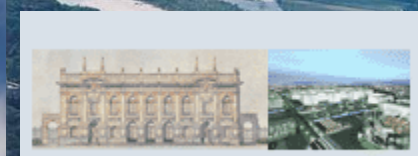
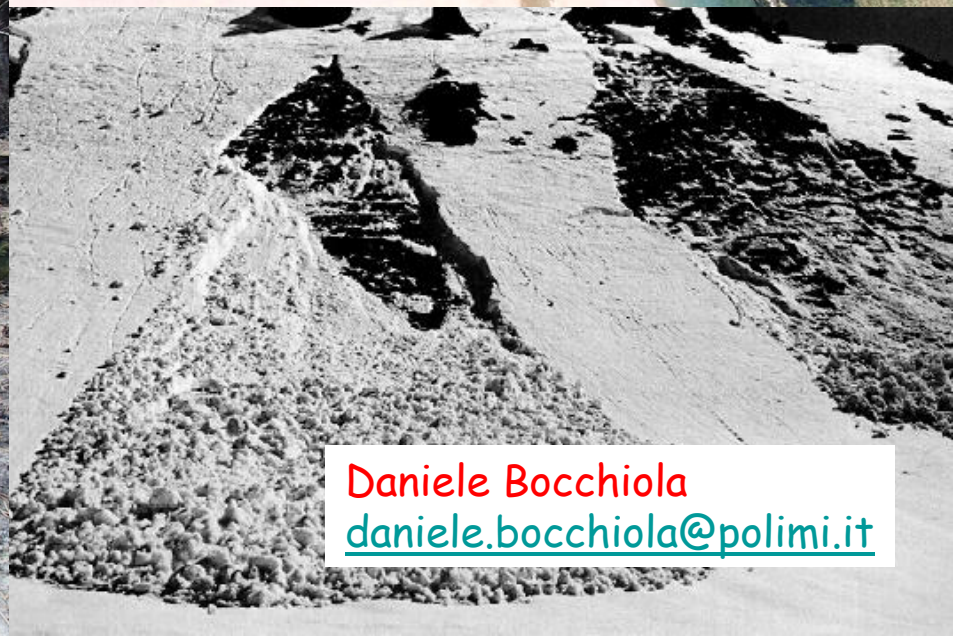


Politecnico di Milano
Dottorato di ricerca

ECO-HYDROLOGY of mountain areas: snow *water resources, snow avalanches, woody debris, and climate change*



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- Definitions
- Ecohydrology of mountain areas
- Projects at POLIMI
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- Avalanches
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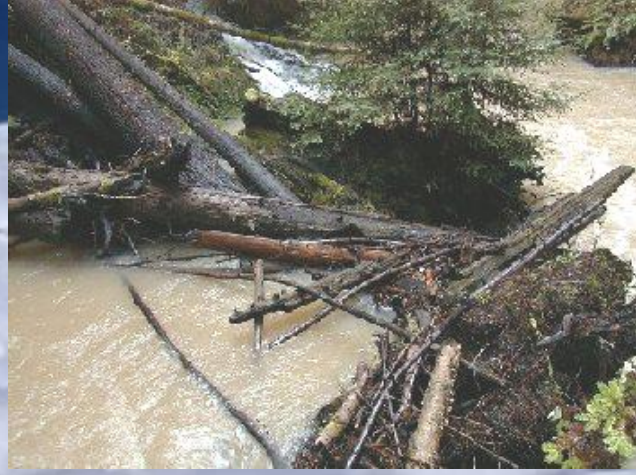


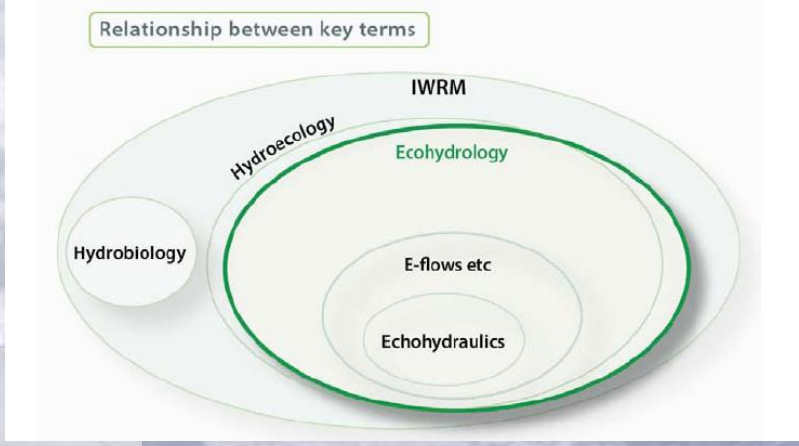
Definitions

The Science of Flow-Ecology Relationships: Clarifying Key Terms and Concepts
R. J. Naiman, S. E. Bunn, L. Hiwasaki, M. E. McClain, C.J., Vörösmarty, M. Zalewski, 2007

Hydroecology – is the study of the bi-directional nature of hydrological-ecological interactions, including feedback mechanisms, at a wide range of spatial and temporal scales (from contemporary to palaeoecological-hydrological viewpoints; GEES 2006). Hydroecology is an accepted term, virtually synonymous and contemporaneous with the term Ecohydrology as applied to aquatic ecosystems.

