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WATER AND WATER MANAGEMENT ISSUES
Report on the State of the Alps

ALPINE CONVENTION

Alpine Signals - Special Edition 2

SUMMARY

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Magnificent aquamarine waters of the Soča River source, Slovenia.
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The present report has been approved by the Xth Alpine Conference, held in Evian (France) 12 March 2009. It has been elaborated by the Permanent Secretariat of the Alpine Convention in conjunction with an ad-hoc expert group chaired jointly by Austria and Germany, in coordination with the French Presidency of the Alpine Conference.

Stakeholders from the science world and relevant NGOs have also contributed to the report.

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ABBREVIATIONS

AC	Alpine Convention
APAT	L'Agenzia per la protezione dell'ambiente e per i servizi tecnici (Agency for Environmental Protection and Technical Services) – Italy
ARPA	Agenzia regionale per la protezione ambientale (Regional agency for the protection of the Environment) - Italy
ATO	Ambito Territoriale Ottimale (Optimal territorial space)
CIPRA	International Commission for the Protection of the Alps
CIS	Common Implementation Strategy of the European Water Framework directive
DPSIR	Drivers-Pressures-State-Impact-Response (Framework)
EAF	Ecologically Acceptable Flow
EEA	European Environmental Agency
EPDRB	Environmental Program Danube River Basin
ESDS	European sustainable Development Strategy
ET	Evapotranspiration
FOEN	Federal Office for the Environment
GAR	Greater Alpine Region
GCMs	General Circulation Models
GCOS	Global Climate Observation System
HD	Habitats Directive
IRKA	Internationale Regierungskommission Alpenrhein (Alpine Rhine International Government Commission)
IRR	Internationale Rheinregulierung (Rhine international regulation)
ISCAR	International Scientific Committee on Research in the Alps
IWRM	Integrated Water Resources Management
MAP	Multiannual Work Programme of the Alpine Conference
NADUF	National (Swiss) River Monitoring and Survey Programme
NAQUA	National (Swiss) Groundwater Quality Monitoring Network - Switzerland
OcCC:	Organe consultatif sur les changements climatiques (Advisory Body on Climate Change) – Switzerland
OECD	Organisation for Economic Co-operation and Development
ÖPUL	Österreichisches Programm einer umweltgerechten Landwirtschaft (Austrian Agri-Environmental Programme)
PAI	Piani di Assetto idrogeologico (Hydro-geological Structure Plans)
PLANALP	Platform Natural Hazards of the Alpine Convention
PPP	Public Private Partnership
RBA	River Basin Agency
SOIA	System for Observation and Information on the Alps
UN-ECE	United Nations Economic Commission for Europe
UWWTP	Urban Waste Water Treatment Plants
WDMP	Water Development and Management Plan
WFD	Water Framework Directive
WGMS	World Glacier Monitoring Service
WLC	Water Local Committee
WRG	Wasserrechtsgesetz (Austrian Water Act)
WWTP	Waste Water Treatment Plants

PREFACE

Integrated water management is one of the main issues for the sustainable development of the Alpine Region. Furthermore, surrounding areas also depend on the water from the Alpine Region for their development. Conflicts of interests therefore arise in relation to the use of water in the Alps. A sophisticated system of water management has been developed over many hundreds of years but this now faces new challenges due to both the increasing use of water and to climate change. The current system of water management therefore needs to be duly adjusted to prevailing conditions on an ongoing basis.

Water is inherently a crucial topic for the Alpine Convention, with the main objective of preserving or re-establishing healthy water systems, in particular by keeping lakes and rivers free of pollution, by applying natural hydraulic engineering techniques and by using water power, which serves the interests of both the indigenous population and the environment alike.

This second report on the State of the Alps has therefore been produced to promote discussion of "Water and Water Management Issues". It describes the integral understanding of "water management", the state of waters in the Alpine space, the relevance of the Alpine space for water supply to surrounding areas, as well as challenges for future water management issues. Important examples include the design of new installations as well as the upgrade of existing ones for the production, transport and distribution of hydroelectricity in order to make optimal overall use of the existing infrastructure system in the Alpine region, taking into account the need for environmental protection. It is also important to develop strategies on how to deal with water scarcity and droughts in the different regions of the Alps.

This new report is the only existing overview document which includes such a rich background of information on the state of waters in the Alpine space.

The full report is available in English on the website of the Alpine Convention (www.alpconv.org) and the summaries in 5 languages (it, fr, de, sl, en) are available in paper version and on the website. The report is published in a special edition series of the "Alpine Signals" and represents a crucial component of the System for the Observation and Information on the Alps (SOIA).

The Permanent Secretariat of the Alpine Convention wishes to thank all the experts and representatives of the Contracting Parties for their valuable contributions. Special thanks go to the Presidency and the members of the ad-hoc expert group, who also hosted the meetings at which this report was discussed and drafted.

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A INTRODUCTION

The Alpine Convention and Water Policy

The Alpine Convention is a multilateral framework treaty signed in 1991 by the eight states of the Alpine arc as well as the European Community. Its main objectives are the sustainable development of the Alpine territory and the safeguarding of the interests of the people living within it, embracing the environmental, social and economic dimensions in the broadest sense. In order to achieve its objectives, the Framework Convention has, over the years, been equipped with a large number of thematic protocols.

Water is listed among the 12 themes in relation to which the Contracting Parties are supposed to take measures and coordinate their policies (Article 2 of the Framework Convention). The Alpine Convention aims inter alia to preserve or re-establish healthy water systems, in particular by keeping lakes and rivers free of pollution and by applying natural hydraulic engineering techniques. This needs to be accomplished by balancing the local population's interests with environmental needs. Water is considered as a crucial element for different uses as hydroelectricity production, irrigation or drinking water as well as in biotopes, especially forests, environmental diversity and in natural and cultural landscape features. On this ground, aspects of water protection are to be found in the Protocols on Energy, Conservation of nature and landscape protection, Soil conservation, Tourism, Spatial Planning and Sustainable Development, Mountain farming, Mountain Forests and Transport. A specific protocol on water is not in place yet.

Moreover, since the time of signature of the Convention in 1991, further relevant issues have appeared, such as changes in water availability and natural hazards, particularly in relation to climate change, growing demand for water and conflicting uses and spatial development related requirements. Additionally to the changes in natural framework, the legal framework and paradigm of water management also changed. Today, water management has to be done on the level of river basins.

The discussions on the need for a separate protocol on water have been quite controversial, in particular on the occasions of meetings of the Permanent Committee of the Alpine Convention held in the years 2003 and 2004. The Permanent Committee explored in these two meetings the possibility of having a water Protocol based on a draft of the International Commission on the protection of the Alps (CIPRA International). Although the view was raised that important topics related to water in the Alps are covered by existing regulations, especially those stemming from the EU Water Framework Directive (WFD) and its daughter directives, the importance of a specific Alpine water dimension was also acknowledged. It was therefore decided to include water as a topic for the Multiannual Working Program of the Alpine Conference (MAP) for the years 2005-2010 of the Alpine Conference.

In the Multi-Annual Work Program of the Alpine Conference (MAP), water resources are mentioned as one of the most important priority topics. The state of water and waters in the Alps is observed within the system for the observation and information on the Alps (SOIA), which is, in the MAP, one of six priorities for its joint work. SOIA aims at contributing to Alpine policy development by providing data and information. Indicators have been set up to monitor the fulfilment of the objectives set out in the Alpine Convention and its protocols – also for water. The Reports on the state of the Alps - a crucial tool for observation and information on the state of the Alps - are published regularly by the Alpine Convention. After the first Report, focusing on Transport and Mobility in the Alps, the Alpine Conference of Alpbach in November 2006 chose water as the topic for the second report on the State of the Alps.

Procedurally, it was decided that the Permanent Secretariat should submit this report to the Alpine Conference in coordination with the presidency of the Alpine Conference, accompanied by an ad-hoc expert group under Austrian-German Presidency, the Focal Points of the Contracting Parties for consultation purposes on the one hand, and the most important stakeholders of science, observers and interested NGOs on the other. The basis for this report have been case studies, highlighting specific aspects, and national contributions on already available information submitted by the members of the Expert Group and Focal Points. As regards to its content, the report focuses on the major water management issues. By analysing the existing legislative instruments in the water sector, it sets the basis for recommendations on the necessary measures in order to address these issues.

Furthermore, the Alpine Conference highlighted the need to continue the dialogue started at the conference "The Water Balance of the Alps" held in Innsbruck in 2006, in particular by means of a second conference in Munich in 2008 involving all the relevant stakeholders. This second conference took place on 30th and 31st October 2008. Three weeks prior to this conference, the draft Report on the State of the Alps 'Water" was put on the web to allow for a sound discussion at the con-

ference. The findings of the draft report were in general well received and supported. Proposals for some issues to be additionally addressed were taken into account as forwarded by several organisations including "CIPRA International", the "Swiss Centre for Mountain Regions", "ISCAR", "WWF Italy", "Deutscher Alpenverein" and the "Verein zum Schutz der Bergwelt".

The only issue of major disagreement was the potential added value of a water Protocol. Experts from the water administrations of all Alpine countries and the European Commission unanimously held the position that due to the broad range of existing regulations in place, there would be no added value of a new legal instrument; CIPRA International strongly disagreed. Against this background, the proposal to set up a platform for water management in the frame of the Alpine Convention was strongly supported. Abstracts presentations and findings of the conference were published by the conference organisers.

Key Issues of the Report on the State of the Alps "Water"

The main contents and findings of the Report on the State of the Alps "Water and water management issues" are summed up in this short version. More details as well as the comprehensive contributions of Alpine countries providing data and an overview on important issues, next to case studies highlighting specific challenges but also solutions, are part of the full version, which is in English on the website of the Alpine Convention (www.alpconv.org).

The general description of water management and description of the Alpine water resources including the driving forces for water management are elaborated. The Report on the State of the Alps "Water and water management issues" compiles and presents harmonized data on the state of waters in the Alps, quality of waters, quantitative aspect of waters, hydro morphology of surface waters, and social and economic aspects of Alpine water, protection against natural hazards, water under climate change and it also provides an overview on regulations concerning waters in the member countries of the Alpine Convention. The identification of major water management issues and main challenges of water management are the outcomes of the Report.

On this basis, the Parties of the Alpine Convention dispose of a structure for reflecting upon further development of specific requirements on sustainable water management in the Alps in order to reach the aims indicated in the framework Convention, the Protocols and the Multiannual Working Programme of the Alpine Conference.

B STATUS OF WATERS IN THE ALPS

B.1 GENERAL DESCRIPTION

B.1.1 WATER MANAGEMENT – AN INTEGRATED APPROACH

The term water management has often been understood to mean only one aspect: the economic use of water. However, the approach of pursuing particular interests independently of other objectives is now history because the more demands are made upon water, the more potential conflicts of interest arise.

Planning of measures must therefore not only take into account the interests of different parties and sectors, but also the fact that the effects of interventions are not only local but also affect conditions further downstream.
This also includes interactions between surface waters and groundwater.
Integrated Water Resources Management (IWRM) therefore concerns not only the immediate environs of the intervention on the watercourse but the whole river catchment area. IWRM means integration of different objectives, time and space.

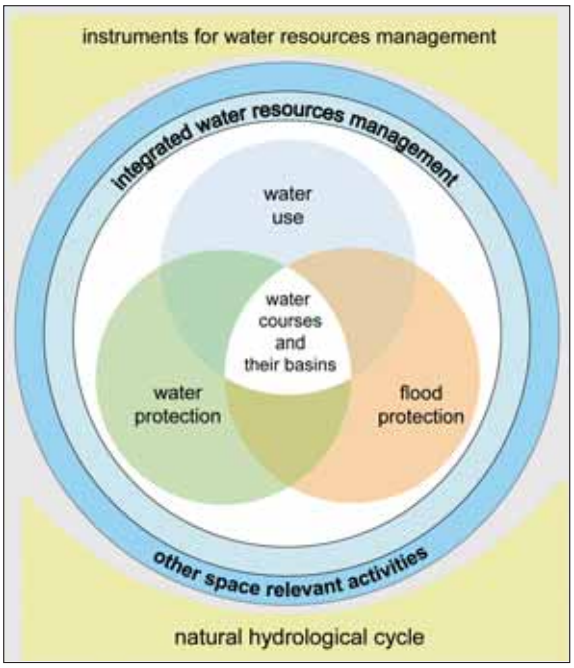

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Fig. B1-1: Water resources management covers all human activities relating to the use of water, protection of water and protection against the hazards of water. Integrated water resources management attempts to take into account and to harmonise these three main objectives.

B.1.2 DESCRIPTION OF ALPINE WATER RESOURCES

Alpine water resources appear in many different forms within the water cycle - rivers, lakes, wetlands, groundwater bodies, glaciers and precipitation. Glaciers, soil as well as artificial and natural lakes are important elements for the storage of water. The discharge of rivers depends on the kind and quantity of precipitation, climatic conditions, season, land cover and from the basic geological situation. Maps 1 to 4 provide an overview on the climatic conditions (topography, rivers, precipitation and temperature) in the Alpine space.

The influence of precipitations on the water cycle and phenomenon such as erosion depend primarily on the land cover. In this respect, forests influence intensively the runoff and retention of water. Additionally, lakes in the Alpine Space, and especially the ones located on the Alps borders, are able, up to a certain extent, to balance the outflow and they are equally important for the retention of sediments. In the Alps, rivers and lakes are highly interlinked and they all flow into the five main Alpine river basins: Rhine, Rhone, Po, Danube and Adige.

The glaciers play an important role for the river runoff mainly during springtime and summertime. Due to climate change, their interaction with the river water regime will be significantly altered in the coming years.

Snow fall is also to be generally considered as a significant parameter for the Alpine water cycle, for water availability and for the distribution of water resources. Snow reacts immediately to temperature and precipitation. Hence parameters like snow cover duration and snow depth in different altitude zones are good indicators for climatic changes.
The Greater Alpine Region may be divided into four climatic sub-regions since hydrological and meteorological conditions differ significantly in the different parts of the Alps. Most climatic elements can be subdivided into these four regions of approximately similar size.

The Central Alpine chain, from the La Grave-Les Ecrins group in the west to the Hohe Tauern group in the east, is the most clearly distinguishable climate border existing in the Greater Alpine Region. A second continental scale climate border could be anticipated between (western) oceanic influences of the Atlantic and (eastern) continental feature of the Eurasian continent.

In the future, the climatic features of these four subregions are likely destined to become even more distinct under climate change.

