Ocean Vector Wind Science Team

Meeting, July 2006

Orographical-induced air-sea interaction: observations and numerical modeling

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Acknowledging

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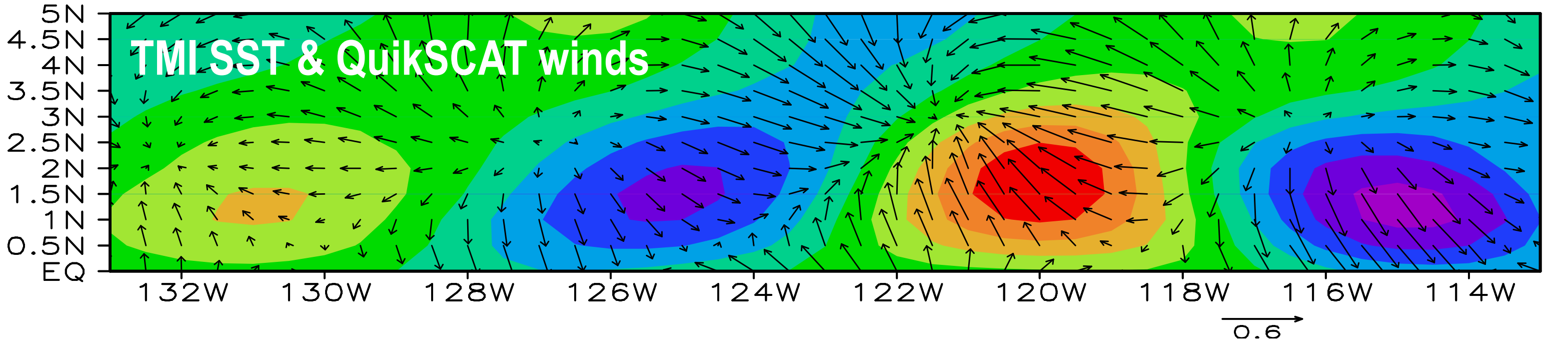
Example results from prior OVWST support

Ocean front-atmosphere interaction

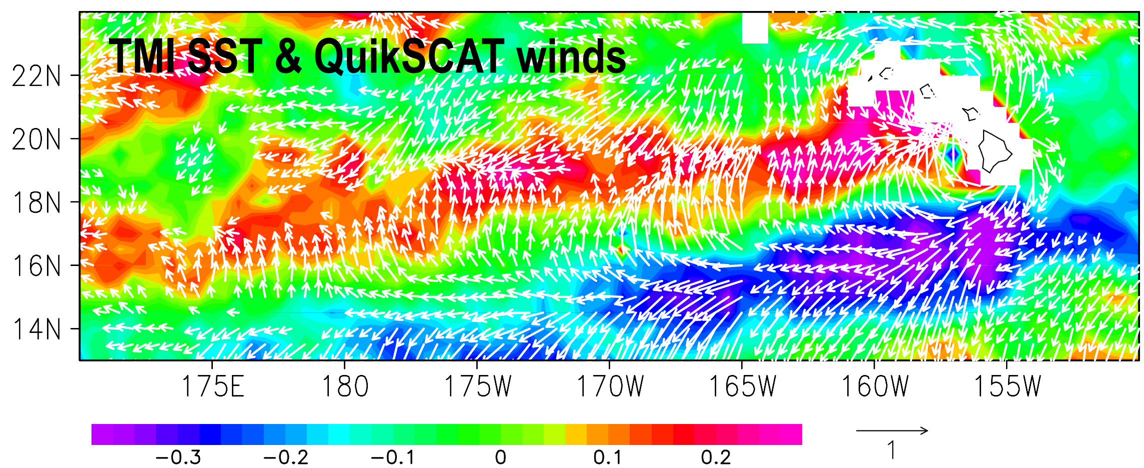
Hashizume et al (2001, JC), Xie (2004, BAMS) ;
Small et al. (2003, JC; 2005, JAS, JGR)



Poster

Orographic-induced ocean-atmosphere interaction

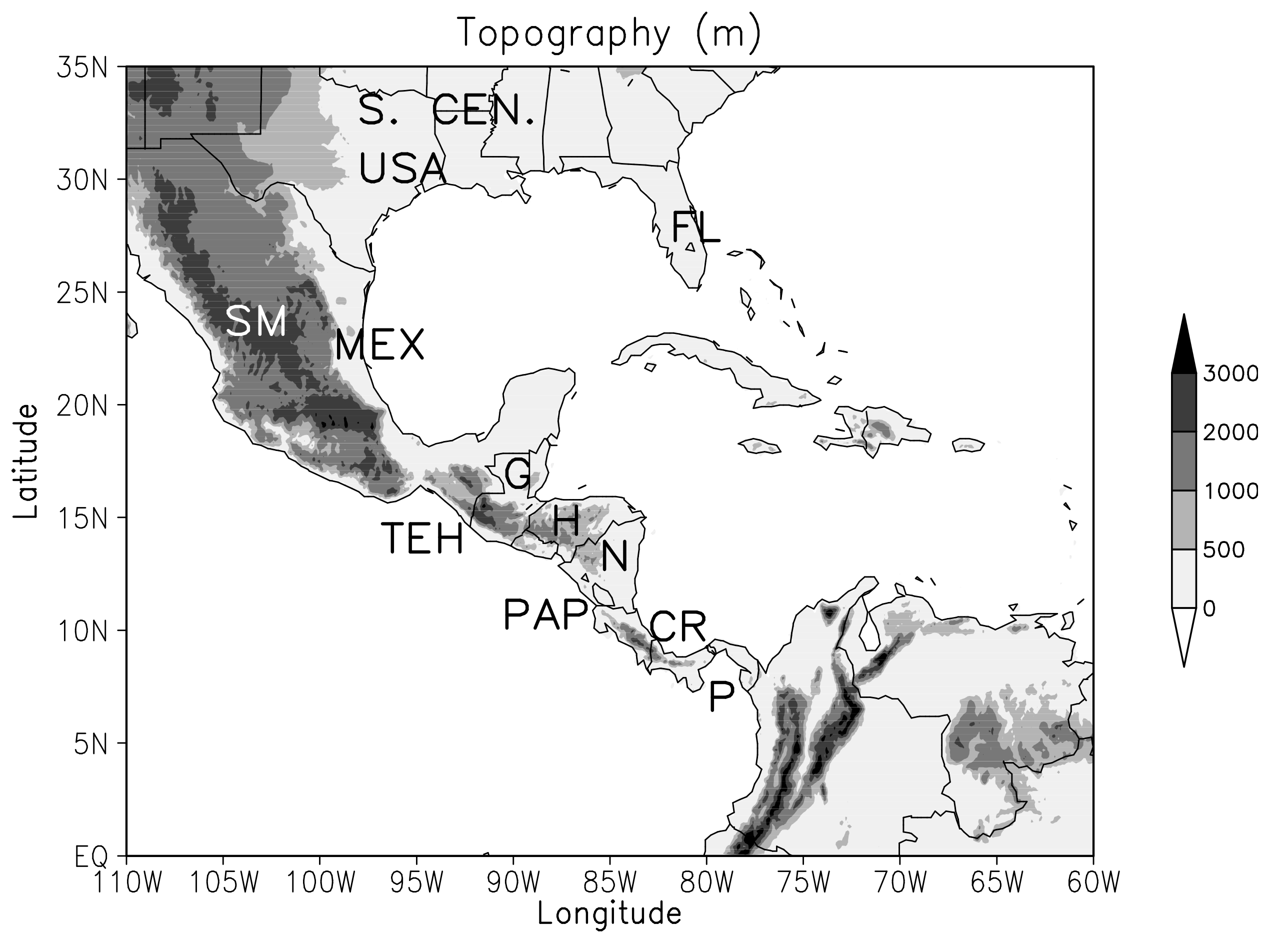
Long wake of Hawaii (Xie et al. 2001, Science)



