

DEVELOPMENT OF FORECAST GUIDANCE FOR SANTA ANA CONDITIONS*

Lawrence D. Burroughs (1)
NOAA/NWS
Ocean Products Center
Washington, D.C.

ABSTRACT

A statistical system has been developed to provide forecast guidance on Santa Ana conditions along the southwestern coast of southern California and the associated winds at several locations. A description of the development of the system is given. Test results on independent data are shown. Examples of the guidance product are provided, and some operational considerations are presented.

1. INTRODUCTION

The Glossary of Meteorology (2) defines a Santa Ana as a "hot, dry, Foehn-like desert wind, generally from the northeast or east, especially in the pass and river valley of Santa Ana, Calif., where it is further modified as a mountain gap wind. . . ." Actually, all of southern California is affected. Wind speed and direction at the coast depend on synoptic scale events, interaction of the Santa Ana circulation with the sea breeze circulation, and topography. Intensity and duration are also dependent on synoptic forcing and mesoscale interaction.

The Santa Ana is generally thought of as a fire weather or aviation weather problem; however, it can also be a marine weather problem. This is particularly true in the San Pedro and Santa Barbara Channels and at the boat harbor at Avalon, Santa Catalina Island, California (AVC) (see Fig. 1). This paper describes the National Weather Service's efforts to develop automated forecast guidance for Santa Ana conditions along the southwestern coast of California. This system forecasts the presence or absence of Santa Ana conditions and the associated winds at the Naval Air Station, Point Mugu (NTD); the Marine Corps Air Station, Santa Ana (NTK); AVC; the Naval Facility, San Nicolas Island (NSI), and the Naval Air Facility, San Clemente Island (NUC) (see Fig. 1).

2. SYNOPTIC FORCING, MESOSCALE INTERACTION, AND TOPOGRAPHIC EFFECTS

Complete details about synoptic forcing, mesoscale interaction, and topographic effects are given by Rosenthal (3) and Richardson (4). Additional details, particularly about the vertical structure of Santa Anas are given by Fosberg et al. (5).

There are three major synoptic events which, when they occur simultaneously, normally give rise to Santa Ana conditions over southern California. These are the development of high pressure over the Great Basin (see Fig. 2), the passage of fronts through southern California, and the development of north to northeast flow aloft along the west coast of the United States. There is a fourth synoptic event which rarely occurs but which gives rise to some of the most intense Santa Ana winds at the coast. This event is the development of a surface low off the southern California coast in addition to the above conditions. The resulting Santa Ana is often associated with showery, unstable conditions and winds of gale (35 to 50 kt) or even storm (> 50 kt) strength.

According to Fosberg et al. (5), the Santa Ana is primarily a lee wave phenomenon, and air flow is nearly isentropic. The

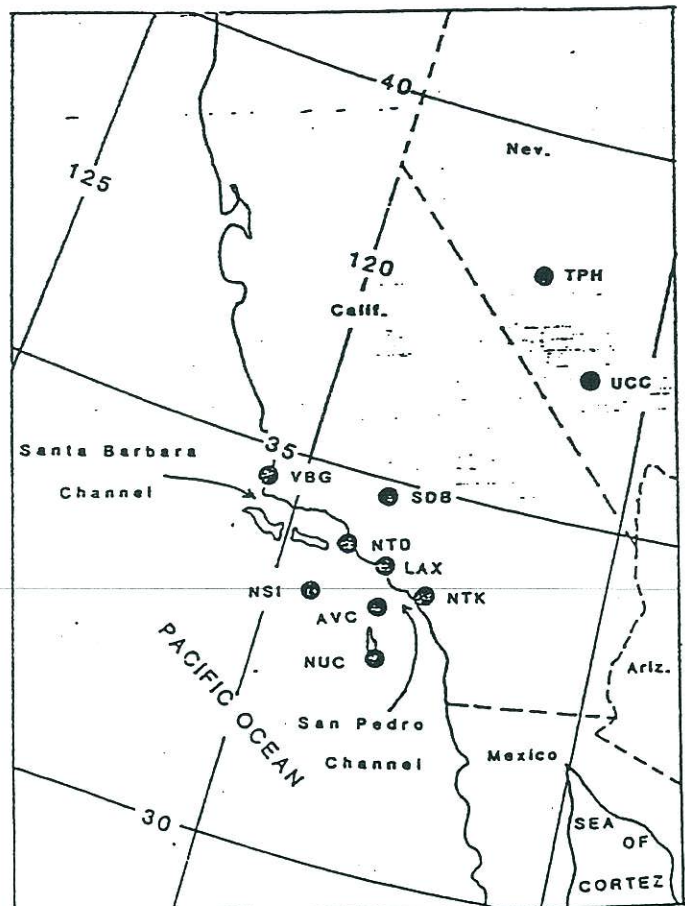


Fig. 1. Station locations for Santa Ana wind forecast system.

mountain ranges of southern California act as barriers to flow out of the Great Basin region. When flow is perpendicular to the mountain ranges, and the static stability and wind shear upstream of the ranges, mountain waves form. When the amplitude of the waves is large, they reach the surface; when the amplitude of the waves is small, they don't. There are periodic and aperiodic components in the surfacing. The periodic components are associated with the interaction of localized circulations, such as the sea breeze, with the mountain waves. The aperiodic effects are determined by the static stability and wind structure upwind of the mountain barrier and are the prime factors in the surfacing. In addition, the air is forced to flow around the San Gabriel mountains and through the major passes. Wind speeds tend to be enhanced through the passes because of venturi effects, and wind direction tends to be oriented along canyon and valley axes.

*Ocean Products Center Contribution No. 1