

CUpEx: Chilean Upwelling Experiment

Tongoy (30°S), 21 Nov – 5 Dic 2009

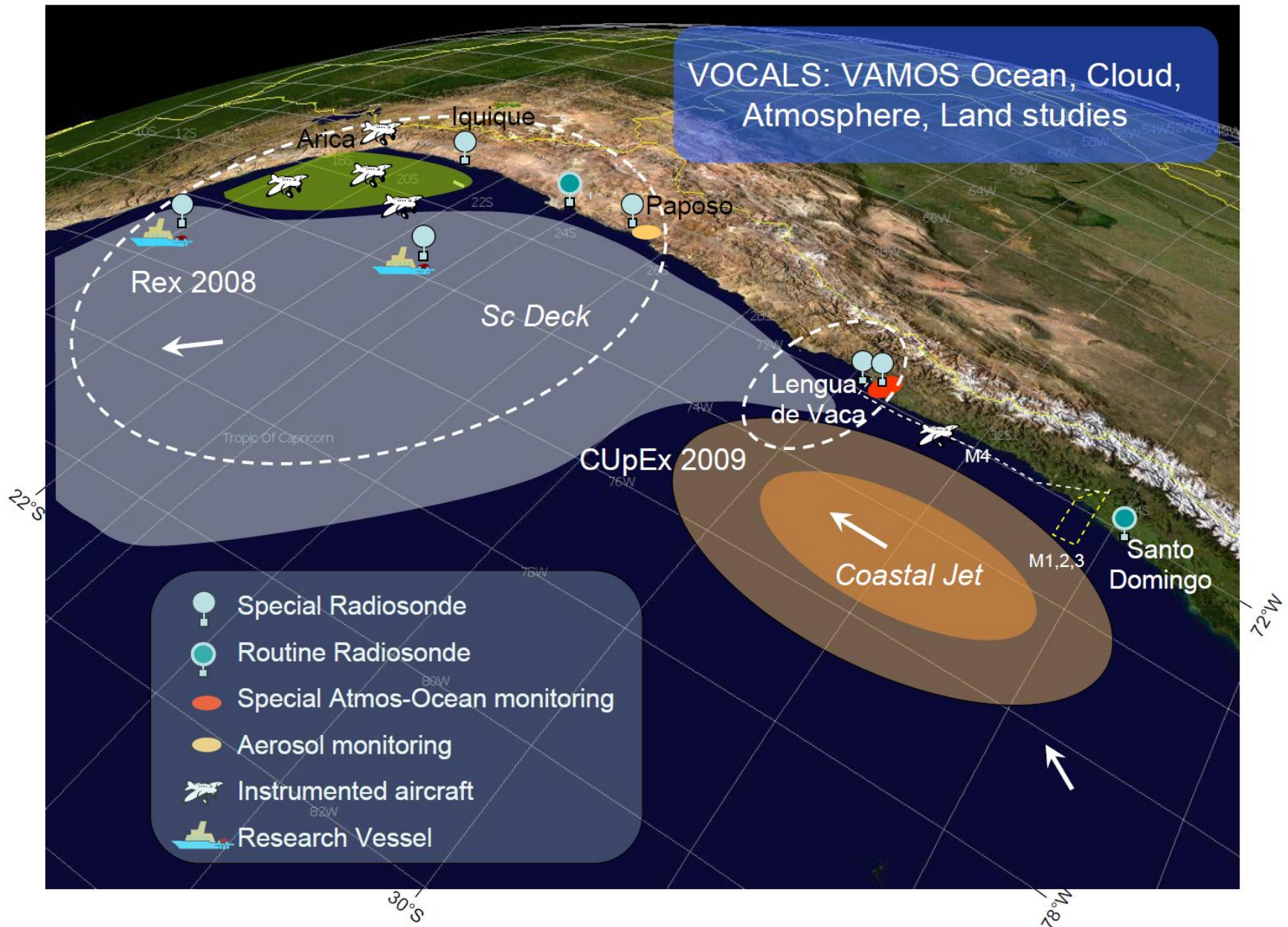
René D. Garreaud¹, José Rutllant^{1,2}, Ricardo Muñoz¹, David Rahn¹,
Marcel Ramos² and Dante Figueroa³

(1) Department of Geophysics, Universidad de Chile

(2) Center for Advanced Studies in Arid Zones (CEAZA), Chile

(3) Department of Geophysics, Universidad de Concepción

VOCALS: VAMOS Ocean, Cloud, Atmosphere, Land studies



CUpEx large-scale context

4518

D. A. Rahn and R. Garreaud: Marine boundary layer over Pacific during VOCALS-REx – Part 2

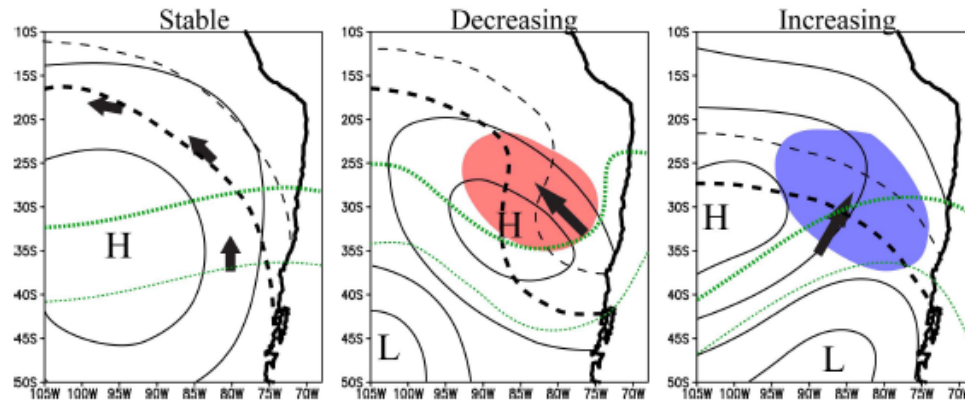
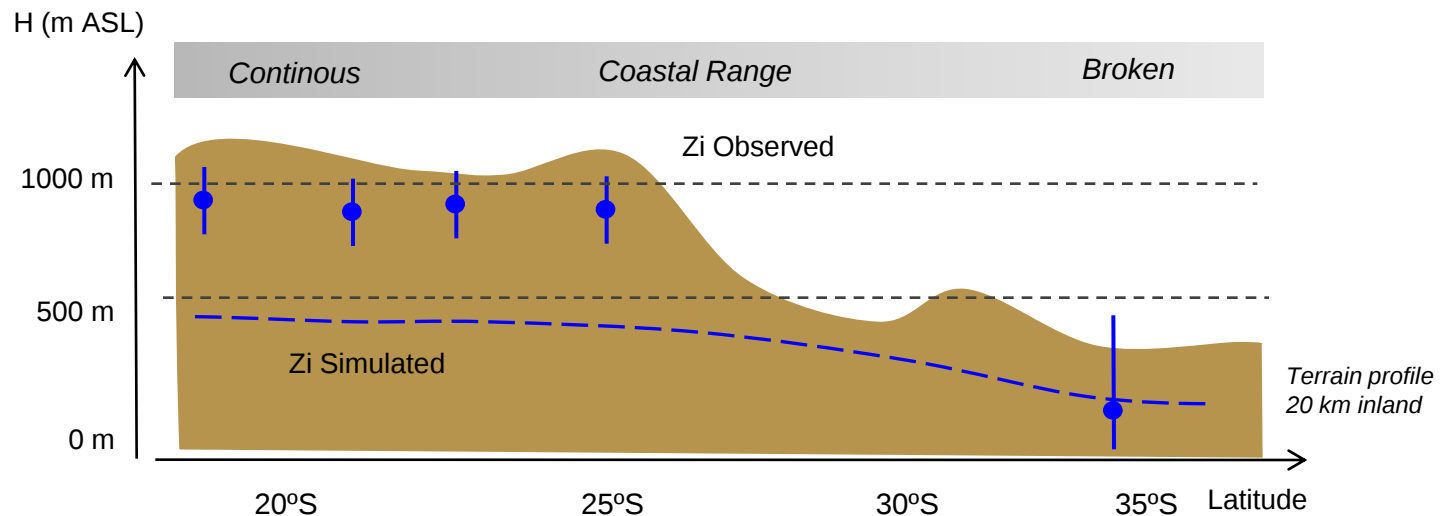
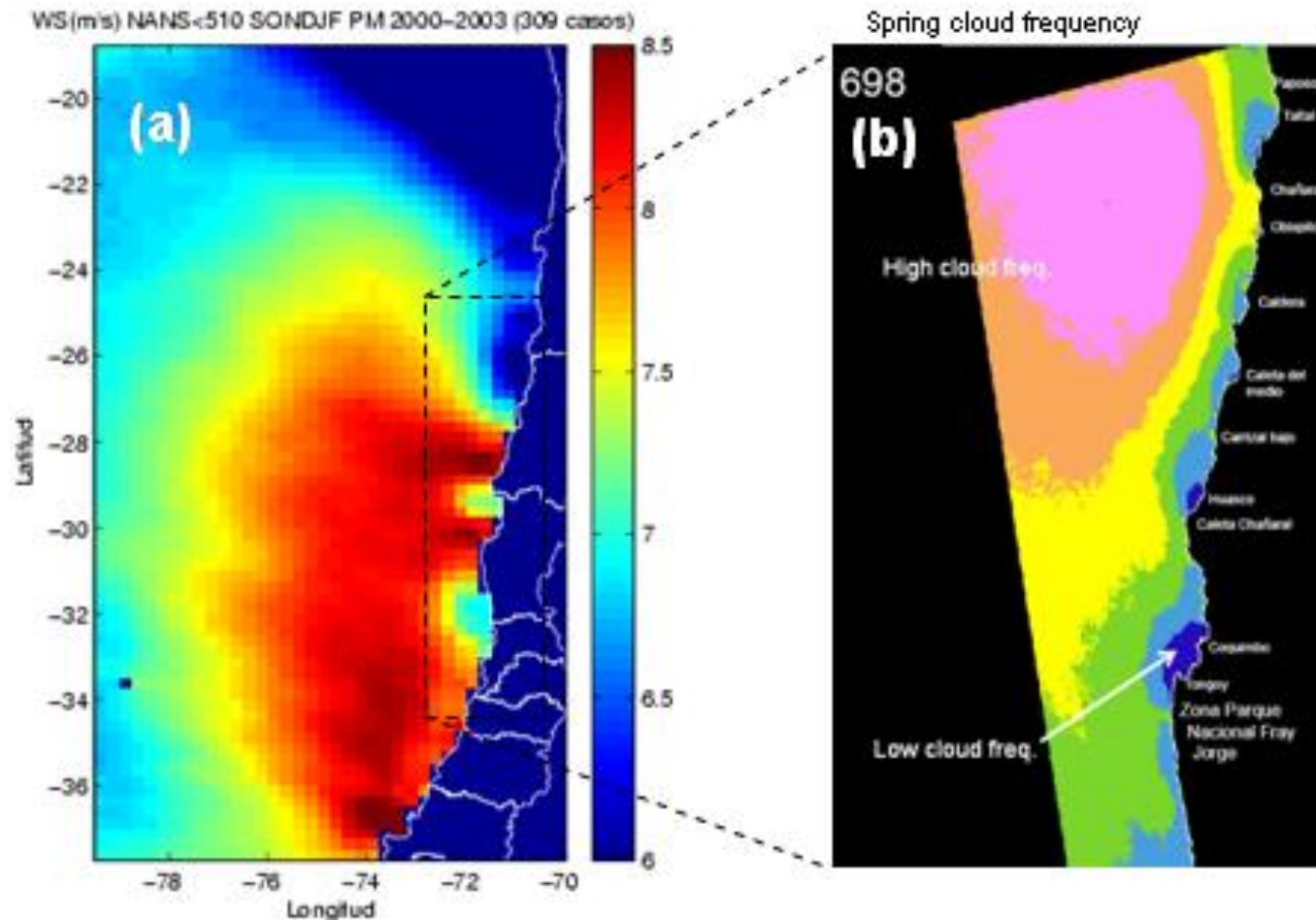


