

Improving understanding, model simulations, and prediction of the Southeast Pacific Climate System



Post VOCALS - REx Report



Foreword

The VOCALS Science Working Group at its meeting in Arica, Chile, 7 November 2008, decided to produce a project-snapshot document at the completion of the field campaign VOCALS-REx.

To this end, all VOCALS Scientists were invited in December 2008 to provide slides with selected aspects of their work. The current document, in four parts, is a collection of those slides.

In many cases the material sent has been included without modifications; in other cases we have made minor changes to improve consistency. We apologize for mistakes that might have been made in these cases.

C. Roberto Mechoso, UCLA
VOCALS Chair

Robert Wood, U. Wash.
VOCALS-Rex Lead PI

Part 1

INTRODUCTION

- **Come sample with me and be my wings: Poem**
- **Goals of VOCALS**
- **Coupled atmosphere-ocean-land hypotheses**
- **Aerosol-Cloud-Drizzle Hypotheses**
- **VOCALS Regional Experiment (Rex) Themes**
- **VOCALS-REx platforms and sampling**
- **Institutions collaborating in VOCALS**
- **Photo Album**

**COME SAMPLE WITH ME
AND BE MY WINGS**

**Rendez vous Ron Brown - C130
VOCALS, South Pacific, October 25, 2008**

Come sample with me and be my wings,
Together we will gather temps and winds
That VOCALS scientists came to find,
And are the only glory that they mind.

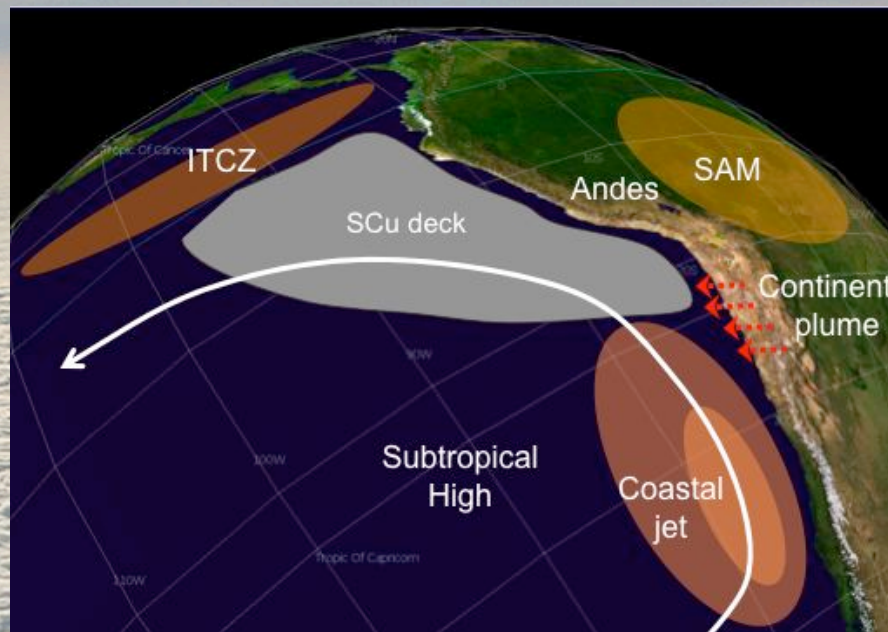
We two will journey from Arica westward,
And again from the IMET buoy eastward,
Along the 20 south of latitude, you up there
While at the ocean surface I do my share.

Admiral Bob with steel determination
Will steer my course without hesitation,
While sending soundings into the misty air
And dropping XBTs into the sea with flair.

And Air Marshall Rob with multi-eagle eyes
will guide you and your band of brothers
up and down across the clouds searching
for aerosols and CCNs to calm their longings.

