28th, November 2013
The JPTM of Sentinel Asia
Bangkok

Activity Plan and Status of GLOFs-WG In Sentinel Asia

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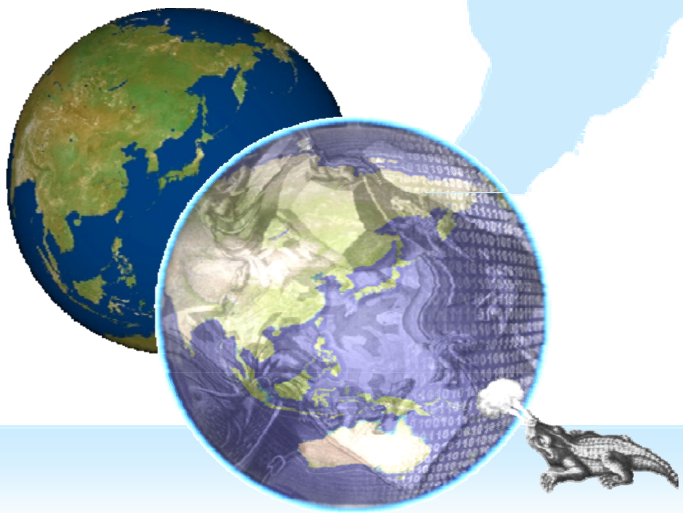
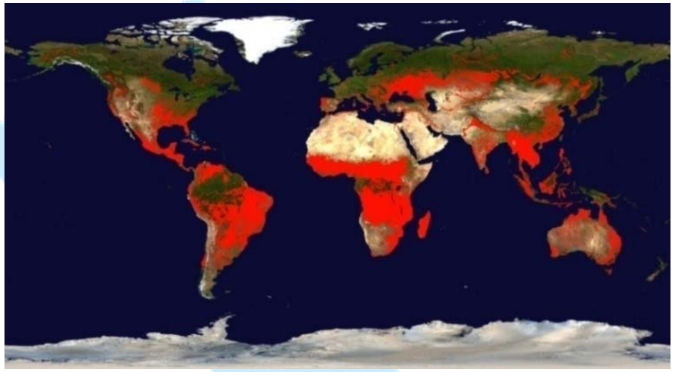


Working Group Activities for Disaster Risk Reduction

- **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

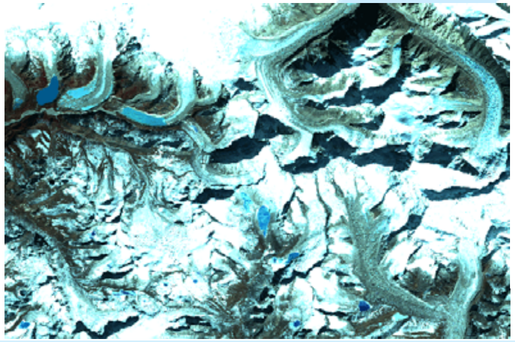


(*)JST: Japan Science and Technology Agency
JICA: Japan International Cooperation Agency

- **Flood WG**
  - -To contribute to the mitigation of flood disasters in Asia
  - -Flood analysis using IFAS

IFAS
Flood Forecasting Using Global Satellite Rainfall Information Based on
Integrated Flood Analysis System

- **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

Initiator Organization and Co-chair of GLOF WG

- Japan Aerospace Exploration Agency (JAXA)
- Asian Disaster Reduction Center (ADRC)
- Keio University → 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.

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.

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)

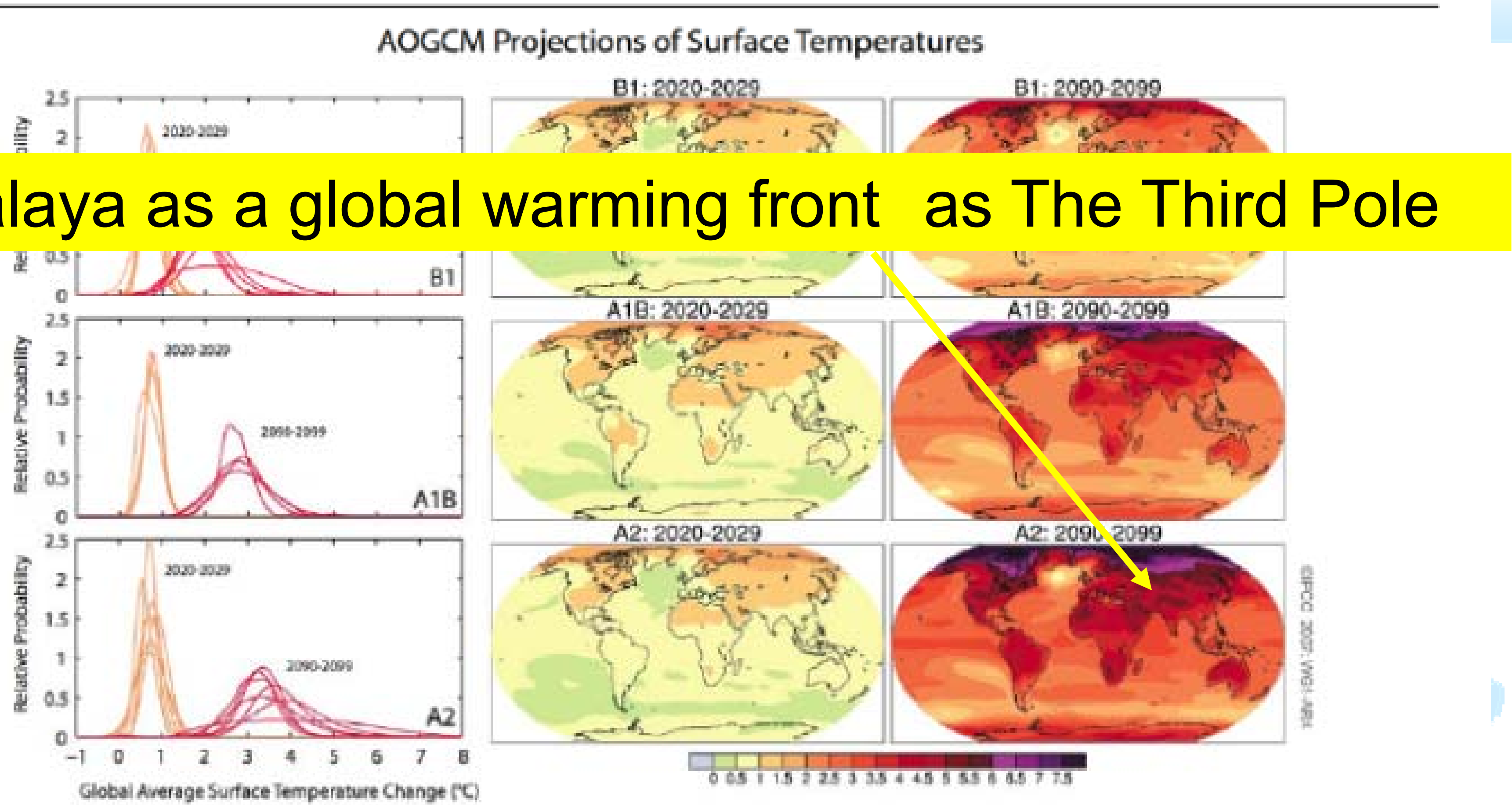


FIGURE SPM-6. Projected surface temperature changes for the early and late 21st century relative to the period 1980–1999. The central and right panels show the Atmosphere-Ocean General Circulation multi-Model average projections for the B1 (top), A1B (middle) and A2 (bottom) SRES scenarios averaged over 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}

IPCC 4AR SPM report (2007)

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

ipcc

INTERGOVERNMENTAL PANEL ON climate change

Geneva, 20 January 2010

IPCC statement on the melting of Himalayan glaciers[1]

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 assessment[2] 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 awaareness created at various levels including politicians, decision makers, the media and the public at large"

ICIMOD

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

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4 October 2013 Last updated at 10:23 GMT

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Himalayas still uphill for climate report

By Navin Singh Khadka
Environment reporter, BBC News

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 on 2013 was a breach of a glacial lake.

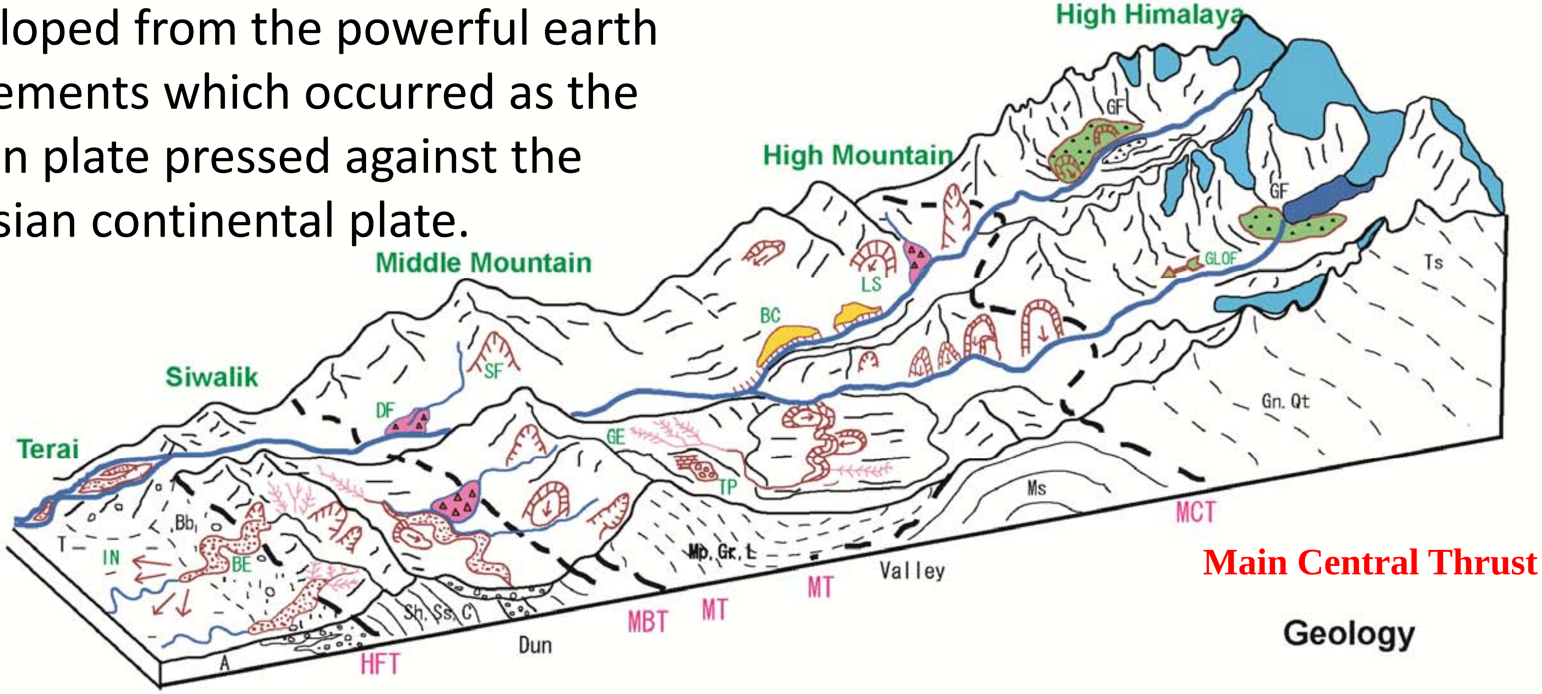
"The heavy precipitation led to the melting of the soft snow and even old ice in the Chorabari and companion glaciers that fed to the Chorabari Lake, which got breached due to excessive water intake from the glaciers," Prof Gupta explained.

"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

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



Geology

A	Alluviuam
C	Conglomerate
Gn	Gneiss
Gr	Grainite
Gf	Glacial and Fluvio-glacial deposits
L	Limestone
Mp	Metamorphosed rocks
Ms	Metasandstone
Ss	Sandstone
Sh	Shale
Qt	Quartzite
Ts	Tibetan sedements
— ~ -	Fault

Hazards

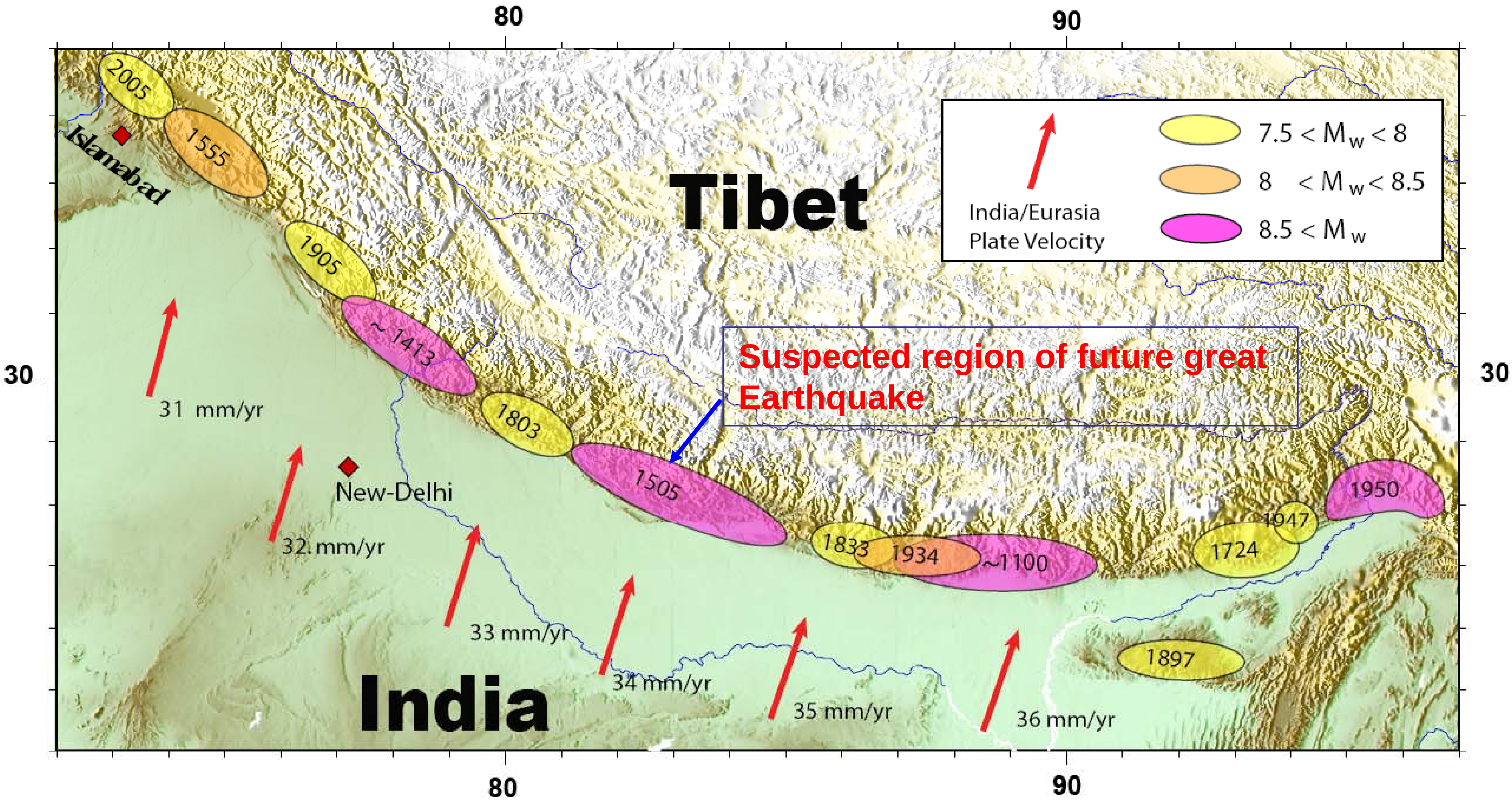
BC	Block collapse
BE	Bank erosion
DF	Debris flow
GE	Gully erosion
GLOF	Glacial lake outburst flood
LS	Landslide(Deep-seatsd)
SF	Slope failure
TP	Rock slide by toppling

Terrain

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

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

Himalaya is a Seismic Active Zone



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

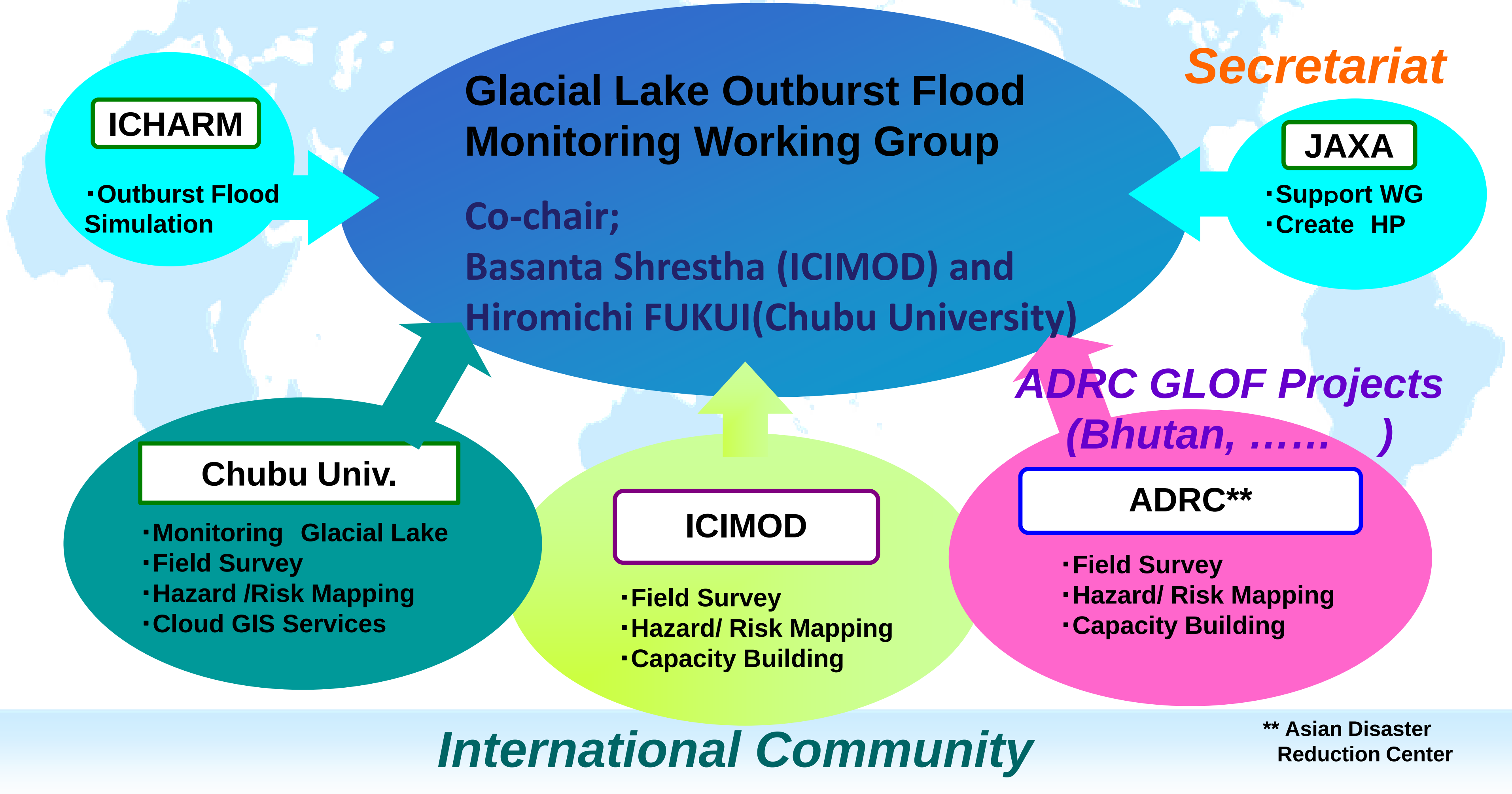
Bilham (2004), Ambraseys and Bilham (2000), Kumar, et al. (2006) Lavé, et al. (2005)

