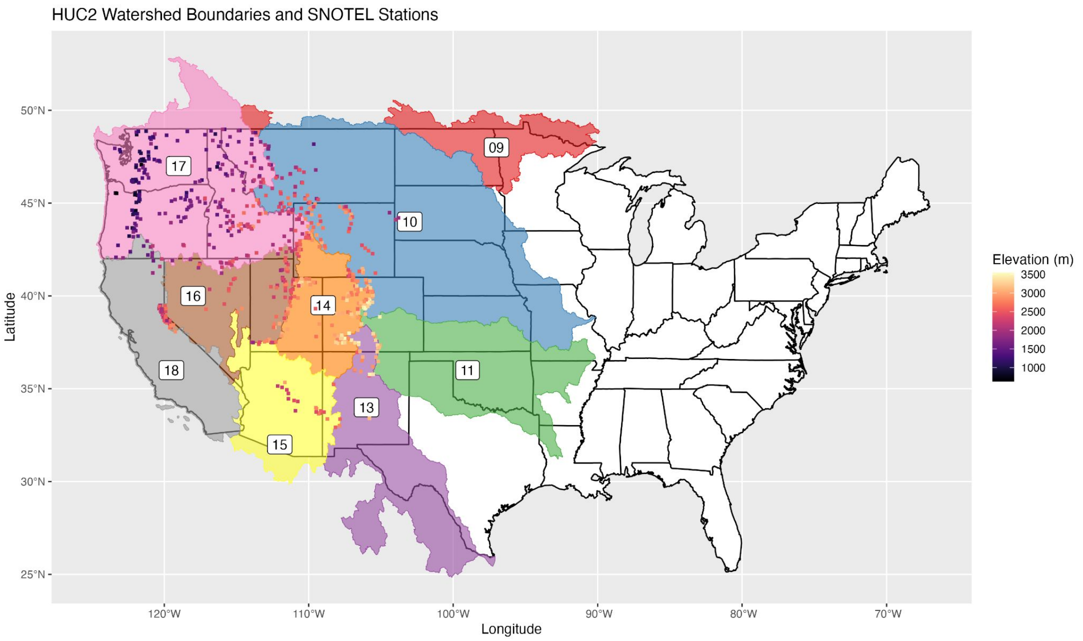
Hydrologic Model Validation of SWE and Streamflow: Noah LSM

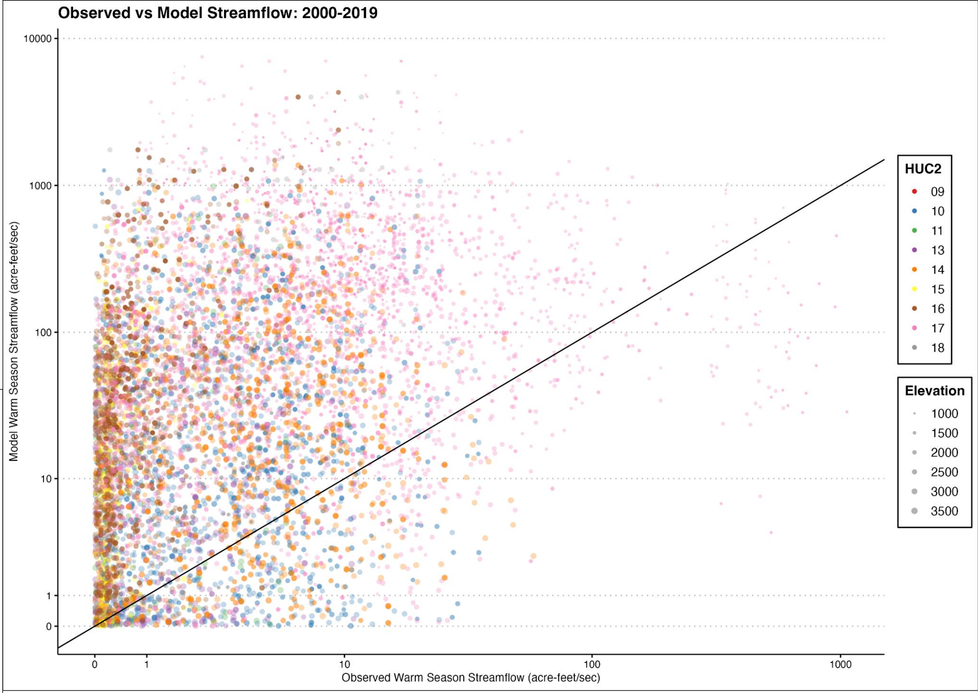
Presented by Ethan Heidtman
Mentor Andrew Badger, PhD

