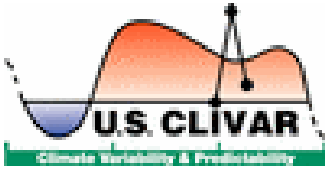
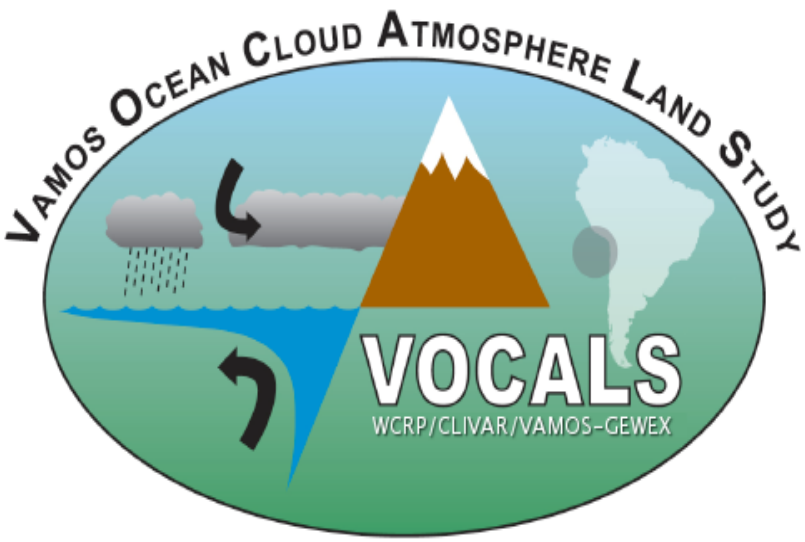
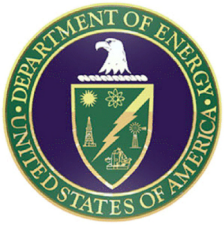