http://gibson.sfc.keio.ac.jp/Website/windpower/

Sentinel Asia

Disaster Management Support System in the Asia-Pacific Region

Framework of GLOF WG

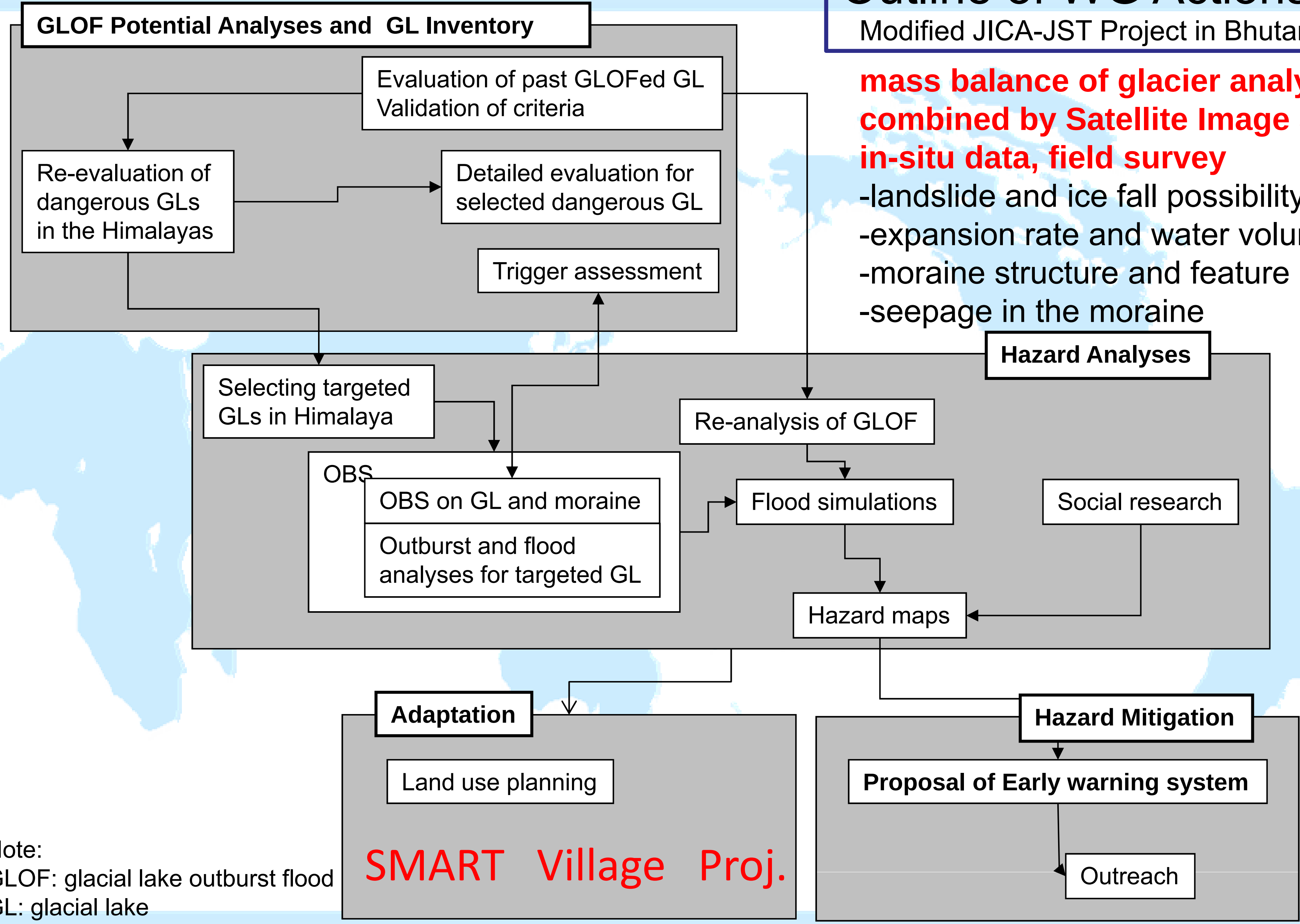


Outline of WG Actions

Modified JICA-JST Project in Bhutan

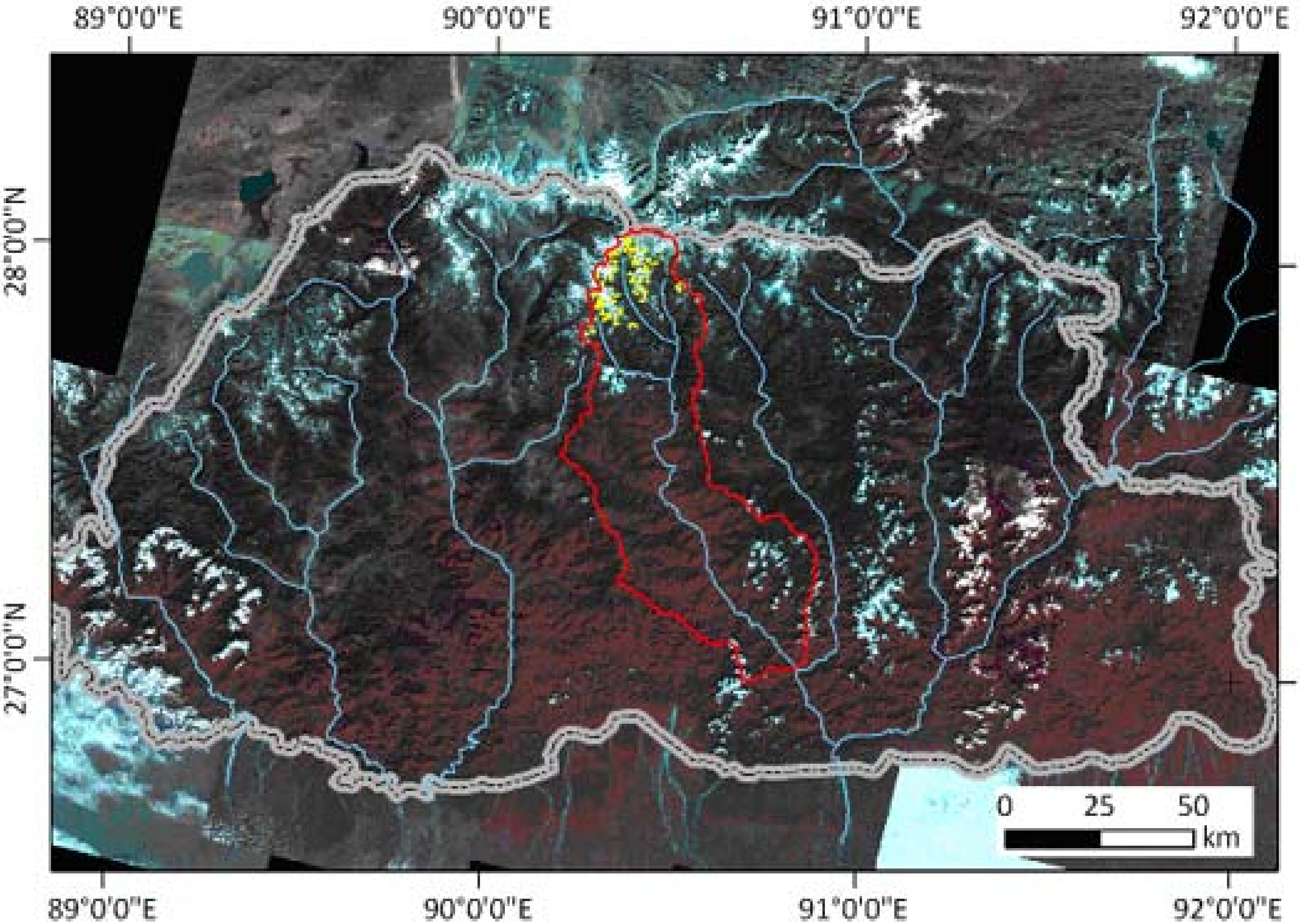
mass balance of glacier analysis combined by Satellite Image and in-situ data, field survey

-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

ALOS-based glacial lake inventory in Bhutan

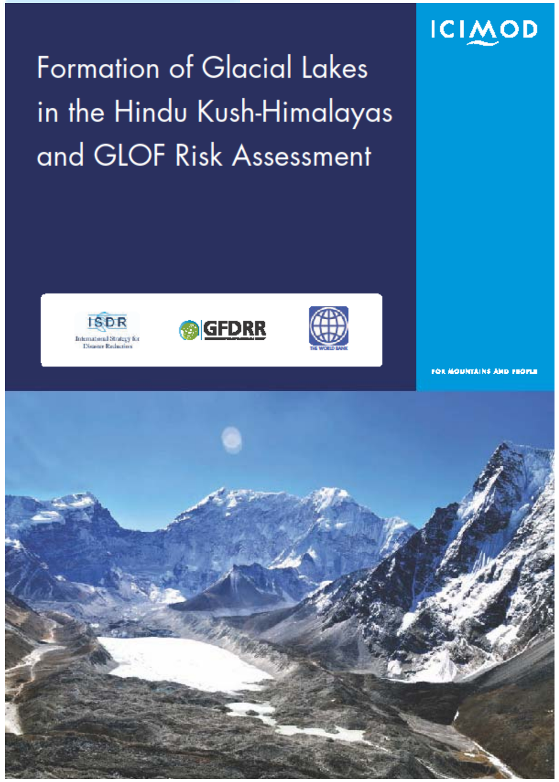


Glacial Lakes Inventory by ICIMOD

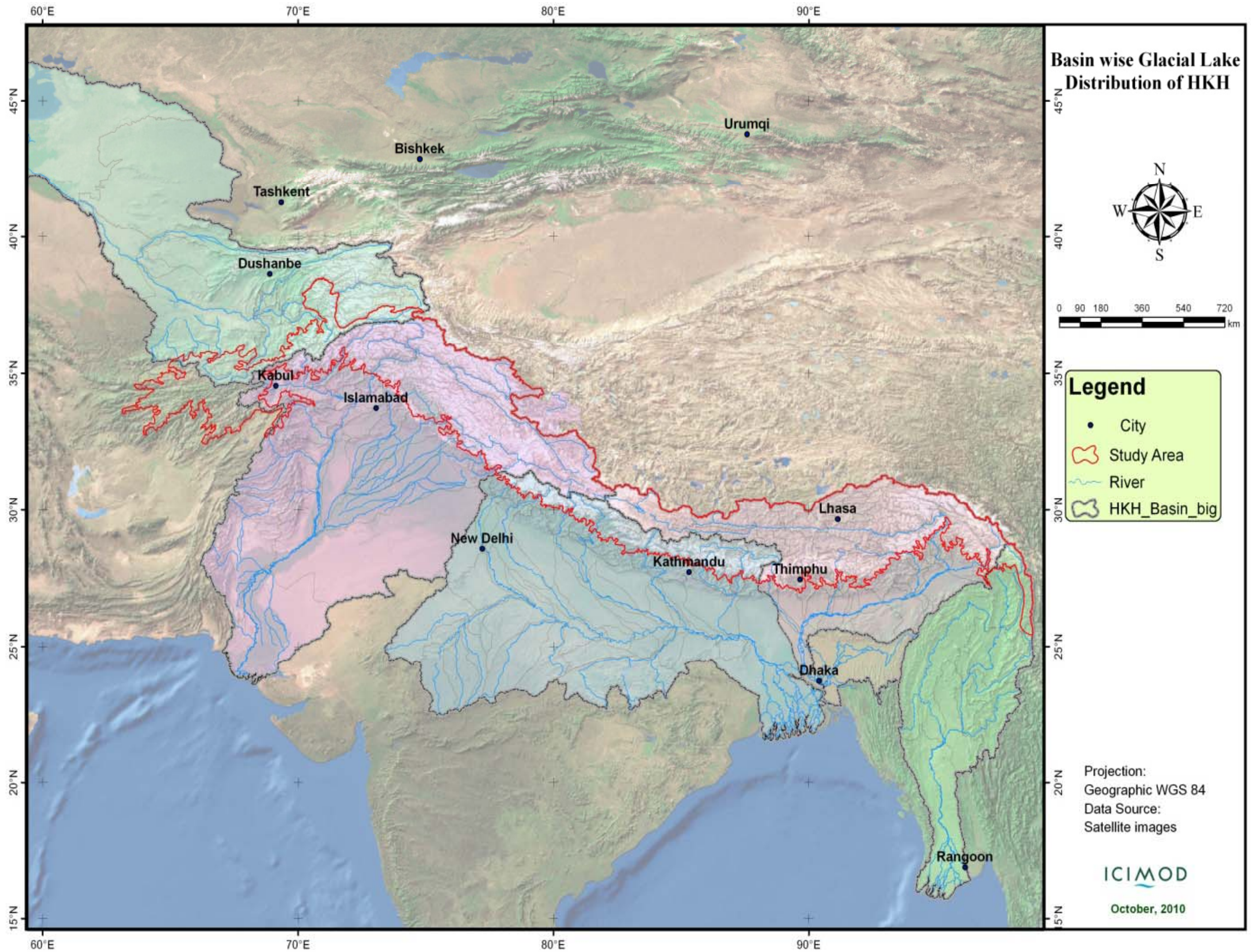
Comprehensive reports on glacial lakes and GLOF of the HKH region

(http://books.icimod.org/demo/index.php/downloads/pd/692)

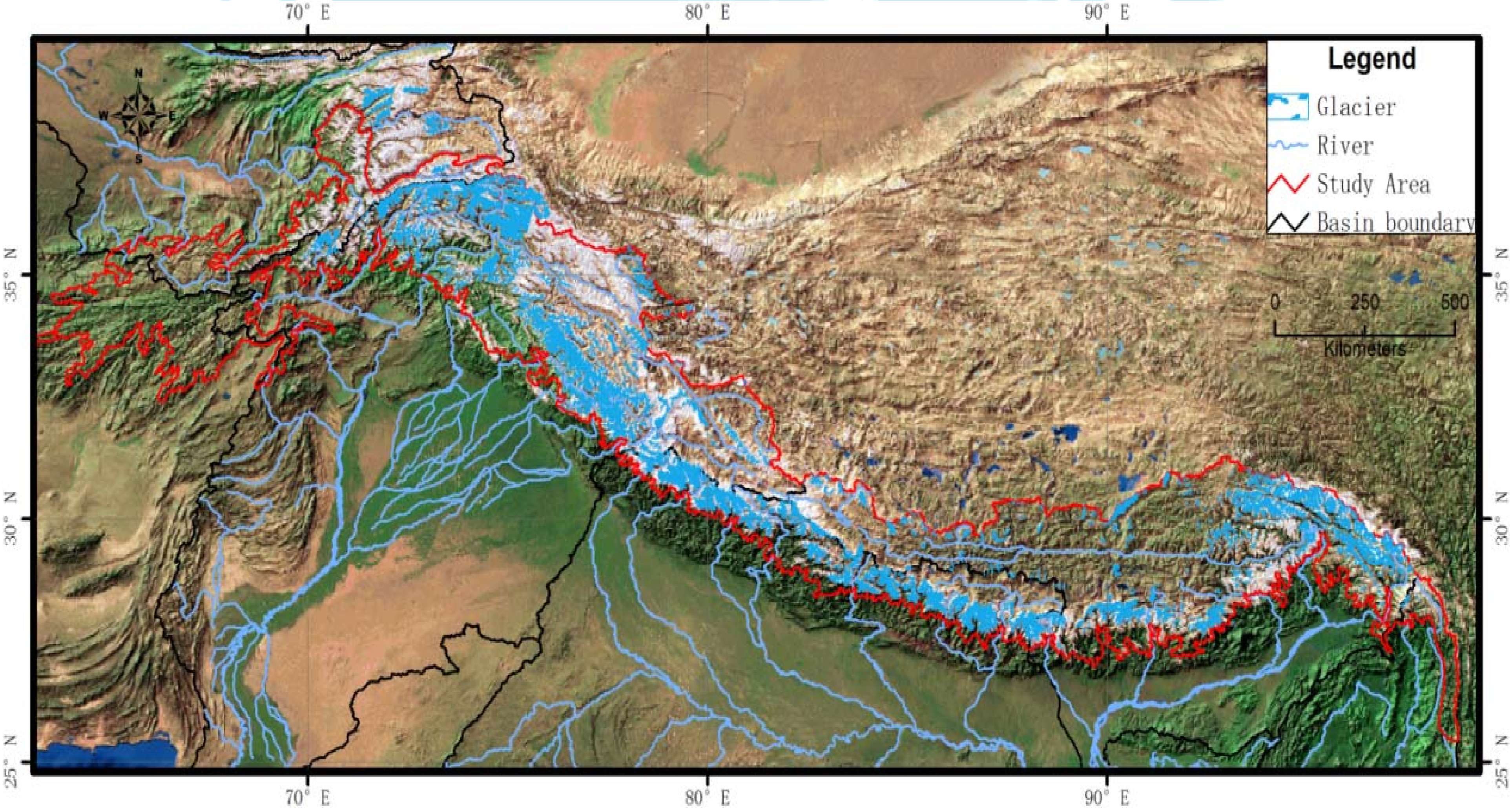
(Ives, JD, Shrestha, RB; Mool, PK (2010) *Formation of glacial lakes in the Hindu Kush-Himalayas and GLOF risk assessment.* Kathmandu: ICIMOD)



