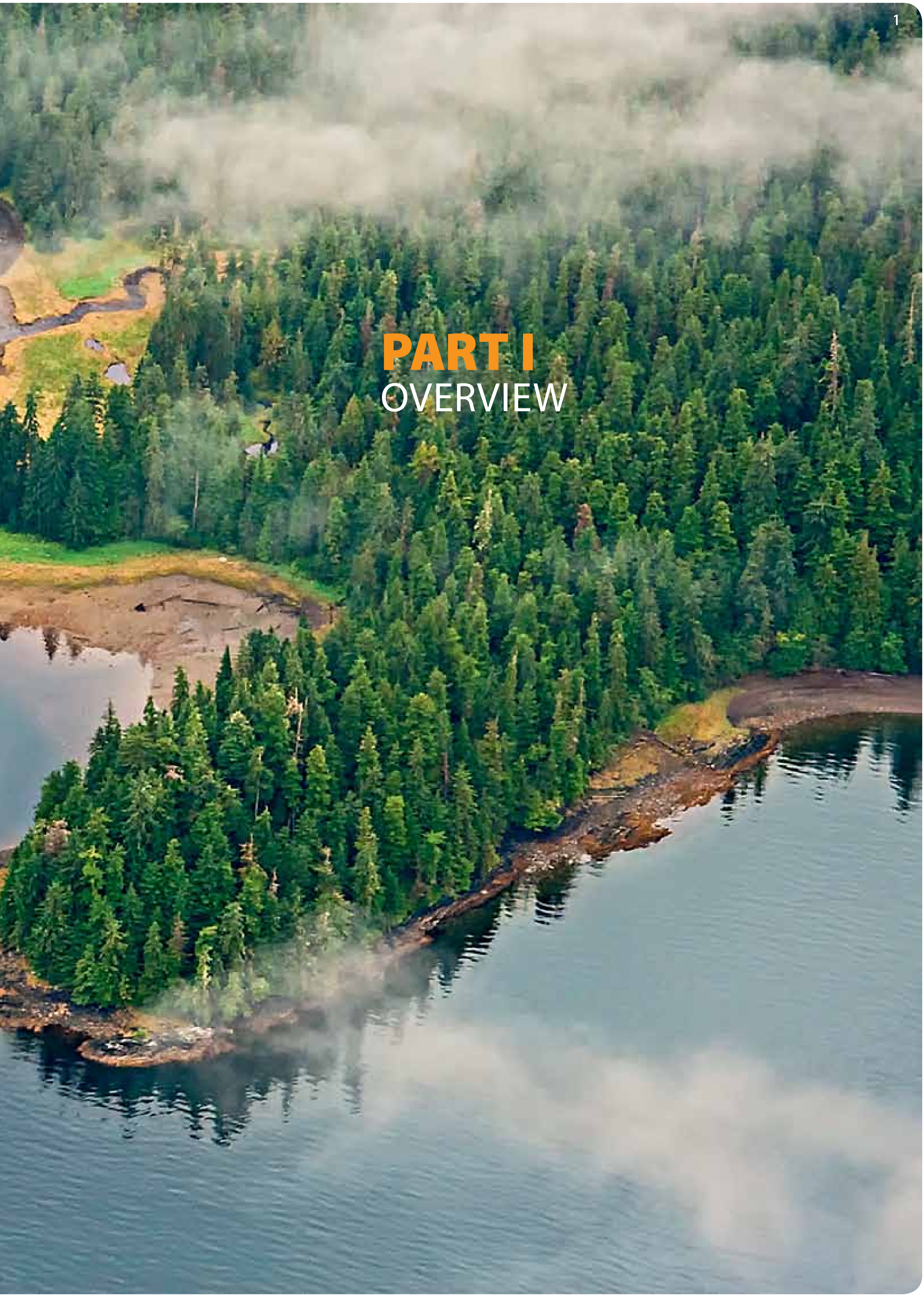
PART I
OVERVIEW



BACKGROUND

Transboundary waters play a key role in the United Nations Economic Commission for Europe (UNECE) region. Their basins cover more than 40% of the European and Asian surface of the UNECE region and are home to about 460 million inhabitants — more than 50% of the European and Asian population of UNECE. They link populations of different countries, are important ecosystems and their services are the basis for the income for millions of people and create hydrological, social and economic interdependencies between countries. Thus, their reasonable and sustainable management is crucial for peoples' livelihoods and well-being in the whole region.

The UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (Water Convention) promotes cooperation on transboundary surface and groundwaters and strengthens their protection and sustainable management. Under the Water Convention, riparian Parties shall, at regular intervals, carry out joint or coordinated assessments of the conditions of transboundary waters and the effectiveness of measures taken to prevent, control and reduce transboundary impacts. The results of these assessments shall be made available to the public. The assessment of resources is of fundamental importance, as it forms the basis for rational planning and decision-making.

The Second Assessment of Transboundary Rivers, Lakes and Groundwaters is the most comprehensive, up-to-date overview of the status of transboundary waters in the European and Asian parts of the UNECE region. It has been prepared upon request by the Sixth "Environment for Europe" Ministerial Conference as an input for the Seventh Ministerial Conference in Astana in September 2011. The Second Assessment has been carried out under the auspices of the Meeting of the Parties to the Water Convention, under the overall leadership of Finland, with the Finnish Environment Institute providing technical and substantial guidance to the whole process.

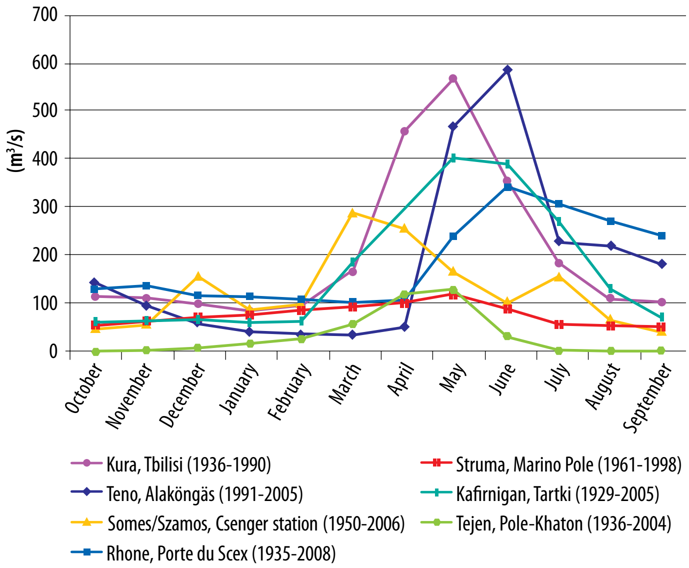
Utilizing data and information provided by national Governments and river commissions, the Second Assessment presents a broad analysis of transboundary water resources, pressure factors, quantity and quality status, transboundary impacts, as well as responses and future trends. It aims to inform, guide and spur further action by national and local authorities, joint bodies and international and non-governmental organizations to improve the status of transboundary waters and related ecosystems.

A DIVERSE REGION

The Assessment highlights great diversities in the natural availability of water resources, pressures, status and responses in the different transboundary basins. Such differences and specificities also reflect the great economic and social differences within the region, which strongly influence both the pressures and status of the water resources as well as the capacity of countries to implement management responses.

