Development of High Performance Computing and the Japanese Planning

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(AIST, Japan)

1. High Performance Computing Infrastructure in Japan

2. HPC for Societal Benefit Area (ex. GEO Grid)

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Japanese 10PF scale computing initiative

New admin

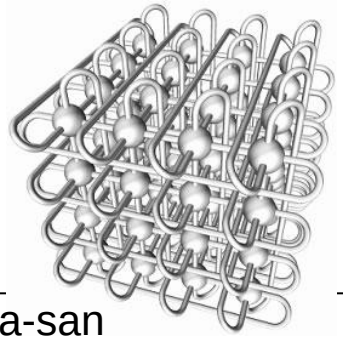
SHIWAKE
Friday, Nov. 13

2007 2009 2011

2008 2010 2012

Building construction

machine operational



Facility @ KOBE, Japan

Computer Wing

Total Floor Area:17,500m^2

2 Computer rooms: 6,300m^2 each

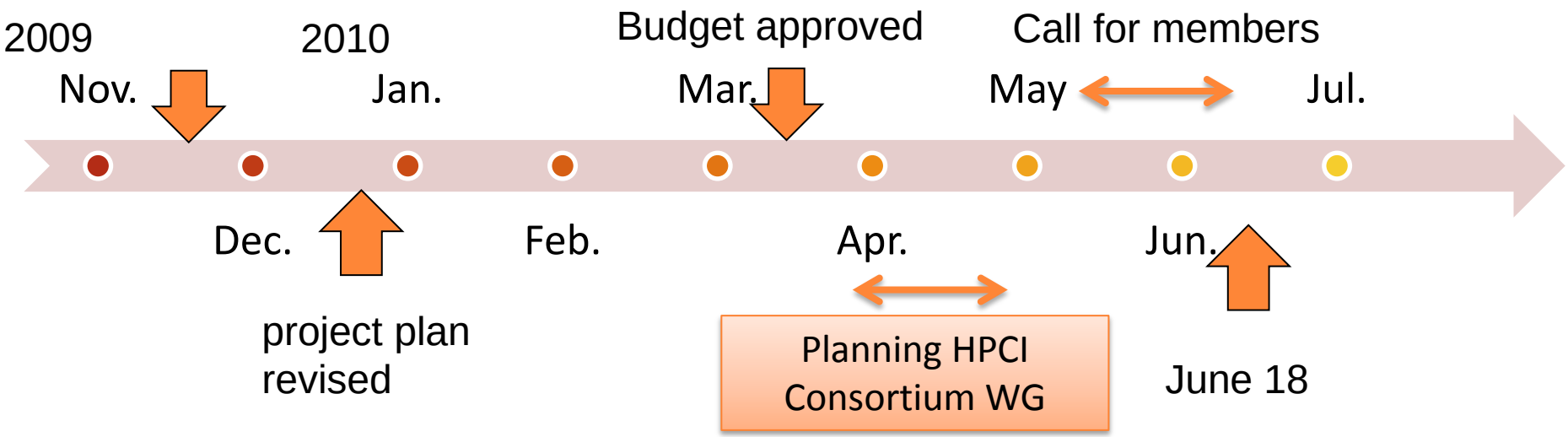
4 Floors (1 underground floor)

=> x4 ES, 2000~4000 racks

SHIWAKE – budget screening

- by the Government Revitalisation Unit
  - Scrutinizing and screening of government supported projects' budget
  - late December – submit the national budget to diet
- Japanese Supercomputer Project
  - Requesting 27B JPY for FY2010
  - questioned spending on the project that has already cost 54.5B JPY (600M USD) and is likely to require another 70B JPY (800M USD).
- Conclusion was:
  - Freeze the project except minor programs

What happened after the SHIWAKE



- Conditional accept – 22.8B JPY
  - Form a consortium to get more user communities involved
    - broaden potential users not only scientist but also SMB, manufacturing firm, etc.
    - All-Japan formation – MEXT + METI + MIC +others
  - Plan to develop THE NATIONAL HPC Infrastructure
    - Kobe is the primary facility but have others networked
    - easy and quick access capability

Federating distributed facilities

PoP

Kobe + Tsubame 2.0 >>> Aggregated other resources

Portal service
Authentication
Workflow
Data xfer
Viz tools

Lessens learnt from NAREGI deployment

- DO NOT expect homogeneous middleware installation
  - Each site won't change its operation policy
  - May assume a simple job submit Queue I/F
- DO NOT integrate horizontally
  - Kobe machine, univ. machines, AIST and commercial machines should be managed independently
  - Never consider to reserve resources across sites at a same period
- DO NOT expect to have single account/ID
  - Identity should be managed by each community
- Use CLOUD computing concept
  - once program developed runs everywhere
  - may use VM/dynamic provisioning for hiding heterogeneity

Next Steps

- The initial member of the HPCI Consortium will be announced shortly – by the end of June, 2010
- It will lead discussion on the design of the infrastructure more detail – by 4Q 2010
- Finding more feasible usage scenario of application
  - Strategic 5 application domains
  - Provide easy access solution to SMEs
    - simply use commercial apps in the facility like SaaS
    - users don't care the machine - unnecessary running it on Kobe or Tsubame
  - From computational science to e-science integrating HPC power and huge data
    - Genome giga sequencer,
    - Earth science data

HPC for Societal Benefit Area

■Understanding the Earth system is crucial to enhancing human health, safety and welfare, protecting the global environment, reducing disaster losses, etc.

- ☐GEOSS 10-Year Implementation Plan at Earth Observation Summit (2005).
- ☐The G8 leaders further agreed to accelerate efforts to strengthen observation, prediction and data sharing within GEOSS in their Declaration on Environment and Environment adopted in Toyako, Japan (2008).

■Coping with environmental changes is a common and important issue in Asian countries.

