



# Landslides Monitoring in Nicaragua

Presented by:

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# Purpose of landslides monitoring

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To understand the past and current behavior of instability of lands, which allows to **evaluate the hazard that these represent**, and particularly, the possibility to preserve constructions.

To know parameters that **determine the movement of land**, for generating engineering works, and to control their final stabilizer effect.

To determine the evolution of soil movements to **EMIT FORECASTS based on their future behavior**. It can be defined by variations of amplitude of the movements which affect the mass of land or the buildings (cracks), so that they work as material test in juridical actions



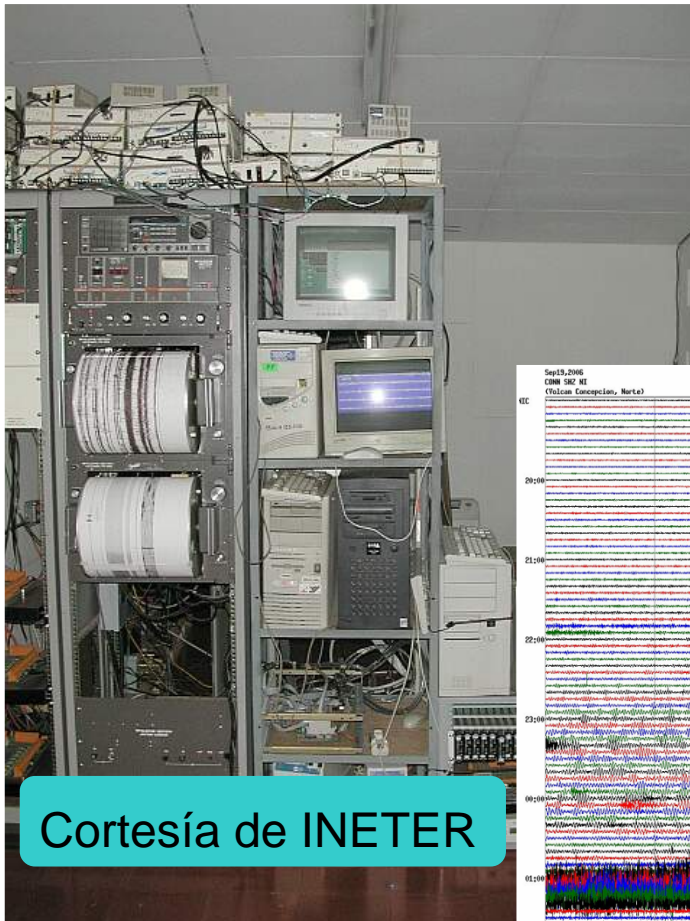
## a)METHODS FOR LANDSLIDES MONITORING

- ❑ **Daily mensuring:** It implies the **definition of responsible-observers of rain precipitation** or specific landslides

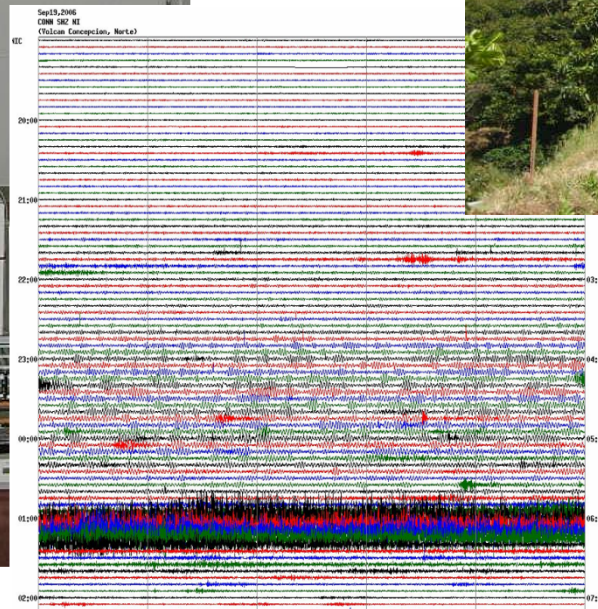




- ❑ Registrations of datas: This task is characterized by an organized registration. The information is distributed to the drawees of decision (communal representatives and local authorities) by radio communication net