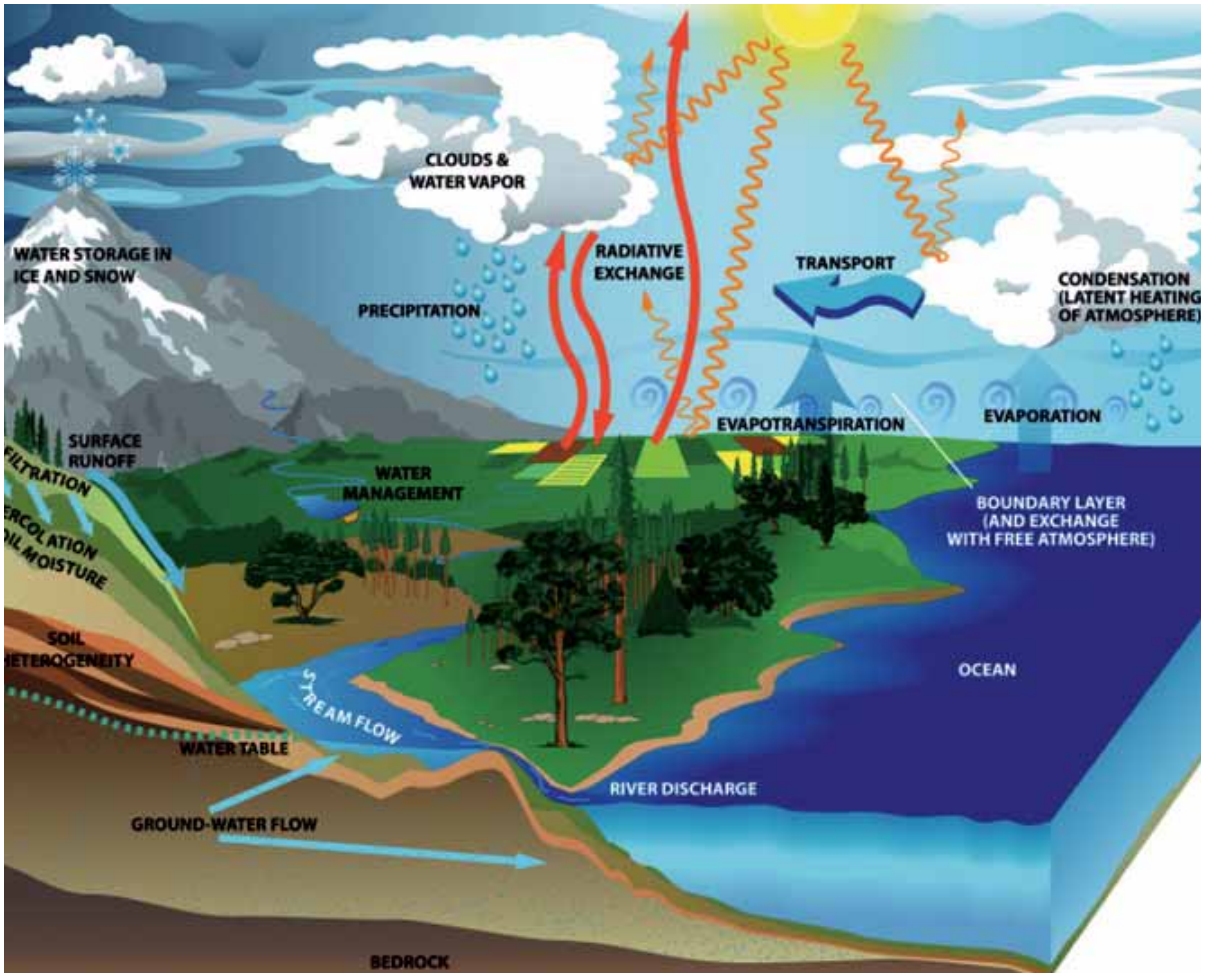


Fig. B1-2: The water cycle
Source: http://www.usgcrp.gov/usgcrp/default.php

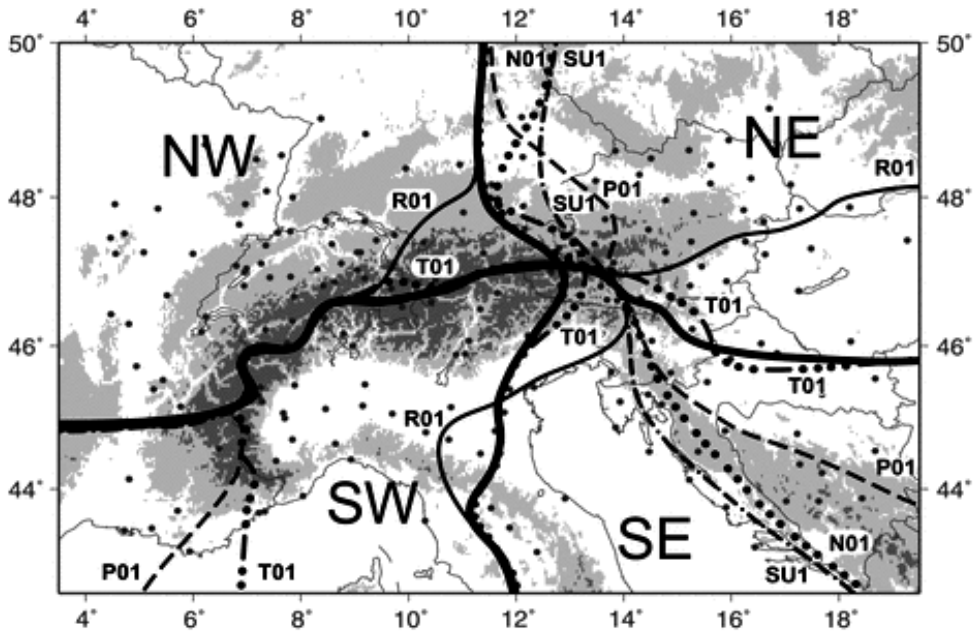
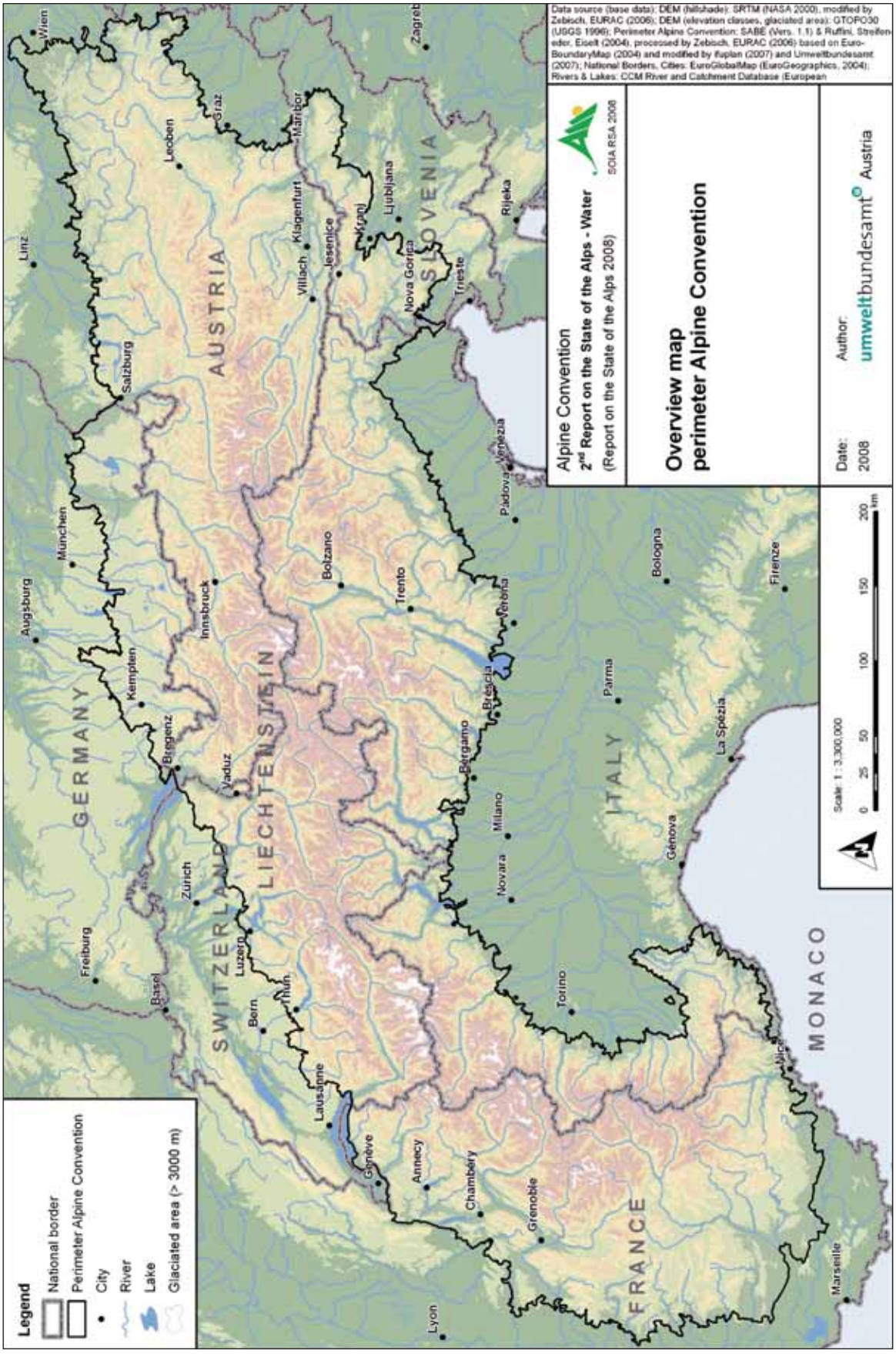
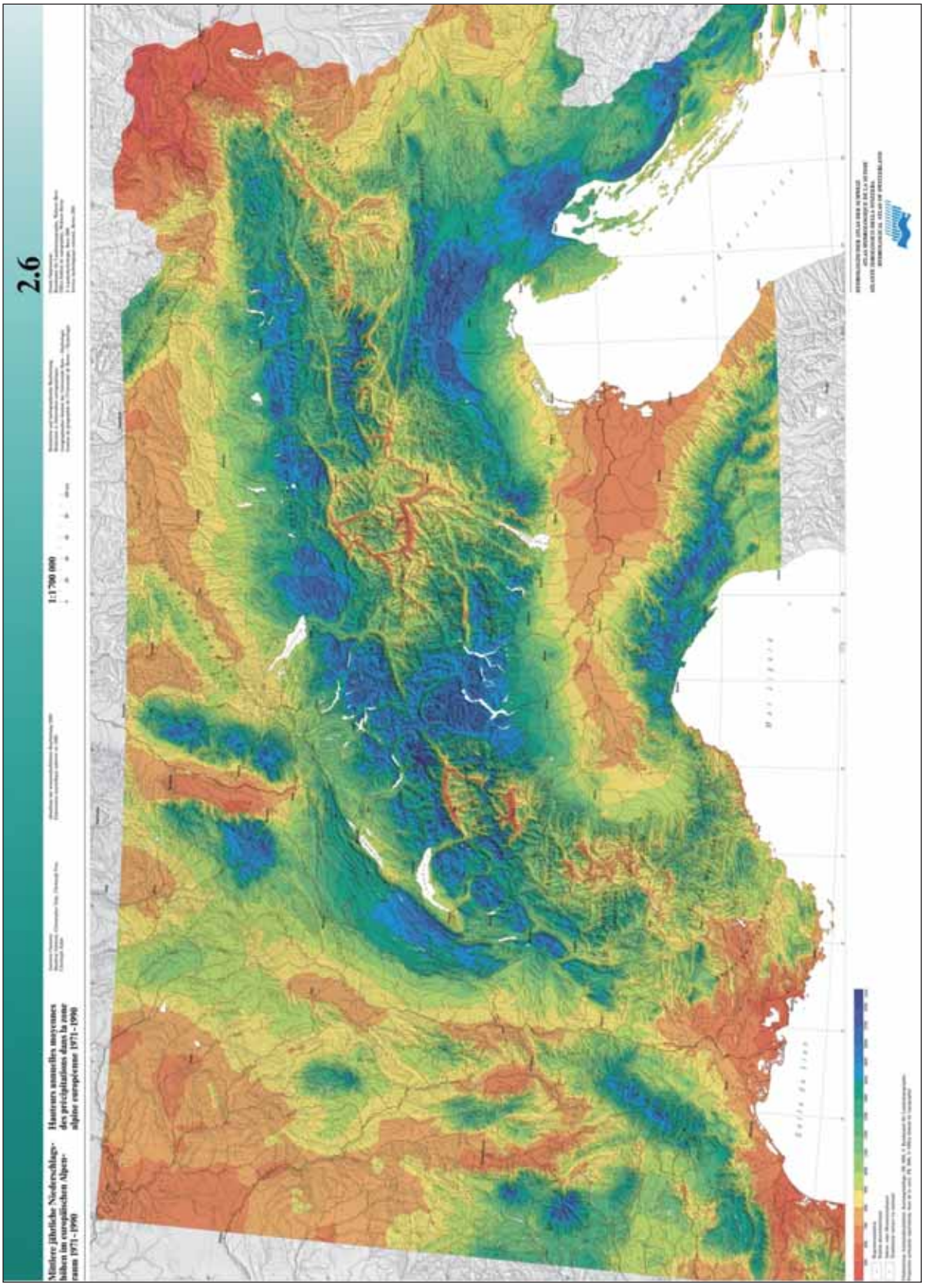


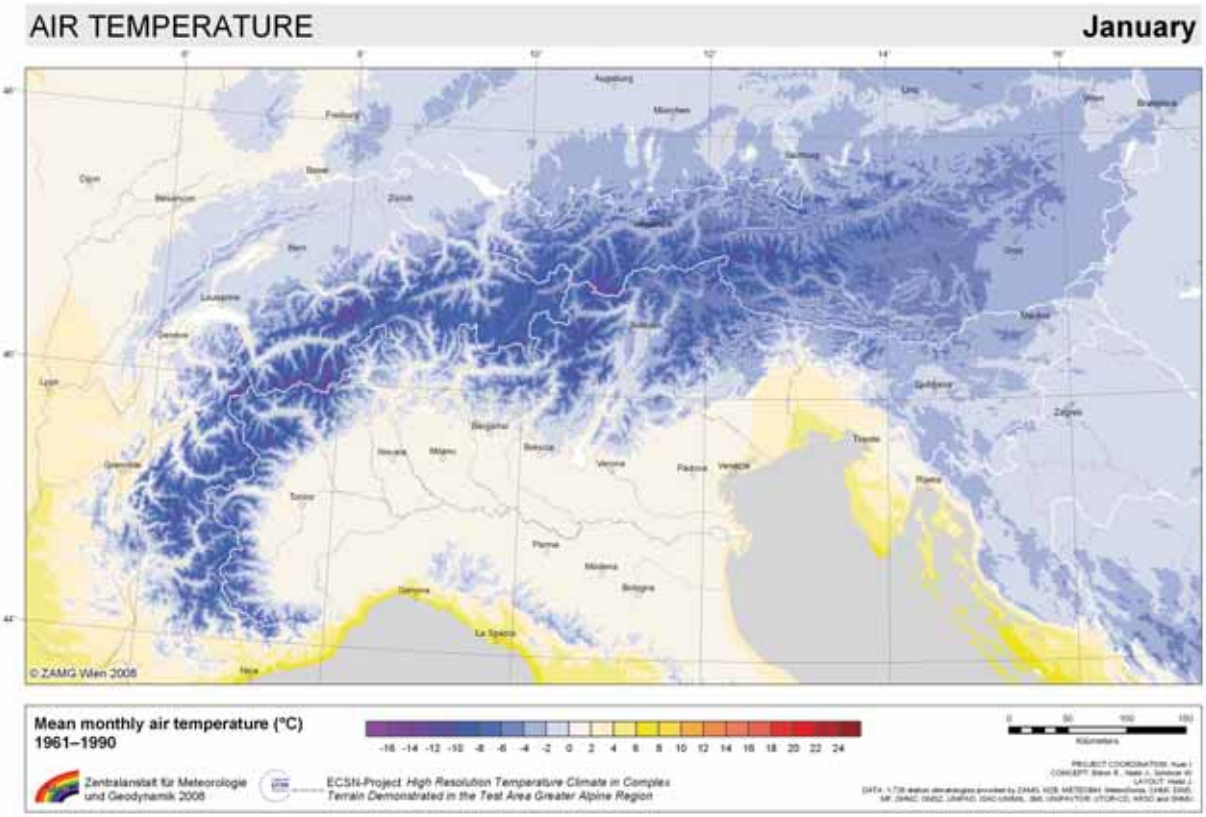
Fig B1-3: The four climatic sub-regions in the Alpine space
Source: Database HISTALP

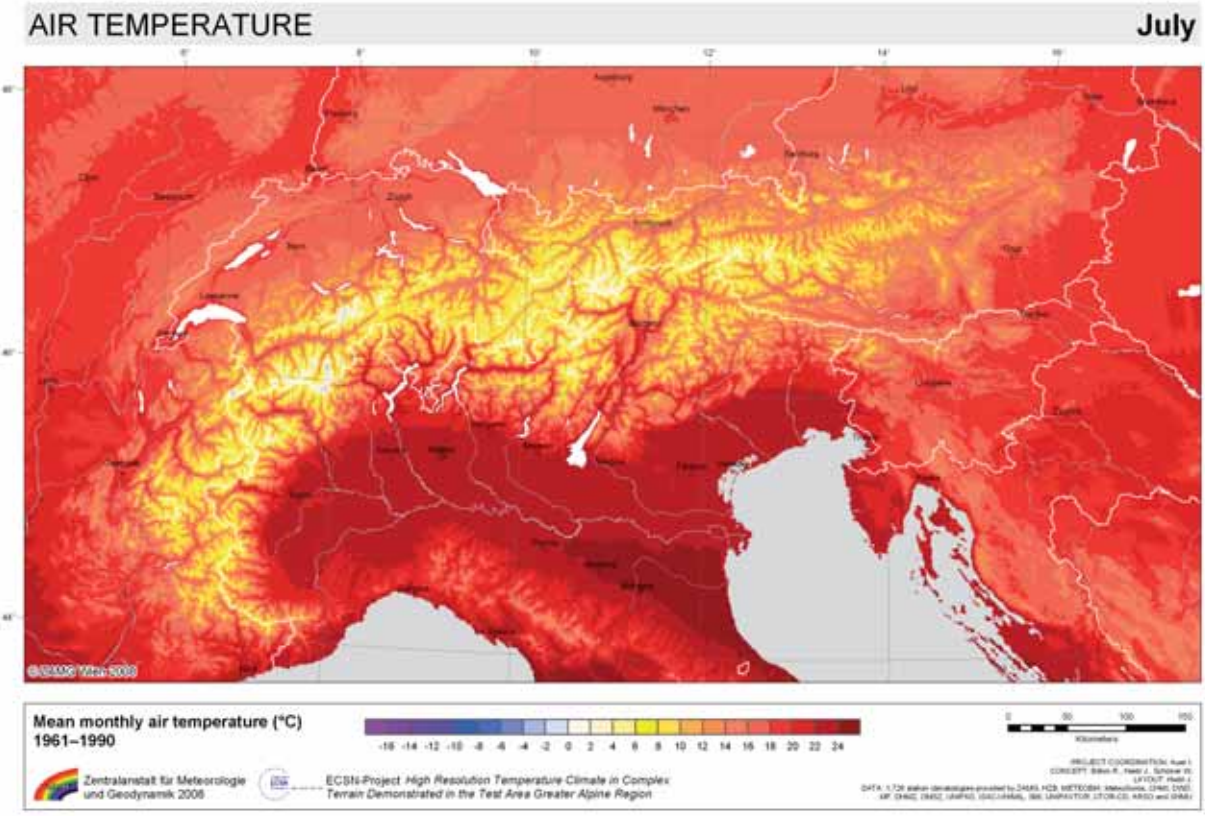


Map 1: Overview Alpine Perimeter

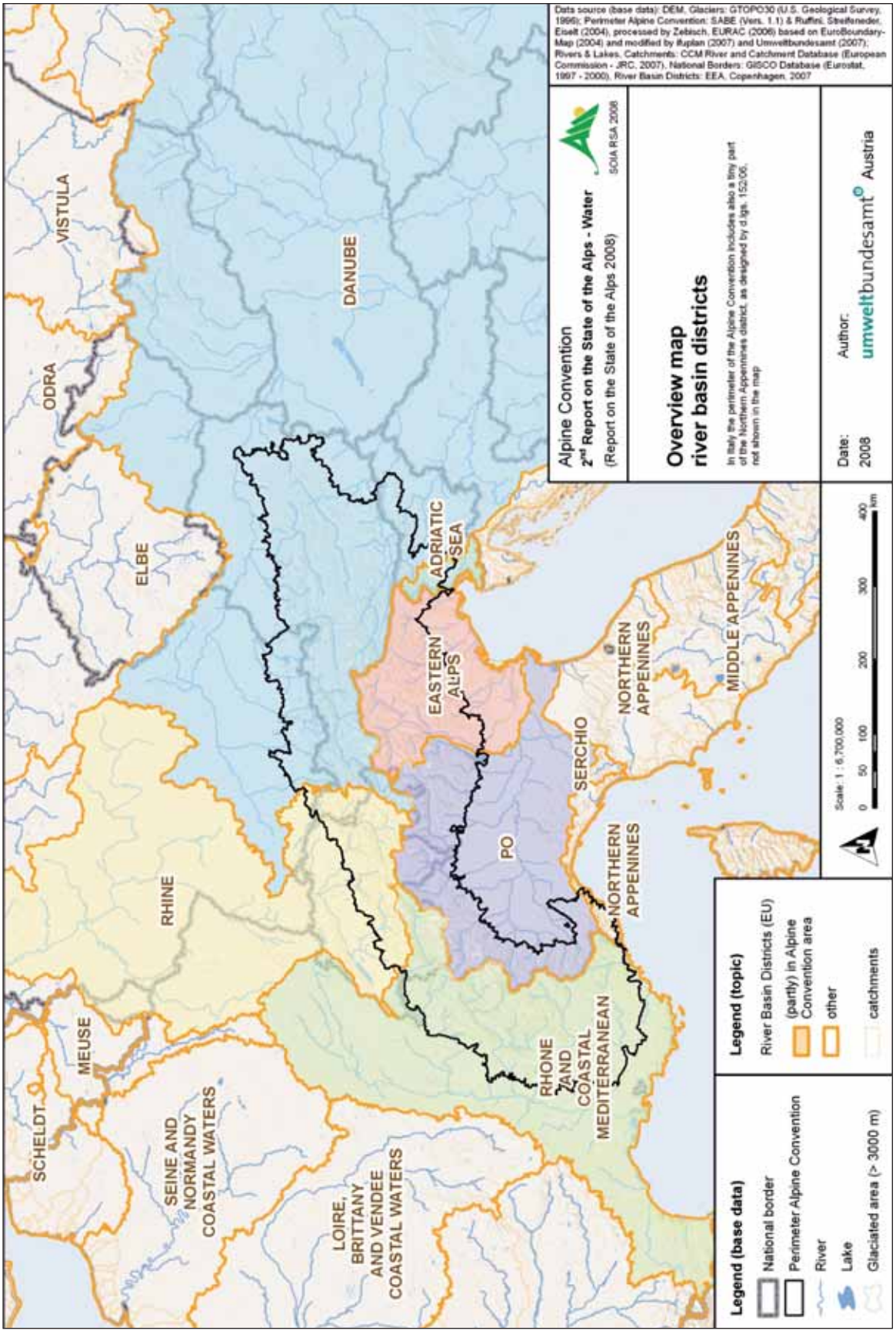


Map 2: Precipitation





Map 3: Average Air Temperature in January
Map 4: Average Air Temperature in July



Map 5: Overview Map River Basin Districts

B.1.3 THE ALPS – 'WATER TOWER OF EUROPE'

The Alps are widely known as the "water tower" of Europe because the hydrological regime of the Alps has a crucial influence on the European water balance, especially because the Alps are located in the centre of Europe (see therefore also map 5 with an overview on the river basin districts).

Although the area in Europe covered by the Alps is comparably small, it supplies a disproportionate amount of water to the outer-Alpine regions. This abundance of water is due to several factors, including the uplift and subsequent cooling of air that turns into rain, the low rate of net radiation, lower temperatures, frequent snow cover and shorter vegetation period which, altogether, result in lower evaporation and higher annual runoff. Especially in spring and summer, the lowlands of the Danube, Rhine, Rhone and Po profit from the Alpine runoff.

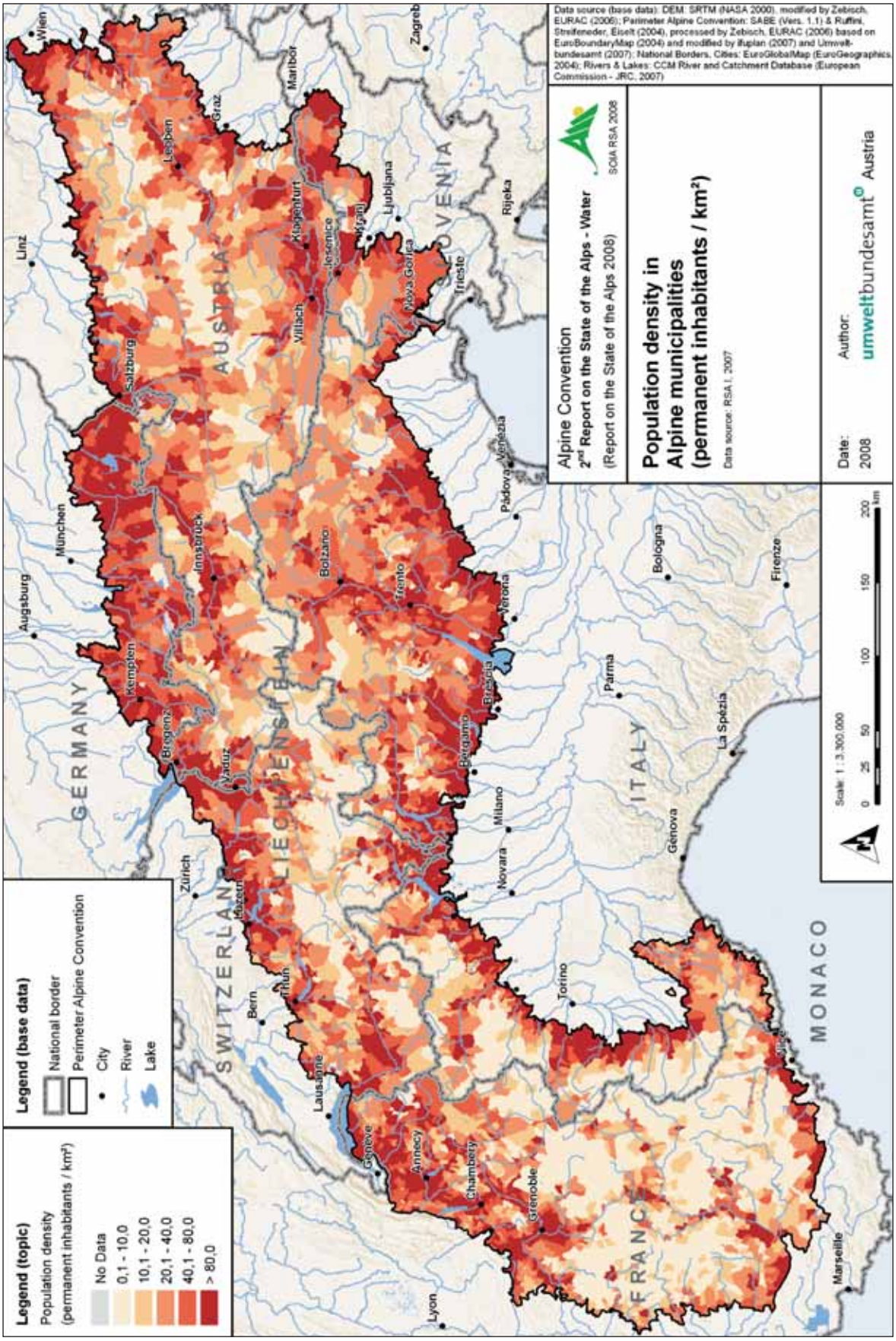
Hence, the Alps supply a disproportionate amount of water from 35% (Danube) up to 80% in peak times (Po) of the overall discharge in the different catchments. The significant contribution of the Alps to the total discharge of the main Alpine river basins always needs to be taken into consideration when dealing with water management issues. Therefore, the Alps also play a specific role in times of water scarcity. Due to climate change, the flow regime of catchments might change to a constantly reduced water level in summer, which has an impact on water quantity as well as on surface water temperatures. As a consequence, it is likely that the need for water, in particular for agricultural purposes and for electricity production, will come into increased competition with the needs of river ecosystems.

