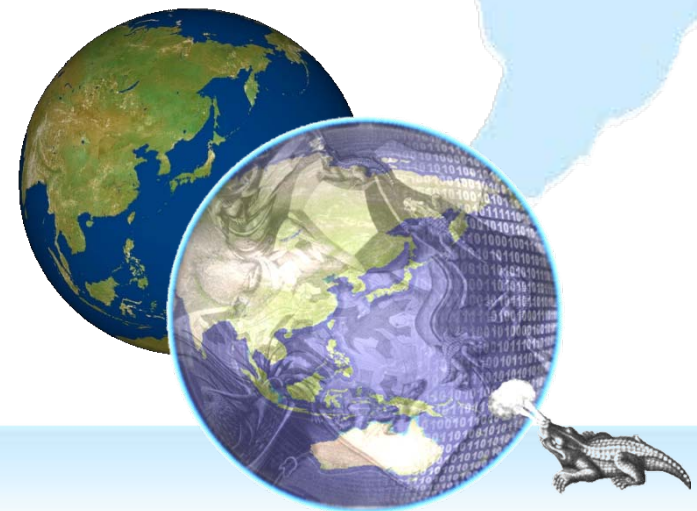


Activity Plan and Status of GLOFs-WG In Sentinel Asia

Dr. Hiromichi FUKUI

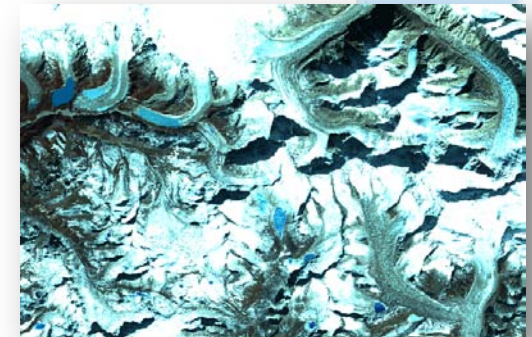
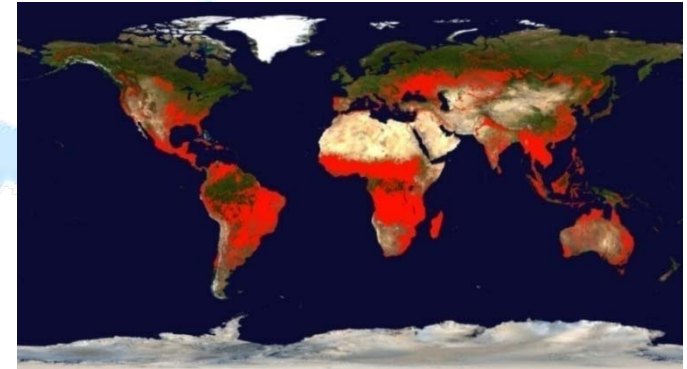
International Digital Earth
Applied Science Research Center (IDEAS)
Chubu Institute for Advanced Study
Chubu University
fukui@isc.chubu.ac.jp



Working Group Activities for Disaster Risk Reduction

- **Wildfire WG**
 - To contribute to the Asia-Pacific region with wildfire management
 - To contribution to REDD-plus
 - JST-JICA(*) project for wildfire and carbon management in a peatland in Kalimantan, Indonesia
- **Flood WG**
 - To contribute to the mitigation of flood disasters in Asia
 - Flood analysis using IFAS
- **GLOF WG** (Glacial Lake Outburst Flood)
 - Monitor and establish early warning system in the risk areas
 - Local awareness and knowledge transfer through capacity building
- **Tsunami WG**
 - Tsunami early warning system

(*)JST: Japan Science and Technology Agency
JICA: Japan International Cooperation Agency



Initiator Organization and Co-chair of GLOF WG

- Japan Aerospace Exploration Agency (JAXA)
- Asian Disaster Reduction Center (ADRC)
- Chubu University, Japan
- The International Centre for Integrated Mountain Development (ICIMOD)
- Hokkaido University, Japan
- International Centre for Water Hazard and Risk Management (ICHARM)
- Ministry of Home and Cultural Affairs, Bhutan
- Department of Survey and Land Records, Bhutan
- Department of Water Induced Disaster Prevention, Nepal
- Survey Department, Nepal
- Institute of Geography and Natural Resources, Chinese Academy of Sciences, China
- Co-chair
Basanta Shrestha (ICIMOD) and Hiromichi FUKUI(Chubu University)

Glacial Lake Outburst Floods

Working Group(GLOFs-WG) in Sentinel Asia

Background

Glaciers as a freshwater reservoir are one of the most sensitive indicators of climate change. In the face of global warming, **most Himalayan glaciers have been retreating**, resulting in an increase in the number and size of glacial lake and a concomitant increase in the threat of glacial lake outburst floods(GLOFs).

Regional Cooperation is needed to formulate a coordinated strategy to deal effectively both with **risk of GLOF** and with **water management** issues.

AOGCM Projections of Surface Temperatures

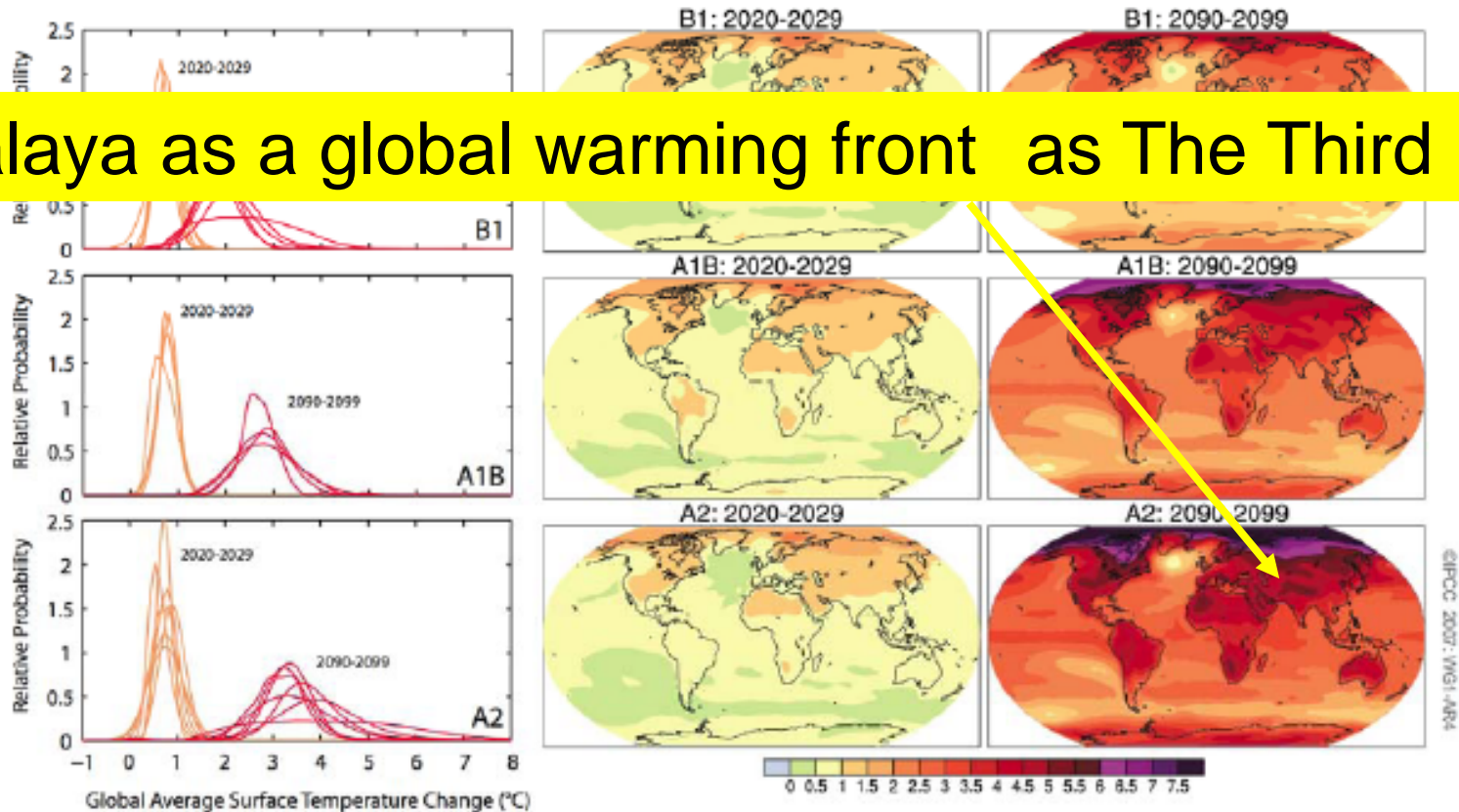


FIGURE SPM-6. Projected surface temperature changes for the early and late 21st century relative to the period 1980–1999. The central and right panels show the Atmosphere-Ocean General Circulation multi-Model average projections for the B1 (top), A1B (middle) and A2 (bottom) SRES scenarios averaged over decades 2020–2029 (center) and 2090–2099 (right). The left panel shows corresponding uncertainties as the relative probabilities of estimated global average warming from several different AOGCM and EMICs studies for the same periods. Some studies present results only for a subset of the SRES scenarios, or for various model versions. Therefore the difference in the number of curves, shown in the left-hand panels, is due only to differences in the availability of results. {Figures 10.8 and 10.28}

Impact of climate change is well observed in the Hindu Kushi-Himalayan Region

The warming in the Himalayas in last three decades has been between 0.15°C - 0.6°C per decade (ICIMOD)

Several studies show that most of glaciers in Himalaya are shrinking at accelerated rates in recent decades

- Melting Glaciers,
- Growing Glacial lakes, and
- Glacial lakes Outburst Floods (GLOFs)



The UN's climate science panel has admitted it made a mistake in asserting that Himalayan glaciers could disappear by 2035.

Geneva, 20 January 2010

IPCC statement on the melting of Himalayan glaciers¹

The Synthesis Report, the concluding document of the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (page 49) stated: "Climate change is expected to exacerbate current stresses on water resources from population growth and economic and land-use change, including urbanisation. On a regional scale, mountain snow pack, glaciers and small ice caps play a crucial role in freshwater availability. Widespread mass losses from glaciers and reductions in snow cover over recent decades are projected to accelerate throughout the 21st century, reducing water availability, hydropower potential, and changing seasonality of flows in regions supplied by meltwater from major mountain ranges (e.g. Hindu-Kush, Himalaya, Andes), where more than one-sixth of the world population currently lives."

This conclusion is robust, appropriate, and entirely consistent with the underlying science and the broader IPCC assessment.

It has, however, recently come to our attention that a paragraph in the 938-page Working Group II contribution to the underlying assessment² refers to poorly substantiated estimates of rate of recession and date for the disappearance of Himalayan glaciers. In drafting the paragraph in question, the clear and well-established standards of evidence, required by the IPCC procedures, were not applied properly.

The Chair, Vice-Chairs, and Co-chairs of the IPCC regret the poor application of well-established IPCC procedures in this instance. This episode demonstrates that the quality of the assessment depends on absolute adherence to the IPCC standards, including thorough review of "the quality and validity of each source before incorporating results from the source into an IPCC Report"³. We reaffirm our strong commitment to ensuring this level of performance.

“we can state that the majority of glaciers in the region are **in a general condition of retreat**, although with some regional differences”

“although the lack of information and knowledge about the glacier melt processes in the Himalayas has been used to politicise the larger issues, the positive aspect of the debate has been the immense awareness created at various levels including politicians, decision makers, the media and the public at large”

Melting Himalayas – ICIMOD’s comments on a turbulent debate

The debate on the rate of melting of the Himalayan glaciers has gained momentum in recent days. The debate has centred on the statement made in the IPCC AR4 Working Group II report that the Himalayan glaciers are retreating faster than in any other part of the world and at the present rate of retreat could disappear by the third decade of this millennium. This has culminated with the statement from the IPCC on 20 January 2010 retracting this one statement in AR4, but reiterating that the broader conclusion of the report is unaffected.

