2010-10-01alt

Hydrological Equipment for Community Early Warning

-Explanatory Note-

- Introduction
- Equipment
  - Characteristics (Advantages and Limitations)
  - Assembly
  - Installation
  - Operation
  - Details of apparatus
  - Tools and parts
- End Note

VOLUNTEERS for the promotion of

COMMUNITY EARLY WARNING (VCEW)

■ Introduction

The World Conference for Disaster Reduction (1995 Japan) emphasized the importance of community-based disaster management (CBDM) in that community operated early warning (COEW) should be a key component.

COEW is necessary especially for communities located in small steep river basins because:

- Floods/debris flows/landslides occur by localized heavy rainfall within the river basin where the communities are located. However in most countries the national observation network is not so dense to cover all such basins.
- Floods/debris flows/landslides occur shortly after heavy rainfall. Therefore people should be warned immediately after rainfall. However in most countries the national early warning system may not be so quick in operation.

To meet such necessity water level equipment and rainfall equipment were developed in the Central America and the Caribbean.

- Water level equipment with automatic alarm function was developed by CONRED (Guatemala)/CEPREDENAC[1)] after Hurricane Mitch (1998) and has since been in use for COEW in Central America.
- Rainfall equipment of similar type was developed by the University of West Indies (Trinidad & Tobago)/CDERA/JICA [2)] in 2004-2005 and has been distributed to Caribbean countries for COEW.

Of various types of equipments being used for COEW, these equipments may be the one suitable for a majority of communities because of the advantages mentioned in the next chapter. For a wider use of these equipments in developing countries, “Volunteers for the promotion of Community Early Warning (VCEW)” (Ref. End Note) has been producing them with some modification of the originals for donation to developing countries[3)]. The equipments are also being sent to international organizations for information sharing among variety of users in the world[4)].

The intention of VCEW is not to provide the equipments to all communities of developing countries but to a limited number of organizations (government agencies, NGOs, academic institutes etc) in each country which will serve as the core for mass production and dissemination and will support communities in O/M, thus establishing a self-reliant system for production and use of the equipments in each country.

■ Equipment

■ Characteristics (Advantages and Limitations)

Advantages

- Cheap in cost: All parts will be available even in developing countries except the relay for the monitoring apparatus which may not be available in some countries;
- Simple in structure: An armature/inexperienced person will be able to assemble but involvement of technician, electric engineer, hydrologist are desirable for the reliable assembling and future improvement. .
- Easy for O/M: Any trouble in O/M can be solved by the persons who assembled the equipment, without resorting to external help which may take time and cost;
- Effective measurement: The observer can measure heavy rainfall and sudden rise in water level without fail even if they occur in the mid-night, due to the alarm system;
- Safe measurement: The observer can measure rainfall and water level safely in the house without going out to the observation sites under storm, mid-night and other difficult conditions.

Limitations

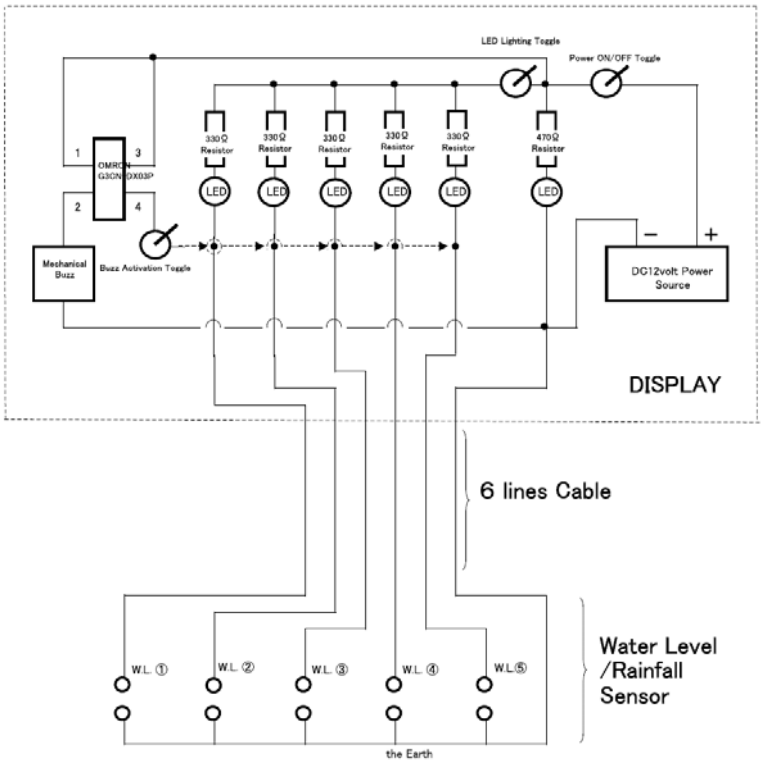
- Rainfall and water level equipment are:
  - not for “real time observation”
  - not for “automatic recording”
- Rainfall equipment is:
  - not for “automatic drain” of accumulated rainfall
  - for accumulated rainfall and not for “intensity “(rainfall during any optional unit time)

