VOCALS Field Exepriment
Coastal Component

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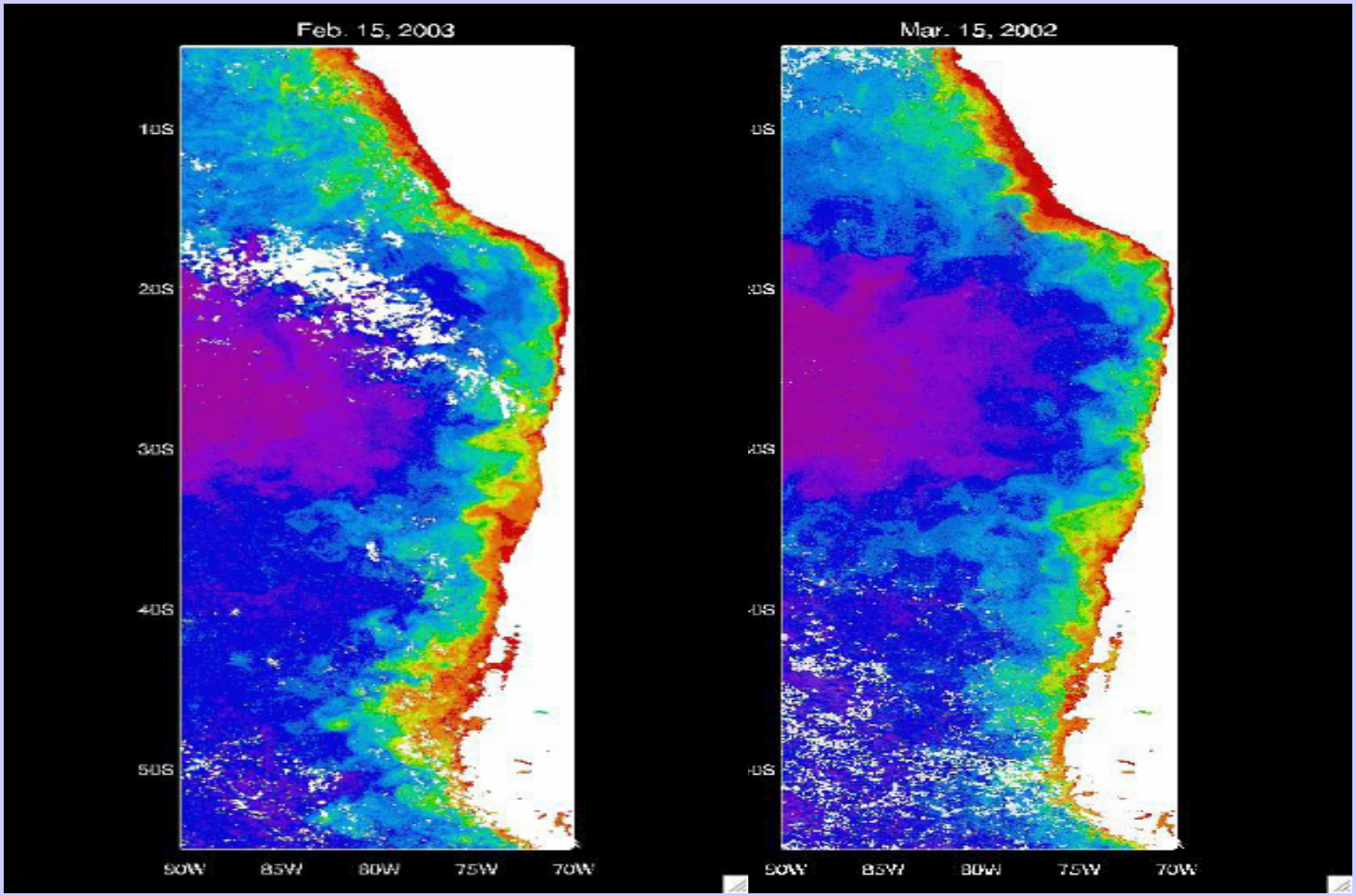
VOCALS Field Experiment
COASTAL COMPONENT

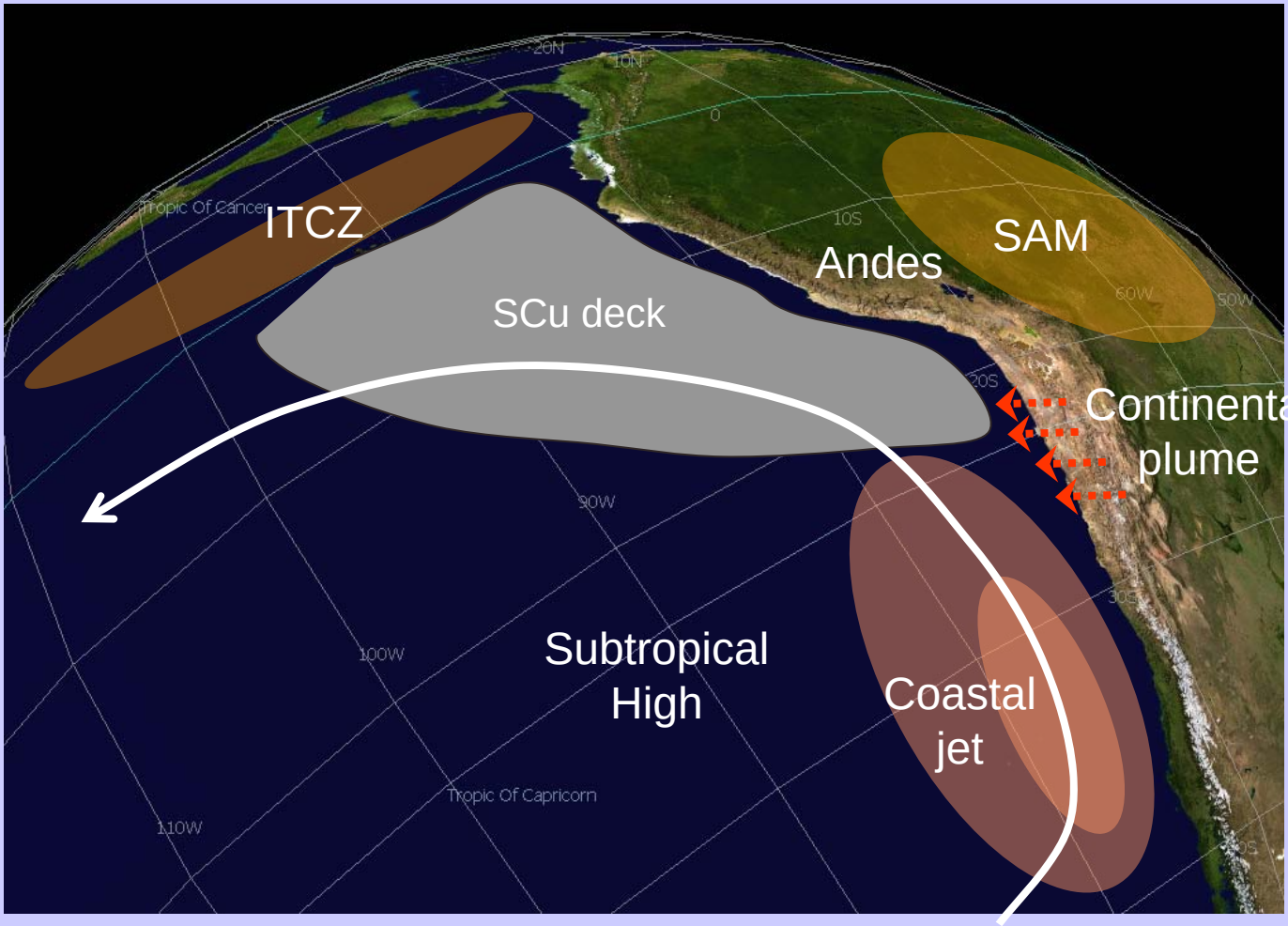
- The region
- Key atmospheric / oceanic features
- Scientific questions / Working hypothesis
- General Objective
- Experimental design overview
- Platforms – instrumentations

