ITB and its Activities in GPS, INSAR and Satellite Altimetry Related Researches

SEAMERGES Kick Off Meeting, Bangkok, 3-5 March 2004

ITB (Institute of Technology Bandung)

- **1920 : TH Bandoeng**
- **1950 : ITB**
- **Present : ITB BHMN**

1. Faculty of Mathematics and Basic Sciences
2. Faculty of Industrial Engineering
3. Faculty of Civil Engineering and Planning
4. Faculty of Earth Sciences and Mineral Technology
5. Faculty of Art and Design
6. Faculty of Pharmacy and Health Technology
7. School of Management and Business

Dept. of Geodetics Engineering

→ 27 DEPARTMENTS, ≈ 1400 staffs, ≈ 10.000 students

Dept. of Geodetic Engineering ITB

- **Name to come :** *Dept. of Geodesy & Geomatic Eng.*
- **Around 40 staffs.**
- **5 Laboratories :**
  1. **Geodesy**
  2. **Geomatics**
  3. **Cadastral Surveying**
  4. **Land Surveying**
  5. **Marine Surveying**
- **Related Equipments and Softwares :**
  - ❖ **14 GPS dual-frquency geodetic-type receivers,**
  - ❖ **Bernesse 4.2, GAMIT, Gipsy and Roi-Pack softwares.**

ITB GPS Related Activities

- *Geodynamics Study*
- *Volcano Deformation Monitoring*
- *Land Subsidence Study*
- *Landslide Study*

GEODYNAMICS STUDIES

1989 – 1994 : GPS-GPS Project (NSF,SIO, RPI, BAKOSURTANAL, ITB, and others)

1992 – 1997 : West Java Geodynamics Project (ERI Tokyo Uni, DPRI Kyoto Uni., ITB, LIPI and others)

1995 – now : GEODYSSEA (EC, GFZ, DEOS, BAKOSURTANAL, ITB, and others)

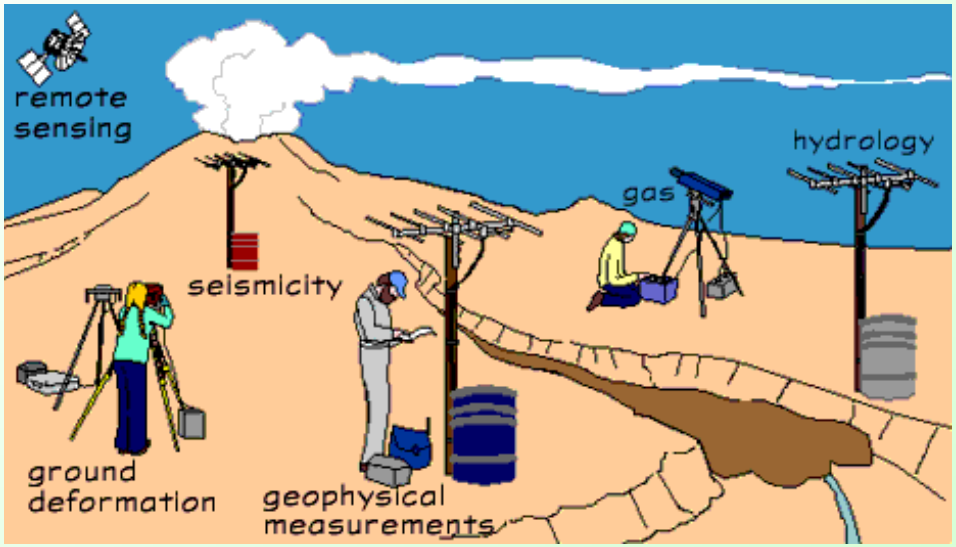
Major Volcanoes of Indonesia

(with eruptions since 1900 A. D.)

USGS

Topinka, USGS/CVO, 2001; basemap modified from: CIA map, 1997; volcanoes from: Simkin & Siebert, 1994