Cortesía de INETER



Dipilto, Nueva Segovia





La Tablazon, Nueva Segovia (Nicaragua) 2008

Meteorological Station



## □ Field geology

Santa Teresa, Carazo



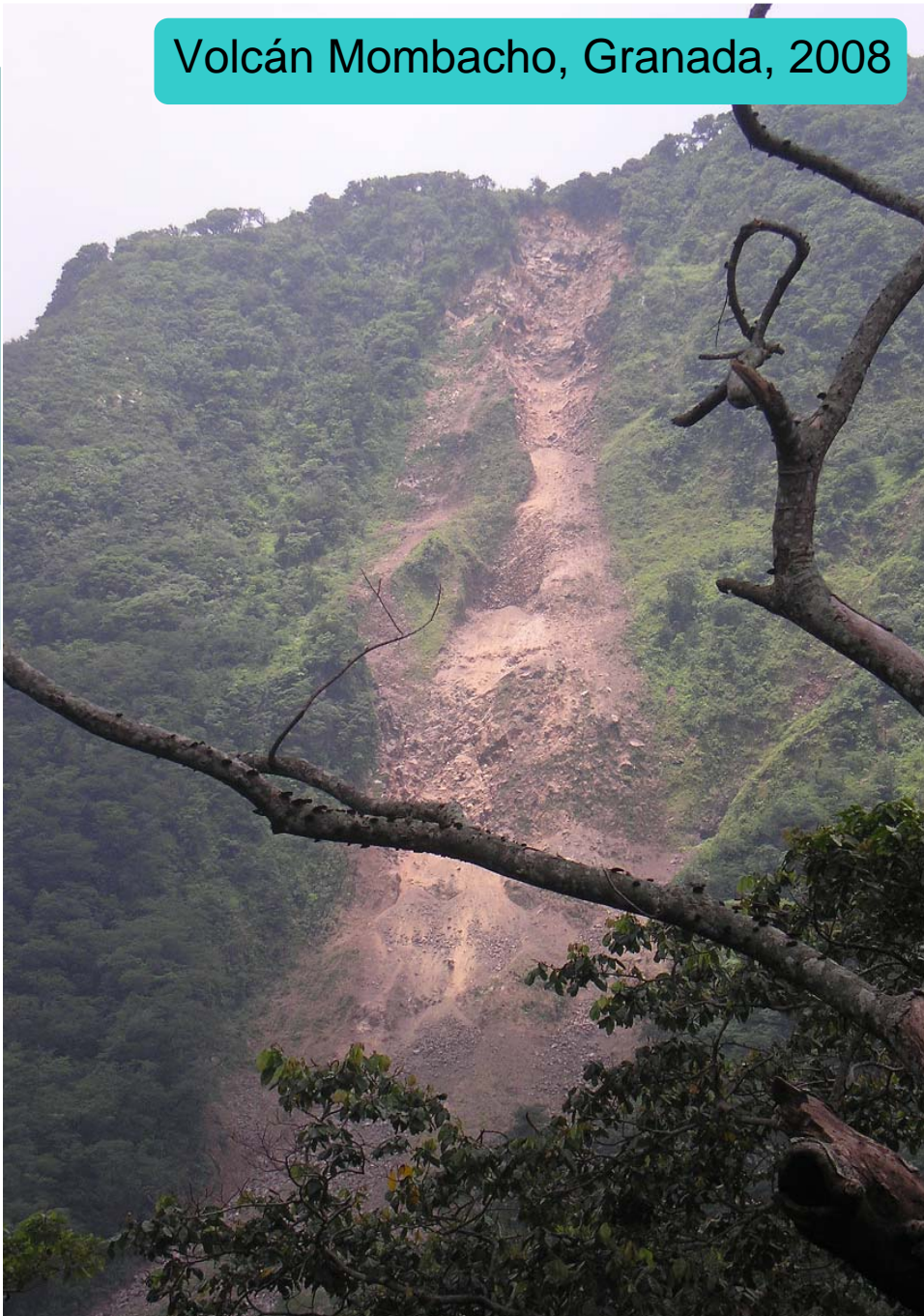
Estelí, 2008



San Juan de Río Coco, Madriz, 2008



Volcán Mombacho, Granada, 2008



Centro de Salud de Murra, Matriz, 2008



San José de Cusmapa, Matriz. 2008



## □ Analysis and forecast of the information:

It is an essential task the definition of protocols that **guarantee security and validity of the information** without **generating false alarms and rumors**.



Dipilto, Nueva Segovia

El Cuá, Jinotega





The analysis of the information allows to settle down preventive orientations for preserving human lives of people living in that place. To reach this, it is required a training process and to have open minds about the meaning of the alerts.

