The Interaction Between Propagating Disturbances and Supercritical Marine Layers on the West Coast of the United States

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LONG-TERM GOALS

In the future, we hope to expand our investigations into the dynamics and clouds of the marine layer. We wish to investigate the relationship between the large scale, upper atmospheric forcing and the marine boundary layer response and the formation of low clouds and fog.

OBJECTIVES

The major objective is to develop a description of the summer marine boundary layer along the west coast. The data captured, and the description will be used to investigate coastally trapped waves in the marine layer, the nature of turbulence, the roll of gravity waves in the near shore, and the extent of supercriticallity in the marine layer.

APPROACH

Make summer surface and aircraft measurements along the California and Oregon coast. Combine other sounding and profiler measurements from other sources to make a data net that extends from San Diego, California to Newport, Oregon. Apply theories to and test hypothesis on the data network.

WORK COMPLETED

Thirteen automated stations were constructed rather than purchased to have properties that were not easily incorporated in purchased stations at a better price. Improvements include minute averages, the highest accuracy commercially available pressure sensor in a remote station, aspirated temperature and humidity seasons and memory logged on flash cards. Stations deployed and maintained along the California coast and from 10 May through 15 October 1994. Twelve RAF C-130 flights were made along the central California Coast in July 1994. Automated stations deployed and maintained along the West Coast between Piedras Blancas, CA to Gold Beach, OR from 12 May through 20 October 1996.

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Papers have been published, or are accepted for publication on the 1994 field season and the 1996 field season. Additional papers are in preparation on long gravity waves in the marine layer and the relation between surface wind divergence and marine layer clouds.

RESULTS

A major result of this study is the measurement of the summer atmospheric marine layer structure between central Oregon and California. This includes the coastal and buoy winds, the inversion base height, the inversion top height and inversion strength.

Our hypothesis is confirmed that the summer marine boundary layer along Southern Oregon and to past Point Conception California and beyond 124 W is supercritical or near supercritical a majority of the time. For every major cape and many minor capes, there is a supercritical expansion fan is on the southern side where the marine layer flow accelerates and thins. On the upwind side of every major cape is a compression bulge where the marine layer thickens and slows .

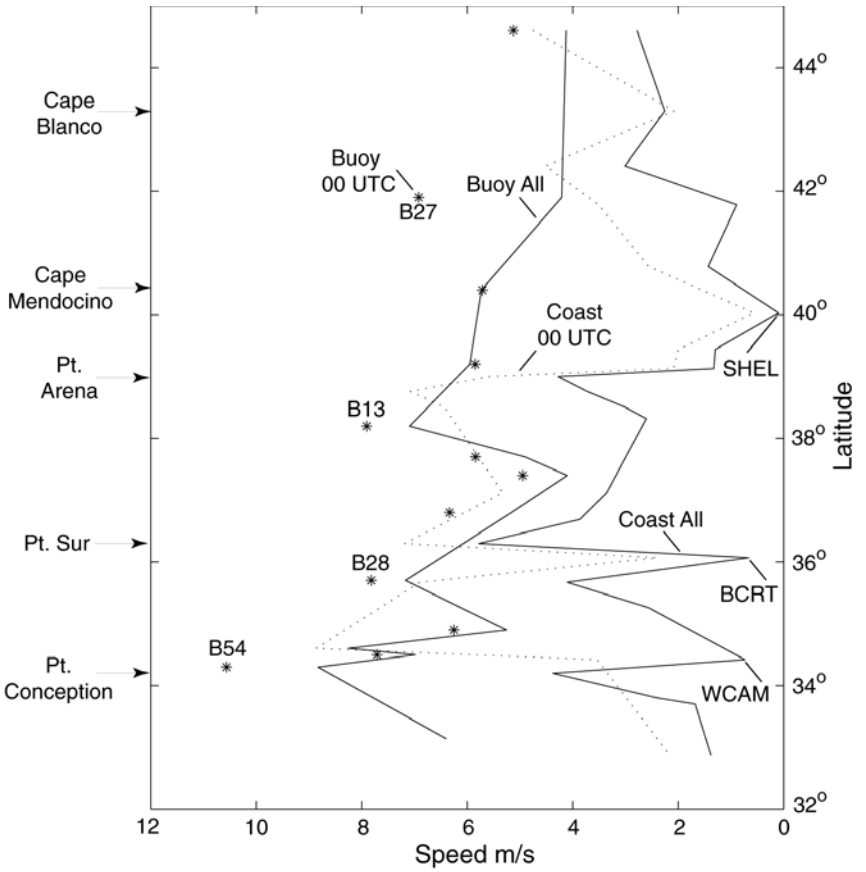

Figure 1. Wind speeds vs latitude. Offshore stations means are the left line and coastal station means are the right line. Diurnal maximum at 1600 PST are shown for the offshore stations (asterisk) and coastal stations (dashed line).