B.1.4 DRIVING FORCES FOR ALPINE WATER MANAGEMENT

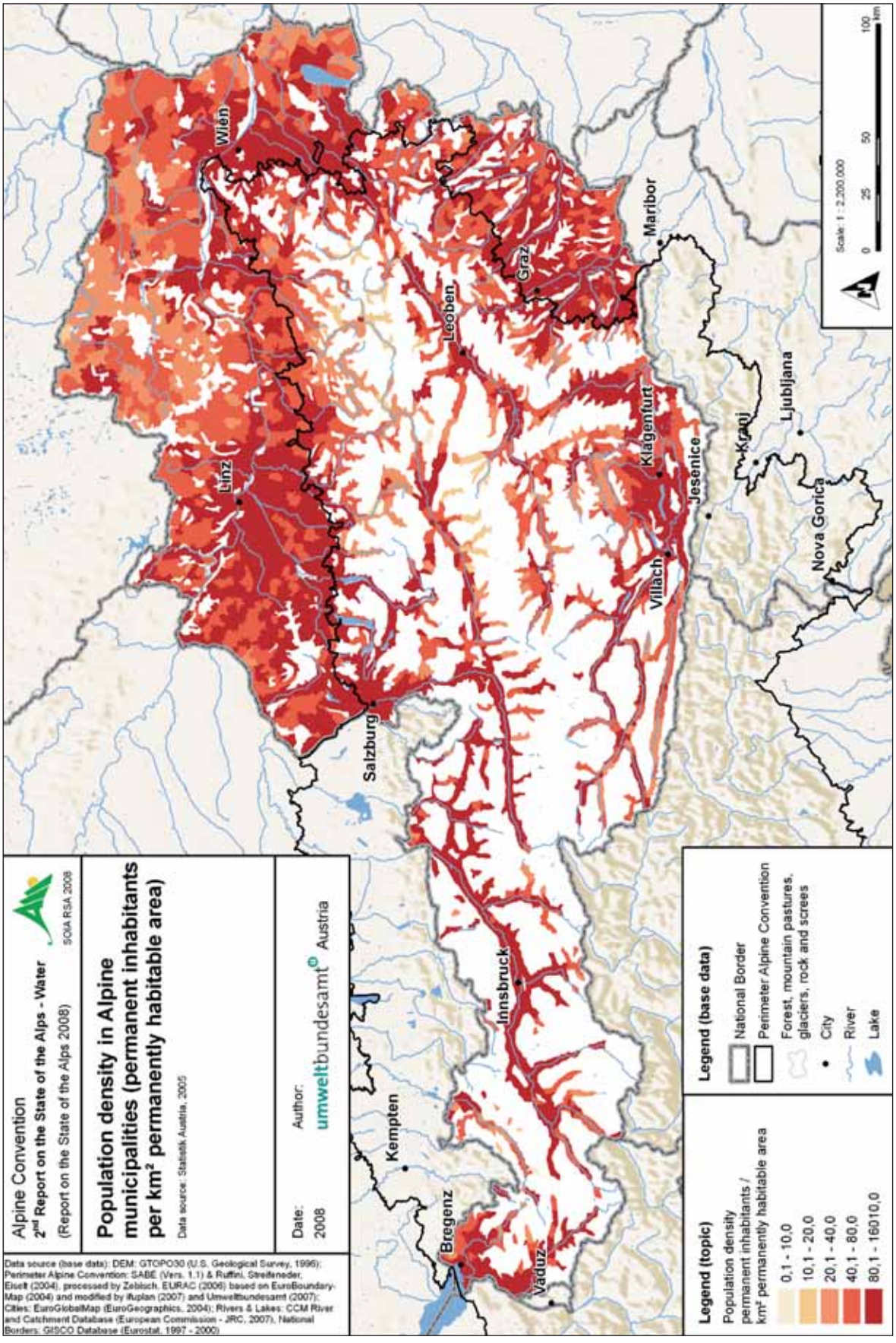
Anthropogenic socio-economic activities causing pressures on the environment are often referred to as "Driving Forces", having a fundamental impact on water management. One of the main objectives of a modern water policy is to ensure sustainable development through consideration of a variety of factors influencing the status of water resources.
Next to human needs and related activities, the spatial framework for these activities is of major importance as well. Due to the special character of the mountainous area with its steep landscape, only a small share of the region is suitable for year-round settlement, concentrating at the bottom of valleys. This fact is amplifying human impacts on Alpine waters in a variety of aspects, which are very characteristic for this European region in many ways. The main driving forces which have been identified will now be briefly addressed.

Population and settlements

The present delimitation of the Alpine Convention area comprises about 190.000 km^2. In 2004, around 14 million people were living in this area. During the 1990s, the population increased in the Alpine Convention area by 7.8%. Map 6 gives an overview on population densities on the basis of Alpine municipalities.
However, topography plays a key role in analysing population density patterns in mountainous regions and in order to understand the influence on Alpine waters. Many parts of the Alps must be considered as unsuitable for human settlements. To give a more realistic picture of the population density, the area of permanent settlement, located at the bottom of valleys, has to be taken into account. Map 7 demonstrates very high population densities in the Austrian part of the Alpine area, concentrated in valleys – a fact due to the lack of suitable space for settlements, industry and infrastructure.
The effect was that Alpine river systems, once naturally braided, were regulated to protect human settlements and infrastructure from flooding, which resulted in an increase of space suitable for settlements on the one hand, but in a loss of ecological diversity on the other. This progressive substitution, which took place over the centuries, is one of the main reasons for the significant changes in the characteristics of Alpine rivers today.



Map 6: Population density in Alpine municipalities



Map 7: Population density in Austria

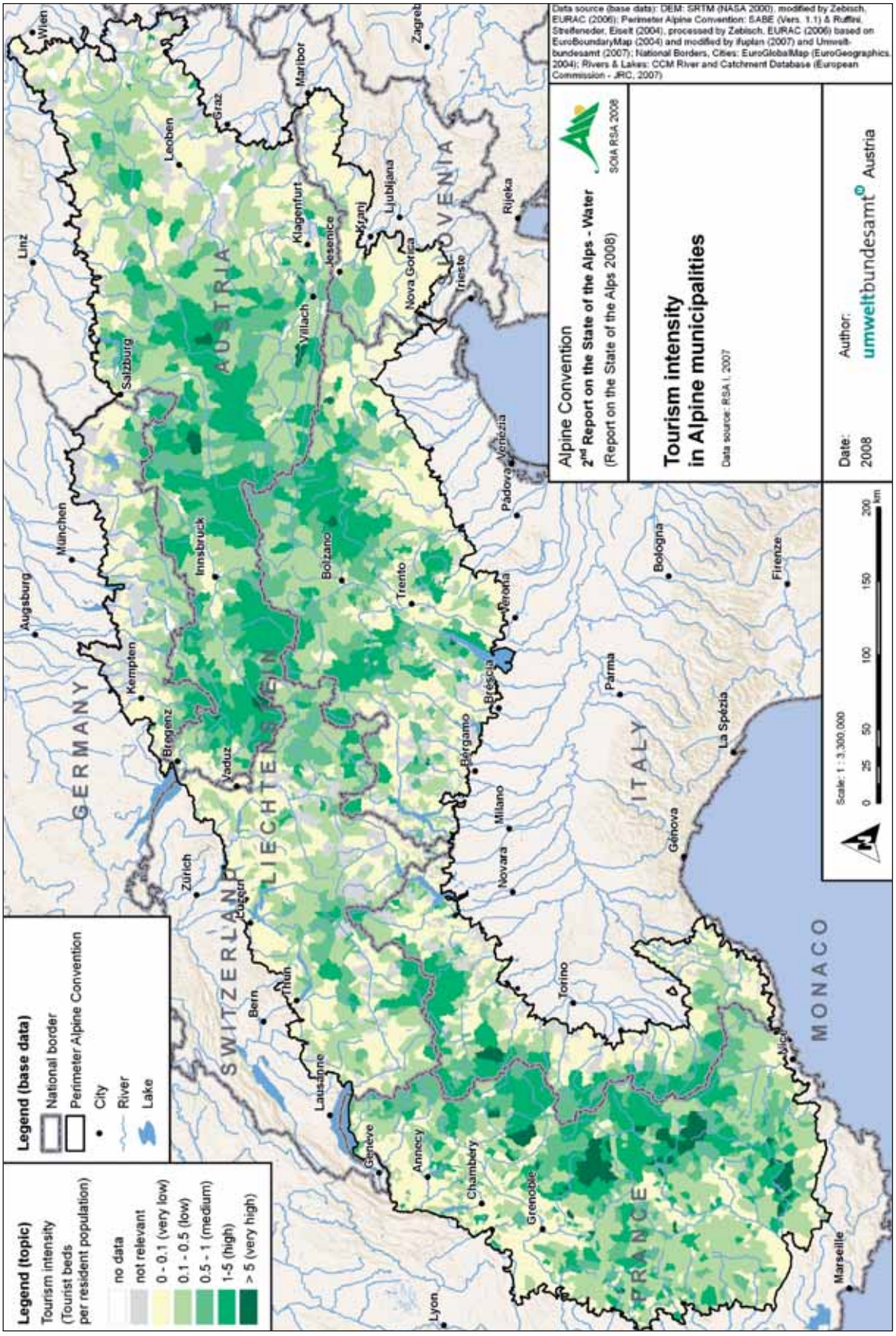
Land use and agriculture

Rough climatic conditions and steep slopes are characteristic of the Alpine area. Hence, suitable areas for agricultural activities are again mainly located at the bottom of valleys, causing pressures on Alpine river systems. Flood protection schemes in combination with drainage were the technical approaches in order to expand limited areas for agricultural activities. Wetlands and related space for rivers were claimed mainly from the 19th century till the second half of the 20th century for the conversion into suitable areas for agriculture in order to secure food supply for the resident population.

However, although agricultural activities certainly have a significant impact on rivers through the conversion of land use, the effects as a driver on the chemical quality of water are rather limited due to the limited application of fertilizers and pesticides. Regarding the quantity of water, irrigation is not frequently exercised in some parts of the Alps because of the high precipitations. Nevertheless, although irrigation is not a major driver, it can become, in some cases, increasingly significant locally, in particular where intensive agriculture is in place, causing pressures on the availability of water for other users or for the environment.

© Urša Gale
Photo B1-1: Space for settlements and infrastructure is concentrated at the bottom of Alpine valleys. (Motorway between Munich and Ljubljana, regional and local roads and the reservoir of the Moste hydropower station). Slovenian Alps, Lipce, Karawanken.

© Kdo Luftaufklärung / BMLV
Photo B1-2: Intensive agriculture by the Drava river, Austria.



Map 8: Tourism intensity in Alpine municipalities

Tourism

The Alps are - because of the attractiveness of their landscape - a popular destination for countless tourists. Tourism can be considered as a key economic factor for many Alpine areas. Map 8 provides an overview on tourism intensities within the Alps.

Tourism has an impact on water management as a driver in several ways. One related aspect is that the total demand for freshwater is increasing on the one hand, causing a rise of wastewater which affects the quality of Alpine river systems on the other. Related seasonal shifts in population densities are causing a particular challenge for the effectiveness of wastewater treatment plants. Furthermore, since tourism infrastructure (hotels, parking lots and commercial facilities) are in need of protection from natural disasters, flood protection works to protect tourist infrastructures are equally contributing to impacting the hydro-morphological situation of Alpine rivers.
One additional aspect is artificial snowmaking, which was increasingly extended in recent years. Since tourist surveys indicated that reliable snow conditions are paramount in the choice of a holiday destination, the number of technical equipments raised steadily, leading to increased abstractions and retention of water from rivers in the Alpine area next to an increase in energy demand. Due to climate change, further pressures on Alpine water resources due to winter tourism are foreseeable.

Energy demand

Since natural resources like fossil oil or coal are scarce in the Alpine space, the use of the energetic potential of water has been of vital interest for the population in meeting the energy needs. Apart from run-of-river power stations which cover a share of the base load for electricity demand, Alpine pump-storage facilities are flexible enough to provide electricity in peak-times.

The long-term use of the energetic potential of water caused considerable impacts and changes on the natural environment, such as the loss of natural habitats, the interruption of river continuity or the reduction of river run-off. Since a bulk of river stretches, economically worthy to be used for hydro power generation, was already developed in the last decades, the remaining stretches, which are still mostly in natural condition, are rising in value since they became more and more unique in the Alpine space. Current developments on the energy market, with increasing prices next to growing demand for electricity, further increase the pressure to build new facilities. Moreover, in the context of climate change, the actual strategies of increasing the share of renewable energy such as hydropower are giving further substance for the debate.

Photo B1-3: Energy demand: small hydropower station built during Napoleonic wars as dam for flushing timber and recently refurbished as small hydropower station. Kanomeljske klavže dam near Idrija, Slovenia.legame.

Environmental protection and nature conservation

Environmental protection and nature conservation increasingly became a driving force for water management since the sensitisation and the awakening of the public interest for environmental issues. This development found its way through the active civil society, public institutions and the political process, and materialised in laws which aim at the sustainable use of the environment or the conservation of nature, including water.

This process widened in the last quarter of the 20th century, with a number of new environmental legislations and policies coming into force within the European Union but also in Switzerland. Map 9 provides an overview on the share of protected areas (Nature 2000-sites and the Swiss "Bundesinventar der Landschaften und Naturdenkmäler von nationaler Bedeutung) in the Alpine space.

Downstream needs

Alpine water represents a major contribution to the whole water balance of related river basins like the Danube, Rhine or Po. Downstream necessities are therefore a key driving force for the management of Alpine water.

Downstream needs are related to the economic sectors which use and depend on water, such as agriculture, tourism, industry, energy and transport but also to the environment and necessity to maintain biodiversity, water quality, diminishing risks of forest fires and soil impoverishment. Coordinated management of Alpine lakes and artificial reservoirs can help mitigate problems with regard to water availability of downstream regions. An integrated and sound management of the water balance, including water stored in the Alps, is the only effective way to prevent and mitigate water shortage impacts.

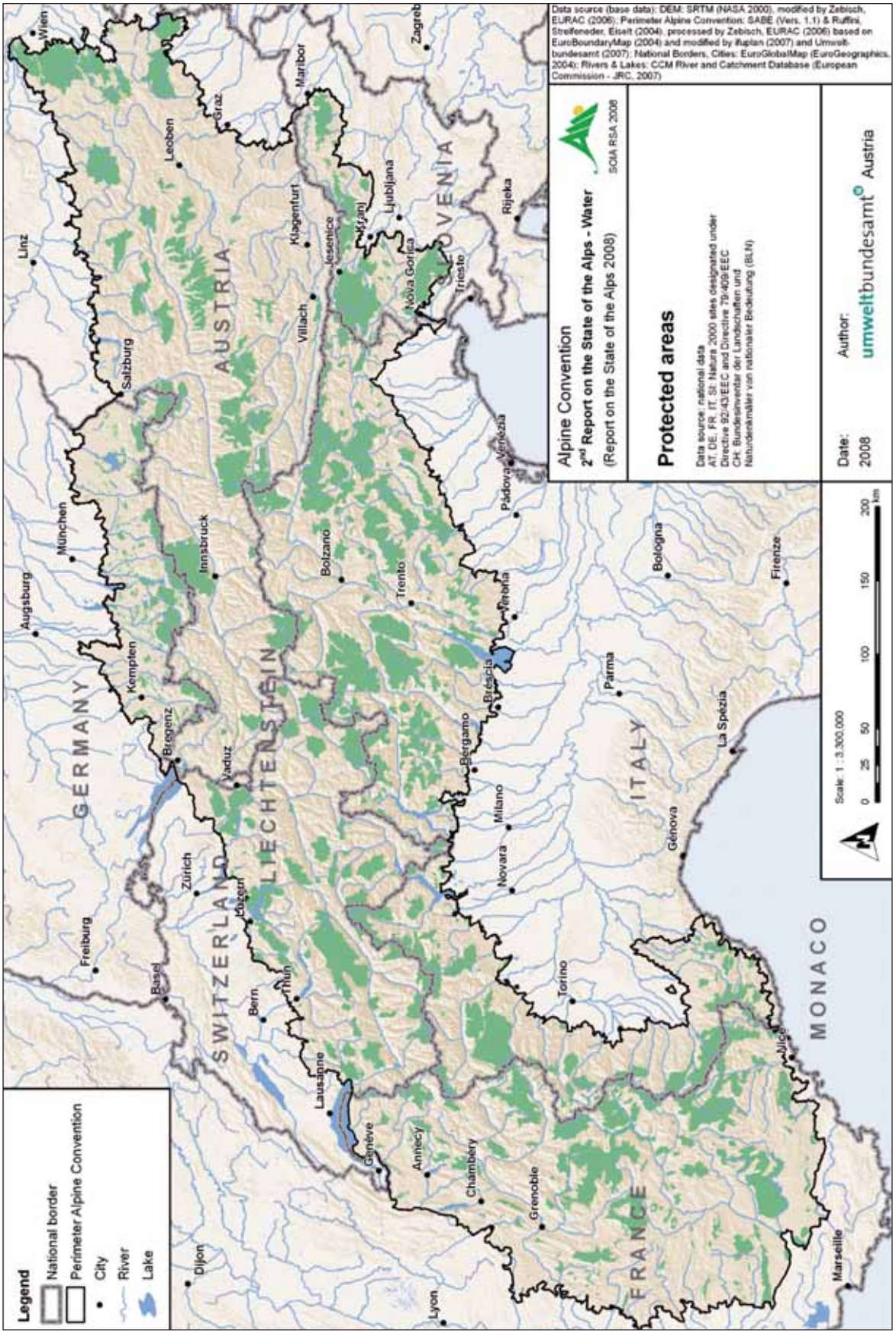
Climate Change

Since the public discussions on climate change crossed a point where it is generally agreed on and accepted that we will very likely have to expect man made drastic and comparably rapid changes in the upcoming decades, the focus shifted towards estimations of the related impacts on our living environment, including water.

Climate change will bring new challenges for water management, not only in Alpine countries but also in the rest of the world. Mitigation measures but also the ability to adapt to the foreseen changes will be necessary in order to avoid negative impacts on human living conditions and our environment.

A combination of technical solutions, farsighted planning and water management, which has to be understood in an as broad form as possible, are key for counteracting against climate change as a driver, which certainly increases the pressures and challenges for Alpine water management.

© A. Bianchini
Photo B1-4: Up- and downstream, Mt Paganella with Lakes Garda and Cavedine in the background.



Map 9: Protected areas

B.2 PRESSURES AND IMPACTS

B.2.1 MONITORING PROGRAMMES

Substantial efforts have been made within the states of the Alpine Convention in order to record the status of Alpine waters. Biological quality elements, hydro-morphological quality elements, general physical-chemical quality elements and other pollutants, such as the ones on the priority substances list (Directive 2008/105/EC) for instance, but also water quantity of surface waters are monitored periodically and strategically aligned with possible pressures occurring within the catchments of Alpine river systems.

As maps 10 to 13 indicate, an adequate coverage of monitoring sites for administrative means is in place. Since monitoring networks had to be established accordingly to the provisions of the EU Water Framework Directive at the latest by the end of 2006, the collection of additional data on biological and hydro-morphological quality elements is currently under way.

A revision of the monitoring network takes place following a six-year cycle – which corresponds to the period during which the river basin management plans apply to EU countries.

© BMLFUW

Photo B2-1: The existence of stone flies is a typical indicator for high water quality. In their larva life-cycle, their habitat is the interstitial space of gravel in the river bed.

