Geo-information Techniques in AIST

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Abstract

Publications and databases in GSJ

The Geological Survey of Japan (GSJ) published geological maps at scale of 1:50,000, 1:75,000, 1:200,000, 1:1,000,000, and 1:2,000,000 during the last 125 years. Other maps like active fault, active volcano, marine geology, hydrogeology, mineral resources, coal, oil and gas fields, intensity of aeromagnetic, and geothermal maps are also published. GSJ published a total of 41 CD-ROM series including 1:200,000 geological maps in vector and raster formats. GSJ established more than 10 databases in the Research Information Data Base (RIO-DB; *http://www.aist.go.jp/RIODB/riohomee.html*) of the National Institute of Advanced Industrial Science and Technology (AIST). The databases include active fault, active volcano, seamless digital geological map, geothermal drill core, marine mineral, geophysical exploration activity, basement rocks, geochemical map, crustal stress, and geological literature databases. These maps and databases have been published on printed sheets, CD-ROMs, and normal html-based websites. GSJ decided to integrate most of these maps and database on a Web-GIS system to facilitate the accessibility of the geological data of the organization in 2005 (GEO-DB project).

GeoMapDB

GSJ introduced a new Integrated Geological Map Database (GeoMapDB) in Sep., 2006 (*http://iggis1.muse.aist.go.jp/en/top.htm*). The GeoMapDB is based on a WebGIS (ArcIMS) technology, which makes it possible to browse, overlay and search geological maps online. The purpose of this database is to make many kinds of geological maps produced by GSJ accessible to the general public. The database contains geological maps with scales ranging from 1:2 million to 1:25,000. The database includes the 1:1 million geological map of Japan (3rd edition), 1:200,000 seamless digital geological map of Japan (*http://www.aist.go.jp/RIODB/db084/index_e.html*), 1:200,000 geological map of Japan (raster at 150 dpi and vector formats), 1:50,000 quadrangle series (raster format), and the 1:25,000 environmental geologic map of the Tsukuba Science City (raster and vector formats). It is possible to search information using the attribute tables of maps in vector format. Legends and cross sections of the 1:50,000 quadrangle series and environmental map of Tsukuba city are available. Links to Quaternary volcanoes and active faults databases are also available. Links to other databases, such as geological literature, outcrop information, dating, geological sample databases would also be made available soon. Three

dimensional (3D) display of the viewing area is also possible. Downloading viewing image at 150 dpi and original files in raster (geotif and KMZ) and vector (shape and eps) formats is possible. Web Mapping Service (WMS) for the 1:1 million geological map of Japan and 1:200,000 seamless digital map of Japan is available. Thus, overlapping borehole data and landslide data from other agencies and overlaying on the Google Earth map is possible. GSJ decided to contribute the data from GeoMapDB to the OneGeology project (*http://www.onegeology.org/*), which aims to make 1:1 million digital geological map of the world using WFS.

GEO Grid

The GEO Grid is a grid technology system to provide securely and rapidly large archives of earth observation satellite data and integrated service with various observation databases and GIS data. The core contents of the system are the observation data from the earth observation satellite (ASTER) and geoscientific information, such as geological and environment technology data in AIST. Numerical simulation of pyroclastic flows on volcanoes using ASTER digital elevation model (15 m mesh) is one of the major application on the GEO Grid project.

Volcanic disaster mitigation maps (Volcanic hazard maps) are available at most major active volcanoes in Japan. A GIS system overlaying various kinds of information and real time numerical simulations on website are necessarily for the next generation volcanic hazard maps.

Pyroclastic flow simulation using the energy cone model was made on the GEO Grid system. An interactive user interface is available on the GEO Grid website. Only two parameters (column collapse height and equivalent coefficient of friction) are necessarily to evaluate potential hazardous area by pyroclastic flows. In this stage, pyroclastic flow simulations are available at 14 volcanoes, such as Merapi (Indonesia), Fuji, Unzen, Sakurajima, Usu, and Bandai Volcanoes. It is possible to update the DEM data during the eruptions by taking new ASTER satellite data. Runtime for each simulation is only 10 seconds to 3 minutes due to grid computing technology. The energy cone simulation on the GEO Grid system is applicable to other disasters such as debris avalanches and landslides. The pyroclastic flow simulation is open to all scientists and local government officials at http://www.geogrid.org/gridsphere. Numbers of applicable volcanoes are increasing. Numerical lava flow and grain flow simulations are planning for the next step.

Integrated Geological Map Database and the GEO Grid project in the Geological Survey of Japan, AIST

Shinji Takarada
Geological Survey of Japan
AIST

New Database System in GSJ

GEO Grid (Global Earth Observation) Project

Development and use of application

Environment | Disaster prevention | Agriculture | Natural Resources

etc.

Various existing map information

Neotectonic map | Geological map | etc.

Overlappable GIS data

Standard Web service I/F

Interoperation | GEON

OGSA basic services

Data Grid

GRID DATA FARM

Base data

DEM | ASTER

PALSAR | MODIS

Computing Grid

(ASC Photo)

AIST Supercluster

High-speed correction processing of satellite data
Development of digital map

PALSAR

ASTER MODIS

Contents

1. Publications in Geological Suvery of Japan (GSJ)

2. Databases in GSJ (RIO-DB)

3. New WebGIS System (GeoMapDB, G-INDEX, GIS Intra)

4. Collaboration with the GEO Grid project using WMS

5. 1991-95 Unzen pyroclastic flow, Japan

6. Next Generation Volcanic Hazard Map

7. Volcanic Gravity Flow Simulation using ASTER DEM

Publications

http://www.gsj.jp/Map/index_e.html

Publications (Printed)

Publications (CD-ROMs)

RIO-DB   Research Information Database

http://www.aist.go.jp/RIODB/riohomee.html

http://riodb02.ibase.aist.go.jp/db084/index_e.html

http://riodb02.ibase.aist.go.jp//activefault/cgi-bin/index_e.cgi

RIO-DB

Quaternary Volcanoes in Japan

Ver. 0.9E
First update___
09 March 2006

This database includes Japanese volcanoes that were active during the Quaternary (ca. 1.7 Ma to present). Most subaerial volcanoes are included. Submarine volcanoes included in this database had erupted, and/or showed seawater discoloration and/or hydrothermal activity. The Japan Meteorological Agency (JMA) has defined active volcanoes in Japan as "volcanoes which have erupted whthin the past 10,000 years or volcanoes with vigorous fumarolic activity."

- Volcano by Region
  - Index Map of Volcanoes
  - Index Map of Active Volcanoes

- Volcano by Name
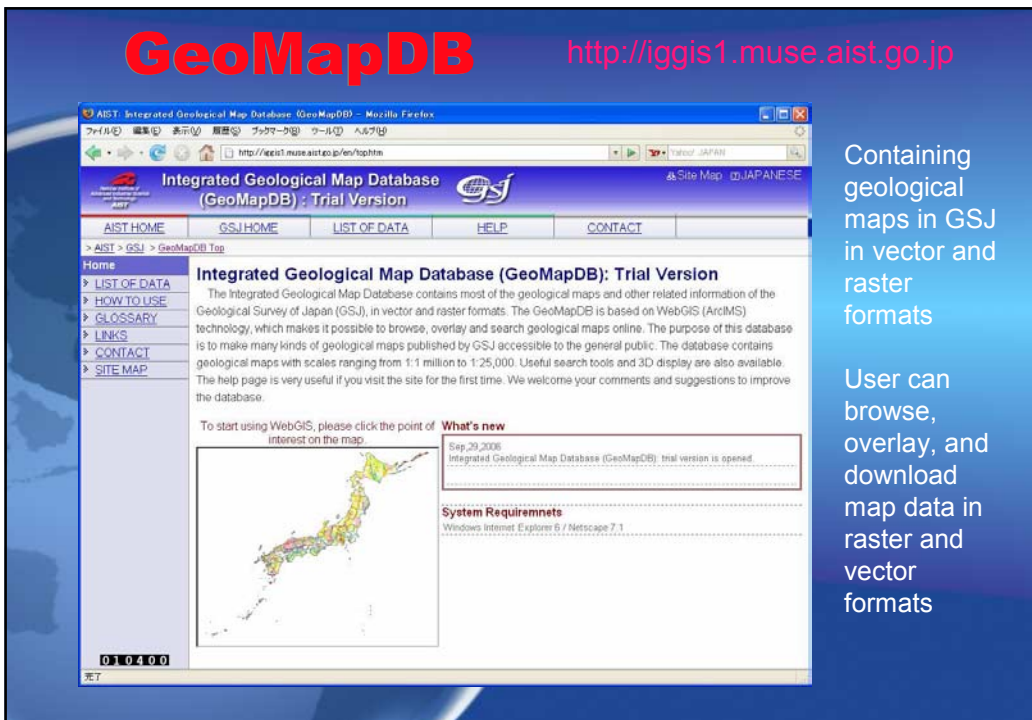 - List of Volcanoes
  - List of Active Volcanoes

