First VOCALS Modeling Workshop (VMW1)
Boulder, May 18-20, 2007

PERU VOCALS COASTAL COMPONENT: MODELING COMPONENT

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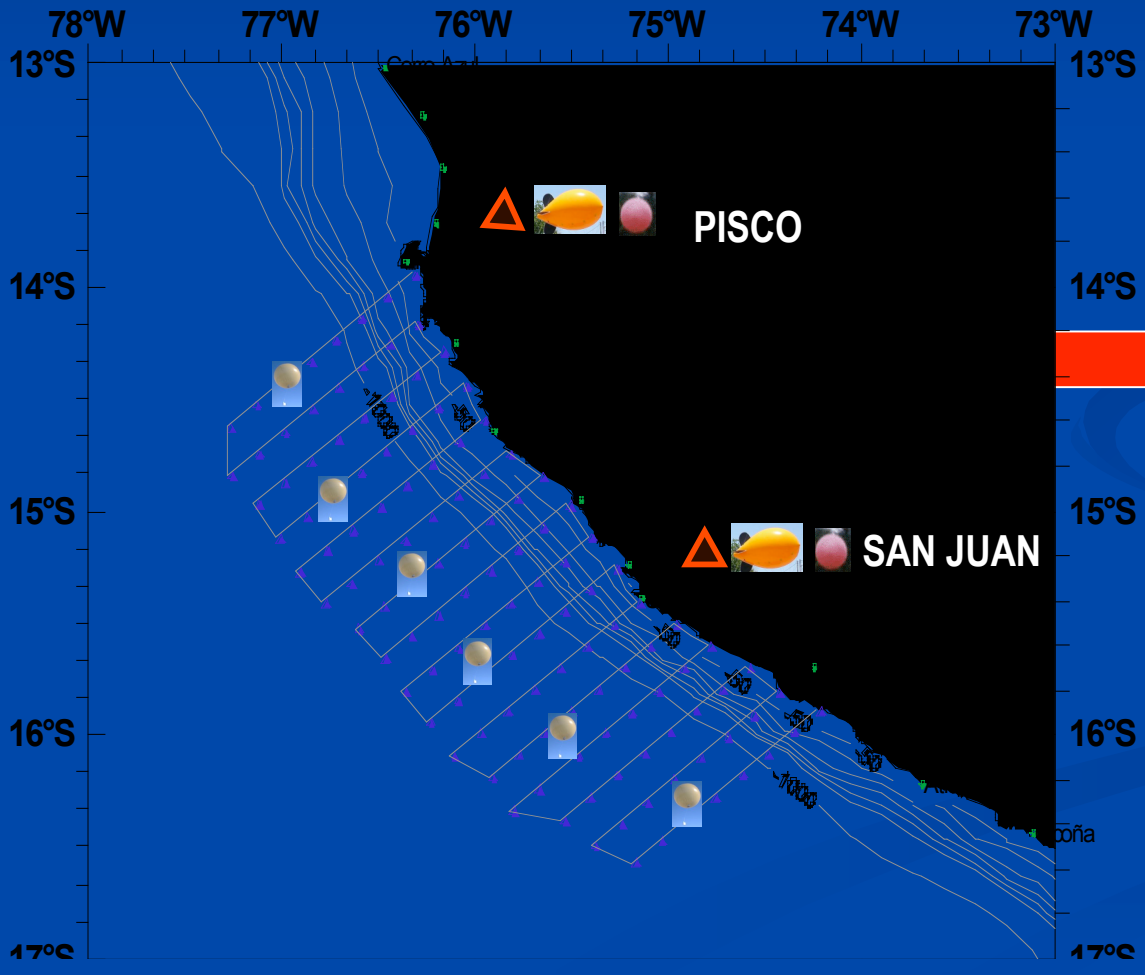
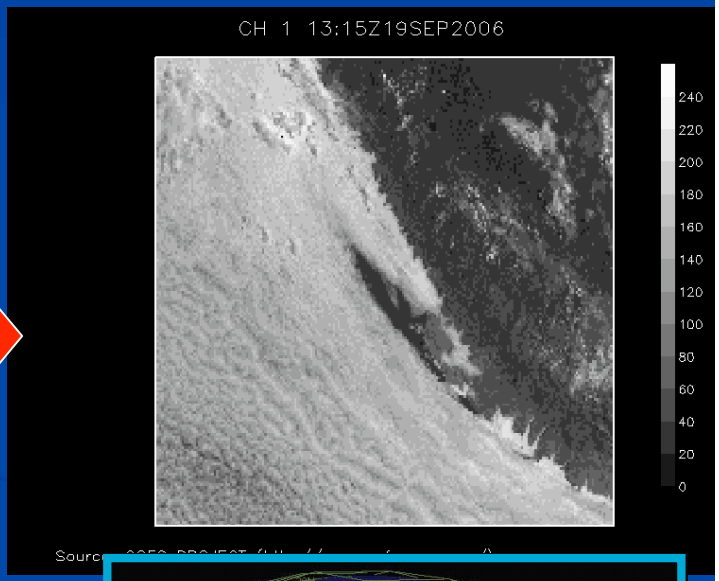
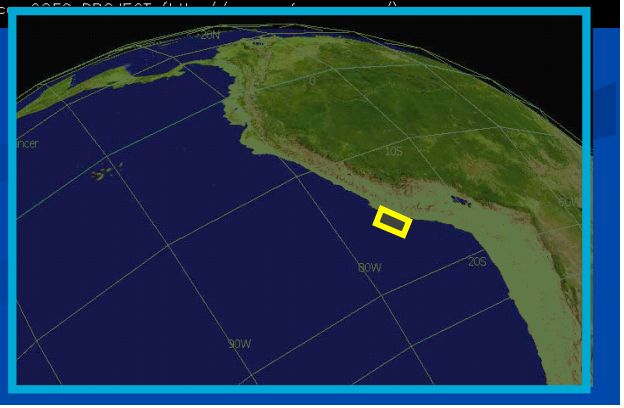
PERU VOCALS Cruise Track

