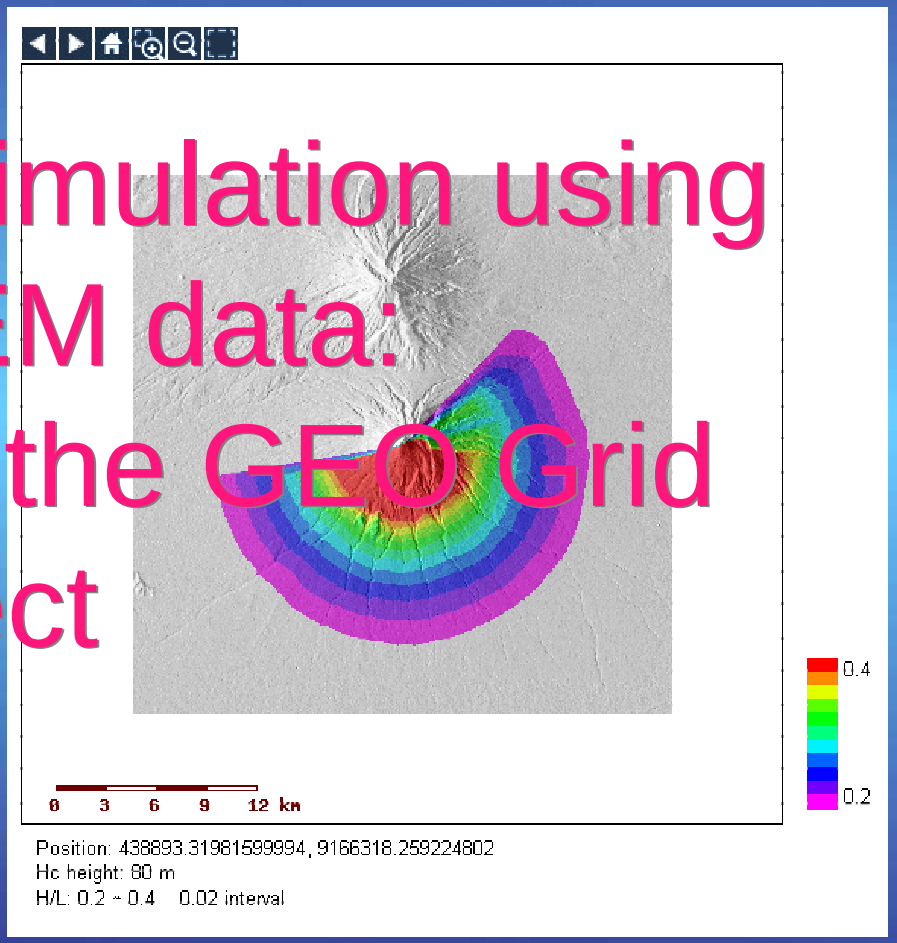
GEOSS Symposium on Integrated Observation for Sustainable Development in the Asia-Pacific Region (Jan. 11-12, 2007)

Volcanic hazard simulation using ASTER DEM data: an application of the GEO Grid Project

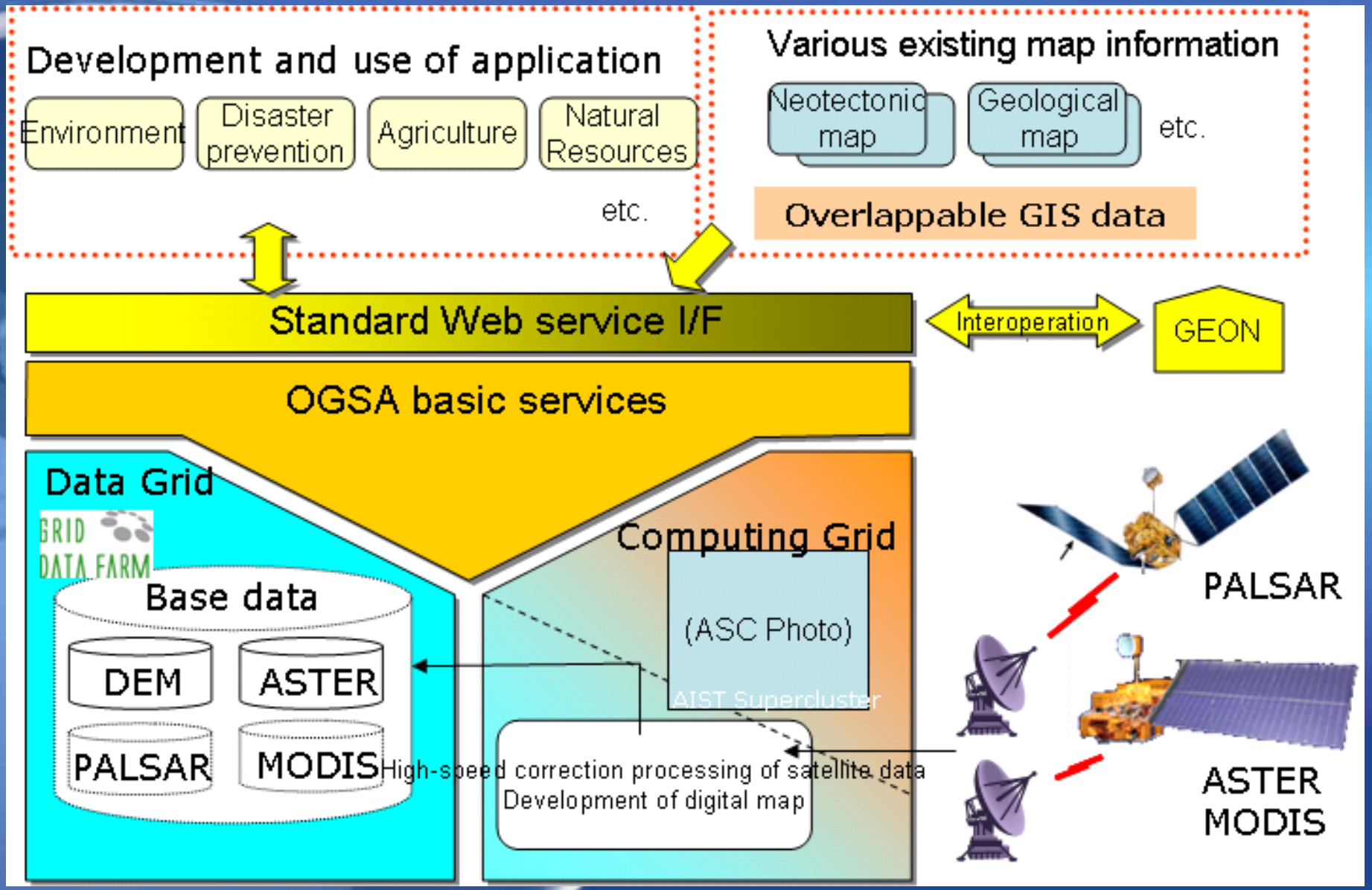


Shinji Takarada
Geological Survey of Japan
AIST

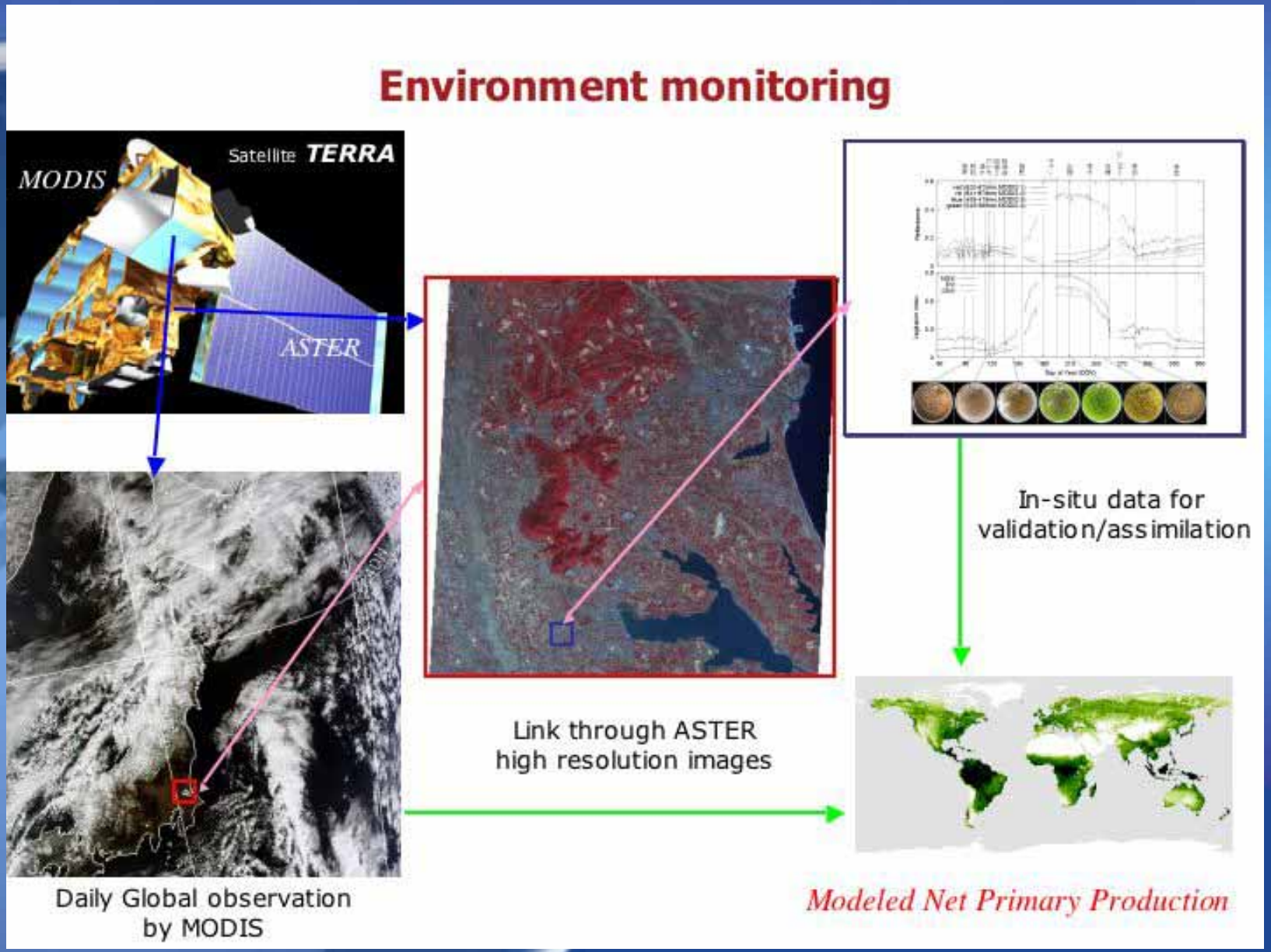
Contents

1. GEO Grid Project
2. 1991-95 Unzen Pyroclastic Flows
3. Next Generation Volcanic Hazard Map
4. Volcanic Gravity Flow Simulation using ASTER DEM data

GEO Grid (Global Earth Observation) Project



GEO Grid (Global Earth Observation) Project



Volcanic Gravity Flow Simulation Team

Shinji Takarada（Geoinformation Center, AIST）

Ryoshuke Nakamura（Grid Technology Research Center, AIST）

Naotaka Yamamoto（Grid Technology Research Center, AIST）

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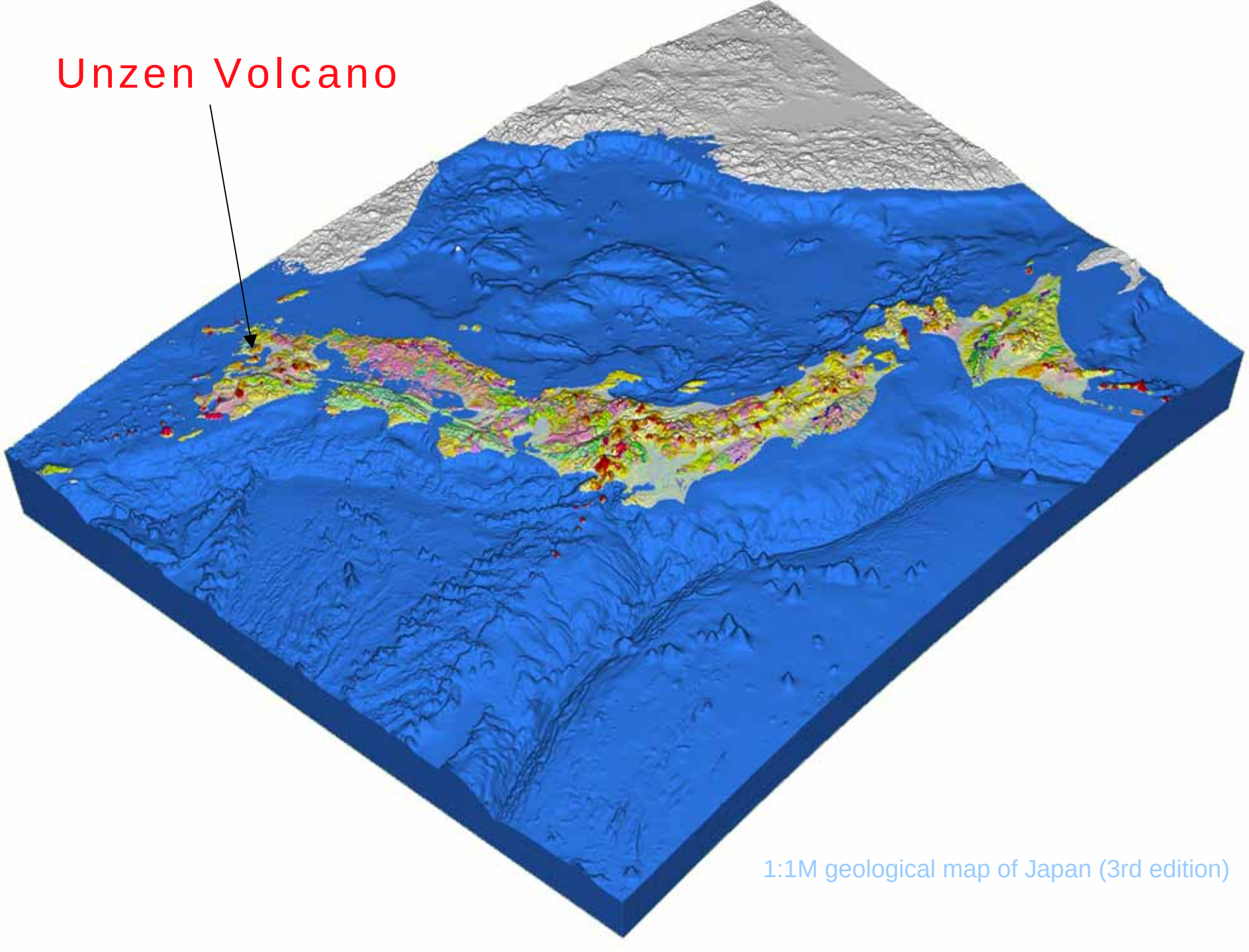


