Climatology of Orographic Precipitation Gradients and Application to Quantitative Precipitation Forecast Downscaling over the Western United States

Orographic precipitation gradients (OPG) relating to the increase or decrease in precipitation amount with elevation are not well studied or analyzed except for case examples. A quality controlled daily OPG data set for the western United States based on a linear regression framework of gauge precipitation observations and elevation for a 39 year time period was created and analyzed to identify spatial and temporal patterns and variability in OPG and some of the drivers of variability on seasonal, annual, interannual, and climatological timescales. Most locations in the western United States experience positive OPG during most of the year, exhibiting an annual cycle with the highest magnitude of OPG in the winter season and lowest magnitude of OPG in the summer season. Coastal locations tend to have higher magnitude OPG and larger variability in OPG than interior locations during cool seasons. Empirical orthogonal function (EOF) analysis identifies two principal components that account for 33 percent of the variability in a subset of the OPG data set, and these modes of variability are related to precipitation amount and atmospheric circulation over the Pacific Ocean. Comparison of daily OPG with similarly calculated three-day and monthly OPG identifies that OPG magnitudes are sensitive to the length of the precipitation accumulation period chosen.

Analysis of daily OPG variability also shows a strong relationship with precipitation amount. A combination of atmospheric variables and the OPG data set was used to develop a framework for prediction of the sign and magnitude of OPG for each facet for each day. This prediction can be used to add increased forecast accuracy to downscaling of numerical weather model quantitative precipitation forecasts (QPF) when compared to traditional day-of-year climatological-based downscaling methods. However, certain complexities may arise or error may be introduced in the process of operational deployment.

Lucas Bohne
MS Candidate

Supervisory Committee: Dr. Court Strong (Chair), Dr. Jim Steenburgh, Dr. John Horel

Monday, February 24, 2020
3:15 PM
295 FASB