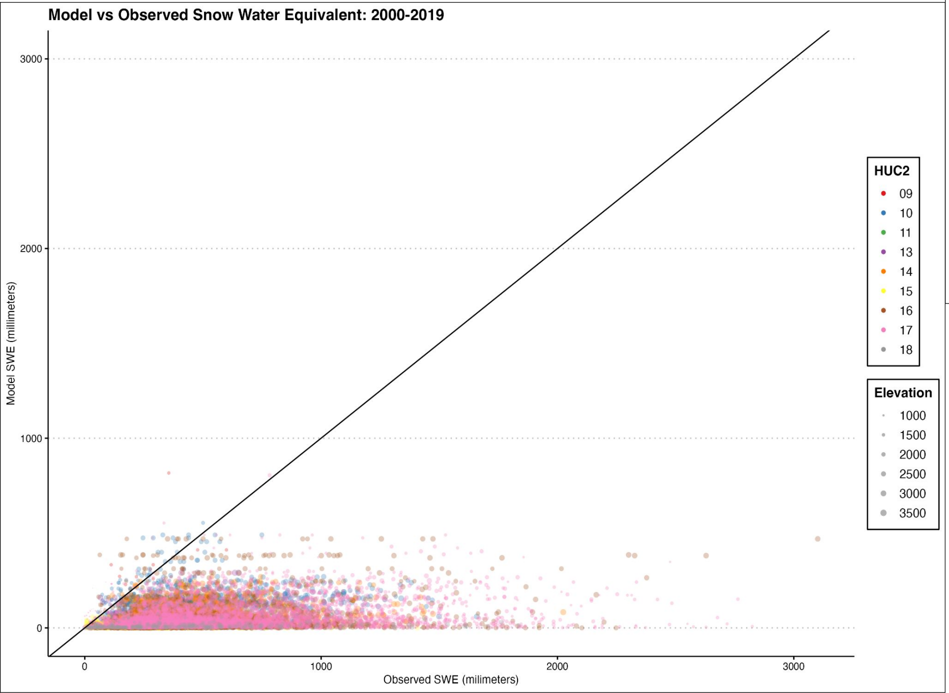
Introduction and Objectives

- Evaluate how well the Noah model can simulate observed snowpacks in the western U.S.
- Our Data:
  - ~650 *in situ* SNOTEL Stations
  - ~270 HUC8s: Small watersheds that make up 9 larger basins (HUC2s)
- The Model:
  - Offline Noah LSM, 0.5 degree resolution
  - Daily data for runoff, drainage, Snow Water Equivalent (SWE)
- How do we test performance?
  - Determine model skill for first-order snow physics