Ecohydrology – There are two definitions of this concept, depending an aquatic or terrestrial perspective. *Aquatic – Ecohydrology* considers the functional interrelations between hydrology, aquatic ecosystem processes and their biota. It uses ecosystem processes as tools to meet freshwater resource management goals, such as enhancing natural processes of nutrient retention to avoid harmful algal blooms (Zalewski 2000). The Ecohydrology perspective is based on the assumption that sustainable management depends on the restoration and maintenance of established fluvial processes, nutrient cycling, and energy flows.

Terrestrial – Ecohydrology is a sub-discipline of hydrology that focuses on ecological processes involved in the hydrological cycle. These processes generally occur within the soil and canopy, and so emphasis is put on transpiration and thermodynamic energy balance at the land surface Although an important concept, it is clearly distinguishable from Hydroecology and Aquatic-Ecohydrology, Ecohydraulics and Environmental Flows.



See Also:
Ecohydrology and hydroecology: A 'new paradigm'?
D. M. Hannah, P. J. Wood and J. P. Sadler, 2004

Some past events

Ecohydrology of high mountain areas

proceedings of the International Conference on Ecohydrology of High Mountain Areas, Kathmandu, Nepal, 24-28 March 1996

by International Conference on Ecohydrology of High Mountain Areas (1996 Kathmandu, Nepal)

Main objectives:
Discussion of principal issues concerning the ecohydrology of high mountain areas and to help specify the needs of regional studies. Papers were divided into six topic areas: regional issues on high mountain ecohydrology; network design, instrumentation, data collection and processing methodology and modelling; atmospheric, hydrological and ecological interactions; role of permafrost, glaciers and snow covers; dynamics and hazards of erosion and sedimentation, ecosystems of high mountain areas and landscape processes; and water quality and limnological issues.

HS17 Ecohydrology of riparian zones and floodplains (co-listed in BG)

This session will focus on multidisciplinary research that monitors, analyses and models hydrological and ecosystem processes at multiple spatial and temporal scales within riparian zones and floodplains. Special attention is devoted to (i) understanding the physical interactions and feedbacks between hydrology, geomorphology and vegetation in riparian and floodplain environments, and to (ii) studies exploring the short and long term dynamics of change in such systems in response to both natural and man-induced flow variability. We encourage contributions on the connections between riparian vegetation growth and hydrology/geomorphology; studies of the impacts of flow regime variability on the floodplains of small and large alluvial rivers; and studies of aquatic habitat response. Contributions exploring the watershed and river management implications of ecohydrological investigations are also invited. This session will combine theoretical and numerical modelling investigations with field experiments, observations, and applications of remote sensing.

And a present one…..

Objectives and Scope:

Many ecological systems owe their existence to physical/chemical properties of groundwater and surface water, and can be damaged if water flow or water properties are changed by anthropogenic or natural processes. The ecological systems may be

- the terrestrial ecosystems we see every day, such as the riparian systems along the rivers, and wetlands found in headwaters as well as in low land areas or
- the subsurface ecological systems that maintain the groundwater that sustains so many people.

To address the resulting issues, this conference brings together engineers and researchers from engineering and ecological disciplines.

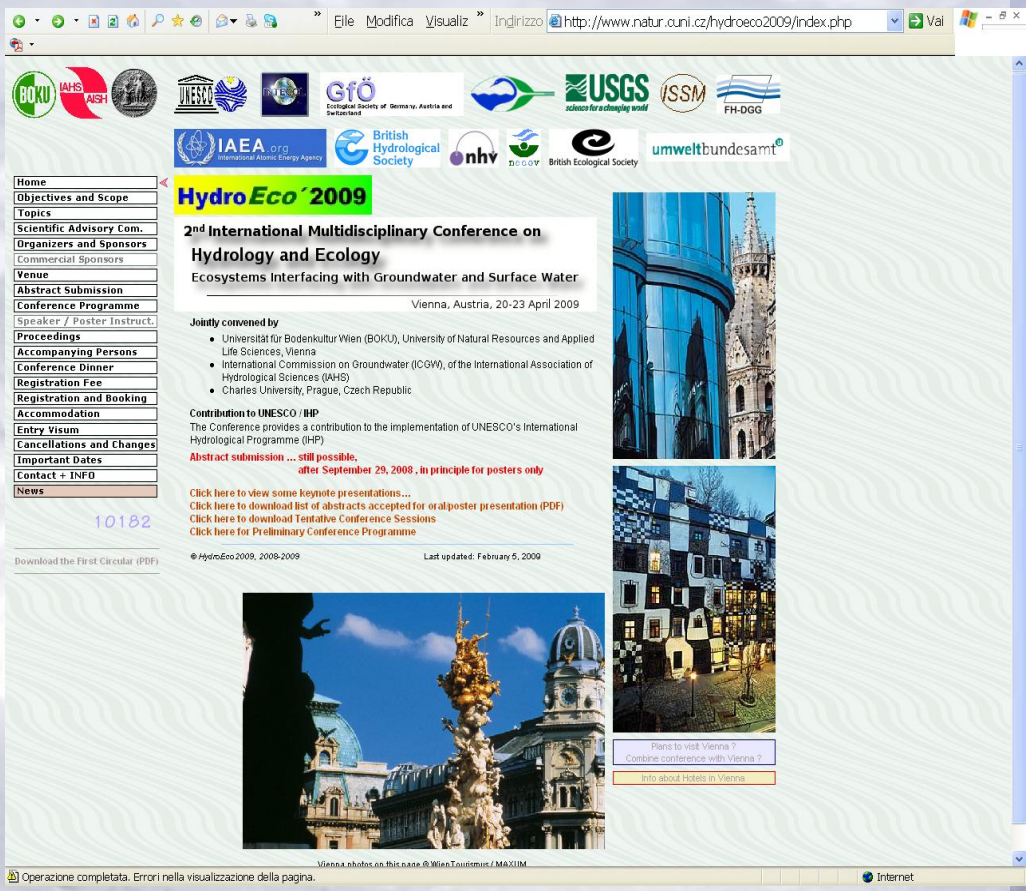
The disciplines include, but are not limited to hydrology, ecology, environmental engineering, biology, chemistry, geochemistry, environmental biogeochemistry, and subsurface microbiology.