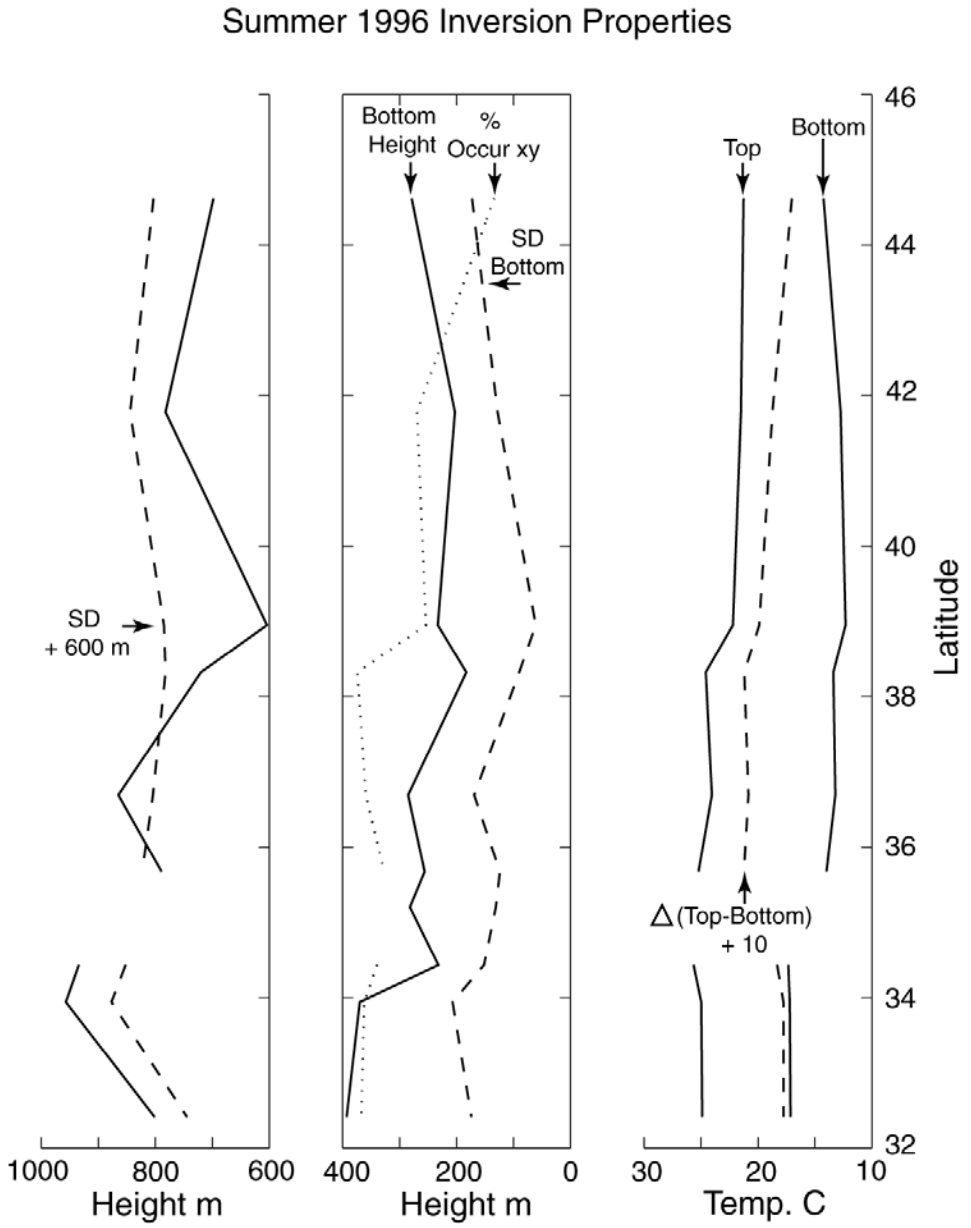

Figure 2. Inversion Properties Left frame: Inversion top height (solid) and standard deviation + 600 m (dashed). Middle frame: Inversion base height (solid), standard deviation (dashed), and percent occurrence of inversion (dotted). Right frame: air temperature of the inversion top (solid, upper), air temperature of the inversion base (solid, lower), temperature difference top minus base +10 C (dashed).

