THE NORTH PACIFIC'S ROLE AS A WORLD WEATHER FACTORY

(Abstract)

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This talk attempted to describe some concepts associated with large-scale atmosphere and ocean interactions over the North Pacific and their effect on weather and climate anomalies there and elsewhere. It was pointed out that monthly and seasonal averages of both sea surface temperature (SST) and atmospheric pressure patterns over the North Pacific usually have dominant size scales of $\frac{1}{3}$ to $\frac{1}{2}$ the width of the North Pacific. The temporal coherence for SST patterns is appreciably greater than for atmospheric pressure patterns; sea surface temperature (SST) patterns may retain their integrity for a couple of years, compared with a month or two for pressure patterns. In both atmosphere and ocean this coherence is due primarily to persistent recurrence. It appears in the atmosphere as geographically fixed repetitive cyclone and anticyclone tracks and as recurrent long (Rossby) wave positioning. The integrated effect of these recurrences on the ocean engenders characteristic SST patterns since heat exchange and advection are closely coupled to air mass characteristics. When SST patterns are correlated at lag and stratified by initial month it is found that anomalous SST patterns generated in winter or spring often recur in the following year and even two years later. It is postulated that these SST patterns are representative of the relatively deep cold-season mixed layer, are masked by the shallow summer warming, and reappear during the fall and winter storms. Patterns generated in summer are much less likely to recur at these time lags because of their shallowness.

As an example of the foregoing concepts, the mean fluctuations in SST and atmospheric flow patterns were described for the two approximately decadal periods 1948–57 and 1958–69. These were exceptionally coherent regimes separated by an abrupt change. The abrupt change and the coherence during the two periods characterized not only the SST and the North Pacific air circulation patterns, but such remote elements as the temperature and snowfall at Atlanta, Georgia and, indeed, the entire Eastern United States. For example, in Atlanta the winters of the 1958–69 period averaged 5° F higher than those of the 1948–57 period. This difference was attributed to downstream influence from the disturbed westerlies in the North Pacific.

An attempt was made to investigate the great upheaval in pattern which occurred mainly in 1957–58. The data show that a slowly progressive planetary trough in the upper westerlies over the North Pacific during this period resulted in extensive and substantial heat losses from the sea to the air. These heat losses were primarily due to the extraction of latent and sensible heat by polar air masses and to the advection of cold water masses from more northerly latitudes. A plot of one year lag correlations of seasonal SST patterns for the entire period suggests that at least a year of consistent alteration is necessary to demolish a preexisting regime.

Finally it was shown that the height of sea level along the coast of Southern California responded to changes in wind stress so that winter heights were almost 6 cm higher in the 1958–69 period than in the 1948–57 period. A detailed account of the above information has been published (see references).

REFERENCES

Huang, Joseph Chi Kan. 1972. Recent decadal variation in the California Current System. *J. Phys. Oceanogr.*, *2* (4): 382–390.

Namias, Jerome. 1972. Large-scale and long-term fluctuations in some atmospheric and oceanic variables, p. 27–48. *In* D. Dyrssen and D. Jagner (eds.) The changing chemistry of the oceans: Nobel symp. 20. Almqvist and Wiksell Förlag AB, Stockholm.

Namias, Jerome, and Robert M. Born. 1970. Temporal coherence in North Pacific sea-surface temperature patterns. *J. Geophys. Res.*, *75* (30): 5952–5955.

Namias, Jerome, and Joseph Chi Kan Huang. 1972. Sea level at southern California: A decadal fluctuation. *Science*, *177* (4046): 351–353.