

*GRAVIMETRIC CHANGES AND ANOMALOUS VARIATIONS OF
THE MEAN SEA LEVEL DURING THE NOVEMBER 29, 1978
EARTHQUAKE*

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RESUMEN

El Instituto de Geofísica de la UNAM ha realizado medidas de gravedad de primer orden a lo largo de la Costa del Pacífico, entre Lázaro Cárdenas, Mich. y Puerto Angel, Oax., con el objeto de detectar posibles cambios gravimétricos debidos a ocurrencia de sismos en esta zona.

En este trabajo se comparan las medidas tomadas en los años de 1972, 1976, 1977 y las que se hicieron después del sismo del 29 de noviembre de 1978.

También se presenta un estudio de las anomalías del nivel diario medio del mar (0^h y 12^h) previas al sismo del 29 de noviembre de 1978.

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In 1976 we established gravimetric points along the Acapulco trench in order to maintain a constant observation to detect relative changes of gravity values produced by the interaction between the Cocos and the North American plates.

The project's first step consisted in the selection of those bench marks, from Comisión de Estudios del Territorio Nacional and Secretaría de la Defensa Nacional (SDN) along the highway between Plaza Azul, Michoacán and Puerto Escondido, Oaxaca, México, which showed to be more firmly placed in order that noise level would be low.

In 1976 gravity was observed in 9 bench marks from the S.D.N., between Acapulco and P.E., using the gravity meters G-93 from the University of Hawaii and G-247 from the University of Mexico. The reference point was the station located in the Acapulco airport, which is in turn connected to the 1st order world station located at the University Campus in Mexico City. (Monges *et al.*, 1963.)

The G-93 gravity meter was rebuilt in order to enhance sensitivity for the secular variation research carried out by Dr. Woollard in Latin America. Although it is more sensitive than the standard ones, it has stability problems. The G-247 gravity meter does not show these problems and its calibration was checked in the Menlo Park Geological Survey installations after being used in the gravimetric studies of the 1976 Guatemala earthquake. (Monges *et al.*, 1976.)

For the observations of 1978, the same G-247 was used, as well as the G-143 from the Inter American Geodetic Survey. The lineality of both gravimeters was checked in the Lacoste and Romberg factory of Austin Tex., and they were calibrated along the Gravity Calibration Line between Mexico and Monterrey.

All measurements were carried out with the "leap frog" method along a highway and in the least possible time.

The comparison between gravimetric measurements observed in 1976 and 1978 along the Acapulco-Puerto Escondido highway, taking as reference the Acapulco airport station, show that between Acapulco and Copala there are no significant changes; nevertheless, starting in Cuajinicuilapa, State of Guerrero, changes increase significantly, diminishing at

Pinotepa Nacional, Oaxaca, to increase again until they reach their maximum in the Puerto Escondido station.

Figure 1 shows recorded location of stations read in 1976, as well as error bars calculated and the error in the mean of several readings in each station.

Values obtained in 1976 were roughly equal and negative respect to the Acapulco value. Since only the change between 1976 and 1978 values is of interest here the 1976 value has been taken as zero level and the circles show the difference between them. Discontinuous lines are error bars of this difference.

Adequate control existed only on one of the gravity meters used. The G-247. Others did not have good control and therefore this may have contributed to the increase in the noise level.

