

Japan International Cooperation Agency – Japan Science and Technology Agency
Science and Technology Research Partnership for Sustainable Development
Integrated study on mitigation of multimodal disasters caused by ejection of volcanic products
Yogyakarta, Indonesia, 9 - 10 November 2015

MODELING OF INFORMATION FLOW FOR EARLY WARNING IN MERAPI AREA

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SATREPS Group 5
2015 November 10

Disasters in Mount Merapi

- **VOLCANIC ERUPTION**
- **80 eruptions** since 1600s with **4 to 6-year intervals** (Geological Agency of Indonesia, 2014)

- **DEBRIS FLOW** or “**LAHAR**”
- Approximately **300 events** since the **20th century** (de Belizal et al, 2013)

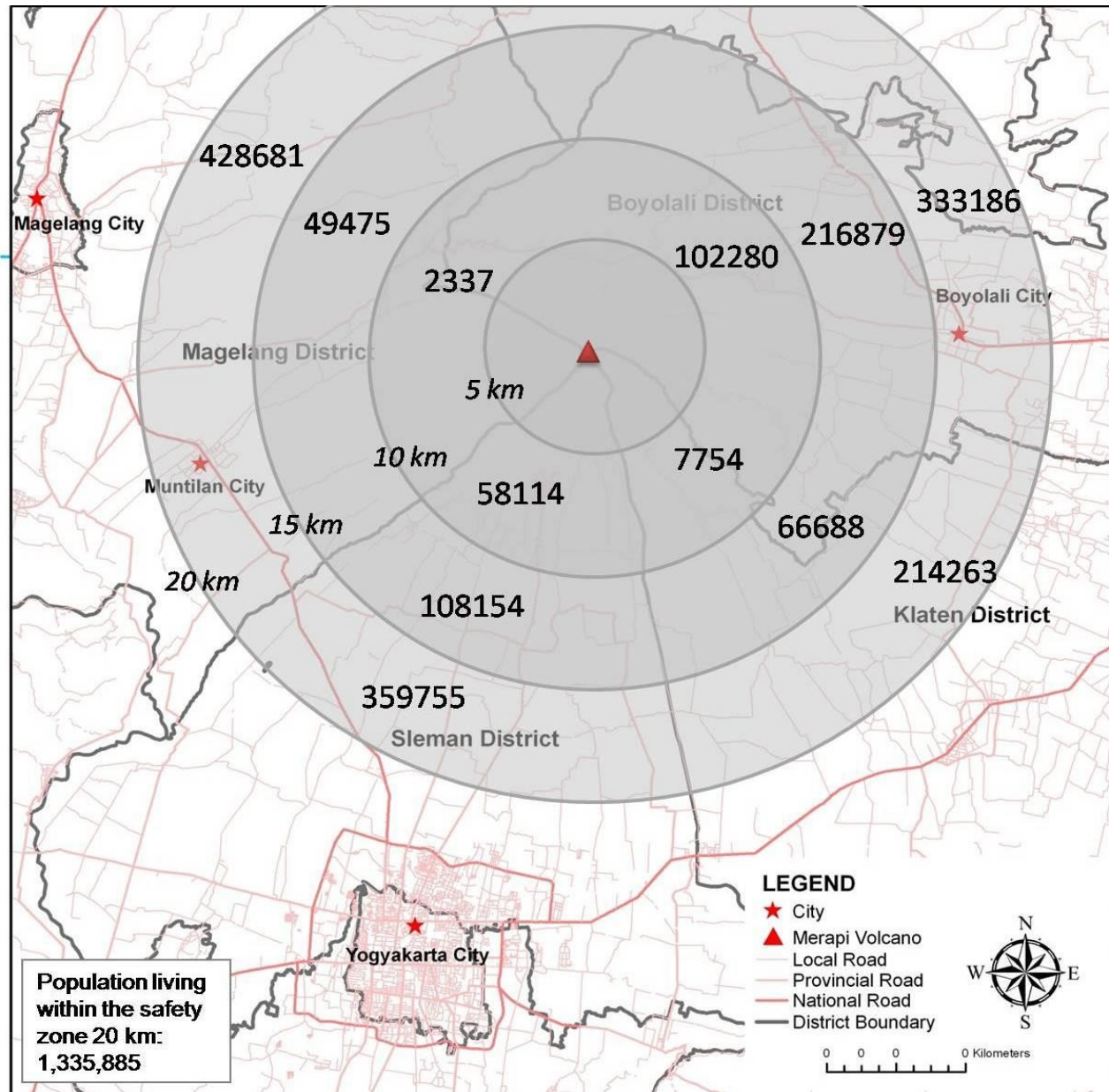


Source: <https://volcanocafe.wordpress.com/>



Source: BMKG

Merapi Area: Highly Populated



(Mei, et al., 2010)

Negative Impacts of Disasters to the People Living around Merapi

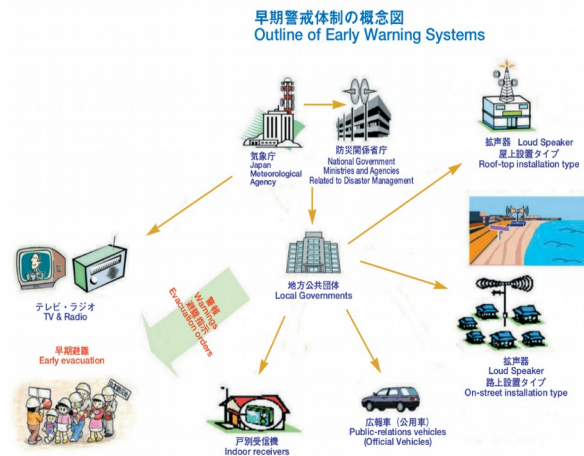
**1,900 deaths and 260,000
displacements
since the 20th century***

*Witham, 2005

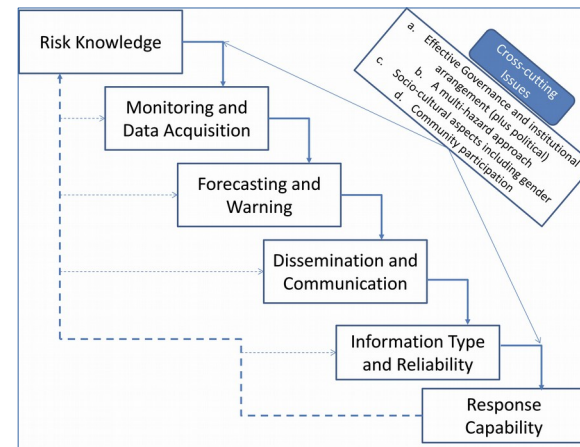
Need To MITIGATE the DISASTERS,
 people should obtain **RELIABLE INFORMATION**

through an

EARLY WARNING SYSTEM

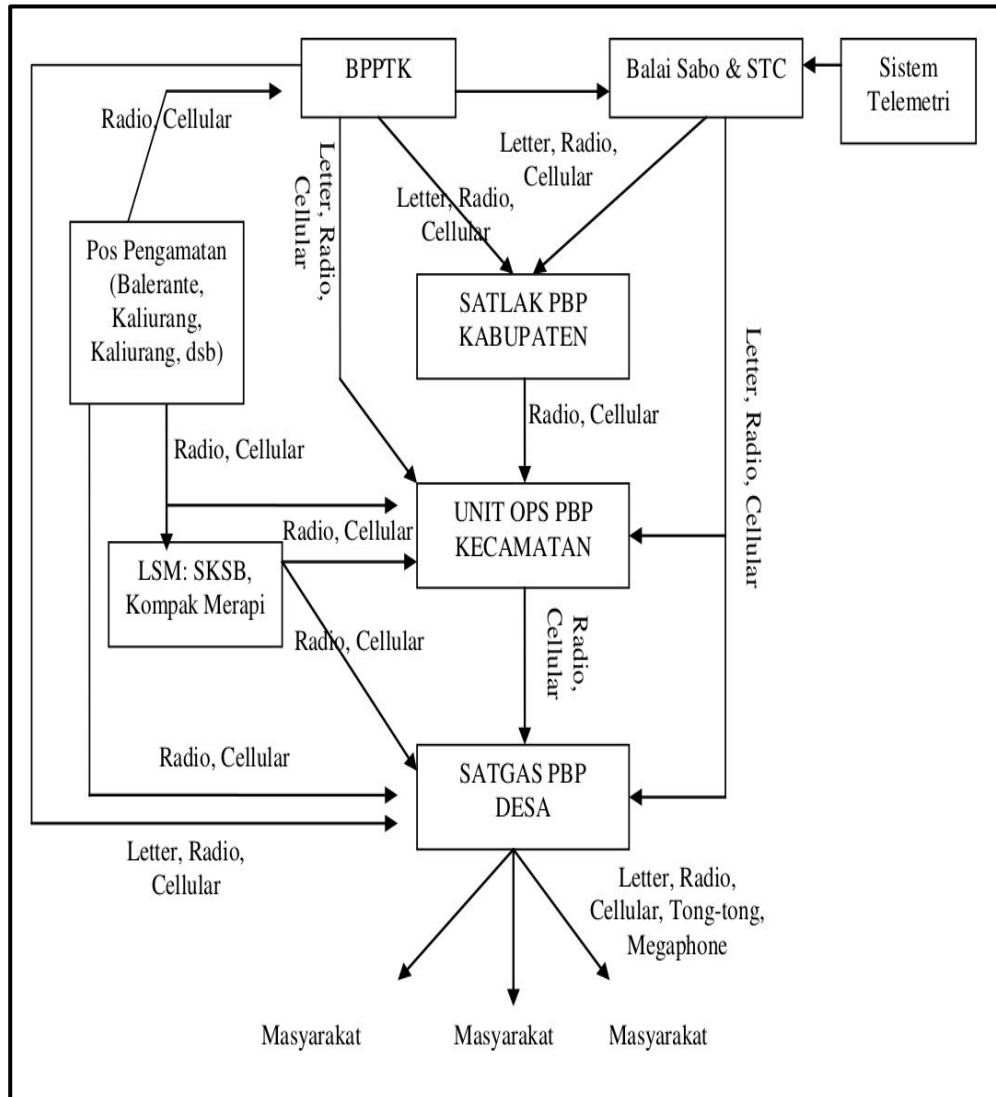


Source: Govt. of Japan, 2006



Source: UNISDR, 2006

2006 Merapi Early Warning Information Flow



- Forecasting agencies, local disaster management units and non-government organizations
- However, **no details** on the **flow of information (data exchange)**

Effect of 2007 Disaster Management Act on EWS



LAW OF THE REPUBLIC OF INDONESIA
NUMBER 24 OF 2007
CONCERNING
DISASTER MANAGEMENT

NATIONAL AGENCY DISASTER MANAGEMENT
(BNPB)

- **Changes in roles** of disaster management units
- **Lack of understanding** on **effect** on EWS in Merapi

Effect of

Act on EWS

RESEARCH PURPOSE:

Reinvestigate Merapi's Early Warning Information Flow (Volcanic Eruption & Debris Flow)



Know the **Structure - Stakeholders and Data**



Identify the **GAPS in flow**

METHODOLOGY:

