Sentinel Asia—Supporting Disaster Management in the Asia-Pacific Region

Symposium   on the Data Sharing Action Plan for GEOS
and the Benefits of Data Sharing
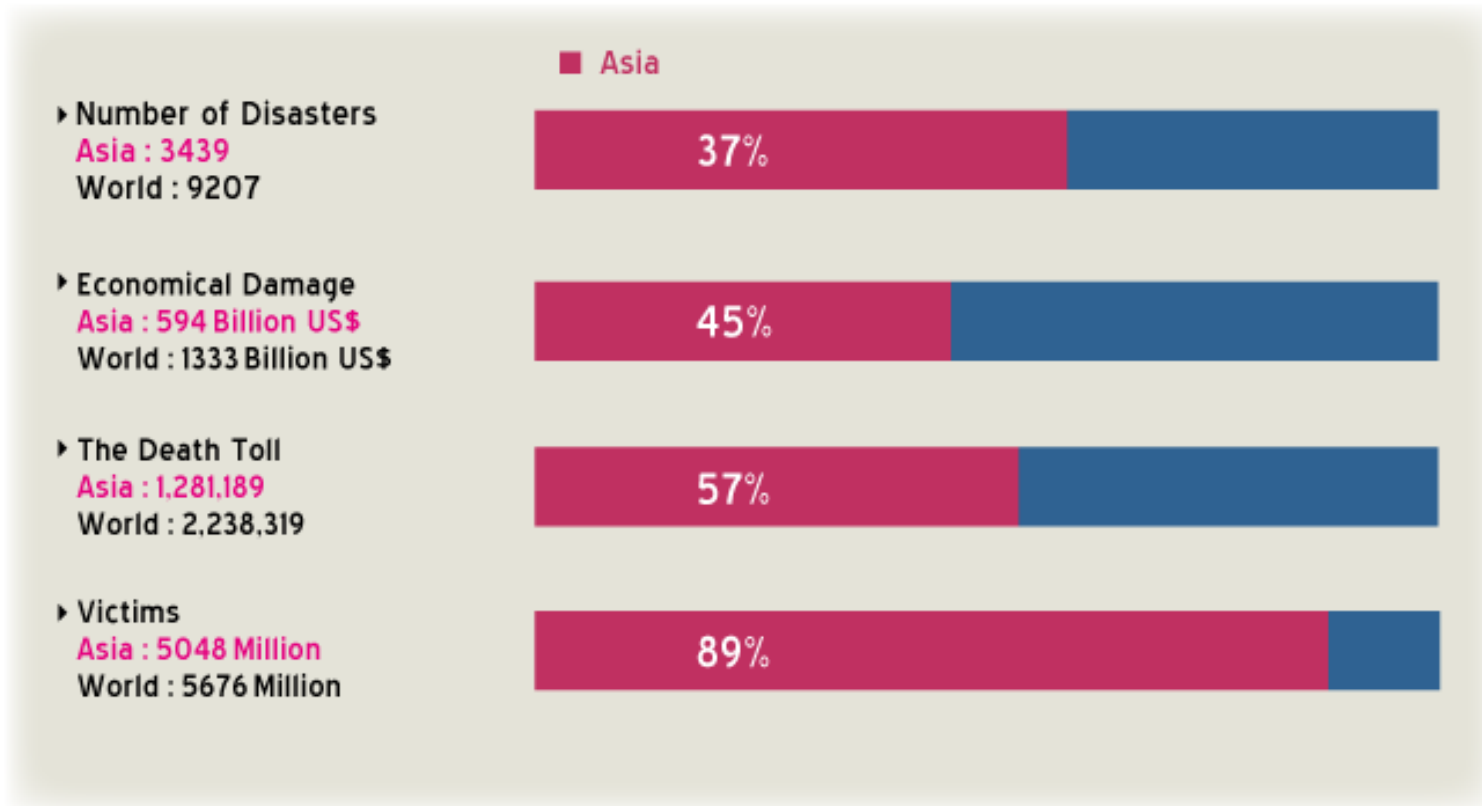Tuesday, 2 November 2010

Chiyoshi Kawamoto
Japan Aerospace Exploration Agency

Contents

1   What is Sentinel Asia?

Background of Sentinel Asia

Asia

Number of Disasters
Asia : 3439
World : 9207

37%

Economical Damage
Asia : 594 Billion US$
World : 1333 Billion US$

45%

The Death Toll
Asia : 1,281,189
World : 2,238,319

57%

Victims
Asia : 5048 Million
World : 5676 Million

89%

Derived from 'ADRC−Natural Disasters
Data Book−2007' originally in CRED EM-DAT, 2007

Asia has been seriously damaged by natural disasters over the last 30 years.

# Asia-Pacific Regional Space Agency Forum

[History] Established in 1993 after the Asia-Pacific International Space Year Conference (APIC) in 1992

[Organizers] MEXT, JAXA and co-host organizations

➢ Past co-organizers: Government or related entities of Mongolia, Malaysia, Republic of Korea, Thailand, Australia, Indonesia, India, Vietnam, Thailand

[Next Session] APRSAF-17 will be held in Melbourne, Australia, on 23-26 November 2010

Sentinel Asia
establishing
Disaster Management
Support System
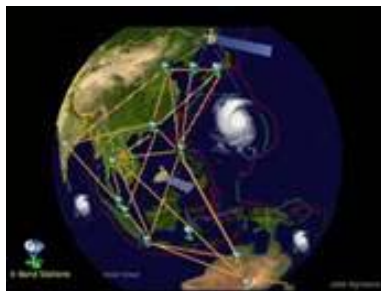
Working Groups

| Earth Observation | Communication Satellite Applications | ISS | Space Education & Awareness |

http://www.aprsaf.org/

Sentinel Asia

Sentinel Asia is a voluntary initiative by a collaboration between space agencies and disaster management agencies, applying remote sensing and Web-GIS technologies to assist disaster management in the Asia-Pacific region.

In Oct 2005, APRSAF-12, in Kitakyushu, Japan, approved the plan to initiate the pilot project.
In Feb 2006, Joint Project Team (JPT) was organized.

Step1 (2006-2007), a pilot project, has finished, and Step2 (2008-2012) has initiated.

Website
http://sentinel.tksc.jaxa.jp/
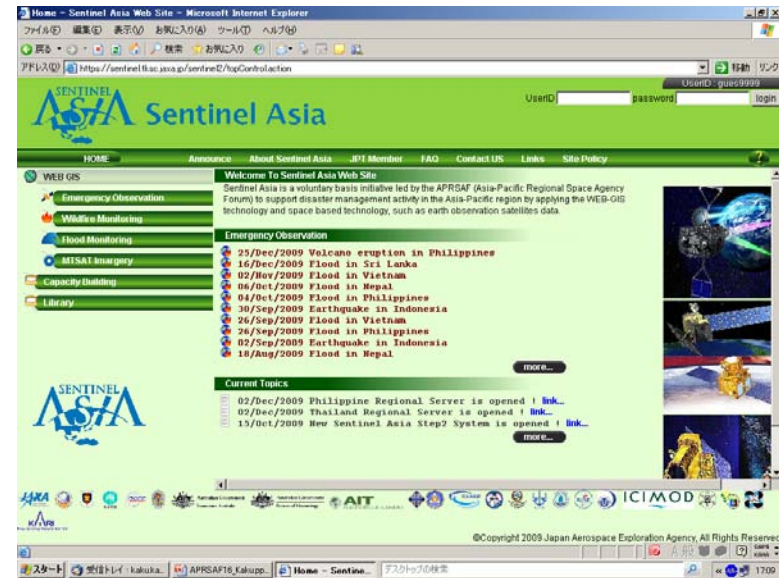
Framework of Sentinel Asia

Space Community

APRSAF*

Data Provision

Promotion of Utilization

Capacity Building

* Asian-Pacific
Regional
Space Agency Forum

Disaster Management Community

ADRC**
Member Countries

Utilization (User)

** Asian Disaster
Reduction Center

Sentinel Asia

Joint Project Team (JPT)
Join Project Team consists of total 69 organizations
including 60 organizations of 24 countries/region and
9 international organizations as of July 2010

International Community

UN / ESCAP   UN / OOSA
ASEAN   AIT   etc.