© GEO

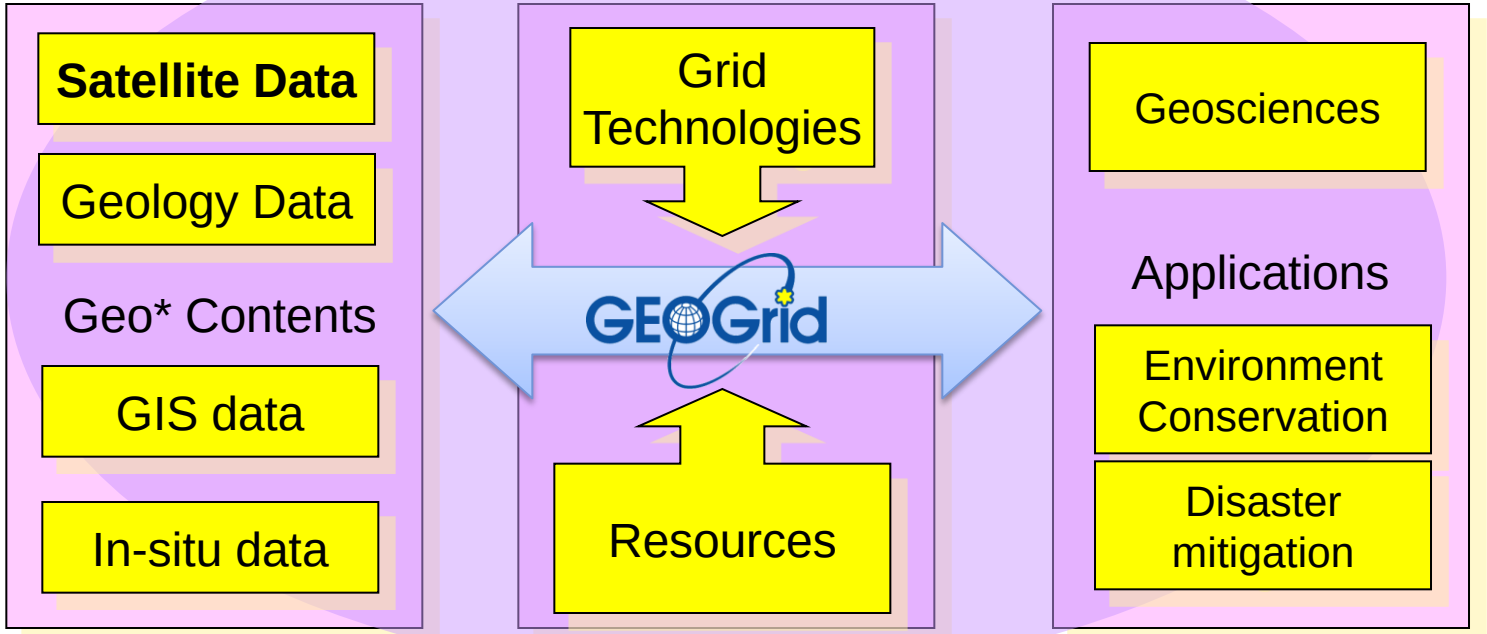
Federation of distributed and heterogeneous Earth observation data is the key to implement the Global Earth Observation System of Systems.

How can HPC-Grid-Cloud help ?

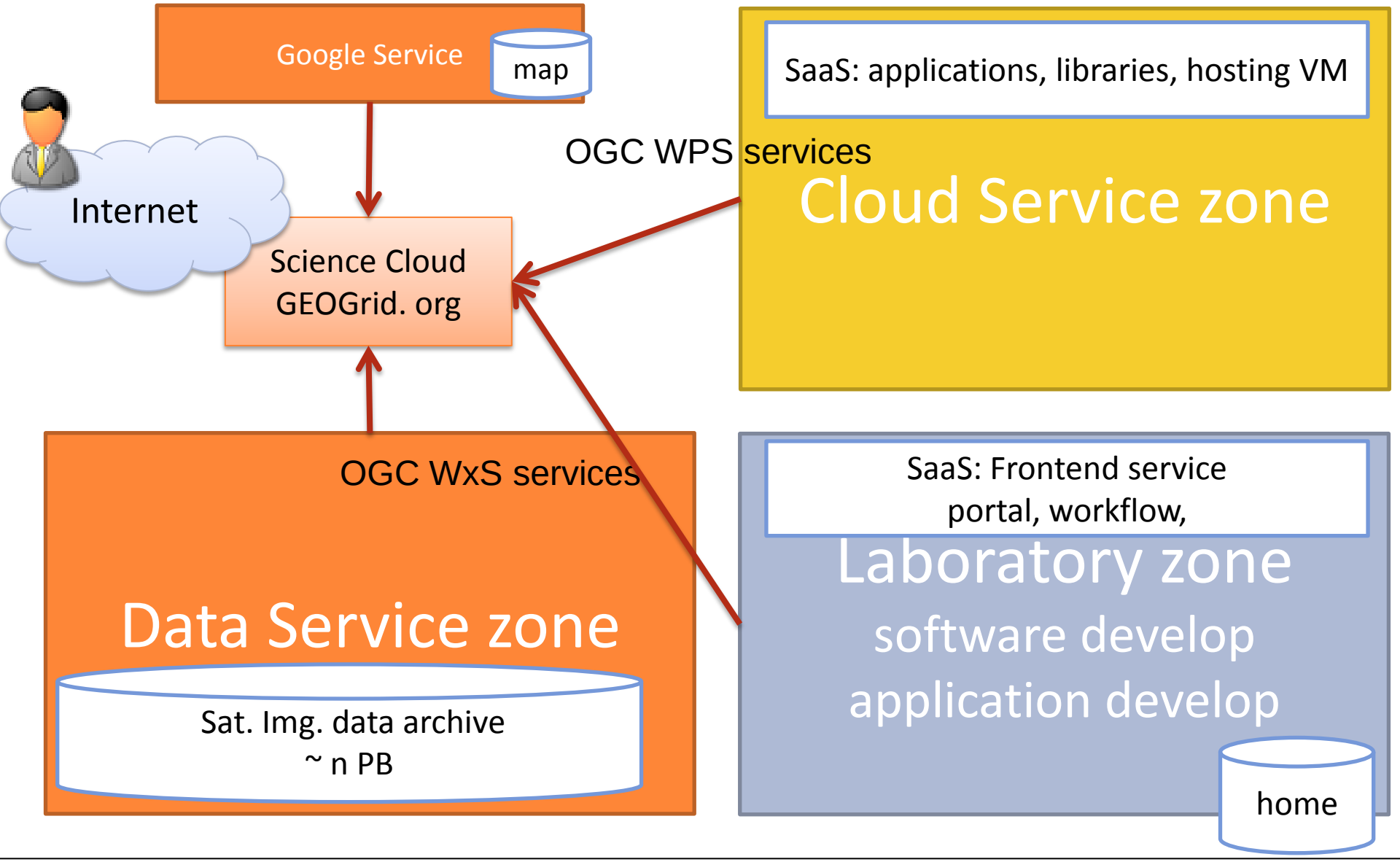
- The GEO (Global Earth Observation) Grid is aiming at providing an *E-Science Infrastructure* for worldwide Earth Sciences communities to accelerate GEO sciences based on the concept that relevant data and computation are *virtually integrated* with a certain *access control* and ease-of-use interface those are enabled by a set of Grid and Web service technologies.

