TOWARD A WATERSHED MODEL FOR CLEAR LAKE



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Blue Ribbon Committee Meeting
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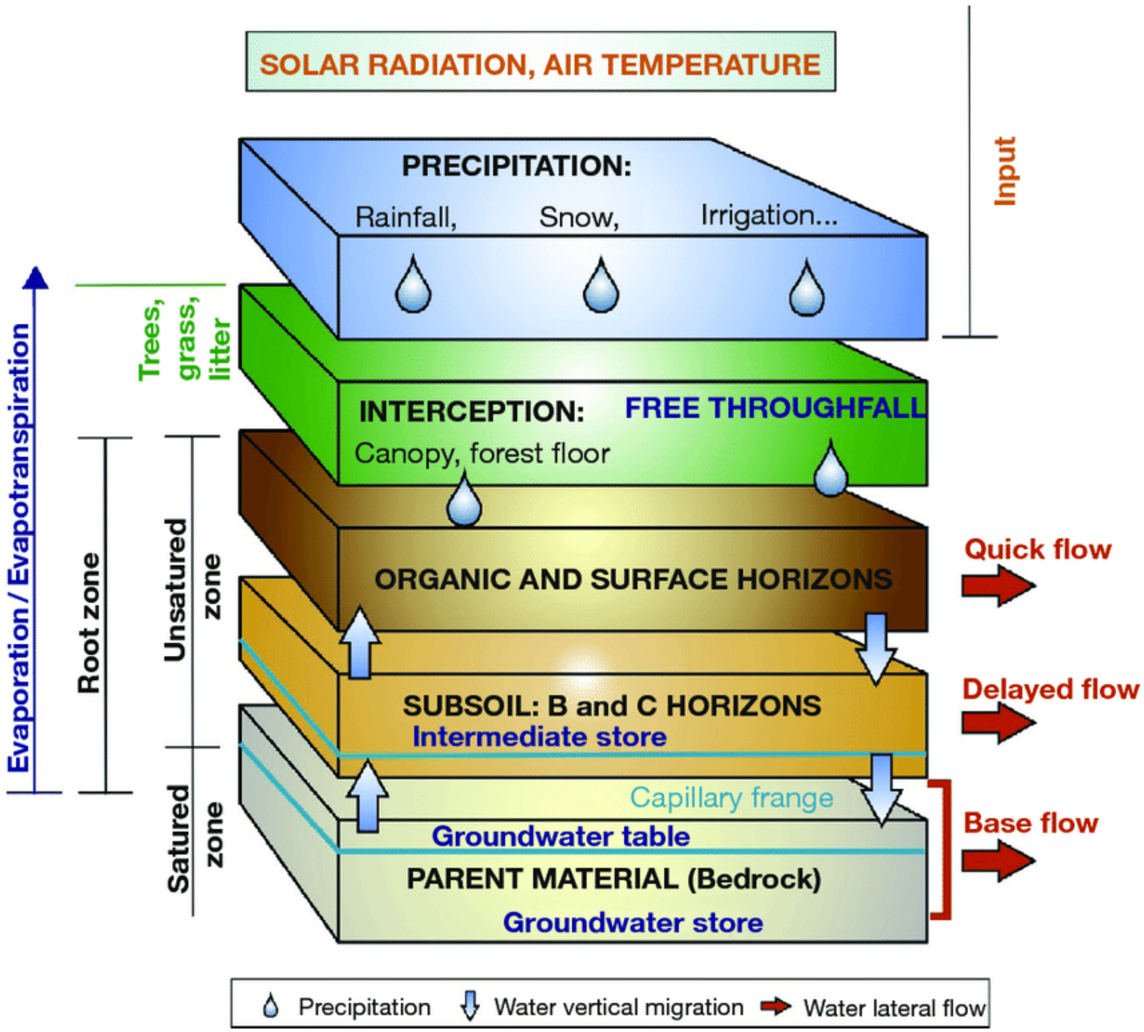
A distributed watershed model is a computer model that uses sets of mathematical equations to:

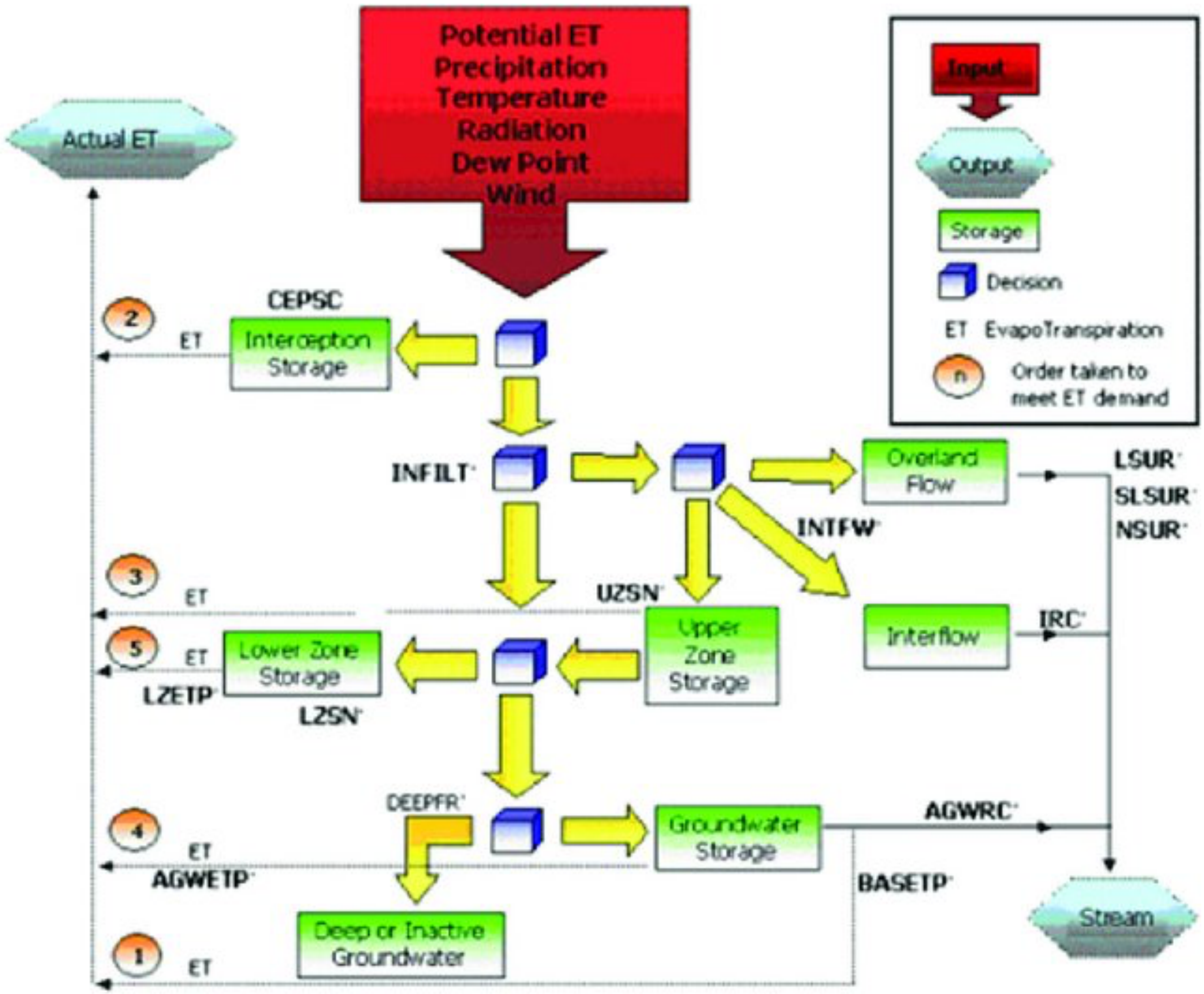
1. Simulate hydrologic processes (movement of water) across and through the landscape