This presentation

- 1. Preliminary studies of gap wind and ocean eddy variability.
- 2. Some interesting aspects of winds off the Big Island of Hawaii.

Preliminary studies of gap wind and ocean eddy variability: Eastern Pacific.



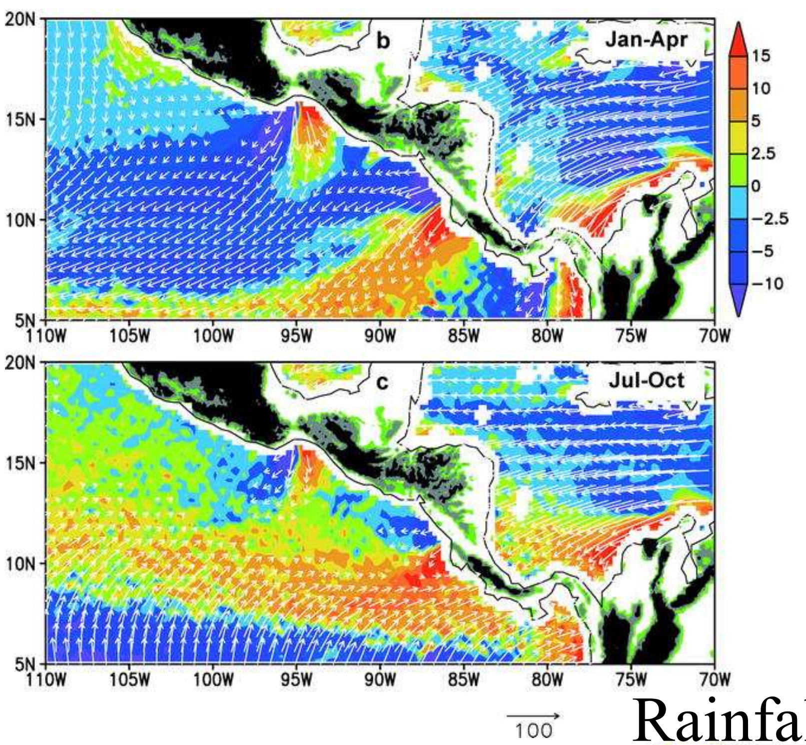
TEH-Tehuantepec

PAP-Papagayo

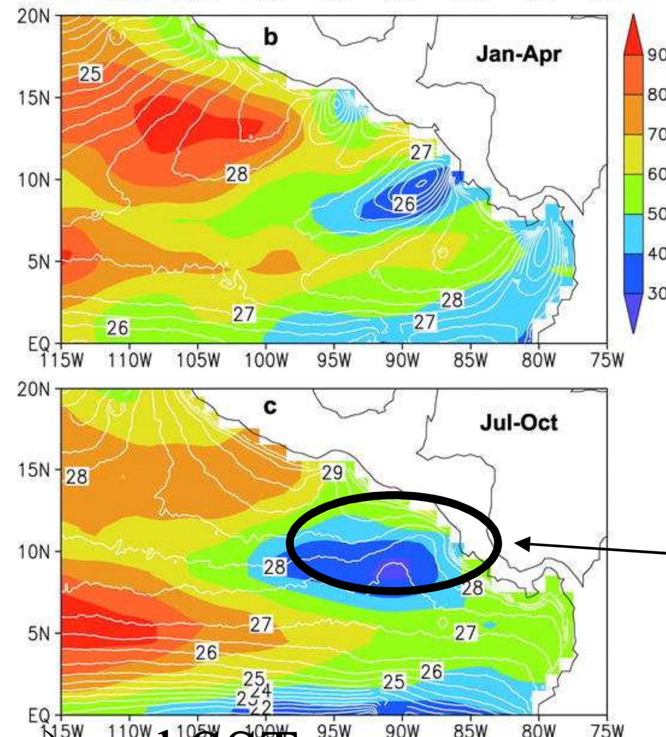
P-Panama

Gap Wind Jets and Costa Rica Dome

Ekman pumping (color) and pseudo-stress vectors

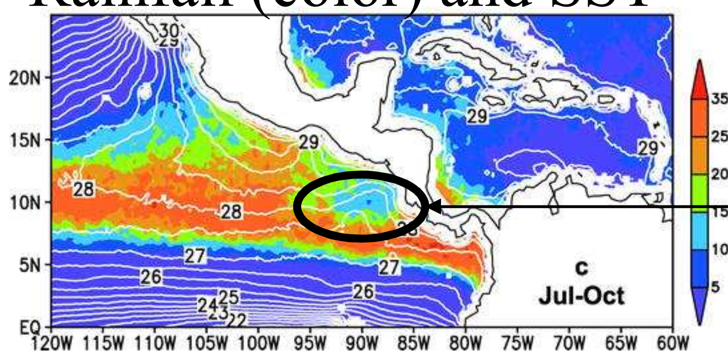


Thermocline depth (color) and SST



Costa Rica Dome

Rainfall (color) and SST

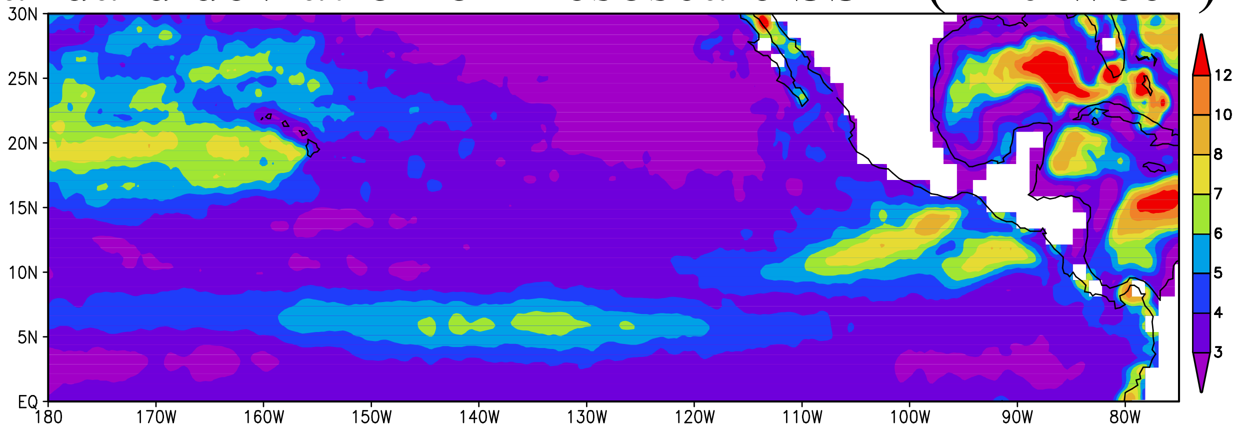


Rainfall ‘hole’ and SST minimum

(Xie et al 2005, J. Clim, 18, 5-)