International Cooperation

JPT meeting in Manila
Philippines,
in July 2010

ADRC Members Countries

29 Members Countries, **5** Advisor Countries
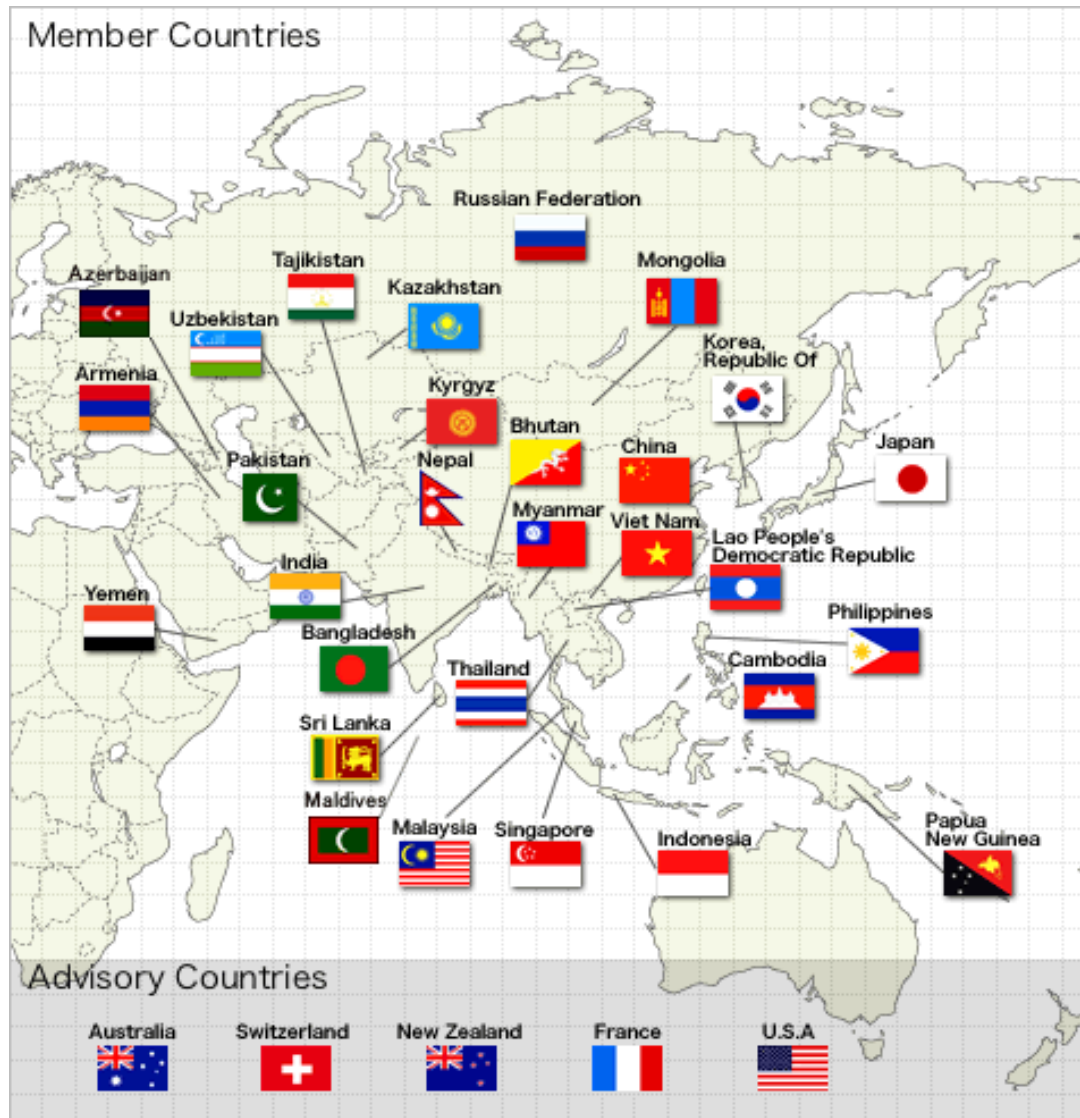
Concept of Sentinel Asia

Collaboration between space agencies and disaster management agencies

Observation

Communication Satellite

Utilization

Space Agency

Earth Observation Satellite

Transmission

Disaster Management Organization

Value-added Information

User Expansion

Governmental Organization (ADRC members)

Local Governmental Organization

Disaster Information

Sharing (Web)

End User

Human Network
Capacity Building・ Outreach

Main Activities

- **Emergency observation**
  accept emergency observation request from JPT and ADRC members

- **Wildfire monitoring, flood monitoring** and **Glacier Lake Outburst Flood monitoring**

- **Capacity building** and **human resource development** for **promotion of utilization**

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2   Emergency Observation

Emergency Observation

WINDS (Japan)

IRS (India)
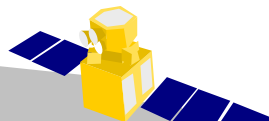
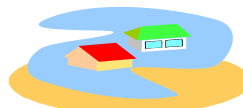ALOS (Japan)

THEOS (Thailand)
FORMOSAT (Taiwan)
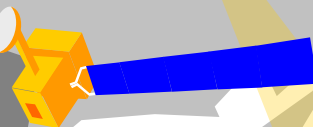
KOMPSAT (Korea)

Users
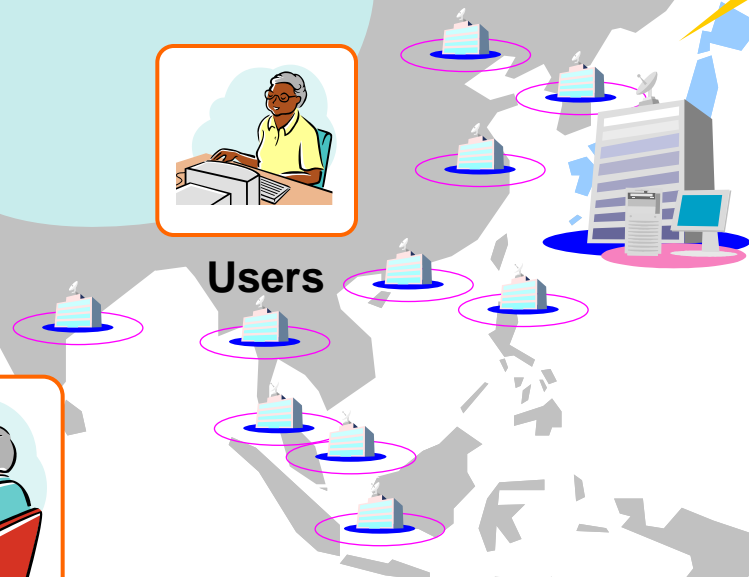
Tsunami
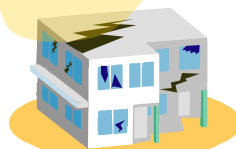
Earthquake

Volcano eruption

Flood

Wildfire

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Data Provider Node (DPN)
Satellites contributing to Emergency Observation

JAXA/Japan
ALOS
PRISM: 2.5m Pan
AVNIR-1: 10m Multi
PALSAR: 10-100m L-Band

GISTDA/Thailand
THEOS
PAN: 2m
Multi: 15m

NARL/Taiwan
FORMOSAT
PAN: 2m
MS: 8m

International Disaster Charter

Sentinel Asia Constellation

ISRO/India
IRS
LISS-4: 5.8m Pan
LISS-3: 23.5m Multi
AWiFS: 56m Multi

KARI/Korea
KOMPSAT-1
EOC: 6.6m
OSMI: 1km

Data Analysis Node (DAN)
A framework of satellite data analysis to provide analyzed products

Emergency Observation Flow

Requesting Organization (RO)
ADRC Members
JPT Members

IDC

Emergency Observation Request
Analyzed Products

Disaster Occurrence

ADRC

Emergency Observation Request

Data Provider Node (DPN)
JAXA
ISRO
GISTDA
KARI
NARL

Emergency Observation Request

Feedback

Disaster Information

Digital Camera Images

Satellite Images & Disaster Information

Archive Images

Images by Emergency Observation

Analyzable Data

Support

JAXA Asia Branch (Bangkok)

JAXA

Support

Sentinel Asia Step 2 System

Data Analysis Node (DAN)

Analyzed Products

Disaster Management Agencies in Asia

AIT, ADRC
CRISP, CAIAG
LAPAN, SD/Sri Lanka
MONRE, ICIMOD
Sri Lanka MoDM, CEA
NCRST

Own Data

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Data/Information Flow in Sentinel Asia

Users

JPT Member
ADRC Member
Public

Other Information Besides Sentinel Asia

Analyzed Products
Information using Web-GIS

Sentinel Asia Step 2 System

Satellite Data

Satellite Data

Own Data such as Map, Satellite Data

Data Provider Node (DPN)

JAXA, ISRO, GISTDA KARI, NARL

Analyzed Products

Analyzed Products

Data Analysis Node (DAN)

AIT, ADRC, ICIMOD LAPAN, MONRE, CRISP CEA, CAIAG, NCSRT Sri Lanka MoDM, SD

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Improvement of Accessibility to Information
Utilization of WINDS "KIZUNA"

Data Provider

Central Server (Japan)
https://sentinel.tksc.jaxa.jp/

WINDS Access System
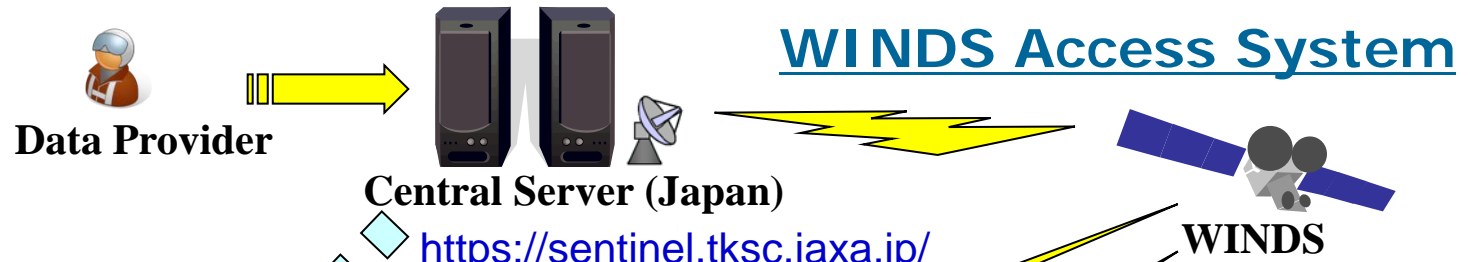
WINDS

Internet Access System

Internet Access

Narrow Band

Data Transmission via WINDS

Regional Server **Regional Server**

Internet Access to Regional Server

Country A · · · Country B · · · Country C · · ·

Regional Server at
Bangkok : https://sentith1.eoc.gistda.or.th/
Manila: https://sentiph1.asti.dost.gov.ph/

