Spatial and Temporal Scales of Sea Level Coherence in the Hawaiian Islands

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Chapter 6

Conclusions

This study identifies the spatial and temporal scales of sea level coherence in the Hawaiian Islands region, based upon tide gauge records at nine island stations. Time series of atmospheric pressure and the winds at five of these stations are also used to explain certain aspects of the sea level variability. The records are divided into winter and summer subsets for which spectra and coherence are calculated.

The seasonal sea level, atmospheric pressure, and wind spectra have significantly different energy levels, in that the winter spectra have much greater energy than the summer spectra. There is an increase of sea level spectral energy during winter from southeast to northwest through the islands that is attributed to larger atmospheric pressure fluctuations at higher latitudes, which cause an enhanced "inverted barometer" response in sea level.

Sea level coherence is very high at all periods from 3 to 180 days at distances less than 20 kilometers. At these periods and distances the coherence between sea level records is not affected by the local characteristics of the stations' harbors nor by the location of the tide gauges on the island. The coherence between sea level records remains very high for distances up to about 500 kilometers at periods from 3 to 20 days. This feature is attributed to the inverted barometer response of sea level to a uniform atmospheric pressure field in the main Hawaiian Islands.

Sea level and atmospheric pressure records are fairly coherent in this region, especially at periods of 5 to 20 days up to distances of order 500 kilometers. The coherence between sea level and atmospheric pressure records shows an unexpected increase with increased distance at periods greater than 45 days. A simple model is developed which attributes this feature to the lack of atmospheric pressure data at the northernmost stations, and to the strength of the atmospheric pressure fluctuations occurring at these higher latitudes.

Sea level is less coherent with wind than with atmospheric pressure in the Hawaiian Islands. At periods of 5 to 20 days for distances less than 500 kilometers the sea level and wind records are fairly coherent in this region. This coherence shows few consistent features and is much "noisier" than the coherence between sea level and atmospheric pressure. During winter at periods greater than 30 days the coherence between sea level and the wind increases with distance. This is an unexpected result, and is probably due to the lack of data and the greater variability at the northernmost stations, as with the atmospheric pressure.