Volcano Monitoring Methods



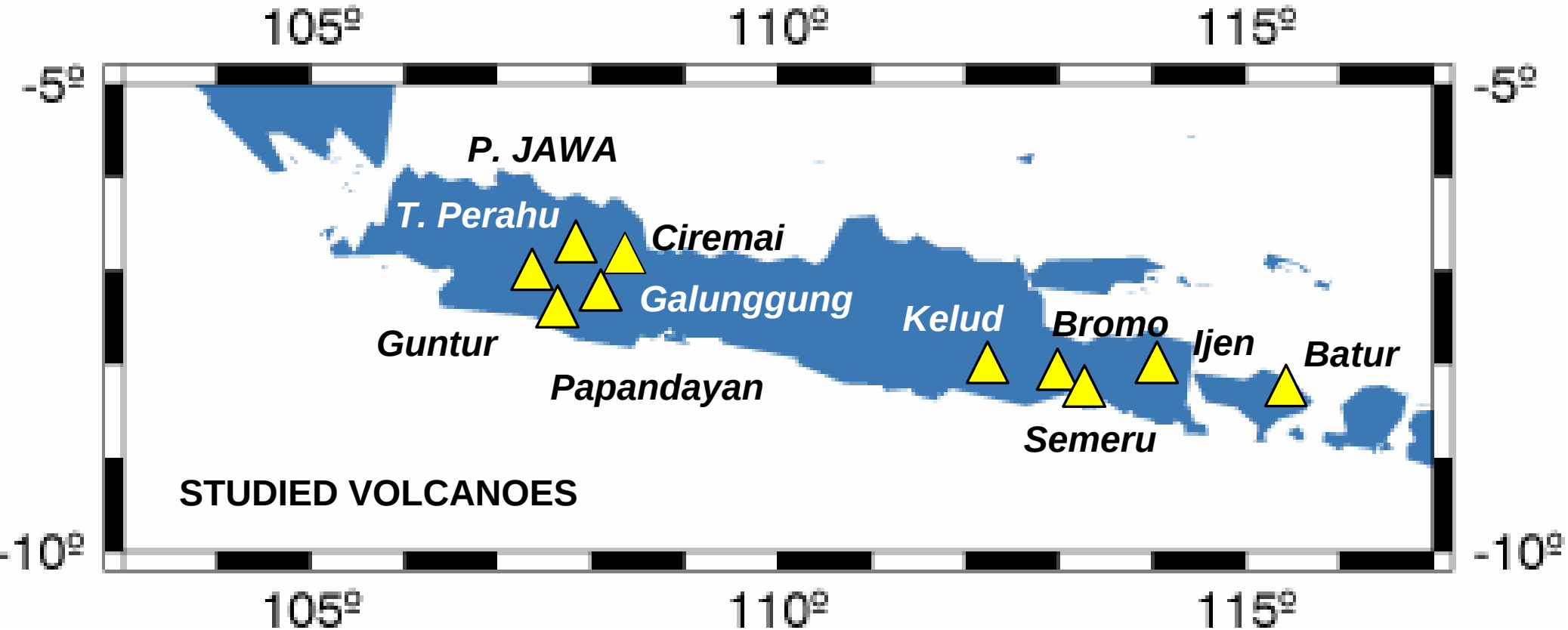
http://volcanoes.usgs.gov/

- Visual
- Seismic
- **Deformation**
- Chemical
- Thermal
- Microgravity
- Geomagnetic
- Remote Sensing

- ***Episodic***
- ***Continuous***

Hasanuddin Z. Abidin, 2001

Location of Studied Volcanoes



GPS Surveys conducted by the Dept. of Geodetic Engineering, Institute of Technology Bandung and the Directorate of Volcanology and Geological Hazard Mitigation

Already Conducted GPS Surveys

VOLCANO	GPS SURVEYS	VOLCANO	GPS SURVEYS
Guntur	Nov. 1996, Feb. 1997, June 1997, Nov. 1997, March 1998, **Oct. 1998, April 1999**, Sept. 1999, Feb. 2000, April 2001, Aug.2002, June 2003	Galunggung	June 2001, Aug. 2002, June 2003
		Bromo	Feb. 2001, June 2002, Aug. 2003
		Batur	May 1999, Feb. 2001, June 2002, Aug. 2003
Papandayan	Oct. 1998, March 1999, Dec. 1999, June 2001, Aug. 2002, Nov. 2002, June 2003	Ijen	June 2002
		Tangkuban Perahu	September 2002
Kelud	May 1999, Feb. 2001, June 2002, Aug. 2003	Semeru	August 2003
		Ciremai	Oktober 2003

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Land Subsidence

Types of Subsidence :

- subsidence due to groundwater extraction,
- subsidence induced by the load of constructions (i.e. settlement of high compressibility soil),
- subsidence caused by natural consolidation of alluvium soil, and
- geotectonic subsidence.

➢ **In Indonesia, land subsidence of urban coastal areas are usually caused by excessive groundwater extraction.**

