

## Proposal for earthquake prediction program II: Satellite observation

UYEDA, Seiya<sup>1</sup>, OYAMA, Koichiro<sup>2</sup>, HAYAKAWA, Masashi<sup>3</sup>, HOBARA, Yasuhide<sup>3</sup>, YUMOTO, Kiyohumi<sup>4</sup>, MOGI, Toru<sup>5</sup>, NAGAO, Toshiyasu<sup>6</sup>, HATTORI, Katsumi<sup>7</sup>, KAMOGAWA, Masashi<sup>8</sup>, KODAMA, Tetsuya<sup>9\*</sup>

<sup>1</sup>The Japan Academy, <sup>2</sup>National Cheng Kung University, <sup>3</sup>The University of Electro-Communications, <sup>4</sup>Kyushu University, <sup>5</sup>Hokkaido University, <sup>6</sup>Tokai University, <sup>7</sup>Chiba University, <sup>8</sup>Tokyo Gakugei University, <sup>9</sup>JAXA

Seismo-electromagnetic research by satellite observation started in Soviet Union in the 1980. After the collapse of USSR, France took over the initiative and its small satellite: DEMETER has already clarified, by statistical analysis of 9000 cases, that night-time attenuation of VLF range electromagnetic emission occurs 4 hours before earthquakes larger than M4.8. (it would have required many 100-years for it by ground observation). Recently, satellite observation has followed in Ukraine, Italy, Taiwan, etc. and similar projects are being planned in Russia, UK, Mexico, India, China, and South Korea.

The European Union has started, under the 7th Research Framework, the Pre-Earthquakes Project to conduct earthquake precursor researches by joint ground and satellite observations, through cooperation with Russia. They have reported about rapid increase in electron density and outgoing longwave radiation anomaly before the Tohoku megaquake. China is particularly active and planning to launch in 2014 their first Seismo-electromagnetic satellite: Zhangheng-1 named after Zhang Heng (78-139) who invented the first seismometer of the world. They plan to add two more satellites by 2017.

The advantage of observation from space is that statistical research on the correlation between precursory phenomena and earthquakes is possible in a dramatically short-time compared with ground observation which is limited in the spatial coverage. Beyond this, the studies on the mechanism of observed phenomena will be facilitated by adoption of various instruments.

It is hoped by not only researchers but also by general public that JAXA, the only space agency of Japan, the country of high seismic and volcanic activity, will soon launch satellites for seismo/volcano electromagnetic observation. It should be kept in mind that the system small satellites proposed here is possible to realize at low cost and can contribute also to extensive fields, such as meteorology, atmospheric and ionospheric sciences, space environment and space weather researches.

In other words, interdisciplinary research is necessary and helpful for pre-earthquake atmospheric/ionospheric phenomena. It is therefore a logical conclusion that we should conduct comprehensive observations of space-time variations of the lithosphere, atmosphere and ionosphere by satellite constellation.

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