Fig. 14. Conceptual model of synoptic conditions during periods of stable, decreasing, and increasing MBL height. Solid contours indicate isobars with high and low pressure labeled. Black, dashed contours indicate isopleths of MBL depth for lower (thin) and higher (bold) height. Green, dotted contours 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

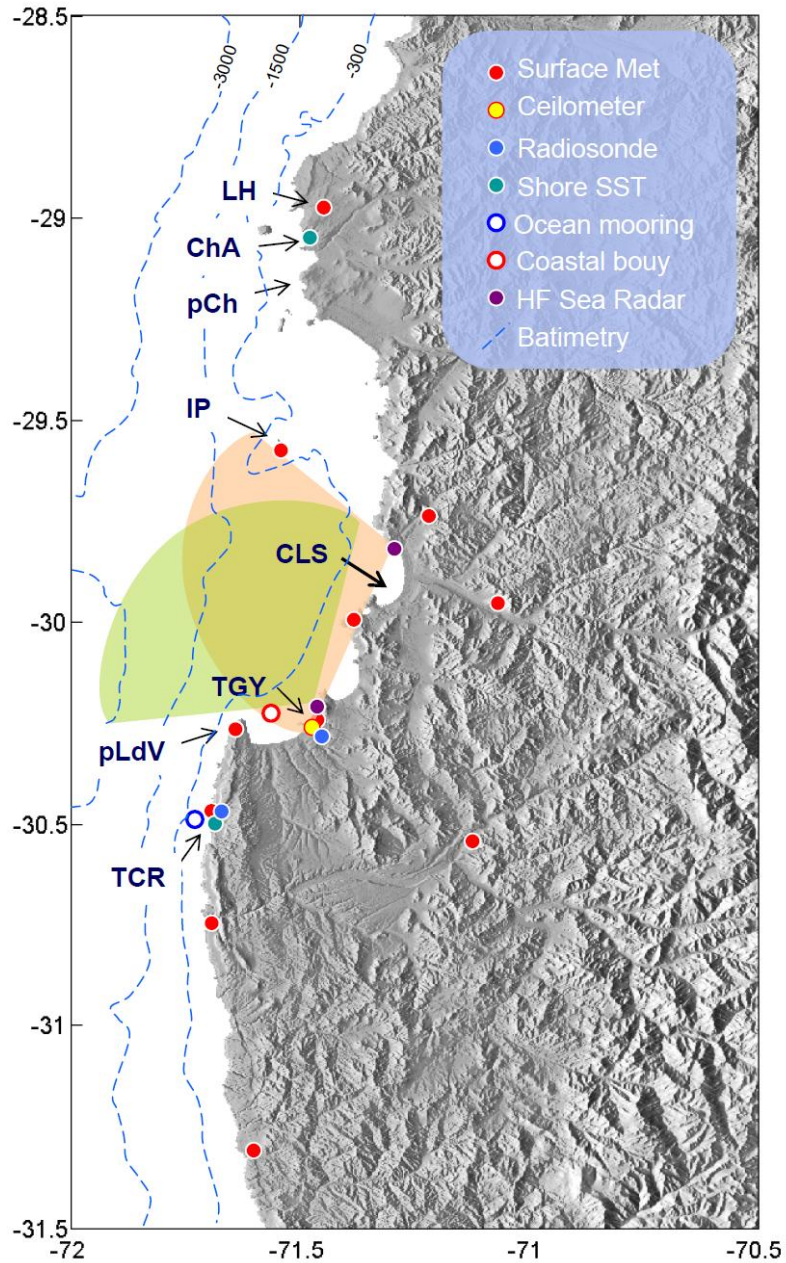
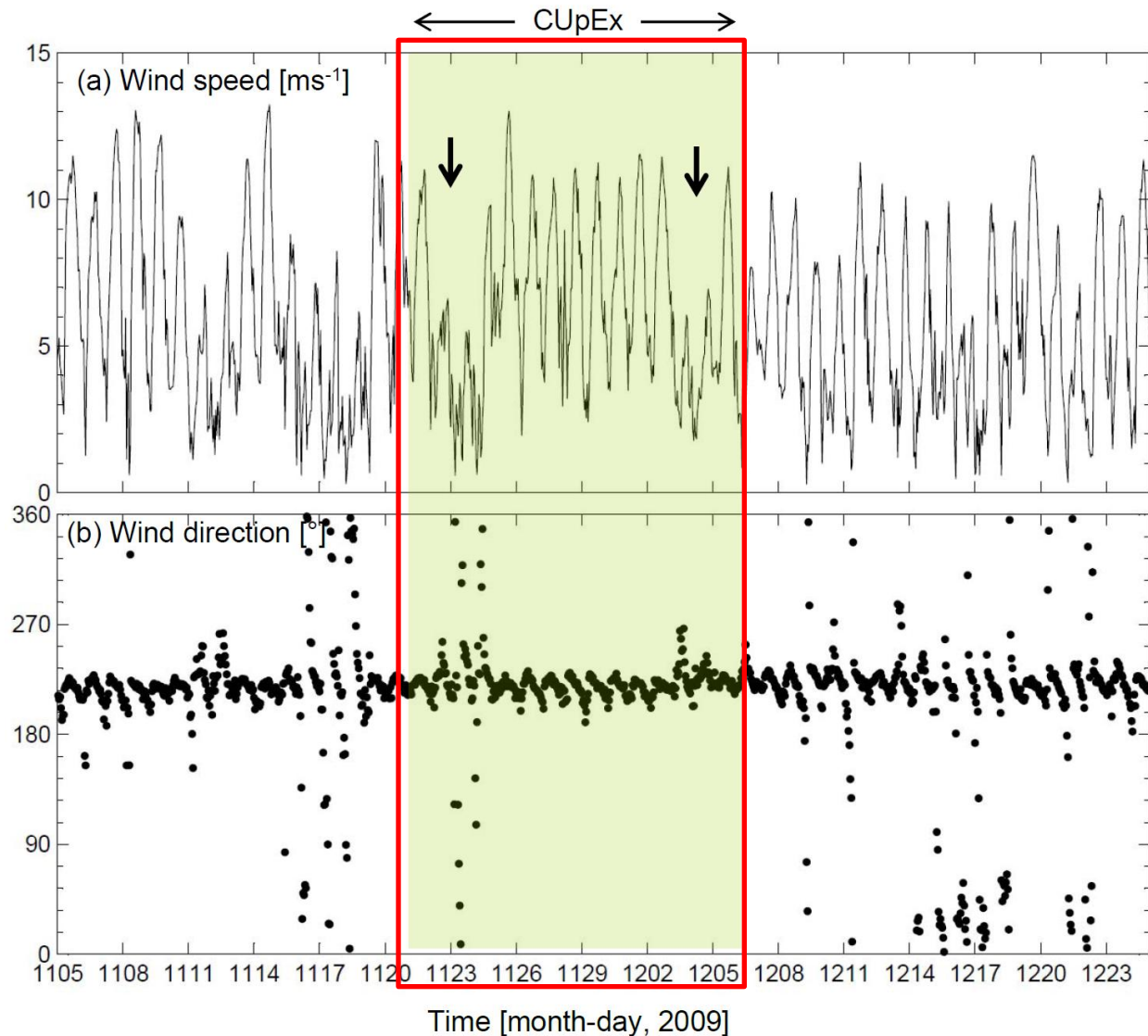


Table 2. Summary of selected meteorological/oceanography experiments conducted in eastern boundary upwelling systems.