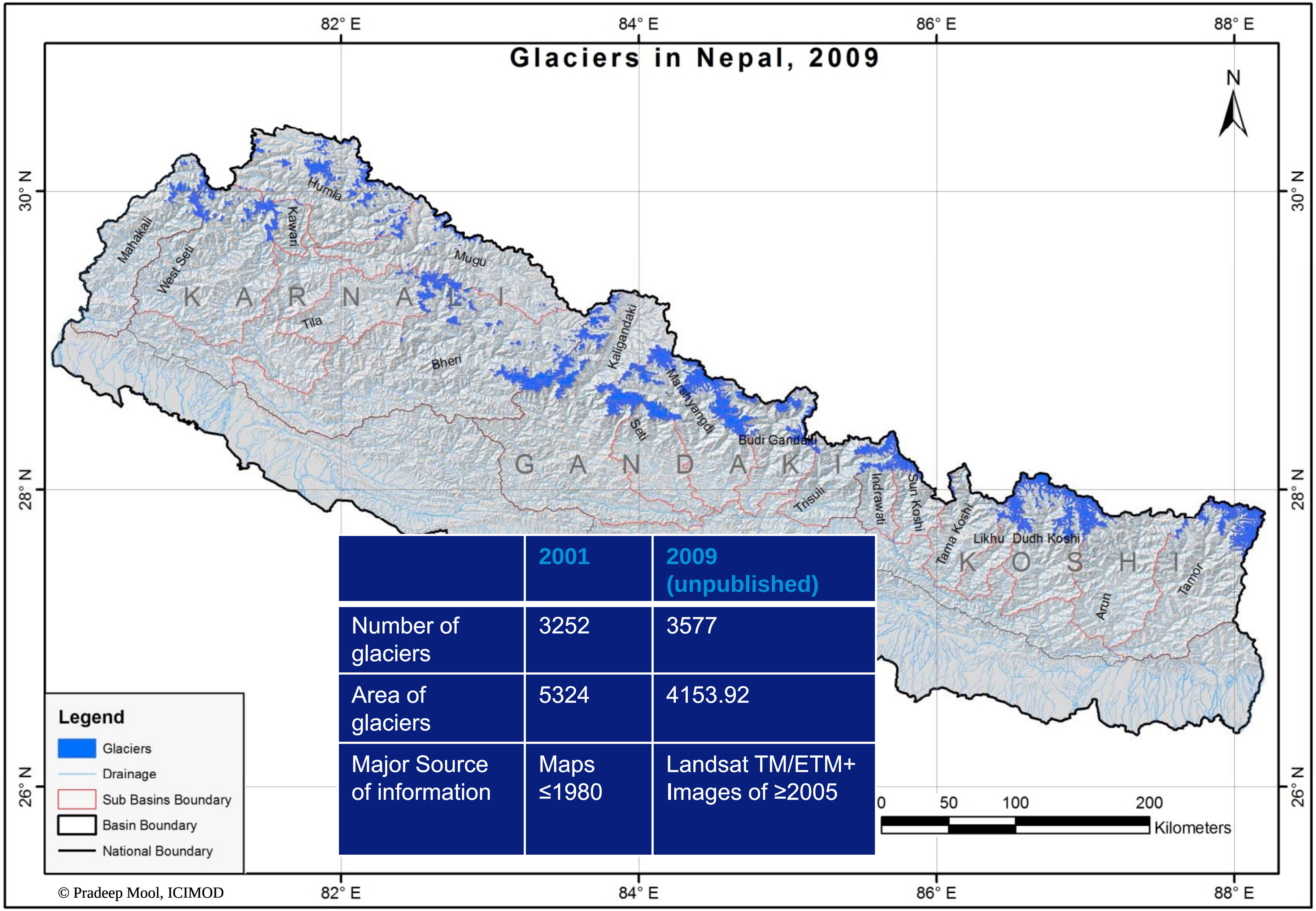
Glacial lake mapping of five river basins of HKH region



Distribution of glaciers in HKH region



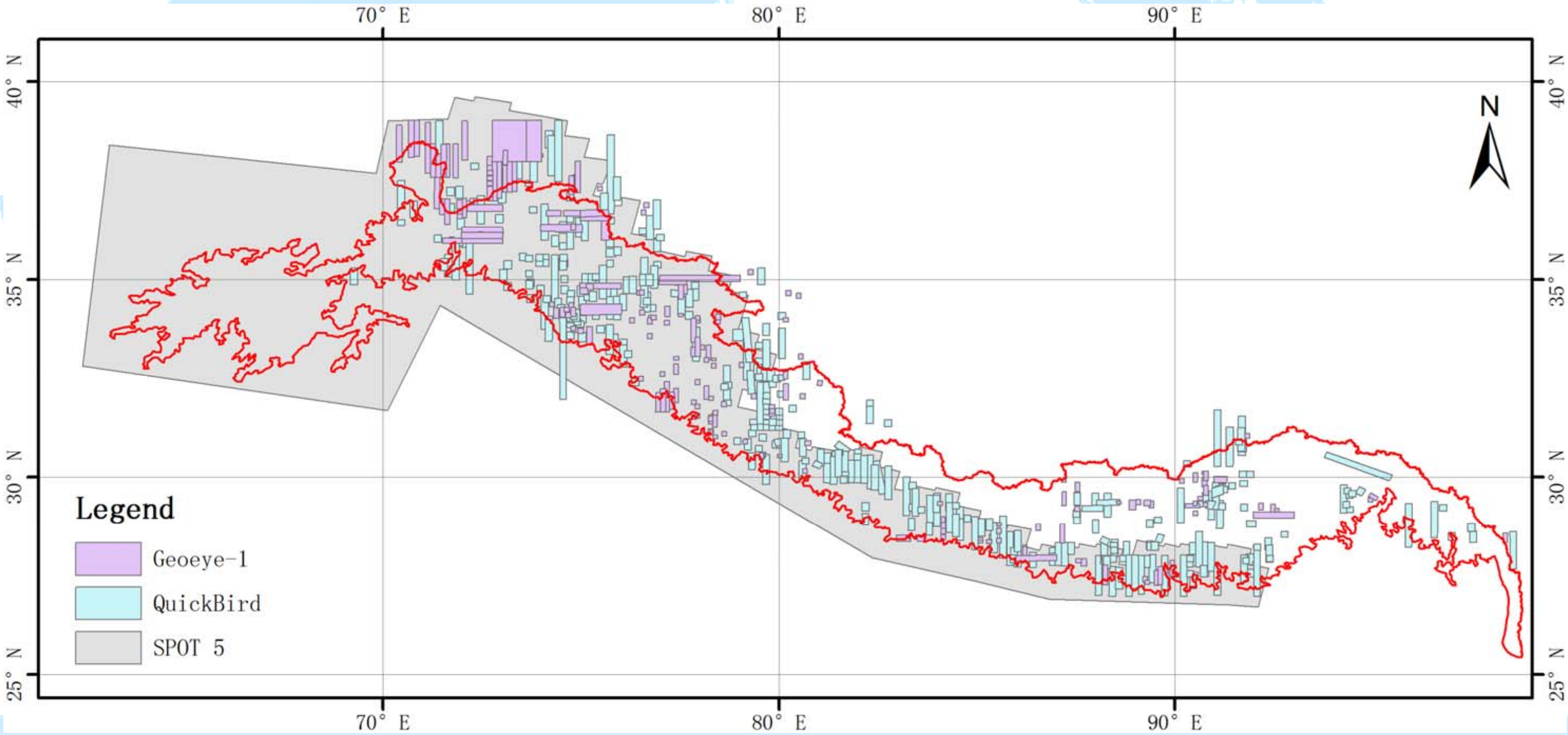
Glaciers mapping



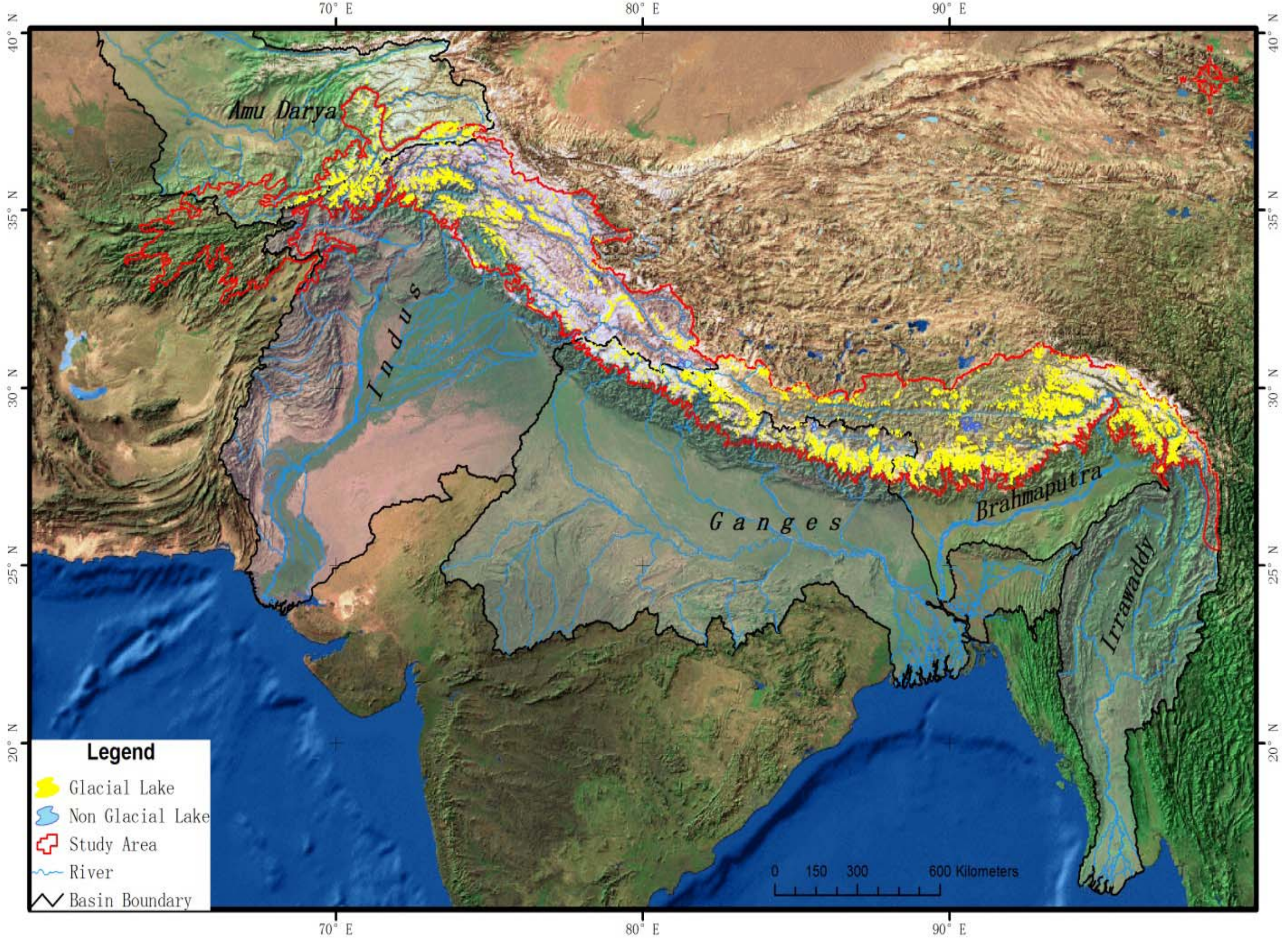
	2001	2009 (unpublished)
Number of glaciers	3252	3577
Area of glaciers	5324	4153.92
Major Source of information	Maps ≤1980	Landsat TM/ETM+ Images of ≥2005

Data source for glacial lake mapping in HKH in 2010

Data source: Landsat TM/ETM+, Geoeye-1, QuickBird, Spot5



Glacial lakes in HKH region



Glacial lake mapping in HKH region

Basin Name	Basin Code	All Lake Number		Total Area (km^2)		Mean Area	Max Area	Min Area	Range of Altitude
		N	%	Area	%	(km^2)	(km^2)	(km^2)	
Amu Darya	Am	1521	7.4	129.4	3	0.09	39.18	0.01	2977-5213
Brahmaputra	Br	10097	49.3	2367	54.8	0.23	625.3	0.01	2464-6058
Ganges	Ga	3840	18.7	598.1	13.8	0.16	270.4	0.01	3405-5980
Indus	In	4889	23.9	1218	28.2	0.25	411.1	0.01	1586-6048
Irrawaddy	Ir	138	0.7	7.86	0.2	0.06	0.5	0.01	3098-4807
Total		**20485**	**100**	**4320**	**100**	**0.21**	**625.3**	**0.01**	**1586-6058**

Prioritization of Potentially Dangerous Lakes in Nepal (ICIMOD, 2010)

No.	Name of the lake	Lake ID Number of 2001 Study	Lake ID Number of 2010 Study	New lakes not listed in 2001	Category
1	Tsho Rolpa	kta_gl_26	kota_gl_0009		I
2	Lower Barun		koar_gl_0009		I
3	Imja	kdu_gl_350	kodu_gl_0184		I
4	Lumding	kdu_gl_28	kodu_gl_0036		I
5	West Chamjang	kdu_gl_467	kodu_gl_0242		I
6	Thulagi (Dona)	gmar_gl_70	gamar_gl_0018		I
7	Nagma	ktr_gl_192	kotr_gl_0133		II
8	Hungu	kdu_gl_464	kodu_gl_0241		II
9	Tam Pokhari	kdu_gl_399	kodu_gl_0193		II
10	Hungu	[illegible]	[illegible]	[illegible]	II
11		[illegible]	[illegible]	[illegible]	III
12		[illegible]	[illegible]	[illegible]	III
13	Barun	[illegible]	[illegible]	[illegible]	III
14		[illegible]	[illegible]	[illegible]	III
15	(Q)	[illegible]	[illegible]	[illegible]	III
16	(H)	[illegible]	[illegible]	[illegible]	III
17		[illegible]	[illegible]	[illegible]	III
18	(S)	[illegible]	[illegible]	[illegible]	III
19	(B)	[illegible]	[illegible]	[illegible]	III
20	East Hungu 2	[illegible]	[illegible]	[illegible]	III
21	Kaligandaki (T)	gka_gl_67	gaka_gl_0022		III

Note:

Categories among the 21 Prioritized Potentially Dangerous Lakes (ICIMOD, 2009 unpublished)

I. six of these were considered potentially dangerous lakes requiring detailed field investigation and mapping,

II.four potentially dangerous lakes which require close monitoring with reconnaissance field surveys, and

III.another eleven lakes which require periodic observation

Required for monitoring of :Trakarding Glacier, Tsho Rolpa glacial lake and surroundings


