wind instruments were installed early in 1957 on the summit of Mt. Lincoln, 8,383 feet above sea level, on the south side of Donner Pass. Instrumental difficulties, especially icing, prevented a usable record during the early months; if these can be overcome, this installation will provide further valuable information on wind movement in the central Sierra Nevada.

In addition, a continuous recorder has been attached to the wind instruments at the Blue Canyon Airways Station of the Weather Bureau, 18 miles west of the laboratory. Records from this location, on a mesa-like hill exposed to winds from all directions, together with those from Mt. Lincoln, will be used for further studies of wind behavior during snowfall in the central Sierra Nevada.

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NEW METEOROLOGICAL AND SNOW STUDIES IN THE CENTRAL SIERRA

By

Kenneth J. Walsh[1/]

A major phase of "Operation Wet Blanket"[2/] is the initiation of new meteorological and snow physics studies in the Central Sierra Nevada. To carry out these new studies, the Forest Service has reactivated the Central Sierra Snow Laboratory near Soda Springs, operated from 1946 to 1953 by the Corps of Engineers and the U. S. Weather Bureau. Reactivation has involved resumption of many of the basic measurements of snow and weather as well as several new ones.

Our meteorological and snow physics studies in the Central Sierra Nevada are not as intensive as those made at the peak of the Engineers' activity at the Central Sierra Snow Laboratory, but they are more extensive. We have set up five meteorological and snow stations. Periodic measurements at one or more stations include incoming and outgoing short wave and long wave radiation, barometric pressure, wind, temperature, relative humidity, snow fall, and snow characteristics. Two of the sites are in the Castle Creek Basin, two in the Onion Creek Basin 6 miles to the south, and one at Blue Canyon, 15 miles to the west. Continuous measurements of the physical elements which affect snow management will provide a necessary base for evaluation of short-term studies of snow physics and long-term studies of snow accumulation and melt and evaporative losses.

Mt. Lincoln Studies

The most spectacular—and also most difficult—of our new studies in the central Sierra is that of wind and temperature on the summit of Mt. Lincoln. This is a flat-topped, well-exposed peak, 8,300 feet above sea level on the crest of the Sierra Nevada about 2 miles south of Donner Pass; it is situated just at the head of our Onion Creek experimental watersheds. The recent installation of a chair lift by the Sugar Bowl Corporation makes Mt. Lincoln the highest mountain peak in the Sierra that is accessible throughout the winter.

Through the generous cooperation of the Sugar Bowl management, we were able to install a recording anemometer and wind direction indicator on the top of the upper tower of the chair lift. A standard instrument shelter, with hygrothermograph, psychrometer, and maximum and minimum thermometers, is anchored nearby. The wind speed and direction recorder and a barograph are installed in a nearby Ski Patrol shelter hut.

No electric power is available on this mountain-top site to keep the anemometer or the wind vane free from snow and ice. During storms in February and March 1957 solid ice more than a foot

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2/ Snow management research conducted by the California Forest and Range Experiment Station in cooperation with the State of California, Department of Water Resources.

thick built up on all surfaces; the anemometer and wind direction indicator were frozen solidly under glaze ice. The instruments were unoperative for several days; no one dared climb the ice-laden ladder, until the sun and wind helped to free instruments from the icy grip.

Clocks were another difficulty. Charts for the wind recorder or hygrothermograph records would not operate at extreme low temperatures; minimum temperatures during the winter months were in the -5 to -20 Celsius range. However, clocks cleaned and oiled sparingly at strategic points with special low-temperature oil operated successfully most of the time.

The instrument shelter was anchored to an old white pine snag about 150 feet west of the tower. Ice storms deposited ice not only on outside surfaces, but, on at least two occasions ice was even deposited on the hygrothermograph hairs. Driving snow storms usually filled the instrument shelter and the hygrothermograph with snow. Since severe storms usually stopped operation of the ski tow, a considerable amount of data was lost.

These difficulties will be alleviated or eliminated for the next snow season by relocating the instrument shelter to eliminate snow drift directly into the shelter, and by redesigning the anemometer and wind direction indicator so they can be heated. Heat will be supplied from propane gas or electrically from a wind-driven generator.