Regional Servers

red: to be set up in 2010
blue: in operation

Mongolia RS (with WINDS)

Japan Central Server

Nepal RS (with WINDS)

Vietnam RS (with WINDS)

Bangladesh RS (with WINDS)

Taiwan RS

Philippines RS (with WINDS)

Sri Lanka RS (with WINDS)

Thailand RS (with WINDS)

Indonesia RS (with WINDS)

Fiji RS (with WINDS)

RS: Regional Server
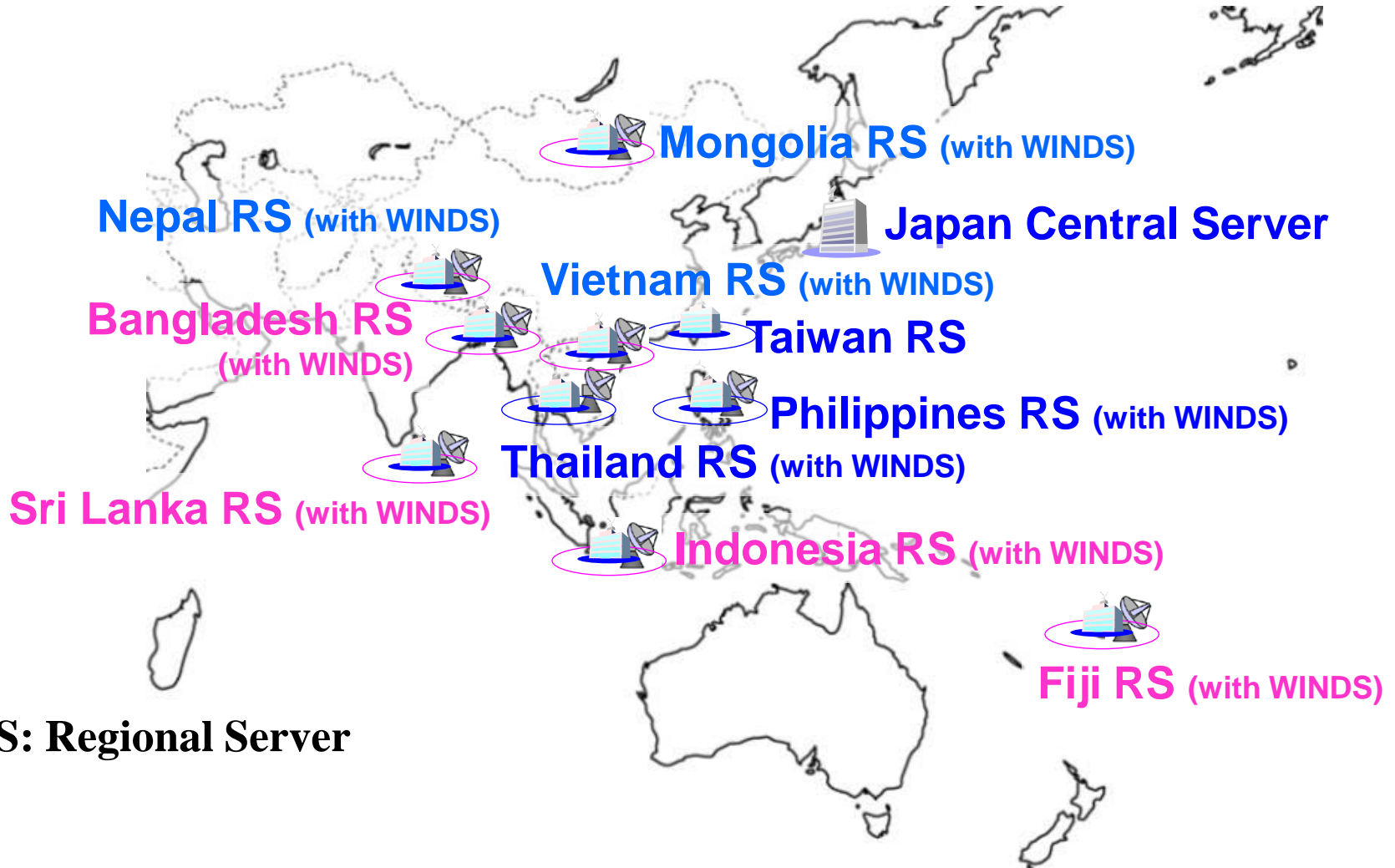
Example of Emergency Observation
Flood in Pakistan in July-August 2010

Daily Precipitation in Pakistan by GFAS
21, 22, 28, 29 July 2010

Flood in Pakistan
Resourcesat-1 Imagery on 31 July 2010

ALOS Imagery on 5 August 2010

FORMOSAT-2 Imagery on 4, 6 August 2010

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ALOS/PALSAR
ScanSAR image mosaics over the Pakistan
and Detection of Flooded areas

RSP189 Old:2010/7/12
RSP186 Old:2010/7/7
RSP192:2010/7/17 2010/8/27 New:2010/8/22
RSP194:2010/8/20

RSP178 Old:2010/7/9
New:2010/8/24

Kabul

Isramabad

AFGHANISTAN

Lahore

PAKISTAN

INDIA

Karachi

Arabian Sea

Mumbai

: Flooded area (decrease of radar backscattering due to the extended water surface)

0km   500km

JAXA

(c) JAXA,METI Analyzed by JAXA

AFGHANISTAN

KABUL

ISLAMABAD

PAKISTAN

NEW DELHI

INDIA

0   500   1000 [km]

Flood Inundation Map by ICIMOD

Flood Inundation map [SUPARCO GRID-1] for the KYYBER-PAKHTOONKHWA and PUNJAB Province, Pakistan

DERAISMAILKHANDIVISION

DERAISMAILKHANDISTRICT

KHYBER-PAKHTOONKHWA

N-55
N-999
N-50
N-999
N-50
N-50
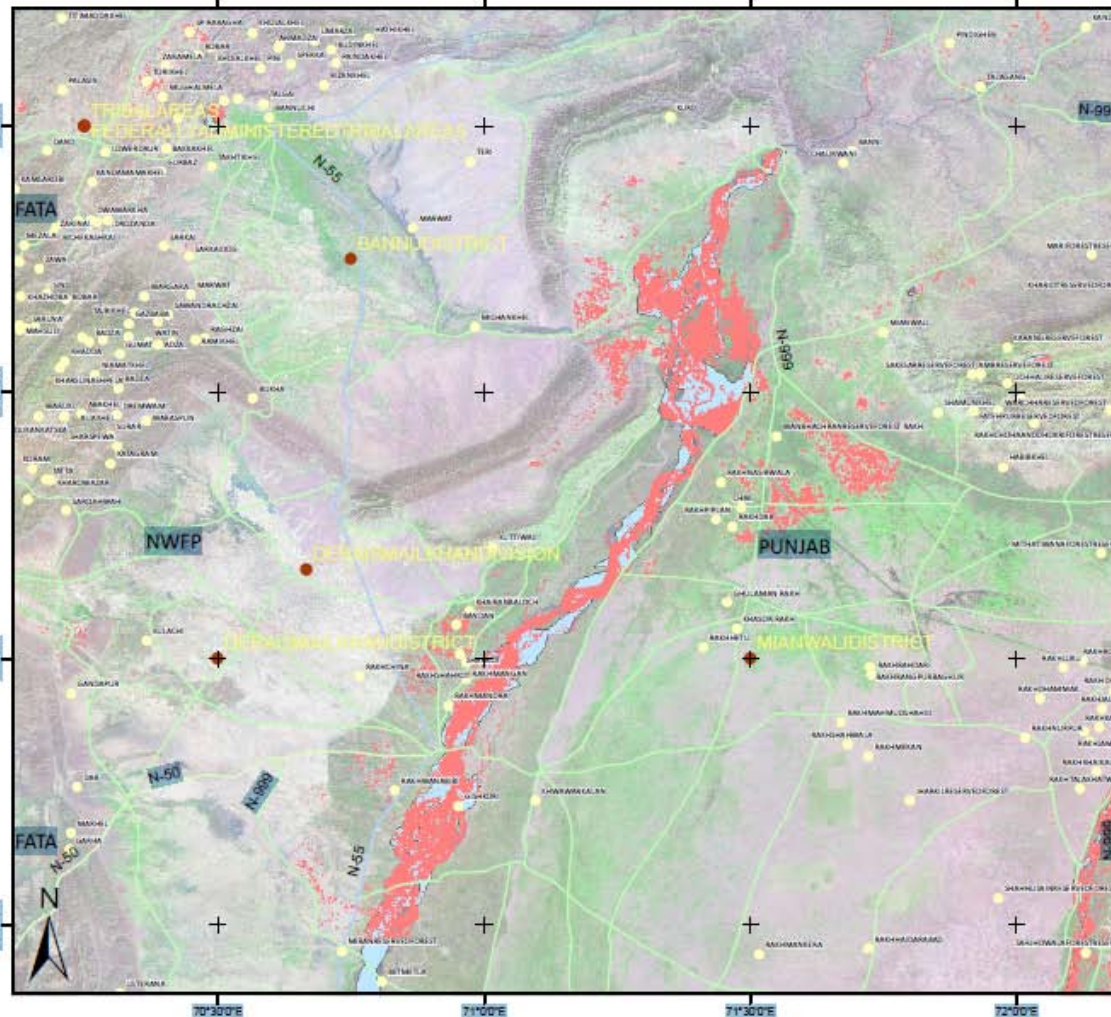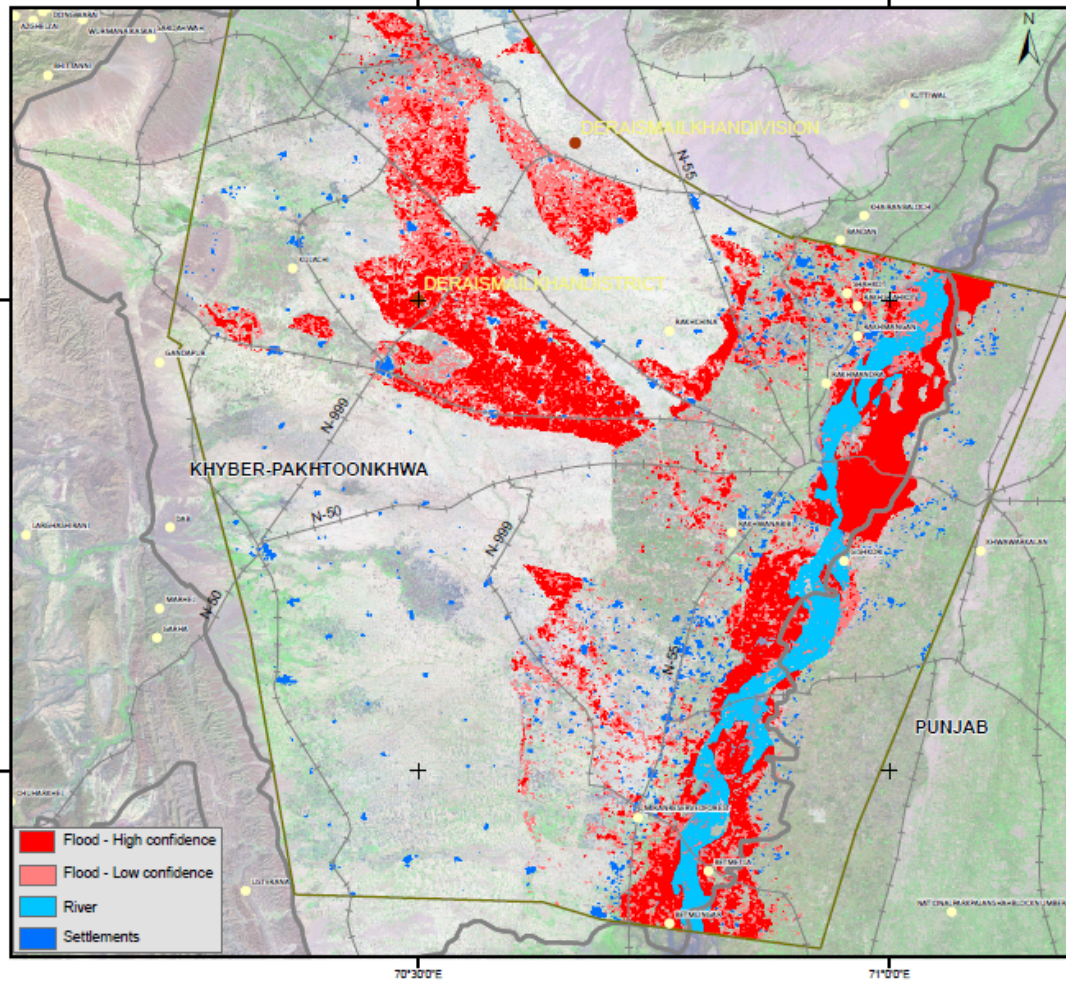
PUNJAB