The nearshore strip off the tropical and subtropical west coast of South America is the longest and perhaps the most productive area of the world's ocean in terms of pelagic fisheries. It accounts for ~20% of the worldwide marine fish catch

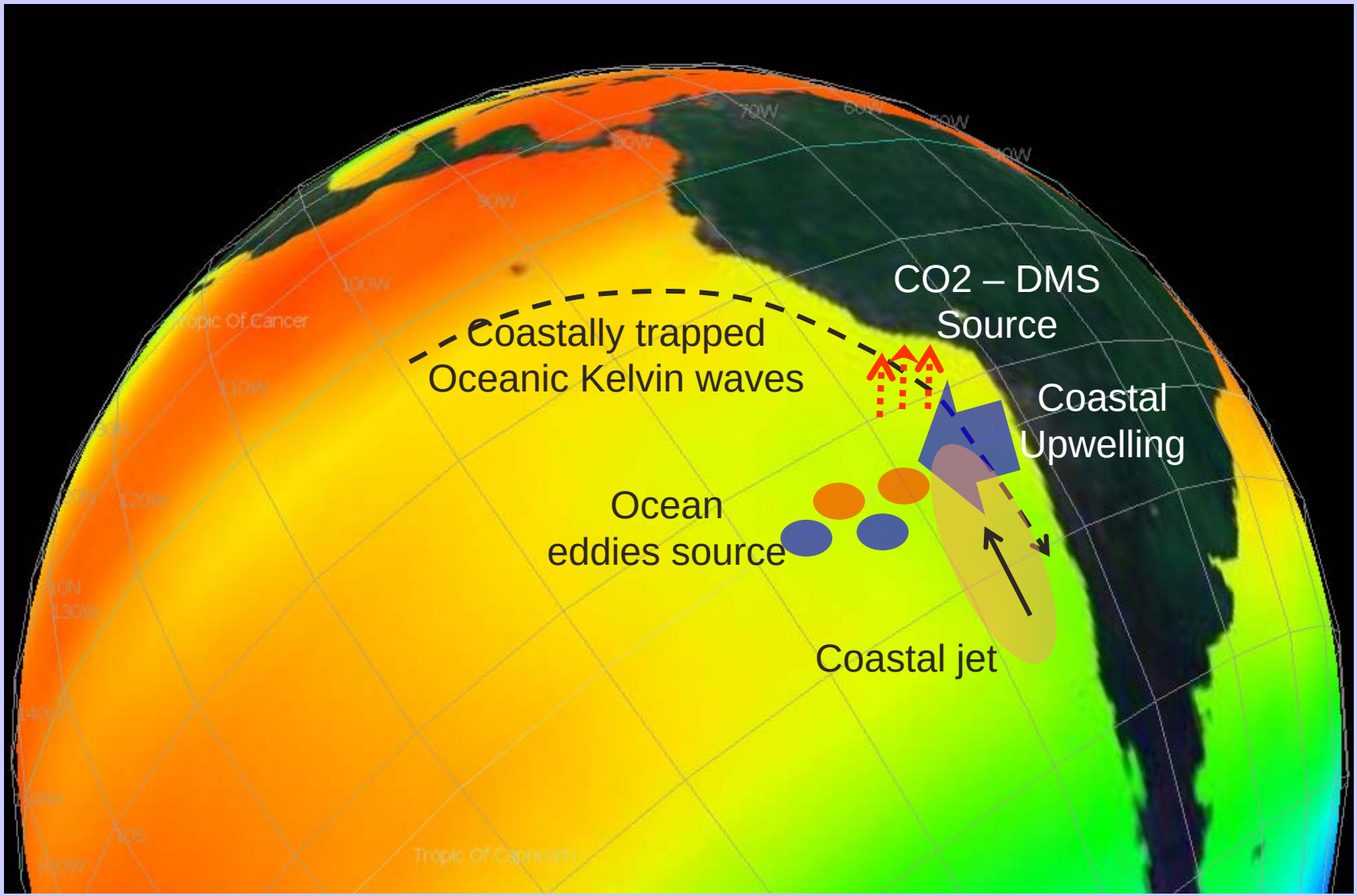
Monthly composites of surface chlorophyll (SeaWIFS data, provided by Ted Strub)