Despite “Limitations”, the equipments will be suitable for COEW in developing countries due to “Advantages”, especially “Simple in structure” and “Easy for O/M”. There are many cases where hydrological equipments are not working which were imported and installed with external assistance.

■ Assembly

- The equipment (rainfall equipment and water level equipment) consists of a sensor for measurement and a monitoring apparatus for display and warning.
- Power is to be supplied by a 12 volt battery or by an AC converter. Solar battery may be considered where power supply is not stable.
- Circuit diagram is given in Figure 1.
- Details of tools for assembly and parts are given in Table 1 and 2 respectively.
- One day will be enough to assemble a set of the monitoring apparatus, rainfall equipment and water level equipment after experiences of assembly of several sets of equipment, if all tools and parts are readily at hand.

Figure 1　Circuit Diagram



- Rainfall equipment
  - The size of the bottle depends on the rainfall amount. 2 litter bottle might be appropriate for many cases, but 3 litter or more can also be considered. When it is necessary to measure a larger amount of rainfall than the depth of the bottle, a smaller bottle can be used for the receiving part.
- Water level equipment
  - Depth/velocity/floating rubbish etc. should be taken into account in the design and installation.

Photo 1
Monitoring apparatus

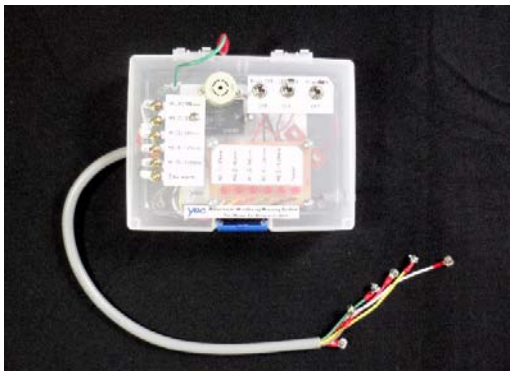


Photo 2 Rainfall equipment and Monitoring apparatus

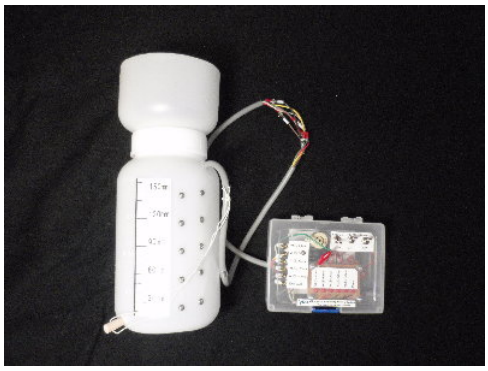
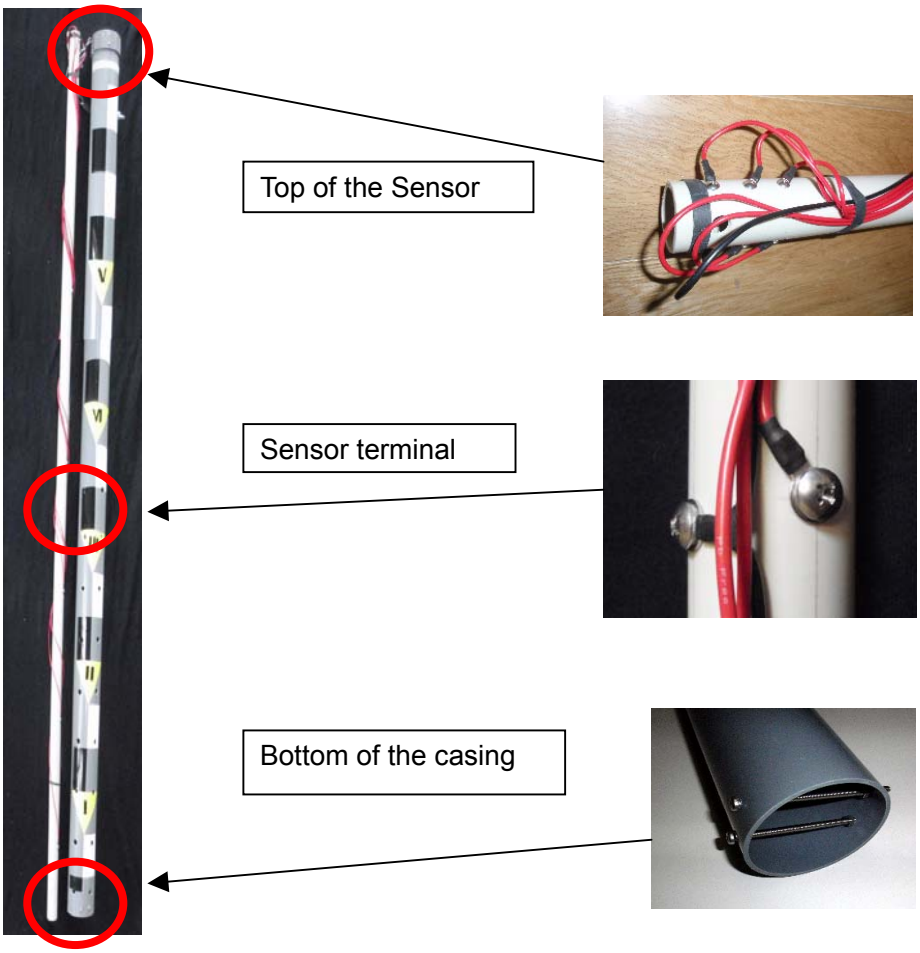


Photo 3 Water level equipment



■ Installation

・ Rainfall equipment

- The sensor is to be installed outside the house and connected by a cable to the monitoring apparatus in the house. The connecting cable can be extended to more than 100 m.

・ Water level equipment

- The sensor is to be installed by the river bank attached to the revetment (photo 4) or a tree (photo 5), or on the artificial basement (photo 6). The sensor is connected by a cable to the monitoring apparatus in the house in the same manner as the rainfall equipment.
- It is important to ensure that the cable should not be stolen or damaged.
- The bottom is to be set higher than the river bed because the measurement is made not of low water levels but of floods levels.

Photo 4
(attached to revetment, Nepal)

Photo 5
(attached to a tree, Costa Rica)

Photo 6
(Installation on the concrete basement, Guatemala)

