

## Internal waves: ocean waves below the surface

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Recall the last time you were at a California beach, staring out over the horizon at the seemingly endless ocean. Have you ever wondered what happens beneath the surface? It turns out that the surface tranquility cloaks a dynamic underwater environment.

Below the ocean's surface, the water column is stratified and tends to form layers. Just like oil sits on top of vinegar in salad dressing, the ocean's lighter waters (typically warm and fresh) sit above its heavier waters (typically cold and salty). These layers of density below the surface of the ocean support what are known as internal waves. Whereas waves on the surface of the ocean grow to be several meters tall, internal waves below the surface of the ocean can grow to be nearly a hundred meters tall in some locations. In other words, these underwater waves that propagate (travel) in the interior of the ocean (below the surface) can grow to be as tall as a small skyscraper!

Just like surface waves break on a beach and form whitewater "swash" that rushes up the

beach, internal waves break in the ocean interior on the continental shelf (the "internal beach") and form what are known as internal bores (the "internal swash"). These internal waves and bores can cause rapid changes in temperature and density, and they have the ability to produce powerful ocean currents.

Internal waves and bores are one mechanism, amongst other physical processes like coastal upwelling, that transport nutrients from the deep ocean into shallow coastal waters. These nutrients allow phytoplankton (the microscopic "plants/grass of the sea" that sometimes make coastal waters look green in color) near the surface of the ocean to grow. These phytoplankton then nourish zooplankton that are eaten by fish and other species that in turn support seabirds and marine mammals like the California sea otter. In other words, these internal waves help support the productivity of the nearshore coastal environment and the beautiful kelp forests, ecosystems, and marine life along our coastline!

