Advancing Probabilistic Snowfall Prediction in the Mountain West and Beyond

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Winter precipitation poses a major challenge for operational weather forecasting and frequently leads to snow- or ice-bound traffic, air-travel disruptions, vehicle accidents, power outages and infrastructure damage. During winter storms, the difficulties of quantitative precipitation forecasting are compounded by the need to also consider factors such as precipitation type, snow-to-liquid ratio, snowfall rate and amount, snow level, and wind transport.

This talk describes one approach for generating high-resolution, medium-range snowfall forecasts over the contiguous western United States where topographic effects strongly modulate precipitation type and snow-to-liquid ratio. The approach involves downscaling ensemble precipitation forecasts from the ECMWF Ensemble (ENS) and the NCEP Global Ensemble Forecast System (GEFS) to 800-m grid spacing using climatological PRISM precipitation analyses and then applying a machine-learning algorithm trained with data collected by snow-safety (i.e., avalanche control) teams at mountain sites through the western US to forecast snow-to-liquid ratio. The result is an 82-member ensemble snowfall forecast that we call the Utah Snow Ensemble and provides probabilistic guidance for precipitation, snowfall, snow level, and snow-to-liquid ratio (see https://weather.utah.edu/index.php?runcode=2024102500&t=ensgefsds&d=6HS&r=WE and links for other products in the left menu bar).

The Utah Snow Ensemble serves as our testbed for predicting snowfall and snow properties over the western US. We are also producing CONUS-wide forecasts of snowfall and snow-to-liquid ratio based on training with CoCoRAHS observations. These will be discussed if time permits.