The unifying theme is the interaction between groundwater and (or) /surface water and ecological systems. A typical example is the hyporheic zone in riparian areas, where the ecological system interacts with water and chemical flows between surface and groundwater.

The goals of the conference are

(1) to provide information that will help interactions between groundwater, surface water and ecology are better understood, measured, simulated, and managed, and

(2) to improve the technological basis for policy decisions (including WFD implementation) related to the reconstruction of ecologically valuable environments and the use of water resources in these environments.



Projects @POLIMI

2005-2008 AWARE: a tool for monitoring and forecasting Available WAter REsource in mountain environment. GMES – Global Monitoring for Environment and Security FP6-2003-SPACE-1.

Including: CNR IRSA, TU Wien, SLF Davos, Universidad de Jaume I en Castellon de la Plana, SRDE, Institut Cartografic de Catalunia

2005-2008 Integral Risk Management of Extremely Rapid Mass Movements "IRASMOS" European project. SUSTDEV-2004-3.IV.1.3 Long-term forecasting of landslides and avalanches.

Including: SLF Davos, CUDAM University of Trento, University Pavia, Meteo France, CEMAGREF,BOKU Wien, NGI Oslo

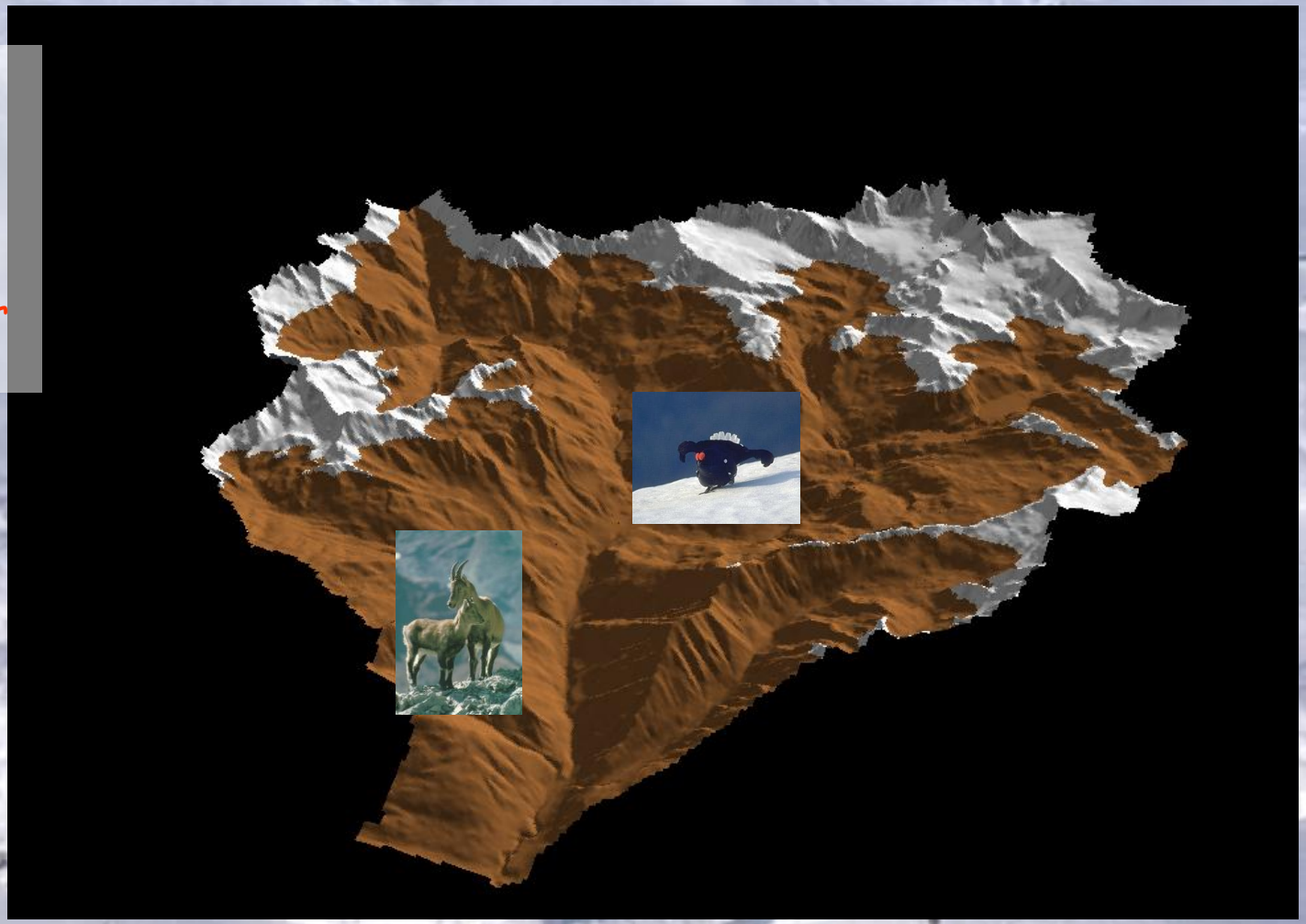
2007-2009 CARiPANDA, Climatic change and water resources in the Adamello park, Cariplo Foundation.

