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A Comprehensive and Effective Earthquake Information System: Contributions to Earthquake Hazard Mitigation for a Local Government

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Synopsis

An earthquake information display system was installed in the disaster prevention crisis management division of the Tottori prefectural office. An environment was established in the disaster prevention administration, where detailed earthquake information could be understood. The purpose of this study is to investigate methods of building and transferring the information which will be useful to actual earthquake disaster reduction, through discussion between the researchers and the local government administration.

Keywords: earthquake information, local government, earthquake disaster reduction

1. Introduction

A M5.3 earthquake occurred on September 16, 2002 at 10:10 (JST) in central Tottori prefecture with a maximum JMA (Japan Meteorological Agency) intensity 4 recorded at 6 sites. Immediately following the earthquake, Tottori prefecture along with local cities and towns were put on an alert. By evening it was recognized that there were no extreme damage and no special situations, and the alert was lifted.

Seismic activity was monitored with the Kyoto University observation system that automatically determines earthquake locations. From these data, this earthquake activity was recognized to be a normal mainshock-aftershock sequence.

On September 19 at 09:00, 3 days after the mainshock, a M3.9 aftershock occurred with intensity 3. Following this aftershock, Totttori prefecture staff remained on 24 hour duty, on the small chance that there might be further seismic activity. Subsequently, staff remained on 24 hour duty for about a month until October 13. Looking back on the earthquake sequence, this was the largest aftershock.

Alerts are usually initiated when seismic intensity 4 is recorded. Intensity information comes from JMA and other independent sources with intensity instruments, and with this clear information, decisions declaring alert levels can be made without confusion. However, it is usually not clear when to end the alert level. Among the people responsible for disaster response in the local government, there are not many with technical knowledge about earthquakes. Furthermore, local government officials, tend not to have sufficient detailed information about earthquakes. Usually information about seismic activity, such as increases and decreases in seismicity, or changes in location, does not reach the local government. In this situation, local governments must make decisions about ending alert levels. The information described above came from a responsible person in the Tottori Prefecture following the earthquake. This project was started as part of the 21st century COE program to meet the needs of the local government for earthquake information.

The Research Center for Earthquake Prediction (RCEP) started work on this research in 2002.

2. Main Points of the Plan

During times of large earthquakes, the local government usually becomes the center of rescue and reconstruction activities. The person responsible for disaster response becomes in charge of administrative affairs and has the responsibility for initiating many actions. However, the responsible person often does not have sufficiently detailed earthquake information.

When a large earthquake occurs, generally actions are undertaken in response to the intensity levels, in accordance with instruction from written manuals. Intensity information is received from JMA and other independent organizations. Since the intensity is given numerically, it is clear and there is usually no confusions about initiating emergency plans. On the hand, declaring the end of the alert is not so clear. The ends of alerts are usually described as times when earthquake activity declines or emergency measures end. This is a subjective decision. It is difficult for administrative person in charge to make this decision. In many cases, local officials consult with advisory committees of university researchers and earthquake experts, for their opinion about the earthquake activity. Usually local government decisions follow the recommendations of advisory committees. Since there are few earthquake experts among local officials, it is difficult to discuss on an equal level with the researchers and experts about the earthquake activity.

On the other hand, from the side that produces the information (university researchers and seismic experts), it is widely unrecognized how this information is used. Usually the data effectiveness and data transfer efficiency is not considered. So, usually the flow of information is one way.

Given this situation, it is important to have cooperation between the researchers and local officials for effective hazard mitigation. Following are target points of this plan,

(a) Local government administrators are provided with detailed earthquake information, and through discussions with the researchers, the administrators' levels of knowledge and experience about seismic activity are raised. One characteristic of the administrative organization is the reassignment of staff every several years, however, if the process described above is frequently repeated, the potential of the whole administration side can be raised, in regards to knowledge about earthquake activity.