Many of the inferences regarding glacial melting are based on terminus fluctuation or changes in glacial area, neither of which provides precise information on ice mass or volume change. Measurements of glacial mass balance would provide direct and immediate evidence of glacier volume increase or decrease with annual resolution. But there are still no systematic measurements of glacial mass balance in the region although there are promising signs that this is changing. China is the only country in the region which has been conducting long-term mass balance studies of some glaciers and it has expressed the intention of extending these to more Himalayan glaciers in the near future. India has recently started to study several glaciers for regular mass balance measurements. Recognising the importance of mass balance measurements, ICIMOD has been promoting mass balance measurements of benchmark glaciers in its member countries and has co-organised trainings to build capacity for this in the region.

ICIMOD has been drawing attention to the severe problems resulting from the lack of good scientific data and information for the Hindu Kush-Himalayan region, especially but not only on glaciers. This severely limits the ability to understand present changes or predict future impacts, a prerequisite for good decision-making thus the Centre has been promoting development of baseline information related to environmental processes and their changes. In early 2002, ICIMOD initiated a regional inventory of glaciers and glacial lakes, based on desk research and analysis of maps, aerial photographs, and satellite images. Since then, partner institutions have continued this work and developed inventories at national scales. ICIMOD is now focusing on assimilating existing information and national data and developing a regional database so that a regional monitoring system on the status of cryospheric elements like snow and glaciers can be put in place. Standardisation of methodologies has been given due emphasis to facilitate integration of the database. At present, ICIMOD is conducting research on critical glacial lakes and is promoting the organisation of mass balance measurements in the region. Based on the analyses we have been doing, we can state that the majority of glaciers in the region are in a general condition of retreat, although with some regional differences; that small glaciers below 5000 m above sea level will probably disappear by the end of the century, whereas larger glaciers well above this level will still exist but be smaller; and that deglaciation could have serious impacts on the hydrological regime of the downstream river basins. Further, it is important to compare and summarise observations from a number of glaciers in different areas, of different size, and at different altitudes to draw clear scientifically justified conclusions about the changes that are occurring.

Although the lack of information and knowledge about the glacier melt processes in the Himalayas has been used to politicise the larger issues, the positive aspect of the debate has been the immense awareness created at various levels including politicians, decision makers, the media, and the public at large, which has led to some positive outcomes in recent months. In this context, the Indian Government has taken a decision to establish a specialised glacier research centre. Similarly, the concept of the Third Pole Environment initiated by the Chinese Academy of Sciences will have a positive impact on minimising the gaps in our basic understanding. ICIMOD is determined to contribute to developing better understanding of basic environmental processes, in particular climate change, glacial melting, and livelihoods impacts downstream, and highly commends these recent efforts made by our member countries.

21 January 2010

4 October 2013 Last updated at 10:23 GMT



Himalayas still uphill for climate report

By Navin Singh Khadka

Environment reporter, BBC News



NASA/SPL

Space imagery tells you only so much. This data must be supported by ground measurements

Although the latest global update on climate change says the vast majority of glaciers worldwide have continued to shrink, scientists have admitted that the Himalayas remain an area where they still have very limited information.

Related Stories

UN '95% sure' humans

AR5

"Combinations of satellite and airborne remote sensing together with field data indicate with high confidence that the ice loss has occurred in several sectors, and that large rates of mass loss have spread to wider regions than reported in AR4.

But there is nothing like this on the Himalayas - the largest body of ice outside the northern and southern polar regions - and scientists say the main reason is **the lack of studies on the ground.**"

Flash floods in Uttarakhand were inevitable, given **the record rainfall**. But their strength was **multiplied by glacial lake outbursts**. And the effects were worsened many times by ill-planned development



WIHG (Wadia Institute of Himalayan Geology) has found that one of the reasons behind the recent catastrophic **floods in Uttarakhand** State of northern India was a breach of a glacial lake.



"The heavy precipitation led to the melting of the soft snow and even old ice in the Chorabari and companion glaciers that fed to the Chorabari Lake, which got breached due to excessive water intake from the glaciers," Prof Gupta explained.



"The mixing of glacial moraine, or debris, with glacial melt water mainly impacted the town of Shri Kedarnath and downstream towns...

Glacial Lake Outburst Floods (GLOFs)

- Glacial lakes formed by rapid retreat of glaciers
- Water volume increase in these lakes from the glacier melt
- Lakes retained by unconsolidated moraine dams and ice core
- Moraine failure due to piping and overtopping
- Triggered by many factors
- Damaging impact downstream
- Common in Nepal, Tibet/China, Bhutan and other parts of HKH



**Dig Tsho Glacial lake Nepal, in April 2009
(after 4 August 1985 Dig Tsho GLOF)**

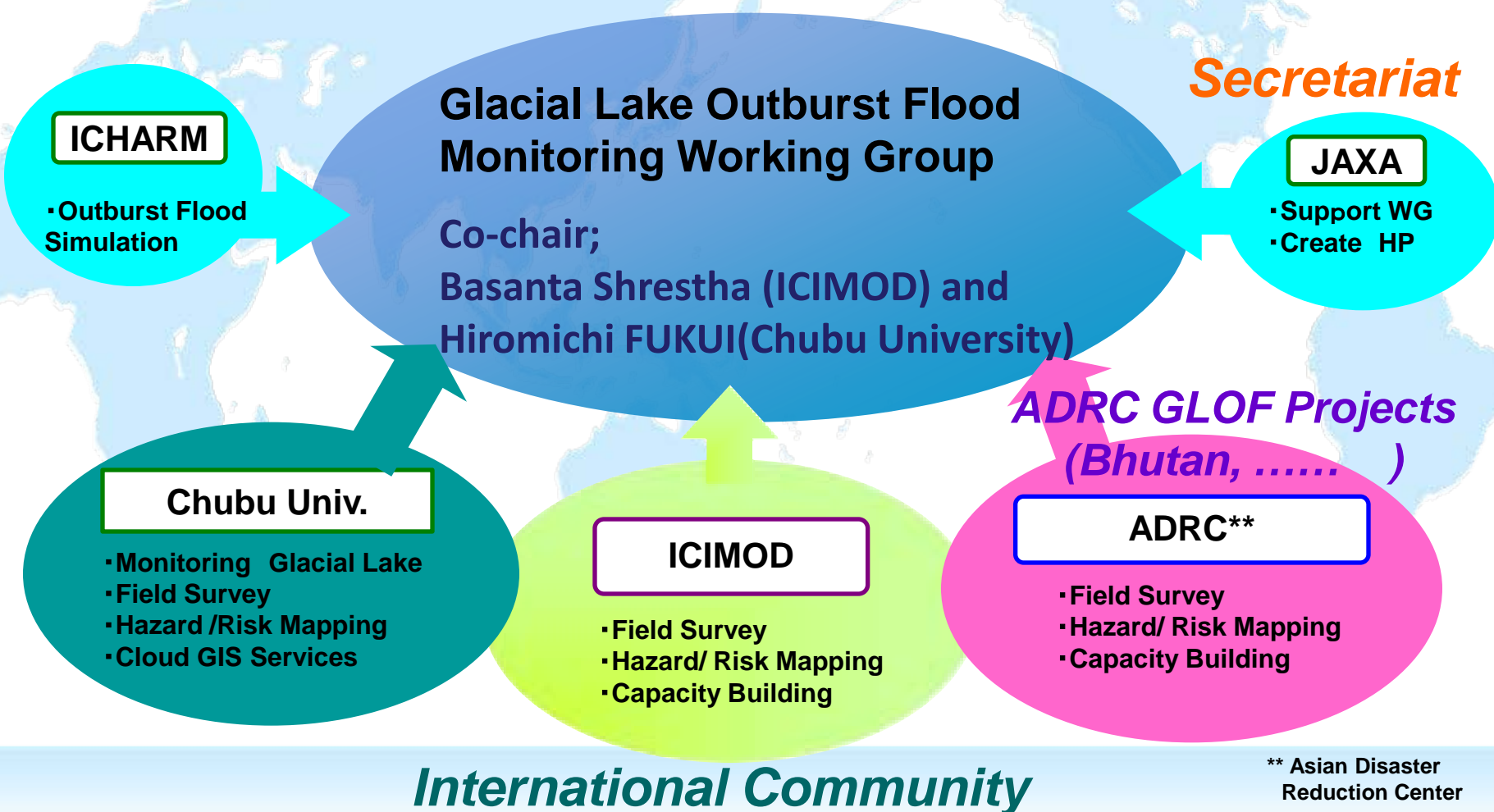
Glacial Lake Outburst Floods Working Group(GLOFs-WG) in Sentinel Asia

Objective

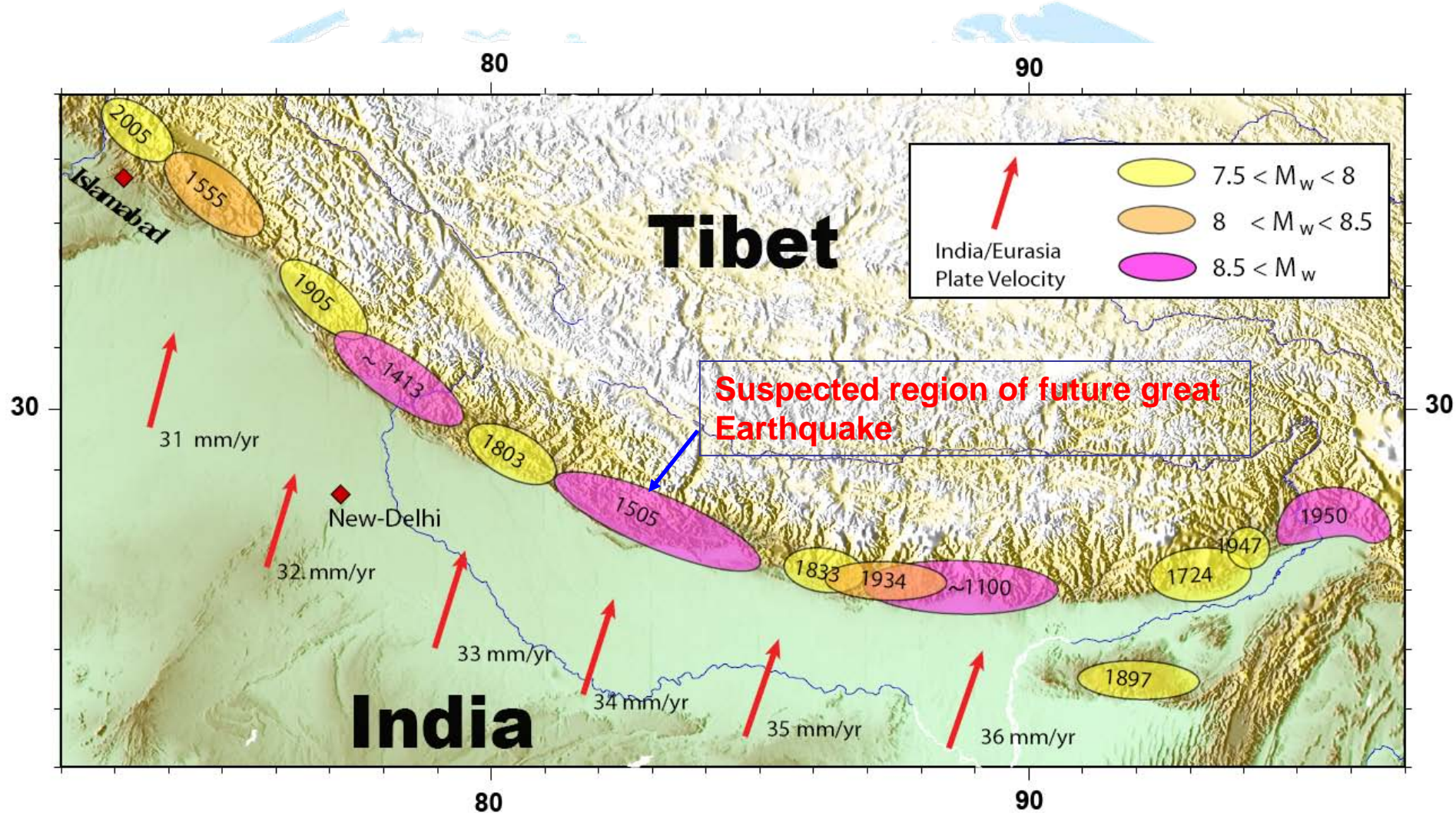
- Contribution to Asia-Pacific Region for Glacial Lake Outburst Floods Prevention and Management.
- Local Awareness of the **Potential Outburst of Glacial Lake** to the Communities.
- Monitoring and Establishment of Early Warning in the Risk Areas.
- Information Distribution and Sharing through the Sentinel Asia Infrastructure.
- Knowledge Transfer through the Capacity Building.



