The Earth in Accelerated Change: Habitats in the 21st Century

Divergence and Convergence in Geography – Approaches and Perspectives at the Department of Geography, University of Zurich

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1 Divergence and convergence, networking and bridge-building

Geography is above all an institutional category. There is a corresponding subject and there are geographic departments such as the Geographic Department of the University of Zurich (GIUZ). The definition primarily creates a common identity of those involved, and thus an outward convergence. However, if one were to ask the lecturers and the researchers at the GIUZ about the research paradigms in Geography to which they assign their research, the answers would without doubt result in divergence.

Nevertheless, we are continuously challenged to portray, or define a discipline in an adequate and comprehensive manner.

One of the GIUZ brochures for students accordingly states:

> «Geography examines the processes which shape and change habitats with the goal to understand the mutual interdependencies; to document changes; to sketch scenarios and develop sustainable strategies of action. Hereby, it discovers both the physical processes and the interaction between man and the environment...»

The program involves variety and complexity. It creates divergence in its demand for specialization with regard to schools of thought, goals, concepts, methods, scales and responsibilities. However, variety and complexity can only be really understood in synopsis; therefore, they demand synthesis, networking of the fields of specialization and a constant analysis of the antagonism between convergence and divergence.

How is this demanding program at the Department of Geography at the University of Zurich (Faculty of Mathematics and Natural Sciences) transposed? First of all, orientation in research and theory encompasses the natural, social, economic, and ever-increasingly also the engineering sciences. In research, the work is focused and usually specialized. In its trend towards specialization, the GIUZ and geography hardly differ from other disciplines and institutions. Divergence in areas of expertise is therefore easier to determine than convergence regarding content. However, also in specialized research questions, there is a preference nowadays to work in teams. From this collaboration, tight networks are established that connect the Department both internally and externally. Such work in interdisciplinary and transdisciplinary networks of specialists creates the foundation for a science, which apart from being driven both by curiosity and creativity towards application-oriented innovation, also explicitly assumes responsibility for the living spaces of future generations.

To assume responsibility for the habitat of future generations – with this commitment, which the GIUZ sees as a primary challenge, the normative aspect of the term «institution» becomes transparent. With the central theme of «Habitats in the 21st Century», which was formulated by the GIUZ as a common goal for research and education, the focus is directed towards local, regional and global dimensions and characteristics of the accelerated changes occurring on our planet.

The potential of geography for transdisciplinary work lies in the fact that *a priori* social scientific research, novel technologies and scientific analyses can be connected; both natural and social processes can be investigated and from these results and their synthesis, strategies of action can be derived. Placing this interconnection and synthesis on the foundations based on a profound theoretical background remains a great challenge for geography! An initial step in this direction would be the disclosure of the theoretically different approaches, i.e. systems theory or action and structural theory, which form the basis of the various research activities. The declared goal of such diversity within scientific culture and varying approaches is the development of fascinating and useful insights.

Thus, the aim is to promote lively debates on real contexts, at different levels and complexities, between integrative-thinking people, who are committed to the research and shaping of habitats: people committed to building bridges and creating networks.

2 Habitats in the 21st century

From the beginning, students of geography at Zurich are confronted with the fact that comprehension of habitats as a created, dynamic system requires and induces more than the responses to the question of where what is found – and this from different perspectives.

The storm «Lothar» (1999) and the terrorist attack, which occurred on September 11 (2001) can be seen as dramatic examples of events of varying scales and system realms, both of which disturb habitats (systems theory) or have drastic consequences on the scope of action for different actors (action and structural theory). These examples show that within geography, different and occasionaly divergent theory discourses can be communicated. This calls for the creation of links for understanding one another, which in turn can be used for mediation and translation of research questions and results externally.

System theory perspective: The comprehensibility and the potential stabilization of systems do not depend only on how much a system is affected, but also on how complex and integrated it is. Not the climate problem per se is the central challenge regarding the basis for life in the future. Rather, the problem of climate relates to questions and feedback regarding energy and water supply, biodiversity, soil degradation, as well as the demographic and socioeconomic conditions and the associated consequences. Furthermore, a critical factor is the relationship between the speed of the course of events and the time required for a correctly managed reaction. As reactions cannot always be adjusted to the pace that might be required, the scope of action in such integrated systems, in which dynamics are ever increasing, is increasingly limited. Many partial systems of habitats are de facto changing with an accelerated pace; they are ever more interwoven and are becoming more complex. The scope of action also depends on how early and adequate problematic developments are recognized, analyzed and made accessible to decision-making.

Theory of action perspective: Existing livelihood strategies of individuals or groups are markedly different; they can be vulnerable or relatively secure, they are interlinked to a certain degree as every decision and its partially unintentional consequences of actions once again posit the framework for further opportunities of action. Human actions considerably influence and determine the development of habitats of today and the future. How and in which constellation of agents global challenges are negotiated, or are decided and finally translated to the local level – these are questions to which an interdisciplinary approach in geography research must deliver answers. Furthermore, it is necessary to analyze agents involved and their power, the knowledge permeating down from the global to the local level, cultural embedding, and last but not least the rules and norms of society.

3 ...and accelerated change

Approximately 20 000 years ago, in recent earth history, so to speak, large glaciers lay in the Lake of Zurich, the surrounding of which today is densely populated. The moraines determined where the city was first built (Roman) and still determines the present day cityscape. This fascinating insight into the past, however, also contains another dimension, when one recalls that the corresponding global change in temperature was about equal to the possible expected rise in temperature of the present century. The current century affects to the life expectancy of today's students, their children and their grandchildren. Not only the living space «Zurich» but also the global habitat will markedly alter for the coming generations.

Therefore, more than ever before, geography is devoted to the description and explanation of the Earth system in the dynamism between space and time (4 dimensionally), and the complexity, and the rational and emotional aspects, so typical of habitats. The question about causality, about the reasons, leads to a deeper understanding of the developments.