➢ **The already observed subsidence areas :**

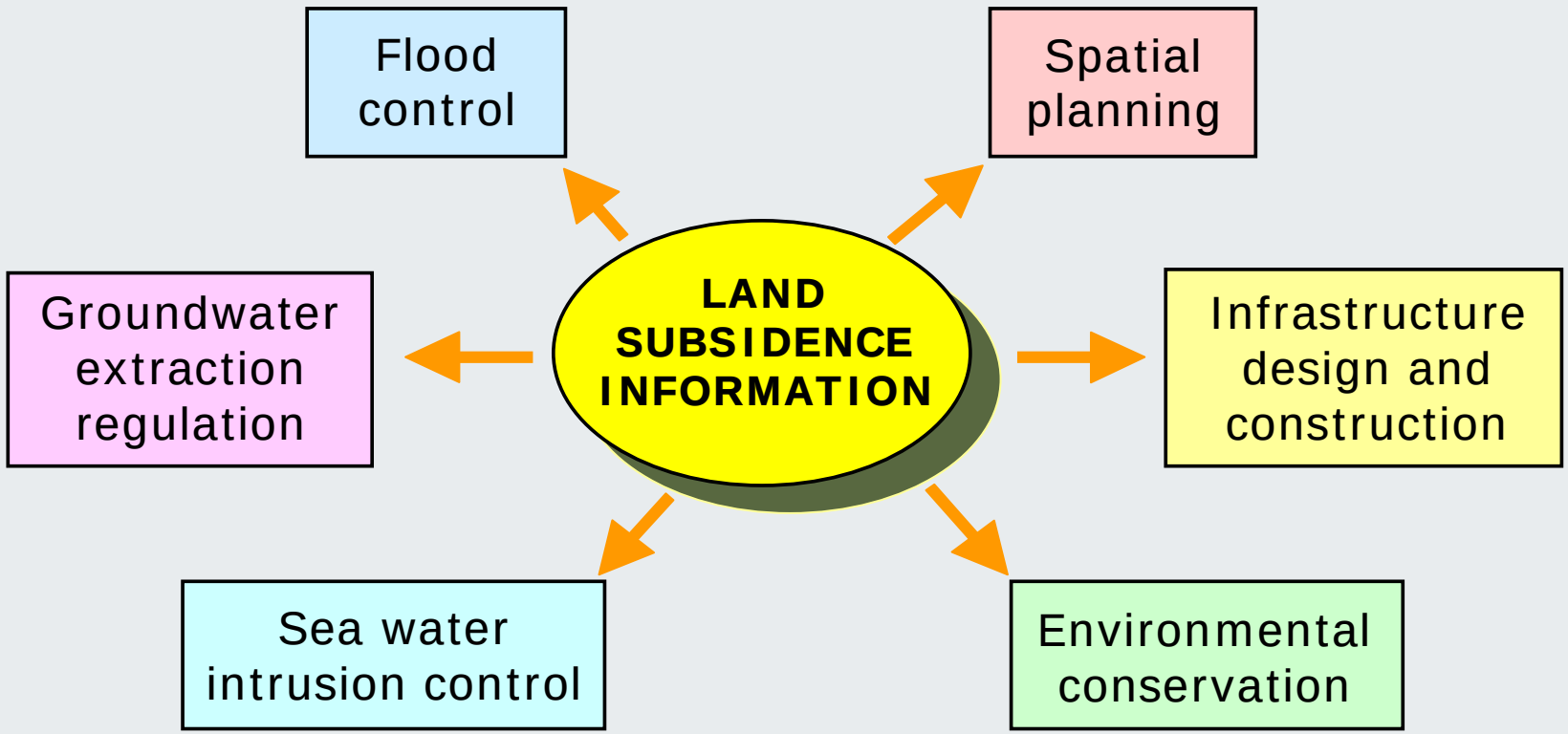
→ **Jakarta, Semarang and Bandung**

➢ **The expected subsidence areas**

→ **Denpasar, Surabaya and Medan**

Hasanuddin Z. Abidin, 2003

IMPORTANCE OF LAND SUBSIDENCE INFORMATION



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JAKARTA & BANDUNG
Sukadana
LAMPUNG
Tanjungkarang-Telukbetung
Java Sea
Merak
Anyer Kidul
Serang
INDONESIA
Jakarta
Bekasi
Pamanukan
Indramayu
Labuhan
Pandegelang
Kandanghaur
Karangampel
Depok
Jatibarang
Bogor
Klangenan
Cirebon
Gunung Pangrango
UJUNG KULON NATIONAL PARK
Cianjur
Bandung
Ciledug
Tegal
Cibadak
Sukabumi
Telaga-kulon
Kuningan
Sukanegara
Garut
JAWA TENGAH
Jampang-kulon
J A W A B A R A T
Cisaga
Tasikmalaya
Purwokerto
Sindangbarang
Sidareja
Kalipucang
Pameutingan
Cilacap
INDIAN OCEAN
Java Trench
5°
6°
7°
8°
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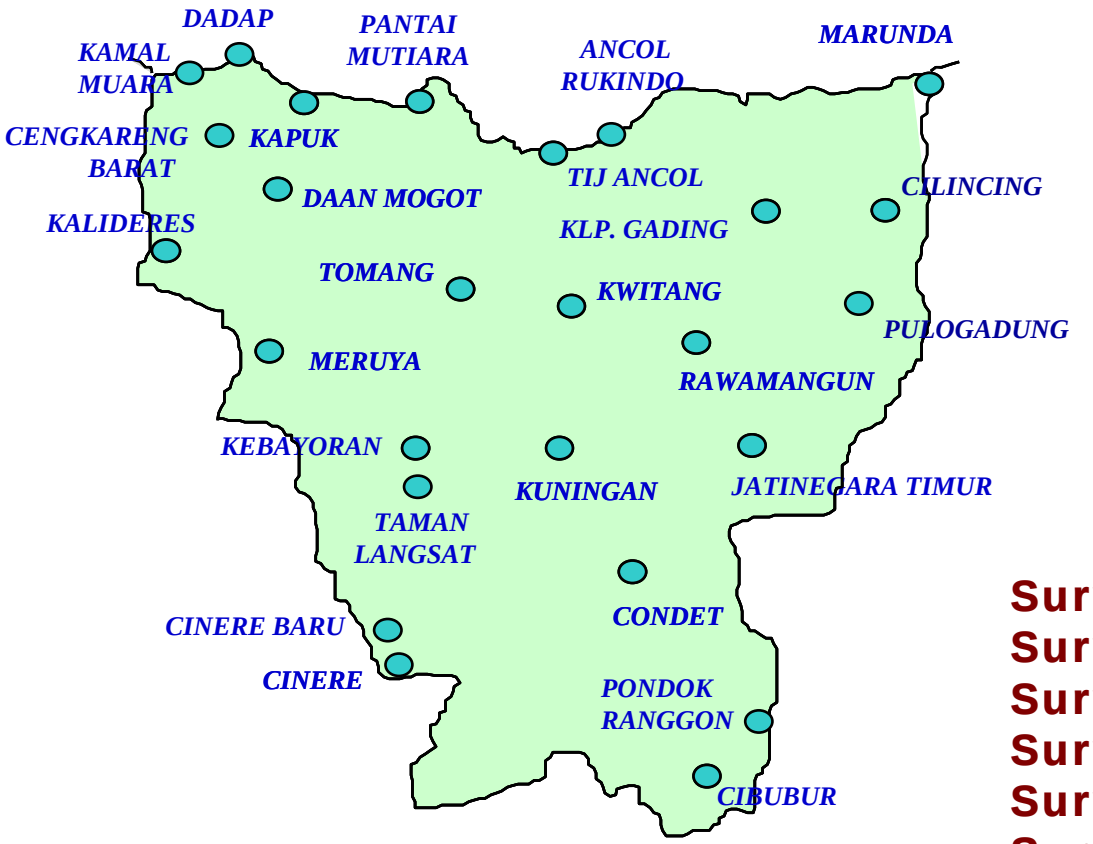
GPS NETWORK FOR MONITORING LAND SUBSIDENCE in JAKARTA AREA



Survey-1 : 24 - 26 Dec. 1997
Survey-2 : 29 - 30 June 1999
Survey-3 : 31 May - 3 June 2000
Survey-4 : 14 - 19 June 2001
Survey-5 : 26 - 31 Oct. 2001
Survey-6 : 02 - 07 July 2002
Survey-7 : 21 - 26 Dec. 2002

