



Is Earthquake Prediction Possible from Short-Term Foreshocks?

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Foreshocks preceding mainshocks in the short-term, ranging from minutes to a few months prior the mainshock, have been known from several decades ago. Understanding the generation mechanisms of foreshocks was supported by seismicity observations and statistics, laboratory experiments, theoretical considerations and simulation results. However, important issues remain open. For example, (1) How foreshocks are defined? (2) Why only some mainshocks are preceded by foreshocks but others do not? (3) Is the mainshock size dependent on some attributes of the foreshock sequence? (4) Is that possible to discriminate foreshocks from other seismicity styles (e.g. swarms, aftershocks)? To approach possible replies to these issues we reviewed about 400 papers, reports, books and other documents referring to foreshocks as well as to relevant laboratory experiments. We found that different foreshock definitions are used by different authors. We found also that the ratio of mainshocks preceded by foreshocks increases with the increase of monitoring capabilities and that foreshock activity is dependent on source mechanical properties and favoured by material heterogeneity. Also, the mainshock size does not depend on the largest foreshock size but rather by the foreshock area. Seismicity statistics may account for an effective discrimination of foreshocks from other seismicity styles since during foreshock activities the seismicity rate increases with the inverse of time and, at the same, the b-value of the G-R relationship as a rule drops significantly. Our literature survey showed that only the last years the seismicity catalogs organized in some well monitored areas are adequately complete to search for foreshock activities. Therefore, we investigated for a set of “good foreshock examples” covering a wide range of mainshock magnitudes from 4.5 to 9 in Japan (Tohoku 2011), S. California, Italy (including L’ Aquila 2009) and Greece. The good examples used indicate that foreshocks bear important value not only for the mainshock prediction but also for the real-time operational discrimination between different styles of activity such as background seismicity, swarms, foreshocks, aftershocks.