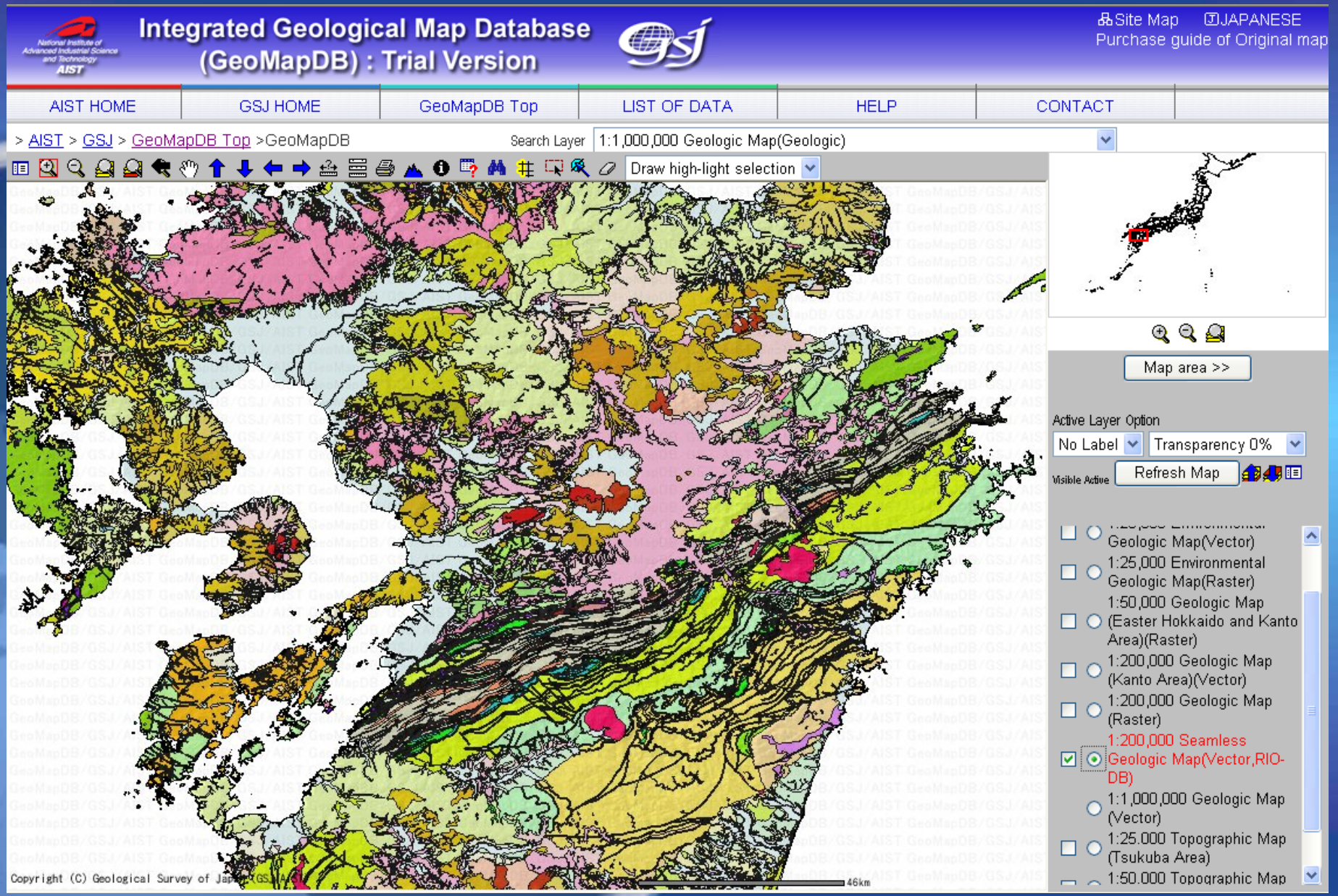
1:1M geological map of Japan (3rd edition)

108 active volcanoes

Rank A
13 volcanoes

Rank B
36 volcanoes

Rank C
36 volcanoes



http://iggis1.muse.aist.go.jp

Seamless geological map of Japan (Kyushu island area)

1991- Heisei-Shinzan lava dome

Mayuyama lava dome

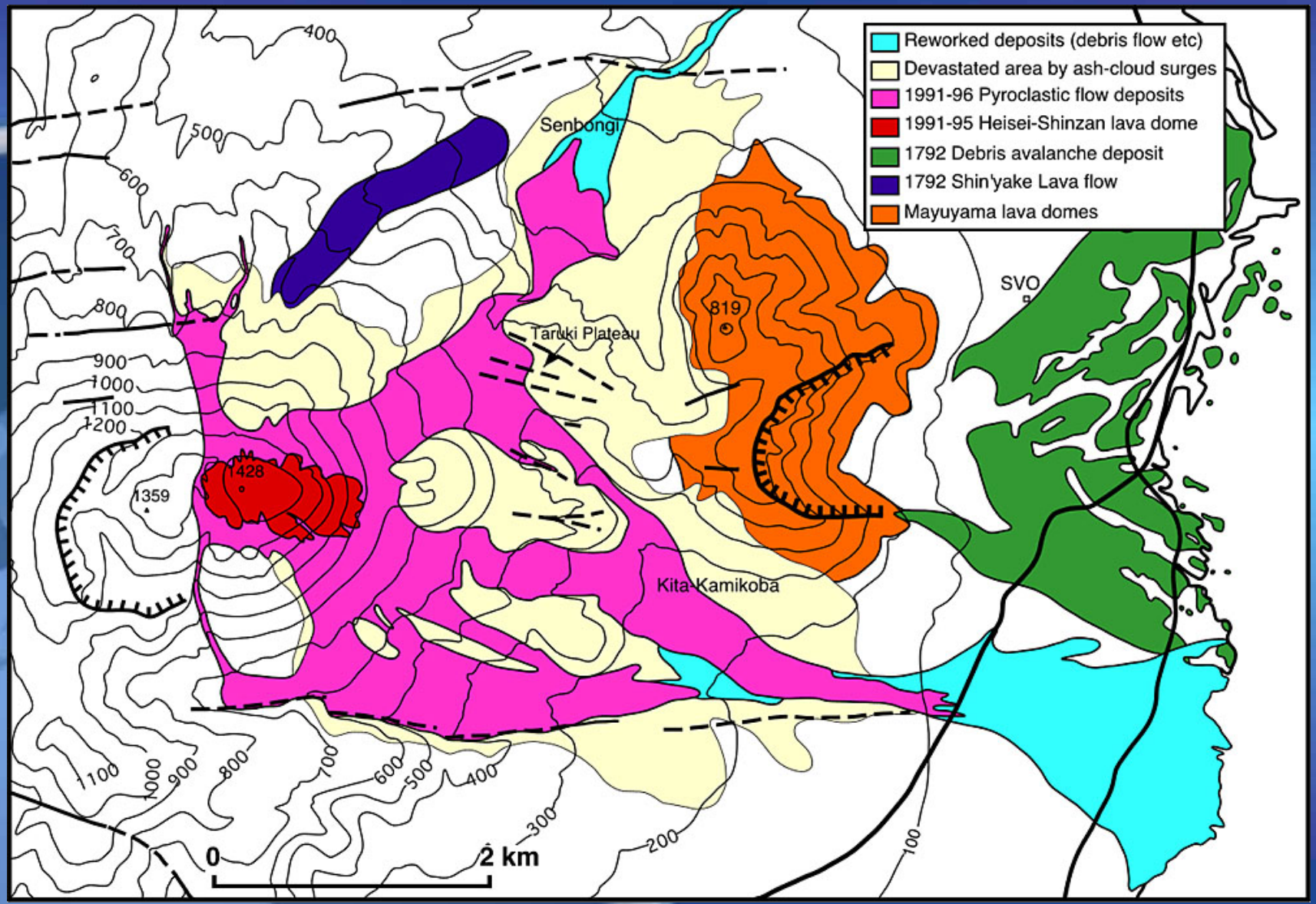
1792 amphitheater

1991- pyroclastic flow deposit

1792 debris avalanche deposit

Photo: Asia Air Survey

Aerial view of the Unzen Volcano



(After Watanabe and Hoshizumi, 1995)

Distribution of recent eruption products

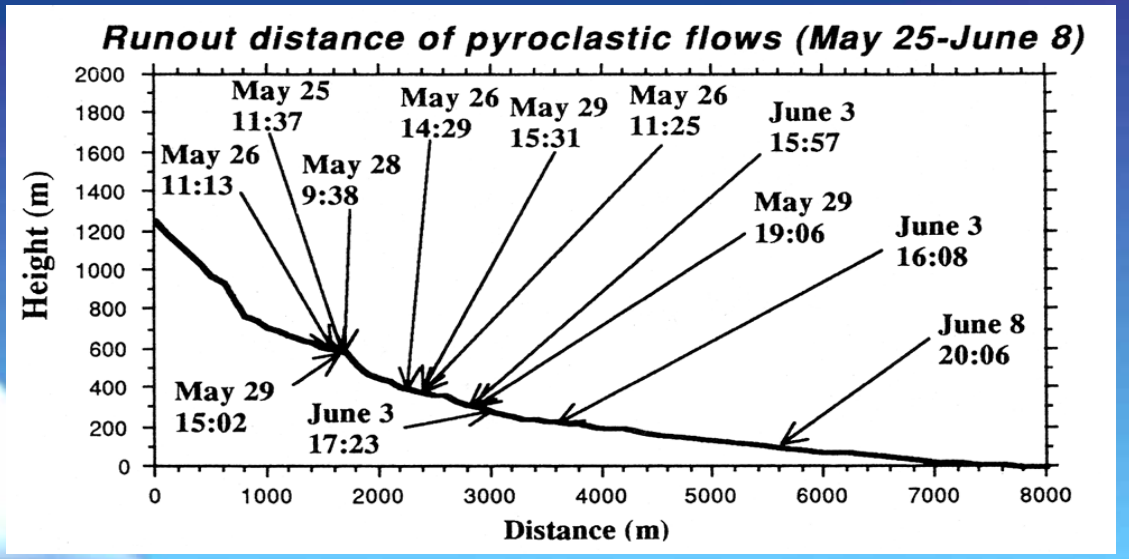
(After Nakada, 1992)

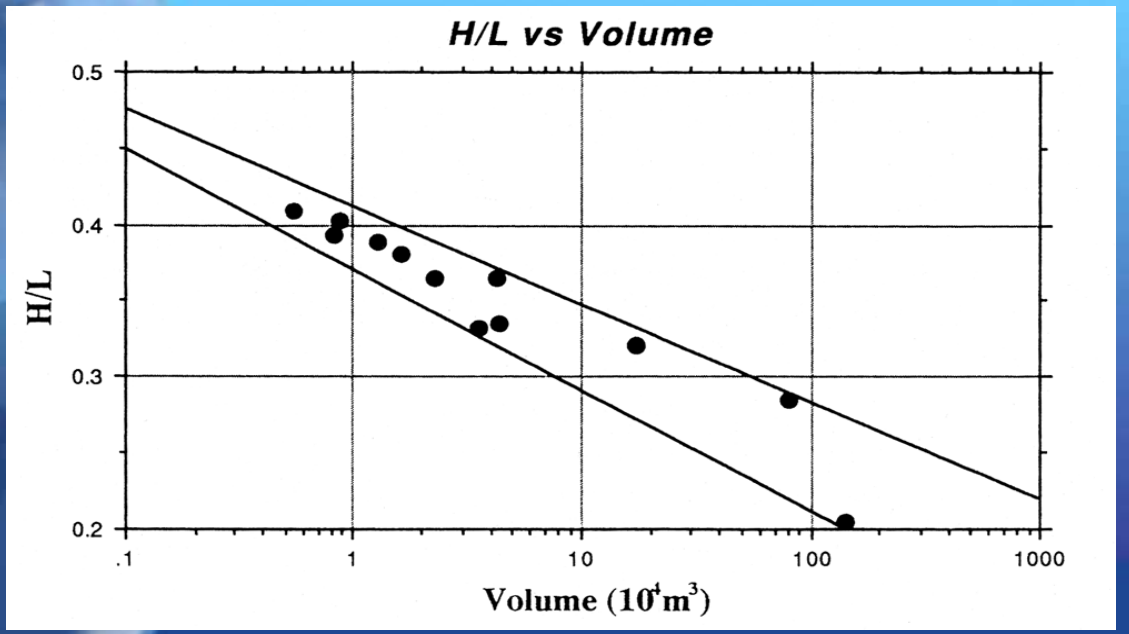
1991 new lava dome

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

(After Nakada, 1992)

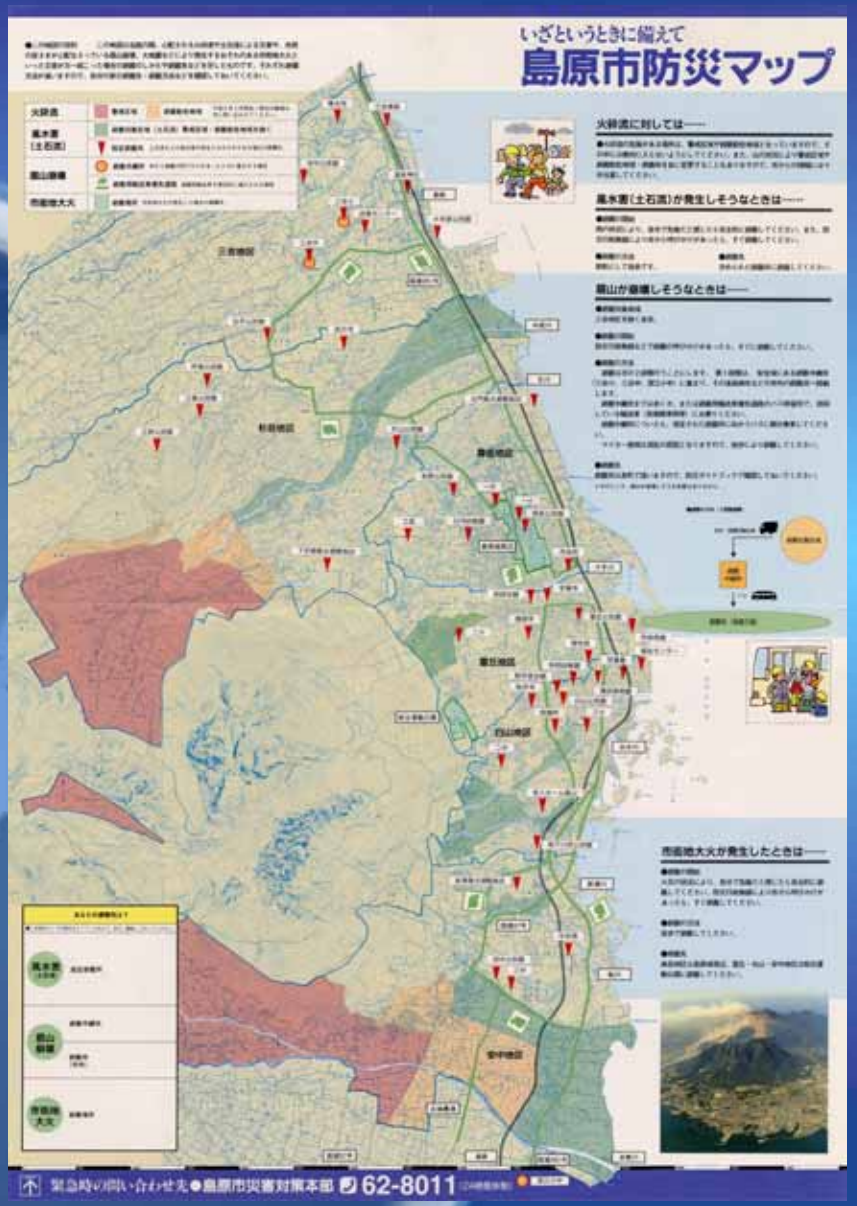
Devastation area attacked by an ash-cloud surge （June 3, 1991)





(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

Volcanic disaster prevention map of Asama Volcano

CCOP projects for volcanic hazard mitigation

1. Database of recent eruptions
   (Share our knowledge and experiences during eruptions)

   Make a “web-base eruption information center”

2. Next generation hazard map

   What is needed for the “Next Generation Hazard Map”?

