A Sea of Change

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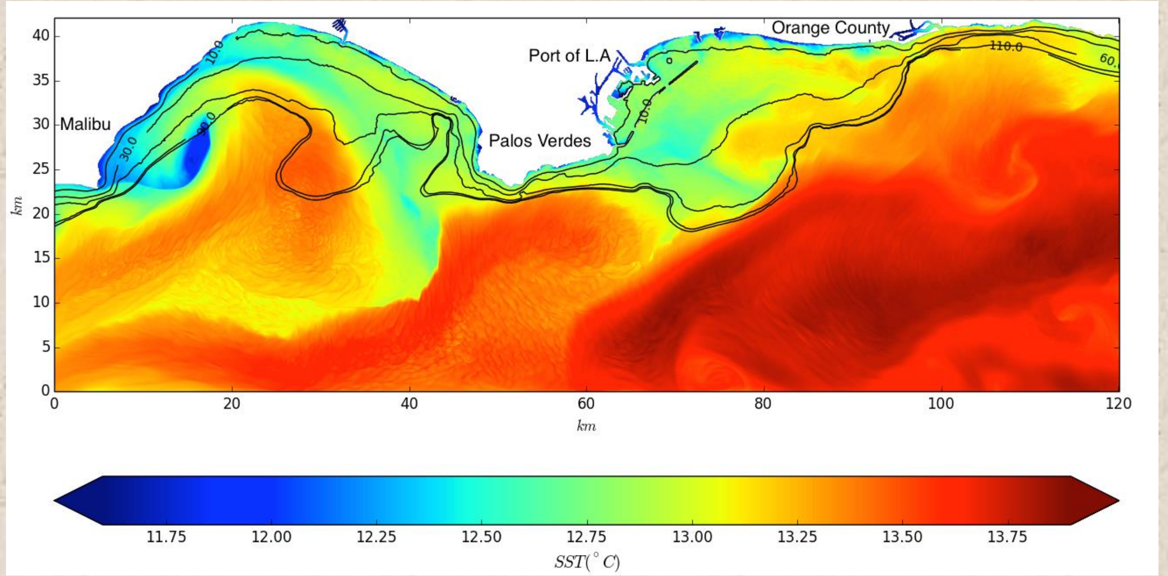
This is the first in a series of articles that will mainly focus on aspects of the coastal ocean. It is my hope that these articles will serve two main purposes. The first is to provide some educational value and inform you of processes that happen along the coast, potentially right in your backyard. The second is a bit more on the poetic side; that these articles will give you an appreciation of how truly dynamic and complex the ocean is all the while maintaining its equally infinite and lucid mesmerizing allure.

This first article is meant to serve as an introduction to the more specific articles that will come later. Each article will focus on one specific coastal process and it is my intent to place these dynamical and/or biogeochemical mechanisms into the context of the California coastal region. I would like to preface the description of these specific mechanisms by trying to simply elucidate one of the most important tools oceanographers use in uncovering and diagnosing natural phenomena. Below is a snapshot from a Regional Ocean Model developed at UCLA. This model is used in research institutions all over the world to analyze the coastal ocean from physical and biogeochemical perspectives. This snapshot shows the sea surface temperature (in degrees Celsius) off the coast of Santa Monica and San Pedro Bay in the Southern California Bight. The black lines on the snapshot indicate bottom depth and they are placed to roughly delineate the continental shelf region from the offshore region.



Now, if the sea surface temperature were completely uniform across this entire region, the ocean here would be a pretty boring place. Thankfully, this is not the case. There are temperature differences all throughout this region. The differences are visualized by the changes in color (red is warm temperature, blue is cold).

Changes in oceanic fields (temperature, salinity, density, nutrient concentration, etc.) across space or time drive dynamics (currents, plankton blooms, etc.). Here is a simple example to help you understand this very fundamental concept: take a pot of room temperature water and put it on the stove. While it is just sitting there at room temperature, no water is moving around in the pot. Now heat up one side of the pot, you'll see that water starts to move around. This is because the fluid (water) wants to balance out the temperature difference created by the uneven heating. This desire for the fluid to reach equilibrium manifests itself in dynamical behavior (in this case flow of water). Let's look at our coastal sea surface temperature snapshot and talk about the spatial patterns (changes) in temperature, because now we know that changes in temperature will drive dynamical behavior and thus we'd like to characterize this behavior by first characterizing the temperature changes. The first feature your eye may be drawn to is the rather warm waters further offshore. You could infer that generally, in this snapshot, the sea surface temperature decreases as your eye moves from the offshore to onshore waters (bottom to top of the picture). To my eye, the second most immediate feature is a cold vortex of the coast of Malibu.

Why is it there, how did it form, what does it mean for the energy balance of the bay? These are questions that a physical oceanographer would seek to answer. If you have a keen visual sense you may also be noticing many small “wiggles" throughout the region. And believe it or not, these “wiggles" are actually a very active area of study. What I would like you to take away from this snapshot is that there are multiple patterns occurring at different spatial scales (the large offshore to onshore temperature difference, and the much smaller scale wiggles). The difference in scales of patterns can just as easily be extrapolated to temporal (time-evolving) patterns. Tides come in and out twice a day. Now ask yourself, how many times a day does a wave break on the shore. There is an obvious difference in the time-scale of wave-breaking and tidal flow. This separation of patterns based on spatial and temporal scales is at the core of how oceanographers isolate, uncover and diagnose behavior for specific spatio-temporal regimes.