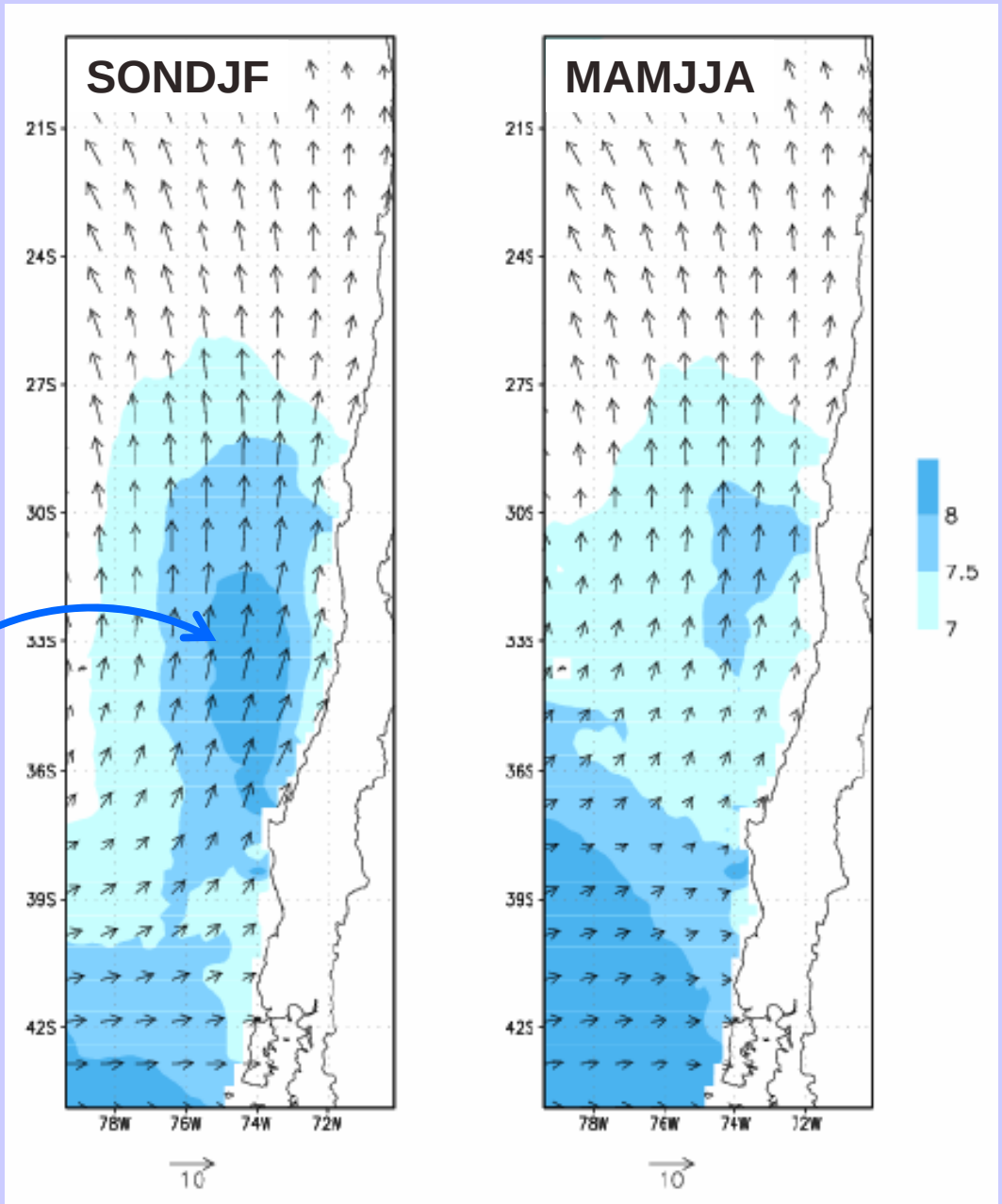
Key atmospheric features over the coastal SEP



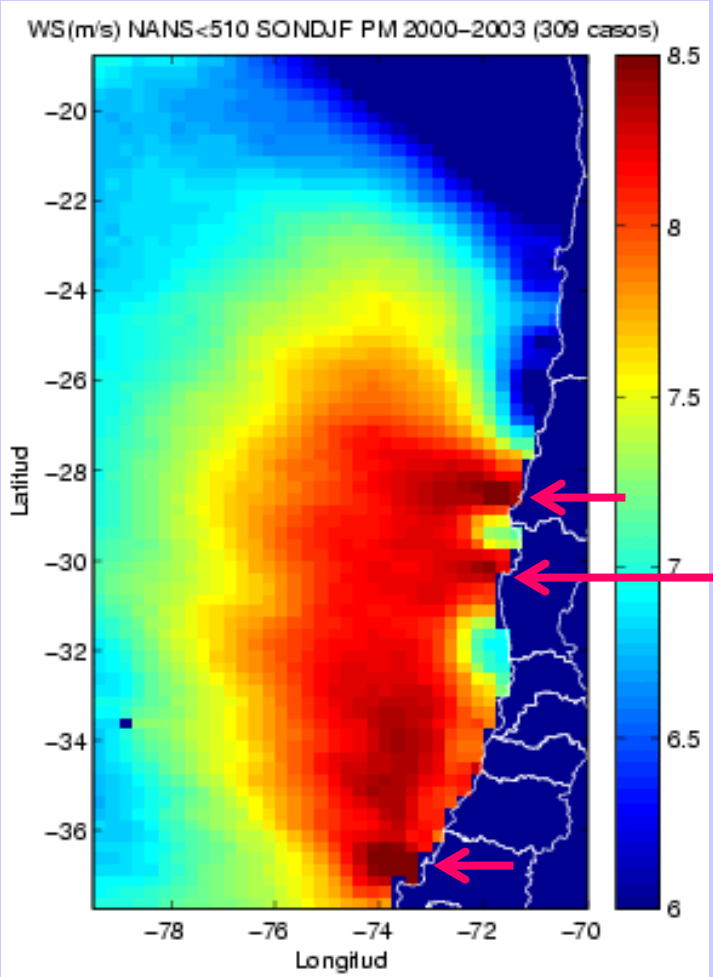
Key oceanic features over the coastal SEP