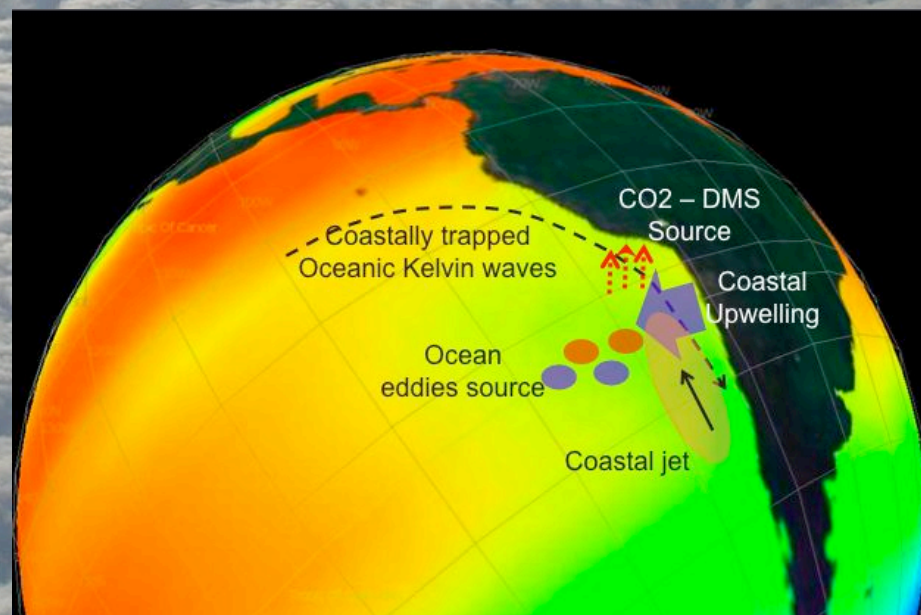
Text: R. Mechoso, Image: C. McNaughton

The South Eastern Pacific

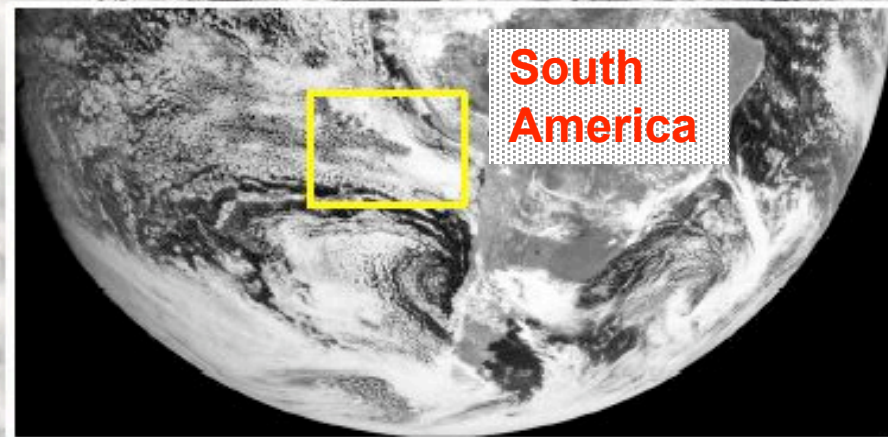
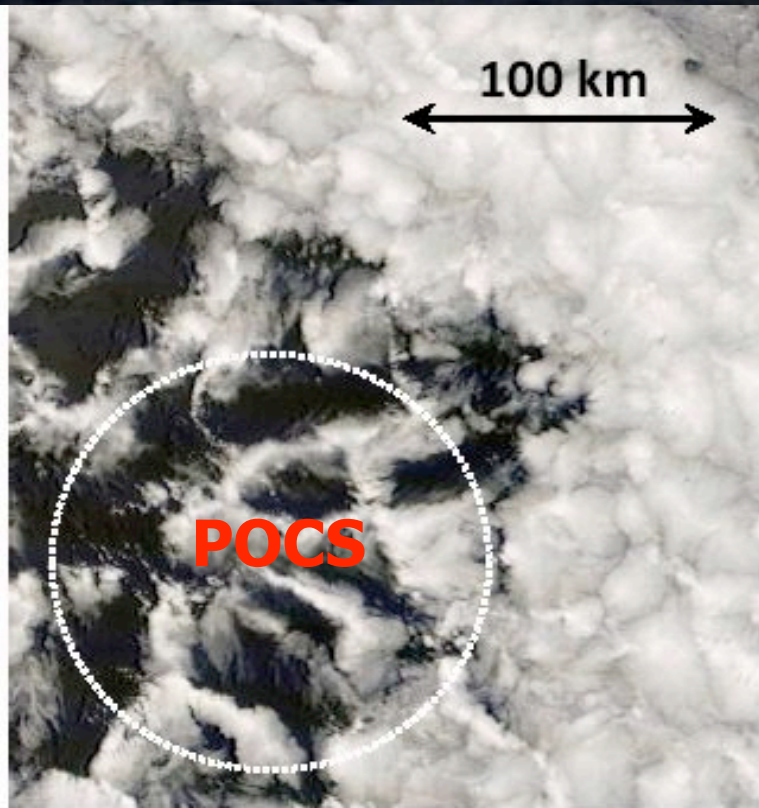


