



bc³

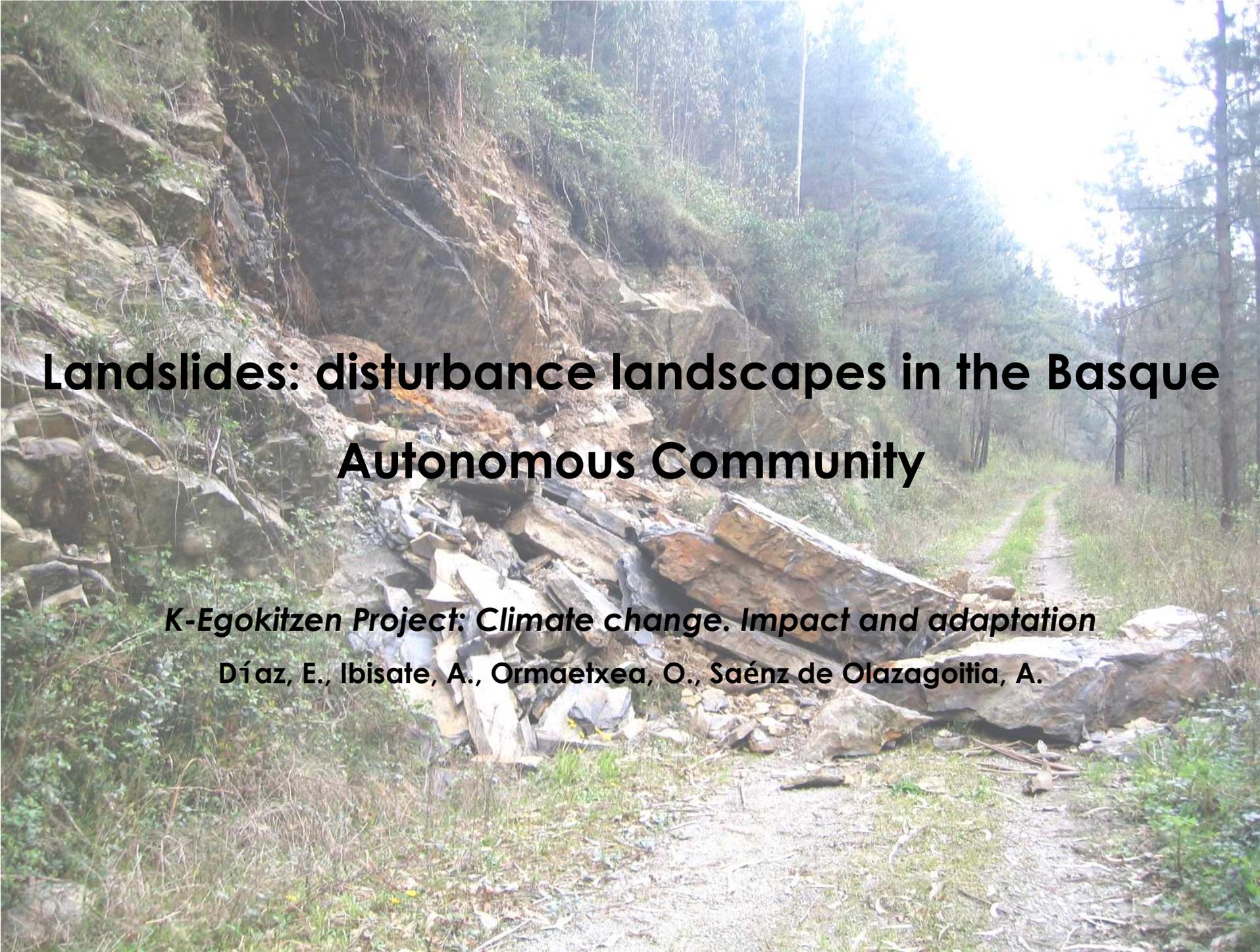
BASQUE CENTRE
FOR CLIMATE CHANGE
Klima Aldaketa Ikergai



klima gune
workshop



Workshop 2011
Addressing Climate Change
through Adaptation



Landslides: disturbance landscapes in the Basque Autonomous Community

K-Egokitzen Project: Climate change. Impact and adaptation

Díaz, E., Ibisate, A., Ormaetxea, O., Saénz de Olazagoitia, A.