AIST: OGF Gold sponsor (a founding member)

AIST: OGC Associate member (since 2007)



GEO Grid System Zones

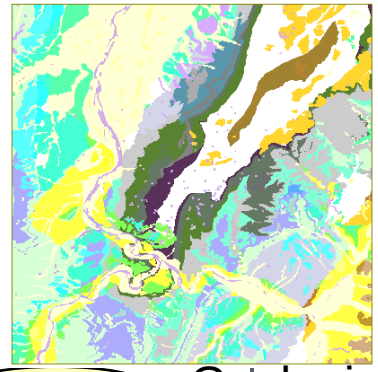


A Workflow example

“Disaster prevention and mitigation (Landslide)”

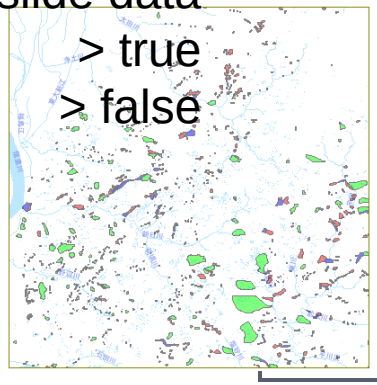
Early warning system based on Susceptibility map

Geology map (GSJ)



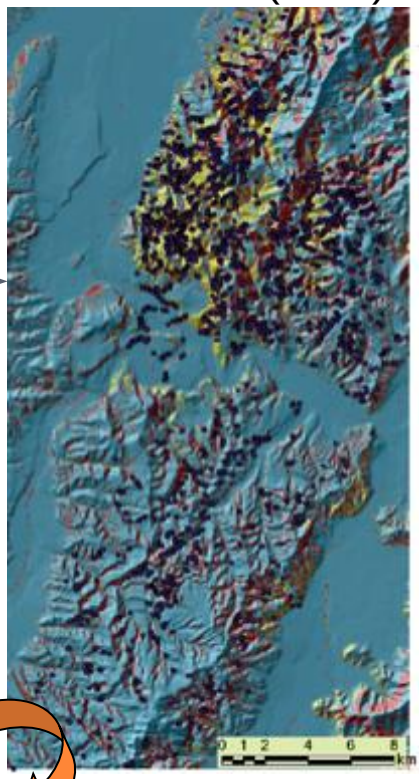
Geology
> rock type
> buffer

Landslide data
> true
> false



Landslide susceptibility index map and its legend
XML(GML)

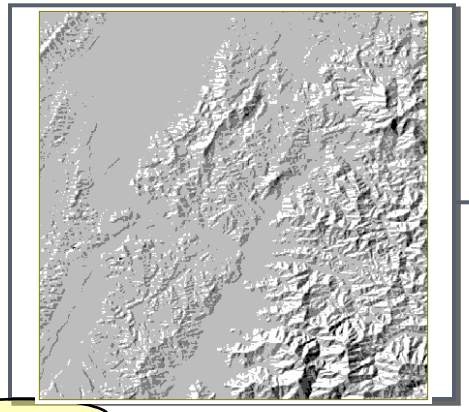
WCS



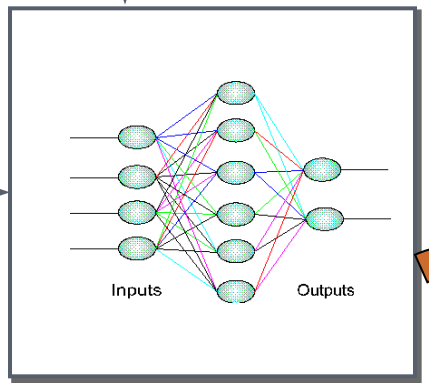
NIED

GSJ

Geologic data (GML) via WFS of Geology DB



DEM (GeoTiff) via WCS of ASTER DB (OnDEM)

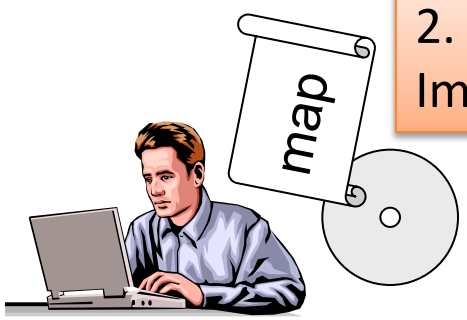


ASTER

High resolution DEM provided from ASTER
Elevation, slope, aspect

Large scale Computer simulation using actual landslide DB

Conventional Approach (Landslide)