Experiment Name	Target region	Period*	Key reference
Coastal Upwelling Experiment I (CUE-I)	Oregon central coast ($\sim 42^{\circ}$ N)	August 1972	Hawkins and Stuart (1980)
JOINT I	Canary/northern Africa coast (21° N)	Spring 1974	Mittelstaedt et al. (1975)
CUEA JOINT-II	Peruvian coast ($12\text{--}15^{\circ}$ S)	Spring 1976	Brink et al. (1978)
Coastal Ocean Dynamics Exp. (CODE)	California coast ($\sim 38^{\circ}$ N)	Spring-summer 1981 and 1982	Beardsley et al. (1987)
Leeuwin Current Interdisciplinary Exp. (LUCIE)	Western Australia ($21\text{--}33^{\circ}$ S)	1986–1987	Smith et al. (1991)
Southern Benguela Experiment	Southern Benguela coast (32° S)	Fall 1987	Bailey and Chapman (1991)
Shelf Mixed Layer Experiment (SMILE)	Northern California coast (39° N)	Winter 1989	Dorman and Winant (1995)
Coastal Waves (CW96)	Central California coast (37° N)	Summer 1996	Rogers et al. (1998)
Autonomous Ocean Sensing Network (AOSN)	Monterey Bay, California coast (36° N)	Summer 2000	Ramp et al. (2005)
VOCALS-Rex Perú Cruise	Central Peruvian coast ($14\text{--}16^{\circ}$ S)	Spring 2008	Grados et al. (2010)
VOCALS-CUpEx	Central Chile coast (30° S)	Spring 2009	Garreaud et al. (2010) and this work

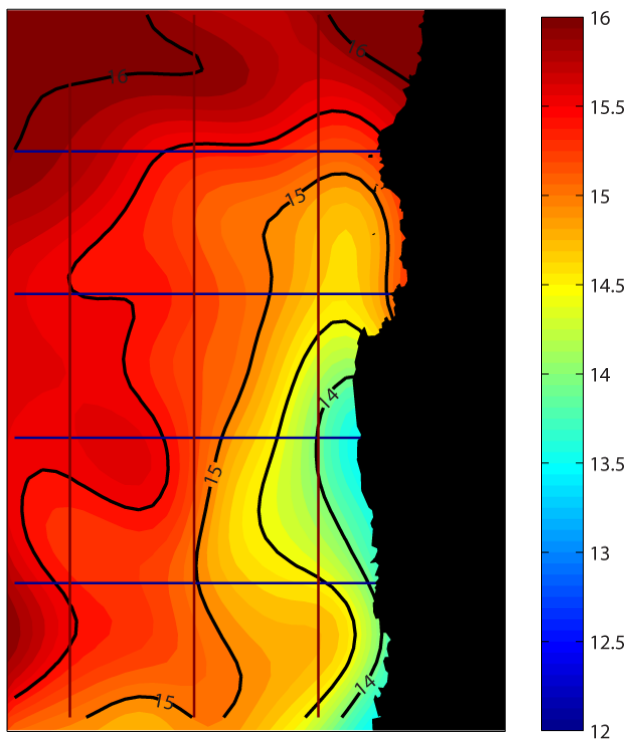
* Season relative to target region.

3.8 m Wind speed and direction at LdV (DGF) Nov-Dec 2009

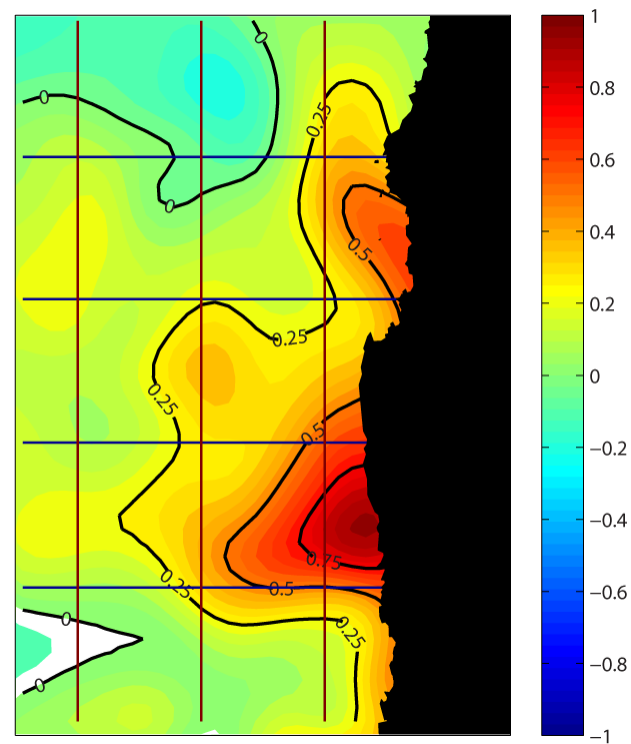


Synoptic variability during CUpEx: SSM/I SST

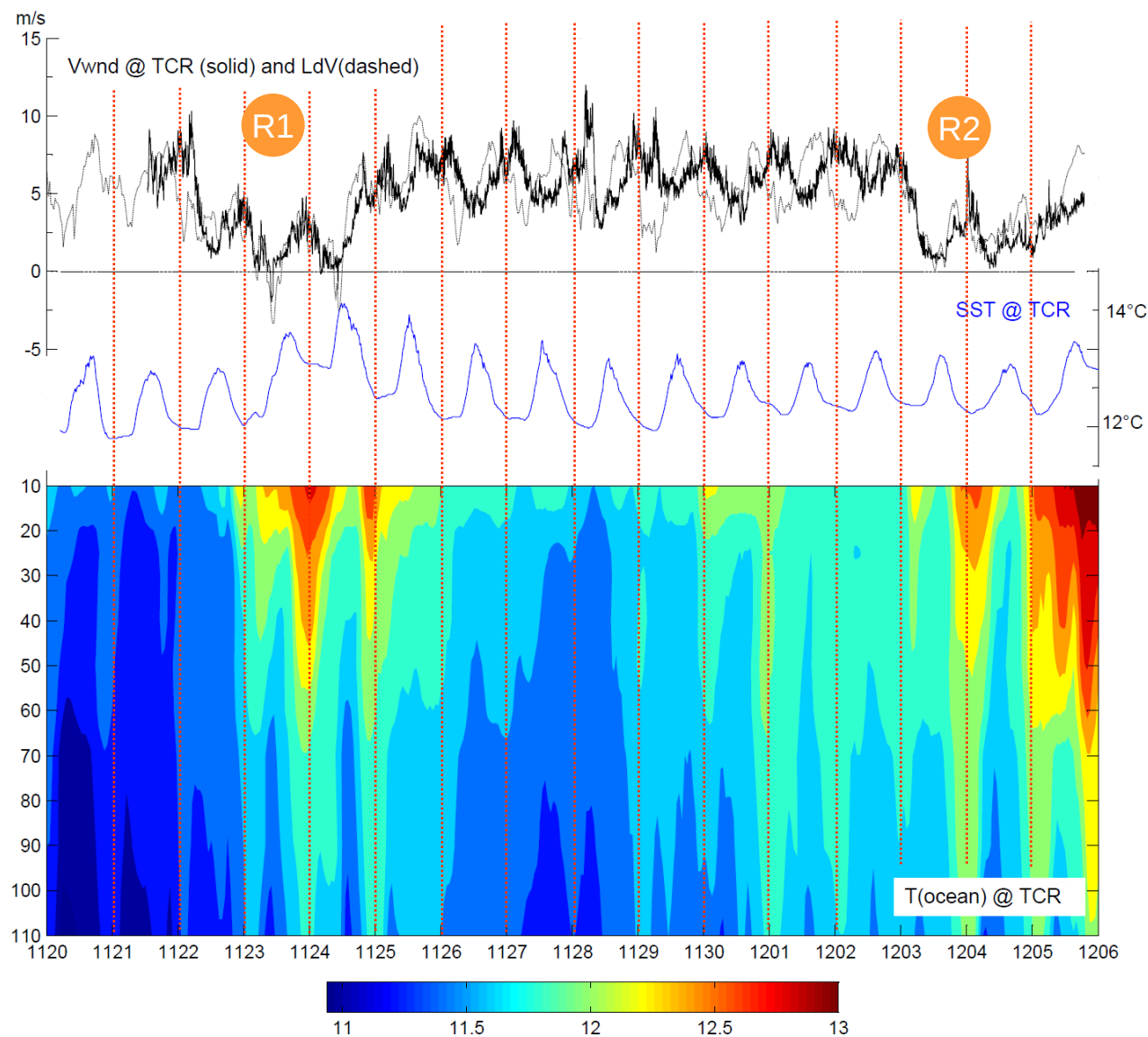
High wind SST field [C]