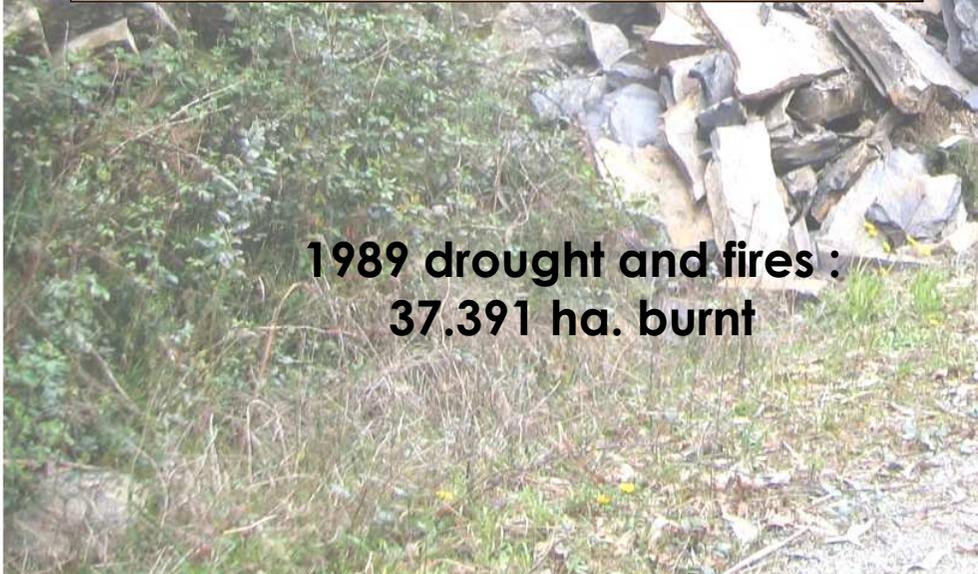
Disturbance milestones during the XXth century



1983 floods: 60 people were killed



1989 drought and fires :
37.391 ha. burnt



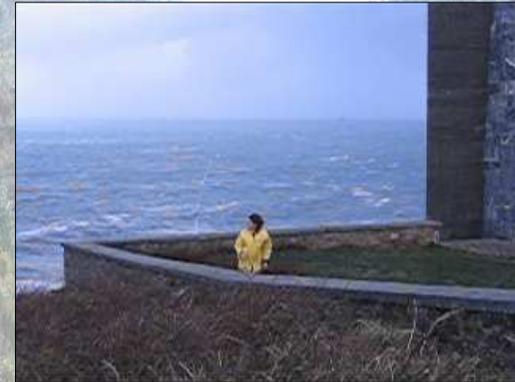
XXIst first decade milestones



-Floods/-Flash floods



- Wind and hail storms



- Perfect storms



-“Galernas” and waterspouts



-Ice and snow at sea level

Slope subsystems too respond to these input and output pulse of material and energy in different ways:

-falls



- flows



- slides



- subsidence



Slope process. Perspectives:

-Slope process within the natural functioning of the system

1.- Movement and output of material



2.- Slope transport



3.- Coupling with fluvial channel



4.- Fluvial transport



-Process as a threat



Threat



Measure

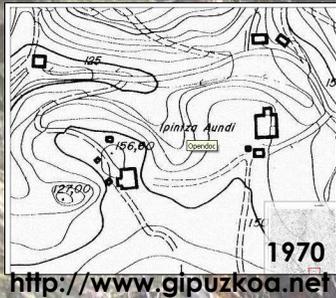


Threat

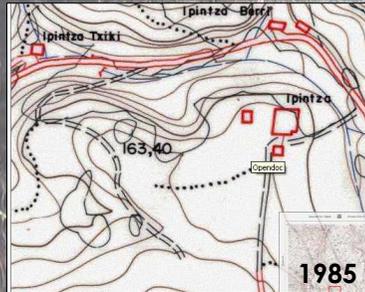


Measure

Threat and limiting factor of the activity



<http://www.gipuzkoa.net>



Example: Plan General de Ordenación Urbana Abanto-Zierbena (Bizkaia)

- Se recorta el núcleo rural de Abanto en la zona de afección a la minas Bodovalle, área cuyos usos están restringidos por el Departamento de Minas del Gobierno Vasco debido a la probabilidad de hundimientos.