(b) This project will provide material to the researcher side about what information is helpful in actual earthquake disasters and how information should be transferred. By repeating this process, improvements in local earthquake disaster response can be improved. This research plan has Tottori Prefecture as a counterpart and Tottori Prefecture is a well-suited a partner for this project for the following reasons.

(1) Over the last 100 years, the San-in district, centered on Tottori, has had a high level of seismic activity, including the 1892 Hamada earthquake (M7), the 1925 Tajima earthquake (M6.8), the 1927 north Tango earthquake (M7.3), the 1943 Tottori earthquake (M7.2), and the 2000 Tottori western earthquake (M7.3). Consequently, the residents of the region have a high level of recognition for earthquake hazards.

(2) Kyoto University established the Tottori Seismological Observatory in 1963, and has continuously maintained observational research of microearthquake activity in the surrounding area. Consequently, there is a high level of knowledge about the seismic activity of the Tottori area.

(3) As a local government, Tottori Prefecture is positively tackling the problems earthquake disaster prevention. Moreover, the prefecture is supportive of information distribution and has been very cooperative with this research plan.

This plan is a research project. In order to ensure successful results, it will be necessary for both the university research side and the local government side to make maximum compromises, within the limits of the restrictions of each respective organization. This type of research cannot be carried out with any local government, and Tottori Prefecture is a very suitable partner for this project.

In actual earthquake disaster mitigation, rapid response immediately following the event is required. This research project does not deal directly with this type of realtime information. Currently, JMA and other organizations routinely provide realtime seismic intensity information. Also, starting in 2004, JMA is planning to distribute "urgent earthquake information". Combining this JMA information with our research will make a more effective system. This project sets as a priority the understanding of detailed seismic activity and earthquake phenomenon.

3. System Configuration

3.1 Hardware Components

Seismic waveform data from high sensitivity networks covering all of Japan, such as Hi-net, JMA network and networks operated by universities, are distributed by satellite from the Earthquake Research Institute, University of Tokyo. Data are received at the Tottori prefectural office and a file of earthquake hypocenters is automatically created. With a delay of about 2 days, an integrated data file of hypocenters is received from JMA. Using the JMA information, an updated hypocentral file is created. So the hypocentral file has recent preliminary information from the Kyoto University system and processed information from JMA for events that occurred more than 2 days prior.

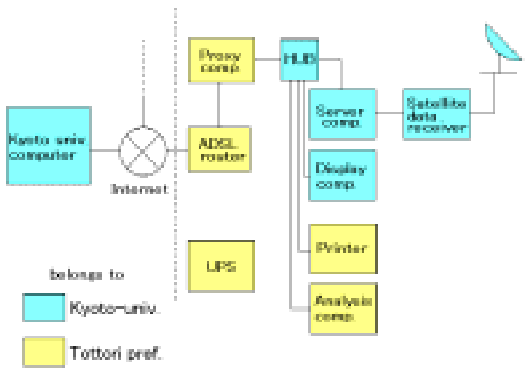

Fig.1 Block diagram of the system

Based on these hypocenter files, the current seismic activity can be viewed on the web display. The hardware configuration is shown in Fig.1. Blue boxes show Kyoto University related equipment and yellow boxes shows Tottori prefecture equipment. The data receiving satellite antenna was installed on the roof of the Tottori prefectural office, and analysis equipment and the display were installed in a rack in the disaster prevention crisis management division on the third floor of the prefectural office. The display is in an easily accessible location because earthquake information may be needed at any time during working hours.

3.2 Display Information

Seismic activity can be viewed on a displayed homepage. The top page is shown in photo 1. The display is driven by a menu and various types of informational screens can be chosen, as shown below.

Photo 1 Top page of the display system

(1) Seismic Activity Information

Hypocenter distributions, space-time plots, event frequency distributions, cumulative event counts, and magnitude-time plots are displayed. Specific regions and time periods can be set and the information on seismic activity described above can be displayed. An example is shown in photo 2.