Primary Source
Satellite Data used :
After Crisis
    PALSAR - JAXA ALOS 05 August 2010
    AWiFS   - IRS P6   31 July 2010
Before Crisis
    AWIFS - IRS P6   23 December 2009

Overview of Flood Inundation Map for the
Khyber-Pakhtoonkhwa and Punjab province.
This map presents the flood inundated areas
for the grid suggested by SUPARCO, Pakistan
following recent heavy monsoon rains.
This analysis is based on pre and post-
disaster satellite imagery collected by
PALSAR – JAXA ALOS and IRSP6-AWiFS data.

Floods were classified into high confidence
and low confidence using spectral
differences and classification method. Please
note that the exact limit of the flood waters is
uncertain due to the coarse spatial resolution
of the satellite sensors used for this analysis.
This analysis has not yet been validated in
the field. Please send ground feedback
to MENRIS Division, ICIMOD.

Secondary Source

Infrastruture layer:
    Locality
    Administrative Regions
    Road Type
    Provinces

Satellite Data (background)
    Landsat ETM+ N-42-30.sid

Map Prepared

ICIMOD

Satellite Data Copyright

JAXA   Sentinel Asia

Legend:
- Flood - High confidence
- Flood - Low confidence
- River
- Settlements

70°30'0"E   71°0'0"E

3 Wildfire Monitoring

Wildfire and Firefighters in Thailand

Global Wildfire Map in 2005

Accumulated Hotspots observed by MODIS/NASA
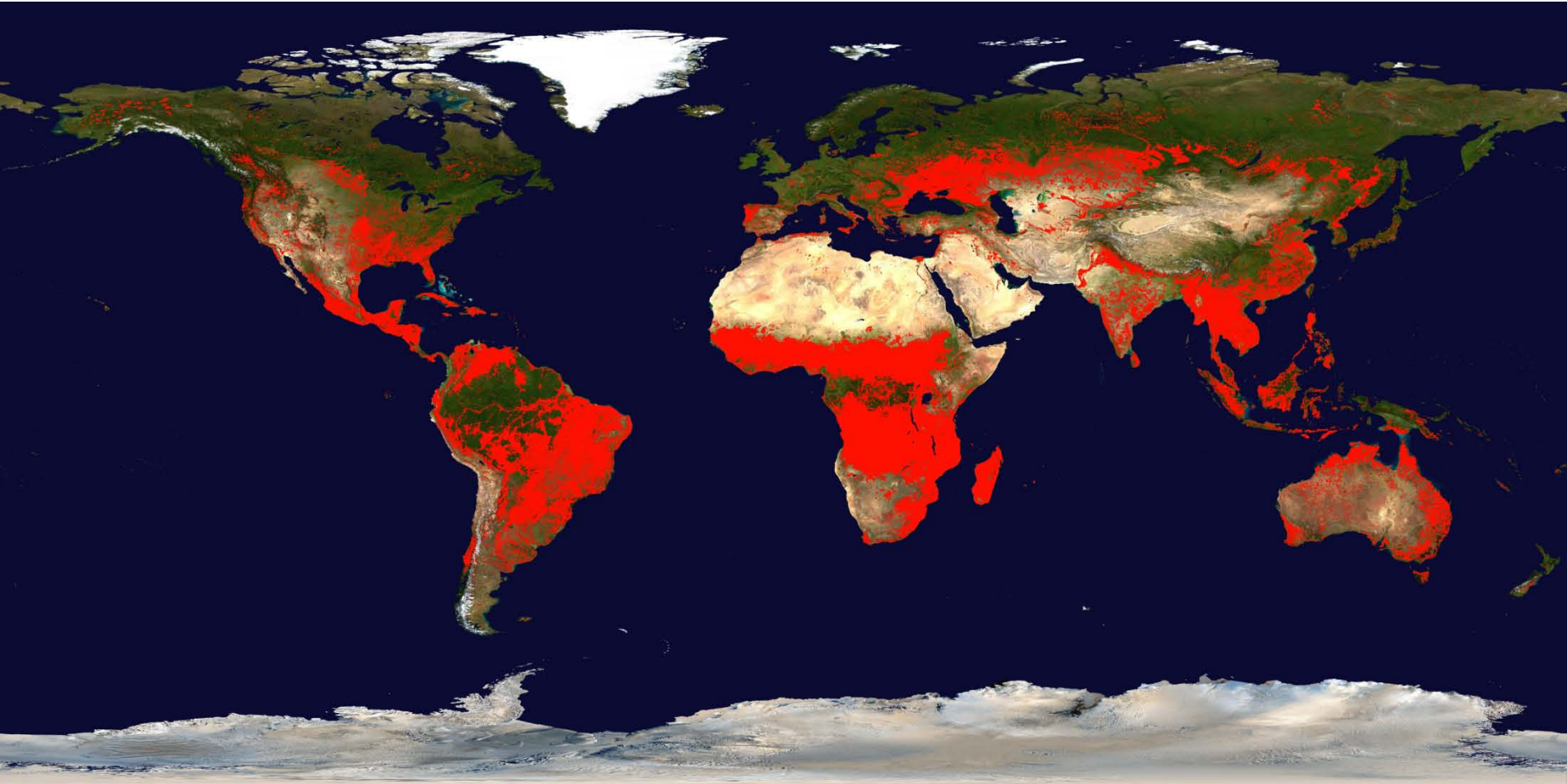
Wildfire Monitoring

Contribution to the Asia-Pacific region for Wildfire Management and Control; and contribution to mitigation of Global Warming

IPCC 2007 Assessment Report
- **CO2 emitted by world fossil fuel use: 271 hundred million ton**
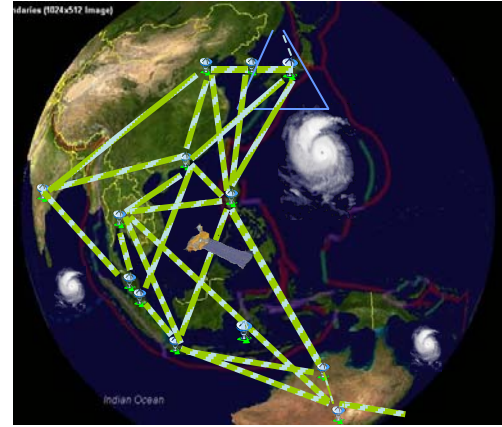- **CO2 emitted by wildfires: 60-150 hundred million ton**

- Hotspots information of the Asia-Pacific Region on Web-GIS: MODIS, MTSAT-1R (Meteorological Satellite)
- Validation and Improvement of MODIS Hotspots Detection Algorithm
- Forecasting of Fire Expansion and Risk Analysis
- Regional Cooperation for Fire Control in cooperation with local Firefighters in Asia

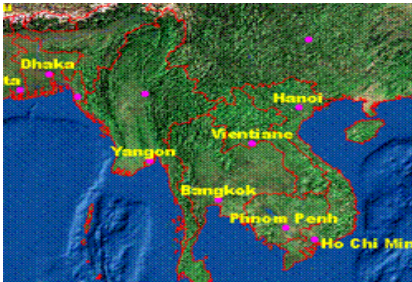M. Fukuda of Fukuyama City University is the WG chair.