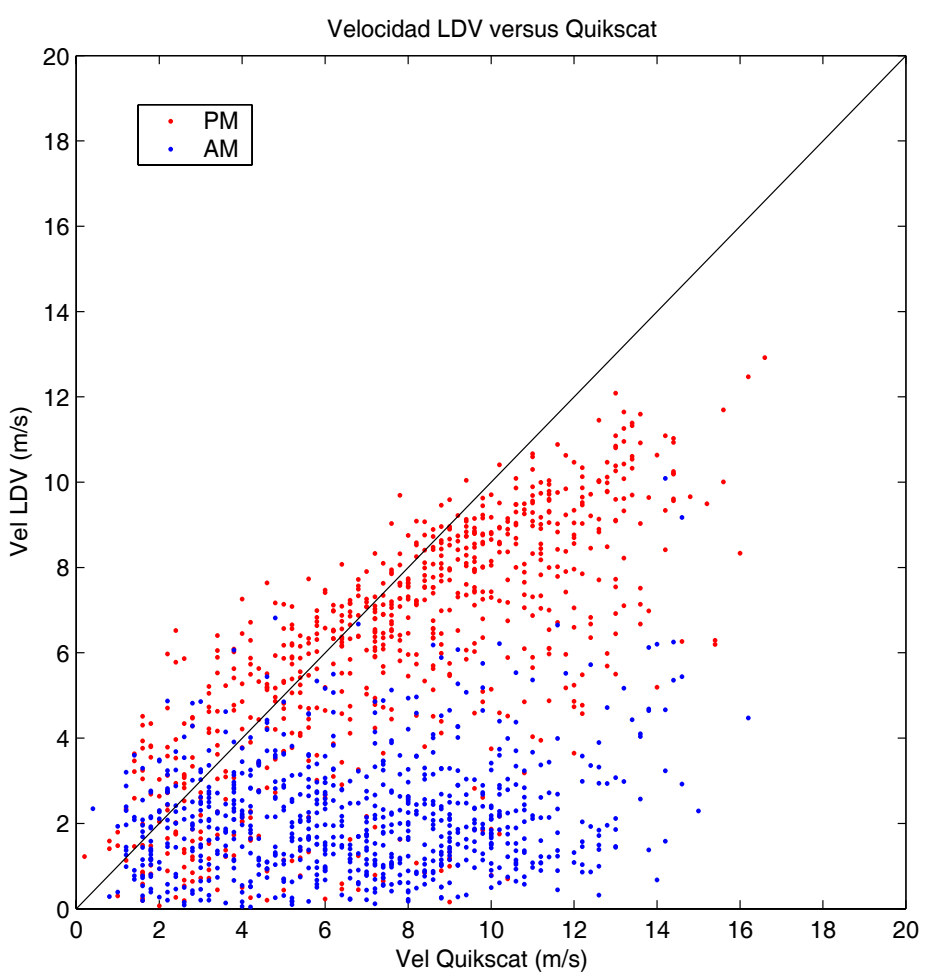


Surface wind climatology (u,v,ws): QSCAT 2000-2003 / 0.25°

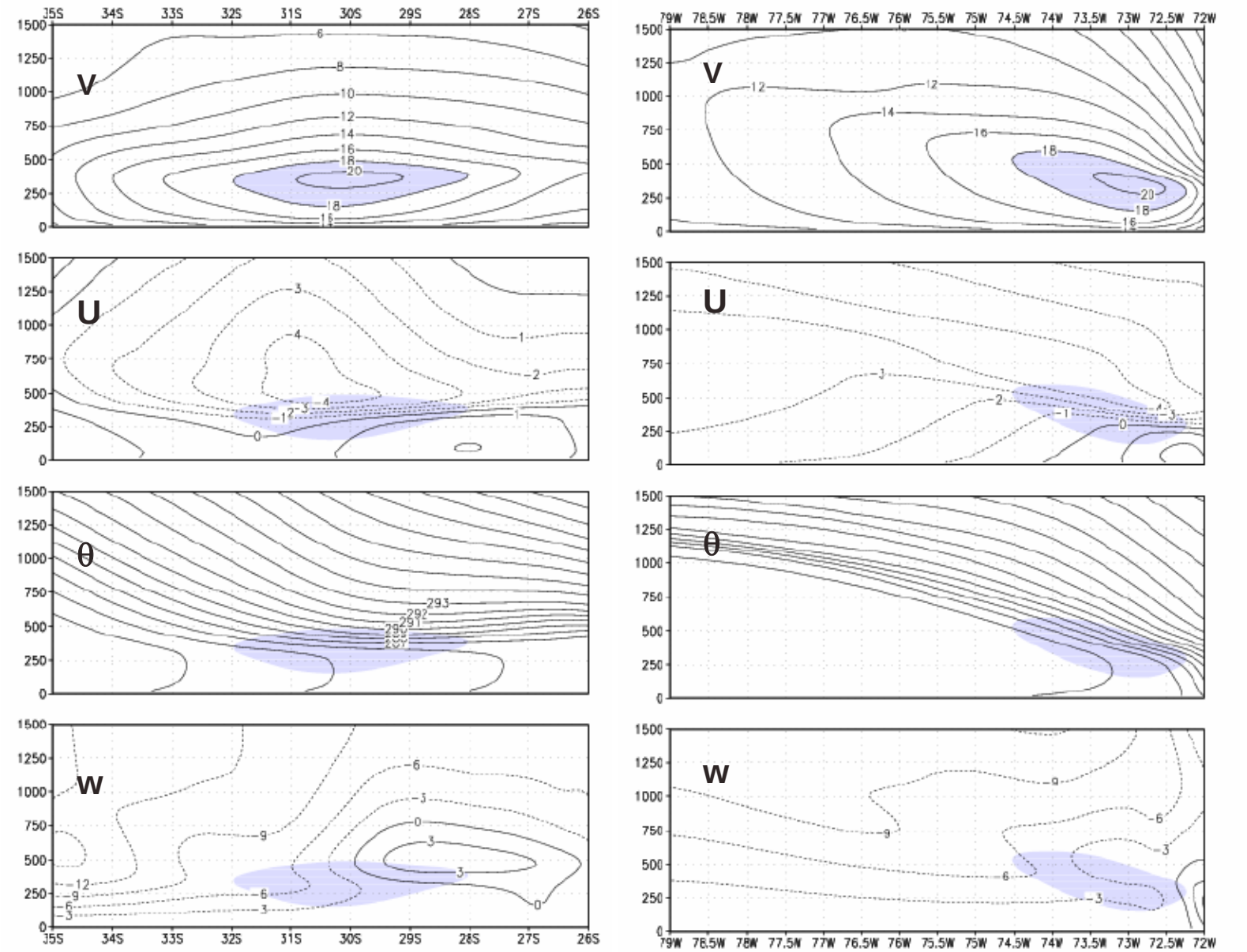


QSCAT also reveals some meso-scale details and insights on the diurnal cycle





Simulated (MM5) structure of the coastal jet

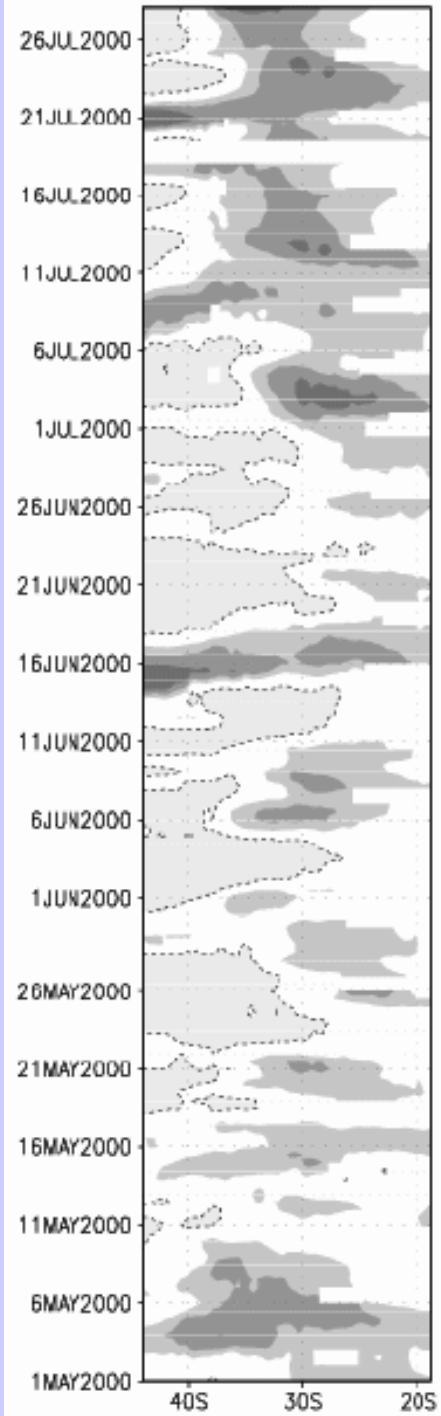


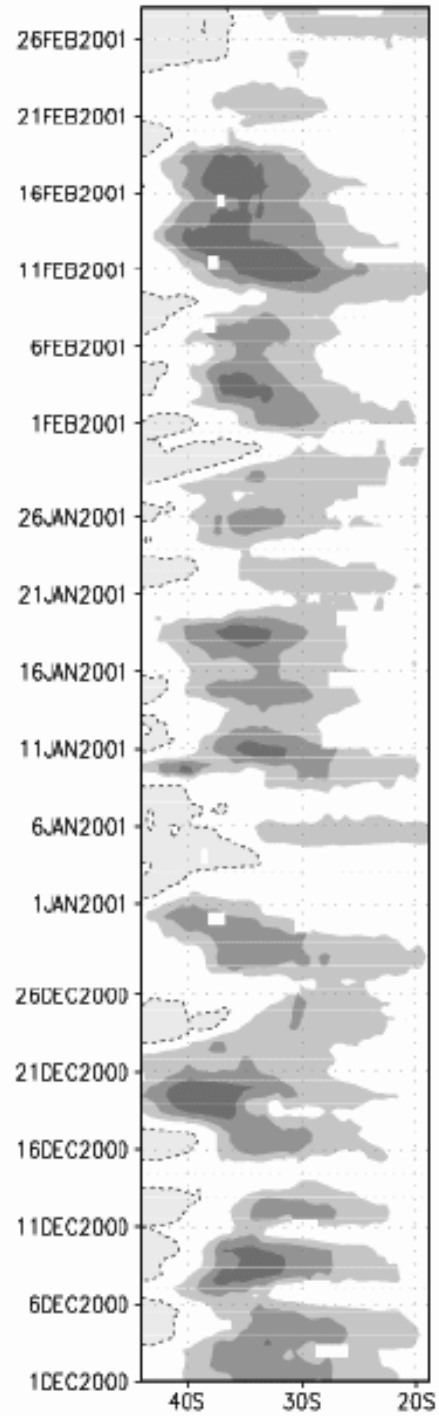
V > 5 10 15 m/s

Time-latitude cross section of the surface meridional wind along the coast

- Jet events (dark shaded) typically a week long (3-15 days)

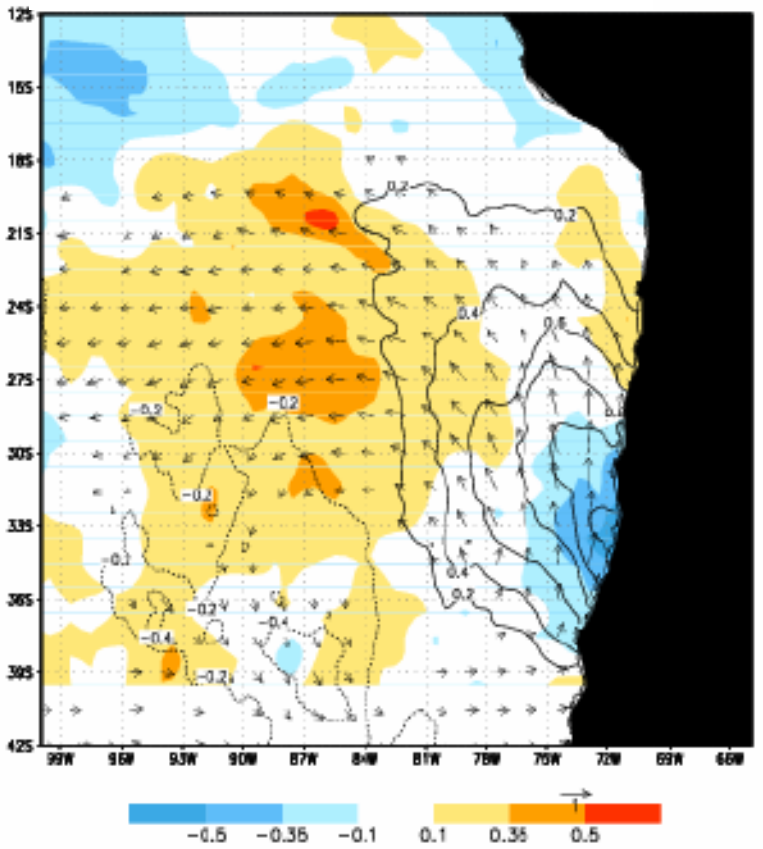
- More frequent, stronger and longer in spring and summer.