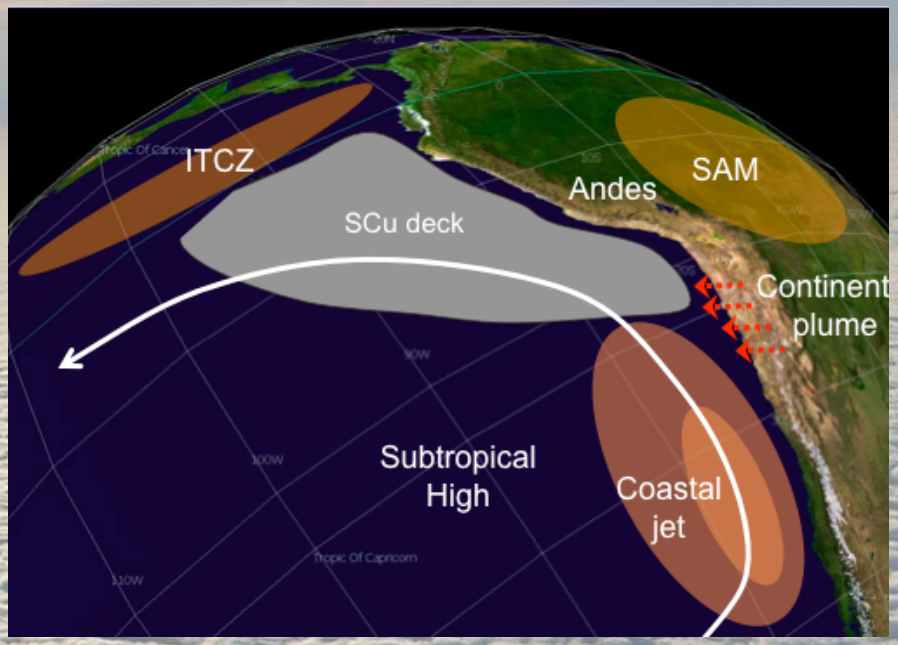


The VAMOS Ocean-Cloud-Atmosphere-Land Studies

C. R. Mechoso, UCLA, VOCALS SWG Chair

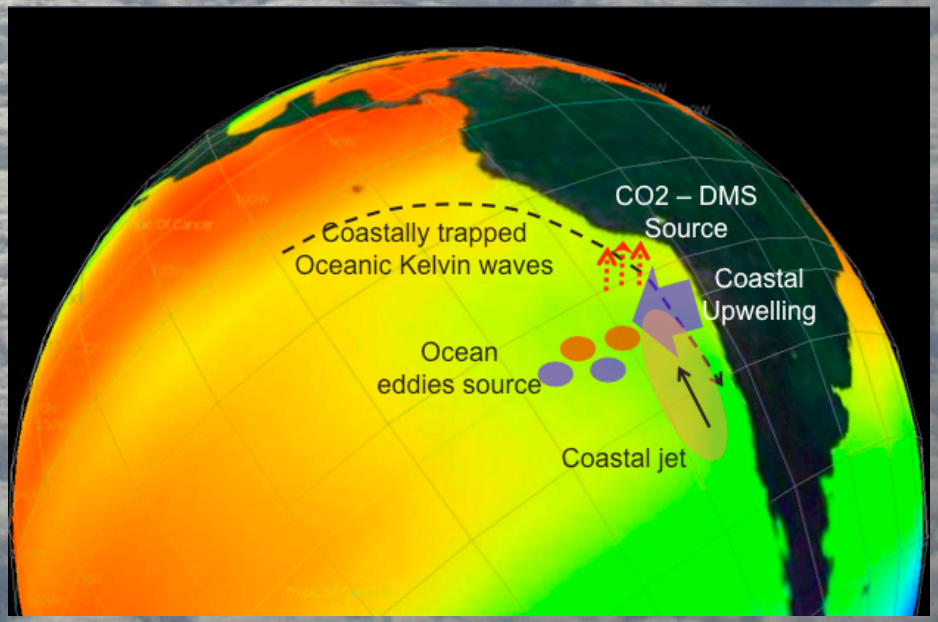


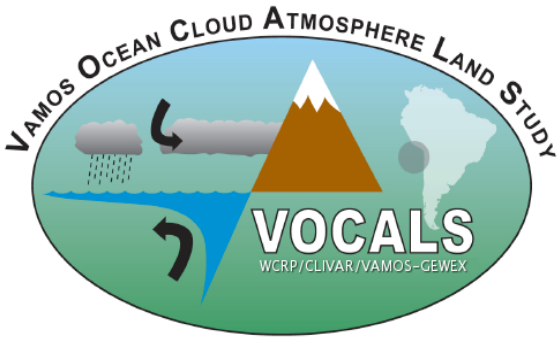
The SEP



- 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

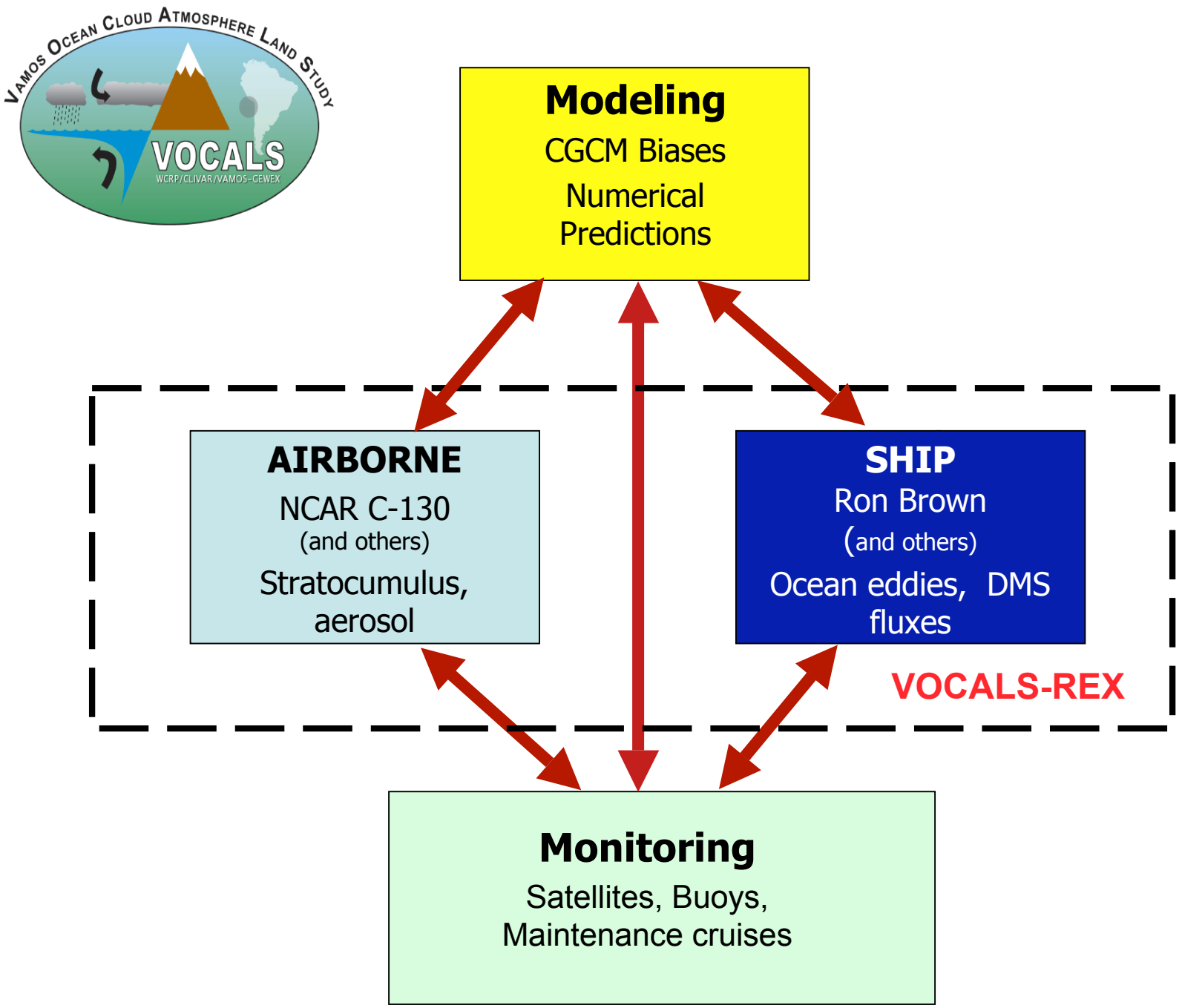




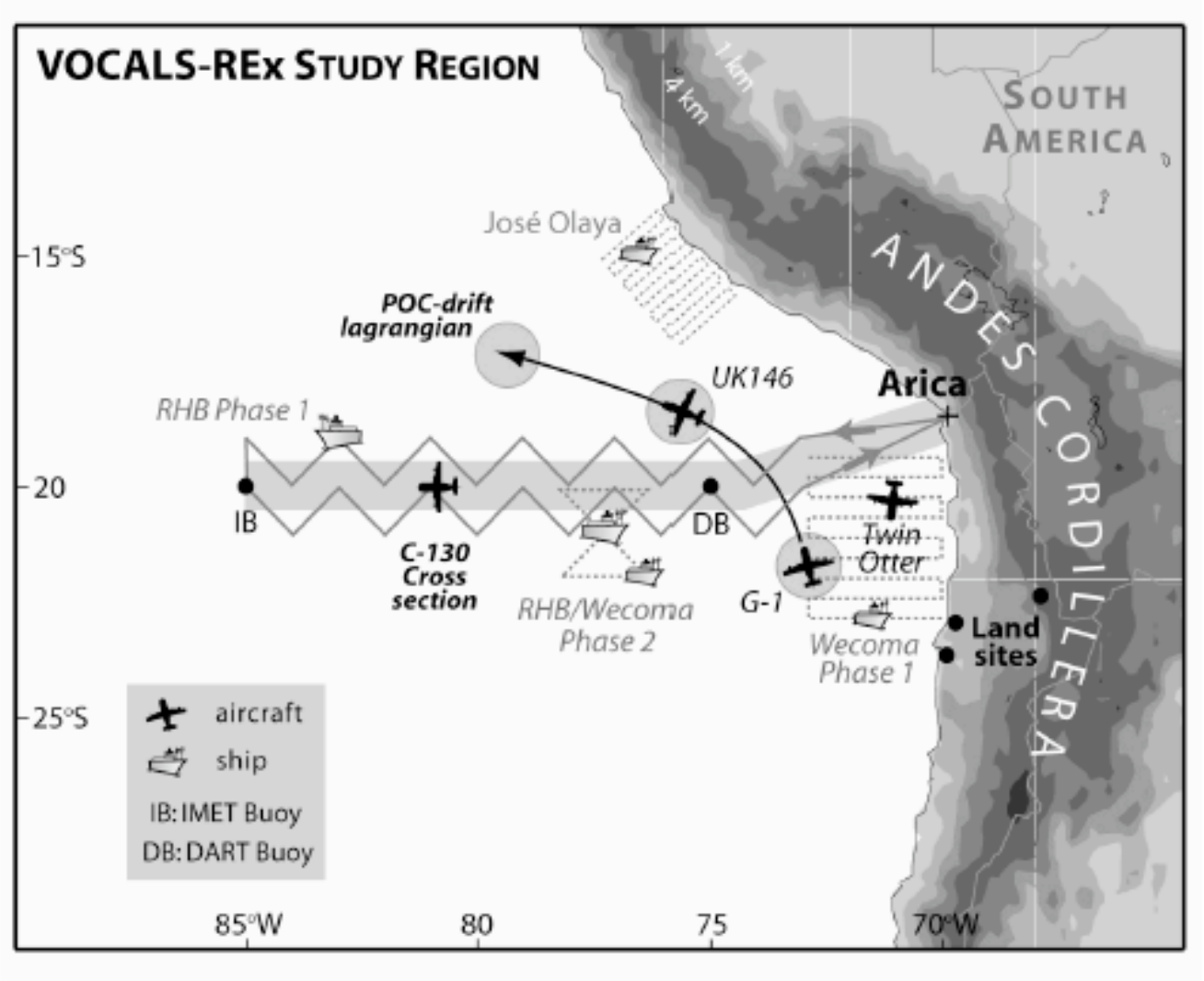
Principal Objectives