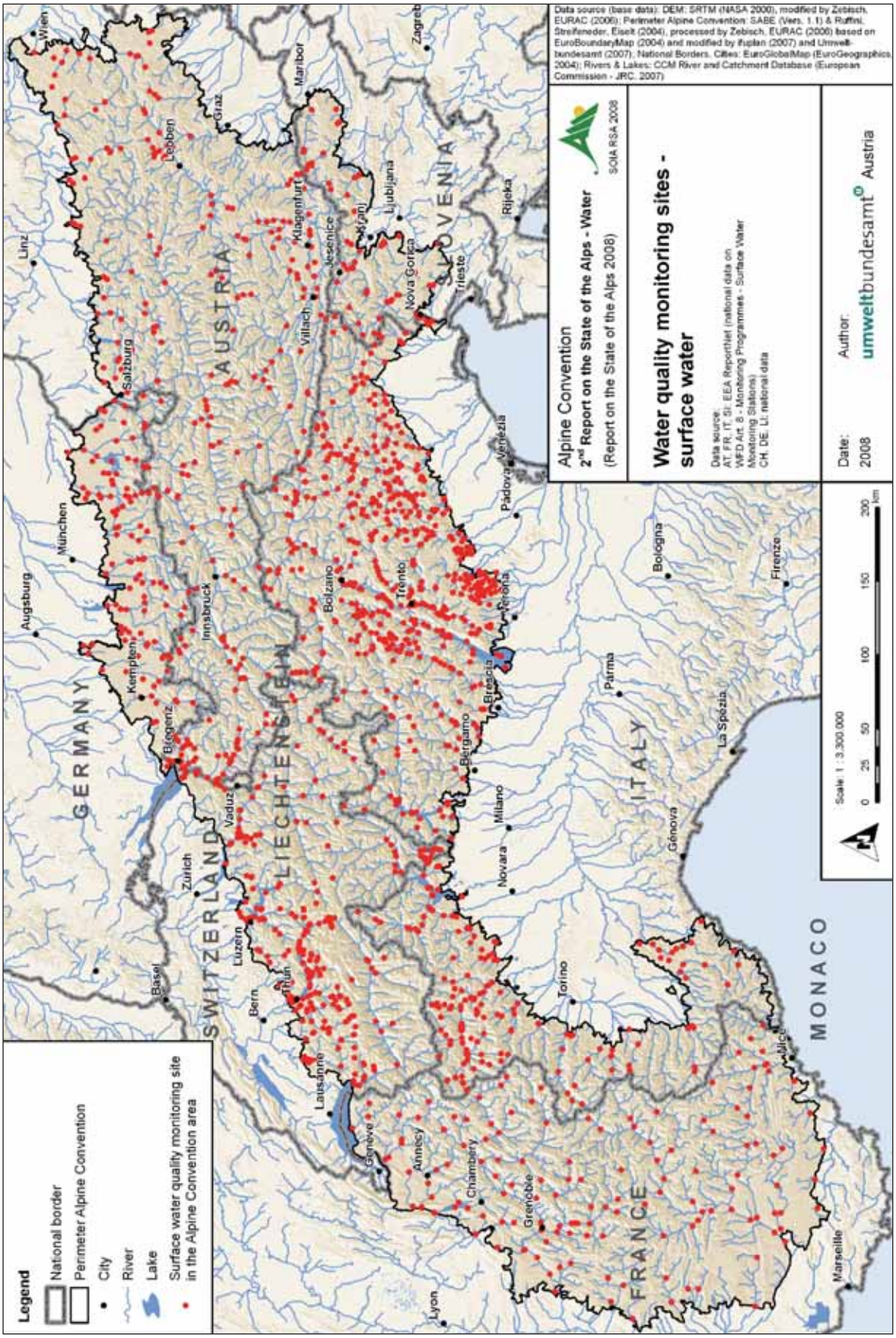
Regarding groundwater, the list of measured parameters naturally differs from surface waters due to the absence of biological and hydro-morphological quality elements.

Therefore, the Alpine monitoring network, which was recently rearranged and modernised with the implementation of the EU Water Framework Directive for EU Member States but also in Switzerland, is considered to be prepared for future challenges with the provision of continuous and area-wide data series on Alpine waters.

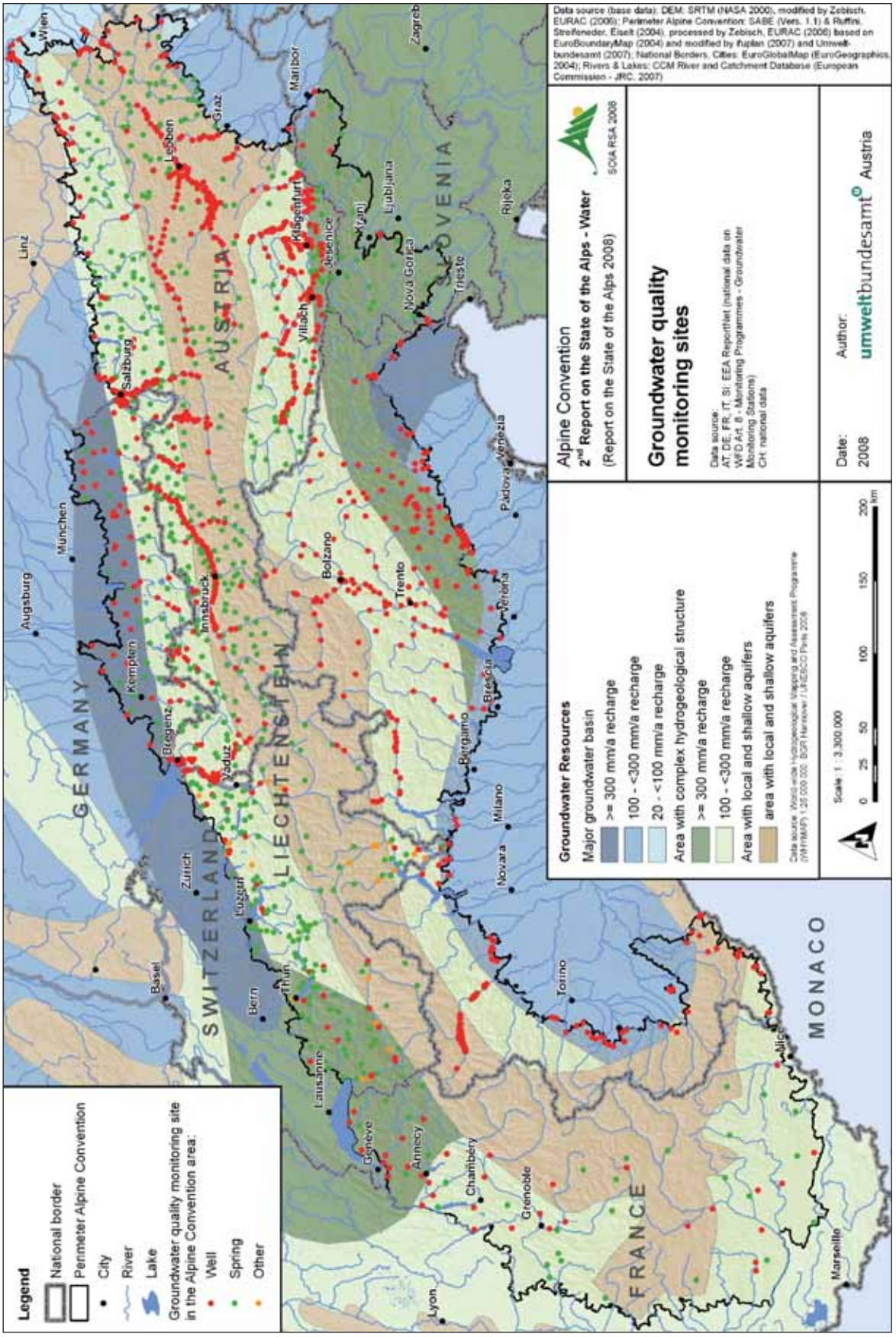
However, a question that still needs to be further assessed is the adequate coverage of higher Alpine regions within the national monitoring programmes. More particularly, long-term data series for waters in such areas could provide valuable information for further research activities. This applies in particular to ongoing research on climate change, where gathering additional data would provide an enhanced basis for scientific projects.

© BAFU/AURA

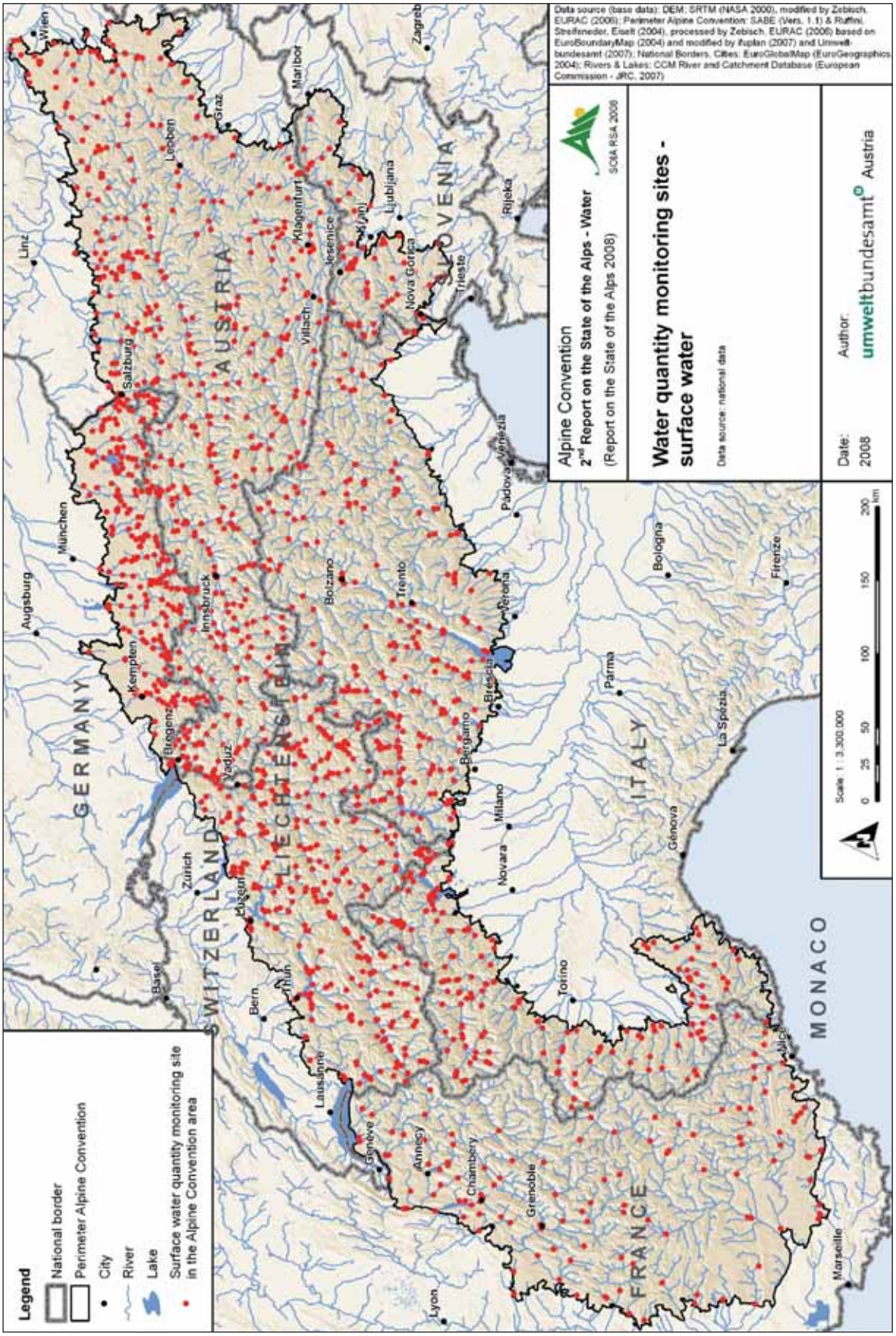
Photo B2-2: Hydrological Gauging Station at Reuss-Seedorf (Switzerland).



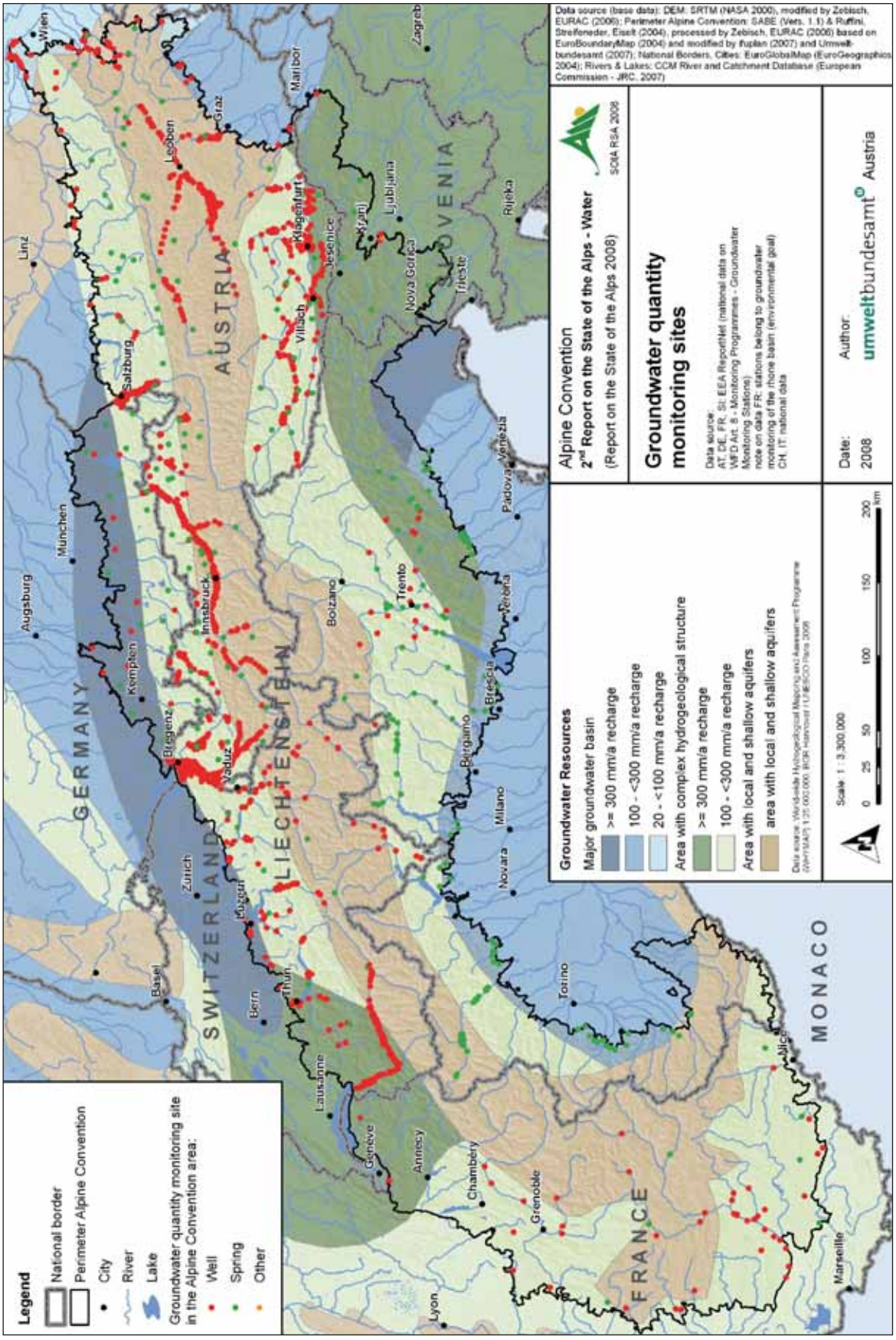
Map 10: Surface water quality monitoring sites



Map 11: Groundwater quality monitoring sites



Map 12: Surface water quantity monitoring sites



Map 13: Groundwater quantity monitoring sites

B.2.2 Chemical Quality of Water

Point Sources of Pollution

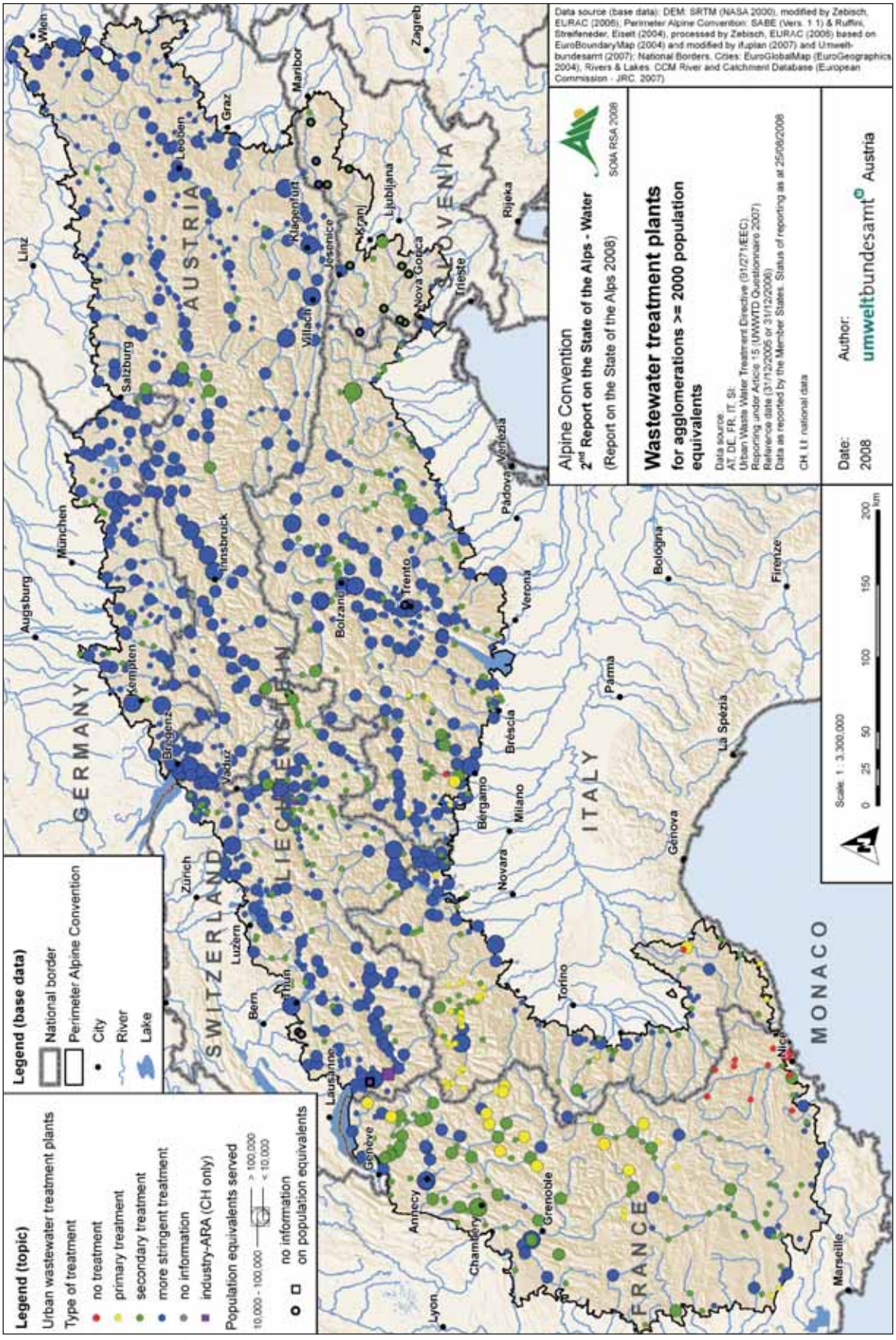
The necessity of treating waste water from point sources before it is discharged into the environment is generally accepted and agreed on within the states of the Alpine Convention. Therefore, considerable expenditures in urban waste water treatment were undertaken in recent decades, leading to the present situation, as indicated in map 14 in which appropriate facilities for the main settlement areas of 2.000 people or more are mostly in place or under way with related high connection rates of the population to centralized systems throughout the whole Alpine perimeter. A 100% connection rate of the population to centralized systems is not aimed for and would not be an adequate solution in terms of economic viability as a certain share of settlements are scattered. The alternative of treating waste water with adequate decentralized facilities is considered as an appropriate solution.

© Rita Newman
Photo B2-3: Major investments in wastewater treatment plants in recent years significantly increased water quality of Alpine rivers and lakes. Sewage Treatment Works Innsbruck, Austria.

However, a challenge for waste water treatment in assuring the adequate effectiveness of purification remains in areas of intensive tourism industry. Moreover, low temperatures decrease the performance of treatment facilities in winter. Higher concentrations (compared to the rest of the year) in treated sewage can therefore be monitored in winter, when the flow periods of Alpine rivers are naturally low.

Regarding industrial direct discharges, legislation and authorisations in place also cover targets and standards regarding the treatment of discharges. Companies are

© Agence de l'Eau Rhône – Mediterranée et Corse
Photo B2-4: Example of intensive tourism industry in the French Alps.



Map 14: Wastewater treatment plants for agglomerations >=2.000 Population Equivalents

therefore obliged to invest in treatment facilities in order to meet environmental targets set by public authorities in charge but toxic waste could remain a concern in areas with industrial facilities.