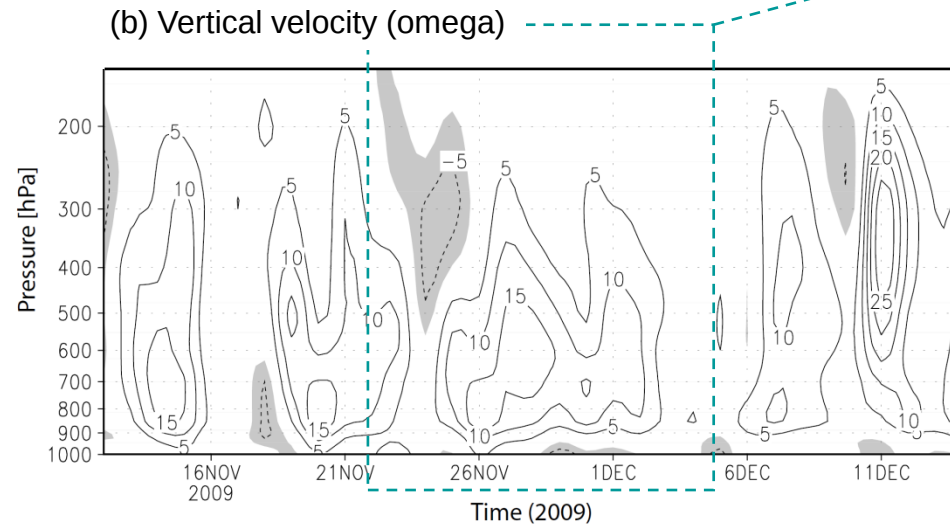
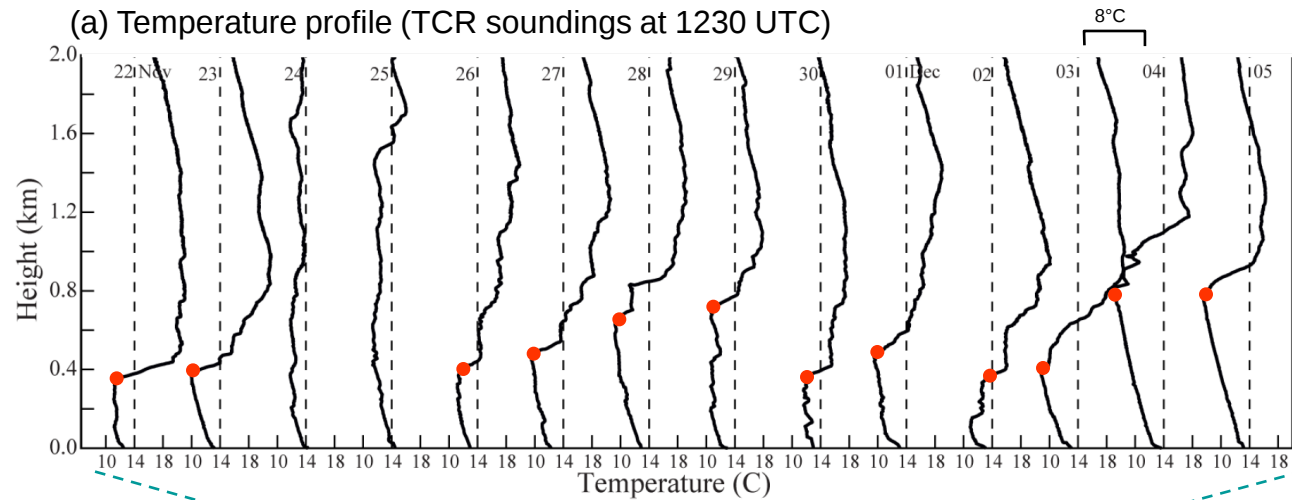
Low - High wind SST field [C]



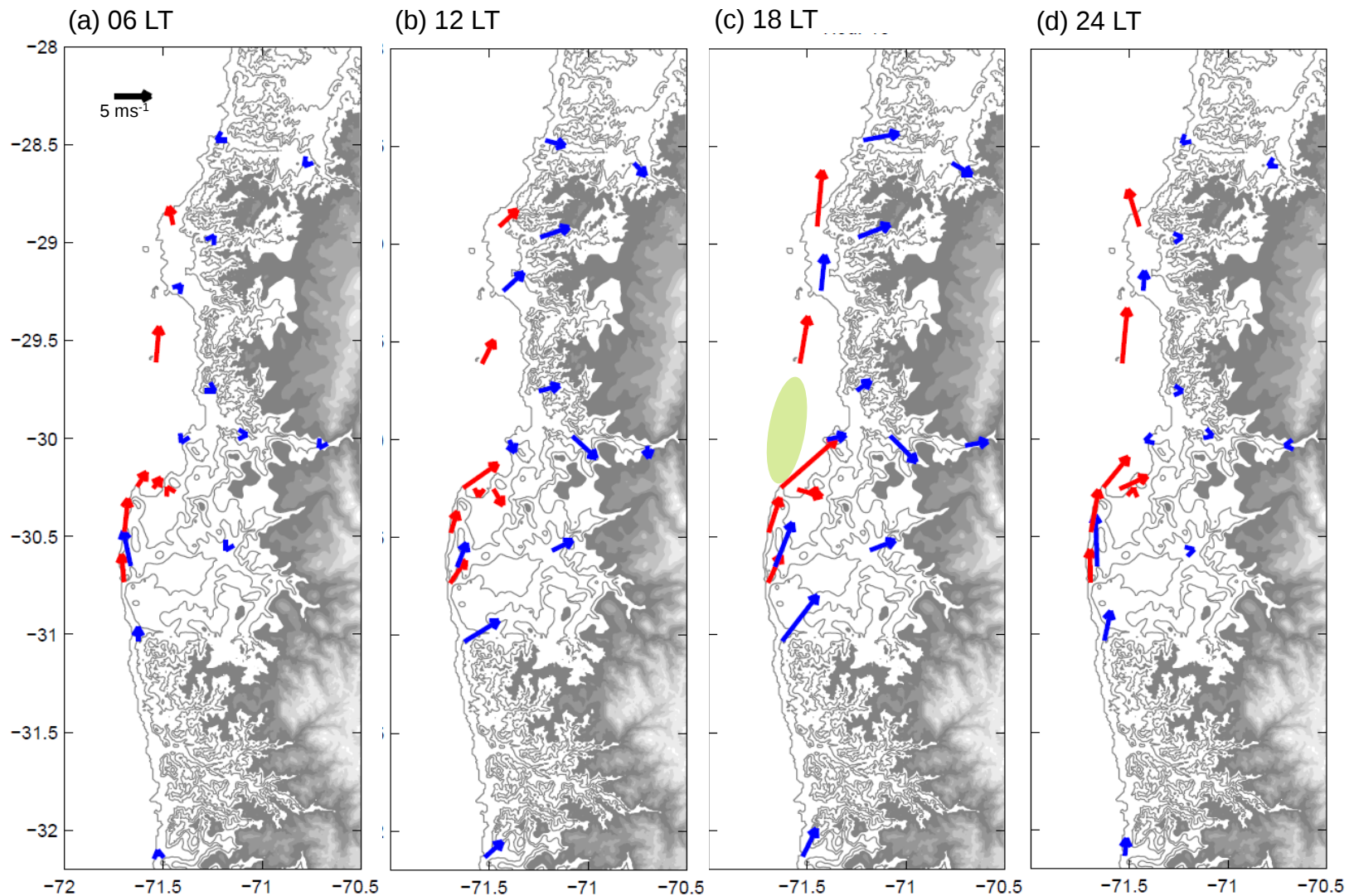
Synoptic variability during CUpEx: Local T(Ocean) & wind



