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Trends in coastal upwelling and sea breeze in the California-Oregon Coast: Land-ocean-atmosphere interactions in data and model

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As the concentrations of atmospheric greenhouse gases rise, continental landmasses warm faster than adjacent oceans due to less evaporation and smaller heat capacity. In the coastal zones, such as the California-Oregon coast, this increased thermal contrast between land and ocean is hypothesized to be responsible for the observed trend in strengthened coastal upwelling due to increased upwelling-favorable wind. Cooler upwelled waters, together with warming land, intensify the intrusion of daytime sea breezes, altering diurnal temperature variability in the coastal areas. As upwelling brings up cold, nutrient-rich water supersaturated with carbon dioxide (CO2), understanding the links between climate change and coastal upwelling has important implications for exchange of CO2 flux between the ocean and atmosphere, and hypoxia in the coastal upwelling system, and hence fisheries habitats and coastal biodiversity. Change in diurnal temperature range also represents important impacts and consequences of the climate change on human society at coasts. Using the long-term in situ land and ocean measurements, this study will examine the coastal cooling, inland warming and penetration of marine air during last three decades in the California-Oregon coast. A particular focus will be placed on understanding the physical processes responsible for spatial patterns in trends. As upwelling and sea breezes are processes that require a mesoscale (i.e. scales of ~10 km) approach in observational and modeling studies, it is necessary to use high-resolution satellite and analysis products in conjunction with the in situ measurements. Data will be used to verify the high-resolution regional coupled ocean-atmosphere-land model simulation. By explicitly resolving coastal upwelling and feedback with the atmosphere and land, the regional coupled model will provide valuable insights on three-dimensional structures of the trends in wind, upwelling, land temperature, and the sea-breezes in the coastal oceans.