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Development of a Regional Coupled Ocean-Atmosphere Model

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Introduction

Development of a coupled model system
to study air-sea interaction processes
to improve ocean-atmosphere prediction

TODAY (Preliminary Results):

What are some effects of evolving SST on the coupled model fluxes?

RESULTS TO BE PRESENTED:

SST spatial structures are clearly seen in the flux fields.

SST affects shortwave fluxes (cloudiness) in the summer.

SST tendency is strongly correlated with latent heat flux anomaly in summer.

- Related to observational studies:
  Ronca and Battisti (*J. Climate*,1997), Chelton et al. (*Science*,2004)

Outline

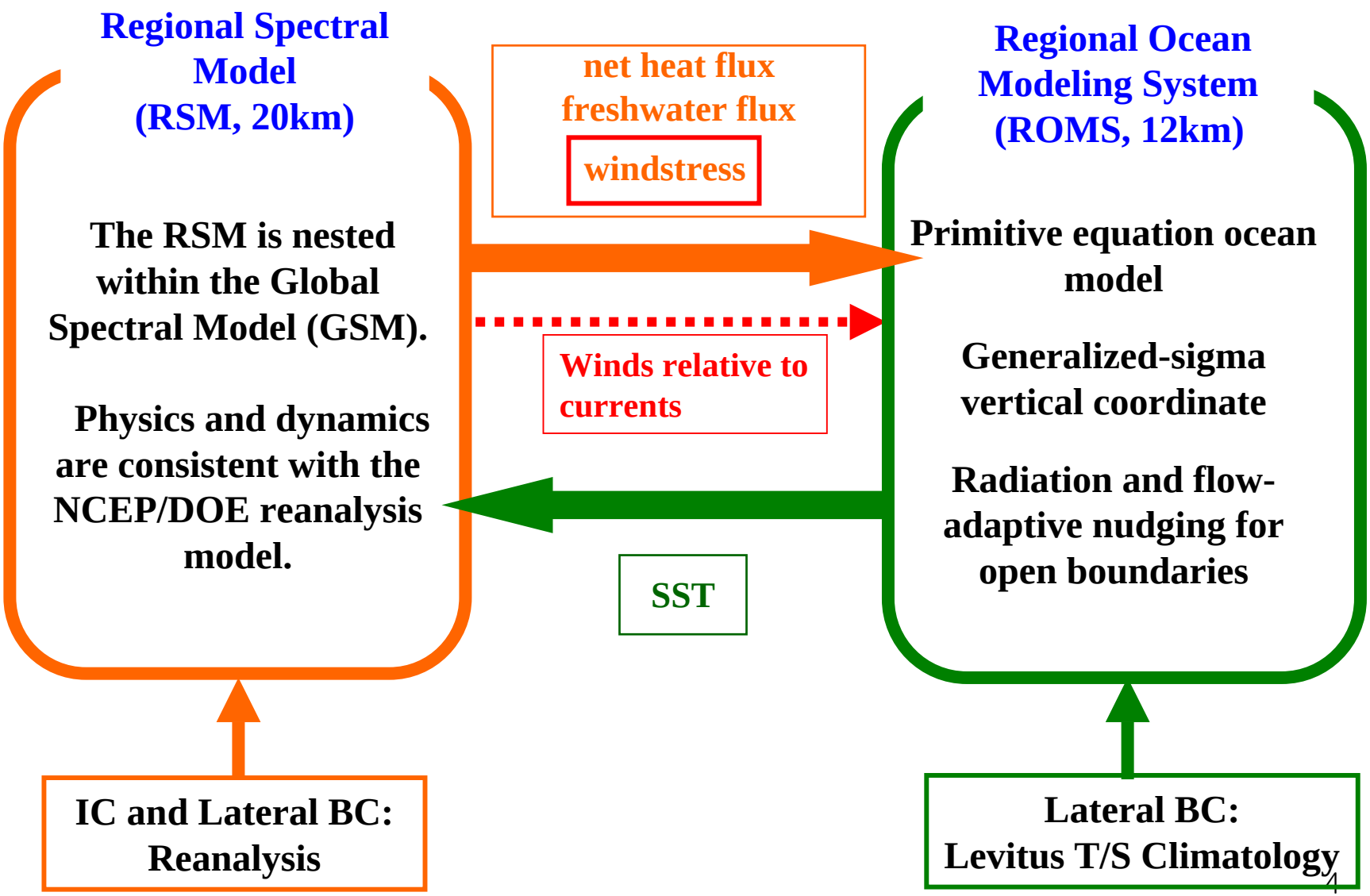
1. Description of Regional Coupled Ocean-Atmosphere Model and Experiments