2. The accompanying erosion and sediment transport that may occur due to steepness, lack of cover, imperviousness, type of land use etc.

3. The accompanying nutrient transport, uptake and release that is occurring due to different activities, soils, reactions etc.



SOLAR RADIATION, AIR TEMPERATURE
Input
PRECIPITATION:
Rainfall,
Snow,
Irrigation...
Trees, grass, litter
INTERCEPTION:
FREE THROUGHFALL
Canopy, forest floor
Evaporation / Evapotranspiration
Root zone
Unsatured zone
ORGANIC AND SURFACE HORIZONS
Quick flow
SUBSOIL: B and C HORIZONS
Intermediate store
Delayed flow
Capillary frange
Groundwater table
Satured zone
PARENT MATERIAL (Bedrock)
Groundwater store
Base flow
Precipitation
Water vertical migration
Water lateral flow

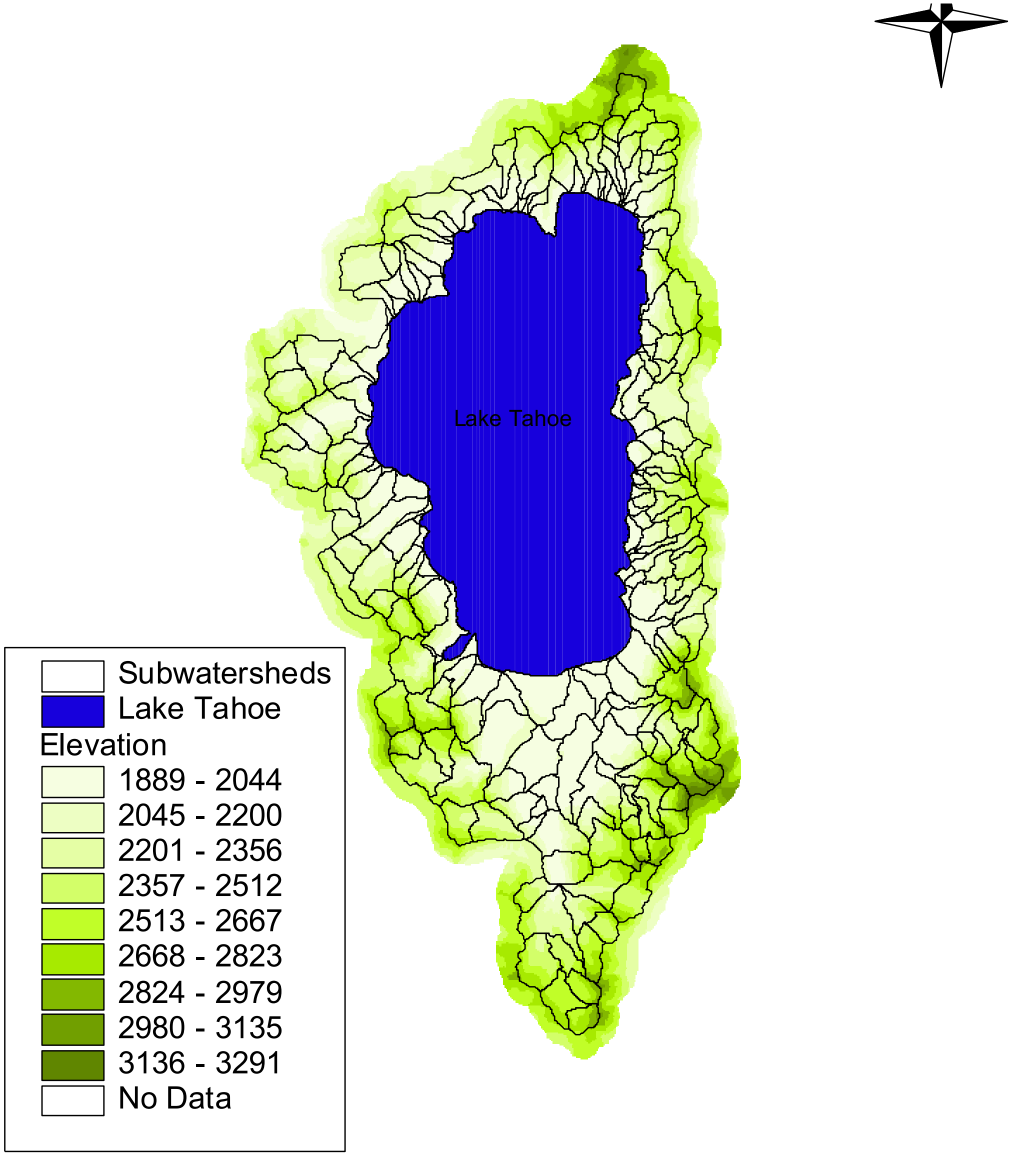

Potential ET
Precipitation
Temperature
Radiation
Dew Point
Wind
Actual ET
Input
Output
Storage
Decision
ET EvapoTranspiration
n
Order taken to meet ET demand
CEPSC
2
ET
Interception Storage
INFILT
Overland Flow
LSUR
SLSUR
NSUR
INTFW
3
ET
UZSN
Upper Zone Storage
Interflow
IRC
5
ET
Lower Zone Storage
LZETP
LZSN
DEEPFR
4
ET
Groundwater Storage
AGWRC
AGWETP
BASETP
Stream
Deep or Inactive Groundwater
1
ET