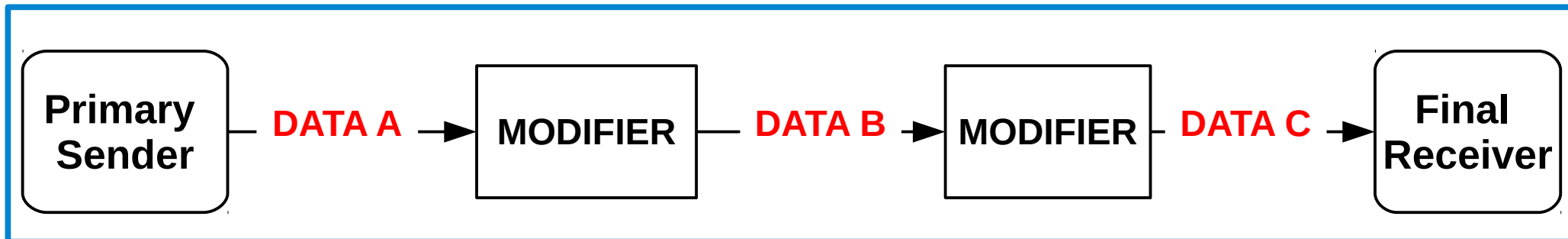
Concept of Information Flow Network



Unit of an Information Flow:
Sender, Data (Information), and Receiver

METHODOLOGY:

Concept of Information Flow Network



Network identifies **Inconsistencies and Gaps** (Vulnerabilities, Redundancies, Bottlenecks, Mistransfers)

METHODOLOGY: Data Collection

SEMI-STRUCTURED INTERVIEWS

(2014 September, 2015 January and 2015 August)

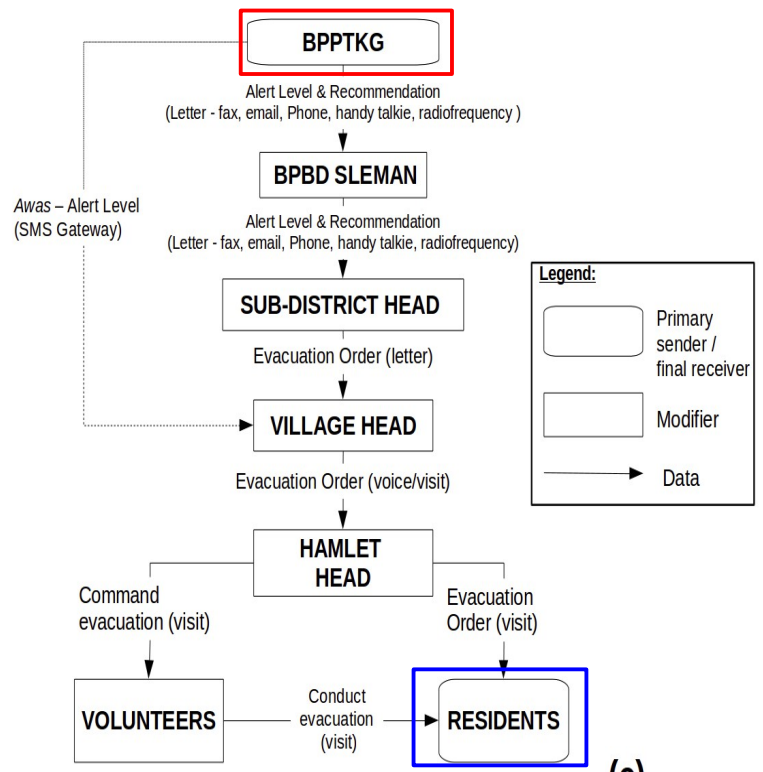
- **Stakeholders** in Merapi EWS (Rahardjo, 2007)

(BPPTKG, Balai Sabo and BPBD in Sleman, Magelang & Klaten)
- *Final Receivers:* **Residents**
- *Questions:*
 - *Data sent and to whom*
 - *Data received & from whom*
 - *Method of delivery*

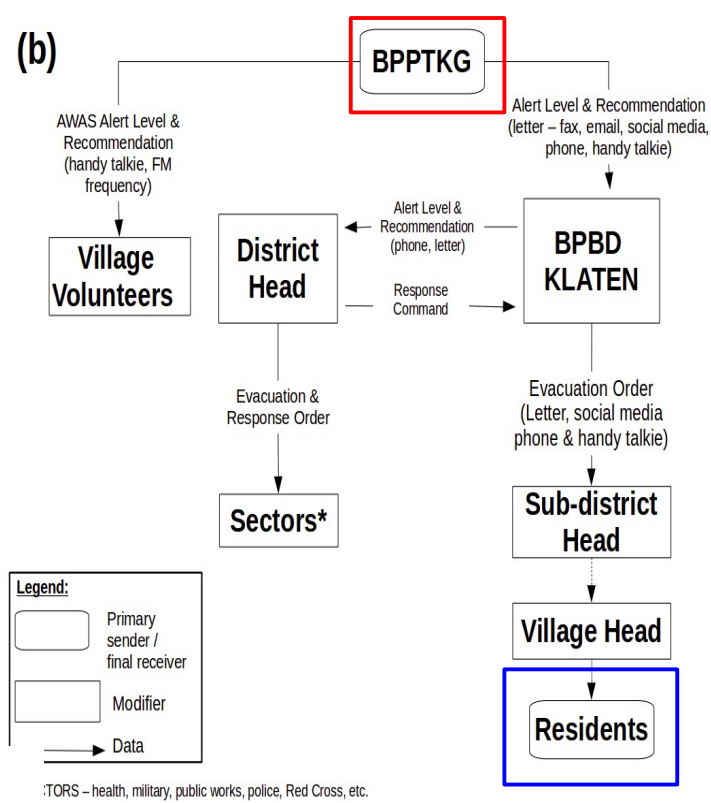


VOLCANIC ERUPTION
INFORMATION FLOW
NETWORKS

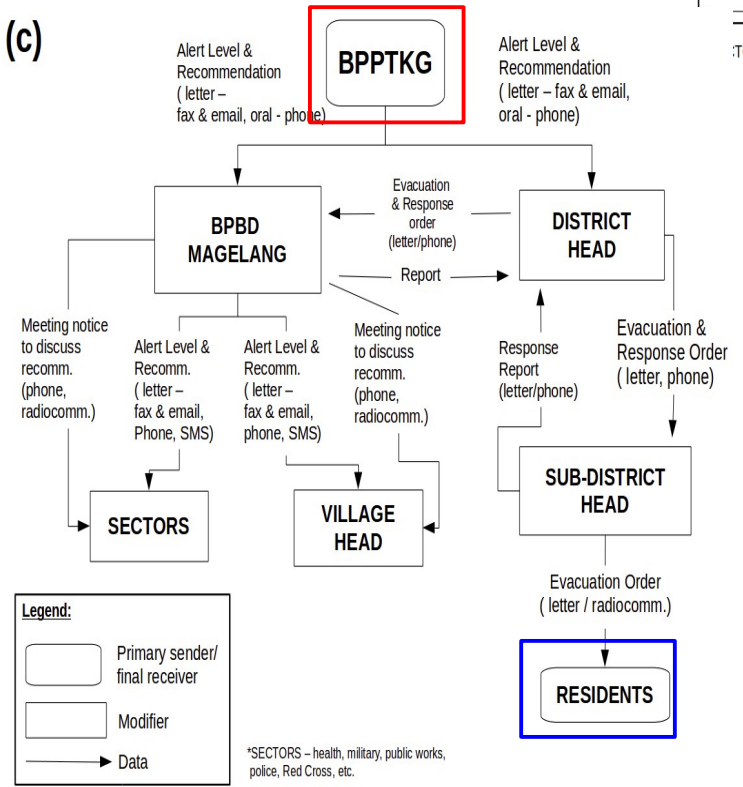
(a)



(b)



(c)

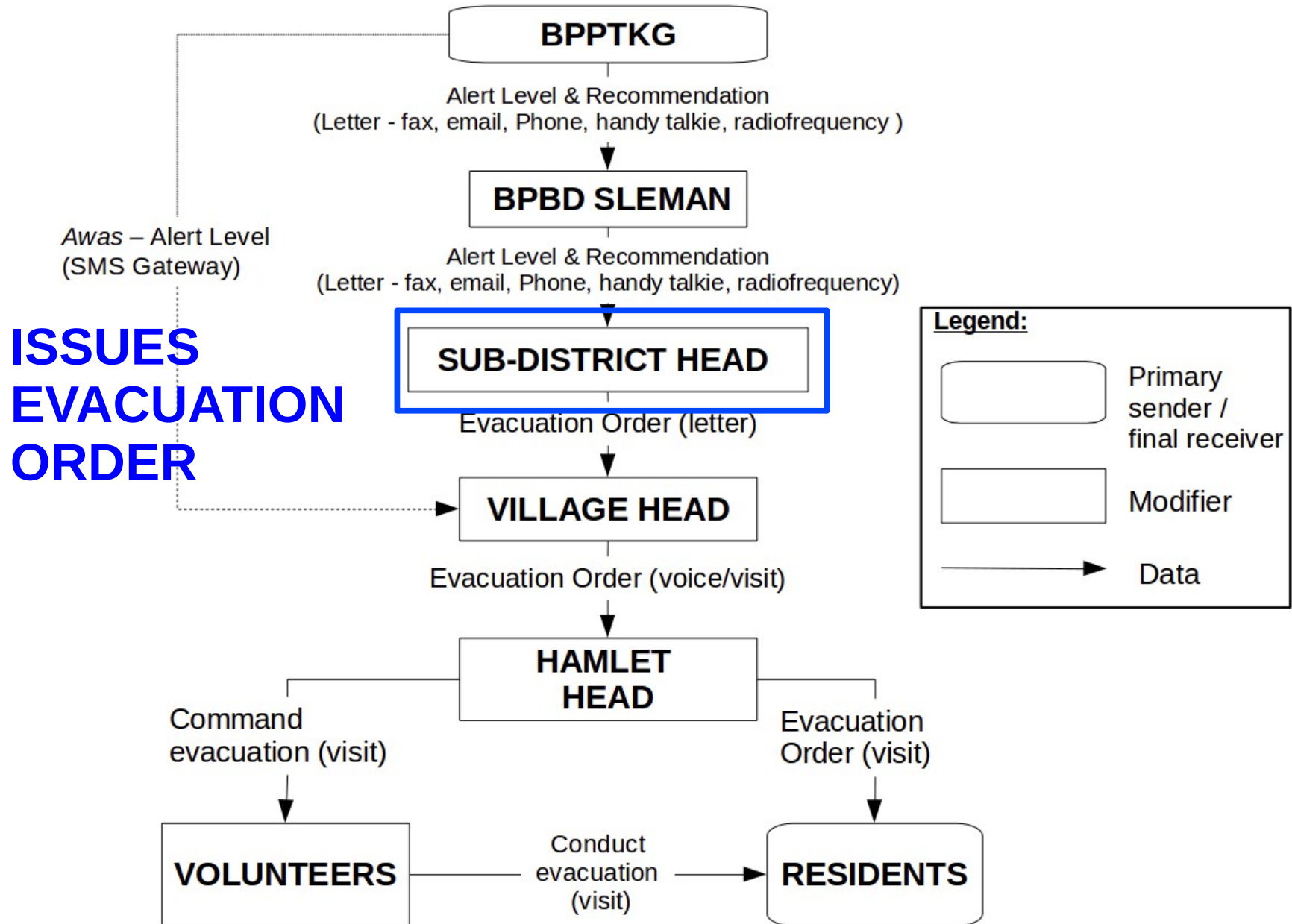


**BPPTKG as
PRIMARY
SENDERS
(source of
information)**

*SECTORS - health, military, public works, police, Red Cross, etc.

