

## Western Boundary Current Working Group Meeting Notes Portland, OR 23–24 August, 2007

*Attending: Kathie Kelly, Mike Alexander, Nick Bond, Hisashi Nakamura, Roger Samelson, Justin Small, Young-Oh Kwon, Terry Joyce, Claude Frankignoul, Meghan Cronin, Bo Qiu, Jimmy Booth (student)*

*23 August, Thursday*

The meeting began at 10 am with a presentation by Young-Oh Kwon on Large-scale air-sea interaction using the CCSM2 model, to finish out the presentations from our teleconferences. The discussion that followed concluded that the connection between changes in wind stress curl (through ocean advection) to heat flux anomalies is consistent across several studies, but there is no consensus on the response of the winds to ocean forcing.

We discussed science issues from our three subgroups (meso-scale, large-scale, and Kuroshio Extension and Gulf Stream comparisons) with respect to the following points.

### **General considerations:**

- What can we do in 1-1/2 years with limited funding?
- How can we bring a group approach (vs individual PIs)?
- Open to entrain other members of the community (e.g. drought group involved a number of modeling centers)
- Relation to decadal variability initiative

The full group reconvened to review and expand the group discussions:

### **Observational Analyses**

Impact of SST fronts and GS/KE on the atmosphere, both surface and above

- Identification of data sets that are able to resolve mesoscale features
- SST & wind products (NOAA 0.25°)
  - Convection & diabatic heating
  - e.g. TRMM, lightning
  - Cloud height, fraction, etc.
  - Precipitation
  - Baroclinic parameters
  - NARR/JMA
  - Cruise data (e.g. Tanimoto's data) – soundings
  - CLIMODE and KESS data
- First Step: Climate mean then extreme years
- Storms (individual) & Storm tracks (climate)
- Cold air-outbreaks
- Role of seasonal cycle

- Need for flux measurements

#### *Mesoscale air-sea Interaction and its effects on the Large-Scale*

- Impact of SST front (Oyashio) versus dynamical front (Kuroshio) fronts on atmosphere
- Atmospheric response to SST anomalies in western boundary current (fronts & recirculation gyres) in mesoscale model experiments (Use same model to compare Kuroshio & Gulf stream). Some examples
  - Strong vs weak gradient
  - Opposite phases of leading SST EOF
  - Actual SST anomalies
- Rectification of response to SST eddies
  - By analogy TIWs => large scale Atmosphere (*Jochum et al., 2007, J Climate, 765-771*)
  - Lateral processes in boundary current regions balancing surface fluxes
- Response in boundary layer & free atmosphere
- Change in convection & storm tracks

#### **Large-Scale Air-sea Interaction**

- Atmospheric Models have different response to SSTs
  - Response to SSTA versus heat flux (Curl especially important)
  - Perform initial value - with AGCM coupled to a mixed layer or more sophisticated ocean model
  - Consistency with observations
  - Does the large scale atmosphere respond to GS variability (observed analysis shows mixed results)?
- Potential Tasks/questions
  - Simulations of basic WBC quantities in coupled models
  - Comparison of decadal variability in IPCC class models
  - Role of remote forcings, e.g. ENSO on KE GS; tropical Atlantic on GS

#### **Gulf Stream - Kuroshio Comparison**

- Structure of fronts
  - Meridional Slope of the GS / zonal KE
  - Multiple fronts
    - two in Pacific, one in Atlantic
    - SST vs dynamical
  - Nonlinear processes in frontal formation
    - Large-scale=> impact on eddies => fronts
  - Role of the subpolar gyres
  - Role of thermohaline circulation
- Atmospheric response to front in 2 basins
  - Winds in Pacific more steady; Atlantic more variable
- Mode water formation
  - Integrated heat flux forcing over the mode water formation region
  - Preconditioning

- Relation to SST/fluxes and thermocline depth (Very different in two basins)
- Spatial scale of recirculation gyre
- Role of advection and capping of the recirculation gyre
- Nature of SSH/current variability
  - Lower frequency in Pacific
  - Relationship to wind forcing: Both have Rossby waves but SSH variability less well related in the Atlantic
  - Role of basin size
- Memory due to mode water: Entrainment/reemergence
- Wind forcing
  - Relation to basin patterns of wind forcing
  - AO driving both oceans?