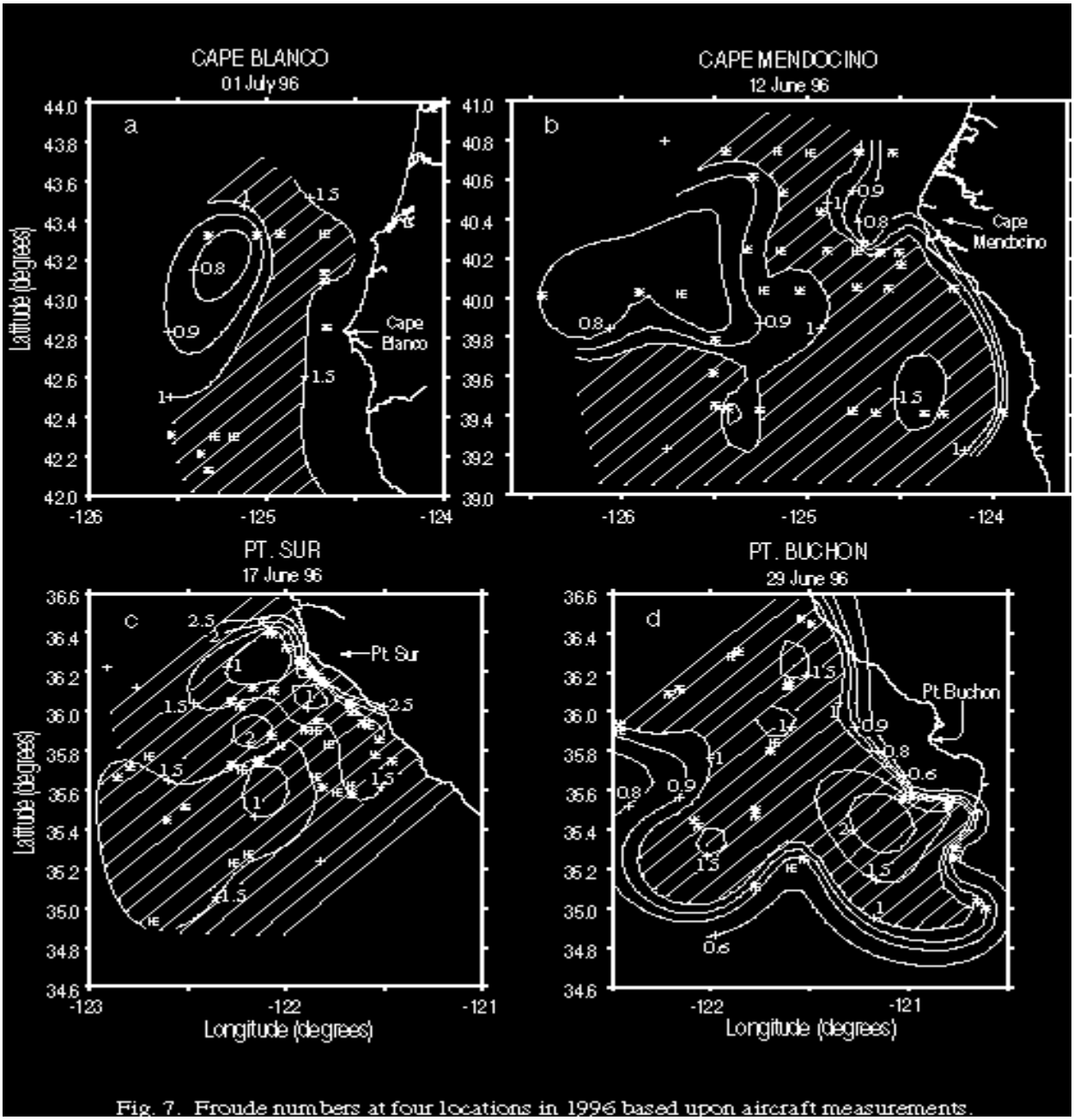

Fig. 7. Froude numbers at four locations in 1996 based upon aircraft measurements.

The Froude number is > 1 and therefore supercritical in the hatched areas. Computation is base upon aircraft soundings, the locations of which are denoted by the asterisks.

IMPACT/APPLICATIONS

The system of 13 automated meteorological stations may be used again for another season to make high quality, high frequency measurements of the coastal zone.

TRANSITIONS

Data from this project was exchanged with NRL Monterey. This included surface observations and aircraft data that was used to test and evaluate the NRL COAMPS model. A copy of all surface hourly observations for the 1994 season has been transferred to Dr. Wendell Nuss in the Meteorology Department at the Naval Post Graduate School so that he may relate the synoptic scale with the local coastal response.

RELATED PROJECTS

1. Within ONR: We have combined our data and work with Wendell Nuss (profiler and sounding data in the Monterey Bay area), and Bill Neff (Profilers at several sites). This forms an antenna to capture the structural aspects and investigate the dynamics of the marine layer. John Baine's light aircraft flight data is being used to shed light on the 9/10 June 1994 trapped event and conditions in the Santa Barbara Channel in 1996.

2. MAST: Sounding data study in the Monterey area that was taken during the MAST June 1994 intensive will be utilized. We are maintaining contact with MAST investigators to make available our data bank.

3. MMS: We are pooling data with this project to extend the data net coverage along the coast. The MMS study has 5 automated meteorological station in the Santa Barbara Channel which was useful for investigating the source of the 9/10 June 1994 trapped event and are helpful in looking other events that occurred in the 1996 summer season.

4. COST '96: The National Science Foundation funded Rogers and Dorman to make NCAR C-130 flights along the California coast in June 1996. Tracks were flown at multi levels down to 30 m and as far as 120 km offshore off the major topographic caps as Cape Mendocino, Pt Sur and Pt Conception.

PUBLICATIONS

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