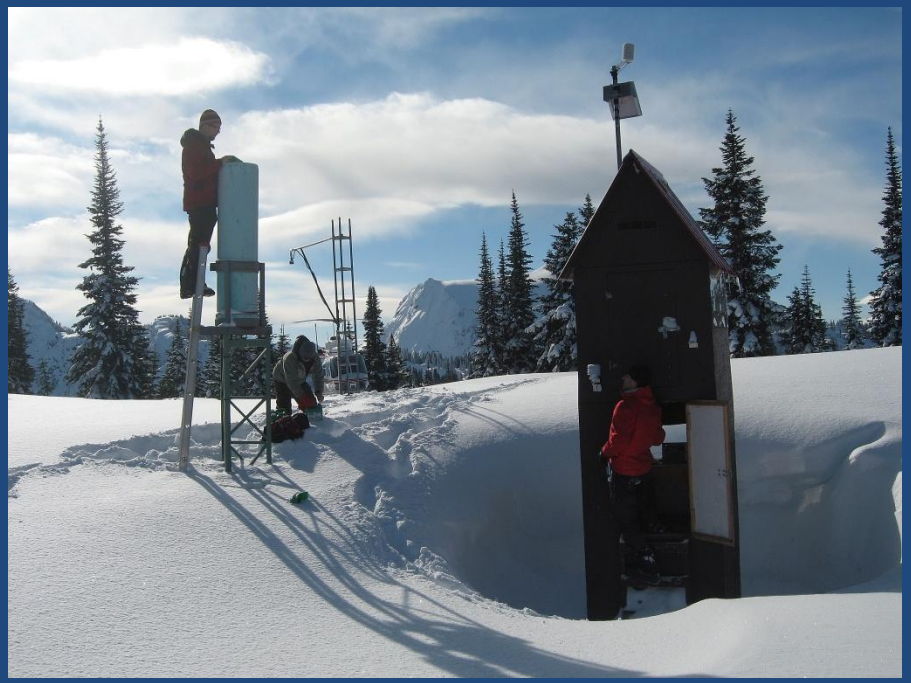
Cowichan Watershed Snow Monitoring Network

Cowichan Watershed Board Technical Advisory Committee Meeting

February 21, 2013

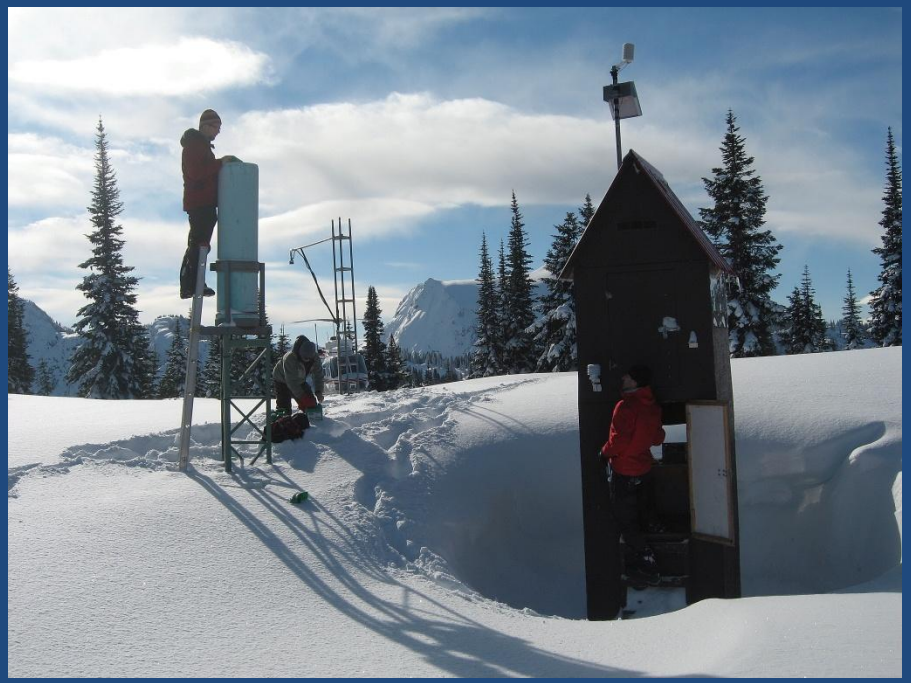
Automated Snow Pillow

- Snow Water Equivalent (SWE) is a measure of the water content of the snow
- usually measured as a depth in mm – allows to be compared to other forms of precipitation
- Is the primary variable used for snow/ hydrology studies



Automated Snow Pillow

- SWE is measured with a "pillow" – liquid-filled bladder and the liquid displacement from the weight of the snow is used calculate SWE
- Temperature Sensor
- Total Precipitation Stand-pipe with antifreeze solution
- Snow depth sensor
- Measurements are taken hourly and sent via satellite networks back to the RFC/MOE



Automated Snow Pillow

PROS

- Provides continuous real-time data (critical for flood forecasting) from remote locations
- Multiple parameters can be measured
- Lower operational costs

CONS

- Can be difficult to identify erroneous data remotely
- Maintenance can be difficult with snow cover (when problems occur, station can be out of operation during critical periods)
- Initial capital costs are high

Manual Snow Survey

- SWE and snow depth are measured by taking repeated core samples of the snow pack
- Cores are weighed, weight of tube subtracted to get the weight and water equivalency