www.20minutos.com 20-12-2005



Diario Vasco 30-01-2008



Diario Vasco 1-02-2010



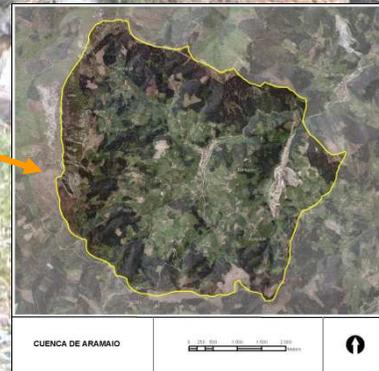
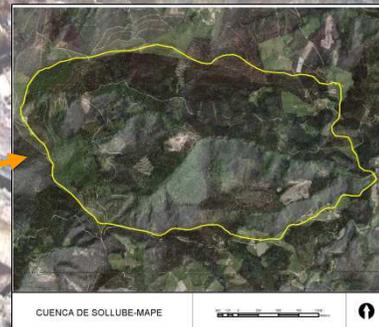
Detour cost: 13.442.844 €

30-01-2010

Global change framework: A change in conditions a change in responses

Goal: Improve our knowledge on these processes' factors in order to adapt ourselves

Object: Atlantic basins (coastal and interior environments)



Specific objectives:

1.- To analyze rainfall data as a triggering factor of landslides.

The most important climate parameter influenced by global change that effects rapid landslides and debris flow is short-term rainfall (Sidle and Ochiai, 2006). Unfortunately this is the most uncertain and most difficult variable to estimate at meaningful spatial and temporal resolutions (IPCC 2007)

2.- To analyze the responds of the slope system through their monitoring and characterization.

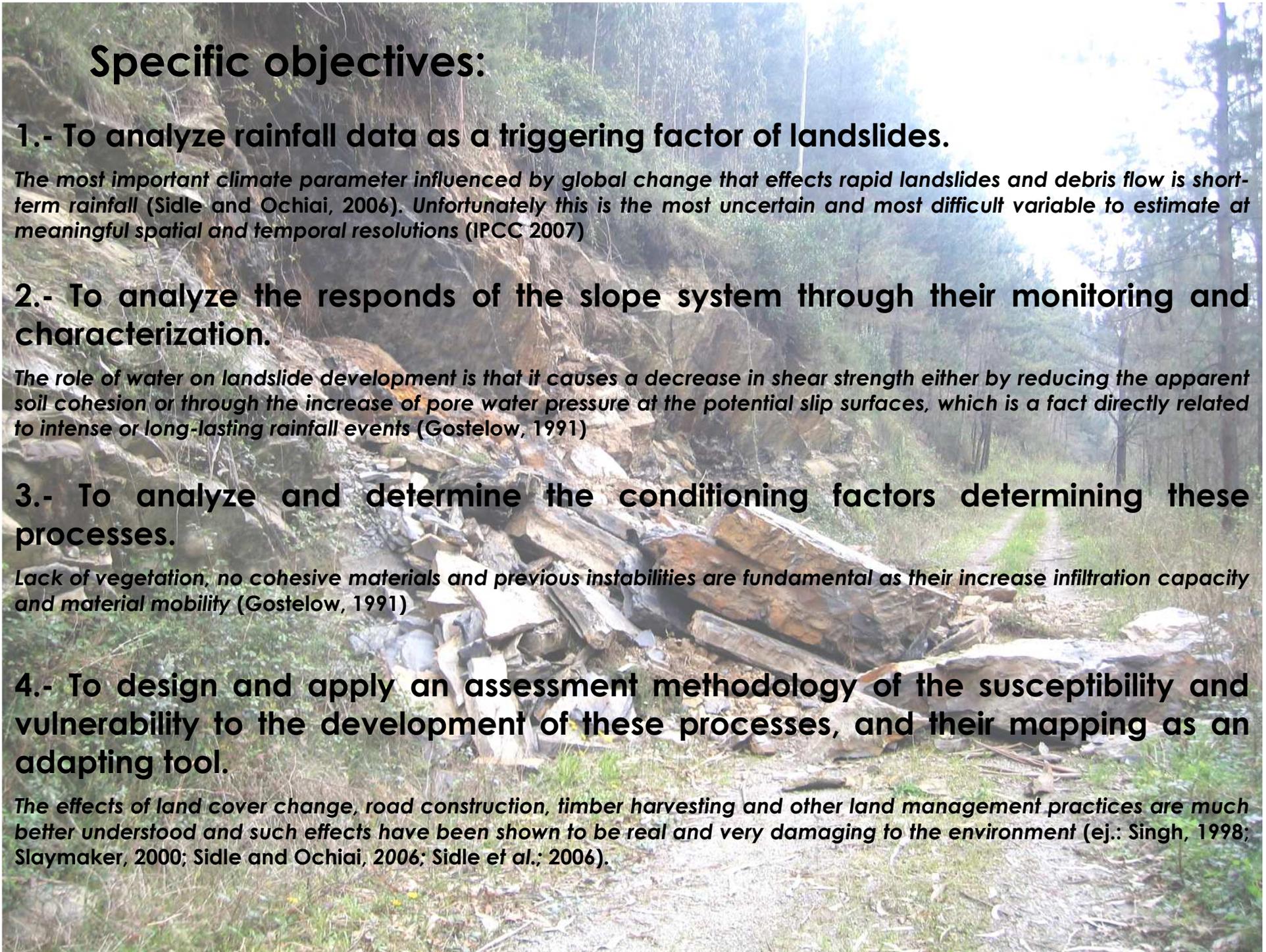
The role of water on landslide development is that it causes a decrease in shear strength either by reducing the apparent soil cohesion or through the increase of pore water pressure at the potential slip surfaces, which is a fact directly related to intense or long-lasting rainfall events (Gostelow, 1991)