Framework of GLOF WG



Himalaya is a Seismic Active Zone

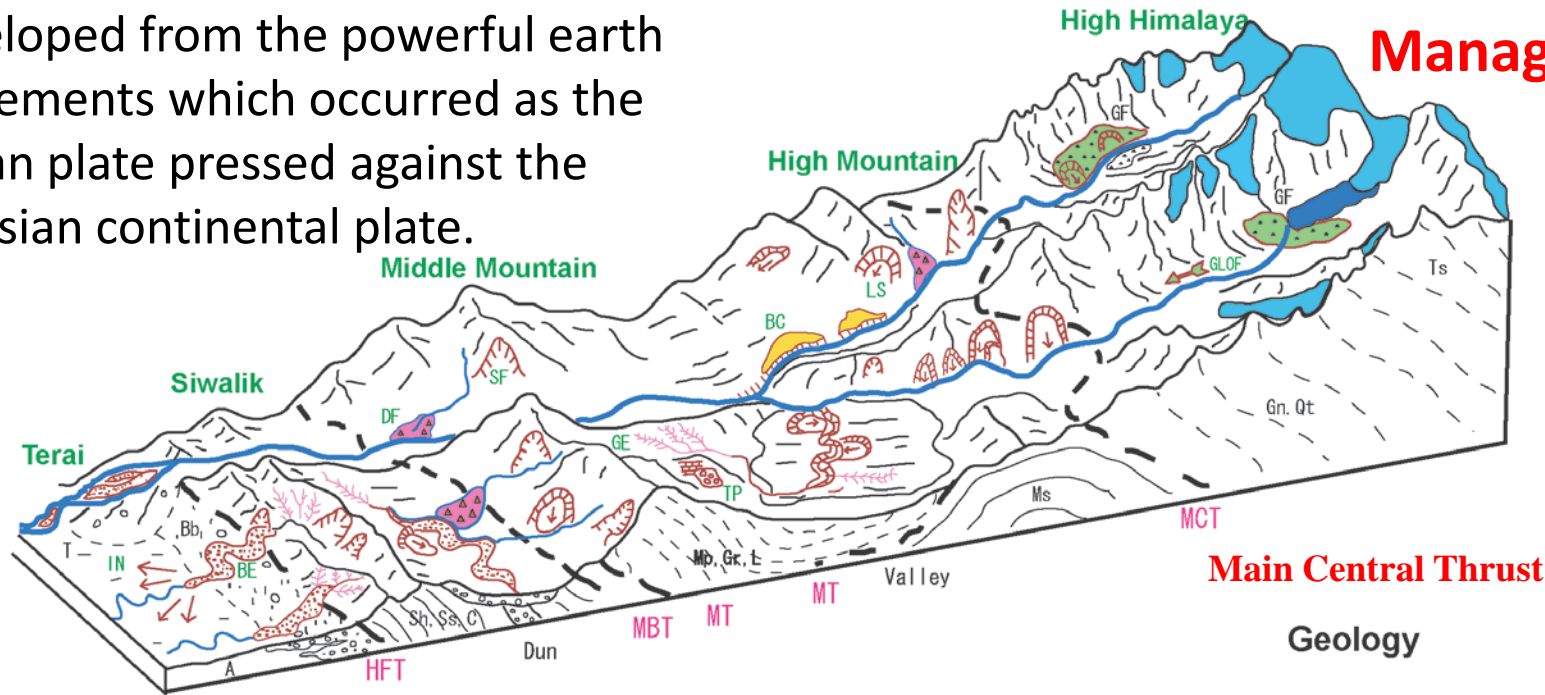


Estimated Rupture Area of major Himalayan earthquakes ($M > 7.5$)

Bilham (2004), Ambraseys and Bilham (2000), Kumar, et al. (2006) Lavé, et al. (2005)

The **Himalayan mountain system** developed from the powerful earth movements which occurred as the Indian plate pressed against the Eurasian continental plate.

River Basin Management



Hazards

	BC	Block collapse
	BE	Bank erosion
	DF	Debris flow
	GE	Gully erosion
	GLOF	Glacial lake outburst flood
	LS	Landslide(Deep-seated)
	SF	Slope failure
	TP	Rock slide by toppling

Terrain

	Glacier
	River
	Lake
	Mountain
	Basin
	Bahbar zone (composed of sand and gravel)
	Terai (composed of silt and clay)

Geology

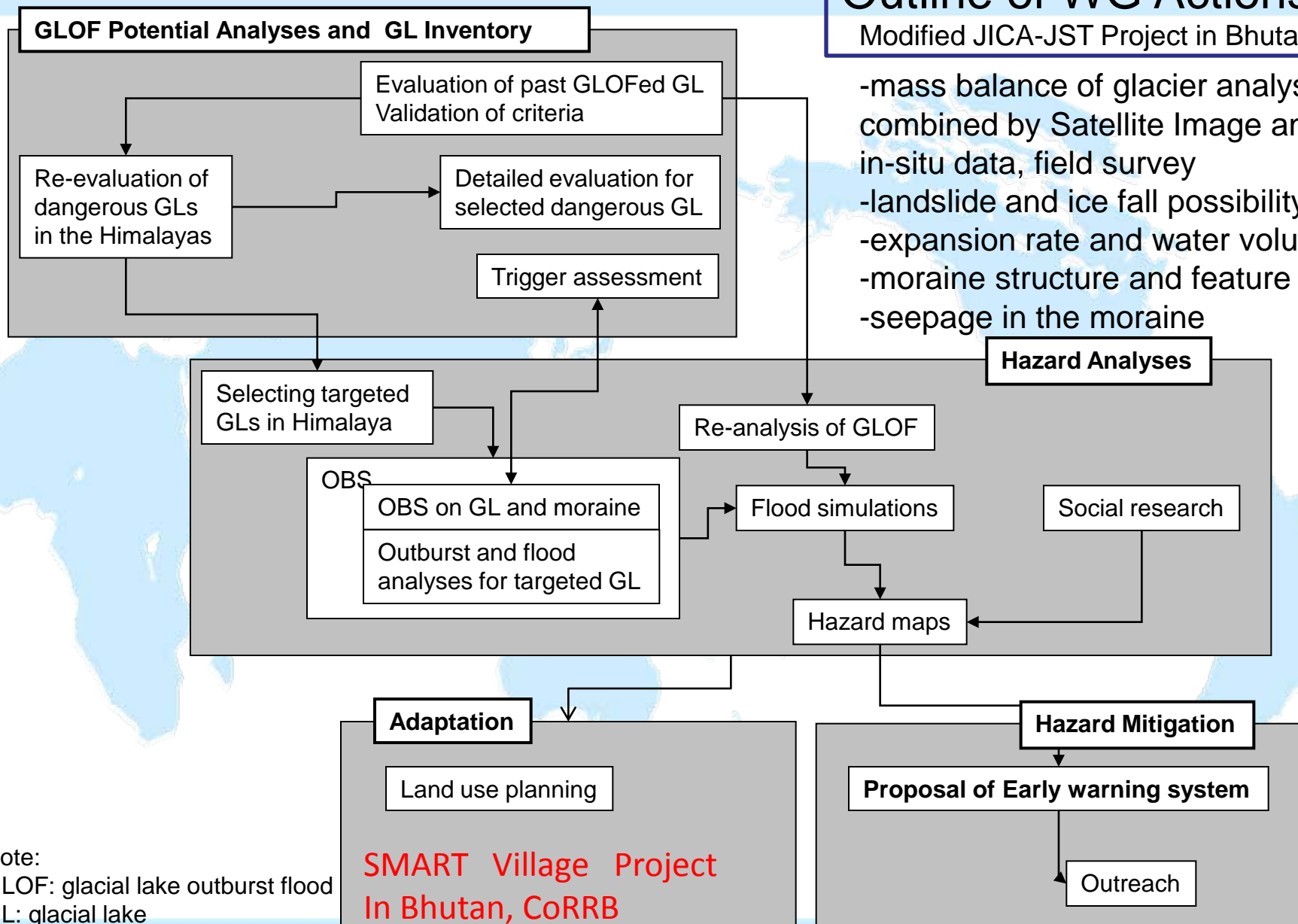
A	Alluvium
C	Conglomerate
Gn	Gneiss
Gr	Granite
Gf	Glacial and Fluvio-glacial deposits
L	Limestone
Mp	Metamorphosed rocks
Ms	Metasandstone
Ss	Sandstone
Sh	Shale
Qt	Quartzite
Ts	Tibetan sediments
	Fault

Types of Water Induced Hazards in Different Physiographic Regions of Nepal
(Modified from Nelson et al., 1980 and Ramsay, 1986)

Outline of WG Actions

Modified JICA-JST Project in Bhutan

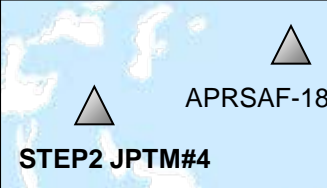
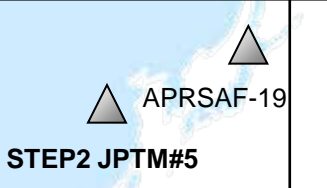
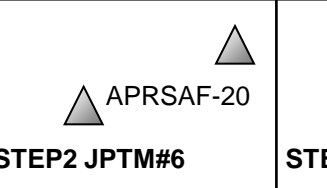
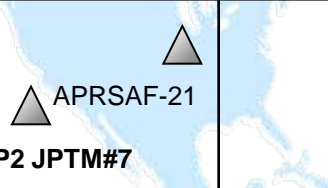
- mass balance of glacier analysis combined by Satellite Image and in-situ data, field survey
- landslide and ice fall possibility
- expansion rate and water volume
- moraine structure and feature
- seepage in the moraine