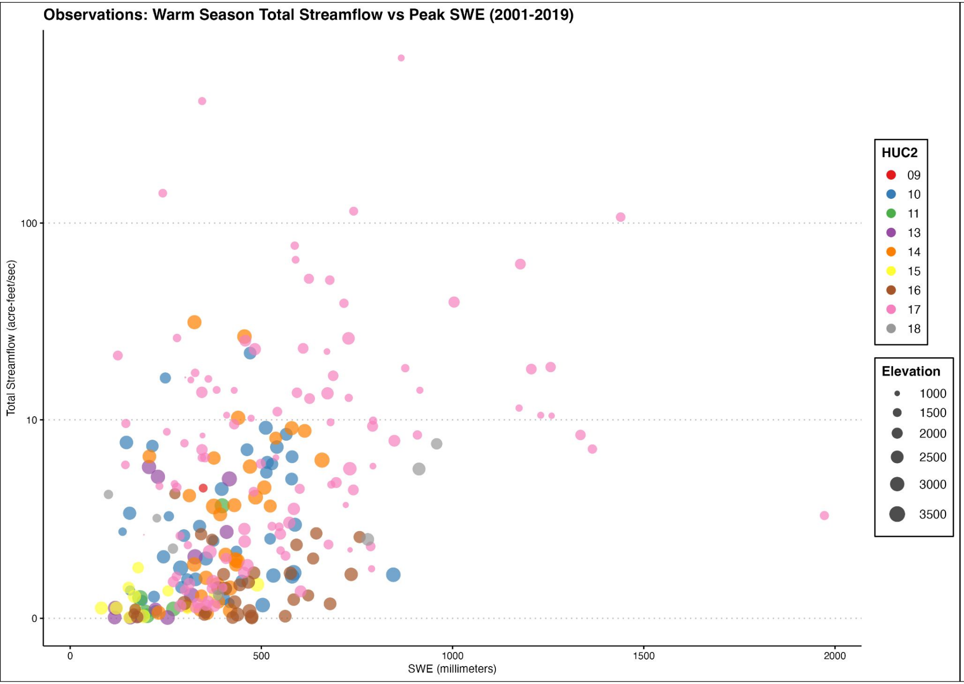
Underestimation of SWE
Overestimation of Streamflow (Q)

