AvH6-48, 2010
6th Alexander von Humboldt International Conference

Droughts and fertility, Pacific Ocean echos from the past Millenium

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An outstanding issue in our understanding of future evolution of climate and coastal ocean dynamics in México and is how the increasing anthropogenic CO2 injection into the atmosphere will change rainfall patterns on land and biological fertility patterns in the coastal oceans. The discovery, barely two decades ago, of a large biological regime shifts in the Pacific spawned the search for the underlying physical variability to explain them. Climate and oceanographic observations soon discovered fluctuations in air temperatures, atmospheric circulation, and ocean temperatures that were remarkably similar in timing and duration to the biological records. Recent modeling work has shown how complex coastal food webs can undergo substantial changes in response to subtle physical forcing. Here we will review some physical and biological fluctuations in the Pacific preserved in high resolution records from the California Current to show their variability patterns for the past millennium, the period prior to the present atmospheric carbon forcing, to explore and evaluate their links with climate forcings known to operate during this period. Hemispheric temperature and pressure gradients are linked to surface circulation patterns on the ocean, thermal structure, and depth of the thermocline separating nutrient depleted surface waters from nutrient rich at depth through the strength of the trade winds. These basin scale gradients oscillate between extremes influenced by large scale events like El Niño or its counterpart La Niña or by basin wide multidecadal fluctuations with similar effects on sea surface temperatures, rainfall variability on land and fertility patterns in the coastal ocean. Our knowledge of these large scale, long period recurring variations becomes critical especially when considering adaptative and sustainable strategies to human-induced climate change.