Manual Snow Survey

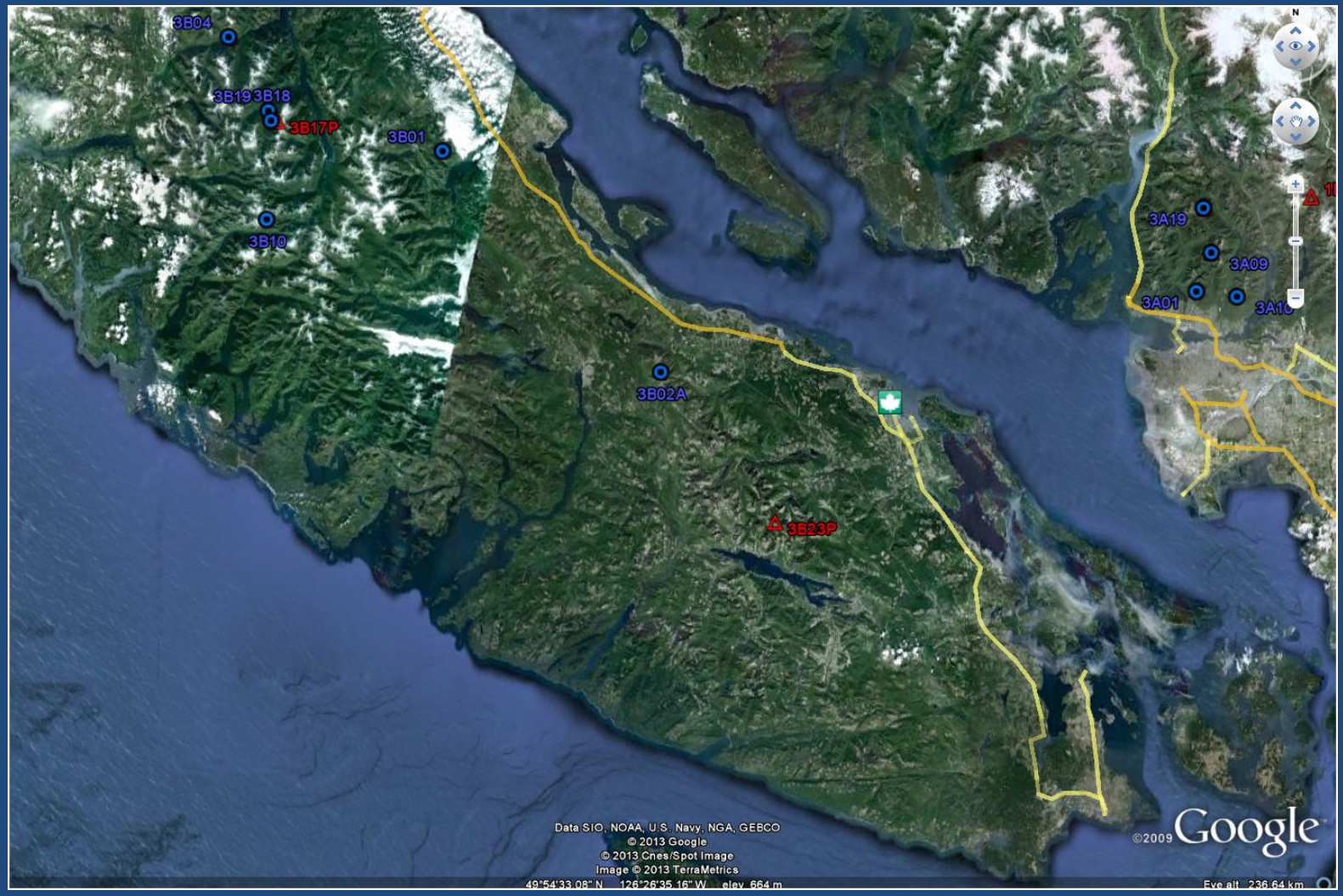
PROS

- Simple, accurate, reliable data measurement
- Particularly useful for seasonal forecasting (total seasonal SWE can be well captured)
- Low infrastructure/capital costs

