



Lavigne F., Bélizal E., Cholik N., Nurnaning A., Picquout A., Mei E.  
Paris 1 Pantheon-Sorbonne University, Laboratory of Physical Geography, France, and  
Center of Volcanology and Geological Hazards Mitigation, Yogyakarta, Indonesia.



Volume of pyroclastic debris likely to be removed by rain in valleys (in excess of  $100 \times 10^6$  cubic-meters) much higher than those calculated after more conventional eruptions (less than  $10 \times 10^6$  cubic-meters);

A new context for lahar occurrence  
(lahar = volcanic debris flows or hyperconcentrated flows)



Most of the Sabo dam structures have been filled by the 2010 pyroclastic flows or subsequent lahars

The eruption occurred at the beginning of the current rainy season, which is more rainy than usual (rainfall typically 4000 mm per year 1500 m a.s.l.), due to the occurrence of La Niña.

GENDOL, Sindumartani, 28 février 2011, 14h30



Some channels totally filled by pyroclastic flows => need artificial path needed for lahars

GENDOL, Sindumartani, 28 février 2011, 16h30



High risk within the Gendol valley

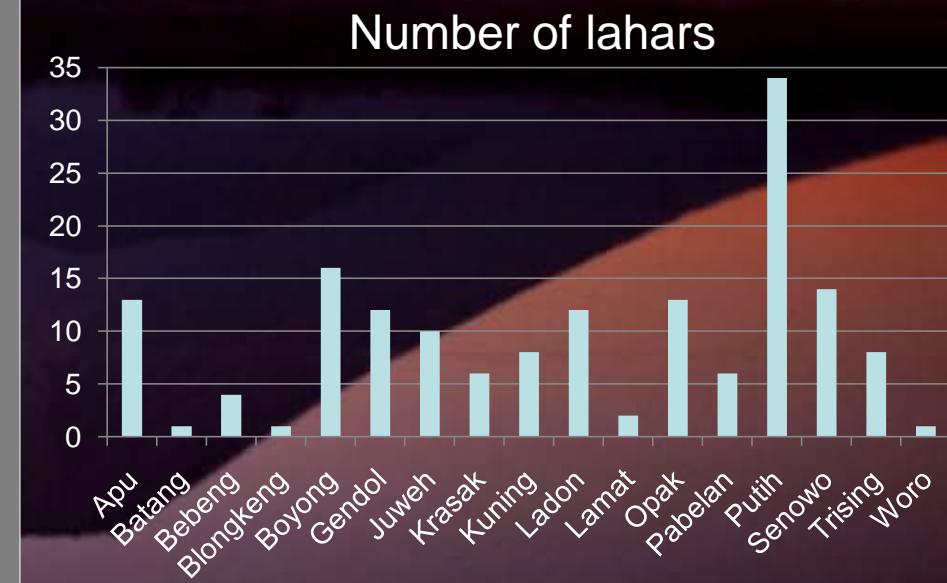
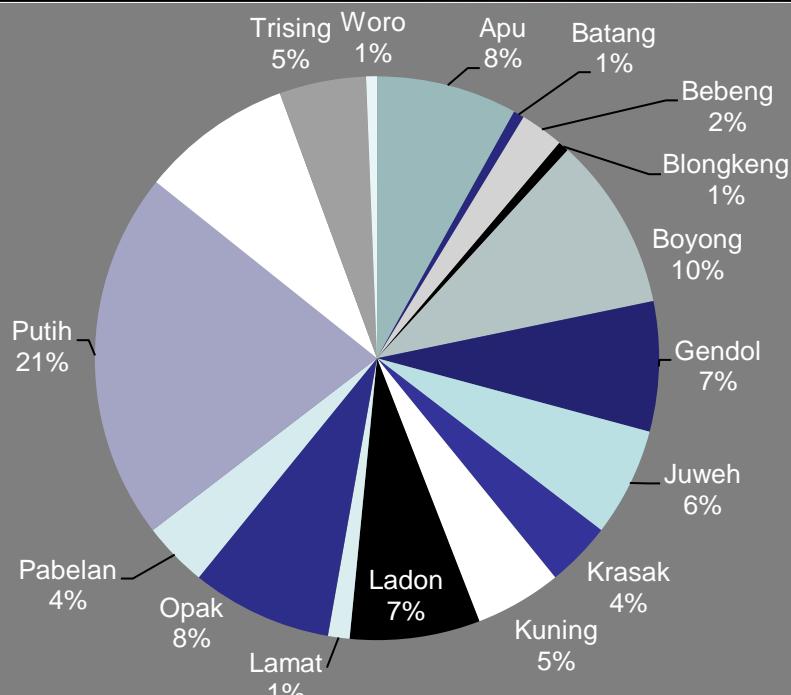
# Goals of the study