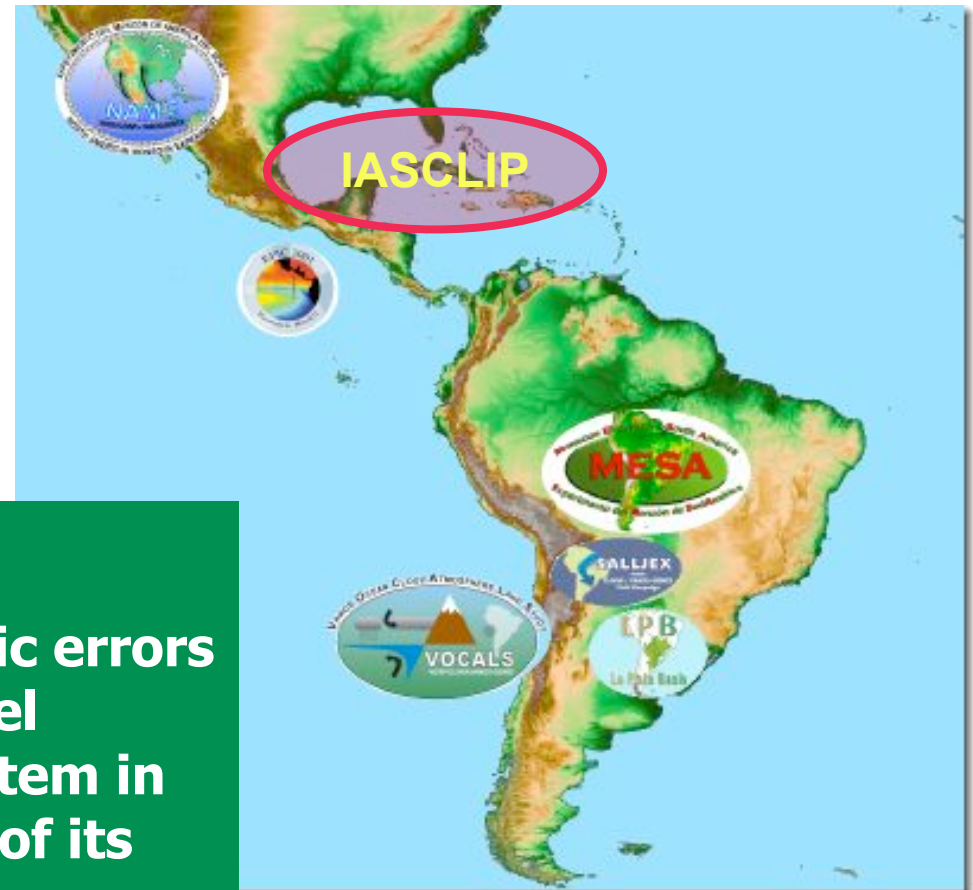
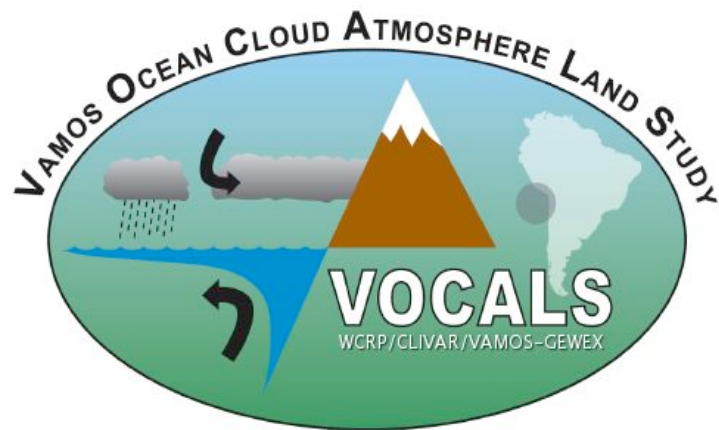
- Cold SSTs, coastal upwelling
- Coastally trapped Kelvin waves and ocean eddies
- Unresolved issues in heat and nutrient budgets
- Important links between clouds and aerosol