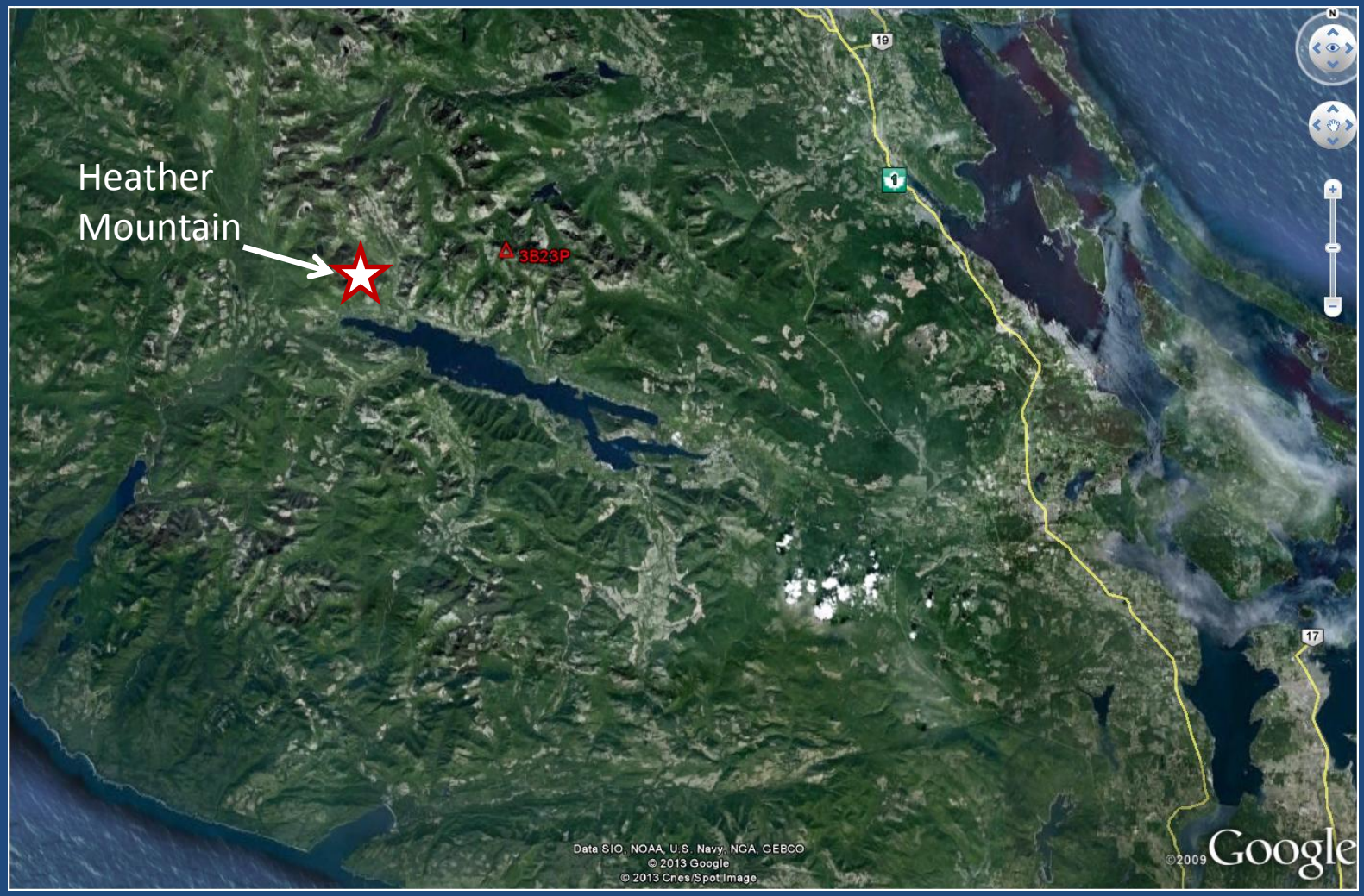
CONS

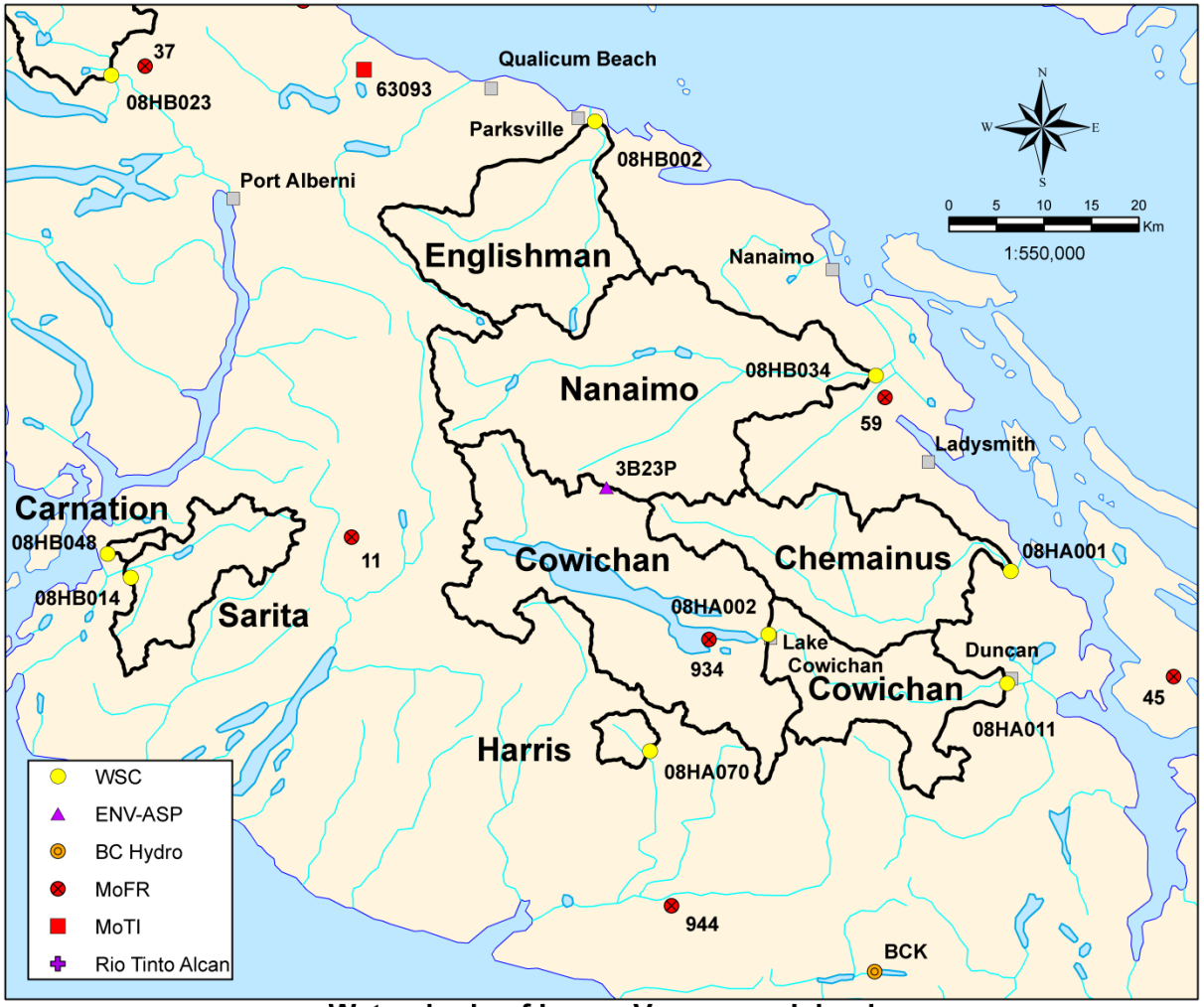
- Low temporal resolution (know data and discrete points in time but not continuously) – less useful for real-time flood forecasting
- Inter-year comparisons require measurements follow a strict sampling schedule
- Issues with access, weather, or resourcing can lead to missing data
- High cost per measurement