NORTH

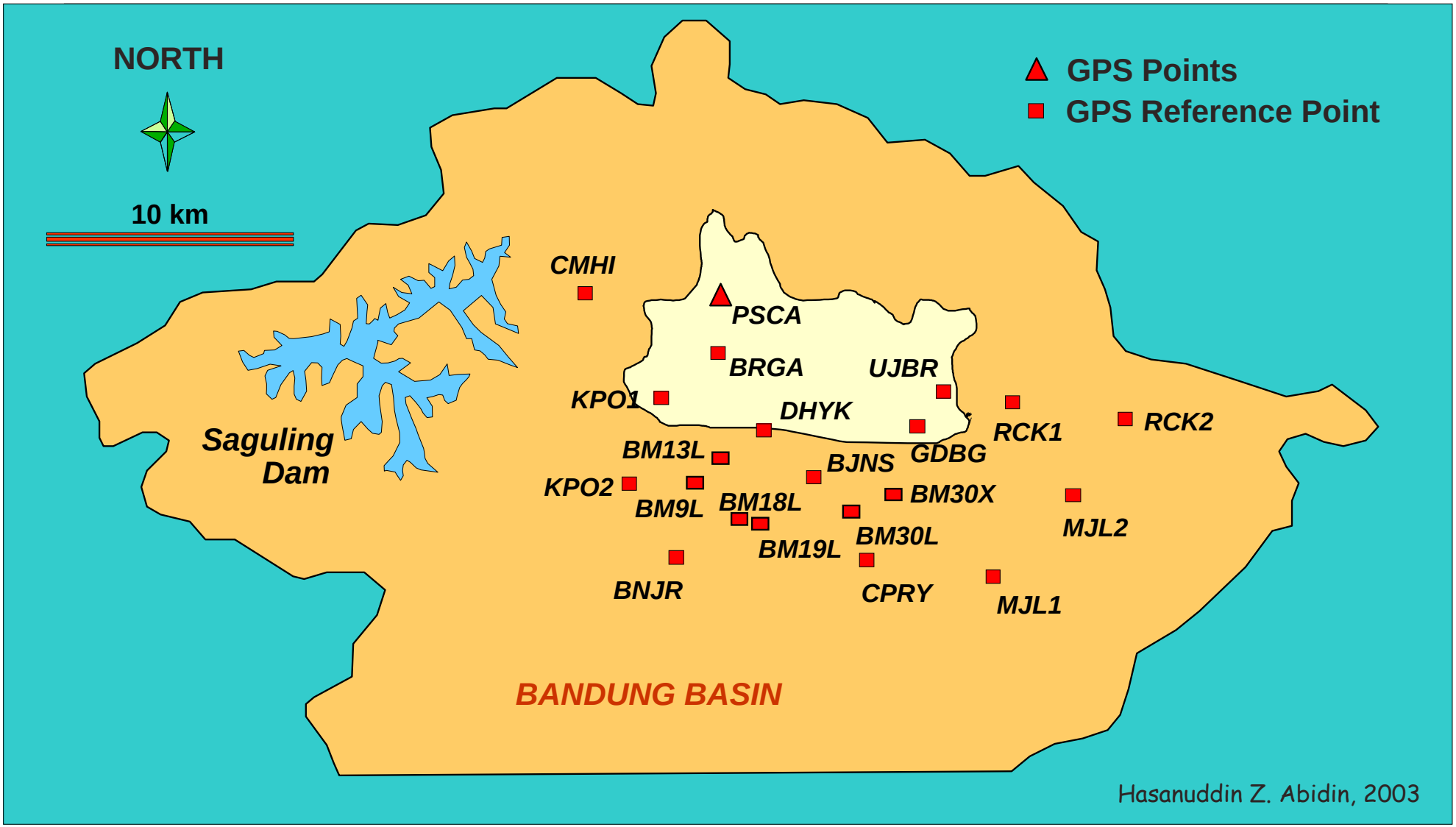
10 km

BAKO

GPS Stations
GPS Reference Station

Hasanuddin Z. Abidin, 2002

GPS NETWORK FOR MONITORING LAND SUBSIDENCE in BANDUNG BASIN



GPS SURVEYS IN BANDUNG BASIN

GPS Surveys	Survey Period	Observation Points
Survey-1	21-24 Feb. 2000	PSCA,BNJR,BJNS,CMHI,DYHK,MJL1,RCK1,RCK2,UJBR
Survey-2	21-30 Nov. 2001	PSCA,BRGA,BNJR,BJNS,CMHI,CPRY,DYHK,GDBG, KPO1,KPO2,MJL1,MJL2,RCK1,RCK2,UJBR
Survey-3	11-14 July 2002	PSCA,BRGA,BNJR,BJNS,CMHI,CPRY,DYHK,GDBG, KPO1,KPO2,MJL1,MJL2,RCK1,RCK2,UJBR,BM9L, BM13L,BM18L,BM19L,B30X,B30R
Survey-4	1-3 June 2003	Same as on Survey-3, except BRGA

Using 7 dual-frequency geodetic-type receivers; Session lengths of 10-12 hours

LANDSLIDE & ITS MONITORING

- Landslide is one of prominent geohazards that continuously affecting Indonesia, especially in the rainy season.
- It destroys not only environment and property, but usually also cause deaths.
- Landslide monitoring and mitigation is therefore very crucial and should be done properly.
- Monitoring of landslide is usually done by using terrestrial techniques, using the systems such as extensometer, EDM (Electronic Distance Measurement), and leveling.
- How about the use of GPS and/or INSAR ?