- **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.**

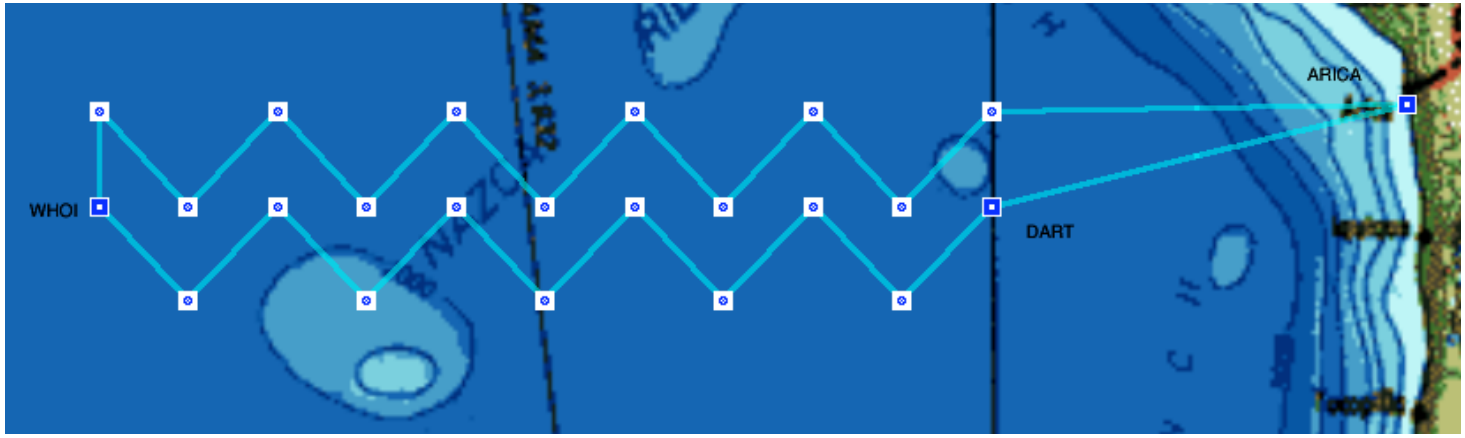
www.eol.ucar.edu/projects/vocals


VAMOS Ocean Cloud Atmosphere Land Study
VOCALS
WCRP/CLIVAR/VAMOS-GEWEX
Modeling
CGCM Biases
Numerical Predictions
AIRBORNE
NCAR C-130
(and others)
Stratocumulus, aerosol
SHIP
Ron Brown
(and others)
Ocean eddies, DMS fluxes
VOCALS-REX
Monitoring
Satellites, Buoys,
Maintenance cruises