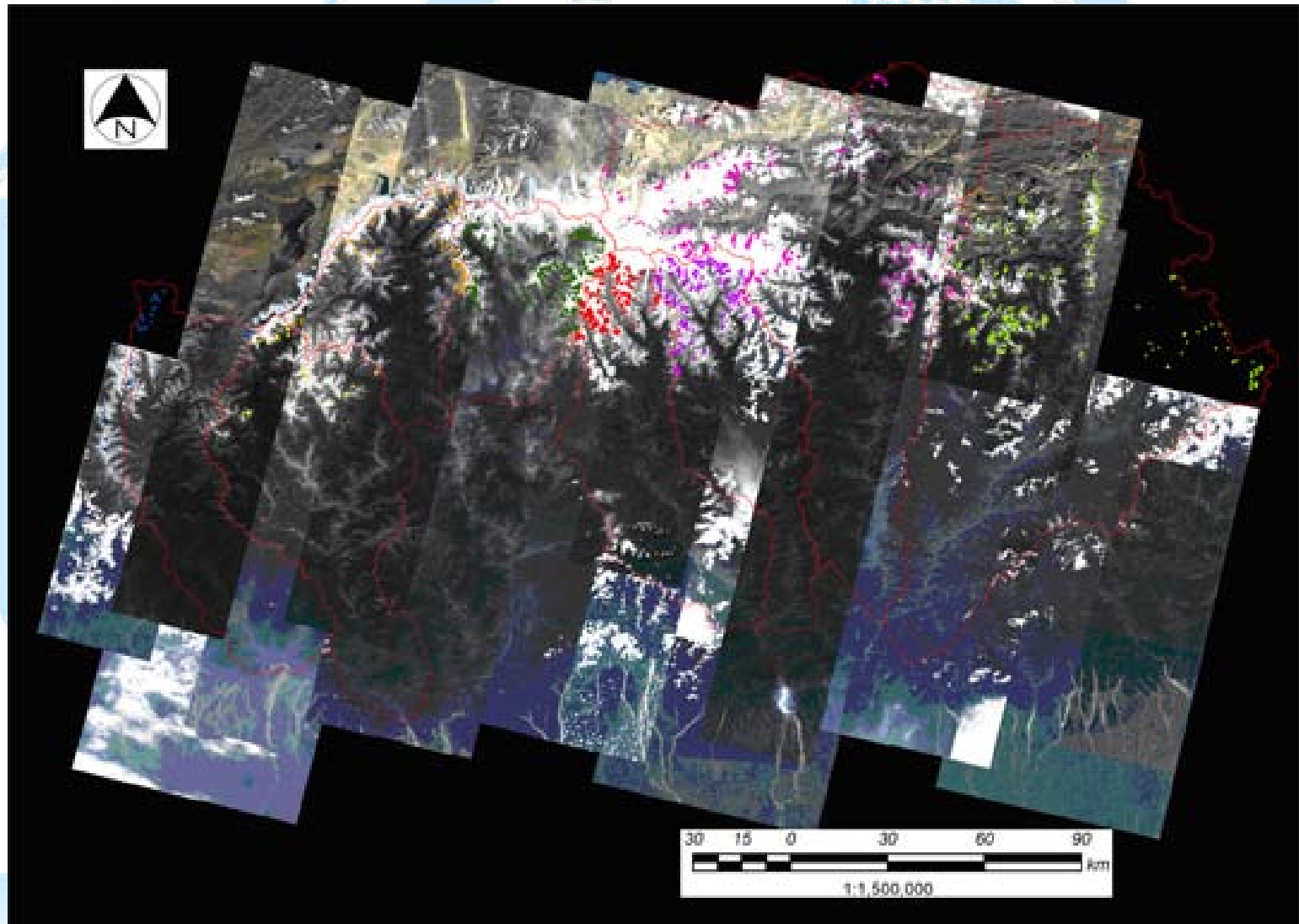
Note:
GLOF: glacial lake outburst flood
GL: glacial lake
OBS: observation

**SMART Village Project
In Bhutan, CoRRB**

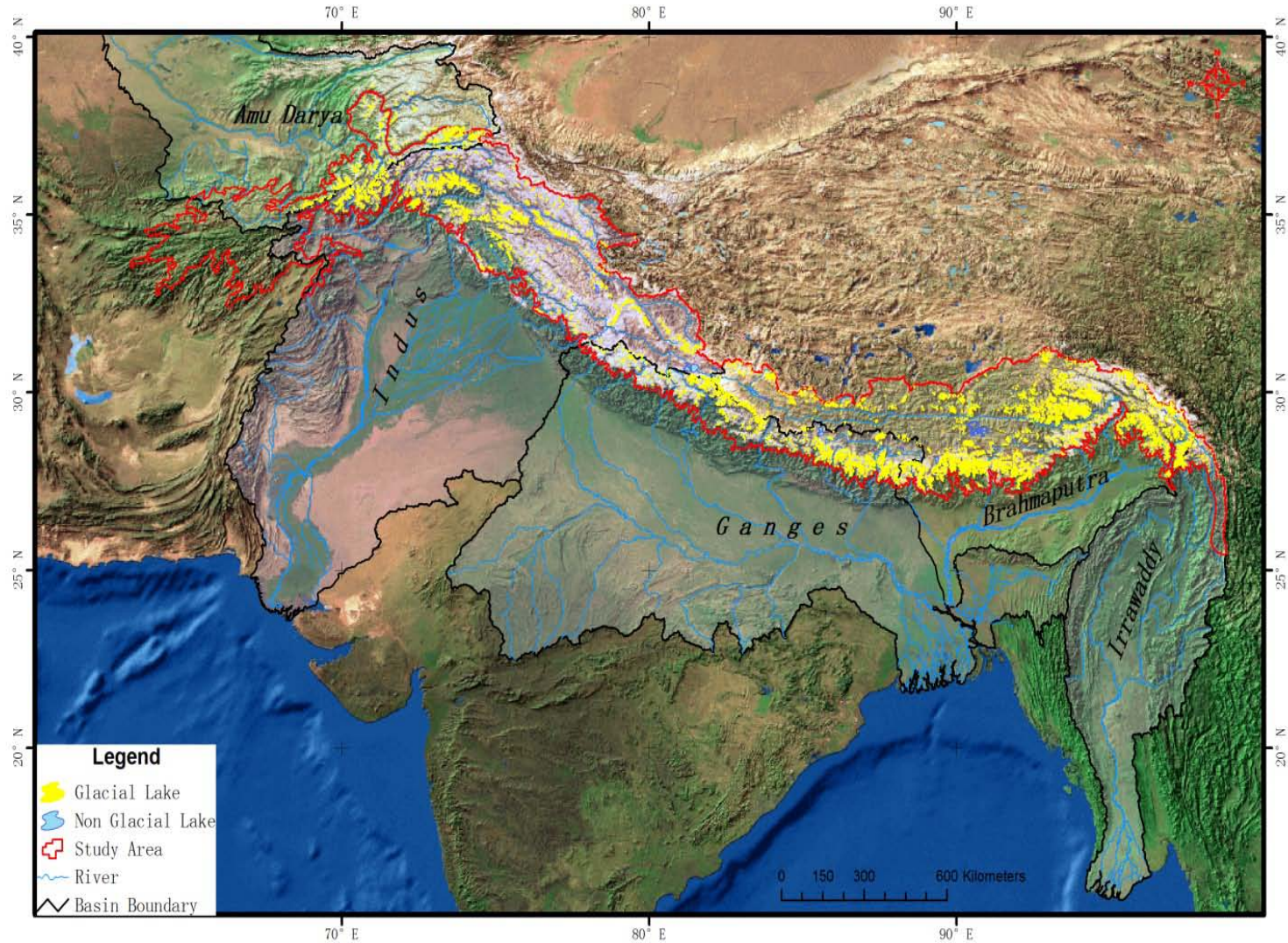
the Glacial Lake Outburst Flood Working Group Action Plan

	2011 fy	2012fy	2013 fy	2014fy	2015fy
	 APRSAF-18 STEP2 JPTM#4	 APRSAF-19 STEP2 JPTM#5	 APRSAF-20 STEP2 JPTM#6	 APRSAF-21 STEP2 JPTM#7	
GLOFs -WG	→				
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Action Plan	→				
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Inventory in Bhutan SATREPS