- To build a database on lahar occurrence since the 2010 eruption of Merapi;
- To study the geomorphological changes of the valleys drained by lahars;
- To assess the economic and social effects of the lahars on the territory, and the lahar risk management.

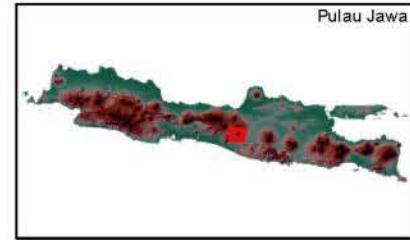
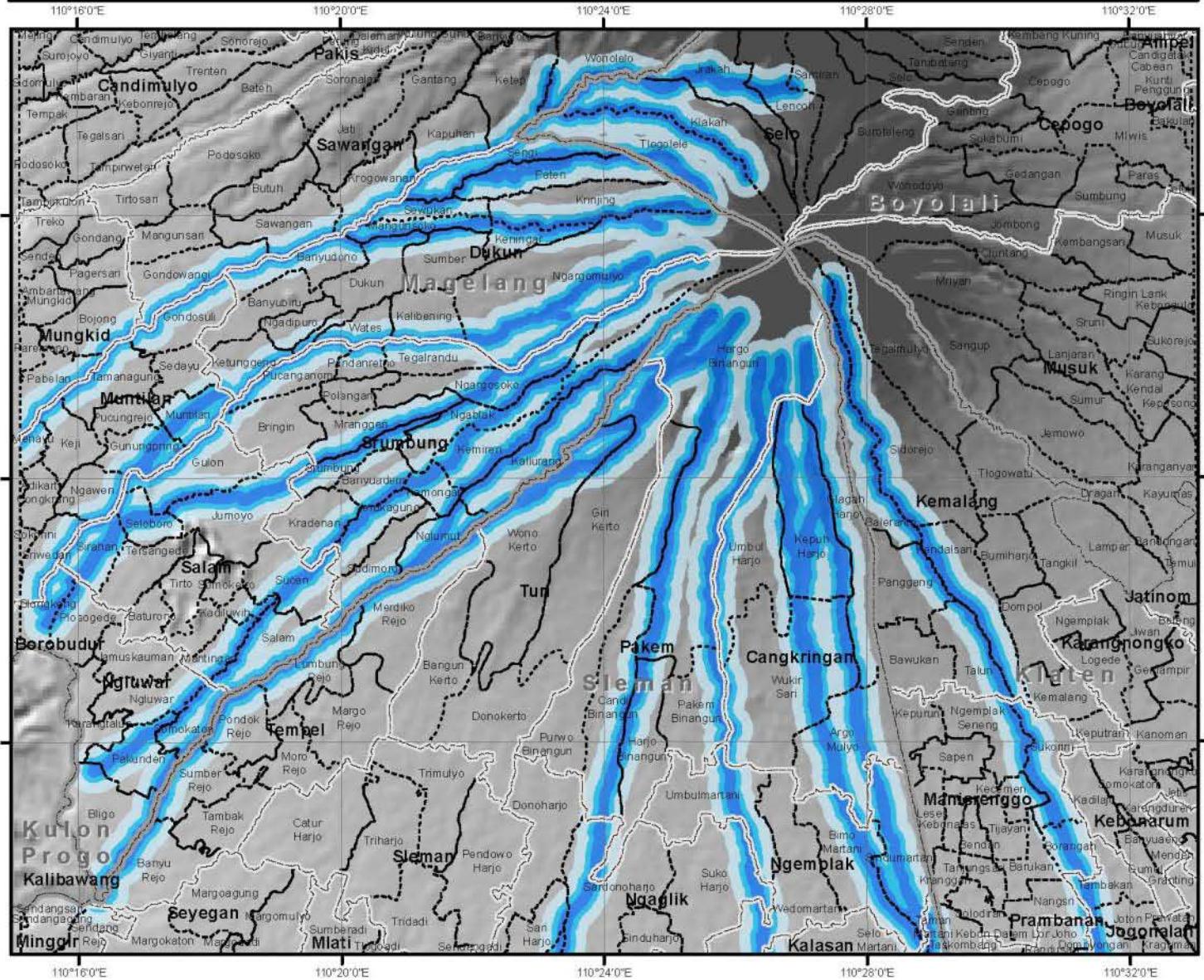
## Methods

