

Overview: C. Roberto Mechoso Clouds and Aerosol: Chris Bretherton OceanFluxes: Bob Weller Aerosol and Biology: Barry Huebert Discussions on Program Requirements







VOCALS ORGANIZATION

C. R. Mechoso, Chair SWG

Atmosphere: C. Bretherton, R. Garreaud
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The overall goal of VOCALS is to develop and promote scientific activities leading to improved understanding, model simulations, and predictions of the southeastern Pacific (SEP) coupled ocean-atmosphere-land system, on diurnal to interannual timescales.

The science objectives of VOCALS include:

• Improving the understanding and simulation of aerosol-clouddrizzle interactions in the marine PBL.

• Improving the understanding and simulating the ocean budgets of heat, salinity, and nutrients in the SEP.

• Characterizing, determining, and alleviating the **systematic biases** of atmosphere-ocean GCMs in the SEP.

• Elucidating and understanding interactions between the SEP climate and remote climates.







Elements of VOCALS in the SEP

- SEP has research-grade buoys and strategic island
- Strong gradients in the climate system
- Imprints of aerosol and mesoscale ocean variability in the structure of PBL clouds
- Strong regional partners, primarily in Chile but also in Peru and Ecuador.
- Possible European presence: PRIMO





Annual Warren Stratus Cloud Amount

Major features of SEP climate

- Cold SSTs, upwelling
- Cloud-topped ABLs
- Influenced by and influential on remote climates (ENSO)
- Unresolved issues in heat and nutrient budgets
- Important links between aerosol and clouds
- Poorly simulated by atmosphere-ocean GCMs
- High biological production and DMS fluxes



Ocean Salinity Section at 88W



Indirect effects of aerosol on climate



Pockets of Open Cells (POCs) are strongly drizzling and almost completely depleted of cloud forming aerosols In the SEP near the coast POCS rarely develop, but away from the coast they are more frequent and extended than in other Scu regions.

Are these behaviors evidence of strong links between aerosol and cloud macrophysical structure? What is the role of drizzle?



IGBP's Surface Ocean Lower Atmosphere Study (SOLAS) will collaborate with CLIVAR on VOCALS. http://www.uea.ac.uk/env /solas/



The surface fluxes of precursor gases (DMS and VOCs) grow the aerosols that control cloud properties. (DMS: dimethylsulfide). The supply of DMS and its oxidation mechanisms limit new particle nucleation and growth.

To what extent do these processes affect the re-filling of POCs with clouds, and what is the role of iodine, ammonia, and organics?

SOLAS proposes to study this chemistry from both ships and aircraft.

Issues in ocean transports



Annual-mean heat flux **into** ocean ~ 30 W m⁻² at 1500 km offshore under persistent low cloud!

How is this net warming at the surface balanced by ocean heat transports?



Ocean eddies and transports



Do oceanic mesoscale eddies play a key role in transport of heat and upwelled water from coastal regions to further offshore?

SEP Climate and South American Monsoon Ascent to the east - Descent to the west











Influence of Peruvian stratus on the tropical atmospheric and oceanic circulations, according to Ma, Mechoso, Robertson, and Arakawa (J. Climate, 1996)

CGCM Problems: NOAA CFS Model

- The CFS model has significant errors in the SEP
- There is a meridional shift in ITCZ (top), a warm SST bias (middle) and insufficient stratocumulus cloud cover, (bottom)
- These errors adversely affect the skill of CFS climate forecasts (ENSO).

What model developments are required to alleviate these errors?

CFS Errors



Modeling Centers are highly interested in VOCALS topics

- Coupled GCM bias in VOCALS region
- Fluxes of carbon and other substances
- Modeling near coast winds and radiative forcing
- Cloud modeling and prediction, with an emphasis on Scu

NCAR Participants: W. Large, D. Williamson, J. Hack, M. Jochum, G. Danabasoglu

NCEP Participants: W. Higgins, P. Xie, W. Wang

GFDL Participants: I. Held, T. Rosati, Ramaswamy, L. Donner, C. Golartz









International Partners - Peru

Field experiment: October-November 2007



Cost ~ \$70K (Peru)

Main goals (main instruments):

- 1. Characterize the near-coastal 3D wind structure *(ship-borne wind profiling radar)*.
- 2. Assess the relation between the wind and mesoscale ocean processes (upwelling and eddies) *(wind profiler, CTDs and ADCP)*
- 3. Determine the dynamical and thermodynamical structure associated with the coastal clearing *(ship-borne radiosoundings)*.

Cruise supplemented with land observations (surface met and radiosoundings)

VOCALS Regional Experiment (VOCALS-REX)

NSF C130

Ship: NOAA Ron Brown

October 2007 (month of highest Sc incidence)





VOCALS-REX Ships: 1. Ron Brown 2. Chilean

October 2007





VOCALS Overall Strategy



VOCALS: Regional Coupled Modeling

- The scientific strategy uses data gathered in VOCALS-REX to establish eddy and frontal structures and assess model verisimilitude, and then uses the models to establish the eddy heat flux consequences.
- The aim is to provide the appropriate framework for understanding regional, small-scale processes and heat budgets.





Modeling Framework for VOCALS

AGCM: Atmosphere General Circulation Model

OGCM: Ocean General Circulation Model



SUMMARY BUDGET (\$K)			
AGENCY	FY 08	FY 07-09	Total
NSF Deployment Pool	1,100	-	1,100
NSF-Climate	60	1,250	1,310
NSF-Ocean	900		900
NSF-Chemistry	1,300		1,300
NOAA	1,452	150	1,602
NASA		200	200
ONR	TBE	TBE	TBE
	4,812	1,600	6,412







VOCALS Timeline











Regional VOCALS October/2007

- SHOA 20-day oceanographic cruise along northern Chile. Onboard radiosonde observations will be made.
- Enhanced radiosonde observations at Santo Domingo (34°S), and Antofagasta (23°S).
- Flights with a twin-engine small airplane equipped with a meteorological package (e.g. AIMMS 20) to sample the AMBL and capping subsidence inversion within the 0- 250 km offshore area at 30°S.
- Coastal automatic weather stations at 30°S and 23°S and a laser ceilometer at 30°S (La Serena airport).
- Possible coordination with CPPS joint southern spring cruises and PRIMO cruise.