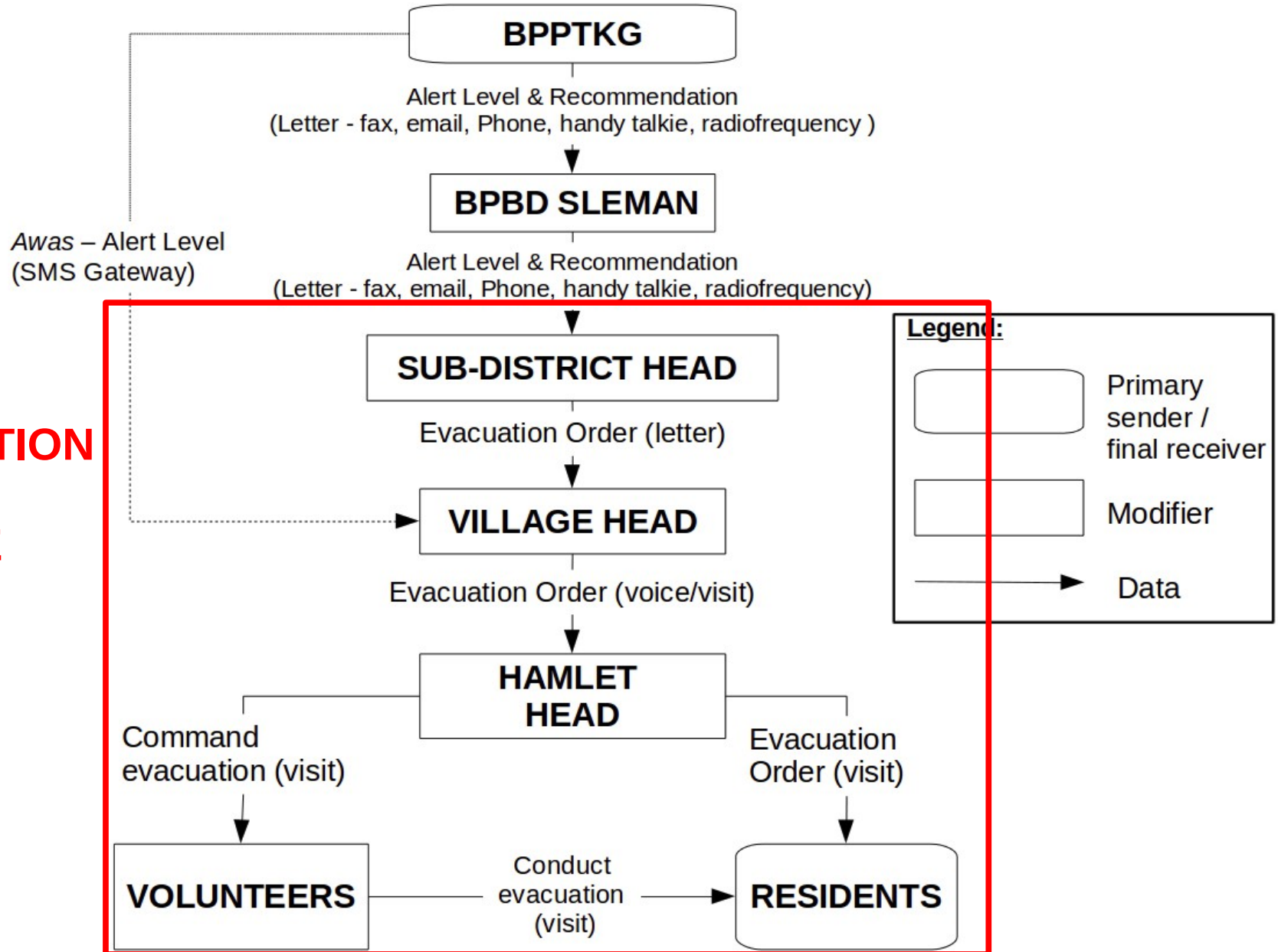
Eruption Flow Network – Sleman District

(a)



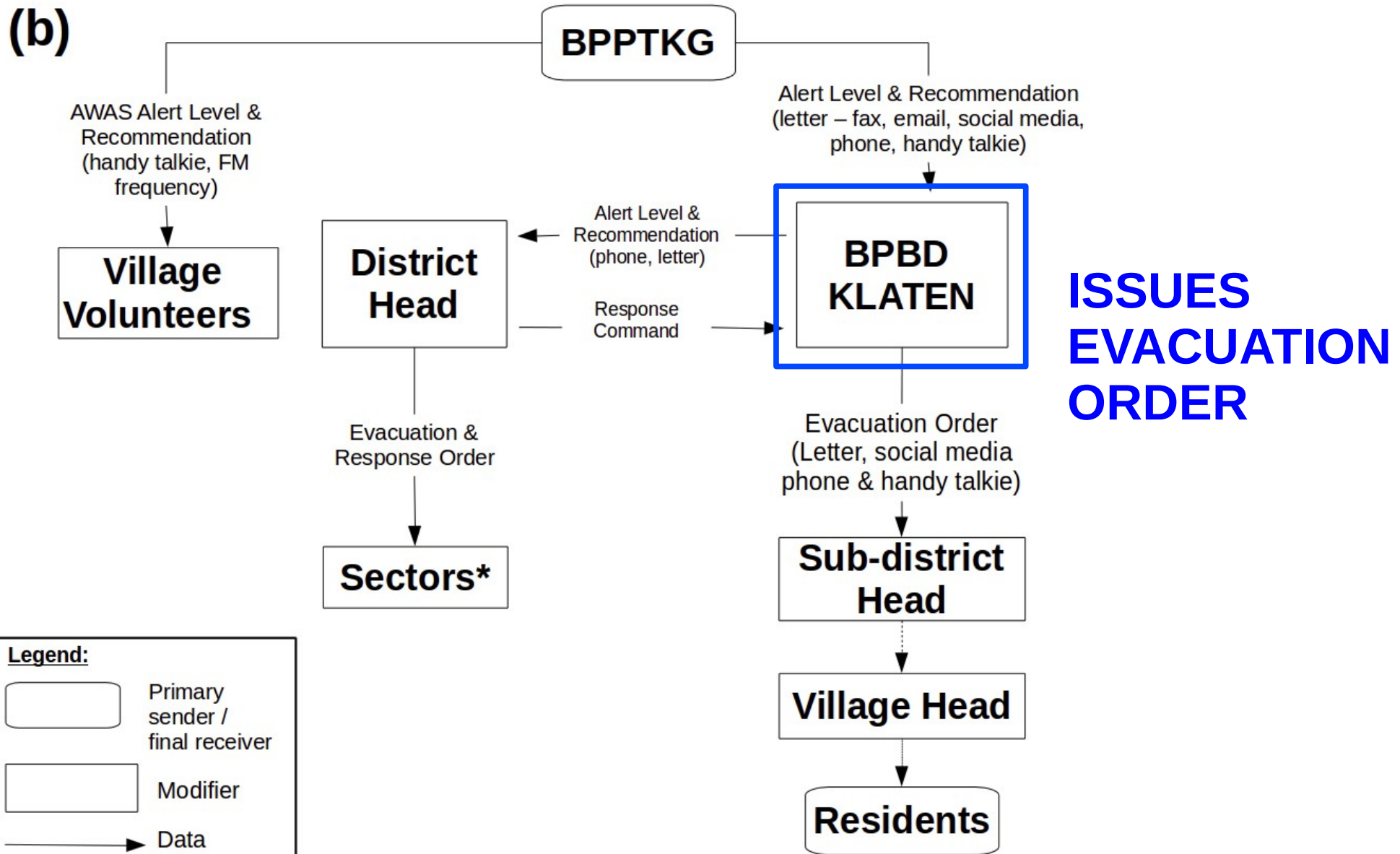
Eruption Flow Network – Sleman District

(a)



**SAME
INFORMATION
IN
MULTIPLE
STAGES**

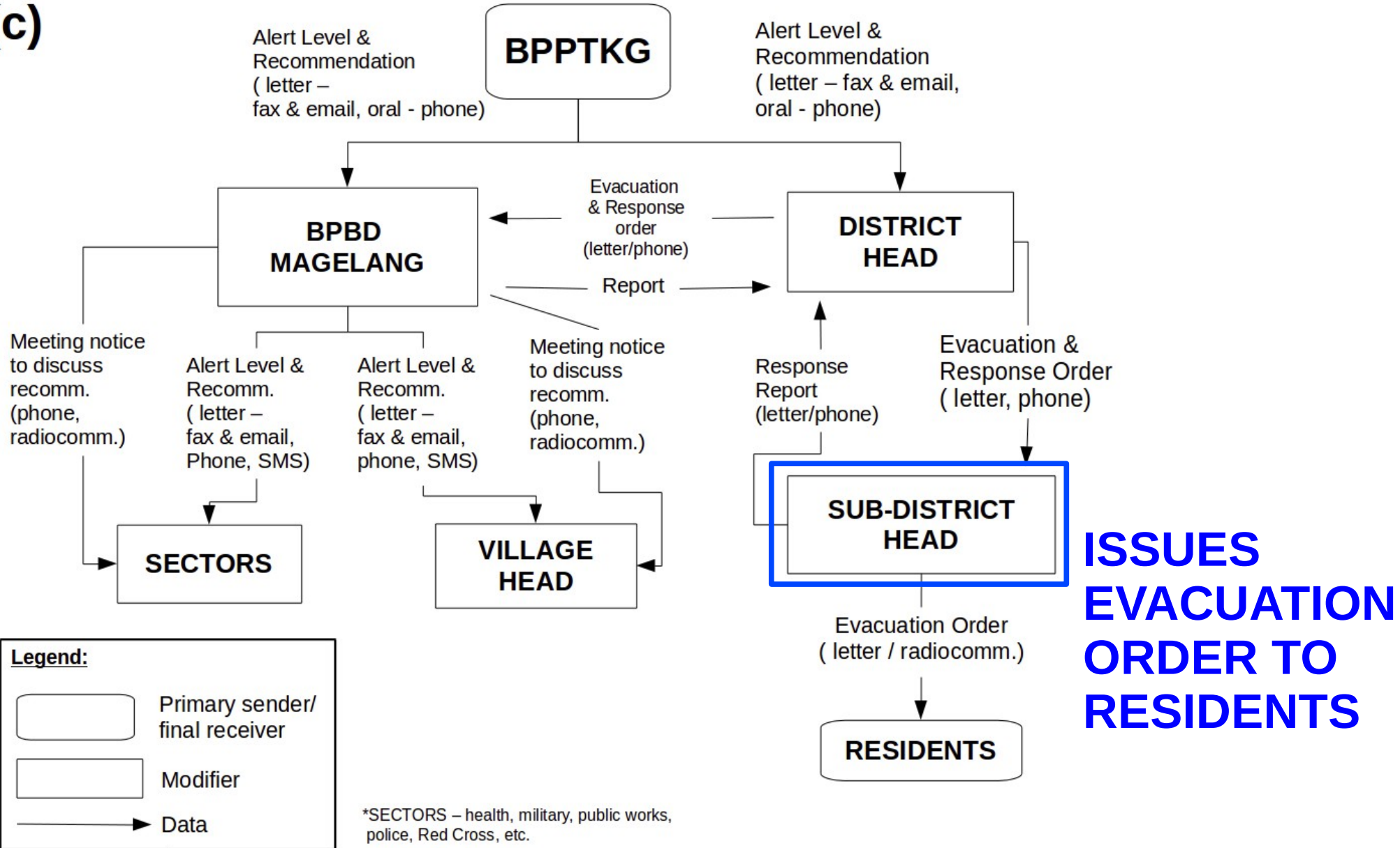
Eruption Flow Network – Klaten District



*SECTORS – health, military, public works, police, Red Cross, etc.