3. Database of hazard maps

   Open “hazard maps” to the public on a website

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

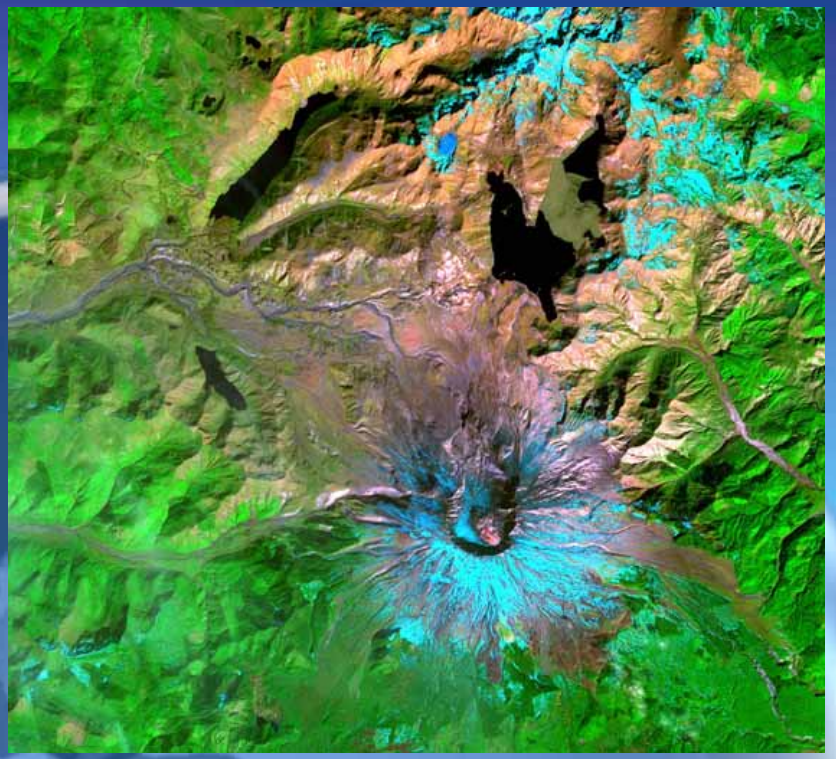
3. 3D Model

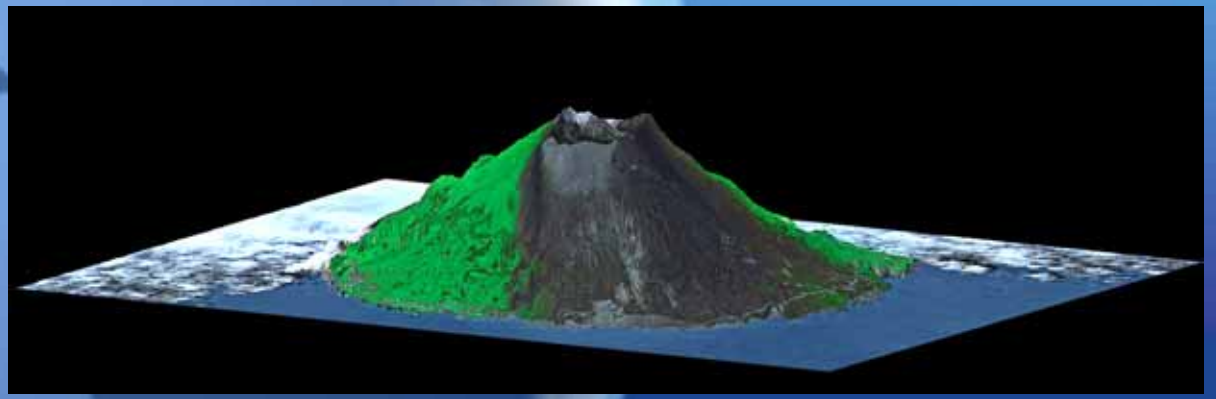
Using high resolution DEM, ASTER (15m mesh)

GEO Grid pyroclastic flow simulation

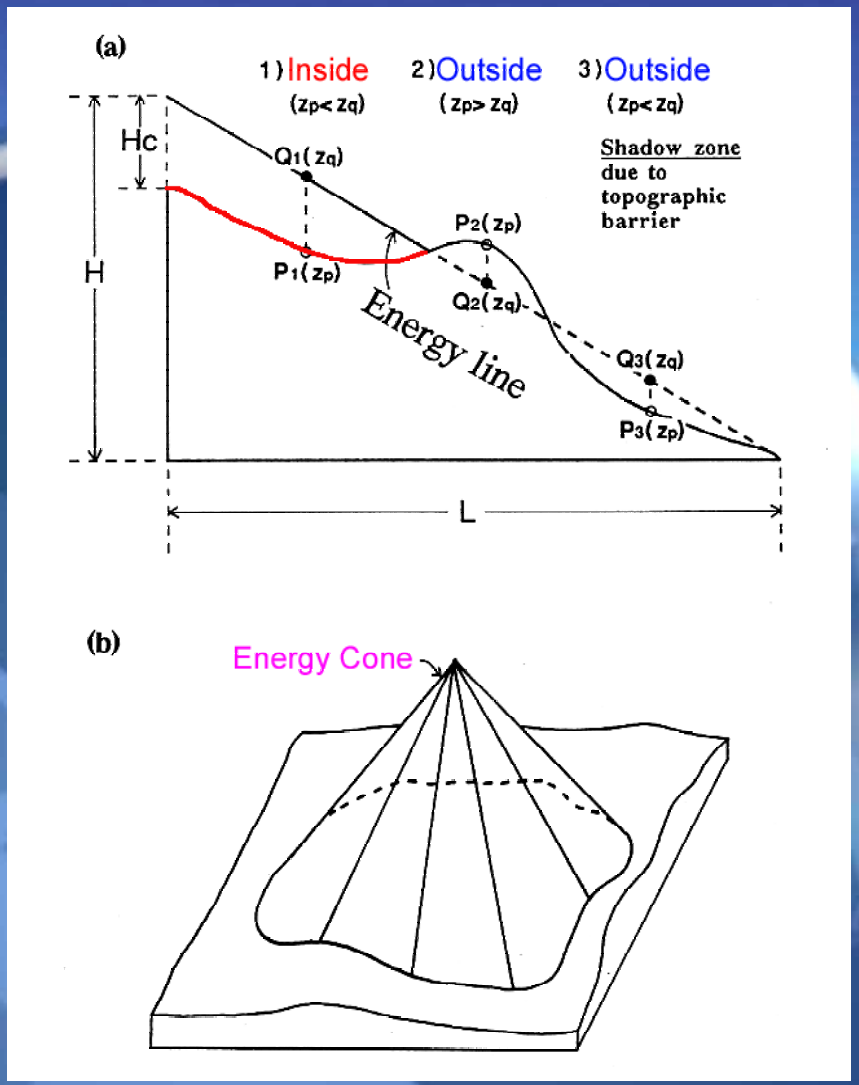
1. Energy Cone Simulation
   - Simple (less parameters, Hc, H/L only)
   - Evaluate potential hazard areas (good for hazard maps)

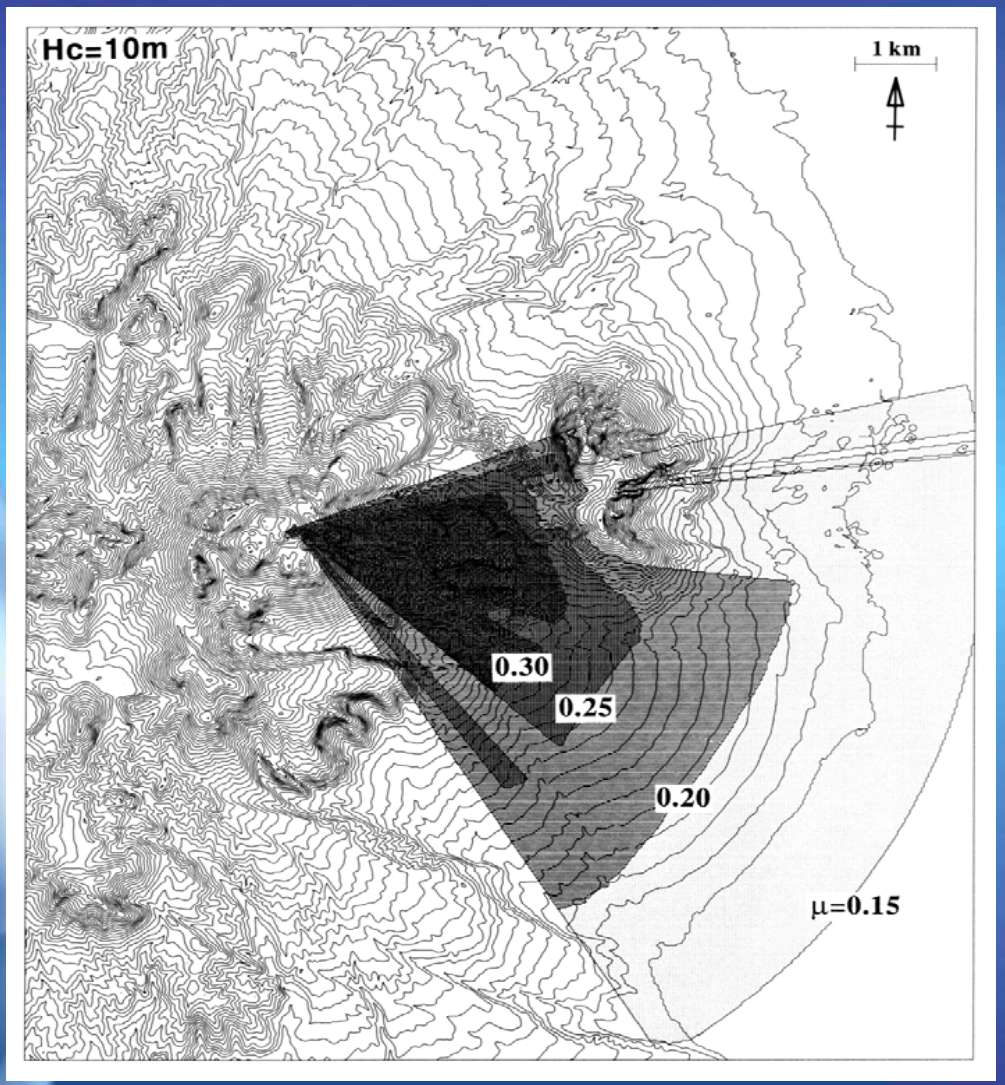
2. ASTER DEM data, Web-base Application
   - High resolution (15m)
   - Applicable all volcanic areas in the world
   - Possible to use updated topography for DEM
   - Possible to open for all scientists in the world





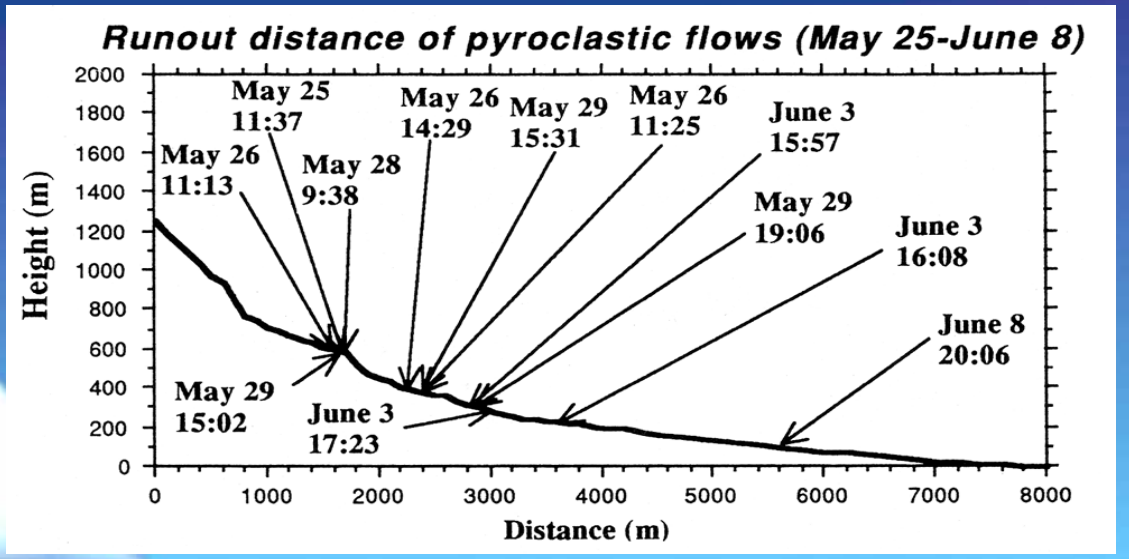
ASTER images and 3D DEM

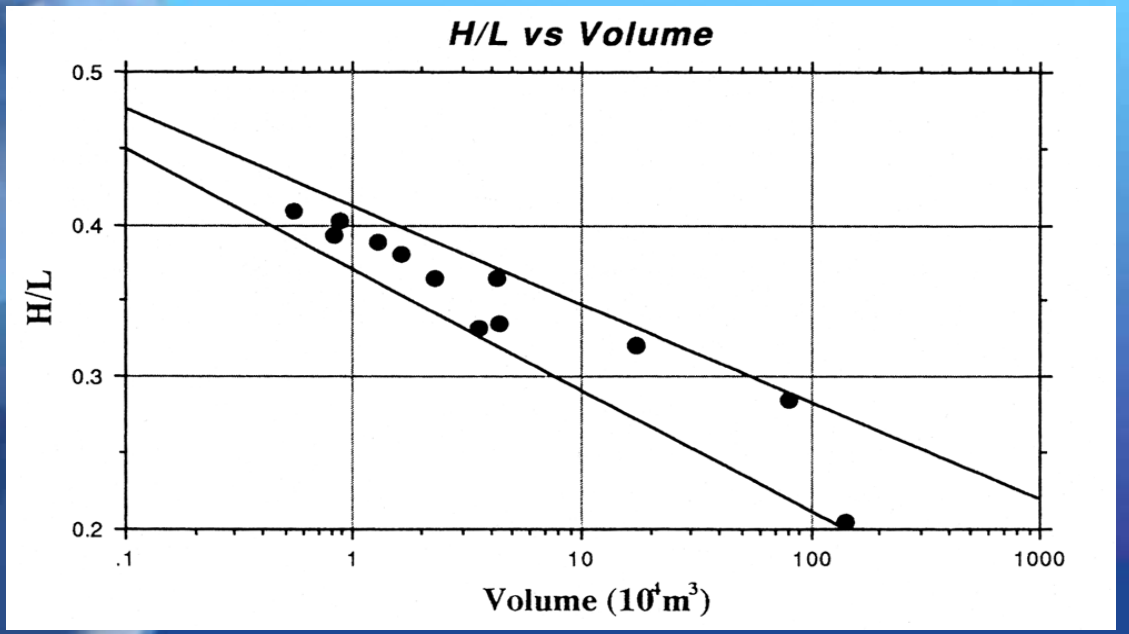




(after Takarada et al., 1993)