Change of scenery: About 200 years ago, there were less than one billion people, in 2000, there were over 6 billion people on Earth. Even if the growth rate has dropped in the last years, absolute growth has never been as high as it is today. 90% of growth takes place in developing countries, while mainly in Western Europe and North America the population is decreasing and ageing. Massive changes in habitats and living scope accompany these developments, accompanied by increasing social and spatial distribution conflicts from the global to the local level. Aside from the centers of economic growth, more and more people and regions are partially or completely cut off from the main current of development.

In analysing and finding a solution to the relevant problems, a renunciation from research into «space» *per se* emerges. Agents of power in a societal context and, hence, the «socially constituted space» (Werlen 2000) are at the epicenter of research into the impulses for a sustainable spatial development, that aims at contributing towards the improvement of living conditions and to reduce the vulnerabilities and risks. The formal, but also the unwritten norms of

Photo 1: 100 m-deep borehole as part of the EU project PACE (Permafrost and Climate in Europe) on top of the Stockhorn (3420 m a.s.l.) at Zermatt, for long-term observation of the permafrost temperature in the rocks. In the background the frozen solid ice and cliff faces of the Lyskamm in the Monte Rosa Group.
100 m-tiefe Bohrung im Rahmen des EU-Projektes PACE (Permafrost and Climate in Europe) auf dem Stockhorn (3420 m a.s.l.) bei Zermatt für langfristige Beobachtung der Permafrosttemperatur im Fels. Im Hintergrund die gefrorene Eis- und Felsflanke des Lyskammes in der Monte Rosa-Gruppe.
Creusement à 100 mètres de profondeur dans le cadre du projet de l'Union européenne PACE (Permafrost et climats en Europe) sur le Stockhorn (3420 m d'altitude), près de Zermatt, en vue d'une observation à long terme de la température du permafrost dans la roche. A l'arrière-plan, le flanc rocheux gelé du Lyskamm dans la chaîne du Monte Rosa.
Photo: W. Haeberli

society, which determine access to and management of resources, are decisive. These regulations change continuously– a process that has no doubt been accelerated by globalization.

4 Research emphasis

In such a comprehensive problem area, a department of geography can only be selective and focused, and yet attempt to promote a sense of the variety in its totality. Present centers of competence in research at the GIUZ, in which networking are significant, can be illustrated by the following examples.

4.1 Snow and ice, landscape and climate in high mountain regions

Snow and ice are characteristic components of high mountain landscapes, that depend heavily on climate and which have very different characteristics and functions in alpine ecosystems. Snow, which depends heavily on short-term weather cycles, is primarily a «nervous interface», between sky, earth and humans. International programs (IPCC, Global Climate Observing System) accept receding glaciers and direct instrumental measurements in complex as reliable key indicators. Permafrost, the «long-term invisible», on the other hand, reacts extraordinarily slowly, however incessantly, and hidden from direct observation, deep underground. Focused research work aims at registering and spatially modeling climate-driven processes in high mountain areas, especially with regard to glaciers and permafrost in connection with natural hazards, changes of landscapes and international climate observation programs (Hölzle et al. 2001). Worldwide glacier observations are coordinated at the GIUZ (Haeberli et al. 2002), contri-