Information (in preparation)

About "Name of Volcanoes in Japanese"

http://riodb02.ibase.aist.go.jp/strata/VOL_JP/EN/index.htm

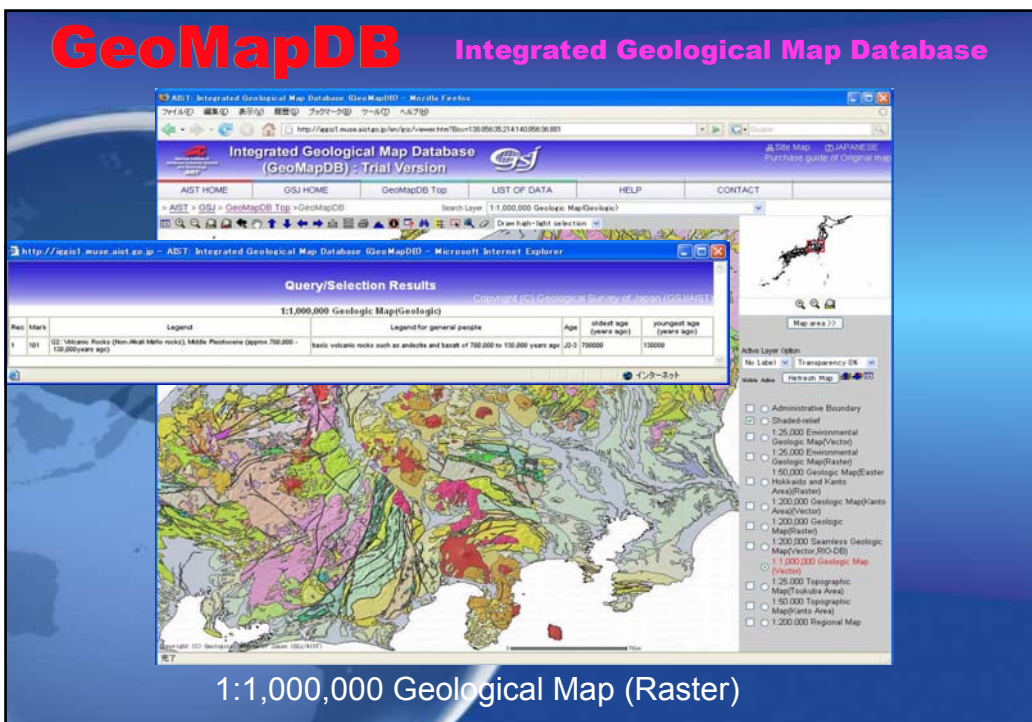## New Database System in GSJ

GeoMapDB http://iggis1.muse.aist.go.jp
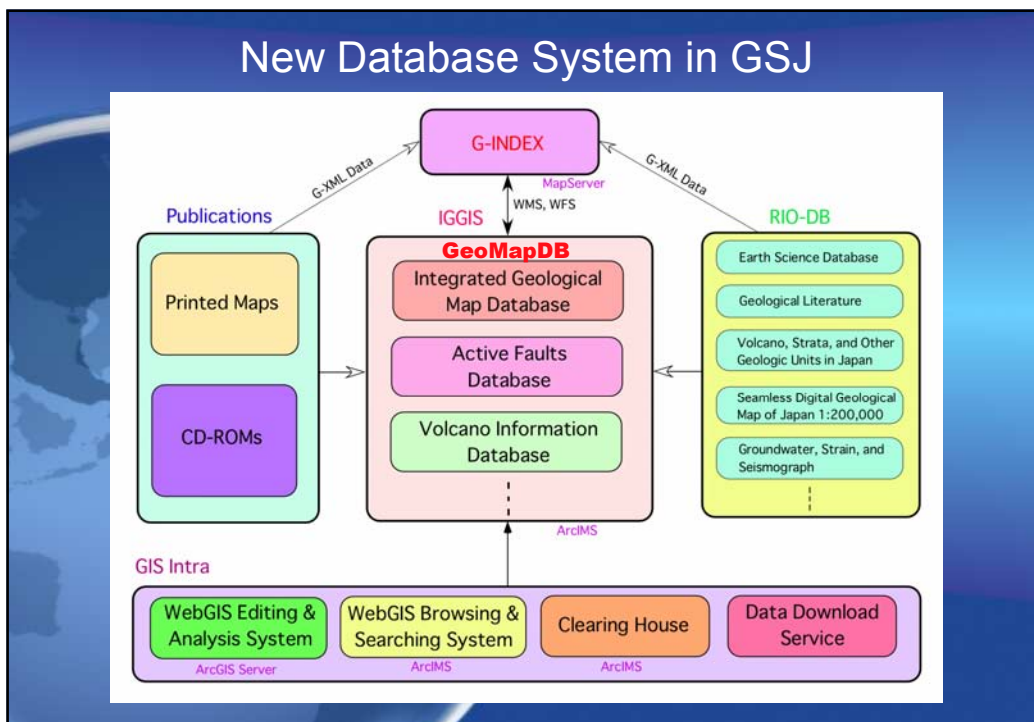
Containing geological maps in GSJ in vector and raster formats

User can browse, overlay, and download map data in raster and vector formats

1:1,000,000 Geological Map (Raster)

1:50,000 Geological Map (Raster)

1:200,000 Seamless Geological Map of Japan (Vector)

1:200,000 Seamless Geological Map of Japan (Volcanic Rocks)
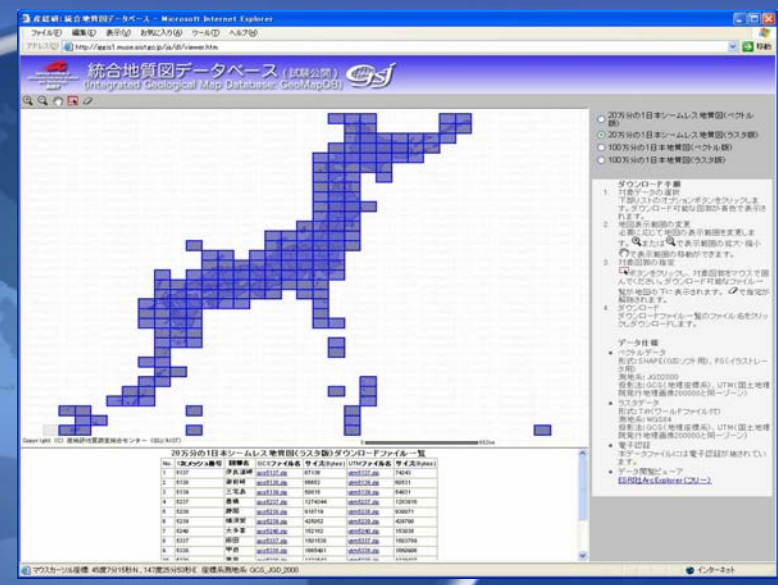
Link to Volcanic Databases
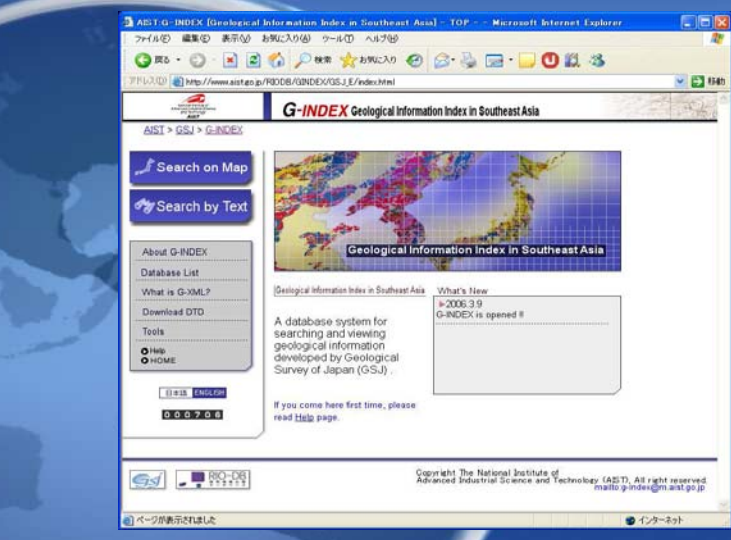
Link to Active Fault Database (RIO-DB)

