FOREST MONITORING PROTOTYPE SYSTEM USING WEB MAPPING TECHNOLOGY

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ABSTRACT
The Ministry of Agriculture, Forestry and Fisheries of JAPAN (MAFF) Agriculture, Forestry and Fisheries Research Council Tsukuba Office and the National Space Development Agency of JAPAN (NASDA) are developing a prototype system to study new services and possibilities of data interoperability for agricultural applications between MAFF and NASDA. In recognition of the need to increase interoperability of geographical spatial data and Earth observation data, emphasis will be placed on using OpenGIS Consortium (OGC) technology for the prototype system. This paper discusses a prototype forest monitoring system using OGC web mapping technology.

1. INTRODUCTION

Earth observation data has been highly effective in environmental monitoring but it is not being used effectively enough in operational systems. Within NASDA there is a desire to promote increased use of Earth observation data in operational systems used for environmental monitoring. Further, through the rapid development of the Internet GIS has expanded from from local applications to applications distributed over the Internet through various tools and interfaces that support distribution of map and location information over the Internet.

Consequently, NASDA decided to produce a prototype system for forest fire monitoring in Thailand using OGC web mapping technology as a means to evaluate the usefulness of OGC technology for forest application as a joint research project between NASDA and MAFF.

2. INTRODUCTION OF OGC WEB MAPPING SERVICE

OGC standards allow companies and agencies worldwide to offer data, tools and processes in ways that are interoperable. Data is delivered by a variety of OGC Web Servers: Web Map Servers (WMS) provide map images (JPEG, GIF, etc.); Web Feature Servers (WFS) provide data from a geographic database; and Web Coverage Servers (WCS) provide source data (GeoTIFF, HDF-EOS, etc.). These servers can provide user selected areas of image data and source data to customers immediately via networks. A Viewer Client can combine these images with images created by other OGC servers located all over the world and from many different kinds of data (see Fig. 1). The forest monitoring system incorporates WMS and WFS servers. Details are provided in Section 3.

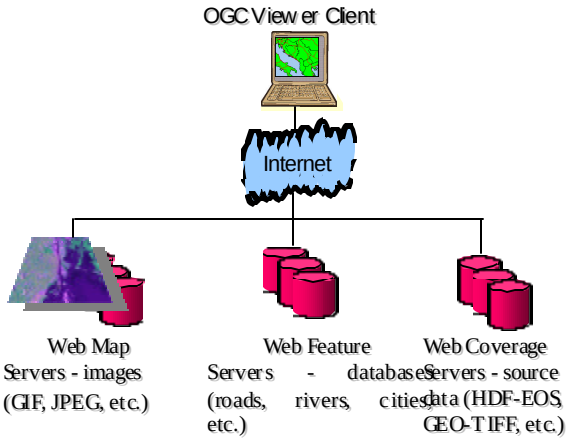

Fig. 1 Accessing WMS, WFS and WCS servers

3. FOREST MONITORING SYSTEM OVERVIEW

3.1 Data Provided

NASDA and MAFF provide the following data for the South East Asia area:

a. AVHRR hot spots (daily data, produced by MAFF)
b. DMSP/OLS hot spots (daily data produced by MAFF)
c. Fire risk maps show the dryness of the area using NOAA/AVHRR data (10 day composite, produced by MAFF).
d. JERS SAR mosaic images (produced by NASDA)

Fire Risk maps and hot spot data are prepared by MAFF under the Asia-Pacific Network for Disaster Mitigation Using Earth Observation Satellites (ANDES) project (http://www.affrc.go.jp/ANDES/), whose objective is to develop near real-time information systems that contribute to preventing/mitigating agro-environmetal and forest disasters by using earth observation satellites.

JERS-SAR mosaic data is produced by NASDA under the Global Rain Forest Mapping Project (GRFM) (http://www.eorc.nasda.go.jp/Sciences/Forest/index.html). GRFM is an effort led by the Earth Observation Research Center (EORC) of the National Space Development Agency of Japan (NASDA) in cooperation with, among others, NASA's Jet Propulsion Laboratory (JPL), NASA's Alaska SAR Facility (ASF), the Space Applications Institute of the Joint Research Centre of the European Commission (JRC/SAI), the Unversity of California, Santa Barbara (UCSB), the Brazilian National Institute for Space Research (INPE) and the National Institute for Research of the Amazon (INPA). Its goal is to acquire contiguous Synthetic Aperture Radar (SAR) data sets of the Earth's major rain forests using Japanese Earth Resources Satellite (JERS-1) data.

3.2 Use case

The following scenario for monitoring a forest fire was assumed:

a. Operators can find the latest fire locations and evaluate further risk of fires by combining Fire Risk maps with the latest hot spot information.
b. For a more detailed understanding the operator can zoom into an area and overlay fire hot spots onto the JERS-SAR mosaic image to understand the topography. Also, the operator can overlay state boundaries, rivers, roads, etc.
c. Operator can do temporal searches on past Fire Risk maps and hot spots.
d. Operator can save the image in JPEG format and hot spot lat/lon information in text format.