2. Interaction of the Atmospheric and Oceanic Response

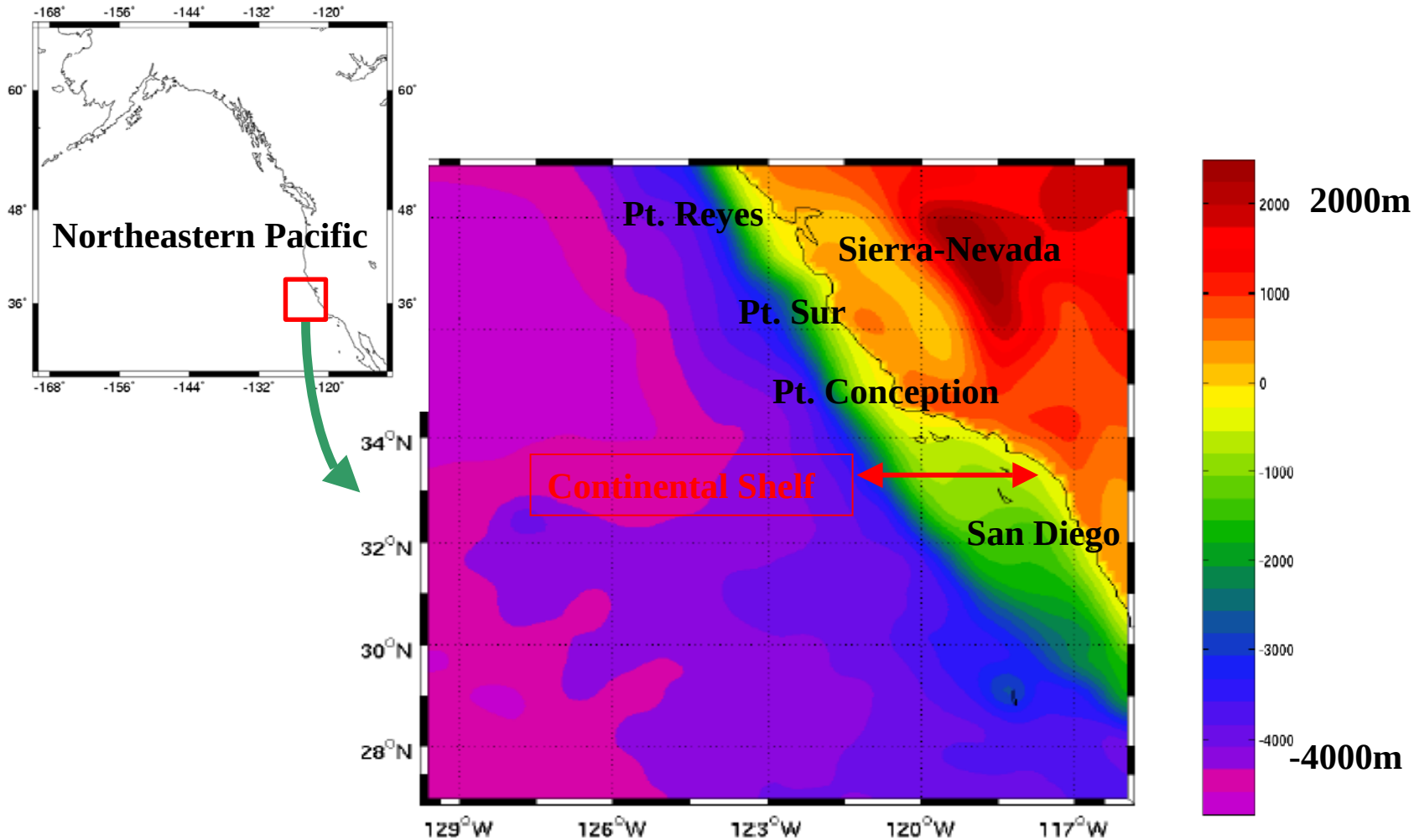
- Co-variability of SST anomaly (and its tendency)
  with components of heat flux anomalies (cf. Ronca and Battisti, 1997)