Mateare, Managua



**San José de Cusmapa**  
**(Madriz, Nicaragua)**  
**October 2008**





## b) PRINCIPAL INSTRUMENTS FOR LANDSLIDES MONITORING

**Radio-communication:** A support equipment to transmit and transfer information between different places



Dipilto, Nueva Segovia, 2008



**Pluviometer:** It measures the quantity of rain (in mm) in a specific place through a direct visual reading. The simple pluviometer (of a direct visual reading) has a recipient and a funnel. Data are taken every 12 hours of pluviometer readings.

Dipilto, Nueva Segovia,  
2008



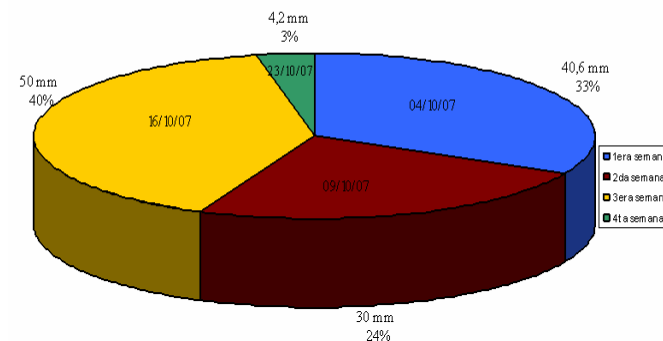
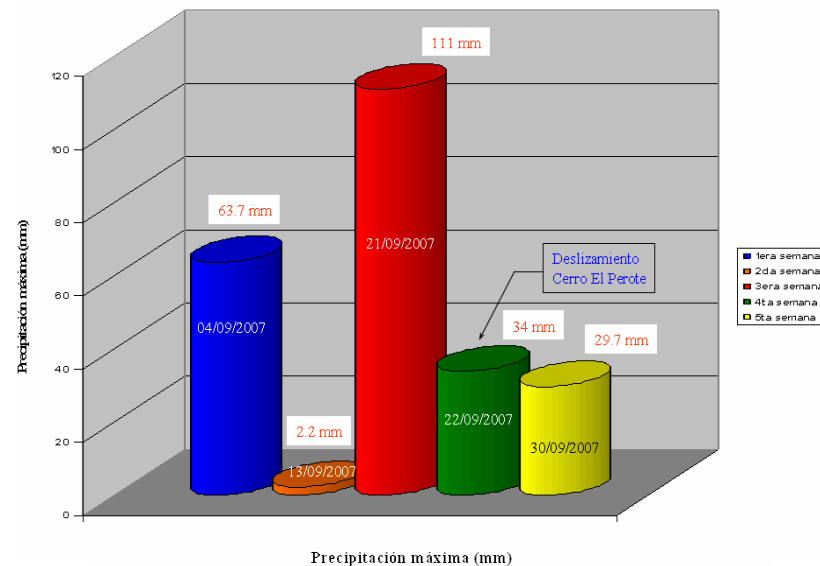


## □ Registration of meteorological variables:

In this place, it's recorded in format digital data based on weather conditions, temperature, humidity, velocity and direction of wind, and the quantity of daily accumulated rain.