- Field observation and measurements of lahars in motion and lahar deposits; completed by secondary data (e.g. U-Tube !)
- Analysis of AFM signals and webcams
- Laboratory analysis (sedimentology and photointerpretation)
- Inquiries

# Tens of lahars already occurred in 16 river channels



# PETA BUFFER JARAK DARI SUNGAI GUNUNG MERAPI



### Legendas

Batas Kabupaten  
Batas Kecamatan  
Batas Desa

Buffer Jarak Dari Sungai

 < 100 m  
 100 - 250 m  
 > 250 m

ID Peta : 2008-06-11\_Buffer\_Jarak\_Sungai\_UNDP

Proyeksi peta : Geographic  
Datum : WGS - 84  
Grid Unit : Lat/Long  
Tanggal Pembuatan : 11 Juni 2008

Sumber :

Hasil Kerjasama :



PSMB UP  
Motorola, Vescom



ERA-UN



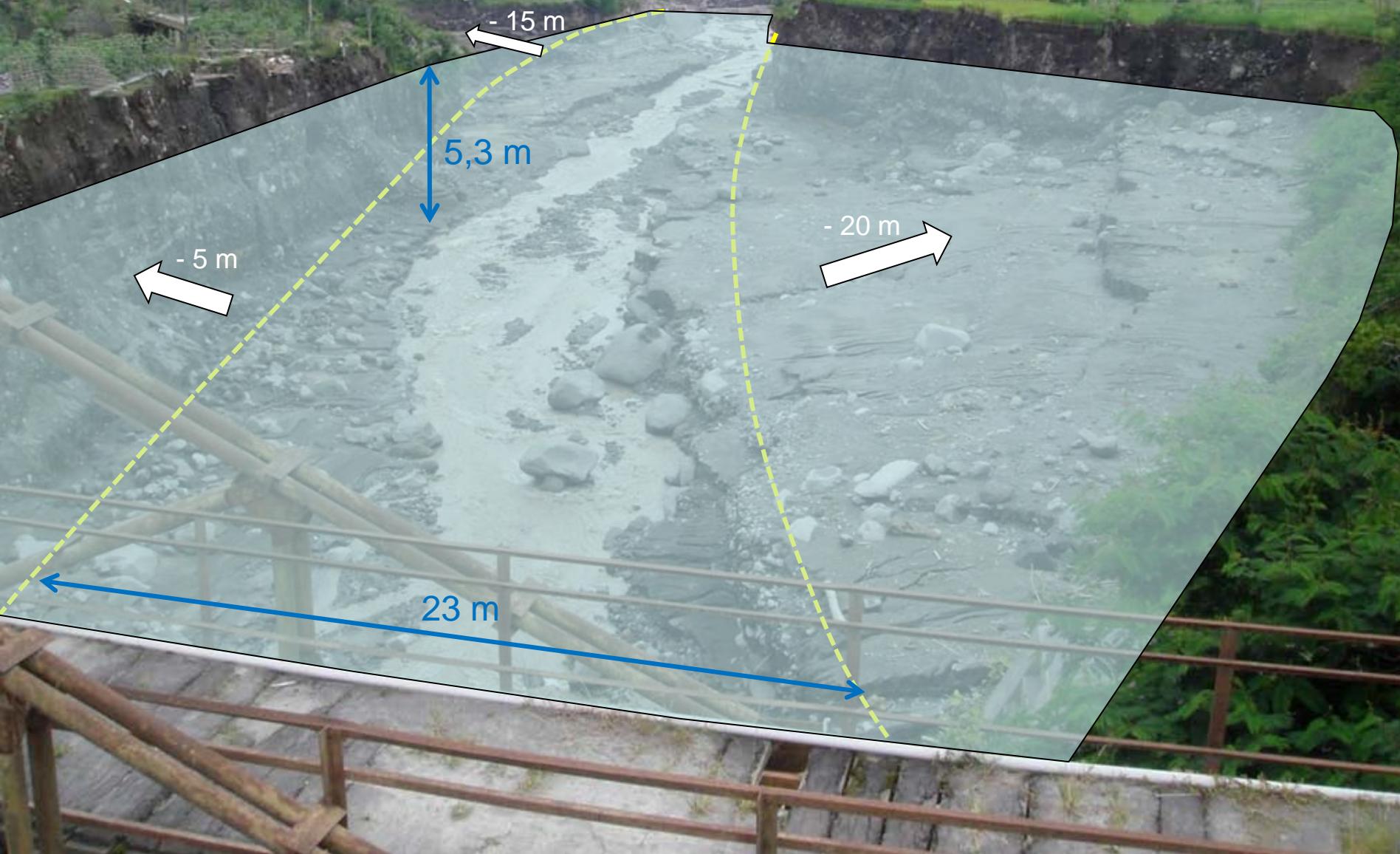
BPPTK  
Yogyakarta

Skala 1 : 160.000  
Pada ukuran kertas A4

Kilometers

# *Geomorphological effects of lahars*

River bank erosion and riverbed incision



## Lahar deposition

Inverse grading



Senowo River, lahar 9-10/01/2011





Boulder deposition in Jumoyo village 3/1/2011

## Excess of sedimentation downstream of the Putih River



## New lahar path along the Putih River through the village of Sirahan

Road destruction by the 9 January lahar  
(photo: 10 January)



Incision of the new channel by the  
23 January lahar (photo: 27 January)



