Validation of Machine-Learning-Based Snowfall Forecasts for Snoqualmie Pass, WA

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Introduction

- Accurate winter storm forecasting is critical in mountainous regions to lower maintenance costs, reduce traffic delays, and protect lives and property
- Complex terrain makes snow challenging to forecast
- Here we examine Snoqualmie Pass, WA, where Interstate-90 traverses the Cascade Mountains
- An average of 27,000 vehicles travel through Snoqualmie Pass each day
- The cost of closing the pass exceeds $700,000/hour

Snoqualmie Pass, WA

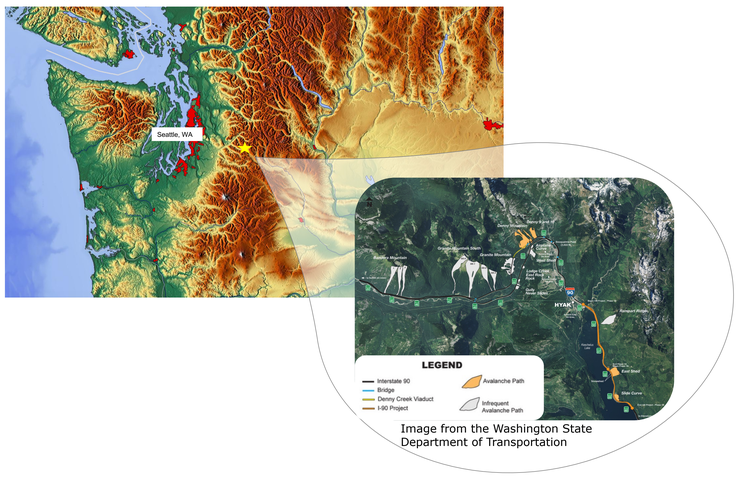
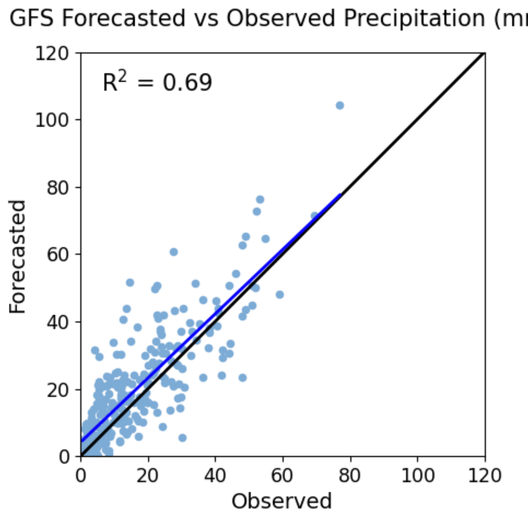
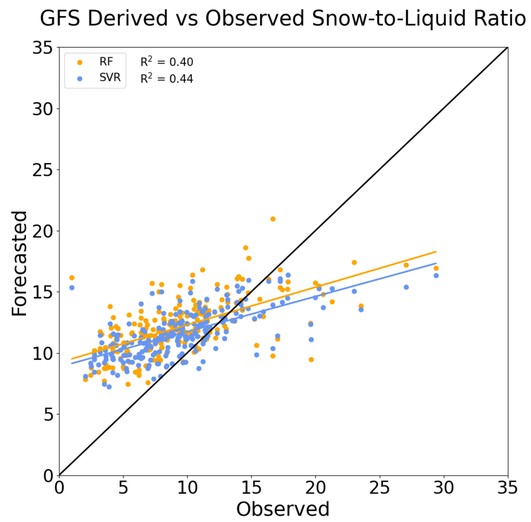
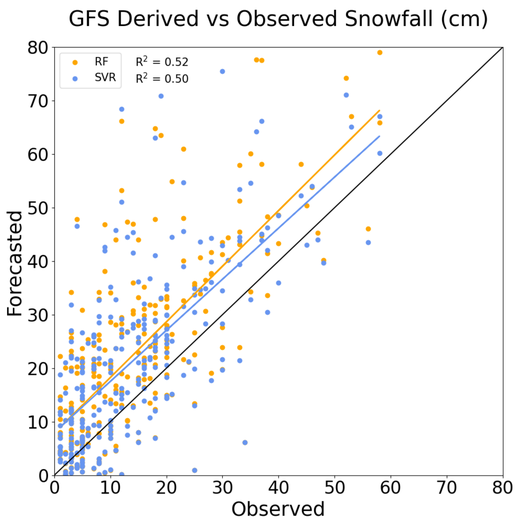