1957-59, Aerial Photo Survey of India

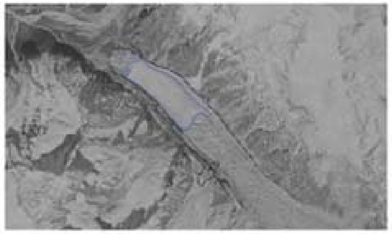

2 December 1983, SpaceLab IR

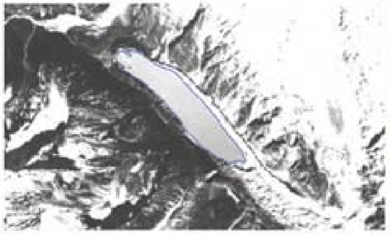

15 January 1999, LISS-3

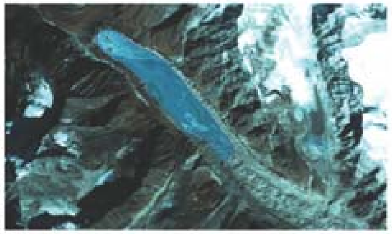

1960 - 68, Schneider Map

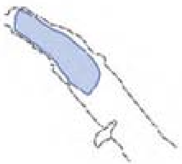

17 December 1991, LandSat TM

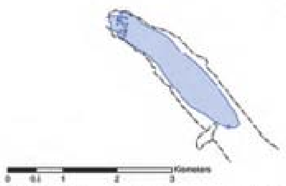

30 October 2000, LandSat ETM+

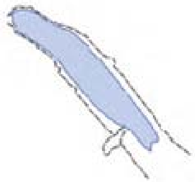

21 November 1973, Corona Image


20 October 1992, Aerial Photo

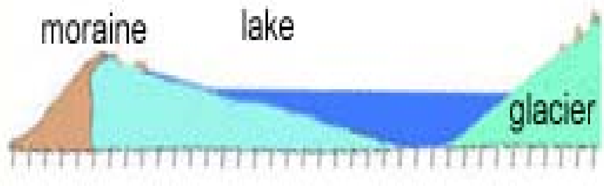

19 January 2007, AVNIR-2


2 November 1975, LandSat MSS

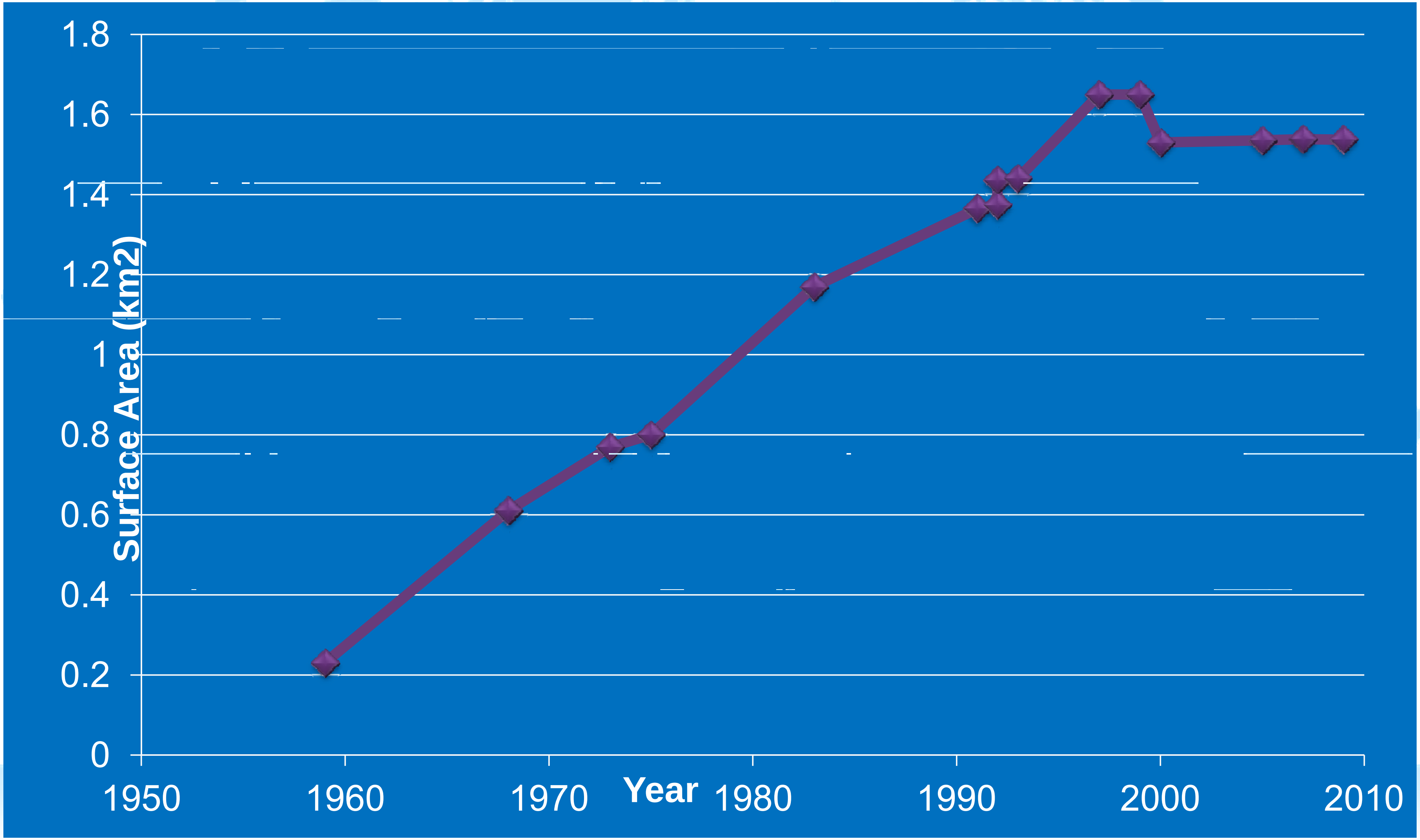

1993 - 94, Field Survey WECS


August 2009, Field Survey ICIMOD

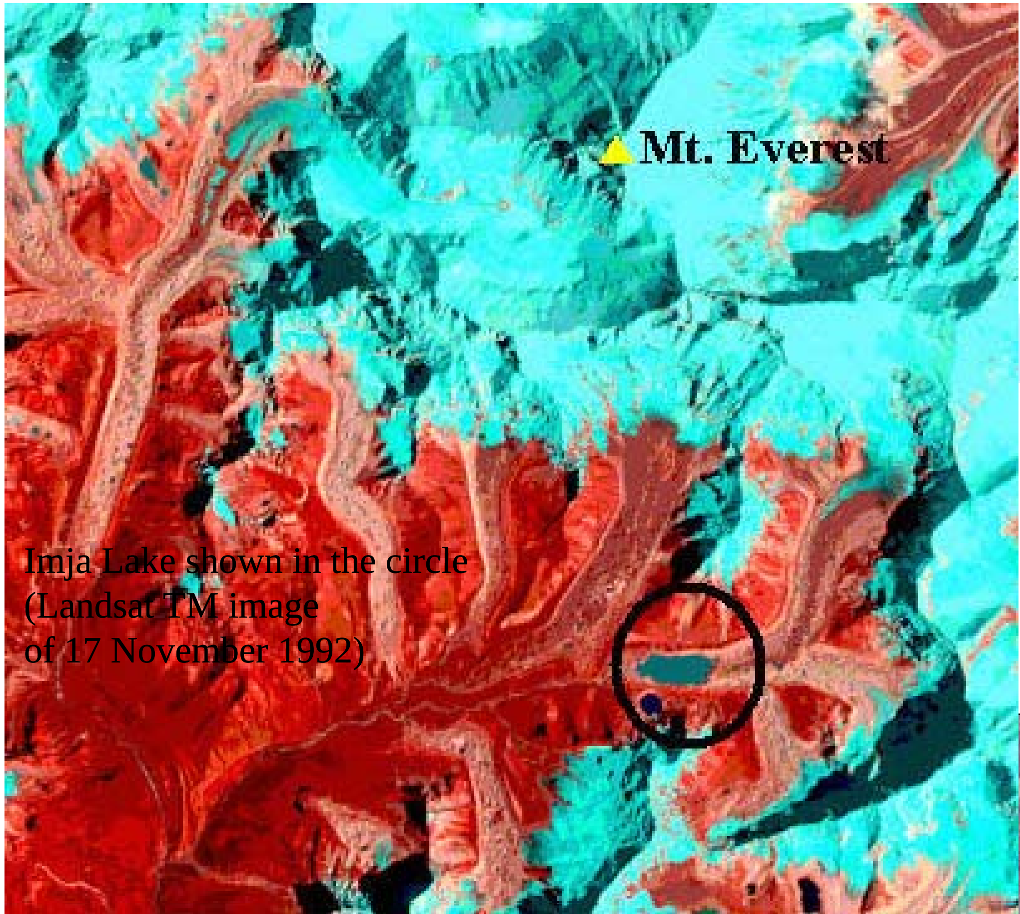
Formation and Expansion of Tsho Rolpa Glacial Lake