3 dimensional view of seamless geological map of Japan (VRML)

Data download service

http://www.aist.go.jp/RIODB/GINDEX/GSJ_E/

G-INDEX — Geological Information Index in Southeast Asia
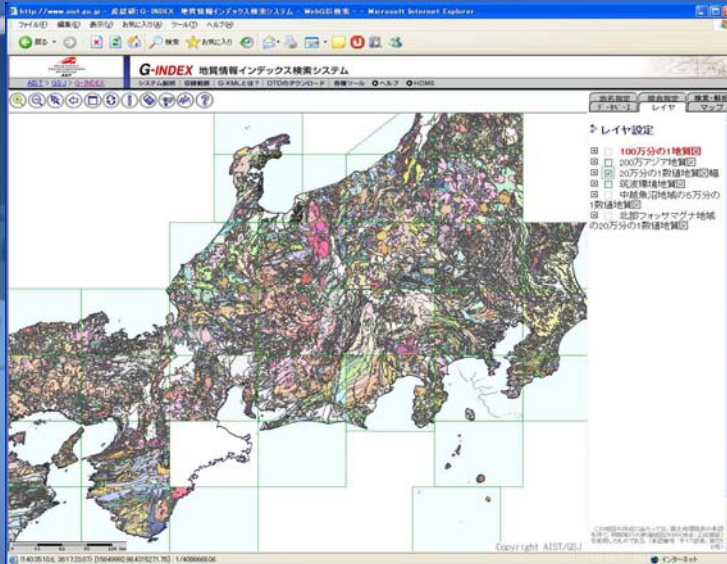
Containing most data in GSJ in vector formats

User can select data, browse, search, and overlay vector data

1:200,000 Geological Maps of Japan

GIS Intra — WebGIS Editing & Analysis System
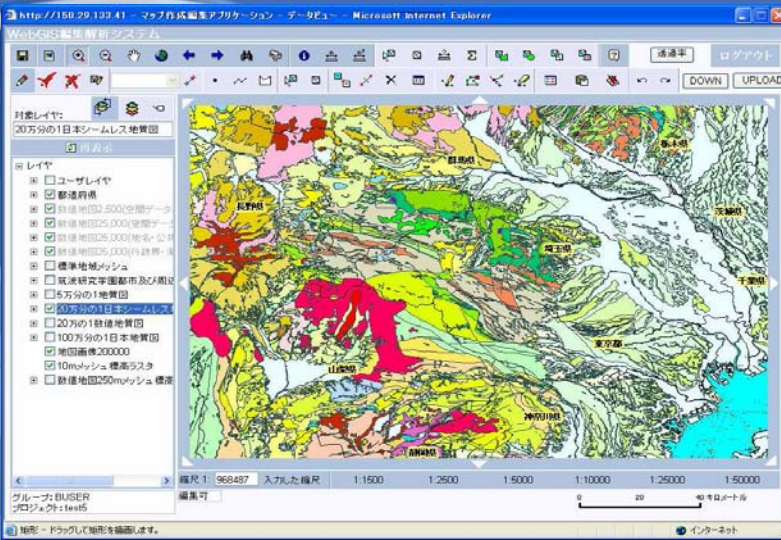
Containing geological maps in GSJ in vector and raster formats

User can add and edit the data, upload and download the data using a web browser

ArcGIS Server 9.1

Collaboration with GEO Grid (WMS)

A test bed overlaying a geological map and ASTER satellite image on the G-INDEX using WMS (Web Mapping Service)
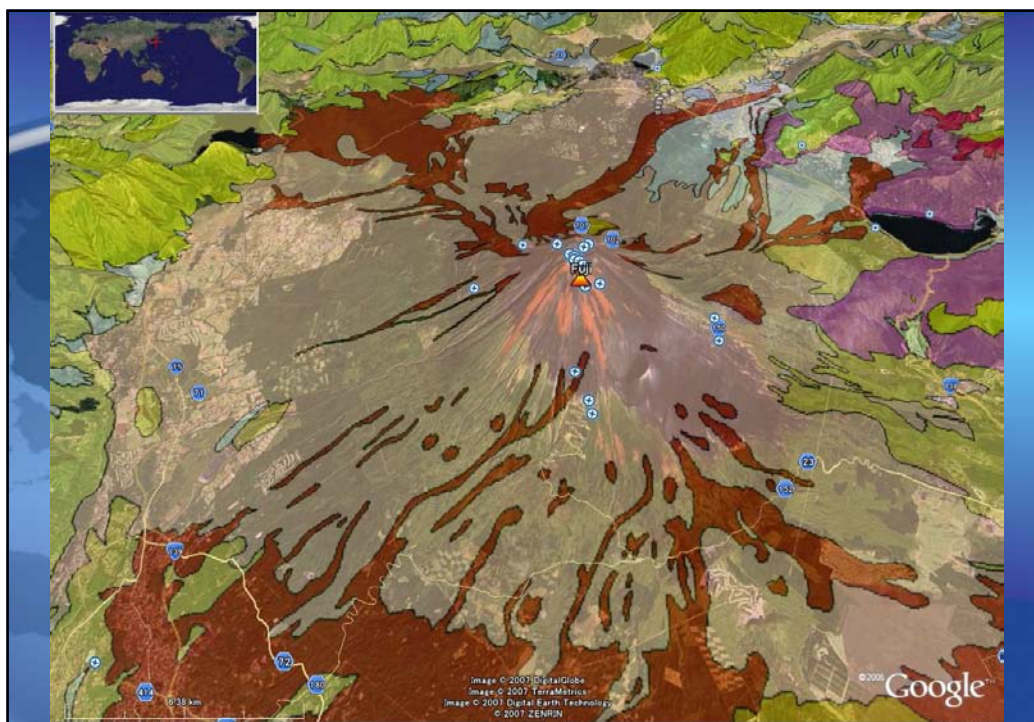
Overlaying landslide and borehole information

Landslide data
(NIED)

Borehole data
(Chiba Prefecture)

Contribution to OneGeology Project

First OneGeology Workshop, Brighton, UK, March 12-16, 2007

Would you like to know more? Please contact OneGeology@bgs.ac.uk
www.onegeology.org

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Contribution to GeoSciML Project