- Cloud-topped ABLs
- Important links between clouds and aerosol
- Influenced by and influential on remote climates (ENSO)
- Poorly simulated by atmosphere-ocean GCMs



Little Weather... ...Lots of Clouds





GOALS of VOCALS

Elimination of CGCM systematic errors in the SEP, and improved model simulations of the coupled system in the region and global impacts of its variability.

Improved understanding and regional/global model representation of aerosol indirect effects over the SEP.

www.eol.ucar.edu/projects/vocals



COUPLED OCEAN-ATMOSPHERE-LAND HYPOTHESES

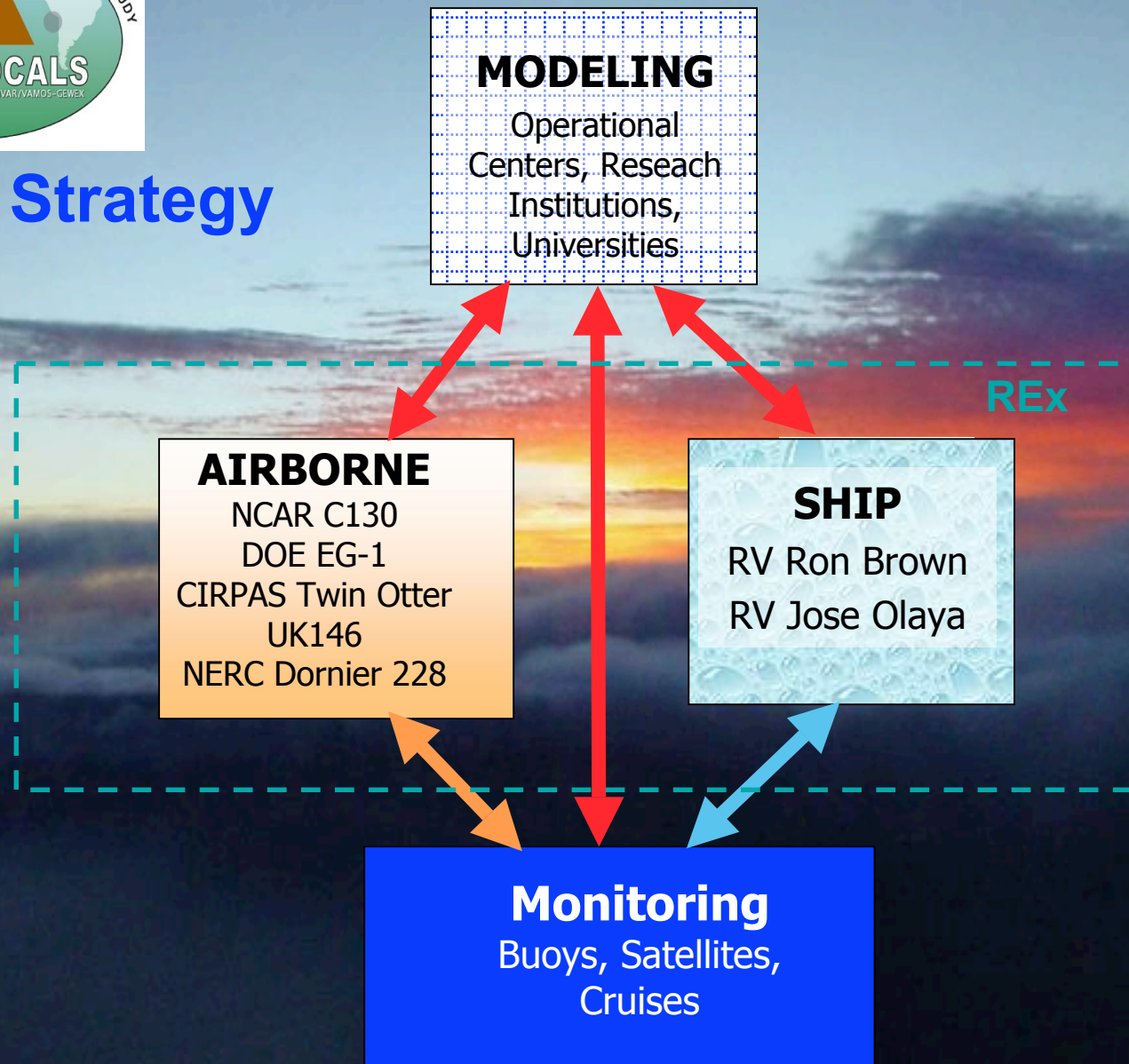
- Oceanic mesoscale eddies play a major role in the transport of heat and fresh water from coastally upwelled water to regions further offshore.
- By changing the physical and chemical properties of the upper ocean, upwelling has a systematic and noticeable effect on aerosol precursor gases and the aerosol size distribution over the SEP.
- The diurnal subsidence wave (“upsidence wave”) originating in northern Chile/southern Peru has an impact upon the diurnal cycle of clouds that is well-represented in numerical models.
- The entrainment of cool fresh intermediate water from below the surface layer during mixing associated with energetic near-inertial oscillations generated by transients in the magnitude of the trade winds is an important process to maintain heat and salt balance of the surface layer of the ocean in the SEP.

AEROSOL-CLOUD-DRIZZLE HYPOTHESES

- Variability in the physicochemical properties of aerosols has a measurable impact upon the formation of drizzle in stratocumulus clouds over the SEP
- Precipitation is a necessary condition for the formation and maintenance of pockets of open cells (POCs) within stratocumulus clouds
- The small effective radii measured from space over the SEP are primarily controlled by anthropogenic, rather than natural, aerosol production, and entrainment of polluted air from the lower free-troposphere is an important source of cloud condensation nuclei (CCN)
- Depletion of aerosols by coalescence scavenging is necessary for the maintenance of POCs.



VOCALS Strategy



VOCALS Regional Experiment (REx)

Themes

- **Aerosol-cloud-drizzle interactions** in the marine boundary layer (MBL) and the physicochemical and spatiotemporal properties of aerosols
- **Chemical and physical couplings** between the upper ocean, the land, and the atmosphere.