VOCALS-REX

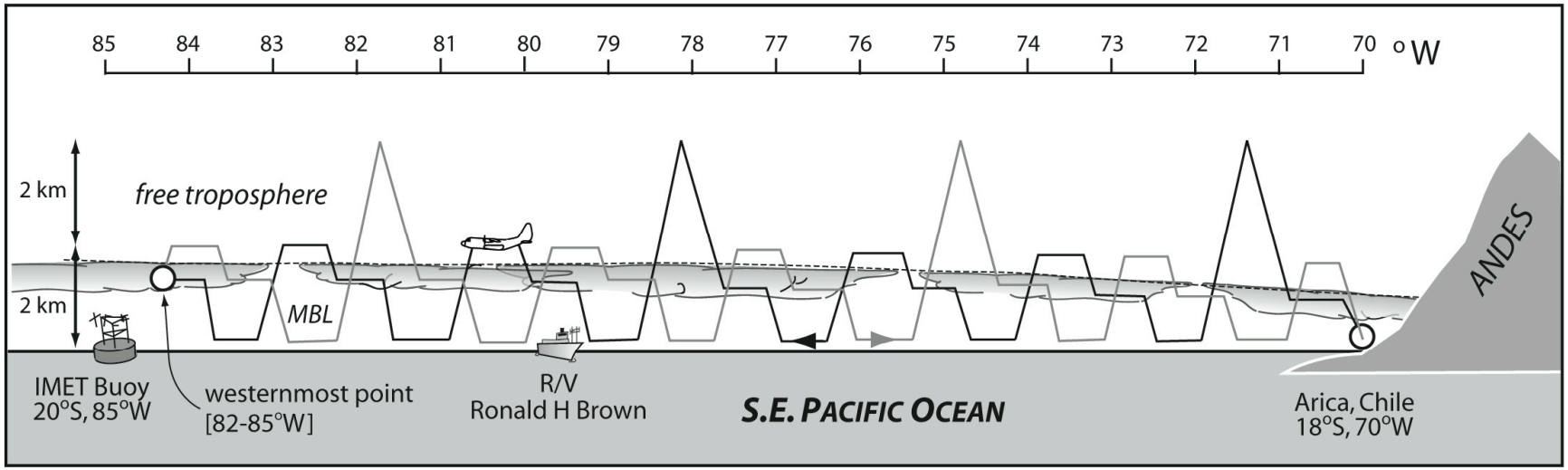

VOCALS-REx Study Region
4 km
1 km
South America
José Olaya
15°S
POC-drift lagrangian
UK146
Arica
RHB Phase 1
20
IB
DB
C-130 Cross section
RHB/Wecoma Phase 2
G-1
Twin Otter
Wecoma Phase 1
Land sites
Andes Cordillera
25°S
aircraft
ship
IB: IMET Buoy
DB: DART Buoy
85°W
80
75
70°W

RV Ron Brown Schedule



- Start of Phase 1: 1 Oct 08 (Arica)
- 8 days steaming west
- 6 days sampling at WHOI Site
- 8 days steaming east
- 6 days sampling at DART Site
- End of Phase 1: 21 Oct 08
- Start of Phase 2: 23 Oct 08
- 6 day min in ocean mesoscale feature identified in Phase 1
- End of Phase 2:15 Nov 08

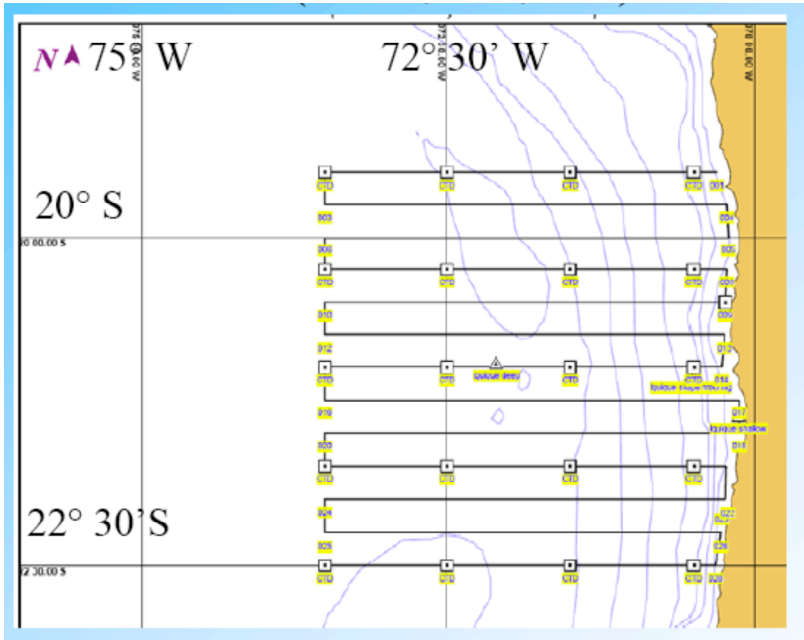
Rex Aircraft Campaign
15 Oct-15 Nov 08



NCAR C-130 Flight Strategies

- **Cross-Sections Missions** along 20S from coast to IMET buoy at 85W, some of which will be coordinated with other ship/aircraft
- **POCS-Drift Missions**, which target mesoscale features