GeoSciML Design Team Meeting, Tucson, AZ, May 9-15, 2007

GEO Grid (Global Earth Observation) Project

GEO Grid: ASTER Satellite Data Archive
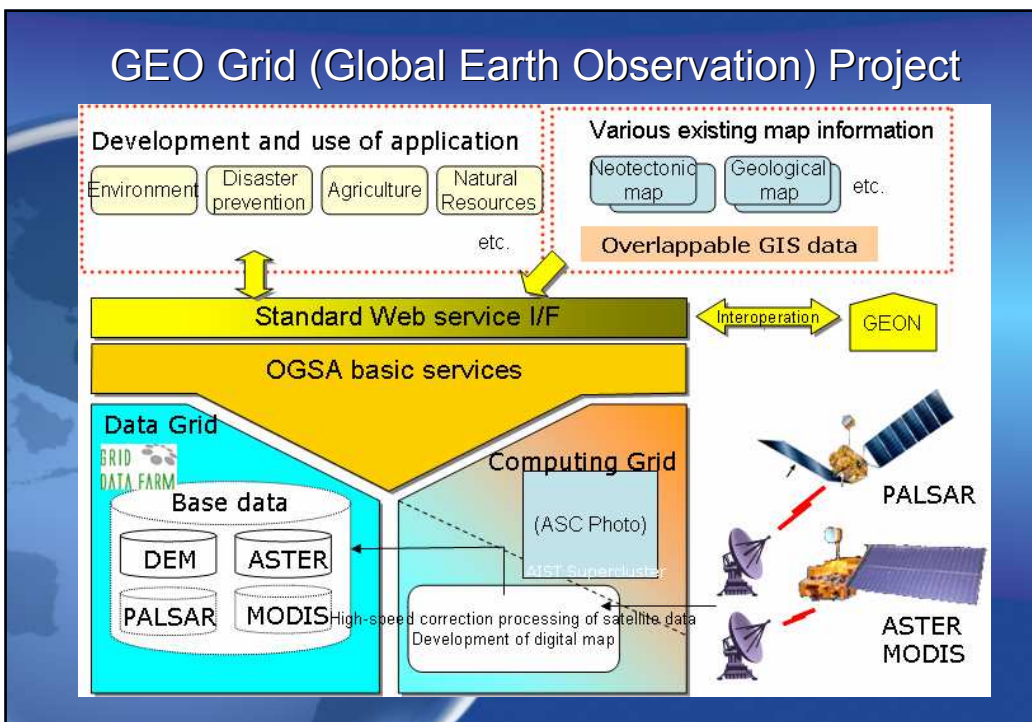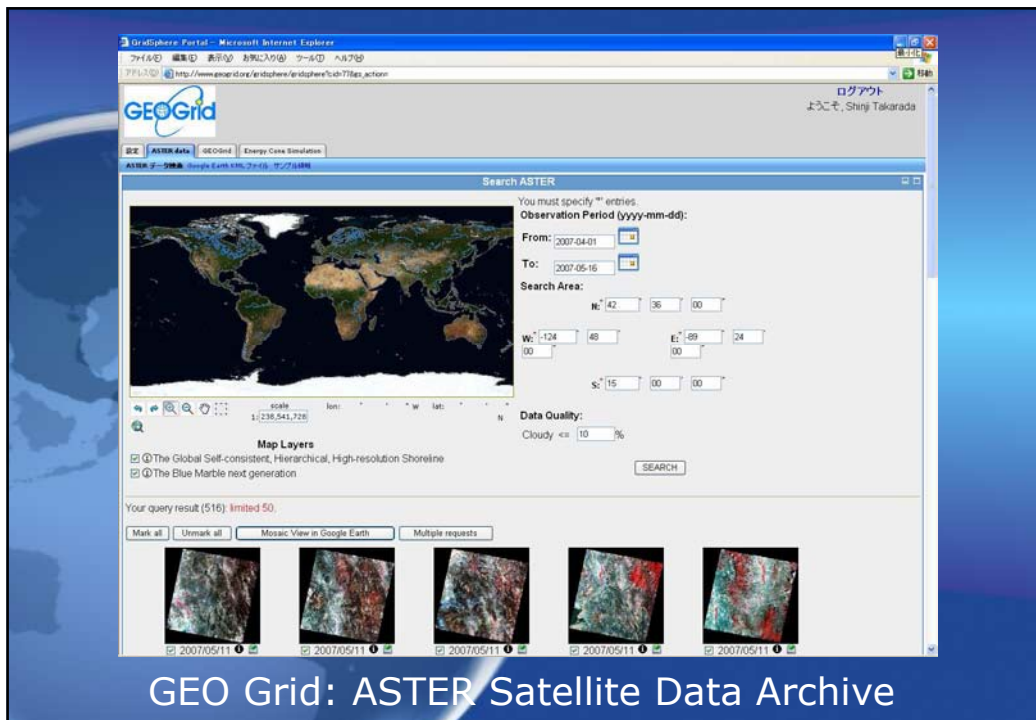
Volcanic Gravity Flow Simulation Team

Shinji Takarada（Geoinformation Center, AIST）

Ryoshuke Nakamura（Grid Technology Research Center, AIST）

Naotaka Yamamoto（Grid Technology Research Center, AIST）

Hirokazu Yamamoto（Grid Technology Research Center, AIST）

Shinsuke Kodama（Grid Technology Research Center, AIST）

Mai Arioka（Institute of Geology and Geoinformation, AIST）

Tsukasa Nakano（Institute of Geology and Geoinformation, AIST ）

Unzen Volcano

1:1M geological map of Japan (3rd edition)

Unzen Volcano

108 active volcanoes

Rank A
13 volcanoes

Rank B
36 volcanoes

Rank C
36 volcanoes

1991- Heisei-Shinzan lava dome

1991- pyroclastic flow deposit

Mayuyama lava dome

1792 amphitheater

1792 debris avalanche deposit

Photo: Asia Air Survey

Aerial view of the Unzen Volcano

Dome-collapse type pyroclastic flow （June 24, 1993)
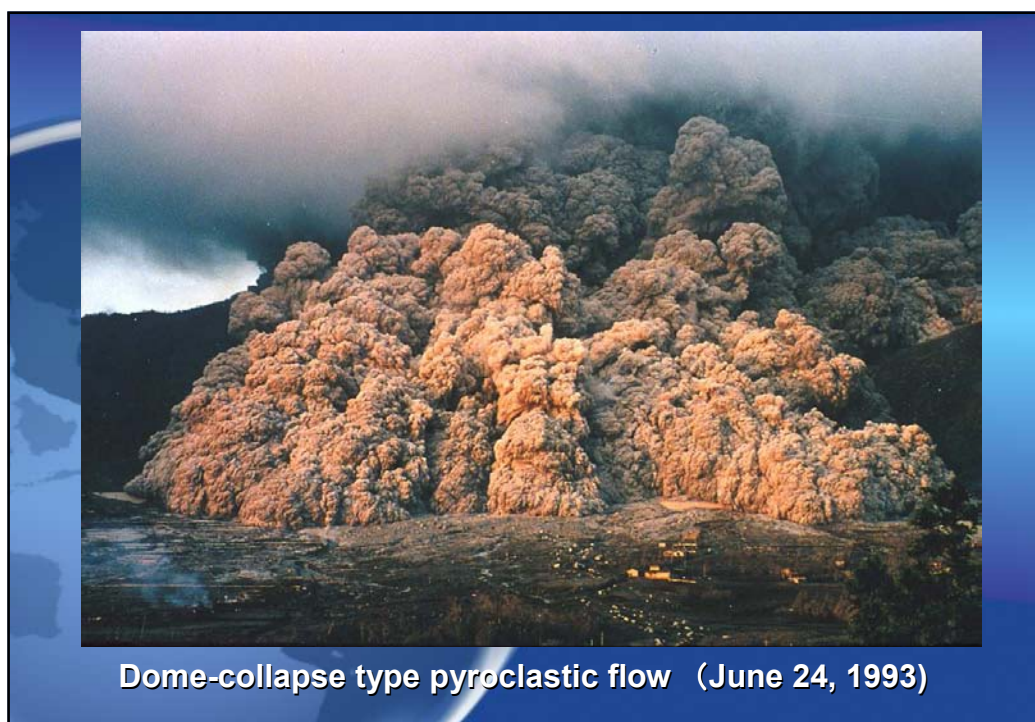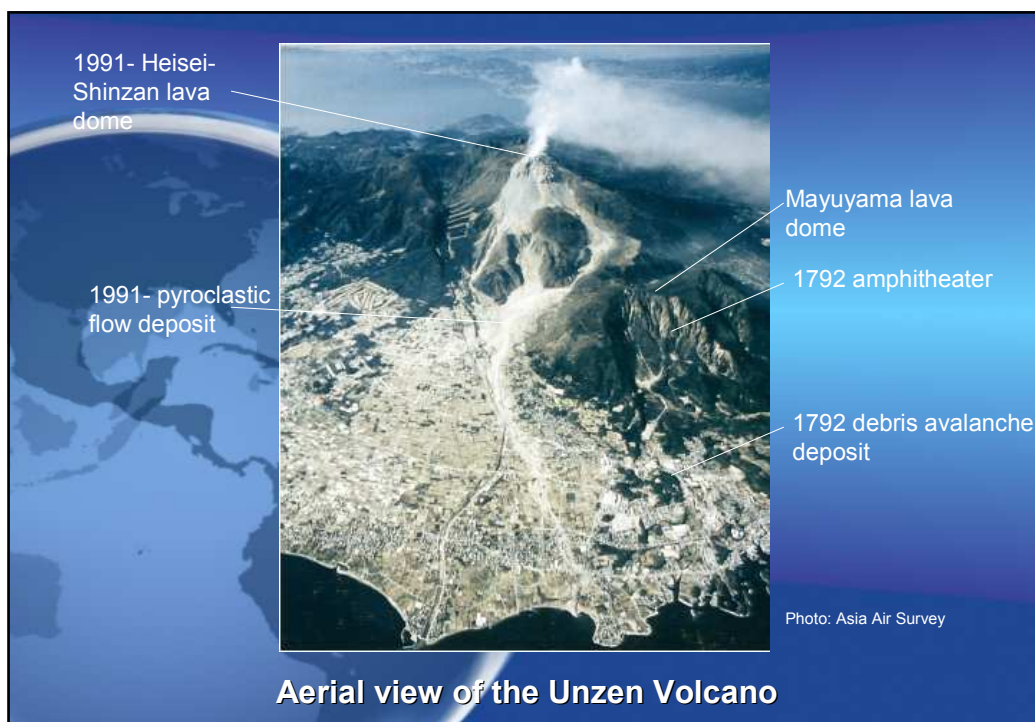
(After Nakada, 1992)