Vancouver Island Snow Monitoring Network



Vancouver Island Snow Monitoring Network

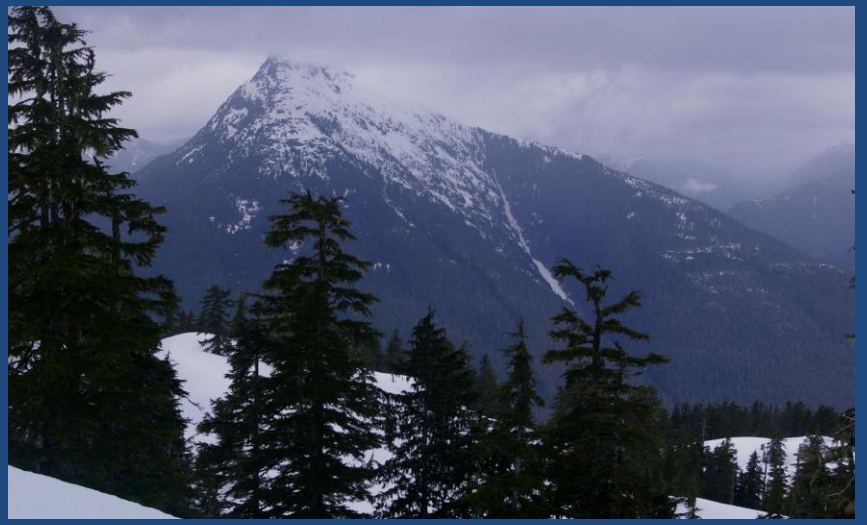


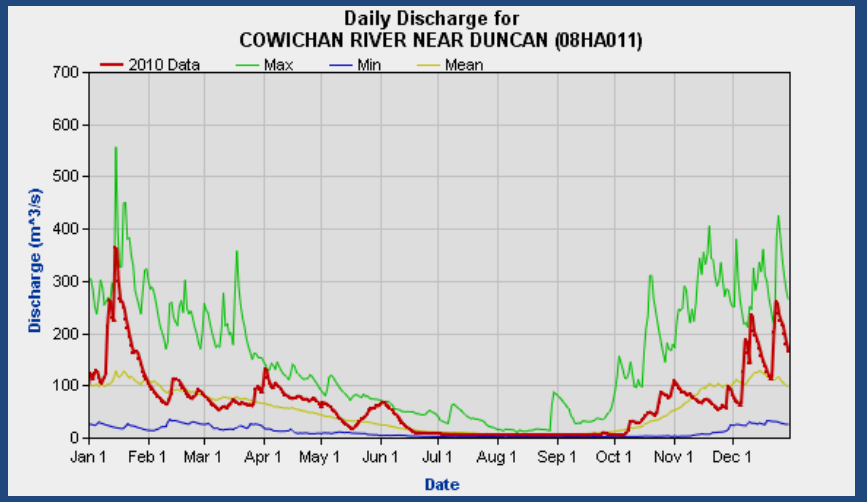


Watersheds of Lower Vancouver Island

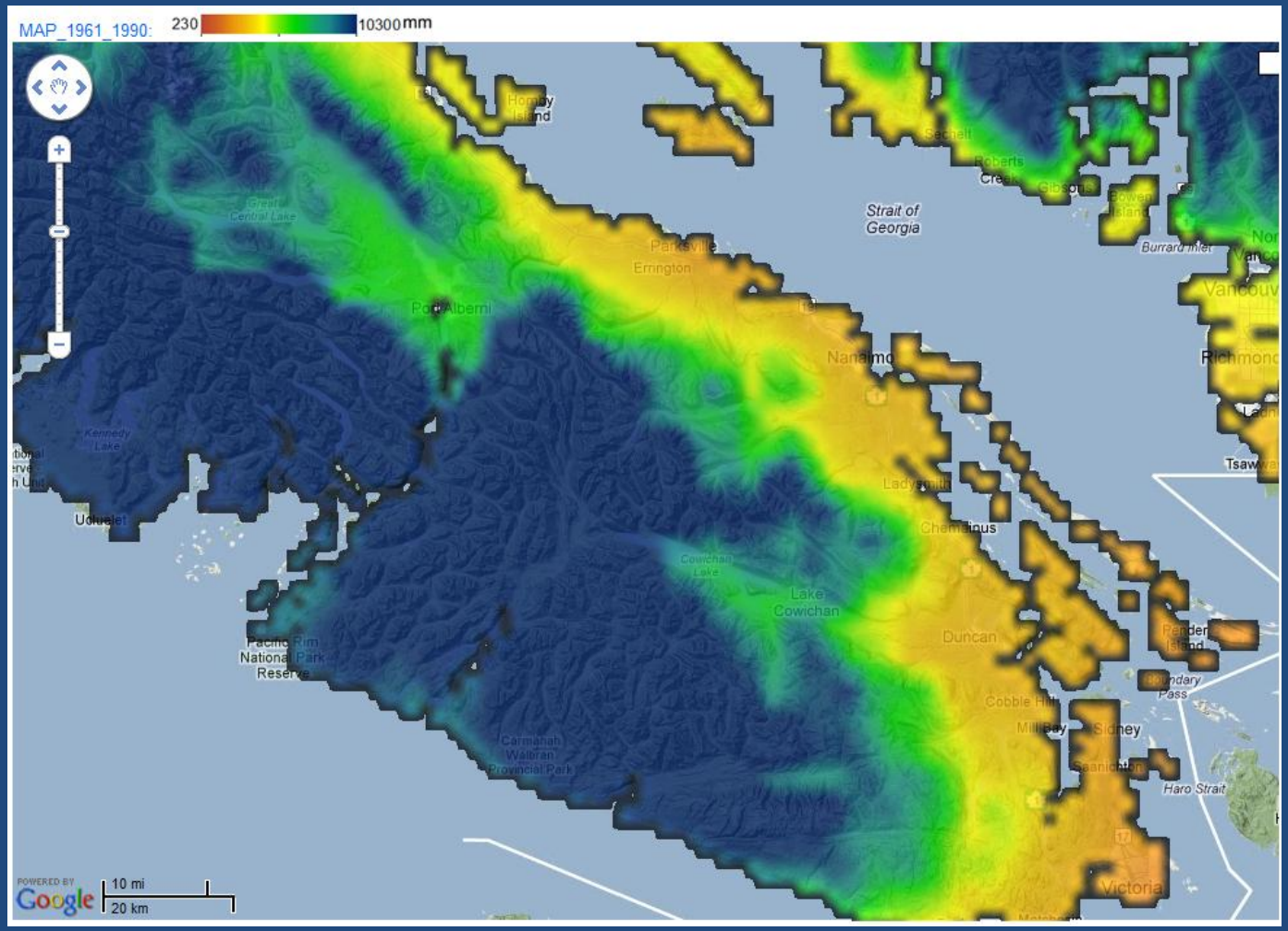
Vancouver Island Hydrology

- Complex terrain (highly variable precipitation both seasonally and during individual rainstorms)
- Strong precipitation gradient from west to east (eg from Cowichan headwaters to mouth)
- Moderate elevation
  - Seasonal snow pack >800m
  - Transient snow pack 300-800m
- Snow plays modest role in river hydrology
  - Floods occur during intense storm events during fall-winter
  - Rain-on-snow can be a big factor
  - For Cowichan, tidal influences
  - Snow melt contributes to flow through late-spring to mid-summer
- Sensitive to climate change