Potential hazard area estimations using energy cone model





(after Takarada et al., 1993)

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

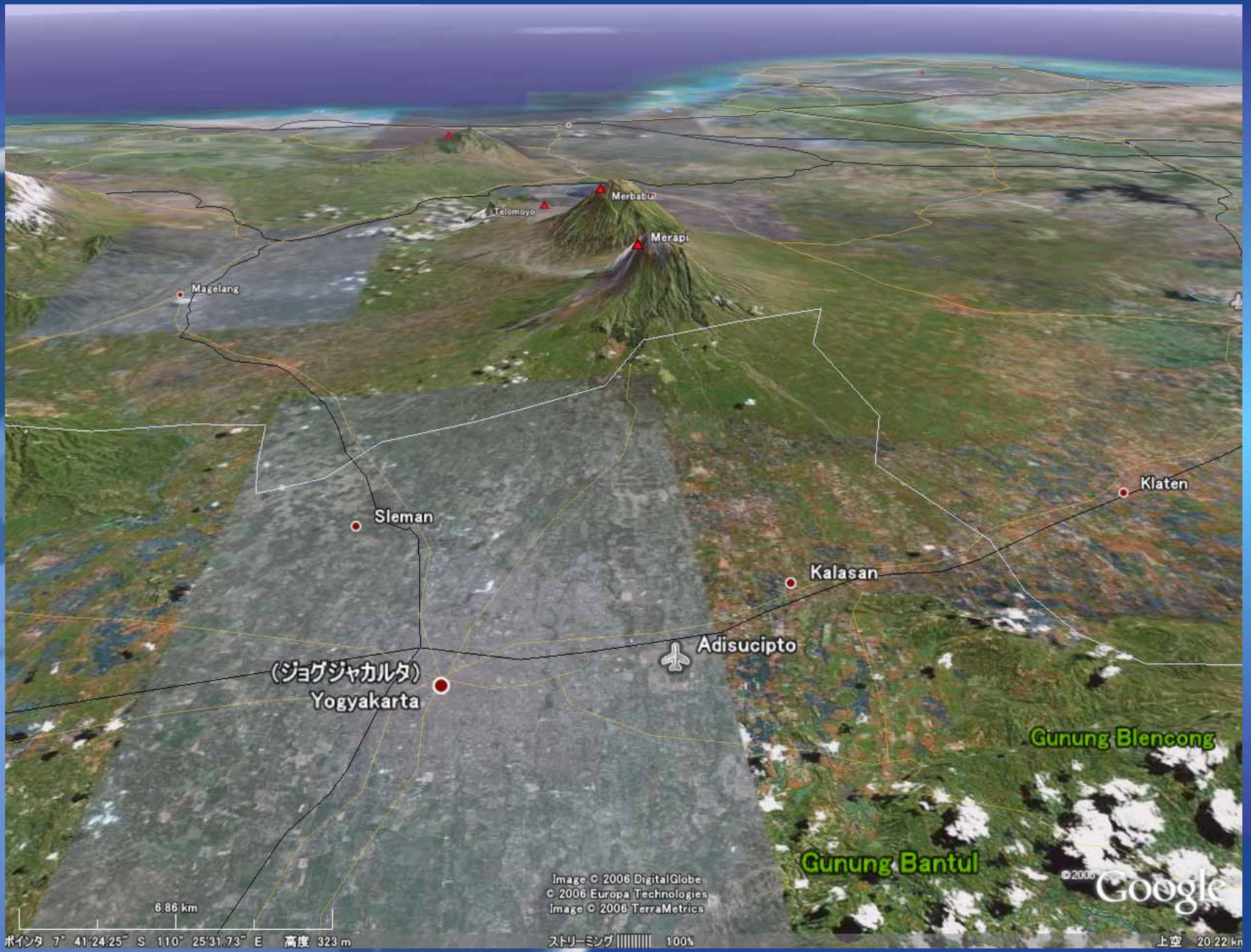
GEO Grid pyroclastic flow simulation

List of Volcanoes

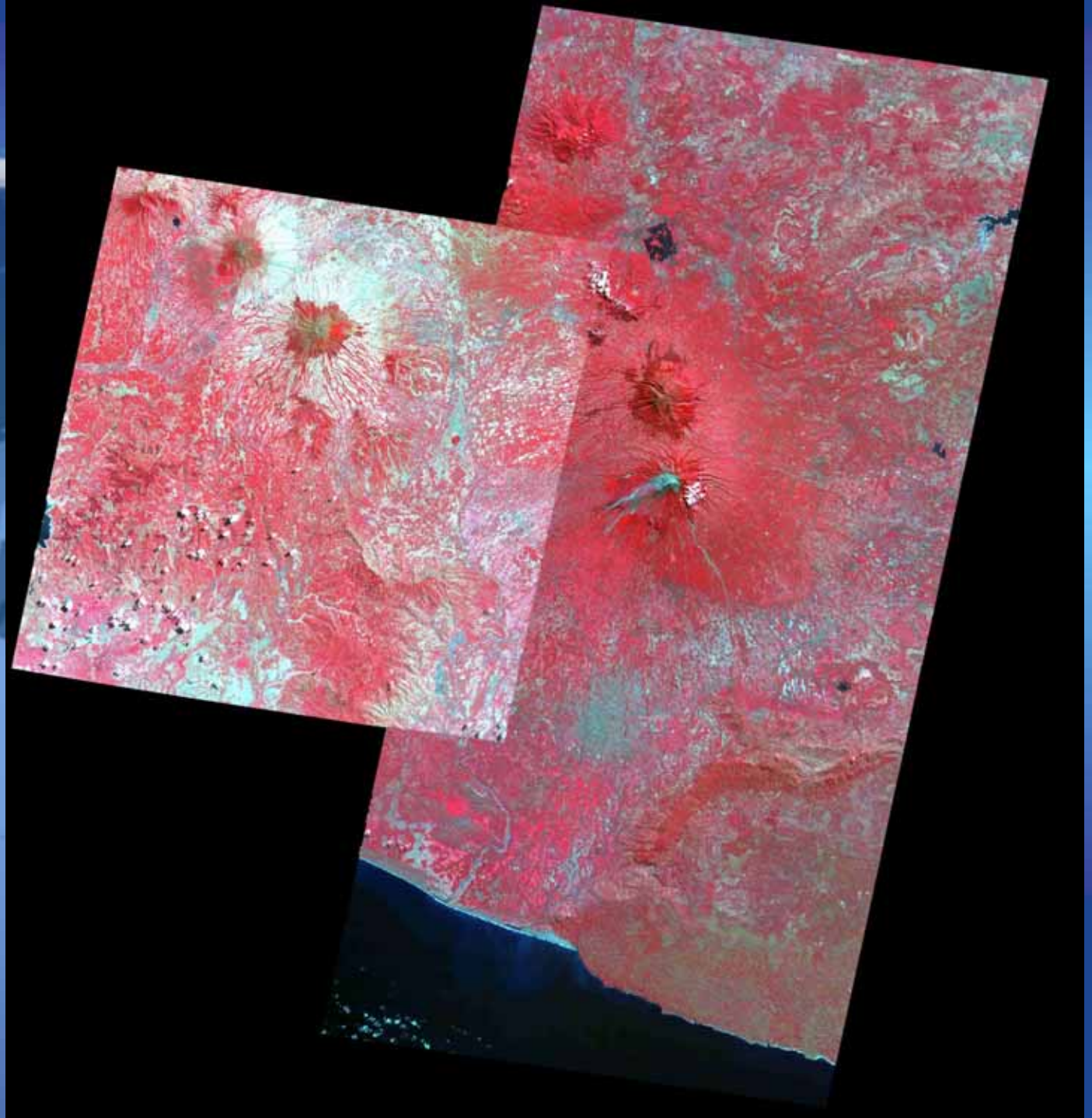
Merapi (Indonesia)

