

THE PROTOCOL

WHAT IS A PROTOCOL?

Protocols for monitoring are detailed study plans that explain what data to collect, manage, analyze and report, and the key components to guarantee the quality of monitoring programs for natural resources.

FOR WHAT PURPOSE?

Monitoring protocols are used by scientists affiliated with institutions dealing with the monitoring, management and protection of natural resources of a region, and that have interest in the results being compared with other zones or used for scientific comparative studies.

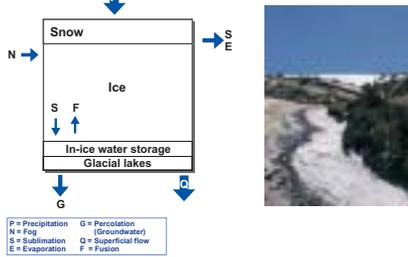
WHY THEY ARE IMPORTANT?

The management strategies for carbon and water require a scientific information base about the processes that affect the cycles, their interactions, dynamics, variability, the practices that optimize storage, the effects of land use, vulnerability to perturbations and potential impacts.

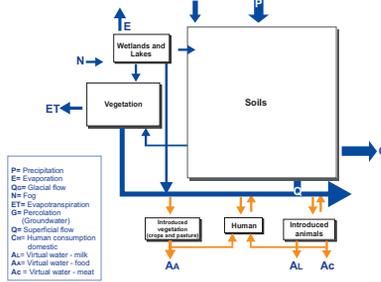
This poster illustrates examples of the components of the protocol, methods, and results of monitoring for carbon and water cycles in high elevation ecosystems.

THE CONCEPTUAL MODEL

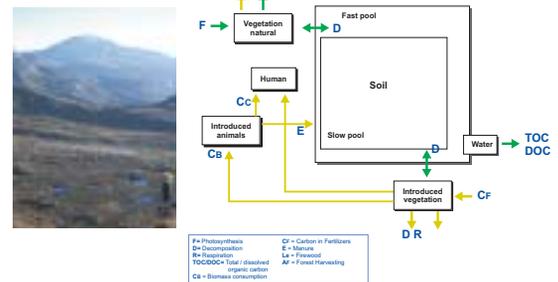
Pools and flows of water in glaciers of high mountains



Pools and flows of water in páramo with anthropogenic intervention



Pools and flows of carbon in high Andean forests with anthropogenic intervention



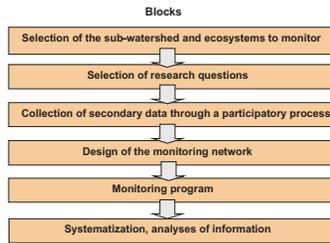
A way to understand the impacts of climate change and land use pressure on high elevation ecosystems, is studying the components of the carbon and water cycles.

In nature carbon and water are stored for a certain period of time in "compartments" such as glaciers, forests, wetlands, lakes, soils and vegetation that are also known as "pools". Water and carbon pass from one compartment to another, or from one physical state to another through processes known as "flow-paths" or "flows" such as precipitation, decomposition or evaporation.

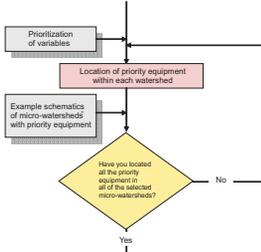
Anthropogenic activities such as ploughing, burning, forest harvesting and grazing have impacts on the pools and modify the natural cycles through vegetation, introduced animals, and human consumption of water and biomass.

ALGORITHM OF THE PROTOCOL

Each block represents a flow of activities, analysis and decisions taken. Norms and criteria, procedures, formats for data capture and instructions for the measurement of variables are associated with the blocks.



Algorithm



Formats and criteria

For each micro-watershed with a glacial ecosystem analyze the following minimum criteria:

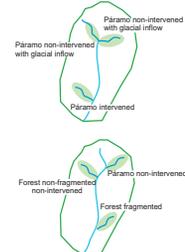
Micro-watershed identification	On an active volcano?	Impacted by volcanic ash?	Slope slopes difficult access?	Plants that are invasive?	More than 3 hours walking distance?
Yes	No	Yes	No	Yes	No
Yes	No	Yes	No	Yes	No
Yes	No	Yes	No	Yes	No

Land use in the upper Barbas river watershed



RESEARCH QUESTIONS

MICRO-WATERSHEDS WITH ECOSYSTEMS:



- Glacier + Paramo
 - Glacier + High Andean Forest
 - Paramo + High Andean Forest
 - Dry Paramo non-interventivo
 - Humid Paramo non-interventivo
 - Humid Paramo intervenido
 - Forest non-fragmented
 - Forest fragmented
- VERSUS:
- Behaviour with climate change
 - Comparison with other ecosystems
 - Effect on water availability
 - Pools and flowpaths of major water resources storage and regulation
 - Pools and flowpaths of major carbon storage and rate of accumulation
 - Human intervention

The research questions are defined based on the characteristics of the selected micro-watersheds for monitoring and comparison between ecosystems.