Eruption Flow Network – Magelang District

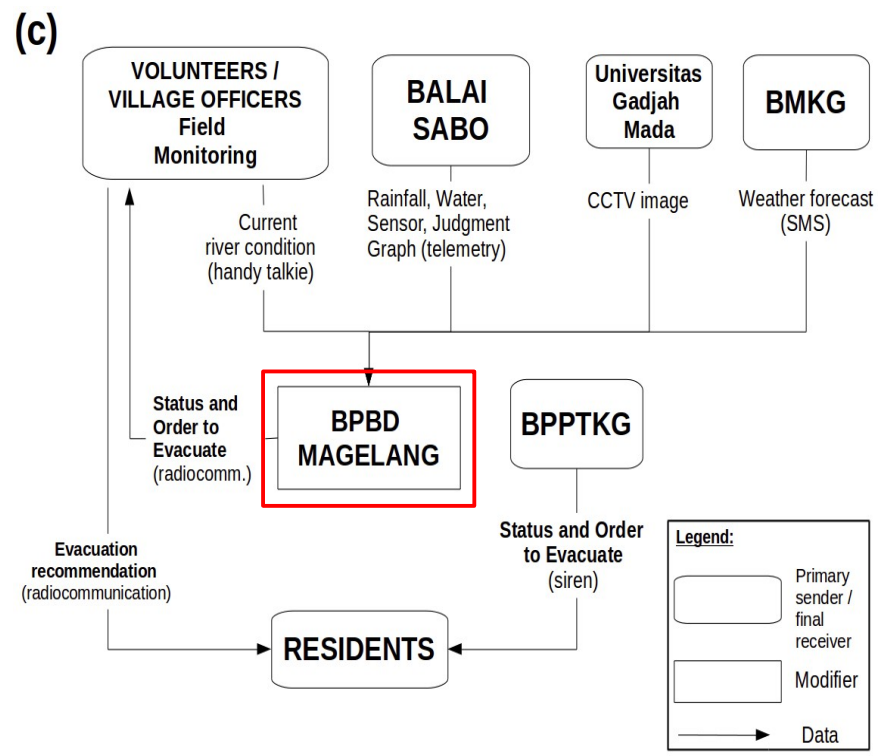
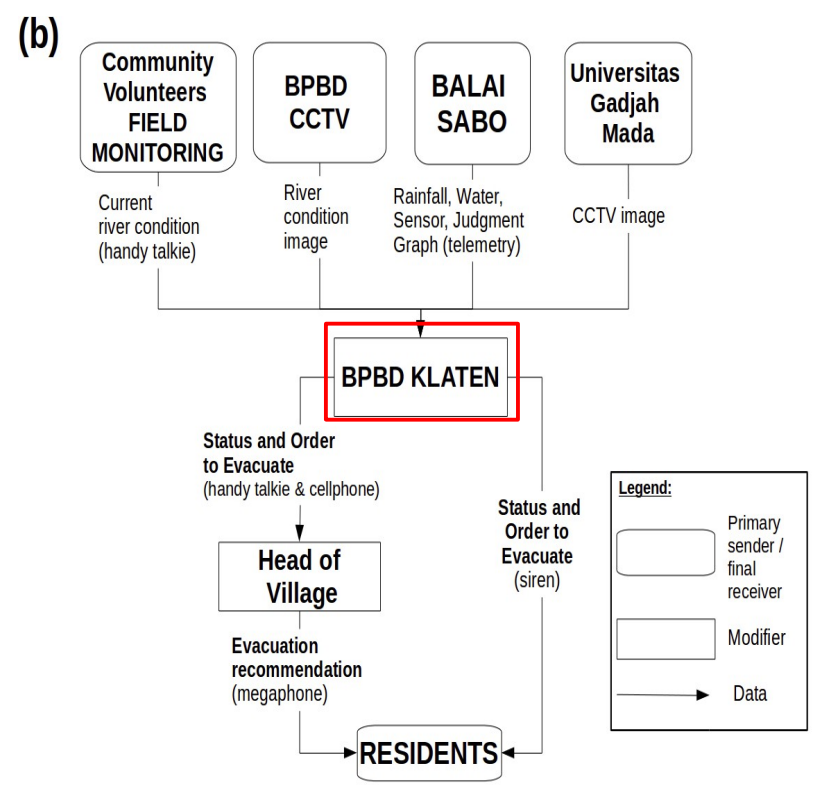
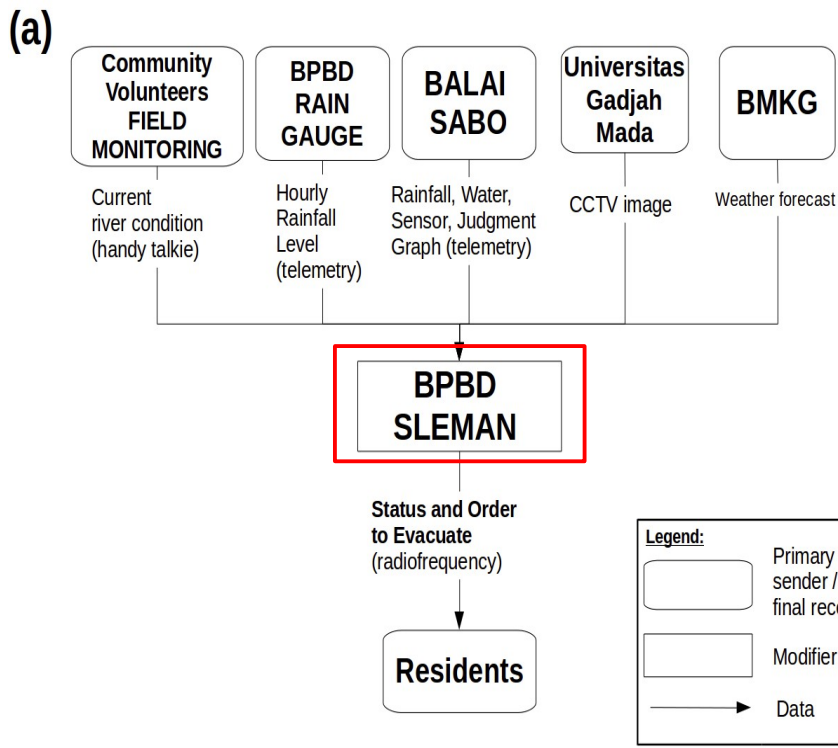
(c)



Volcanic Eruption Information Flow Networks: Summary

- Information flow formed after **bureaucratic structure**
- **Consistency: BPPTKG** as primary sender
- **Inconsistencies:**
 - **Information flow networks** are different per district
 - **Roles of Local governments / BPBDs** vary per district
- **Vulnerabilities:**
 - Inconsistencies may result in **differences in time of delivery & meaning of information**
 - May result in **bottlenecks** due to multiple stages in the delivery

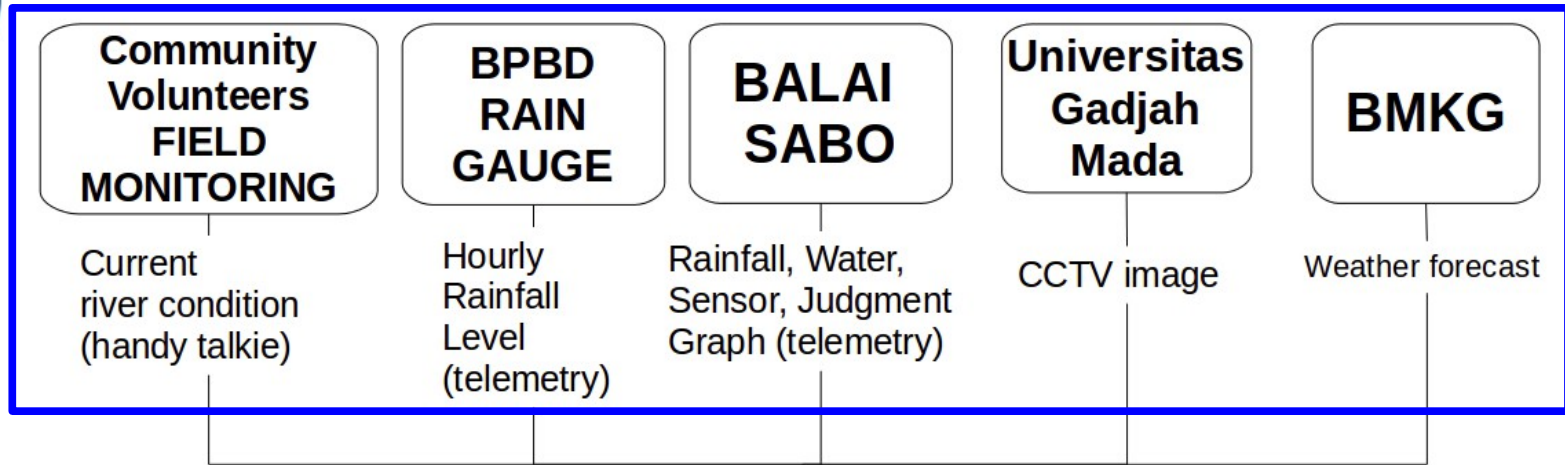
LAHAR INFORMATION FLOW NETWORKS



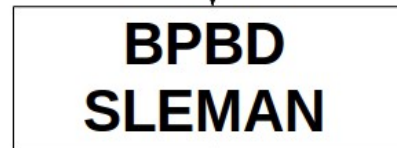
BPBD as the SINGLE MODIFIER (decision-maker)

Lahar Flow Network – Sleman District

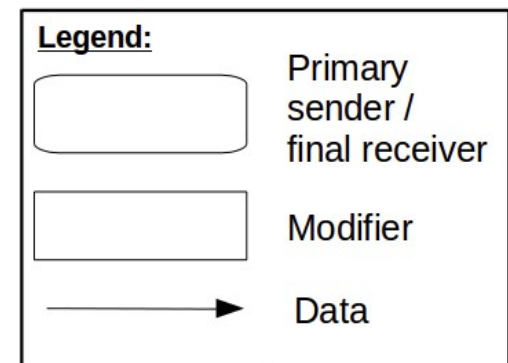
(a)