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LAMPUNG
Merak
Anyer Kidul
Serang
Kragilan
Tanara
Kramat
Tangerang
Balubuk
Kelapadua
Sungaibuntu
Jakarta
Bekasi
Kampungsawah
Turi
Muaracilamaya
Lemahabang
Cikampek
JAWA BARAT
Mandalawangi
Labuhan
Pandegelang
Karawang
Depok
Cibarusa
Wirasinga
Kalicaah
Kadumula
Mayak
Cibinong
Cipanas
Campea
Bogor
Ciloto
Citeureup
Gunungkencana
Purwa
Sumur
Sareweh
Citorek
Purasedar
Mahendra
Megamendung
Situpotong
Cianjur
Cimahi
Cikawung
Cibadak
Sukabumi
Bandung
Bayah
Cibeber
Ciparay
Warungpeuteuy
Sukanegara
Soreang
Cibogo
Ciateul
Pengalengan
Jampang-kulon
Santosa
Ciragil
Cibeber
Ciagra
Muaragede
Cikajang
Cikaret
Sindangbarang
Cijarian
Cidaun
Cimari
Bangbayang
6°
6° 30'
7°
7° 30'
107°
107° 30'
INDONESIA
MALAYSIA
Jakarta
Bandung
Semarang
Surabaya
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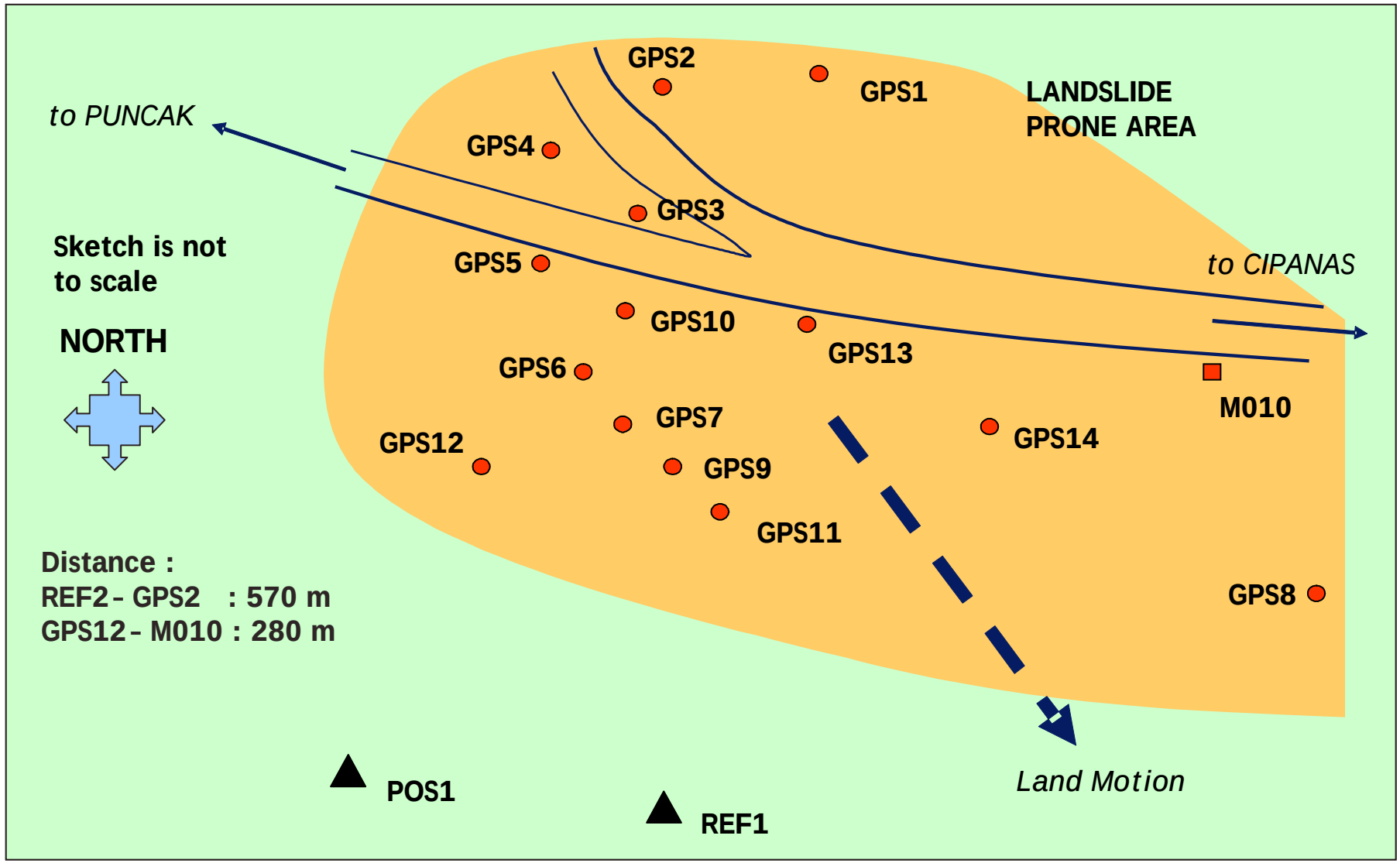
Landslide GPS Monitoring Network in Ciloto



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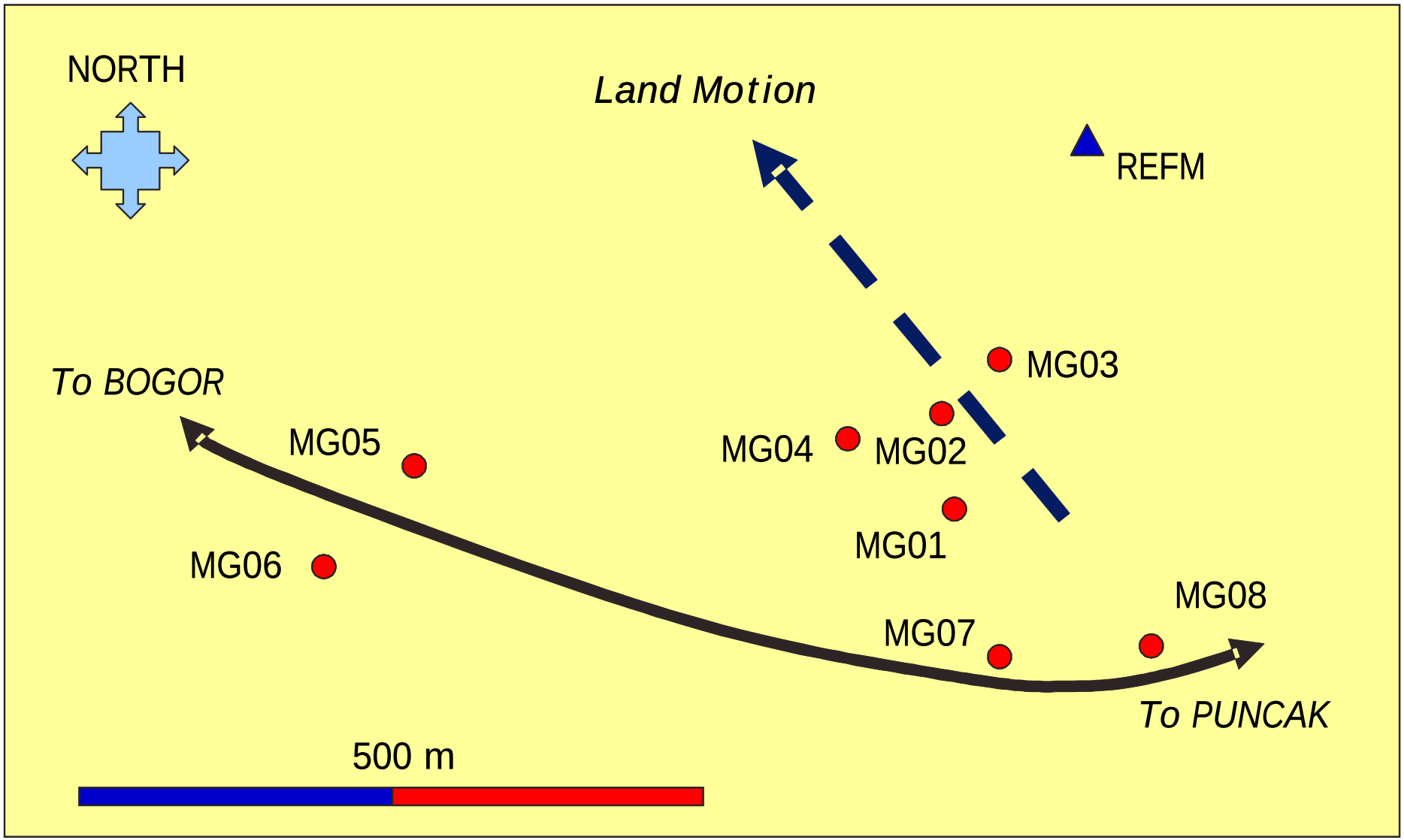
Landslide GPS Monitoring Network in Megamendung