3. Conclusion and Future Work

Regional Coupled Ocean-Atmosphere Model



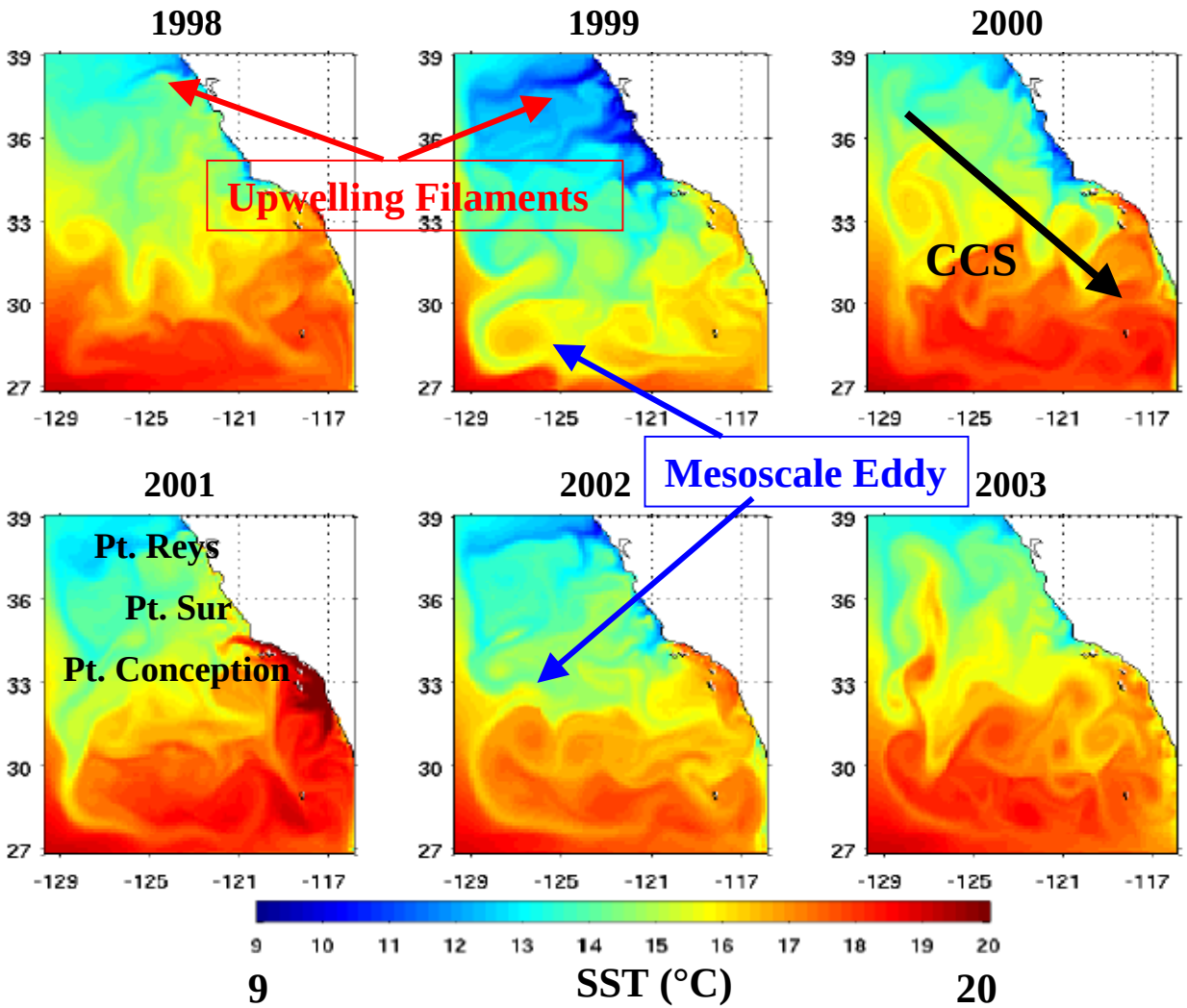
Model Domain and Experiment



Model Run from 1996 to 2003 with *Daily Coupling of Forcings*.