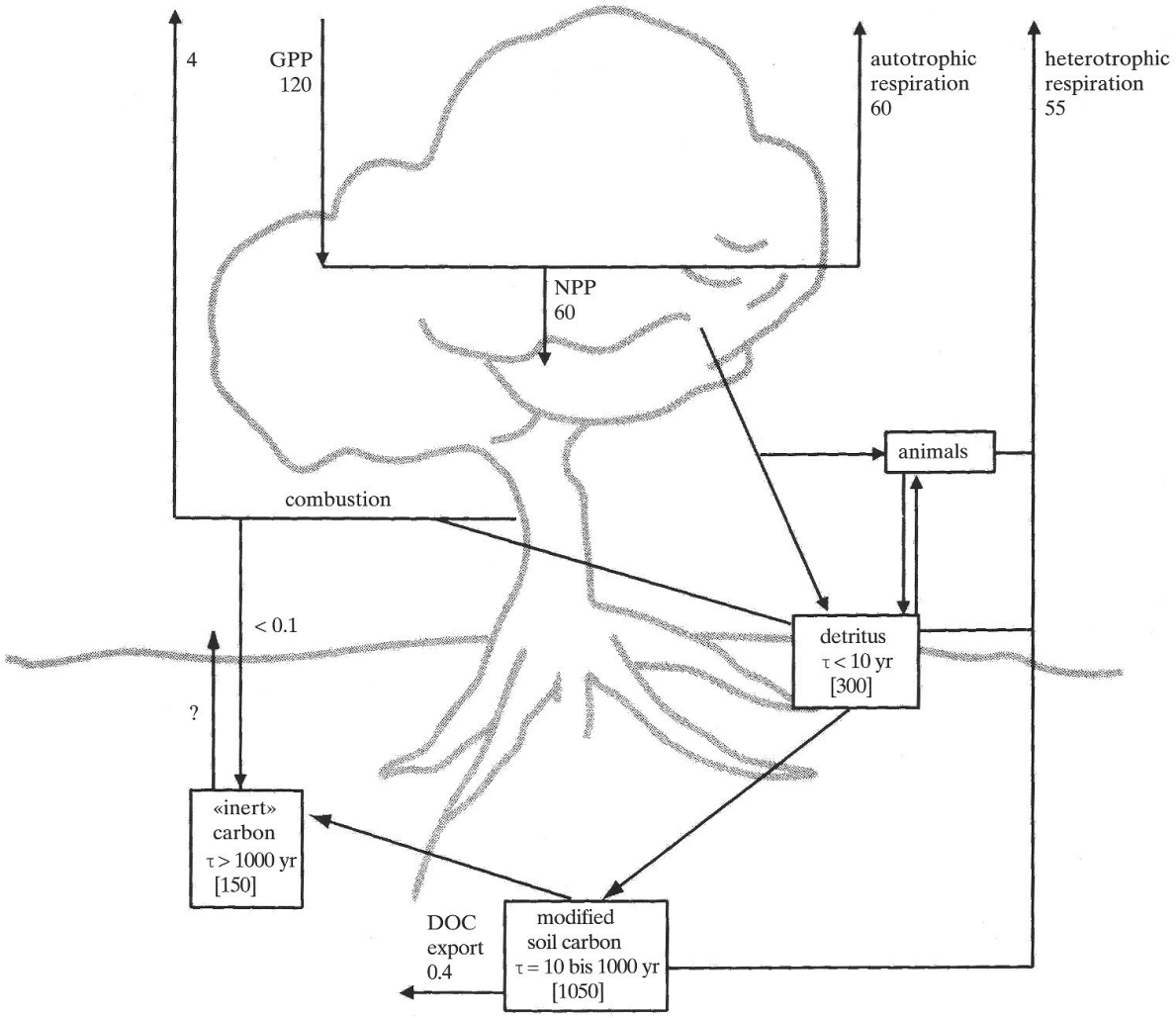

Figure 1: The terrestrial carbon cycle. Pools (Pg carbon) and fluxes (Pg carbon per year) for the 1980s. GPP: Gross Primary Production; NPP: Net Primary Production; τ: turnover time in years (yr).
Der terrestrische Kohlenstoffkreislauf. Speicher (Pg Kohlenstoff) und Flüsse (Pg Kohlenstoff pro Jahr) für etwa 1980. GPP: Brutto-Primärproduktion; NPP: Netto-Primärproduktion; τ: Umsatzrate in Jahren (yr).
Le cycle carbonique terrestre. Réserves (Pg carbone) et flux (Pg carbone/année) autour de 1980. GPP: production primaire brute; NPP: production primaire nette; τ: taux de mouvement en nombre d'années (yr).
Source: Intergovernmental Panel on Climate Change (IPCC) 2001b

butions to the European North-South transsect of permafrost borehole observations are delivered, and national observation networks for glaciers and permafrost are monitored (Kääb et al. 2002) (Photo 1). Remote sensing and GIS technologies for spatial-quantitative assessments of ice avalanches, lake outbursts, rock falls and debris flows in high mountain regions are being systematically developed and implemented. In Switzerland, with regard to conversion, integral space-time information is an instrument for analysis, planning and management in the climatically sensitive Alpine region. Abroad, security questions are more likely to be at the fore – recent examples include power plants in the Andes, glacier hazards at the Belvedere Glacier in Italy, or in connection with a large rock/ice slide in the Caucasus.

4.2 Soil, vegetation, and the carbon cycle in the human-environment system

The «life layer» of the Earth is characterized by various and highly complex interactions. Soil, vegetation and carbon cycle (Figure 1) are investigated by means of a whole spectrum of techniques, including inorganic-chemical and biochemical analysis, pollen analysis, dendrochronology and radiocarbon dating. Processes and turnover rates of organic matter in the soil, forest fires, and carbon stocks in the soils, rates of erosion, and clay mineralogy of alpine soil are

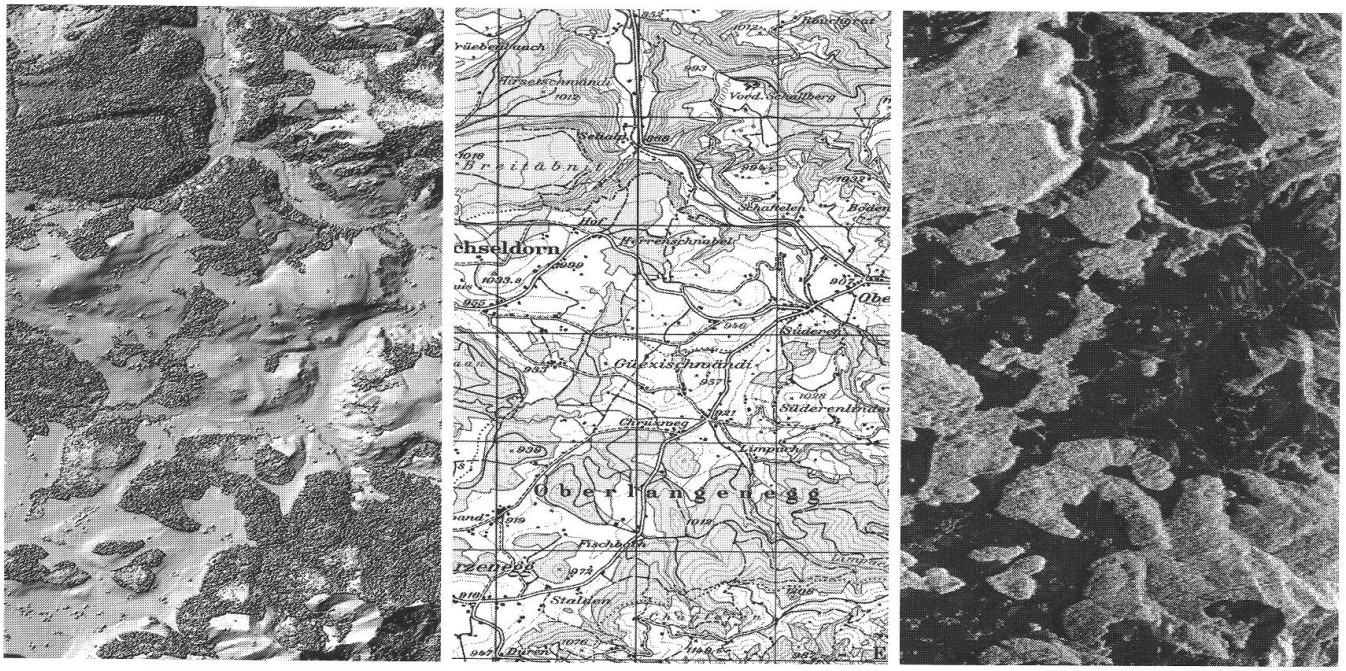

Figure 2: Synergies of sensor systems: LIDAR First Pulse digital surface model (left), Swiss Topo Map 1:50'000, region Oberlangenegg/BE (middle), E-SAR C-band, detection of forests by synthetic aperture radar (right)
Synergien verschiedener Sensorsysteme: LIDAR First Pulse Oberflächenmodell (links), Landeskarte 1:50'000 Gebiet Oberlangenegg/BE (Mitte), E-SAR C-Band, Erfassung von Waldflächen durch Radar mit synthetischer Apertur (rechts)
Synergies de systèmes de capteurs: modèle de surface (gauche) LIDAR First Pulse, carte nationale suisse 1:50'000, région Oberlangenegg/BE (milieu), E-SAR bande C, détection de forêts par radar à synthèse d'ouverture (droite)
Copyright «Swiss topo»

understood as a function of climate, time, substratum, and the history of the vegetation and climate in the Alpine region.