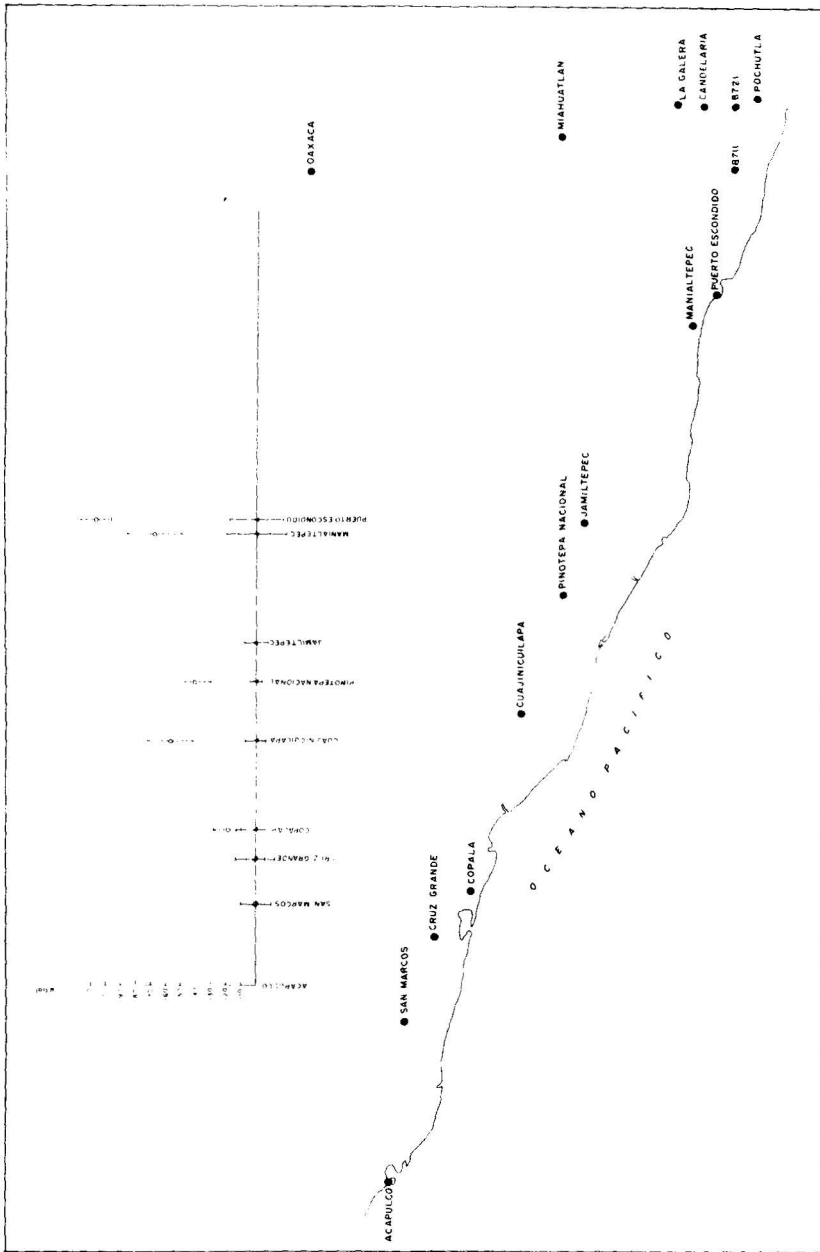
Due to problems exposed above, the results shown here for the November 29, 1979 earthquake of Oaxaca, Mexico, should be taken with caution. Notwithstanding, the results are significant enough to be considered in the interpretation of the mentioned event.

Information on sea level changes was obtained in Acapulco, Manzanillo and Puerto Angel, using standard automatic tide gauges. The zero level of the scale is controlled by several bench marks close to the tide gauge. The signals were low pass filtered, using the filter D-49 by Groves, which removes sea level daily and semi-daily variations, but allows variations of more than one week.

Figure 2 shows monthly average of sea level in Manzanillo, Acapulco and Puerto Angel for the years 1978 and beginning of 1979. We observe the negative phase caused by the meteorological variation with a period of one tropical year from January to June. Between June and the half of October, the positive phase began to descend normally. However, between November and the middle of January, an anomaly in the seasonal phase change is seen. This is most clearly observed in Puerto Angel. At the end of January, the seasonal cycle is back to normal. Figure 3 shows daily variation in the average sea level for the Pacific coast, together with earthquakes of magnitude larger than 4 for 1978 and the beginning of 1979. It appears to be some correlation between the in-