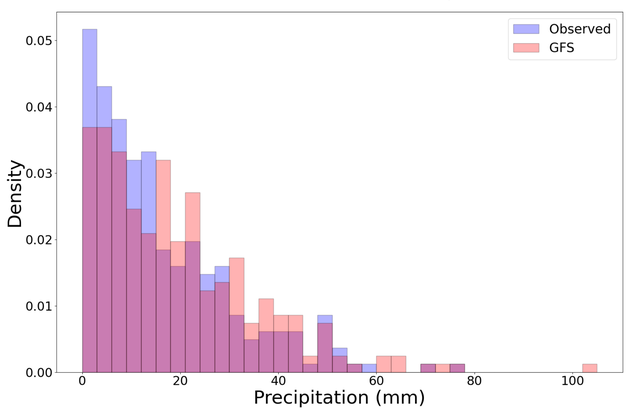
Image from the Washington State Department of Transportation

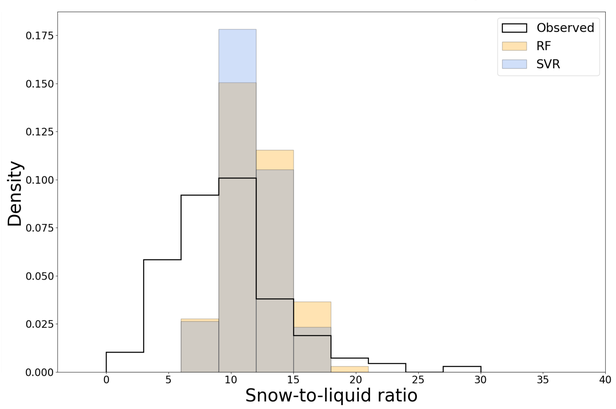
Results

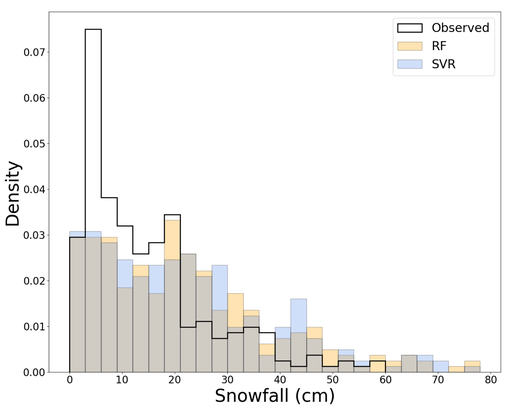












Data and Methods

- Here we validate precipitation, snow-to-liquid ratio (SLR), and snowfall amount forecasts for the past four cool seasons (2019/2020 - 2022/2023) derived from the Global Forecast System (GFS)
- Machine learning was used to predict SLR, which was used to derive a snowfall forecast from the GFS precipitation forecast
- In this study, we focus on random forest (RF) and support vector regression (SVR) machine-learning techniques

Key Findings:

1. The GFS slightly overpredicts precipitation
2. SLR shows bias towards higher values in a narrow range
3. Application of the RF and SVR models for snow-to-liquid ratio results in an overprediction of snowfall

Discussion

- Hypothesis cause for error: GFS model biases
- Future work: evaluate the sources of error in the GFS forecasts and machine-learning SLR models

Acknowledgements

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Data from the Washington State Department of Transportation Avalanche Forecasting and Control Team