Sentinel Asia: Wildfire Monitoring by MODIS
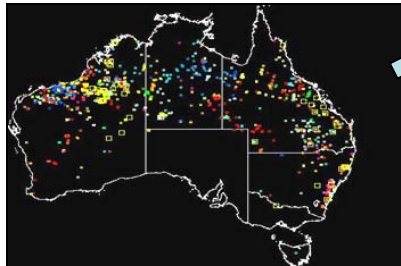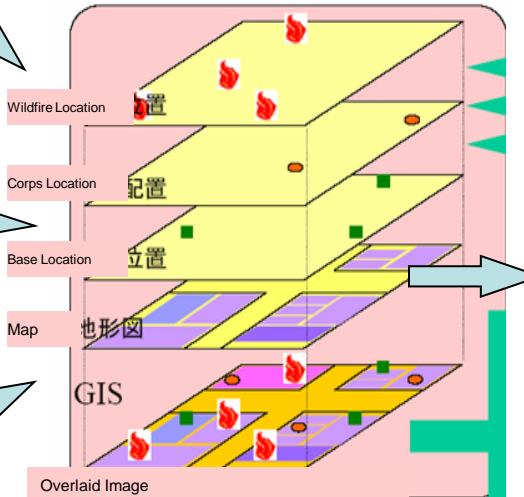

University of Tokyo (Japan)

AIT/Univ. of Tokyo(Thailand)

CRISP (Singapore)
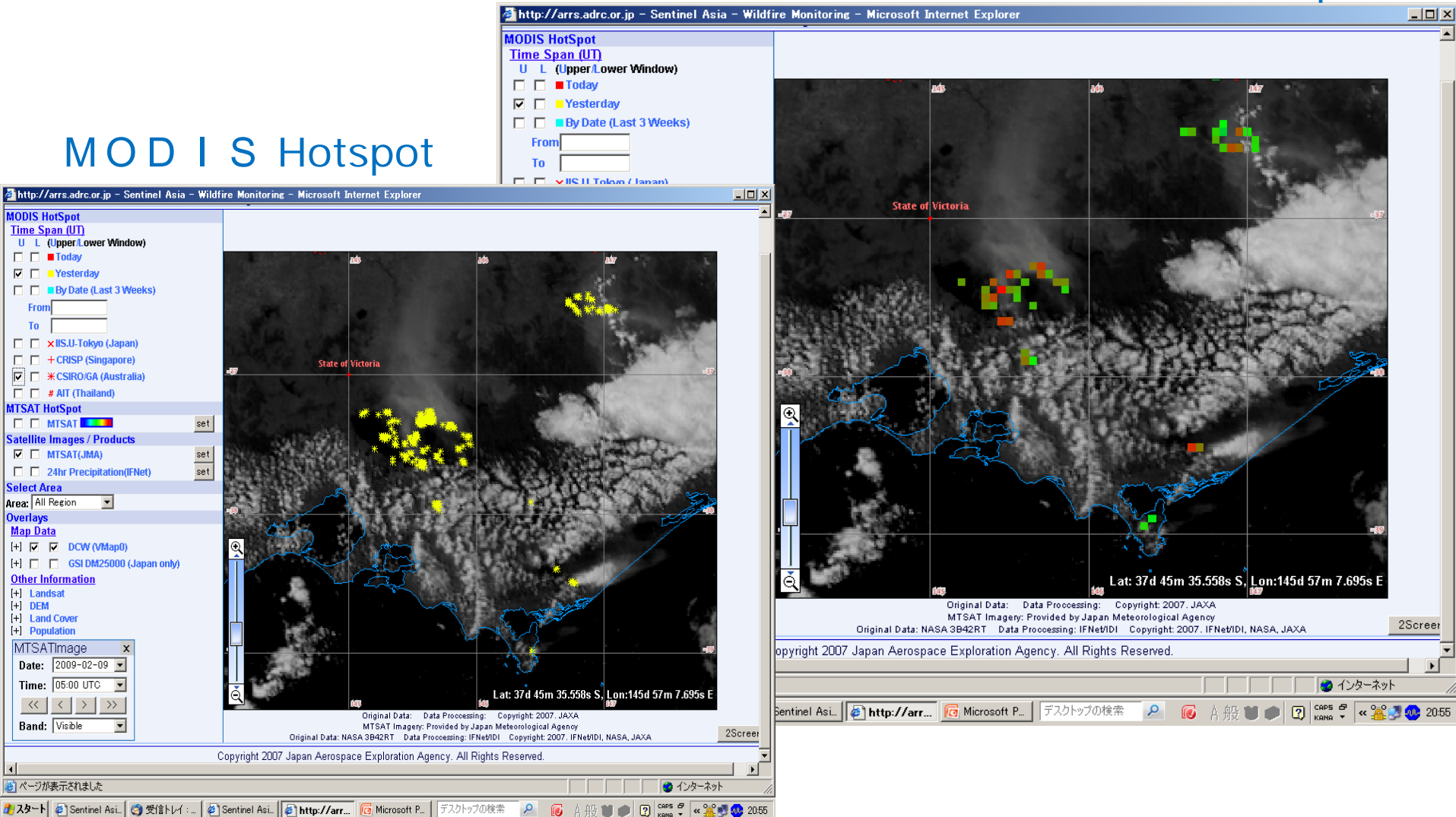

CSIRO (Australia)