# Damages by lahars

Damages on settlements

Destruction of Jumoyo village 3/1/2011

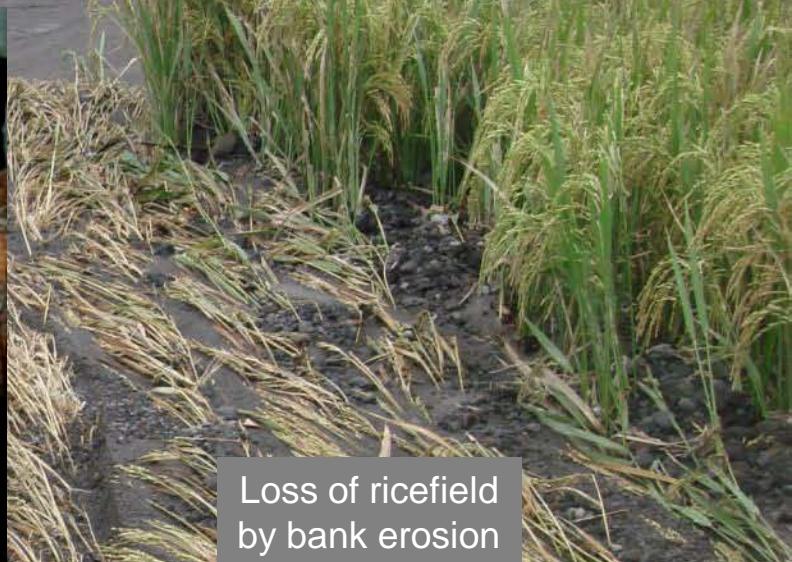


Destruction of commercial buildings



## Damages on agricultural land

Submersion by lahars



Loss of ricefield  
by bank erosion