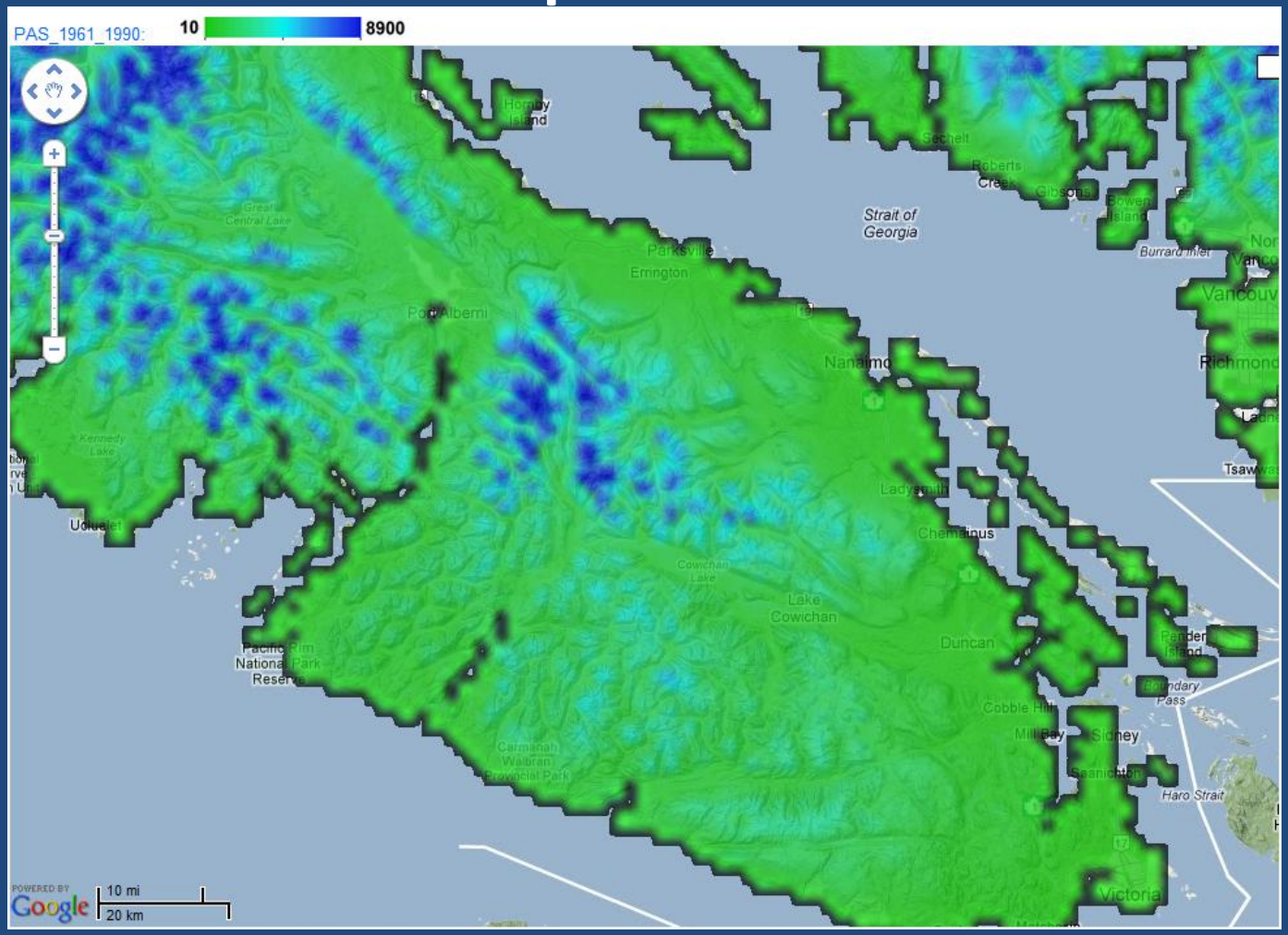


Mean Annual Precipitation



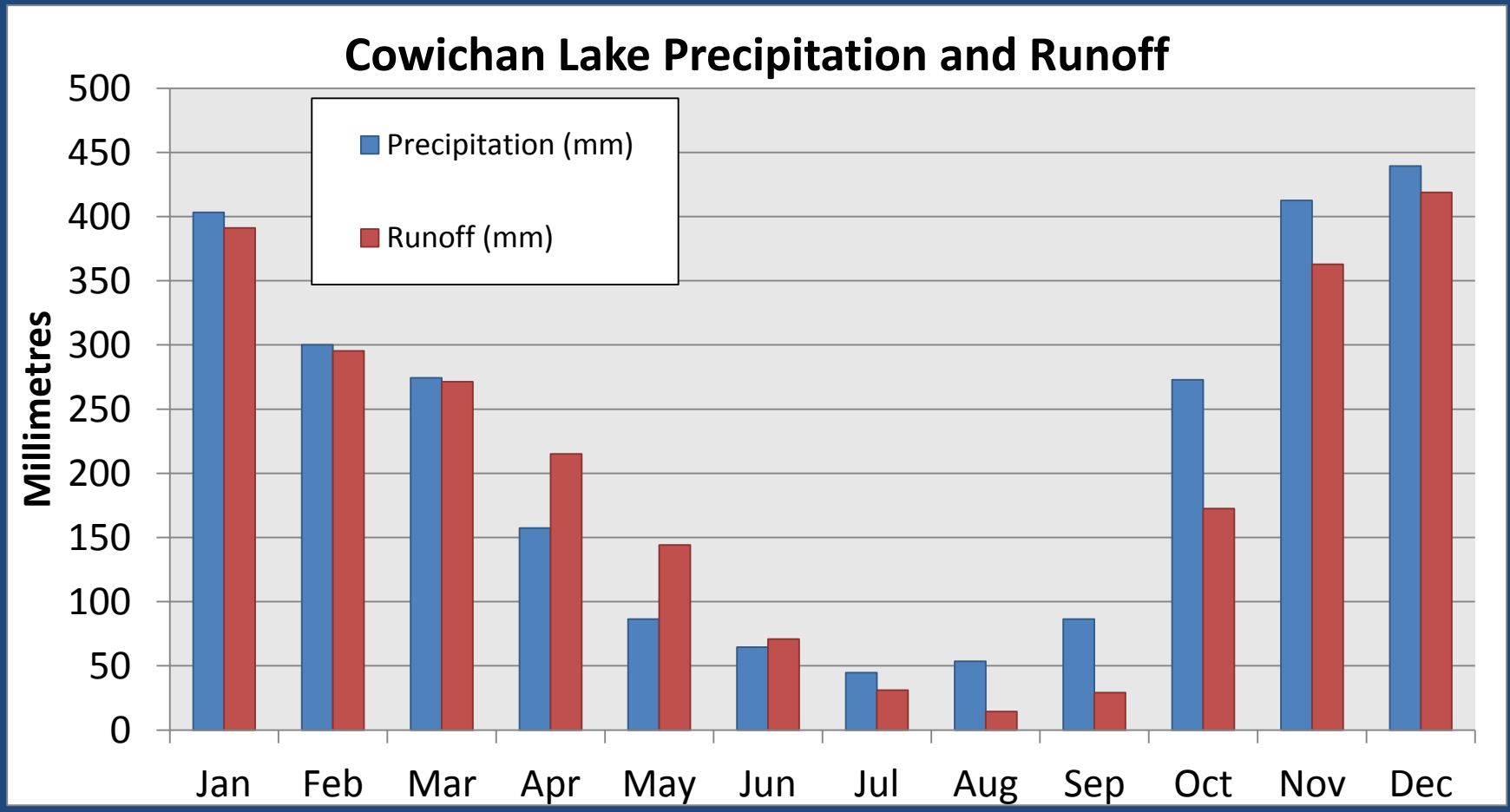
Source: ClimateBC

Annual Precipitation as Snow

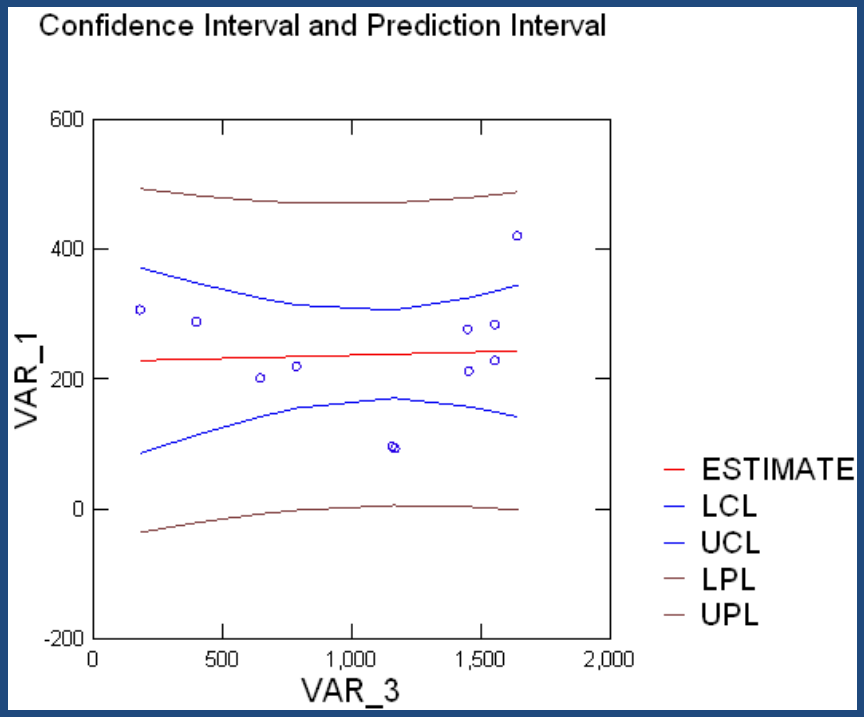


Source: ClimateBC

