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Relationship of Short-Term Precipitation Records at Yucca Mountain to Long-Term Climate Records

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Performance assessments for a potential high-level waste repository at Yucca Mountain, Nevada, depend upon assumptions about future climate for time periods of thousands to a million years. Precipitation data has been collected from a number of Yucca Mountain Project (YMP) meteorological stations for the past 10 to 20 years and used in conjunction with data from nearby meteorological stations as input to models for estimating net infiltration for the modern climate in the performance assessments. Because the characteristics of past and potential future climates are often scaled to present-day or Holocene climate, the question arises, Do the measured data reflect a representative modern climate covering the Holocene Epoch?

The climate at Yucca Mountain is believed to have been generally hot and dry for the past 8,000 to 11,000 years covering the Holocene Epoch, following a period of glacial transition when the climate was cooler and wetter. For longer periods, climate records have been developed based on correlations to Earth's orbital patterns (the Milankovitch cycle) and to analog data based on isotopes and fossil records. The longer paleoclimatic records are not considered further here. This analysis assesses the overlap of (i) short-term 10- to 20-year YMP meteorological records, (ii) 50- to 100-year records from meteorological stations in the surrounding areas of Nevada and California, and (iii) 8,000-year records supported by tree-ring data collected in the nearby White Mountains. The 1990s was a period of prominent El Niño influence, which resulted in greatly enhanced winter precipitation in southern Nevada. If the 10- to 20-year period of record at the YMP stations was anomalously wet, averages developed from this record may be a biased indication of long-term climate. Average precipitation values for the past 10 to 20 years and for the entire record were calculated from regional 50- to 100-year meteorological stations. Mean annual precipitation over the past two decades is generally consistent with averages from the entire 50- to 100-year records, although the differences (positive and negative) in averages are highly variable between stations. Records from regional meteorological stations over the past 50 to 100 years coincide with a period of decreased tree-ring width, which implies a period of decreased precipitation. Based on a short period of overlap with meteorological stations, a mapping of tree-ring width to precipitation magnitude is provided. Other supporting data for the tree-ring interpretation are explored (e.g., bioturbation indices from Pacific Coast marine sediments). The uncertainty of a quantitative estimate of a representative Holocene annual precipitation value to use in performance assessments is discussed.

This is an independent product of CNWRA and does not necessarily reflect the views or regulatory positions of NRC. The NRC staff views expressed herein are preliminary and do not constitute a final judgment or determination of the matters addressed or of the acceptability of a license application for a geologic repository at Yucca Mountain.