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NETWORK PLATFORM OF REMOTE SENSING FOR NATURAL DISASTER MONITORING & INFORMATION SERVING AND ITS APPLICATIONS

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ABSTRACT:

Natural disaster is an intricate human-Earth interactive system produced by interaction between natural system and human producing & living system. Because of its geographical characteristics and long history, China suffers from natural disasters of excessive categories frequently. Natural disasters have been causing great economic loss and become one of the main factors that stunt Chinese economic development.
Remote sensing, Geographic Information Systems and network have their particular advantages and potential in researching on nature disasters. Remote sensing observation data bear the macroscopical trait and the characteristic of comparative high time-efficiency and dynamic-linking, which makes them possible to record the situations of major natural disaster regions repeatedly. The remote sensing satellite sensors also have the corresponding spectrum to different natural disasters. GIS owns the functions of managing, analyzing and model operating the spatial database and system-integrating. Network provides quick channels for releasing information. The integration of these technologies gives an effective support for monitoring and assessing natural disasters.
With the support of Remote Sensing, GIS and network technologies, Natural Disaster Monitoring Center, Institute of Remote Sensing Applications and Chinese Academy of Sciences have developed the Network Platform of Remote Sensing for Natural Disaster Monitoring & Information Serving, which has experienced nearly a hundred disasters since its operation in 1996 and has became one of the 14 national websites including the State Council of People's Republic of China. This paper is to introduce this platform's system objective, system structure, system function, natural disaster database and its applications.

1. INTRODUCTION

Natural disaster is an intricate human-Earth interactive system produced by interaction between natural system and human producing & living system. Situated in middle-latitude monsoon zone with uneven precipitation distribution, complex terrain, intense neotectonic movement, and with several thousand years of human producing activities, China suffers from natural disasters of excessive categories and high frequency. According to the incomplete statistics, the direct economic loss caused by natural disasters in a year averages at 48 billion in 1950s, 55.6 billion in 1960s, 59 billion in 1970s, 69 billion in 1980s, and soaring to 175.3 billion in 1990-2000, and the loss amount to 3 to 6 percent of GDP since the establishment of China. Natural disaster has become one of main factors that stunt Chinese economic development.

Remote sensing and Geographic Information Systems have their peculiar advantages and potential in researching on nature disasters. Remote sensing observation data bear the macroscopical trait of covering most area of China in several satellite paths; the characteristic of comparative high time-efficiency and dynamic-linking make them possible to observe the major natural disaster regions repeatedly every day; the designs of remote sensing satellite sensors also take into account of the diversity of ground environment, which makes the sensors have the corresponding spectrum recognizing ability to different natural disasters. GIS owns the functions of managing, analyzing and model operating the spatial database and system-integrating; network provides quick channels for releasing information, the integration of these technologies gives an effective support for monitoring and assessing natural disasters.

With the support of Remote Sensing, GIS and network technologies, Natural Disaster Monitoring Center, Institute of Remote Sensing Applications, Chinese Academy of Sciences has developed the Network Platform of Remote Sensing for Natural Disaster Monitoring & Information Serving.

2. SYSTEM OBJECTIVES

The main objectives of the platform include:
1) The system has realized the operation of monitoring and assessing many sorts of natural disasters. Every day the diagram and report regarding disaster distribution , intensity，duration and so on should be provided in the three to four hours once getting the data, and the accuracy can reach 90 percent or higher.

2) The system includes some technologies such as Remote Sensing Data Preprocessing, Disaster Information Exacting, Disaster Loss Assessing and Information Network Serving.

3) The system can effectively support the dynamic monitoring based on weather satellites; if necessary, it also can ensure the operation of extracting disaster information, assessing and quick-reporting the loss based on data of space-borne SAR, air-borne SAR, Landsat TM and so on.