■ Operation

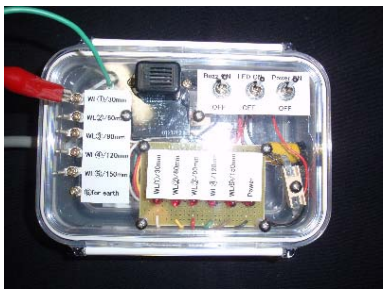
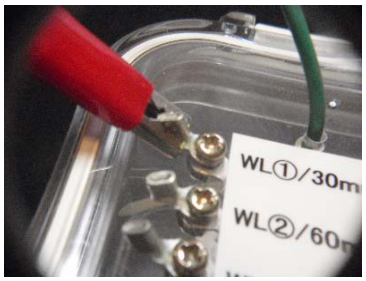
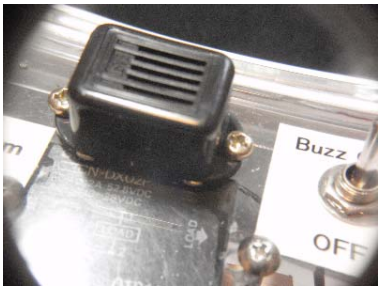
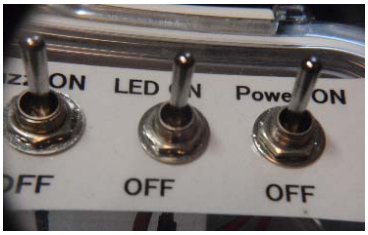
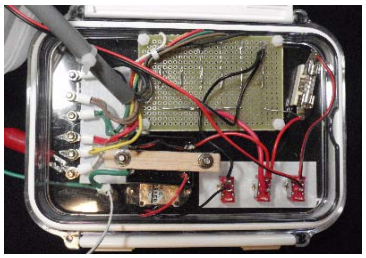
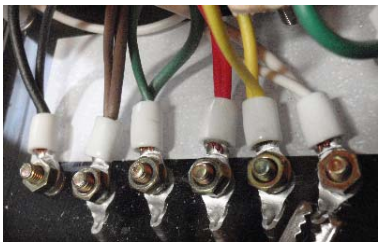
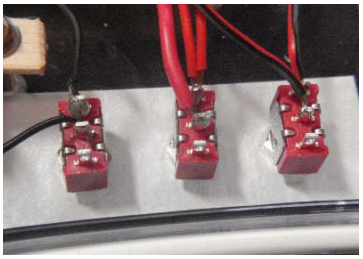
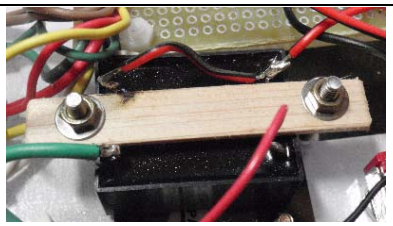
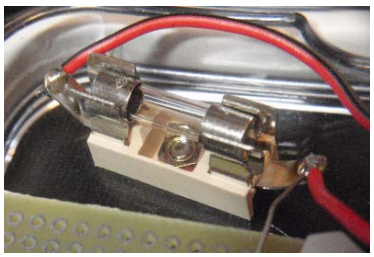
・ Using a 6-line cable, 5 stages of accumulated rainfalls and water levels can be monitored, and the alarm buzzer can be activated at any of the selected stage of accumulated rainfall and water level.
・ It is recommended to turn OFF either the LED switch or buzzer, because having the both LEDs and buzzer activated at the same time may cause instability in functionality of the buzzer.

・ Rainfall observation
- The critical rainfall amount (for alarm, warning, evacuation etc) shall be determined based on the relationship between rainfalls (accumulated rainfalls or the combination of accumulated rainfalls and rainfall intensity) and inundation areas and occurrence of debris flows/landslides.
- The rainfall intensity can be known from the accumulated rainfall and the time from the previous accumulated rainfall and the time.
- The observation is to be made only during monsoon season. During the monsoon season the observer records the daily rainfall amount. The accumulated rain should be drained every morning at the fixed time.
- When information on possible disaster (floods, debris flows, landslides etc) is announced by the meteorological agency, the observer should be stand-by for observation.
- Each time the accumulated rainfall reaches one of 5 stages, the observer records the amount and the time, and informs to the community leader and the municipal authority etc.

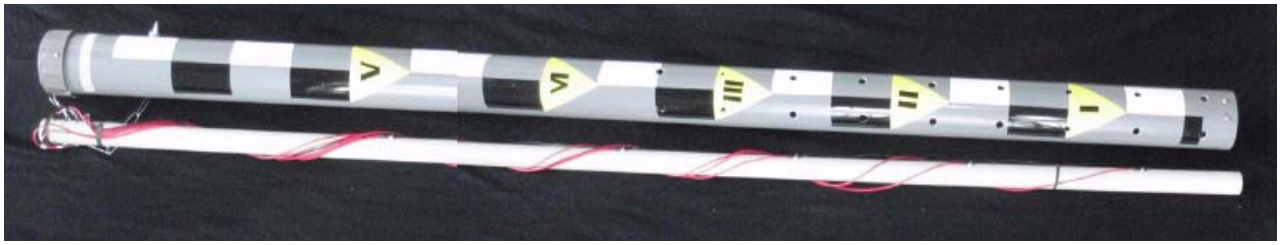
・ Water level observation
- Operational procedure similar to the rainfall observation will be applied to the water level observation.
- The critical water levels (for alarm, warning, evacuation etc) shall be determined based on the relationship between the water levels at the observation point and areas of possible inundation.
- When a possible flood is announced by the meteorological agency, the observer should be stand-by for observation.
- Each time the water level reaches one of 5 stages, the observer records the water level and the time, and informs to the community leader and the municipal authority etc.