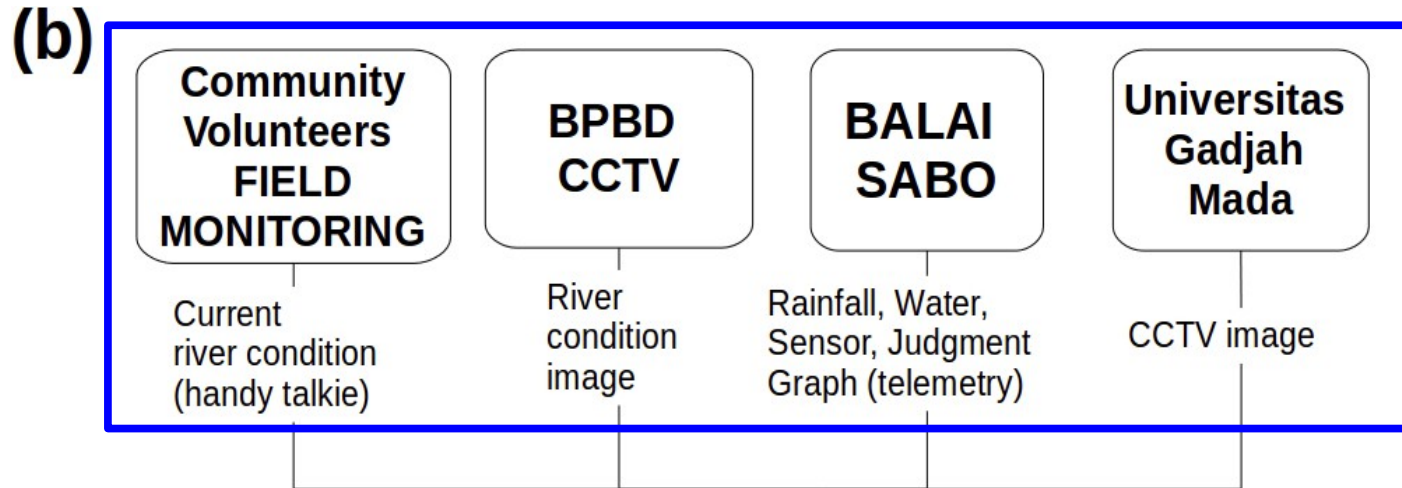
Alert levels
based on
thresholds of
different
sources



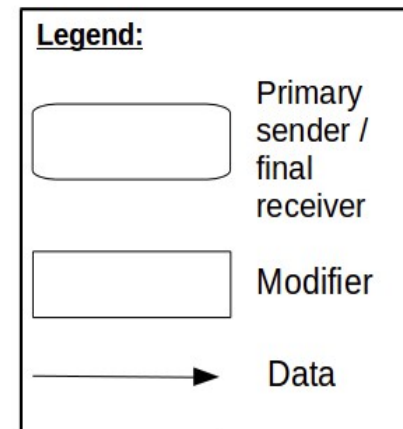
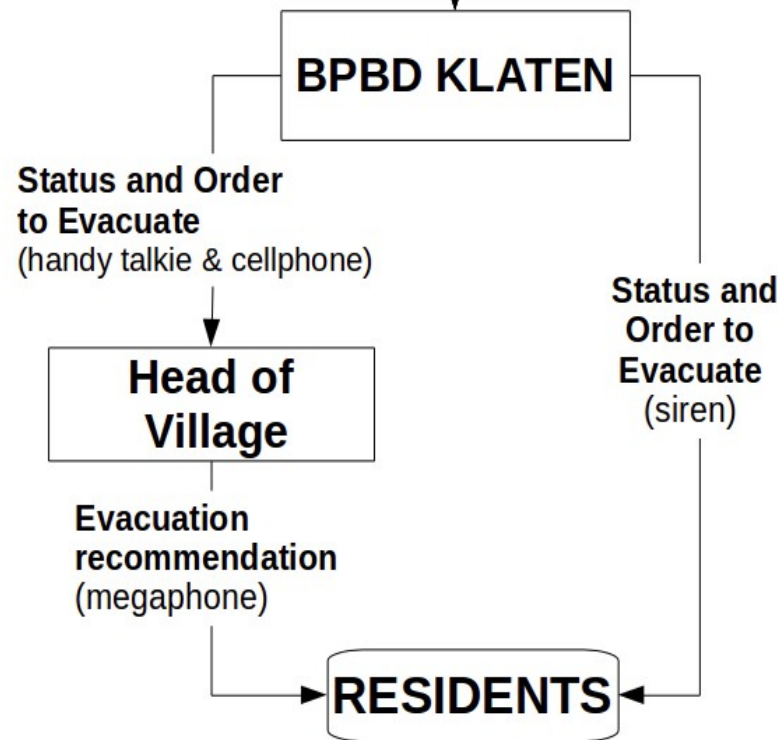
Status and Order to Evacuate (radiofrequency)



Lahar Flow Network – Klaten District

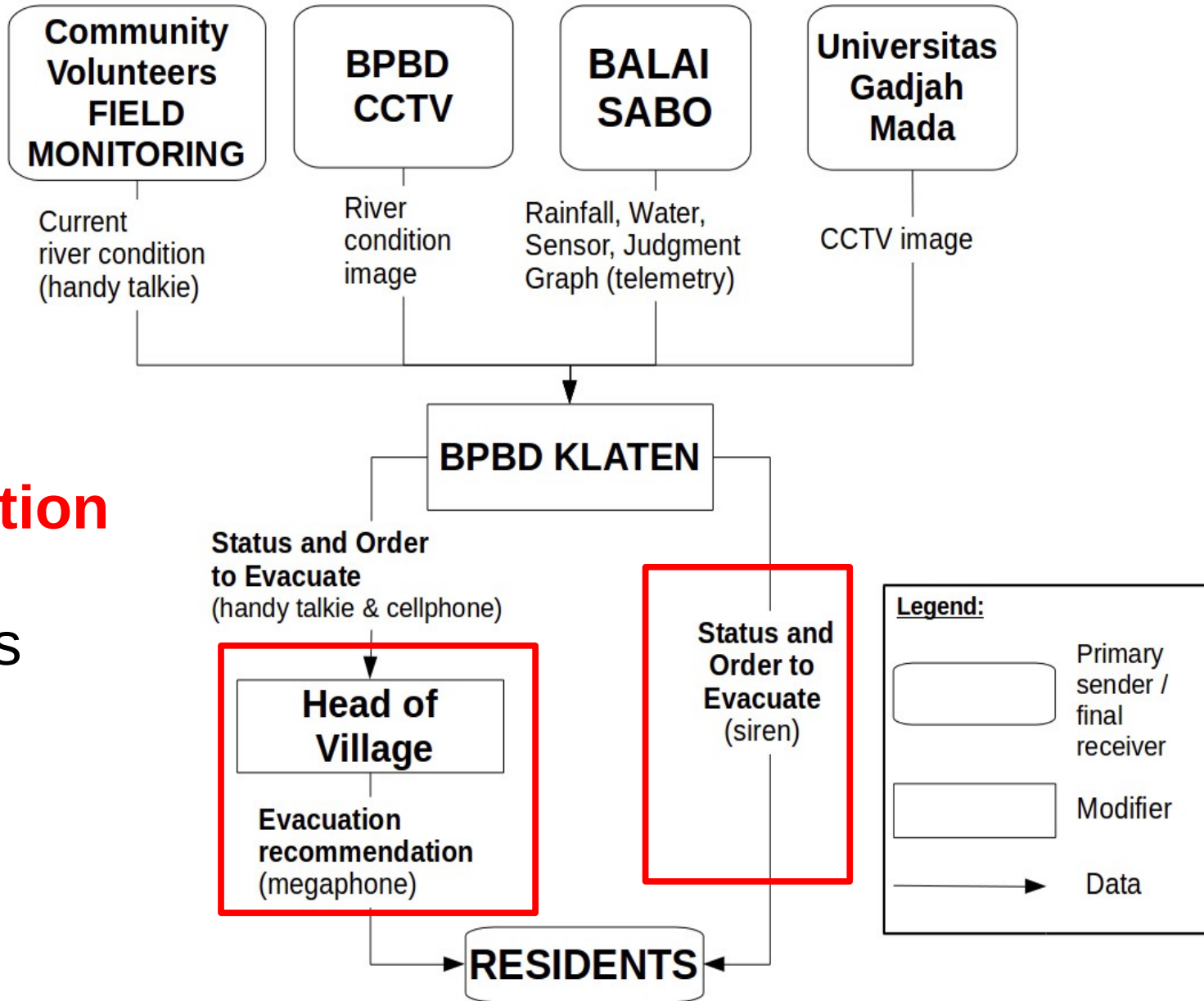


Based on **different sources (no alert levels)**



Lahar Flow Network – Klaten District

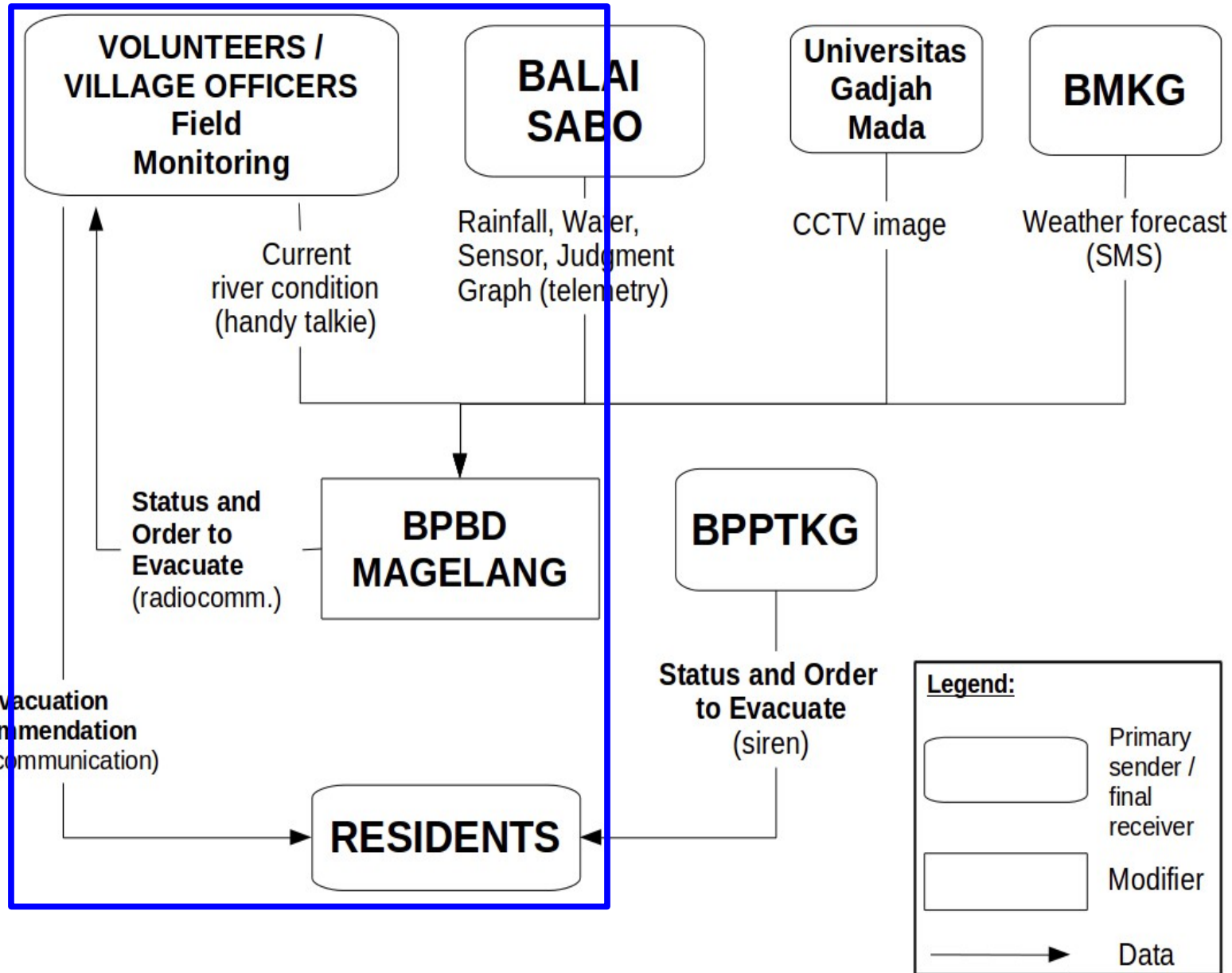
(b)