Interannual Variability of SST

Snapshots of Averaged SST of May 10 - 14, 1998-2003



-Upwelling filaments in SST occur north of Pt. Conception

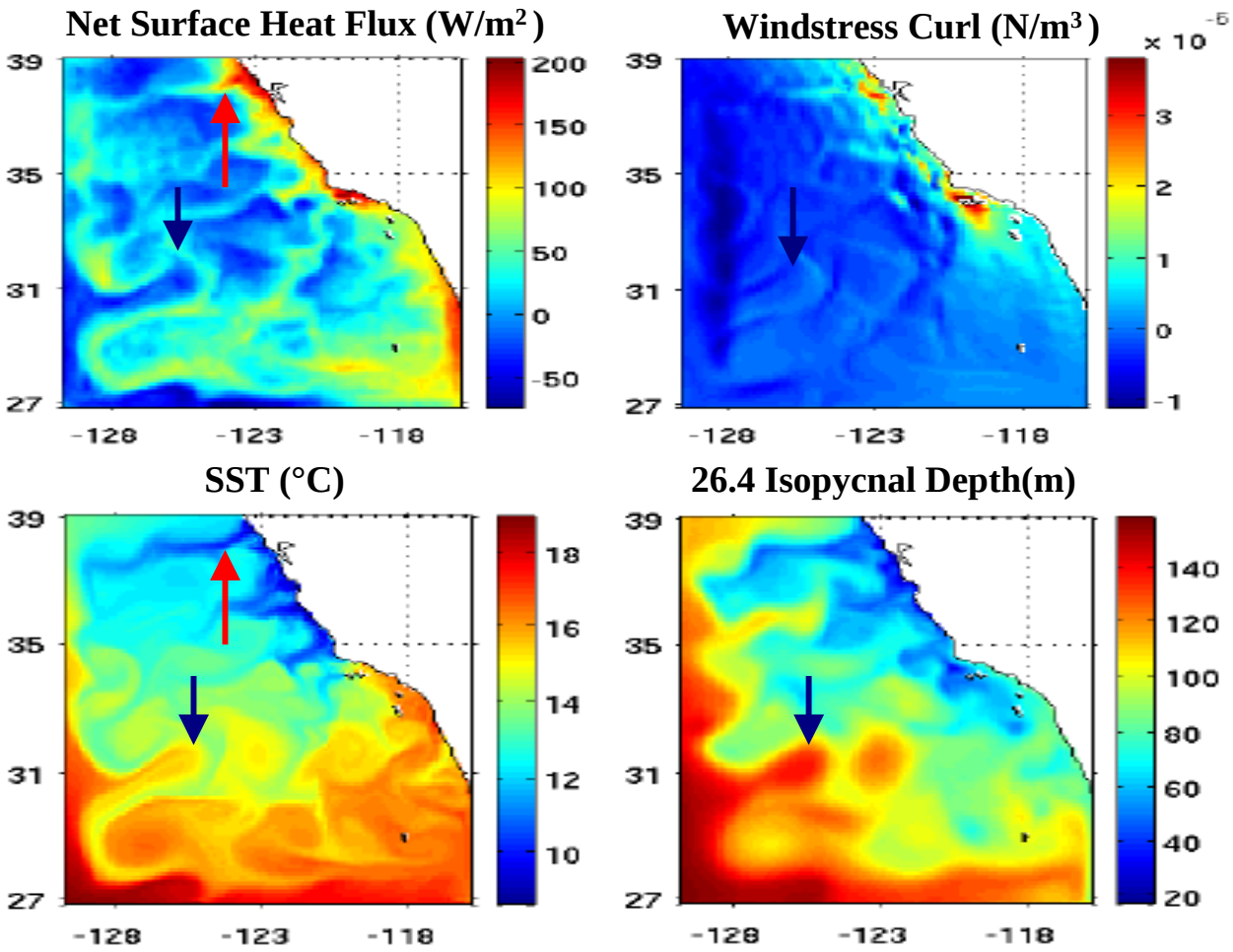
-Mesoscale eddies and meanders of the CCS generate strong SST gradients

→ ***Do these mesoscale SST features affect the local atmospheric boundary layer?***

SST Patterns in Heat Flux and Wind Stress Fields
Example: May 10-14, 1999

SURFACE FLUXES

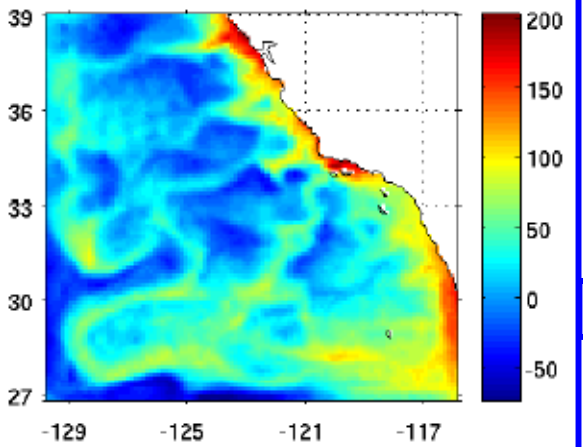
OCEANIC VARIABLES



How do the ocean fields and surface fluxes covary?