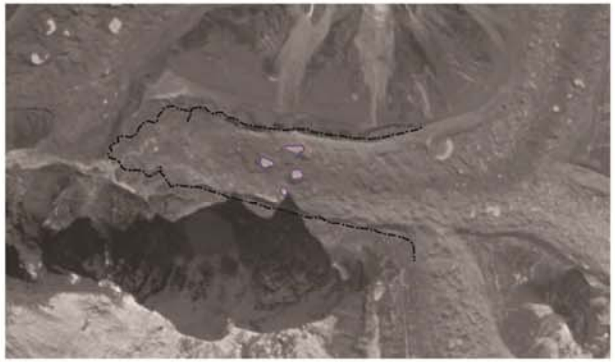
Growth of Tsho Rolpa Glacial Lake



Imja Tsho glacial lake



22 April 1991

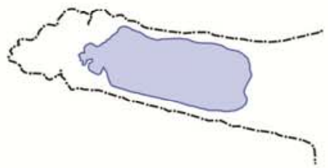


15 December 1962, Corona Image

20 October 1992, Aerial Photo

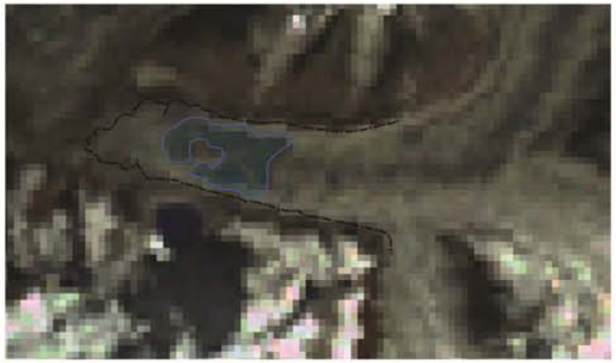
4 December 2006, ALOS PRISM Image

1967, Survey of India Topographic map

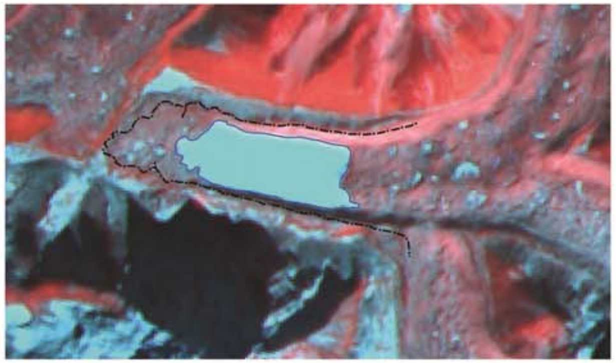


July 1997, Field Survey GEN/ DHM

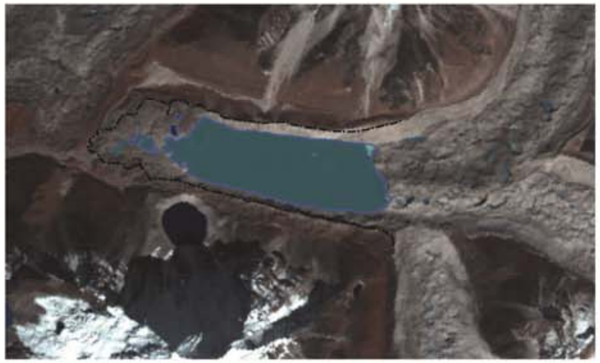
20 November 2007, AVNIR2 Image



15 October 1975, LandSat MSS Image

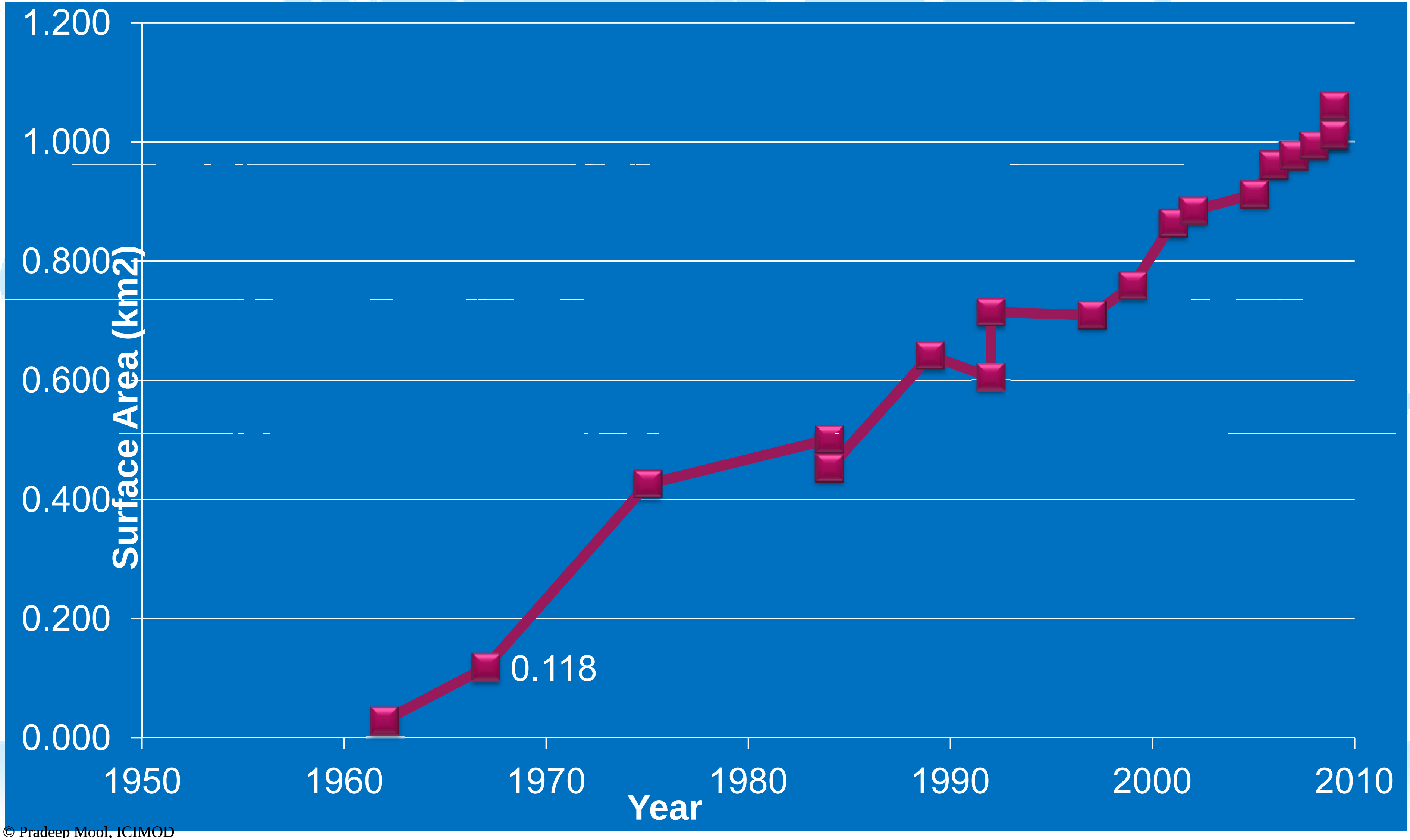


15 January 1999, LISS-3 Image

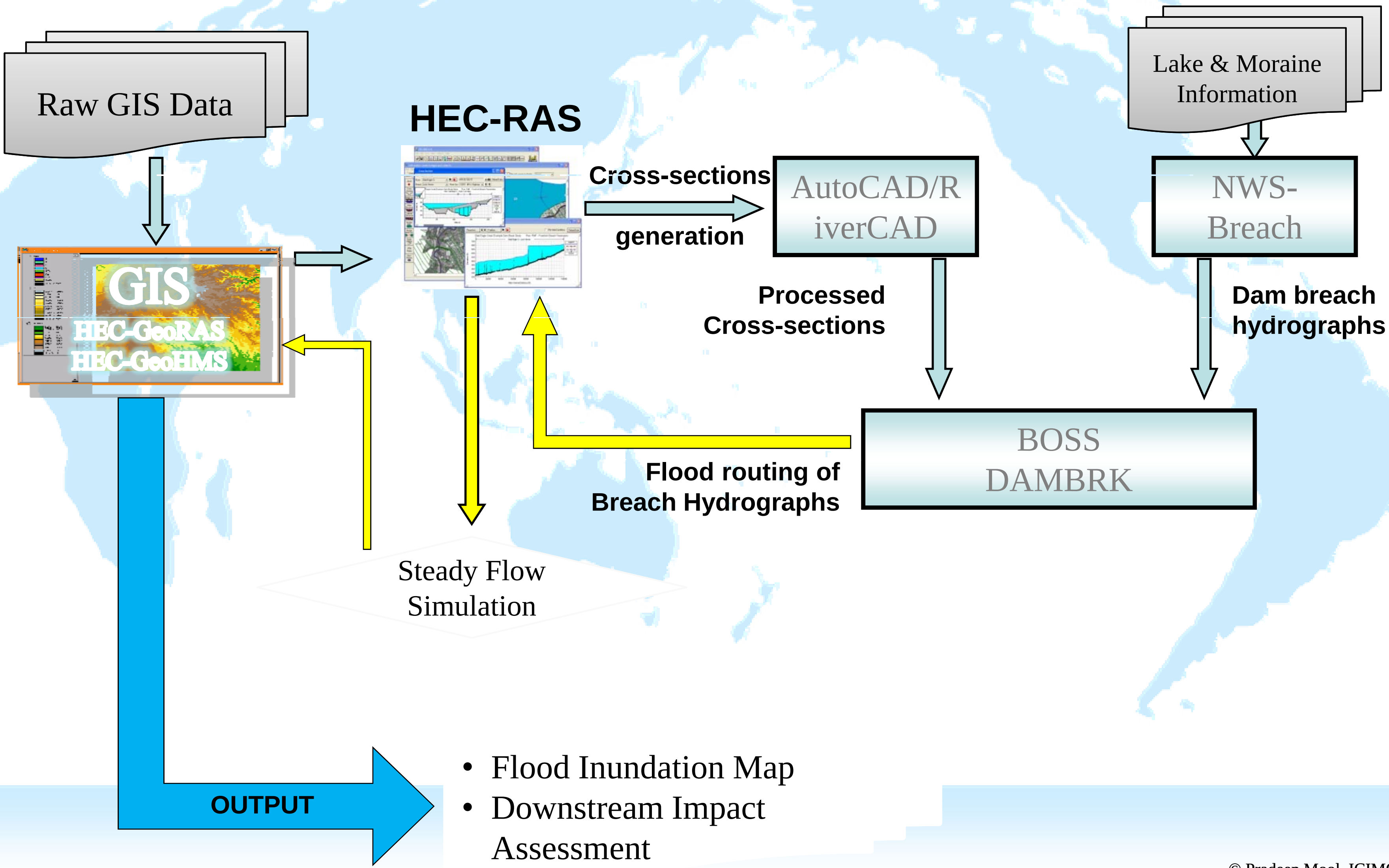


24 November 2008, AVNIR2 Image

Growth of Imja Glacial Lake



Dam Break Modeling



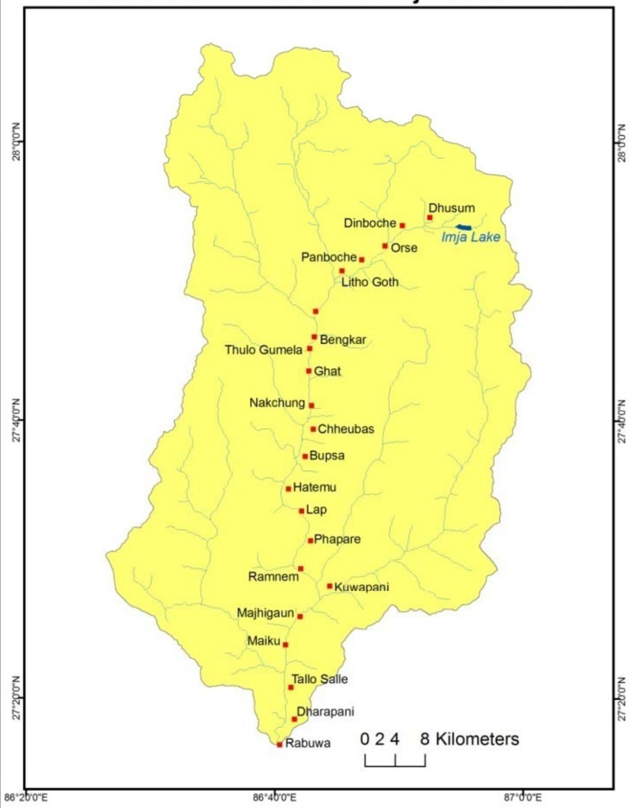
Imja Tsho glacial lake

Results of Dam Break Model

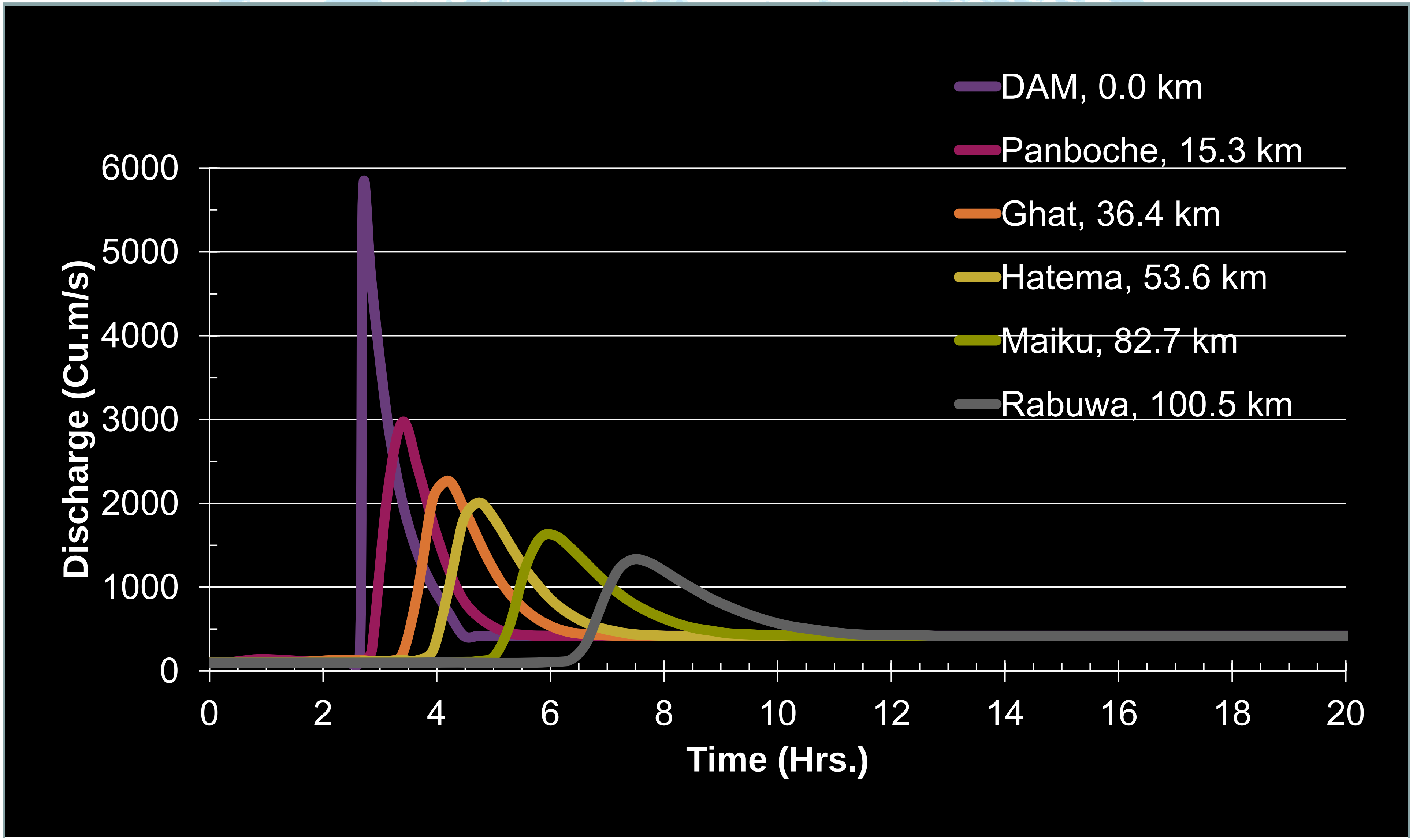
SN	Location	Distance from Dam (km)	Maximum Flow (Cu.m/s)	Max. Flood reaching time (hrs)	Maximum Stage Elevation (m MSL)	Normal Flow Water Elevation (m MSL)	Normal Flow Depth (m)	Flood Depth* (m)
1	DAM	0.00	5708	2.124	4994.42	4983.17	2.17	11.25
2	Dhusum	4.16	3813	2.989	4704.17	4698.87	1.10	5.30
3	Dinboche	7.97	3409	3.124	4334.44	4327.97	1.97	6.47
4	Orse	11.69	3159	3.259	4047.08	4040.82	1.11	6.26
5	Panboche	15.72	2965	3.394	3792.06	3786.88	2.18	5.18
6	Litho Goth	20.71	2766	3.529	3266.96	3264.30	1.08	2.66
7	Confluence	25.25	2604	3.665	2905.78	2898.35	1.51	7.43
8	Bengkar	29.18	2493	3.800	2725.83	2720.46	2.46	5.37
9	Thulo Gumela	32.94	2383	3.935	2595.02	2590.18	2.03	4.84
10	Ghat	37.34	2264	4.205	2419.05	2413.05	1.62	6.00
11	Nakchung	41.17	2192	4.340	2099.61	2096.43	1.15	3.18
12	Chheubas	44.30	2148	4.340	1784.02	1778.24	3.24	5.78
13	Buspa	48.16	2102	4.340	1604.60	1598.43	2.43	6.17
14	Hatemu	53.22	2011	4.745	1418.06	1412.32	2.32	5.74
15	Lap	57.89	1956	4.880	1236.80	1228.64	4.07	8.16
16	Phapare	62.72	1894	5.016	1104.41	1098.04	3.04	6.37
17	Ramnem	67.77	1835	5.151	943.07	938.21	2.21	4.86
18	Kuwapani	71.98	1785	5.421	839.05	832.44	3.01	6.61
19	Majhigaun	77.70	1707	5.691	741.51	736.17	2.75	5.34
20	Maiku	82.33	1640	5.961	638.29	635.51	0.94	2.78
21	Tallo Salle	88.55	1551	6.367	533.29	529.21	2.21	4.08
22	Dharapani	93.35	1475	6.772	487.30	483.01	1.73	4.29
23	Rabuwa	100.20	1328	7.447	446.25	442.62	2.62	3.63

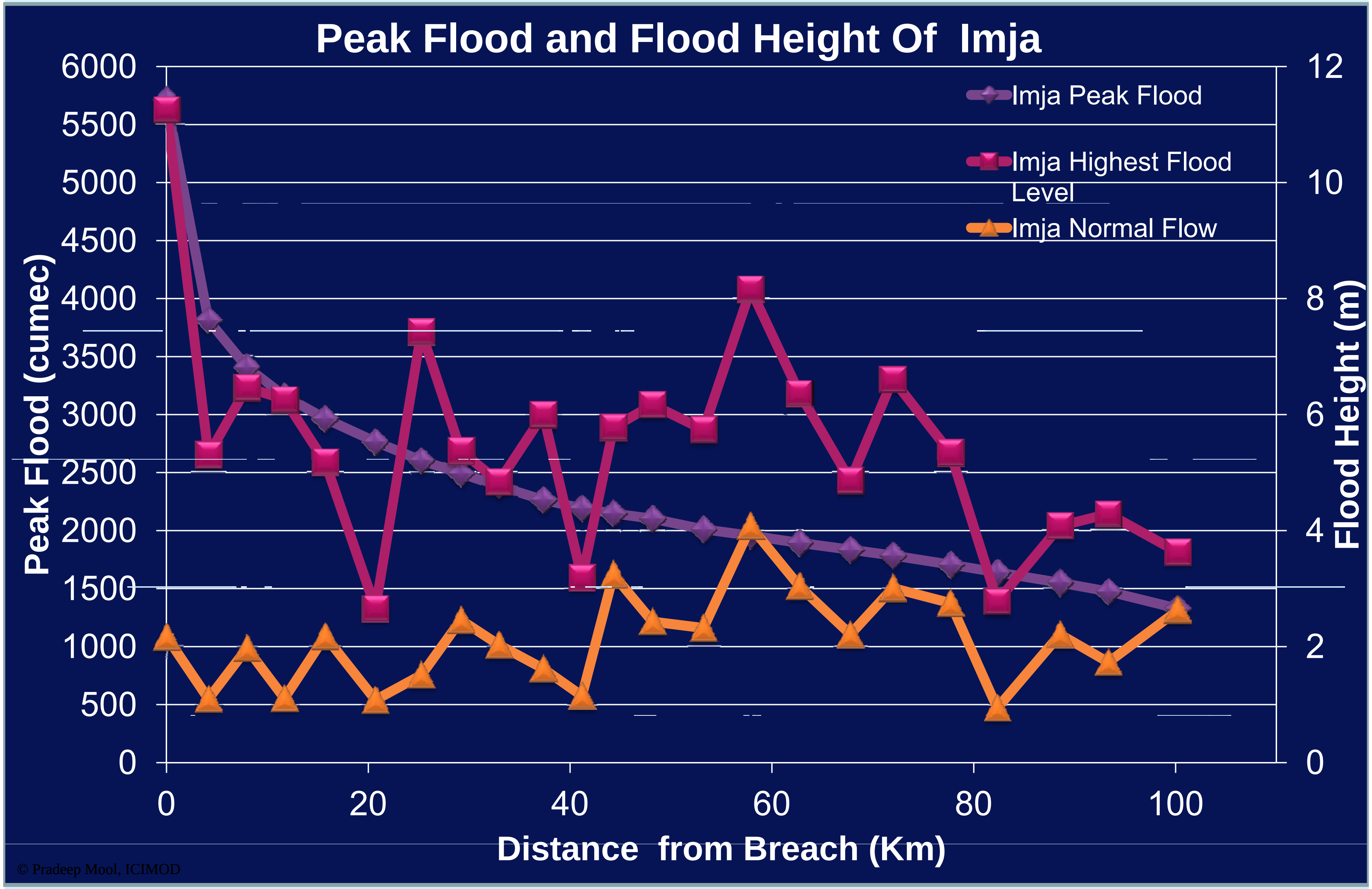
*above the normal flow depth

Settlements at Downstream of Imja Glacier Lake

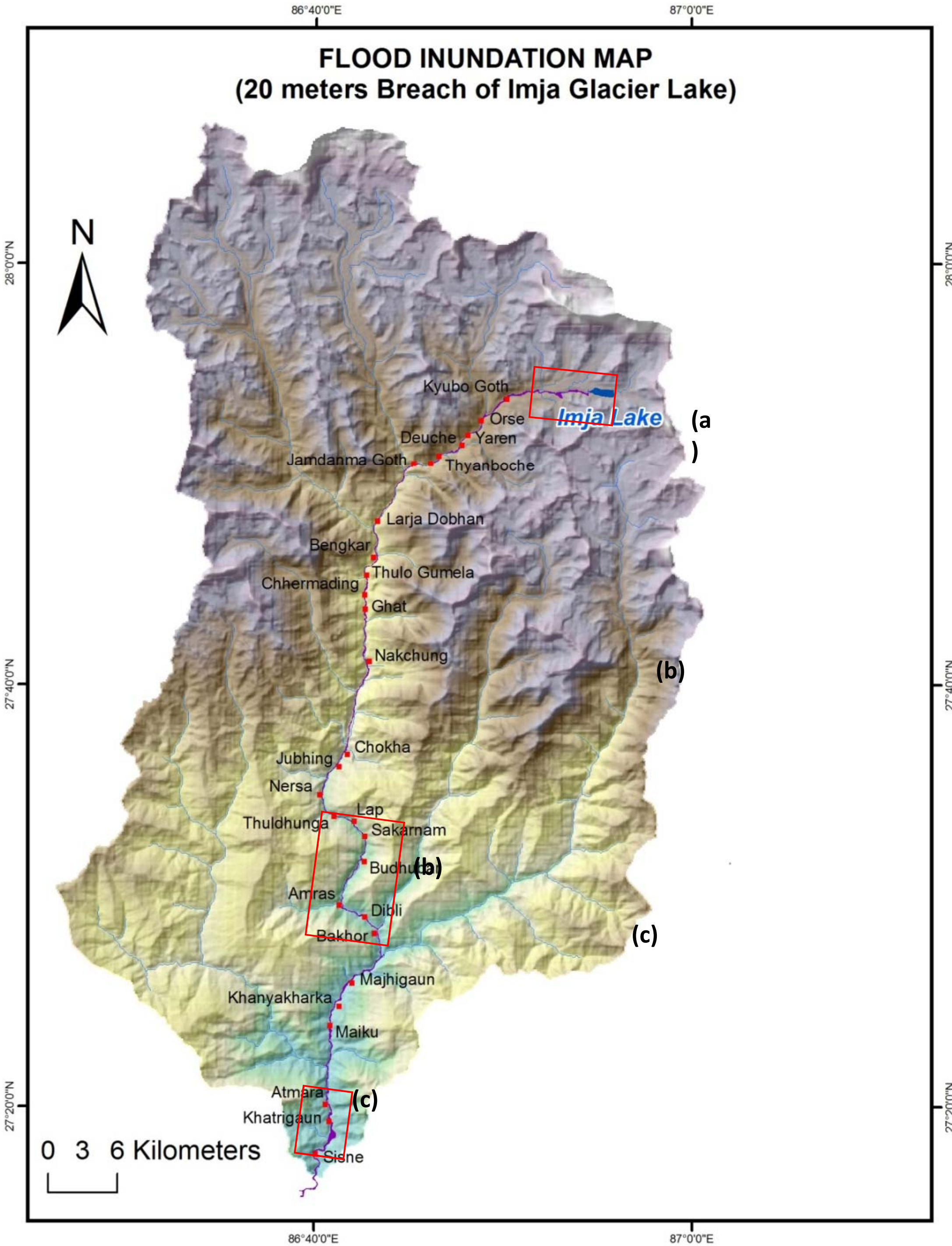


Attenuation of Imja Potential GLOF

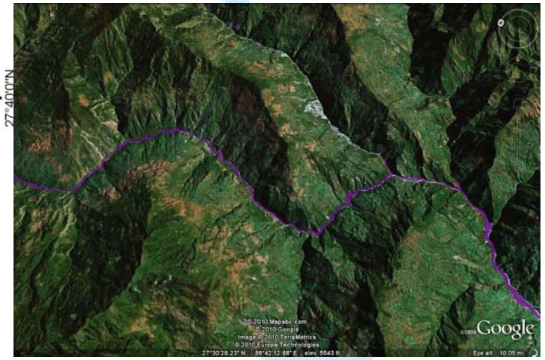


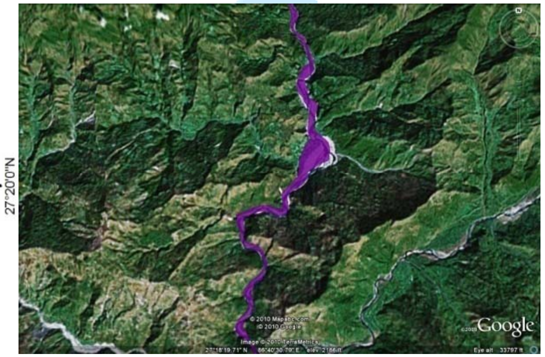


Peak Flood and Flood Height Of Imja
Imja Peak Flood
Imja Highest Flood Level
Imja Normal Flow
Peak Flood (cumec)
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
Flood Height (m)
12
10
8
6
4
2
0
0
20
40
60
80
100
Distance from Breach (Km)


FLOOD INUNDATION MAP
(20 meters Breach of Imja Glacier Lake)
N
86°40'0"E
87°0'0"E
28°0'0"N
27°40'0"N
27°20'0"N
Imja Lake
(a)
Kyubo Goth
Orse
Yaren
Deuche
Jamdanma Goth
Thyanboche
Larja Dobhan
Bengkar
Thulo Gumela
Chhermading
Ghat
Nakchung
(b)
Chokha
Jubhing
Nersa
Lap
Thuldhunga
Sakarnam
Budhuban
Amras
Dibli
Bakhor
(c)
Majhigaun
Khanyakharka
Maiku
Atmara
Khatrigaun
Sisne
0 3 6 Kilometers

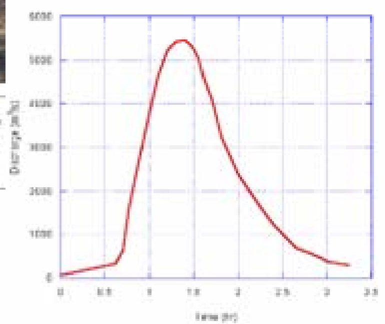

Google


Google

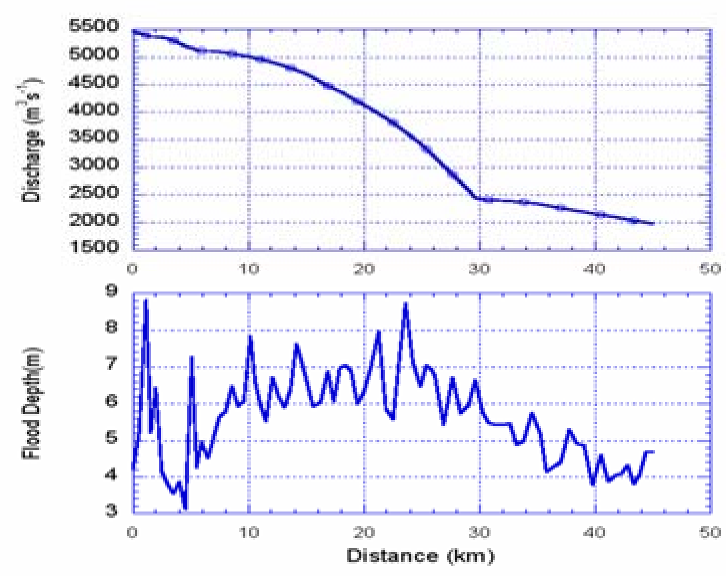

Google

Simulation of GLOF scenario from Imja

Place	Ch (km)	Time (min)	Discharge (m^3s^{-1})	Flood Depth (m)
Lake outlet	0.0	0.0	5461	
Dingboche	7.518	13.9	5094	5.81
Orso	11.545	18.8	4932	5.53
Pangboche	13.648	21.3	4800	7.62
Larja Dovan	25.940	34.8	3223	6.91
Bengkar	29.669	38.8	2447	6.64
Ghat	34.559	46.4	2355	5.75



