COAMPS Simulations of the Coastal Atmosphere

Roger M. Samelson
College of Oceanic and Atmospheric Sciences, Oregon State University
104 Ocean Admin Bldg, Corvallis, OR 97331-5503 USA
phone: (541) 737-4752 fax: (541) 737-2064 email: rsamelson@coas.oregonstate.edu

Eric D. Skyllingstad
College of Oceanic and Atmospheric Sciences, Oregon State University
104 Ocean Admin Bldg, Corvallis, OR 97331-5503 USA
phone: (541) 737-5697 fax: (541) 737-2540 email: skylling@coas.oregonstate.edu

Award Number: N000140110231
http://www.coas.oregonstate.edu/~faculty/samelson.html

LONG-TERM GOALS

The long-term goal of this project is to improve our ability to understand and predict environmental conditions in the coastal zone.

OBJECTIVES

The objectives of this project are to conduct and analyze mesoscale model simulations of the coastal atmosphere using the Naval Research Laboratory's Coupled Ocean-Atmosphere Mesoscale Prediction System (COAMPS), to provide model-based atmospheric forcing fields to coastal ocean modelers, to compare COAMPS model results to scatterometer and aircraft observations and to other model results, and to investigate and quantify the response of the coastal lower atmosphere to sea surface temperature variations.

APPROACH

The approach used in this project is to combine numerical model results with in-situ and remote-sensing observations to understand and quantify physical processes in the coastal lower atmosphere and test their representation in mesoscale atmospheric models.

WORK COMPLETED

The COAMPS atmospheric model has been implemented for the Oregon coastal zone and daily simulations have been conducted and archived for the period June 2000 to September 2001 (http://www-hce.coas.oregonstate.edu/~cmet/). Statistics of the resulting wind stress fields over the coastal ocean have been computed for the period June through September 2000. Similar statistics for this period have been computed for the University of Oklahoma Advanced Regional Prediction System (ARPS) and the National Center for Environmental Prediction (NCEP) Eta model, and for observed

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **30 SEP 2001**	2. REPORT TYPE	3. DATES COVERED **00-00-2001 to 00-00-2001**

4. TITLE AND SUBTITLE **COAMPS Simulations of the Coastal Atmosphere**	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) **College of Oceanic and Atmospheric Sciences,,Oregon State University,104 Ocean Admin Bldg,,Corvallis,,OR, 97331**	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

14. ABSTRACT
The long-term goal of this project is to improve our ability to understand and predict environmental conditions in the coastal zone.

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)**	**5**	

wind stress fields from the QuikSCAT/SeaWinds scanning microwave scatterometer. A preliminary comparison of these COAMPS, ARPS, Eta, and QuikSCAT wind stress fields has been completed.

Some initial model configuration and testing has been completed for the study of sea surface temperature effects on the coastal lower atmosphere. In addition, this project has provided partial support for related efforts associated with observations of the coastal ocean and atmosphere during summer 2001, including daily forecast guidance for aircraft and shipboard operations.