## A threat for water network



Water network crossing the Opak River



High sediment load in the Progo River

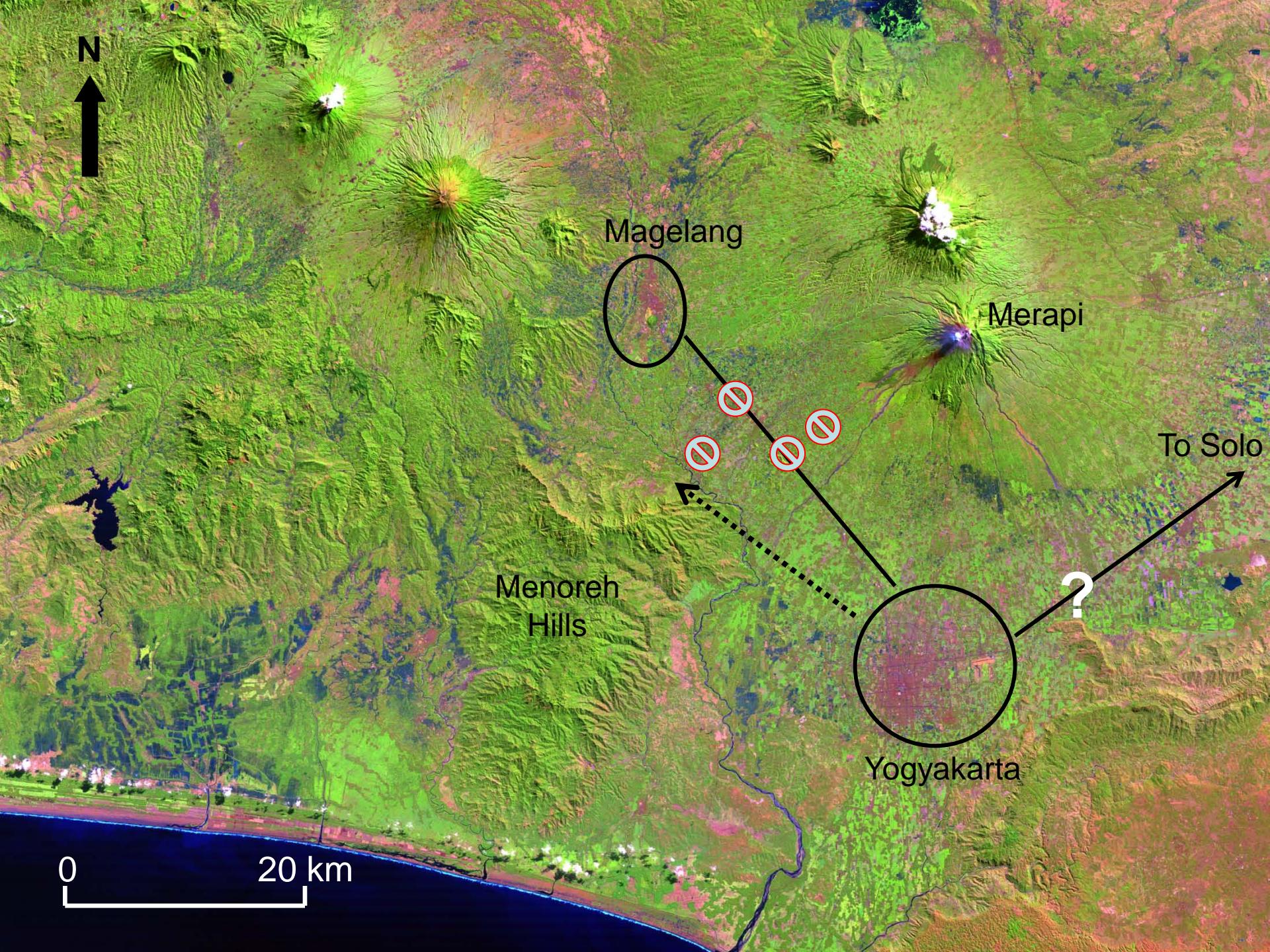


## Disturbance of circulation network



## Destruction of bridges





## Disturbance of the sand mining operational system



# *A danger for the people*



- 2 fatalities