Synoptic variability during CUpEx: MBL & TI



Mean diurnal cycle during CUpEx: Sfc winds



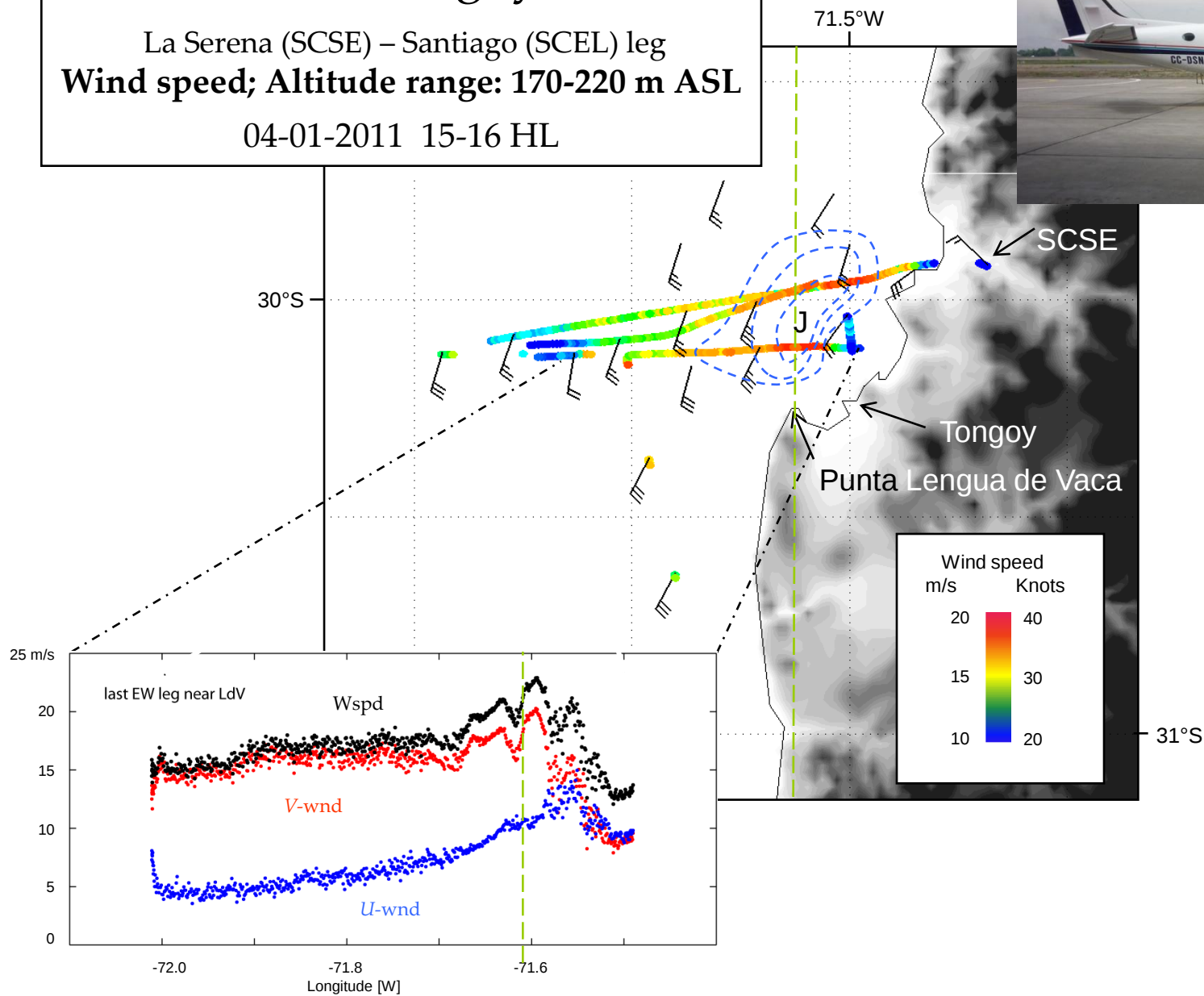
Misión Tongoy 02

La Serena (SCSE) – Santiago (SCEL) leg

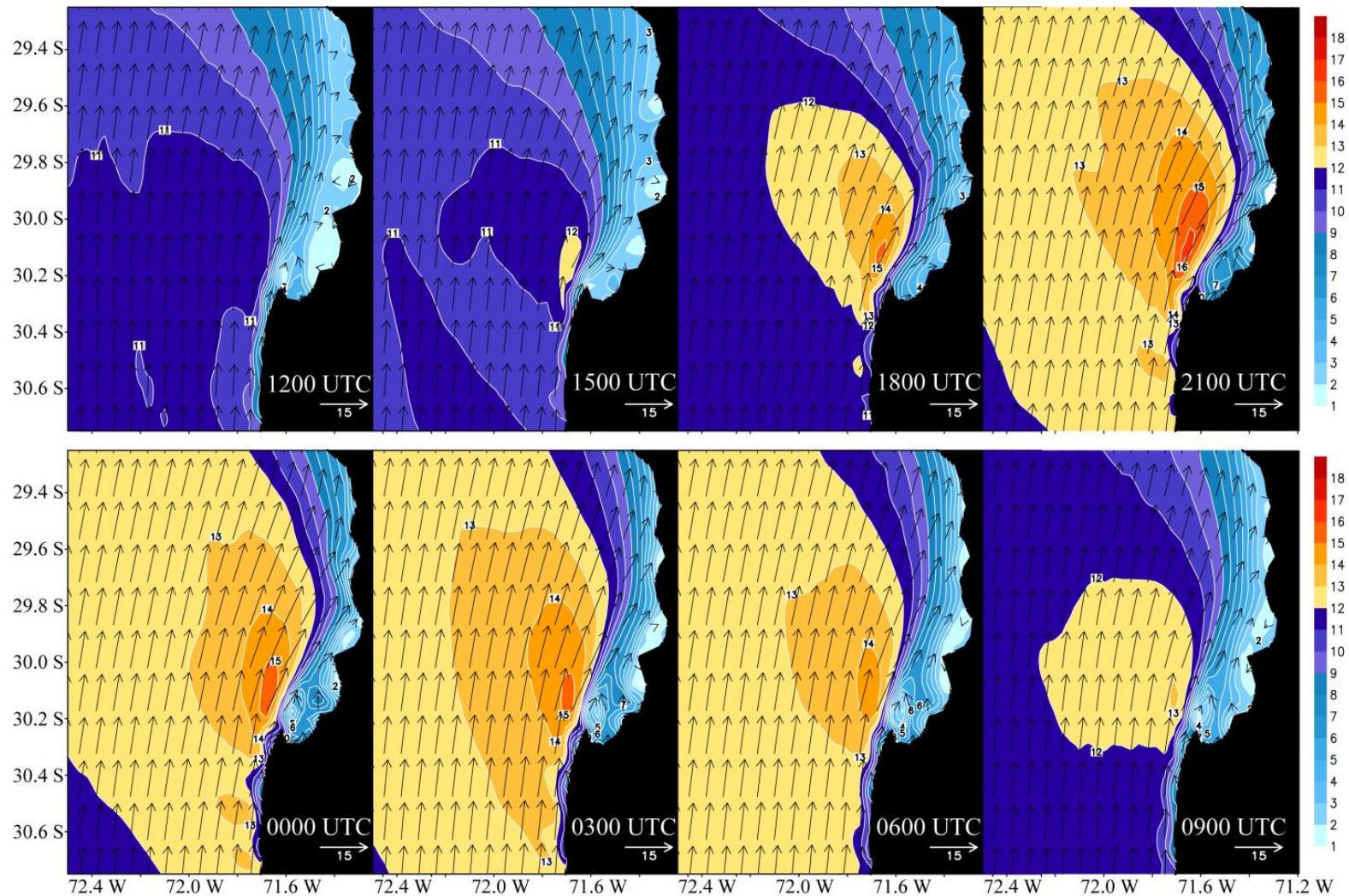
Wind speed; Altitude range: 170-220 m ASL

04-01-2011 15-16 HL

AIMMS-20 @ BE90

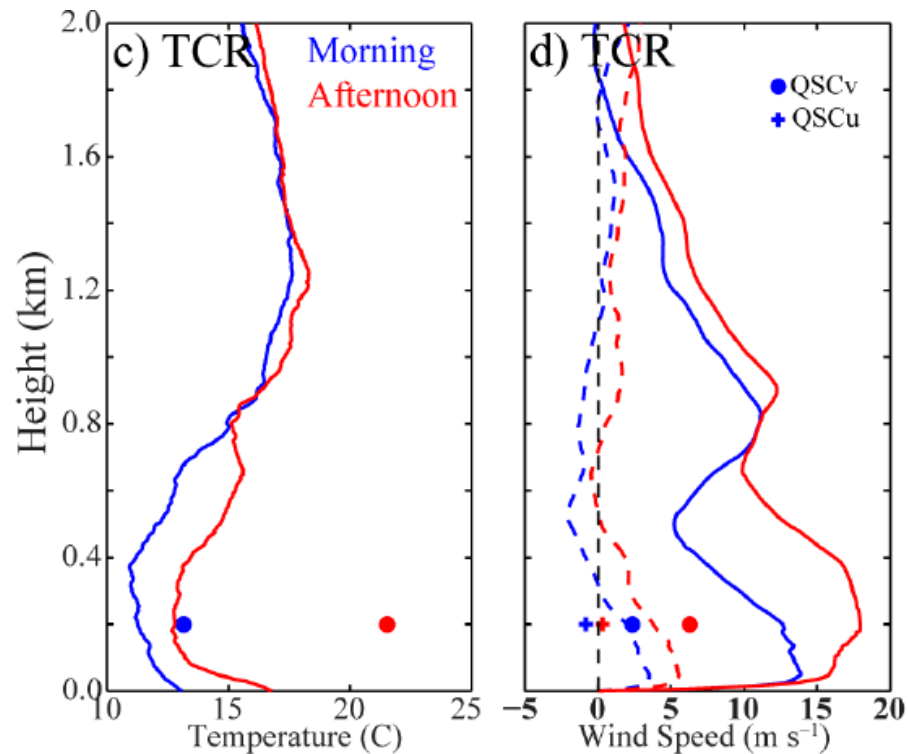


Mean diurnal cycle during CUpEx: Sfc winds (WRF 3km)