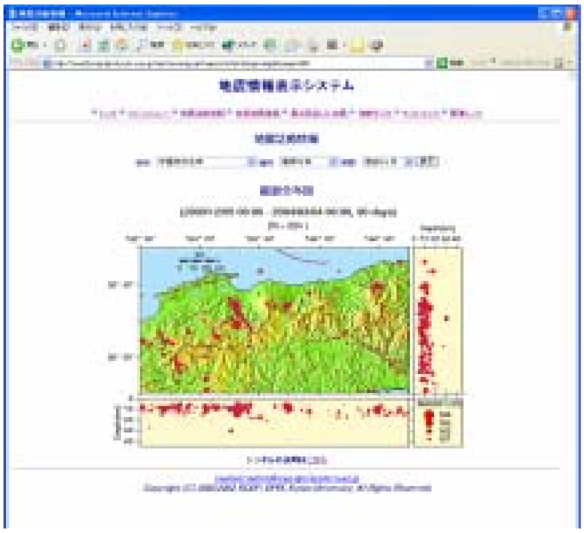

Photo 2 Example of the seismic activity webpage

(2) Felt Earthquake Information

Information released by JMA on felt earthquakes is

Photo 3 Example of the ground motion monitor webpage

displayed.

(3) Ground Motion Monitor

Hourly plots of continuous ground motion waveforms can be displayed by specifying a seismic station, instrument component and requested time. Processing of normal earthquake data analyzes only the events that are triggered by set conditions. Therefore, hypocenters of earthquakes which do not trigger the system, are missed. Since much information can be acquired from continuation waveform recordings at an observation point, this provides effective and intuitive information about the seismic activity. An example is shown in photo 3.

(4) Other

A site map and related links to other websites are provided.

4. Problems and Future Considerations

4.1 Requirements for Data Use

When two or more organizations are using the same data, as in this research plan, some problems are likely to arise. This research program is a cooperative effort between a research-oriented university and a local governmental organization, for which there are few previous examples in Japan. Various kinds of restrictions exist for the two organizations and the biggest problem will be to the appropriately consider the permissions and restrictions on data use .

It is unavoidable that some restrictions and conditions will exist depending on the type and the contents of data. Most of these restrictions or conditions are designed to remove responsibility and burden from the side of the data producer. They are based on considerations of the many possible problems that might occur, so many conditions may be placed on the data use, and smooth use of data may be difficult. The restrictions on data use should probably be made as loose as possible, when considering the development of a future information society. We suggest that it should be the responsibility of the user side if problems arise.

4.2 Information Policy

All of the research results should be available to the public without any restrictions. However, all of the legal ramifications of the many yet unspecified users, have not been completely considered. Although it may seem contradictory to the text in 4.1, we recommend a gradual process in releasing results to the public. In the end, complete release to the public is expected. However, as results are generated with the information use, it will become necessary that user responsibility is put into practice.

4.3 Personnel Changes

Persons in government roles of responsibility usually transfer between posts every several years, so over a long time period it is difficult to maintain staff that have become skilled in earthquake information. However, the system should endure over many years of use, outlasting personnel changes. If not, one has to conclude that the system has a low utility value. The mission of the university researcher, as an information producer, is to build a system that produces earthquake information that can be easily understood by ordinary residents.

4.4 Limits and Possibilities of Earthquake Information Research

The current system in operation has the capability to provide only an outline of the seismic activity. Starting in 2004, JMA began distributing ‘urgent earthquake information’ in test mode. It is difficult for the research side to routinely provide this kind of real-time information. On the other hand, researchers are adept at providing very detailed information. Within the local government, suitable information should be properly used for the appropriate purposes. Moreover, persons in responsible positions are replaced every several years, so the number of people within the local government that are capable of understanding the earthquake information is always increasing. This results in a higher potential for the local government disaster response structure and a more effective system. The system which is being constructed, will be used to help the disaster response administration of the local government better understand seismic activity. Tottori Prefecture and the Disaster Prevention Research Institute, Kyoto University have formed an agreement to further this research plan. Through discussion between researchers and local government staff, we expect that the results of this project will produce an effective system that produces information which is easily understood by the local residents of Tottori prefecture.