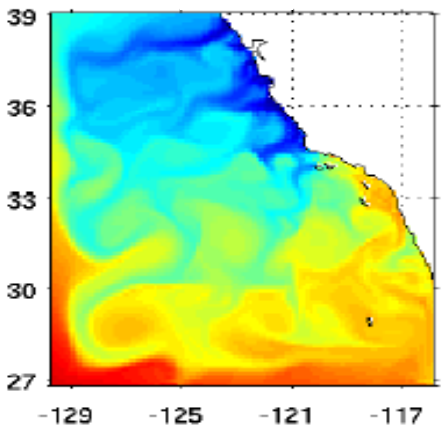
Net Heat Flux Components for 10-14, May, 1999

***Net* Heat Flux (W/m^2)**

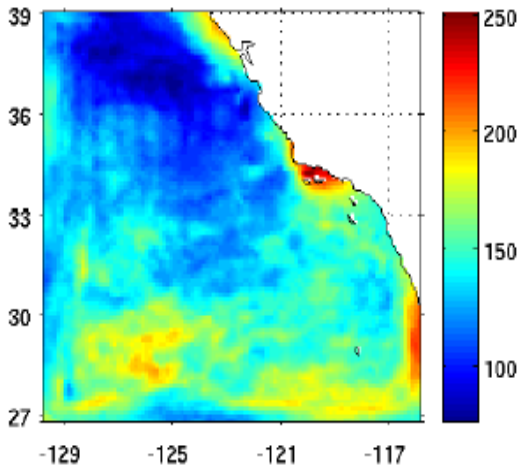


***Net* Heat Flux = Shortwave + Longwave + Latent + Sensible**

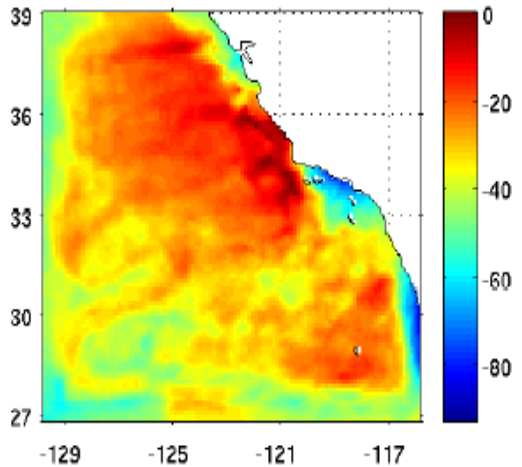
SST



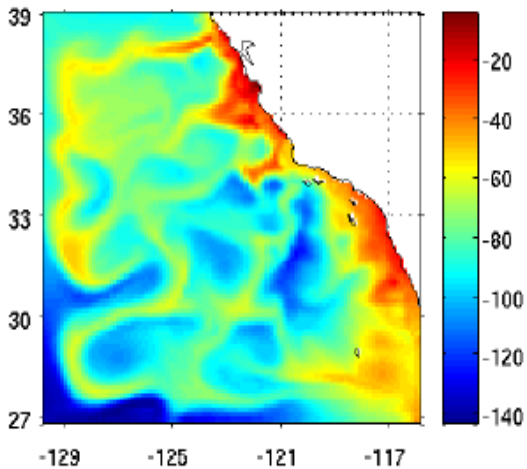
Shortwave Radiation



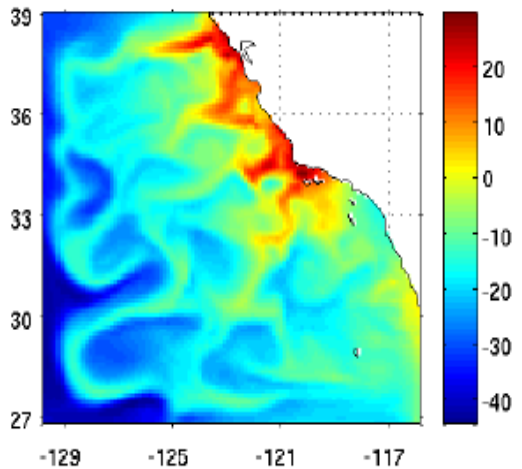
Longwave Radiation



Latent Heat



Sensible Heat



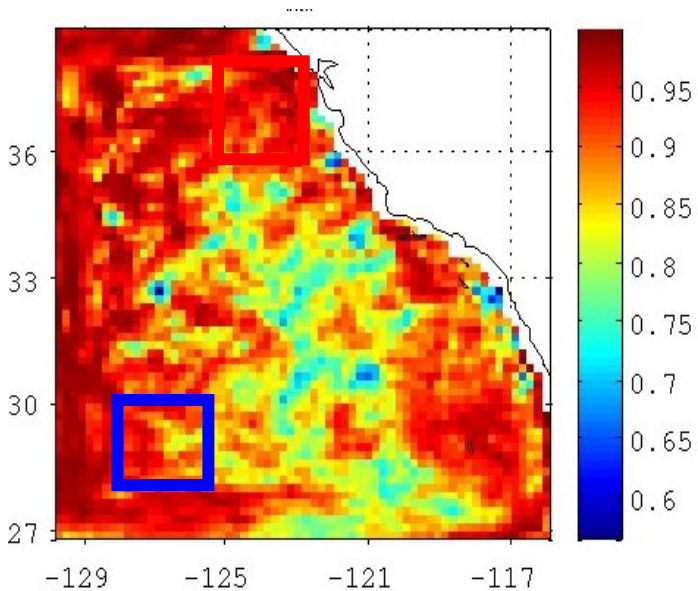
Covariance of SST tendency with each heat flux in Summer months