Double information sent to residents

Lahar Flow Network – Magelang District

(c)

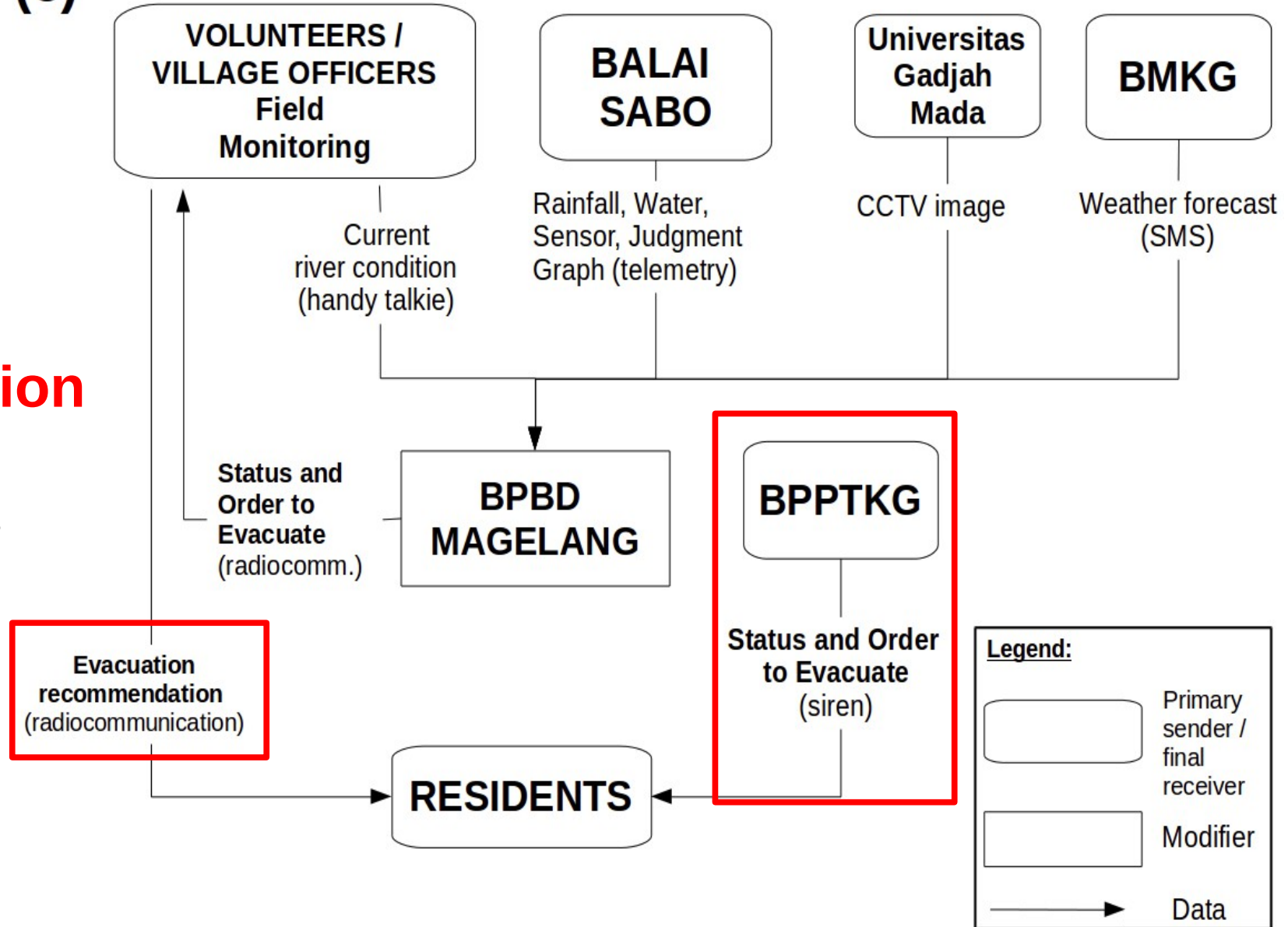


- Based on **field monitoring** (“piket”)
- **Forecasting data** may not be used

Lahar Flow Network – Magelang District

(c)

Double information sent to residents



Lahar Information Flow Networks: Summary

- Information flow as a result of **past experiences**
- **Consistency: BPBD** as modifier
Inconsistencies: Decision-making for evacuation
- **Vulnerabilities:**
 - **Double information** sent to residents may cause confusion
 - **Decision-making** based on different sources (forecasting and field observation)

Comparison of EW Information Flow Networks (Eruption vs. Lahar)

- **Inconsistencies** in structure

Volcanic Eruption: Single source, many modifiers/receivers

Lahar: Many sources, single modifier

- **Inconsistencies** in roles of local governments and BPBDs
- Vulnerabilities exist in **information management** and **decision-making**

CONCLUSIONS

- Early warning information flow networks constructed **per district for both disasters**
- **Inconsistencies** between the networks for **both disasters** and **per district**
- In the information flow perspective, Merapi EWS is prone to **vulnerabilities**

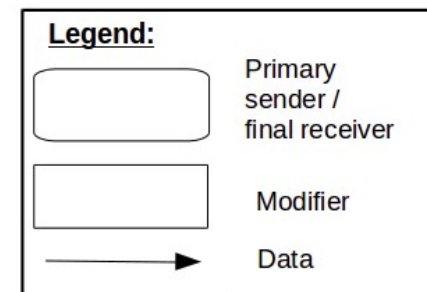
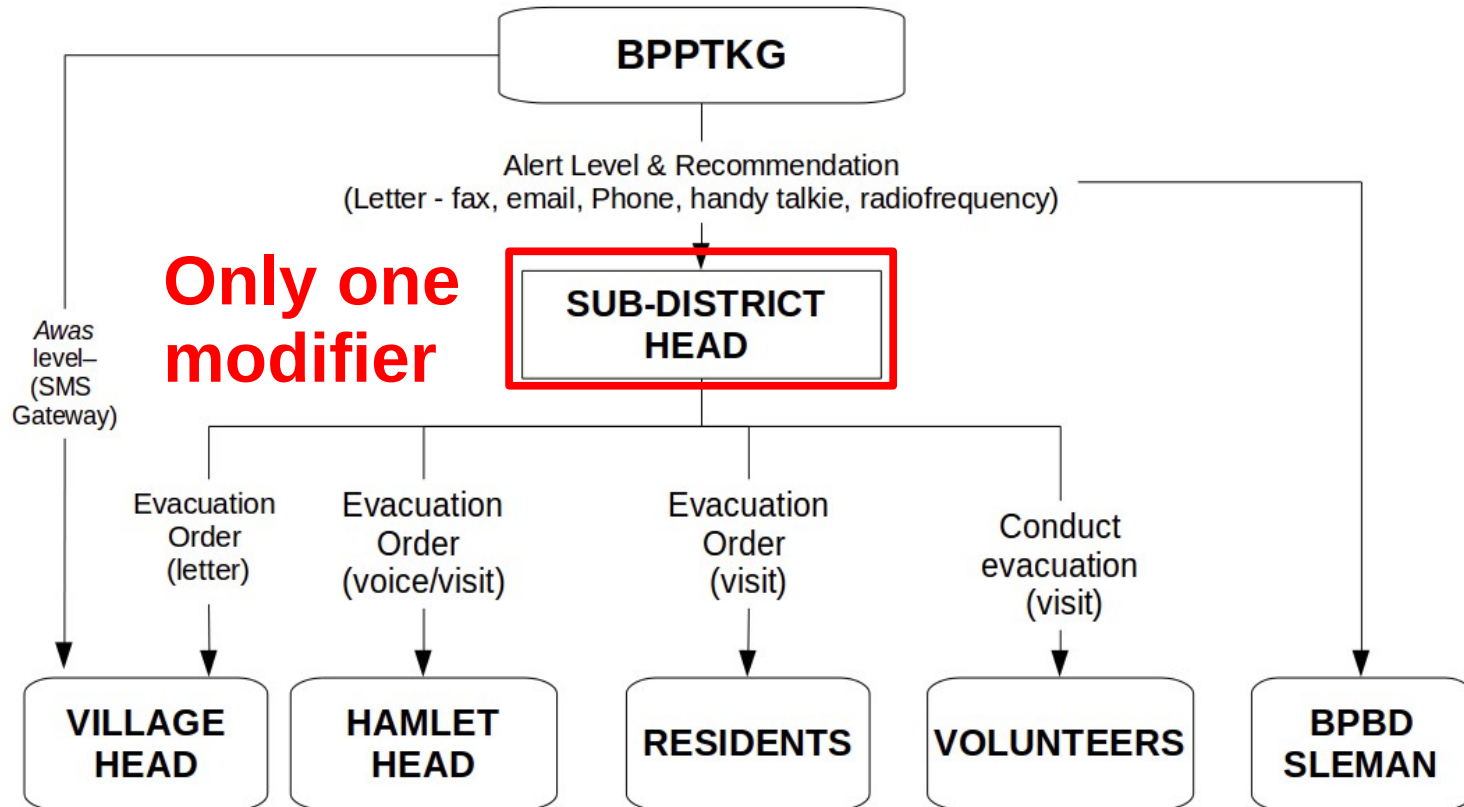
End of Presentation.

THANK YOU.