STEP 1 - Subwatershed Delineation

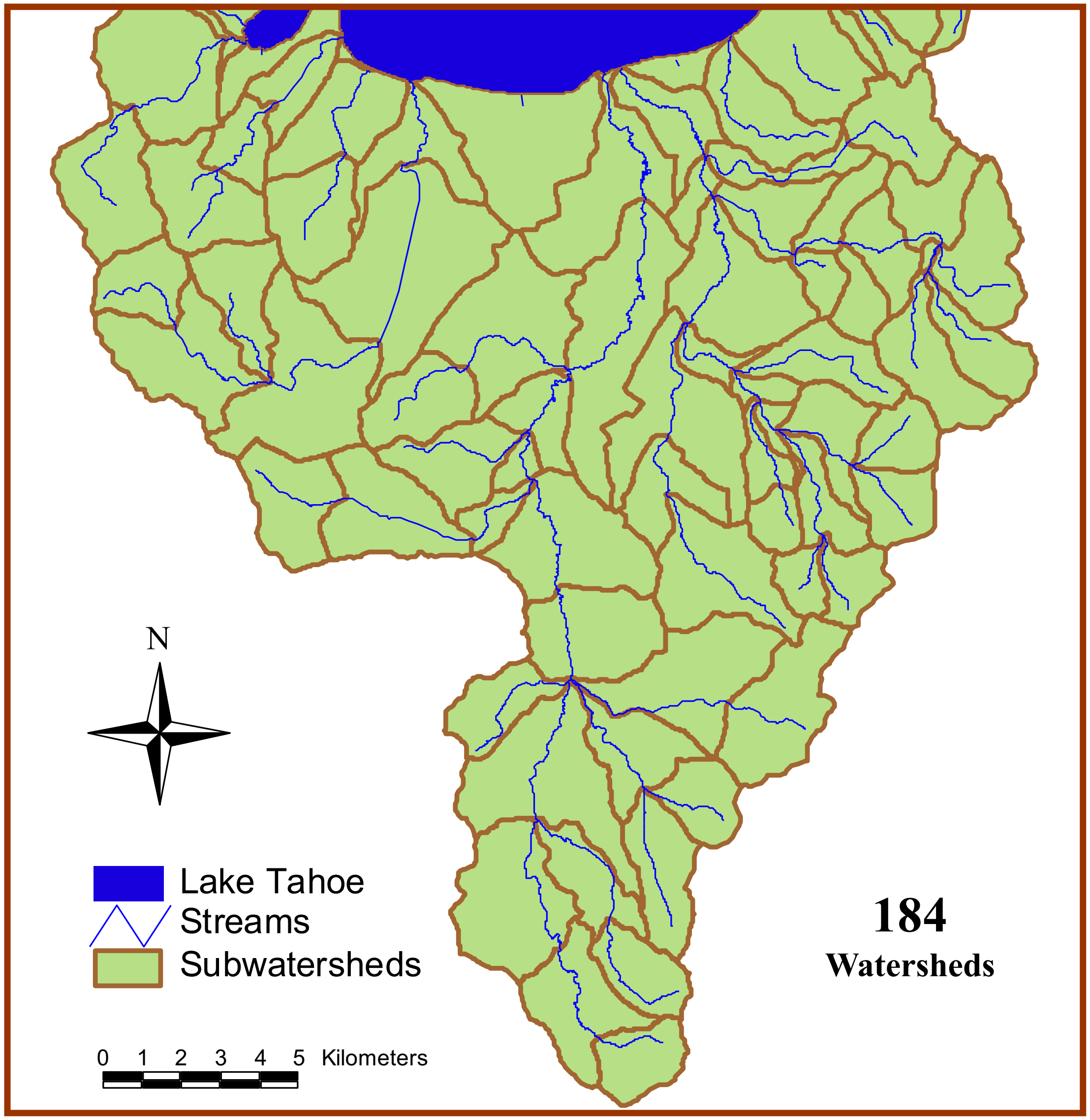
- Subdivision of the watershed into discrete components
- Delineation based on:
  - elevation (topographic data)
  - stream connectivity
  - location of flow and water quality monitoring stations
- Each subwatershed is modeled with 1 representative stream
- Each subwatershed is modeled with 1 representative meteorological time series

Sub-watershed Delineation

This is provided by the Lidar data from which a Digital Elevation Model (DEM) has likely been produced already