Gap Wind Jets and Ocean Variability

Standard deviation of mesoscale SSH (<40 week)



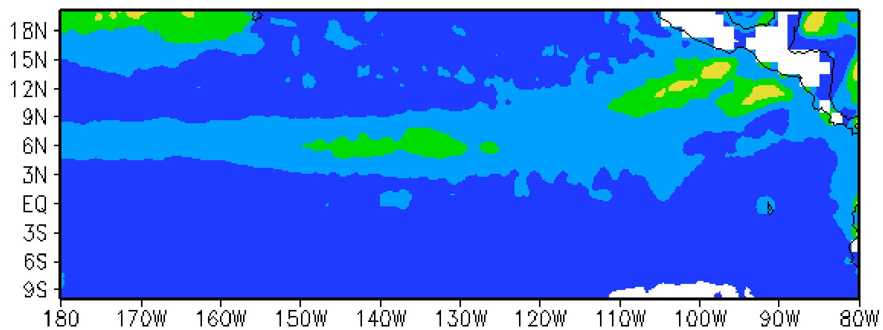
What are the dynamics of the ocean eddies?

1. gap-wind-forced(Giese 1994) 2. shear of NEC/NECC (Perigaud 1990) 3. NECC retroflection 4. radiation of Rossby waves

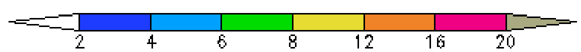
High Resolution Ocean Model Simulations

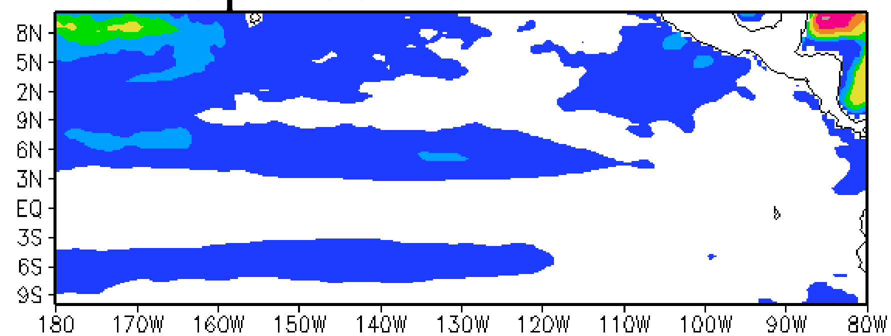
1/10° global ocean model (MOM3) run on Earth Simulator (OFES)

Comparison of mesoscale SSH variability in observations and OFES forced with different wind products.