Satellite observation network

Web-GIS interface
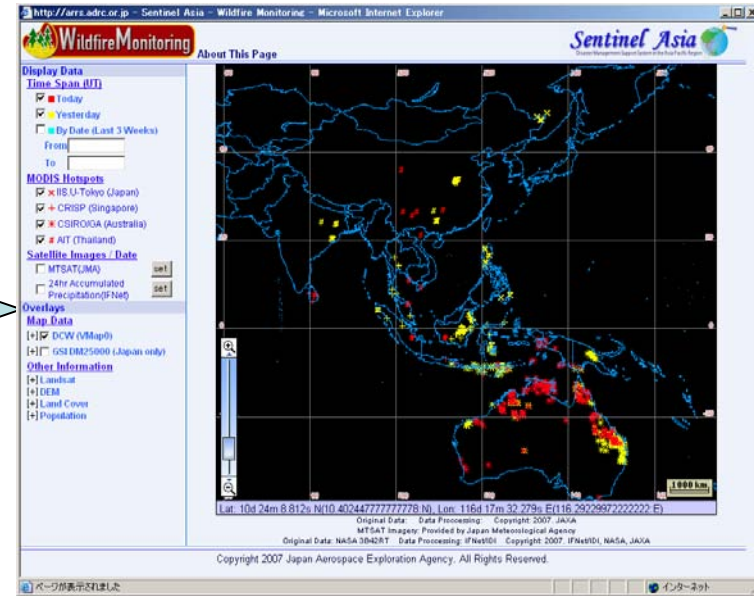
Hotspot map of Asia

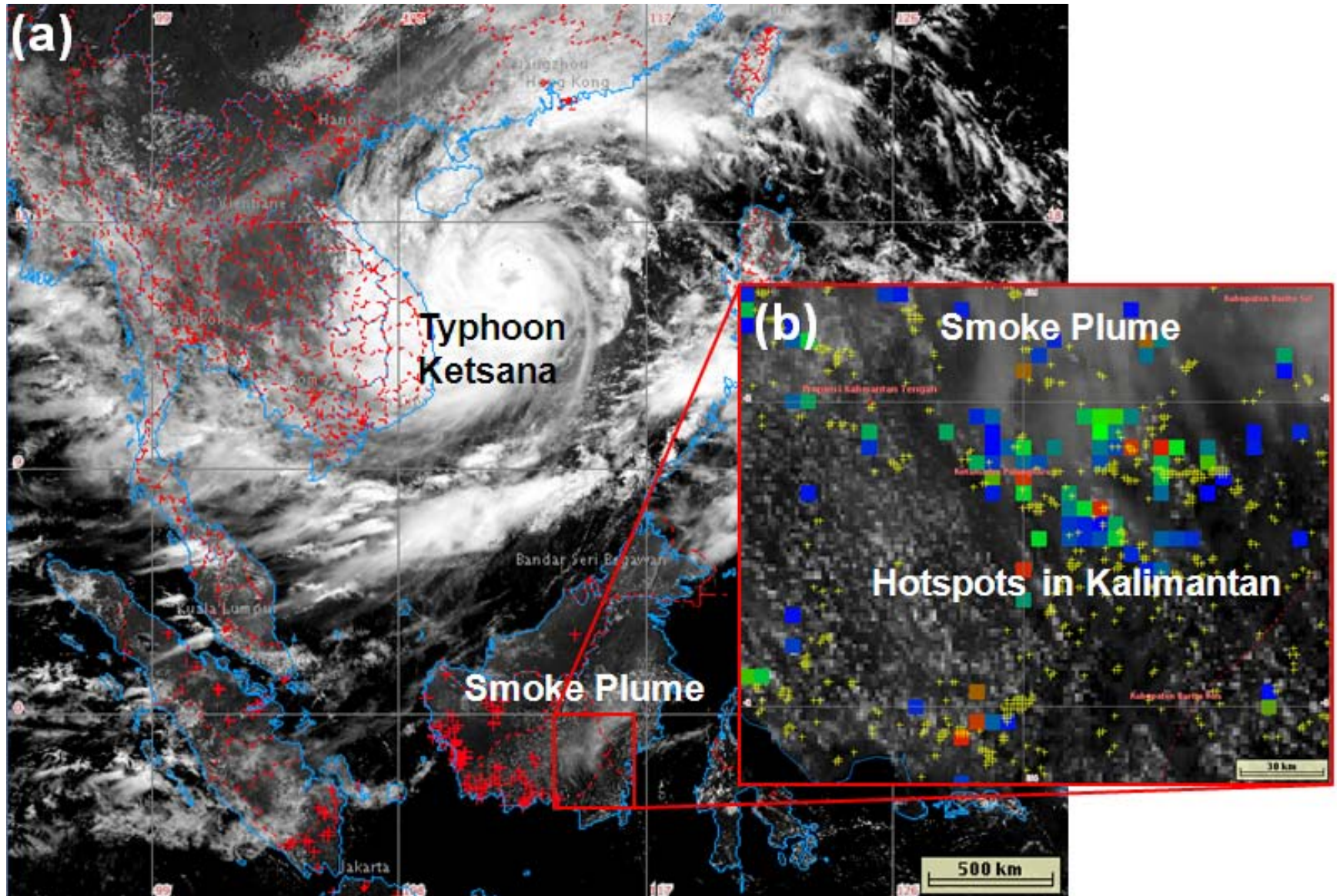# Bushfires in Victoria, Australia
in February 2009

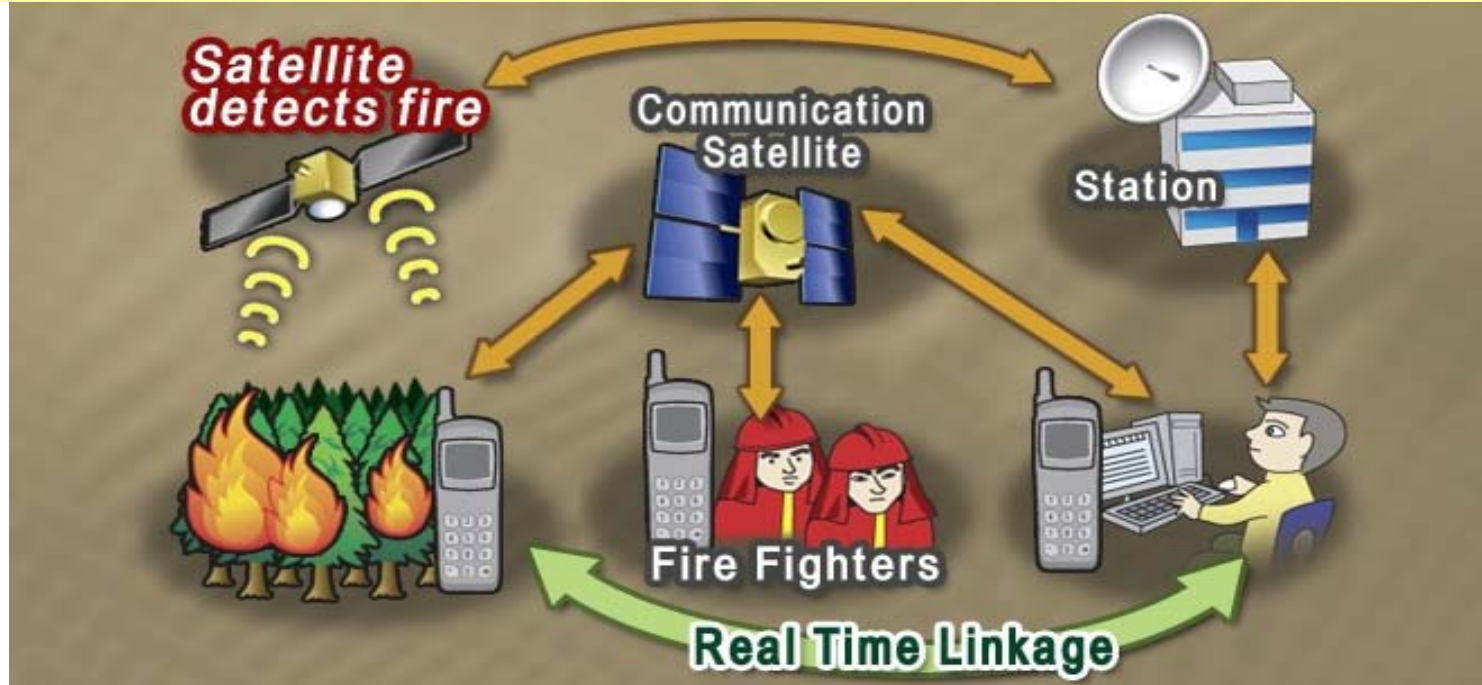# Typhoon Ketsana in Vietnam and Wildfire in Indonesia on 28 Sept. 2009

Operational Goal of Sentinel Asia Wildfire Control Initiative

Satellite detects fire

Communication Satellite

Station

Fire Fighters

Real Time Linkage

Regional Cooperation in Step2

JST/JICA Project "Wildfire and Carbon Management in Kalimantan, Indonesia"

11/08/2005

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JICA/JST Project

Project for wildfire and carbon management in a peatland in Kalimantan, Indonesia organized by Hokkaido University under the framework of the research program supported by JST and JICA

Haze caused by Peatland Fires in Kalimantan, Indonesia in September 2009

Photos are provided courtesy of A. Usup, Palangka Raya University.
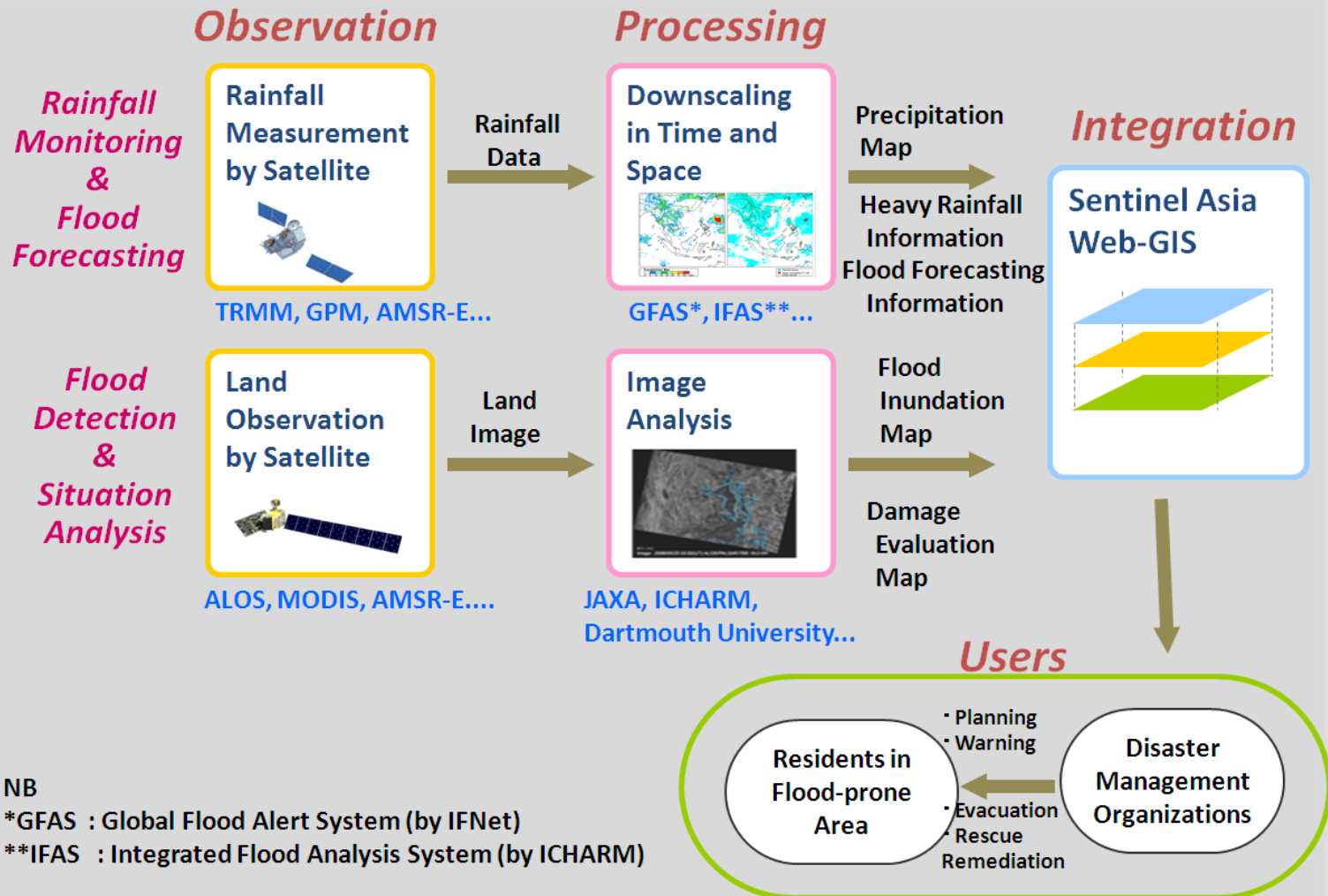
4 Flood Monitoring