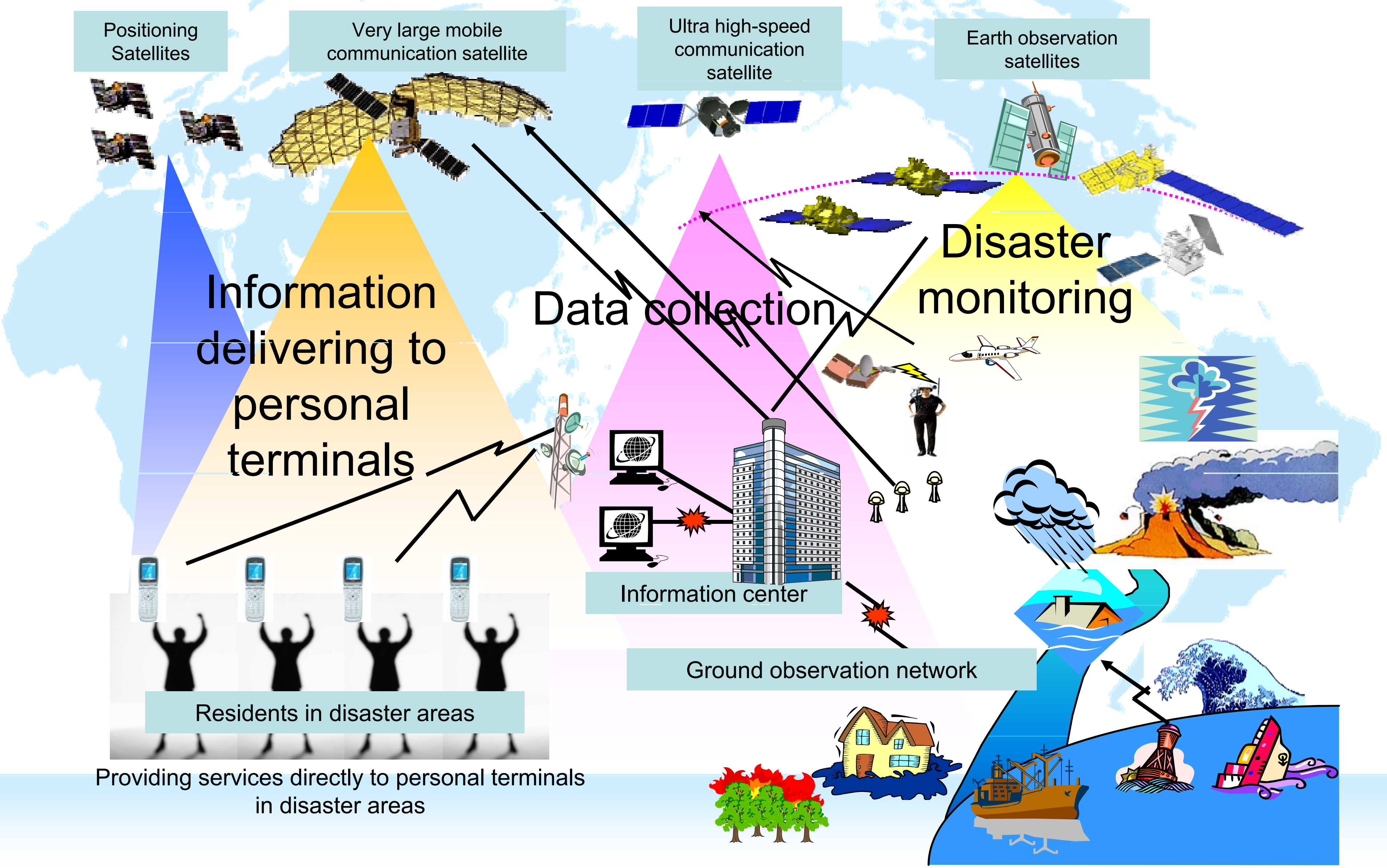
GLOF hydrograph of Imja



Peak flow and peak flood depth along the rivers

GLOF Vulnerability at Dingboche

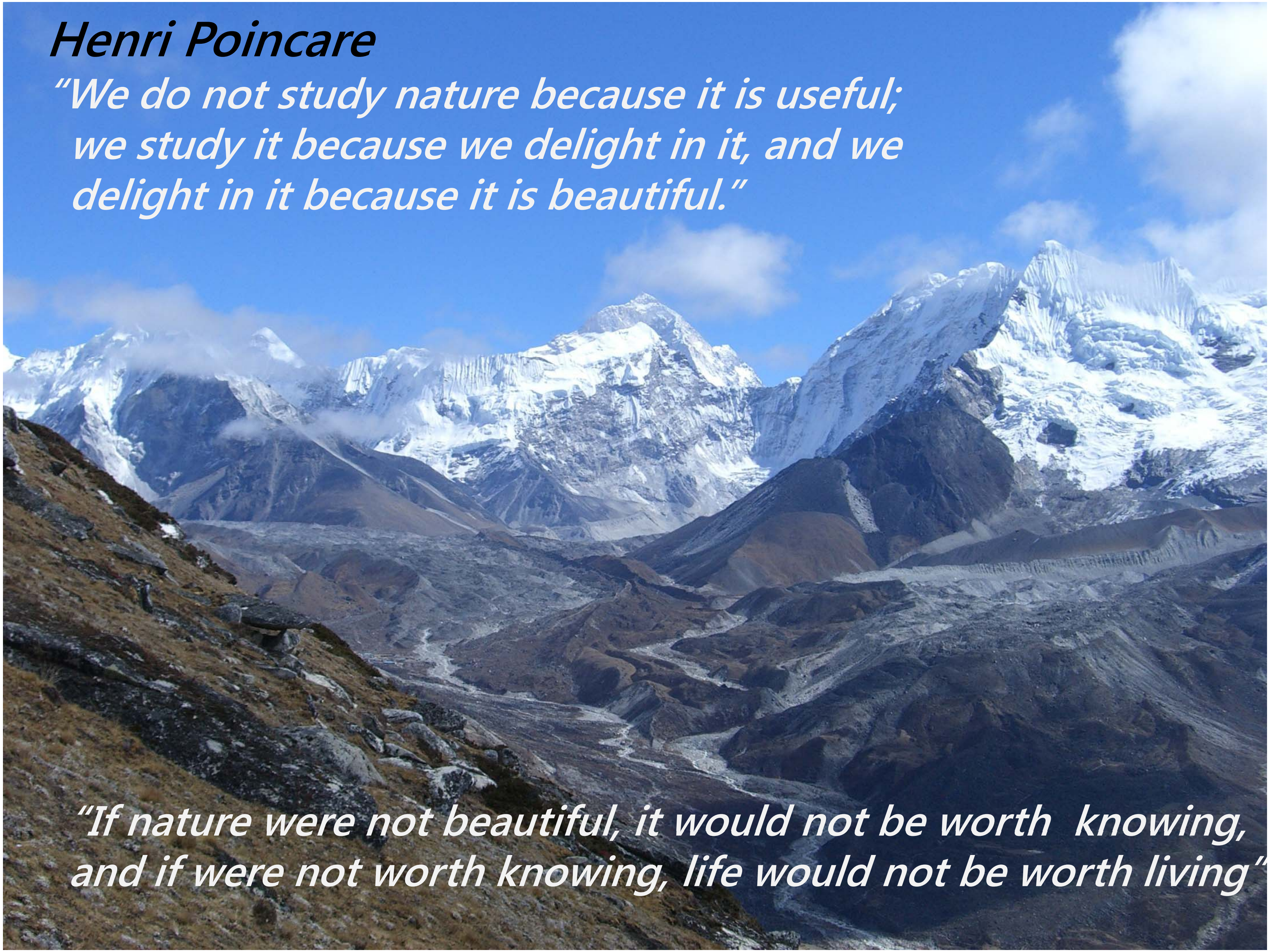
JAXA Vision of a Disaster Management Support System in the Asia-Pacific Region

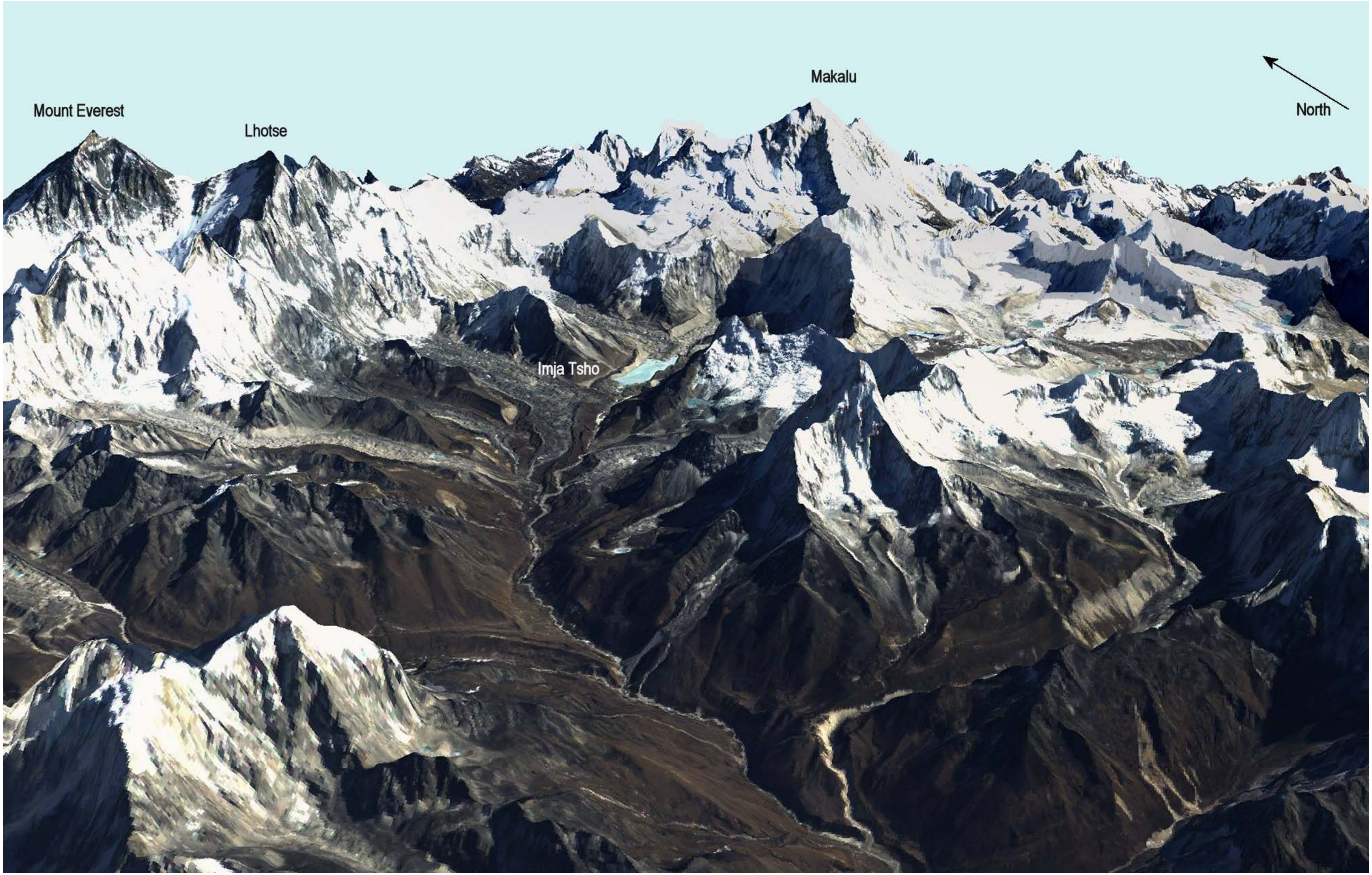


Case Study 2

Pilot project on Monitoring Imja Glacial Lake

--- Global Warming Front Monitoring System


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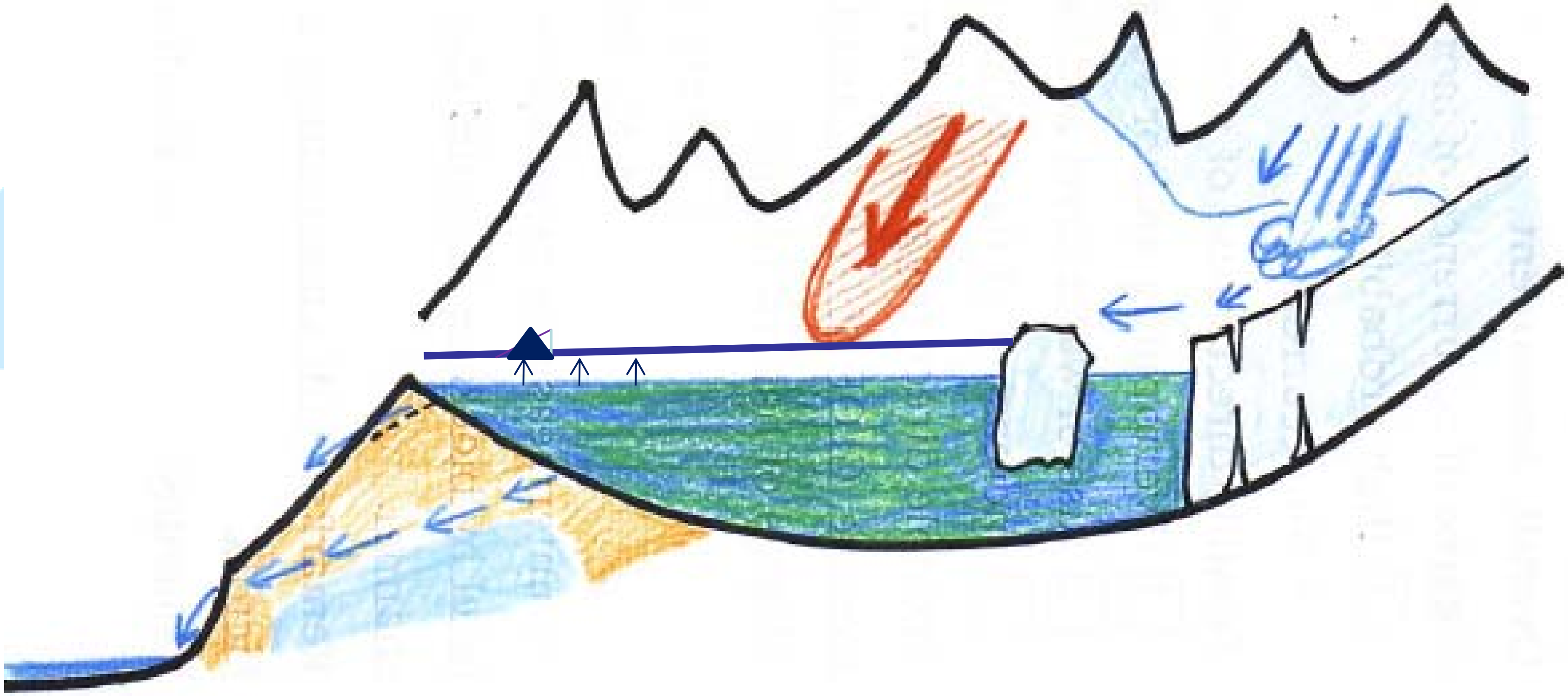
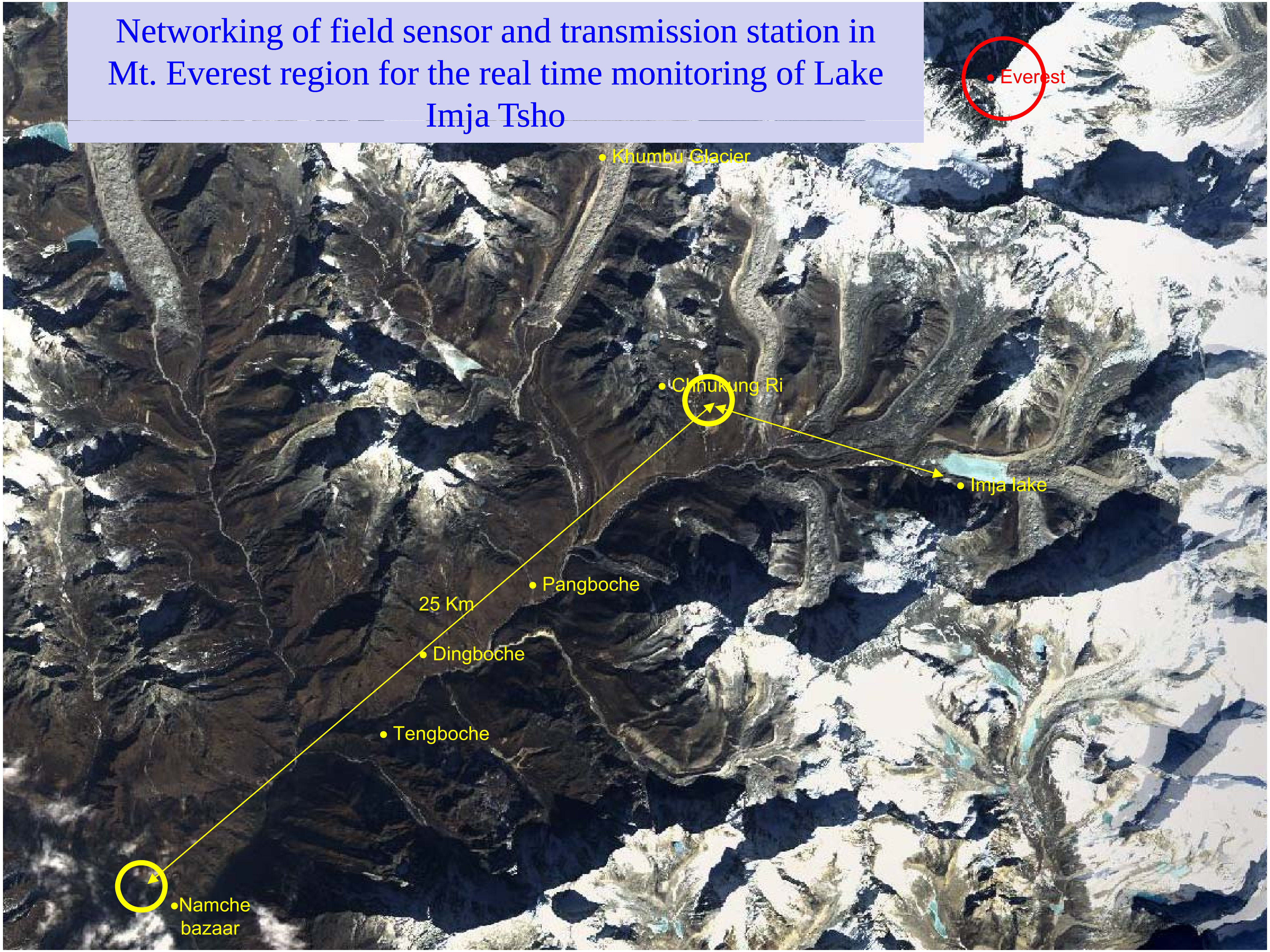
On this joyous & memorable occasion, the Gross National Happiness Commission joins the Nation in offering its deepest felicitations and humble prayers for the well being and everlasting happiness of

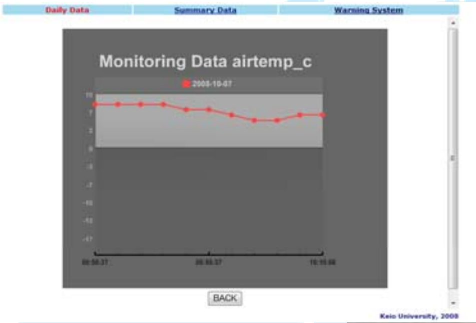
Climate Change and Triggers of GLOF



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


Networking of field sensor and transmission station in Mt. Everest region for the real time monitoring of Lake Imja Tsho
Everest
Khumbu Glacier
Chhukung Ri
Imja lake
Pangboche
25 Km
Dingboche
Tengboche
Namche bazaar