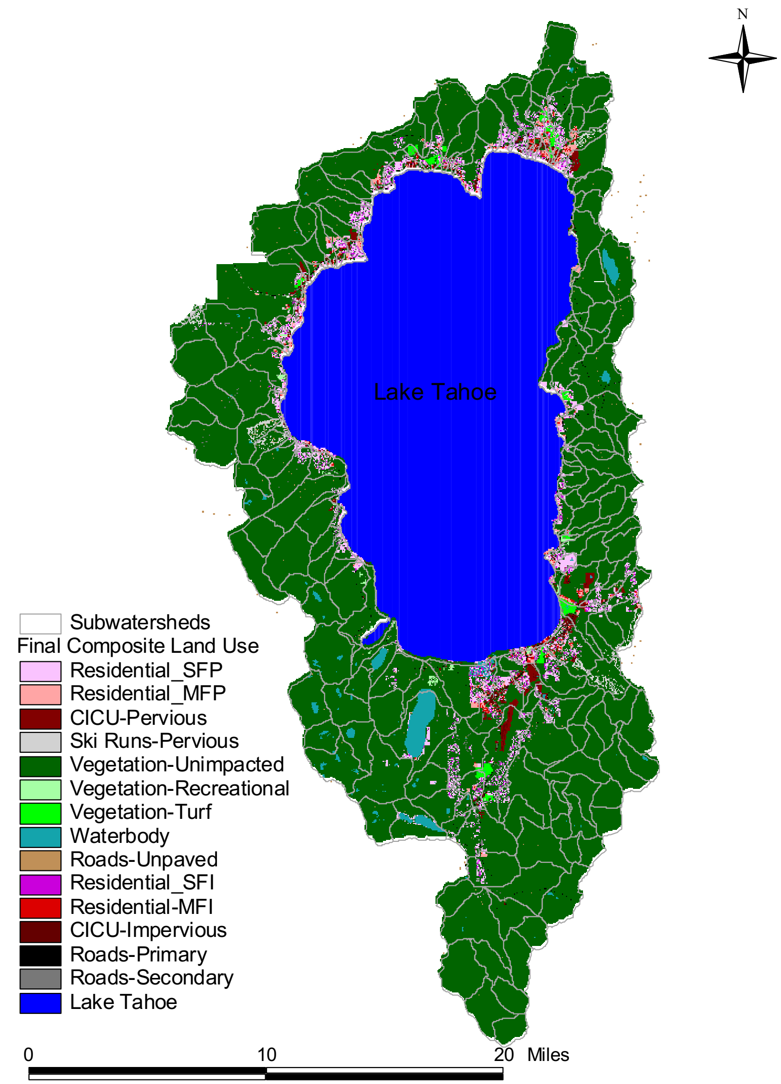


The Use of Sub-Watersheds is What Makes it a Distributed Watershed Model

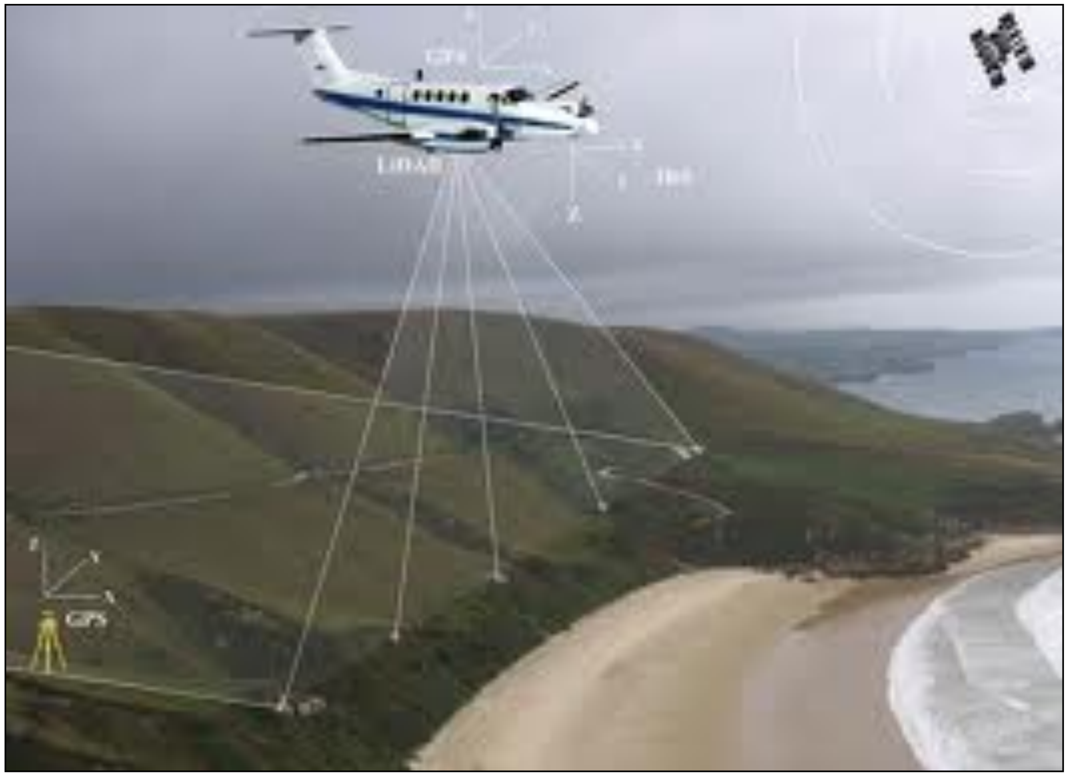


Step 2 - Land Use Classifications

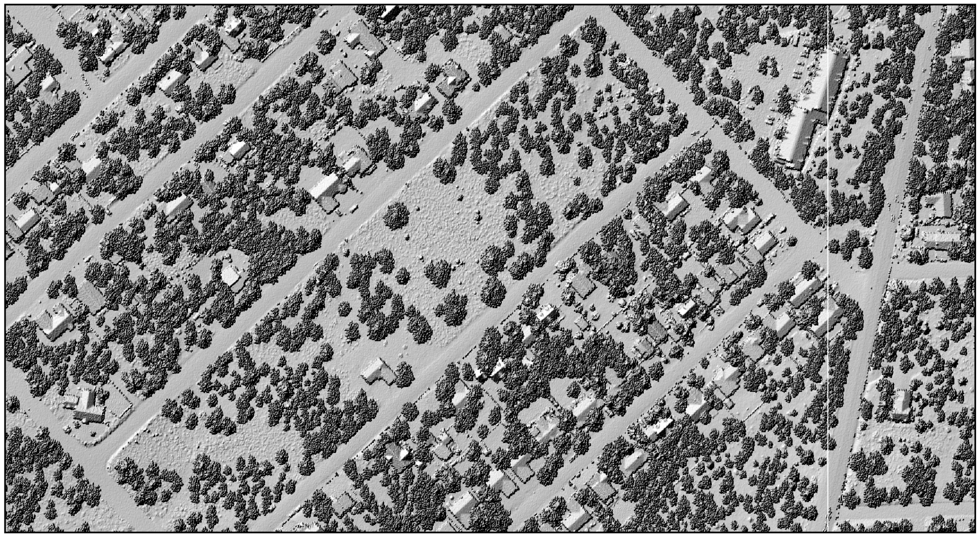
This is provided by existing GIS layers, high resolution satellite data, Lidar data etc.



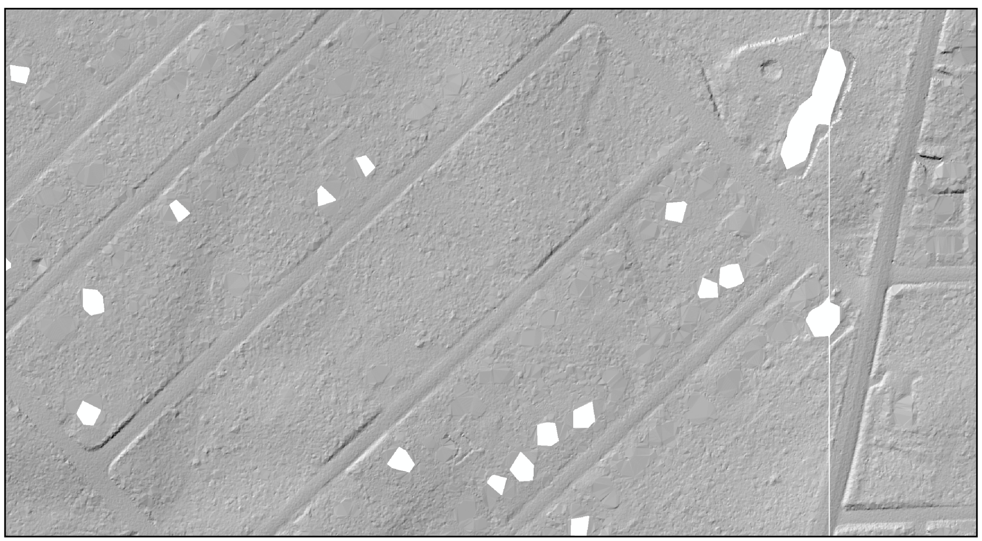
LIDAR



LiDAR is a remote sensing technology that measures distance by illuminating a target with a laser and analyzing the reflected light.