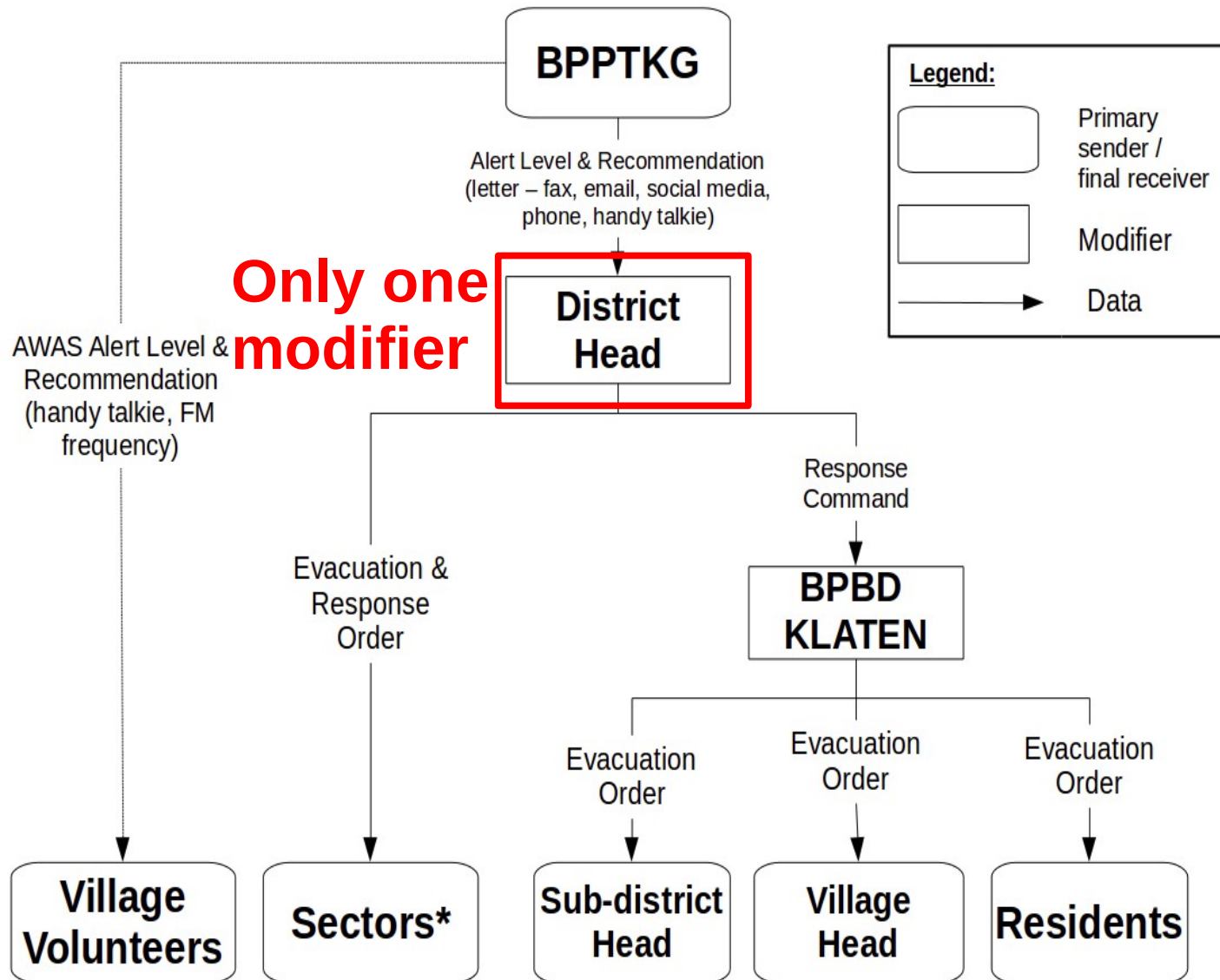
有難うございました。

Terima kasih.

Rearranged Eruption Flow Network: Sleman District

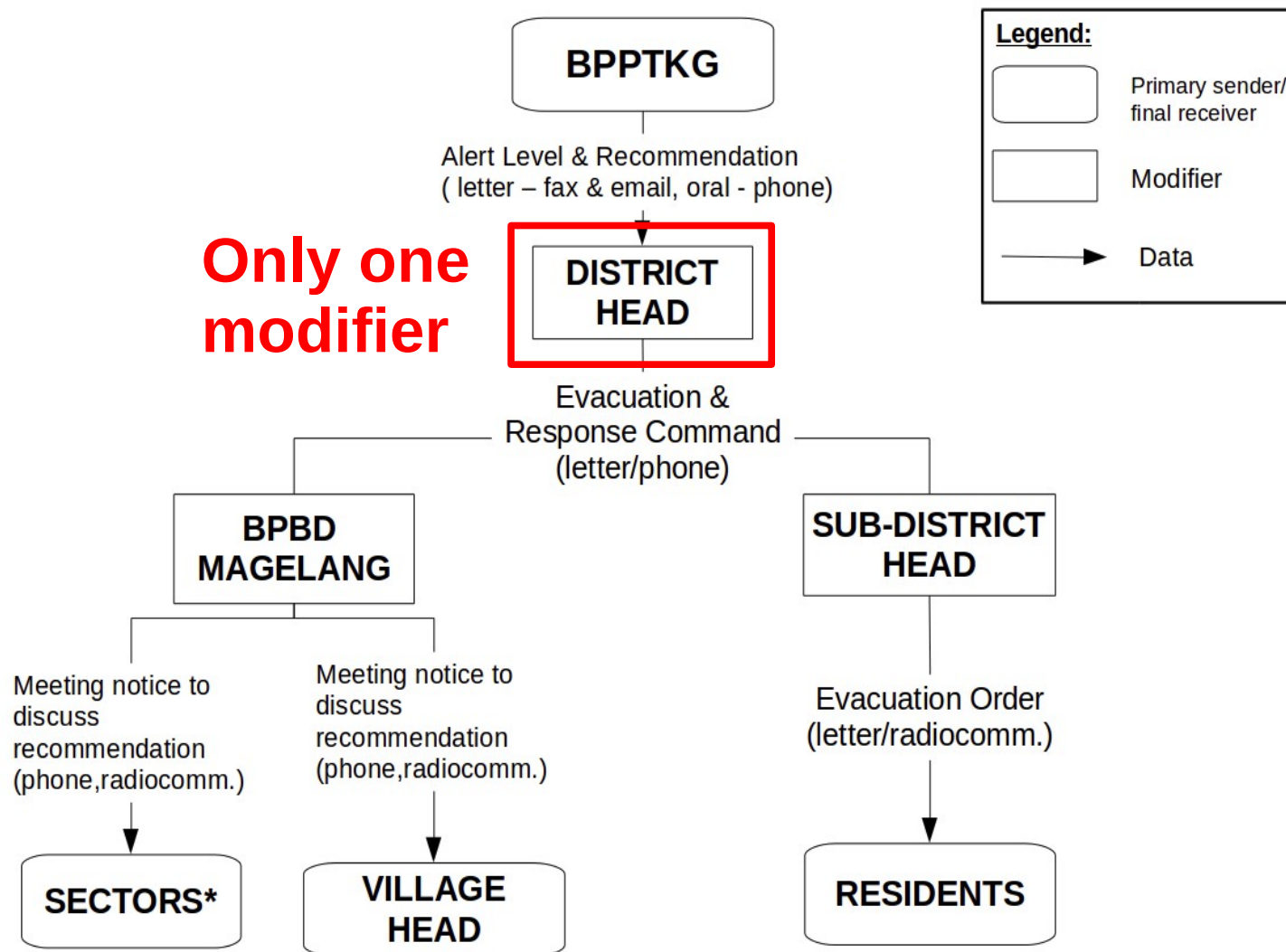


Rearranged Eruption Flow Network: Klaten District



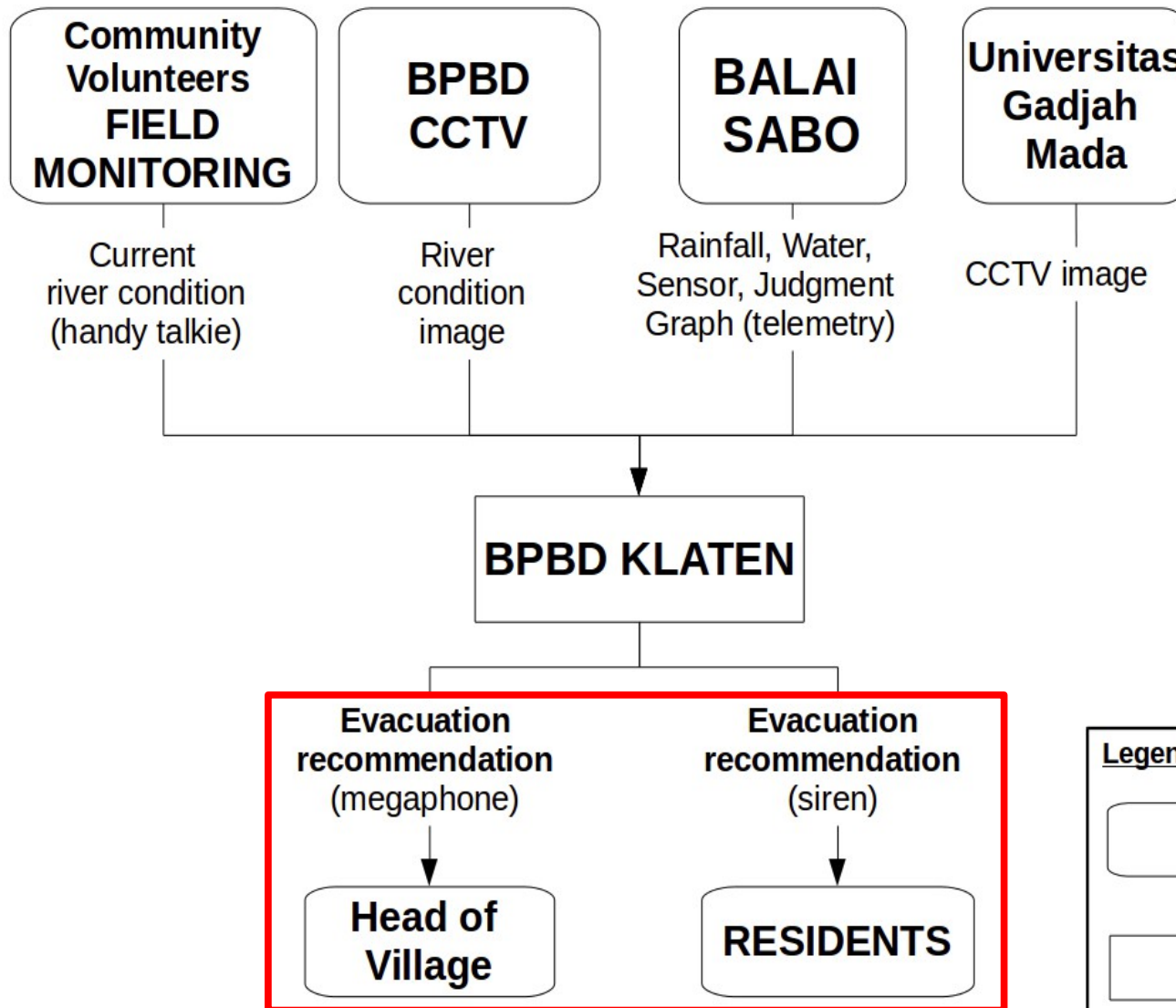
*SECTORS – health, military, public works, police, Red Cross, etc.