Devastation area attacked by an ash-cloud surge （June 3, 1991)
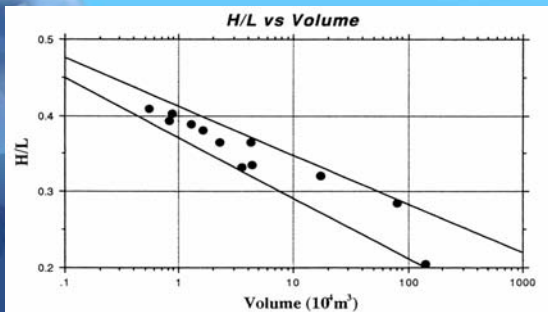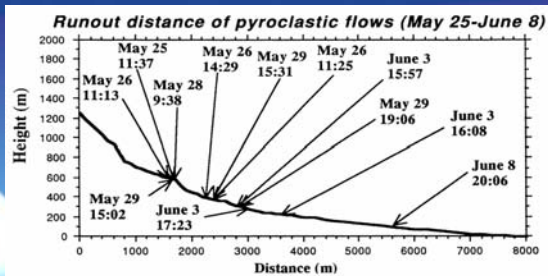
(after Takarada et al., 1993)

Runout distance and H/L-Volume relations of Unzen pyroclastic flows

Volcanic disaster prevention map of Unzen Volcano

Volcanic disaster prevention map of Usu Volcano

Next Generation Hazard Map

1. Using a GIS System

 Overlay all historical eruption products
Overlay satellite image, resident's information
Pictures and short video footage to explain possible volcanic eruptions
How to evacuate (route, where, what to bring, etc)

2. Real Time Hazard Map

 Computer simulations using a laptop computer and/or on website
Energy Cone Model, granular flow model, Bingham flow model

3. 3D Model

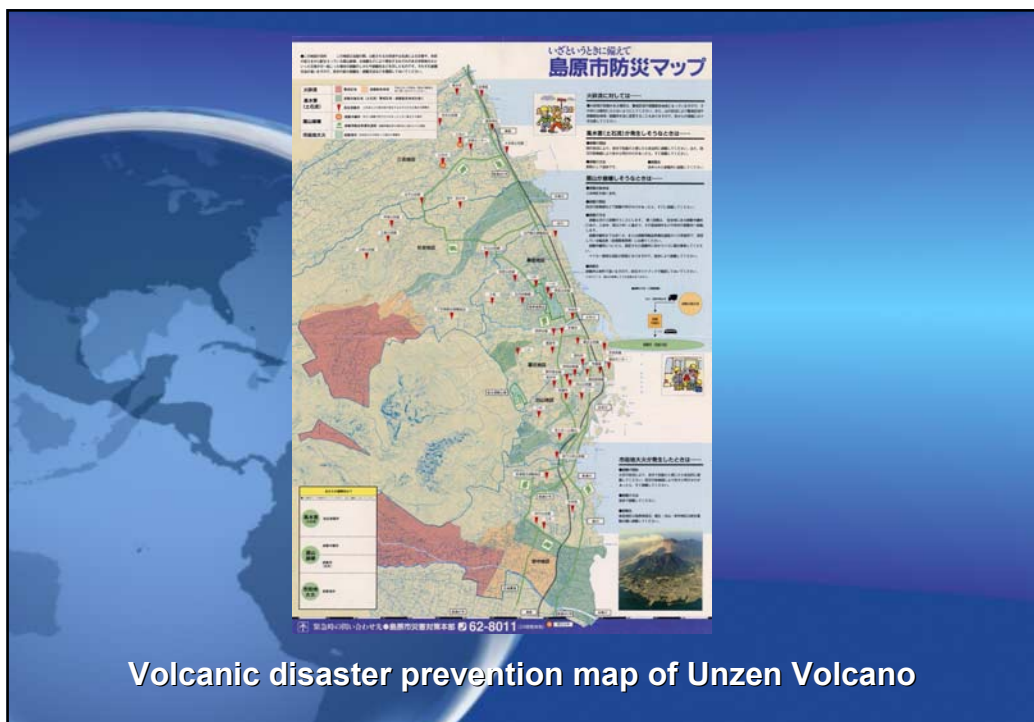 Using high resolution DEM, ASTER (15m mesh)

GEO Grid pyroclastic flow simulation

1. Energy Cone Simulation
   Simple (less parameters, Hc, H/L only)
   Evaluate potential hazard areas (good for hazard maps)

2. ASTER data DEM, Web-base Application
   High resolution (15m)
   Applicable every volcanic areas in the world
   Possible to use updated topography for DEM
   Possible to open for all scientists in the world

ASTER images and 3D DEM

(after Takarada et al., 1993)