Including: Parco dell'Adamello, Università degli Studi di Milano, Istituto di Fisica Generale Applicata, Dip. di Scienze della Terra, ARPA Lombardia, Università di Brescia

Snow cover

Snow cover duration affects habitat for mountain species and dynamics of soil and permafrost

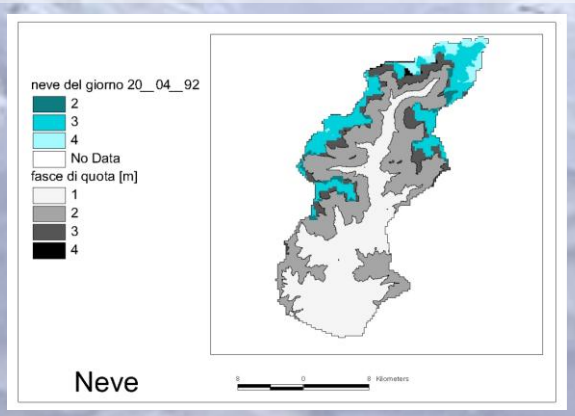
Here, the example is given of *capra ibex* (Stambecco) and *Tetrao tetrix* (Gallo forcello) , heavily sensitive to snow cover dynamics

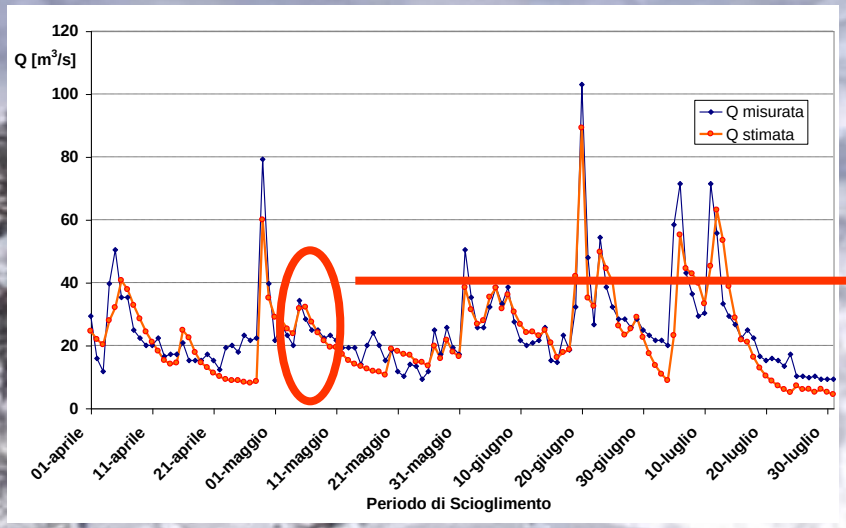


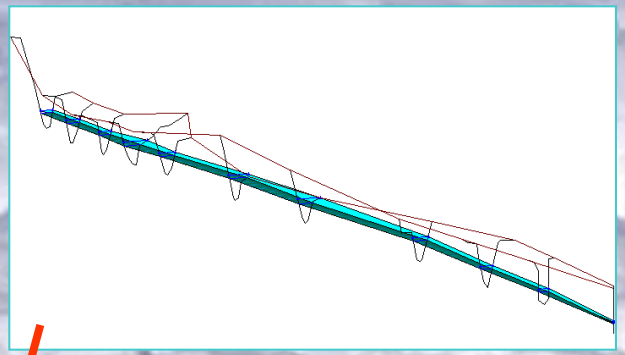
	15 ott	15 nov	15 dic	15 gen	15 feb	15 mar	15 apr	15 mag
SCA (Km^2)	162	301	317	311	298	270	251	81

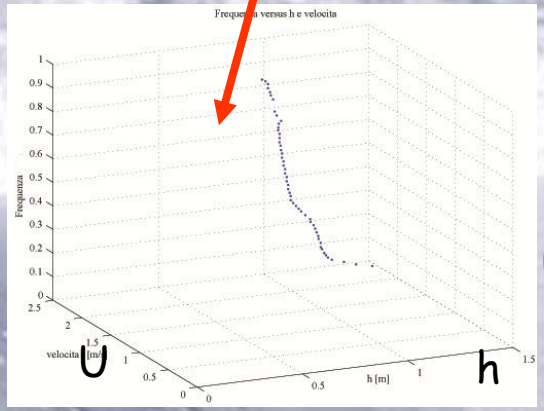
Snow melt flows

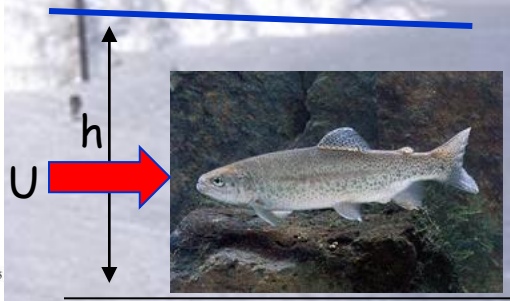
Snow cover duration affects habitat suitability for for benthonic species