4) By means of network environment, the system can integrate every kind of technical achievement and multi-source data,

including remote sensing, thematic and statistic data, to support the enlargement and perfection of network platform to monitor and assess the natural disaster successively, and to provide the disaster information serving to the Party Central Committee，the Ministry and the provincial and civil governments.

3. SYSTEM STRUCTURE AND NATURAL DISASTER DATABASE

With the support of Remote Sensing, GIS and network technologies, Natural Disaster Monitoring Center, Institute of Remote Sensing Applications, Chinese Academy of Sciences has developed the Network Platform of Remote Sensing for Natural Disaster Monitoring & Information Serving. As what is shown in Fig.1, the overall framework of the system is mainly composed of three sections:
(1) Information Generating Section of Remote Sensing for Disaster Quick Reporting, mainly composed of five subsystems:
ⅰ Remote Sensing Data Preprocessing subsystem
ⅱ Disaster Information Exacting subsystem
ⅲ Disaster Loss Assessing subsystem
ⅴ Disaster Background Database Subsystem
ⅵ Network Disaster Information Sending subsystem

(2) Network Information Serving Section of Disaster Quick Reporting, mainly composed of three subsystems:
ⅰ Disaster Information Online Serving subsystem
ⅱ Disaster Information Switching Center subsystem
ⅲ Network Applied Technology Integrating Circumstance

(3) Section of Disaster Information Network Users: users of the Disaster Information Serving Network, according to the data's security classification and prescript concerned and their Access Privileges, could timely and continuously obtain the information they need and they could access via LAN of State Information Center, China Economic Information Network and INTERNET.

During the developing, running and serving of the system, the DDB of Remote Sensing Quick Observing and Reporting comes into being according the traits of natural disasters. It includes disasters information in the last several decades, the basic geographic data of different scales, and the flood assessing background---the Remote Sensing Data of Warning Water Area, the data of environmental and economical background and the result of monitoring. It is mainly composed of the following Databases：
Database of Land use Classified Map
Database of Country Administrative Divisions
Database of Historical Remote Sensing Images
Database of Remote Sensing Image Control Points
Database of Disaster Information Remote Sensing Quick-Reporting
Database of Social Economic Statistics
Database of Flood Disaster Warning Water Extent

The Database can provide effective data-support and necessary reference information for the subsystems of Network Platform of Remote Sensing for Natural Disaster Monitoring & Information Serving. The database system has set up the objective standard for disaster loss assessing by quantificational remote sensing, has ensured the accuracy and consistency of assessing data and has provided the new data layer for digital disaster.

4. SYSTEM FUNCTIONS

Network Platform of Remote Sensing for Natural Disaster Monitoring & Information Serving has six principal functions:

Remote Sensing Data Preprocessing function: mainly including Image Geometric Correction, Image Enhancement, Image Data Fusion and Map Image Overlay.

Disaster Information Exacting function: mainly including Information Exacting of meteorological satellite AVHRR Image, SAR image, Landsat TM Image and Remote Sensing airborne SAR Image.

Disaster Loss Assessing function: mainly including estimating the area of extinct crop and its corresponding economic loss, estimating the population of the village and town in disaster, estimating the loss of Anti-disaster and Communication Construction, planning reestablishment of living sub-region.

Disaster Information Sending function: mainly including Disaster Information Report Generating, Disaster Information Chart Editing, Image and Chart Decorating, Data Packing, Report, Image and Chart Printing out, Metadata Compiling, and Disaster Information Sending.

Disaster Information Online Serving function: mainly including Disaster Information receiving, Disaster Information Unpacking, Disaster Information Editing, Disaster Homepage Generating, Loading and Maintaining, Disaster Information Network Serving, Access Privileges Administrating and User Information Recording.

Disaster Information Inquiring function: Disaster Information receiving, Disaster Information Unpacking, Disaster Information Editing and Loading, Disaster Information Metadata Editing, Loading and Inquiring, Disaster Information browsing, downloading and Output.