Regarding soil organic matter, interest lies mainly in three research areas. One of these is the observation of lipids and lignin, which enter the soil through plant or microbial biomass and are set there for a long time (Gleixner et al. 2001; Schmidt et al. 2002). However, the amount of time that the majority of these substances remain in the soil is still unknown. In field experiments, isotopically labelled parts of plant biomass are placed in the soil over many years. Using structural and isotopic methods, the turnover rates of lipids and lignin are determined and modeled at the molecular level.

Altered frequency and intensity of forest fires can influence climate through a multitude of mechanisms (Czimczik et al. 2003). The boreal forest soils of Siberia are, after each fire, and in a time series, surveyed with the aid of biogeochemical analysis techniques, in order to assess the influence of the fire on the carbon balance and the isotopic composition of the organic matter in the soil.

Late glacial, Holocene, historical, and recent changes of forest landscapes and forest border ecotones are being reconstructed in the Alpine region. In addition, invasive exotic plants in Switzerland as well as the connection between vegetation dynamics and degradation of farmland in the Mediterranean region are being surveyed.

4.3 Development of technology and knowledge transfer in remote sensing

With regard to remote sensing, technologies, methods and applications are developed on one hand at the GIUZ, while on the other, we are concerned with knowledge transfer in concrete projects.

New methods of classification and dynamic monitoring of land use are refined and applied in projects both at home and abroad. Projects today centre on the classification of forest and land use changes in Switzerland, Iran and Patagonia (Kellenberger et al. 2002).

The processing and application of data from radars with synthetic aperture (SAR), radar-interferometry,

and polarimetry enable the production of high quality, digital terrain models, uninfluenced by precipitation, cloud cover, or/and time of the day. Minute variations in vegetation cover and the Earth's surface are measurable and thus support large scale surveillance in many disciplines. (Small et al. 2001; Stebler et al. 2002). In combination with LIDAR techniques (Light Detection and Ranging), new opportunities are offered to assess, for example, the biomass and structure of forests (Figure 2).

With the aid of spectral research in the optics field, radiometry, imaging spectrometry and spectroscopy, basic research is conducted in the areas of vegetation analysis, «precision farming», monitoring of water pollution and the detection of aerosols (Kneubühler 2002; Strub et al. 2003; Keller 2001; Bojinski et al. 2002). The scientific leadership of the APEX project of the European Space Agency (ESA) is at «Remote Sensing Laboratories» (RSL), in which an airborne imaging spectrometer of the youngest generation is being planned and developed in cooperation with Swiss-Belgain industry. It serves, among others, for the calibration and validation of hyper-spectral satellite systems of ESA (Schaepman et al. 2003). The scientific part of the «National Point of Contact» at the RSL makes available its know-how about the use of remote sensing data to both scientists and the interested general public. The development of suitable visualization methods is pursued especially in combination with remote sensing and GIS methods for an improved transfer and better perceivability of detected, modeled and predicted events (Biegger et al. 2002; Hirtz 2003).

The large number of projects funded by third parties in remote sensing attests the great interest of Federal Offices, industry, and national as well as international research institutes and organizations. The basis for this is a broad and intensive education and a prolific cooperation with the other divisions of the Department of Geography. A careful networking within projects of ESA, other international organizations, with universities and research centers is closely observed.

4.4 Environmental concepts using the example of nature conservation areas

Environmental degradation and the decline in biodiversity are currently being diagnosed in scientific and political discourse as having negative effects both globally and locally. In response, national and international organizations are attempting to design nature conservation areas, and more so in the countries of the developing world. Western nature constructs, which are translated into international nature conservation concepts, are the constructs that are given priority. They are globalized and implemented at a local level, operating at another cultural and economic context, through concrete measures.

At the GIUZ the following questions, amongst others, are investigated: which local livelihood strategies meet with the nature conservation measures? Which concepts of «nature» and «nature conservation» exist in the interacting groups and organizations in the nature conservation areas? At the forefront of the history of international nature conservation, different interests and power endowments of those involved are pursued (Soliva 2002) (Figure 3); however, also the specific demands of the local population and tourists (Backhaus 2001; Backhaus & Kollmair 2001) on protected areas are analyzed. The goal of the current investigations is to elaborate a framework of guidelines for appropriate, socio-culturally grounded nature conservation concepts (Müller-Böker et al. 2001), and above all to constructively examine participative approaches of resource management (Geiser 2001). In cooperation with the WWF, research results are transfered into practice in the current project of the Kanchenjunga Conservation Area in Nepal (Müller-Böker & Kollmair 2000).

4.5 Geography as a bridging subject in research on the impact of climate

> «People, who live in potentially affected areas or work in potentially affected branches of industry, want to know what they must deal with; and those, who decide on political measures for protecting climate, want to know not only which consequences their decisions can have, but also the consequences of decisions they renounced» (KRUPP 1995: 13).

Research on the impact of climate is concerned with the connection between climates on the one hand, as well as natural and anthropogenic elements of our habitats on the other. A classical example of this would be the examination of the suitability of climate for different activities. In recent times, the definition has been used in connection with climate change. Besides the scientific aspects of climate change, social and economic questions are increasingly being posed. Central to a social scientific research into the impact of climate are awareness and the adaptation process. Physical climate and climate change, respectively, must be kept separate from the social construct of climate and climate change. At any one time, players act on the basis of the social construct towards climate change.