Dipilto, Nueva Segovia







## Proposition of Systems for Landslides Detection

- ☐ Locate rupture areas in depth
- ☐ Quantify the movements against time
- ☐ Calculate velocity and direction of displacement of landslides (that is, to locate the most instability area)
- ☐ Predict the rupture of soil
- ☐ Emit a **STATE ALERT**



# GEOTECHNICAL INSTRUMENTAL



**Extensometer tape**



**Piezometer**



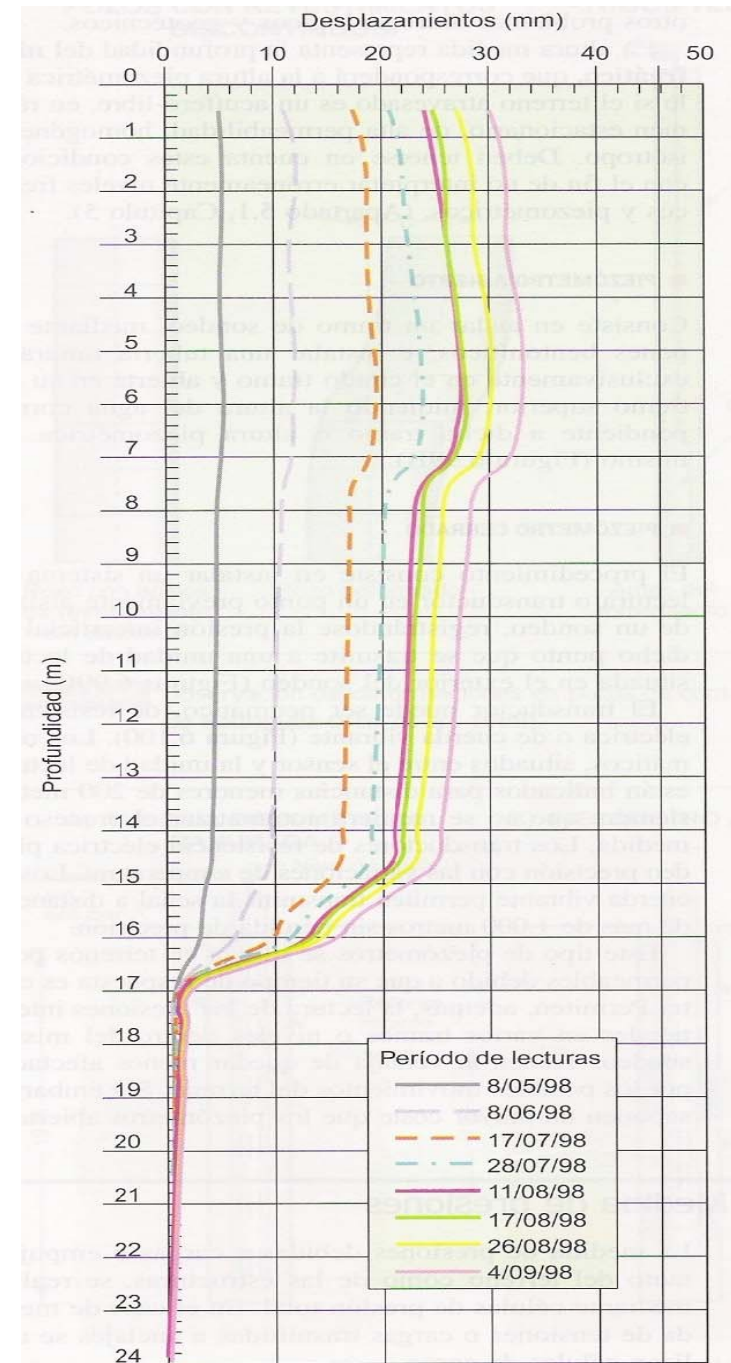
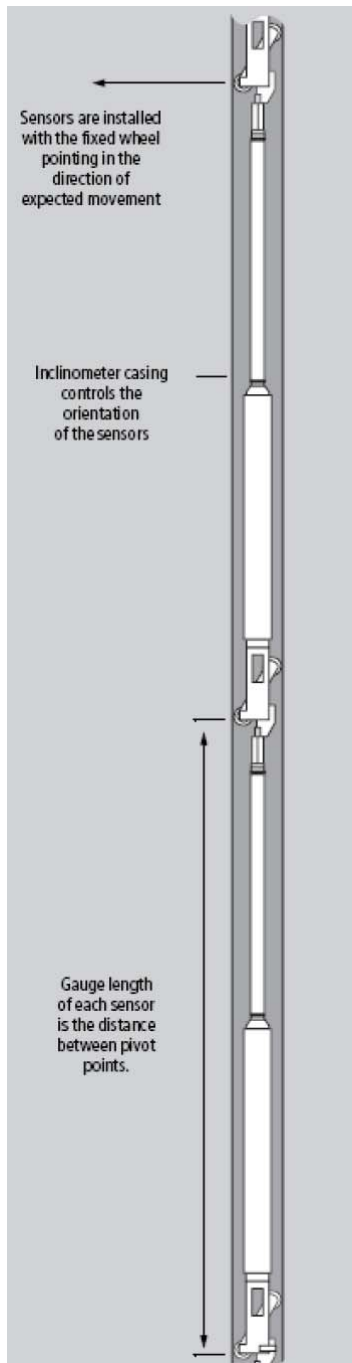
**Inclinometer**