US UNOLVS Vessel

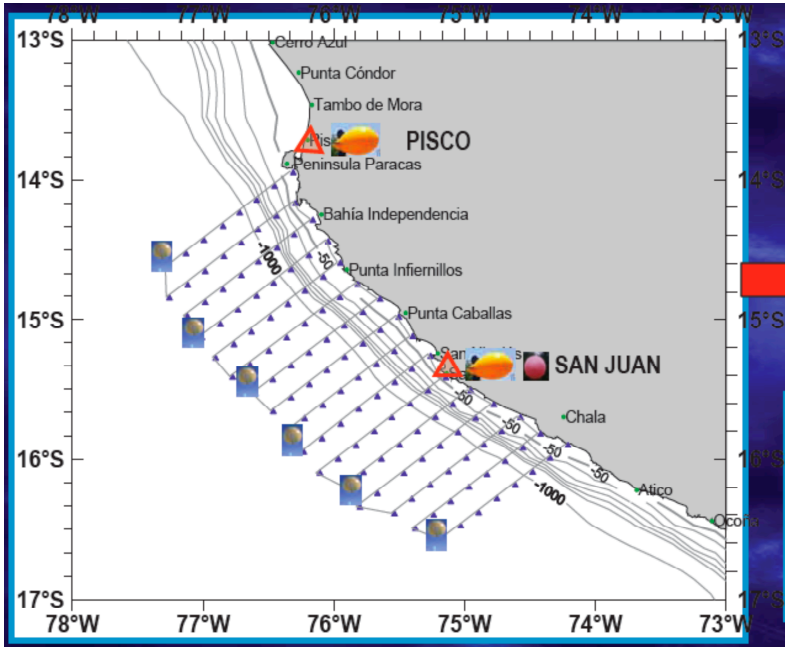


Phase 1:

- SeaSoar with continuous flow through sampling to 200m depth
- Twenty deep CTDs (5 hours each, 4 days)
- Three coastals mooring will be turned around
- Gliders and drifters will be deployed to sample eddies
- Radiosondes and other atmospheric measurements

In Phase 2, this vessel will survey around the Ron Brown the mesoscale ocean feature identified in Phase 1

R/V Jose Olaya, Peru

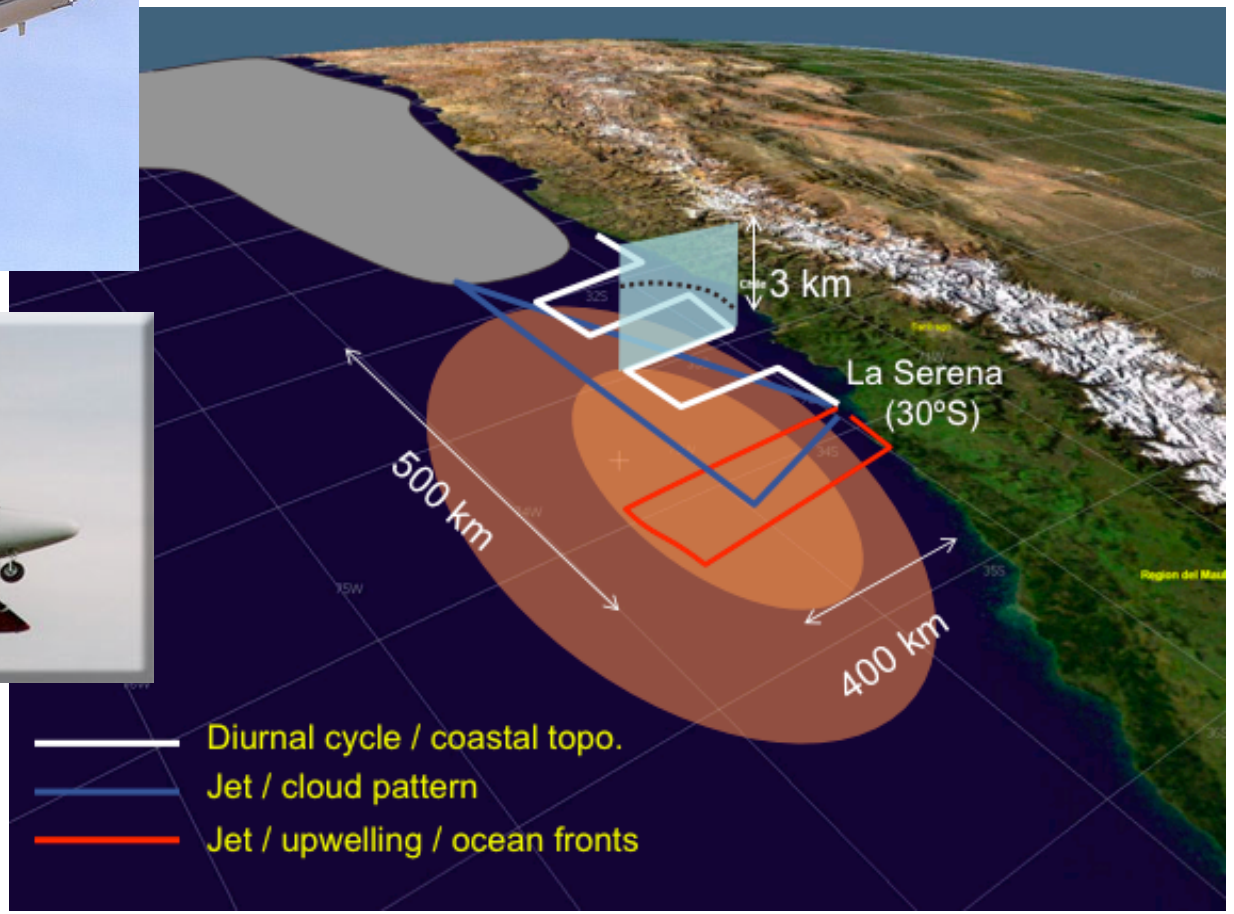


1. Characterize the near-coastal 3D wind structure *(ship-borne radiosoundings)*
2. Assess the relation between the wind and mesoscale ocean processes (upwelling and eddies) *(ship-borne radiosoundings, CTDs/ADCP)*
3. Determine the dynamical and thermodynamical structure associated with the coastal clearing *(ship-borne radiosoundings and land observations)*
4. Document the upwelling plume and the upwelling fronts between Pisco and San Juan
5. Estimate the coupling between the coastal jet and the upwelling front
6. Determine the northward advection of the upwelling plume and the related water masses

Additional sampling of the region using gliders may result from a collaboration between IMARPE in Peru and French investigators (CNRS).