NOVEMBER, 2008

- Quasi permanent coastal clearing,
- Strongest coastal winds.
- Strongest coastal upwelling Strong oceanic eddy activity







Atmospheric observations

Field experiment: November 2008

Cruise observations:

Radiosoundings every 10Km is ideal or minimum 6 x transect (4 near the coast & 2 off shore)

Automatic met. Station

Land observations

Air temp. & humidity by tethered balloons up to 2km height, every 3 hours

Wind profile with pilot balloons, every 3 hours

SFC temp, hum & wind from DCP

SCIENTIFIC MAIN MOTIVATIONS

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

Motivations and contribution to Vocals modelling objectives

• Study the impact of high-resolution coastal winds on the upwelling intensity, structure, and variability

• Estimate how good the model replicate the coastal wind system and its relationship to coastal upwelling, coastal clearings, SST's, including coastal topography.

•Study the connection of the equatorial variability with the eddy activity and the triggering of the extra-tropical Rossby waves

•Related impact on the biogeochemical component (ROMS/PISCES)

• Document and quantify the transport of heat, salt and nutrients offshore of the upwelling area by eddies, filaments and mean currents

• Estimate the impact of air-sea coupled processes in sub-regions of the SEP, using WRF and ROMS in a coupled mode

•Perform high resolution numerical simulations of the low-level near-coastal flow off Peru using MM5 regional atmospheric model.

•Validate model simulations using satellite data, such as scatterometer winds for the offshore region, and cloudiness from GOES imagery.

•Validate model simulations using available upper air data from ship-borne radiosoundings and from a tethered balloon soundings done in Pisco and San Juan as well as using available surface meteorological data.

Modelling tasks:

- General Methodology: the downscaling of oceanic and atmospheric reanalysis (SODA, ERA40, Mercator-Vert, NCAR/NCEP, AVN) using ROMS and WRF with a bio-geochemical model (PISCES, Aumont et al. (2003)) embedded in it and MM5.