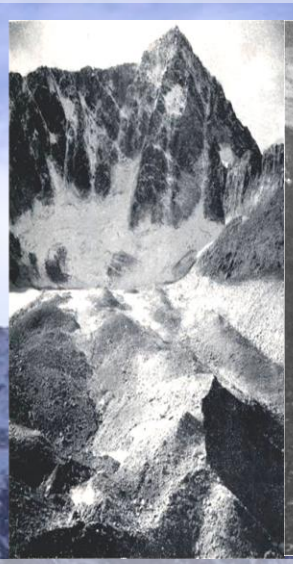


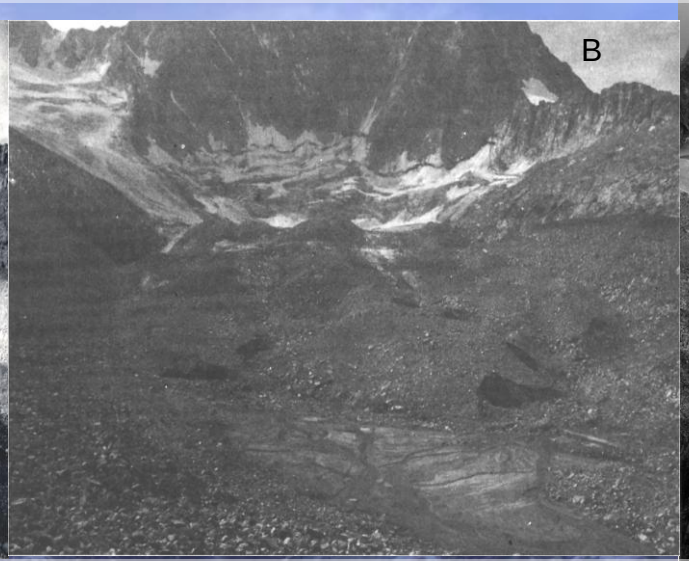


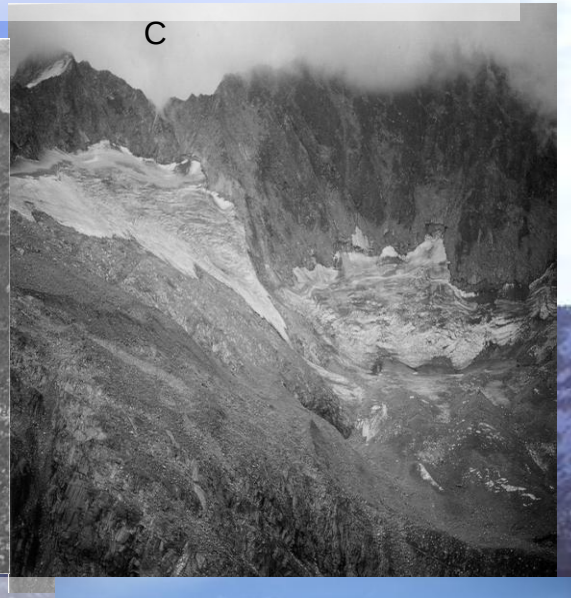


Climate change

Modified dynamics of the criosphere under climate change scenarios impacts alpine water resources and eco-hydrology

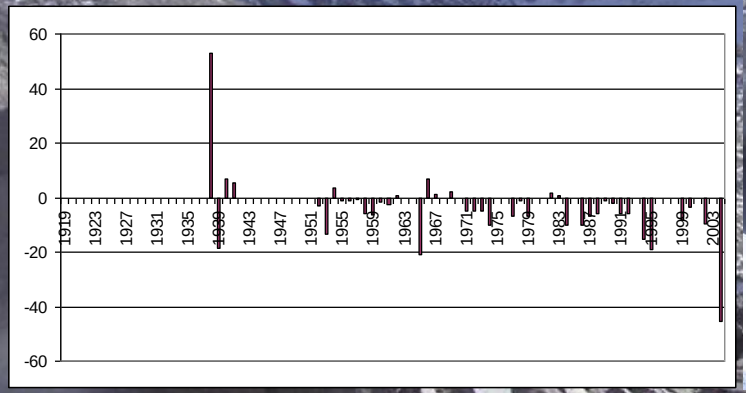






Ghiacciaio del *Venerocolo, gruppo Adamello-Brenta.*

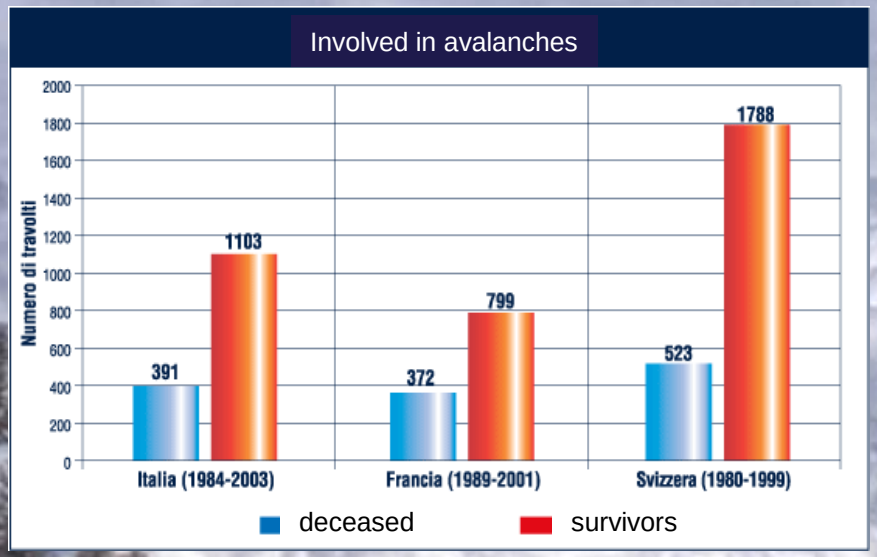
A: 1970, B: 1989 e C: 2003.