*24 August, Friday*

We discussed tasks for the Working Group and outlined specifics in breakout groups:

**Review Papers: one or two?**

- Role of WBCs in air-sea interaction
- Western boundary current, ocean oriented

*Topics*

- Ocean (SST vs Qnet) effects on atmosphere
- Differences between Kuroshio & Gulf Stream
- Relationship to thermohaline circulation
- Two roles: mean state & variability
- Ocean fronts anchors mean state
- Role of variability in fronts on atmosphere much less clear
  - Impact on storm track
  - Affect cyclogenesis directly
  - SST variability along Oyashio front but Qnet variability is located on Kuroshio front
- Remote influences, e.g. ENSO effect on the Kuroshio
- How do coupled models simulate these interactions? (Use OFES/Earth Simulator and other data to describe the fronts)

**Evaluation of coupled IPCC models**

*(requires research before/if inclusion in review paper)*

- Mean state (e.g. position, strength, variability of WBCs)
- Scatter plots of models between two fields, include obs
- Leads/lags between WBC & atmosphere is it the same as in the observations
  - Heat budgets in key regions
  - CCSR (MIROC high-res, eddy permitting)
  - Initiative like DRYCOMP, Define metrics

- Contact Jay Fein/Dave Legler about seed money for a DRYCOMP type proposal to study wbc issue (Nick, Roger)
- Contact Tom Delworth at GFDL about high resolution coupled model two hundred year run (*Mike*)

### **KESS/CLIMODE comparisons**

- Atlantic/Pacific comparison of detailed fluxes (vertical and horizontal) over the mode water formation region (*Roger, Bo*)
- Role of ocean eddies

### **WBC Monitoring**

- In situ data used to verify weather forecast models & reanalyses and provide recommendations for improving NWP.
- NCEP fluxes via COARE algorithm (Host at CDC)
- What observations are needed to address WBC issues?  
Regions / latitudes? OE/KE  
Surface met & flux, subsurface?

### **Action Items/timeline**

#### *Group tasks:*

- 1) review paper on KE/GS comparisons of mode water, forcing, and air-sea fluxes  
=> *outline by early-mid October (Bo, Kathie, Terry)*
- 2) review paper on large scale atmosphere-ocean interaction related to the WBC  
=> *outline by early-mid October (Mike & Young-Oh)*

**Note: topics such as "storms and storm tracks" could fit in either of these two outlines so we will need to discuss whether to write a single review paper instead**

- 3) 1-2 pages on looking at WBCs in IPCC models, request \$ for DRYCOMP type analyses (endorsed by WBC WG) perhaps funded through a SUGR grant  
Analyses of WBC and related atmospheric variability in IPCC models  
=> *Nick, Roger, Mike, Hisashi - Contact Youichi Tanimoto)*
- 4) regional, coupled mesoscale model experiments:
  - storm tracking and formation;
  - comparisons for N Pacific and N Atlantic;
  - non-storm vs. storm/CAO statistics of fluxes
 => *Nick, Kathie, Justin, Roger, Hisashi to contact Benmei Taguchi*  
=> *meet/telecon in Sept (Cronin, Bond, Kelly, Thompson (Booth), Small)*
- 5) Observing system for meeting in Hawaii  
=> *Meghan, Hisashi*
- 6) Model metrics issues  
MJO working group: model comparisons with small grants  
What needs to be right? How do we encourage the modelers to improve results?  
=> *use metrics ideas to focus review papers*  
*include model analyses in review papers?*

*Notes:*

*KESS/CLIMODE analysis renewal proposals are pending or imminent*  
*Hisashi has a review paper on storms*  
*Justin has a review paper on fronts*

**All action Items are to be completed prior to our next teleconference in November**  
**Review paper outlines to be circulated before telecon**

**Final Conference:**

- separate meeting in summer 2008
  - possibly Chapman Conference - AGU support, AGU encourages monograph
- => *Bo takes lead*
- Consider session at AGU, Fall 2008
  - goals:
    - raise profile of WBCs for climate
    - KESS/CLIMODE results
    - International community involvement: Claude and Hisashi
    - Monitoring systems (relation to AMOC)
    - Ocean observing system requirements