CUpEx: Chilean Upwelling Experiment
Tongoy (30°S), 21 Nov – 5 Dic 2009

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Fig. 14. Conceptual model of synoptic conditions during periods of stable, decreasing, and increasing MBL height. Solid contours indicate isobars with high and low pressure labeled. Black, dashed contours indicate isopleths of MBL depth for lower (thin) and higher (bold) height. Green, dotted contours indicate isopleths of 500-hPa height for lower (thin) and higher (bold) height. Vectors indicate low-level wind speed and direction. Decreasing (increasing) MBL heights indicated by red (blue) shading.
CUpEx Regional Context

Understand the alongshore structure of the MBL and its diurnal cycle

Max Sfc Wind Speed → intense upwelling → eddy kinetic energy
CUpEx sites

- Surface Met
- Ceilometer
- Radiosonde
- Shore SST
- Ocean mooring
- Coastal buoy
- HF Sea Radar
- Batimetry

Images showing various field sites and equipment setups.
Table 2. Summary of selected meteorological/oceanography experiments conducted in eastern boundary upwelling systems.

<table>
<thead>
<tr>
<th>Experiment Name</th>
<th>Target region</th>
<th>Period*</th>
<th>Key reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>JOINT I</td>
<td>Canary/northern Africa coast (21° N)</td>
<td>Spring 1974</td>
<td>Mittelstaedt et al. (1975)</td>
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<tr>
<td>CUEA JOINT-II</td>
<td>Peruvian coast (12–15° S)</td>
<td>Spring 1976</td>
<td>Brink et al. (1978)</td>
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<tr>
<td>Coastal Ocean Dynamics Exp. (CODE)</td>
<td>California coast (~38° N)</td>
<td>Spring-summer</td>
<td>Beardsley et al. (1987)</td>
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<td>1981 and 1982</td>
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<tr>
<td>Coastal Waves (CW96)</td>
<td>Central California coast (37° N)</td>
<td>Summer 1996</td>
<td>Rogers et al. (1998)</td>
</tr>
<tr>
<td>VOCALS-Rex Peru Cruise</td>
<td>Central Peruvian coast (14–16° S)</td>
<td>Spring 2008</td>
<td>Grados et al. (2010)</td>
</tr>
<tr>
<td>VOCALS-CUEx</td>
<td>Central Chile coast (30° S)</td>
<td>Spring 2009</td>
<td>Rondan et al. (2010)</td>
</tr>
</tbody>
</table>

* Season relative to target region.
3.8 m Wind speed and direction at LdV (DGF)  
Nov-Dec 2009
Synoptic variability during CUpEx: SSMI SST

High wind SST field [°C]

Low - High wind SST field [°C]
Synoptic variability during CUpEx: Local T(Ocean) & wind
Synoptic variability during CUpEx: MBL & TI

(a) Temperature profile (TCR soundings at 1230 UTC)

(b) Vertical velocity (omega)
Mean diurnal cycle during CUpEx: Sfc winds

(a) 06 LT  
(b) 12 LT  
(c) 18 LT  
(d) 24 LT

5 ms$^{-1}$
Misión Tongoy 02

La Serena (SCSE) – Santiago (SCEL) leg

Wind speed; Altitude range: 170-220 m ASL

04-01-2011  15-16 HL

Wind speed; Altitude range: 170-220 m ASL

04-01-2011  15-16 HL
Mean diurnal cycle during CUpEx: Sfc winds (WRF 3km)

Rahn, Garreaud, Ruti\textlant 2010
Mean diurnal cycle during CUpEx: Upper-air data

Talcaruca (note double jet structure)  Tongoy (note large PM warming)

AM & PM Profiles
SQ1-Climatological near-coastal wind máxima around 30°S:

Structure? Wind-SST feedback or expansion fan Effect?

- Aircraft zonal coastal jet missions
- Radiosonde from R/V
- Modeling: control(?) + sens. runs
New Conceptual Model for Coastal Jet

- Offshore Low Pressure Perturbation (L')
  - ~0.3 hPa

- Daytime temperature change aloft 4-6°C

- Coastal range (~600 m)

- MB Height ~450 m

- Critical Flow Fr < 1

Rahn, Garreaud, Rutllant 2010
Preliminary CUpEx results

• MBL structure at 30°S in the transition between stable regime to the north and more synoptically active regime to the south.

• MBL structure at 30°S better simulated (WRF) than farther north (Zi about right)

• Near shore wind field exhibits significant alongshore variability, dominated by near coastal jets downwind of major points. Ocean implications?

• Near coastal low-level jets due to (diurnally varying) thermal contrast rather than expansion fan.
Misión Arauco 02

Wind speed, Altitude range: 170-220 m ASL

28-01-2011  15-16 HL
Figure 1: The 10-m wind derived from QuikSCAT averaged over November and December 1999-2008 for the (a) morning and (b) evening satellite passes.
Mean diurnal cycle during CUpEx: Sfc currents

D. Figueroa, DGEO-UdeC
Synoptic variability during CUpEx: ASCAT 10-m winds

(a) 24 Nov.  
Low Wind

(b) 1 Dec.  
High Wind

(c) 4 Dec.  
Low Wind
Proyecto AIMMS-20 en BE90

Laptop + Programa

CPM + IMU + GPS

GPS x 2

Proyecto AIMMS-20 en BE90

ADP

CPM Switch

Heater Switch

GPS

ADP