Already ten years ago the geographer and climate researcher Sterr (1993) referred to geography, a classical bridge between the geosphere and the anthroposphere, as being capable of making important contributions to research on the consequences of climate.

The relevant work at GIUZ (Abegg 1996; König 1998; Bürki 2000) concentrates mostly on the aspects of

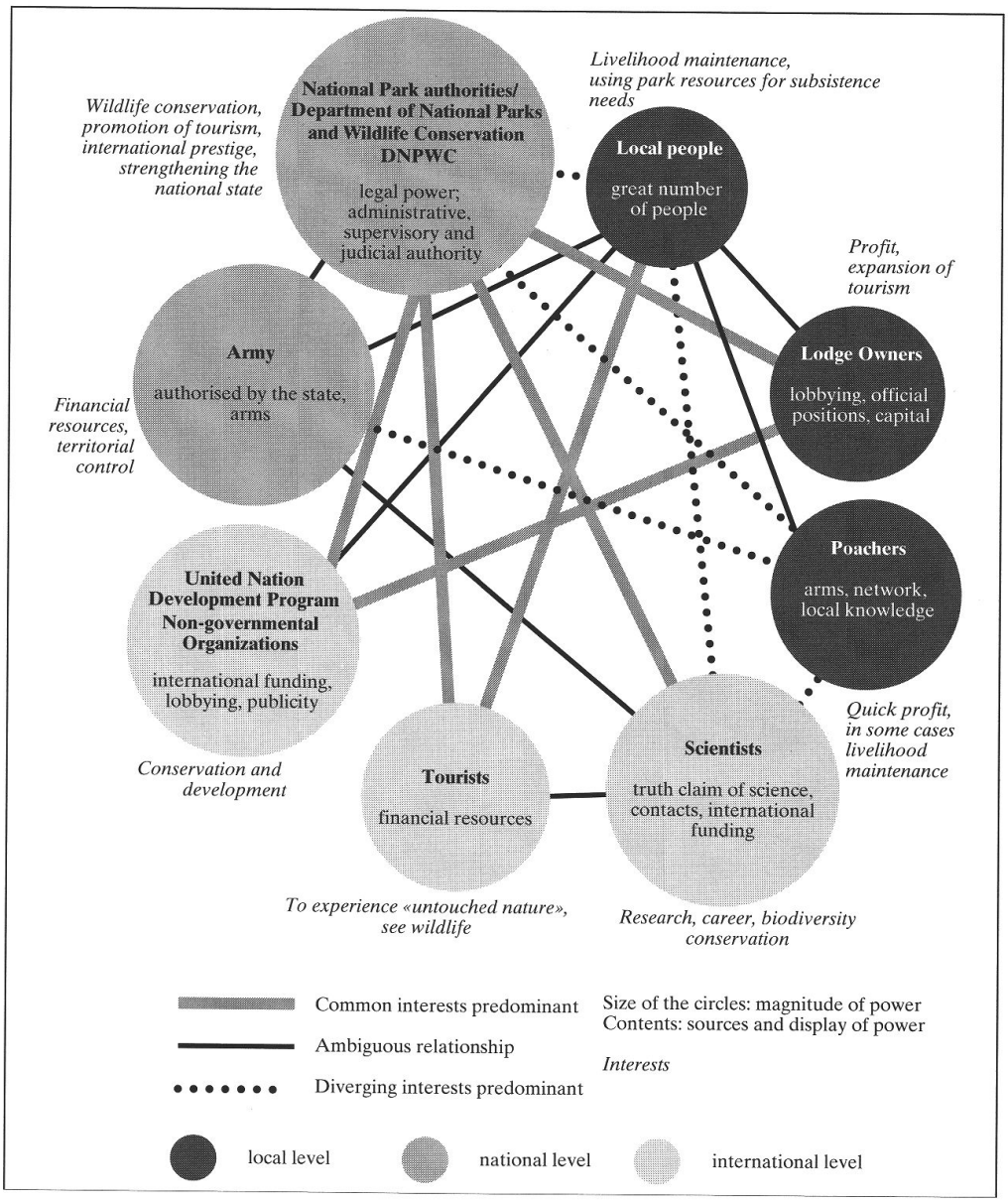

Figure 3: Actor groups, interests and power endowments in the Bardiya National Park (Nepal)
Akteurgruppen, Interessen und Machtverhältnisse im Bardiya Nationalpark (Nepal)
Groupes d'acteurs, intérêts et conditions de pouvoir au Parc national Bardiya (Népal)
Source: Soliva 2002

snow and tourism. They confirm that geography, in the sense of a «committed geography» (Boesch 1989), not only makes contributions in transdisciplinary cooperation, but also has a duty to do so (Photos 2 and 3).

4.6 Geographic information science and quantitative analysis

Technological developments over the last few decades have brought with them a number of methods and aids that open up opportunities for geographic research. On one hand traditional research approaches can be supported and made more effective with geographic information systems; on the other hand, a new kind of «geography making» that is close to reality is made possible with, for example, decision-making support systems. In a globalized world, in which the mobility of people, goods, capital and information can hardly be restricted, social and cultural differences are becoming more important, and physical-spatial distances are acquiring new quality and meaning. In these changed circumstances, new challenges and formulations of questions come to light for quantitative geography:

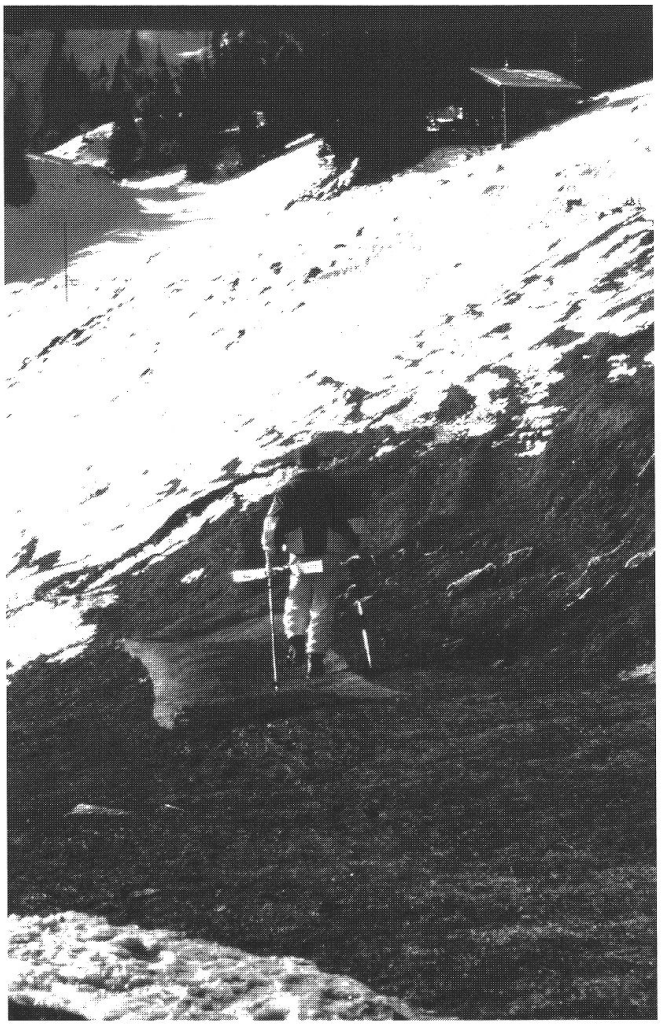

Photo 2: In search of snow
Auf der Suche nach dem Schnee
A la recherche de la neige
Photo: B. ABEGG

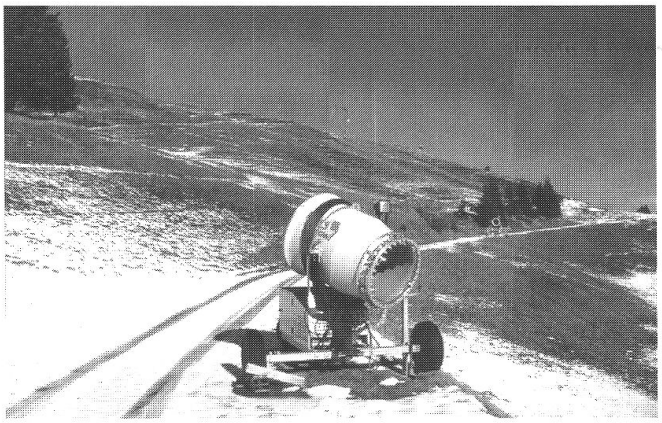

Photo 3: Snow-cannon: artificial snow production
Schneekanone: künstliche Produktion von Schnee
Canon à neige: production artificielle de neige
Photo: B. ABEGG

definitions, methods, and models of spatial analysis have to be considered, thought over and developed further. Another significant and recent development is the rapidly growing availability of spatially encoded data and the acceptance of the use of computer aids for solving spatially relevant questions in the economy, at all administrative levels as well as in the private domain. With this prerequisite, the specialized research teams at the GIUZ for geographic information science and technology contribute not only towards development of new analysis techniques and methods. They also elaborate, in cooperation with environmental and social scientific groups within and outside the department, insights for relevant questions of our time. For example, forest fire research, analysis with the aid of terrain modeling, cartographic and statistical analyses of socially relevant and quantitatively recorded conditions and processes in the domains of economics, politics, traffic and medicine. (Further examples of research in the GIS field can be found in the contribution by HURNI et al. in the same journal).

5 Challenges, visions, and perspectives for research

5.1 Mountains: the focus of the climate question

More or less «eternal» ice characterizes the image and the genesis of high mountain landscapes. Influenced by anthropogenic climate change, landscapes and habitats of the high mountain areas, along with snow and ice, could change dramatically in the coming decades (HAEBERLI & BENISTON 1998). The increase in the rate of change or the compression of the corresponding time scales ought to be a critical challenge for the people affected and a prime example for the surrounding areas of the increasing imbalances. These courses of events are given the most attention in the glaciology and geomorpho-dynamics departments at the GIUZ. High-resolution climate models and satellite images coupled with GIS-based spatial simulations for snow and ice, and 4-dimensional numerical mathematical models for conditions in the presently frozen or glacier-covered underground not only create new opportunities for long-term measurement networks in the global and regional framework of climate observation. In the future, they will also aid in assessing the consequences of complex interactions and their effects on living conditions.

To be able to deal with the relevant developments in a meaningful way, new decision chains and responsibilities are needed. Ever increasingly, swift changes in the highly interconnected, complex systems that have been brought out of balance must be observed, documented and interpreted in a realistic manner. This challenge does not only make the use of information technologies necessary but above all requires close cooperation between science, authorities and the public.

5.2 Humans and global biogeochemical cycles

Carbon, oxygen, hydrogen and nitrogen: these four elements, which are essential for life, are constantly being transformed by biological, chemical and physical processes. Existing in differing chemical combinations at any one time, these basic elements of life combine with further organic compounds and are set free and transported and distributed in the atmosphere and hydrosphere. Finally, they find their way back into the biosphere to be transformed by organisms once again. Due to the amalgamation of processes that take place, be it in the biology kingdom of living organisms, or in chemical-physical processes in the geosphere and atmosphere, these cycles are known as «biogeochemical cycles» of elements. Research into the numerous biogeochemical conversions that are involved in this substance cycle, is one of the largest and most urgent scientific challenges of our time. This is because man has been intervening with technical measures on a global scale, and with great velocity, into these natural cycles without having known until now what the consequences of these actions have been. Human intervention not only affects land exploitation but also *inter alia* the trace gases in the atmosphere that have an impact on climate. Research into global biogeochemical cycles of terrestrial systems – especially soils – is a central, relevant topic of national and international importance in which the GIUZ is decisively involved. The importance of the research becomes clear immediately when one recalls that the significance of terrestrial systems (and especially soil as a carbon sink) has probably been underestimated until now; and that the industrialized nations could partially achieve the goal of the Kyoto protocol (reduction of CO_2 emission into the atmosphere) by changing land use as well as reducing emissions.