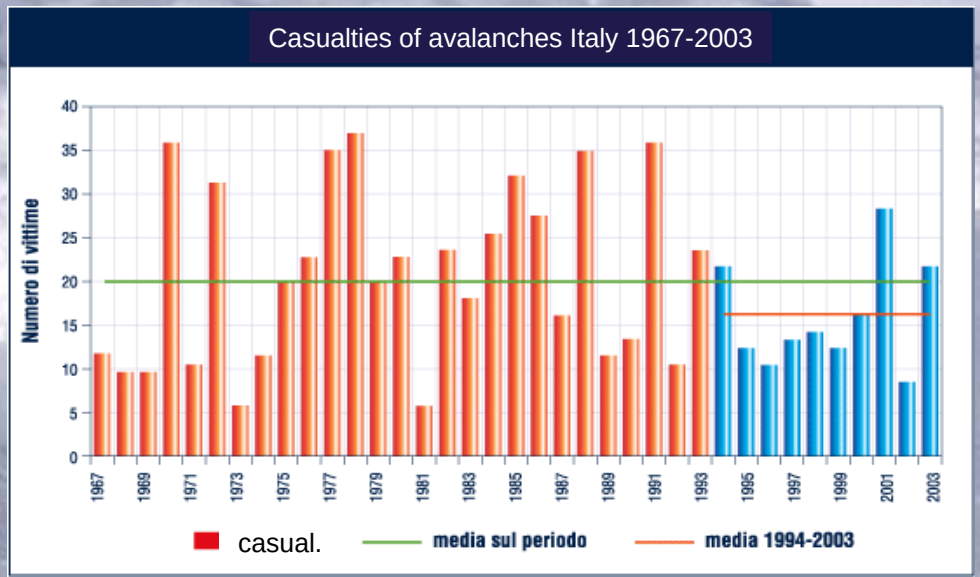
By kind permission of Prof. C. Smiraglia

Avalanches

The European Alps are characterized by relevant tourism during winter and feature a considerable amount of ski resort areas. Every year, several avalanches occur in the area, and a large number of casualties occurred in the last 20 years all over the Alps; in more than 1/3 of the cases the people involved died.



The number of fatalities has decreased recently due to the new prevention techniques and risk mapping

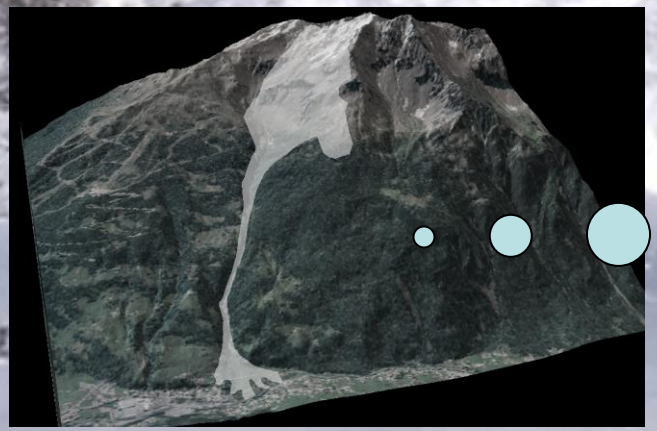


However, not only avalanches are a threat, but they represent earth shaping and ecological values in mountain ranges

