9th Alexander von Humboldt International Conference
Istanbul | Turkey | 24 – 28 March 2014
AvH9-36

Fractal approach in relation to natural hazard forecast

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One of the most realistic scenarios of the complex system evolution is their self-organized critical dynamics. Self-organized criticality (SOC) emerges from the so-called slowly driving interaction dominated threshold systems (SDIDTS). Many geophysical systems as lithosphere, atmosphere, hydrosphere, etc belong to such class of SDIDTS. The dynamic equilibrium in SDIDTS is achieved through avalanches of different size including very large destructive avalanches, which we attribute to natural hazards. The most important fingerprint of the SOC state is fractal organization of the output parameters both in space (self-similar structures) and in time (flicker-noise or 1/f fluctuations). So we can apply fractal methods to geophysical data obtained in those systems to monitor their evolution to the critical state. In this presentation, we demonstrate a support of such idea on the basis of fractal analysis of ULF emissions and seismicity distributions in relation to some strong earthquakes. We show that there is definite dynamics in variations of fractal and multifractal characteristics of those geophysical data on the earthquake preparatory stage. So the certain high order fractal dimensions of the seismicity distribution in the Kobe area of Japan decreased before the date of the damage Kobe earthquake of 17 January 1995. The first order fractal dimensions of the ULF electromagnetic time series increased prior to the Guam earthquake of 8 August 1993 as well as prior to the swarm of Japanese earthquakes of July-August 2000. That gives us a possibility to consider the corresponding dynamics as the earthquake precursory signatures and pay a special attention to fractal approach when develop the earthquake forecasting methods. We present the other supporting arguments based on specific variations of the seismicity multifractal spectrum in relation to the forthcoming strong earthquakes. We suggest applying the same fractal approach to any other geophysical data obtained from different hazard systems to monitor their criticality and thus providing a basis for natural hazard forecast.