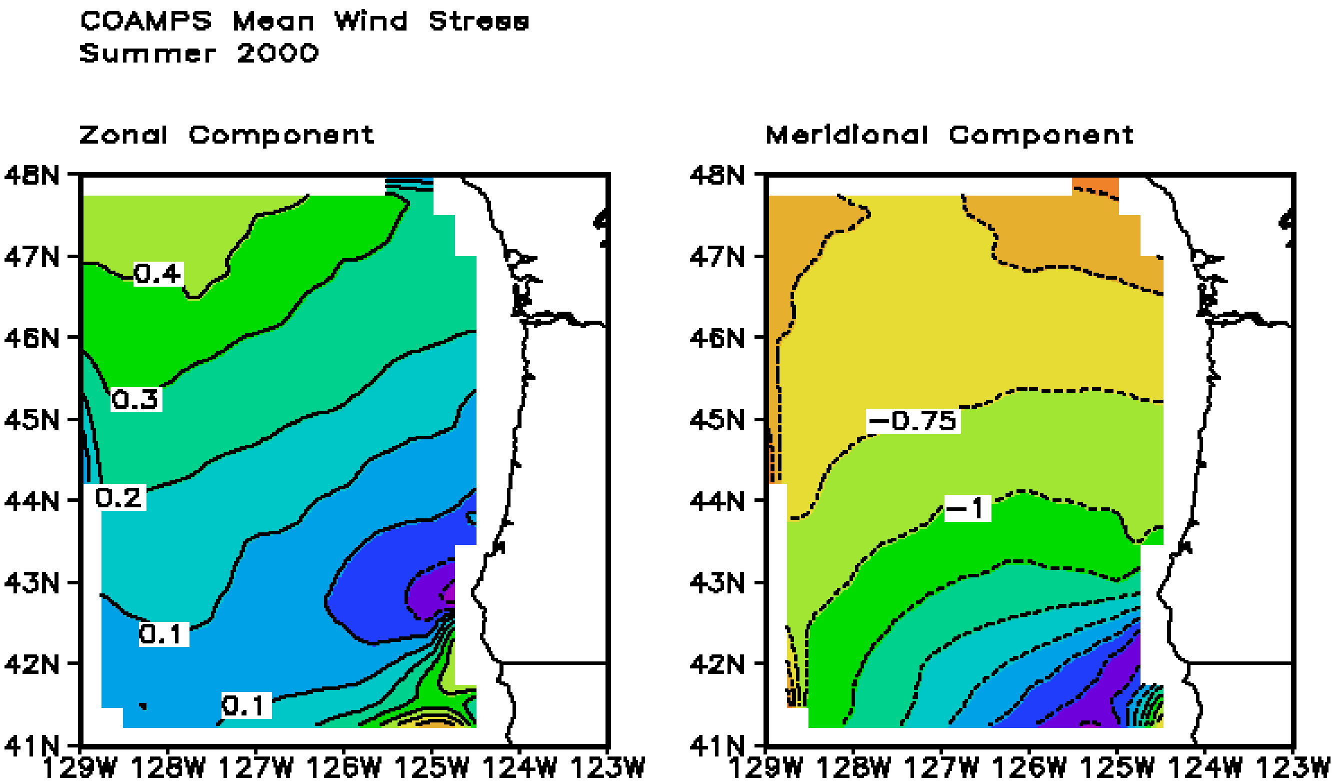

Figure 1. Contours of zFigure 1 zonal (left panel) and meridional (right panel) mean wind stress (dyn cm^{-2}) for 15 June through 30 September 2000, from daily COAMPS simulations, computed from stress fields coincident with nominally twice-daily QuikSCAT scatterometer observed stress fields. Cape Blanco is the westernmost land point, near 42.8N, 124.6W. Contour intervals: 0.1 (left panel) and 0.25 (right panel) dyn cm^{-2}.

RESULTS

The initial comparison of model and scatterometer wind stress fields during summer 2000 has revealed a number of interesting features that will be the subject of continued investigation. The mean summer 2000 stress fields from the scatterometer and all three models show structure that is qualitatively similar to that found in a preliminary model-scatterometer comparison during summer 1999 (Samelson et al., 2001): clockwise rotation of stress southward along the coast, from southeastward in the north to southward in the south, with attendant southward increase in southward stress, and localized intensification near Cape Blanco in the south. There is approximate quantitative agreement between the COAMPS (Figure 1) and QuikSCAT (Figure 2) mean stress fields. COAMPS overestimates mean meridional stress, relative to the QuikSCAT observations, by an amount ranging from roughly 0.1 dyn cm^{-2} in the north to 0.25 dyn cm^{-2} in the local maximum near Cape Blanco. In contrast, both the ARPS and Eta models underestimate the mean stress, relative to the QuikSCAT observations. The Eta model also places the axis of maximum mean stress near Cape Blanco roughly 50 km northwest of its location in the QuikSCAT observations and the other two models. We interpret the intensification near Cape Blanco as an orographic effect similar to those previously observed and modeled along the California coast (Winant et al., 1988; Samelson, 1992; Burk et al., 1999).