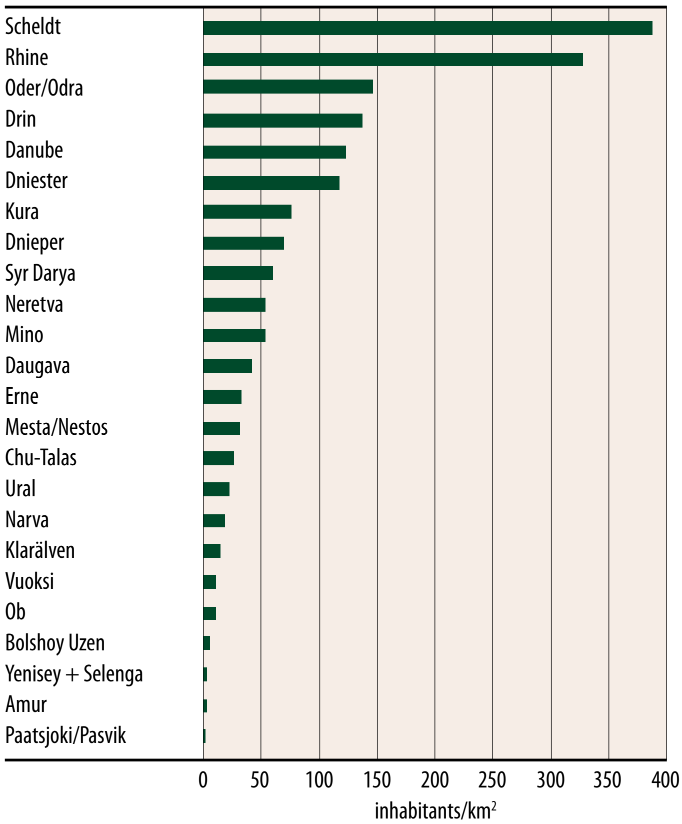
In the area that extends from the arid parts of Central Asia to the humid temperate areas of Western Europe and from the Mediterranean to the Northern European tundra zone, natural water availability varies significantly, even though people influence it through withdrawals, diversions and storage. In addition to the climate, the seasonal distribution of flow in rivers depends heavily on their sources: the rivers that receive much of the flow from snow-melt commonly have a pronounced spring flooding period. In glacier-fed rivers from high mountains the higher flow is better sustained well into the summer. Rivers with an important base flow (groundwater contribution) or with big lakes in their basin are more stable providers of water. Depending especially on the catchment characteristics and intensity of rainfall, relatively stable flow or short-duration flooding may result in rain-fed rivers. The beds of rivers flowing into desert sinks may be dry for a significant part of the year. The seasonal water availability situation is further influenced by climate variability and change. Consequently, the water management challenges vary in time and space.

MONTHLY DISCHARGES OF SELECTED RIVERS IN THE UNECE REGION



Population density varies greatly in the UNECE region and in the different transboundary basins: ranging from 300 inhabitants/km² and above for the most populated basins (the Scheldt and the Rhine) to less than 10 inhabitants/km² in some basins in Northern Europe and Central Asia.

POPULATION DENSITY IN SELECTED BASINS (INHABITANTS/KM²)



Moreover, the diversity of demographic developments is reflected in the evolution of population trends over time. Between 1960 and 2010, several subregions have experienced considerably high growth rates: Central Asia, with a more than 145% population increase; the Caucasus, with a 65% increase; and South-Eastern Europe, showing a 75% increase. On the other hand, for most countries in Western and Central Europe, there is a trend towards stable or even declining populations.

The region is also highly diverse with respect to patterns of economic development. Some of its countries are among the richest in the world, while others — particularly those whose economies have been in transition since the 1990s — are still catching up. Per capita levels of gross domestic product (GDP) vary widely. While for the European Union (EU), the average GDP per capita at prices and purchasing power parities is about 30,000 USD, the average for countries in Eastern Europe, the Caucasus and Central Asia and the Balkans is around a third of that, and for several countries in the Caucasus and Central Asia the GDP per capita can be less than a sixth of this figure. Countries with transition economies experienced a major collapse in economic activity in the early 1990s. By 2010, two decades after the transition period began, some of the countries in Eastern Europe, the Caucasus and Central Asia as well as South-Eastern Europe have increased their per capita incomes approximately 50% above their 1990 levels. However, the majority has only returned to something similar to their 1990 level, while a few economies (Georgia, the Republic of Moldova, Serbia, Tajikistan, and Ukraine) remain 30 per cent or more below that level.

Finally, a factor that has a strong impact on the social and economic situations, on water and the environment, and, above all, on transboundary water cooperation, is the significant number of past — and in some cases still frozen — political conflicts, including in the Balkans, the Republic of Moldova and the Caucasus, and to a lesser degree in Central Asia.

ADVANCEMENT OF TRANSBOUNDARY COOPERATION

Compared with other regions in the world, the UNECE region is the most advanced in terms of cooperation on transboundary waters. Almost all concerned countries have taken measures to establish transboundary water cooperation on their shared waters, have entered into bilateral and multilateral agreements and have established joint bodies to facilitate transboundary water cooperation. Much of this progress has been facilitated by the UNECE Water Convention.

However, the level and effectiveness of cooperation varies in the region. Transboundary water agreements range from specific technical ones only covering a part of a basin — e.g. boundary waters — to broad agreements covering the whole river basin and addressing a wide spectrum of water management and environmental protection issues.