2. Input data preparation using Image Processing & GIS software

In most case, commercial

- Convert Format
- Convert Projection
- Extract the Area of Interest

3. Number crunching Calculation

1. Data acquisition

Simulation Program

Request

Request

Request

Upload

If you need a large computing resource…

Application Server

Download

Result

DEM

CD-ROM
FTP

CD-ROM
FTP
Hard copy

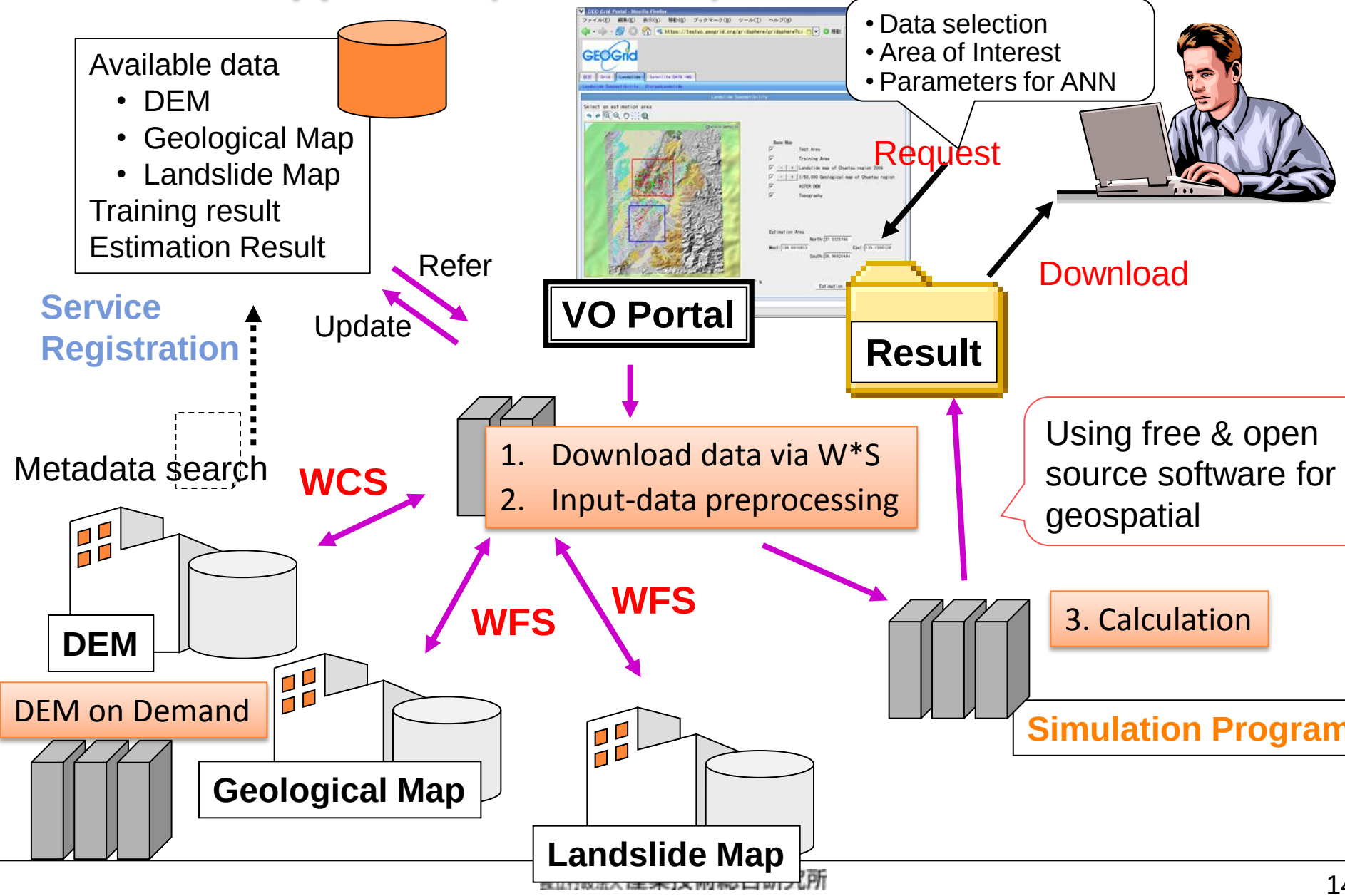
Geological Map

FTP
Hard copy

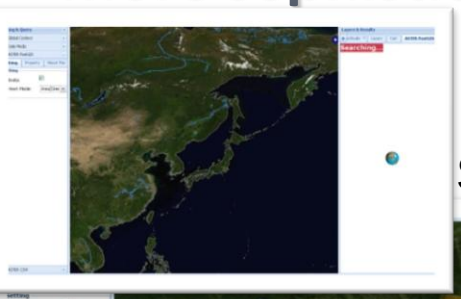
Landslide Map

Many manual operations! (e.g. data preprocessing) multi-data policies

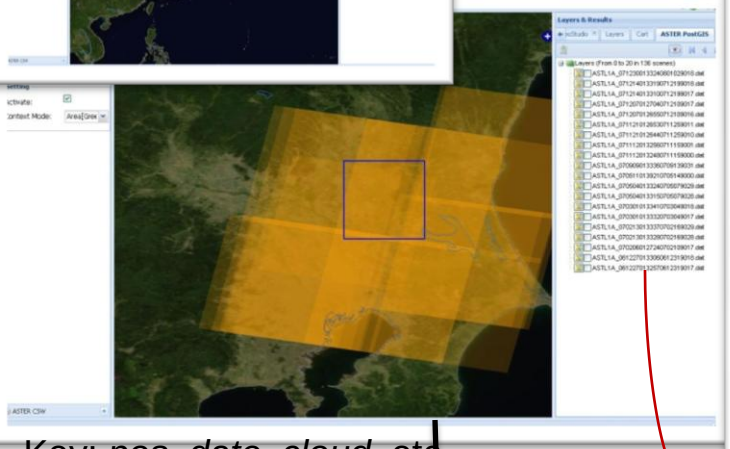
GEO Grid Approach (Landslide)