Flood Monitoring

To contribute to the mitigation of flood disasters in Asia through:

- Precipitation data (GFAS) on Web-GIS
- MTSAT imagery on Web-GIS
- Observation of Inundated Area (as an emergency observation)
- Flood Analysis using IFAS developed by ICHARM
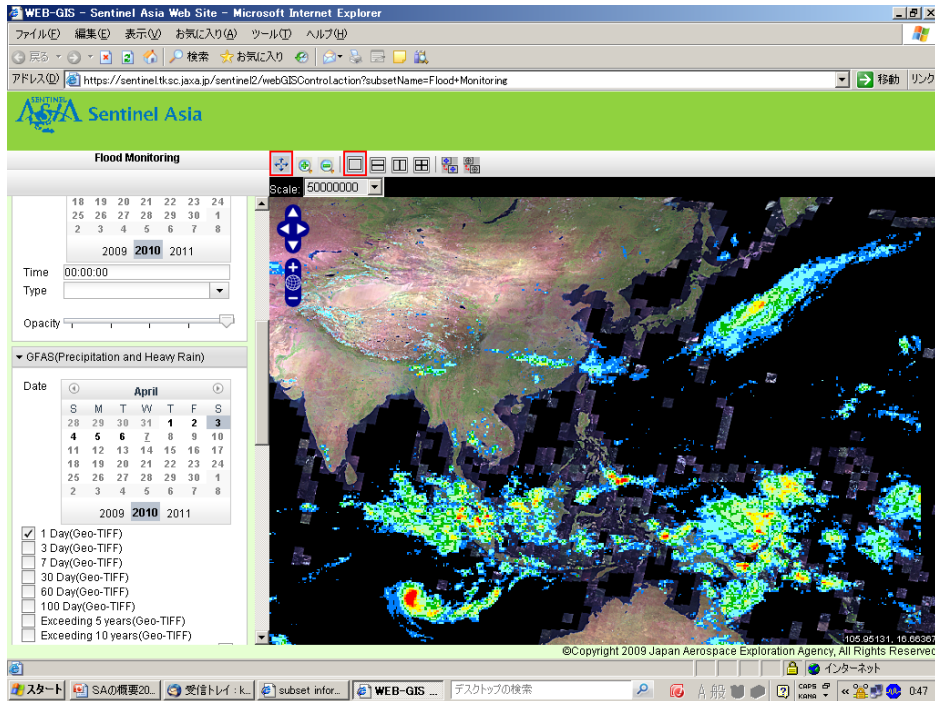
K. Fukami of ICHARM is the WG chair.
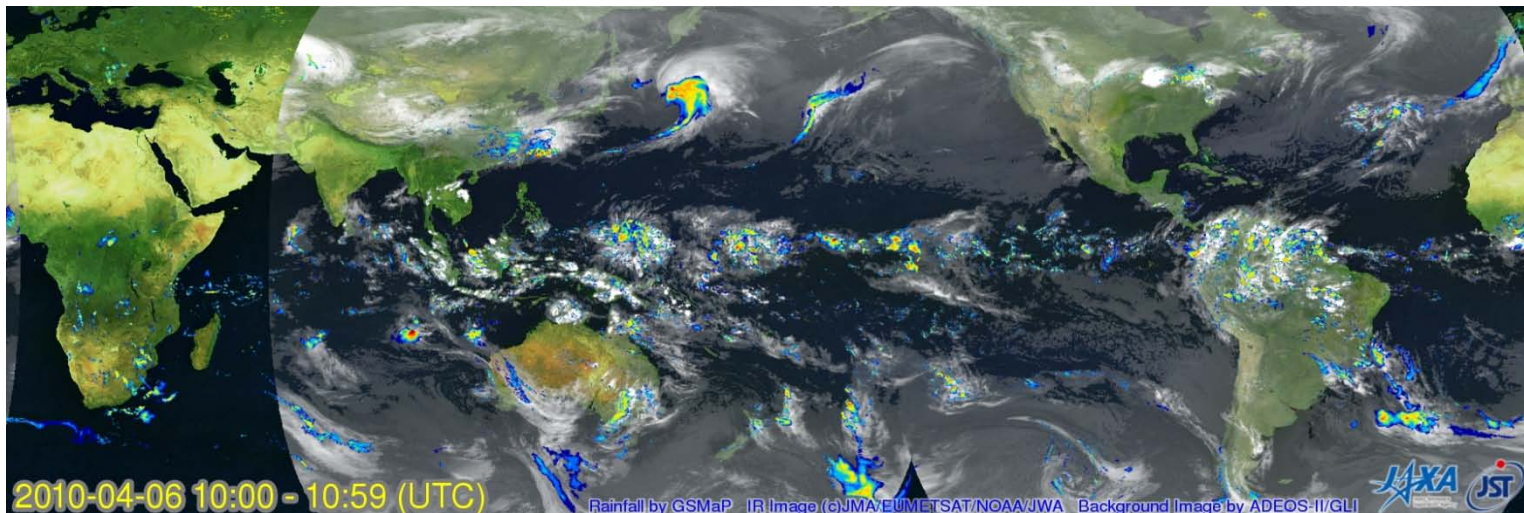
Sentinel Asia Flood Monitoring

Precipitation Data

GFAS
Accumulated daily precipitation

GSMaP
Near real-time hourly precipitation

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MTSAT(Meteorological Satellite) Imagery on GIS

Flood Forecasting using IFAS

Flood Forecasting Using Global Satellite Rainfall Information Based on

Integrated Flood Analysis System
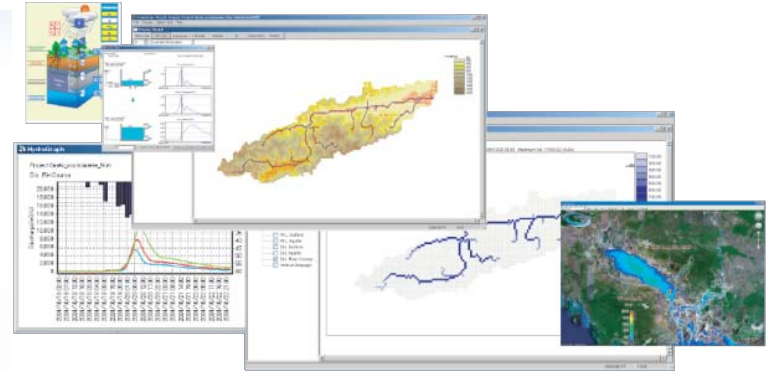
⁓ Key Features ⁓

1. **_Integration of Satellite-based rainfall_** for flood analysis
2. **_Multi-_**run-off analysis **_engines_**
3. **_Automatic_** data downloads and model operation
4. **_User friendly and Visualized Interface_**
5. **_Easy, but high-level analysis tools_**
6. **_Free_** distribution

Worldwide flood forecasting and analysis, basin by basin

5 Glacial Lake Outburst Flood (GLOF) Monitoring

# Glacial Lake Outburst Flood Monitoring Working Group (GLOF-WG)

Co-chair:
Basanta Shrestha (ICIMOD) and Hiromichi FUKUI (Keio University)

Action Plan:

Collaboration of **ADRC Project for Bhutan** and **Keio University Project for Nepal**.

1. Satellite Image Utilization on Glacial Lake Inventory.
2. Identify Potential Outburst Glacial Lake.
3. Monitor and Establish Early Warning System in the Risk Areas.
4. Generate Hazard Risk Mapping for Glacial Outburst Flood.
5. Simulation and Modeling for the Flood Scenarios.
6. Information Sharing through Sentinel Asia Infrastructure.
7. Local Awareness and Knowledge Transfer through Capacity Building.