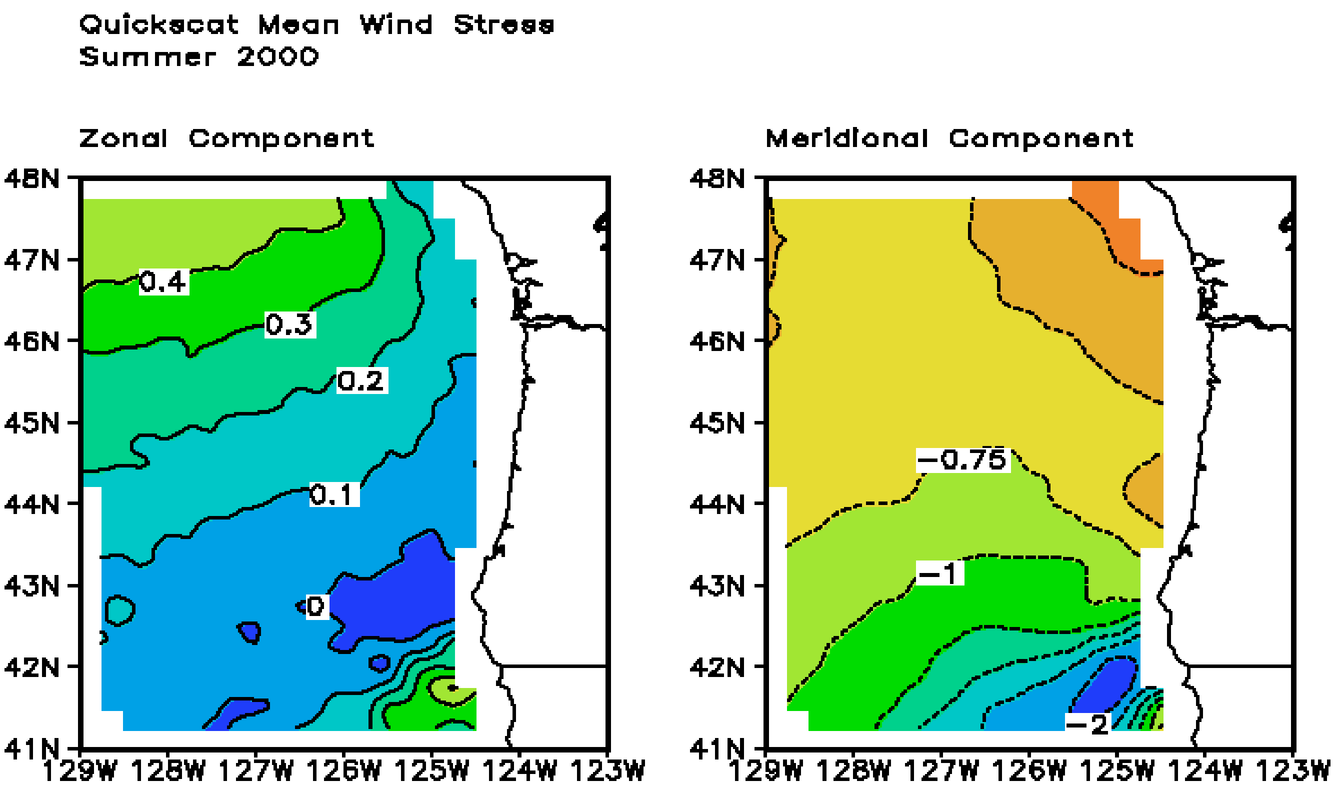

Figure 2. Contours of zonal (left panel) and meridional (right panel) mean wind stress (dyn cm^{-2}) for 15 June through 30 September 2000, from nominally twice-daily QuikSCAT scatterometer observations. Cape Blanco is the westernmost land point, near 42.8N, 124.6W. Contour intervals: 0.1 (left panel) and 0.25 (right panel) dyn cm^{-2}.

The COAMPS simulations are also yielding interesting information on the diurnal cycle along the Oregon coast. Since the twice-daily scatterometer passes coincidentally occur roughly at opposite phases of the diurnal cycle, they may be analyzed to extract diurnal effects. The COAMPS simulations and QuikSCAT observations reveal a reversal of the diurnal cycle of alongshore stress off the southern Oregon coast that is only weakly or not at all apparent in previous observations and modeling (Bielli et al, 2001) and in the summer 2000 ARPS and Eta model results. This reversal involves intensification of the southward meridional stress offshore and south of Cape Blanco during the local morning hours, instead of the local evening as is found over most of the coastal domain. Analysis of the dynamics of this reversal is in progress.

IMPACT/APPLICATIONS

The primary potential future impact of these results is on the design and use of prediction systems for coastal oceanic and atmospheric conditions.

TRANSITIONS

Wind stress fields obtained in this project are being used in dynamical and data assimilation studies by coastal ocean modelers (J. S. Allen, OSU).

RELATED PROJECTS

The ARPS and Eta components of this study and the summer 2001 aircraft observations are supported by the NSF project "COAST: Coastal Ocean Advances in Shelf Transport." The QuikSCAT scatterometer component of this study is being conducted in collaboration with D. Chelton and M. Freilich (OSU), with support from NASA Grant NAS5-32965 for Ocean Vector Winds Science Team activities. Part of the research on the lower atmosphere response to sea surface temperature is being conducted in collaboration with L. Mahrt (OSU). Additional support for the research reported here has been provided by the ONR project "Predictability in Unstable, Continuous Systems."

REFERENCES

Bielli, S., P. Barbour, R. Samelson, E Skyllingstad, and J. Wilczak, 2001. Numerical simulations of the diurnal cycle along the Oregon coast during summertime northerly flow. Monthly Weather Review, submitted.

Burk, S, T. Haack, and R. Samelson, 1999. Mesoscale simulation of supercritical, subcritical, and transcritical flow along coastal topography. J. Atmos Sci., 56, 2780-2795.

Samelson, R., 1992. Supercritical marine-layer flow along a smoothly varying coastline. J. Atmos. Sci., 49, 1571-1584.

Samelson, R. M., P. Barbour, J. Barth, S. Bielli, T. Boyd, D. Chelton, P. Kosro, M. Levine, E. Skyllingstad, and J. Wilczak, 2001. Wind stress forcing of the Oregon coastal ocean during the 1999 upwelling season. Journal of Geophysical Research-Oceans, accepted with revisions.

Winant, C., C. Dorman, C. Friehe, and R. Beardsley, 1988. The marine layer off northern California: An example of supercritical channel flow. J. Atmos. Sci., 45, 3588-3605.