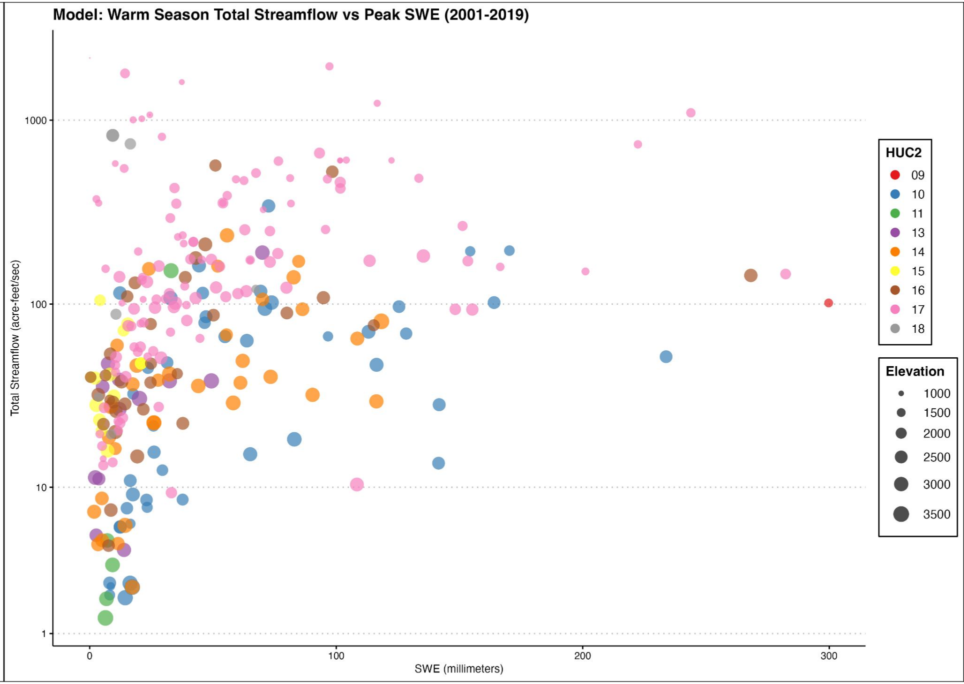




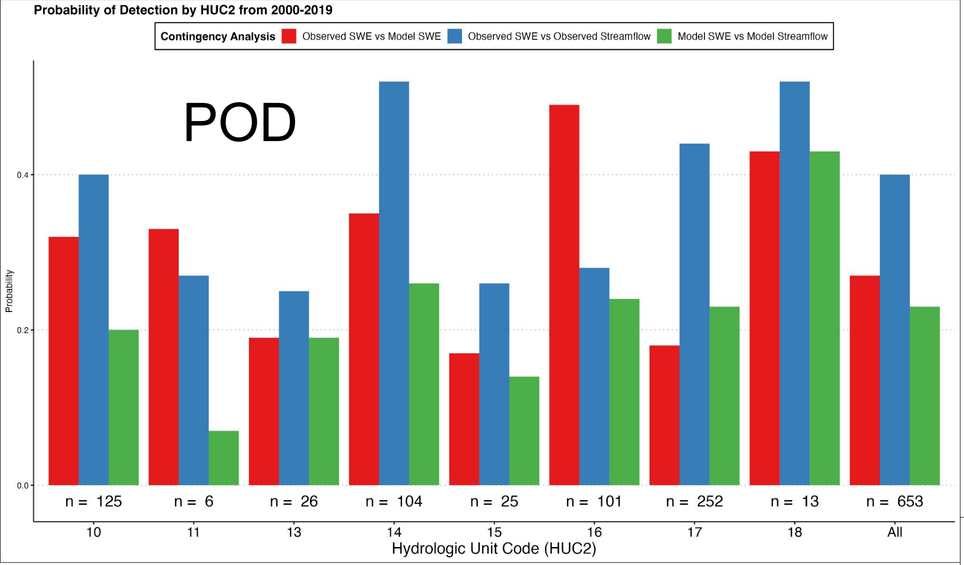
Consider the model grid size! Model values were approximated using half-degree bounding box, generally much larger than our HUC8s

How does streamflow respond to snowpack?





Notice the magnitude differences!



Hits (years correctly simulated)	False Alarms (years incorrectly simulated)
Misses (years incorrectly NOT simulated)	Correct Negatives (all other years)

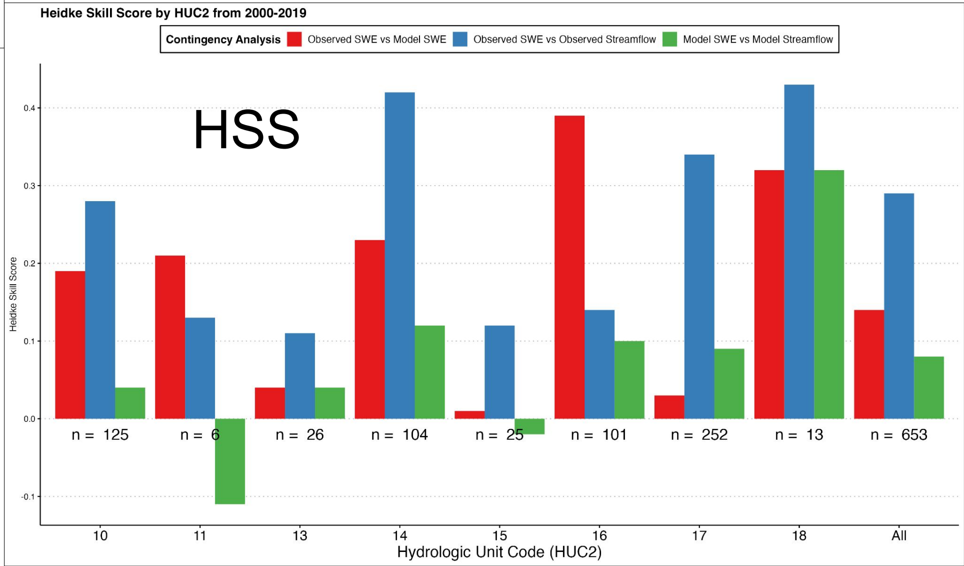
Does the model simulate the same lower 20% water years as the observations?

Performance Indicators:

Probability of Detection (POD)

Heidke Skill Score (HSS)

Obs SWE vs Model SWE
Obs SWE vs Obs Q
Model SWE vs Model Q



Takeaways

- Model-produced snowpacks are generally smaller and thus underpredict observed values
- The model does fairly well in replicating “drought” years
  - Atmospheric forcing produces low-SWE years in concert with observations
  - These ‘drought’ SWE years tend to produce ‘drought’ streamflows
  - Other meteorological factors play a role, but were not investigated
- Generally, skill is reduced by model limitations
  - Half-degree resolution (fairly coarse)
  - Does not capture finer topographical features
  - Multiple HUC8s can be within the same grid cell
- Captures first-order relationship between SWE and Q
  - Although there is under/overprediction, the model’s skill is good, meaning the underlying physics are correct
  - At higher resolutions, we think the model would perform better