Development of a Regional Coupled Ocean-Atmosphere Model

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6th Conference on Coastal Atmospheric and Oceanic Prediction and Processes
85th AMS Annual Meeting
January 11, 2005, San Diego
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:
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

Regional Spectral Model (RSM, 20km)

The RSM is nested within the Global Spectral Model (GSM).
Physics and dynamics are consistent with the NCEP/DOE reanalysis model.

IC and Lateral BC: Reanlysis

net heat flux
freshwater flux
windstress

Winds relative to currents

Regional Ocean Modeling System (ROMS, 12km)

Primitive equation ocean model

Generalized-sigma vertical coordinate

Radiation and flow-adaptive nudging for open boundaries

Lateral BC: Levitus T/S Climatology

SST
Model Domain and Experiment

Northeastern Pacific

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?
How do the ocean fields and surface fluxes covary?
Net Heat Flux Components for 10-14, May, 1999

\[ \text{Net Heat Flux (W/m}^2\text{)} = \text{Shortwave} + \text{Longwave} + \text{Latent} + \text{Sensible} \]
Covariance of SST tendency with each heat flux in Summer months

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

Local NC of \(dSST'/dt\) with latent heating

Normalized Covariance (NC)

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

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)

\[
NC = \frac{\langle Q_{lh} SST \rangle}{\left( \sum_{i=1}^{4} \langle Q_i SST \rangle^2 \right)^{1/2}}
\]

Local NC of SST’ with each component

- Shortwave
- Sensible heat

Negative correlation of SST with cloudiness in summer

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