Fuji
Unzen
Kirishima
Sakurajima

Yotei
Tarumae
Usu
Bandai

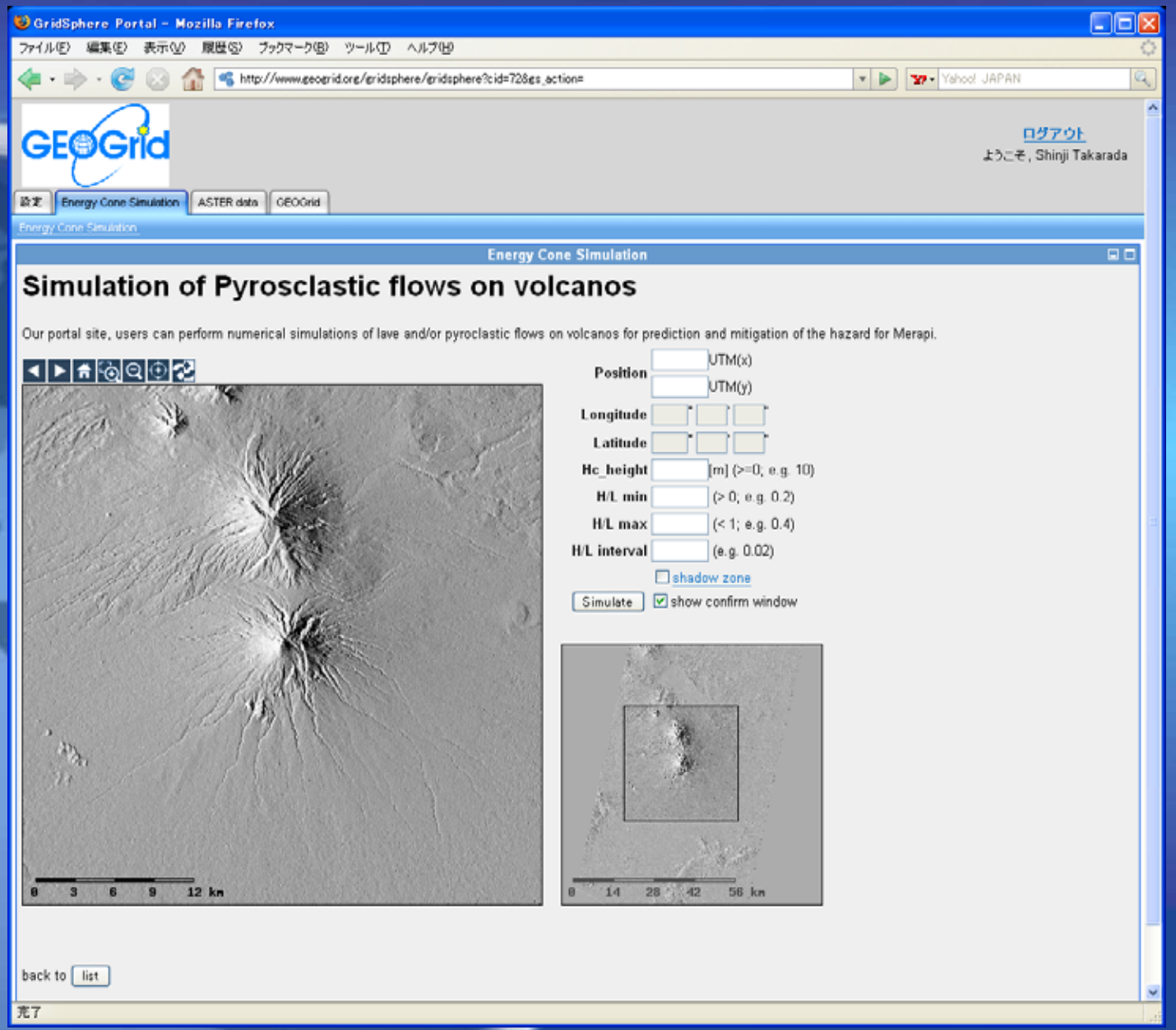


Merapi Volcano

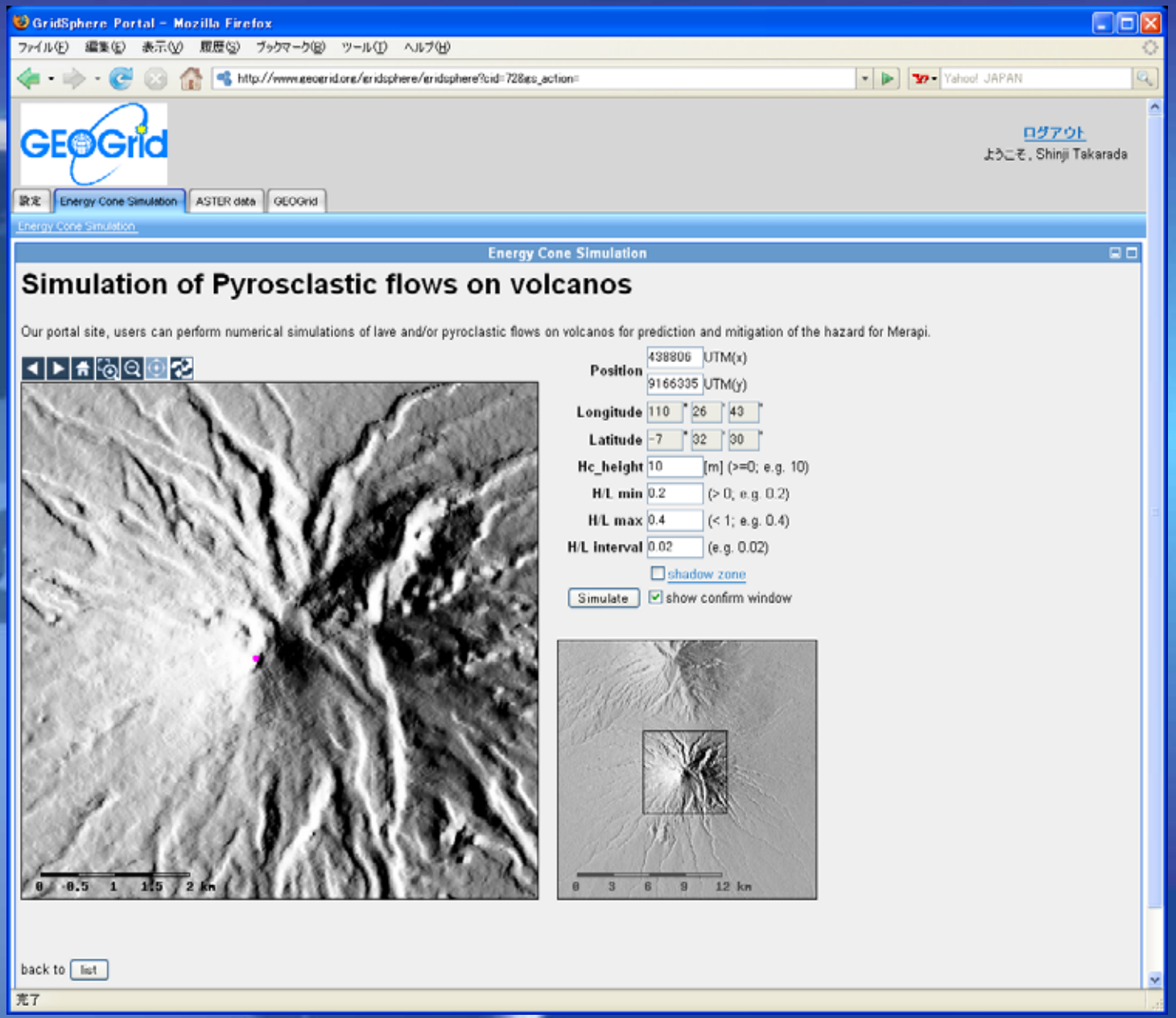


ASTER DEM data taken on June 30, 2003

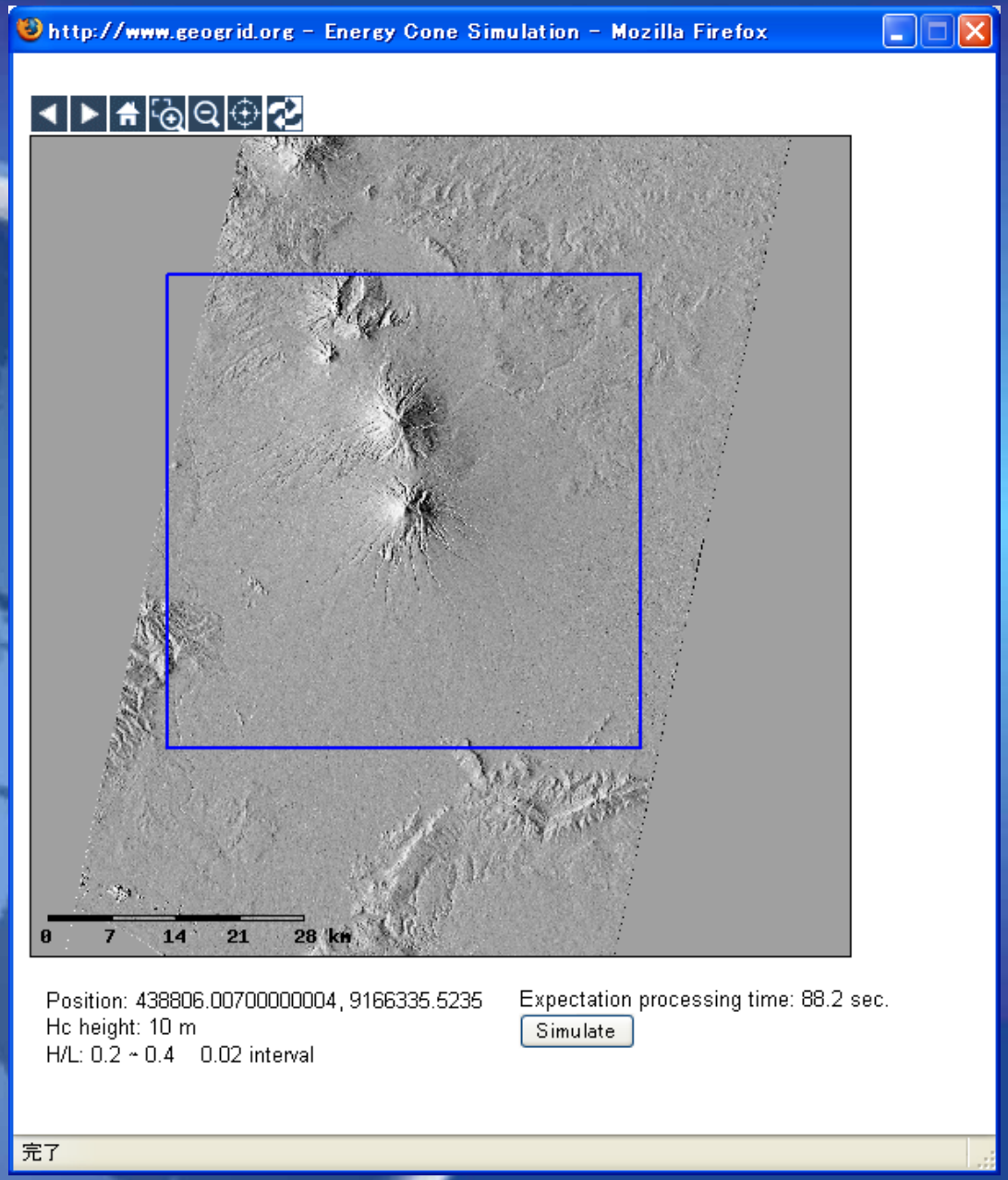
Modified using DEM data on Aug. 5, 2002



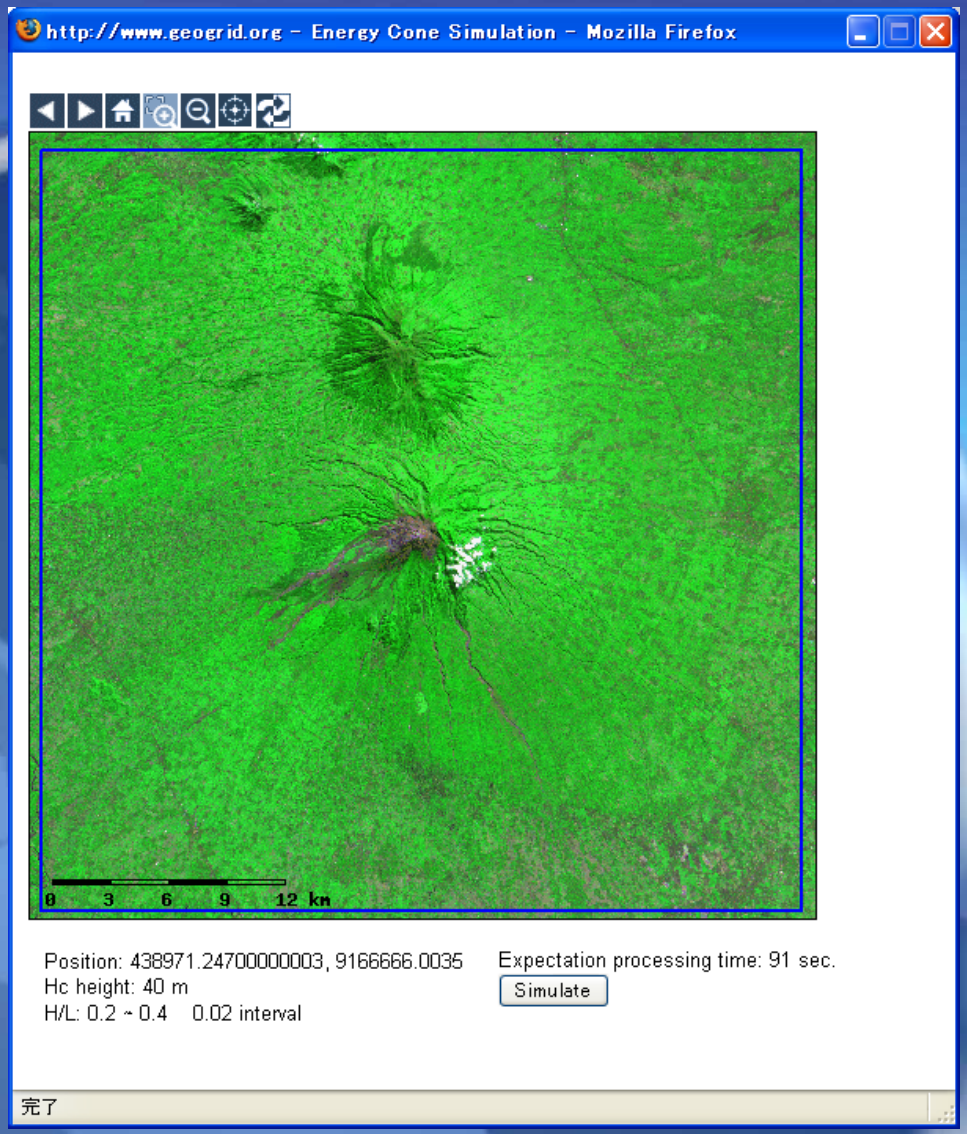
Initial view

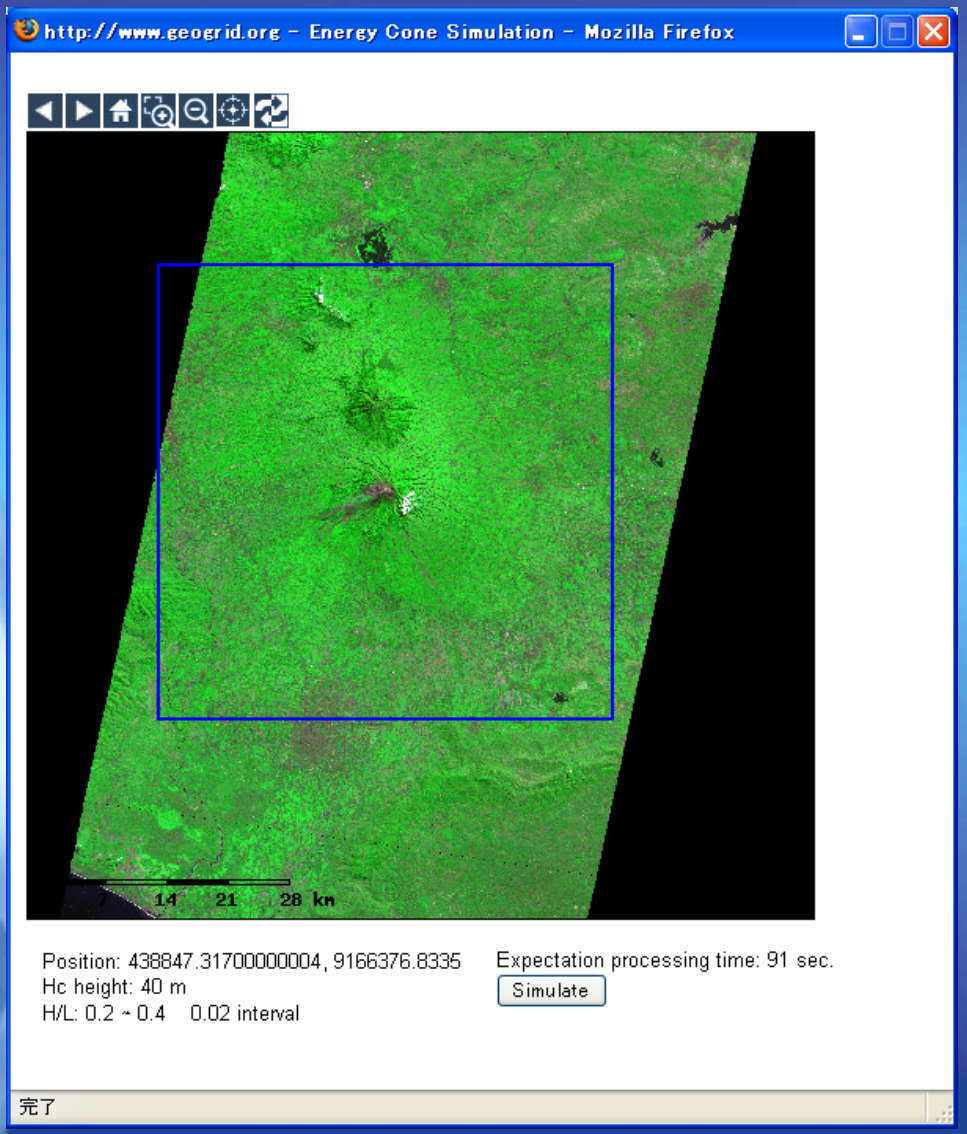