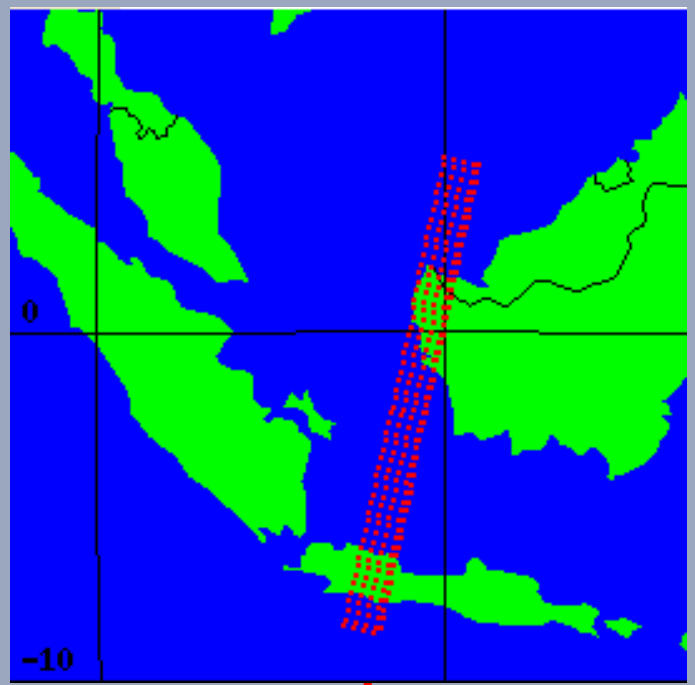


How About INSAR ?

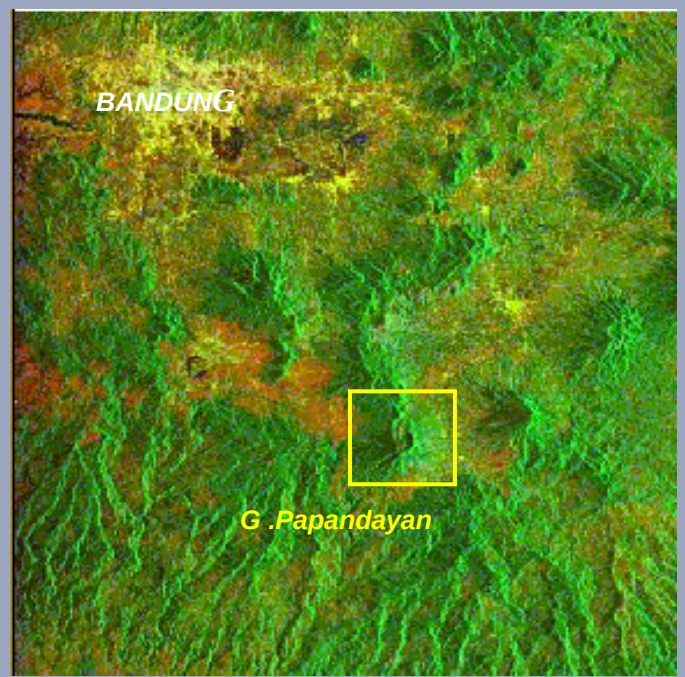
- **Research experience is still very limited.**
- **Just acquire ROI-PACK software (Linux based).**
- **Potential research areas :**

  - volcano deformation study
  - land subsidence study

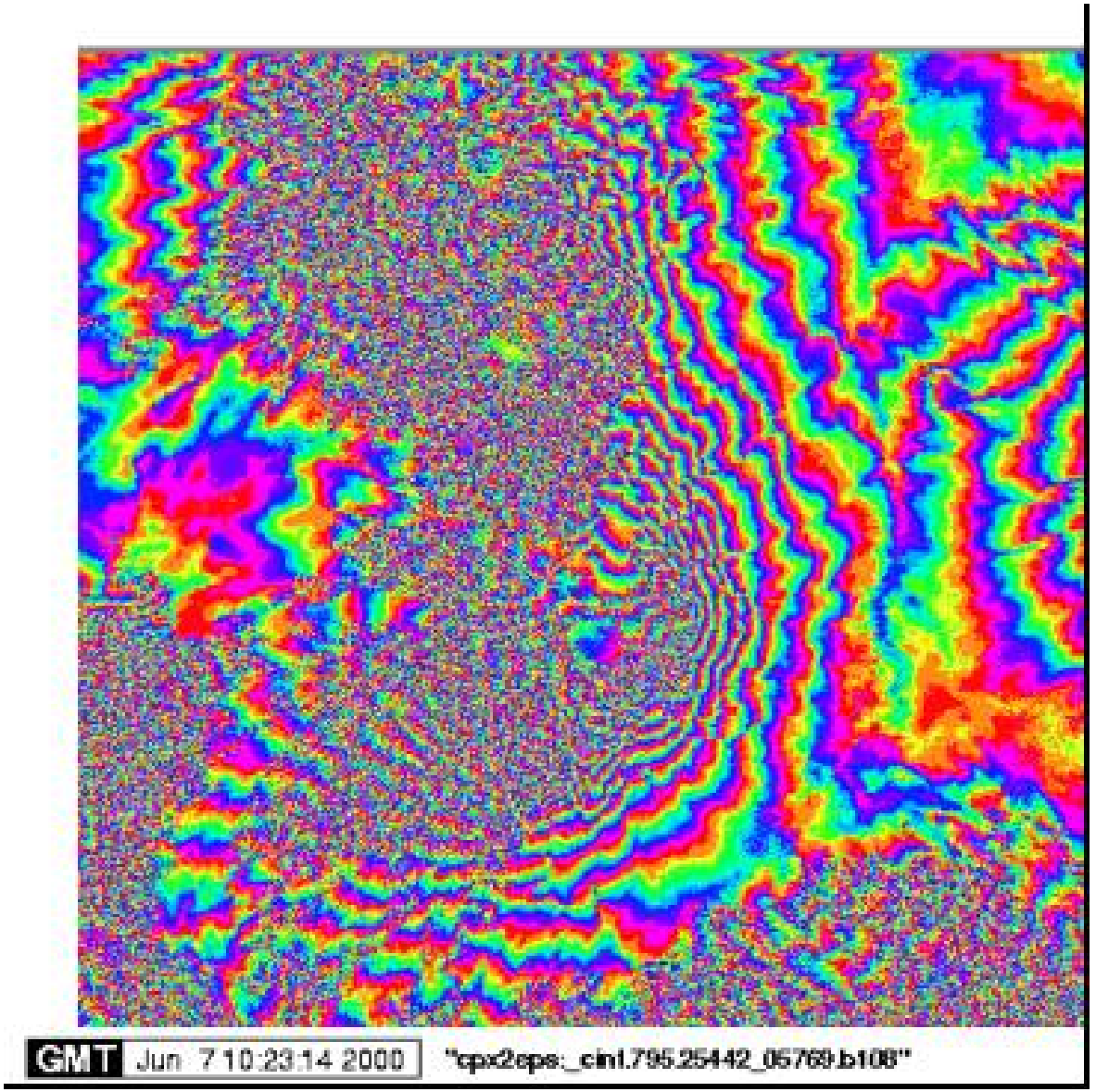
PRELIMINARY STUDY (PAPANDAYAN Volcano)



