

THE EFFECTS OF ENSO PHASE ON THE OCCURRENCE OF COARSE PARTICLE MOTION IN CALIFORNIA COASTAL STREAMS

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Abstract: The entrainment and transport of coarse gravel and cobble bed material is a relatively infrequent occurrence in most streams, typically a few to several tens of days per decade. Although infrequent, the movement of coarse bed material constructs and maintains the channel morphology, removes silt and sand that accumulates in the streambed during periods of stability and limits the encroachment of vegetation into the channel. Recent investigations have demonstrated a connection between the El Niño-Southern Oscillation (ENSO) and streamflows along the Pacific Coast of the U.S. The influence of ENSO phase is especially strong for relatively large flows, those equaled or exceeded <1% of the time, that are sufficient to move coarse bed particles.

In order to examine the effects of ENSO phase on the frequency of coarse bed-material motion, we determined the occurrence of initial motion and general motion of the median bed particle, d_{50} , in 17 California coastal gravel-bed streams with complete or nearly complete flow records for the period 1950-2005 and little or no flow regulation or depletion. There is a well-developed south-to-north pattern of particle motion depending on ENSO phase, as well as a significant increase from south-to-north in the total number of days when the daily mean discharge exceeds the threshold of initial and general motion of the median bed particles. In the southern most streams, 72-90 percent of all daily mean discharges sufficient to entrain the d_{50} particle occurred during an El Niño phase. Conversely, only 1-10 percent of all daily mean discharges sufficient to entrain the d_{50} occurred during a La Niña phase. A majority of the total number of days with either initial motion or general motion occurred during relatively few years, about 1 in 5 and then during one El Niño phase. Periods lasting 2-5 years with few or no days of discharge sufficient to exceed the initial motion threshold are common in the coastal streams of Southern California. The number of days with relatively large discharge during a La Niña phase gradually increases northward. Near 40°N, occurrences of bed particle motion are distributed about equally among the La Niña, Neutral, and El Niño phases. Accordingly, daily mean discharges sufficient to exceed the initial motion threshold typically occur, on average, a few to several days per year in the coastal streams of Northern California. General motion of bed material, however, is an uncommon occurrence even in these streams.