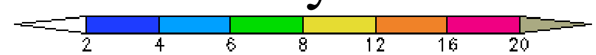


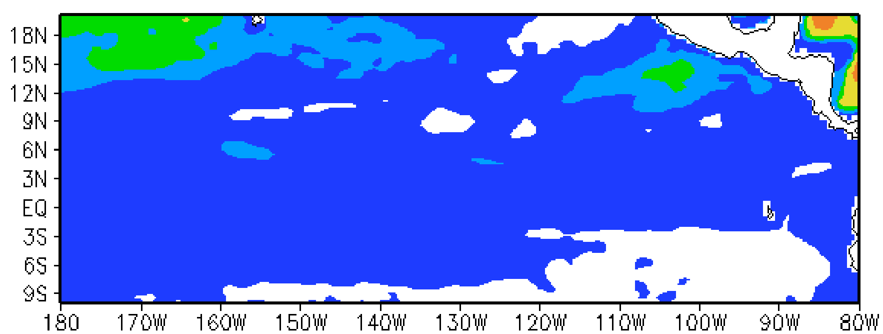
TOPEX/POSIDON



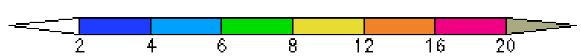


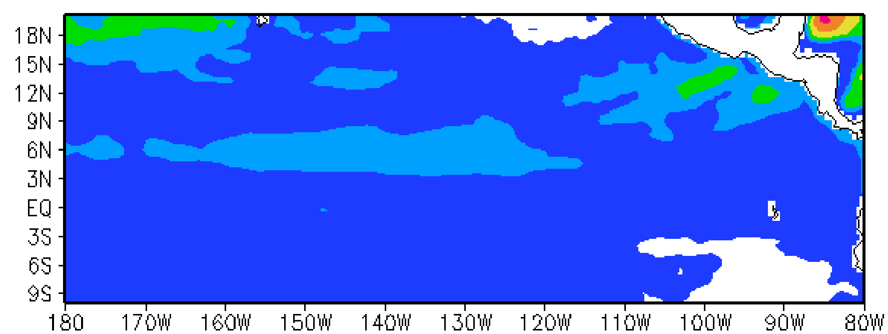
OFES forced by climatology



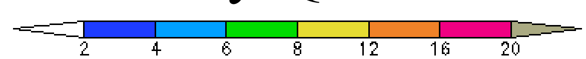


OFES forced by NCEP Daily



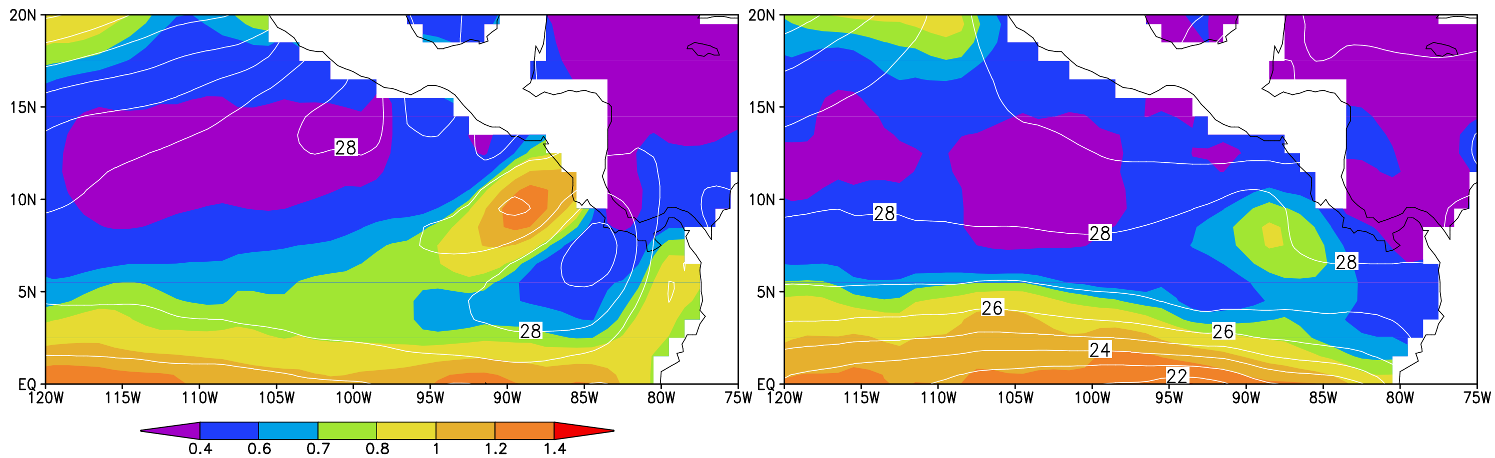


OFES forced by QUIKSCAT



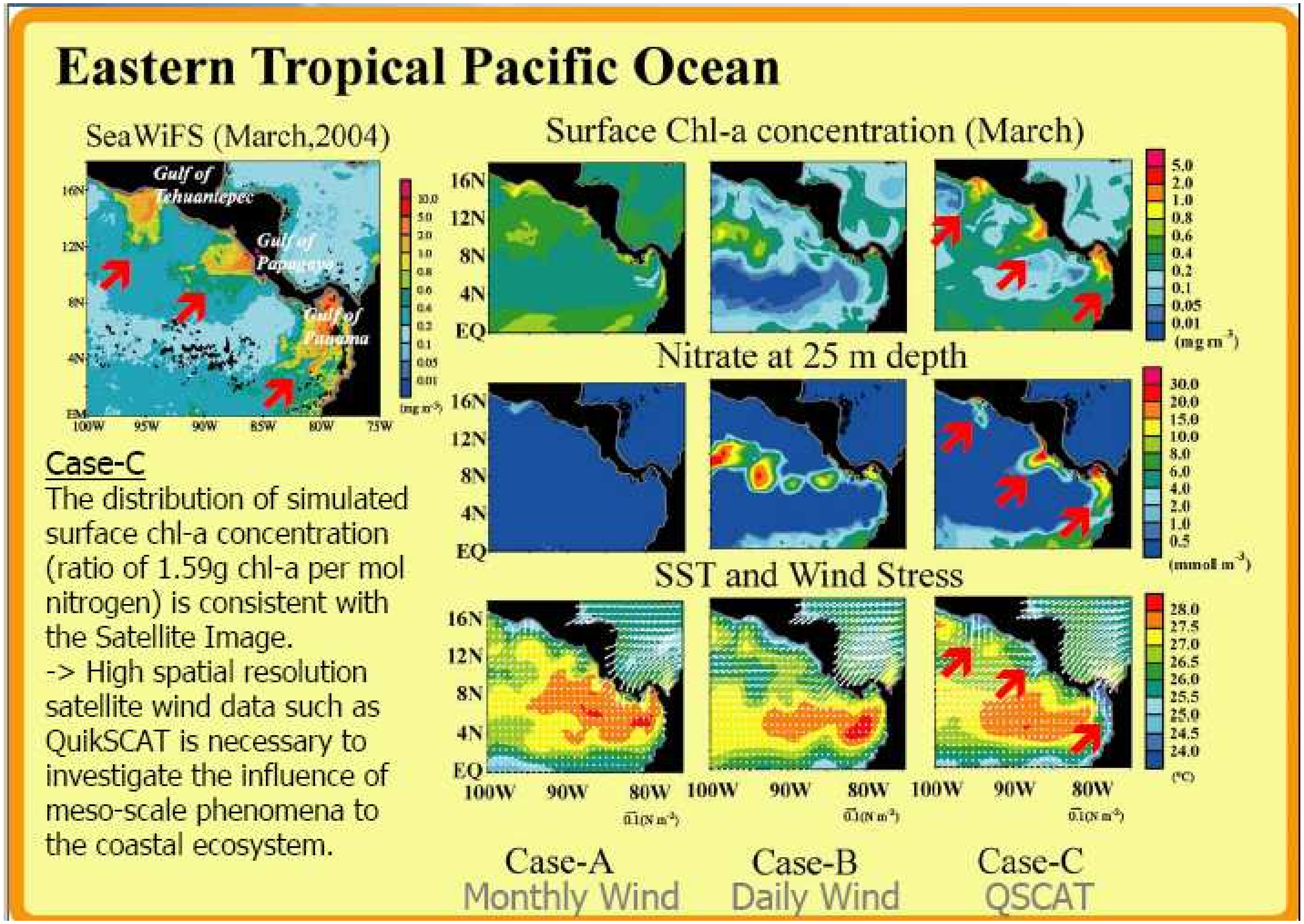
Gap Wind Jets and Ocean Variability

Stan. Dev. Of interannual SST variability and climatological SST



What causes interannual variability of SST (ENSO?, Tropical Atlantic Variability?).

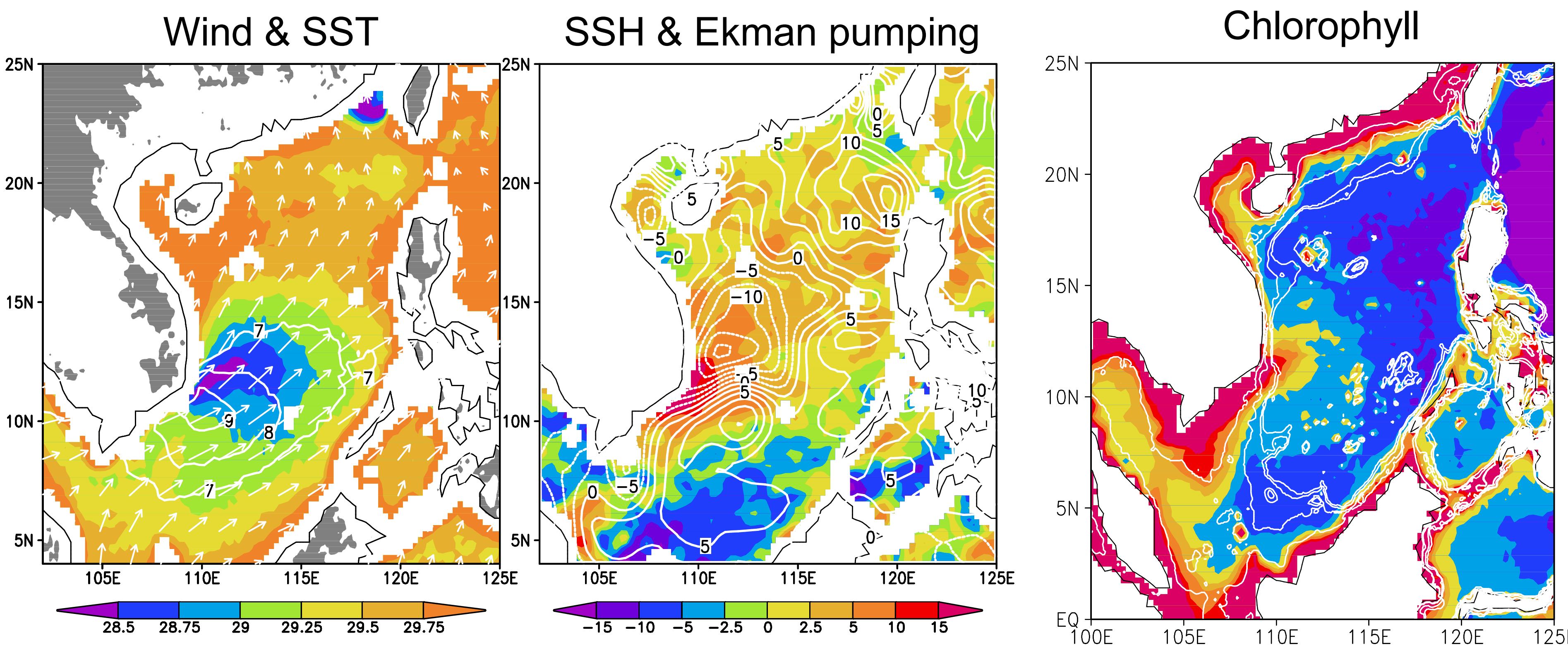
High Resolution Ocean Model Simulations (2)

