1998

Mesoscale Coastally - Trapped Response To Synoptic Variability

Nuss, Wendell A.

https://hdl.handle.net/10945/44299

Mesoscale Coastally-Trapped Response To Synoptic Variability

Wendell A. Nuss
Department Of Meteorology, Code MR/Nu
Naval Postgraduate School
589 Dyer Road, Room 254
Monterey, CA 93943-5100

nuss@arashi.met.nps.navy.mil
408-656-2308 (Office)
408-656-3061 (FAX)

Funding Document Number: N001498WR30111

LONG-TERM GOALS

The long term goal of this project is to improve our understanding and forecasting of mesoscale coastally trapped weather events along mountainous coastlines.

OBJECTIVES

The objectives of this project are to document the mesoscale structure of coastally-trapped phenomena along the U.S. West Coast, establish the relationship between the synoptic-scale structure and the onset of coastally-trapped disturbances, determine the sensitivity of coastally-trapped phenomena to synoptic-scale variability, and to establish forecast criteria for predicting coastally-trapped disturbances. This work is supported entirely by the Office of Naval Research Marine Meteorology program through the Coastal Meteorology Accelerated Research Initiative.

APPROACH

The primary approach used in this study is to document the structure and evolution of coastally-trapped disturbances through observational studies using drifting buoys, coastal profilers, and existing meteorological observing sites along the U.S. West Coast. A field program was designed and conducted during the summer of 1996 during which observations were collected for several coastally-trapped disturbances as well as other coastal weather events. Mesoscale and synoptic-scale surface and upper-level analyses have been done to document the forcing and evolution of the coastally-trapped disturbances. These analyses are being used to relate the evolution of these disturbances to the triggering synoptic-scale events that occur in the overlying atmosphere.

WORK COMPLETED

The primary tasks completed in 1998 have been related to the analysis of observations collected during the summer 1996 field program. Mesoscale surface analyses and synoptic-scale analyses of the upper-levels has been done for all wind reversal cases from 1996. These analyses include all available experimental data and are being used for diagnostic studies. Mesoscale analyses have been done subjectively by a student, Steven Sopko utilizing satellite imagery, aircraft, and other observations for these events. Larger-scale synoptic analyses have been done using the three dimensional multiquadric

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **1998**	2. REPORT TYPE	3. DATES COVERED **00-00-1998 to 00-00-1998**
4. TITLE AND SUBTITLE **Mesoscale Coastally-Trapped Response to Synoptic Variability**		5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)		5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Naval Postgraduate School,Department of Meteorology,Monterey,CA,93943-5502**		8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR’S ACRONYM(S) 11. SPONSOR/MONITOR’S REPORT NUMBER(S)
12. DISTRIBUTION/AVAILABILITY STATEMENT **Approved for public release; distribution unlimited**		
13. SUPPLEMENTARY NOTES **See also ADM002252.**		
14. ABSTRACT		
15. SUBJECT TERMS		

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**3**	

data assimilation system developed at NPS.

In addition to the processing of the 1996 field program cases, the classification and synoptic comparison of wind reversal cases from 1994-1996, completed during 1997, has been written as a paper for submission to Monthly Weather Review. This paper describes the character of the synoptic scale structure for coastal wind reversals that show distinct propagation and those that do not seem to propagate at all.

Finally, a study of the synoptic-scale relationships to the occurrence of a coastal jet near Pt. Sur was also done in 1998. This study utilized the NCEP Eta model and observations from buoy 46028 (southwest of Pt. Sur) and buoy 46042 (near Monterey Bay) to define the synoptic-scale structure associated with enhanced wind speed at buoy 28 compared to buoy 42. The basic hypothesis was that wind enhancements in the coastal jet around points and capes can be traced to basic signatures in the larger scale atmospheric structure.

RESULTS

The new results to report for 1998 come from the analysis of the 1996 wind reversal events and their relationship to the classification and synoptic characterization study done the previous year. The classification and synoptic characterization study reported for the previous year demonstrated that the synoptic-scale structure varies between propagating and non-propagating coastal wind reversals. The closer analysis of the 1996 events using the observations from the field experiment show more specifically how the synoptic-scale structure and forcing influences the coastally trapped wind reversal. Wind reversals from July and early September 1996 have been thoroughly analyzed (Sopko) and show very different synoptic forcings. The September case is strongly forced by the synoptic scale as the development of a coastal low is tied to the amplification and retrogression of a weak upper-level trough. This results in the reversal of the coastal pressure gradient and subsequent coastal wind reversal. The July case shows a synoptic structure more characteristic of the composites described by Mass and Bond (1996). In this case, the advection of warm temperatures across the coast north of San Francisco is very much responsible for the pressure gradient reversal and trapped disturbance. This case differed from the classic structure of Mass and Bond (1996) in that offshore flow was very weak and primarily associated with an amplifying thermal ridge in the mid-troposphere. These results (Sopko) indicate that the mechanism to produce the coastal pressure gradient reversal can vary considerably but that those associated with thermal forcing at low levels are more likely to produce a propagating disturbance.

The study of the coastal jet and its relationship to the synoptic-scale structure has yielded some important insights into the development of enhanced winds near points and capes. While these results are rather preliminary, they indicate that the synoptic-scale structure is very key to producing the coastal jet structure along the California coast. Not unexpectedly, the stronger the synoptic-scale pressure gradient and winds at 850 mb (above the marine boundary layer), the stronger the coastal winds tend to be. The jet only exists if the large scale supports it. More surprising was the fact that the periods of most enhanced winds to the south of points and cape was associated with stronger flow above the marine boundary layer and more pronounced cold advection. This synoptic-scale structure favors a deeper marine layer, which would tend to minimize the potential for super-critical channel flow and expansion fan wind enhancements near points and capes. The implication is that this synoptic structure provides an important upper boundary condition at the top of the marine layer which results in a stronger surface flow through thermal wind effects across the inversion. This study is not complete and these issues are being examined more thoroughly using the Pt. Sur soundings taken during 1996.

IMPACT

This work has an impact on coastal forecasting and tactical-scale meteorological modeling efforts. The dependence of the coastally trapped response and coastal jet on synoptic scale factors indicates the potential sensitivity of coastal forecasts of these events to synoptic scale model forecast errors.

TRANSITIONS

These results are being transitioned to operational forecasting uses through their presentation to the NWS forecasters in Monterey. Continued collaborations with these forecasters and publication of these results in a paper to be submitted to Monthly Weather Review will contribute to the transition of these results to operational forecasters.

RELATED PROJECTS

The Real-time Environmental Information Network and Analysis System (REINAS) project funded by ONR is related as datasets are being stored in the REINAS system and visualization tools are being developed from cases observed during the field effort. A coastal modeling project at DRI funded by DOD will also examine some of the cases observed during the field program.

REFERENCES

Coastal Meteorology Web Page: http://www.met.nps.navy.mil/~nuss/coast.html

Sopko, S. 1998: Synoptic and mesoscale structure of three coastally trapped wind reversals. NPS Masters Thesis.