LiDAR Point Cloud
(all LiDAR points)

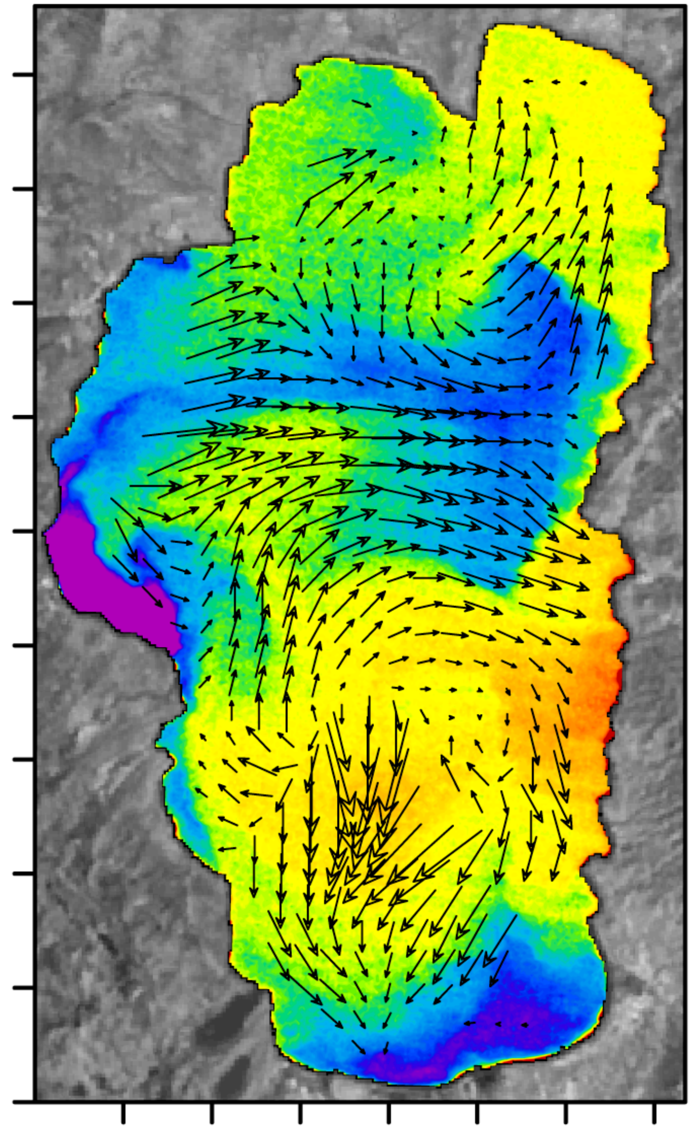


Bare Earth
(LiDAR ground points)

“Satellite Survey”

Countless uses of satellite data

- Weather (from past data) – for watershed model?
- Water temperature - - climate change, lake water movement etc.
- Algal blooms (cyano and general)



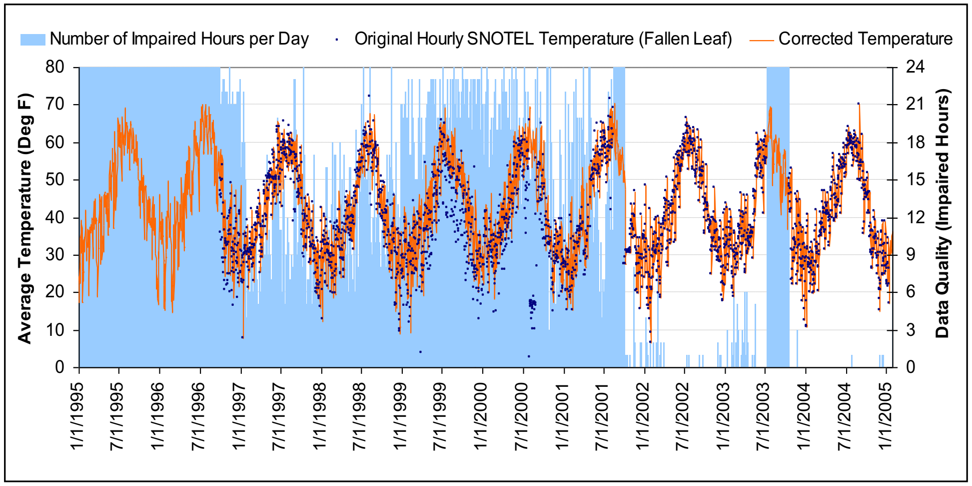
Step 3 – Determining erosion potential

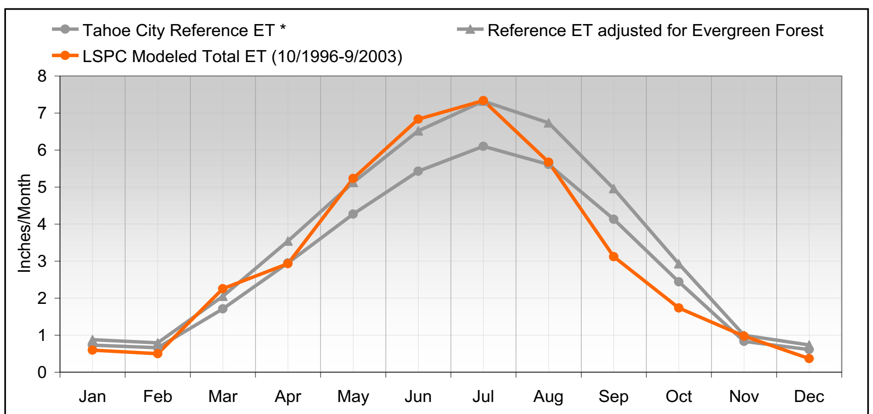
This is based on GIS layers of soil types, ground slope, coverage etc. Produces erodibility classes