Summer months (JJASO) of 5 day-averaged 7-year data (monthly mean removed)

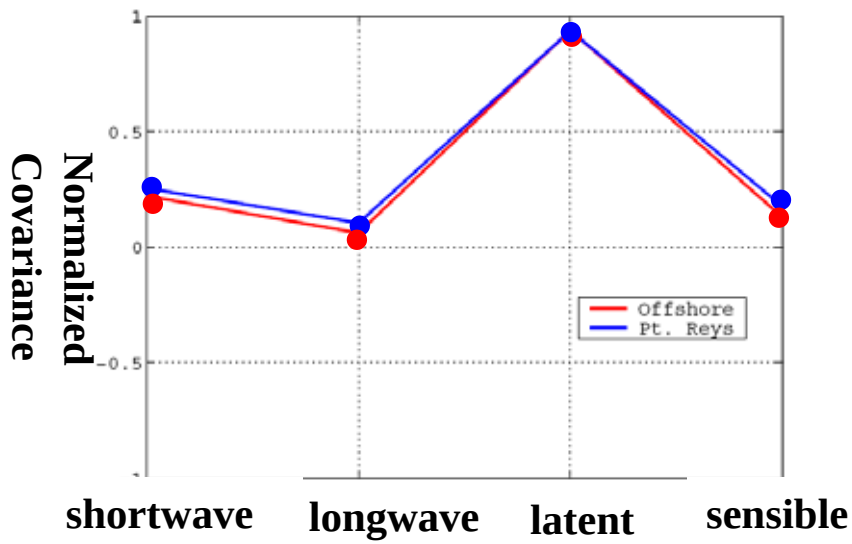
Normalized Covariance (NC)

$$NC = \frac{\left\langle Q'_{lh}, \frac{\partial}{\partial t}SST' \right\rangle}{\left[\sum_{i=1}^{i=4}\left(\left\langle Q'_{i}, \frac{\partial}{\partial t}SST' \right\rangle\right)^2\right]^{1/2}} = 0.97$$

Local NC of *dSST'/dt* with latent heating



NC of dSST'/dt for 2 regions



Ronca and Battisti: Latent heat flux significantly covaries with windspeed.