5. Acknowledgements

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自治体における地震防災に貢献する正確かつ役に立つ地震情報およびその提供手法に関する研究

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要旨

自治体の地震防災行政の現場では，震度情報に基づいた対応がとられる。しかしそれ以上の詳細な地震情報が不足する場合が多い。本研究では，自治体行政の現場にいて詳細な地震情報に接し得る環境を整備する。そのシステムの試用をもとに，自治体防災担当者と地震研究者が連携協力し議論して，実際の地震防災に役立つ地震情報の構築と伝達手法を研究する。

キーワード：地震情報，地方自治体，地震災害軽減

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大地震発生に伴う復旧・復興は通常は自治体が中心で実施される。大地震の発生の際，一般に各地の自治体は，震度４で警戒態勢に入る場合が多い。震度情報は気象庁や独自の震度計観測網から得られる。この情報は明確であるため，警戒態勢に入るか否かを迷うことはない。これに対して，警戒態勢の解除の規定は抽象的な場合が多い。自治体の防災担当者には地震の専門的知識を有する者が少ないのが普通である。さらに，自治体当局には，判断の根拠とすべき詳細で迅速な地震活動情報，例えば，地震活動の盛衰や活動域の変遷などの情報，が不足しがちである。そのような状況下で警戒態勢解除の判断をする必要がある。

一方，地震データを生産する側（大学や専門機関）は，自らが生産した情報がどのように活用されているかについての認識に欠ける場合が多い。自治体行政や社会が真に求める情報を発信していないかもしれない。また，データの有効活用や効果的な伝達方法について意識することは少ない。すなわち，情報の一方的発信の場合が多い。

これらの現状を踏まえて考えると，地域地震防災の充実のためには，行政と研究者側との連携協力によって，真に役に立つ情報を構築し，自治体防災の現場で利活用できる環境を作ることが必要である。リアルタイム情報として，気象庁による緊急地震速報が試験運用されているが，それに加えて詳細な地震活動情報を活用することは，地震防災に有効である。その目指すところは，

（a）詳しい地震情報を行政に提供することで，地震活動の把握がより可能となる。また，それらの試験的な活用に際して，行政側と研究者側が一緒に議論することで，行政側の地震活動に対する知識や経験を増大させる。行政機構の特色として，数年ごとの人事異動があるが，上に述べた活動を繰り返すことで，行政側全体としての地震活動に対するポテンシャルが高まる。

（b）実際の地震防災に対して役に立つ情報とは何か，その伝達方法はどうあるべきかについて，研究者側に検討材料を提供する。それをもとに，実際の役に立つ情報の構築が図れる。

これらを繰り返すことで，地域地震防災の向上と有効情報の構築，その伝達方法の改善が期待される。

本研究計画は鳥取県をカウンターパートとして実施する。

全国の大学および Hi-net などの高感度定常観測網の地震波形データが，東京大学地震研究所から人工衛星によって配信されている。そのデータを鳥取県庁において受信し，自動的に震源決定を行い震源ファイルを作成する。気象庁からの統合震源速報データで，震源ファイルは書き直される。従って，過去約２日以上前に関しては，気象庁の震源データ，最近の約２日間に関しては，京大方式による自動処理震源が用いられる。

これらの震源ファイルをもとにして，Web 上で地震活動状況を見ることができるシステムを，鳥取県庁の防災危機管理課執務室に設置した。職務中でも随時必要に応じて地震情報を見て検討することができるためである。

今後，防災行政の現場での試用を経ながら，社会の要望を生かしたよりよい地震情報の構築と伝達手法の研究を進める予定である。