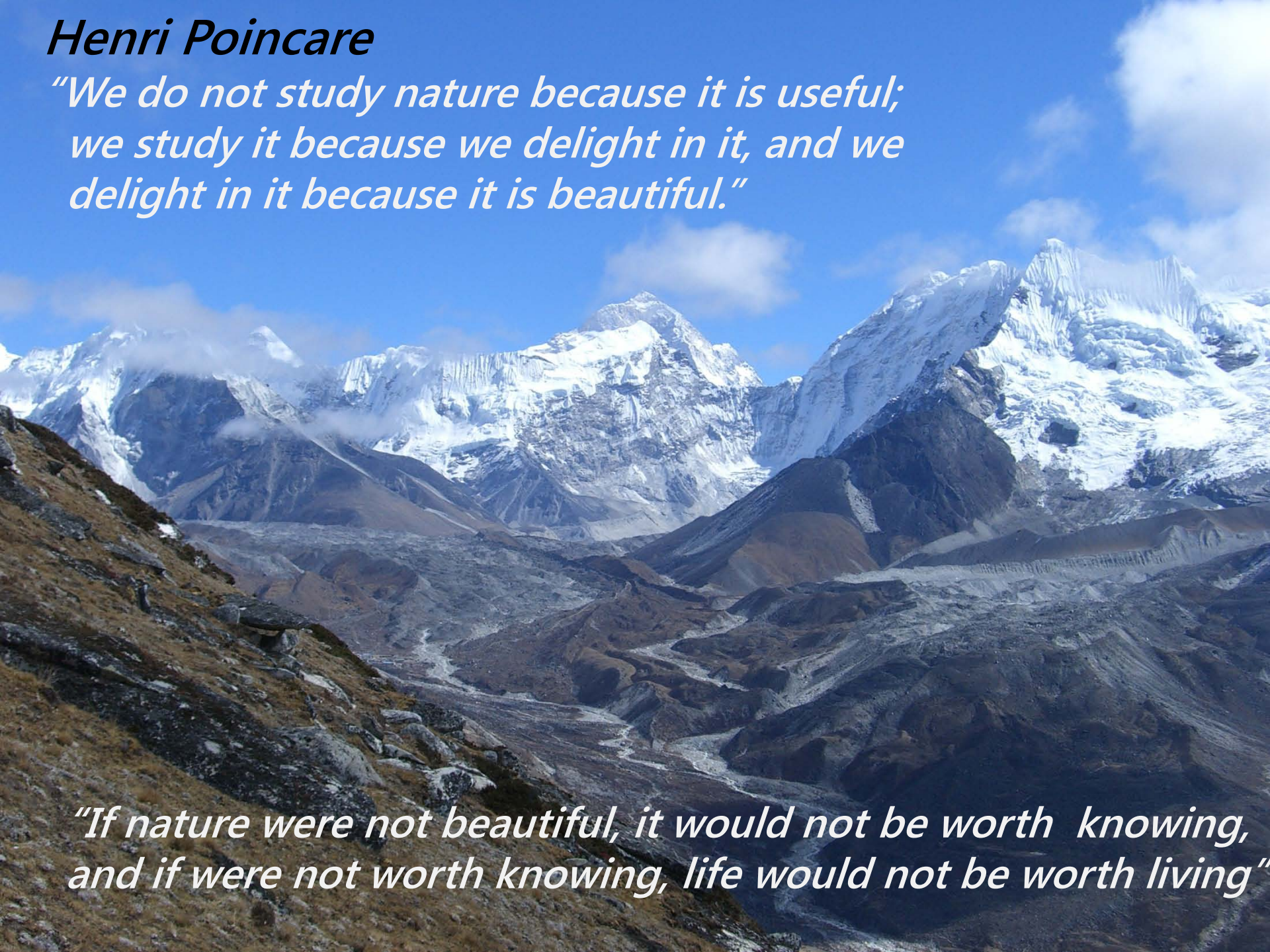
Glacial lakes in HKH region

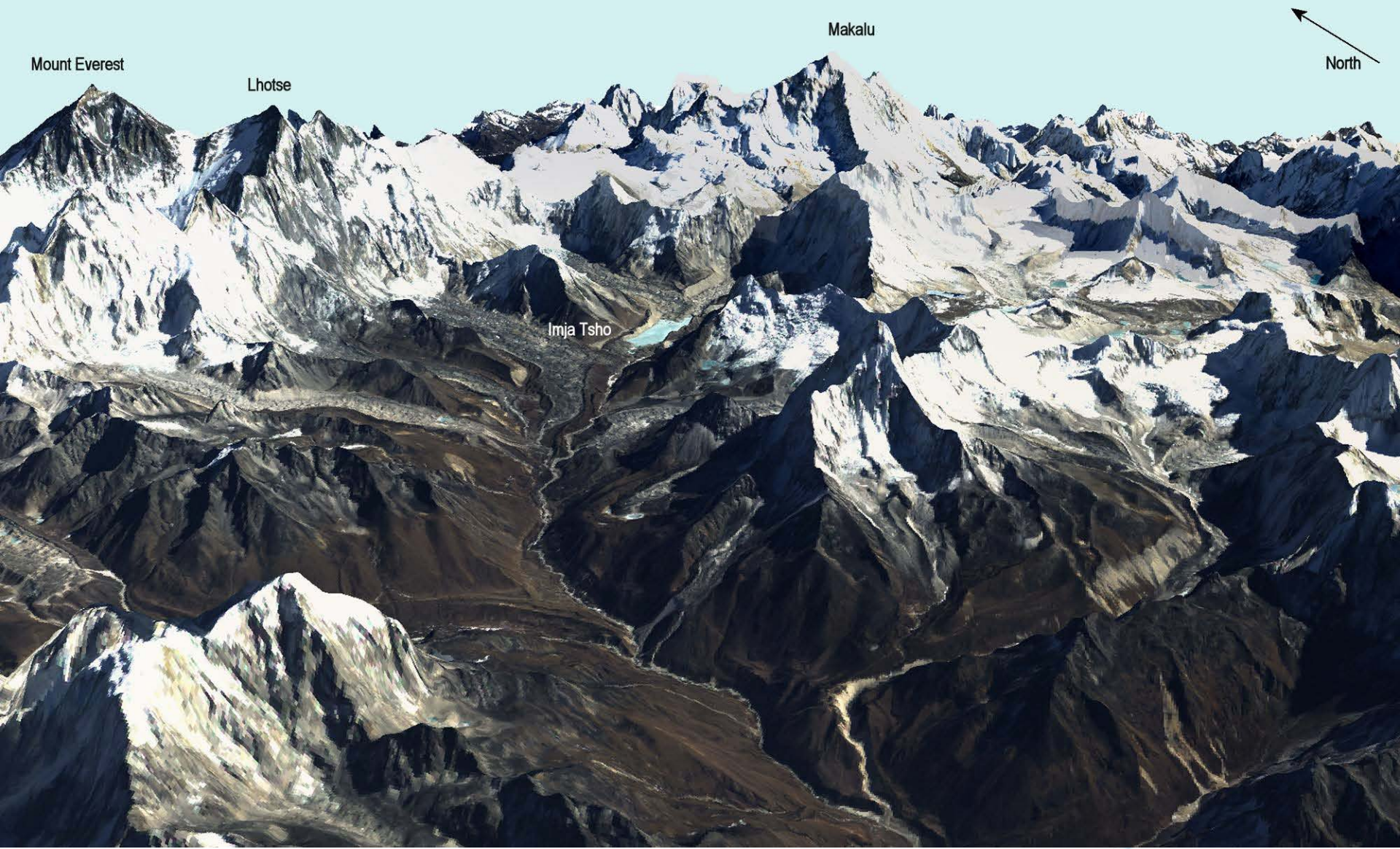


Henri Poincare

*"We do not study nature because it is useful;
we study it because we delight in it, and we
delight in it because it is beautiful."*

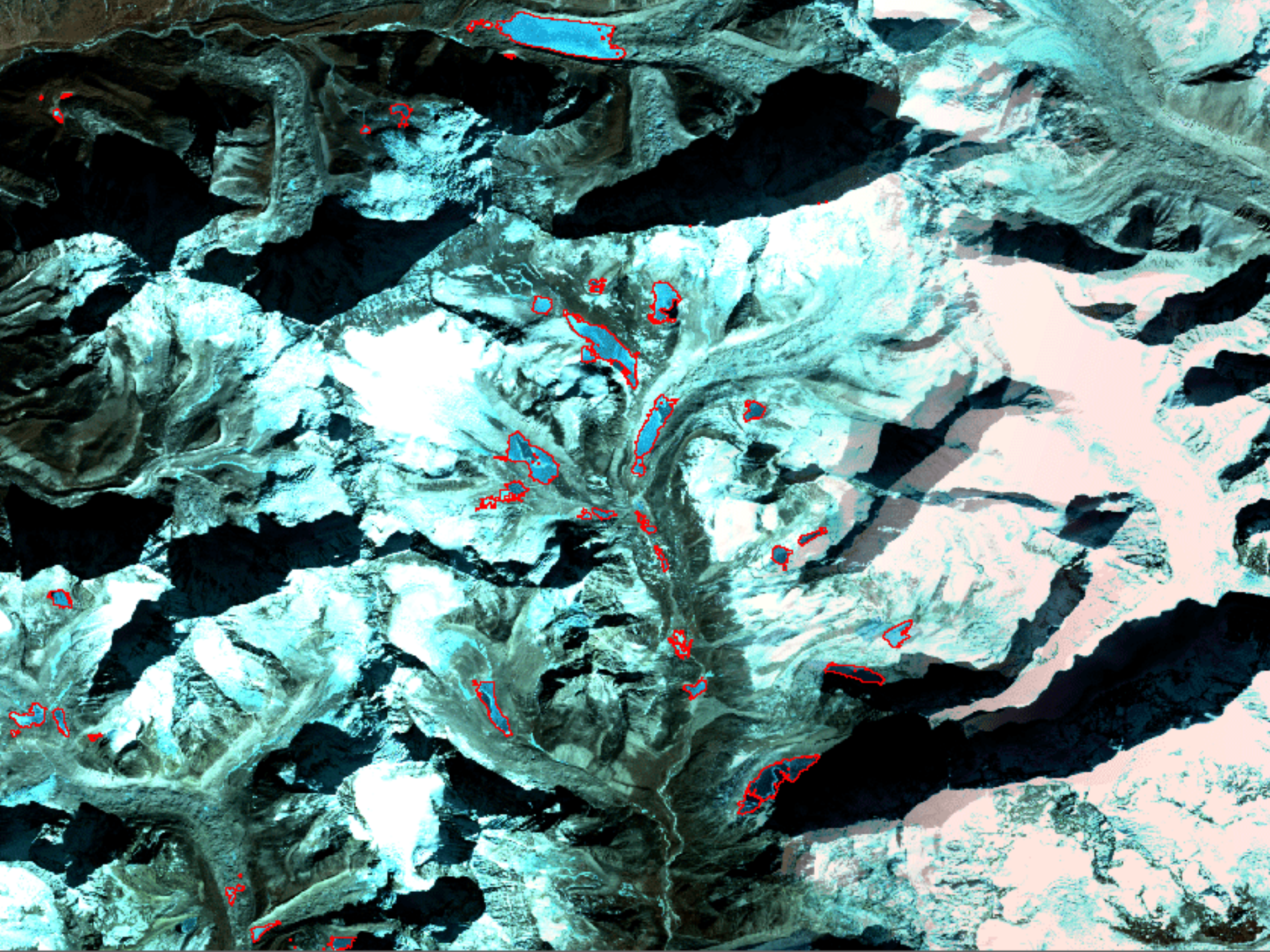
*"If nature were not beautiful, it would not be worth knowing,
and if were not worth knowing, life would not be worth living"*



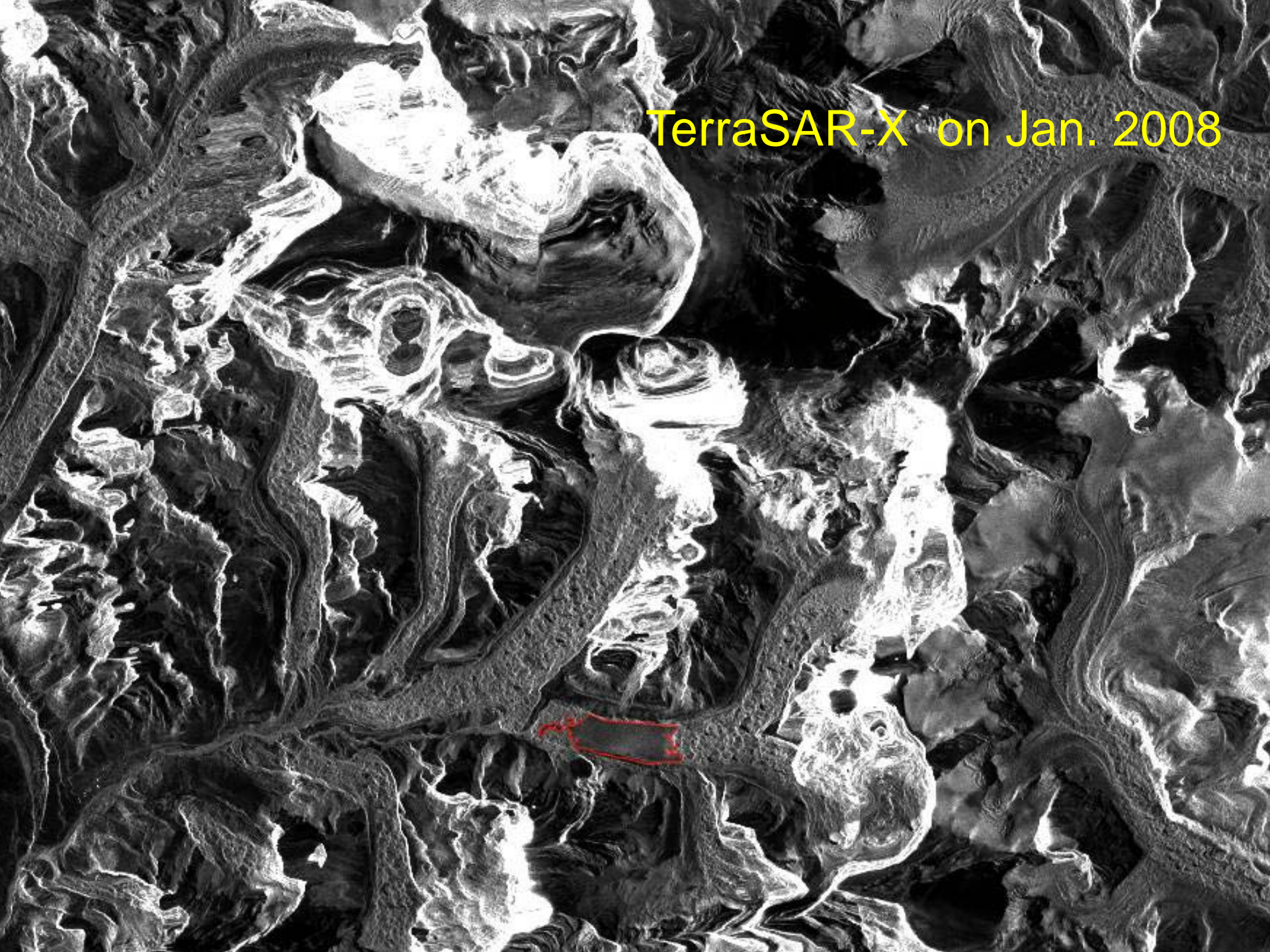


Case Study on Imja Glacial Lake in Himalayan Range
(SRTM + ALOS)



