

## Effects of recent environmental changes on global seismicity

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Holistic view on nature's complex systems nowadays is inseparable from profound human effects on these systems. Industrial society disrupts the unity of material and energy fluxes, distorts the environmental balance and aggravates environment, a basis of our existence. Presently rising concern about Global Warming, the anthropogenic activities and its consequences has always overlooked the changes related to the future tectonic activity. In general, the number of strong earthquakes in the world has been steadily growing from the 1750-s. Today Global Warming is the cause for a powerful planetary redistribution of water masses from the polar regions to lower latitudes. A water loading of the equatorial region of the Earth is taking place due to the changes of circulation of atmosphere, ocean and specific spatial characteristics of the ocean. One of additional processes is the flow of water away from Greenland or Antarctica, which occurs when the gravitational pull of the ice-sheet disappears. As a result of reduction of water resources of the continents, they have become lighter for  $11000 \text{ km}^3$  for the last centuries; the decrease of water masses in polar regions as result of glaciers shrinking was more than  $15000 \text{ km}^3$ . All these masses have been discharged into the ocean and distributed equally on its surface. But, since 70% of the ocean area is between 0-40 latitudes, only in these limits water mass has increased by  $20000 \text{ km}^3$ . Hence, water displacement from polar and middle latitudes to subequatorial regions during warming period, produces lightening of high latitudes and weighting of low latitudes. This leads to a disturbance of a mass balance between the land and the ocean, and changes characteristics of the Earth's rotation. Rising of the sea level, occurring at the rate  $3.1 \text{ mm per year}$ , results in accumulation of potential energy in the ocean ( $7.2 \cdot 10^{26} \text{ erg per year}$ ). Its geophysical realization can cause huge effects. It provokes an increase of earthquakes and the frequency of volcanic eruptions (Fig. 1). It was suggested by Kennett and Thunell [1975] that periods of active volcanism seem to be well correlated with those for transgression in paleo-sea-level changes. This correlation may be reasonable if the additional crustal stresses for the water loading are not negligibly small compared with the crustal stress level before water loading. Kennett and Thunell thus suggested that the stress accumulation caused by surface mass redistribution may become a trigger and/or accelerator of geological phenomena such as volcanism and movement of active faults. Rampino et al. [1979] suggested that the redistribution of water that accompanies glaciations and deglaciation gives rise to both hydro-isostatic and glacioisostatic readjustments. Asymmetric mass loading, as on Greenland, requires that the global spin axis adjust to the new symmetry of mass. Realignment of the geoid will then lead to worldwide stress that might trigger eruptions. Crustal adjustment will be more active along the plate margins and major lineament-fault intersections. Chapell [1975] noted that the stress gradients associated with the mantle flow beneath continental margins in response to glacial loading and unloading are  $10^5$  times larger than the stress gradients associated with earth tides, which are known to affect the timing of some earthquakes and volcanic eruptions. Among other reasons for mass-balance disturbance on land, affecting seismic activity, are: anthropogenic industrial activities (materials, annually moved by humans (about  $10000 \text{ km}^3$ ) are bigger than the volume of materials coming naturally from the land to the ocean; changes of areas covered with snow and humidity distribution; abrupt movements of glaciers in Greenland and Antarctica. All these mass-balance disruption related facts are important for seismic problems in terms of increasing probability of such types of natural phenomenon as earthquakes and volcanic eruptions.