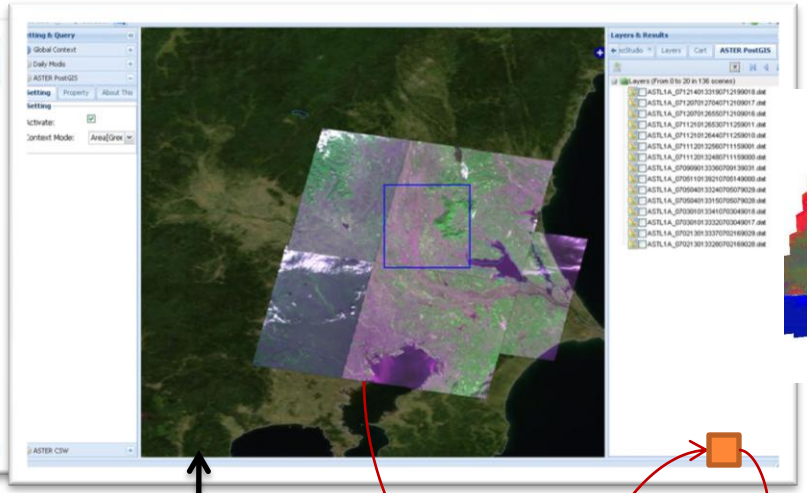


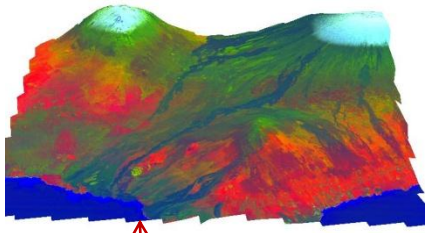
More sophisticated, more standard approach



Search







Key: *pos, date, cloud*, etc.

ASTER Search Service

On demand

WMS

WMS/(WCS)

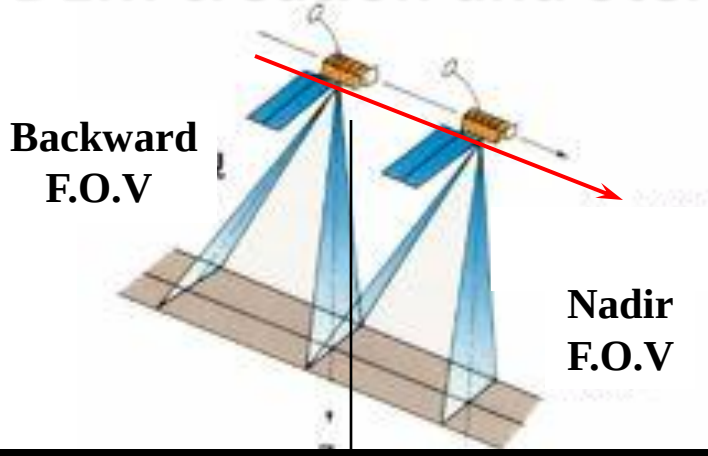
CS-W

Metadata

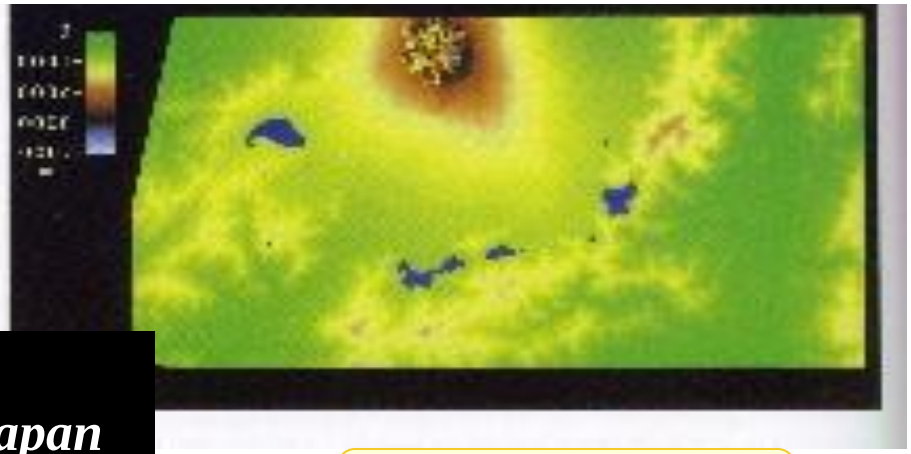
Sat. Data

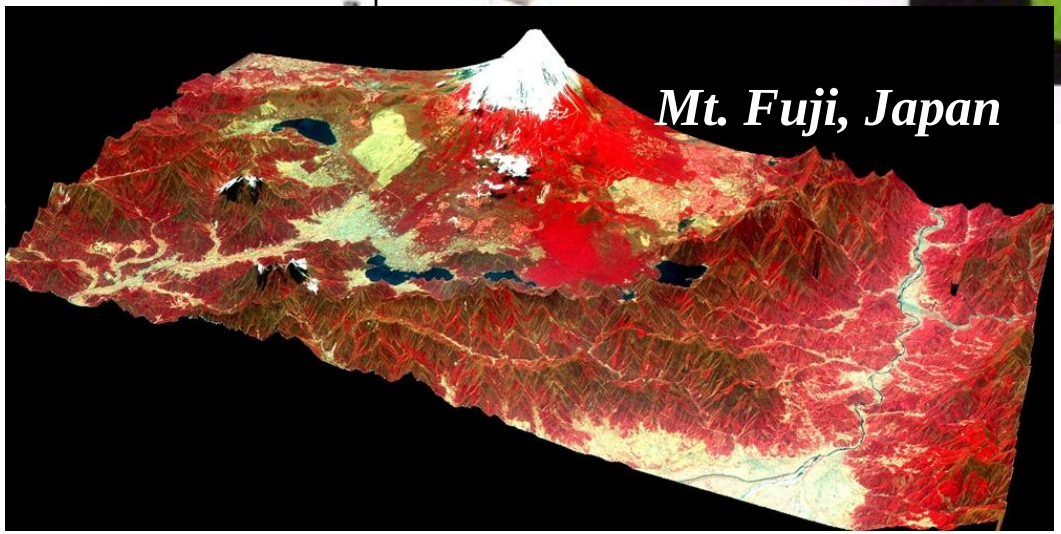
WMS: Web Map Service – jpeg, png
WCS: Web Coverage Service - Raster

DEM creation and Stereo-Matching



DEM (Digital Elevation Model)