Real Time Sensing – Image, …

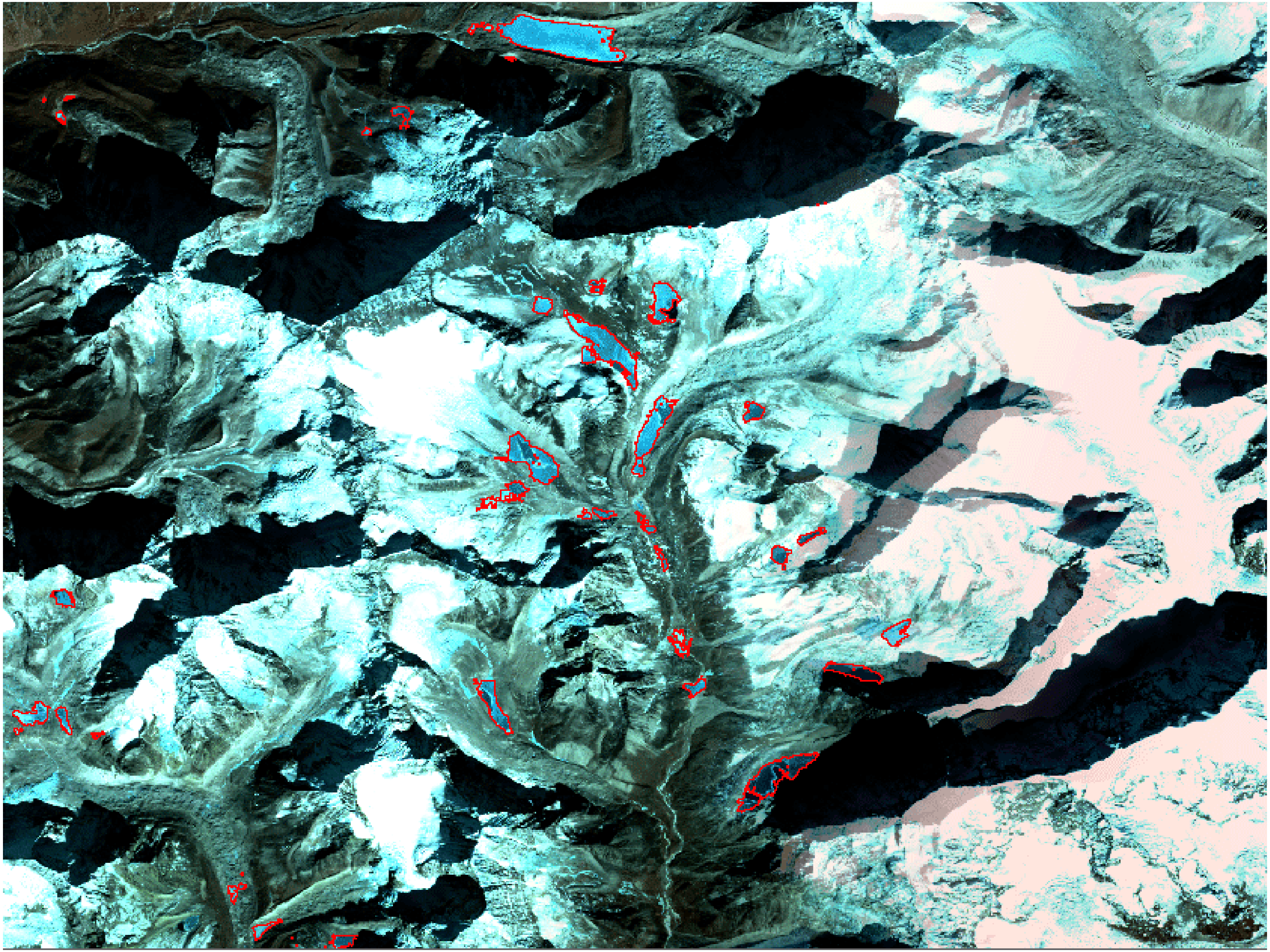


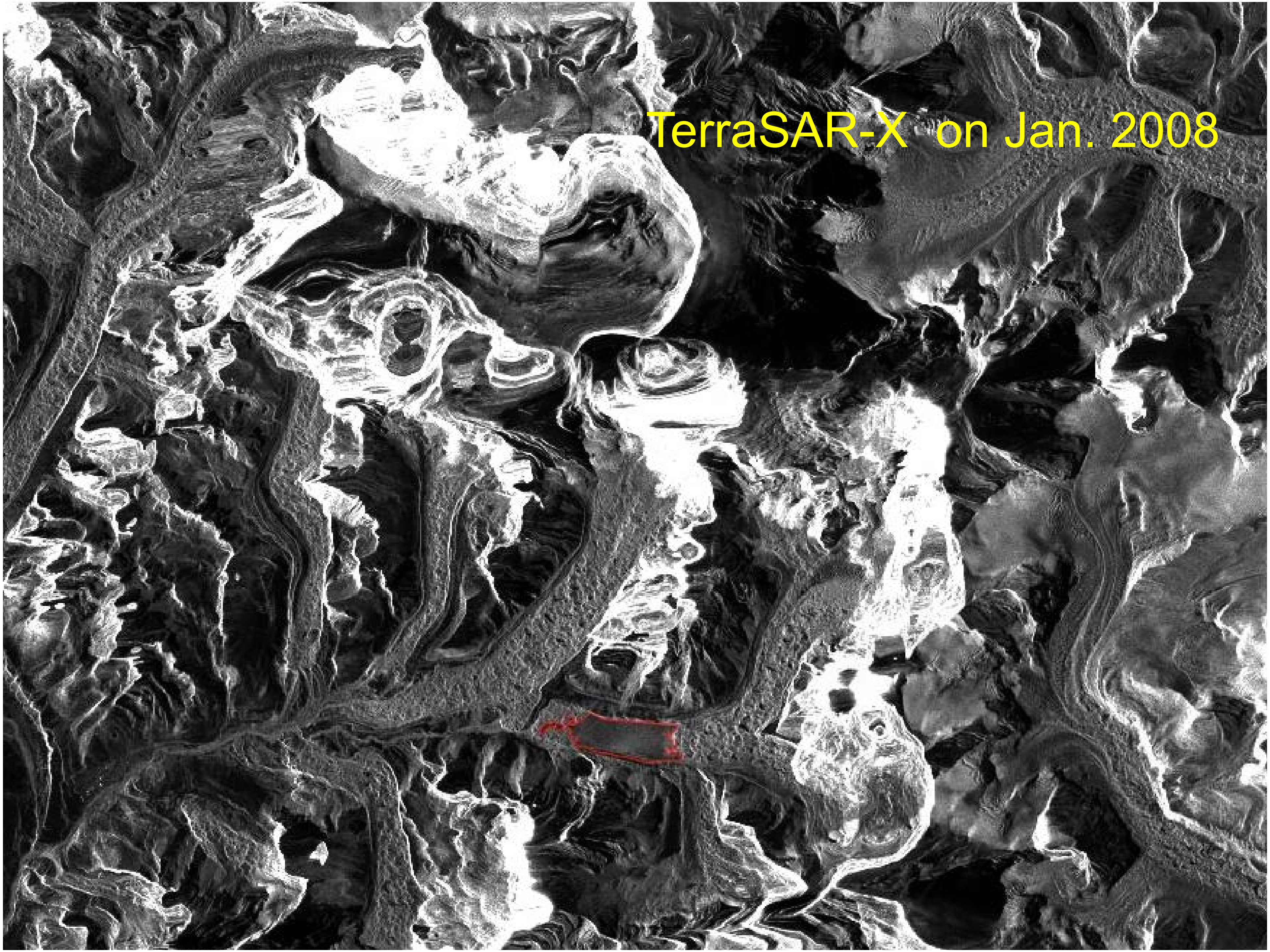
5/9

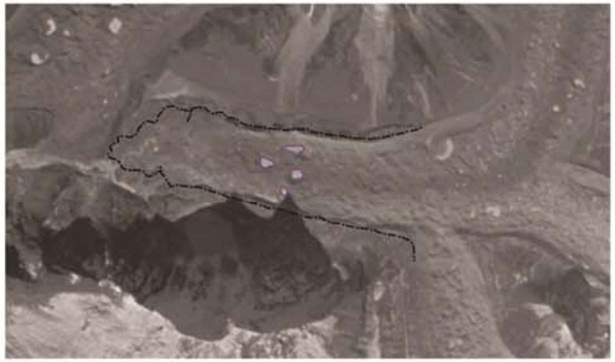
5/10

5/11

5/12




TerraSAR-X on Jan. 2008

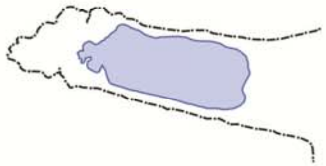


15 December 1962, Corona Image

20 October 1992, Aerial Photo

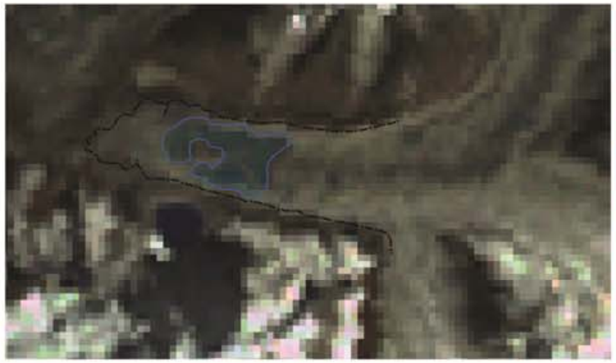
4 December 2006, ALOS PRISM Image

1967, Survey of India Topographic map

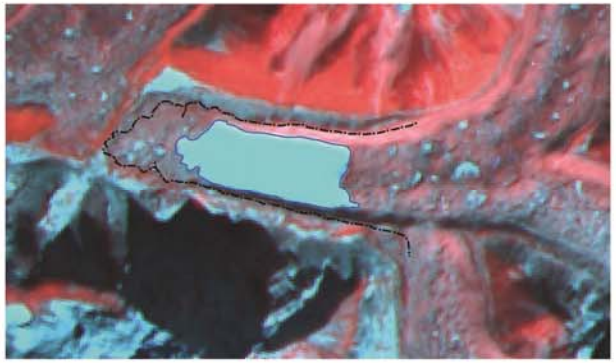


July 1997, Field Survey GEN/ DHM

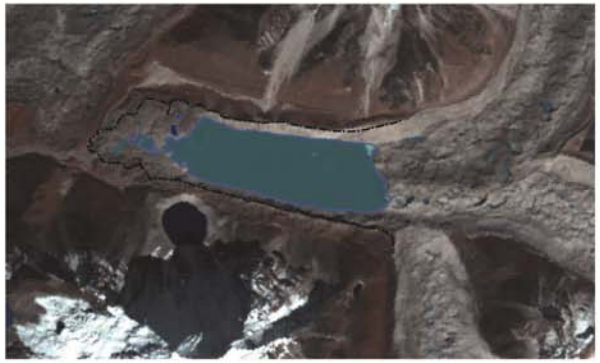
20 November 2007, AVNIR2 Image



15 October 1975, LandSat MSS Image



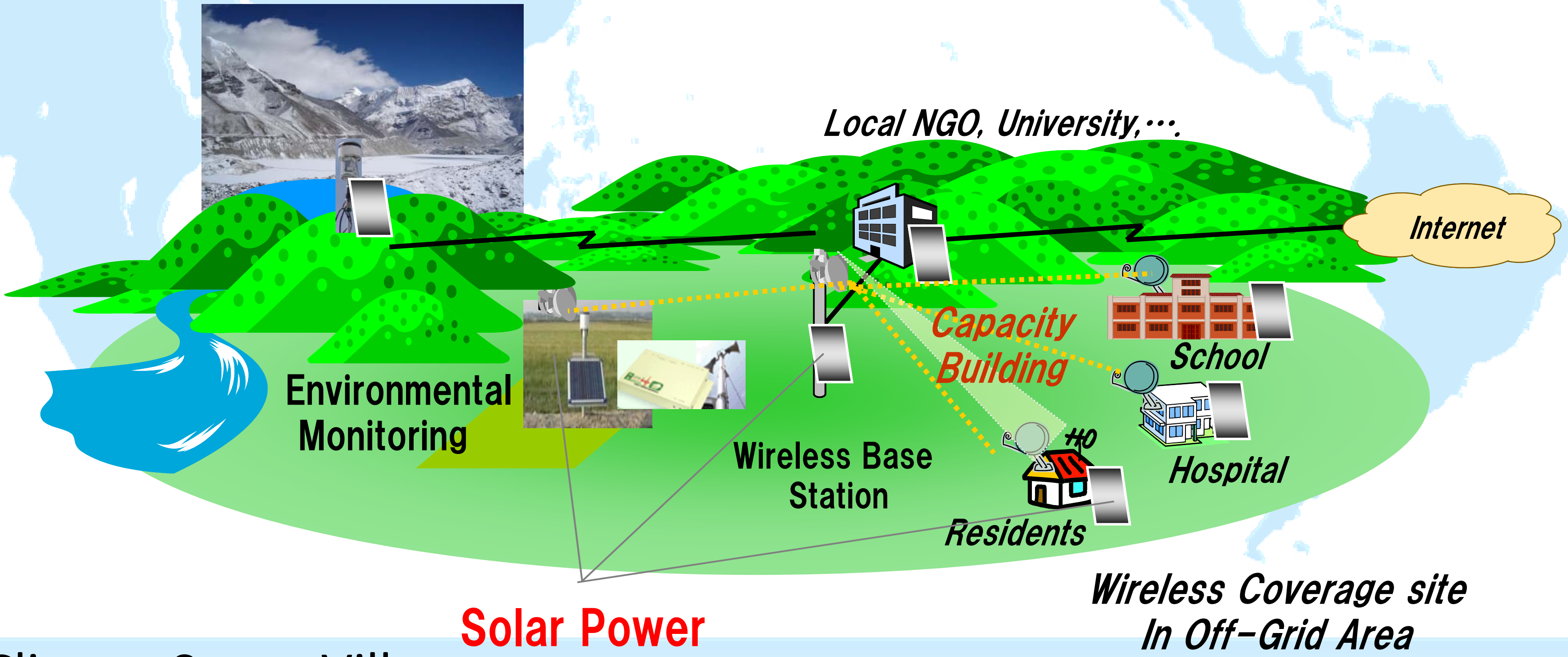
15 January 1999, LISS-3 Image

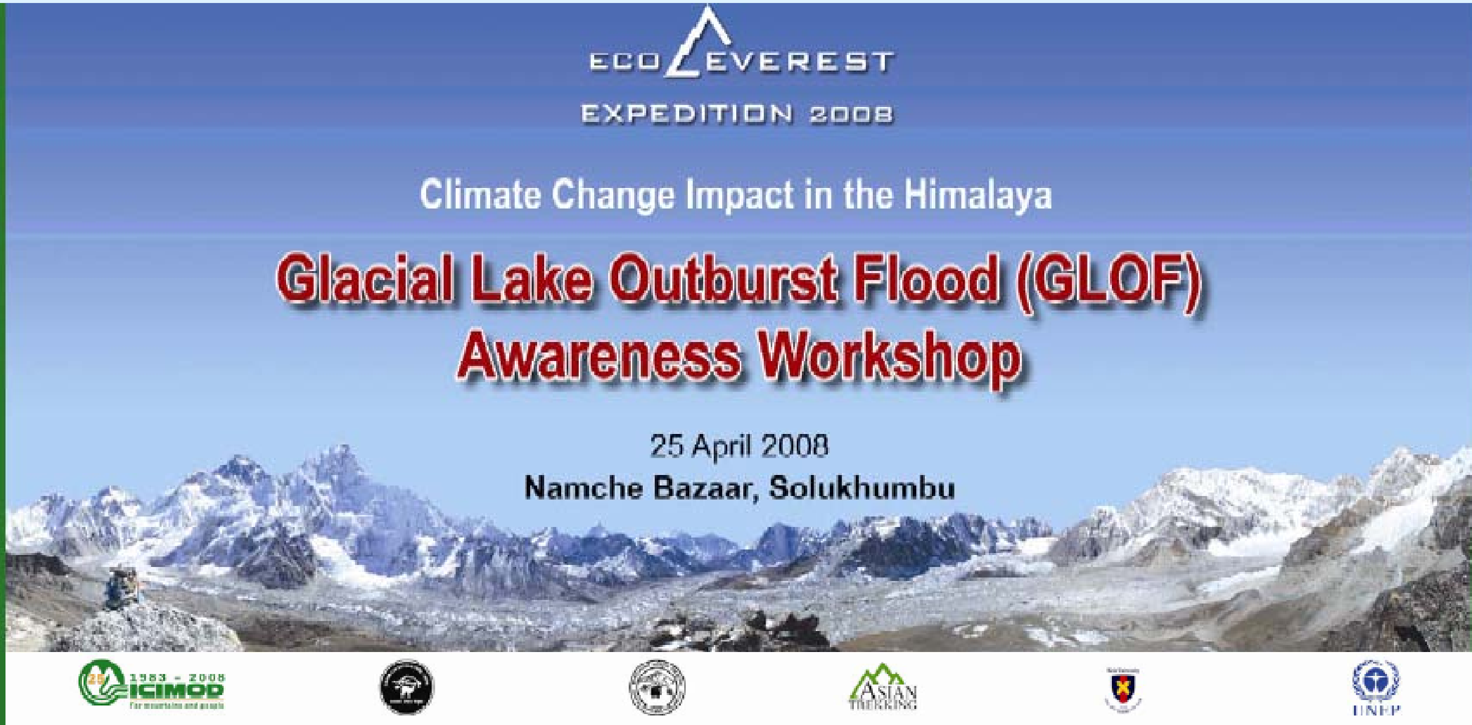


24 November 2008, AVNIR2 Image

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

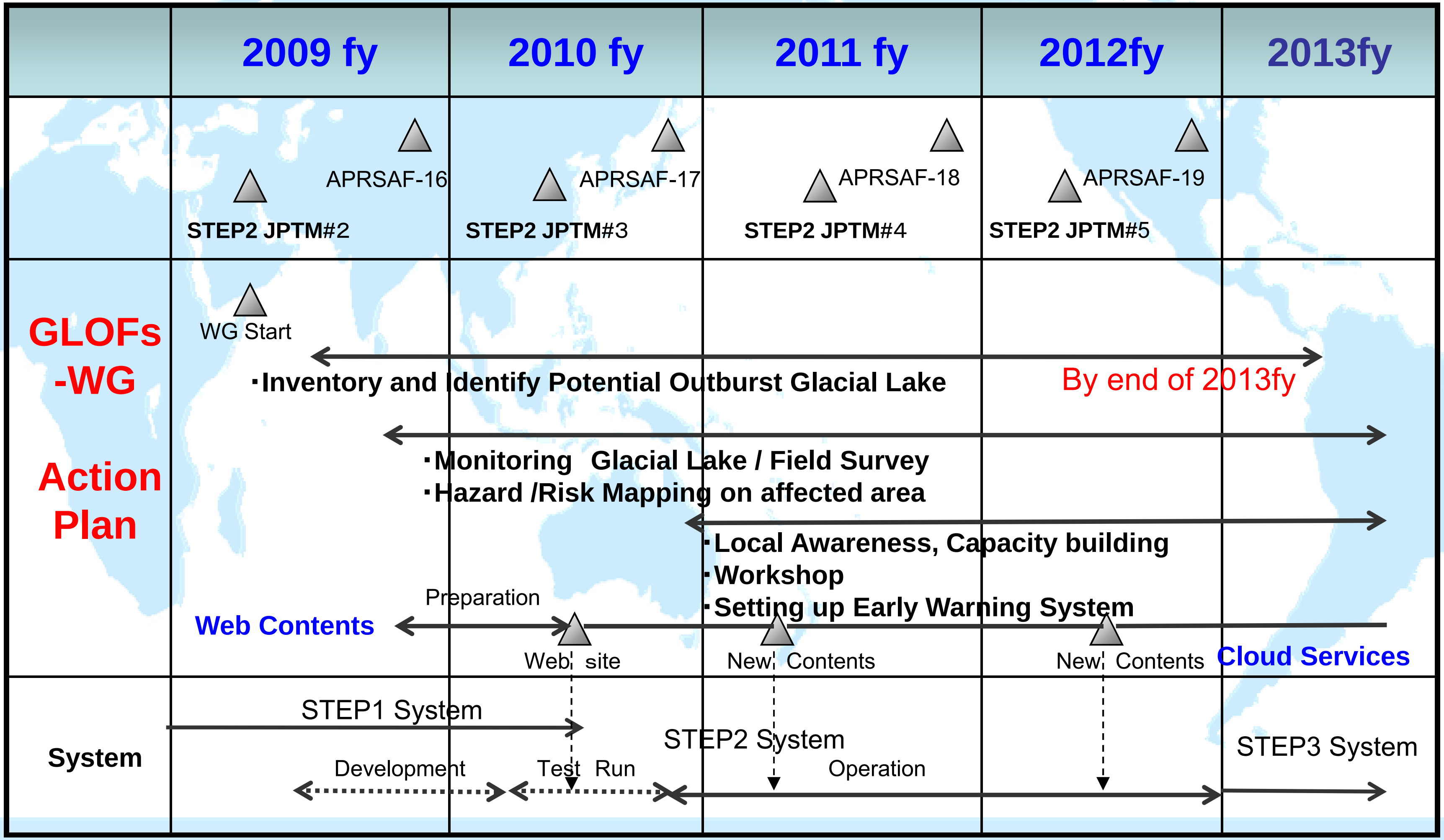
- -Providing **Internet** as Social Infrastructure: Improve Digital Divide
- -Providing **wireless sensor network** for environmental monitoring
- -Providing **early warning systems** for Multi-Hazards, such as GLOF