- People wounded or burned

Lahars as a touristic attraction



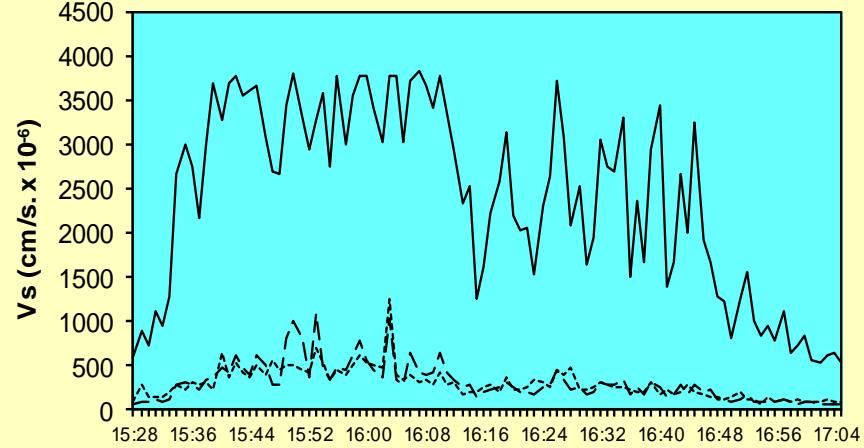
## Risk prevention

### 1. Institutional measures

#### Information



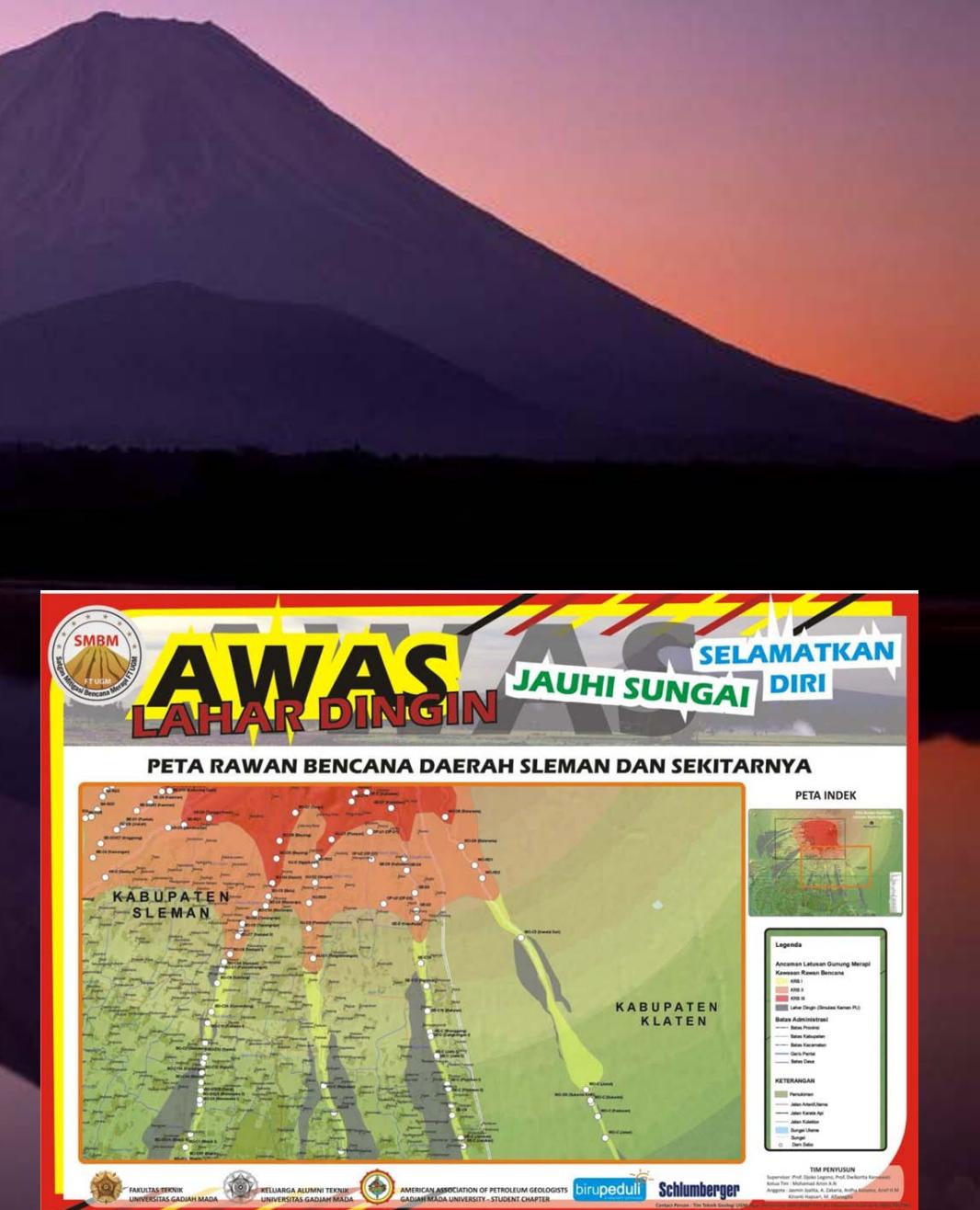
Hazard map and lahar detection from CVGHM: AFM and webcams