Potential hazard area estimations using energy cone model
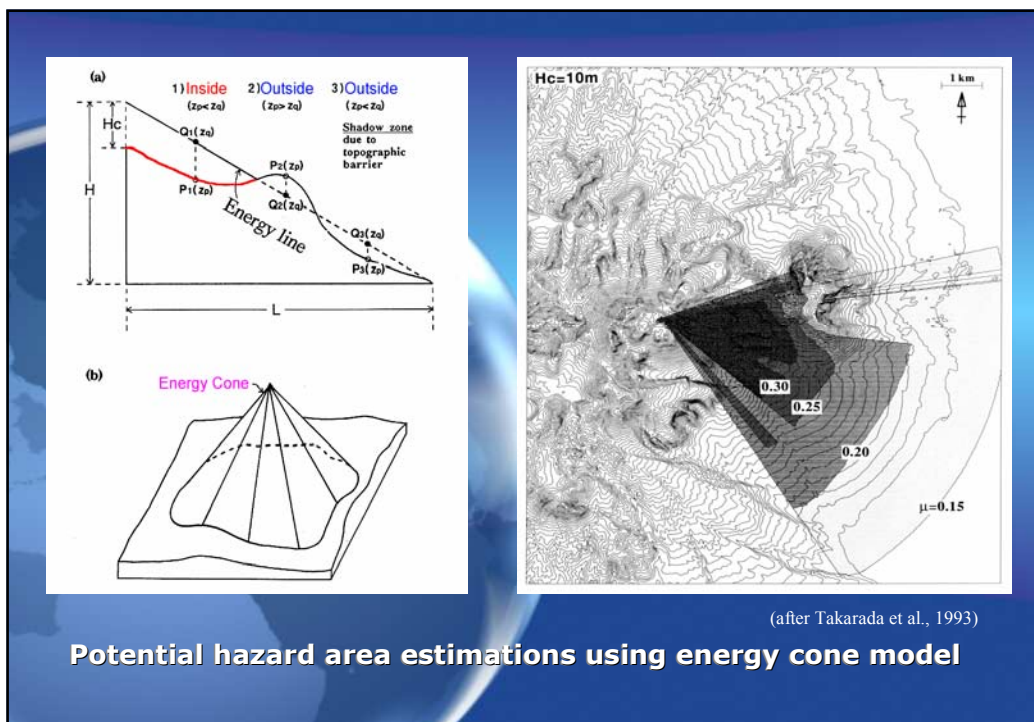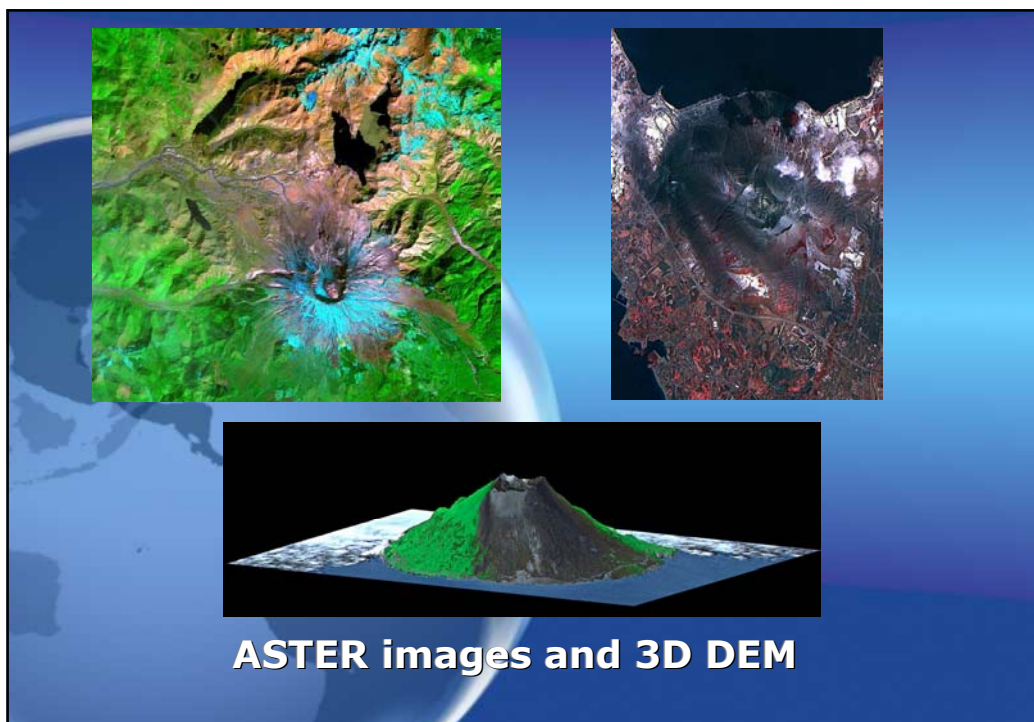
Volcanoes

1. Asama Volcano, Japan
2. Aso Volcano, Japan
3. Bandai Volcano, Japan
4. Fuji Volcano, Japan
5. Kirishima Volcano, Japan
6. Sakurajima Volcano, Japan
7. Tarumae Volcano, Japan
8. Unzen Volcano, Japan
9. Usu Volcano, Japan
10. Yotei Volcano, Japan

11. Merapi Volcano, Indonesia