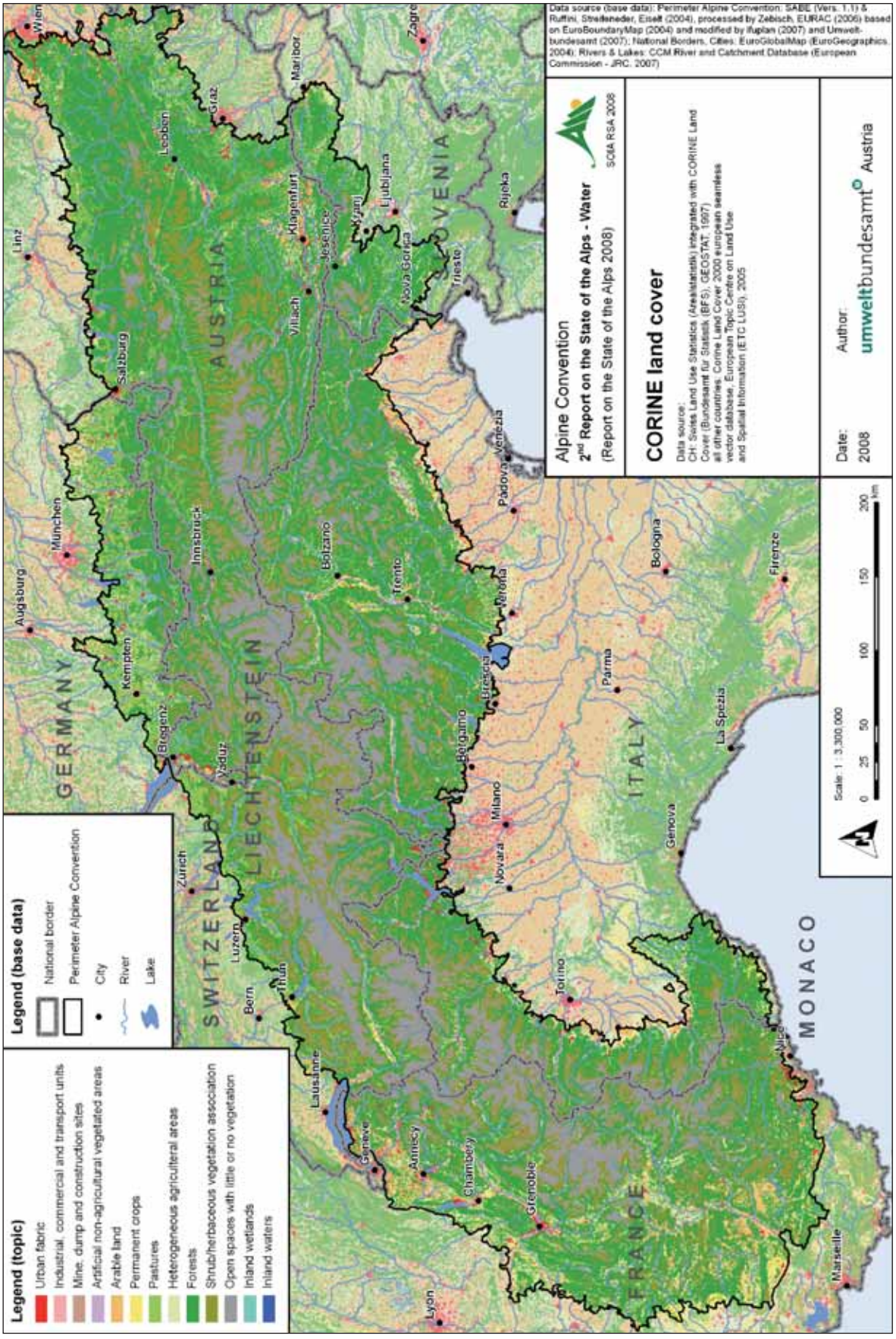
Diffuse Sources of Pollution

Since diffuse pollution is closely connected to land use, one of the main potential sources for diffuse pollution is agriculture. However, compared to lowland areas, the Alpine space is lacking of comparative advantages in the production of agricultural goods. Steep slopes, comparable poor soils, high altitudes (see therefore also map 15 on CORINE Land Cover) and rough climatic conditions restrict more intensified forms of agricultural production. This is especially the case for farming activities on arable land. Agricultural land use is therefore often carried out in form of extensive cattle grazing and dairy farming on pastures, leading, in combination with high precipitation rates, to related low concentrations of nutrients or pesticides in Alpine freshwater systems. Hence, diffuse pollution from agricultural sources is therefore generally considered as a minor problem for the chemical quality of Alpine water resources but can occur on a local level especially at the bottom of the Alpine valleys and on the fringes of the Alpine region.

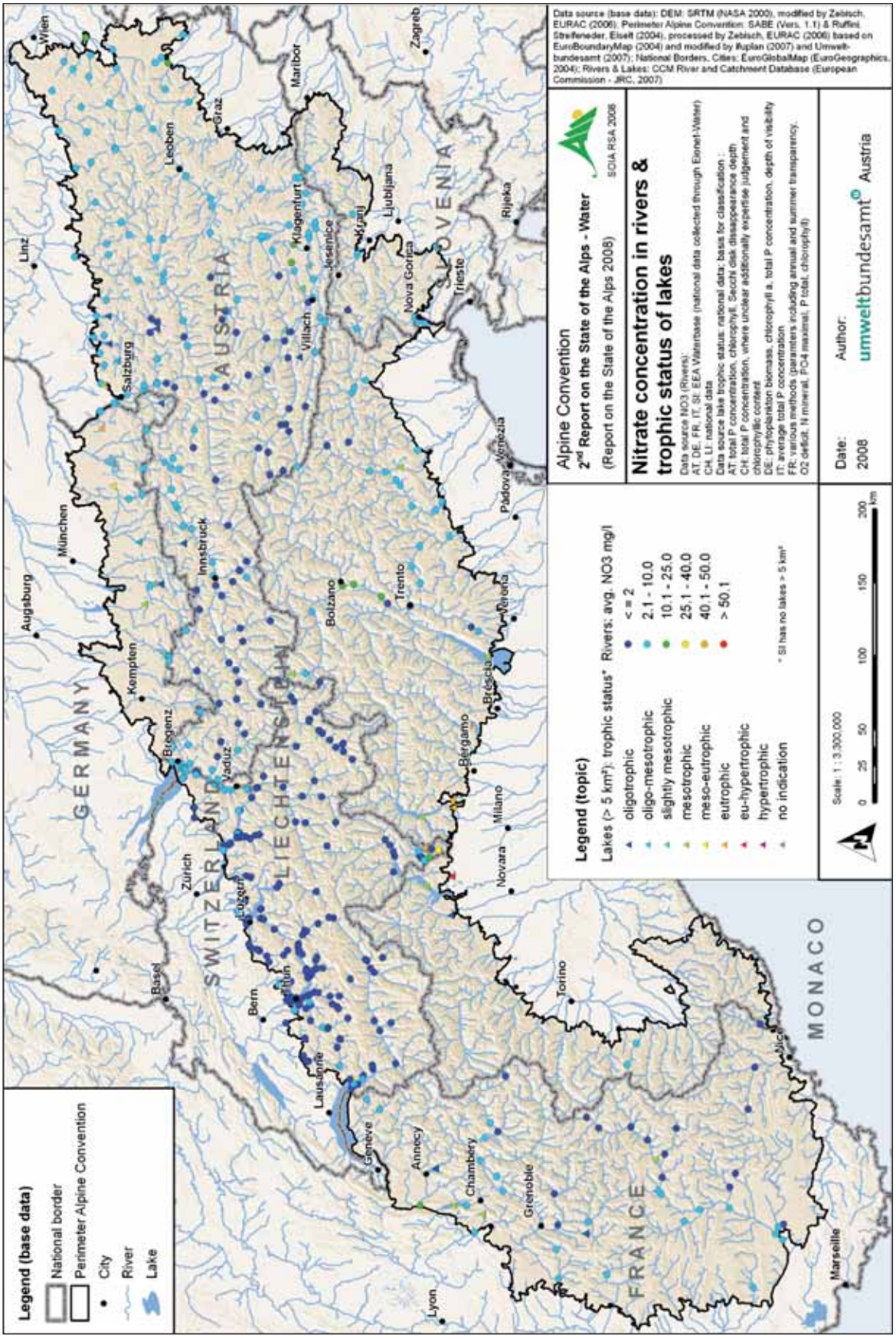
With regard to other forms of diffuse pollution, concentrations often reflect the natural background concentration in case of heavy metals for instance. In case higher concentrations occur, they mostly indicate point source pollution from mining activities or industrial facilities.

© BMFLUW
Photo B2-6: Algae blooms are an obvious sign for eutrophication caused by an excessive supply of nutrients due to water pollution.

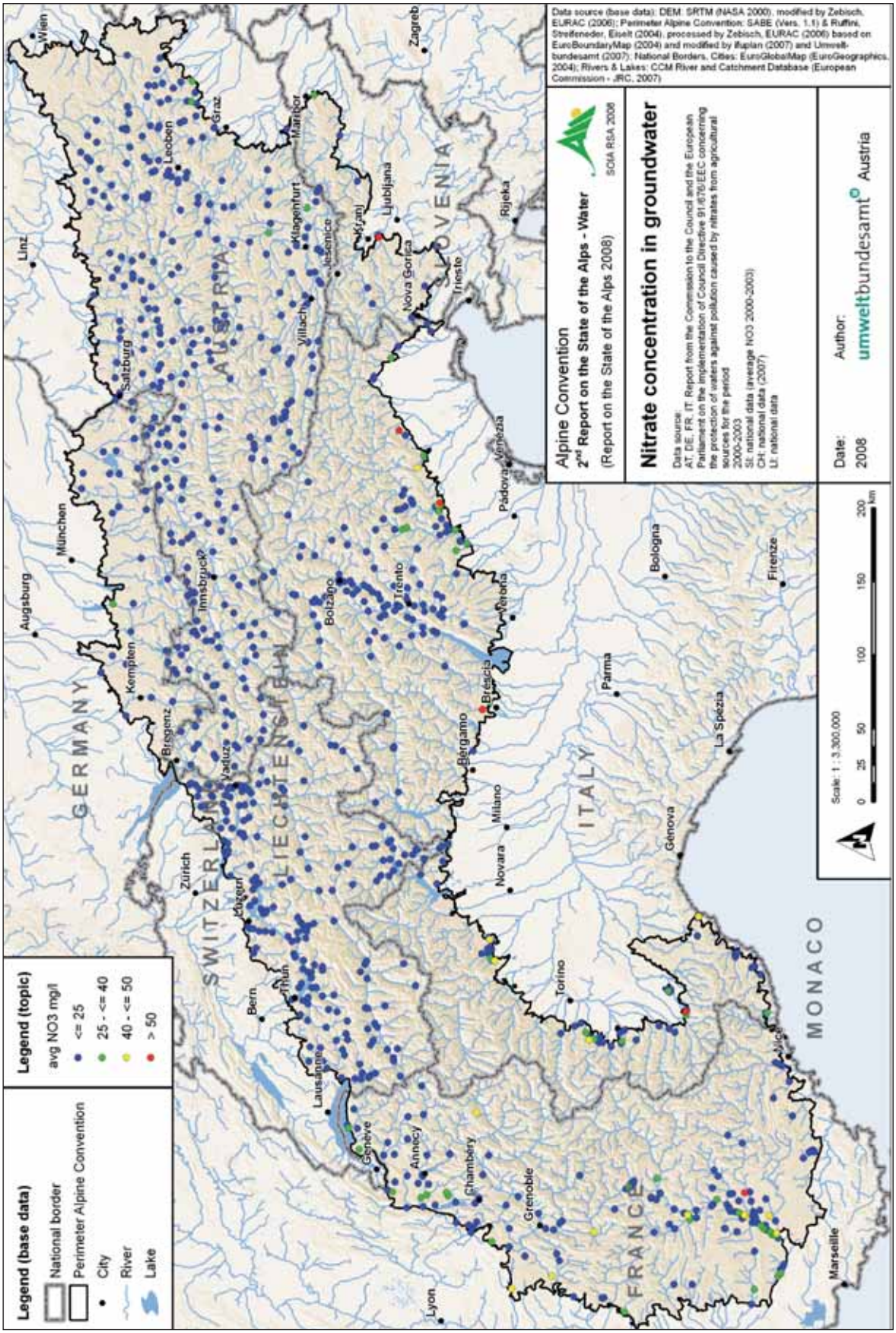
© A.Bianchini
Photo B2-5: Cattle grazing on high altitude pasture lands at Mt. Sciliar's foot as a form of traditional agriculture in the Alpine area.



Map 15: CORINE land cover



Map 16: Nitrate concentrations in rivers and trophic status of lakes



Map 17: Nitrates concentration in groundwater

© Š. Prelc
Photo B2-7: Example of irrigation system for apple yards in South Tyrol.

Chemical Status of Surface and Groundwater in the Alps

Substantial efforts in tackling point and diffuse source pollution have been carried out in the last decades and have led to the present situation. Map 16 provides an overview on the situation regarding nutrient concentrations (i.e. nitrates) in Alpine rivers and the trophic status of lakes.

Regarding rivers and lakes, the growth of algae and eutrophication are driven by phosphates. The map shows that inner-Alpine lakes in particular show very low levels of nutrients, which classifies them as "oligotrophic" and corresponds to the typical natural conditions. The situation looks different for lakes situated along the outskirts of the Alpine perimeter. The trophic status there can reach levels up to classifications between "mesotrophic" and "eutrophic" at times, hence higher concentrations of nutrients and a related higher productivity can be detected – an indicator for environmental impacts due to agricultural activities and discharges from human settlements. However, higher nutrient concentrations do not necessarily mean that the lake is polluted, since lakes in lowland areas often show higher nutrient concentrations of natural origin.
As far as Alpine rivers are concerned, nutrient concentrations are generally very low, with values inferior to 10 mg/l and, in the case of nitrates (NO_3), even inferior to 2 mg/l most of the time. In very few cases, the values reach levels of up to 25 mg/l – a figure which can still be considered as unproblematic for human health, since the threshold value for nitrates in drinking water is specified to be 50 mg/l in most of the Alpine states.

With respect to nitrates in Alpine groundwater, map 17 provides an overview on the measured concentrations. The map shows a similar situation compared to the nitrate concentrations in Alpine surface waters. The inner-Alpine area shows low concentrations of nitrates in groundwater beneath 25 mg/l NO_3. Increased concentrations between 25 and 40 mg/l and, only in very few cases, more than 40 mg/l, can occur at the lower regions and outskirts of the Alpine arc, where the pre-conditions for agricultural activities are more suitable. However, as there are no potential major pressures impacting the quality of groundwater bodies, nutrient pollution is therefore generally considered as a minor problem for groundwater within the Alpine area. In the case of pesticides, the topic is closely connected to diffuse nutrient pollution since pesticides are also applied on agricultural land. Again, impacts on the chemical quality of Alpine waters due to the pollution with pesticides, either of surface or groundwater, is no major issue for Alpine water management since concentrations are mostly minor and often below the limit of detection. This is the case for most of the Al-

pine area where concentrations rarely exceed the 0,1µg/l limit fixed for drinking water (e.g. in areas with intensive agriculture such as vineyards).

Regarding heavy metals and priority substances, discharges appear mainly at urban agglomerations and industrial facilities in valleys or on the outskirts of the Alpine perimeter. The overall majority of urban agglomerations and industrial facilities are already connected to either urban waste water treatment plants or are subjected to imposed conditions regarding the concentrations and composition of the effluent in the case of direct dischargers. Concentrations of such substances in Alpine waters are therefore largely within the threshold values determined by national legislations (Directive 2008/105/EC).

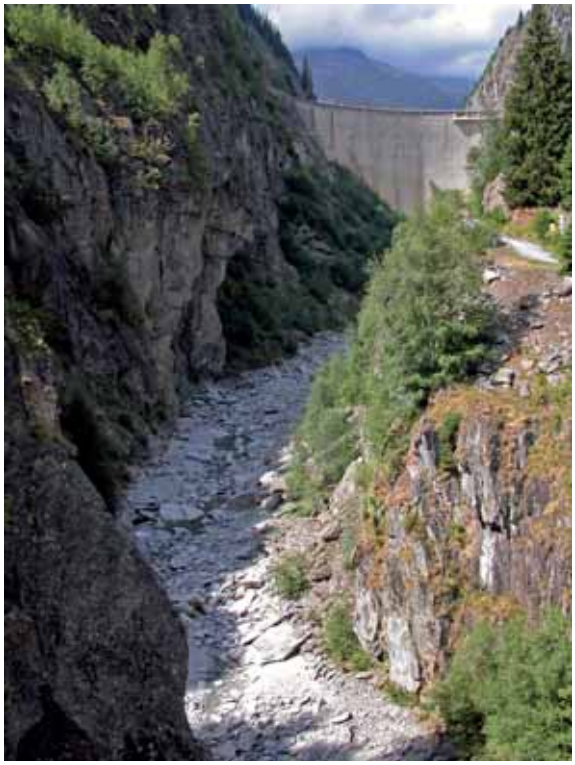
B.2.3 WATER QUANTITY

Water Abstraction, Residual Water and Hydro-Peaking

The abstraction of water from Alpine river systems occurs for several reasons. Besides a share of water being used in some regions for industrial purposes, agricultural irrigation or technical snow production, hydro power generation can be considered as the main reason for water abstraction with the aim of facilitating the existing energy needs. This circumstance is leading to the fact that a significant share of river stretches is not in good ecological status as ecological flow requirements are not met.

Additionally, hydro-peaking is causing pressures on aquatic life forms in regions where installed storage and pump-storage power stations are providing energy in times of increased electricity demand. In Alpine regions in particular, too little residual flow downstream of abstraction sites together with hydro-peaking is – beside morphological deficits – recognized as a major challenge for water management in order to achieve the objectives of the legal framework in place.

Since permissions for new facilities are already taking into account the need for realizing environmental objectives, additional measures are required for reducing the negative impacts of existing facilities on the freshwater ecology. A step-by-step approach is considered as an appropriate procedure for necessary investments in the modernisation of such facilities.
The aim of using water while meeting environmental objectives at the same time is backed up by existing legal requirements in the Alpine states, where the EU Water Framework Directive and the legal system in Switzerland are considered as a strong supporting instrument for solving the conflict of interests between the different stakeholders.



© *Sandra Crameri*
Photo B2-8: Insufficient residual water in rivers is one of the reasons for not meeting the ecological requirements in a significant share of Alpine river stretches. River Massa after the "Gebidem" dam, Canton of Valais, Switzerland.

Special Alpine Issue: Water Abstraction for Artificial Snowmaking

Artificial snowmaking can represent an important adaptation strategy to enhance winter tourism in view of the changing climatic conditions. In regions like Davos, where winter tourism generates up to 30% of the regional income, the potential loss without artificial snow production would be significant. Snowmaking facilities

© BAFU
Photo B2-9: Artificial snowmaking.

can thus be considered as an insurance benefit for the local economy. However, considering a continued rise in temperatures, snowmaking may cease to be economically attractive. In the long term, an investment into alternative offers for tourism may have to be envisaged.

On a local basis, temporal water stress due to snowmaking can occur. Artificial snowmaking may cause user conflicts between mountain railways (operators of snowmaking facilities), households and other water demand stakeholders. The retention and storage of water in ponds can contribute towards mitigation of such effects. However, such infrastructure entails further construction works in fragile environments and therefore, during the authorization process, due consideration has to be given to environmental concerns (see below). An additional step to solve water scarcity problems can be a regional water resources management plan, contributing towards balancing the interests of different water users.

In view of the potentially negative ecological effects, every new snowmaking facility needs to be evaluated already in the planning process for its impact on the environment. Legal obligations in order to meet ecological flow conditions such as residual flow, the "Tourism", "Soil conservation" and "Mountain forests" Protocols of the Alpine Convention, as well as standards in terms of nature conservation sites, are important. Particularly in ecologically sensitive and endangered habitats, artificial snowmaking should be prevented. Currently, environmental regulations in this respect differ from country to country and even within countries.

In order to optimize the process of balancing conflicting interests related to artificial snowmaking, all relevant stakeholder groups, i.e. mountain railway companies, communities, tourism organizations and nature conservation agencies need to collaborate and exchange their views and positions in the planning process in order to take into account and consider possible upcoming problems as early as possible.
To conclude, artificial snowmaking may be a relevant factor for the water resource management on a local level. However, considering the water cycle on a regional scale, or even for the entire Alpine region, the water volumes used for artificial snowmaking are minor. Besides, the water extracted for snowmaking remains within the regional hydrological system.

Droughts and Water Scarcity

Within the Alpine Convention area, droughts and water scarcity are not perceived as a major issue due to the relatively high precipitation rate of the whole area, the snow cap and the glaciers contribution. Both droughts and water scarcity were experienced in short periods and in small areas during the summer period e.g. in recent exceptionally dry years from 2003 to 2007.

Water which is stored in the Alps and its management has a notable effect and plays a considerable part in preventing and mitigating the consequences of droughts also on areas downstream. In recent years, the occurrence of drought and water scarcity events has been increasing in both intensity and frequency, and it is destined to grow in the future under the predicted effects of climate change. This may have important consequences also in the Alpine area and its related river basins. In these circumstances, drafting effective strategies to prevent and mitigate drought risks is becoming a priority task. Common lines of expected intervention can be synthesised into a better management of the available resource. This could be reached first of all by reducing demand on the one hand, but also by the diversification and utilisation of additional water resources on the other.