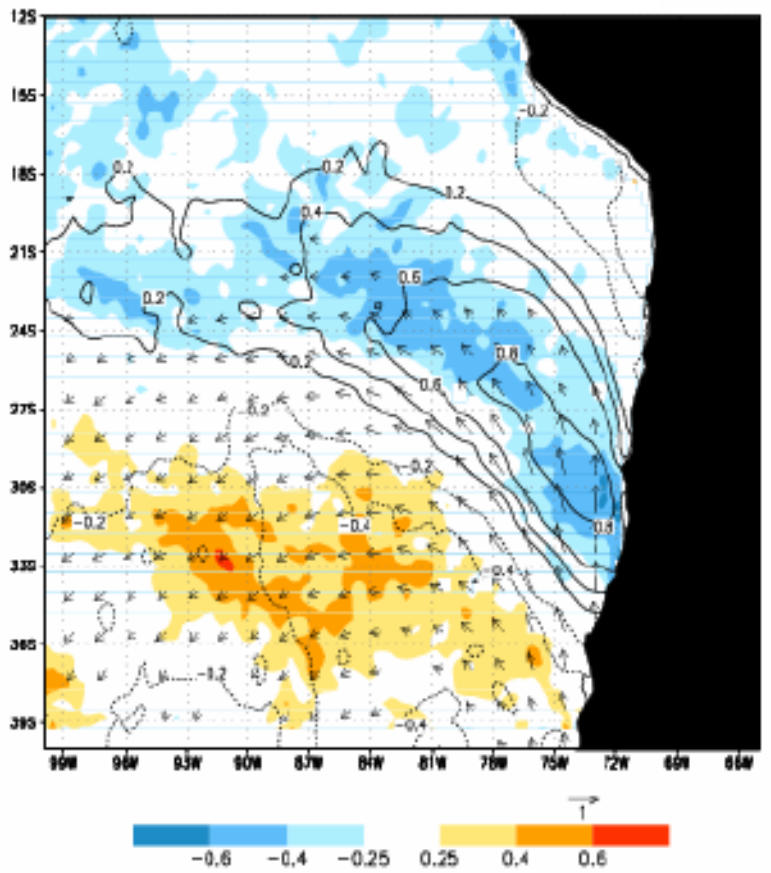


1-Point correlation map. V(33S/73W) regresed upon

U,V elsewhere (vectors)
WS elsewhere (contour)
Cloud elsewhere (colors)



U,V elsewhere (vectors)
V elsewhere (contour)
SST elsewhere (colors)



Jet events associated with: Stronger anticyclone / Reduced Sc near the coast / Increased Sc off the coast / Sea surface cooling at and downstream the jet

A few relevant scientific questions

1a. How do synoptic-scale features influence the Atmospheric MBL circulation (coastal jet), structure, and clouds within the coastal area?

