

Santa Ana Wind Effects in the Bight (SAW)
Analysis Feasibility and Plan
November 21, 2009

Santa Ana winds are notable phenomena on the Southern California coast and are often associated with catastrophic fires. At the coast they drag surface water offshore which is replaced by cold water from depth, that is, the Santa Ana winds produce local upwelling. This upwelling contributes to mixing and subsequent phytoplankton blooms. Hence, Santa Ana winds can affect the entire Bight ecology.

The effects of Santa Ana winds on the ocean have not been well studied. We want to know how significant are Santa Ana winds to inner-Bight processes. An accounting of processes affected or generated by Santa Ana winds would be the first task. An initial list of processes includes wave generation, current flow and mixing, and their effects on marine life.

Subsequent questions include how often do Santa Ana winds occur, what are their average effects, what is the depth dependence, how large are extreme events, how far offshore are their effects felt and for how long.

These questions can be answered using a variety of available data sources supplemented by additional instrumentation. The sources include archived satellite data, coastal radar, buoys, moorings and marine thermographs.

Oceanic Santa Ana wind effects appear to be observable from a variety of spaceborne imaging sensors that can provide Bight-wide information. The surface winds can be inferred from scatterometry and wind retrievals obtained from QuikScat are readily available in geolocated format. Surface temperature effects, such as produced by upwelling, can be measured by AVHRR, which is also readily available in mapped format. Changes in chlorophyll content can be measured from SeaWiFS or other ocean color sensors. These would indicate phytoplankton blooms.

Offshore wind, wave and air temperature data can be obtained from several NOAA buoys and weather stations located in the Bight and Catalina Island. The UCLA mooring appears to be in an excellent location for the study and includes sensors distributed in depth and capable of measuring biological activity. The CCD temperature array can measure shallow underwater Santa Ana effects at the island as can the CINP array around the northern Channel Islands. There is a weather station at WIES which can supply surface wind data for Catalina.

Finally, the Southern California Coastal Ocean Observation System (SCCOOS) may have data available to analyze wind-generated currents throughout the inner Bight. To date, SCOOS data have not been readily available.

The supplemental instrumentation can be thermographs and current measuring devices set along the coast at various locations. These would measure the spatial coastal extent of the upwellings and the magnitude of the temperature changes.

Data sources and their availability are shown in Table 1. A CMS study of Santa Ana wind effects on the Bight appears feasible considering the availability of the appropriate data.

Table. Data Sources

Sources	Data type	relevance	availability	URL
Satellites				
AVHRR	SST-spatial	physical	good	www.class.ncdc.noaa.gov
SeaWifs	Ocean color	biological	good	http://oceancolor.gsfc.gov/
QuikScat	Surface winds	physical	spotty	http://manati.orbit.nesdit.noaa.gov/quikscat
SCCOOS				
HF radar	Surface currents		?	www.sccoos.org
<i>in situ</i>				
Moorings/buoys				
SMBO	Current depth		spotty	Http://quercus.igpp.ucla.edu/smbo/
NOAA	Air T, wind, SST		Good	www.ndbc.noaa.gov
Thermograph arrays				
CCD	Ocean temp.		Possible	None
CINP	Ocean temp.		possible	None
CMS	Ocean temp.		future	None

Plan

The analysis plan is to divide the work into sequential phases, with each phase being a self-contained research project that builds upon the tools developed, experiences acquired and results obtained from a previous stage. The first stage is to acquire and work with satellite data for a case study. This study will build experience in working with satellite data and will provide information for determining future instrumentation selection and placement. It will help formulate questions and research strategy for the next stage.

The second phase will look at Santa Ana wind statistics as pertain to the Bight. It may include results from CMS instrumentation and will incorporate lessons learned from the first phase. These statistics will be used to compute the importance of Santa Ana winds to Bight processes. Additional phases will be planned as desired.

SAWEB Phase 1

This project will examine data sets that capture signals for large Santa Ana events. This analysis should illuminate various ocean processes affected by the winds, indicate optimal locations for planned experiments, and develop experience for subsequent analyses.

The archetypical Santa Ana event to be examined is that which occurred October 21 through 25, 2007. This event was associated with devastating fires in Malibu.

Interesting spaceborne data sets are readily available as shown in Figure 1, and a signal was measured by the UCLA mooring (not shown).

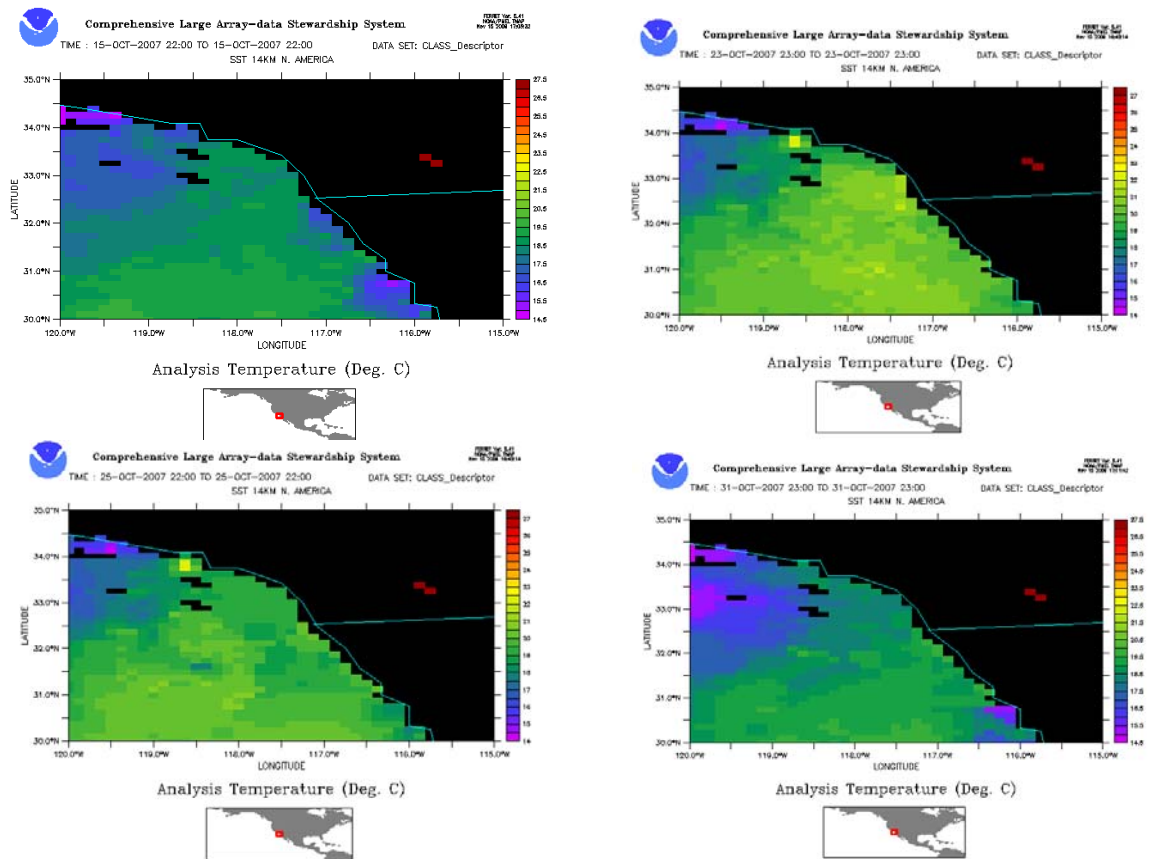


Figure 1. AVHRR signal of Santa Ana wind effects.