Studies at the Laboratory Headquarters

An instrument shelter has been mounted in an opening just south of the headquarters building. It can be raised or lowered to be about 4 feet above the snow surface. Temperature and relative humidity within the shelter are recorded by hygrothermograph; readings are checked daily by use of a psychrometer and maximum and minimum thermometers.

Precipitation is measured by a weighing-type rain and snow gage mounted in a forest opening at an elevation of about 15 feet above the ground (about 4 feet above the average maximum snow depth). Snow depth is measured daily, and water equivalent of accumulated snowpack is measured three times per week at several points within the opening. In addition, a snow board is used to determine amounts of new snowfall daily. Crystal type and size of new snow are measured here.

An anemometer and wind direction indicator are mounted on a stripped tree nearby. Data from these are recorded continuously.

Radiation records are taken by instruments maintained at a height of about 6 feet above the snow surface. Short-wave radiation, incident and reflected, is measured by means of Eppley pyrheliometers; all-wave radiation, hemispherical and net, is measured by means of Beckman-Whitely radiometers. All radiation data are continuously recorded.

Upper Meadow Studies

The 1956-57 winter measurements were taken at the Castle Creek No. 5 snow course, located in the Upper Meadow. This course has been measured for the California Cooperative Snow Surveys since 1946. Regular snow course measurements of snow depth and water equivalent are taken at weekly intervals. In addition, an instrument shelter was mounted on a pole so that it could be maintained about 4 feet above the snow surface. Temperature and relative humidity within the shelter are recorded by a hygrothermograph; these readings are checked weekly by use of a psychrometer and maximum and minimum thermometers. A snow board was placed near the instrument shelter to measure weekly accumulation of new snowfall.

Onion Creek Studies

Accumulated precipitation and of snowpack depth were measured within the Onion Creek drainage. The Onion Creek snow course, part of the State Cooperative Snow Survey since 1939, was measured once each week. In addition, two forest openings were selected within the drainage in which to measure precipitation and snowpack. One of these sites is located in the lower part of the basin about 150 feet north and upslope from the State snow course. The other is located in the upper part of the basin about 1/4 mile southwest of Mt. Lincoln at an elevation of about 7,500 feet, just below the uppermost extent of timber.

At each of these sites accumulated precipitation is measured by use of Sacramento-type storage gages. Snow depth and water equivalent of the snow is sampled at several points within each opening at weekly intervals.

Blue Canyon Studies

To provide wind direction and velocity measurements at another "mountain top" station, recorders were installed at Blue Canyon where they will be operated with the cooperation of the Weather Bureau. The Blue Canyon Station is on a flat-topped ridge some 15 miles to the west of the laboratory headquarters. Wind records from this station will be correlated with and supplement those taken on Mt. Lincoln.

Conclusion

The new basic measurements of the meteorological elements and snow at five stations in the Central Sierra, together with the Corps of Engineers-Weather Bureau records, will provide sound physical base for studies of snow accumulation, snow melt, and evaporative losses from snow and soil in the Central Sierra.

THE USE OF FOURIER SERIES IN STREAMFLOW FORECASTING

By

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Scope

Brevity and clarity require that only the basic idea involved in the Use of Fourier Series in streamflow forecasting be presented in this paper. Several variants on the procedures herein described are currently under investigation. These additional studies are in varying stages of completion. As far as they have been completed they show considerable promise.

The method herein described has been used only on the Logan River in Utah. As soon as possible it will be tried on other streams. Thus far, however, the objective has been to experiment with several forecasting methods for one stream before advancing to other streams.

Basic Data

Basic data should be consistent. That is, all data including precipitation, streamflow, temperature, snow survey, etc. should be corrected for any changes in location of the station or for any other changed conditions or procedures under which the data were collected.

Data available for these studies included:

1. Daily and average monthly temperatures at valley stations.
2. Daily and monthly precipitation at valley stations.
3. Daily and monthly streamflow, Logan River near Logan, Utah.
4. April 1 snow survey data at 7 mountain stations in the Logan River drainage. At some stations snow data are available for other times of the year, but in this analysis only the April 1 data were used. The method described herein, however, can be adapted to snow data collected on a monthly basis.

Soil moisture data are now being collected at 4 stations in the Logan River watershed. Data are insufficient yet to be included in this analysis. The method can be adapted to include soil moisture data as soon as sufficient data are available.

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