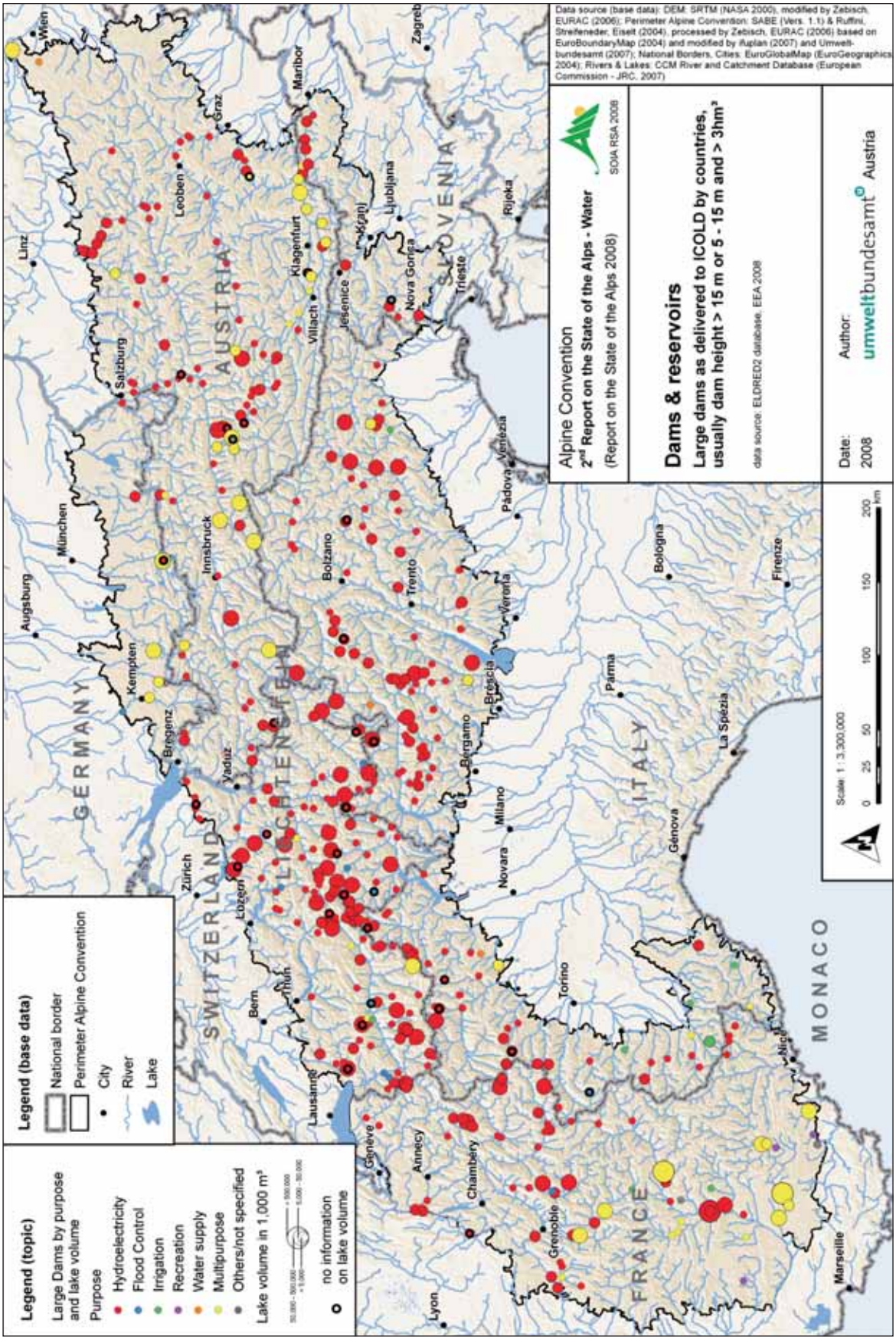
All the countries agreed with the necessity that a connection between water scarcity, droughts, climate change and their associated adaptation strategies, including the aspects already dealt with in the EC Green Paper on adaptation to climate change in Europe, should be integrated into the implementation of the Water Framework Directive (WFD) and its River Basin Management Plans as much as possible.

Reservoirs and Regulated Lakes

After the main boom of reservoir constructions in the Alps during the period from 1950 to 1970, and after stagnation until the turn of the millennium, reservoirs are becoming important once again for the European electricity supply system by satisfying peak demand (map 18 is providing an overview on existing large dams and reservoirs in the Alps). This fact can be regarded as a natural comparative advantage for peripheral Alpine valleys and regions, which are in many ways not always favoured economically. The mentioned circumstance may be reflected

- mostly in the expansion and optimization of existing reservoirs,
- in the construction of new reservoirs and
- in the installation of pump-storage facilities.

© W. Bouffard
Photo B2-10: Pumping water from an Alpine torrent across the Durance gorges near the "Mur des Vaudois", for l'Argentière-la-Bessée electric powerplant (Hautes Alpes, France).



Map 18: Dams and reservoirs

Related to these developments is an obvious risk that this further exploitation might increase the impacts on the ecological conditions. However, it is most likely that energy (supply guarantee) and climate (CO_2-free energy production) policies will act as drivers and continue to promote the development of reservoirs. On the other hand, the nature conservation side also has powerful means provided at EU-level by the Water Framework Directive and in Switzerland by the existing water protection legislation and related ongoing initiatives. To sum up, both economic and ecologic parties have a secured position. Procedures focusing on weighing of interests are indispensable and should strive for optimized compromise, where both concerns are taken into account. Innovative solutions mitigating the adverse ecological effects of reservoirs (sufficient residual flow, artificial flooding, attenuation basins against hydro-peaking, definition of less valuable areas with increased exploitation and determination of ecologically highly valuable areas without exploitation etc.) have been suggested.

Reservoirs and lakes also have an important function as balancing elements in the water cycle: more than ever, their role of providing water for the downstream area during dry periods may be increasingly stressed in the light of climate change, for which dry and hot summer spells are predicted to occur more frequently. It is however important to note that the potential of regulating and topping up runoff for the downstream area is limited due to restricted lake storage capacities and the interests of parties at the shores of the lakes themselves. Thus, expectations from downstream areas should take this into account and regard upstream lakes only as an attenuating factor for satisfying their demands while looking for solutions on the demand level.

© *AXPO*
Photo B2-11: Reservoir and regulated lakes as balancing elements in the water cycle (Vorderrheinbasin).

B.2.4 RIVER HYDROMORPHOLOGY

In the whole Alpine area, rivers were extensively modified during the last 150 years. A study performed by CIPRA in 1992 already revealed major impacts on river hydromorphology. According to data provided by the member states, approximately half of all larger rivers are affected by this development. The changes happened mainly within altitudes of up to 800 meters a.s.l. There, a competition for scarce living space has taken place. A large part of the settlement and traffic routes, as well as a great part of the agricultural usable land, was reclaimed by man from the rivers and their wetlands within this period. For flood protection and hydropower production, impairments of the natural watercourses with longitudinal and transverse construction works have taken place even in high altitude. River continuity for the migration of fish and other aquatic organisms is today strongly hindered. At nearly each Alpine river, straightening, removals, canalizations, dams, water retaining structures, abstractions or other adaptation works to the needs of humans have been implemented to a certain extent.
Today, with an increased level of knowledge and awareness on river ecology, which is also reflected in the European-wide implementation of the EU Water Framework Directive and comparable regulations in Switzerland, the important role of river morphology and continuity as an outstanding factor for the overall ecological status is widely recognized. Furthermore, in the meantime, the Alpine states also gained experience for several years on how to establish ecological measures in the course of the construction of flood protection works. Flood protection measures are coupled, where possible, with river expansions, re-establishment of the continuity and improvement of the structure.

Therefore, in case of new flood protection measures in the Alpine states, these aspects have to be considered in line with the provisions of modern water legislation in place. In the course of the implementation of this piece of legislation, revitalisation measures have to be realized not only in connection with flood protection works but also with hydropower plants. An objective is to grant the Alpine rivers more space and dynamics for river-morphological exchange processes. Challenges in this respect can vary widely and range from strongly modified rivers like the Alpine Rhine to greatly unimpaired systems like the Tagliamento River.

© Walser-image.com
Photo B2-12: Alpine Rhine
© Wurtsbaugh W.
Photo B2-13: Tagliamento, Italy
Alpine Rhine (Photo B2-12) and Tagliamento (Photo B2-13) – an example of river which experienced heavy modifications and one in mostly natural condition with regard to river morphology.

B.3 ALPINE WATER - SOCIAL AND ECONOMIC ASPECTS

B.3.1 PROPERTY RIGHTS AND PROVISIONS FOR THE ACCESS TO WATER

Being a first necessity good to be shared among potential users, the legal status of water was already defined in every country a long time ago. Regulations developed further in recent times along with various kinds of additional uses arising.

Legislation in the Alpine countries does not give a uniform definition for the ownership of water but there are rules concerning the access and use of water. As a common exception, private property rights for water (for groundwater resources in most cases) remain to the land owner. Although in countries such as France and Italy, water is specified to be a common patrimony of the whole nation or a "shared asset", legislation in all countries takes into account:

- the ownership of the site where the resource is situated (ground, riverbed, lake or basin) and
- the intended form of use (private use in households, private use for industrial facilities or agriculture, energy production or public interest).

Only "minor uses" (such as household needs) are not subjected to any prior authorisation. In most other cases, either licenses or authorisations are mandatory prior to use. The limits vary, as we can notice for the example of Austria: the use of groundwater by the land owner is restricted to the abstraction of water to cover his domestic need as long as only "hand driven" means are used or the rate of abstraction is proportionate to the size of land. All other uses need a prior authorisation by the competent authority.

Common points regarding regulation in the Alpine states (e.g. the definition of minor uses, concrete remarks on common property conditions) could be summarized as following:

- all uses above insignificant levels are in need of prior authorisation,
- although property rights may vary, regulative instruments, in practice, secure water management in public interest,
- common aims in the field of water management (recovering quality, sustainability, coordination in between various uses…) are shared by every country and have recently also been set by the EU Water Framework Directive for EU member states,
- property rights are balanced to a great extent by the need of prior authorisation for the use of water in order to implement integrated water management.

To sum up, the utilisation of Alpine water resources can be considered as regulated by public authorities to a great extent. Private use of water is mostly subject to prior authorisation which takes consideration the public interest.

B.3.2 CHARGES REGARDING THE USE OF WATER

In all Alpine countries, mandatory authorisation practices for different kinds of water uses are in place when exceeding a certain level of sampled flow-rates (below that level, a simple declaration might be enough). Firstly, claimants have to provide information on expected usage and justify the need for use and foreseeable impacts on the environment. On that basis and if necessary, regulatory authorities also give rulings on financial considerations or on potential compensation payments for impacts on the environment.

Fees linked to drinking water and sanitation services (collecting and treating wastewater) are collected normally by the public service administrator. This administrator might be from local authorities (government corporation) or a private administrator instructed by local authorities. The fees cover daily running costs (procedures, employees) but also write off infrastructure and investment costs for the facilities. On top of the fees for exploitation and write off, other fees, such as VAT and, in some countries, fees on tapped resource or released pollution, should be added.

Apart from the public service of supplying drinking water, other usages (by-pass, storage for hydro-electric production, industrial samples, fish farming, irrigation, artificial snow production) can, in some countries, also be individually subjected to the same fees. In France for instance, these fees are the foundation of water agencies as they constitute the only financial resource.

Basically, the "user pays" principle is applied in all Alpine States as users who impact negatively (by-pass, storage, sample or pollution) on water bodies are obliged to fulfil stringent imposed conditions in the course of the using process and (or) have to pay compensatory fees for the protection of nature and landscape. The arrangements to levy water usage fees vary from one country to another and depend mainly on the regional situation and historical development.

Switzerland in particular levies fees for the use of water resources for hydropower generation, which represents an important source of income for mountain cantons and mountain municipalities. The objective of such approach is that regions where hydropower stations are situated benefit from the use of the resources made available to users. However, it has to be pointed out that due to differences in the ownership of installations, traditions and the historical development, various

Country	Minimum €/m³	Maximum €/m³	Average €/m³	Comments (most of the provided figures are for water supply only)
Austria	0,33	~ 2,00	~ 1,00	The average additional fees for wastewater disposal in Austria are about 1,69 €/m³. Total: ~ 2,69 €/m³
France	0	~ 4,00	~ 1,32	Including connection fee (0,40); to be added: sewage collection & treatment (0,60), and various taxes (0,31) makes a total of 2.23€/m³.
Germany	0,52	3,95	1,85	BDEW-Wasserstatistik 2007, including connection fee and tax
Italy	0,78	0,96	n.a.	Covers the costs for the water service, drains and purification
Slovenia	0,12	0,45	n.a.	-
Switzerland	~ 0,40	~ 2,00	~ 1,00	-

Table B3-1: Overview on domestic water supply prices

approaches for generating benefits for the regions concerned are in place in other parts of the Alpine perimeter. An additional aspect is that this issue also has to be seen in light of transfer payments coming from outside of the Alpine perimeter to build protection infrastructure against natural hazards for instance.

Further discussions on these issues concerning services and water use may be expected in line with fulfilling Article 7 of the Energy Protocol and Article 11 of the Spatial Planning Protocol in the frame of the Alpine Convention, but especially in association with the implementation of Article 9 of the EU Water Framework Directive.

B.3.3 PUBLIC OR PRIVATE – MANAGEMENT SYSTEMS FOR WATER SUPPLY

Public drinking water services (for households and users connected to the public grid) have mostly been developed during the past century. Although some people in isolated areas still rely either on rain water supply, individual wells, cooperative plants or individual spring catchments, most of the Alpine population benefits from public water supply systems.

Water supply facilities are frequently owned and managed by public authorities. However, in some cases, the equipments are completely or partly managed by private organisations. Therefore, the ownership of facilities with private shareholding remains too diverse and complex to summarise in this document. It depends, in particular, on the prevailing provisions to guarantee public control of the service.
In general, the Alpine space is not lacking in water resources for domestic use. This is the case even during exceptional dry periods. Furthermore, in all countries, only a small fraction of the population is dependent on individual water supply schemes; such exceptions mainly occur in areas with difficult access and for isolated settlements. Therefore, water services remain a public responsibility which mainly involves local public authorities.

Variations in the ownership of public service facilities and in the status of their operators occur in some countries or are the subject of tough discussions. In spite of this diversity, the trend seems to go in the direction of preserving (or consolidating) "public" control over this public service, even if privatization is, sometimes and on a local level, under debate in some countries.

The following table is aiming to provide a rough overview on water pricing for domestic consumption in the Alpine countries. Whenever data were available, prices for wastewater collection and treatment as well as charges and fees appear in the right column as a commentary. However, it has to be pointed out that the information provided does not allow a strict comparison of the water charges since data relying on various sources and calculations are consequently not directly comparable: they might or might not include connection fees and the dates of the survey might differ. Some data are national while others only concern the Alpine perimeter of the country in question.

B.3.4 HYDROPOWER GENERATION IN THE ALPS

The topic of hydropower generation is one of the key issues for Alpine water management. Apart from being a key economic asset for the whole Alpine perimeter, the benefits of hydro power as a highly reliable and largely CO_2-free renewable source of electricity production and its contribution towards serving the energy demand of the Alpine states are of considerable importance next to the additional value of helping stabilise the European energy grid.
An overview on 500 and more installations with a power output greater than 10 Megawatt is provided with map 19.

However, since growing energy demand, increased prices for electricity as well as reduction targets for CO2 emissions act as a driver for Alpine water management in advising further expansions and additional facilities, these developments are causing pressures on the ecological status of river systems. In this context, new projects for hydropower generation are currently discussed controversially once again.
Next to providing energy and tackling climate change, there is the additional need to meet water and nature protection objectives as further targets for environmental protection and sustainable development. The construction and operation of hydropower stations is linked to unavoidable impacts on the river stretches and wetlands. Thus, beside the advantage of almost emissions-free energy production through hydropower, there is a need to optimise hydropower facilities in order to strike a balance with the ecological requirements of the affected water systems and adjacent land ecosystems. Furthermore, river stretches which are in or near natural conditions are becoming more and more unique in recent years and are threatened with modifications, which is leading to a conflict of interests.

National provisions for a sustainable water use with the aim of solving this conflict are in place within all the Alpine states. The implementation of the EU Water Framework Directive (WFD) for instance, defining ambitious objectives for environmental protection with a pragmatic approach in the case of exceptions, is considered as a strong supporting instrument for balancing the interests of different stakeholders and as a vital contribution towards sustainable development. This also applies to the situation regarding already existing facilities, where necessary upgrading in order to meet ecological targets is expected to be a practical outcome to achieve the goals of a modern environmental legislation.

© Tauern Touristik GmbH
Photo B3-1: Alpine Reservoirs provide energy in peak-times of electricity demand. Kaprun Mooserboden Reservoir, Austria.

One should highlight in this respect the potential win-win-situations, where the energy yield on the one hand but also the ecological situation on the other can be improved through modernisation measures which are applied on existing facilities.
Hence, there is a strong recommendation to continue the discussions between all stakeholders in order to achieve sustainable solutions concerning hydropower generation and environmental requirements in line with the dialogue taking place at European level.

At the workshop in Berlin in June 2007 on a common implementation strategy for the EU Water Framework Directive (WFD) with regard to hydropower generation, the following key conclusions have been reached:
Holistic approaches for hydropower use are needed. The focus should be on catchment level and not only site-specific or on water body level. Advantages are recognised in form of pre-planning mechanisms to facilitate the proper location and identification of suitable but also non-suitable areas for new hydropower projects. A 'master plan' for the future development is highlighted as an appropriate instrument in order to enable a transparent planning process, taking into account remaining potentials with regard to energy production next to environmental criteria as well as other water uses. At least three categories could be distinguished: suitable, less favourable and non-favourable areas. The identification of these categories should be carried out with the involvement of all stakeholders based on transparent criteria, including revisions within a certain period of time. These drafted steps are considered to be an appropriate instrument for achieving sustainable solutions for future challenges, since objectives regarding renewable energy supply, climate change, but also nature protection have to be met. Small and large hydropower should be treated equally with regard to promotion (in map 20 in the example of Slovenia, the large number of additional small hydropower stations next to large facilities in the Alpine space is indicated).

With regard to further exploitation of the hydropower potential, two particular issues should be addressed in more detail:

- What should sustainable solutions look like if we consider that even if the total remaining potential for hydropower generation were exploited, the gained additional energy yield may only cover the projected increase in energy consumption for some years? After this period, the striving for additional renewable energy sources would be retained with the exception of the hydropower generation whose potential would have disappeared but not the corresponding ecological impact due to the added facilities.
- The latter question applies to small and micro hydropower schemes with respect to their contribution to the achievement of the objective of increasing renewable energy production which should be assessed and evaluated against their impact on Alpine river systems.

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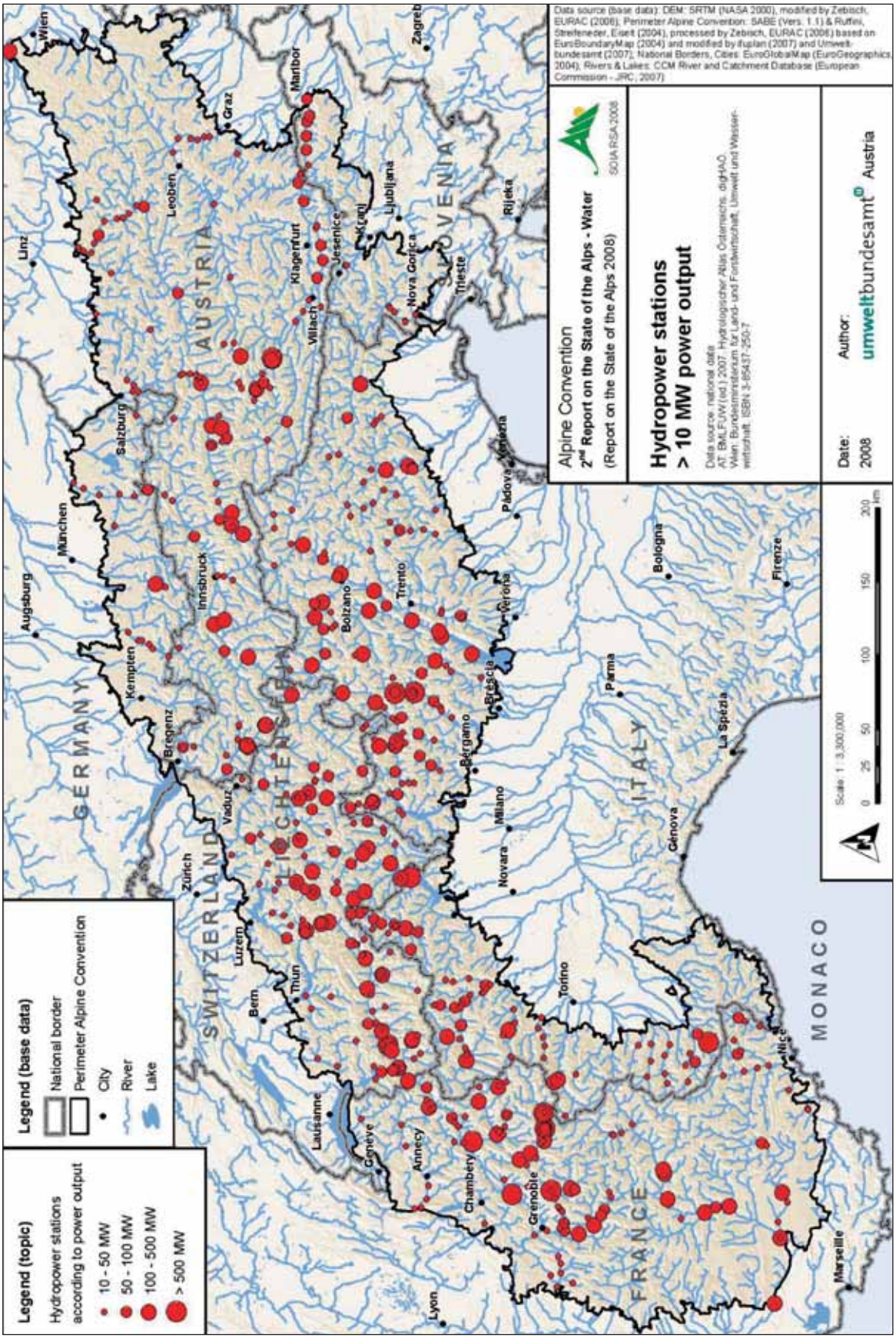
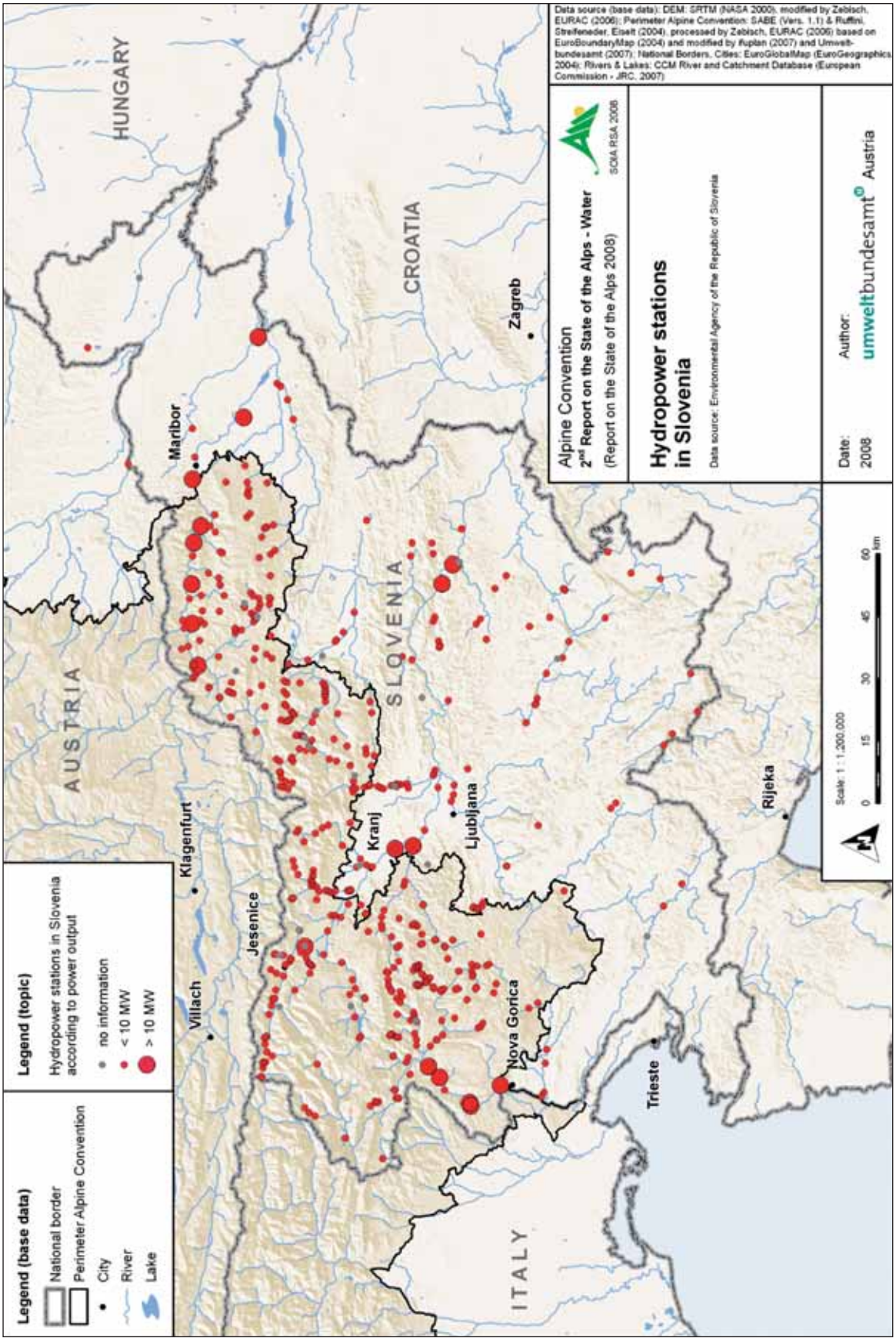
Photo B3-2: Next to the large-scale facilities of 500 MW and more indicated on Map 19, thousands of small and micro hydropower stations are in place in the Alpine area.