VOCALS-REx Platforms



NSF C-130



NOAA Ronald H Brown



Paposo



IMARPE José Olaya



CIRPAS Twin Otter



Iquique



NERC Dornier 228

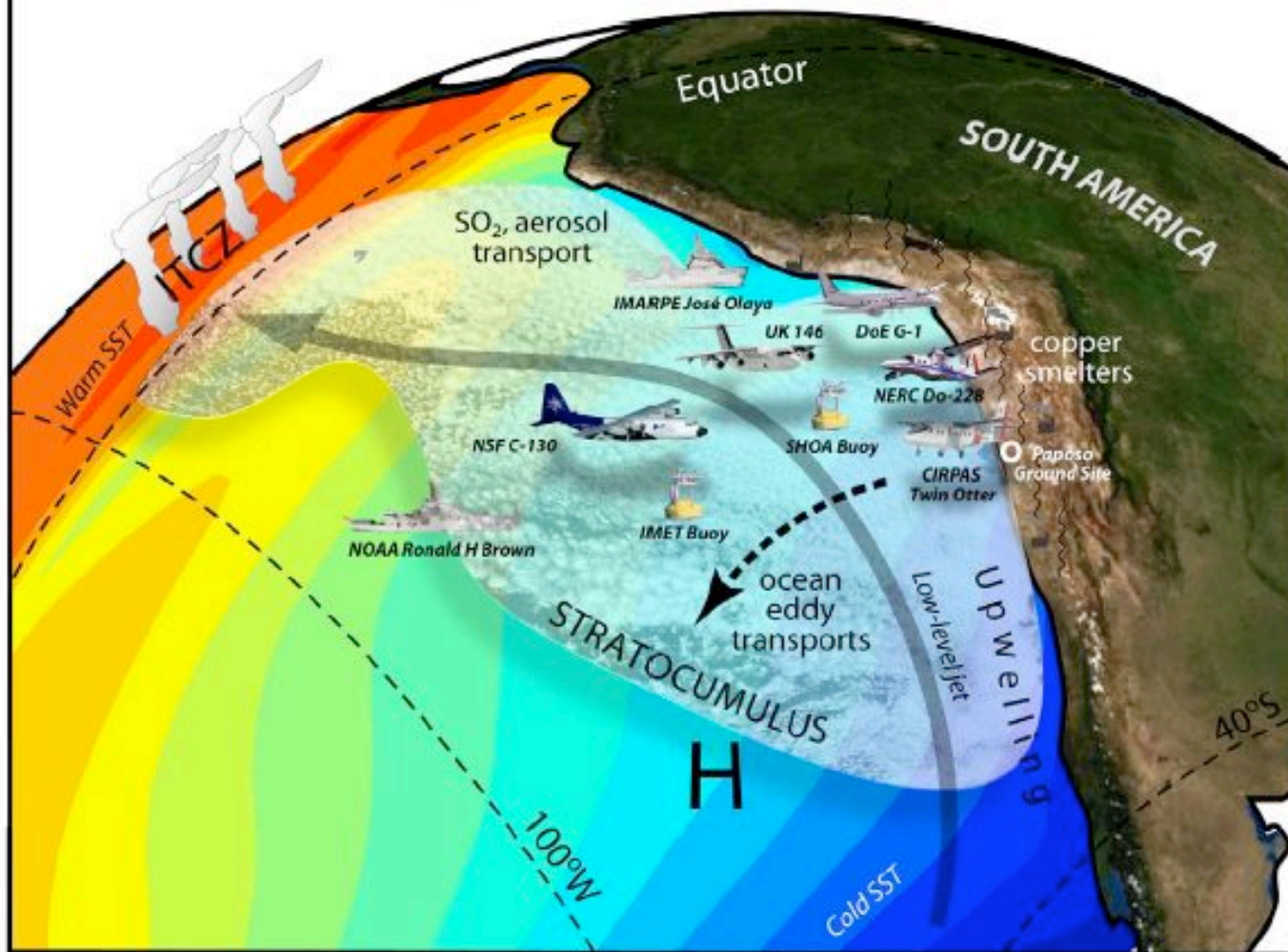


DoE ASP G-1



UK FAAM BAe-146

VOCALS Regional Experiment



Universities

Arizona
Arizona State
California Los Angeles
California Irvine
California San Diego
California Santa Cruz
Chile, Chile
Concepción, Chile
Colorado Boulder
Colorado State
Drexel
Hawaii
Iowa
Leeds, UK
Manchester, UK
Miami
N. Andres Bello, Chile
Naval Post. School
North Carolina State
Oregon State
Purdue
Reading, UK
Washington
Wyoming