ECO EVEREST
EXPEDITION 2008
Climate Change Impact in the Himalaya
Glacial Lake Outburst Flood (GLOF)
Awareness Workshop
25 April 2008
Namche Bazaar, Solukhumbu
1983 - 2008
ICIMOD
ASIAN TREKKING
UNEP


2008/4/25 10:34

the Glacial Lake Outburst Flood Working Group Action Plan



Towards Step3

- Regular mapping and monitoring by Satellite image and Field work
  - Detailed survey physical measurement and UAV at moraine area
- 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

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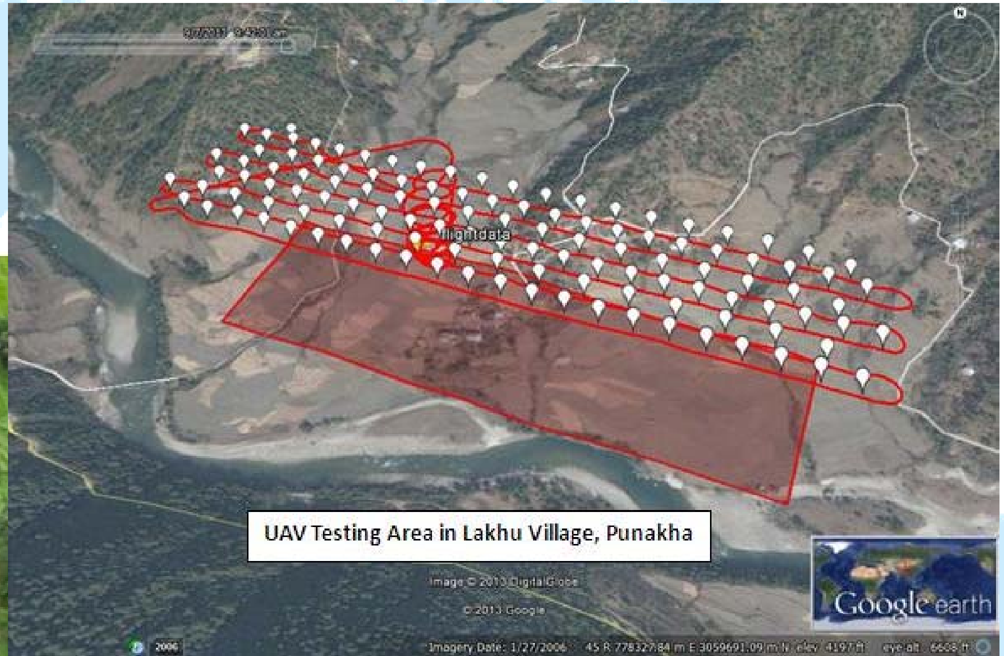
On this joyous & memorable occasion, the Gross National Happiness Commission joins the Nation in offering its deepest felicitations and humble prayers for the well being and everlasting happiness of

Unmanned Aerial Vehicle (UAV) and mapping of research site

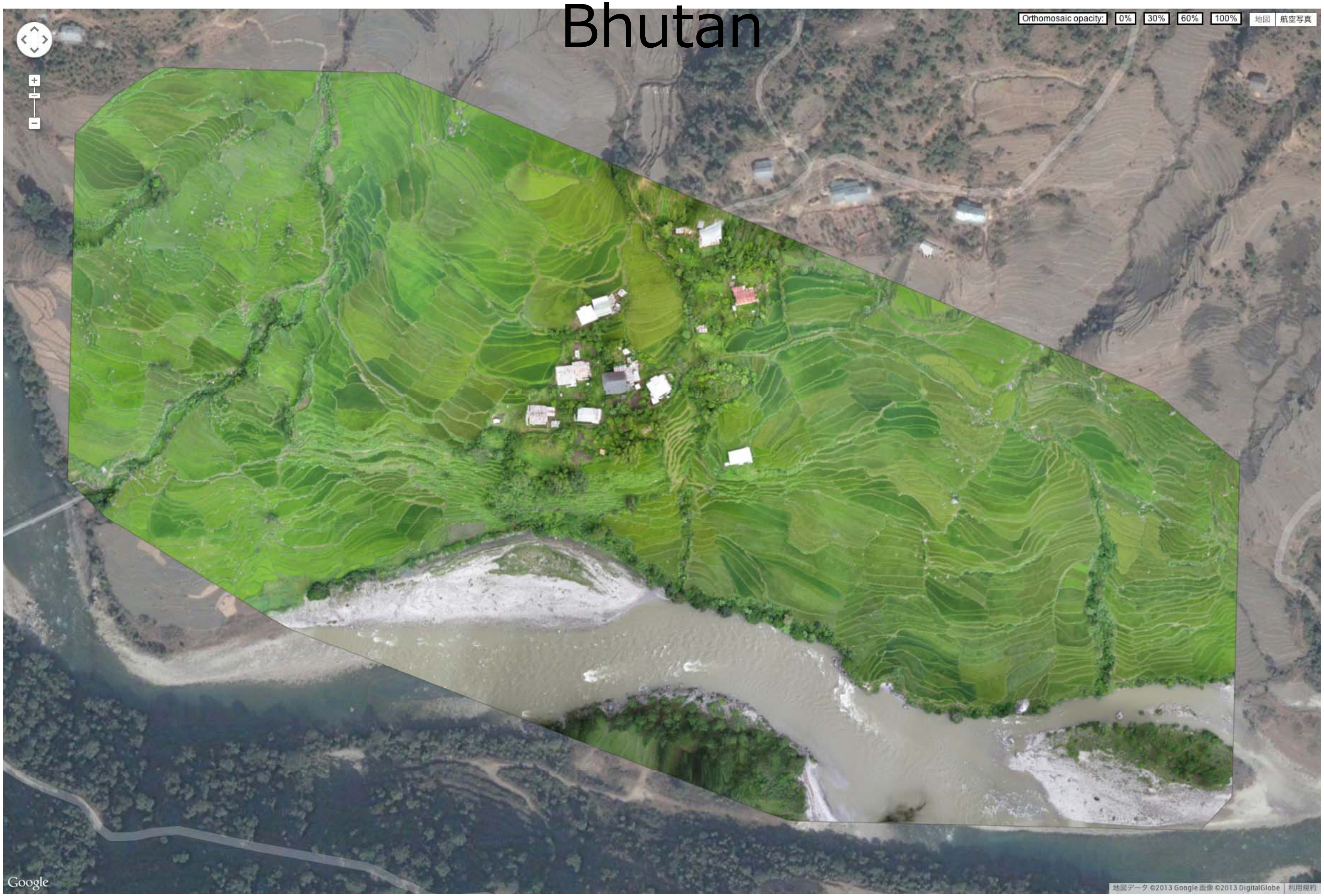


UAV Testing Area in Lakhu Village, Punakha


Photo taken by UAV close to the ground


eBee, Sensefly

2D Ortho-mosaic Image of Lhaku Village in Bhutan

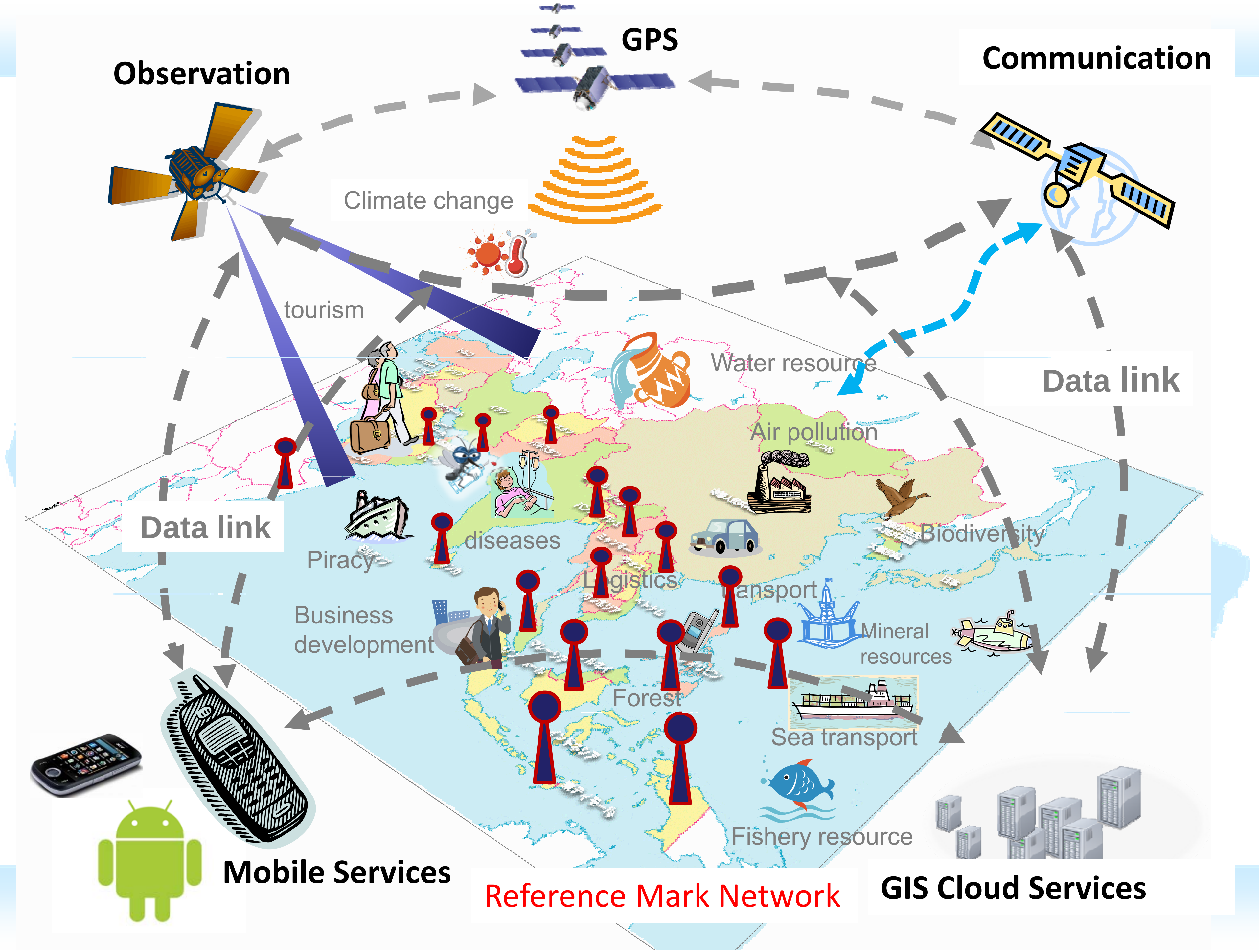


3D Point Cloud Image of Lhaku Village in Bhutan

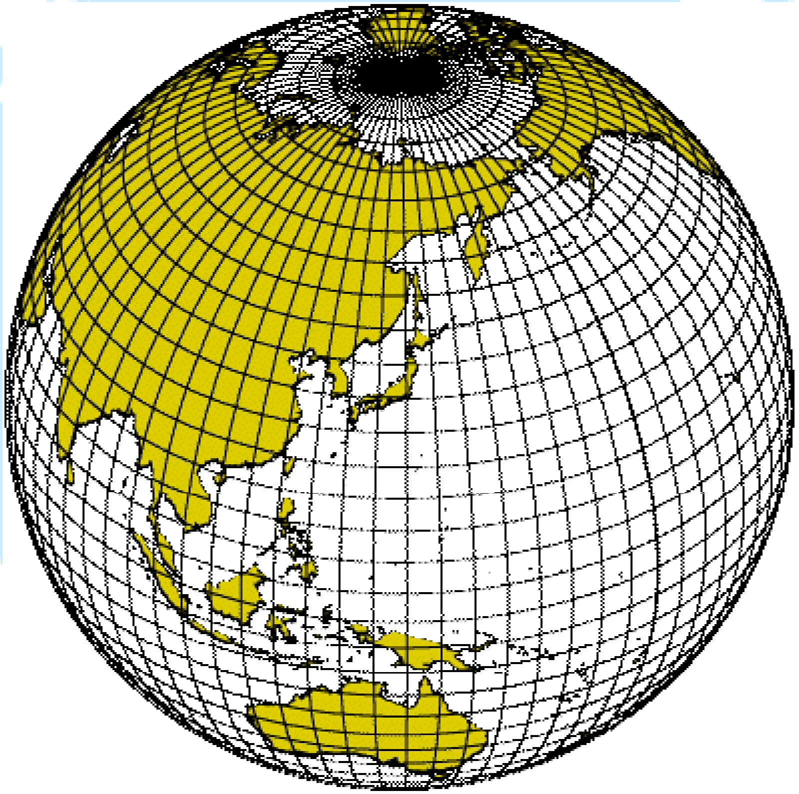
2D Ortho-mosaic Image of Kathmandu in Nepal

2D Ortho-mosaic Image of Kathmandu in Nepal

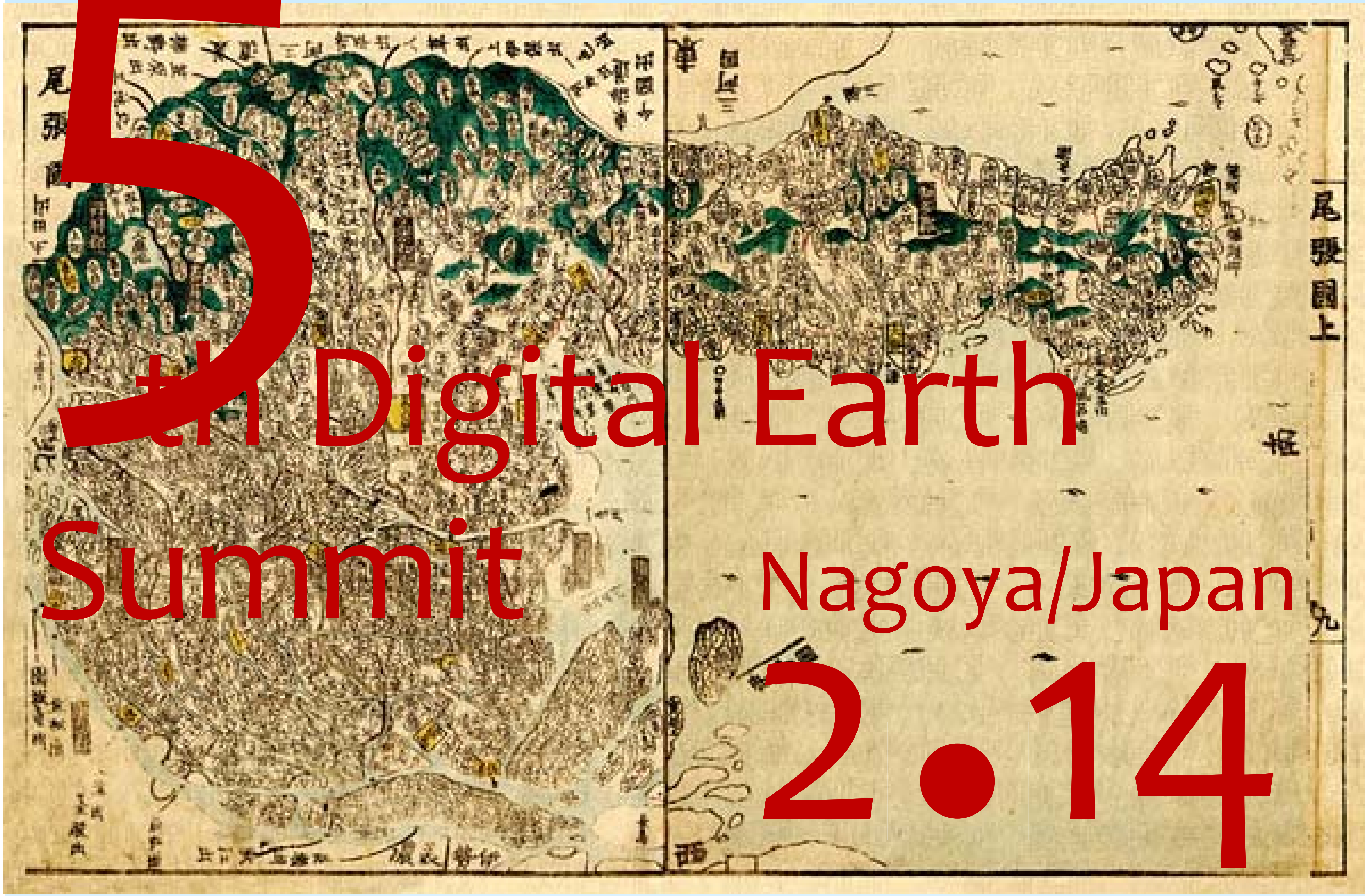
3D Point Cloud Image of Kathmandu in Nepal


GPS
Observation
Communication
Climate change
tourism
Water resource
Data link
Air pollution
Data link
Biodiversity
diseases
Piracy
Logistics
Transport
Business development
Mineral resources
Forest
Sea transport
Fishery resource
Mobile Services
Reference Mark Network
GIS Cloud Services

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



See you
on Digital EARTH
Summit Nagoya


5th Digital Earth Summit
Nagoya/Japan
2•14

Location of Nagoya

DE for ESD Background

Aichi-Nagoya and International Events on Sustainability

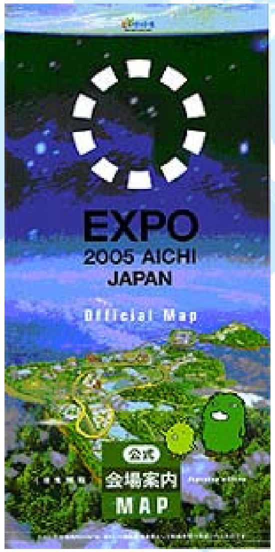
Digital Earth Summit
- **ESD**
- **Citizen Science**

2014 World Conference on ESD, End of the Decade meeting

Convention on Biological Diversity

2010 CBD (Convention on Biological Diversity) COP10

Hop, Step, Jump!!



2005 2005 Japan International Exposition
Theme: *Nature's Wisdom*

2005~2014 : UN Decade of Education for Sustainable Development(ESD)