Also, the competences of joint bodies vary: with time and trust they tend to expand to include new areas and an increasing environmental mandate, so as to enable joint bodies and riparian States to implement the basin approach and the principles of integrated water resources management (IWRM).

Despite the overall progress, on some major transboundary rivers there is still a need for an agreement covering the whole basin, and for a joint body to facilitate basin-wide cooperation. In other cases, the level of cooperation is weak and not suited to respond to the complex challenge of balancing competing uses, including environmental protection needs.

Therefore, the role of the Water Convention to support UNECE countries in their efforts to improve transboundary cooperation, progress towards the conclusion of agreements, establish or strengthen joint bodies and address emerging issues of transboundary cooperation is important. That role will acquire an additional dimension with the entry into force of the amendments opening the Convention to countries outside the UNECE region, thereby facilitating also the cooperation with non-UNECE countries sharing waters with UNECE countries.

CLIMATE CHANGE

Recognizing the threats from climate change, the Second Assessment seeks to provide a picture of the predicted impacts on transboundary water resources, as well as the measures planned or in place to adapt to climate change.

Climate change impacts will vary considerably across the region and even from basin to basin. Yearly and seasonal water availability is projected to change significantly in the coming decades, and increased precipitation intensity and variability will increase the risks of floods and droughts. Mountainous areas will face glacier retreat and reduced snow cover. In Southern Europe, the Caucasus and Central Asia, climate change is projected to lead to high temperatures, droughts and water scarcity. In Central and Eastern Europe, summer precipitation is projected to decrease, causing higher water stress. In Northern Europe, a general increase in precipitation is projected.

Through the related changes in water resources, these impacts will have far-reaching effects on society. Economic sectors which are projected to be most affected are agriculture (increased demand for irrigation), forestry, energy (reduced hydropower potential and cooling water availability), recreation (water-linked tourism), fisheries and navigation. Serious impacts on biodiversity also loom.

UNECE countries are at different stages of developing and implementing adaptation strategies. But while efforts to plan and evaluate the options for adaptation at the national level are being carried out in most of the countries, such efforts are ongoing only in a few transboundary basins. Downscaling impacts of climate changes at the basin level is a common challenge.

ECOLOGICAL AND BIODIVERSITY ISSUES

A major innovation of the Second Assessment is the specific attention devoted to ecological and biodiversity issues, through the assessment of 25 Ramsar Sites[1] and other wetlands of transboundary importance.

In spite of important progress made in recent decades in their protection and management, wetlands continue to be among the world's most threatened ecosystems, mainly due to ongoing drainage, conversion, pollution, and over-exploitation of their resources. Instead, wetlands should be recognized as a natural infrastructure essential for the sustainable provision of water resources and related ecosystem services. Using a wetland wisely means to maintain its ecological character (i.e., the combination of the ecosystem processes, components and services) through the implementation of the ecosystem approach. In this respect, transboundary cooperation is crucial where functional units of wetland ecosystems stretch across national (or administrative) borders.

The selected sites in the Second Assessment, which have been assessed by the Ramsar Convention secretariat in close cooperation with experts on these sites, illustrate different degrees of transboundary cooperation in managing wetlands. In some cases, two or even three bordering countries have agreed to cooperate in the management of their shared wetland. Some Ramsar Sites included in the assessment have been declared by one country but extend into the territory of another country where they are not yet protected. Other Ramsar Sites have been included which have been designated separately on each side of the border, but miss a joint official designation as a transboundary wetland to enable joint management of the ecosystem.

[1] A site included on the List of Wetlands of International Importance under the Convention on Wetlands of International Importance, especially as Waterfowl Habitat (Ramsar Convention).

MAIN SUBREGIONAL FINDINGS

To reflect the great diversities of the UNECE region, the Second Assessment has a strong subregional focus and highlights characteristics and specificities of five UNECE subregions: Western and Central Europe; South-Eastern Europe; Eastern and Northern Europe; the Caucasus; and Central Asia.

These, partly overlapping, subregions were defined for the purposes of the Assessment. The criteria for their delineation are not based on political boundaries but rather with a view to taking into account similarities of water management issues in the transboundary basins. Yet, even within these subregions big differences are observed.