Input parameters



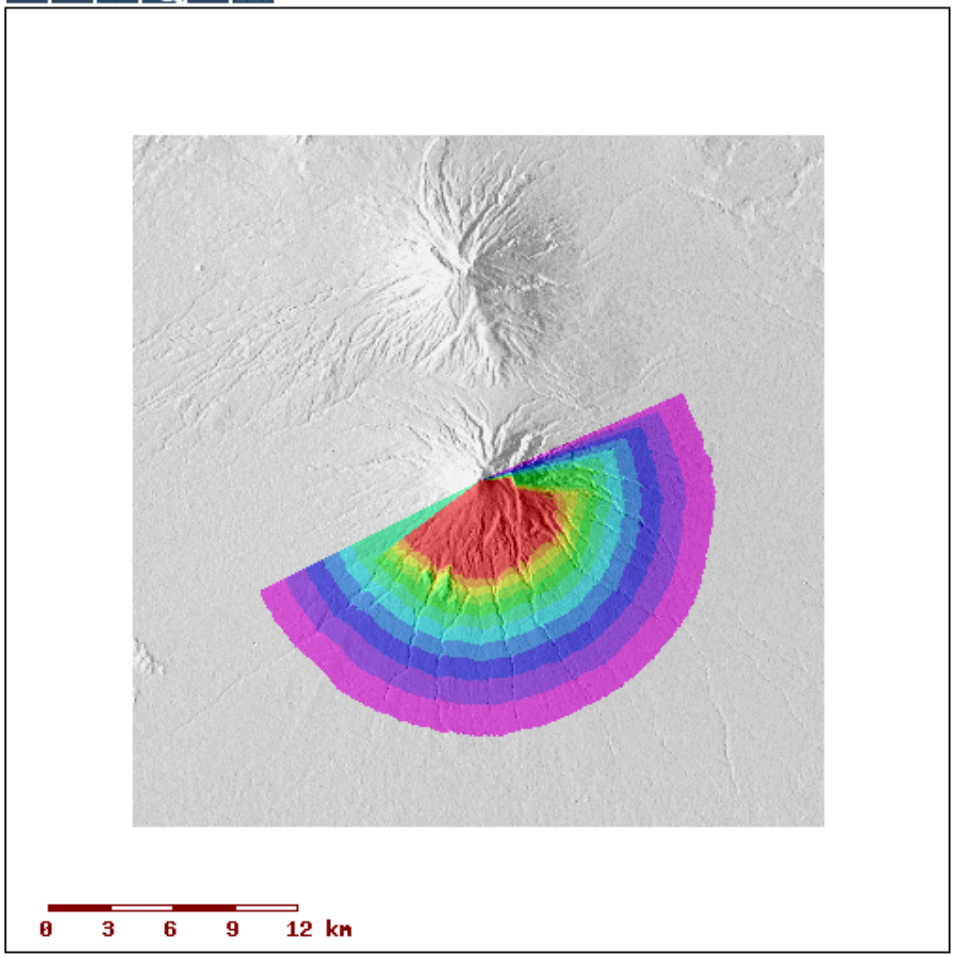
Confirmation view





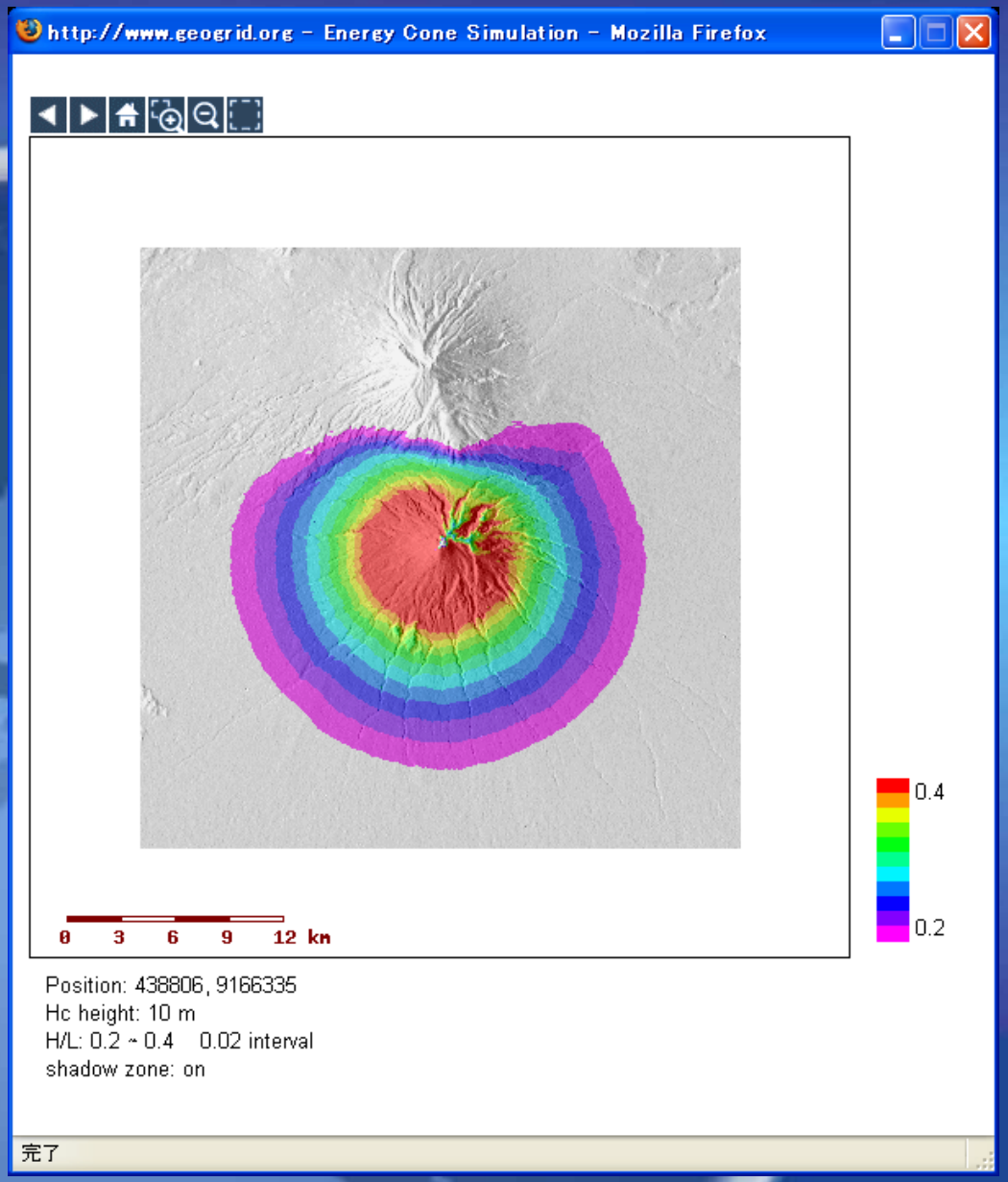
Confirmation View (Ortho Image)

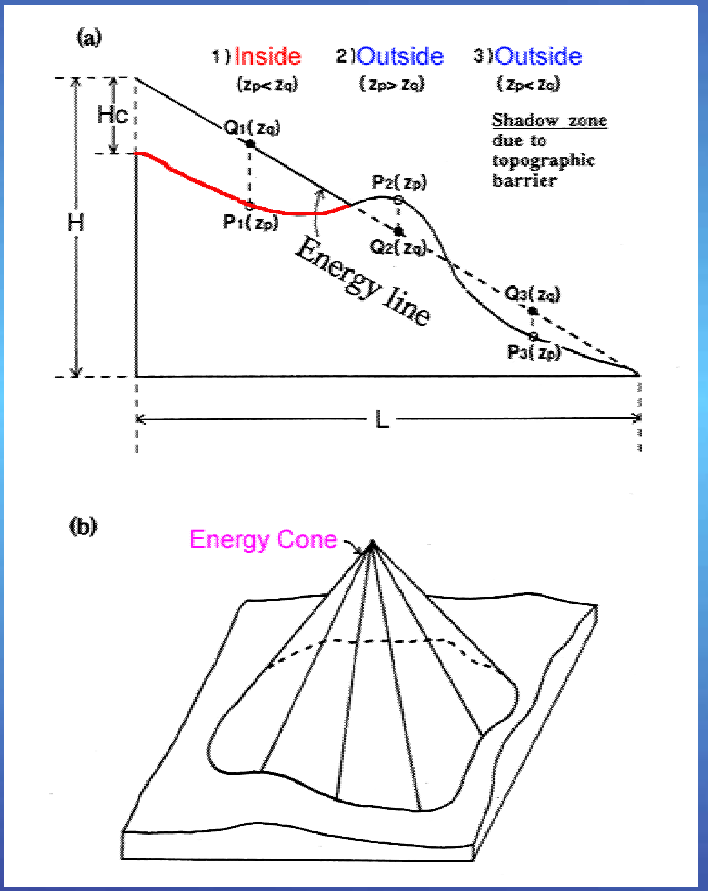
http://www.geogrid.org - Energy Cone Simulation - Mozilla Firefox



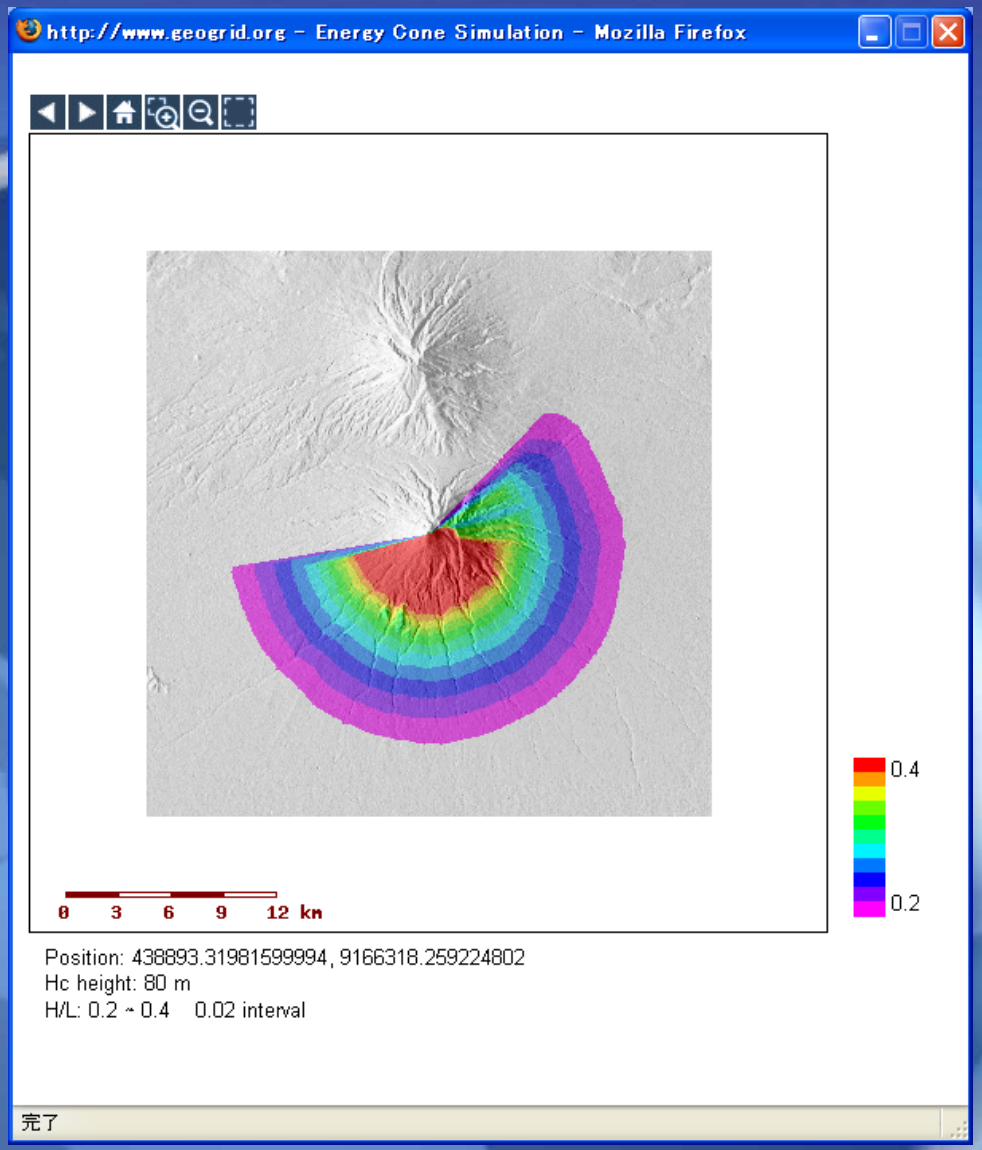
Position: 438806.00700000004, 9166335.5235
Hc height: 10 m
H/L: 0.2 ~ 0.4 0.02 interval