1b. How well are these effects simulated by regional numerical models?

1c. How the coastal-jet/-upwelling system will evolve in a different climate change scenarios?

2a. On what time and space scales does continental heating and mechanical forcing impact on the AMBL clouds and structure in the coastal area?

2b. What are the feedback scales between upwelling plumes (SST gradients, current shear), mesoscale eddies over the AMBL clouds and structure in the coastal area?

3a. Do natural (DMS, sea-salt, mineral dust) and anthropogenic (SO2 emissions) aerosols significantly modulate AMBL clouds (cloud cover, droplet radii, etc.)?

3b. Are aerosols and low SST's in the offshore region controlled by offshore transport by eddies generated by instabilities in the coastal ocean upwelling jet, particularly at 30 and 15 °S?

Working Hypotheses

H1a. Coastal jet events forced by migratory antyclones crossing southern Chile.

H1b. Distintive cloud pattern associated with the jet (clear core / cloudy donwstream) due to zonal flow atop the AMBL.

H1c. Enhanced shear-driven turbulence during coastal jet foster upwelling and ocean eddy activity on time scales of hours.

H2a. Strong diurnal cycle of alongshore winds at the coast due to a reversal in cross-shore flow forced by continental heating/cooling.

H2b. Diurnal coastal clearing instigated by heating/cooling of the Andean slope via changes in the low-level divergence field along the coast.

H2c. Areas of persistent clouds / clear-skies associated with mechanically-driven, mesoscale, standing eddies forced by coastal topography

H3a. Mean low-level flow conducive for the formation of a “continental plume” (CP) extending several hundreds km. offshore.

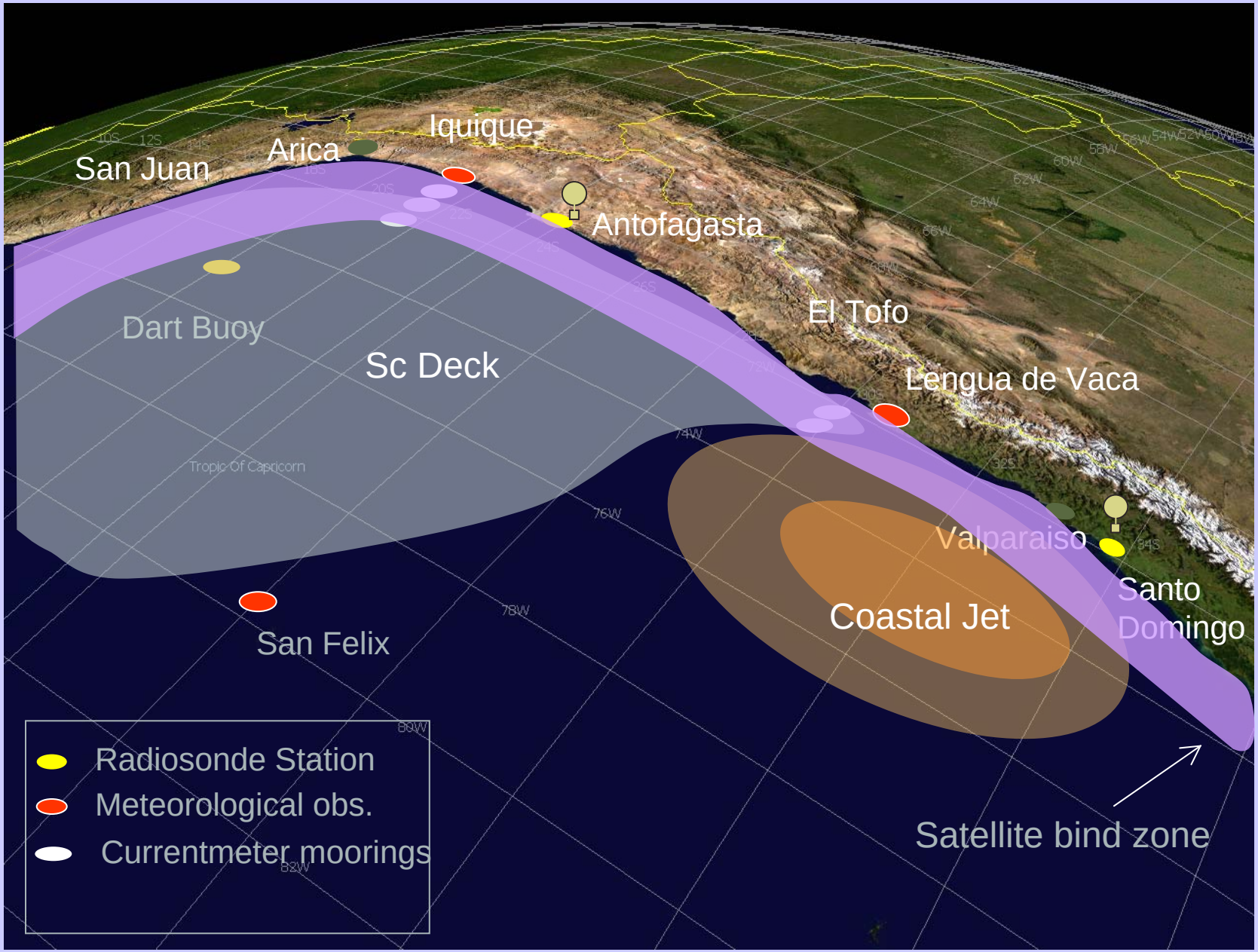
H3b. CP is greately enhanced during coastal low episodes, including pockets of continental air moving thouthands of km. offshore.

VOCALS Field Experiment
COASTAL COMPONENTS

The **V**AMOS **O**cean-**C**loud-**A**tmosphere-**L**and **S**tudy - **R**egional **Ex**periment (VOCALS-REx) is an international field experiment designed to better understand physical and chemical processes central to the climate system of the South East Pacific (SEP) region…the field experiment is ultimately driven by a need for improved model simulations of the coupled climate system.

In the **Coastal Component** of VOCALS-REx we focus our study in the air-sea-land-cloud interactions explaining time-space variability of the nearshore (0-100 km) stratocumulus cloud deck and associated atmosphere-ocean upwelling dynamics and climate.

