Simulating the Snoqualmie Pass Snowpack

This model simulates the components of the energy balance of a snowpack over a day (24 hours) and calculates the snowmelt, rainfall and total water available for runoff.

How to run the model

To begin, open up the "Snow Melt Activity.xlsx

The Inputs required are the meteorological weather conditions above the snowpack that day:

Air temperature (C)
Wind speed (m/s)
Relative humidity (%)
Precipitation (mm/day)
Solar Radiation (W m^2 day^{-1})
Thermal Radiation (W m^2 day^{-1})

These values need to be the averages over a 24 hour period. Changing these values will update the Output boxes that show modeled rainfall and snowmelt from each energy balance component.

The equations used to calculate each component of the snow surface energy balance are shown if you scroll to the right (Columns Q-AD). These equations take the input weather conditions and calculate the total energy from each component in the Red output box.

Then, the sum of all components is converted into a depth of melt water.

Finally, any rainfall that drains through the snowpack is added to the snowmelt to produce the total *Water available for Runoff*. Runoff is the any water that does not enter the soil, but literally runs-off and would eventually enter a river, where it can cause flooding, generate power, or provide drinking water.

Q1) What energy balance components melt the most snow at Snoqualmie Pass?

1. Click on the second tab "INPUT Options", which contains meteorological input data for three different distinct days at the Snoqualmie Pass station.
2. Copy and paste the input data from each day into the Input box on the main tab.
3. What components provide the most energy on each type of day?
4. What days generated the most melt at the site?

Q2) What matters more for basin flooding during an extreme rain-on-snow event? **Snowmelt or rainfall?**
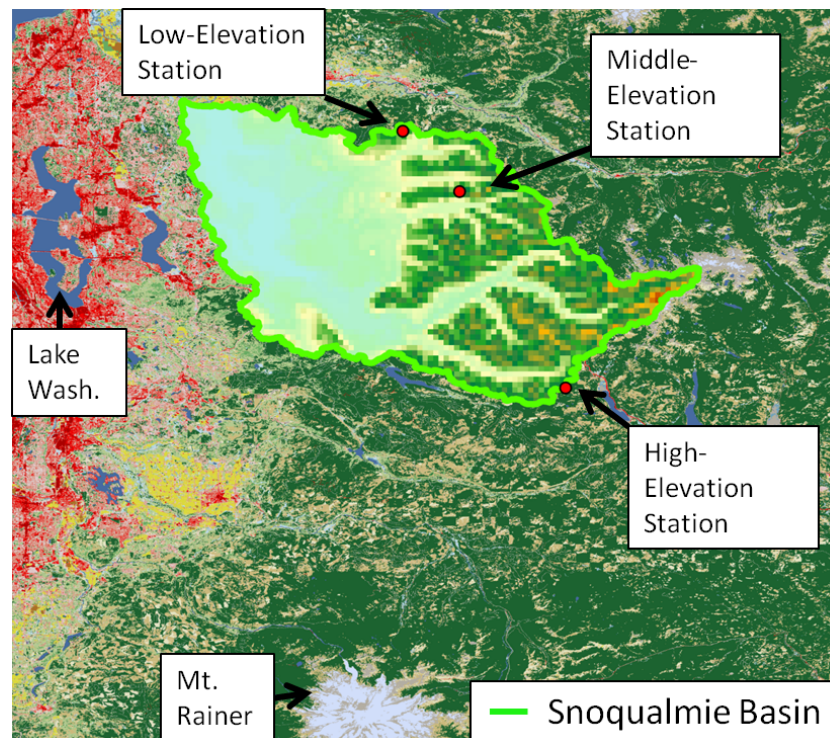
Map of the Snoqualmie Basin and locations of three stations at
High-, Middle-, and Low-Elevations.

1. Move to the third tab "Historic Snoqualmie Flood".
2. Use the meteorological input from the three stations at High, Middle and Low elevations within the Snoqualmie Basin to run the snow model at each station.
3. Comment on the importance of snowmelt vs. rainfall at different elevations during on the 8th of January 2009. What is the ratio of snowmelt to rainfall at each elevation?
4. Assuming that each station represents one third of the total basin area, what is the total basin ratio of snowmelt to rainfall?

Q3) The future climate of the PNW is projected to be warmer and see extreme storms more often. In what ways could an increased winter air temperature and more frequent extreme precipitation impact rain-on-snow floods in the Snoqualmie Basin and PNW?