How interactions between climate and vegetation impact hydrological processes in mountain headwater basins

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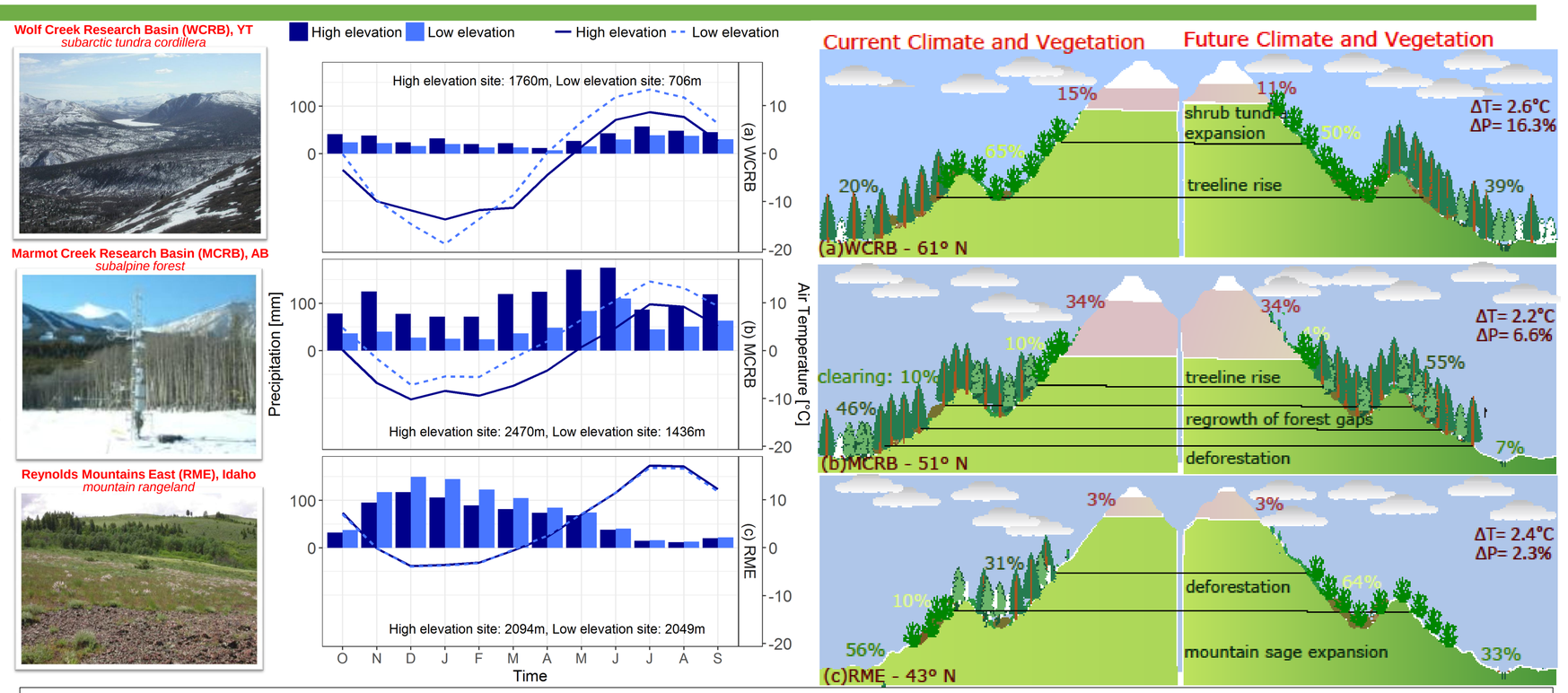
Research Objective

To investigate the hydrological response to climate and vegetation changes in mountain headwater basins.

Methodology

The Cold Regions Hydrological Modelling platform was used to create hydrological models of three research basins along the Western Cordillera. These models were driven with climate model-based perturbations of meteorological observations. Vegetation was also perturbed based on expectations of ecological change with climate – more shrubs and trees.