- Zone:

  Peru Coastal Jet – ROMS (1/27°), WRF (>1/6°)
  MM5 (6x6 km)

- Initial conditions:

  for MM5: NCAR/NCEP reanalysis/ AVN

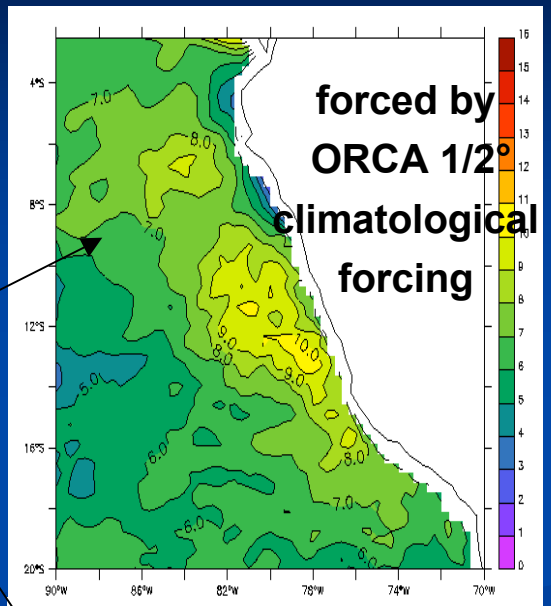
- Boundary conditions:

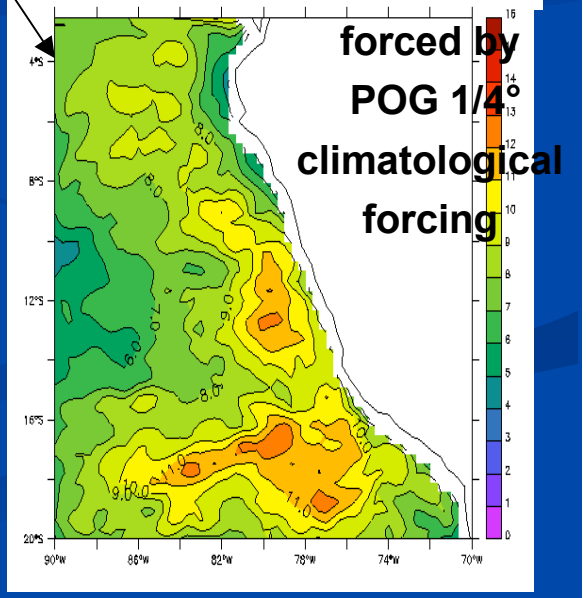
  Control Run (ROMS – 1/6°)
  AVN –1º

- Tools: ROMS_AGRIF, OASIS (coupler)

Influence of OGCM forcing at ROMS open boundaries:

Eddy Kinetic Energy
(squared, in cm/s)
in ROMS (1/9°)

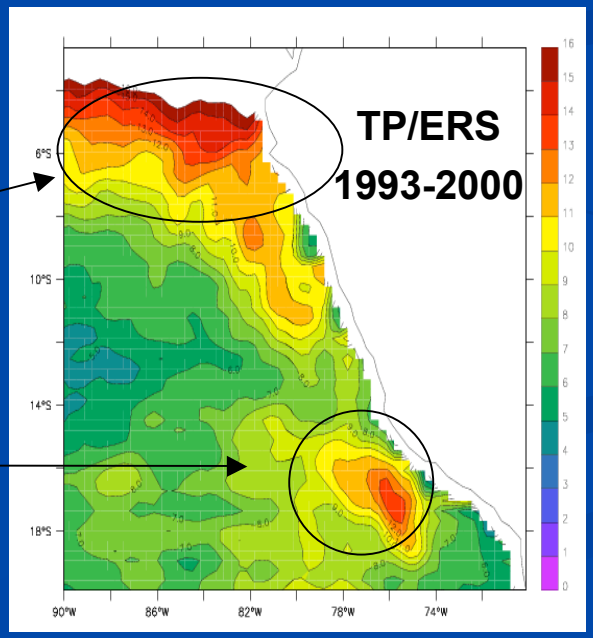




- average level of EKE is OK in ROMS (1/9°)