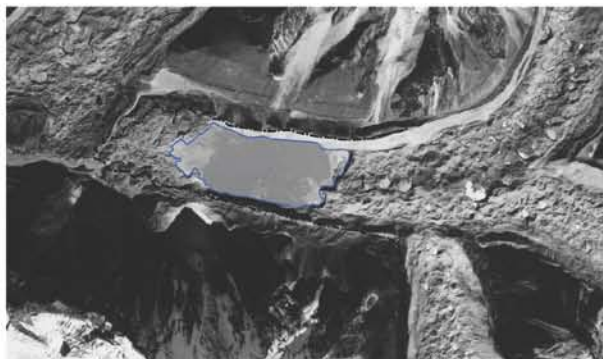


TerraSAR-X on Jan. 2008

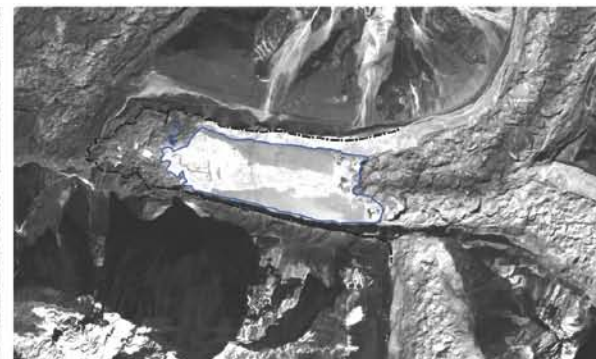




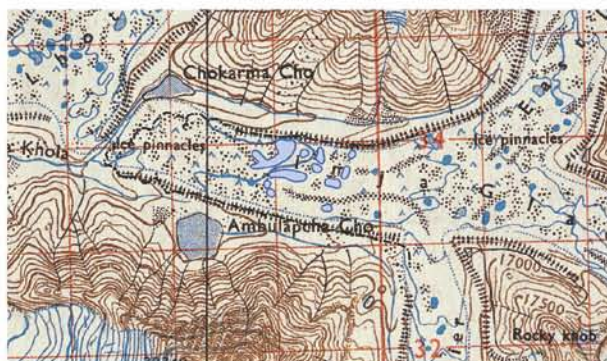
15 December 1962, Corona Image



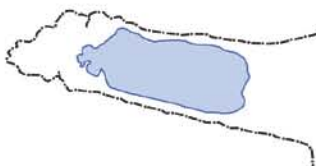
20 October 1992, Aerial Photo



4 December 2006, ALOS PRISM Image



1967, Survey of India Topographic map



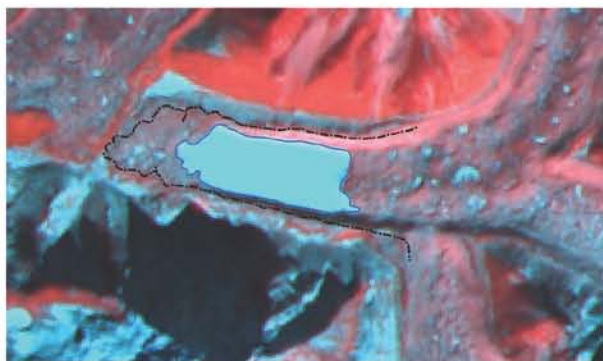
July 1997, Field Survey GEN/ DHM



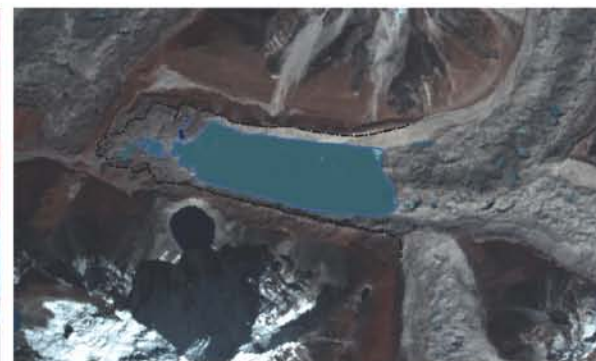
20 November 2007, AVNIR2 Image



15 October 1975, LandSat MSS Image

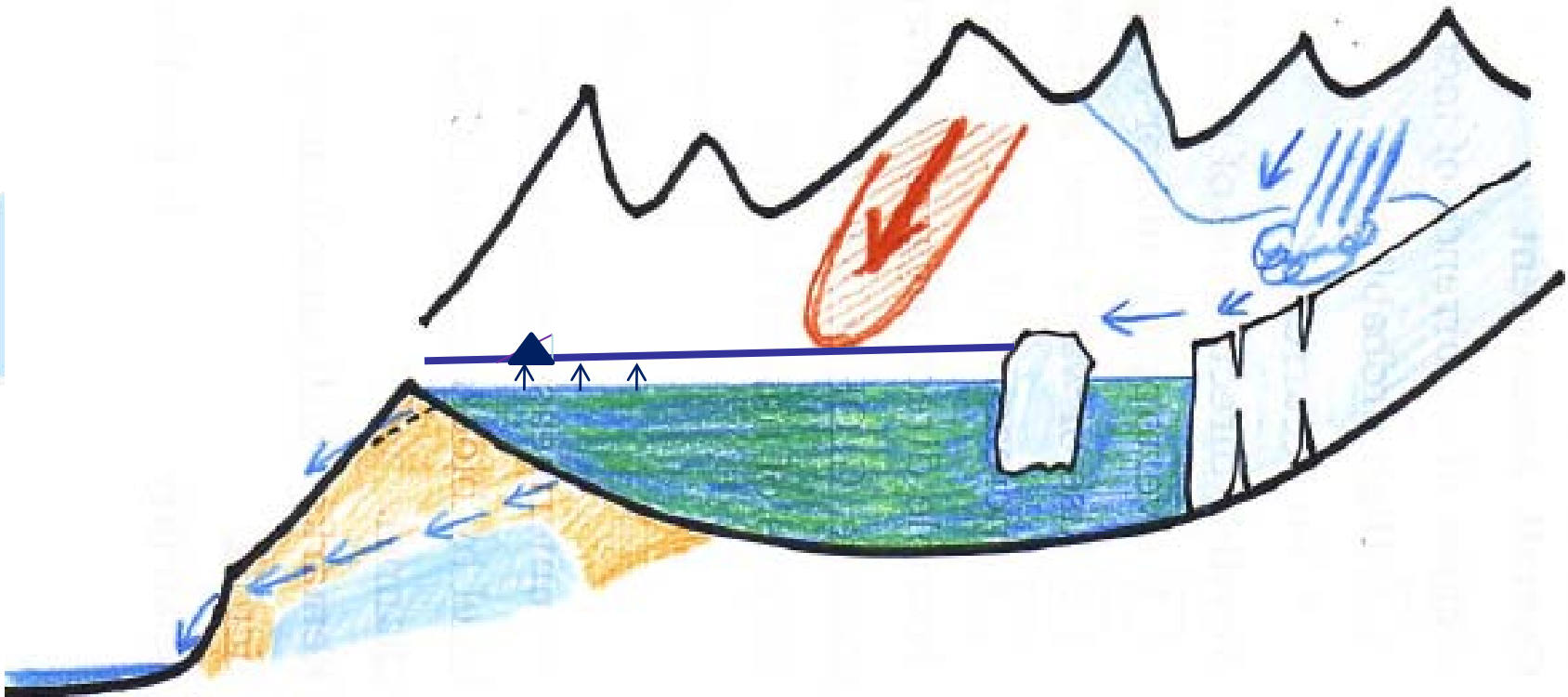


15 January 1999, LISS-3 Image



24 November 2008, AVNIR2 Image

Climate Change and Triggers of GLOF



<http://wwwsoc.nii.ac.jp/ajg/ejgeo/210124iwata.pdf>





ཀླུ་ཡོངས་དགའ་སྐྱིད་དཔལ་འཛིན་མཁའ་མགས།

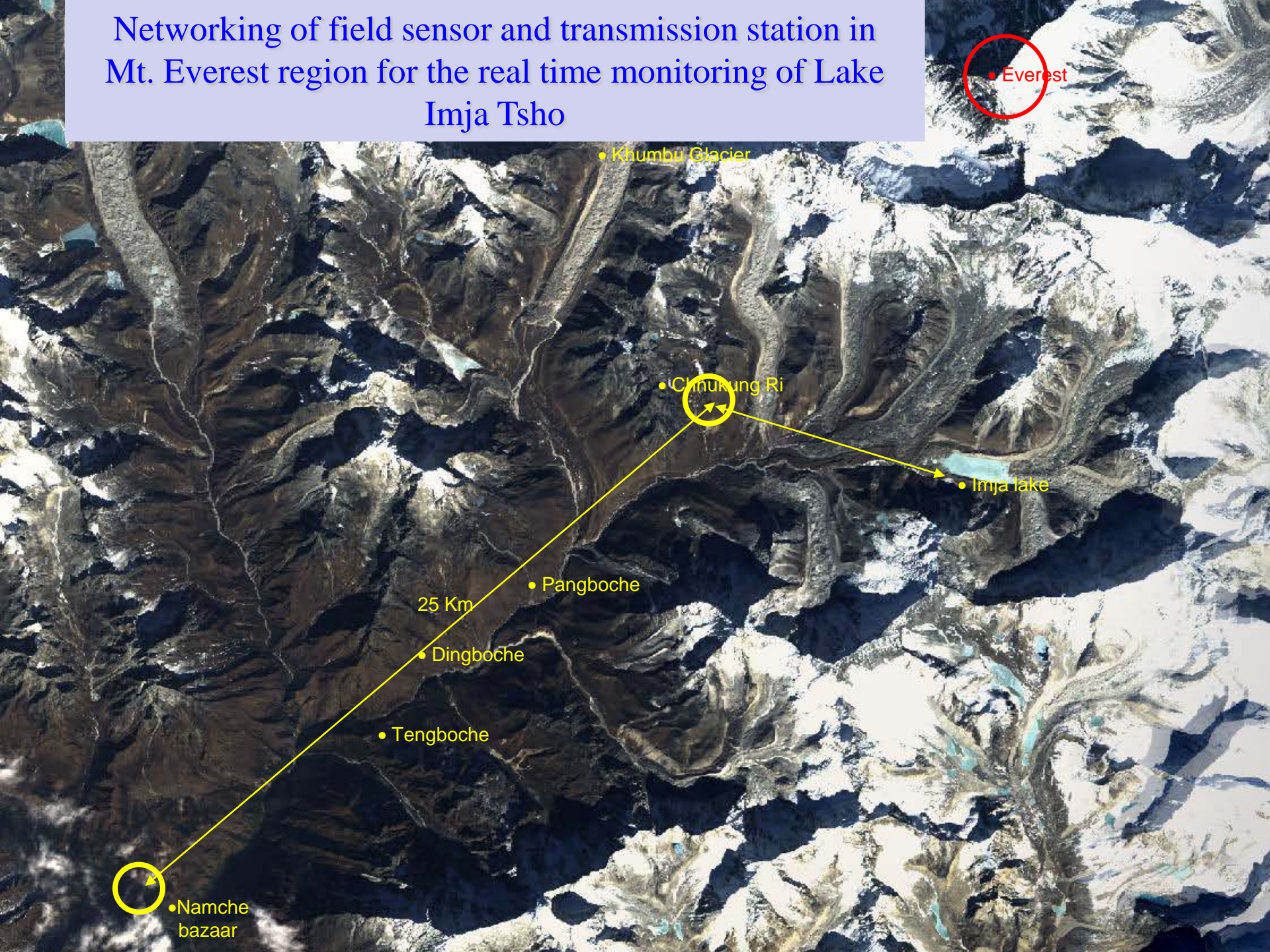
Gross National Happiness Commission

[Home](#) [About Us](#) [Central Plan](#) [Local Government Plan](#) [Policies](#) [Reports & Publications](#)



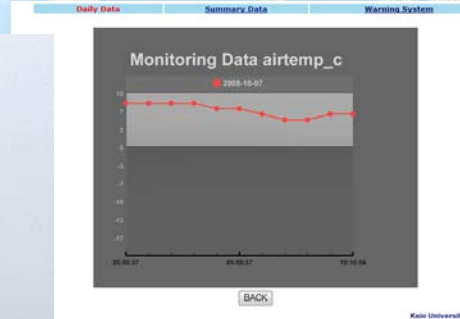
On this joyous & memorable occasion, the Gross National Happiness Commission joins the Nation in offering its deepest felicitations and humble prayers for the well being and everlasting happiness of

Networking of field sensor and transmission station in Mt. Everest region for the real time monitoring of Lake Imja Tsho





Real Time Sensing ... Image, ...