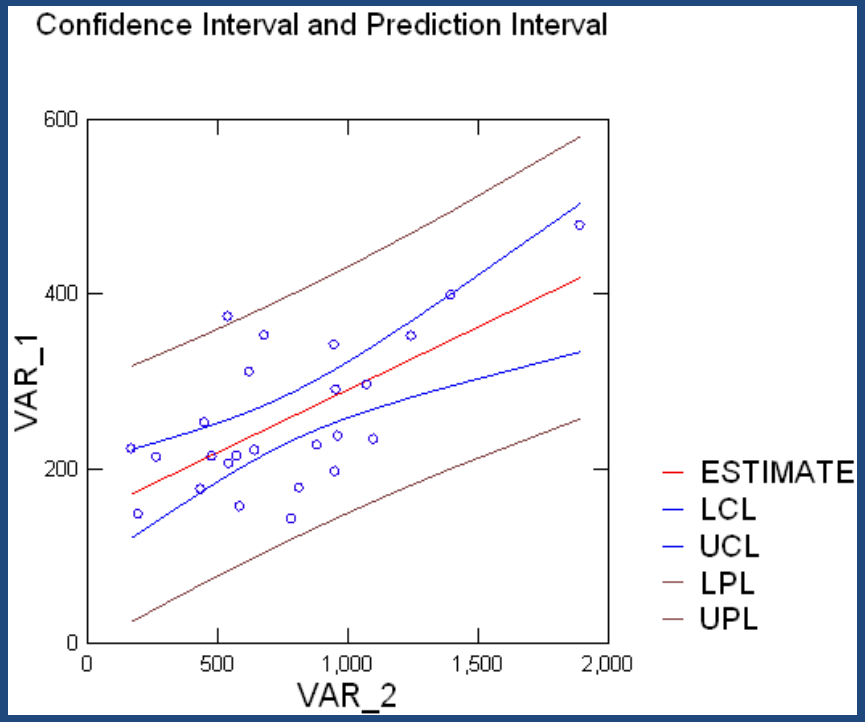
	Jump Creek ASP	Heather Mountain MSS
Period of Operation	1996-Present	1951-1991
Elevation (m)	1134	1170
Average Apr 1 SWE (mm)	1500	842
Estimated MAP (ClimateBC)	3420	5040


Cowichan Lake Precipitation and Runoff