#### Restriction of access



## 2. Universities and NGO's actions



### 3. Community-based measures

Physical self-protection



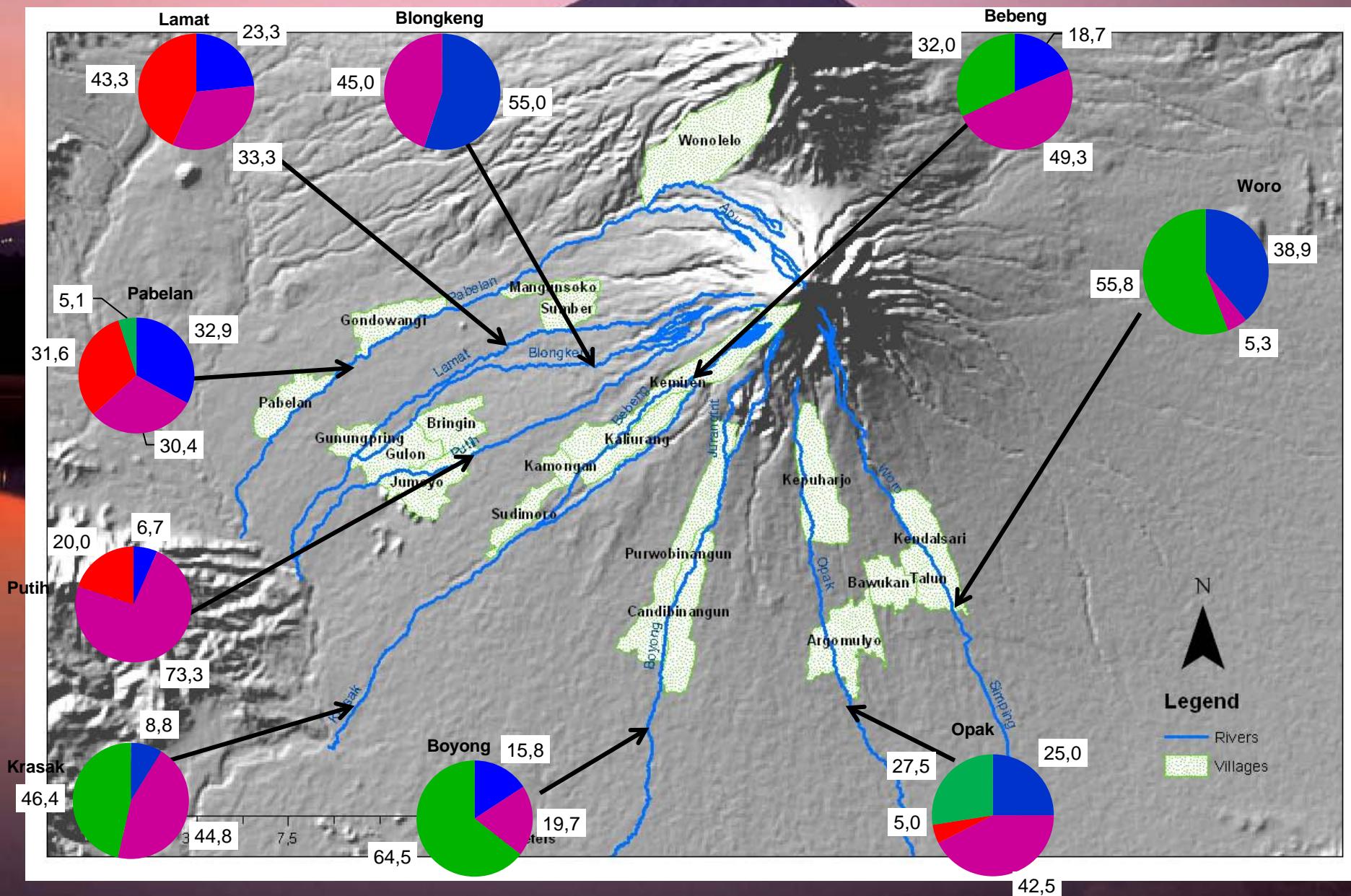
# Risk perception of lahar – December 2010