3.- To analyze and determine the conditioning factors determining these processes.

Lack of vegetation, no cohesive materials and previous instabilities are fundamental as their increase infiltration capacity and material mobility (Gostelow, 1991)

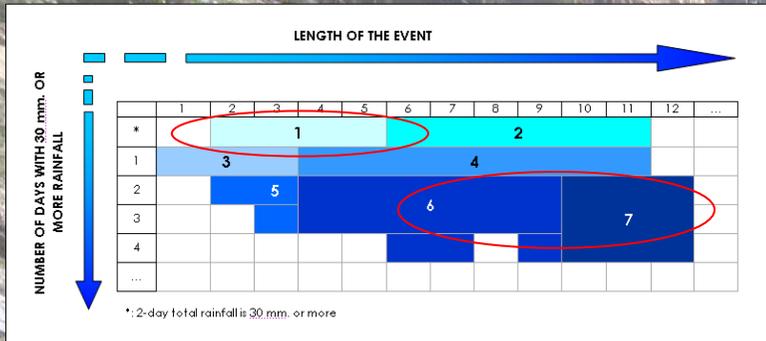
4.- To design and apply an assessment methodology of the susceptibility and vulnerability to the development of these processes, and their mapping as an adapting tool.

The effects of land cover change, road construction, timber harvesting and other land management practices are much better understood and such effects have been shown to be real and very damaging to the environment (ej.: Singh, 1998; Slaymaker, 2000; Sidle and Ochiai, 2006; Sidle et al.; 2006).

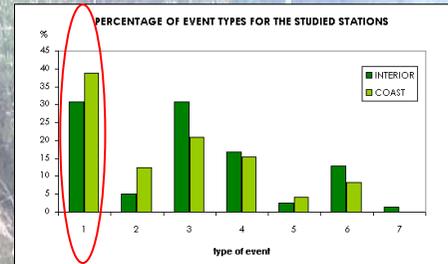


1.- Triggering factors: Rainfall analysis

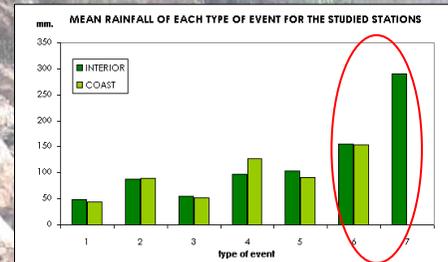
Rainfall event: one precipitation day of at least more than 30 mm.



