Coastal cooling and marine productivity increasing off Peru

The upwelling system off Peru is of environmental and economic importance due to its high fish productivity. It has been suggested that global warming may be leading to increasing temperature differences between the coast and the ocean, causing increases in alongshore wind stress and coastal upwelling in this zone. Upwelling brings nutrients from deep waters toward the surface, increasing biological productivity.

To confirm reported trends of increasing coastal cooling and rising biological productivity, Guiterrez et al. analyzed sediment records spanning the past 150 years as well as instrumental records from the main upwelling zone off Peru. They found that sea surface temperatures have been declining since the 1950s in the main upwelling zone. The cooling trend is likely linked to increased upwelling in spring, during which there is enhanced biological productivity. (Geophysical Research Letters, doi:10.1029/2010GL046324, 2011) — ET

Mapping U.S. West Coast surface circulation

A network of high-frequency radar systems designed for mapping ocean surface currents now provides unprecedented detail of coastal ocean dynamics along the U.S. West Coast, according to Kim et al. The network has grown over the past decade from a few radars to what is now considered the largest network of its kind in the world, providing nearly complete coverage of currents along approximately 2500 kilometers of shoreline. With an ability to resolve kilometer-scale currents out to approximately 150 kilometers offshore, the technology has been used for local oceanographic studies in addition to applied applications for supporting oil spill response, search and rescue, fisheries, and coastal discharge assessment.

Using observations collected by a centralized data assembly center, the authors present a multiyear synthesis of the dynamics of the surface currents of the U.S. West Coast. The surface circulation is governed by a complex combination of factors including tides, winds, Earth’s rotation, synoptic ocean signals, and interactions of these forces.

The researchers report on the geographic differences of these dynamics and illustrate how the high-frequency radar system is able to characterize phenomena such as the seasonal transition of alongshore surface circulation, submesoscale eddies, and coastally trapped waves. The researchers envision that the network will continue to provide valuable real-time monitoring of the U.S. West Coast as well as long-term, science-quality records of ocean climate signals. (Journal of Geophysical Research-Oceans, doi:10.1029/2010JC006669, 2011) — ET

Modeling saturation overshoot in porous media

Infiltration of water into soils or porous rocks often follows unpredictable, preferential flow paths, also known as fingers. These fingers are caused by a condition called saturation overshoot, where the water content in the finger tip is greater than the water content in the finger tail. Why this happens has puzzled researchers,
as overshoot cannot occur in traditional models. DiCarlo et al. used modeling and experiments to bridge the pore-level and continuum-scale physics behind saturation overshoot. Their model predicts the types of soils and initial conditions that are susceptible to overshoot and preferential flow. (Water Resources Research, doi:10.1029/2010WR009879, 2011) —ET

**Determining the underlying pattern of Arctic snowfall**

Across the Arctic terrain, more than a hundred bright orange markers dot the landscape, sticking up from the fallen snow. The fiberglass poles, standing 1.5 meters high and spaced 100 meters apart, allow Sturm and Wagner to track snow depth over their 1-square-kilometer research area in Alaska. These depth measurements may be simple, but trying to turn them into a prediction of future snowfall distribution is far more difficult. A rough estimate of the amount of snow expected in an area can be estimated from weather models, but the smaller-scale distribution of snow across the landscape is often dictated by interactions among wind, topography, and vegetation, factors that models have difficulty simulating.

Fortunately, topography and vegetation tend not to change drastically from year to year. The authors used this fact, along with data from 14 annual spring snow depth distribution surveys, to produce a map of the underlying pattern of snowfall in their study area. The researchers find that while the magnitude of the snowfall depth changed with the weather, the distribution was remarkably consistent. They used this depth distribution pattern, along with only three snow depth measurements, to reproduce the snowfall coverage for an independent winter; their reproduction was accurate to within a few centimeters, similar to the accuracy of weather-driven models. Further, the researchers used their snowfall distribution map to optimize a weather-driven model, increasing its predictive accuracy by up to 60%. (Water Resources Research, doi:10.1029/2010WR009434, 2010) —CS

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