Current Observation System



SHOA has schedule an institutional cruise for October 2007 to acquire coastal hydrographic data along north-central Chile. Let's take advantage of that opportunity:

• The Oceanography group at U-Concepción will pay 20 extra days to tend their sub-surface current-meter mooring at 30º and 21ºS (10-12 days in each grid), and perform a number of CTD stations. CTD data will be complemented XBT, ship mounted ADCP, and continuous, along track obs. of pCO_2 and pN_20, and 5 satellite-tracked surface drifter will be released in each area.

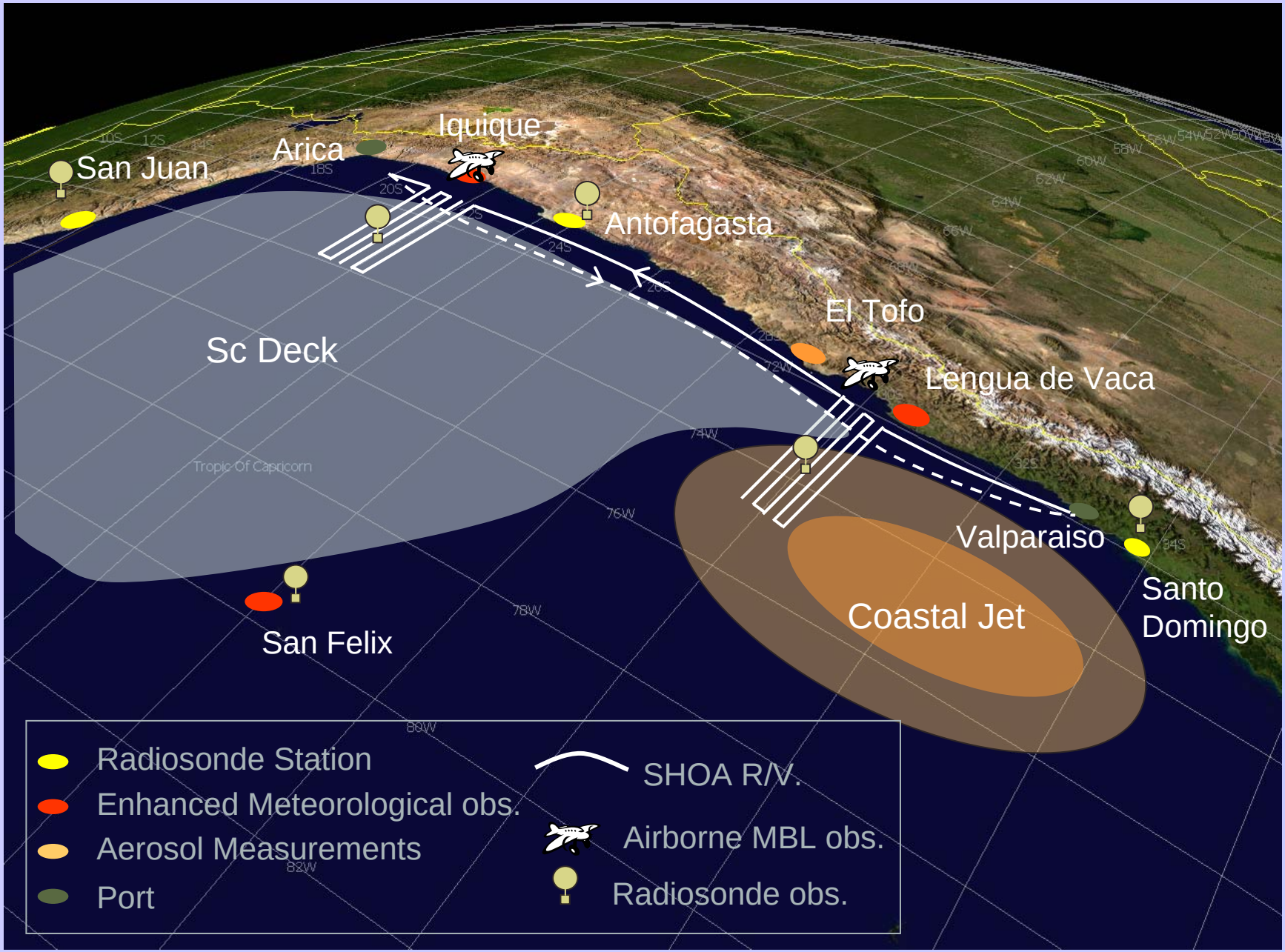
• The Meteorology group at U-Chile will perform on-board radiosonde observations (4/day) and continuous, along track meteorological observations. Ceilometer/Wind profiler will be nice but need to be borrowed ETL. Emphasis in the day-to-day variability.

•Simultaneous with the ship at 30ºS, a light aircraft (Chilean AirForce Twin Otter) equipped with a basic meteorological package will sample the AMBL and capping inversion within the 0-100 km offshore area, aiming to better define the diurnal cycle.

• Cloud and aerosol size distribution and chemical properties will be sampled at a coastal land-site (Antofagasta, 22ºS). See more in Laura Gallardo presentation.

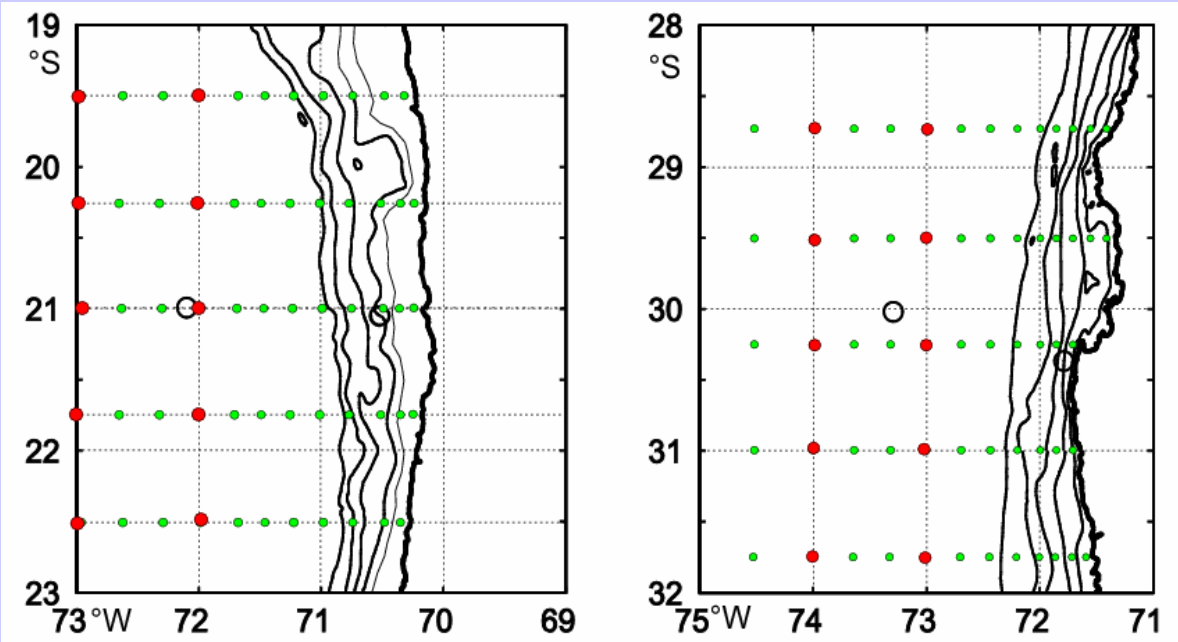
• Both realistic simulations and idealized process studies with regional atmosphere (MM5, WRF) and coupled ocean-atmosphere models of the coastal zone will be useful in providing a context for analysis of the observations and methods to examine the roles of specific physical mechanisms of interest.

