

Along-Strike Variation in Locking on the Cascadia Subduction Zone, Oregon and Northern California

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The tectonic uplift rate along the Cascadia subduction zone provides a constraint on the magnitude and distribution of plate coupling. Observations of sea level change at six permanent NOAA tide gauges (Crescent City, California to Astoria, Oregon) over the past 73 to 81 years provide measurements of uplift rate along the Cascadia subduction zone in a geocentric reference frame, once the rate of regional sea level change is removed from the time series. We use a satellite-based estimate of regional sea level rise to place the relative tidal uplift rates in an absolute vertical reference frame. Repeated high quality leveling lines add a dense network of point observations along the coastal route between the tide gauges, as well as five trench-perpendicular transects (Burgette et al., 2005). We anchor the leveling estimates of uplift rate into the absolute reference frame by using a weighted least-squares adjustment that accounts for errors in both the tidal and leveling data. Absolute uncertainties in uplift rate range from 0.3 to 1 mm/yr. In recent years we have collected GPS observations along the leveling lines in an attempt to better anchor the inland endpoints. The first order pattern of uplift rate decays from maximum values near the coast to zero inland, in a pattern consistent with models of elastic strain accumulation above a locked subduction zone. To investigate



Figure 1: The first deployment of the EarthScope GPS Campaign Systems occurred along the Oregon coast in the summer of 2005.

the along-strike variation in uplift rate pattern, we divide the region into northern, central, and southern sections. Because subduction coupling is believed to be fundamentally a function of depth, and the dip of the interface varies along strike, we compare uplift rates between sections using the plate interface geometry of McCrory et al. (2004). Preliminary modeling results indicate that the along-strike 3D geometry of the coastline and plate interface are not sufficient to explain variations in uplift rate. This finding suggests that the width of the locked zone and degree of coupling must vary along-strike. The data are best fit by a decrease in the width of locking below Oregon near Astoria (Weldon et al., 2006).

References

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