GSA DATA REPOSITORY 2011340 Limber and Murray

SUPPLEMENTARY INFORMATION

METHODS

The volume of beach sediment released during sea cliff erosion and retreat, determined by cliff height and composition, is scaled to a beach width by the beach geometry constant, γ. For simplicity and tractability in the analytical model, we assume that the beach wedge at the base of the cliff is triangular with a constant height. So, for example, if the volume of sediment eroded from the sea cliff through time is determined by the product of effective cliff height (*HC*), cell size, and cliff retreat distance, that sediment volume must be deposited cumulatively at the base of the cliff while maintaining the shape of a triangle with a time-varying beach width, *w* (Figure 2, main text). Therefore, in our case, the cumulative sediment released from cliff retreat must be multiplied by a factor of two (because the volume of the triangular beach wedge is one-half the product of beach height, width and cell size) to determine the beach width. For different beach geometries the constant γ must be adjusted accordingly.

INITIAL COMPARISONS OF MODEL RESULTS TO NATURE

The comparisons for the Santa Cruz and Oceanside study sites (Figure 1) are detailed in Limber and Murray (2011), and the same methods were used for the San Francisco site discussed in the main text. Methods are summarized only briefly here. A more detailed map of the San Francisco site is shown in Figure 1, and maps of the Oceanside and Santa Cruz sites can be found in Limber and Murray (2011). The rockiness variable values (see Equation 5, main text) and coastline lengths for all three study sites are listed in Table 1, and we assume the time-averaged height of the beach is on the order of 2 m. Uncertainty estimates for analytically predicted rockiness are based on the measurement ranges for the variables listed in Table 1. An uncertainty estimate of ±0.10 was assigned to rockiness measured from aerial photography to reflect user, source, and interpretation error. The sediment loss rate, S, is a difficult parameter to assign a value to, as there are few available observations of gross coastline sediment loss. Observations of shoreline erosion (or accretion) rates are typically net rates (i.e. balance of sediment gains and losses), rather than gross rates (i.e., losses only). As a proxy, we used long-term net shoreline change measurements (Hapke et al., 2006), acknowledging that the actual rate of S is likely larger than those observations. For Oceanside and San Francisco, it was not necessary to approximate S because the values of HC were large enough such that S needed to be unrealistically fast (1.2 – 4.8 m/yr and >9.3 m/yr, respectively) to bring the predicted value of rockiness above zero and change the predicted coastline configuration. In addition, the average net shoreline change rates for Oceanside were positive (accretionary; Hapke et al., 2006), suggesting that the magnitude of S may be relatively small.

FIGURE CAPTION

Figure DR1. Location map for California study sites. Inset shows detail of the San Francisco study site.

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Figure DR1.


5 km
Pacific
Ocean
~11 km
CALIFORNIA
San Francisco
Santa Cruz
Oceanside

TABLE DR1. ESTIMATES OF ROCKINESS VARIABLES FOR SANTA CRUZ, OCEANSIDE, AND SAN FRANCISCO STUDY SITES

Variable	Santa Cruz	Oceanside	San Francisco	References
S (m yr^{-1})	0.3 - 1.0	N.A.	N.A.	*
E_0 (m yr^{-1})	0.08 - 0.14	0.05 - 0.20	0.3 – 1.0	†, §, #
H	8.5	15.5	>20	§, #, **, ††
C	0.1	0.8	0.8	§, #, **, ††
Length (km)	~20 km	~70 km	~11 km	

*Hapke et al., 2006
†Hapke and Reid, 2007
§Young et al., 2010
#Limber et al., 2008
**Perg et al., 2003
††Best and Griggs, 1991