

Persistence of Soil Moisture in the Cariboo Mountains, BC

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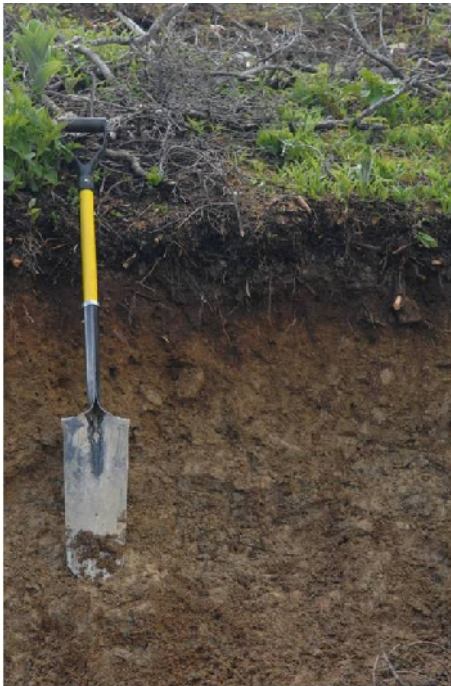
Overview

- Abbreviations
- CAMnet
- Who Cares
- The Project
- What I did...
- Autocorrelation
- Results
- Wrapping Up
- Future Direction
- Acknowledgements



Abbreviations

- SM = soil moisture



Soil pit at Mt. Tom, pic taken by Paul Sanborn,
June 16, 2008

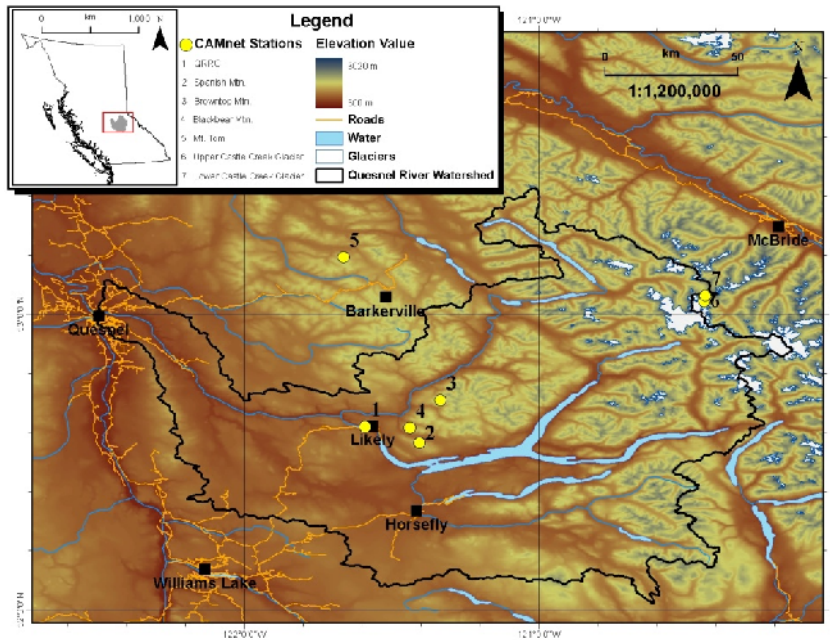
- CAMnet = Cariboo
Alpine Mesonet (our
weather station)