**Extensometer**



# INCLINOMETER











Equipo	Funciones/Características	Imagen
<b>Extensómetro de Cable Flexible Roctest WR-Flex</b>	Medidor de asientos con rango de lectura 25, 50, 100, 150, 250 y 300 mm Precisión 0.1 a 0.5%F.S. con resolución 0.01 a 0.025 mm	
<b>Central de Toma de Datos Automatizada Roctest SENSLOG 1000X</b>	Datalogger para monitorización remota de hasta 225 canales. Ver ficha técnica adjunta.	
<b>Extensómetro de Varillas Sisgeo</b>	Medidor de asientos con rango de lectura 25, 50, 100, 150, 250 y 300 mm Precisión 0.1 a 0.5%F.S. con resolución 0.01 a 0.025 mm	
<b>Automatic Read Out</b>	Unidad de lectura portátil, registra los datos de posición, fecha y tiempo de lectura en formato transferible a PC	

**Extensometer**



# State of Alert for landslides

Example: Cerro El Volcán (Dipilto) and communities La Tablazón, El Volcán, Las Nubes y Dipilto Viejo

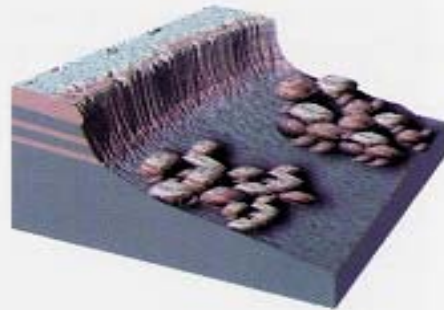
STATE OF ALERT	
<input type="checkbox"/> For rains of 60mm with 3 hours of duration	
<input type="checkbox"/> Rains of 100mm, with 6 hours of duration	
<input type="checkbox"/> Rains of 150 - 300mm, with 12 hours of duration	 <i>Evacuation</i>
<input type="checkbox"/> Rains > 300mm with 24 hours of duration	