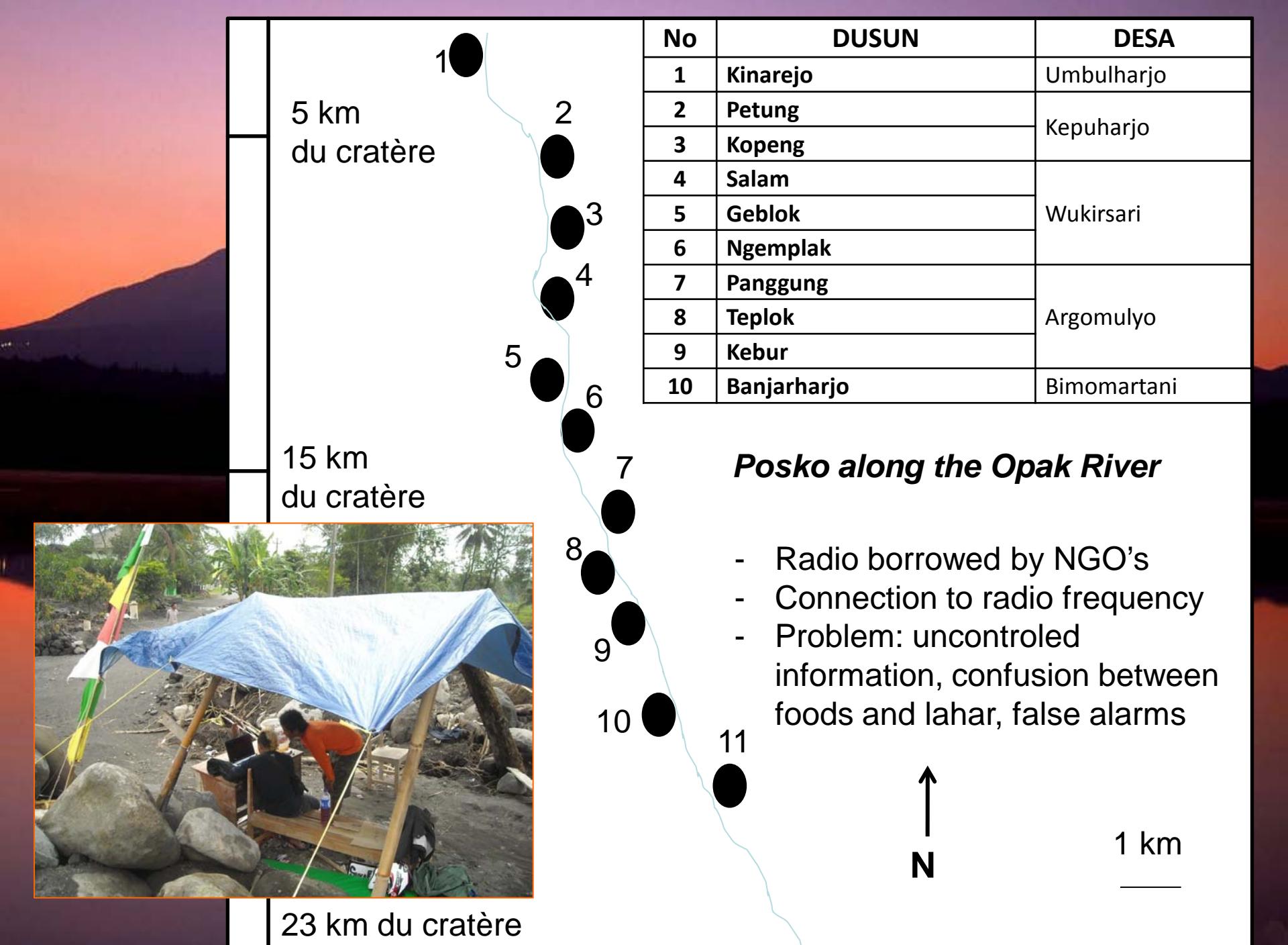
■ Not frightened

■ A bit frightened

■ Frightened

■ Very frightened







MIA VITA



CNRS

LGP  
LABORATOIRE DE GÉOGRAPHIE PHYSIQUE



Thank you for your attention