May/9th



May/10th



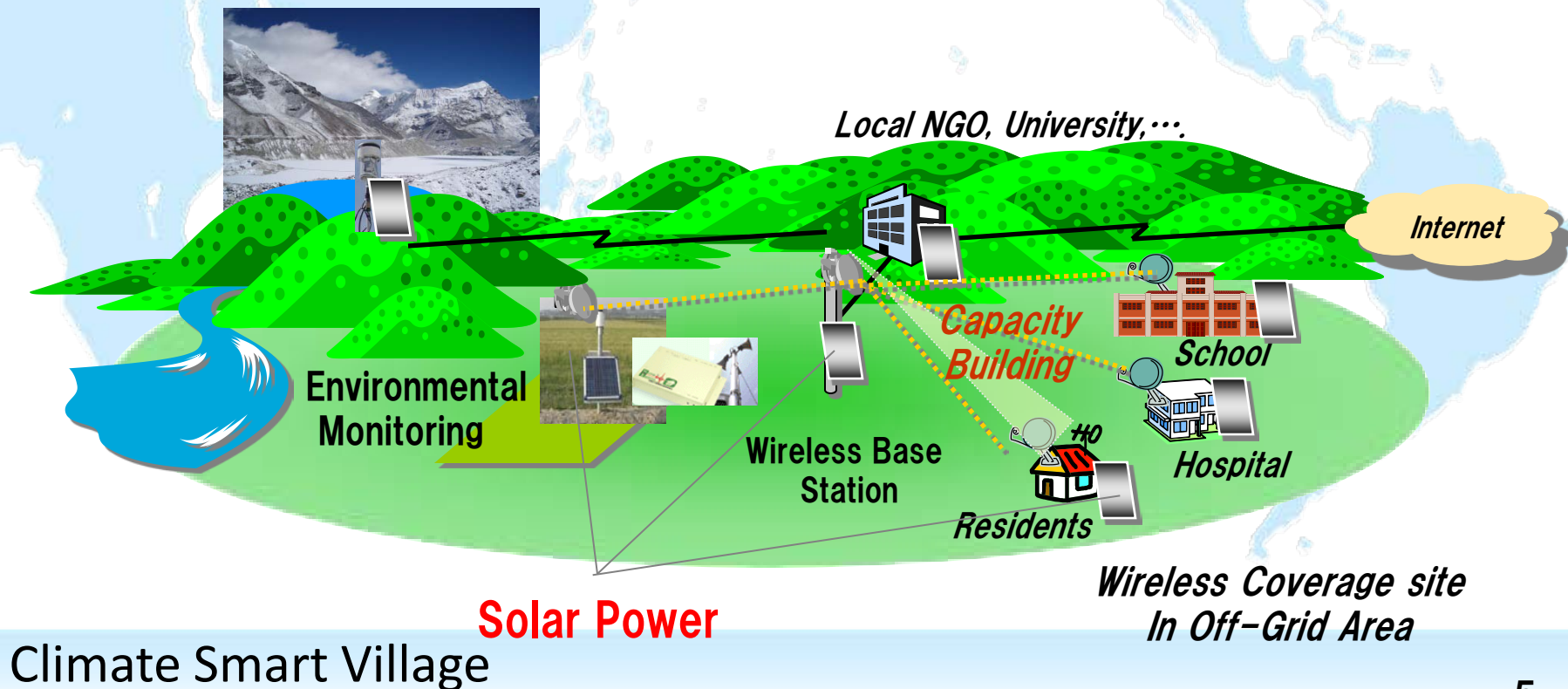
May/11th



May/12th

Solar energy-based systems to serve as Early Warning System by Wireless Sensor Network

- Providing **Internet** as Social Infrastructure: Improve Digital Divide
- Providing **wireless sensor network** for environmental monitoring
- Providing **early warning systems** for Multi-Hazards, such as GLOF



EWS in the Himalayas for dealing with flash floods and landslides

- **A Multi-hazard Early Warning System** for Climate Risk Management
- Schematic flood / landslide monitoring and prediction system, Sensor Cloud Services
 - Robust, Continuous, Sustainable Sensing and Communication
- Schematic District Emergency Control
- Communities could be entrusted with the EWS, and they would be able to monitor it on a regular basis
 - Public Awareness and Capacity building,...

ECO  EVEREST
EXPEDITION 2008

Climate Change Impact in the Himalaya

Glacial Lake Outburst Flood (GLOF) Awareness Workshop

25 April 2008
Namche Bazaar, Solukhumbu



2008/4/25 10:34



2008/4/25 10:34

Observation

GPS

Communication

Climate change

tourism

Data link

Data link

Piracy

diseases

Business development

Logistics

Transport

Mineral resources

Sea transport

Forest

Fishery resource

Biodiversity

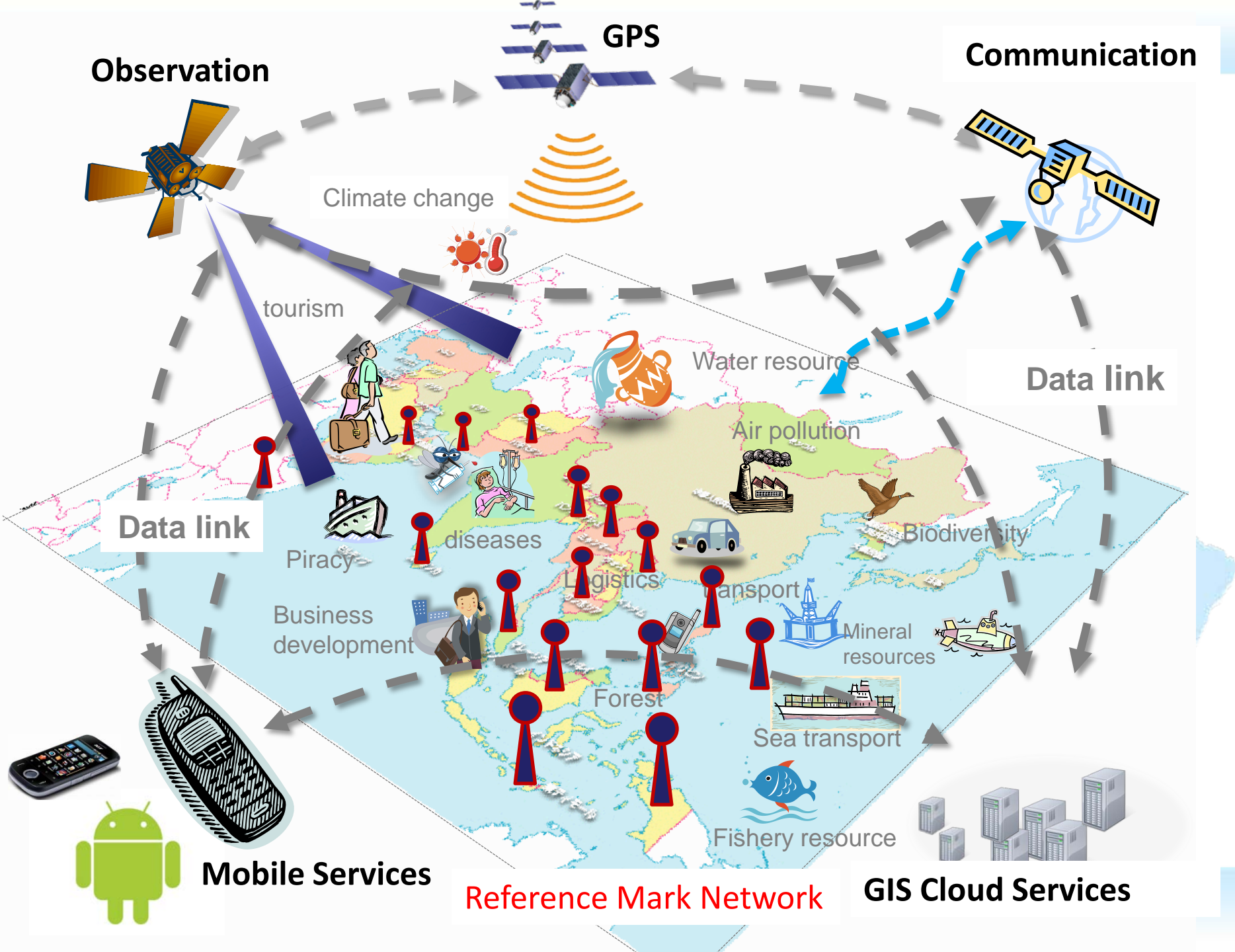
Water resource

Air pollution

Mobile Services

Reference Mark Network

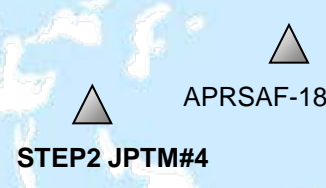
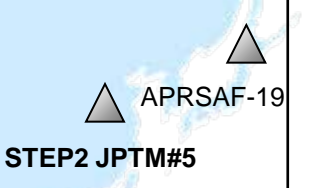
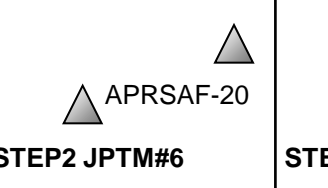
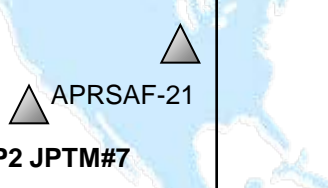