Chilean Coastal Component

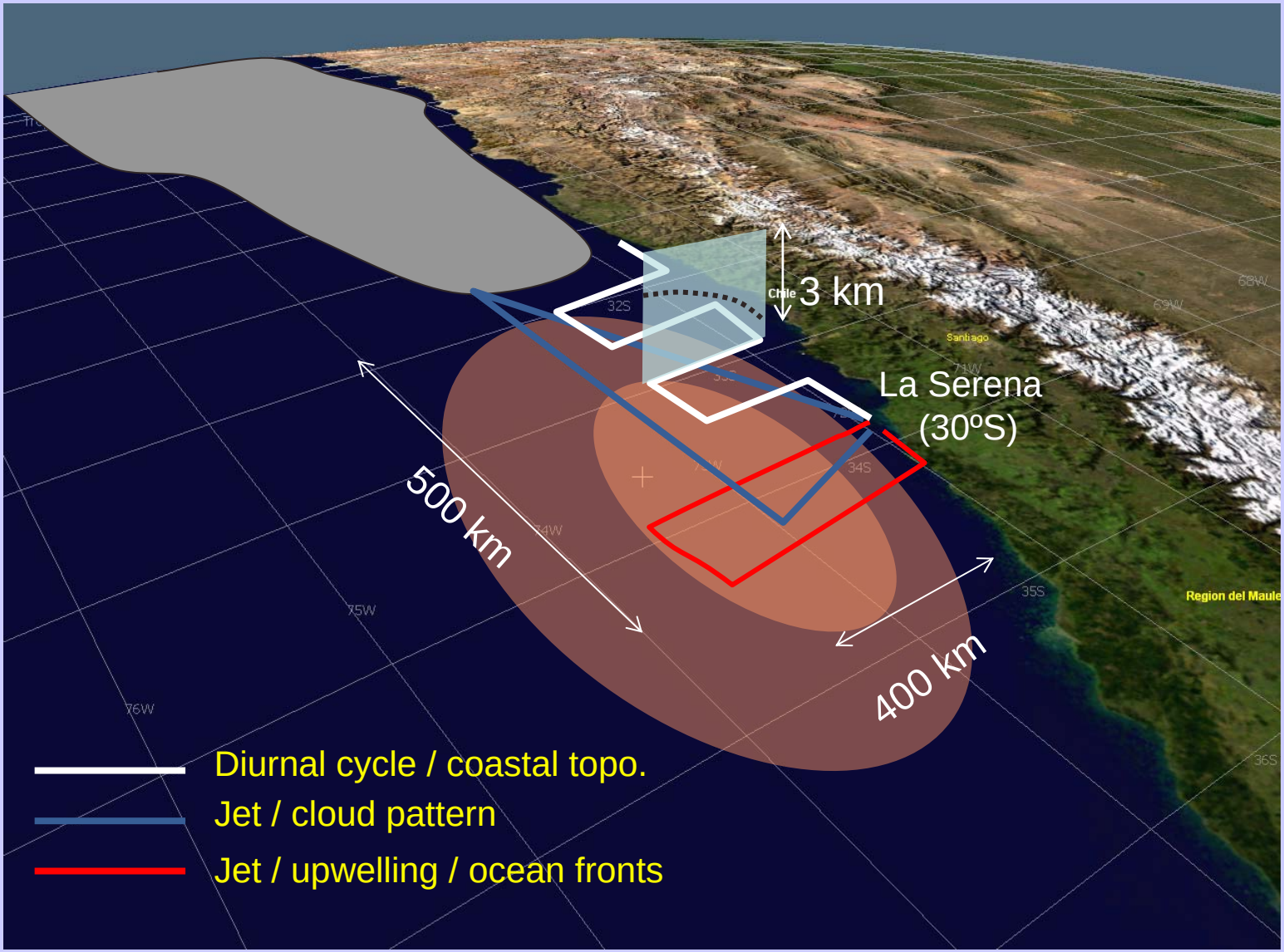


CTD-O stations along the intensive study regions.

Red dots: 4000 m CTD casts. Green: 1000 m CTD casts



Proposed Twin Otter Flight Patterns



Platform	Instruments	Observations	Contact
Chilean Airforce Twin Otter aircraft	AIMMS20 AQ instrument suite	Temperature, humidity, winds, turbulence	Gallardo (Universidad de Chile)
SHOA R/V Atmosphere	Radiosondes, surface meteorological package, NOAA wind profiler	MBL structure and dynamics	Rutllant/Garreaud (Universidad de Chile)
SHOA R/V Ocean	CTD-O, ADCP and thermo-salinograph, water sampling	Upper ocean physical and chemical structure	Pizarro (Universidad de Concepcion)
Antofagasta (land site)	Counterflow virtual impactor (CVI), bulk filter measurements, Differential mobility analyzer (DMA)	Cloud and aerosol size distribution and chemical properties, cloud droplet residual properties	Gallardo (Universidad de Chile) and Krejci (MISU, Sweden)
Modeling	PSU/NCAR MM5 regional atmospheric model	MBL/coastal jet structure and variability, diurnal subsidence wave generation	Garreaud (Universidad de Chile)

Coarse budget estimates

• 40-50 flight hours	US$80,000
• AIMMS20 AQ airborne meas. package	US$50,000
• Radiosondes (RS80) Antofagasta	US$10,000
• Shipboard obs: Helium, balloons, technician	US$20,000
• Aerosols and Stratus (El Tofo obs. site)	US$60,000
•Equipment to borrow from NOAA-ETL: RS80 receiver, PRT, ceilometer, wind profiler	US$20,000
TOTAL	**US$240,000**

Critical Tasks – Schedule

- May 2006: Secure realization in SHOA cruise
- May 2006: Secure collaboration of Air Force
- June 2006: Secure funding from UConcepción to extend SHOA Cruise
- June 2006: Submit proposal to FONDECYT including support for Met/Chem observations
- July 2006: Secure collaboration from ETL