12. St. Helens Volcano, USA
13. Etna Volcano, Italy
14. Vesuvius, Italy

Merapi Volcano

ASTER DEM
data taken on
June 30,
2003

Modified
using
DEM data on
Aug. 5, 2002

Initial view

Confirmation View

Results of Pyroclastic Flow Simulation (Hc=30m, H/L=0.2-0.4)
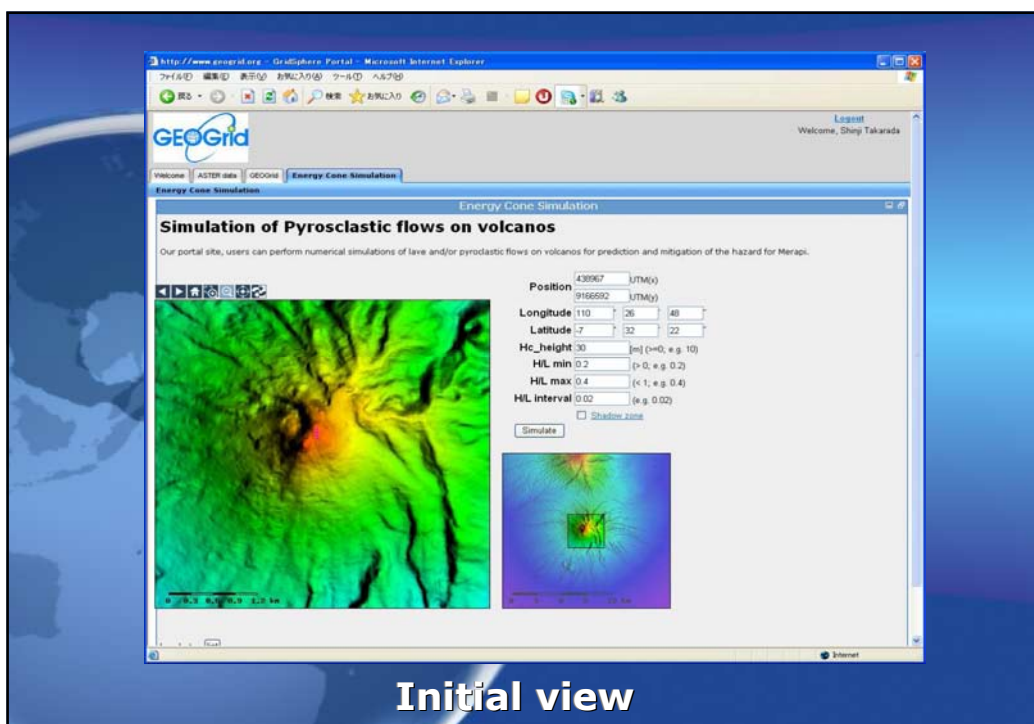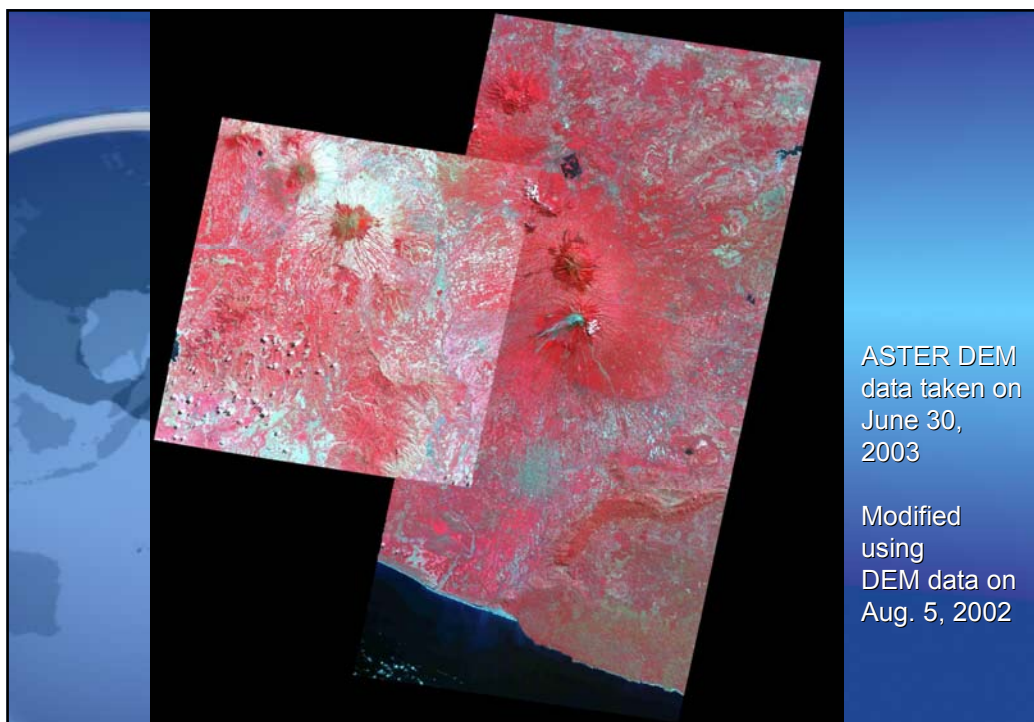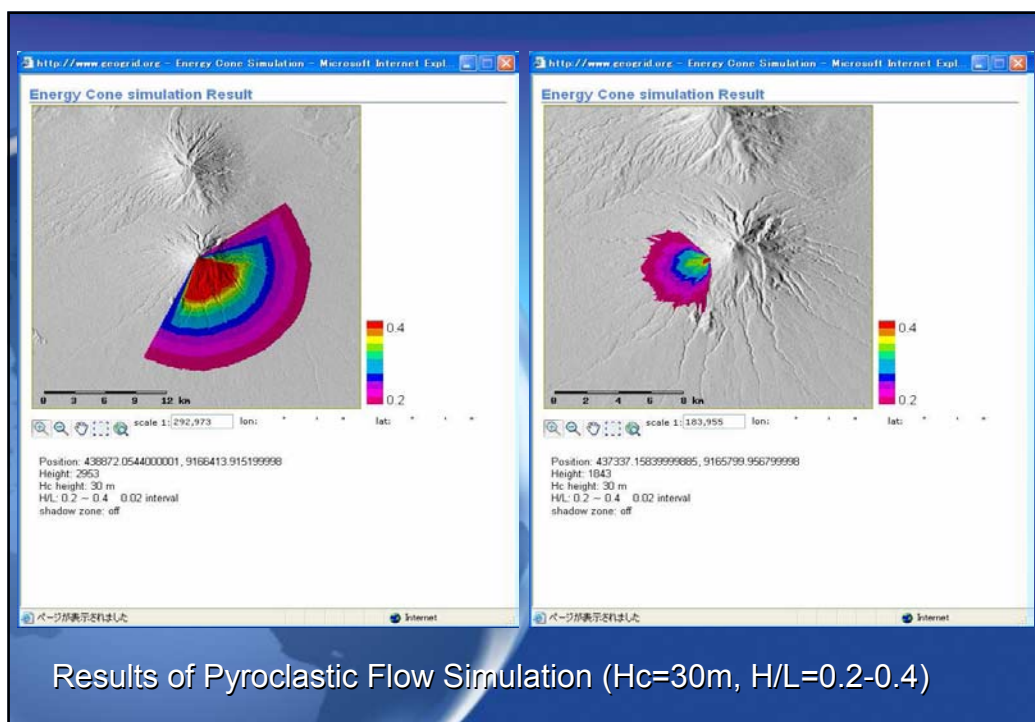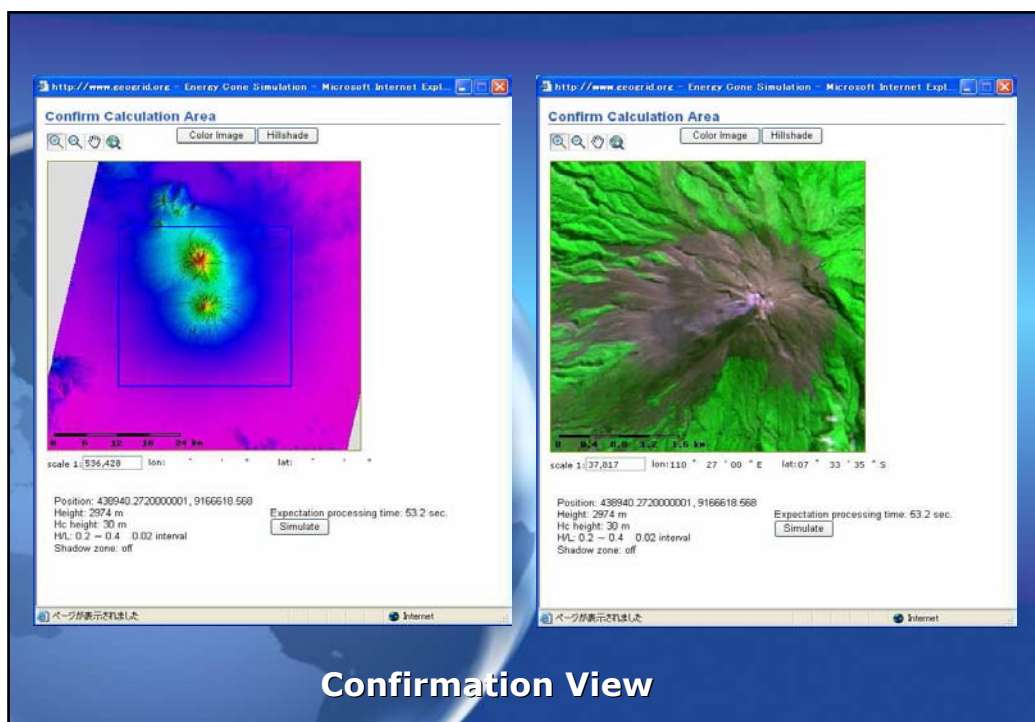
Unzen Volcano

