Estimating Olympic Peninsula precipitation from upper air wind and humidity

L. A. Rasmussen, H. Conway, and P. S. Hayes
Geophysics Program, University of Washington, Seattle WA 98195, U.S.A.


Abstract. Daily precipitation at Forks, a lowland station on the west side of the Olympic Peninsula, correlates well over 1948-1996 with wind and moisture in twice-daily upper air soundings at a nearby radiosonde station. Values at 850 mbar are taken as an index of the total moisture flux. The model estimates precipitation by using the component, raised to a power, of the wind in a particular critical direction scaled by the relative humidity. Thresholds are imposed for the wind component and the relative humidity to reduce the likelihood of estimating precipitation from weak onshore flow on dry days. The critical wind direction, about 238°, is where the long-term mean of the relative humidity is maximum rather than where that of the absolute humidity is. A spilt-sample analysis indicates that the model parameters are highly robust against sampling error. This simple moisture flux model estimates Forks precipitation well; the coefficient of determination for daily precipitation $r^2 = 0.50$ improves to 0.84 for monthly values. Results from a mesoscale precipitation model were negligibly better. For 19 other stations around the periphery of the mountainous peninsula, the critical direction varies only from 210° to 257°. Precipitation on the peninsula is greatest where the moisture flux from the southwest encounters topographic upslope; elsewhere, it is lower but still occurs primarily when the 850-mbar wind is from the southwest rather than in the local upslope direction. For stations on the north side of the peninsula the critical direction is more westerly, and for stations on the east side it is more southerly.