Step 4 - Watershed Model Land-use Categories

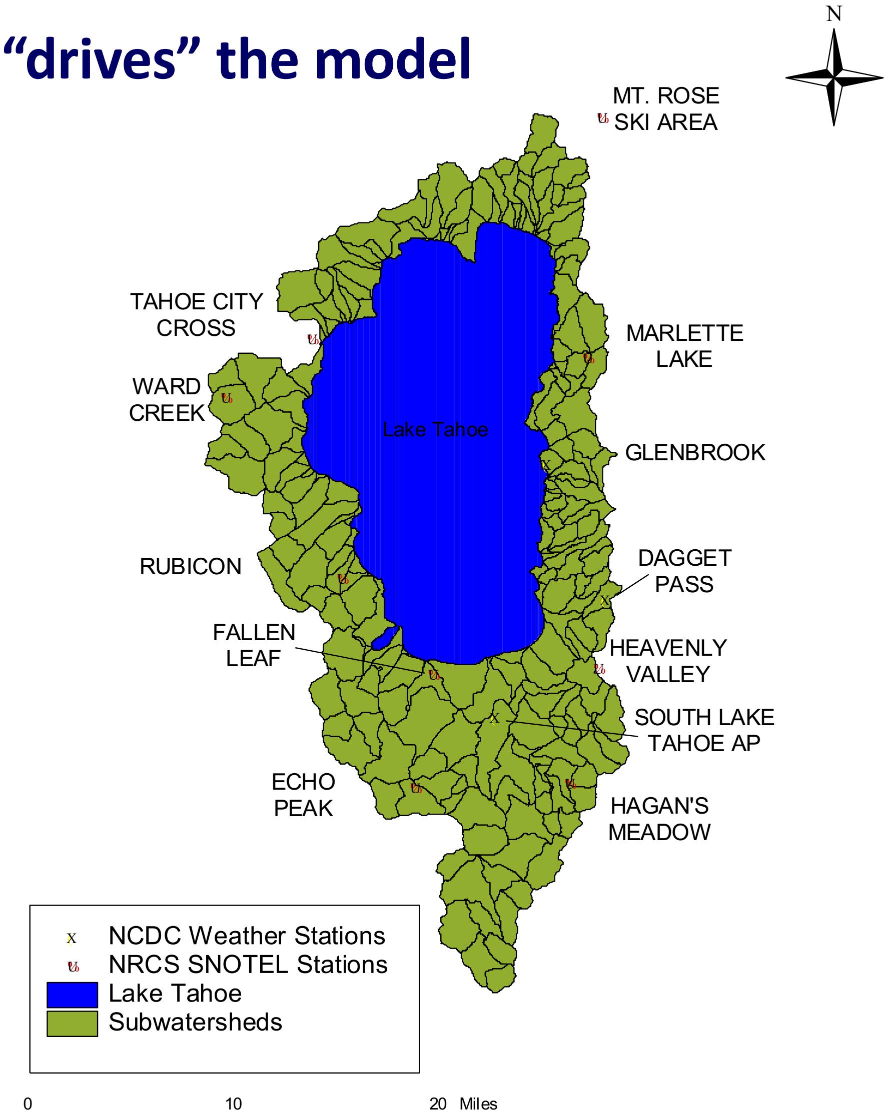
Landuse Category	Pervious/Impervious	Subcategory Name
Single Family Residential	Pervious	SFR - Pervious
	Impervious	SFR - Impervious
Multi Family Residential	Pervious	MFR - Pervious
	Impervious	MFR - Impervious
Commercial/Institutional/ Communications/Utilities	Pervious	CICU - Pervious
	Impervious	CICU - Impervious
Transportation	Impervious	Primary Roads
	Impervious	Secondary Roads
	Pervious	Unpaved Roads
Vegetated	Pervious	Ski Runs
	Pervious	Recreation
	Pervious	Burned
	Pervious	Harvest
	Pervious	Turf Areas
	Pervious	Erosion Potential - 1
	Pervious	Erosion Potential - 2
	Pervious	Erosion Potential - 3
	Pervious	Erosion Potential - 4
	Pervious	Erosion Potential - 5

