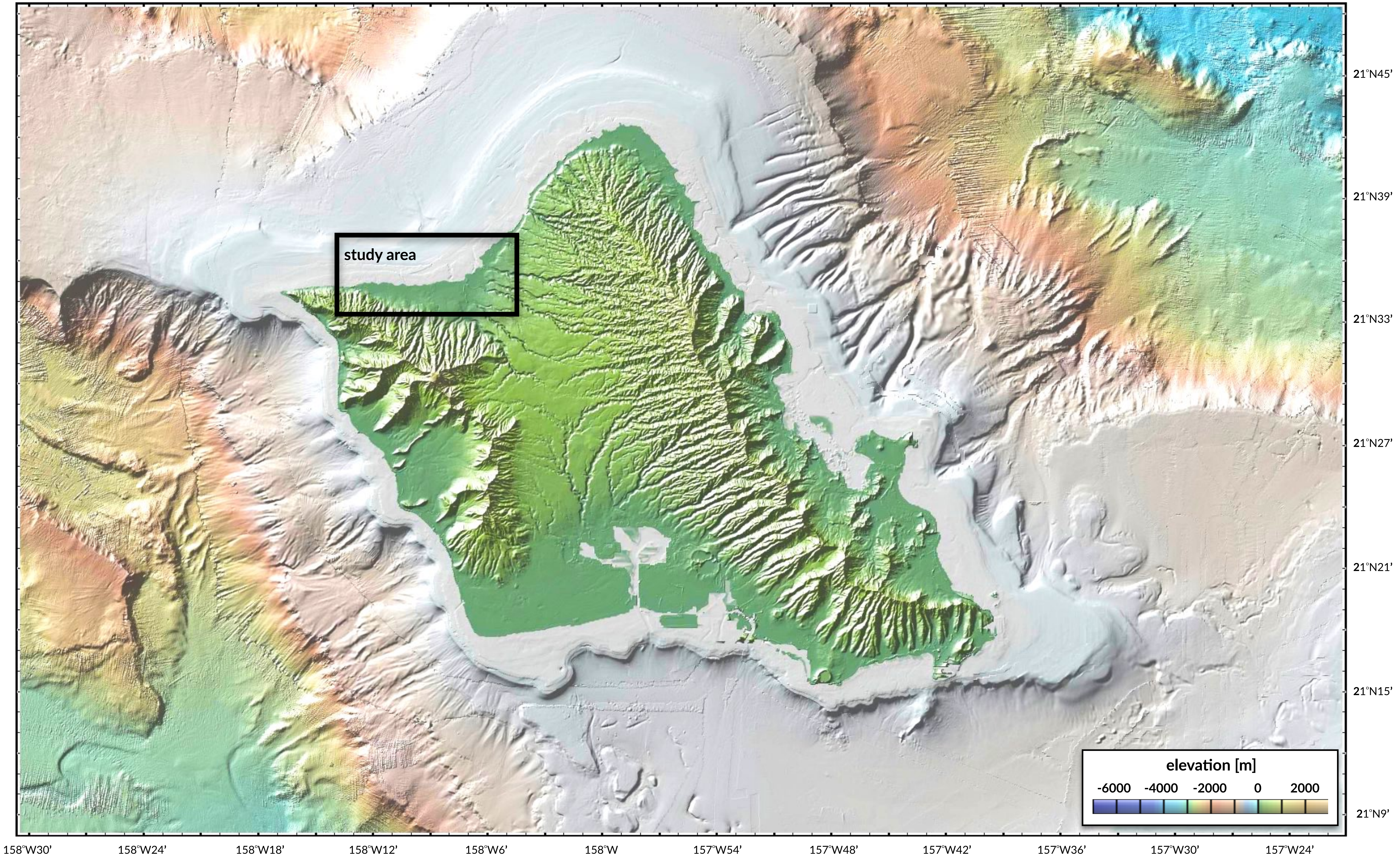
Better physics for coastal dynamics

Sediment transport

using open-source dataset



NOAA Center for Tsunami Research

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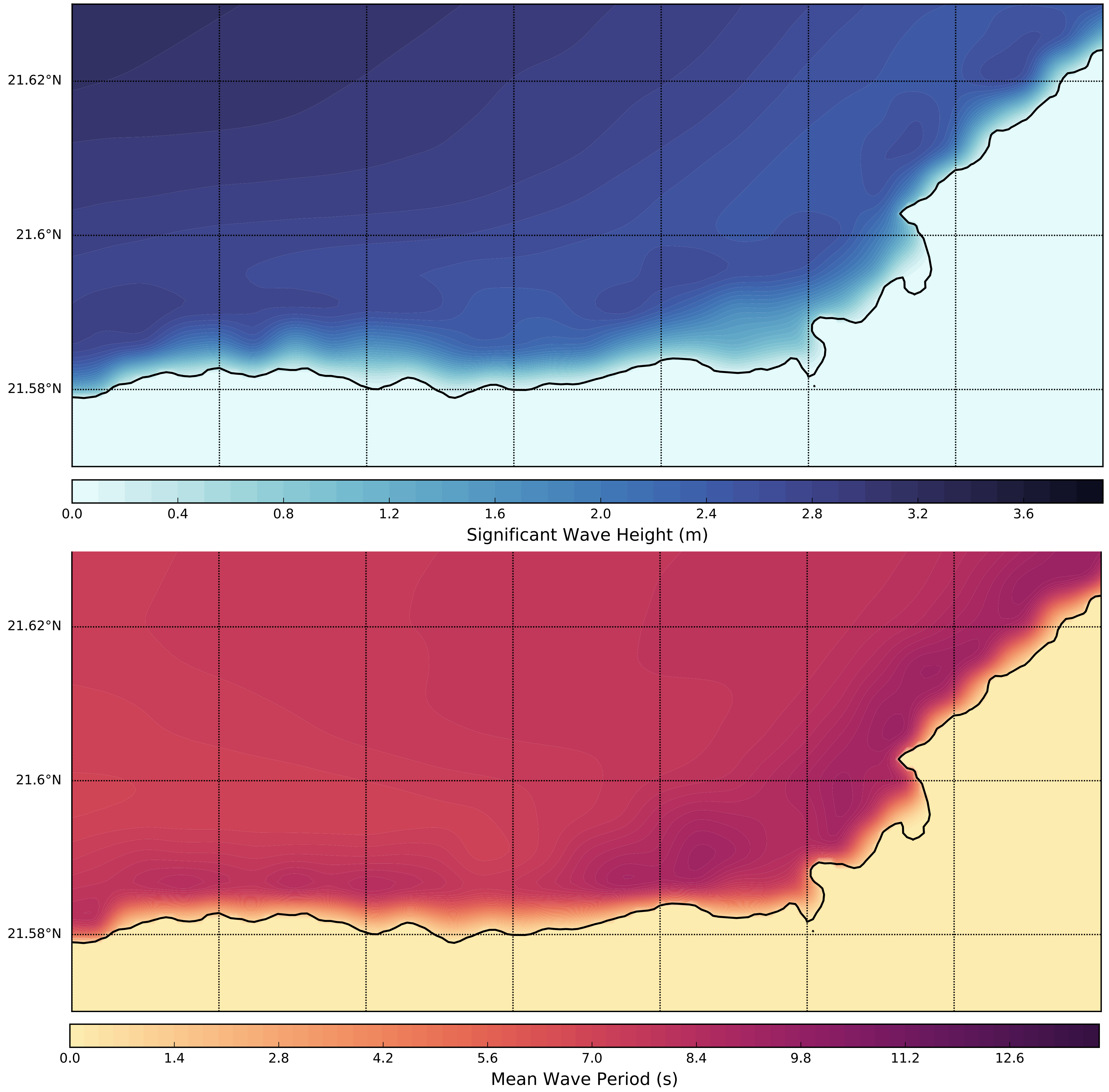
Sediment transport

PacIOOS SWAN wave dataset



Under pure waves (*i.e.* with no superimposed current), the wave-generated bed shear stress τ_w is typically conceived of as a quadratic bottom friction:

$$\tau_w = \frac{1}{2}\rho f_w U_{w,b}^2 \qquad [2]$$

where ρ is water density, f_w is the wave friction factor, and $U_{w,b}$ is the maximum over-the-wave-cycle horizontal wave-orbital velocity. Inserting into equation [2] the linear shallow-water approximation for $U_{w,b}$, given by:

$$U_{w,b} = (H_s/2)\sqrt{g/h} \qquad [3]$$

where g is the acceleration due to gravity and h the water depth, yields an expression for τ_w in terms of the wave height [Green & Coco, 2013]:

$$\tau_w = \frac{\rho g f_w}{8}\frac{H_s^2}{h} \qquad [4]$$

Assuming that the wave boundary layer is hydraulically rough turbulent, the wave friction factor, by definition [Nielsen, 1992], depends solely on the bed roughness k_b relative to the wave-orbital semi excursion at the bed A_b. Following Soulsby [1997], we use:

$$f_w = 1.39(A_b/k_b)^{-0.52} \qquad [5]$$

where $A_b = U_{w,b}T_m$ and k_b is evaluated as a grain roughness [Smith & McLean, 1977] given as $2\pi d_{50}/12$, where d_{50} is the median grain size of the bed sediment.
Most waves in the region reach wave base at approximately 20 m depth and convert their wave energy into shear stress across the sea floor, providing a means for mechanical abrasion of both carbonate framework and direct sediment producers. As an example figure 2 shows the derived values for horizontal wave-orbital velocity and shear stress obtained from PacIOOS dataset.