

Earthquake Weather: Relationships between barometric pressure changes and seismicity

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It has been widely shown that seismic activity can be triggered by stress changes of a few kiloPascals (kPa) over periods of tens of seconds associated with passing surface wave trains from remote earthquakes. Less well investigated is whether kPa-range stress changes over periods of hours-to-days associated with changes in barometric pressure can also influence seismicity.

We analyze multi-year earthquake catalogs for five regions in western North America (Southern California, Northern California, Pacific Northwest, Utah, and the Great Basin) to investigate a possible relationship between the rate of seismicity and changes in barometric pressure. Our preliminary results show that multi-day changes in barometric pressure are generally associated with higher rates of seismicity (Figure 1), with increases in seismicity occurring with both positive and negative changes in barometric pressure. We performed our analysis over a range of barometric pressure sampling window sizes, smoothing filters, and methods for determining the pressure change over the window. In general the results appear robust across methods and smoothing filters but only show a clear relationship between pressure change and seismicity with windows longer than one day. Possible mechanisms for this effect include triggering of critically-stressed faults by small stress changes and/or by barometric pressure-induced changes in pore pressure in the fault.

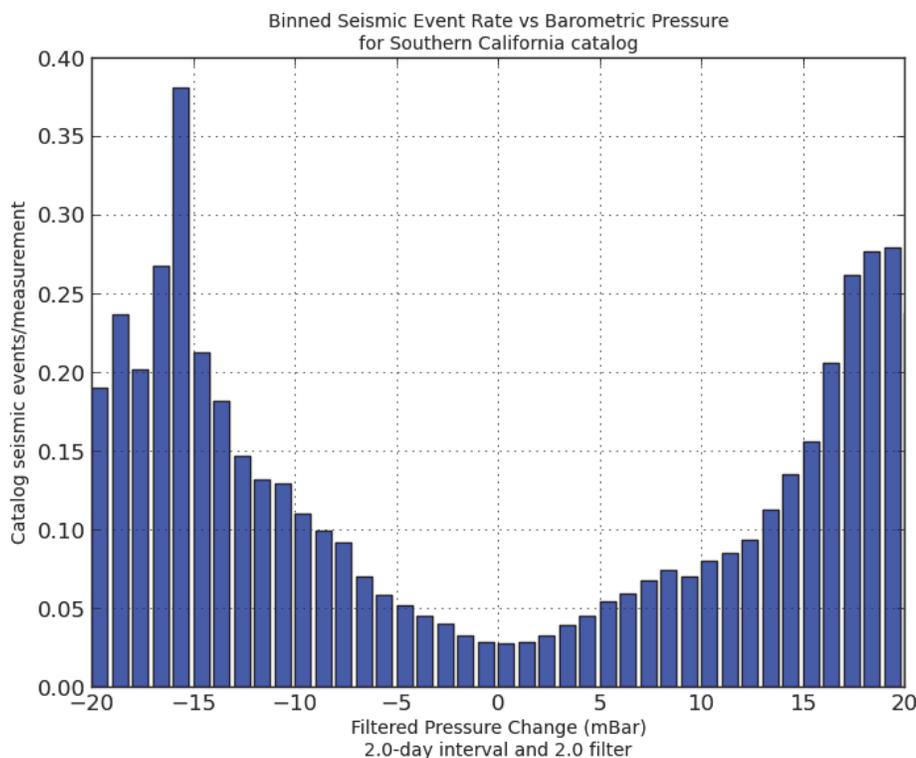


Figure 1: Barometric pressure change and southern California earthquakes. Each earthquake in the catalog is associated with the smoothed barometric pressure change over the two days prior to that event, measured at the weather station nearest the event location. Event counts are summed in 1-mBar wide pressure change bins. Two-day windowed pressure measurements are made hourly at each weather station, and event counts are normalized by dividing the number of earthquakes in each bin by the number of hourly measurements falling within the pressure range of that bin. This yields a seismic rate in number of earthquakes per hourly measurement at that pressure change level. The plot of seismic rate by pressure bin shows that seismic rate is lowest where there is little barometric pressure change and increases with increasing change in pressure.