Monitoring of Imja Lake in Nepal
by Keio University
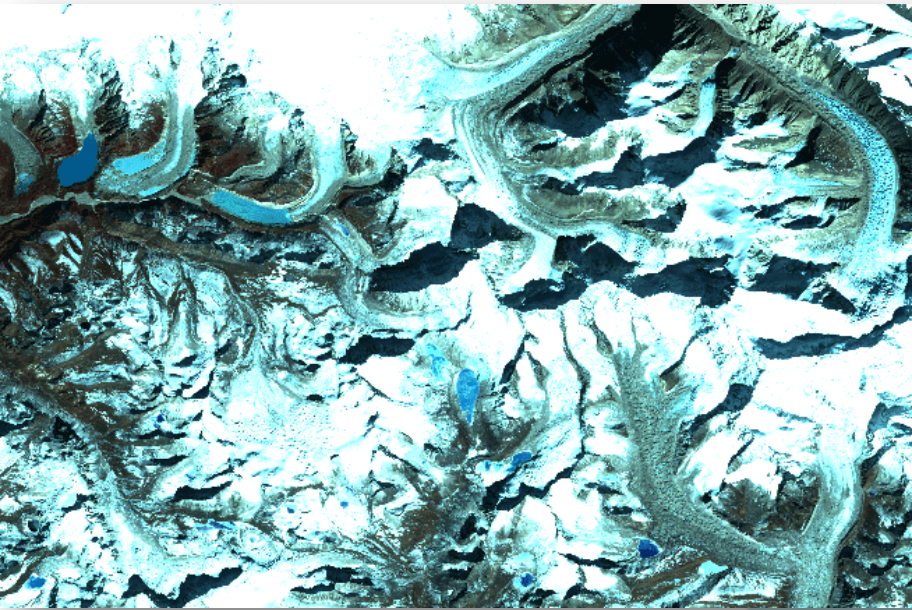
6 Capacity Building and Human Network

Capacity Building and Human Network

Human Network
the most fundamental
underpinning of
the project

The 5th Training by JAXA, hosted by MoDM in Sri Lanka, in February 2010

The 6th Training by JAXA, hosted by GISTDA in Thailand, in July 2010

7 Toward Further Utilization

Toward Further Utilization

The point will be:

- Regional cooperation including end-users
- Cooperation for disaster risk reduction (DRR) in preparedness phase
- Local Awareness and Knowledge Transfer through Capacity Building
- Human resources development and human network
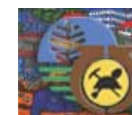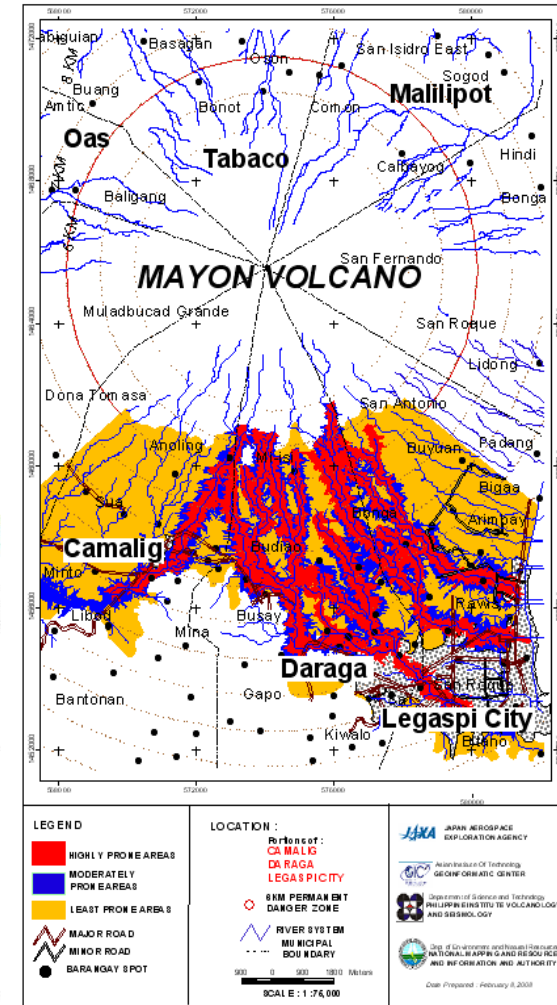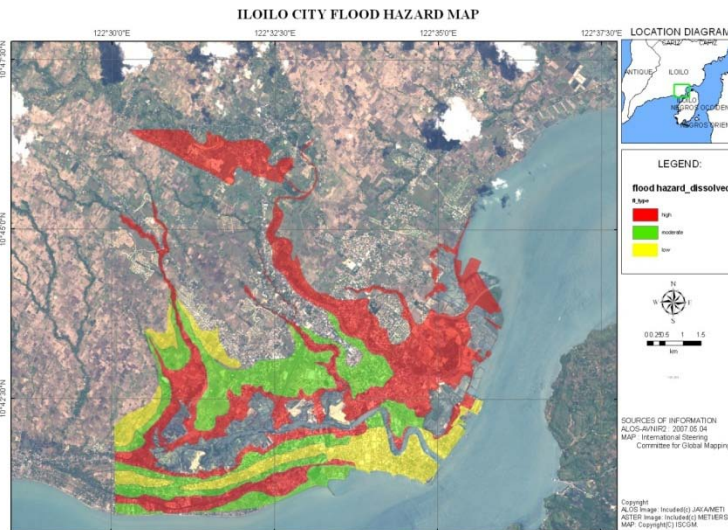
Sentinel Asia Success Story (SASS)

Cooperation with Philippines through Creating Hazard Map using ALOS Data

LAHAR - Mt. Mayon (PHIVOLCS)

Flood - Antique Province (MGB)

Flood - Iloilo City (PAGASA)

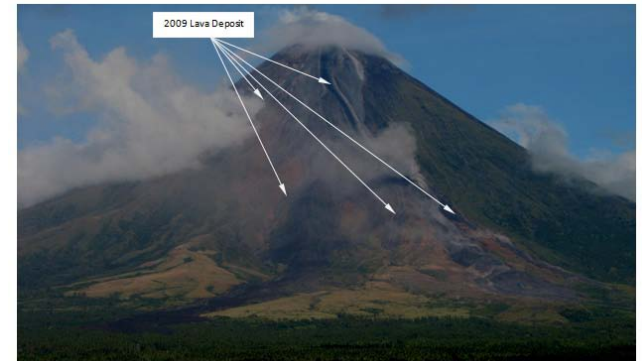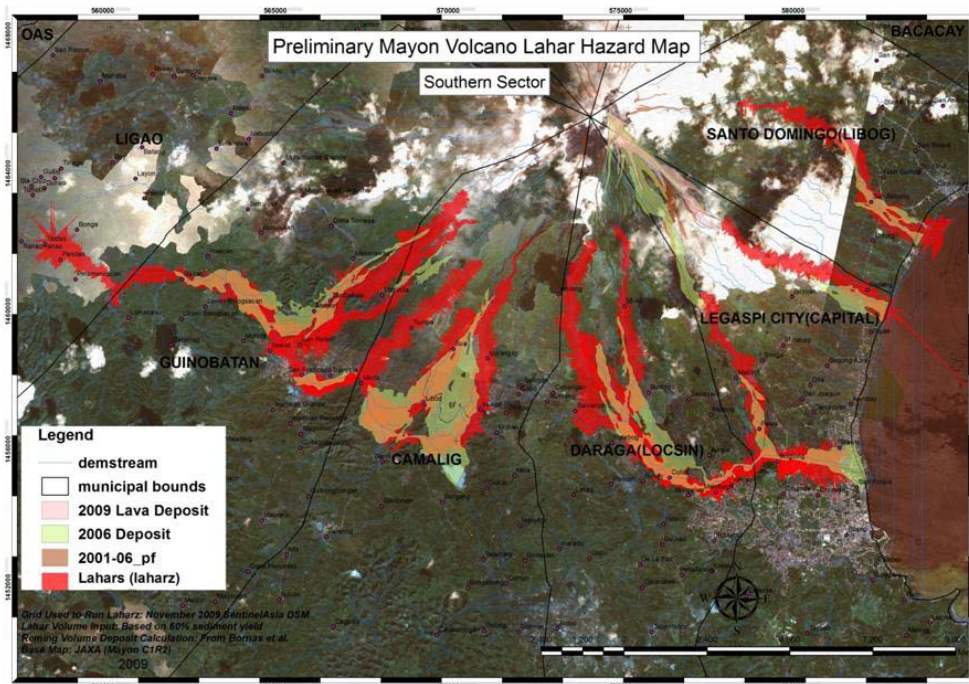PCASTRD DOST   OCD NDCC   PHIVOLCS   NAMRIA   MGB   PAGASA

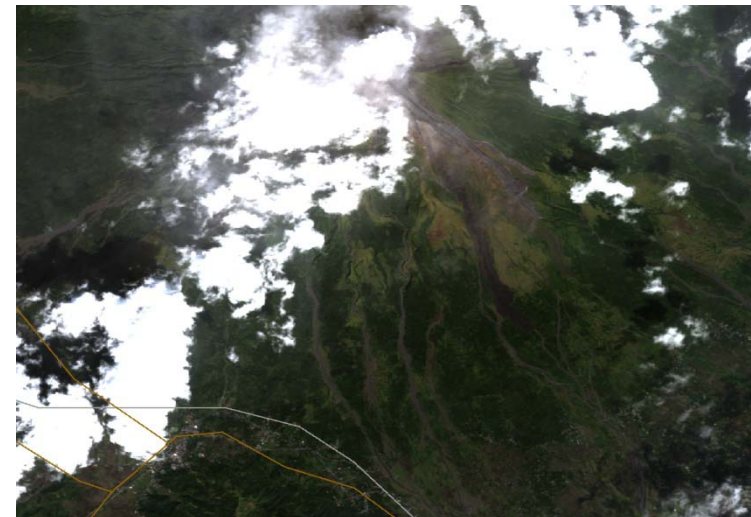# Eruption of Mayon Volcano in Philippine on 14 December 2009

- Emergency observation was made by ALOS/ AVNIR-2 and PRISM, which was used by PHIVOLCS to update Lahar Hazard Map.
- **The hazard map was used for an evacuation alarm to residents.**

Mayon Volcano
on 30 December 2009

Lahar Hazard Map updated by PHIVOLCS using ALOS imagery

Imagery by ALOS/ AVNIR-2 on 25 Dec. 2009

Sentinel Asia website
http://sentinel.tksc.jaxa.jp/ (Japan)
http://sentith1.eoc.gistda.or.th/ (Thailand)
http://sentiph1.asti.dost.gov.ph/ (Philippines)
http://sentiasia.nspo.org.tw/ (Taiwan)

Japan Aerospace Exploration Agency
Satellite Applications and Promotion Center
Sentinel-Asia Project Office
E-mail : sentinel.asia@jaxa.jp