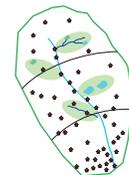
DESIGN OF THE MONITORING NETWORK

For each selected sub-watershed and the relevant research questions, the monitoring network is designed in accordance with criteria for the prioritization of variables.

Biophysical:

Pool or flow path	Variable	Index	Priority
Inflows	Production of biomass	1.00	A
	Pasture	1.00	A
	Crops	1.00	A
Pools	Vegetation	1.00	A
	Soils	1.00	A
Outflows	Discharge	1.00	A
	Respiration	0.33	M

Socio-economic:



Geographic:

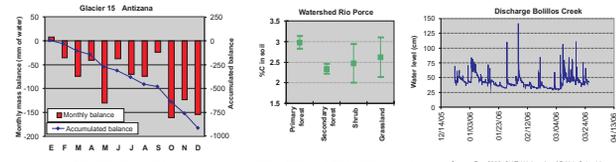


Sampling design: 50 households minimum or 10% Upper, mid and lower sub-watershed Principal land uses



SYSTEMATIZATION

The systematization of data refers to the collection and transfer of information to a central database, and the analysis and synthesis of monitored variables to consolidate information at the project scale, for the carbon and water cycles.



SELECTION OF THE SUB-WATERSHED AND ECOSYSTEMS TO MONITOR

The selection of the sub-watershed and ecosystems to monitor aims to account for the relative importance of the high elevation ecosystems and their variability, and logistics for the implementation of monitoring.

- Criteria for selection: Zones of high mountains of interest >2750 msnm
- Criteria - indispensable: Accessibility
- Criteria - necessary: Local capacity, Representative sub-watersheds, Monitorability (area, drainage, homogeneity, etc.), Comparable ecosystems, Existing monitoring equipment, Priority watersheds, Use, shortages or risks
- Criteria - desirable: Security, Local capacity, Representative sub-watersheds, Monitorability (area, drainage, homogeneity, etc.), Comparable ecosystems, Existing monitoring equipment, Priority watersheds, Use, shortages or risks

PARTICIPATORY BASE LINE

The collection of secondary data is done in a participatory process:

- Identification and involvement of interest groups
- Creation of a Learning Alliance
- Validation of indicators at the local level
- Assignment of responsibility for data compilation
- Creation of metadata and quality control

Metadata for socio-economic variables

Type of information	Source of information	Method of collection	Sample size
Production system			
Agriculture - types of crops			
- use of agrochemicals			
- burning (shrub to grassland) and frequency			
- past land use (e.g. 10 years ago)			
- agricultural practices (ploughing, mechanization)			

MONITORING PROGRAM

The monitoring program provides the detail for the installation of equipment and procedures for the collection of data corresponding to each selected variable.

Biophysical:

Wetland coring

Description	Profiles, characteristics of the soils and wetland age
Equipment	Russian corer
Location	Transects of each monitored wetland
Measurement technical	Insert the corer closed, rotate 180°, remove Sample for analysis of organic matter, carbon content and age with C14
Operation	Field requirements: 2 persons, 1.5 hours per meter of core
Results/analysis	Wetland profile, Wetland volumen, Carbon content, organic matter, C14 age

Geographical:



Verify and/or adjust the georeferencing of selected images, and complete the geographic information data base including inventories of wetlands and forests.

Socio-economic:

PROYECTO PROTOCOLO AGUA Y CARBONO ALTA MONTAÑA
CONVENIO IDEAM-CIAT
ENCUESTA SISTEMAS DE PRODUCCION

Formulario No. 101 Fecha: 15 mayo 2006

1.1. Nombre de la finca: *Macaria*

1.2. Localización: *04 31 09 9 N 76 10 27 8 W Altura 2853 m*

USO DE LA TIERRA: *AGROPECUARIO*

Cobertura	DESCRIPCION	AREA	DESEMPEÑO
Cultivo	pasas	10 ha	Comercio 90% familia 10%
Planto	jenaca	3 ha	Familia 100%

Water consumption

Implementation of the questionnaire and spatial location of sampled households; measurement of water consumption for multiple uses.