Map 19: Hydropower stations with a power output greater 10MW



Map 20: Hydropower stations in Slovenia

Author unknown
Photo B3-3: Tradition of dam building in the Alps /historical picture, Klavže near Idrija, Slovenia.

B.3.5 WATER MANAGEMENT FOR SOLVING CONFLICTS

Conflicts on water in the Alpine area may be the result of various factors like for instance the preservation of ecological and environmental aspects in connection with hydropower generation, water pollution, the reduction of water availability due to water scarcity and droughts, upstream-downstream relationships or the abstraction of water for irrigation or artificial snowmaking.

Since various pressures and demands on Alpine water resources exist, adaptive management within a framework large enough to take into account such dynamics is required. Different instruments for water management in order to prevent or solve potential conflicts include a legislative framework, bi and multilateral agreements, planning instruments, conferences or scientific approaches in order to facilitate the characterisation and solution of such conflicts. An outline of existing legislative instruments and agreements in place is provided in the chapter on the legal framework.
Hence, since water management issues are dynamic and multidisciplinary, they require an appropriate approach. Bodies for water management (competent authorities) are in place in order to handle such issues. Problems have to be solved at the appropriate level (local problems at local level and regional problems at regional level, etc.) and existing agreements have to be updated continuously. Political representatives and all stakeholders in general have to be involved in the ongoing processes of water management using the instruments in place. Therefore, awareness of the previous conflicts, which have been solved, should be highlighted to stakeholders. In order to be sustainable, compromises have to be searched between economical, ecological and social aspects.

C PROTECTION AGAINST WATER RELATED NATURAL HAZARDS

Due to its natural conditions, the Alpine range is extremely exposed to natural hazards. Avalanches, landslides or rock falls occur with extreme velocity and intensity. The damages caused are significant, but usually limited in their spatial extension. In general, flood events constitute the highest risk and damage potential for valleys in the Alpine region. In torrent catchment areas with high precipitations, flood hazards are frequently combined with high volume of bed load sediments and wood debris which can cause log jams and unpredictable courses.

Measures for the improvement of flood protection are taken in all Alpine states and technical upgrading is intensified for flood control. Especially in the last years, natural hazards with great damage potential have occurred very often and intensely.
The Alpine countries were forced to increase their annual investments because there are more complex solutions to be developed for the flood control systems. Furthermore, every new infrastructure and measure regarding rivers has to comply with the EU Water Framework Directive and comparable regulations in Switzerland. An ecosystem oriented point of view, including appropriate management of sediment loads - which should also integrate the needs of stakeholders, land owners and land use - is an appropriate way to reach this aim.

Natural hazards cannot be avoided. There is a general consensus today in the Alpine range that only consistent investigation of protection measures and the application of an integral risk management can be the answer to the challenges posed by natural hazards. The Platform "Natural Hazards" (PLANALP) of the Alpine Convention is the appropriate board for a continuous experience exchange and optimisation of integral risk management.

In October 2008, the experts of PLANALP elaborated the following recommendations to the member states for dealing with natural hazards:
It must be stated that the population, buildings and important infrastructure facilities can only be protected effectively if the authorities, owners, insurance companies and the population enter into a risk dialogue that

© Schweizer Luftwaffe
Photo C-1: Torrent / debris flow event in Brienz (Switzerland) on 24/08/2005.

Country	Annual investments on protection from natural hazards	Area [km²] (% of Alpine space)	Inhabitants [Mio.] (% of Alpine space)
Austria	280 Mio. €	54.339 (28,46 %)	3,136 (23,79 %)
France	- -	40.900 (21,42 %)	2,198 (16,68 %)
Germany	42 Mio. €	11.152 (5,84 %)	1,333 (10,11 %)
Italy	340 Mio. €	52.653 (27,58 %)	4,454 (33,79 %)
Lichtenstein	4 Mio. €	160 (0,08 %)	0,029 (0,22 %)
Monaco	- -	2 (0,001 %)	0,030 (0,23 %)
Slovenia	12 Mio. €	6.767 (3,55 %)	0,375 (2,85 %)
Switzerland	400 Mio. €	24.940 (13,07 %)	1,625 (12,33 %)
Total	--	190.912 (100 %)	13,183 (100%)

Table C-1: Alpine State's public investments in prevention measures against damages caused by natural hazards in the Alpine perimeter (Alpine Signal 1, Permanent Secretariat of the Alpine Convention, 2003)

targets existing natural risks and derives a plan of action. In drawing up this action plan, a comprehensive solution should be chosen that allows ongoing protection from natural hazards. Within the scope of the Alpine Convention, governments are required to give the following measures top priority:

Mitigation:

- Reduce the burden on the environment by acting in a sustainable way. Treat non-renewable and limited resources with care.
- Ensure the long-term provision of the resources needed for integrated, holistic natural hazard management.

Adaptation:

- Promote and support integrated risk management that fully exploits the potential of possible protective measures in a coordinated way. These protective measures include prevention (land use planning, early warning systems, care of protective forests, renaturalisation of waterways, protective structures), disaster management (intervention) and reconstruction.
- Considering the increasing frequency and intensity of events, it is vital that existing and planned protective measures be reviewed in terms of the conceivable overloading of protective structures.
- Targeted, consistent risk dialogue with all of the parties involved in order to strengthen prevention efforts and promote risk-consciousness and the acceptance among the public of risk-appropriate action.
- Promote knowledge to ensure risk-appropriate land use via targeted training.
- Promote and support the early recognition of potential hazards influenced by climate change, such as avalanches, flooding, mudslide and landslide hazards.

The approaches in the Alpine States are largely identical. The development of hazard zone maps with respect to single natural hazards is based on the calculation of statistical frequency of 100 to 150 years. Most Alpine States are currently developing or have already implemented danger or risk zone maps. With these plans, the dangers for the settled areas and their infrastructure as well as the future land use planning can be handled more effectively.

A new benchmark for the Alpine States is the EU-Directive on the Assessment and Management of Flood Risks which is currently implemented. After a preliminary assessment of the flood risk, the flood dangers and flood risk maps are being developed with the help of a standard for low, middle and, if necessary, high probability. On the basis of these maps, flood risk management plans are to be developed by the end of 2015. The approach which Switzerland follows is comparable and the hazard maps need to be completed by 2011.

D CLIMATE CHANGE IN THE ALPS AND IMPACTS ON WATER RESOURCES

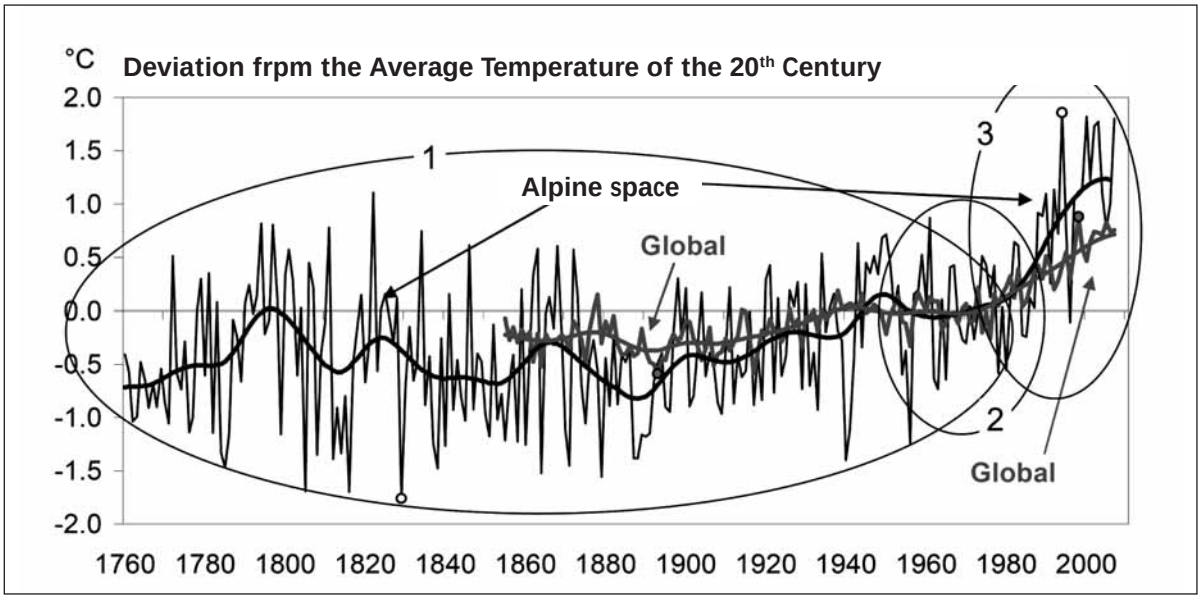


Fig D-1: Average of the annual air temperature in the Alpine space 1760-2007 (black) and the global average 1858-2007 (grey)
1: last natural period – solar flux and volcanic activity dominant
2: increasing influence of human activity – the period of aerosols
3: start of the global warming period
Jones et al., 1999; Auer et al., 2007 (modified)

Alpine climate is highly complex due to interactions between mountains and the general circulation of the atmosphere. The ridges have an average elevation of 2500 m above sea level with a maximum of 4800 m which can constitute a barrier for atmospheric circulation. Another cause of complexity inherent to the Alps arises from the competing influences of a number of different climate regimes in the region, namely Mediterranean, Continental, Atlantic and Polar. The Alps can be divided into four or five climatic sub-regions: the Northwest, the Northeast, the Southeast, the Southwest sub-regions and the high-elevation sub-region following the main crest-line of the Alps.

According to temperature measurements over the past centuries, the warming in the Alps over the last century exceeded 1.5°C, which is more than twice the global warming average. The years 1994, 2000, 2002, and particularly 2003 have been the warmest on record in the Alps in the past 500 years. Unlike temperature, precipitation variation over the European Alps shows considerable spatial differences according to both seasonal mean features and short-term and long-term variability. However, the summer 2003 was likely to be the driest in the context of the last 500 years.

The recent warming trend is now producing symptoms such as reduced snowfall at lower altitudes or retreating glaciers that can be expected to worsen with climate change. In the future, increased floods and rock falls are expected. Projected changes for mountain regions suggest that the European Alps are likely to have slightly warmer winters with more precipitation than in the past, while the summer climate may become much warmer and drier than today. It seems likely that Alpine climate change will lead to changes in timing and amount of run-off in European river basins and that floods and droughts will become more frequent.

Initially, glacier retreat is projected to enhance the summer flow in the rivers of the Alps, although the contribution of ice melting to the mean runoff is often overestimated (for instance, the contribution to the mean runoff amounts only to about 1% for the total area in Switzerland). However, when glaciers shrink, summer flow is projected to be reduced by up to 50% in catchments which are strongly directly influenced by glaciers today.

Summer discharge of Alpine catchments may significantly decrease but still be dominated by snow melt.

Winter floods may become more frequent in the lower parts of the Alps. These winter floods in the Alps belong however in general to the class of small to middle but not to the extreme events. Because the Alps are the primary source for major rivers such as the Rhine, Rhone, Po and Danube, the impact of reduced mountain discharge would be felt far beyond the mountainous regions themselves.

In particular, further research will be necessary to quantify impacts of climate change on the water cycle at regional levels in more detail and to translate findings of climate models into hydrological parameters (such as water tables or discharges).

The forecasted impacts on water resources may heavily affect the status of natural and anthropogenic systems. Therefore, together with mitigation measures, it is necessary to implement strategies of adaptation to the modified hydrological conditions consistently with the mitigation measures, in order to avoid negative impacts of these changes. On different administrative levels, several measures and activities in mitigation and adaptation to climate change may be necessary.

Water management adaptation and mitigation measures in terms of Climate Change was worked out within the frame of the Climate Action Plan of the Alpine Convention and in the River Basin Management Plans in line with the CIS Policy Paper on Climate Change of the EU water directors and the European Commission from June 2008.

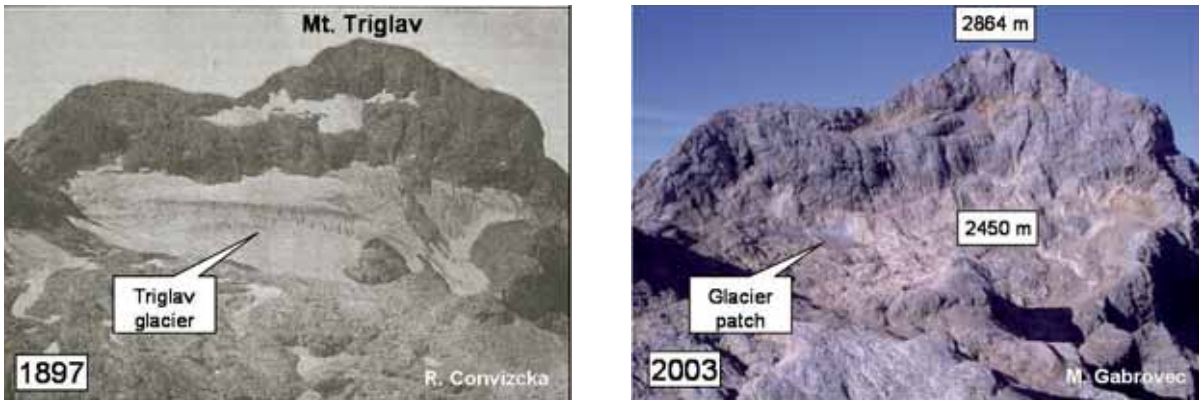


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Photo D-1: Disappearing glacier on the Mount Triglav, Slovenia. Impacts of Climate Change in the Alpine region can most obviously be observed at glaciers. It is predicted that climate change will also have an influence on the water cycle and water availability.

E EXISTING LEGAL FRAMEWORK CONCERNING WATER MANAGEMENT

In the chapter on the legal framework, the relevant existing legislation concerning water management in the Alpine area is presented.
It relates to the provisions of the Alpine Convention and its Protocols as well as to EU legislation and similar measures in application in non-EU States. Furthermore, a number of bi and multilateral agreements between countries for trans-boundary and basin-wide water management are in place (see table number 2 in the Annex).

The Alpine Convention

The Alpine Convention is a multilateral framework treaty signed in 1991 by the eight states of the Alpine arc as well as the European Community. Water management is one of the topics in relation to which the Parties of the Alpine Convention committed to take adequate measures, with the objective to preserve or re-establish healthy water systems, in particular by keeping lakes and rivers free of pollution, by applying natural hydraulic engineering techniques and by using water power, which serves the interests of both the indigenous population and the environment alike.

Eight implementation protocols have been adopted and are now in force in the countries which have ratified them:

- Protocol on Energy
- Protocol on Spatial Planning and Sustainable Development
- Protocol on Conservation of nature and the landscape protection
- Protocol on Mountain Forests
- Protocol on Tourism
- Protocol on Soil conservation
- Protocol on Transport
- Protocol on Mountain Farming

Most of these Protocols have some bearing or influence on water management in the Alps. As water is one of the essential environmental media, it is normal that it comes to relevance whenever the natural environment, considered in all its aspects, is at stake.

In addition to Protocols, the Ministerial declaration on Climate Change, adopted in November 2006, also mentions the need for the development of adaptation strategies with regard to Climate Change impacts on Alpine waters.

European Union Legislation

Water policy and management in the area of the Alpine Convention is, to a considerable extent, influenced by the legislation of the European Union (EU) on water. The most important documents of this legislation are listed in table 1 in the Annex and include provisions setting the framework in the field of water policy (EU Water Framework Directive), provisions for the assessment and management of floods, nature protection and conservation, drinking water, bathing water, water suitable for fish-breeding, quality of surface water, protection of groundwater, urban waste water treatment, pollution from agricultural sources and others.

Water management legislation in Switzerland and Liechtenstein

A comparison between the Swiss water legislation and the EU-Water Framework Directive came to the conclusion that in water protection matters, both are based on similar principles and follow the same general approaches, enabling where necessary a coordinated cooperation. This statement is underpinned by already realized and ongoing water protection programmes between Switzerland and their neighbouring countries. The same applies with respect to the flood protection policy.

Liechtenstein implements EU legislation on water, following the integration of key elements of EU water legislation into the European Economic Area Agreement.

International Conventions, Agreements and Co-ordination

Several international conventions and agreements are aiming at enhancing coordination and setting common objectives in the field of water management between the different countries.
The UN-ECE (United Nations Economic Commission for Europe) "Convention for the Protection and Use of Transboundary Watercourses and International Lakes" (Water Convention) sets a milestone for transboundary water management in the European region. Moreover, under this convention, the "Protocol on Water and Health" was adopted in June 1999, and the "Protocol on Civil Liability" was adopted in May 2003. The Protocols are, however, not yet ratified by all countries.

Furthermore, as additional elements for international coordination with significant importance, there are many bi and multilateral agreements in place between the countries for transboundary and basin-wide water management within, but also outside of the Alpine area. Those agreements are listed in table 2 in the Annex.

Conclusion

A comprehensive set of legislation in the frame of the European Union, the Alpine Convention but also within Switzerland, as well as transboundary agreements are in place. Water management with regard to EU legislation is largely based on EU directives. While it is binding as regards to the results to be achieved, it leaves EU Member States the necessary discretion in approaching the different water management and environmental challenges. A particularly good example is the EU Water Framework Directive, which obliges Member States to tailor the quality objectives for surface water bodies according to their local characteristics.

This framework character is underlined and strengthened by the fact that all water legislation is based on Article 175 (1) EC Treaty which provides for majority decisions, but which allows Member States to maintain or introduce more stringent measures to protect their aquatic environment.

All directives follow the pattern of

- identifying the problems (environmental and others) with regard to the water,
- adopting action plans and/or management plans with programmes of measures to address the identified problems,
- monitoring the different water bodies in order to prevent new pollution or other problems. Transition periods and limited derogation possibilities allow taking into consideration specific local or unforeseen circumstances.