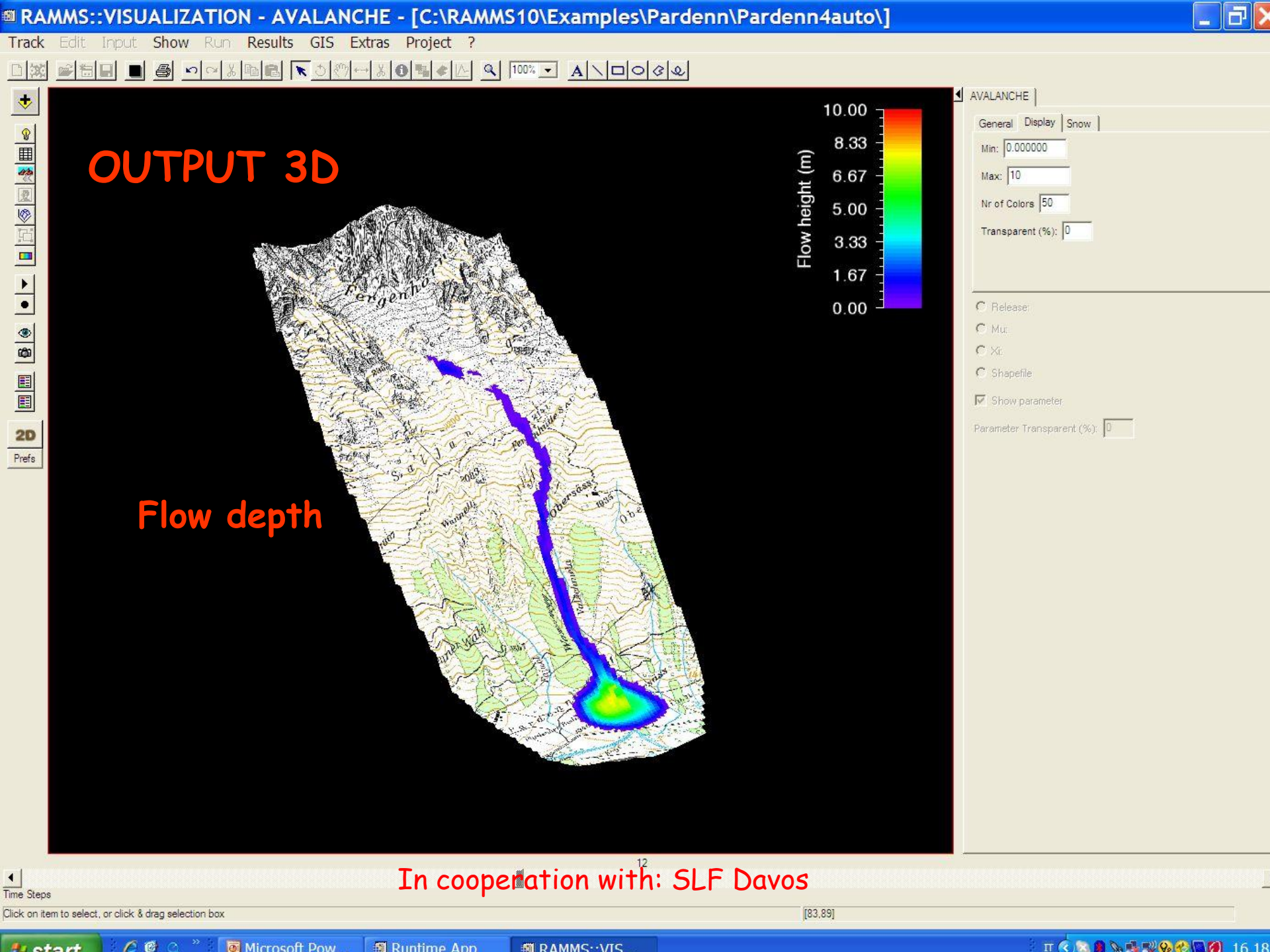
Avalanches impact vegetation distribution, morphology and even animal feeding and nesting

Avalanches sweep tracks clear of snow, so the tops of plants may stick out. Mountain goats and deer frequently trot out to graze

Avalanches remove trees, so that But plants and shrubs that can't grow under shady conifers spring up in these sunny chutes, providing nutrition for large mammals like bears. Grizzly bears are detected more often in landscapes with avalanche chutes, alpine, bare rockand relatively young and logged stands.



Within active avalanches tracks, tree height and width are smaller than within non avalanche tracks at the same altitude, indicating modified forest structure from avalanches

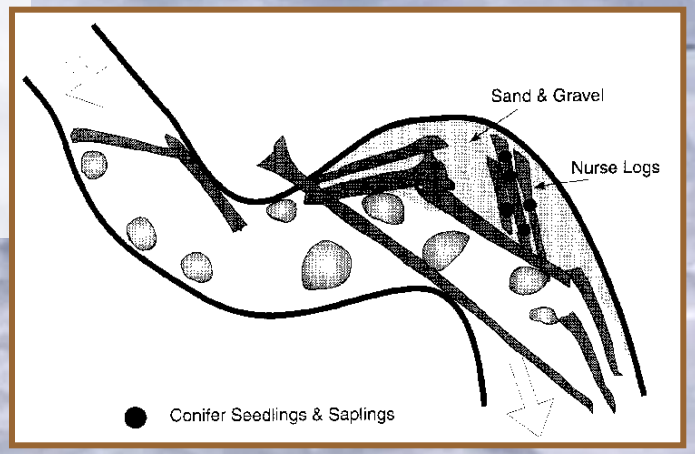


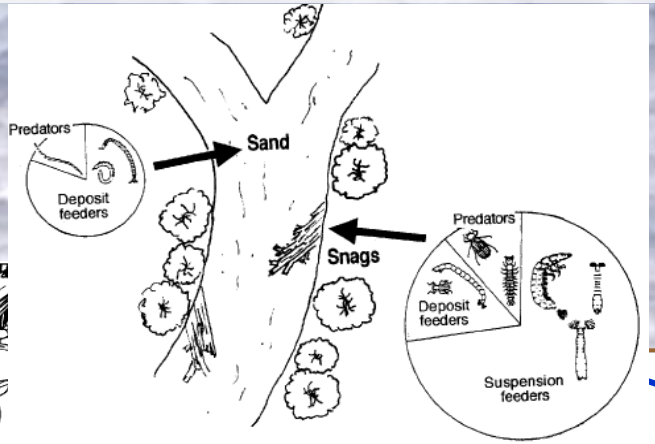
In cooperation with: SLF Davos

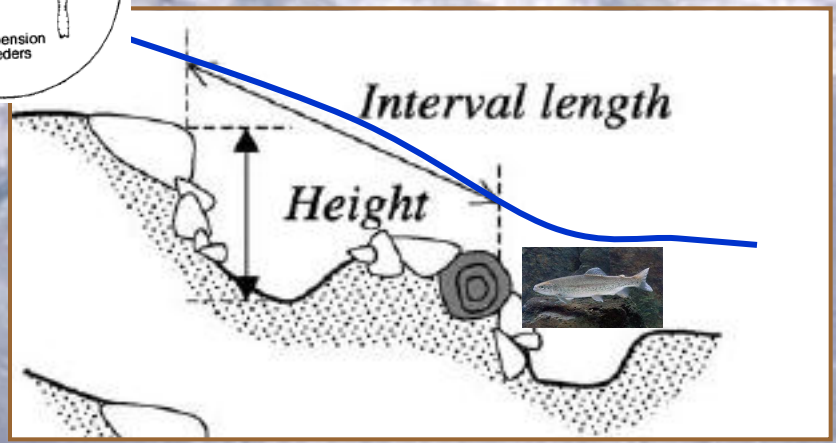
Woody debris

Dead vegetation (Woody Debris) of coarse size (LWD) is of utmost importance in ecology of riverine environment

