LANDSLIDE DISASTER PREDICTION SUPPORT SYSTEM BASED ON WEB GIS

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ABSTRACT

Landslide disaster prediction support system was developed to support individual judgments on the potential for a landslide disaster by presenting the risk of landslides within a limited sub-region. The system has three main functions: (1) it displays areas that are prone to landslides together with the degree of risk. This information includes two- and three-dimensional displays of dangerous slopes and areas likely to be affected by landslides; (2) it presents semi real-time displays of the degree of risk of shallow landslides and multi parameter radar information. This is based on rainfall in each mesh (rain intensity, cumulative rainfall, distribution, time sequential data, etc.) and the degree of risk of shallow landslides; and (3) it presents other information including data on past landslide disasters, hazard maps (e.g., dangerous areas that are prone to sediment disaster), and so on. A prototype system is now working.

1. INTRODUCTION

In the context of natural disaster prevention measures in recent years, there have been increasing indications of the limitations of “hard” measures, and of the importance of “soft” measures. In fields related to landslides, the Law Related to the Promotion of Landslide Prevention Measures in Landslide Warning Regions, etc. (the “Landslide Prevention Law”) was implemented on April 1, 2001 in Japan, leading to the promotion of policies aimed at strengthening “soft” measures such as control of housing and other new structures, promotion of movement of existing residences, preparation of hazard maps and information disclosure, and the establishment of warning and evacuation systems. As part of this trend, an important issue is the development of methods for accurately displaying information related to the possibility of landslide occurrences in a format that residents can easily understand. Here, we will report on a system for transmitting information related to the danger of landslide occurrences quickly and in an easy-to-understand format, targeting incidents ranging from large-scale landslides to small-scale surface collapses caused by heavy rains. This is called LAPSUS (LAndslide disaster Prediction SUpport System).

2 GOAL OF THE SYSTEM

A number of different methods have been proposed for indicating the danger of landslides. One method that has already been put into practice from a wide-area approach is "Landslide Occurrence Danger Indication" using the "soil rain volume index" proposed by the Ministry of Land, Infrastructure and Transport. Several similar methods have been proposed to indicate the danger of landslide occurrences from a wide-area perspective, but we have yet to see any practical methods for indicating the level danger on individual slopes, or in small, limited regions. The main goal of this system is to support disaster prevention measures and judgments by individuals, by indicating to regional residents the danger of landslide occurrences in small, limited regions in a format that is easy for those residents to understand

