JOINT COLLOQUIA

A special Colloquium was held in January 1962 at which Mr. Jerome Namias, Chief of the U.S. Weather Bureau's Extended Forecasting Branch was the speaker. A summary of his talk follows.

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Feed-back Influences of Surface Abnormalities or Short Period Climatic Fluctuations

by J. Namias

Climatic fluctuations are influenced by

(1) Abnormalities in sea water temperatures

(2) Abnormalities in soil condition; whether it was dry or wet

(3) Variations in snow cover.

Of these, droughts and abnormalities in soil condition associated with it would be of special importance to Australia.

Firstly, though deviations in ocean water temperatures were small (about 6° - 8° at most), they were extensive and therefore a large source of heat. Abnormally high sea water temperatures were caused by an abnormality in the northerly component of the wind system over the sea. This is a feed-back effect, as abnormal sea temperature could in turn affect the wind system.

A special study was made of the recurrence of certain periodic features, such as drought and abnormal surface phenomena, with a view to finding out what causes them. For this purpose average monthly and seasonal 700 mb charts were studied. 700 mb charts for the seasons summer 1957 through to spring 1958, showed a steady eastward displacement of a trough and its associated anomaly from west-central Pacific to the west coast of the United States. There was also high correlation between anomaly fields at 700 mb and in the surface charts. Good correlation was also observed between the northerly drift of winds and temperature anomalies.

It was also found that during the period summer through fall to winter, the anchored Asiatic trough associated with monsoons develops each year but not in the identical position. It could sometimes cause an increase in zonal winds over the ocean and give a boost to cyclones along the front of the Asiatic Monsoon.

Secondly, soil condition is associated with droughts and appears to have a marked feed-back effect. In the Great Plains of the United States, drought effects have lasted for several years.

In the regional pattern of the circulation associated with droughts in the Great Plains, an anticyclone is evident in the 700 mb chart of departures from normal, with subsiding dry air flowing into its core from the northern westerlies. Persistent anticyclones of this type are almost always accompanied by well developed anticyclones over the adjacent oceans. Mean charts of many years showed that these sub-tropical anticyclones are in harmonious arrangement and if any two exist, the third is favoured to develop.

Auto-correlation is evident between spring and summer, and also between the land anti-cyclone and the two oceanic cells. It appears evident that the spring circulation regime over the plains determines weather to such an extent that the ground is influenced and controls subsequent circulation and weather. This feed-back mechanism might operate through rainfall. Now, when the southern plains have been dominated in spring by a dry regime (which is usually warm too) and the soil desiccated, a persistent upper level anticyclone in early summer is favoured, as over a desert. On the other hand, following a wet spring some of the heat might be used to evaporate the excess water in and on the soil, and will not be available perhaps to sustain the upper level anticyclone.

Tests were made with 60 to 84 years' records of average temperatures and total precipitation using classes of temperature as cold, normal and warm, and of rainfall as light, moderate and heavy. Contingency tables were prepared showing the frequencies with which the different summer temperature and precipitation classes followed the various combinations of spring conditions (e.g., cold and wet, warm and dry). It showed that desiccating springs (warm and dry) favour the droughty summers, for summer warmth goes with dryness.

It was also found that cyclones to the north of the Pacific cell cause an increase in temperature and feed-back to the cell. Mr. Namias also indicated that there was a peak in wind speeds of zonal westerlies in high latitudes. It was not certain whether this and other effects are caused by extra-terrestrial sources such as solar flares or the quantity of ozone in the upper atmosphere.

He went on to compare the Australian and Antarctic regions with the corresponding regions in the northern hemisphere. He said that Dr. Berson of the C.S.I.R.O. was working out pressure normals for the Australian and southern hemisphere regions. 700 mb anomalies could be correlated with the surface anomalies here too. On a hurried examination of available data he found that with high pressure at latitude 50°, the sub-tropical ridge is further south.

There were three cells here too, viz. east of New Zealand, north of the Bight and southwest of Australia. He also observed that large undulations of a meridional character in the northern hemisphere could have repercussions in the southern hemisphere, through the Doldrum belt.

Lastly, Mr. Namias spoke of the positive feed-back mechanisms that operate when snow cover occurs in an area where it is uncommon. The change in albedo caused by snow cover is from 2 tenths to 8 or 9 tenths.

When the southern boundary of snow was south of its normal position, as in February/March 1960, the sea-level circulation showed a tremendous North American continental anticyclone, representing the net effect of repetitious outbreaks of cold Polar anticyclones following rapidly developing east coast cyclones. Anomalies were evident in the temperatures of the lower 3 km of the atmosphere and in the thickness lines. Cooling is due to the direct effect of the snow and also to transport of Polar air masses southward.

Class estimates for this period, based on computations from the 700 mb mean chart, showed very good agreement with the observed temperature anomalies, even though the numerical errors of the estimate were quite large in some areas. In areas to the north and to the west, errors of the estimate were quite small and it is probable that snow cover reduced temperatures in the central areas by as much as 8° to 10° per day.

Correlation between each day's sea level pressure map and the 30 day mean map, of which it was a part, showed that cyclogenesis was followed by a rise in the feed-back loop.

It thus appears that normal and abnormal heat sources control these anomalies. In future it might be possible to use satellite pictures of ice fields and snow cover and satellite measurements of ocean temperatures in the study of these anomalies and their effects on weather trends.