Ocean-Atmosphere Interaction in the Eastern Pacific; Coupled Modeling Study

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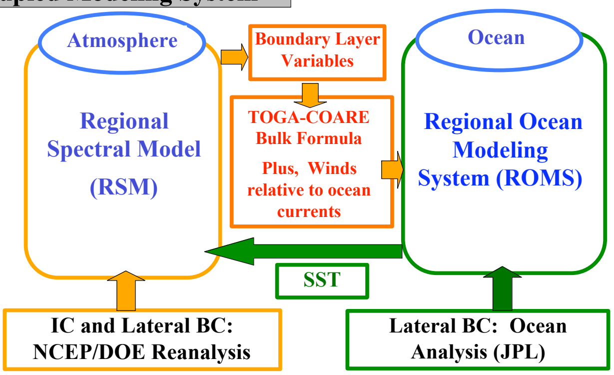
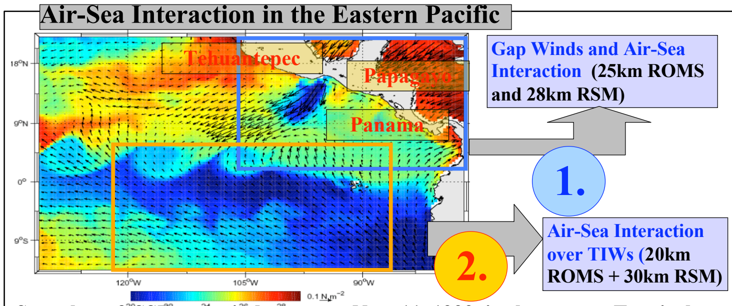
Introduction

A high-resolution ocean model (ROMS) has been coupled to regional atmospheric model (RSM) to understand small-scale air-sea interaction process. Using the coupled modeling system, various aspects of ocean-atmosphere coupling in the eastern Pacific and the tropical Atlantic ocean are under investigation. This poster illustrates a few examples on air-sea interactions near the tropics and in the midlatitude ocean of the eastern Pacific.

Coupled Modeling System

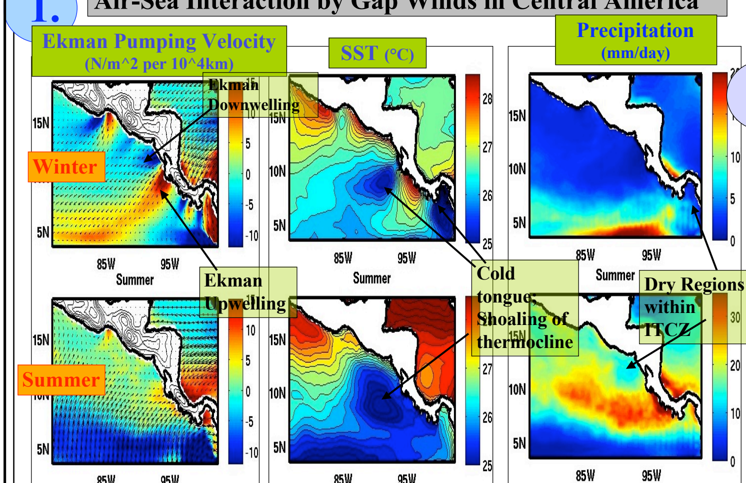


Air-Sea Interaction in the Eastern Pacific



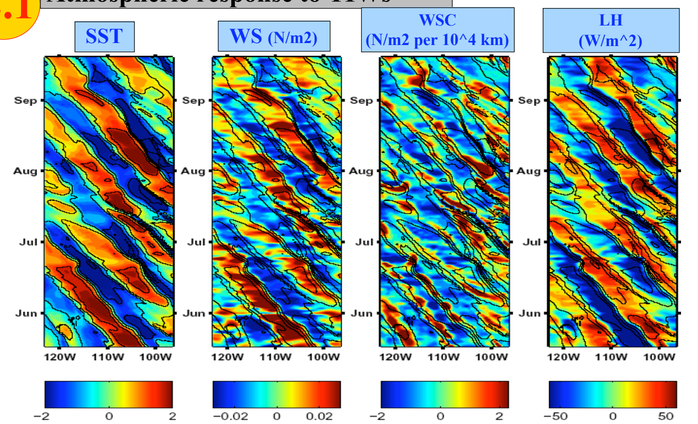
Snapshot of SST and wind-stress on Nov. 11, 1999 in the eastern Tropical Pacific ocean domain by coupled model. Figure illustrates clear signal of equatorial cold tongue and TIWs near the equator, and gap-wind induced cold tongue near Gulf of Tehuantepec, hint of Costa Rica Dome near the Gulf of Papagayo.