Step 5 - Meteorology – this is what "drives" the model



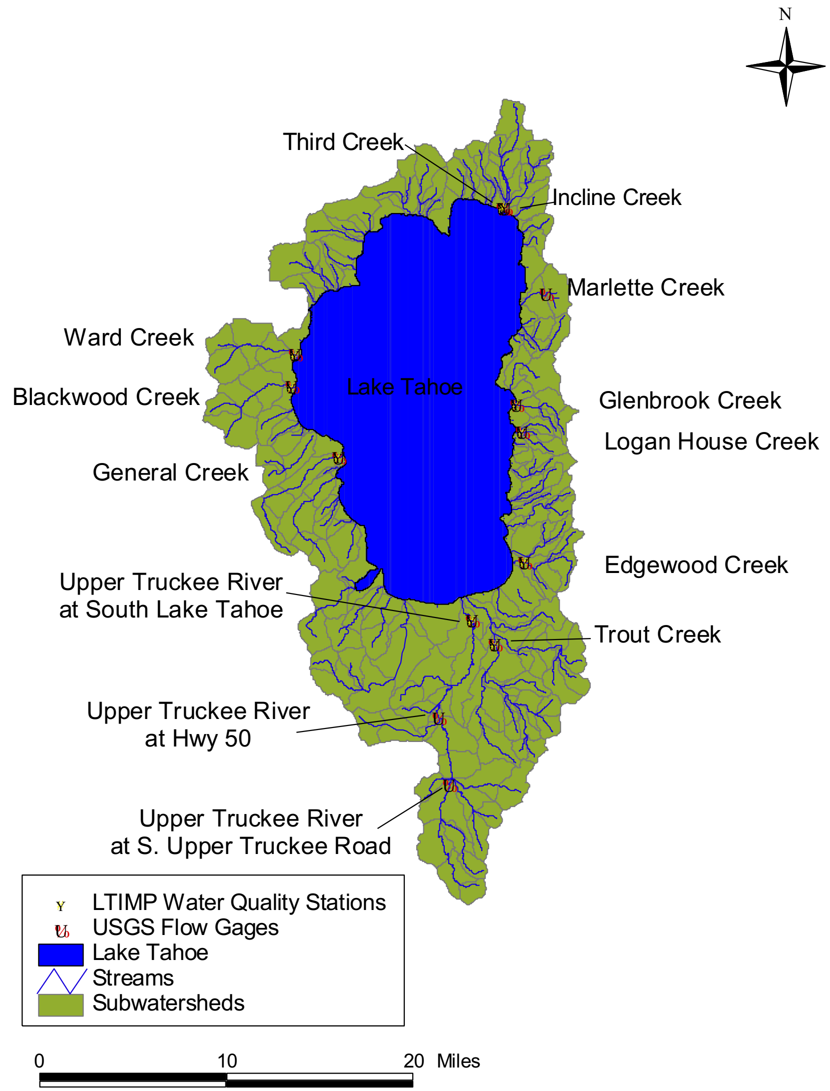


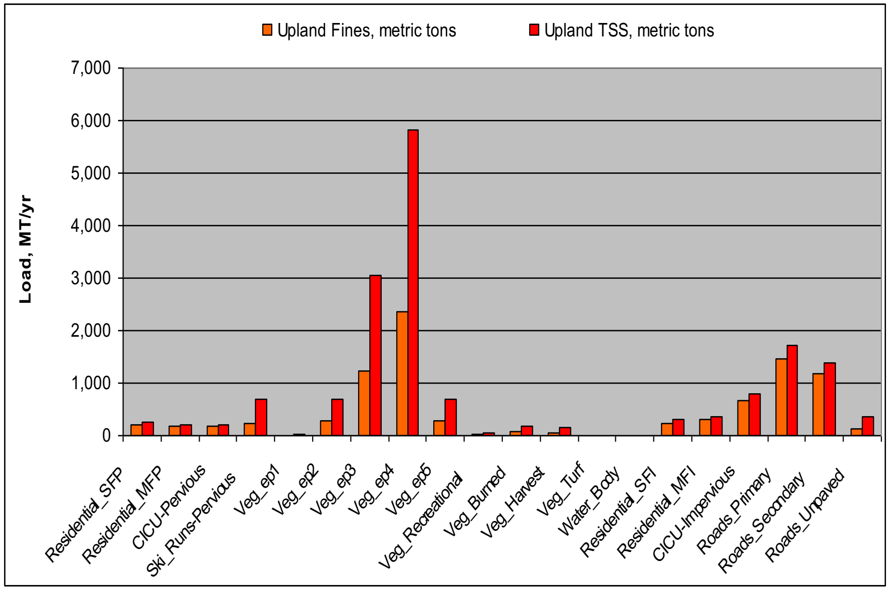
* Historical average monthly reference crop evapotranspiration for Tahoe City, California
UC Davis Division of Agriculture and Natural Resources, Publication 21454

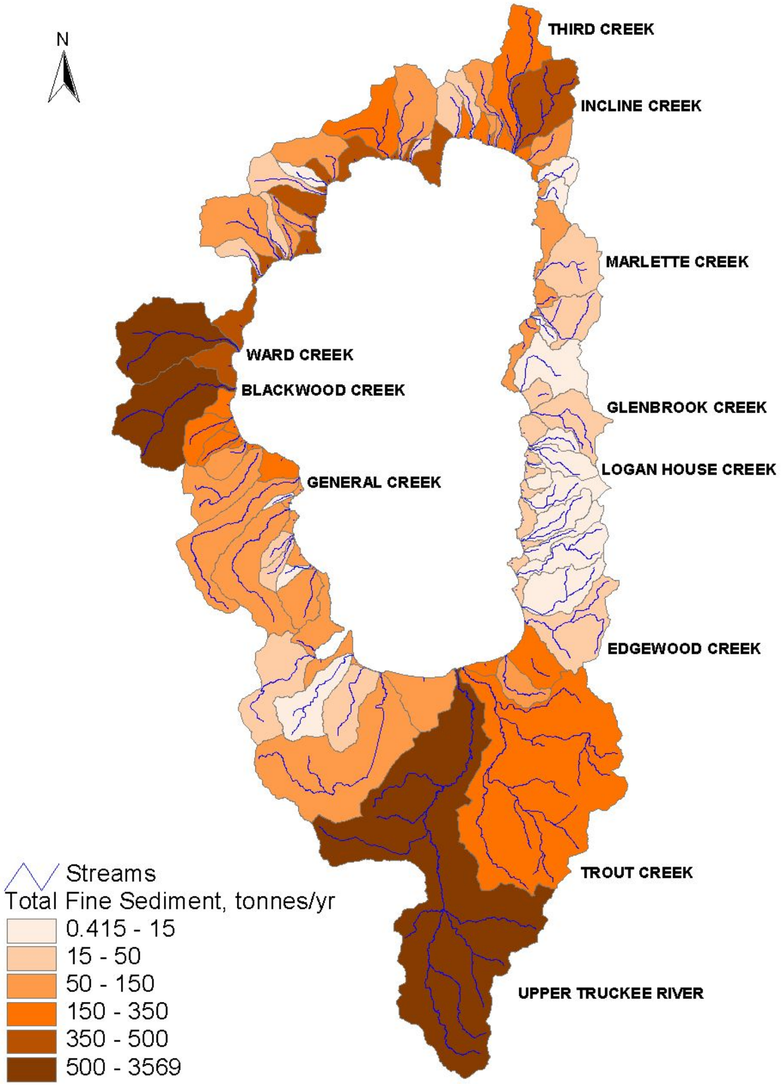


Step 6 - Calibration and Validation

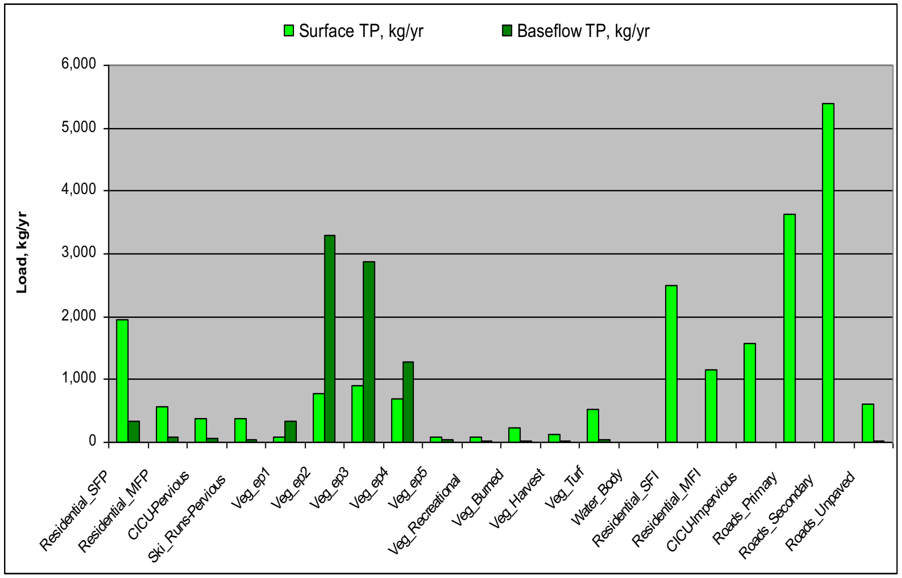
- This is the hard part.
- Need at least 1 year of meteorological data to “input” to the model for “calibration”, and at least 1 year to ”validate” the model performance.
- Calibration - adjust individual coefficients for erosion, nutrient release etc. so that data from gauging stations match the measured values. TOC
- Validation – change nothing, confirm that model can represent a different set of data
- If insufficient or poor stream data, the results are of dubious value - GIGO