5. APPLICATIONS

Network Platform of Remote Sensing for Natural Disaster Monitoring & Information Serving has experienced nearly a hundred disasters since its operation in 1996 and has became one of the 14 national websites including the State Council of People's Republic of China, the Sate development Planning Commission, the Ministry of Civil Affairs, the Ministry of Agriculture and so on. Using the NOAA/AVHRR data to monitor and assess the different natural disasters macroscopically everyday and using TM, space-borne SAR, air-borne SAR and other remote sensing data when the situation of a disaster is severe, the system can satisfy the need of government and the leaders of provinces in controlling the disasters and reestablishing of livelihood. The monitoring area of the system covers China and part of Southeast Asia, and has gained 243 sorts of achievement in flood, drought, earthquake (Figure 2), sandstorm (Figure3), red water bloom, mudrock flow, fire and so on.
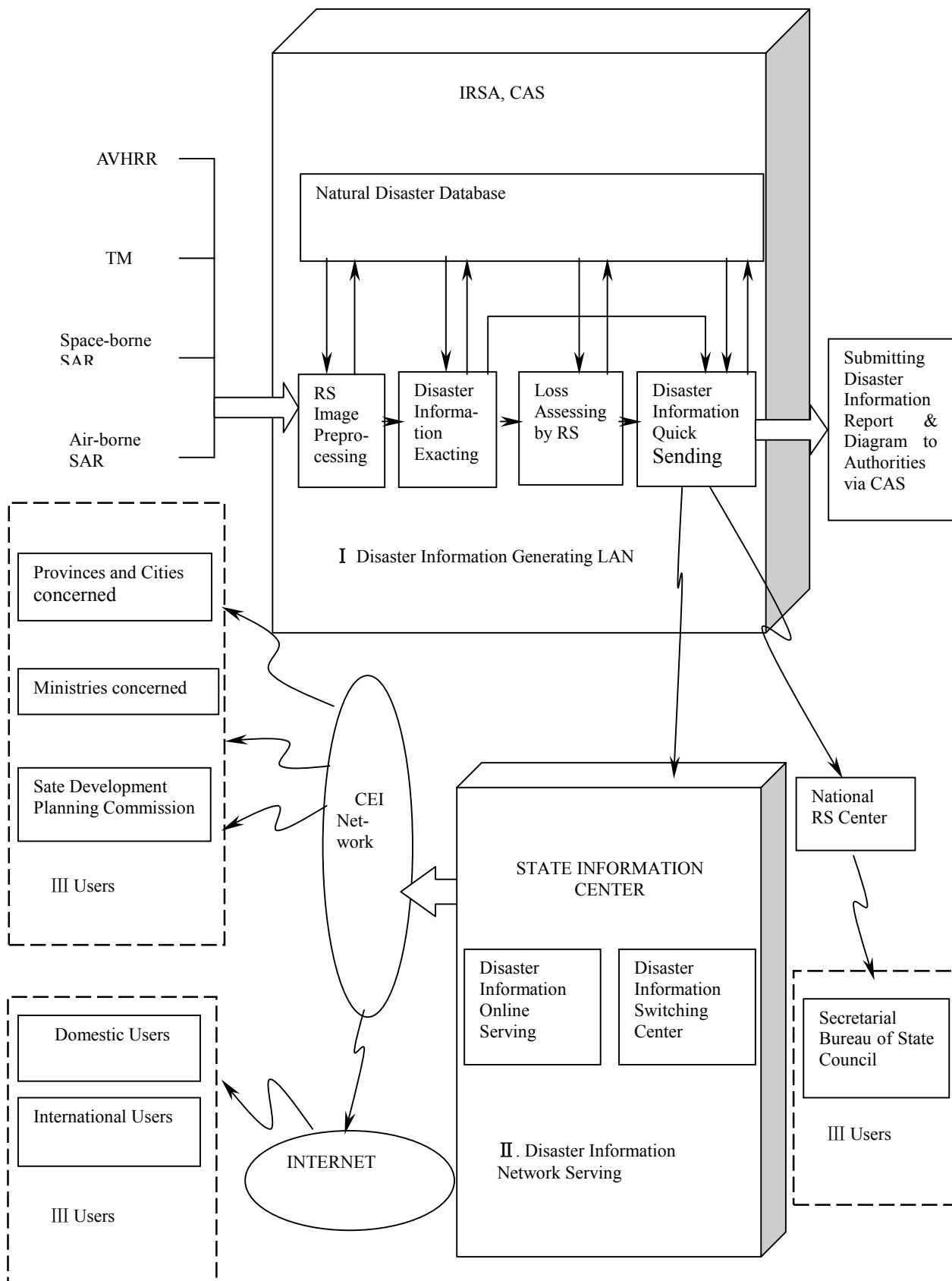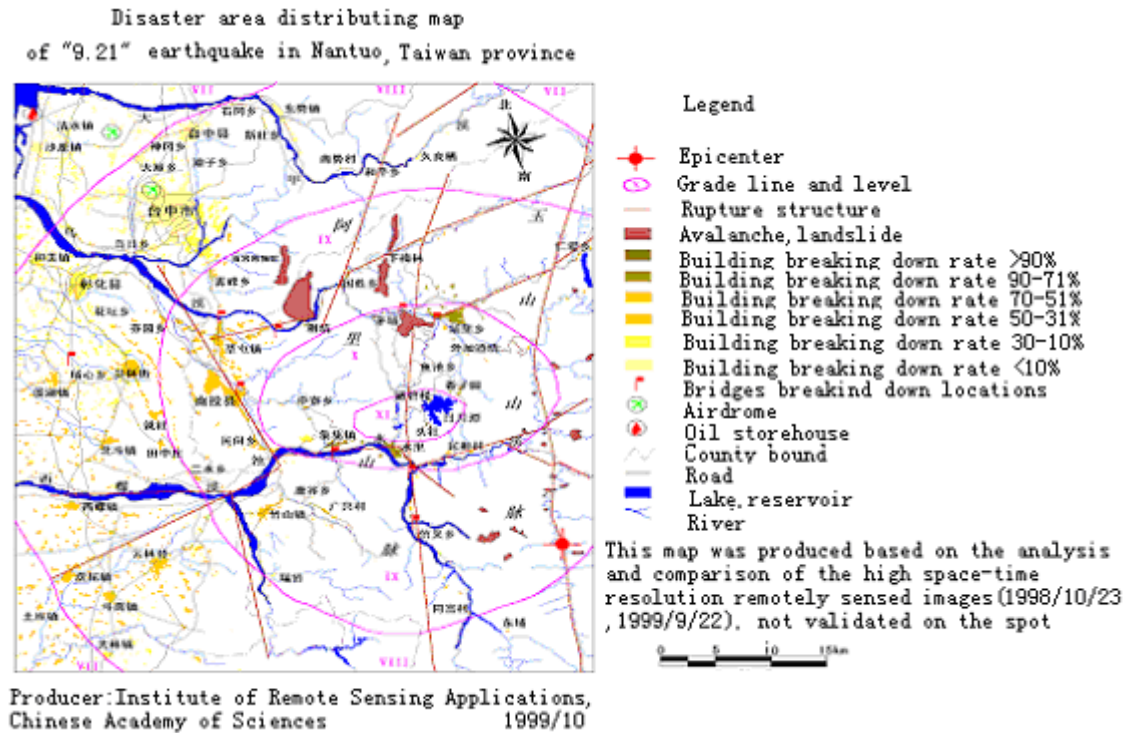
Figure 1. Global Structure of the Platform