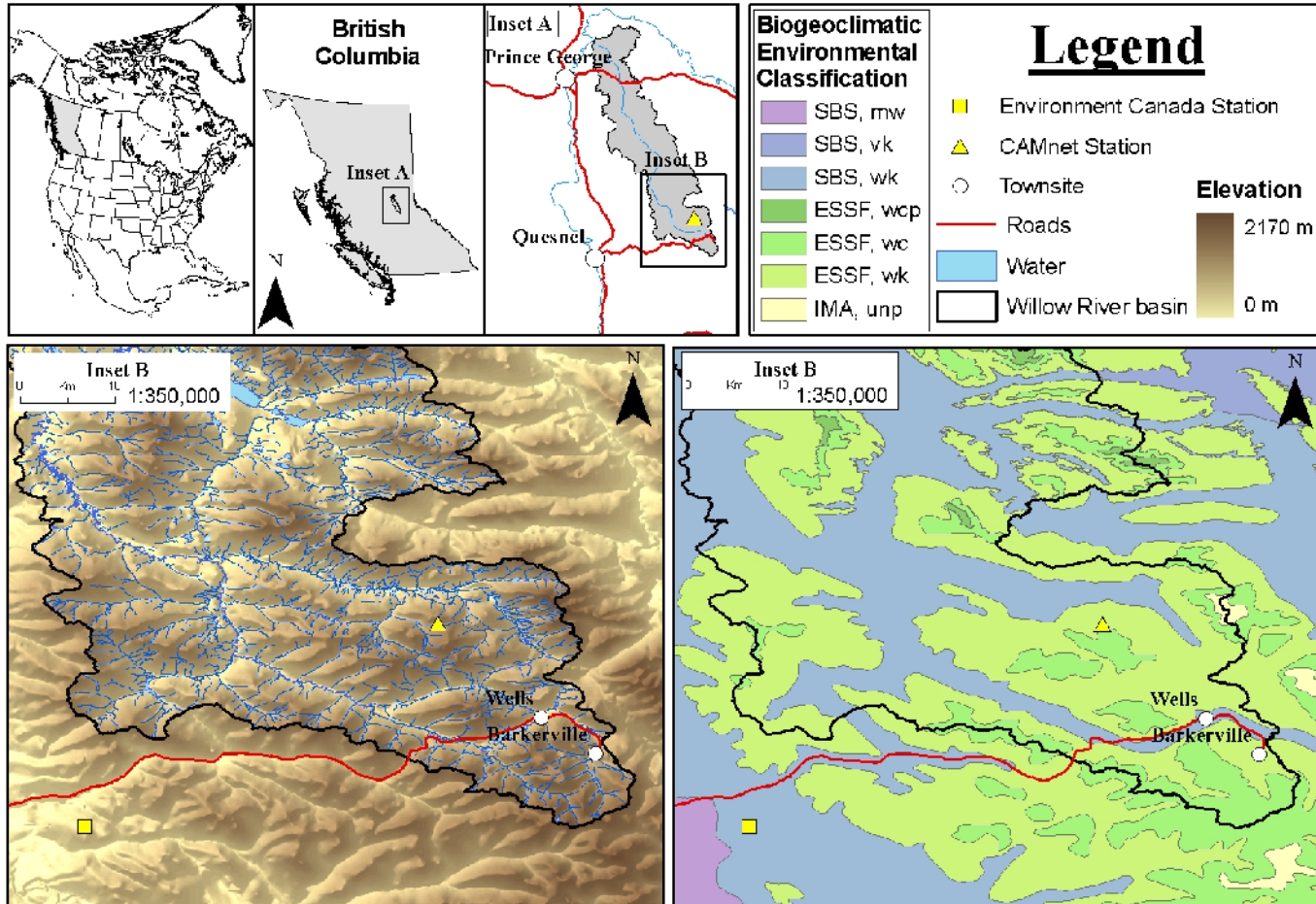
View from Browntop Mountain meteorological tower,
photo taken by Marco Hernandez, date unknown

CAMnet

- Mt. Tom is Station 5
- Outside of Quesnel River Watershed
- Willow River Watershed
 - Over 3000 km²
 - Enters Fraser River at Willow Creek, just south and east of Prince George
 - Originates at Jack of Clubs Lake, near Wells in the Cariboo Mountains, BC



The Area



Who Cares?



- Vegetation
 - Need soil moisture for evapotranspiration
- Critters
 - In the soil and all around, need food and nutrients in soil
- People
 - Agriculture, ground water supply
- Industry/Infrastructure
 - Affects working season duration, erosion, water availability, etc...

Photo of spruce forest from enature.com
<http://www.enature.com/fieldguides/enlarged.asp?imageID=19697>

The Project

- Set out to monitor soil moisture at 3 depths
- Allows us to track how soil moisture moves vertically through the soil profile
- Sampled root depth zone ~ 35-50 cm in the Mt. Tom area
- Rocks limit spacing and depth of sampling



Photo of sampling pit at Mt. Tom; sensors at 10, 20 and 35 cm depths

What I did...

- Looking for temporal patterns in the time series
- Test for persistence of soil moisture using autocorrelation (wait for it.....)
- Look at 2 separate time periods... before freeze-up and the spring melt
- Compare to data for year as a whole but we won't discuss this today... I'll tell you why

What is autocorrelation?

- Nerdy stats that compare values at each time step with preceding values to see how similar they are
- More similar = more persistence
- Less similar = less persistence
- Positive (negative) correlation = increasing (decreasing) together in time

