

# **DYNAMICS OF FORCED COASTAL-TRAPPED DISTURBANCES**

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## **LONG-TERM GOALS**

The long-term goal of this project is to improve our ability to understand and predict meteorological conditions in the coastal marine atmospheric boundary layer.

## **OBJECTIVES**

The objective of this project is to investigate the dynamics of coastal marine atmospheric boundary layer winds including the generation and propagation of coastal-trapped disturbances and their interaction with coastal orography and with orographically-modified ambient winds.

## **APPROACH**

The approach taken in this project is to obtain analytical and numerical solutions of idealized mathematical models of the marine atmospheric boundary layer and to compare these solutions to observations and to results from more complex models.

## **WORK COMPLETED**

Numerical model solutions of hydraulically supercritical and subcritical flows have been computed for domains with irregular coastline geometry. The nonlinear interaction of coastal-trapped disturbances and transcritical steady-state flows has been analyzed (Rogerson, submitted 1997).

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The vertical structure of coastal-trapped disturbances has been analyzed for linear models with continuous and two-layer stratification (Samelson, submitted 1997a).

## **RESULTS**

The numerical investigation of transcritical flows has described the spatial structure of steady-state flows corresponding to different levels of constant pressure-gradient forcing, and the interaction of coastal-trapped disturbances with the steady base flows. The model flows demonstrate that nonlinear coastal-trapped disturbances can be halted near coastline bends by supercritical flow conditions. The interaction of strong coastal-trapped disturbances with supercritical regions of the flow is accompanied by an eddy-generation process that resembles satellite images of stratus during the observed May 1982 coastal-trapped event off California.

The analysis of the vertical structure of coastal-trapped disturbances has shown that the presence of a stable layer above the boundary layer inversion increases the gravest mode phase speed and supports the existence of higher modes. Results from the two-layer study suggest that the observed vertical structure of isotherms at the leading edge of the 10-11 June 1994 event may arise during a transition from a directly forced, barotropic, alongshore velocity response to a regime dominated by wave propagation, as coastal-trapped vertical modes excited by mesoscale pressure gradients begin to disperse at their respective phase speeds.

Ongoing research is focused on numerical investigation of the forcing, propagation, and decay of nonlinear coastal-trapped disturbances. Collaborations with Steve Burk (NRL-Monterey), to compare idealized model flows with COAMPS simulations, and with Kate Edwards and Clint Winant (SIO) to perform model/data comparisons, are underway.

In addition, this project has provided partial support for studies of the coastal ocean response to wind forcing (Samelson, 1997b), the effect of spatial variations in turbulent mixing on the large-scale ocean circulation (Samelson, 1997c), and chaotic mixing in a quasi-geostrophic jet (Rogerson et al., 1997).

## **IMPACT**

Results from this theoretical and numerical modeling effort will contribute to the overall goal of improving weather prediction models through enhanced understanding of the dynamics that control coastal meteorological conditions.

## **TRANSITIONS**

## **RELATED PROJECTS**

This work is part of the ONR Coastal Meteorology ARI.

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