The application of the EU provisions is the task of the EU Member States. The European Commission has to ensure that the provisions are actually applied and has, in this regard, a surveillance function as well as the right to submit applications to the European Court of Justice under article 226 of the Treaty. The participation of the public in decisions on plans programmes and projects, as well as the publication of implementation reports, ensure transparency in decision-making and application of the water management measures.
In EU Member States, the implementation of the Water Framework Directive and the setting up of River Basin Management Plans are under way in order to achieve good status by 2015. Exemptions are possible with regard to time and ambition; however such exemptions have to be reasoned in detail. The daily practical enforcement and implementation is a particular challenge. The EU legislation is in compliance with the provisions of Article 2 (2) of the Alpine Convention which mentions the objective to preserve and re-establish healthy water systems.

For all transboundary river catchments, international river commissions are in place and ensure the coordination on a basin-wide level.

F MAJOR WATER MANAGEMENT ISSUES AND THE MAIN CHALLENGES FOR THE FUTURE

The Alps contribute to a disproportionally high share of water compared to the catchment area, which is fed into large European river systems. This is the reason why water from the Alps is of vital importance for the surrounding extra Alpine regions and also for large parts of Europe. Furthermore, the Alps are still one of the largest continuous areas on the continent with outstanding unique and diverse natural habitats. Ever growing pressures caused by man are increasingly threatening this heritage and the ecological functioning of watercourses.

Sound water management is one of the objectives of the Alpine Convention laid down in its Article 2 (2). A number of Protocols in force already address water-related issues. Water is also mentioned as one of the topics in the Multi-annual work programme of the Alpine Conference. A specific initiative was taken in 2006 in form of international conferences ("the Water Balance in the Alps", Innsbruck October 2006, Munich October 2008). Finally, water as a crosscutting issue is of relevance in relation to the Action Plan of the Alpine Convention on climate change. In this plan that was adopted at the Ministers' Conference in March 2009 in Evian, several measures on water were defined, such as reducing water consumption, improving the use of water and reducing the impact of hydro-electric plants on the environment. With these priorities, the objectives (reinforce the implementation of the Water Frame Directive, prevent water shortage, develop plants according to the ecology of water streams) must be implemented specifically in the Alps in the coming years.

It has clearly been demonstrated in the previous chapters that a broad range of water management issues have to be tackled within the Alpine region in order to address the pressures. Nature and extent of challenges for water management are quite diverse within the Alpine perimeter due to differences in climate, geology, topography, land use, the intensity of settlement areas, history, or the socio-economic background. Pressures and impacts which are considered to be a major challenge at local or regional level do not necessarily emerge in other regions, neither are necessarily a major issue for the whole Alpine wide space.

Concrete examples for this broad range of issues, whose relevance varies according to local and regional conditions, include

- the chemical quality of water, where the national contributions based on results of the dense monitoring network in place show for most surface waters and groundwater a low level of pollution due to (comparatively) low(er) pressures. Additionally, mitigation measures were already taken in the past and low concentrations of pollutants can also be explained by the high dilution of chemical substances due to high precipitation and river discharges.

  Nevertheless, some problems were reported, mainly localized on the outskirts of the Alpine region in areas with industry, intensive land use and agriculture.

- problems with regard to the availability of water. The overall picture provides real abundance of water due to high precipitation in the entire region, which as a consequence is characterized as "The Water Tower of Europe". Nevertheless, the submitted national reports, case studies and scientific studies cited clearly reveal the existence of problems occurring at local level in the Alpine Region, leading to conflicts among water users and to negative ecological impacts. The reasons for this may be quite diverse, covering the full range of water abstraction - from irrigation purposes, the production of artificial snow, drinking water supply in times of touristic high seasons paired with natural low water availability in winter or periods of occasional droughts in summer. This is particularly relevant in the Southern part of the Alps, also as a consequence of climate change.

Major water management issues

Having a look at the entire Alpine region, the assessment of the national contributions in the previous chapters provides a clear picture of the major water management issues and efforts which are shared by all Alpine countries or at least by most of them. In particular they include the overriding need

- to provide **integrated risk management against natural hazards,** as the high expenses made each year for this particular field indicate,

- for EU Member States to **implement and update river basin management plans** according to the time schedule of the EU Water Framework Directive including coordination with non EU countries,

- to find ways and approaches to **use hydropower without impairing excessively river ecology** and river hydro-morphology, with a particular focus on

preserving the remaining rivers and river stretches which are still unspoilt,

- to **remediate hydro-morphological impacts of the past** due to flood protection measures and hydropower plants and here in particular, to restore river continuity, to improve lateral connectivity of rivers with their surrounding terrestrial habitats and groundwater bodies, to provide an ecological sound amount of residual water, to reduce the negative effects of hydro- peaking and last but certainly not least

- to **adapt to the consequences of climate change** in spite of all efforts to mitigate the causes of the ongoing change. Based on modelling results it is predicted – depending on the contemplated region – that more or less pronounced changes will occur in temperature and precipitation and thereof resulting impacts on the water balance. Forecasted changes may therefore

  - increase the risk and impact of natural hazards, including in particular floodings and, where relevant, rock falls due to the warming up of permafrost, and therefore require enhanced efforts for integrated risk management beyond the already high level of efforts,

  - increase periodical problems with droughts and water scarcity - in particular in the southern and south-eastern parts of the Alpine range - which may require enhanced efforts in the management of water quantity and paying attention to downstream needs,

  - impact water availability due to changing runoff from glaciers and snow-cover,

  - impact the already exploited amount of hydropower generation via changes in the water balance as well as efforts to increase hydropower generation in line with the EU target of increasing energy efficiency, reducing greenhouse gas emissions and increasing the share of renewable energy each by 20%, thus potentially endangering those river stretches close to natural conditions,

  - have an impact because of increased pressures (like artificial lakes and related skiing infrastructures), including increased water and energy demand for artificial snow production.

Main challenges for the future

In order to assess the need for action, it is necessary to take note of the current situation in terms of policy response to the main identified issues.
With regard to **natural hazards,** as demonstrated in the report, technical approaches and solutions have been in place for some time to find a sound balance between the ecological needs of rivers and new flood protection measures. The concept of providing more "space for the river" is state-of-the-art and put into place with the exemption where a lack of space is imposing clear limits.

The same applies to the **hydropower** sector. As shown in the report, viable approaches can lessen impacts on river ecology and are already in place or on the way for the hydropower sector and can be taken as inspiring examples for other hydropower plants built in the past. Ecological sound residual water requirements and fish passes, tailor-made for the local situation, have gradually become standard and state-of-the-art for authorisations of new water use grants and installations or prolongations of existing consents.

Overall, the review of the legal framework in chapter E has revealed that a broad range of **key water legislation has been put in place** since the adoption of the Alpine Convention in 1991.

The new frame is largely based on EU water legislation for EU member states. The approach followed by Switzerland is also taking into account the vision of "Integrated Water Resource Management" as this is the case for EU countries as well. Key acts include legislative instruments for targeting point as well as diffuse sources of pollution next to EU legislation on Environmental Impact Assessment.

According to the EU Water Framework Directive, clear ecologically oriented targets, tailor-made to the specific type of surface waters have to be met within an ambitious timeframe. Its objective of no deterioration of the status of surface and groundwater and its broad legal frame for water management are already in place or on the way of implementation. The hydrological basin, which the Water Framework Directive is addressing as a management unit, is considered as the ideal spatial reference and as a milestone for modern water management. Furthermore, the explicitly type-specific approach is sufficiently differentiating the special conditions of Alpine countries.

Furthermore – complementary to this new legal frame - a **comprehensive set of bi and multilateral agreements** ensures transboundary as well as basin wide multilateral coordination of approaches and solutions to water management issues.

Last but not least, an additional set of provisions already enshrined within the frame of the **Protocols to the Alpine Convention** are also targeting specific water issues (e.g. hydropower production in the energy Protocol; artificial snow production in the tourism Protocol). The assessment of the existing legal framework (EU legislation, bi and multilateral Conventions such as the Alpine Convention) shows that, **overall, a comprehensive set of provisions and instruments is in place.**

Against this set of legislation in place and taking into account ongoing work on river basin management in line with the provisions of the EU water framework Directive, it emerges that the **identified challenges can be tackled by making use of the existing instruments.**

Rather than producing a new water specific piece of legislation for the Alpine region at this stage in order to overcome potential gaps resulting from a lack of ratification of Protocols or from a lack of implementation of EU legislation, it is of major importance to **ensure that implementation efforts of the existing rules are continued and intensified** in order to properly reflect the variety and intensity of issues at stake in the different Alpine regions.

By way of conclusion, the following can be recommended:

- To **ensure the proper implementation and reinforce implementation means of existing legislation** (including inter alia socio-economic aspects resulting from Article 7 of the Energy Protocol, Article 11 of the Protocol on Spatial Planning and recovery of costs for water services - Article 9 Water Framework Directive),

- to follow up the **implementation of the EU Water Framework Directive with the focus on hydromorphology,** river continuity and to achieve synergies in relation with the need to provide more space for rivers; but equally taking into account, when setting up the River Basin Management Plans, the need to adapt to the impacts of climate change as recommended in the CIS policy paper on climate change of the EU water directors and the European Commission from June 2008,

- to **assess the ongoing developments in the hydropower sector** and the benefits resulting from a further exploitation for hydropower generation against their impact on nature and hydro-morphology. By doing this, particular attention should be paid to the assessment of small hydropower plants and their relative contribution to meet targets of renewable energy production,

- to consider already available knowledge on effects of climate change when designing new installations with a long life time such as hydro power plants or flood protection works in order to make them "climate proof",

- to **quantify the effects of climate change on water management** issues in more detail, to adapt interregional models to the high diversity of conditions in the different regions within the Alpine perimeter and in particular to translate forecasted changes of temperature and precipitation into hydrological parameters (e.g. river flows) for the entire network of surface waters and finally

- to **further enhance cooperation of the scientific community** on ongoing efforts and involvement of the whole water management sector also with the view to find viable approaches on how to deal with Alpine research in the future.

An idea emerging from the conference in Munich and considered worthwhile to be pursued was the setting up of a **platform for water management**, similar to PLANALP, which could inter alia serve for the exchange of best practice examples or for a proper follow-up of recommendations listed above. The official decision for the creation of the platform was adopted in March 2009 at the Xth Alpine Conference.

A broad range of additional potential issues which could be addressed within this platform has been put forward in the Munich conference in the comments received thereafter. Such proposals cover inter alia the elaboration of guidelines for ecological and economical aspects of hydropower generation, guidelines for residual water, an enhanced involvement and closer co-operation between the research communities and administration in water issues with regard to climate change and bio-diversity, a review of forthcoming River Basin Management Plans whether Alpine specific issues have been taken into account appropriately or the extension of monitoring networks. The platform will comprise of the representants of the Parties of the Alpine Convention as well as relevant active stakeholders in science, economy and NGOs.

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Photo F-1: Pristine waters of the Alps are the treasury of Europe for coming climate change water shortages. Alpine water treasure. Dvojno jezero, Triglav National Park, Slovenia.

Tab. E-1: Existing Legal Framework Concerning Water Management

EXISTING LEGAL FRAMEWORK CONCERNING WATER MANAGEMENT			
Category	**Topic**	**EU Legislation in Place for Austria, France/Monaco, Germany, Italy, Liechtenstein and Slovenia**	**Similar National Legislation in Switzerland**
General Framework	Framework in the Field of Water Policy	- Directive 2000/60/EC - Water Framework Directive	- Article 76 of the Swiss Federal Constitution of 18.04.1999 (SR 101) - Federal Law on Water Protection of 24.01.1991 (SR 814.20)
	Assessment and Management of Floods	- Proposal for a Directive on the Assessment and Management of Floods	- Federal Law on Hydraulic Engineering of 21.06.1991 (SR 721.100) - Ordinance on Hydraulic Engineering of 2.11.1994 (SR 721.100.1)
	Nature Protection and Conservation	- Directive 85/337/EEC - Assessment of the Effects of Certain Projects on the Environment - Directive 92/43/EEC - Habitats Directive Directive 79/409/EEC - Birds Directive - Directive 2001/42/EC (SEA Directive)	- Federal Law relating to the Protection of the Environment of 7.10.1983 (SR 814.01) - Ordinance on Environmental Impact Assessment of 19.10.1988 (SR 814.011) - Federal Law on the Protection of Natural and Cultural Heritage of 1.07.1966 (SR 451) - Federal Law on Hunting of 20.06.1986 (SR 922.0) - Ordinance on Hunting of 29.02.1988 (SR 922.01) - Federal Law on the Protection of Natural and Cultural Heritage of 1.07.1966 (SR 451)
Specific Uses of Water	Drinking Water	- Directive 98/93/EC on the Quality of Water Intended for Human Consumption	- Annex 2 letter 2 of the Water Protection Ordinance of 28.10.1998 (SR 814.201) - Law on Foodstuffs of 9.10.1992 (SR 817.0) - Federal Department of the Interior Ordinance on Drinking Water, Water from Sources and Mineral Water of 23.11.2005 (SR 817.022.102) - Ordinance on Foreign Substances and Content Substances of 26.06.1995 (SR 817.021.23)
	Bathing Water	- Directive 2006/7/EC - Management of Bathing Water Quality and Repealing Directive 76/160/EEC	- Water Protection Ordinance of 28.10.1998 (SR 814.201)
	Water Suitable for Fish-Breeding	- Directive 2006/44/EC - Fish-Breeding Directive	- Federal Law on Fisheries of 21.06.1991 (SR 923.0) - Ordinance concerning the Federal Law on Fisheries, of 24.11.1993 (SR 923.01)
Release of Substances	Quality of Surface Water	- Proposal for a Directive on Environmental Quality Standards Decision 2455/2001/EC - List of Priority Substances	- Federal Law on Water Protection of 24.01.1991 (SR 814.20) - Water Protection Ordinance of 28.10.1998 (SR 814.201)
	Protection of Groundwater	- Directive 2006/118/EC - Groundwater Directive Directive 80/68/EEC - Protection of Groundwater Against Pollution Caused by Certain Dangerous Substances	- Federal Law on Water Protection of 24.01.1991 (SR 814.20) - Water Protection Ordinance of 28.10.1998 (SR 814.201)
	Urban Waste Water	- Directive 91/271/EC - Urban Waste Water Treatment Directive	- Federal Law on Water Protection of 24.01.1991 (SR 814.20); - Water Protection Ordinance of 28.10.1998 (SR 814.201)
	Pollution from Agricultural Sources	- Directive 91/676/EEC - Nitrates Directive - Directive 86/278/EEC - Sewage Sludge Directive - Directive 91/414/EEC - Plant Protection Products	- Federal Law on Water Protection of 24.01.1991 (SR 814.20) - Water Protection Ordinance of 28.10.1998 (SR 814.201) - Annexes 2.5 and 2.6 of the Ordinance on Chemical Risk Reduction of 18.05.2005 (SR 814.81)
	Others	- Directive 96/61/EC - IPPC Directive - Directive 2006/11/EC - Dangerous Substances - Directive 96/82/EC and Amending Directive - Seveso Directive - Directive 2006/507/EC - Persistent Organic Pollutants	- Federal Law relating to the Protection of the Environment of 7.10.1983 (SR 814.01) - Ordinance on Chemical Risk Reduction of 18.05.2005 (SR 814.81) - Ordinance on Protection against Major Accidents of 27.02.1991 (SR 814.012) - Ordinance on Chemical Risk Reduction of 18.05.2005 (SR 814.81)

Tab. E-2: Bi- and Multilateral Agreements for Trans-Boundary and Basin-Wide Water Management in the Alpine Area

Bi- and Multilateral Agreements for Trans-Boundary and Basin-Wide Water Management in the Alpine Area					
#	**Contracting States (of AC-Countries)**	**Waters**	**Year**	**Title of agreement**	**Commission**
1	A, CH, D, FL	Lake Constance	1960	Übereinkommen über den Schutz des Bodensees gegen Verunreinigungen (Agreement for the protection of Lake Constance against pollution)	Internationale Gewässerschutzkommission für den Bodensee http://www.igkb.de/ (International commission for the protection of Lake Constance)
2	A, CH	River Inn	2003	Abkommen zwischen der Republik Österreich und der Schweizerischen Eidgenossenschaft über die Nutzbarmachung des Inn und seiner Zuflüsse im Grenzgebiet (Agreement between the Federal Republic of Austria and the Swiss Confederation on the utilisation of the river Inn and its tributaries in the border region)	Österreich-Schweizerische Kommission für die gemeinsame Nutzung des Oberen Inn (Austrian-Swiss commission for the common use of the upper Inn)
3	A, CH	River Alpenrhein	1892	Staatsvertrag zwischen der Schweiz und Österreich-Ungarn über die Regulierung des Rheines von der Illmündung stromabwärts bis zur Ausmündung desselben in den Bodensee (Treaty between Switzerland and Austria-Hungary on the regulation of the river Rhine from the estuary of the river Ill downstream to Lake Constance)	Internationale Rheinregulierung http://www.rheinregulierung.at/ (International regulation of the river Rhine)
4	A, I, D, SL (CH*) *cooperation	River Danube	1998	Übereinkommen über die Zusammenarbeit zum Schutz und zur verträglichen Nutzung der Donau (Donauschutzübereinkommen) (Agreement on the co-operation for the protection and the reconcilable utilisation of the River Danube)	Internationale Kommission zum Schutz der Donau http://www.icpdr.org/ (International commission for the protection of the Danube river)
5	A, D	Danube Catchment	1991	Vertrag zwischen der Republik Österreich einerseits und der Bundesrepublik Deutschland und der Europäischen Wirtschaftsgemeinschaft andererseits über die wasserwirtschaftliche Zusammenarbeit im Einzugsgebiet der Donau (Treaty between the Federal Republic of Austria on the one hand and the Federal Republic of Germany and the European Economic Community on the other hand concerning the co-operation in the field of water management regarding the river Danube catchment area)	Ständige Gewässerkommission nach dem Regensburger Vertrag (Standing commission for water protection according to the treaty of Regensburg)
6	A, SL	River Drau	1954	und der Regierung der Föderativen Volksrepublik Jugoslawien über wasserwirtschaftliche Fragen an der Drau vom 25. Mai 1954, welches am 15.01.1955 in Kraft getreten ist (Agreement between the Federal Republic of Austria and the Federal Government of the People's Republic of Yugoslavia on water management questions at the Drava river from 25th May 1954, coming into force on 15th January 1955)	Österreichisch-Slowenische Kommission für die Drau (Austrian-Slovenian commission for the Drava river)

Tab. E-2: Bi- and Multilateral Agreements for Trans-Boundary and Basin-Wide Water Management in the Alpine Area

Bi- and Multilateral Agreements for Trans-Boundary and Basin-Wide Water Management in the Alpine Area					
#	**Contracting States (of AC-Countries)**	**Waters**	**Year**	**Title of agreement**	**Commission**
	A, SL	River Drau	1993	Notenwechsel zwischen der Österreichischen Bundesregierung und der Regierung der Republik Slowenien betreffend die Weiteranwendung bestimmter österreichisch-jugoslawischer Staatsverträge (Exchange of notes between the Federal Republic of Austria and the Government of the Republic of Slovenia on the ongoing appliance regarding certain Austrian-Yugoslavian treaties)	
7	A, SL	River Mur	1956	Abkommen zwischen der Republik Österreich und der Föderativen Volksrepublik Jugoslawien über wasserwirtschaftliche Fragen der Mur-Grenzstrecke und der Mur-Grenzgewässer (Mur-Abkommen) (Agreement between the Federal Republic of Austria and the Federal People's Republic of Yugoslavia on water management questions regarding the river Mur borderline and the river Mur border-watercourses (Mur agreement)	Österreichisch-Slowenische Kommission für die Mur Austrian-Slovenian commission for the river Mur
8	F, CH	Lake Geneva	1963	Abkommen zwischen dem Schweizerischen Bundesrat und der Regierung der Französischen Republik betreffend den Schutz der Gewässer des Genfersees gegen Verunreinigung (Agreement between the Swiss Federal Council and the French Republic on the protection of Lake Geneva against pollution)	CIPEL : Commission internationale pour la protection des eaux du Léman (http://www.cipel.org) (International Commission for the Protection of Lake Geneva)
9	I, CH	Italian-Swiss-Waters	1972	Abkommen zwischen der Schweiz und Italien über den Schutz der schweizerisch-italienischen Gewässer gegen Verunreinigung (Agreement between the Swiss Confederation and the Italian Republic on the protection of the Swiss-Italian Waters against pollution)	CIPAIS: Commissione Internazionale per la Protezione delle Acque Italo-Svizzere (http://www.cipais.org/) (International Commission for the Protection of the Italian-Swiss Waters)
10	CH, F, D, L, NL	River Rhine	1999	Übereinkommen zum Schutz des Rheins (Convention on the Protection of the Rhine)	IKSR - Internationale Kommission zum Schutz des Rheins http://www.iksr.org/ (International Commission for the Protection of the Rhine)
11	CH, F	River Doubs	1993	Abkommen zwischen dem Schweizerischen Bundesrat und der Regierung der Französischen Republik über die Ausübung der Fischerei und den Schutz des aquatischen Lebensraumes im Grenzabschnitt des Doubs (Agreement between the Swiss Federal Council and the French Republic on the exercise of fishery and the protection of aquatic environment in the border section of the River Doubs)	Commission internationale pour la pêche dans le Doubs (International Commission on the fishery in the River Doubs)
12	CH, A, FL	River Alpenrhein	1998	Kooperationsvereinbarung Alpenrhein (Cooperation agreement Alpenrhein)	nternationale Regierungskommission Alpenrhein http://www.alpenrhein.net/ (International governmental commission for the Alpenrhein)

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