Research Institutions

Brookhaven Nat.
COLA
CNRM/GAME France
CNRS/LMD France
IMARPE Peru
Inst. Geofísico del Peru
IPRC
JISAO
LEGOS
LOCEAN France
NASA/GSFC
NCAR
NCAS, UK
NOAA/ESRL
NOAA/GFDL
NOAA PMEL
NRL
Pacific Northwest
Scripps
Woods Hole

Institutions Collaborating in VOCALS

Logistic Support:
UCAR JOSS

Operational Centers

BMRC Australia
CPTEC Brazil
ECMWF Int.
JMA Japan
MetOffice UK
NCEP US

VOCALS Development Group

C. Roberto Mechoso, Chair SWG
University of California, Los Angeles, USA

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University of Washington, USA

Barry Huebert
University of Hawaii, USA

Carmen Grados, Peru Lead PI
Instituto del Mar del Peru (IMARPE), Peru

Bruce Albrecht, Chair SWG (99-02)
University of Miami, USA

VOCALS-REx Science Team

FUNCTION	PARTICIPANT
Science Director	Rob Wood
C-130 Flight Scientist	Rob Wood, Chris Bretherton
BAe146 Flight Scientist	Hugh Coe, Phil Brown
G1 Flight Scientist	Pete Daum
Dornier Flight Scientist	Geraint Vaughan
Twin Otter Flight Scientist	Bruce Albrecht
Ronald H Brown Lead Scientist	Bob Weller
José Olaya Lead Scientist	Carmen Grados
All other VOCALS PIs	n/a
VOCALS Science Working Group (SWG)	Bruce Albrecht, Chris Bretherton, Hugh Coe, Tony Clarke, Chris Fairall, Jerome Fast, Laura Gallardo, Carmen Grados, Bill Large, C. Roberto Mechoso (Chair), Hualu Pan Yuqing Wang, Bob Weller, Rob Wood (Vice Chair) Paquita Zuidema, José Meitín and Carlos Ereño (ex officio)

Students Fliers and Sailors



**ROB WOOD UW
US LEAD REX-PI**



**BOB WELLER
RON BROWN 1**

75°W, 15.4°S, we have been deploying the 14th radio sonda. Everything is going well so far except a little delay due to some problems with the rosette (CTD sampler). The sea is a little rough. One of us has been disembarked in San Juan because he could not eat (sea sick). The measurements for the San Juan section **Station 14** exhibit very interesting features. We look forwards to seeing the rest of it...

The "Radio sonda" team from the BIC Olaya ship, Julien, Percy and Boris.



10:00 am Briefing during REx, Arica, Chile, 11/08



**HUGH COE UK
UK LEAD PI**



Ron Brown

Usarán robot submarino para pronosticar El Niño

We Can Do It!

'Glider' vigilará el mar peruano

US\$300 mil

PESO 50 kg en aire 200 gr en agua

2 m

IPISCO
El 'glider' permanecerá tres meses entre Cuzco y San Juan, a 100 km de la costa.

RECORRERÁ
Recogerá información repetitiva en un área de 150 km y a 200 m de profundidad.

SE DESPLAZARÁ
Su curso se cambia desplazando su centro de gravedad vía satélite.

USARÁ
Usa una pequeña batería de 2 watts para sus sensores.

COMUNICACIÓN
Tiene capacidad de comunicación en doble sentido vía satélite.

COSTO
Tiene un costo aproximado de US\$300 mil.

SECCIONES
Sección frontal húmeda. Sección de cubierta principal frontal. Batería.

ALCANTAZA
Alcanza una velocidad de entre 20 y 40 cm por segundo en horizontal y entre 10 y 20 cm por segundo en vertical.

ALTA
Alaleta antena.

COMPUTADORA
Computadora.

SECCIONES
Sección frontal húmeda.

**CARMEN GRADOS
PERU LEAD PI**