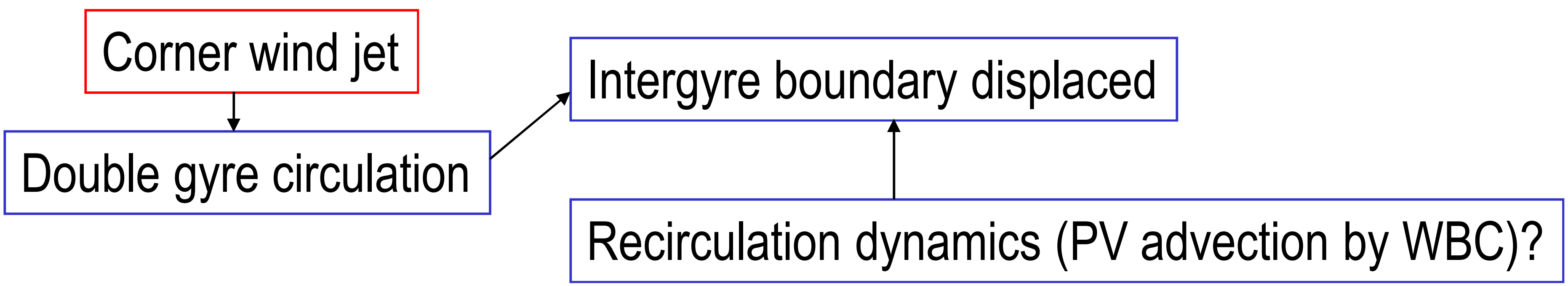


Courtesy Y. Sasai (FRCGC, Japan), OGCM for Earth Simulator (OFES): MOM3, 1/10 degree.

Orographical-induced double-gyre circulation in the South China Sea (Xie et al 2003, JGR(O))

Orographical-induced double-gyre circulation in the South China Sea (July-August)





Some interesting aspects of winds off the Big Island of Hawaii.

Hawaiian wake and return flow

Smith and Grubisic, JAS, 1993. Based on aircraft measurements.

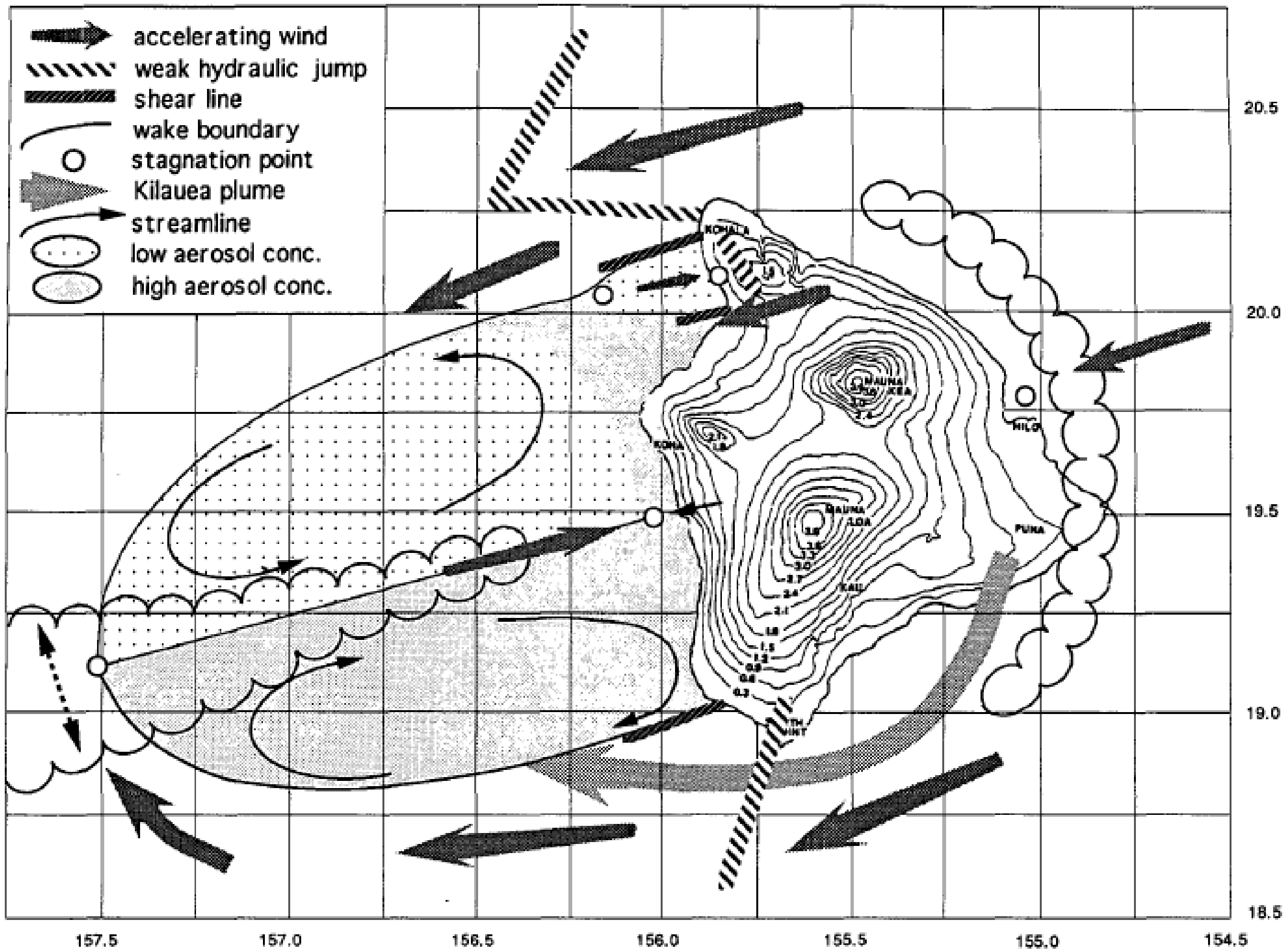
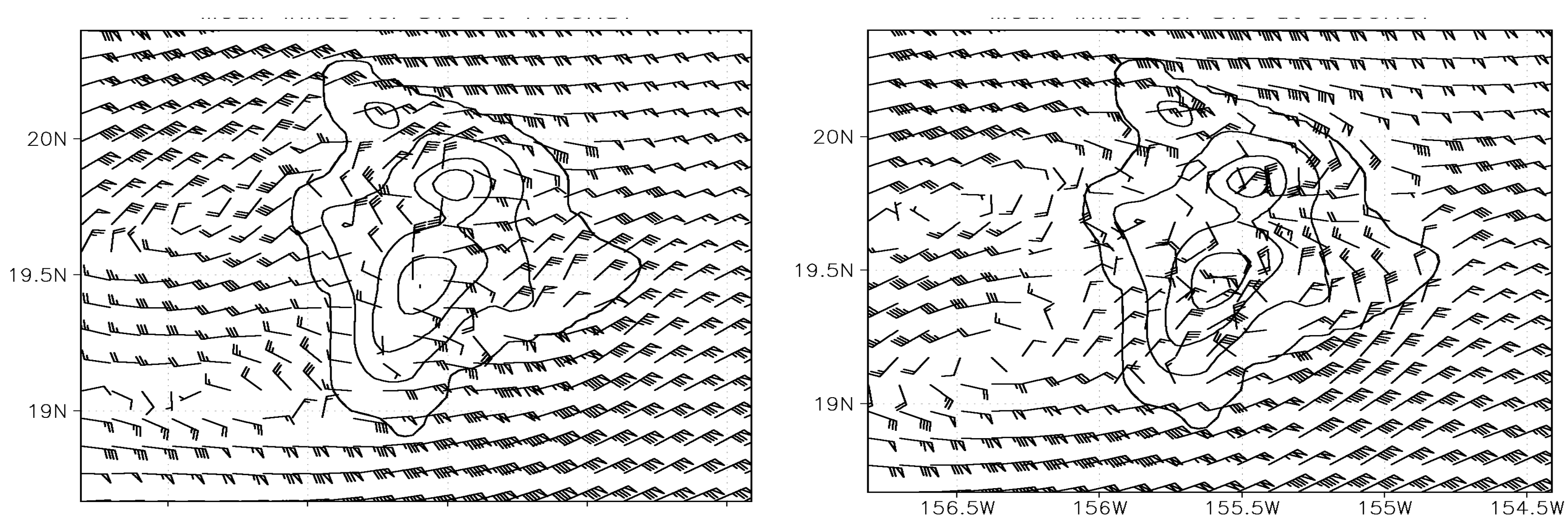


