Oscillations of the West Coast Subsidence Inversion in Relation to the Forecasting of Stratus

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To study the factors to be considered in forecasting the ceilings in summer stratus over Southern California, a close network of upper air observing stations was established during 1944. Four-hourly radiosonde observations were taken at five stations in the area, and for a short period captive balloon soundings were obtained from a ship just off the coast. These observations were augmented by airplane soundings and upper wind observations. The project was carried out cooperatively under the Joint Meteorological Committee, through the cooperation of the meteorological services of the U. S. Army Air Forces, the U. S. Navy Bureau of Aeronautics, the Weather Bureau, and the University of California at Los Angeles.

Study of the data showed that the stratus top is almost invariably at the base of the strong inversion which is present over the region throughout the summer. The relative humidity in the clouds was frequently considerably below 100%, 90% being the most frequent maximum value in stratus over the Los Angeles area. The departure from 100% is attributed to the presence of hygroscopic nuclei, due principally to industrial pollution.

The inversion, on the average, slopes upward from the coast both toward land and sea, but shows no definite slope in a direction parallel to the coast until late in the summer. Its height shows a definite diurnal oscillation which varies in a direction normal to the shore. Over the sea and near the shore the inversion is highest in the morning and lowest in the evening, while inland its maximum height occurs in the afternoon. Analysis of the diurnal variation showed that over the sea it is caused primarily by the divergence of the diurnal wind oscillation, to which is added over land the influence of insolational heating and the advection of changes in inversion height due to its slope.

Study of the diurnal wind oscillation in the region indicated that the land-sea breeze at the shore merges with the valley-mountain wind to form a continuous flow. Its observed vertical structure agrees with that of the theoretical model, with the land breeze aloft persisting after the sea breeze sets in at the ground to form the counter-current to it, and vice versa. The diurnal wind oscillation is not limited vertically by the inversion. Both the sea breeze and the land breeze start near the ground and increase in thickness with time. In about half the cases of stratus at UCLA the land breeze had reached the inversion before stratus occurred; so advection could not be responsible for its occurrence.

In addition to the diurnal oscillation of the inversion, there are marked variations in its daily average height and other characteristics. The daily average height is associated with the occurrence of stratus, days with no stratus having low inversions. The inversion height is strongly correlated to the coast-inland pressure gradient. Prediction of pressure gradient is dependent on forecasting of the pressure field.

Since the pressure changes in Southern California in summer are small and subtle, an understanding of the mechanism producing them is necessary to enable one to forecast them. The hypothesis that they are waves in the southerly flow aloft seems inconsistent with the observations. Further investigation of this question is essential to the solution of the problem of stratus forecasting. For the present, kinematic methods using pressure tendencies or 24-hour pressure changes must be used.

From the forecast of the pressure field, the trajectories of the air which will reach the station may be evaluated, and the structure of the air deduced. Consideration of the average diurnal variation and probable deviations therefrom, *together with the relationships* between stratus and temperature structure, will yield a forecast of the stratus duration and ceiling.

Further study of the data is planned with emphasis on finding the causes for the deviations from average diurnal behavior, and devising methods for forecasting the trajectories of air reaching the region and the effects of them on the structure of the air.—*Authors' summary.*

In the *discussion*, Floyd Young mentioned the definite diurnal variation in haze—clear in the morning, hazier as the day goes on.