WESTERN AND CENTRAL EUROPE

Background, water management issues and responses

For historical reasons, also linked to the economic development around main navigation waterways, transboundary water cooperation has a long tradition in Western and Central Europe. Many bilateral, river basin, and lake agreements have existed for decades, most of them based on the Water Convention. River commissions for the large river basins and lakes — the Danube, Rhine, Moselle and Saar, Meuse, Oder, Elbe, Scheldt, Lake Constance and Lake Geneva/Lac Léman — have evolved into very effective forums of cooperation.

There are many transboundary wetland areas in the subregion, which is also the most advanced in terms of transboundary cooperation in this field: of the 13 officially designated transboundary Ramsar Sites worldwide, 6 are in Western and Central Europe.

The EU Water Framework Directive (WFD)[2] has had a very positive impact and has been a strong driver for promoting IWRM, in particular through the requirement to develop and publish, by December 2009, the first River Basin Management Plans, and to establish programmes of measures. Non-EU countries in the subregion, Norway and Switzerland, also implement the WFD, or pursue comparable aims in their approaches to water management.

The underlying causes of water pollution in Western and Central Europe are diverse and vary considerably across the subregion. The dominant pressures are agricultural activities, the urban environment and the legacy of the industrial development history of the subregion. In some parts of the subregion, landfills, forest exploitation, mining, aquaculture and inefficient wastewater treatment are all causes of water and environmental pollution.

Agricultural activities dominate land use in most of the large transboundary river basins and constitute a significant pressure on both the quality and quantity of water resources. Diffuse pollution from nitrogen and phosphorus fertilizers and pesticides remains a major cause of impaired water quality. From the quantity point of view, the increased abstraction of groundwater for irrigation in southern countries (where agriculture constitutes the largest consumptive user of water) has resulted in a decline in water levels, salt water intrusion and the drying up of wetlands. Illegal water abstraction, particularly from groundwater for agricultural use is still widespread in some countries.

The Urban Wastewater Treatment Directive[3] and comparable legislation in non-EU countries have improved, and will further improve, water quality with respect to nutrients and other substances. Implementation of these legislations has not only led to a higher collection rate of wastewaters, but also driven improve-

ments in the level of wastewater treatment over recent years. The majority of wastewater treatment plants in Northern and Central Europe now apply tertiary treatment, although elsewhere in the EU, particularly in the south-east, the proportion of primary and secondary treatment remains higher. Thanks to the measures taken, downward trends in organic and nutrient pollution are evident in most of the transboundary waters in the subregion; however these trends have levelled in recent years and eutrophication remains widespread. Moreover, the discharge of micropollutants via wastewater treatment plants and diffuse sources constitutes an emerging challenge for water protection.

In order to reduce industrial pollution, significant efforts have been made by industries to reduce water use and pollution loads by recycling, changing production processes and using more efficient technologies to help reduce emissions to water. Coal and iron mining remains a major pressure impacting on surface and groundwaters in some river basins.

Almost all of the transboundary river basins experience hydromorphological changes as a major pressure, often extending back to the industrial development of the subregion. These structural changes take two main forms — riverbed straightening and maintenance to enable navigation, gain exploitable land and prevent flooding, and the construction of dams for electricity generation, flood protection, flow regulation or water supply, or combinations of these objectives. These changes disturb the natural flow and sed-

[2] Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy.
[3] Council Directive 91/271/EEC of 21 May 1991 concerning urban waste-water treatment.

TRANSBOUNDARY SURFACE WATERS IN WESTERN AND CENTRAL EUROPE

Map produced by ZOÏ Environment Network, July 2011

iment regime of rivers, hinder the achievement of good ecological status objectives, destroy habitats for fish and other water organisms and prevent fish migration. As a result, many rivers have been disconnected from their flood-plains and the hydrological regimes of many wetland systems have been heavily altered in the past. An important cause of hydromorphological changes is the hydropower sector. In 2008, hydropower generated 16% of Europe's electricity, and there are currently more than 7,000 large dams in Europe and a number of large reservoirs. Hydropower has been a particularly dominant aspect of industrial development in the northern and Alpine countries. To reduce the impacts of hydromorphological changes, numerous restoration projects are under way aiming to restore habitats, river continuity (e.g., to facilitate fish migration) and biodiversity. The water retention and flood protection function of flood-plains is also increasingly recognized.