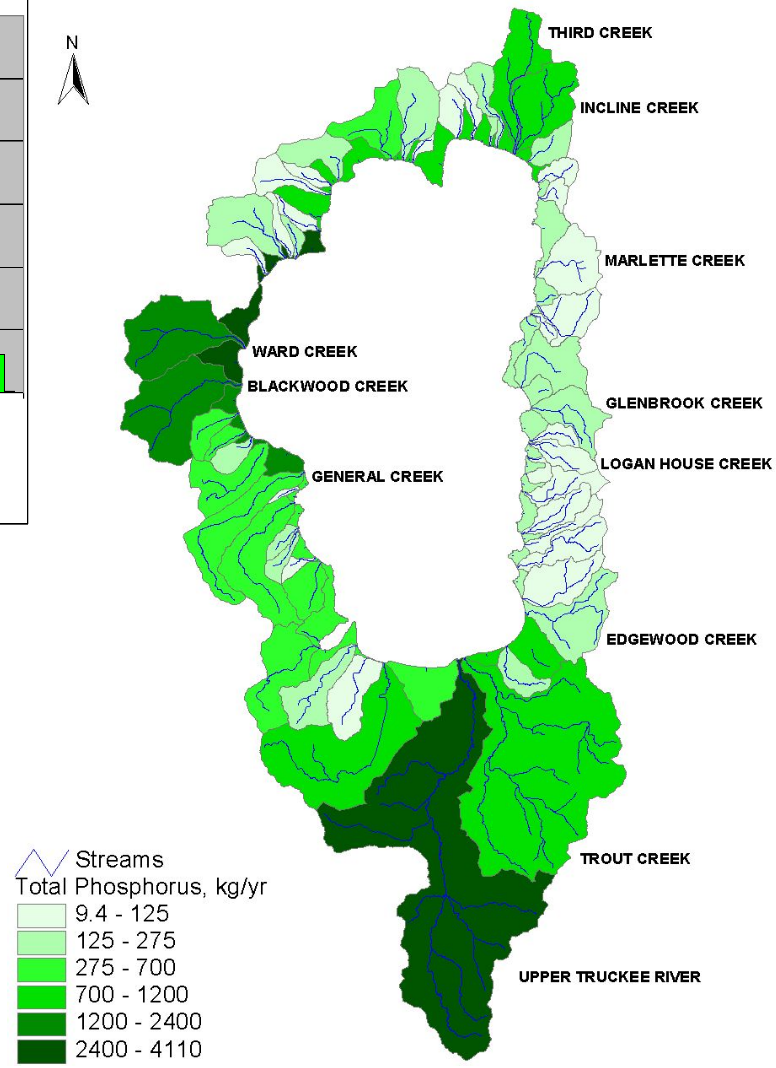


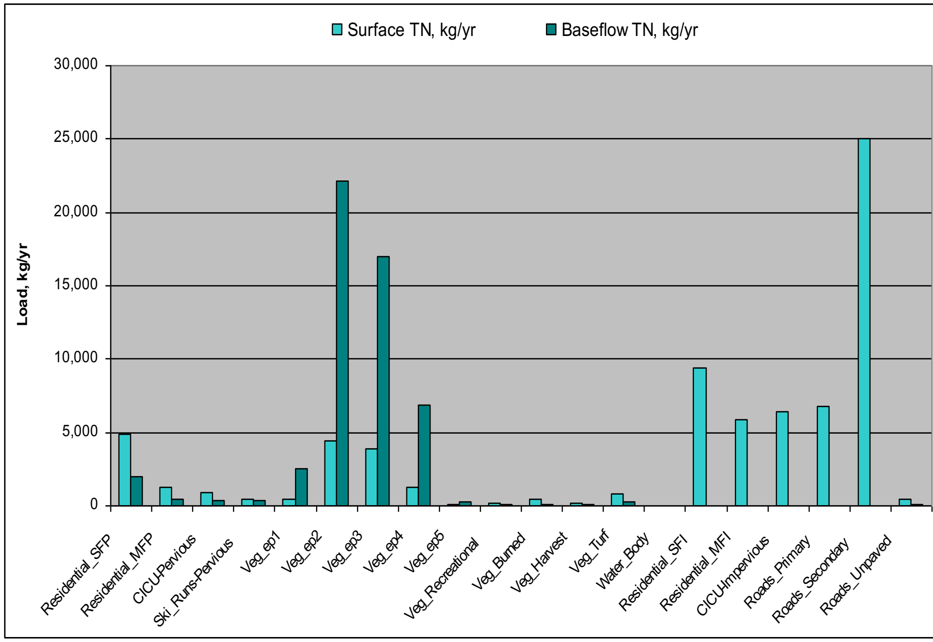


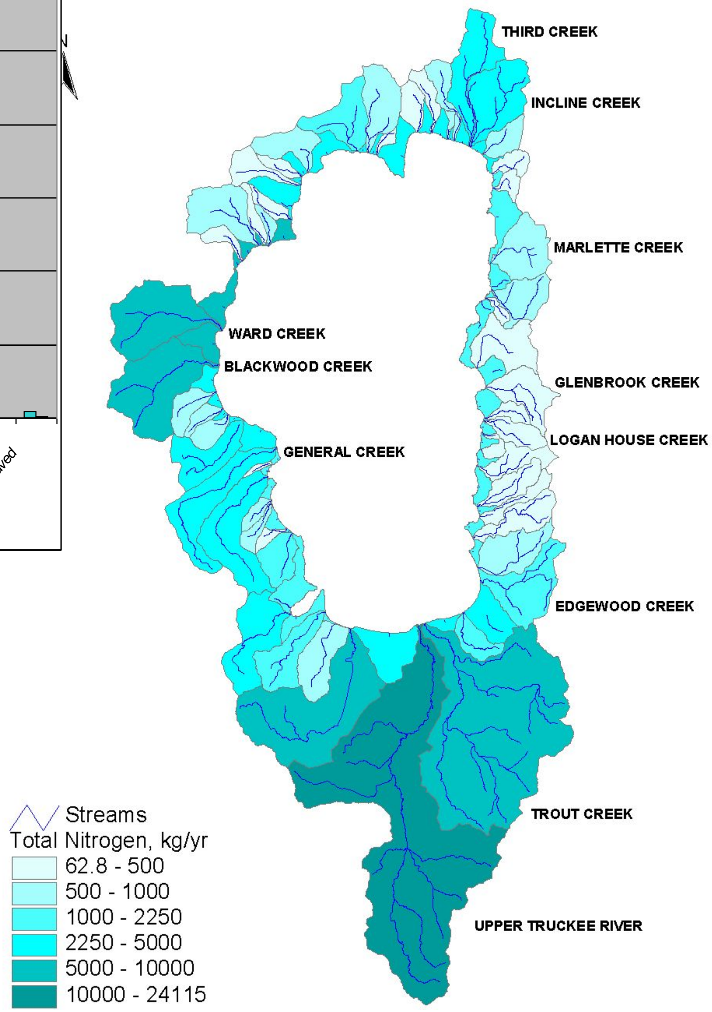
Output - Fine Sediment Loads



Output - Phosphorus Loads







Output - Nitrogen Loads