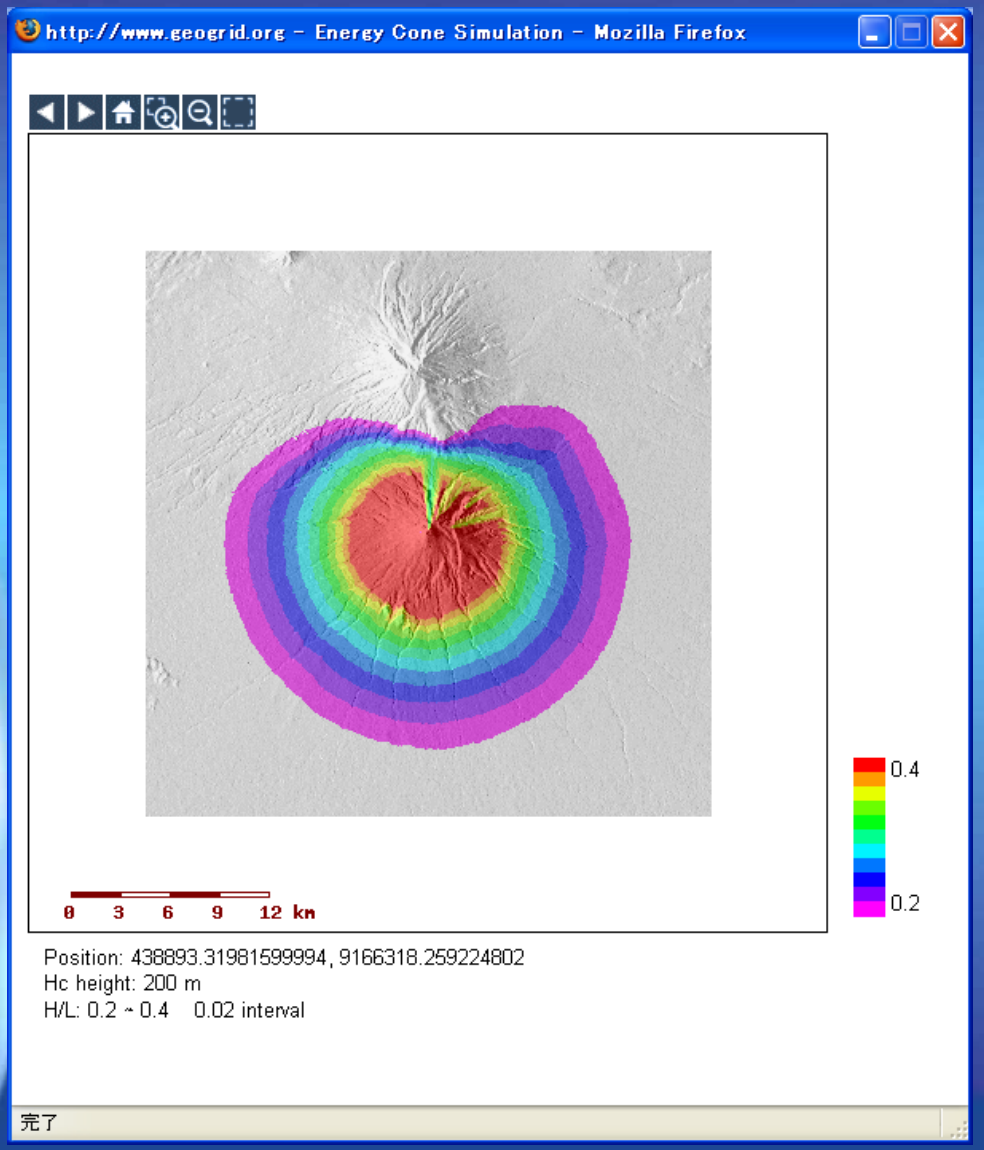
完了





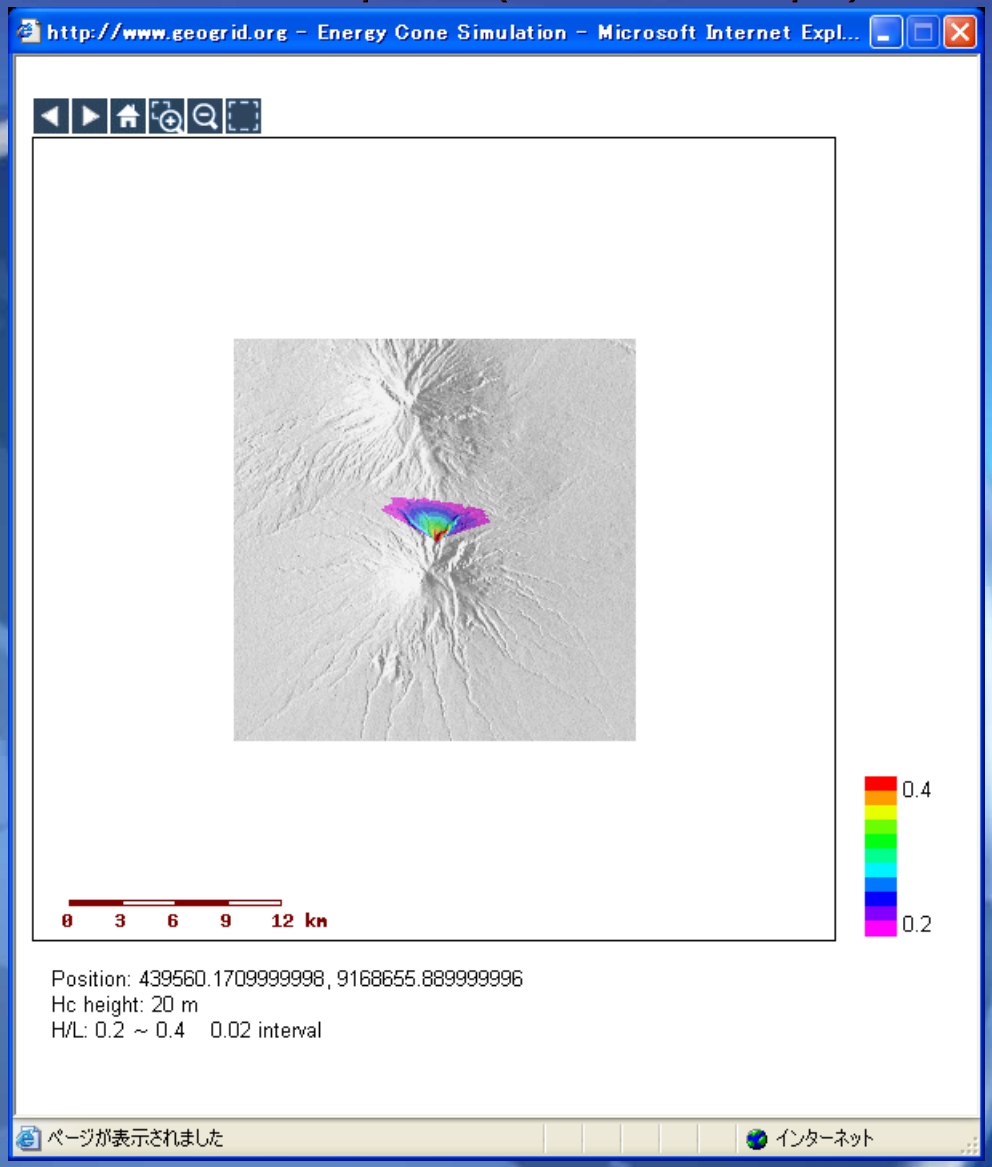
Result of Energy Cone Simulations (Shadow zone on)



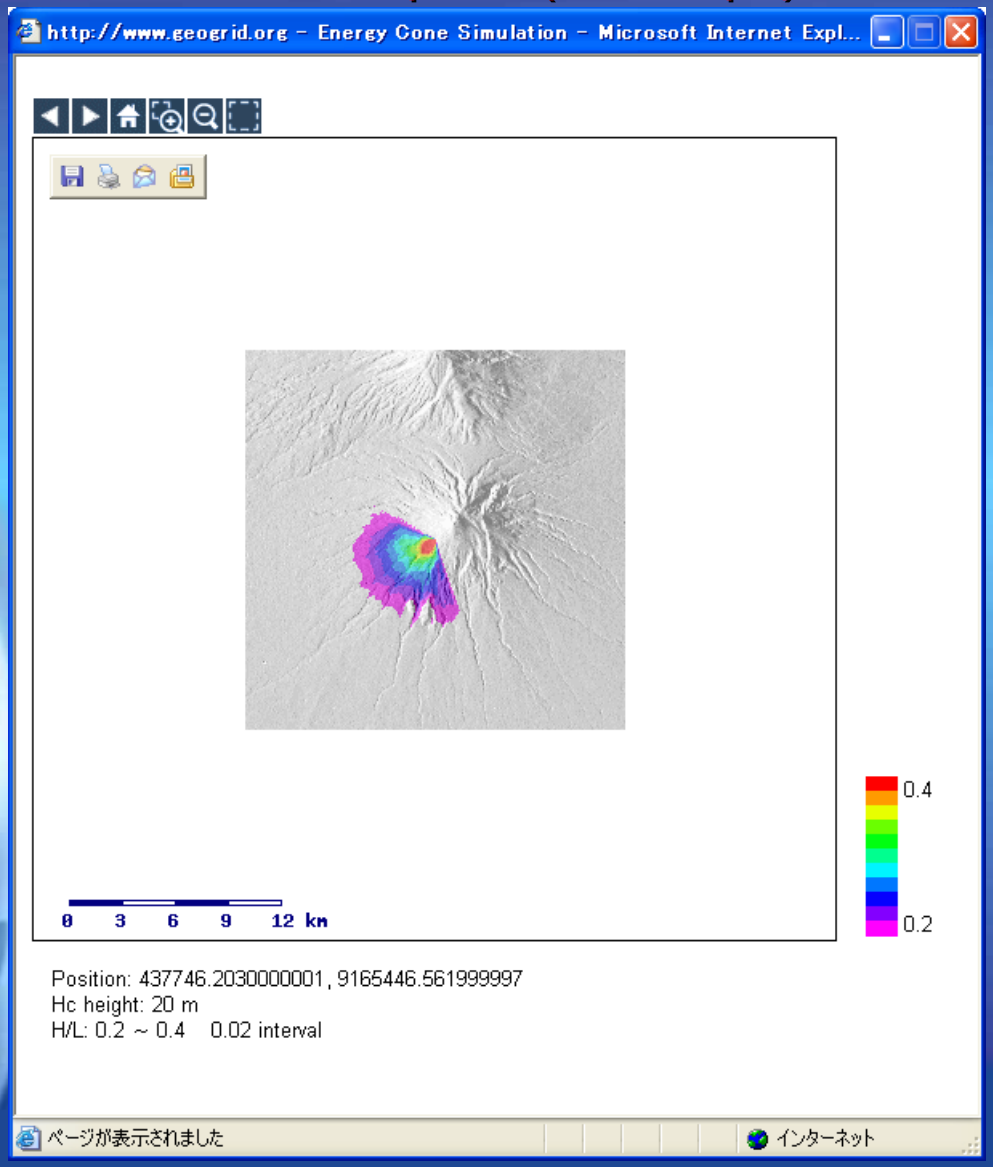


Results of Energy Cone Simulations (Hc=80m, 200m)

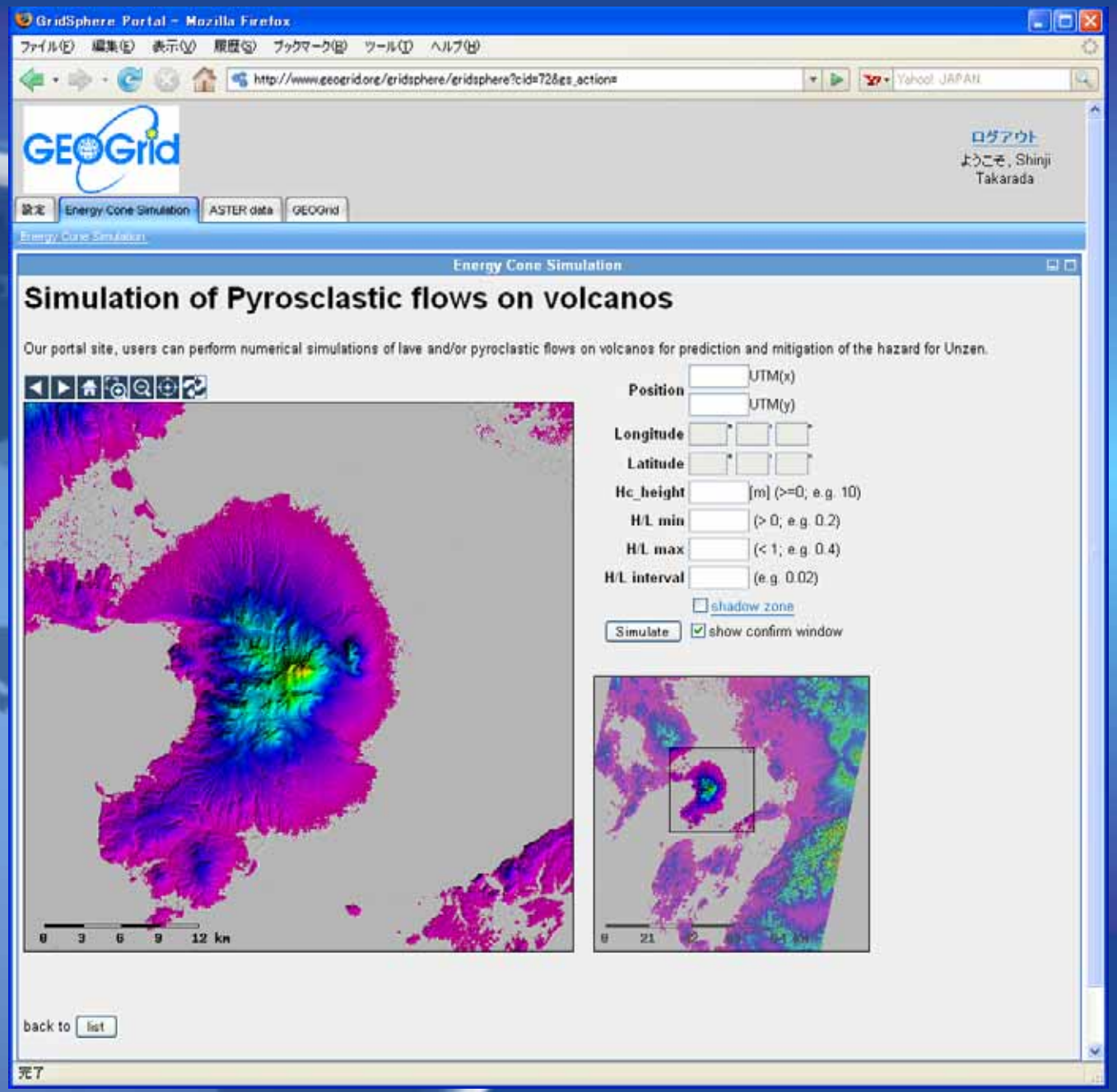
Frank Eruption (northern slope)



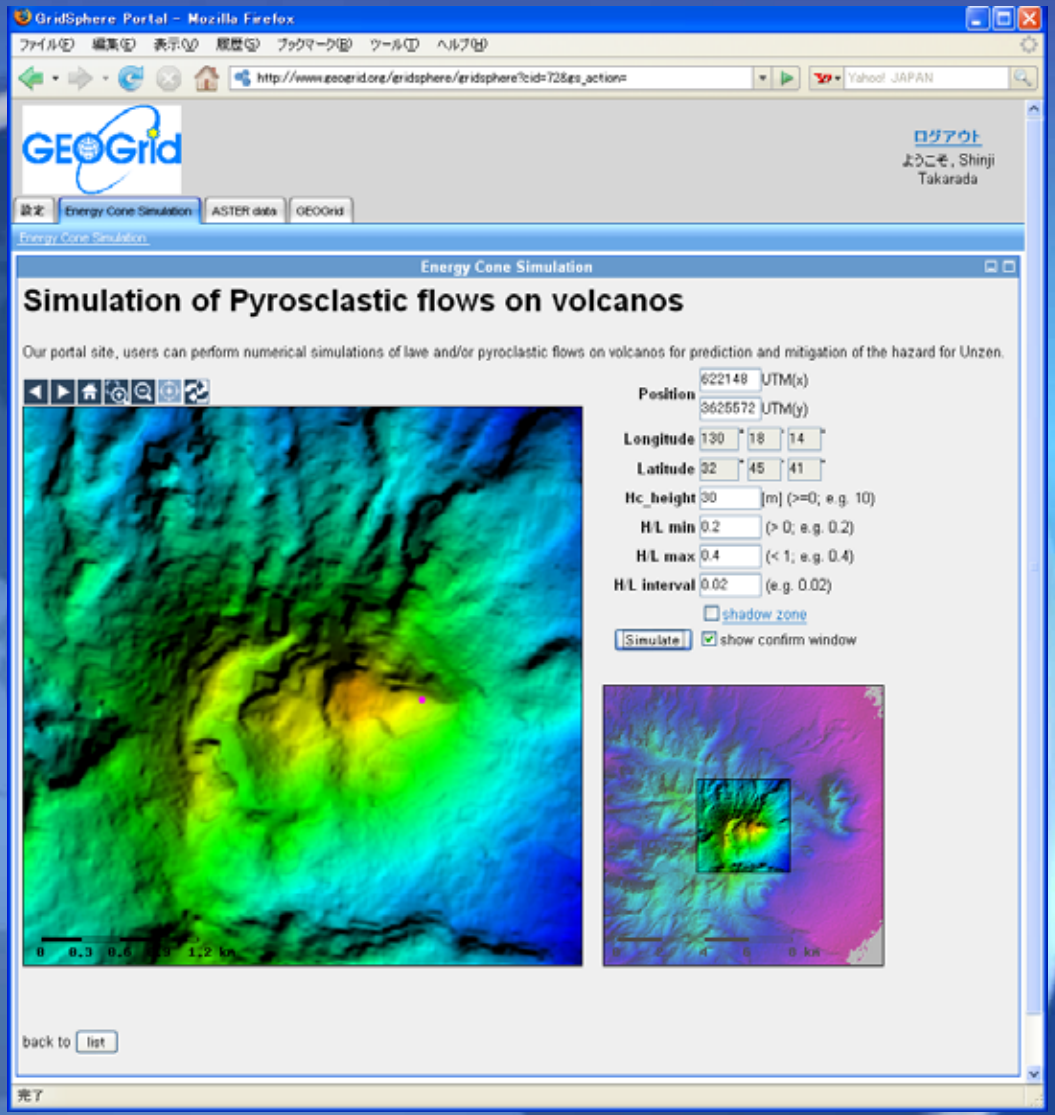
Frank Eruption (SW slope)