FIG. 18. Summary diagram depicting features observed in Hawaii's wake. Dashed two-way arrow at the downstream end of the wake is suggesting the existence of a north to south drift. The upstream rainband and "centerline" cloud are also outlined.

MM5 Simulations: mean surface winds under strong trade winds

Island blockage, combined with land breeze, leads to onshore winds on leeward side, strongest during day.

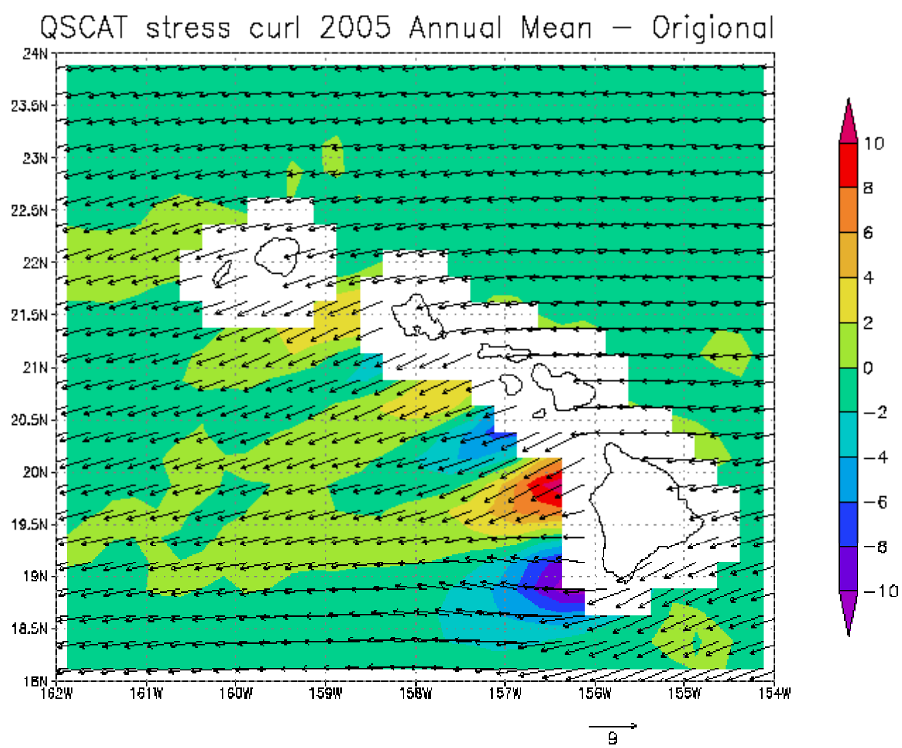
Strong 1400HST **Strong 0200 HST**

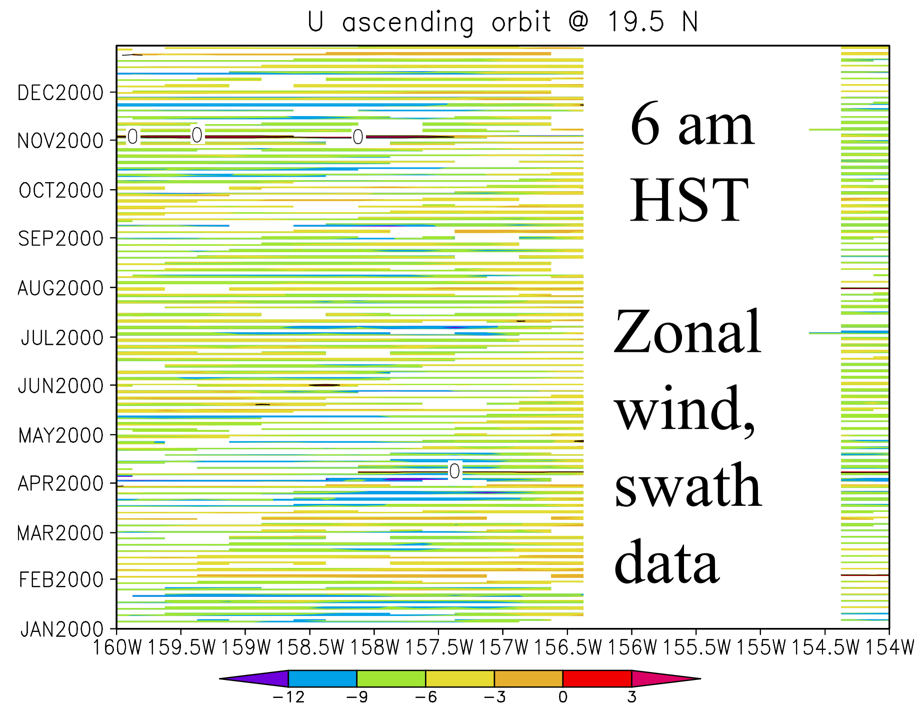


There is a convergence zone between the westerly return flow in the wake and the land breeze at night over the leeside coastal region. During the day, the westerly return flow is enhanced by the sea breeze over the leeside coastal region.