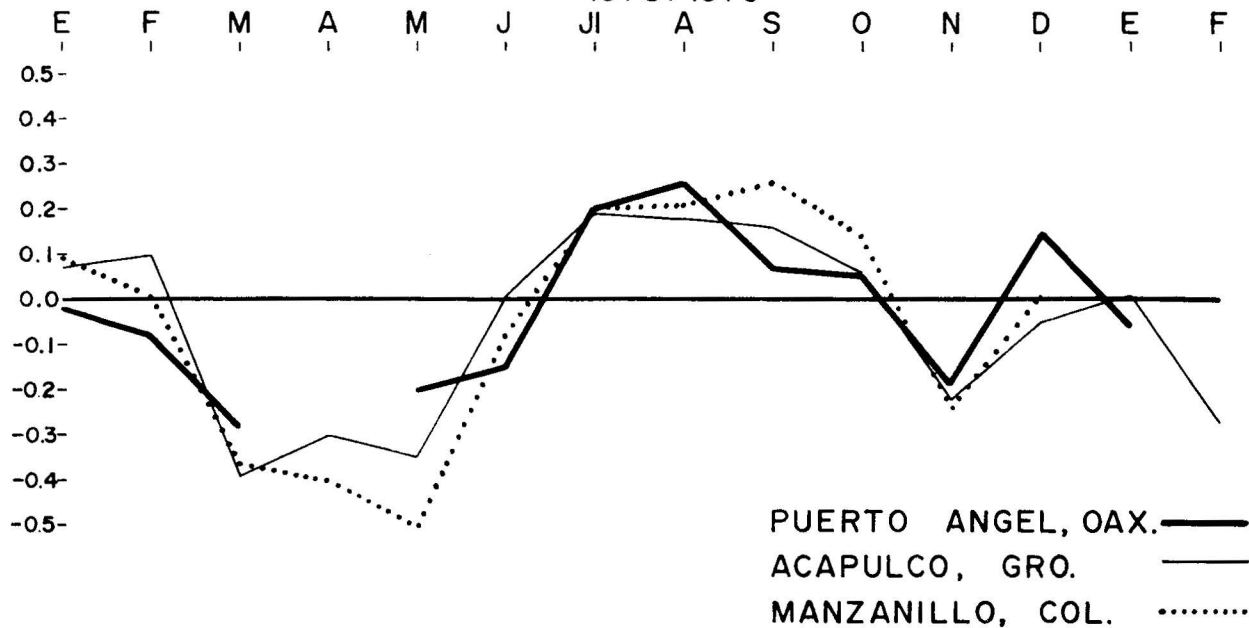
crease in the seismicity and the anomaly in the sea level seasonal variation. It may be necessary to eliminate all oceanographic and meteorological parameters, which influence sea level, before associating these anomalies with tectonic phenomena.

In the case of the Oaxaca Earthquake, which produced a small Tsunami, sea level came back to normal quickly in contrast with the January 1966 earthquakes in Puerto Angel, where a permanent change did occur (Fig. 4). (Grivel *et al.*, 1971.)