LWD retains particulate organic, provids substrate for biomass production by benthic macroinvertebrates and fostering higher levels of invertebrate species richness and abundance. Large wood creates zones of flow acceleration and deceleration that provide higher levels of physical diversity, which are important to fish. Fishes use submerged LWD for overhead cover from predators, as a velocity shelter, as a visual barrier from other fish and possibly for orientation as well as a source of prey.
Further, LWD provide zone for colonization of vegetation in river







United Nations Environment Programme
Division of Technology, Industry and Economics

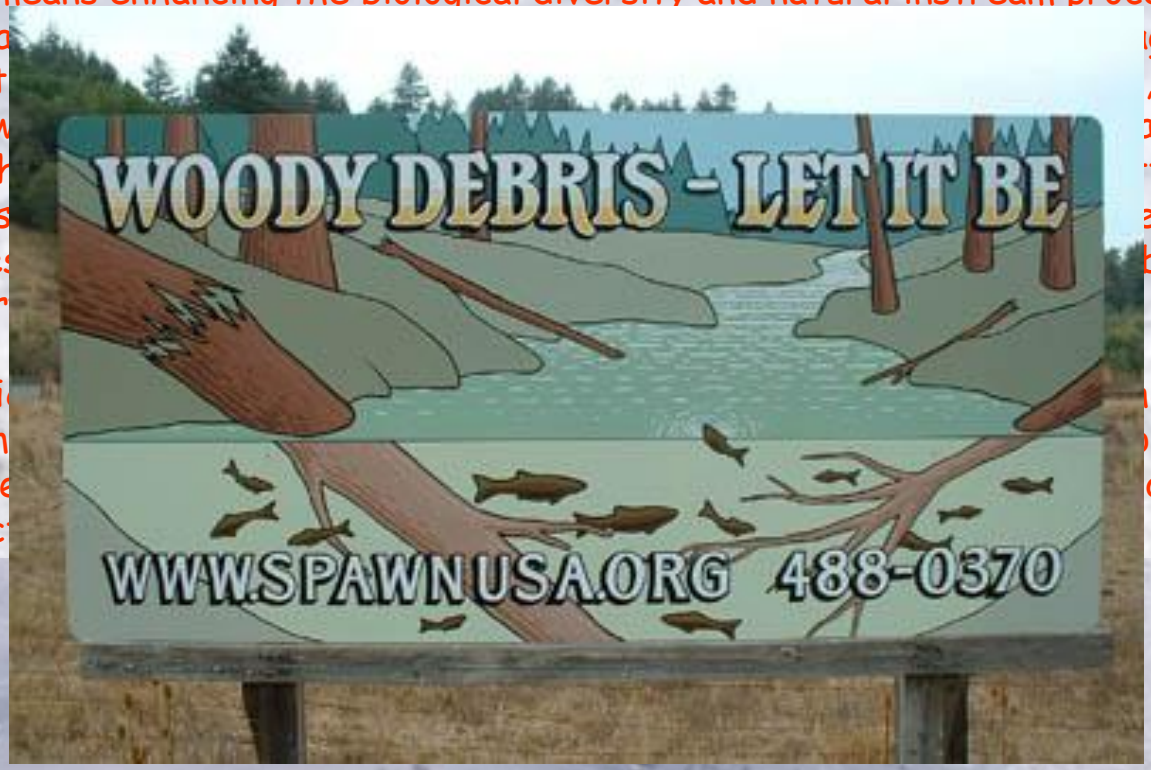
Guidelines for the Integrated Management of the Watershed
Phytotechnology and Ecohydrology

RESTORATION OF STREAMS FOR WATER QUALITY IMPROVEMENT AND FISHERY ENHANCEMENT

According to European Union (EU) Water Framework Directive (WFD), stream restoration for water quality improvement should consider the restoration of the ecological integrity of the whole stream ecosystem. This means enhancing the biological diversity and natural instream processes. The concept of **Ecohydrology** (Za gement tool toward enhancement of t , ecohydrology may be proposed as a new anagement (IWRM) and for WFD. With th terns of sediment erosion and depos e enhanced. The first step in stream res basic element of water quality and fisher

..

Several hierarchi ed context have been developed. Fish m rised of pools, runs, and riffles, and to the on - as well as to their secondary charac



In conclusions

Anyone who can solve the problems of water will be worthy of two Nobel Prizes, one for Peace and one for Science..

J. F. Kennedy, 1963

For those who are interested, I will hold (joint with Prof. R. Ranzi and Dr. M.C. Rulli) the course for PhD (delivered first in summer 2007):

Mountain Hydrology:

1) *Hydrology of snow (8-10 hrs)*
2) *Snow avalanches (8-10 hrs)*
3) *Woody debris (8-10 hrs)*

I look forward to meet you there..