Pyroclastic Flow Simulation

Unzen Volcano

Results of Pyroclastic Flow Simulation (Hc=20m, H/L=0.2-0.4)

Fuji Volcano

Pyroclastic Flow Simulation (Hc=50m, H/L=0.2-0.4)

St. Helens Volcano

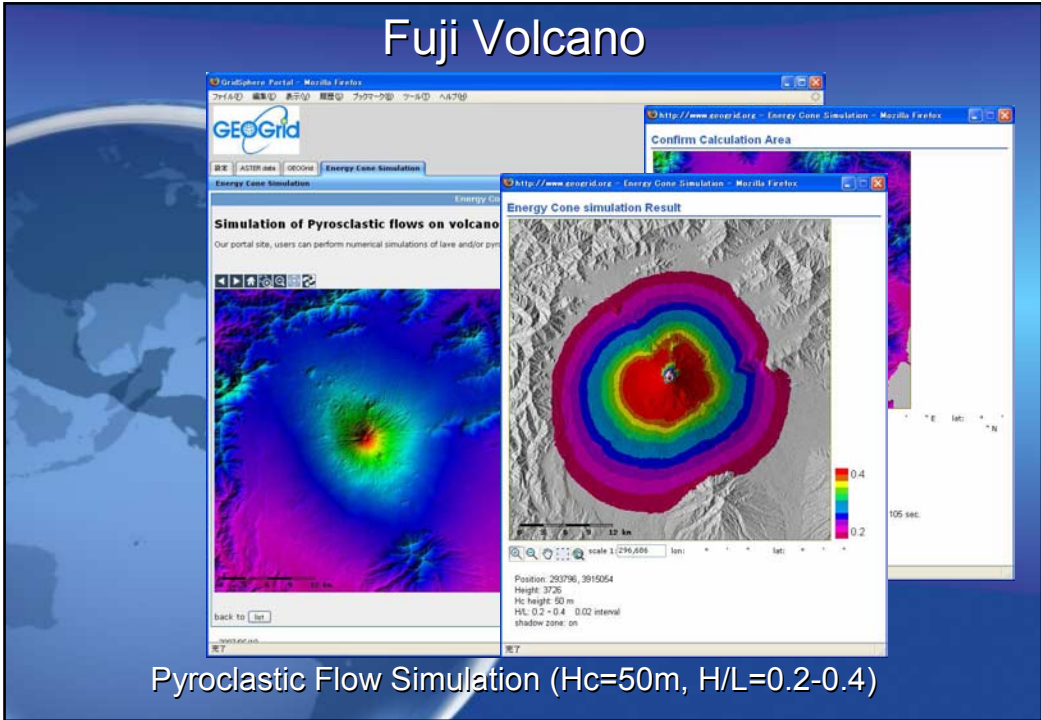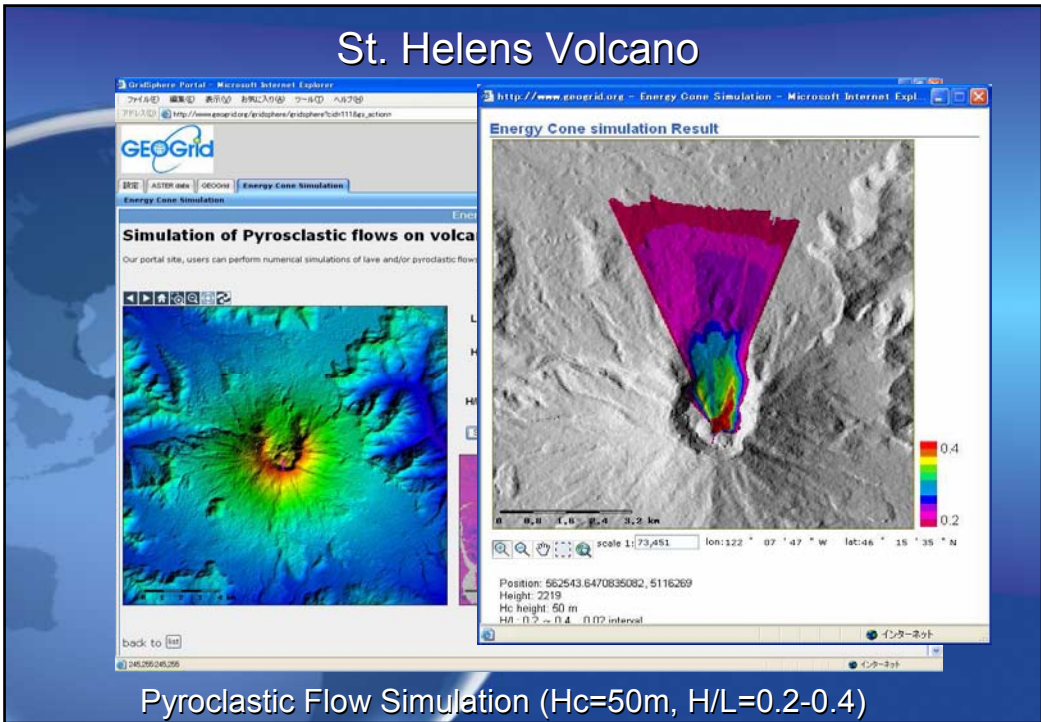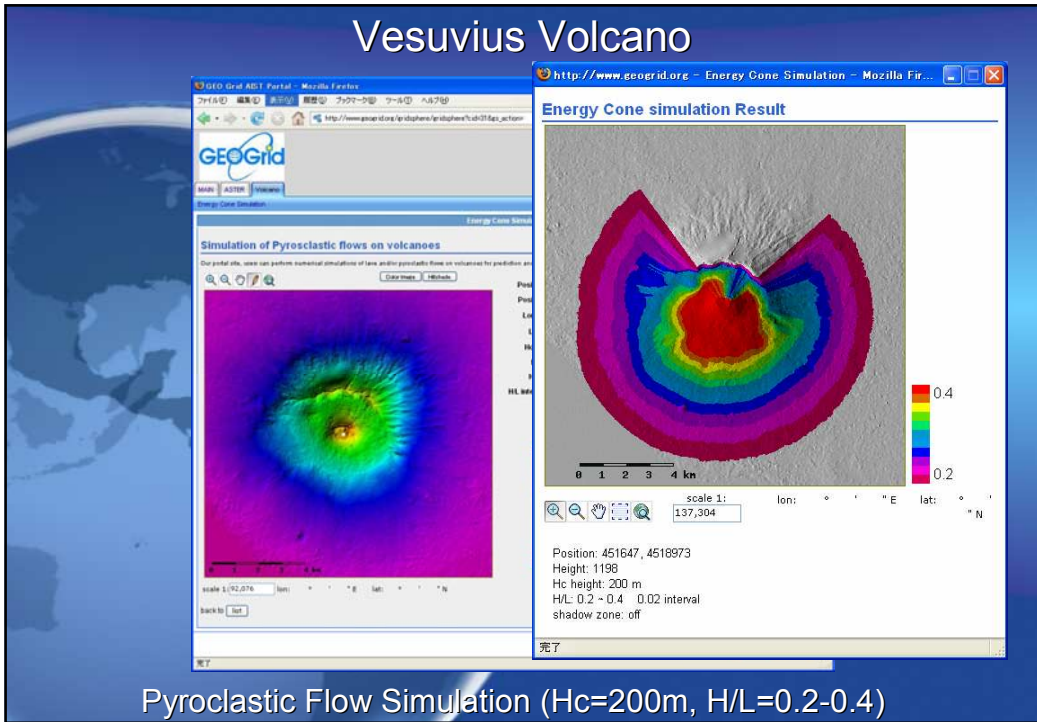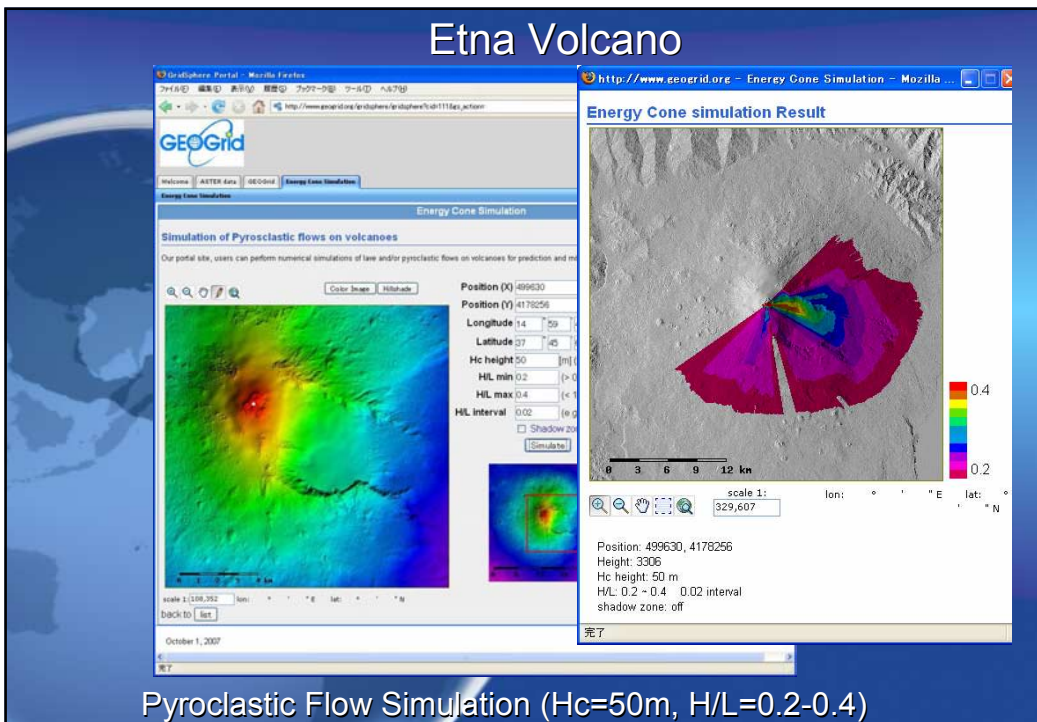Pyroclastic Flow Simulation (Hc=50m, H/L=0.2-0.4)

Vesuvius Volcano
Pyroclastic Flow Simulation (Hc=200m, H/L=0.2-0.4)

Etna Volcano
Pyroclastic Flow Simulation (Hc=50m, H/L=0.2-0.4)

GEO Grid Website

http://www.geogrid.org/gridsphere/gridsphere

Summary

1. Publications and databases in GSJ
Large number of geological publications (printed and CD-ROMs)
RIO-DB (eg. Geolis, Seamless geological map, Quaternary Volcanoes)

2. New WebGIS System (GeoMapDB, G-INDEX, GIS Intra)
GeoMapDB (Integrated Geological map database)
G-INDEX (Portal index site)
GIS Intra (ArcGIS Server for Scientists in GSJ)

3. Collaboration with the GEO Grid project using WMS
Overlaying Geological maps and ASTER satellite images
Overlaying on the Google Earth
Overlaying borehole and landslide information from other
  WebGIS Servers
Contribution to the OneGeology Project and GeoSciML

Summary

4. 1991-95 Unzen Pyroclastic Flow

High temp. and High Speed, Volume=10^4-10^6m^3, H/L=0.2-0.4

5. Next Generation Volcanic Hazard Map

Overlapping any kinds of data sets using GIS system
Real Time Hazard Map (Available on a laptop and on a website)
High resolution DEM data（ASTER 15m, Applicable for all volcanoes
in the world)

6. Volcanic Gravity Flow Simulation using ASTER DEM

Pyroclastic flow simulations using energy cone model
Possible to access all scientists in the world on a website
Possible to update DEM after changing topography due to eruptions
High-speed processing using Grid computing technology（0.1-3min）
Applicable to other natural disasters (landslides, debris avalanches)