Millimetres
500
450
400
350
300
250
200
150
100
50
0
Precipitation (mm)
Runoff (mm)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

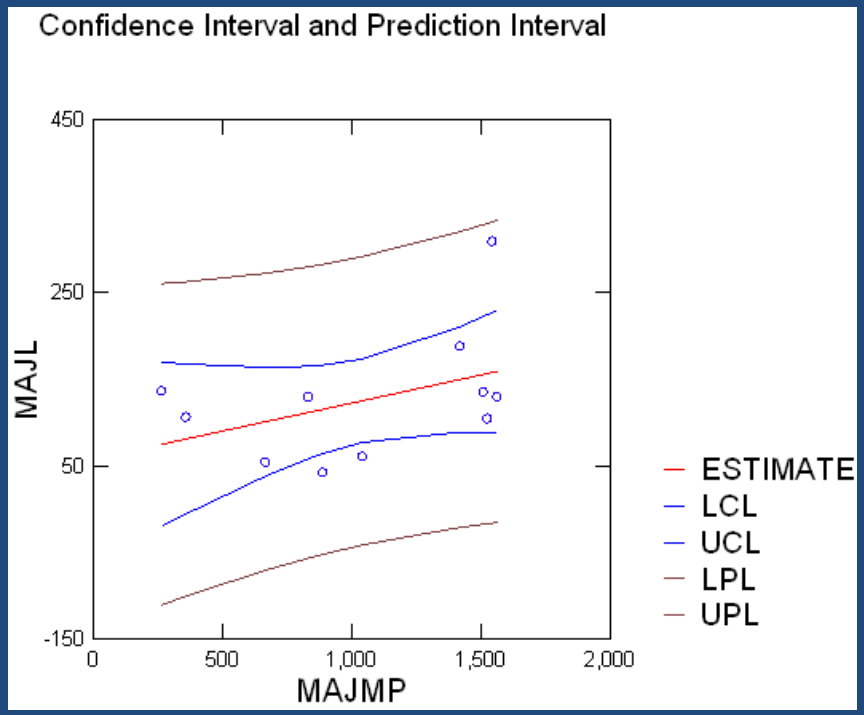
April-June Runoff vs. Jump April 1st SWE