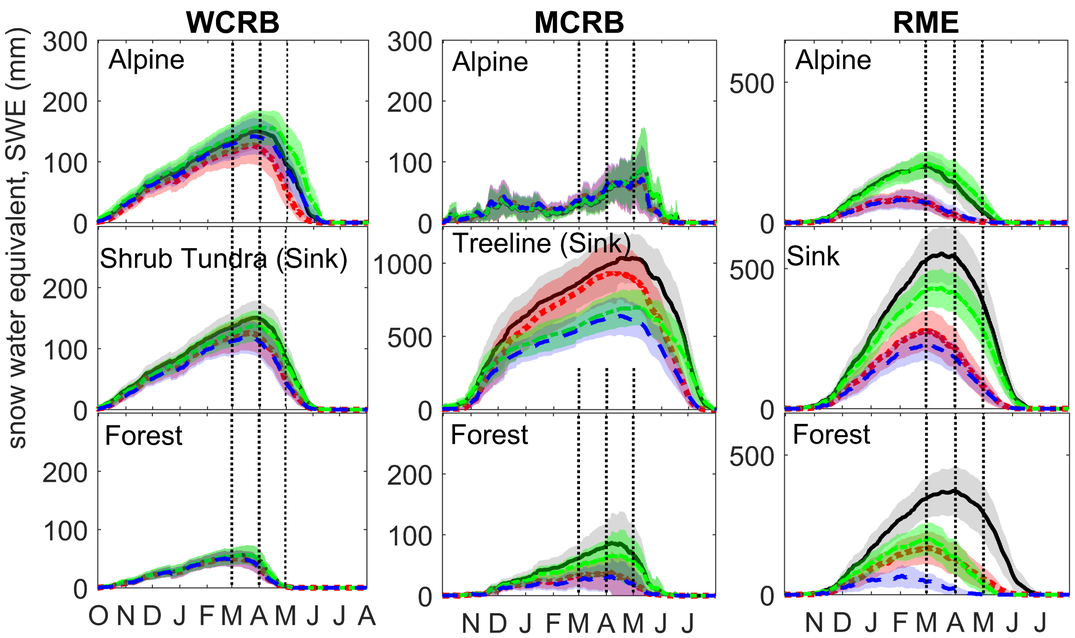


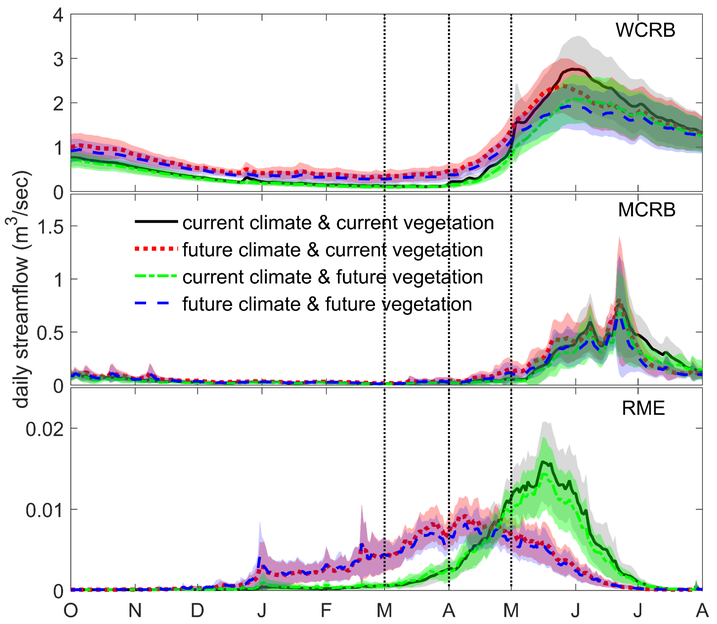
Monthly perturbed climate: Historical observations + Δ

Δ = 2041-2070 climatology - 1971-2000 climatology

11 RCMs were used from North American Regional Climate Change Assessment Program.

Snow and Hydrograph Response to Change





- Under a combined climate and vegetation change scenario:
  - *Despite offsetting effect of alpine vegetation changes, maximum snow accumulation decreases in all of the elevation bands.*
  - *The date of the maximum snow accumulation advances 24 days in WCRB, 5 days in MCRB and 40 days in RME.*
- Earlier snow ablation is slower as it occurs when the solar irradiance is lower and hydrographs are attenuated despite warmer temperatures. Climate impacts are most evident in the warmest basin (RME).

Conclusions

- Climate change impacts on snow regime are far more evident at the warmest basin (RME), and at lower elevations.
- At high elevations, the effects of climate change on snowpack and runoff are smaller and partially offset by vegetation change.
- Basins with a large elevation range and cold conditions at high elevations (MCRB, WCRB), were more resilient to climate change.
- Consideration of both climate and vegetation changes is needed to assess impacts of change on mountain hydrology.

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