VOCALS Coastal

ONR Twin Otter
DOE G-1



VOCALS Modeling

- Downscaling to the VOCALS-REx region
- Modeling and analysis of stratus buoy maintenance cruises
- Diagnostic studies using observed and simulated datasets.
- Regional and global model development guided by Hypotheses
- Model assessment prior to Rex (Pre-VOCA)
- Development of of a Multi-Scale Seasonal to Interannual Prediction System (MUSSIP)

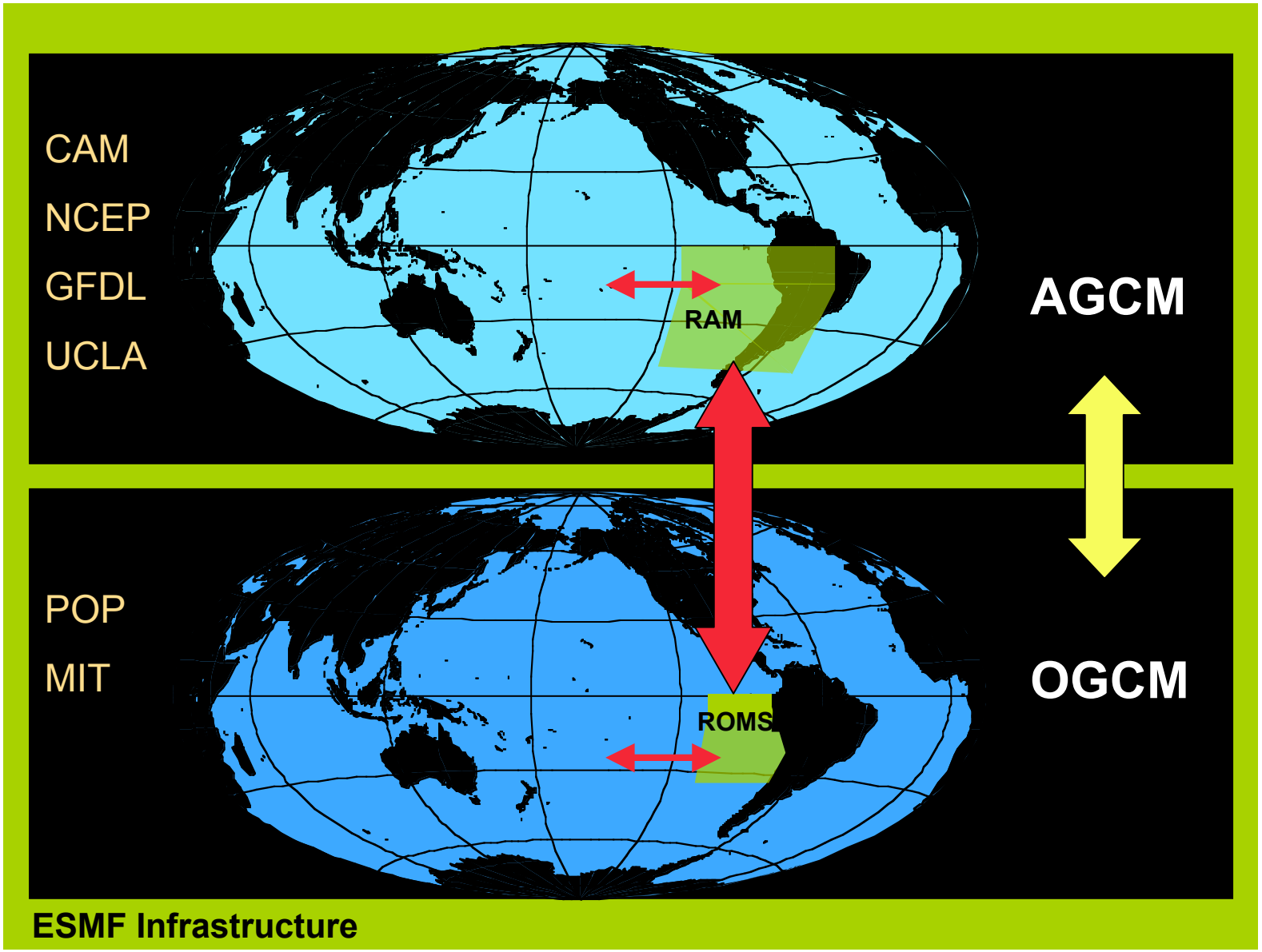
The VOCALS modeling vision is based on the concept of a multiscale hierarchy of models.