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Figure 2. Disaster area distributing map of "9.21" earthquake in Nantuo, Taiwan province
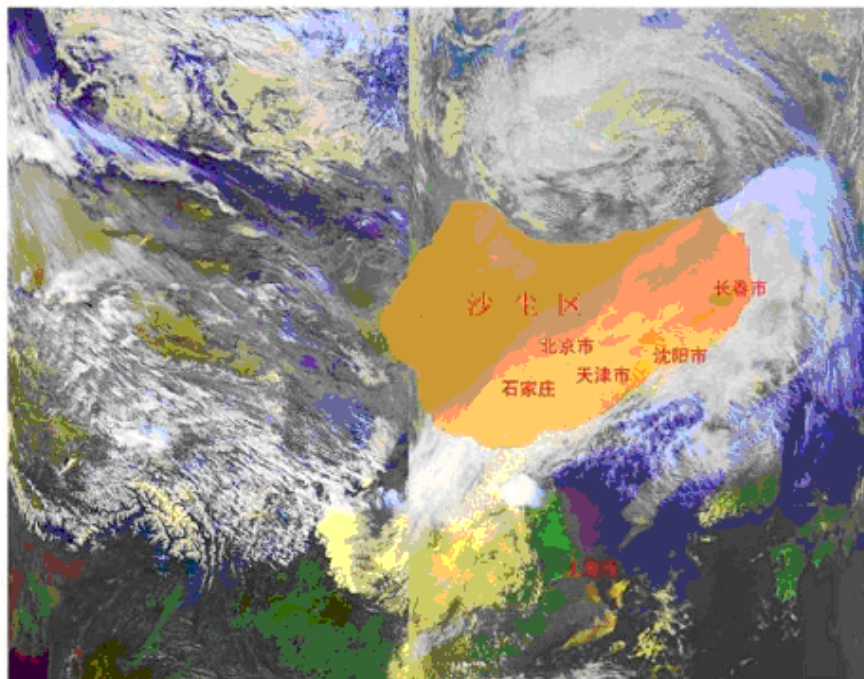

