

WILFRIED HAEBERLI (*)

CLIMATE CHANGE AND GLACIAL/PERIGLACIAL GEOMORPHODYNAMICS IN THE ALPS: A CHALLENGE OF HISTORICAL DIMENSIONS

ABSTRACT: HAEBERLI W., *Climate change and glacial/periglacial geomorphodynamics in the Alps: a challenge of historical dimensions.* (IT ISSN 1724-4757, 2005).

In the Alps, there is a long tradition of scientific research on glaciers and on landscapes formed by perennial surface ice. Investigation of problems connected to high-mountain permafrost is much newer. The interest in both, however, has risen considerably during recent years. This is primarily due to their close relationship with climate change. Glaciers and permafrost do indeed react sensitively to changes in atmospheric temperature because of their proximity to the melting point. As a consequence, climatic changes during the 20th century have caused pronounced effects in the glacial and periglacial belts of mountain areas. Fast if not accelerating changes in ice conditions of cold mountain areas now increasingly influence the appearance and perception of alpine landscapes, the seasonality of melt-water runoff, the intensity of erosion and sedimentation, the stability of high-altitude slopes and the general hazard situation. To anticipate and mitigate such consequences of climate change represents a challenge of historical dimensions to the fields of glacial and periglacial geomorphology.

KEY WORDS: Glaciers, Permafrost, High mountains, Climate change, Natural hazards.

RIASSUNTO: HAEBERLI W., *Cambiamenti climatici e geomorfodinamica glaciale/periglaciale nelle Alpi: una sfida di dimensioni storiche.* (IT ISSN 1724-4757, 2005).

C'è una lunga tradizione di ricerca scientifica sui ghiacciai e sui paesaggi perennemente coperti da ghiaccio nelle Alpi. Le ricerche su problemi riguardanti il permafrost di alta montagna sono invece più recenti. In entrambi i campi, comunque, l'interesse è notevolmente aumentato negli ultimi anni. Ciò è soprattutto dovuto alle loro strette relazioni con i cambiamenti climatici. Ghiacciai e Permafrost sono, infatti, molto sensibili ai mutamenti della temperatura dell'atmosfera, data la loro prossimità al punto di congelamento. Di conseguenza, i cambiamenti climatici del 20° secolo hanno prodotto consistenti effetti sulle fasce glaciali e periglaciali delle aree montuose. Rapidi se non accelerati cambiamenti delle condizioni del ghiaccio nelle aree montane fredde stanno ora influenzando in maniera crescente l'aspetto e la percezione

del paesaggio alpino, la stagionalità dello scorrimento delle acque di fusione glaciale, l'intensità dell'erosione e della sedimentazione, la stabilità dei versanti di alta montagna e una generalizzata situazione di rischio ambientale. Anticipare e mitigare tali conseguenze dei cambiamenti climatici rappresenta una sfida di dimensioni storiche nei campi della geomorfologia glaciale e periglaciale.

TERMINI CHIAVE: Ghiacciai, Permafrost, Alta Montagna, Cambiamento climatico, Rischi naturali.

INTRODUCTION

Investigations of questions related to glacial and periglacial geomorphology in the Alps has a long and important research tradition. The deciphering of landforms and traces in the landscape created or affected by glaciers and frozen ground have revealed the often dramatic evolution of our planet. In the 19th century, the detection of the ice ages led to intense ideological discussions about the creation of the world, the stability of its climate and the evolution of living conditions on earth (Haeberli & Zumbühl, 2003). Since then, decades of intensive worldwide research have helped to create a comprehensive basis of scientific knowledge about landscape evolution through time in the Alps and their forelands (Castiglioni, 2004) as influenced by glaciers and frozen ground.

Such an advanced state of knowledge now constitutes an important instrument in dealing with new challenges of historical dimensions and increases our ability to cope with aspects related to future glacial and periglacial processes and landforms. These new challenges are primarily generated by increasing human activity which uses but also affects, more and more, environments in high mountain regions as well as their surrounding lowlands and which induces changes lasting over time scales spanning from years to decades, centuries, millennia and sometimes beyond (Watson & Haeberli, 2004). The disappearance of

(*) *Glaciology and Geomorphodynamics Group, Geography Department, University of Zurich, Switzerland.*