Penant=5 m/s, barb=1m/s, half barb=0.5m/s

Errors in QSCAT winds lee of Hawaii?



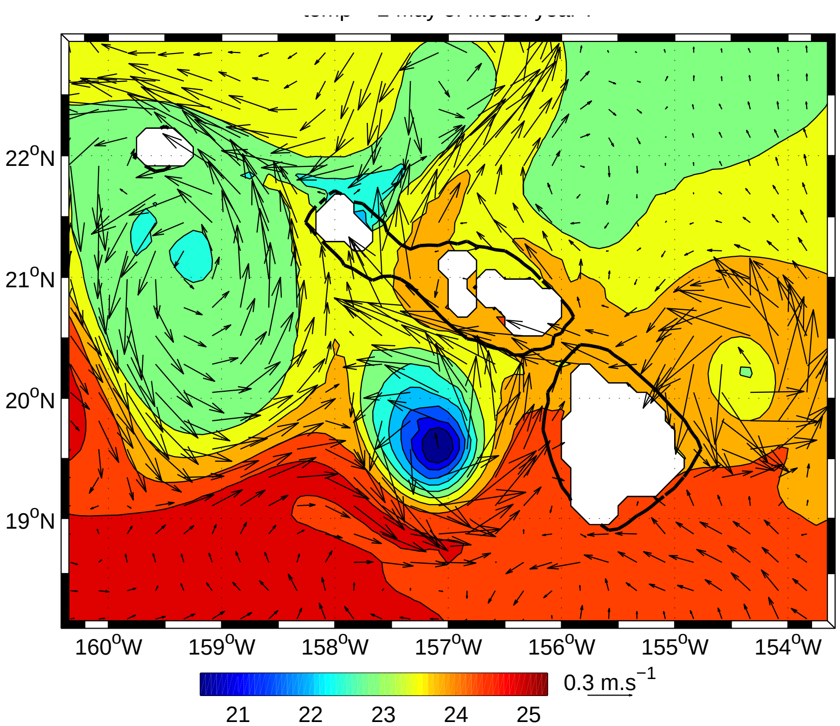


QuikSCAT does not show return flow to west of Big Island. This means the wind stress curl is underestimated. Possibly due to incorrect solution of direction ambiguity, guided by reanalysis winds.

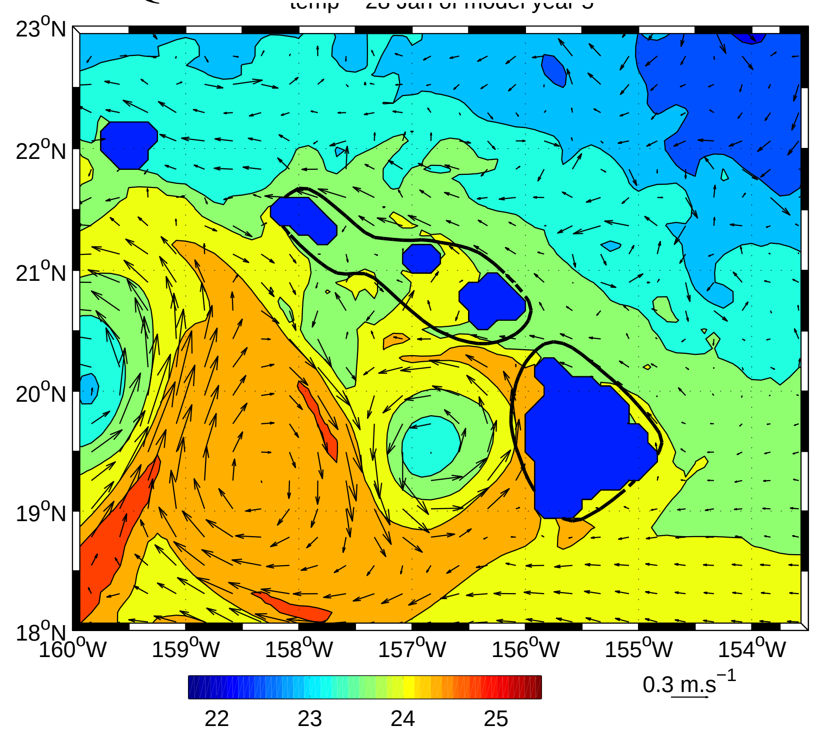
Errors in QSCAT winds lee of Hawaii? Response of Ocean

The regional ocean model (ROMS) is forced by surface stress from either MM5 or QuiKSCAT. Near surface temperature (color) and horizontal velocities.