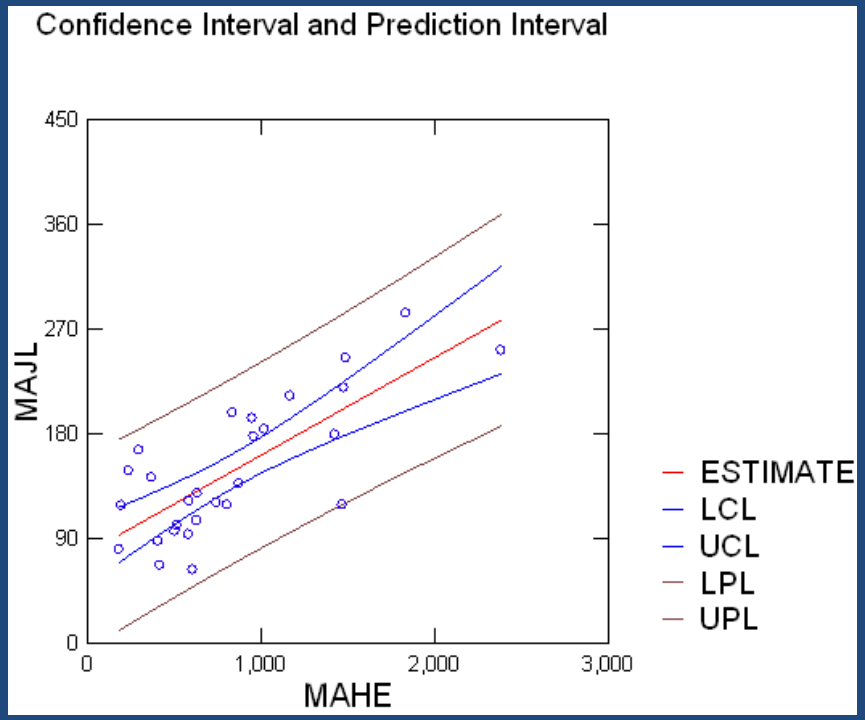
April-June Runoff vs. Heather April 1st SWE



May-July Runoff vs. Jump May 1st SWE



May-July Runoff vs. Heather May 1st SWE



Summary

- Jump Creek ASP is very limited for seasonal forecasting (r^2=0.01-0.09)
- Improved seasonal correlations with historic Heather Mountain site
  - Still low correlation (r^2=0.36-0.59)
  - Highest correlation with May 1st snow and May-July runoff volume. In general May 1st data performed best
  - The very nature of the hydrology on Vancouver Island (rain-dominated systems) will limit any usefulness of any seasonal forecast
    - Highly dependent on rainfall amounts at all times of year (which is inherently difficult to predict)
    - Gain some modest prediction of the few months that snow melt contributes to volume

Summary

- An ASP site provides real-time data that can be useful for flood forecasting
- Currently rely on Jump Creek data and Mesachie Forest Service station for real-time watershed data
- Rainfall rates at various locations in the watershed can be highly variable during storms (due to storm track, intensity, local topography)
  - Uncertain/unlikely that a Heather Mountain station would be more “representative” of the watershed
  - Temperature/snowmelt rates are less variable than rainfall rates
  - Ideally would have broad coverage of rain gauges to capture spatial variability of rainfall rates
  - Flood forecasts will inherently have a high degree of uncertainty due to the inability to capture rainfall rates across the watershed

Comments

- What is the data being used for?
  - Flood forecasting?
    - will increase spatial coverage of precip and snow melt
    - May or may not increase accuracy from Jump Creek
    - Are there alternatives that would improve forecasting abilities
      - Options for broader, simple rain gauge network?
      - Increased modelling techniques, particularly hydro-dynamic modelling on the lower floodplain which considers tidal influence

Comments

- What is the data being used for?
  - Seasonal forecasting?
    - will increase precision of seasonal forecasts
    - Co-locating at same location as historic manual surveys will provide for a longer term/more robust data set
    - Spring-summer seasonal forecasts inherently low precision (influence of summer precipitation)
    - Will not be able to predict extremes (eg 2012 would have forecasted higher than normal seasonal flows, would not have predicted historic dry spell)
    - An individual May 1st manual survey might fill the seasonal data need
      - Might not be sufficient if there is also an interest in trying to capture long-term trends and climate change

Comments

- Location?
  - Leveraging the existing data set at Heather Mountain is advantageous
    - Know that it correlates to runoff
    - Can utilize that correlation immediately to make use of the data
  - Other locations?
    - May or may not correlate as well as the Heather Mountain Site
    - Would need to do contemporaneous surveys at Heather Mountain develop a correlation/be able to utilize the historic data set
    - Without calibrating to Heather Mountain, it will be many years/decade of monitoring before it would start to have real benefits to seasonal forecasting

Comments

- Who is using the data?
  - What will the operational effect be of this data and potential for moderate increases in seasonal forecasting ability
  - How is uncertainty over summer precipitation dealt with?