Rearranged Eruption Flow Network: Magelang District

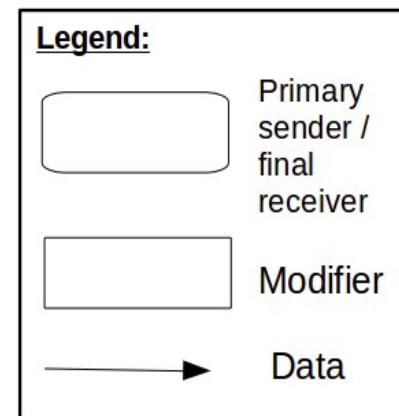


*SECTORS – health, military, public works, police, Red Cross, etc.

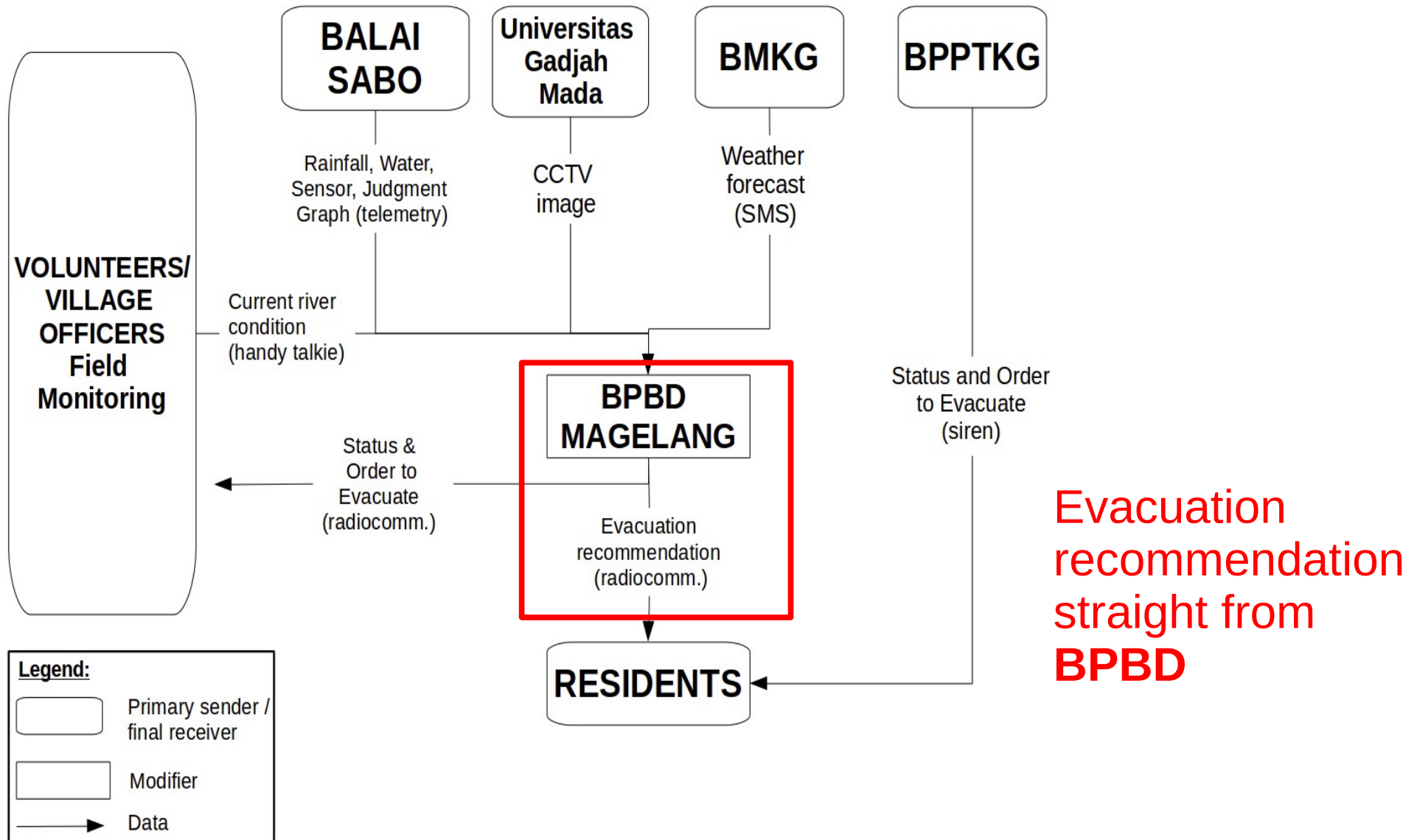
Rearranged Lahar Flow Network: Klaten District



Evacuation
recommendation
to **Head of
Village** and
Residents



Rearranged Lahar Flow Network: Magelang District



110°15'0"E 110°19'12"E 110°23'24"E 110°27'36"E 110°31'48"E 110°36'0"E



7°29'24"S
36"S

Merapi Summit

BPBD Magelang



BPBD Sleman



BPBD Klaten



Balai Sabo

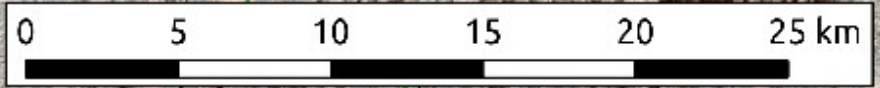


BPPTKG



Legend

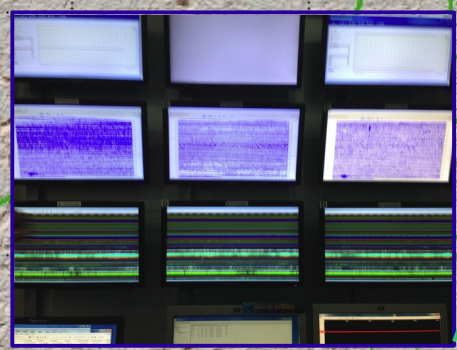
— Road



7°3'48"S
7°46'12"S
7°50'24"S

7°42'0"S
7°46'12"S
7°50'24"S

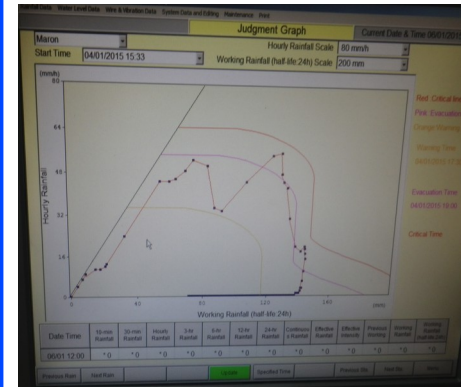
110°15'0"E 110°19'12"E 110°23'24"E 110°27'36"E 110°31'48"E 110°36'0"E



Volcanic & Debris Flow Monitoring & Forecasting Agencies' Data

VOLCANIC ACTIVITY: Alert Level & Recommendation based on Seismic, Deformation and Geochemistry Analyses

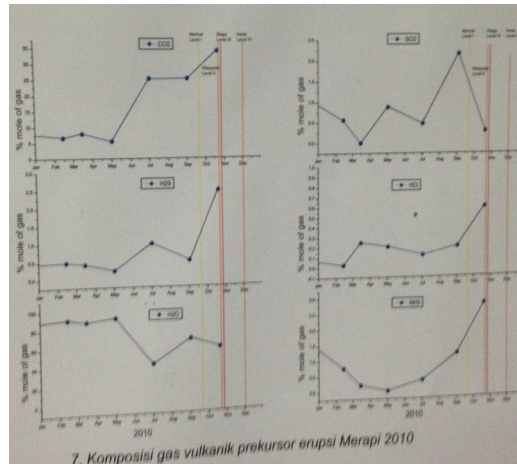
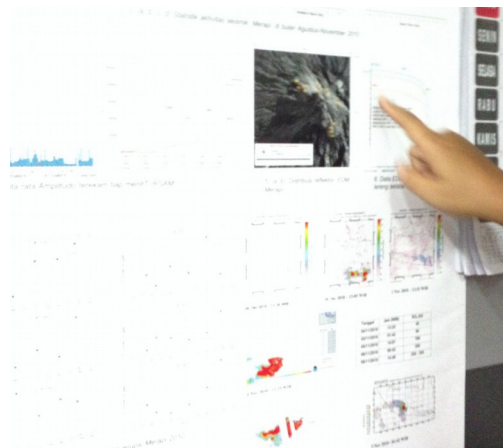
DEBRIS FLOW: Judgment Graph with Risk Levels, Rainfall & Water Level, Debris Flow Sensor



Wire & Vibration Latest Data

Wire Info		Kaliwang	Pulwatu	Gembal	Genar1	Jurango	Total
Wire1	Cut	27/10/2011 17:30					
	Restored	24/11/2011 17:00					
Wire2	Cut	27/10/2011 17:30					
	Restored	24/11/2011 17:00					
Wire3	Cut						
	Restored						

Vibration Info		Kaliwang	Pulwatu	Gembal	Genar1	Jurango	Total
Vib1	Vibration						
	Restored						
Vib2	Vibration						
	Restored						



Rainfall Daily Report (all station)

Date Time	Maroon		Pawangan		Marangan		Batadjan		Genar1	
	Rhombus1	Rhombus1	Rhombus1	Rhombus1	Rhombus1	Rhombus1	Rhombus1	Rhombus1	Rhombus1	Rhombus1
0401 01:00	+0	+27	0	27	0	19	0	0	0	0
0401 02:00	+0	+27	0	27	0	19	0	0	0	0
0401 03:00	+0	+27	0	27	0	19	0	0	0	0
0401 04:00	+0	+27	0	27	0	19	0	0	0	0
0401 05:00	+0	+27	0	27	0	19	0	0	0	0
0401 06:00	+0	+27	0	27	0	19	0	0	0	0
0401 07:00	+0	+27	0	27	0	19	0	0	0	0
0401 08:00	+0	+27	0	27	0	19	0	0	0	0
0401 09:00	+0	+27	0	27	0	19	0	0	0	0
0401 10:00	+0	+27	0	27	0	19	0	0	0	0
0401 11:00	+0	+27	0	27	0	19	0	0	0	0
0401 12:00	+0	+27	0	27	0	19	0	0	0	0
0401 13:00	+0	+27	0	27	0	19	0	0	0	0
0401 14:00	+0	+27	0	27	0	19	0	0	0	0
0401 15:00	+9	+9	9	9	9	33	70	2	2	2
0401 16:00	+12	+21	12	21	12	35	105	14	14	14
0401 17:00	+49	+70	49	70	49	21	141	9	9	9
0401 18:00	+55	+125	55	125	55	15	126	1	1	1
0401 19:00	+20	+145	20	145	20	2	143	0	0	0
0401 20:00	+10	+155	10	155	10	1	156	0	0	0
0401 21:00	+1	+156	1	156	1	0	156	0	0	0
0401 22:00	+0	+156	0	156	0	0	156	0	0	0
0401 23:00	+0	+156	0	156	0	0	156	0	0	0
0401 24:00	+0	+156	0	156	0	0	156	0	0	0
Total	156	—	156	—	156	—	156	—	156	—
Average	6	—	6	—	6	—	6	—	6	—
Max	10	—	10	—	10	—	10	—	10	—