3.3 Science requirement

For an operational system it is important to talk to actual or potential users of the system to determine user-friendly operational characteristics. Use of this prototype system was directed toward operations in Thailand for monitoring of forest fires in Thailand. However, it was not possible to interview operators in Thailand. So operational characteristics were determined from discussions with scientists who had experience working with operational forest fire monitoring personnel in Thailand. Thus, the system requirements determined from discussions with scientists are shown below.

a. Simple & Easy operation of User I/F

- Target users are forest monitoring operators in Thailand.
- Operators are not familiar with Satellite images, so their User I/F should be simple & easy to use.

b. Must consider the low internet bandwidths in S.E. Asia.
c. Must provide the actual hot spot data (text format), not only the images.
d. Must show a distance scale (km).

3.4 System configuration

The Forest Monitoring prototype system includes:

a. Fire risk map server (Web Map Sever, ver.1.1.0): SUN Solaris 2.7
b. JERS-SAR mosaic data server (Web Map Server, ver. 1.1.0): LINUX
c. Hot spot data server (Web Feature Server, ver. 0.0.14): LINUX
d. Forest monitoring Client: LINUX

The following additional software was used:

a. IDL (ESRI)
b. PERL
c. PostgreSQL
d. EarthNavi (NEC Aerospace systems, Ltd.)

The major functions for the prototype system are:

a. Combine multiple maps (images) from the above servers.
b. Providing hot spot lat/lon information as text.
c. Overlay feature data. (coastlines, roads, rivers, etc.).
d. Save the combined images.

The prototype system configuration is shown in Fig. 2.

3.5 Main considerations for system design

Integration of user requirements and web mapping technology was taken into consideration in the system design. The main considerations for the system design were:

a. Take narrow bandwidths into account:
   We evaluated the number of times images and data were transmitted between web map clients and WMS/WFS, and wanted to minimize the number of transmissions. When the operator does a temporal search on Fire Risk maps, multiple maps may be found. So:
   - Web Map Client sends a GetMap request for only the most recent image to the WMS.
   - Web Map Client does not support GetCapabilites (WMS sends a message when a new Fire Risk map is added, WFS sends a message when new hot spot data is added).
   - Web Map Client contains the GIS data for coastlines, rivers, state boundaries, etc. (does not need to access WFS for this).

b. However, WMSs and WFS support GetCapabilites and GetMap functions for other Web Map Clients.

Scientists wanted the system to show the number of days that a fire had burned in the same area. The solution chosen was to show the age of the fire by its color. Thus, a new fire is shown in red, a fire one day old is shown in pink, and fires that are two or more days old are shown in another color.

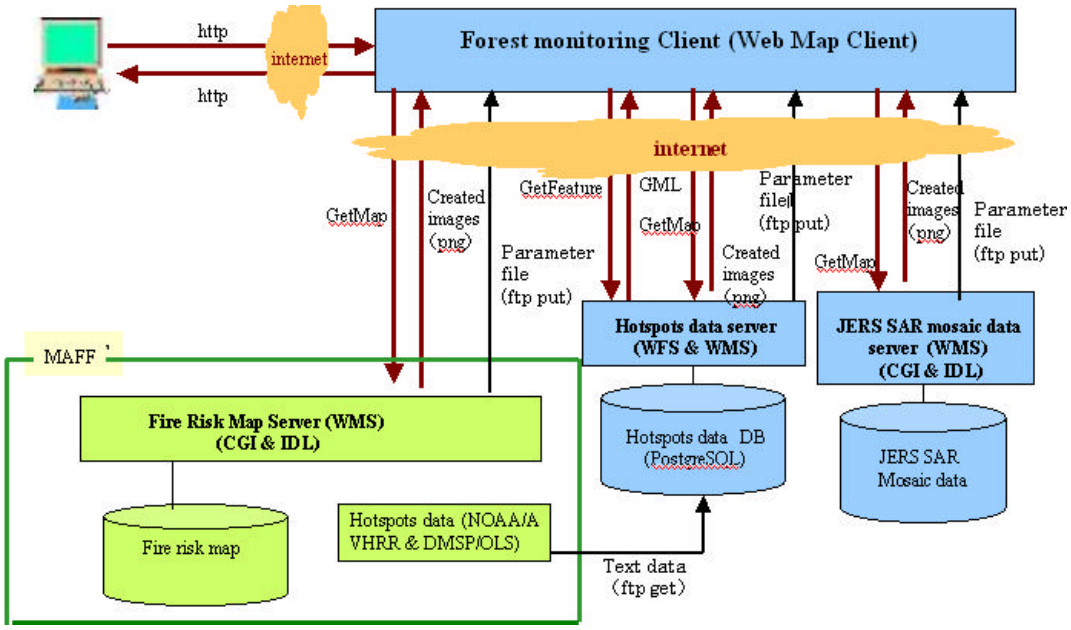

Fig. 2 Forest Monitoring prototype system configuration

4. SCHEDULE

The system design was finished in September, 2002 and development began in October, 2002. Prototype system operation is scheduled to begin in January, 2003.

5. IN THE FUTURE

We have completed the design of a prototype for an operational forest fire monitoring system based on the OpenGIS interface standard web mapping technology. In addition we have designed an operator's client which provides additional methods to reduce use of limited bandwidth in Asia.

After the prototype system becomes operational we will obtain comments from the users to guide us in developing a more useful system. In addition, this data will be available to the planned Digital Asia Network for Southeast Asia since the WMSs can provide their data to standard OpenGIS clients as well as the specialized clients developed for this prototype system. Thus, this data will be available to other users.

In the future we plan to study the development of a WCS to provide source data to scientists.

6. REFERENCE

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