*Cortesía de Cruz (2005)*

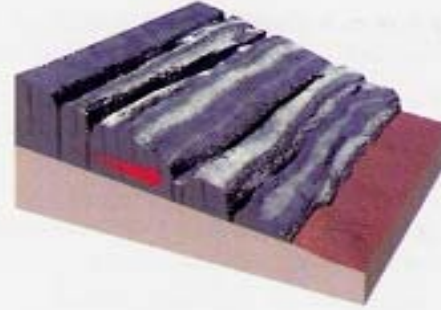




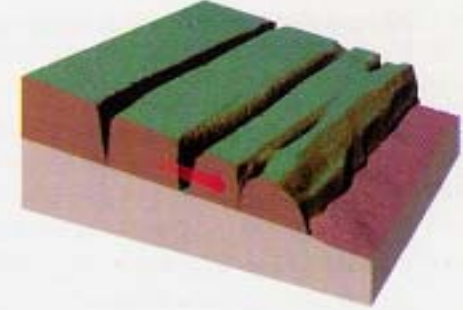
Desprendimiento tipo Vuelco



Desprendimiento tipo Desplome

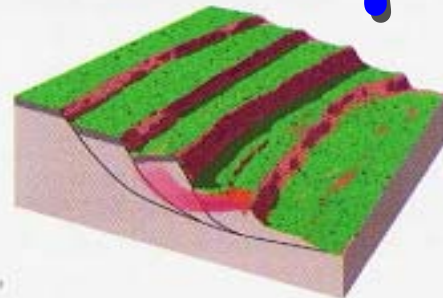


Deslizamiento Traslacional en roca

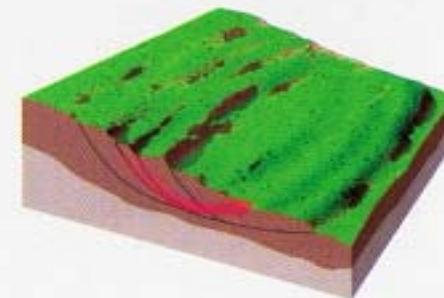


Deslizamiento Traslacional en suelo

¡Thank you!



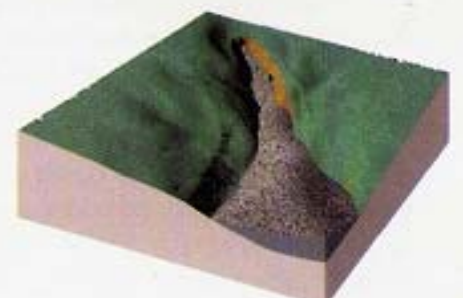
Deslizamiento rotacional 1



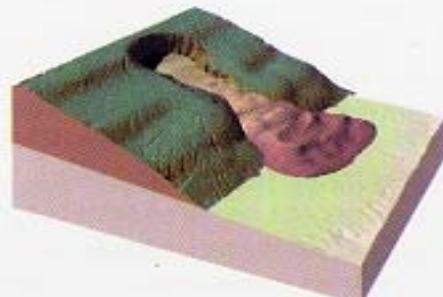
Deslizamiento rotacional 2



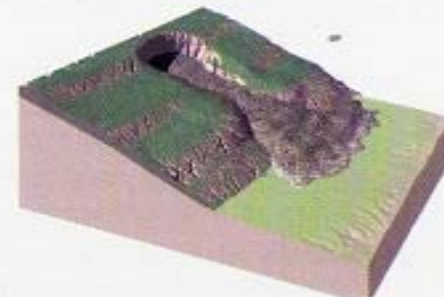
Colada tipo Flujo de Lodo



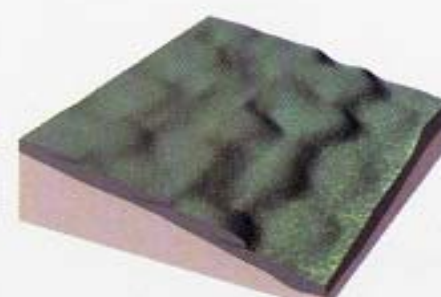
Colada tipo Derrubio



Flujo de Suelo



Flujo de Derrubios



Colada tipo Solifluxión



Colada tipo Reptación