Figure 3. Map of areas influenced by sandstorm in Huabei, northeast regions (20 March 2002)

6. FUTURE VISTA

The quantificational assessment and forecast of natural disasters is still a technological bottleneck in the world. Researching deep into the remote sensing mechanism about natural disasters, and then improving technological level and decision-making capability in mitigating, preventing and controlling the natural disasters, are the main objectives of research in remote sensing about natural disasters for the future. The concrete work involves:

Research in disaster remote sensing data-mining method: there are two methods in using the remote sensing data to exact the disaster information, one is interactive-exacting, and the other is model operating. With the higher requirement on time-efficiency of the disaster information, interactive-exacting method must advance to model-operating method, and thus it is necessary to research the disaster information analyzing and exacting methods on the condition of different image resolution, sensor and different manner in data fusion.

Construction of 'digital disaster' system: digital disaster is the basic research of disaster monitoring, assessing and forecasting. The digital disaster is the organic composition of digital Earth, concerned with spatial data of historical disasters, dynamic resource & environment database of different scales, remote sensing data of different resolution, time sequence and sort, DEM data of different precision, meteorological, hydrographic and economic statistics data of spatial long time-sequence.

Research in layout of the countrywide disaster division based on remote sensing: divide the natural disaster division

according to the physical geographic condition, climate condition and anti-disaster construction and realize the countrywide disaster classification and division, such as disaster division of different types (drought type, flood type, flood and drought mixed type, and so on); disaster division of different degrees (serious degree, middle degree, light degree and so on.

4) Research in index system of countrywide disaster loss synthesizing and assessing: disasters in China are always multiple types, and the economic loss of the region bears the trait of comprehensibility. The crux of disaster loss synthesizing and assessing is to select the assessing index and its corresponding threshold value according to the type and degree of the disaster. In term of the index system and the continuous disaster information, we can synthesize and assess multi-steps loss according to different administration cells, and then provide the daily/monthly/ quarterly/yearly report of disaster monitoring and assessing to the country.

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