Studied Area



Green shows vegetated or lay-over areas
Blue shows water covered areas
Red shows rock covered areas or homogeneous plantation.
Yellow shows urban areas

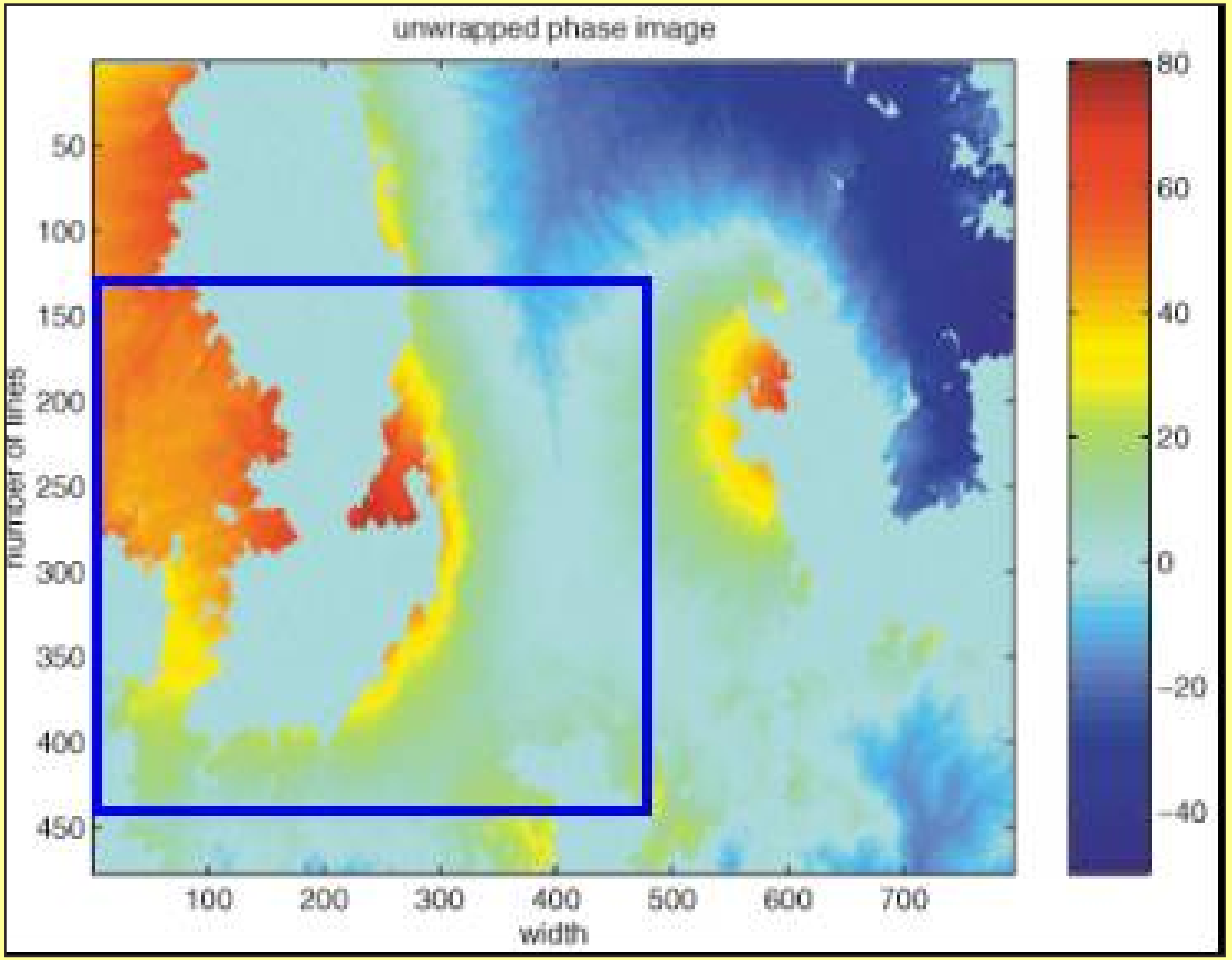


INTERFEROGRAM

PAPANDAYAN Volcano

ERS1-25442/ ERS2-5769

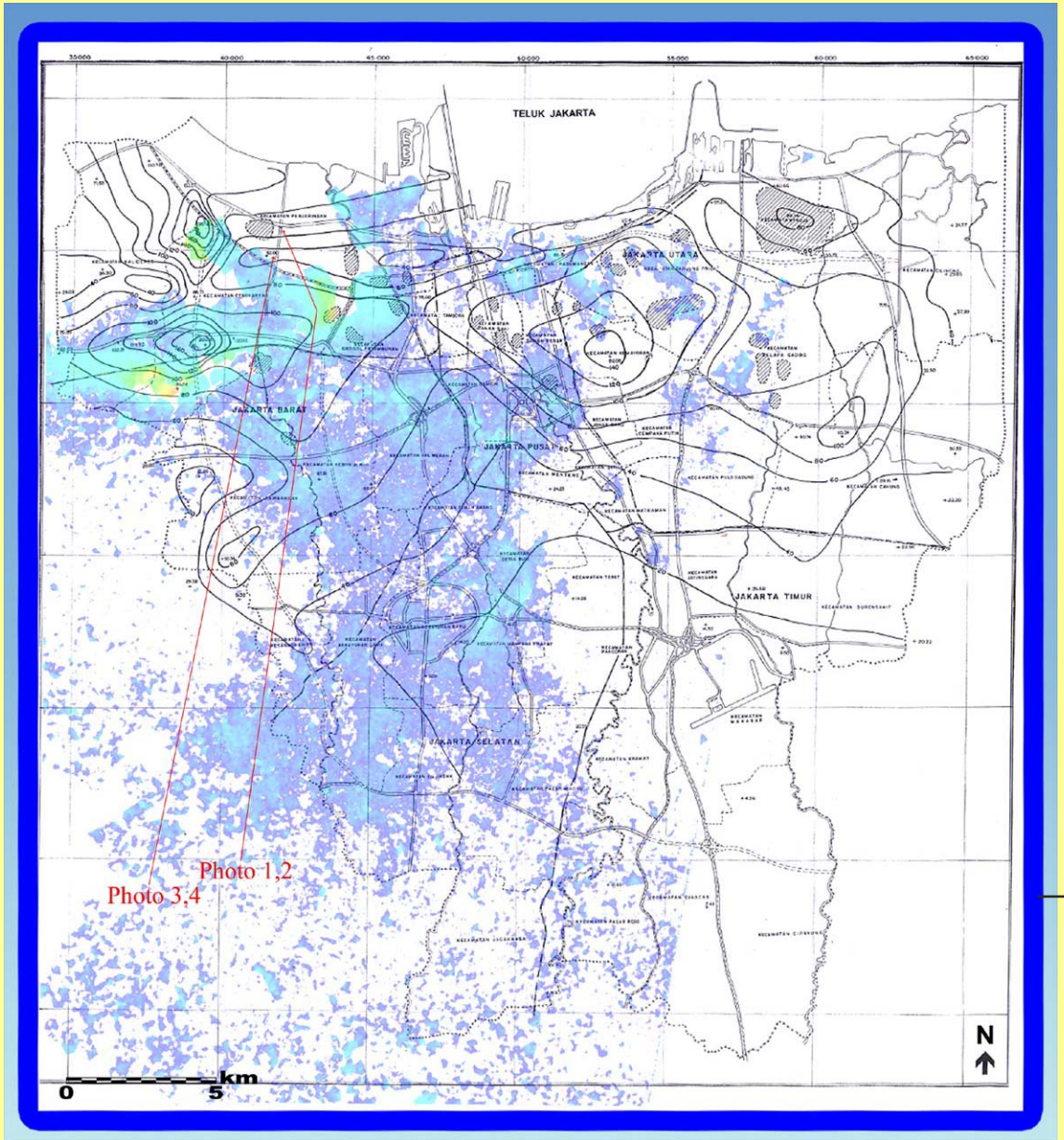
2D PHASE UNWRAPPING, PAPANDAYAN Volcano



The result is very poor

Maybe due to a heavy vegetation

Annual JAKARTA Subsidence Rates from InSAR



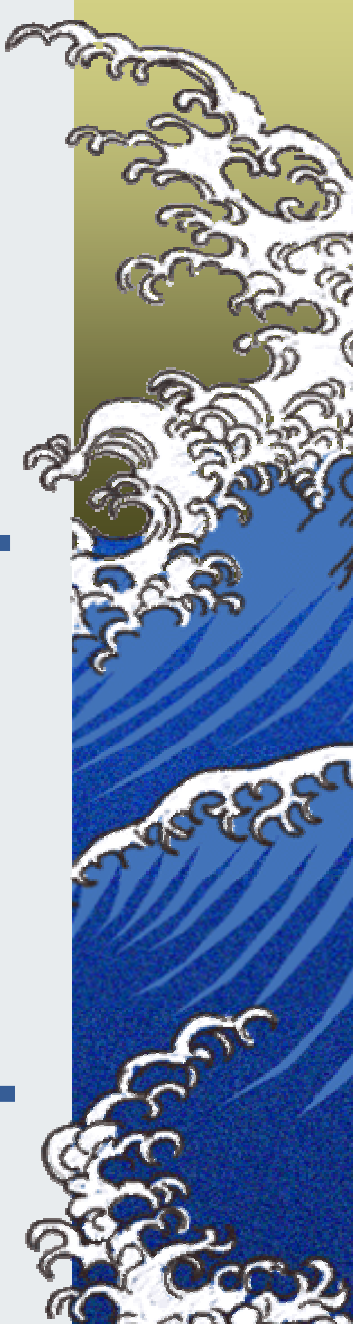
JERS-1/SAR data, processed using VEXCEL 3D SAR Processor

10 cm/year (1993-95)
6 cm/year (1995-98)

Good correspondence with the results from Leveling and GPS Surveys.

Leveling (1982-1997) and InSAR results.

Satellite Altimetry in Indonesia



Research and applications development is still in preliminary stage.

- **Institute of Technology Bandung (ITB)**

  Geoid determination

- **National Survey and Mapping Agency (Bakosurtanal)**

  Sea Surface Topography determination

Potential Applications of Satellite Altimetry Data in Indonesia

Oceanography and meteorology

- Climate prediction
  - El Nino/La Nina monitoring
- Weather forecasting
  - Marine navigation
  - Offshore engineering
  - Marine meteorology
  - Fisheries and marine biology

Geodesy and geophysics

- Gravity field of the earth
- Vertical datum unification
- Geodynamics studies
- Natural hazards monitoring