AGCM: Atmosphere General Circulation Model

RAM: Regional Atmospheric Model

OGCM: Ocean General Circulation Model

ROM: Regional Ocean Model



VOCALS AEROSOL-CLOUD-PRECIPITATION HYPOTHESES

	Hypothesis	Obs.	Models	PI Teams [primarily modeling/obs/both]	IDs [deliverable integrated datasets]
1 A	Variability in the physicochemical properties of aerosols has a measurable impact upon the formation of drizzle in stratocumulus clouds over the SEP.	C-130, RHB, Twin Otter, G-1, BAe-146	LES WRF-Chem GCMs	Howell/Huebert/Clarke Bandy/Blomquist Wood/Bretherton Covert/Bates/Quinn Albrecht Feingold Daum Cotton/Carrió Ovchinnikov/PNNL Jensen Anderson/Twohy Lawson/Baker	Combined dataset with collocated measurements of cloud thickness, LWP, aerosol and cloud microphysical properties, and precipitation rate
1 B	Precipitation is a necessary condition for the formation and maintenance of pockets of open cells (POCs) within stratocumulus clouds.	C-130, RHB, G-1	LES COAMPS	Wood/Bretherton Fairall/Yuter/deSzoeke Leon/Snider Feingold Albrecht Daum Wang/NRL Jensen Lawson/Baker	GCSS BLCWG Cases documenting POC formation/maintenance Satellite-derived mesoscale classification (POC, closed cells….) across VOCALS study region
1 C	The small effective radii measured from space over the SEP are primarily controlled by anthropogenic … aerosol production, and entrainment of polluted air . . . is an important CCN source.	C-130, RHB, G-1, Twin Otter, BAe-146 Land site	WRF Chem CTMs GCMs	Huebert/Clarke Covert/Bates/Quinn Gallardo/Cordova Zuidema Wood/Thorton/Zaveri Twohy/Collett/Anderson Donner/Golaz Fast/PNNL	6 Cross-Section Flights documenting MBL, lower free-tropospheric, cloud and aerosol structure, along 20°S at same local time of day
1 D	Depletion of aerosols by coalescence scavenging is necessary for the maintenance of POCs.	C-130	Parcel Model GCMs LES GCMs	Leon/Snider Feingold Jensen Lawson/Baker	Lagrangian multi-flight case studies of aerosol evolution in polluted and clean conditions

VOCALS COUPLED OCEAN-ATMOSPHERE-LAND HYPOTHESES

	Hypothesis	Obs.	Models	PI Teams [primarily modeling/obs/both]	IDs [deliverable integrated datasets]
2A	Oceanic mesoscale eddies play a major role in the transport of heat and fresh water from coastally upwelled water to regions further offshore.	RHB, R/V Wecoma, R/V Olaya, C-130	ROMS CGCMs	Weller/Straneo Grados Paulson/Letelier/Dever/Pizarro Miller Garreaud Strub/Chelton McWilliams/Hall/Large Mechoso/Pan	To be defined
2B	Upwelling…has a systematic and noticeable effect on aerosol precursor gases and the aerosol size distribution in the MBL over the SEP.	C-130 RHB	WRF-Chem GCMs	Huebert/Matrai Blomquist/Huebert Covert/Bates/Quinn Strutton/Hales Fast/PNNL	To be defined
2C	The diurnal subsidence wave …has an impact upon the diurnal cycle of clouds and provides a . . . framework for analysis of numerical model performance . . .	RHB R/V Wecoma R/V Olaya Twin Otter Land site Quikscat	MM5/WRF GCMs	Garreaud/Rutllant Bretherton/Wood Takahashi/Silva Wang/NRL	Diurnal composite lower tropospheric and MBL structure at 5 distances (100-1500 km) from the Andes
2D	The entrainment . . . associated with . . . near-inertial oscillations generated by transients in … the trades is an important process to maintain heat and salt balance . . .	RHB R/V Wecoma	Parcel Model LES	Gregg Weller/Straneo Ward McWilliams/Hall/ Gruber/Large	To be defined
2E	Poor representation of stratocumulus …near coastal winds, and of mesoscale circulations in the ocean provide a major contribution to systematic coupled GCM model errors in the SEP.	C-130 Cross Sections RHB vertical structure Chilean land site IMET buoy long term data	CGCMs	Mechoso/Pan Kohler Garreaud Wang/Xie/deSzoeke Bretherton Donner/Golaz S. Wang Fast/PNNL	VOCALS Assessments (PreVOCA and VOCA) Model improvement for alleviation of systematic errors.

Pre-VOCALS atmospheric model forecast/analysis assessment (PreVOCA)

GOAL: To critically assess the ability of global/ regional models (atmospheric, chemical transport…) to simulate salient synoptically-varying characteristics of the VOCALS region

WHY? Learn about model biases, current ability of CTMs to forecast for REx etc. A means for leveraging REx data. More tightly controlled sequel after REx.

WHAT? Oct. 2006?, 4xdaily VOCALS-region outputs

WHEN? Submissions to Rob/Chris by October 07?

NOT: An intercomparison. Participants may use their favorite forecast/analysis approach as a first cut.

What to compare

[**bold = potential satellite validation**]

3D Fields:

meteorology (T,q, u, v, w)

clouds (LWC, fraction, microphysics, radiative $\mathbf{r_{eff}}$)

and/or (for chemical transport models)

emissions/concentration of major aerosol species and precursors [how to compare with obs?]

2D fields:

T_{sfc}, z_{sfc}, land fraction, SLP

LWP, low-cld fraction, precip, **low-cld-top z**, $\mathbf{r_{eff}}$ **& T**.

10m vector wind, 2m T, q

LHF, SHF, **TOA**/sfc **radiative fluxes**.

Surface flux/met at stratus buoy location

Satellite data sources

GOES (diurnal cloud-top T)

MODIS (clouds, microphysics)

Quikscat (surface winds)

AMSR (WVP, cloud LWP)

CloudSat/CALIPSO (drizzle, MBL depth, aerosol scattering…)

TRMM (TMI SST)

WHOI stratus buoy also provides surface flux/met obs.