1. Air-Sea Interaction by Gap Winds in Central America



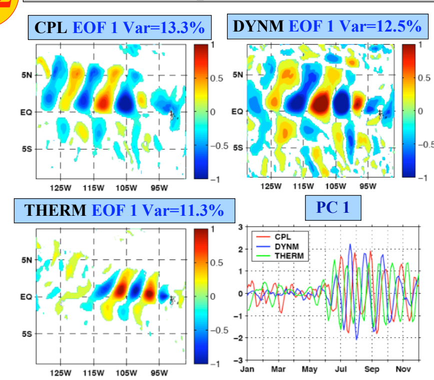
5-year model climatology clearly indicates that gap winds through Tehuantepec, Papagayo, and Panama exert Ekman forcing as well as wind-induced mixing and cooling on eastern Pacific warm pool. Cool region within warm pool in turn suppresses atmospheric deep convections and thus precipitation of comparable size but 2 seasons later within ITCZ, as is observed by satellite (Xie et al., 2005).

2.1 Atmospheric response to TIWs



SST, wind-stress (WS), WS curl (WS Curl), and latent heat (LH) flux from June to October in 1999 by coupled model. TIW-induced SST leads to modification in wind-stress and its derivatives (Chelton et al. 2001) as well as turbulent flux fields (Thum et al., 2002); WS is in phase, WSC in 90 degree out of phase, LH is 180 degree in phase with SST.

2.2 Effect of Atmospheric Feedback on characteristics of TIWs.



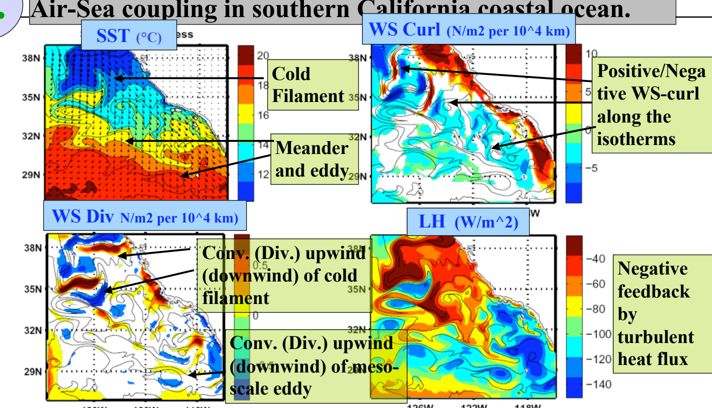
DYNM: 1-year run of ROMS with RSM wind-stress and climatological heat flux;

THERM:1-year run of ROMS with RSM heat flux and climatological wind-stress;

CPL: 1-year run of ROMS with RSM wixxnd-stress and heat flux;

The 1st EOFs (2nd EOFs are in 90 out of phase with similar variance explained) show that turbulent flux provides damping on TIW-induced SSTs (Chelton et al., 2004, Xie et al., 2004), while wind-stress leads to amplification of TIWs; *CPL* shows intermediate intensity. Different atmospheric feedback also influences on the period, phase-speed, and initiation time of TIWs; heat flux produces TIWs earlier with shorter period (less than 30days) but more (~7) mostly east of 115W, while wind-stress produces 5 strong TIWs. Again, full coupling has intermediate characteristics of TIWs (cf. Pezzi et al., 2004).

3. Air-Sea coupling in southern California coastal ocean.



Effect of SST gradient on surface winds and turbulent flux fields are also evident over California coastal ocean on various spatial and temporal scales. Over short-lived cold filament off Pt. Reys, wind-stress curl (divergence) follow isotherms where wind-stress are parallel (perpendicular) to them (Chelton et al. 2001). The same patterns are observed over meander of current and associated meso-scale oceanic eddies (more evident in longer time mean, not shown).