ROMs forced by MM5 simulated winds



ROMs forced by QuiKSCAT winds

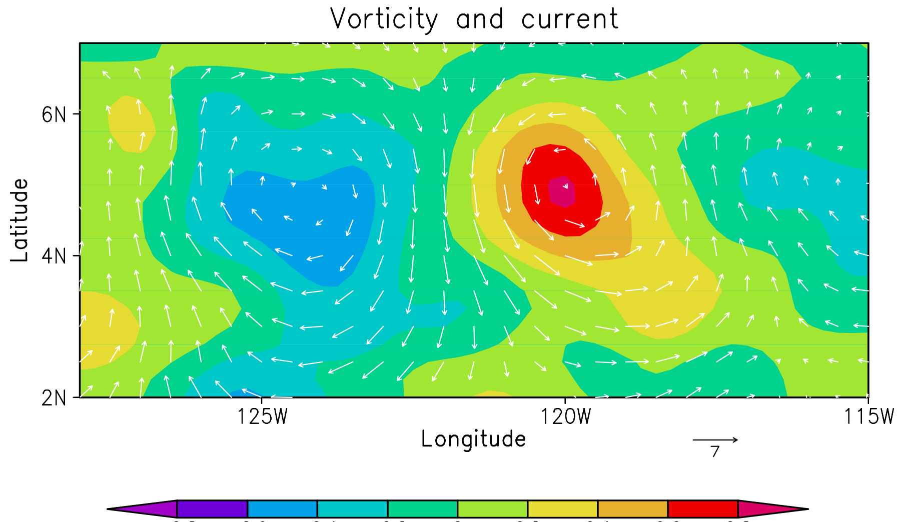


Future Work

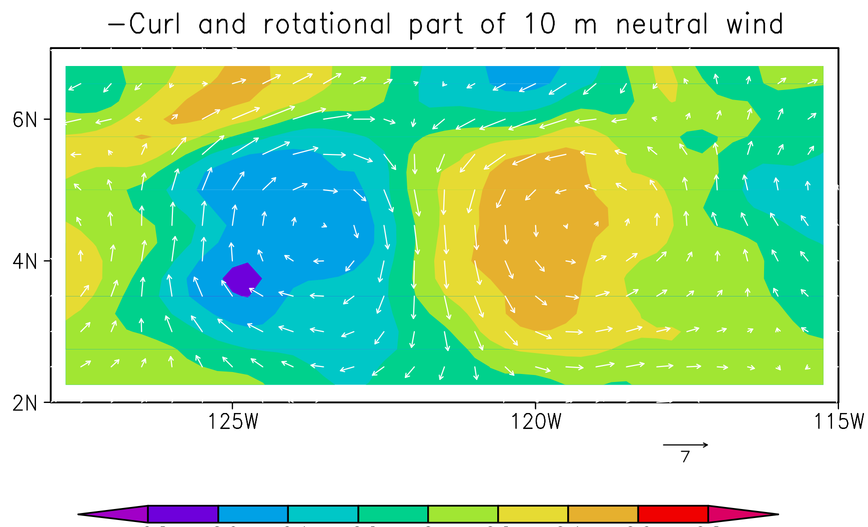
- Gap winds and East Pacific ocean eddies: joint analysis of satellite data and OFES model for
  - eddy generation process (wind forcing vs mean current instabilities)
  - Interannual variability
- South China Sea: ocean eddy and orographically forced gap winds off Vietnam
  - Intraseasonal variability
  - Interannual variability
- Big Island, Hawaii:
  - Can we improve QuikSCAT wind direction in lee of Hawaii using regional model e.g. MM5 ?

POSTER: Ocean currents in QuiKSCAT stress: Tropical Instability Waves

Following Kelly et al 2001, Cornillon and Park 2001, Park et al 2006.



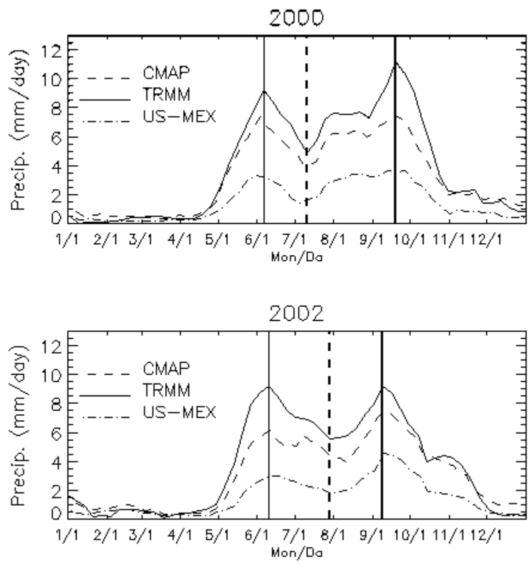
a) From altimetry: geostrophic vorticity (color) and geostrophic currents (vector.) Both are regressed onto vorticity at 4.5 N, 120 W.



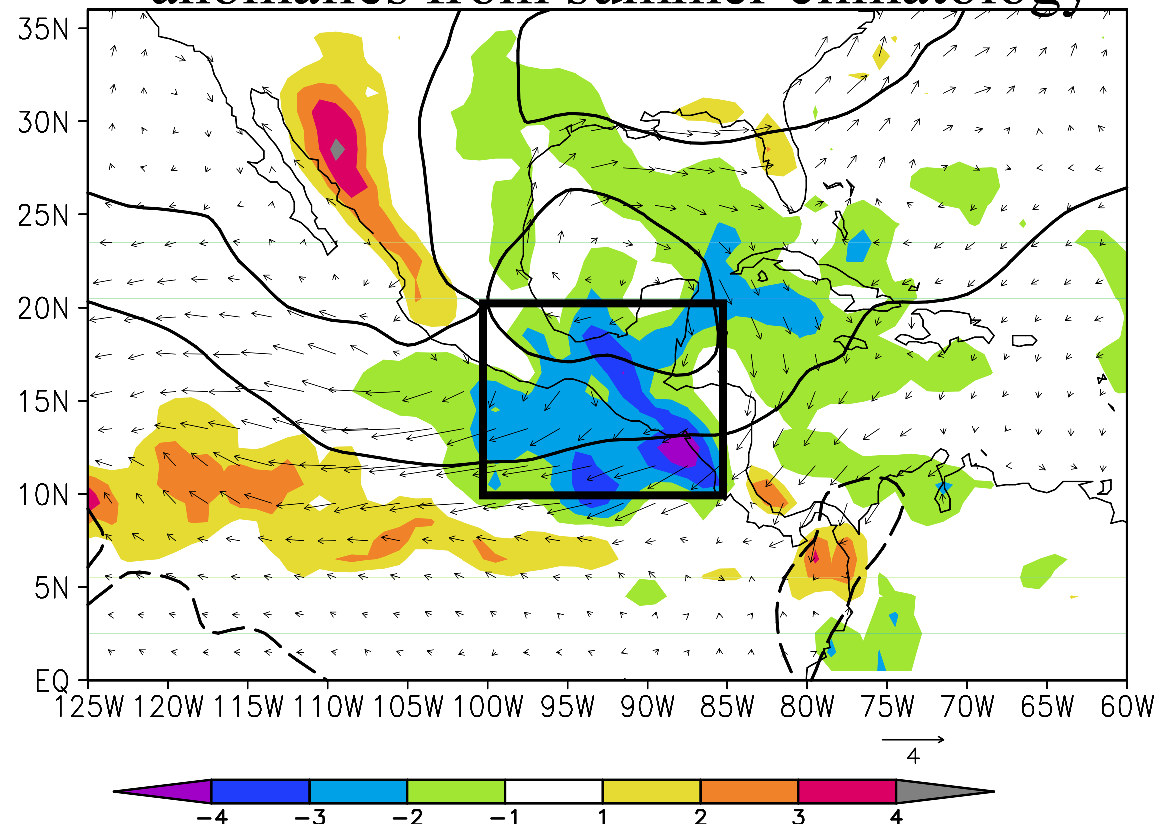
b) From QuiKSCAT: minus curl of 10 m neutral winds regressed onto same vorticity index as in a). Vectors show the rotational part of the neutral winds, and vector units are same as in a).

Gap Wind Jets and Mid-Summer Drought

Precip. Area averaged over box shown at right



Composite of mid-summer drought anomalies from summer climatology



Precip (col, mm/day, TRMM3B42), Surface pressure (NCEP, 1hPa), and QSCAT 10 m winds

In mid-summer there is a secondary maximum of Papagayo and Tehuantepec jets associated with the 'Mid-Summer Drought' (Magana et al 1999). Fluxes dry air from Atlantic towards central America.