

CLIVAR WG on Air-Sea interaction at Western Boundary Currents

Subgroup discussion on Small-scale air-sea interaction

A breakout group formed to discuss the importance of small-scale (ocean frontal scale) air-sea interactions. The following discusses some ideas about numerical modeling experiments to support and enhance observational data.

Observations from KES and CLIMODE provide detailed data of the ocean and atmosphere system at selected points. To maximize this data, joint analysis with reanalysis data or numerical model should be used. There is an opportunity for regional and mesoscale atmospheric modelers to use the experimental data for benchmarking and analysis. The response to the WBCs of the atmosphere, and synoptic storms in particular, may be studied in detail.

1. Atmospheric Modeling

1.1 Available Reanalysis and Models

1.1.1 Reanalysis data. e.g.

- NCEP/NCAR reanalysis,
- NCEP-DOE (NCEP2), and
- The downscaled North American Regional Reanalysis (NARR). This has high resolution (32 km) but is forced by Reynolds 1 degree SST.
- ECMWF – ERA40: there are also high resolution operational and reanalysis products from ECMWF but I believe these cost money.
- Also JMA reanalysis http://jra.kishou.go.jp/AboutJRA25_en.html describes the JRA25 data and has a useful comparison table of different reanalyses products.
- Please feel free to comment on these datasets.

1.1.2 Models

- Regional models (loosely defined here as models with resolution of 0.25 degree or higher, hydrostatic, which are capable of many multi-month simulations) may look at the seasonal ensemble of storms and how they relate to the WBC and surface fluxes. E.g. IPRC “regional” model – Atlantic (Justin), Pacific (Bunmei Taguchi, Shoshiro Minobe’s student Kohei Takatama, other?).
- Higher resolution mesoscale models (non-hydrostatic) could be used to investigate individual storm processes in detail. E.g. WRF “mesoscale” model - Jimmy Booth (Atlantic). Nick Bond (Pacific).

1.2 Simulation ideas

- ##### 1.2.1 Simulations of experimental periods.
- ¹The focus of the new modeling could be on the intensive experimental survey periods (e.g. CLIMODE Jan-Mar 2006, 2007) or KES (dates needed here). Investigation of the surface fluxes, and the atmospheric boundary layer and synoptic storm development over SST gradients

¹ (Roger and Eric have performed some short simulations for CLIMode already –some case studies with LES. The case studies are of cold air over GS and warm air over a shelf water eddy. The ETA model (downscaled NCEP) is used to provide surface fluxes information.)

can be performed. For regional and mesoscale models, need to choose appropriate boundary conditions – surface and lateral – and initial conditions. Question: what would the observationalists like from such experiments?

1.2.2 Sensitivity studies. The response of synoptic storms to WBCs may be dependent on various factors, such as the state of the NAO or AO, or the upstream conditions (strength of the jet over the US continent), and interannual/decadal changes of the SST distribution. We propose to run simulations to test these sensitivities, by considering

- NAO – different polarities of NAO - this changes rapidly on subseasonal timescales.
- SST- Prototype SST patterns will be produced, e.g. for years with a high latitude GS extension vs a low latitude. Timeseries of Gulf Stream position vs SST anomaly may be used for idealized simulations – Terry Joyce. Do we want to try artificially large amplitude SST anomalies as done by Palmer and Sun (QJRM1985)? Sensitivity to SST product and resolution (Reynolds or AMSR?). Note that a new much improved SST analysis product is available from Reynolds et al:

<http://www.ncdc.noaa.gov/oa/climate/research/sst/oi-daily.php>

- Kuroshio stable vs unstable?

1.2.3 Processes of interest etc.

- Extra-tropical storm processes. Jimmy Booth to simulate pair of storms, whether one storm preconditions the later. Dependence on SST.
- Tropical to extratropical transition. Nick Bond has presented results showing that the forecasting skill for tropical storms that transition to extra-tropical storms is very low. He plans to run mesoscale experiments (with WRF model) with NCEP boundary and initial conditions. Pacific. End of summer/fall.
- Relationship of surface storm track to upper storm track. QuikSCAT observations show that the surface storm track (defined by variance of 10 m synoptic meridional winds) lies along the GS and extension. (Kelly, Small). In addition, the frequency of very high wind speeds (>20m/s) is high in warm SST patches associated with WBCs (Xie, Sampe, submitted). This is clearly important to mariners, forecasters etc. How deep does this WBC surface storm track extend, why does it exist, and how does it relate to the classic storm tracks defined in the free troposphere? (See also Hisashi's papers on this subject using numerical models and observations.)
- Depth of the atmospheric response to the WBC. Recent obs are suggesting that the response to the WBC extends as high as the mid to upper troposphere (Minobe, Xie, submitted). If this is so, will this affect remote climate variability via teleconnections? (Small)

1.3 Way forward

- Choose models and reanalysis data
- Define experiments (domain, dates, surface and lateral bcs, initial conditions): hopefully complementary between different groups (e.g. with high resolution mesoscale modeling of a short period included in a longer simulation of a regional model).