Pre Processing

↓

Stereo Matching

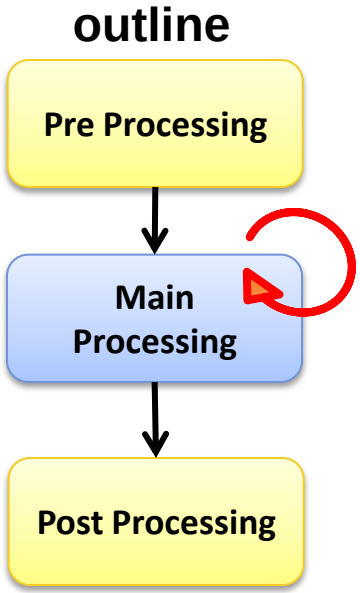
↓

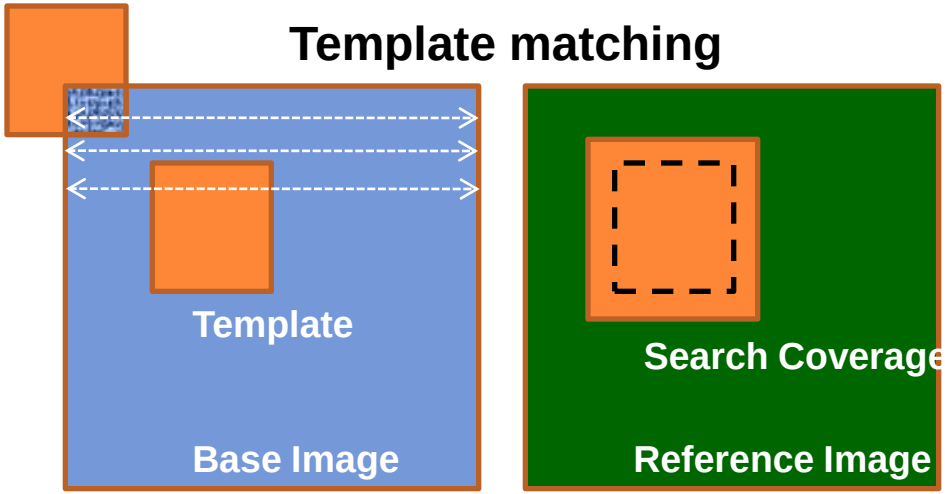
Ortho / DEM

Stereo-matching software has often been used in generating a Digital Elevation Model (DEM) from a pair of satellite imagery data sets to compute height from parallax views using two photographic images.

Analysis of the program（outline）

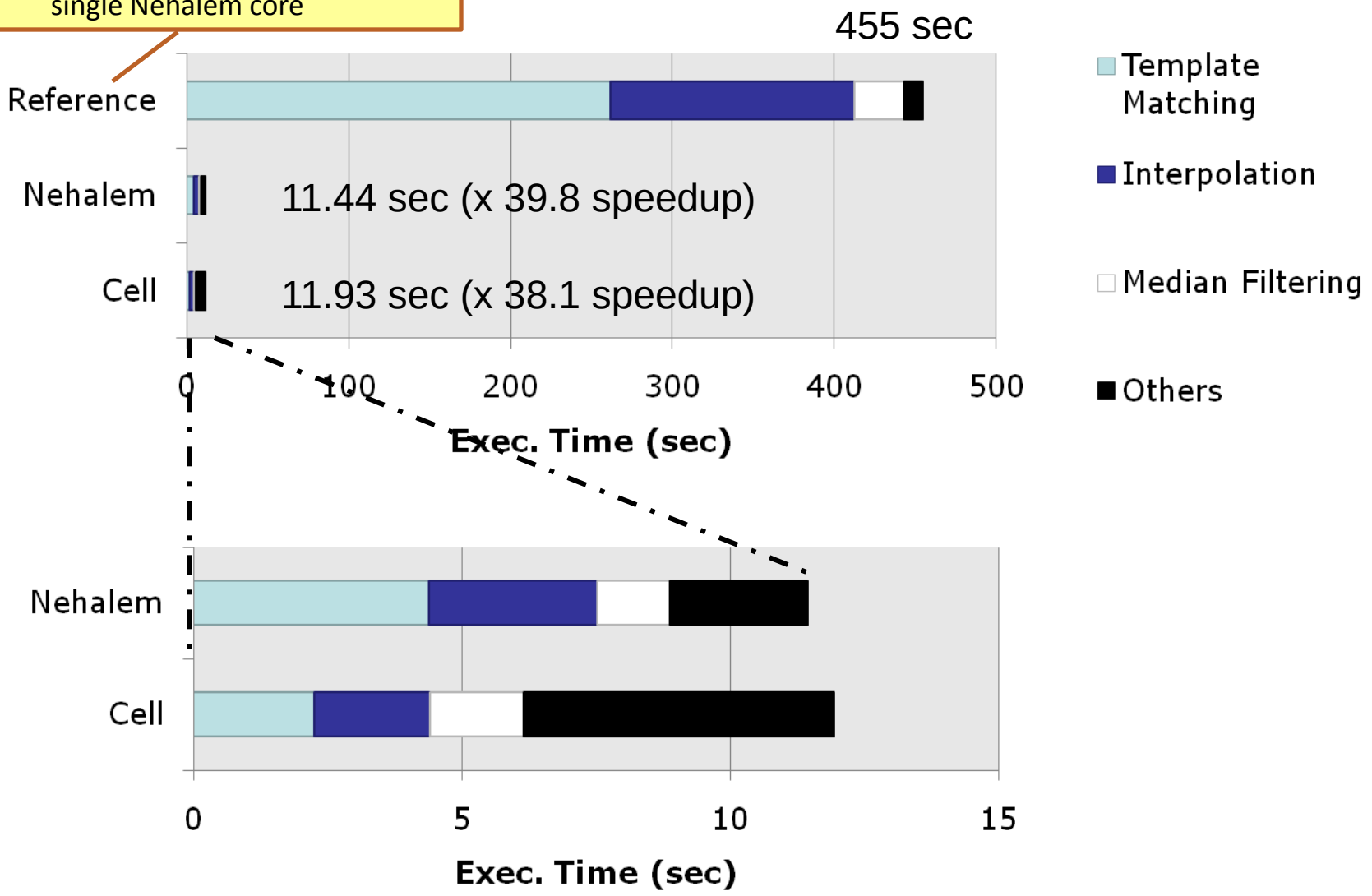
- Outline
  - Compare image data from different sensors
    - Calculate correlative coefficient and identify spots.
    - Complement missing data and generate altitude.
- Pre processing
  - Input data
  - Initialize structures
- Main processing
  - Template Matching
    - Compare two images and identify spots.
  - Interpolation
    - Complement missing data
  - Median Filtering
    - Remove noise
  - Other filtering
  - Output data
- Post processing
  - Free buffers