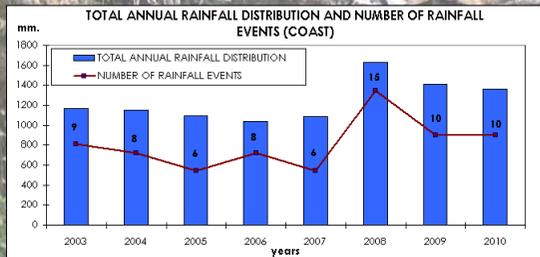
- Characterization of events: quantity/duration



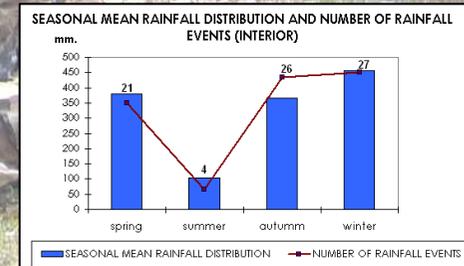
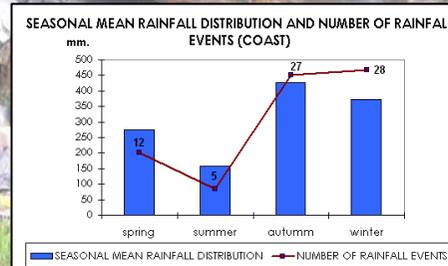
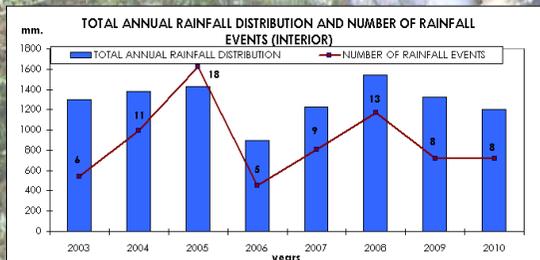
-Number of events



-Rainfall mean quantity

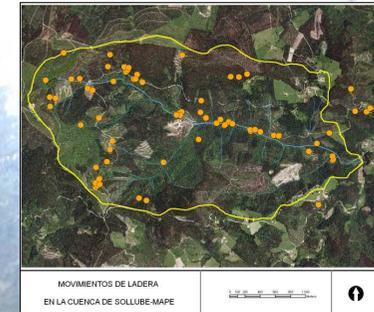
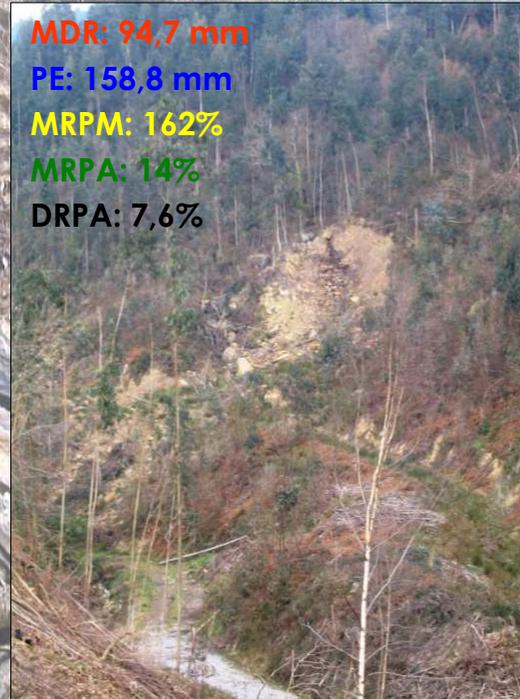


-Seasonal precipitation and distribution of events



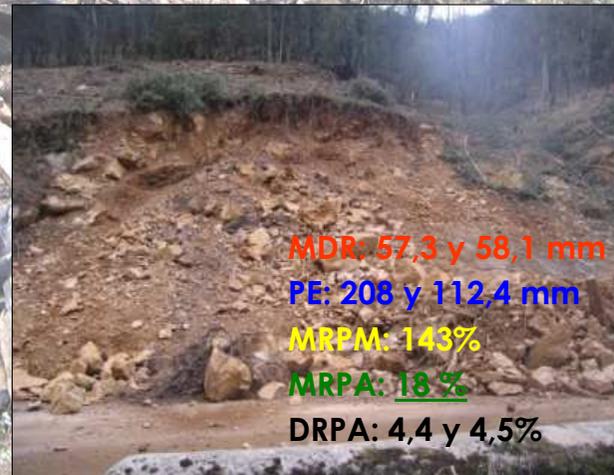
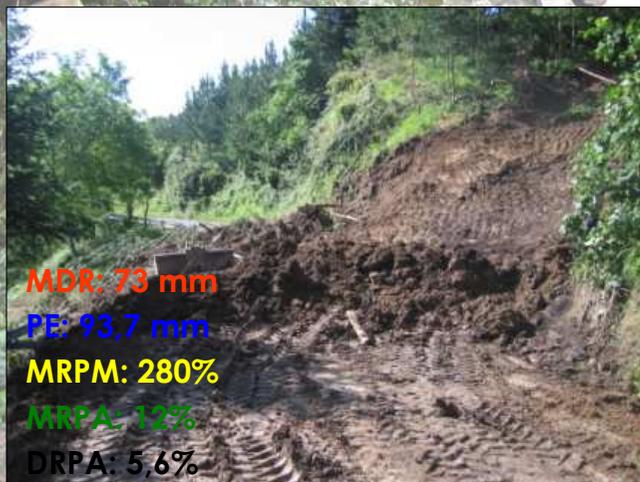
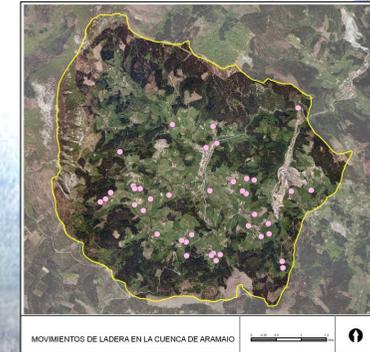
- Annual precipitation and distribution of events