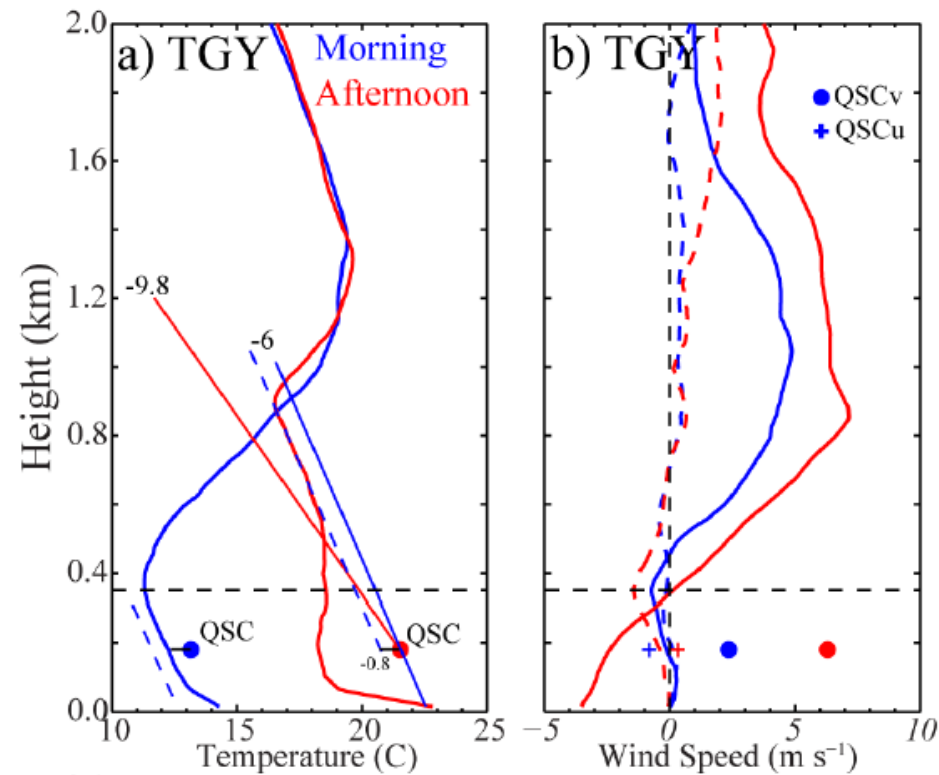


Mean diurnal cycle during CUpEx: Upper-air data

Talcaruca (note double jet structure)



Tongoy (note large PM warming)

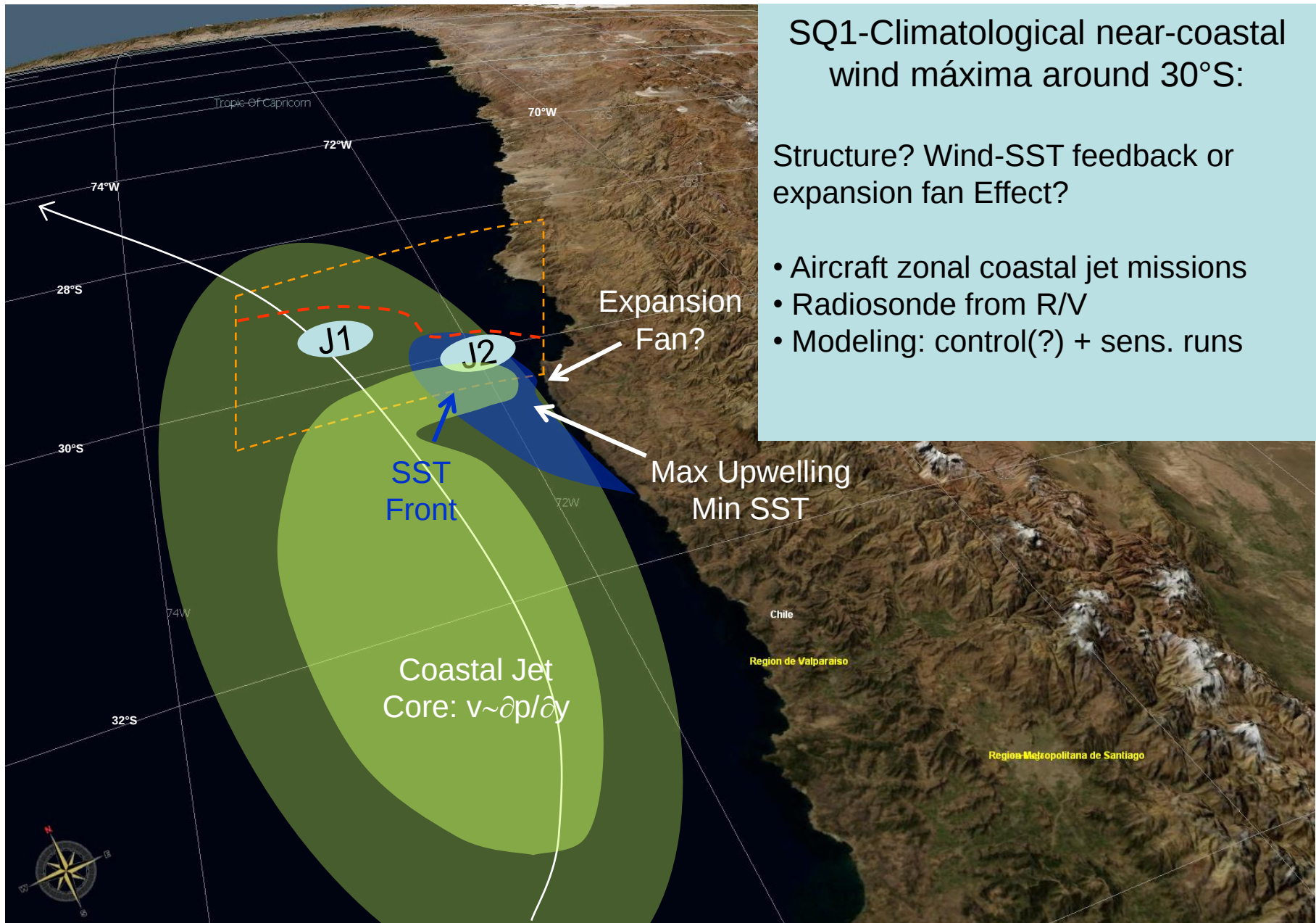


AM & PM Profiles

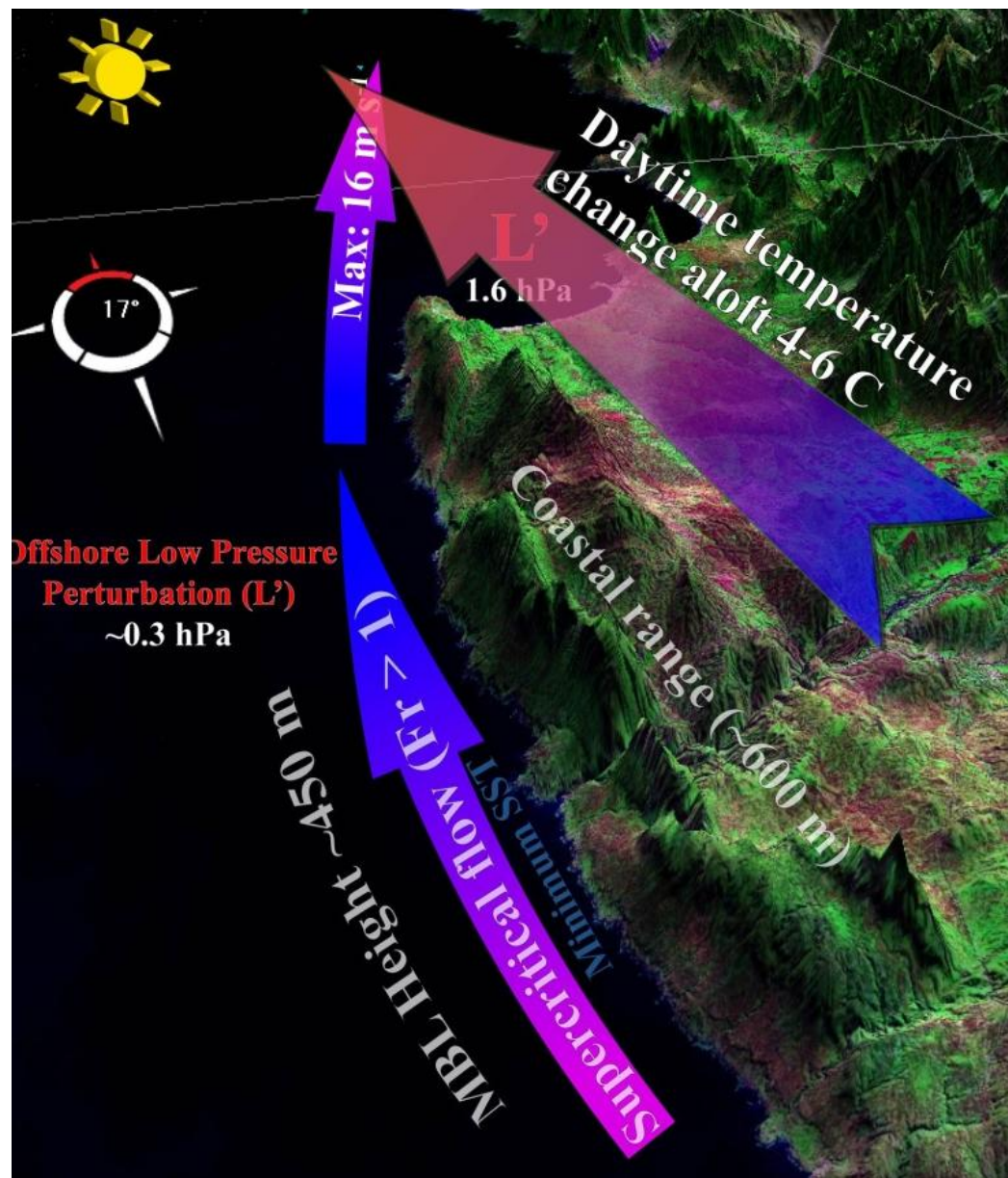
SQ1-Climatological near-coastal wind máxima around 30°S:

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



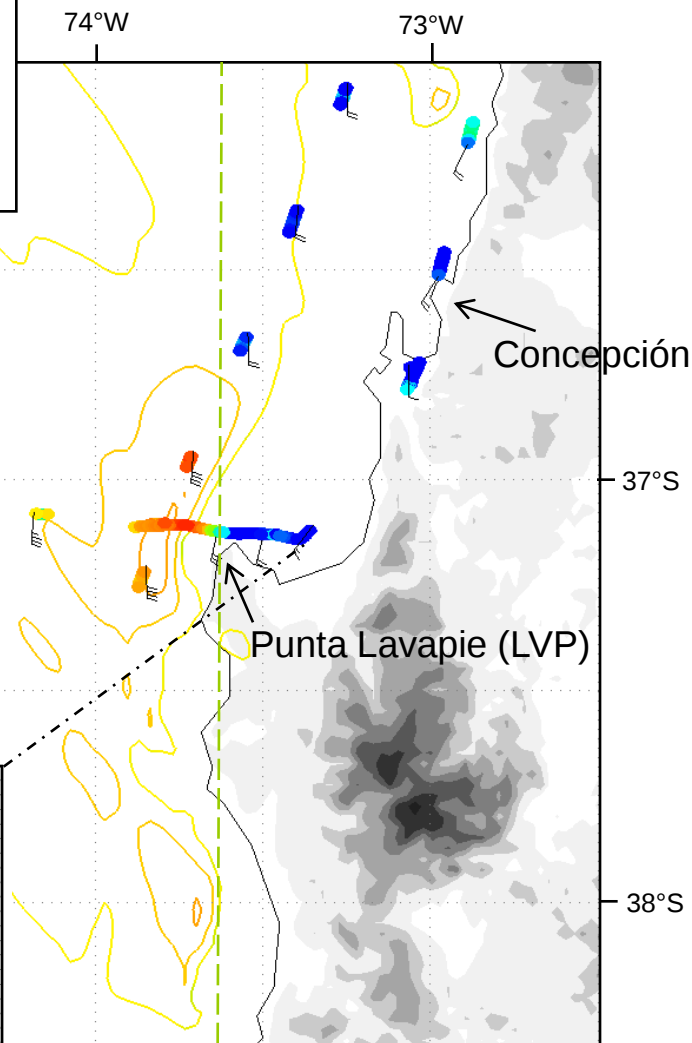
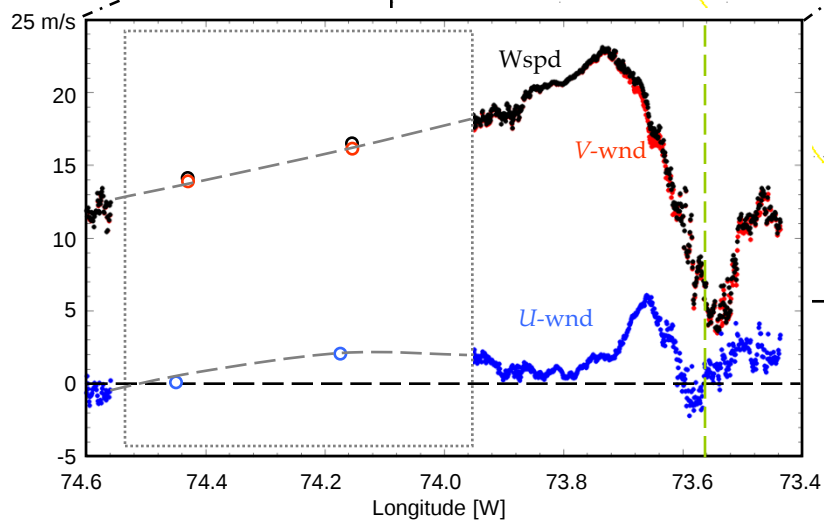
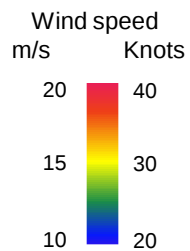
Preliminary CUpEx results

- 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



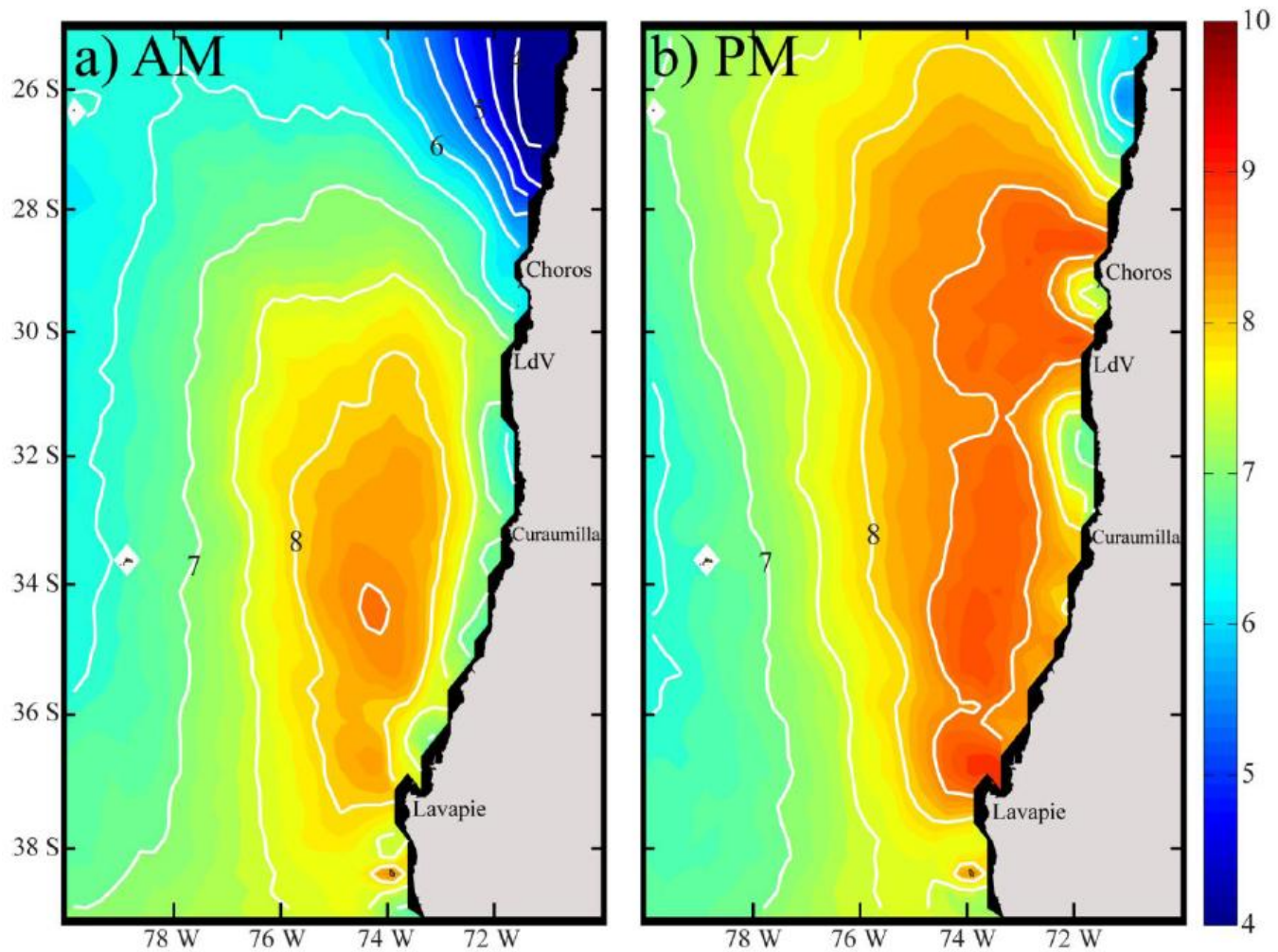
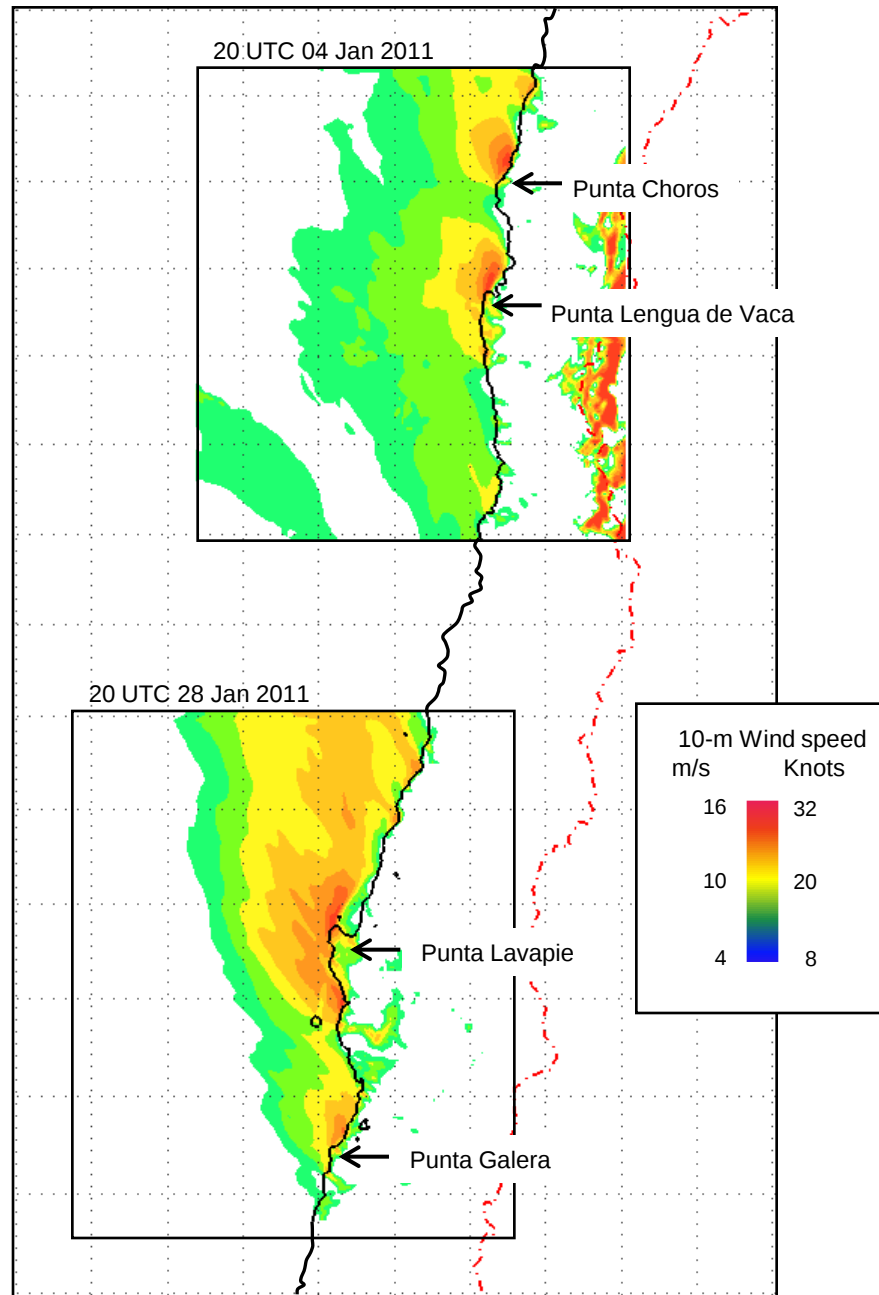
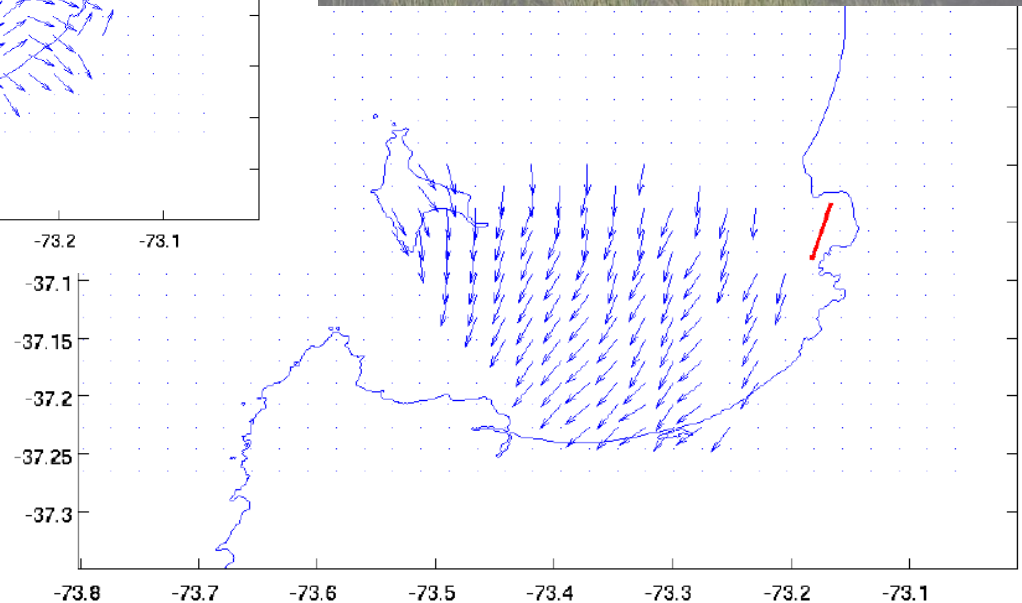
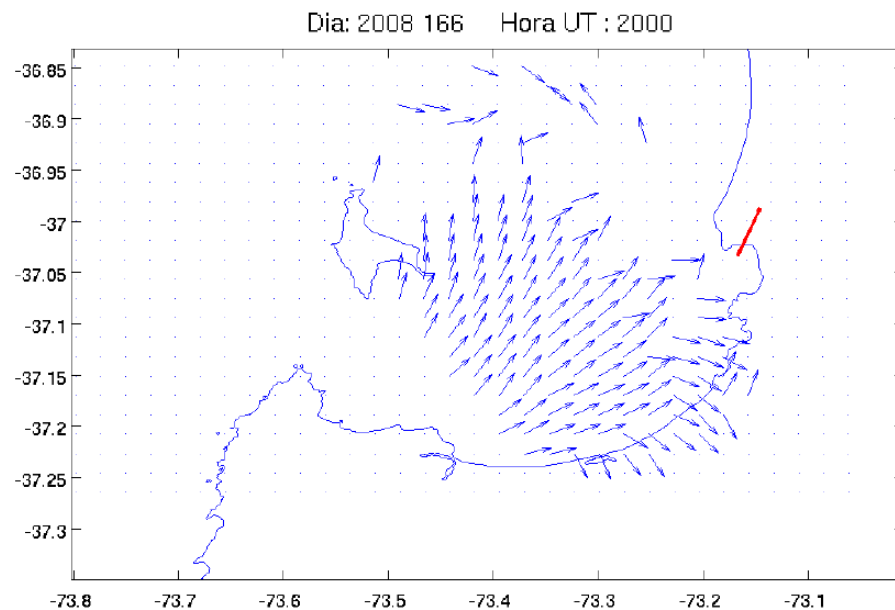