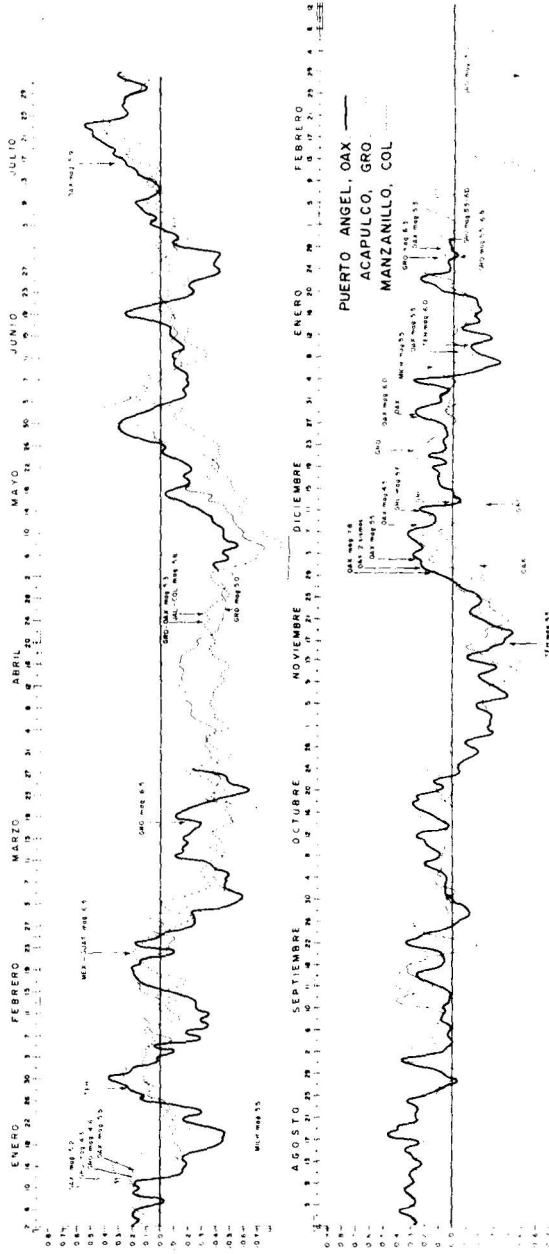


GRAVIMETRIC STATIONS 1976-1978

VARIACION MENSUAL DEL NIVEL MEDIO DEL MAR 1978/1979

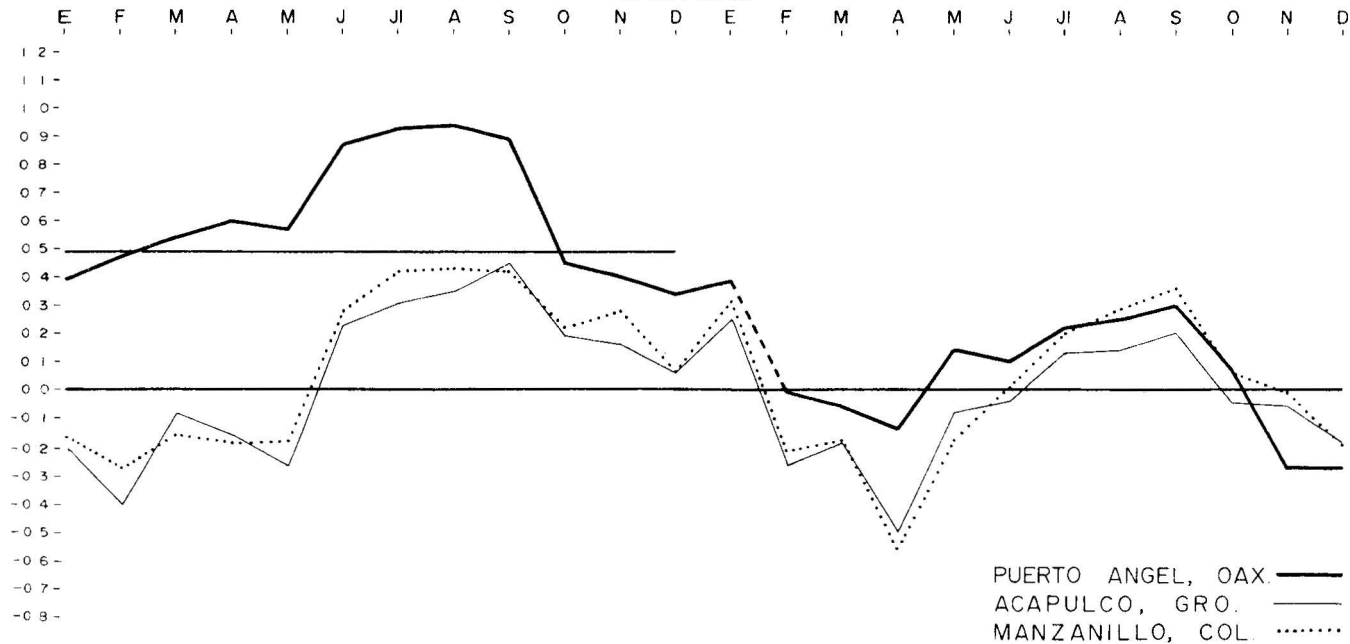


VARIACION DIARIA DEL NIVEL MEDIO DEL MAR - 1978/79



VARIACION MENSUAL DEL NIVEL MEDIO DEL MAR

1965/1966



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