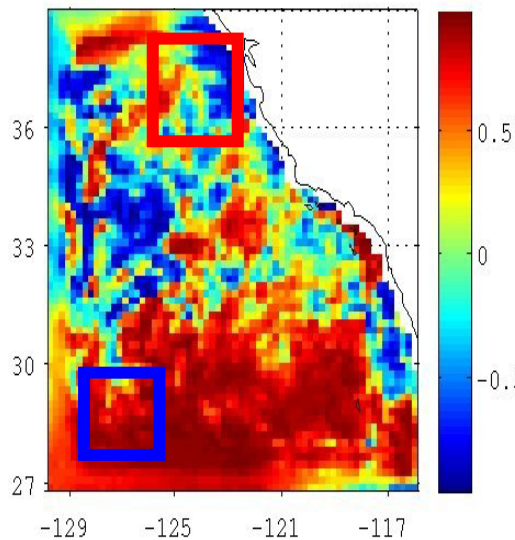
Covariance of SST and each heat flux in Summer months

Normalized Covariance (NC)

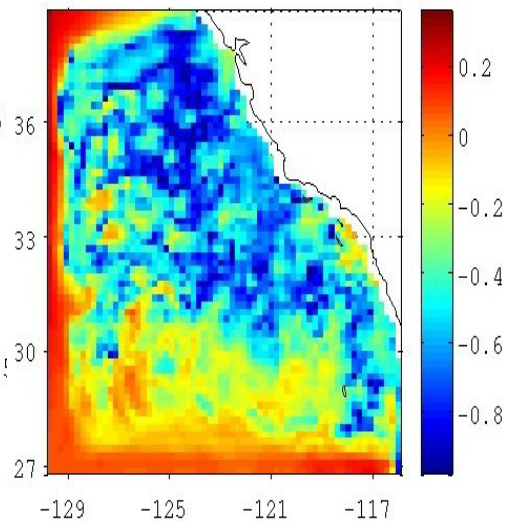
$$NC = \frac{\langle Q'_{lh} SST' \rangle}{\left[\sum_{i=1}^{i=4} \left(\langle Q'_i SST' \rangle\right)^2\right]^{1/2}}$$

Local NC of *SST'* with each component

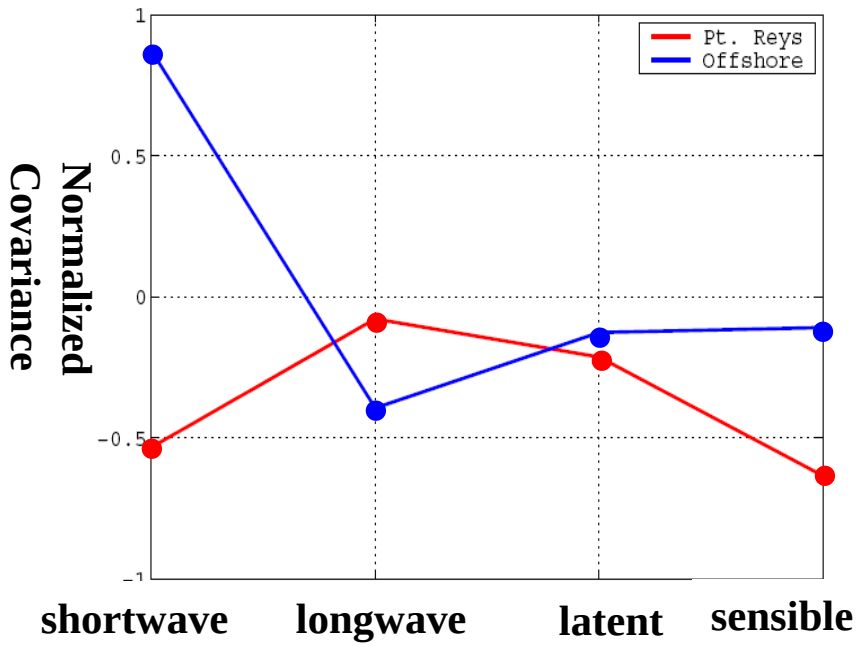
shortwave



Sensible heat



NC of SST' for 2 regions



Negative correlation of SST with cloudiness in summer

-(Klein and Hartmann(1993), Norris and Leovy(1994))

Conclusion

1. SST spatial structures are clearly seen in the flux fields.

2. SST tendency is strongly correlated with latent heat flux in summer month (in spite of mesoscale eddy signatures in SST)

3. SST affects solar heating flux through cloudiness in the summer months.

Future Work

- Future Work

Include ocean currents in calculation of coupled model windstress

Replace climatological boundary condition with ocean analysis

Multi-nesting coupled modeling

Thank you!