■ Details of Apparatus

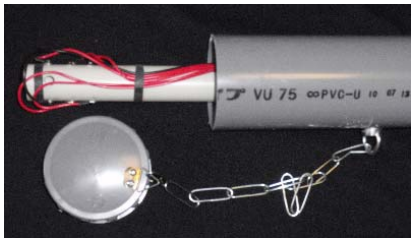
Monitor

		
Front face	Selective terminal	Buzzer
		
Tong switch	Back	Selective terminal (back)
		
Tong switch (back)	Relay	Fuse

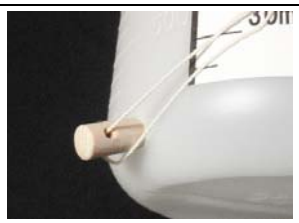
Water Level Equipment



Casing(L:2 m, ϕ: 75mm) tube and Sensor pole(L:2m, ϕ:40mm)

		
Head cover and connecting terminal	Bottom of casing tube	Sensor terminal

Rainfall Equipment

		
	Sensor terminal	Drain cap
		
Total view	Rain receiving parts	

■ Tools and Parts

Table 1　Tools for assembly

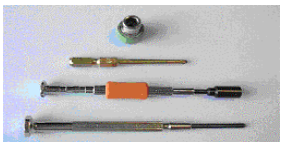
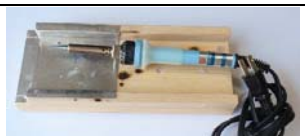
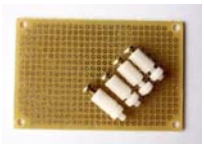
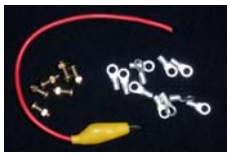
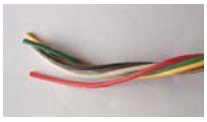
	Soldering iron for electric work Solder for electric work Flux for soldering		Driver
	Radio pliers		Mini driver Hexagonal nut driver for M3
	Pliers (small) Nipper Pinchers		
	Rasp		Tap for M3 screw
	Metal cutting saw		Tester
	Scissors (small) Scissors (large)		Electric driver drill
	Cutter (small) Cutter (large)		
	Drills		

Table 2　Parts

(1) Parts for Monitoring Apparatus

Appearance	Item	Model	Standard	Unit	No.	Reference. Price (yen)	Reference cost (yen)
	Plastic case		0.5 litter	pc.	1	300	300
	Universal basis	AE-3G	2.54mm pitch 72x47mm	pc.	1	100	100
	Spacer for basis	10mm	4pcs. 1 set	pc.	1	100	100
	Mechanical buzzer	PB21-5Z02	9v(3-12volt) with activating circuit	pc.	1	200	200
	M3 Screw to fix buzzer	6mm		pcs.	2	5	10
	Relay	OMRON G3CN-DX02P		pc.	1	1,250	1,250
	M3 Screw to fix relay	20mm		pcs.	2	5	10
	M3 washer			pcs.	2	5	10
	M3 nut			pcs.	2	6	12
	Wood bar						
	Carbon resistor	1/4W 330Ω		pcs.	5	10	50
	Carbon resistor	1/4W 430Ω		pc.	1	10	10
	High brightness LED	Red		pcs.	6	10	60
	Tong switch	ST-1061		pcs.	3	100	300
	Bagworm clip			pc.	1	100	100
	M3 screw for selecting terminal	6mm		pcs.	6	5	30
	M3 nut			pcs.	6	6	36
	M3 squash terminal	Round		pcs.	11	5	55
	Glass pipe fuse	N30C	2A	pc.	1	40	40
	Fuse holder			pc.	1	40	40
	M3 bolt	6mm		pc.	1	5	5

	M3 Nut			pc.	1	6	6
	DC jack	inner φ2.1mm outer φ5.5mm		pc.	1	100	100
	Wire (2)	6 lines cable	0.25mm.sq.	cm	10	3	30
	Wire (3)	Black/red wire		cm	50	1	50
	Wire (1)	6 lines cable	0.5mm.sq.	m	1	100	100
	M3 bolt			pcs.	6	5	30
	M3 nut			pcs.	6	6	36
	M3 squash terminal			pcs.	6	5	30
	AC converter	Input: 100-240V Output: 12V, 2A		pc.	1	1,000	1,000
TOTAL							4,100