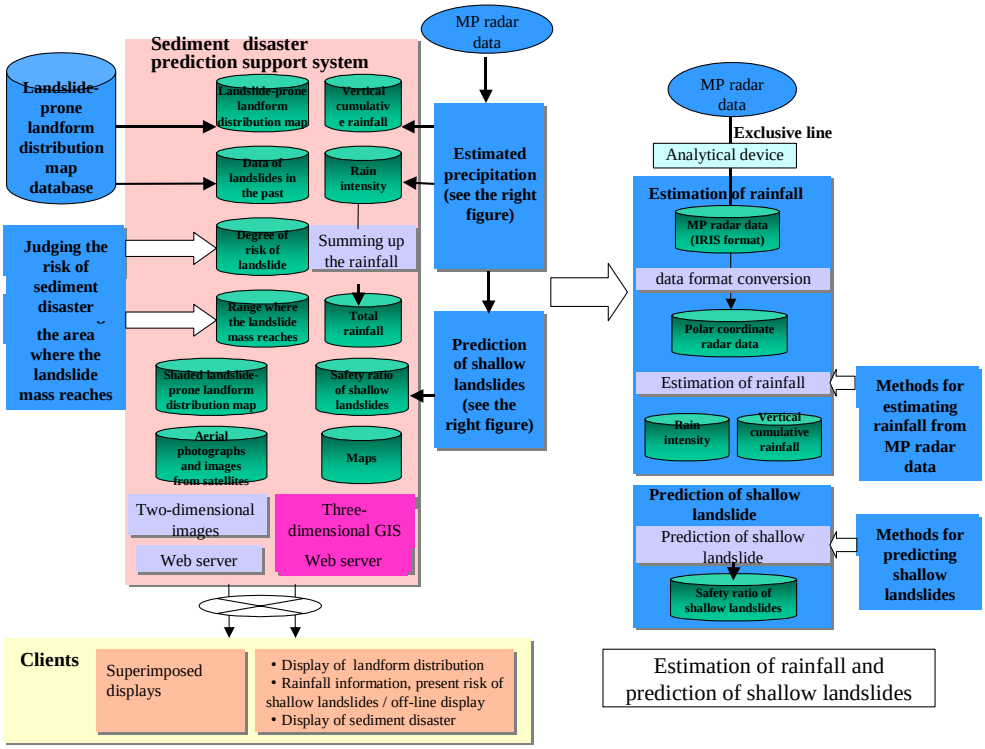
3 INFORMATION PROVIDED BY THE SYSTEM

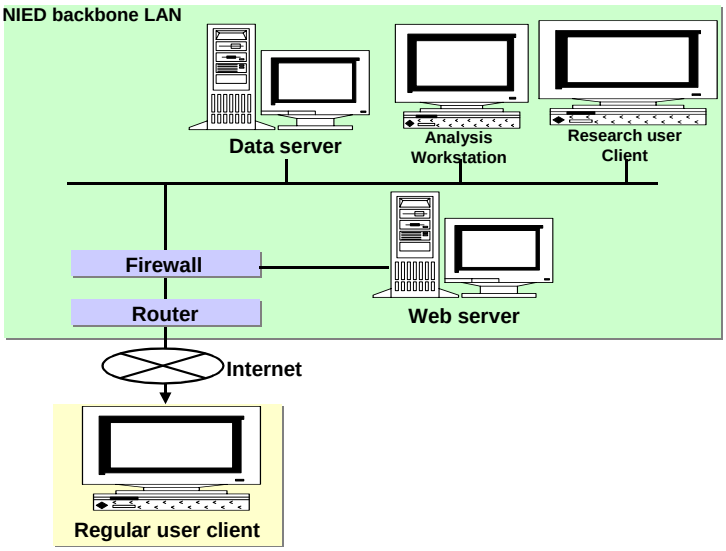
The two natural phenomena targeted by the system are large-scale landslides (over about 150m wide and long) and shallow landslides caused by heavy rain. The information provided by the system is outlined below (Fig.1, 2). The development of this system is a part of a larger project, based on the theme of "Special Project on Landslide Disaster Prevention" . Research related to the specific types of information outlined here is currently being undertaken simultaneously as sub-themes of the same project.

1) Danger of landslide slopes: Results of evaluations of the danger of reoccurrence in locations that have in the past demonstrated movement, deformation, or other landslide topography. Danger is divided into 3-5 stages (Fig.3).

2) Scope of landslide debris flow: The area over which the debris will be distributed or will accumulate in the event that a landslide occurs – in other words, the expected area of damage ranked on a 2- or 3-step scale.

3) Danger of shallow landslides: Input includes rainfall strength and patterns from a multi-parameter radar (MP Radar) that takes measurements in pseudo-real time. Indicates changes





over time in the danger of shallow landslide, calculated in a 50-m grid based on parameters including topography, soil layer depth, cohesion, diameter of soil particles, and percentage of water content in the soil (Fig.6).

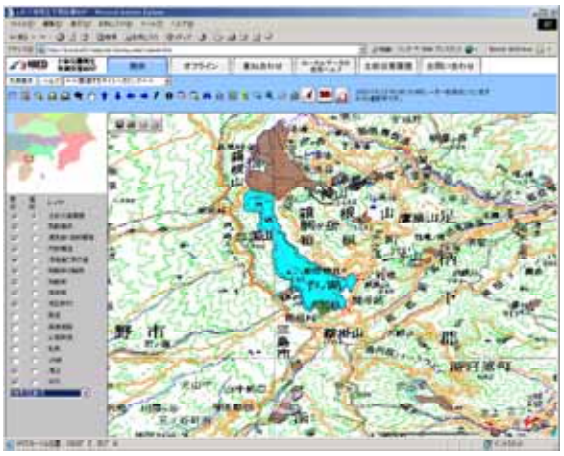
The above items represent information directly related to the danger of landslides. Important related information includes:

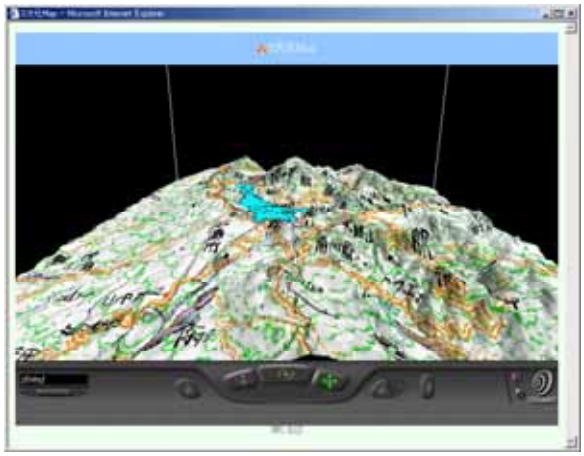
4) Radar rainfall distribution: Pseudo-real-time, high-accuracy rainfall distribution by MP radar (cumulative rainfall, vertical cumulative rainfall, rainfall strength, etc.) This data, representing highly accurate information, would be transmitted to the general public, and would also be provided to specialists in the field of disaster prevention research.

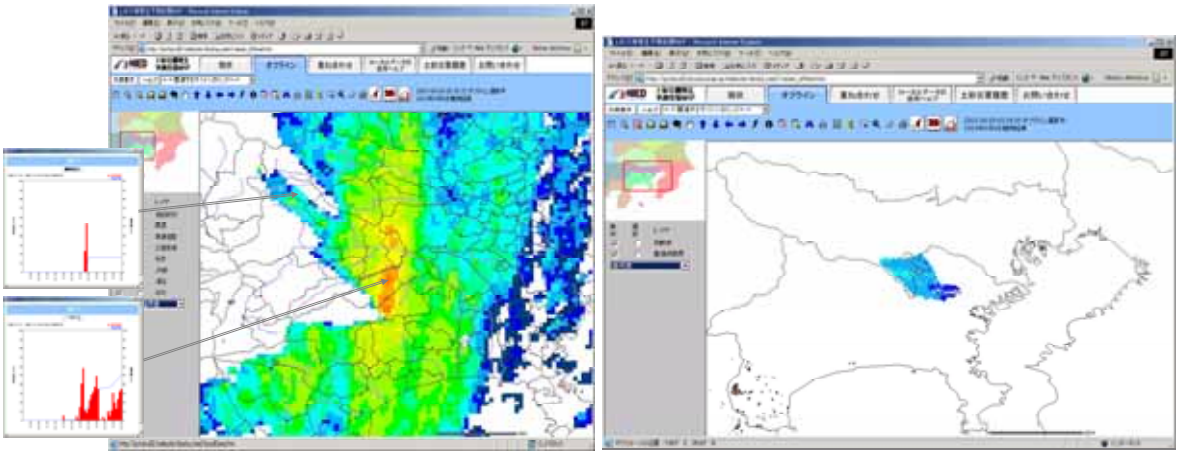
5) Other information: Shaded topographical landslide maps, landslide information for existing residents, aerial photographs, satellite images, etc.

4 MAIN FUNCTIONS

The display combines Internet GIS and 3D / pseudo-3D display functions. The main functions are listed below. In the future, we plan to incorporate a display of on-site







measurement results for high-risk slopes.

1) 3D display of regions at risk for landslides (Fig.4)
2) Pseudo-real-time rainfall distribution (at roughly 6-min. intervals in 500-m grids)
3) Changes over time in rainfall strength (Fig.5)
4) Pseudo-real-time display of shallow landslides risk distribution (at roughly 6-min. intervals in 50-m grids)(Fig.6)
5) Translucent / layered display of various types of disaster information (this enables comparative studies of multiple types of information on a GIS display)
6) Display of past rainfall information / shallow landslides risk information (off-line)

5 IN CONCLUSION

The goal of this system is not to provide support on a wide-area basis, but rather to provide this support on the level of the individual or the small municipality. For this reason, it is necessary to accurately evaluate the risk in individual slopes, but at the current research level, it is difficult to provide conclusive evaluation results. We are thus conducting research in parallel in this regard, and we plan to create an even more effective system that reflects the results of this research. We have completed a prototype of the system described here, and are conducting test operations targeting rainfall conditions within a roughly 60-km radius of Atsugi City in Kanagawa Prefecture in Japan, as well as landslide damage in the Tanzawa region and other areas.

8 REFERENCES

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