2.- Events – Slope processes relationships checked *in situ* in the coast basin



MDR: maximum daily rainfall
PE: precipitation of event
MRPM: monthly rainfall percentage to the monthly mean
MRPA: monthly rainfall percentage to the annual mean
DRPA: daily rainfall percentage to the annual mean

2.- Events – slope processes relationships checked *in situ* in the interior basin



MDR: maximum daily rainfall
PE: precipitation of event
MRPM: monthly rainfall percentage to the monthly mean
MRPA: monthly rainfall percentage to the annual mean
DRPA: daily rainfall percentage to the annual mean

3.- Analysis of processes: determining factors

• Steep slopes



• Existing of detritic material from weathering processes and forestry practices that is easy to move with concentrated hyporheic water



• Existing waterproof substrate under a mud material layer of fluid character with water presence



• Layered structures with dip-slopes facilitating gravitational falls



• Imbalances in charge, morphology (geometry and slope) and hydrology (superficial drainage infiltration conditions) that roads, trails, walls, scarps and irrigation ditches



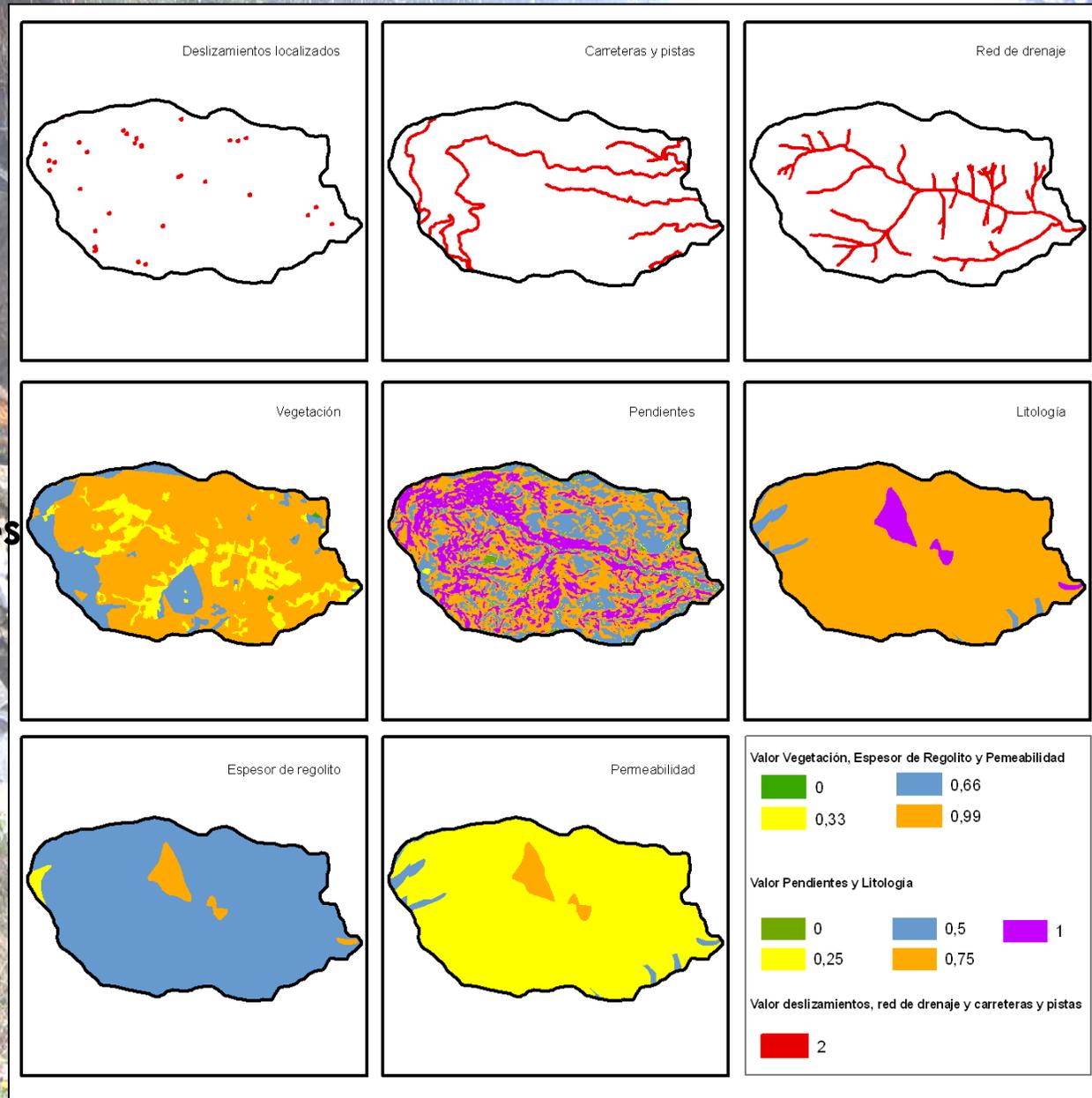
• A development of an incised drainage network over the modified material and with a torrential runoff regime favoring toe erosions and bench and slope instability.