Results of the optimization

Exec. time of the original program on a single Nehalem core

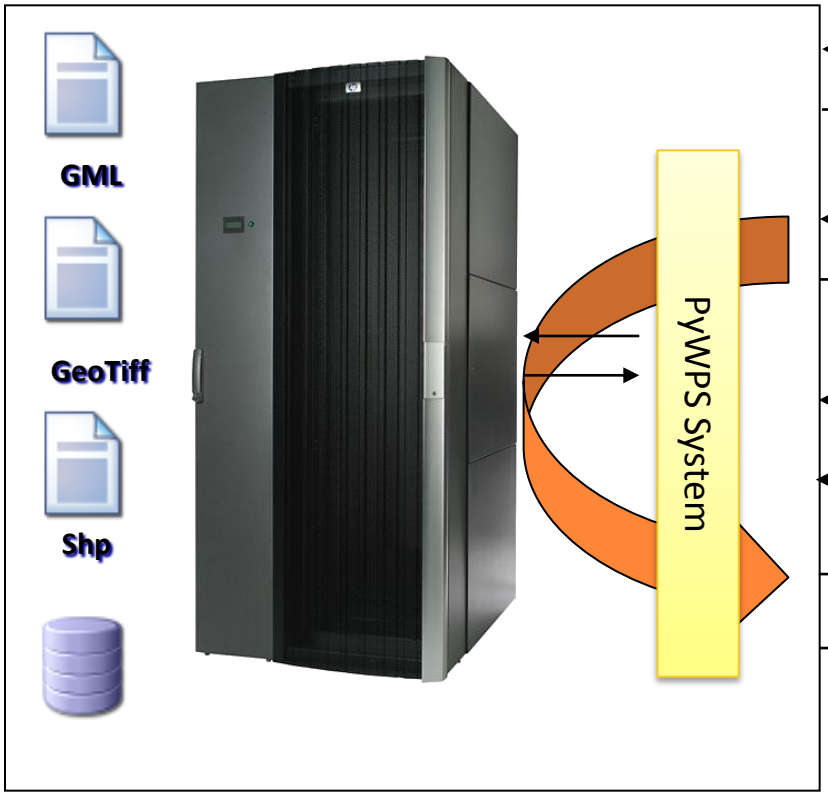


Web Processing Service

- Recently, Open Geospatial Consortium (OGC) launches a draft specification of Web Processing Service (WPS) , originally named Geoprocessing Service.

- The specified Web Processing Service provides client access to pre-programmed calculations and/or computation models that operate on spatially referenced data.
  - The result of request process are available to download for further analysis at user's machine.