- Intraseasonal equatorial waves needed in the OBC forcing

- better wind forcing near Pisco is needed



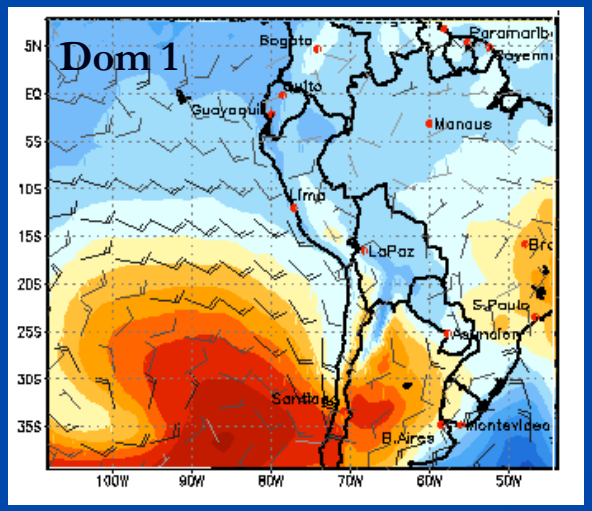
MM5 CONFIGURATION

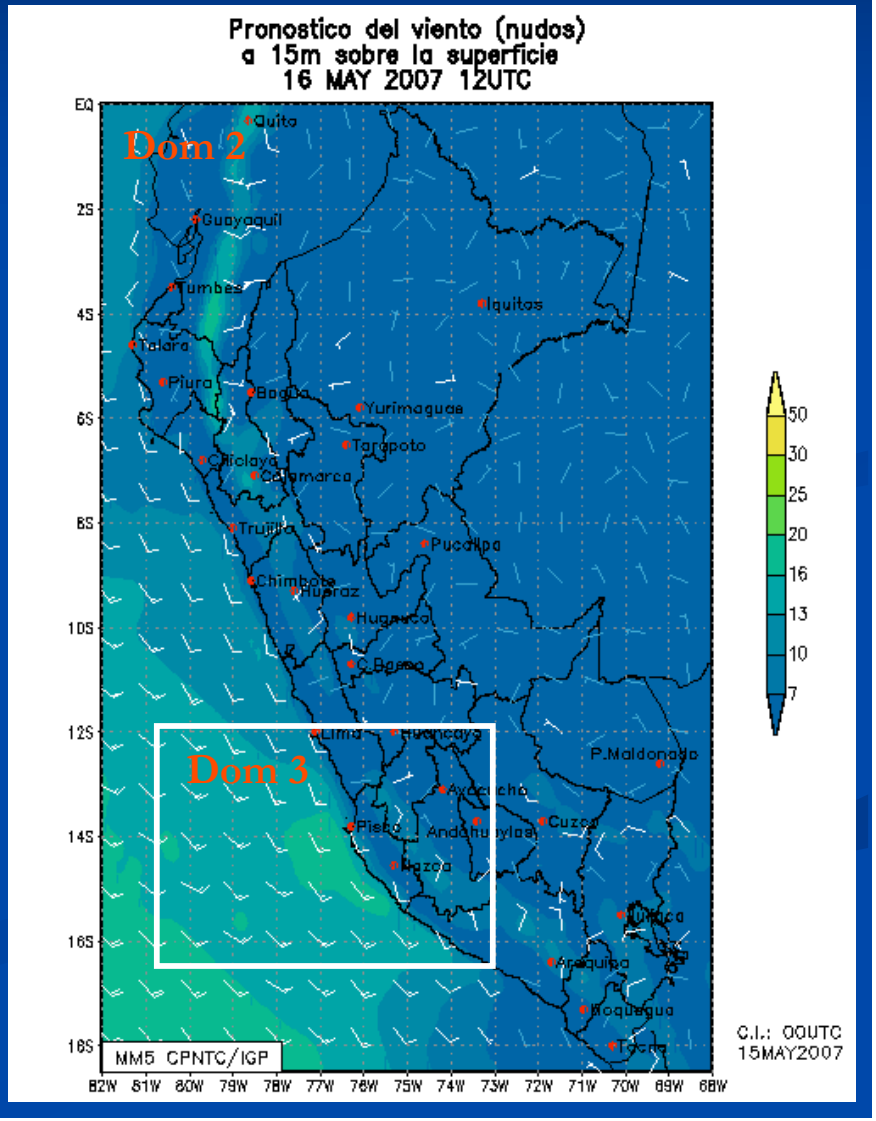
Physics

Cumulus: Grell
Shallow convection: NO
Explicit moisture: Simple ice
PBL: Gayno-Seaman