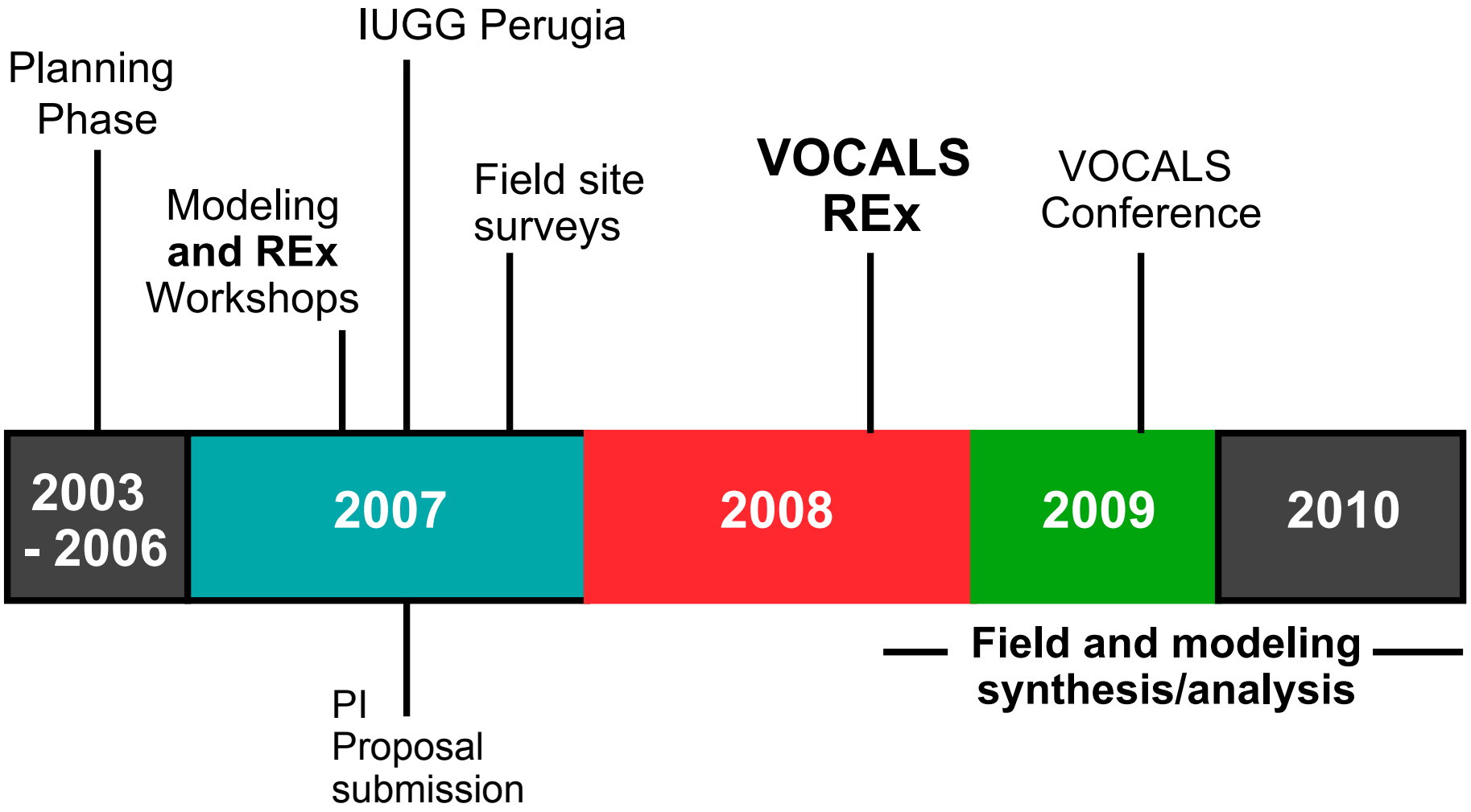
Who?

- NCAR CAM (Rasch/Bretherton)
- NASA GMAO (Bacmeister)
- GFDL (Ramaswamy)
- ECMWF (Koehler)
- NCEP GFS (Pan, Mechoso)
- iROAM (Y. Wang)
- U. Chile WRF (Garreaud)
- COAMPS (S. Wang)
- MMF (Khairoutdinov)
- Others?

Timeframe

- Previous experience tells us that a two-stage process works (first stage acts as a trial period to refine the process, fields, etc.)
- First stage prior to REx, second stage after REx

VOCALS Timeline



VOCALS Calendar

Since US CLIVAR Summit, 26-28 July 2006

- **Proposal submitted to NSF/NOAA** (R. Wood PI; C. Bretherton, B. Huebert, C. R. Mechoso, R. Weller): **1 Sep 06**
- **NSF/NOAA decide that "VOCALS is GO": 6 Dec 06**
- **VOCALS Workshop at VAMOS Panel Meeting (VPM10), Santiago, Chile: 3-4 April 07**
- **First Modeling Workshop: 18-29 May 07**
- **First Rex Preparatory Workshop: 11-12 June 07**
- **NCAR EOL Facility Request: 1 Jul 07**
- **NSF deadline for VOCALS proposals: 15 Jul 07**
- **VOCALS UK Consortium Planning Meeting, Reading, England: 27 Jul 07**
- **NOAA deadline for VOCALS proposals. LOIs due 20 Jul 07; Full proposals due 21 Sep 07**
- **Joint NSF/NOAA Panel on VOCALS 15-16 Oct 07**
- **NSF/NOAA funding decisions expected early 08**
- **Joint Modeling/REX Preparatory Workshop: Feb 08 (tentative)**

VOCALS Calendar - Continued

Since US CLIVAR Summit, 26-28 July 2006

- **Ron Brown departs from Charleston, SC, USA: 20 Sept 08**
- **Rex Operations Center established in Arica, Chile: 20 Sept 08**
- **REx Ship Phase 1: 1 Oct - 21 Oct 08**
- **Rex Aircraft Campaign: 15 Oct - 15 Nov 08**
- **REx Ship Phase 2: 23 Oct - 15 Nov 08**
- **R/V Jose Olaya (Peru) coastal cruise: 25 Oct - Nov 7**