5.3 Comprehension and surveillance of our planet

The past decade has been accompanied by an increased public awareness towards the earth, its natural environment, and the effects that human influence has on it. Global threats like climate change, the ozone hole, pollution of the troposphere and the earth's oceans, and very recently, an intensive El Niño, fires in Oceania and South East Asia, and floods in Central Europe have brought closer to the public the need for surveillance and comprehension of the processes in the natural environmental system. The mid and long-term inhabitability of our earth has become a central issue. The solutions to the problems of sustainability and human action have clearly become also a question of remote sensing, since the observation of the earth from space offers superb possibilities for the surveillance and comprehension of our planet. For this, fundamental research, as well as applied research, which encompass the implementation and routine application of algorithms and solutions, are required. We would like to continue to develop this area further: to connect theory and practice; to attempt to explain the processes that lead to the alteration of our earth; to look for solutions for the sustainable development of our earth together with the other divisions in geography as well as with neighbouring disciplines.

5.4 Globalization and the North-South partnership

Development-oriented research in geography now more than ever has the task of contributing towards the realization of sustainable development and thereby to develop special strategies for the elimination of spatial and societal disparities at the local, regional and global levels. More and more people are becoming connected through globalization processes; framework conditions for their actions and their consequences are thereby constantly changing (Backhaus 1999). For some, new opportunities emerge whilst for others increased limitations are posed. Research partnerships with so-called countries of the South is an important prerequisite for investigating these processes and for engaging in a constructive dialogue with political decision-makers, non-governmental organizations and development agencies (Geiser et al. 2001).

In the coming years, the main activities of the human geography division will concentrate on the transdisciplinary and interdisciplinary long-term research program «NCCR North-South». Its goal is to investigate the core problems of unsustainable development in developing and transition countries and to make a contribution towards the mitigation of the syndromes of global change, especially in those regions, which are cut off from the mainstream of economic development. The research groups of the GIUZ and their partners deal within this network with the topic «institutional change and livelihood strategies». On the one hand, local activities that decide on the methods and the sustainability of resource use are analyzed. Simultaneously, regional and international institutions, which are embedded in national economic and globalized processes exert their influence on the practices and strategies of the rural population and come across already existing and generally informal institutions. The interface between local strategies and institutional regulations (e.g. political interventions) has a key role.

5.5 Spatial planning and sustainable development

The approach represented by economic geography at the GIUZ can be portrayed as action-oriented and its scope includes the politics of spatial planning. Just as for spatial planning politics, which is the generic term used to cover spatial development and regional politics, a comprehensive understanding of development lies at the basis of this approach, which in the context of sustainability, goes beyond «mere» economic aspects.

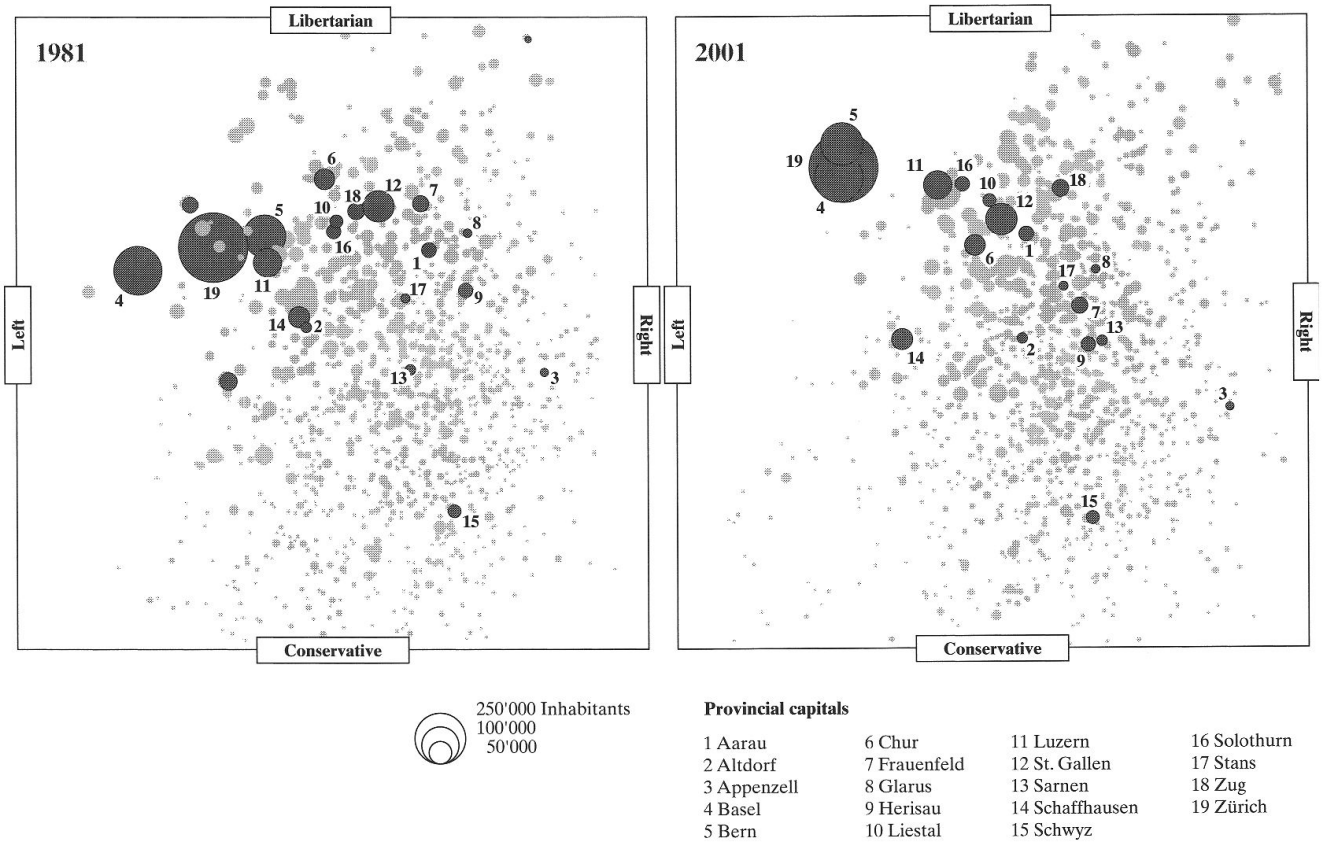

Figure 4: Growing ideological gap between core cities and their surrounding provincial areas
Wachsender weltanschaulicher Graben zwischen Kernstädten, ihrem Umland und der Provinz
Clivage géopolitique croissant entre les noyaux urbains, leur espace ambiant et la province
Draft: HERMANN & LEUTHOLD