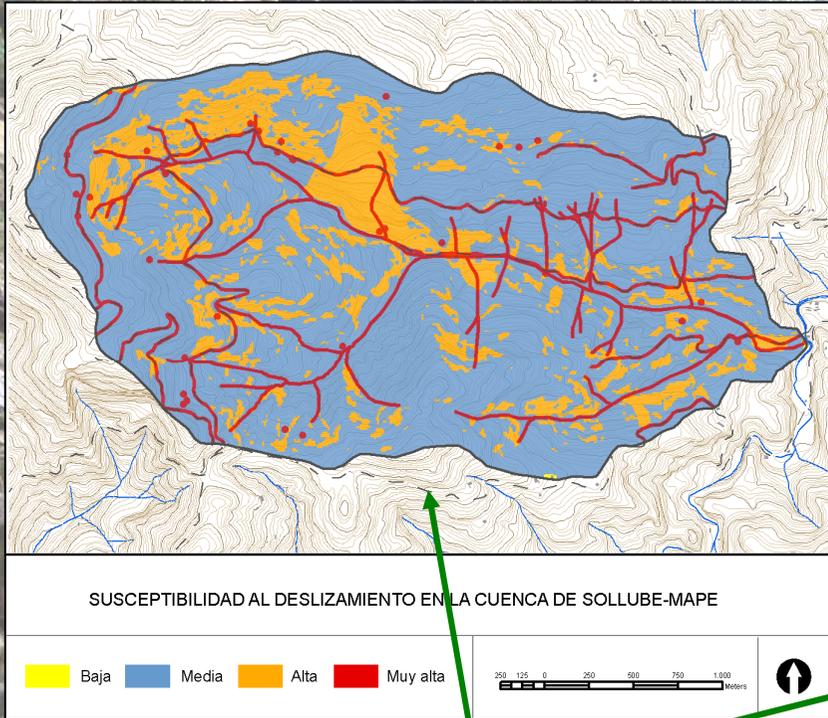
4.- Design and implementation of a threat assessment methodology:

Thematic maps:

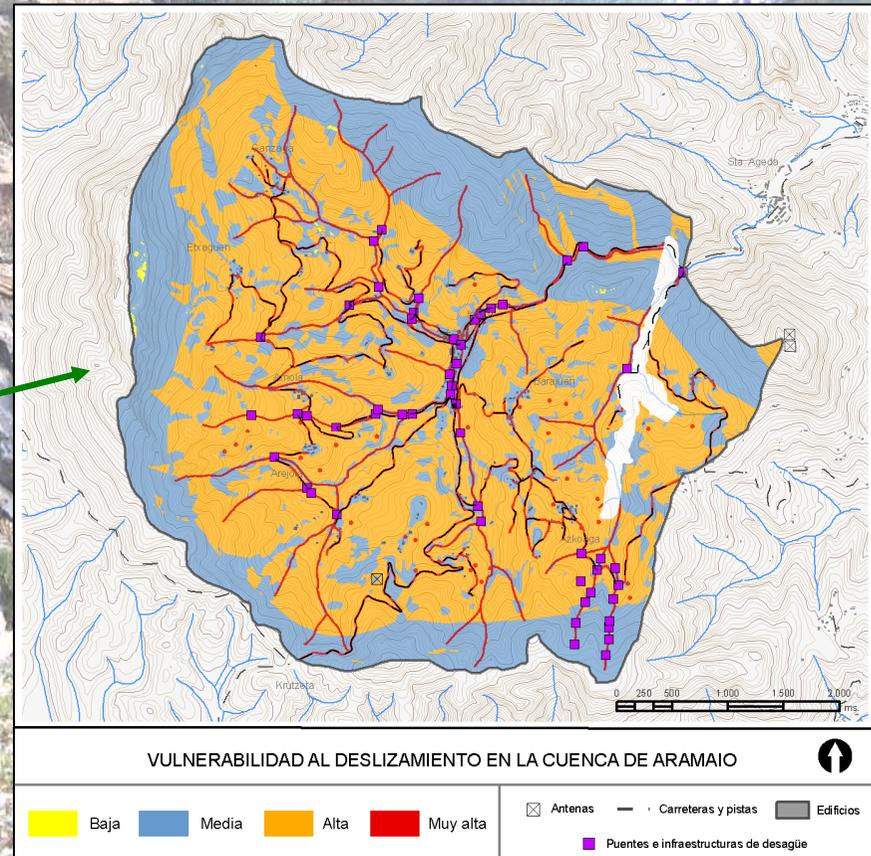
- existing landslides
- roads and trails network
- drainage network
- vegetation and land uses
- slopes
- lithology
- regolith depth
- permeability



5.- Diagnosis: Susceptibility and exposition mapping

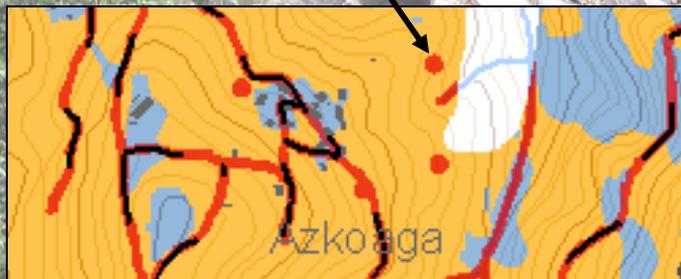
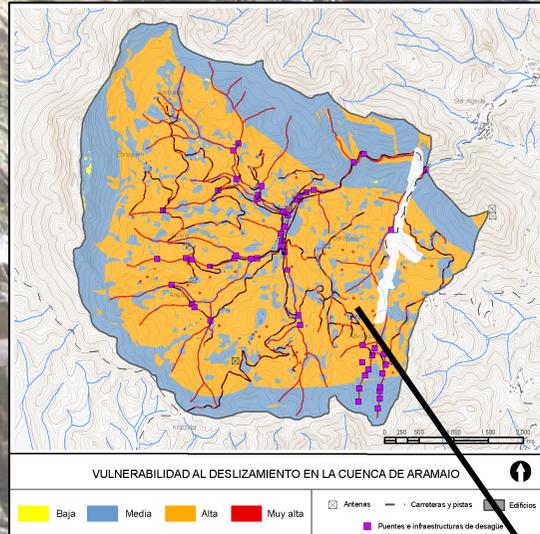


SUSCEPTIBILITY VALUE	% COAST	% INTERIOR
Low 0,58-2,04	0,03	0,13
Medium 2,05-3,503	72,04	39,27
High 3,504-4,96	18,53	53,66
Very high	9,40	6,93



6.- Our contribution: a cartographic tool for a good land management

the extreme precipitation in the Basque Country will increase around 10% throughout the 21st century (Moncho et al. 2010)



a higher priority must be placed on understanding land use/landslide interactions and applying this knowledge to the management (Slaymaker, 2001; Sidle and Ochiai, 2006)



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