(2) Parts for Rainfall Equipment

Appearance	Item	Model	Standard	Unit	No.	Reference price (yen)	Reference cost (yen)
	2 litter large neck bottle			pc.	1	600	600
	2 litter narrow neck bottle			pc.	1	600	600
	M3 stainless bolt	25mm		pcs.	10	5	50
	M3 stainless nut			pcs.	16	6	96
	Stainless wire			cm	30		10
	6 lines cable	0.5mmsqr		m	1	100	100
	M3squash terminal	Round		pcs.	6	5	30
	M3 squash terminal	Y shaped		pcs.	6	5	30
	Metal strip	10mm x 80mm		pc.	1		10
	M3 stainless bolt	8mm		pc.	1	5	5
	M3 stainless nut			pc.	1	6	6
	M3 stainless washer			pc.	1	5	5
	Wood Peg			pc.	1		
TOTAL							1,542

(3) Parts for Water level Equipment (Height: 2m, Distance: 30m)

Appearance	Item	Model	Standard	Unit	No.	Reference Price (yen)	Reference cost (yen)
	Plastic pipe for sensor	φ40mm x 2m		pc.	1	700	700
	Plastic pipe for casing	φ75mm x 2m		pc.	1	800	800
	Stainless wood screw			pcs.	10	13	130
	M4 Stainless washer			pcs.	10	5	50
	M4 Squash terminal	Round		pcs.	10	6	60
	Wire	Black		m	3	30	90
	Wire	Red		cm	8	30	240
	End cap	75mm		pc.	1	190	190
	M3 Stainless bolt	6mm		pcs.	3	5	15
	M5 Stainless bolt	100mm		pcs.	2	20	40
	M5 Stainless nut			pcs.	4	10	40
	M3 Stainless bolt	6mm		pcs.	6	5	30
	M3 Squash terminal	Round		pcs.	6	5	30
	Wire (1)	6 lines cable	0.5mm.sq.	m	30	100	3000
	M3 Squash terminal	Round		pcs.	6	5	30
	M3 squash terminal	Y shaped		pcs.	6	5	30
	Color adhesive seal	Outdoor use	10cmx4 5cm	pcs	3	240	720
TOTAL							6,195

■ End Note

Volunteers for the promotion of Community Early Warning (VCEW) is a group of persons who wish to work voluntarily for the promotion of Community Operated Early Warning (COEW) in developing countries, making use of their respective experiences in developing countries and international organizations as well as in Japan.

There are various types of equipment ranging from simple one to advanced one, of which each community chooses the most suitable one considering the O/M capacity etc. VCEW wishes that the equipment it offers will be useful for a number of communities in the world.

VCEW further wishes that such an offer will lead to further development of hydrological equipment by voluntary groups, academic institutions, private firms etc. in the world so as to meet the needs of so many communities of different O/M capabilities and other conditions.

Members of VCEW :

- Mr. Hidetomi Oi : Ex-staff of Japanese Government (Min. of Construction), UN (UNDRO) and JICA. JICA expert in Nepal, the Caribbean, Central America and others. Email:Oi-Hidetomi@jica.go.jp
- Dr. Toshikatsu Omachi : Ex-staff of Japanese Government (Min. of Construction) and UN (ESCAP). JICA expert in Indonesia, Panama and others. Email:omachi-t@gyao.ne.jp
- Mr. Susumu Ueda : Electric engineer belonging to Electric Safety Association. Voluntary works for community early warning in Nepal and Japan. Email:sin@kisnet.ne.jp

Foot notes :

1) The development of water level equipment was initiated by Dr. Juan Carlos who worked for CEPREDENAC, UN Platform for the Promotion of Early Warning (UNPPEW) and is currently working for UN SPIDER. when he was working for CEPREDENAC.
2) The development of rainfall equipment was initiated by Prof. Jacob Opadeyi of University of West Indies, Trinidad and Tobago, He produced 50 units of rainfall equipment for distribution to CDEMA member countries and conducted training for concerned personnel of CDEMA member countries regarding the use of the equipment in 2007.
3) The equipment has been sent to Guatemala, El Salvador (SNET), Trinidad and Tobago (University of West Indies), Indonesia, Lao PDR, Sri Lanka, Nepal and Thailand (as of 1 October 2010)
4) The equipment has been sent to UN Platform for the Promotion of Early Warning (UN PEW), ESCAP, WMO, ICIMOD, CEPREDENAC and CDEMA (as of 1 October 2010).