Web Processing Service Server



Provision in a cloud

WPS url

GetCapability

Execute Request

send files

Notification

get files

appln VM

GeoGrid.org

data in cloud

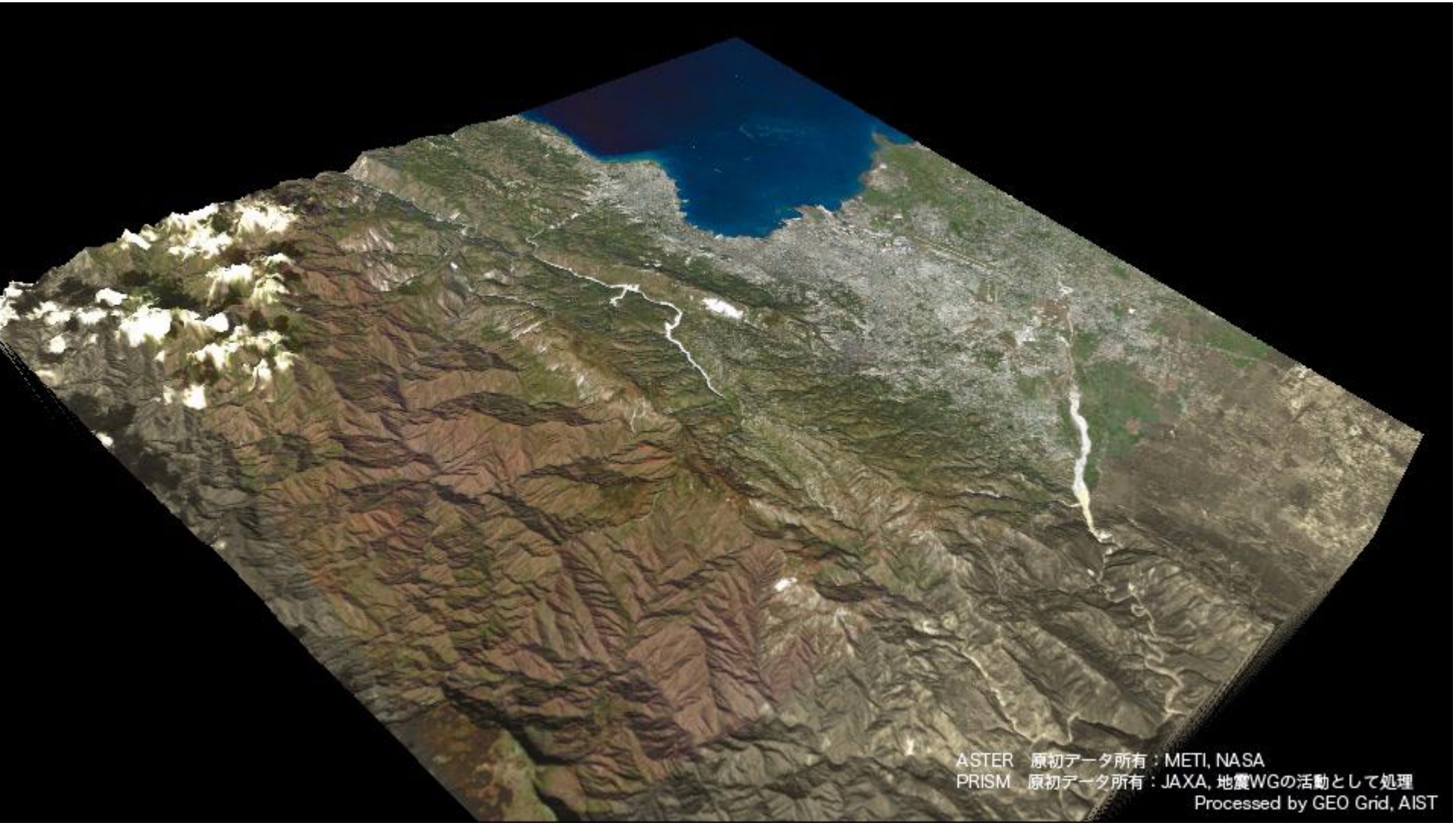
local data

User

**Execute Request

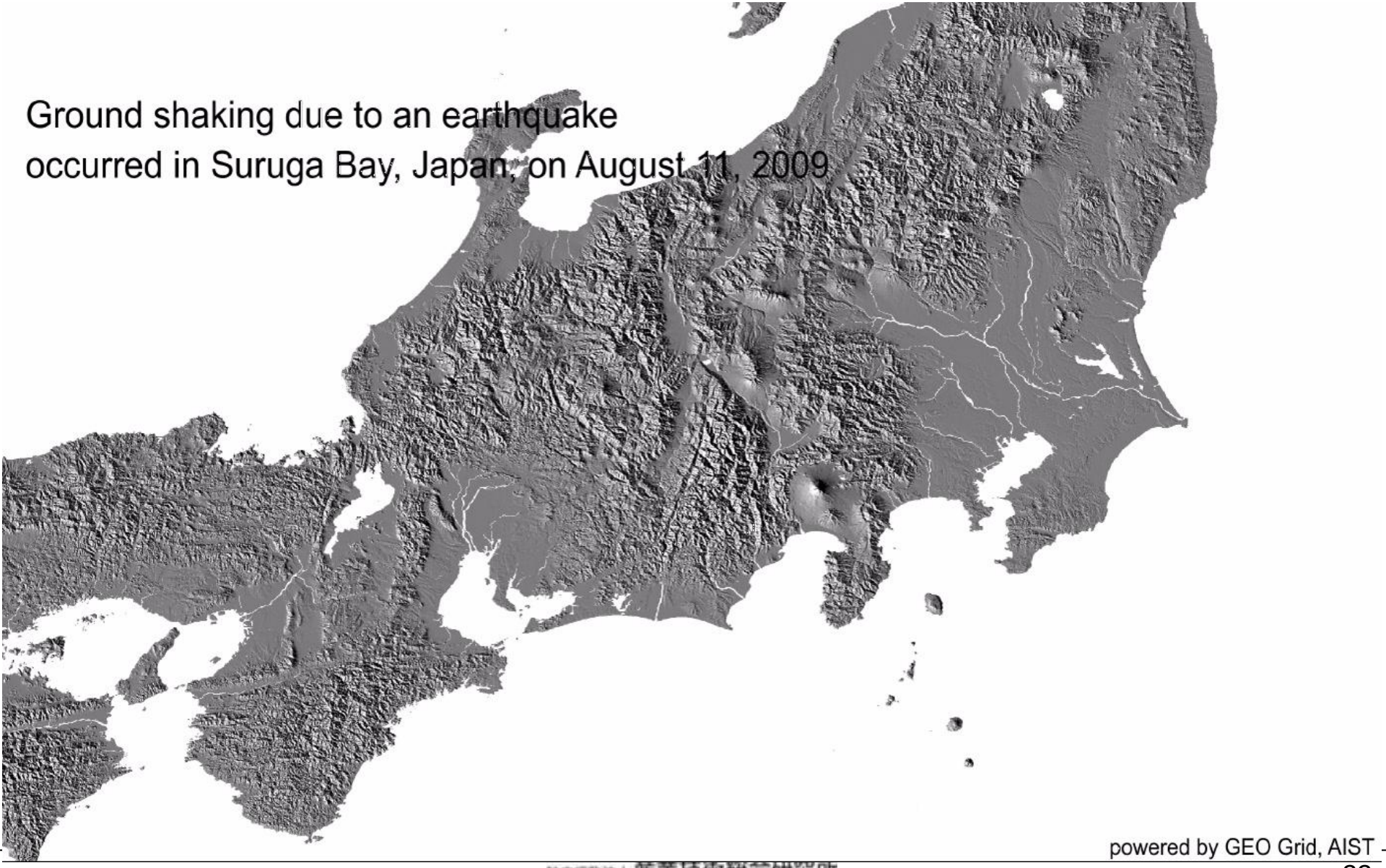
http://wps.org/cgibin/wps.py?service=wps&
version=0.4.0&request=execute&
Identifier=shortestpath&Datainputs=cost,0,x1,596527,y1,4921298,
x2,598173,y2,4923383&store=true&status=true

Haiti landscape after shake – created by PRISM + ASTER



Ground shaking sensor data interpolation (250m mesh)

100ms



powered by GEO Grid, AIST

Two topics' Summary

- High Performance Computing Infrastructure
  - Unfortunately, it is unable to reveal to public (nor myself ☺)
  - But, initial consortium will be formed soon
  - Federate facilities provided by multiple resource owners
  - note: Kobe + Tsubame >>> other resources

- HPC with *REAL* data in GEO sciences
  - One of the most beneficial area for society
  - Feeding real data to HPC is the KEY
  - Need to comply with existing standards - WPS
  - Grid, Cloud, Sci-SaaS –like concept would save the management cost