

Earthquake Prediction Research - Past, Present and Future

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Some 40 years have past since several countries embarked on large scale EQ prediction research. As the goal has not been attained, the concerned community became pessimistic especially on short-term prediction. It has been particularly so in Japan (after Kobe) and USA (Parkfield). Although hydro-geochemical (e. g., Wakita, Kuo) and electromagnetic approaches (e. g., Varotsos, Fraser-Smith, Yoshino/Gohkberg, Kopytenko, Hayakawa/Molchanov, Uyeda/Nagao/Hattori, Asada/Baba) have made some advancements in the meantime, they have not succeeded at all in defeating the general skepticism. Lately, however, new move for EQ prediction has been uplifted in other places such as Taiwan (iSTEP, Tsai/Liu). Characteristic to the new move is that it is armored with new scientific and technological advancements, unavailable 40 years ago, such as all kinds of IT, EM, space geodetic and hydrological/geochemical knowledge, and the program is so designed from the beginning that all possible methods are well integrated. Such is not so easy in a country where entry of new elements is hampered by barriers thrown up by vested interests of conventional groups.

There are, moreover, other new scientific achievements are arising such as the shear-wave splitting method (Crampin). Serious attempts are also being developed to achieve predictions by sophisticated analysis of seismicity data and their time resolution is approaching the realm of short-term prediction (e. g., Sobolev, Keilis Borok/ Kossobokov/ Shebalin, Rundle, Varotsos). They are based on the rapidly developing non-linear statistical physics of non-equilibrium systems. It may take time, but their achievements will eventually be understood even by the conservative majority. Another new aspect is the so called LAI coupling which states that the lithosphere, atmosphere and ionosphere are closely coupled (e. g., Hayakawa/Molchanov, Pulinets). This concept may be even more difficult for conventional scientists to swallow, but it was derived first from the observed pre-seismic anomalous transmission of radio waves (e. g., Hayakawa/Molchanov, Kushida, Moriya, Kamogawa) and second supported by directly observed anomalies in the ionosphere (e. g., Liu). Thirdly, further supporting information is beginning to be provided from the micro-satellite observation (French DEMETER, Parrot). It is well known that GPS by satellites is extremely useful, but now their data on TEC (total electron content) are proving especially useful for LAI-coupling studies. Moreover, thermal infra-red (TIR) monitoring by satellite seems to show significant anomalies before EQs (e. g., Singh, Ouzonov/Freund), which has in turn been correlated with the ground based radon emission monitoring (e.g., Tramutoli). These observations will not only serve to prove the existence of individual phenomenon, but also to contribute in establishing the physical picture of the total phenomena. Thus, the satellite technology is becoming an extremely powerful tool, hitherto unavailable, for short-term EQ prediction. Following French pioneering DEMETER which stemmed from aborted Russia/Ukraine projects, there are proposals for launching EQ monitoring micro-satellites in countries like Turkey, where the next disaster may hit Istanbul, Mexico, and Italy, not to speak of Russia and Ukraine. In fact, Quakesat was launched, but without success, in 2003 in USA. Practically, neither practical usefulness nor physical background has been proven for these new attempts. However, can it be the reason for not trying them? Situations in Japan will be briefly reviewed and proposal will be made that a fundamental reform of our national EQ research program is needed to lead, and at least keep up with, the progress of this science of short-term EQ prediction.