Domain and resolution:

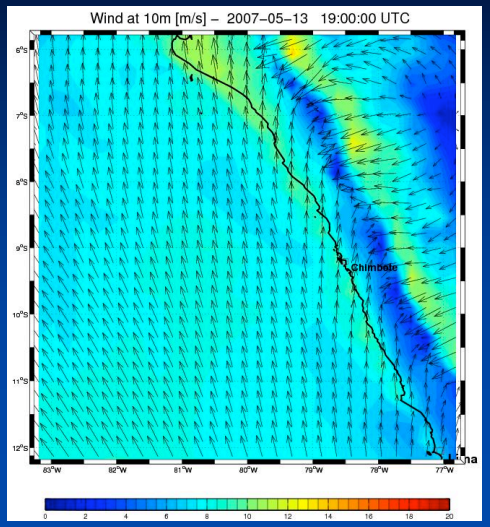
1 domain: South America (110-45ºE/40ºS-10ºN)
54x54km
2 domain: Peru (20ºS-0º)
18x18km
3 domain: Pisco-San Juan (16.5-12ºS/80-73ºW)
6x6km

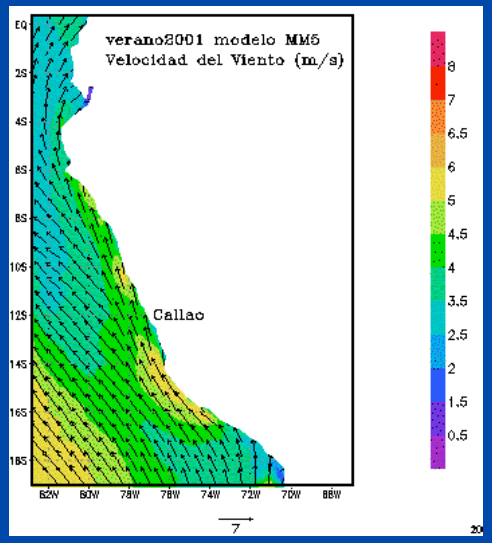




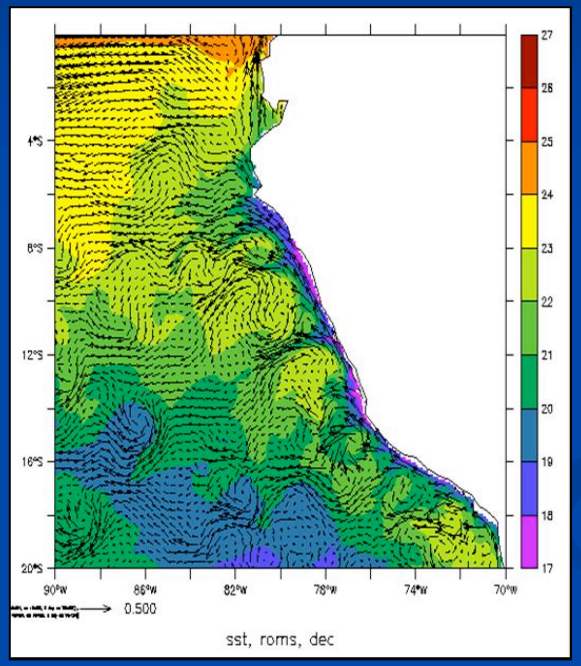
On-going modeling activity:

MM5 – WRF (1/6°)

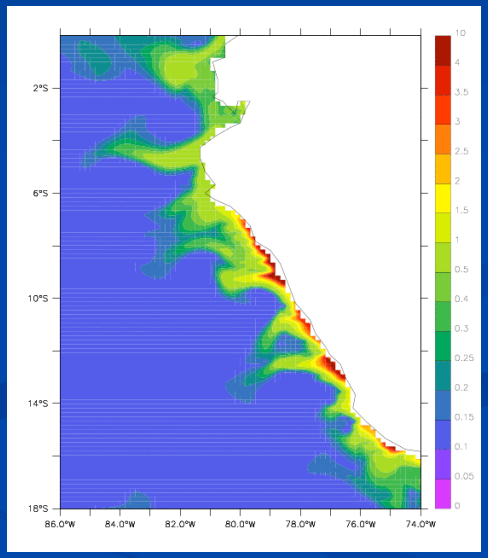




ROMS (1/9°) – Config.
Penven et al. (2005)

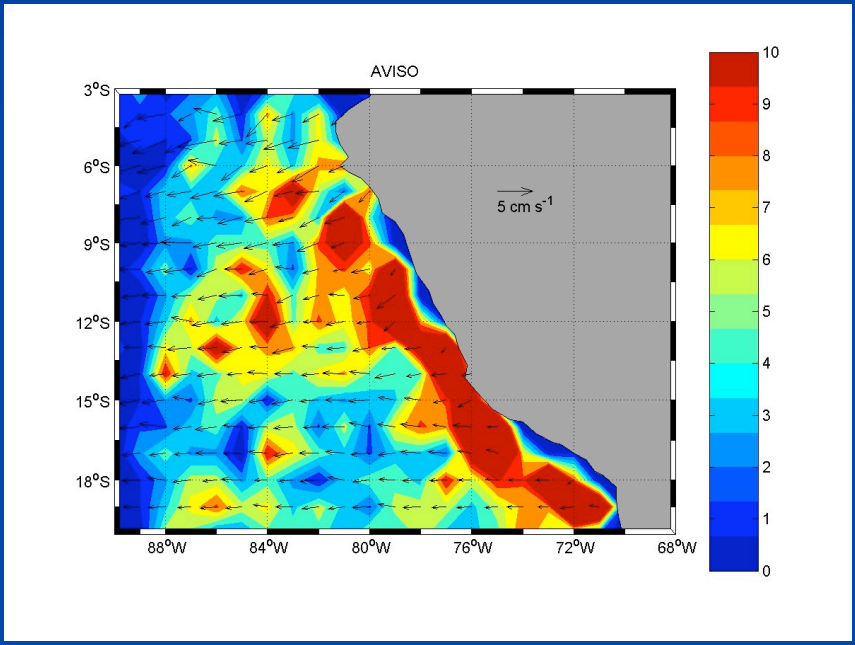


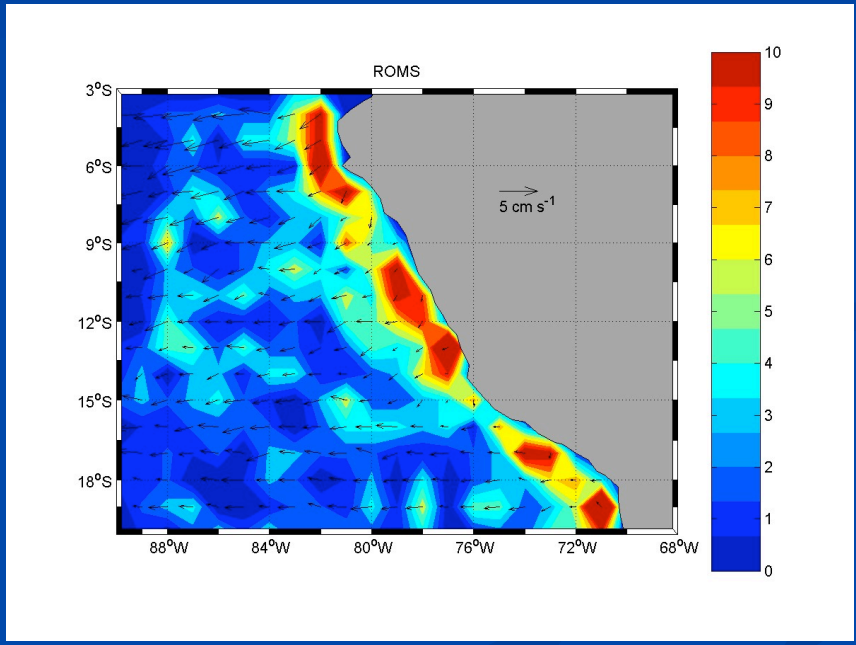
ROMS/PISCES (1/6°)