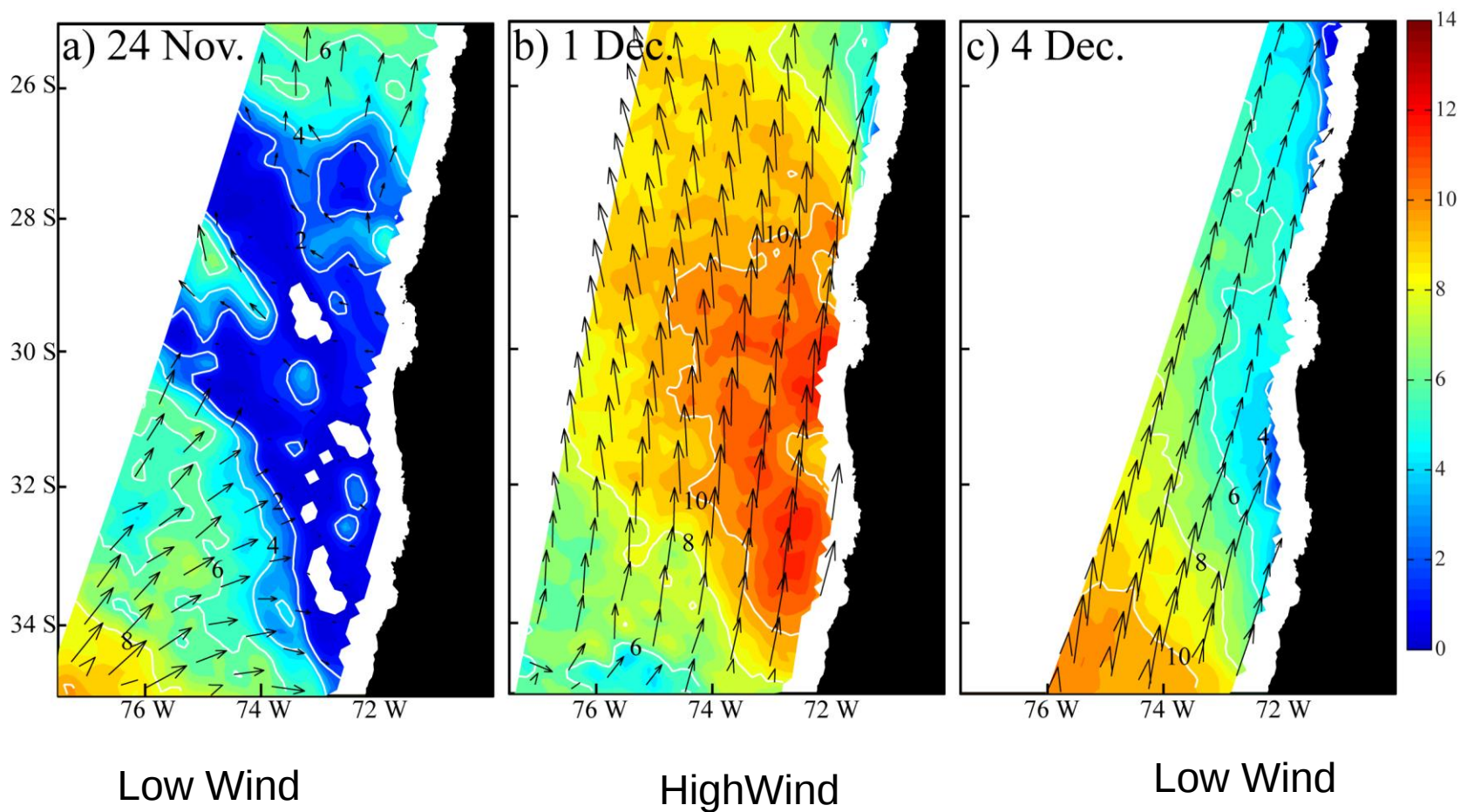
Figure 1: The 10-m wind derived from QuikSCAT averaged over November and December 1999-2008 for the (a) morning and (b) evening satellite passes.



Mean diurnal cycle during CUpEx: Sfc currents



Synoptic variability during CUpEx: ASCAT 10-m winds



Proyecto AIMMS-20 en BE90