GIS Cloud Services



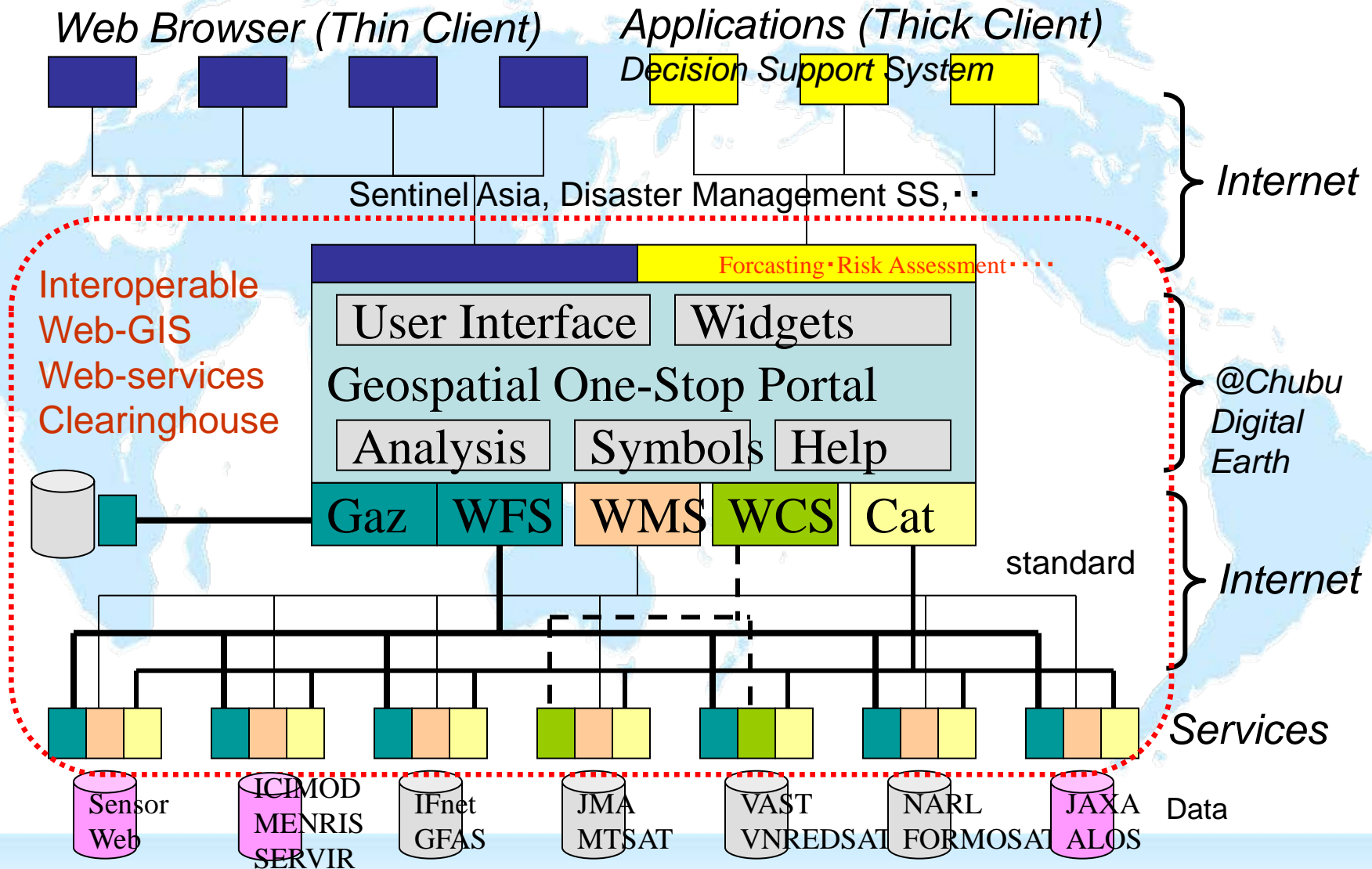
Working Items For Step3

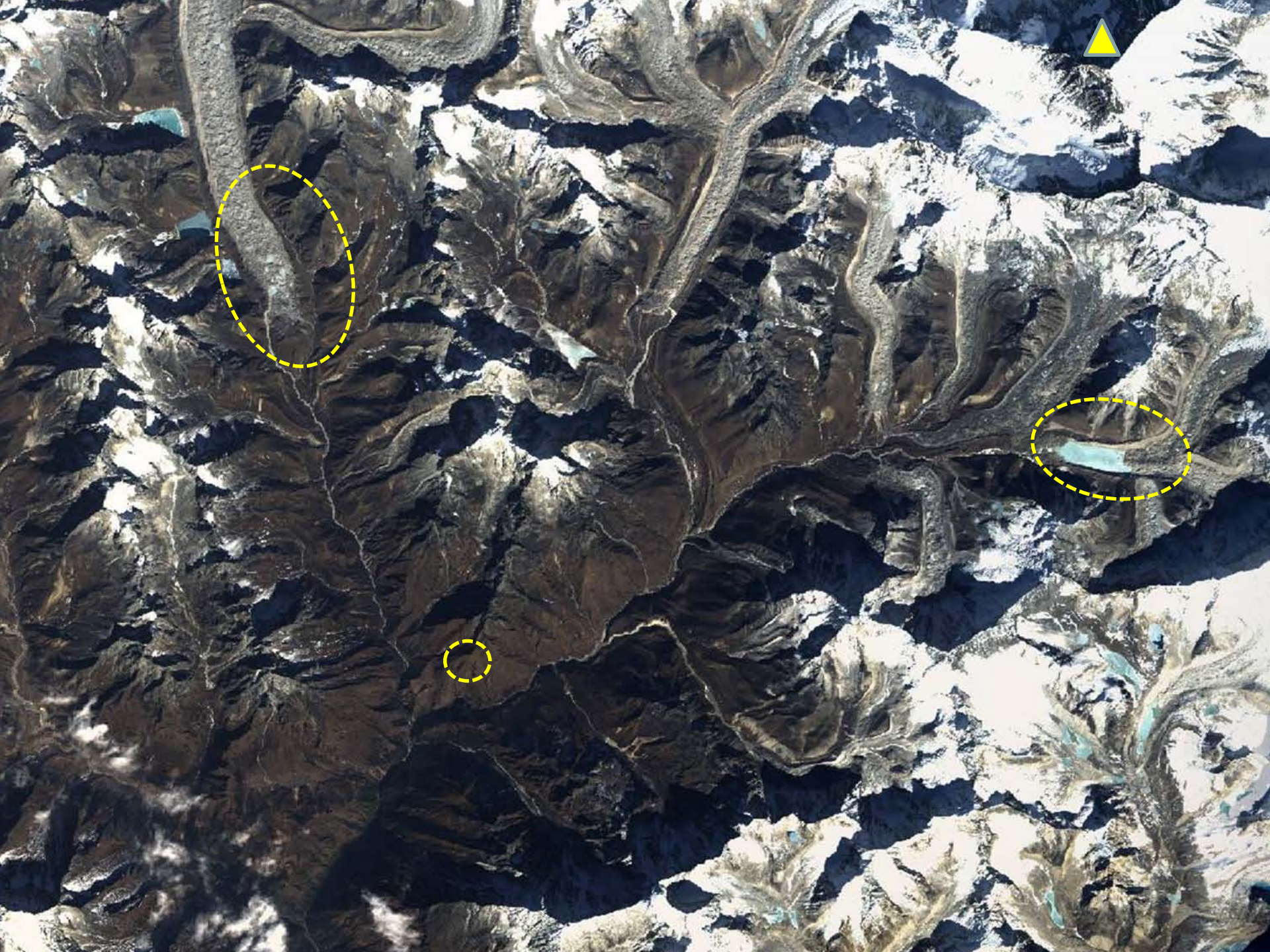
- Regular mapping and monitoring by Satellite image (ALOS2, etc.) and Field work
- Information Sharing by Cloud GIS
 - Glacial Lake Inventory by the end of 2014fy
 - Hazard and Risk Mapping by the end of 2015fy
- Mitigation and Adaptation: Early Warning System
 - Case study on some lakes by the end of 2015fy
- Regional and Global cooperation
 - South – South cooperation (Andean-Himalayas) by the end of 2016fy

the Glacial Lake Outburst Flood Working Group Action Plan

	2011 fy	2012fy	2013 fy	2014fy	2015fy
	 APRSAF-18 STEP2 JPTM#4	 APRSAF-19 STEP2 JPTM#5	 APRSAF-20 STEP2 JPTM#6	 APRSAF-21 STEP2 JPTM#7	
GLOFs -WG	 •Inventory and identify Potential Outburst Glacial Lake				
Action Plan	 •Monitoring Glacial Lake / Field Survey •Hazard /Risk Mapping on potentially dangerous and affected area				
	  •Local Awareness, Capacity building, Workshop •Setting up Early Warning System Web Contents     Preparation Web Site New Contents Cloud Services				
System	STEP2 System		STEP3 System		
	 Operation		 		

Geo Web Services for GLOF : Digital Earth Platform for data sharing

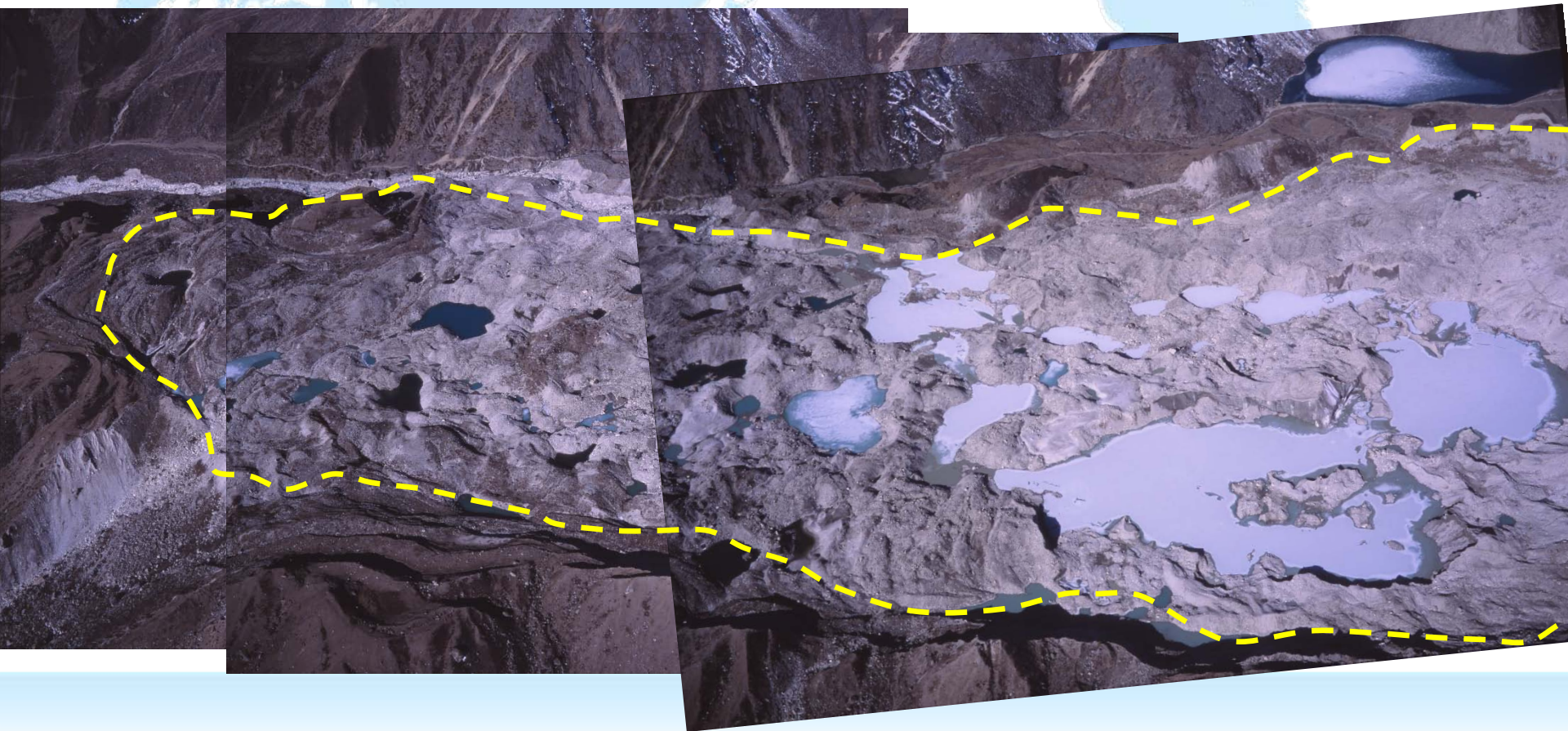




Fieldwork in Potential Glacier Lake?

Ex) Terminal of the Ngozumba Glacier

Planning by JAC(Japan Alpine Club)



Unmanned Aerial Vehicle (UAV) Mapping for Hazard Map



eBee, Sensefly



2D Ortho-mosaic Image of Lhaku Village in Bhutan



3D Point Cloud Image of Lhaku Village in Bhutan



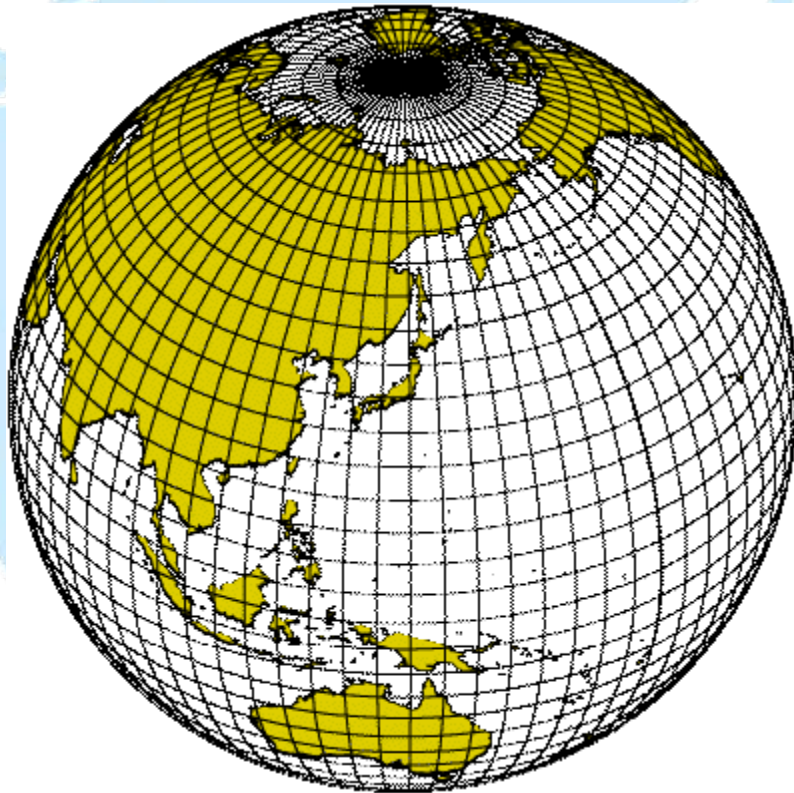
Monitoring of Glacial Lake and Terminal Moraine from Space(ALOS-2)

- Regularly Monitoring for changes in the area of Glacial Lake
- Regularly Monitoring for changes in the Volume of Substance of the Terminal Moraine by PALSAR-2 DinSAR



Trigger of GLOF

-- Please Contact at; fukui@isc.cubu.ac.jp



See you
on Digital EARTH
Summit Nagoya