Under developpement: WRF (1/9°) – ROMS (1/27° - Chimbote and Pisco) – ROMS/PISCES (1/27°)

Mean Eddy genesis in altimetry and ROMS(1/9°)

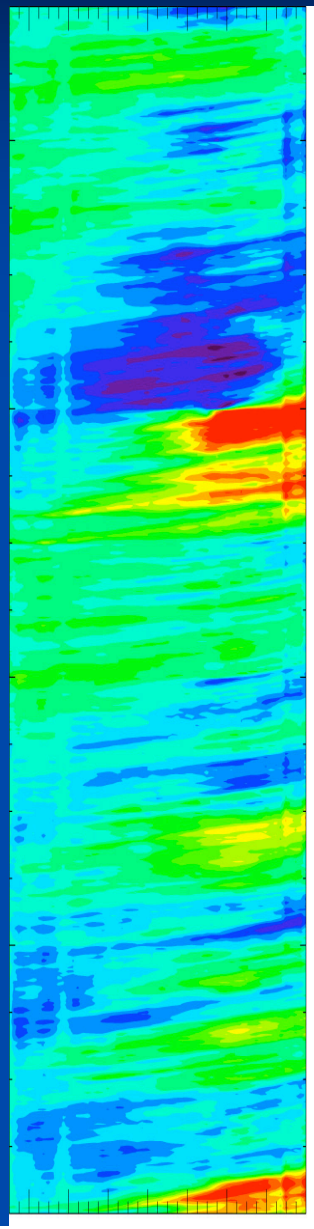


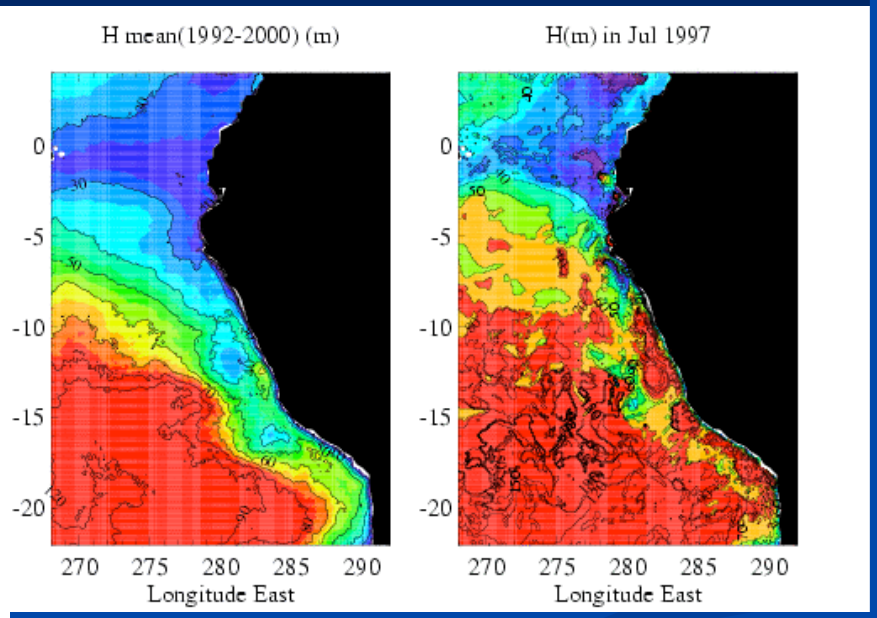


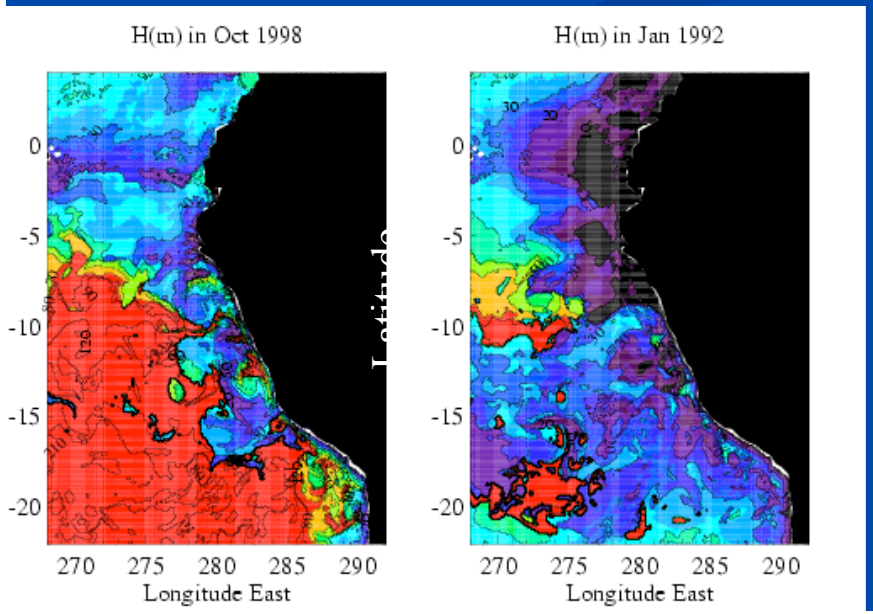
A. Chaigneau, pers. com.

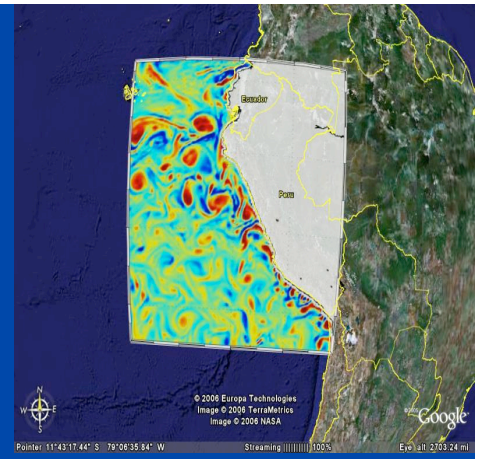
ROMS 1/9° : Forcing: ERS winds, CIMAP fluxes
Boundary forcing: ORCA 0.2°

Equatorial Kelvin wave (1992-2001)









Thermocline depth as simulated by ROMS(1/9°) 1992-2000

ANR-PCCC « Peru Chile Climate Change » (2006-2009)

Core group: Boris Dewitte, Ali Belmadani (LEGOS), Vincent Echevin, Alexis Chaigneau (LOCEAN), Abdel Siffedine (Paleotropique), Oscar Pizarro, Aldo Montecinos (UdeC), Carmen Grados, Dimitri Gutierrez (IMARPE)

Main question: 'How climagechange as simulated by the state-of-the-art Coupled General Circulation Models (CGCMs) is likely to impact the Peru-Chile upwelling system?'.

From a downscaling strategy of oceanic models (ROMS and WRF), we expect to understand the mechanisms that control the low frequency variability of mesoscale activity along the Peru-Chile coast and its connection with the equatorial variability.

Post-doc opportunity: atmospheric downscalling (from June 2007)