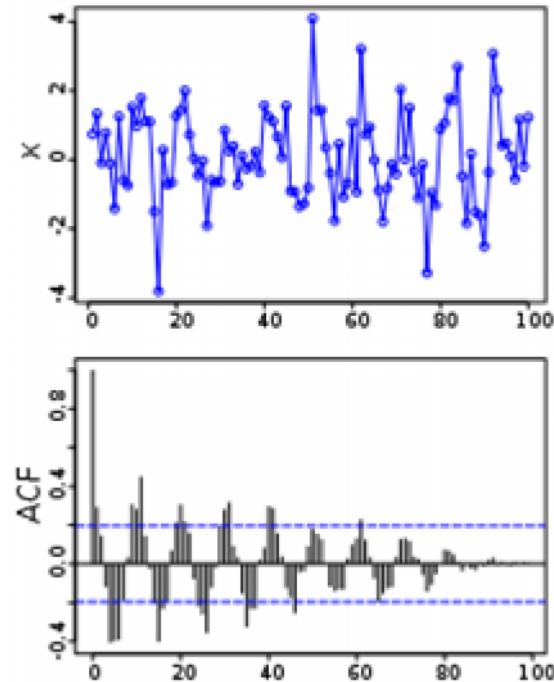
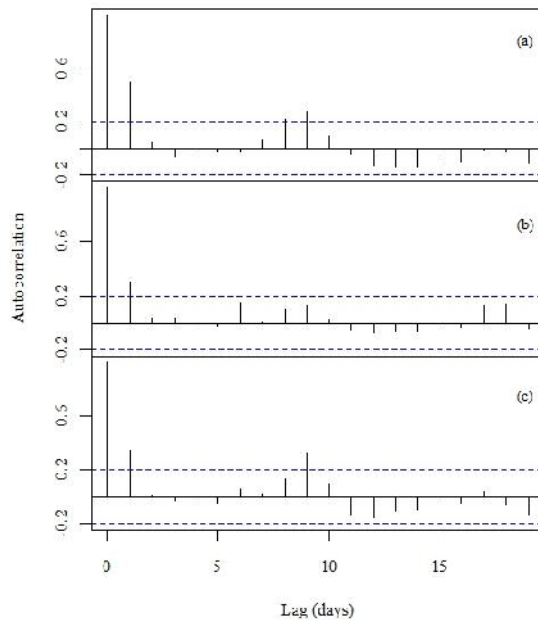
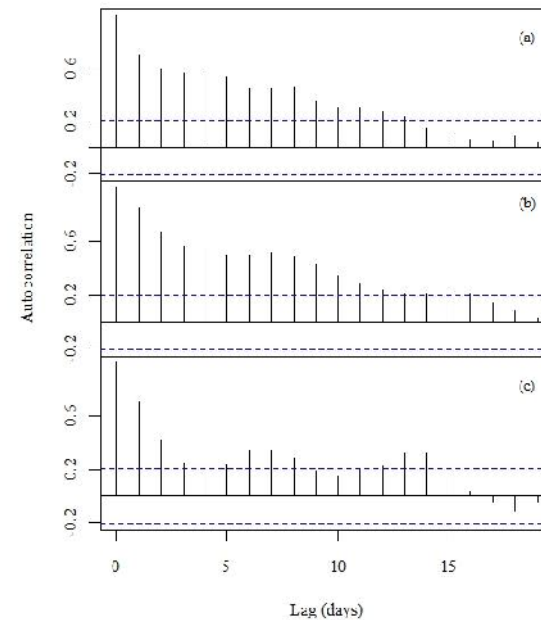


Image from Wikipedia page on time series analysis
http://en.wikipedia.org/wiki/File:Acf_new.svg

Results



Autocorrelation functions for fall freeze-up period, Aug 15, 2008 to Nov 20, 2008 @ a) 10 cm, b) 20 cm and c) 35 cm depths



Autocorrelation functions for spring melt period, Apr. 1, 2009 to , June 15, 2009 @ a) 10 cm, b) 20 cm and c) 35 cm depths

- Persistence no more than 2 days in fall freeze-up vs. up to 13 days in snow melt period
- Autocorrelation of series diminishes with depth such that persistence is on order of only 3-4 days at 35 cm depth, following sinusoidal pattern typical of synoptic weather phenomena (like rain... on average occurs about every 7-10 days)

Why we won't look at annual data today

- Annual data are leveraged (highly influenced) by the SM data from winter
- WHY?
 - Snow cover prevents infiltration of water to soil so that SM values through the winter are determined by conditions in the fall
- What does that mean?
 - Presumably, wetter than average years would have wetter than average SM conditions leading into fall freeze-up
 - In spring, higher than average SM could lead to soil erosion if limits for infiltration are exceeded
 - Data from winter affect overall average resulting in false representation of how moisture is retained when soil is exposed to atmosphere

Wrapping Up

- Persistence of SM is dependent on the occurrence of precipitation events
- Soil water moves quickly through the soils at Mt. Tom, residing no longer than approximately 3 days (in the upper 35 cm) after any liquid precipitation event
 - Likely due to steepness of terrain $\sim 3^\circ$ grade
- Snow cover provides an endless source of water to soil during snow melt period
 - reflected in the autocorrelation analysis showing persistence of SM on order of 10 to 13 days from April 1, 2009 to June 15, 2009

Future Directions

- Look at adjacent watershed (ICH- Interior Cedar-Hemlock Forest)
 - Elevational changes in snow depth and contribution of snow from higher elevations to water budget of lower elevations and valley
 - Projected changes in vegetation and ecotones with climate change