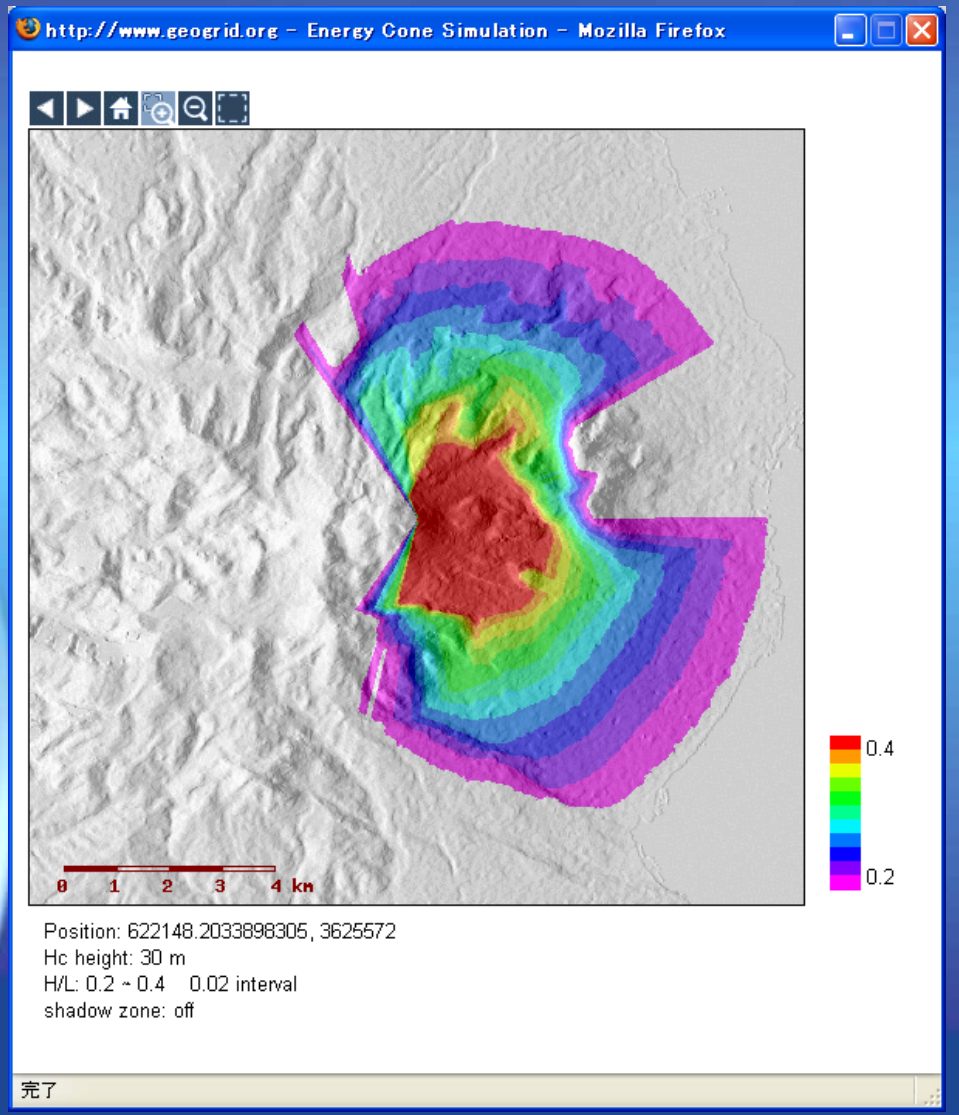


Results of Energy Cone Simulations

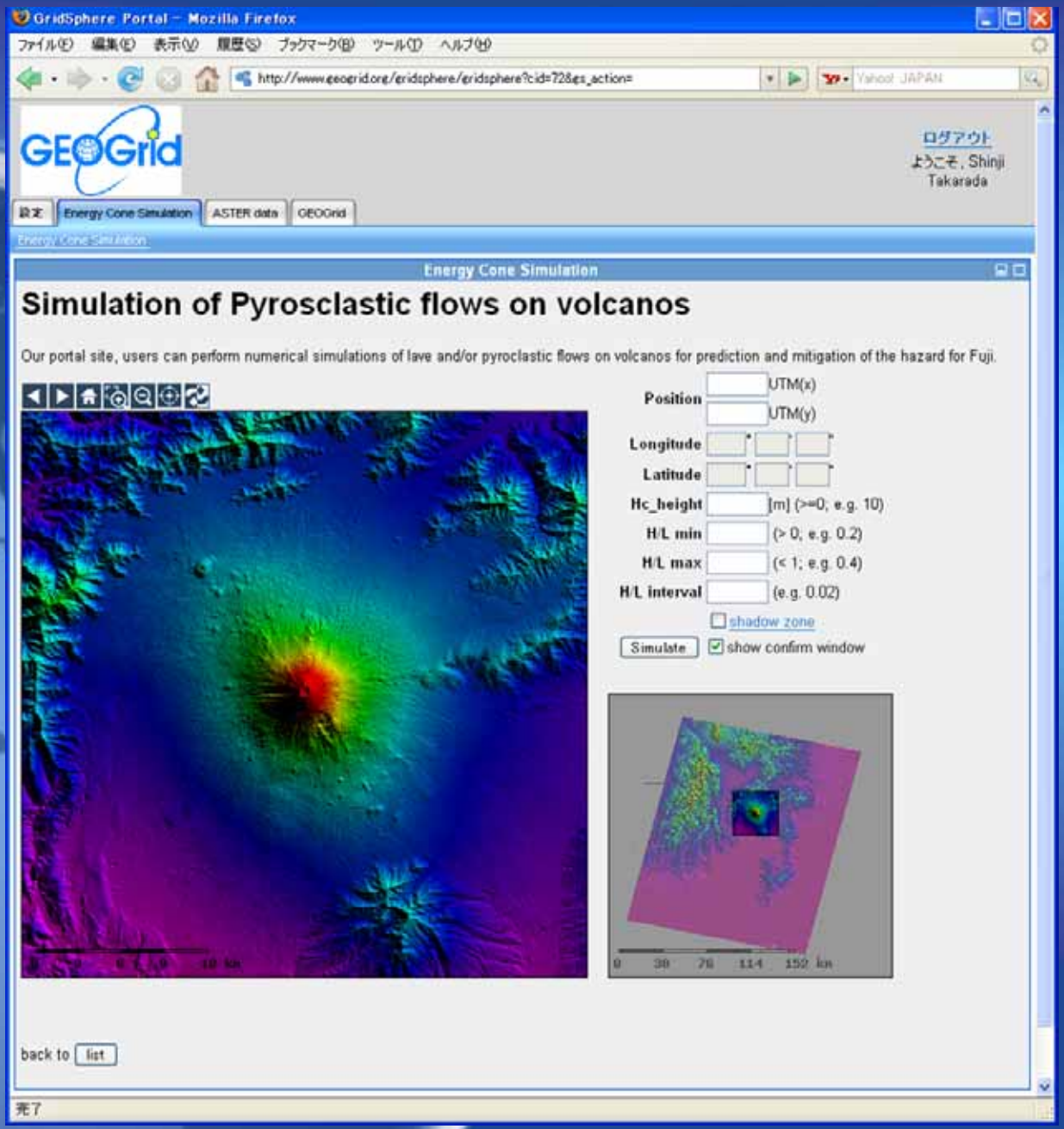


Result of Energy Cone Simulation (Unzen Volcano)

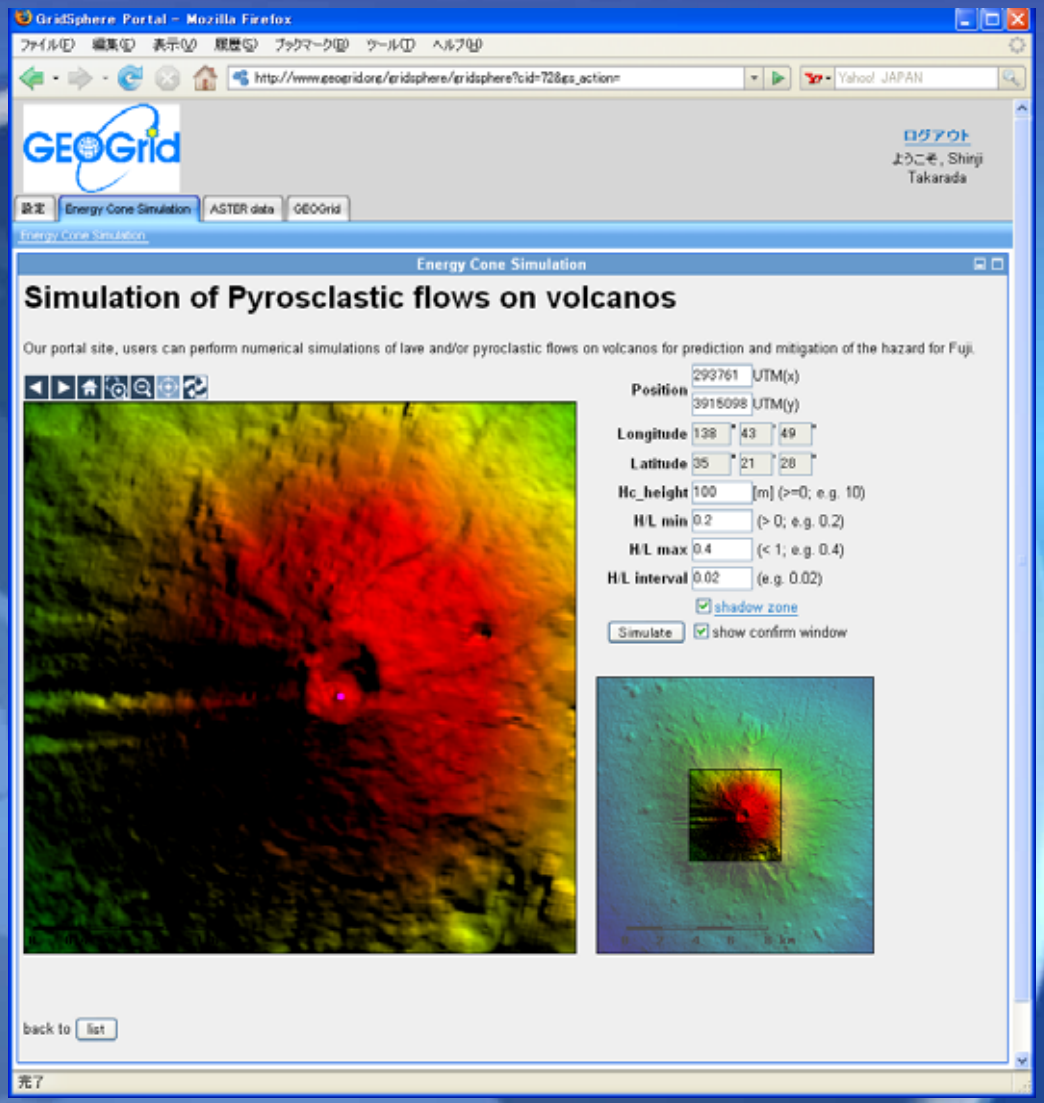


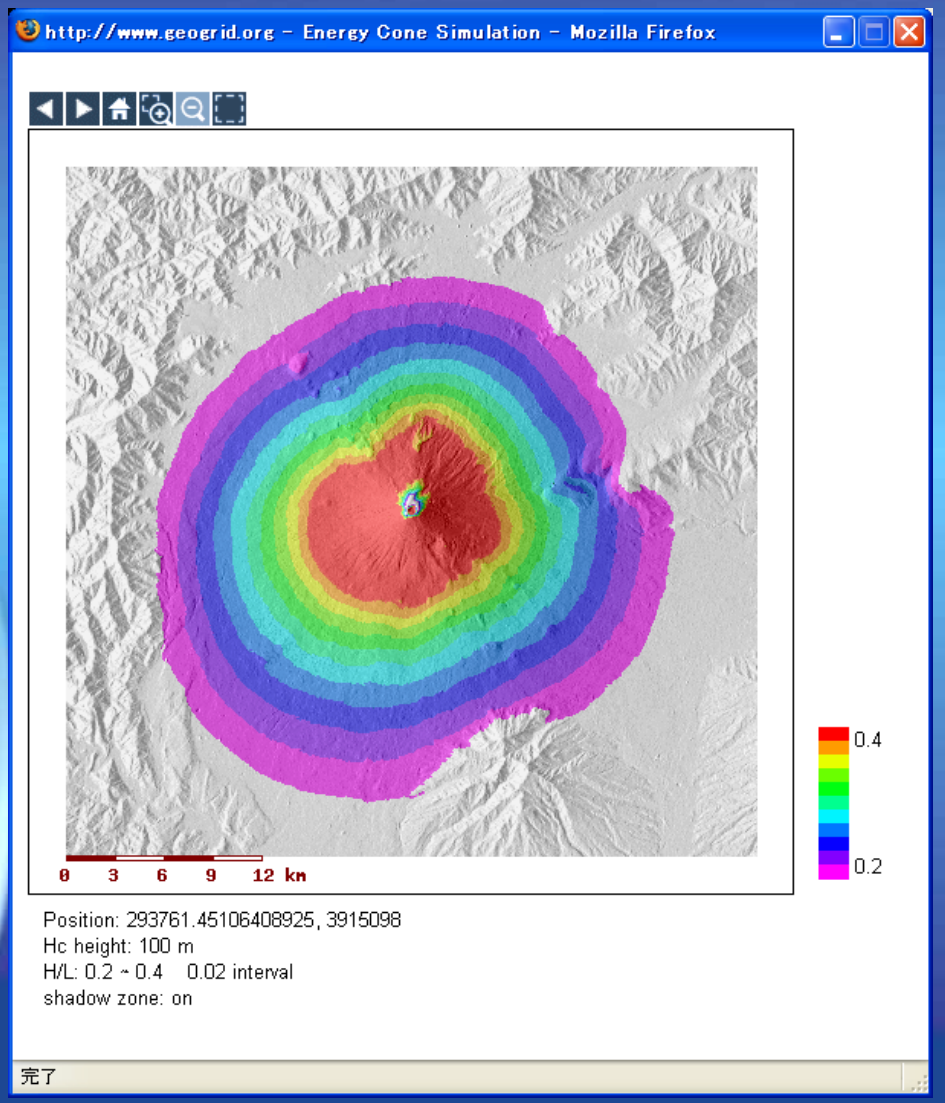


Result of Energy Cone Simulation (Unzen Volcano)



Result of Energy Cone Simulation (Fuji Volcano)





Result of Energy Cone Simulation (Fuji Volcano)

Summary

1. 1991-95 Unzen Pyroclastic Flow

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

2. Next Generation Volcanic Hazard Map

Overlapping any kinds of data sets

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)

3. 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)