The task of economic geography is to investigate both the intentional and the unintentional consequences of action of the players, who on the basis of their potential for action, significantly influence and determine habitat development today and in the future. It concentrates on spatial perspectives of economic actions and their consequences. Investigation does not mean that development and its problems merely be described, analyzed and predicted. Rather, it requires solutions and formulation of suggestions and also that the normative and political levels, i.e. realization, translation, are given the necessary attention. The broad economic geographic ways of looking at a problem necessitate thematic and regional concentrations in research. From a regional perspective, the main but not exclusive emphasis is placed on problems within Switzerland, naturally always taking global networks into consideration. Thematic emphases are tourism research, housing market research, gender research, research along the centre-periphery incline, from inner city development opportunities and problems between relations of the centers with their surrounding areas; it even includes questions of protection and development in peripheral regions. With regards to both research and teaching, transdisciplinary and the opportunities for interdisciplinary networks are consciously cultivated at the University of Zurich and beyond.

5.6 Regionalization and segregation in the «City of Switzerland»

Just as in many West European countries, the majority of the population lives predominantly in urban living contexts. The phenomena, which until a few years ago, were limited to core cities are now leaving their mark on the entire Swiss Midlands. Traditional spatial dichotomies, such as city and country or centre and periphery are in the process of dissolution and are being superceded by new principles of regionalization, which, for example, gentrification, marginalization, and provincialization, manifest themselves on different levels of scale (HERMANN & LEUTHOLD 2002b). This socio-geographic restructuring, with its conventional concepts of centrality and agglomeration, rest-

ing on disparities in infrastructure and function, can no longer be sufficiently portrayed. Rather, it is increasingly based on social connotations, diverging mentalities and milieus. These new phenomena are not limited to a small country like Switzerland. One can find similar processes in other European countries, within the EU and increasingly also in other cultural contexts, for example in Turkey or in the Far East. As a result of urbanization and the development of a multicultural society, society and the state are asking new questions (e.g. tax disparities, uneven distribution of burdens, the formation of ghettos, integration problems) and create areas of responsibility with largely regional components. Comprehension, description, analysis and quantification of large and small-scale regionalization and segregation processes and their consequences are a prerequisite for any suggestion for solutions and approaches. Domestic migration research and the investigation of persistence and change in political-moral milieus in Switzerland constitute a thematic emphasis at the GIUZ (Hermann & Leuthold 2001, 2002a) (Figure 4).

5.7 Informed and informative decision support in environmental research

Geographic information systems have managed to spread in the last few years as a means for decision support in all areas of the spatial sciences. Thereby, thanks to the availability of competitive, commercial software systems the transdisciplinary use is also guaranteed. The growing significance of GIS-supported procedures, coupled with a rising complexity of the problems investigated by environmental research, calls for an extension and improvement of the instruments available today as well as of the methods in which they are applied. For this reason, future research of the GIS division, in cooperation with other divisions at GIUZ will be devoted to selected and exemplary areas of environmental research, such as snow and ice, forest fire research, and wildlife biology, in an attempt to continuously improve the methodological preconditions for sound research with GIS. A first challenge is presented by the creation of the necessary instruments for a meaningful GIS-supported environmental research. An example of this would be the work over many levels of scale, which today is still very limited in GIS. The development of multi-scale databases (e.g. for forest fire research) is promoted, as is the procedure of automatic cartographic generalization. Today's GIS are also lacking in the way they handle the dimension of time. From a geographic perspective, especially the procedures for the integration of space-time analysis of observation data (e.g. patterns of movements in the observations of animals) would be interesting. A second challenge presents itself with regard to the use of GIS methods in application models.

A key element here is the modeling of uncertainties in GIS operations (e.g. the influence of uncertainties in terrain models on models of glacier development), which as of today have not been studied much and hence have received relatively little consideration by applied science. A further challenge (and opportunity) is presented by the use of new approaches of information technology, such as multi-agent systems, which allow a modeling that is centered on agency, or even location-based services that enable one to bring GIS from the workplace into the field.

6 Prospects for geography and habitats of the future

Globalization, accelerated change and habitat are topics of great, and without a doubt, increasing relevance. Of special interest are the agents, who decisively leave a mark on the habitat, as well as the field of tension between global and regional/local influences on the habitat. Last but not least, the opportunity to pursue relevant, creative and transdisciplinary research of a high caliber in flexible teams can and must be taken, and should be brought into the syllabus.

Geographic approaches for a «description of the changing Earth» are becoming increasingly more important the further the systems move away from the brief historic-empirical basis of knowledge, in other words the faster the societal and therein also the scientific certainties are changing. Thus, it can be seen from the activities of the Intergovernmental Panel on Climate Change (IPCC) and the numerical models of the climate system used, with all their scientific, technological and socio-economic political aspects, that traditional and new scientific disciplines have been involved for a long time. Geography has by no means lost itself; quite the contrary, remote sensing and geo-information science link technological research to cultural or demographic backgrounds of land use structures, to radiation and soil humidity, as well as to carbon cycles in climatic systems and their corresponding ramifications and consequences. Successful bridge building is now more important than ever and is built upon the comprehension promoted by geography for the variety of scientific languages and schools of thought involved. The Geography Department of the University of Zurich, with its internal and external networks, contributes to the foundations required to build those bridges.

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