## Seasonal variability of oceanographic conditions on the Pacific continental shelf of the southern Baja California peninsula

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#### Map and bathymetry of the study area



### Study area

- Area of interest is about 350 km long and up to 80 km wide.
- The Bahia Magdalena Almejas lagoon system is located in the central part of the study area (24.5° N).
- A width of the continental shelf varies from 20-30 km (Magdalena lagoon system) to 70-80 km (Gulf of Ulloa).
- The average continental shelf gradient varies from 0.001 to 0.004. That of the continental slope from 0.03 to 0.06.
- The IMECOCAL grid of stations only covers the northern part of the Gulf of Ulloa.

## **Principal goals of the study**

- Seasonal variability of the thermal structure and circulation pattern on the continental shelf of the southern part of the Baja California peninsula
- Can tropical and subtropical waters penetrate northward along the coast as far as Punta Eugenia?
- Evaluation of upwelling intensity on the Pacific shelf of the southern part of the Baja California Peninsula.

### Introduction

#### The most important forcing mechanism that affect both the California Current system and shelf circulation is wind stress.



Seasonally averaged sea surface wind in 2000.

(PFEL/FNMOC data, www.pfeg.noaa.gov)

**Left**: Roden (1971) described for November 1969 the poleward flows of the Tropical Surface Waters up to the Punta Eugenia and Equatorial Subsurface Waters along all the peninsula.



**Right**: Durazo and Baumgartner (2002) (CalCOFI and IMECOCAL data for 1997-99) assumed that during the EI Niño years this northward advection intensified, especially for Equatorial Subsurface Water at depth.

## Data used

- Averaged weekly and monthly SST distributions calculated from AVHRR data for the period from 1996 to 2003 (provided by NOAA)
- Sea height anomalies, calculated from altimetry data, and geostrophic currents calculated for a 10-day period using Ocean Circulation and Climate Advanced Model (OCCAM) model with Levitus climatology. These data are provided on the page of the NOAA/AOML/CoastWatch project (www.aoml.noaa.gov/phod/ dataphod/work/trnanes/INTERFACE/index.html).
- Averaged daily and monthly series of Coastal Upwelling Index (CUI) are provided on the PFEL Website (www.pfeg.noaa.gov).
- Four hydrographic surveys (CTD) were made on board of R/V "El Puma" (March and December of 2003 and 2004) on the continental shelf in front of the Magdalena-Almejas lagoon system.
- Three CTD transects were made in Apr 2000, Feb 2001 and Apr 2002 in front of the main inlet of Magdalena Bay.

## Average monthly SST anomalies for the period from 1996-2003 (AVHRR data)



## Sea height anomalies (SHA) calculated from satellite altimetry data (NOAA/AOML/Coast Watch data)



## Average seasonal geostrophic currents calculated from SHA using the OCCAM model with the Levitus climatology for the period from 2003 to 2006 (NOAA/AOML/Coast Watch data)

#### Jan-Mar

**Apr-Jun** 



Average seasonal geostrophic currents calculated from SHA using the OCCAM model with the Levitus climatology for the period from 2003 to 2006 (NOAA/AOML/Coast Watch data)

#### Jul-Sep

**Oct-Dec** 



## Seasonal cycle of off-shore Ekman transport, with 0.5 latitude resolution, for entire Pacific coast (left) and for the latitude of the Magdalena bay (right), calculated using PFEL methodology.

#### Units are metric tons per second per 100 m coastline.



## Typical SST anomaly at the latitude of Magdalena Bay (April 2002)



# Comparison of Coastal Upwelling Index (CUI) with difference in SST between the upwelling zone and the adjacent sea.



# Sampling grid used during the 2000-2004 surveys (R/V "El Puma", hydrographic boats).



### Typical stratification patterns in front of Magdalena Bay in Spring (Mar 2003)



#### Field observations of the coastal upwelling pattern in front of Magdalena Bay in March 2003



# Comparision between TS- diagrams in the Spring and Fall (2003 data).



## **Concluding remarks**

- Analysis of the 2001-06 data shows that, from January to June, relatively cold and low salinity waters (TrW and sometimes SAW) are present on the continental shelf in front of the Magdalena lagoon system.
- In Summer and Fall, subtropical surface water (StSW), eastern tropical Pacific waters(TSW) and, ocasionally, Equatorial subsurface Water (EsSW) penetrate along the coast northward as far as Punta Eugenia, including the continental shelf in front of Magdalena bay.
- Inspite of relatively low upwelling intensity (CUI<130 m\*\*3/s/100m) in the southern part of the peninsula, the favorable bottom topography provokes a well-developed upwelling pattern in SST distributions over the continental shelf, including the area in front of the Magdalena Bay.

Thank you.