Water availability varies and populations are unevenly distributed through the subregion and within countries. Water scarcity occurs widely in the southern parts of the subregion, where demand is often met by water transfers from other river basins, water reuse and desalination. Also in the rest of the subregion, large areas are affected by water scarcity and droughts: a comparison of the impacts of droughts in the EU between 1976–1990 and 1991–2006 shows a doubling of both the area and the population affected.[4]

Climate change is projected to lead to significant changes in yearly and seasonal water availability. Water availability is predicted to increase generally in the north, whereas southern areas, which already suffer most from water stress, are likely to be at risk of further reductions in water availability, with increasing frequency and intensity of droughts.[5] Rising temperatures are expected to change the seasonal flow distribution of rivers by pushing the

[4] *Source:* The European Environment: State and Outlook 2010. European Environment Agency.

[5] *Source:* Impacts of Europe's changing climate — 2008 indicator-based assessment. EEA-European Commission Joint Research Centre-World Health Organization (WHO). 2008.

snow limit in the northern and mountain regions upwards and reducing the proportion of precipitation which falls as snow. This will in turn decrease the level of winter water retention and increase winter flows in many rivers.

Furthermore, climate change may induce changes in land use, agricultural activities and cropping patterns, with rising temperatures resulting in the northward extension of cultivation of a whole range of crops. Hotter and drier summers are likely to increase the demand for irrigation, reduce river flows, and reduce dilution capacity thereby leading to higher pollutant concentrations. Despite these concerns, the subregion seems to have the capacity to adapt to the impacts of climate change. Many promising first steps have been taken, notably in several of the major transboundary basins — the Danube, Rhine and Meuse.

The way forward

Cooperation on shared waters is generally advanced in Western and Central Europe. However, in transboundary basins where international cooperation is less established and joint bodies/river commissions are less effective, implementation of the WFD has been limited to the national borders or, at the basin level, has mostly involved the preparation of separate national plans without real coordination and cooperation. Further efforts are needed to strengthen cooperation in the implementation of the WFD in transboundary basins. This is even truer for transboundary groundwaters, starting from the joint designation of transboundary groundwater bodies.

The legislative framework for water protection is generally well established across the subregion and its implementation has resulted in a general improvement in the quality of water resources and the environment in general. Efforts need to be exerted to attain full compliance with this legislation and longer-term political and financial commitment will be needed to achieve the desired environmental objectives, given that a substantial proportion of water resources in the subregion are at risk of not achieving a good status by 2015, as required by the WFD.

Water scarcity and water conservation are important issues, particularly in the south where the potential for water depletion and drought is higher. Better enforcement is required to reduce the still common illegal abstraction of groundwater. Moreover, policies and measures to manage water demand — including, e.g., water pricing, water reuse and recycling — need to be developed further and put in place where not yet applied.

Integration of different policies remains a challenge also in the EU and there is a risk that improvements in water management are compromised by other sectoral policies. The Swiss agricultural policy and recent reforms of the EU Common Agricultural Policy have resulted in a decoupling of agricultural subsidies from production, and the introduction of cross-compliance mechanisms to help address environmental concerns. Further reform of agricultural policies is, however, required to improve water use efficiency and irrigation practices and to reduce nutrient losses. Implementation of the Renewable Energy Directive[6] is likely to increase the cultivation of biofuel crops, which will result in the release of more nutrients into the environment and increased use of agrochemicals. Implementation of this Directive is also likely to increase demand for hydropower generation, with consequent pressures and impacts on surface waters. Adaptation policies related to climate change and long-term energy provision need to be developed to minimize the negative impacts on water resources and ecosystems, and hence to avoid simply transferring environmental problems between sectors.

SOUTH-EASTERN EUROPE

Background, water management issues and responses

Transboundary basins cover about 90 per cent of South-Eastern Europe and more than half of the transboundary waters are shared by three or more countries. Therefore, effective cooperation is crucial for regional progress on water management issues.

However, transboundary cooperation remains weak, or at best uneven. Low political prioritization of the issue, financial constraints, insufficient institutional capacity, weak information exchange and joint monitoring and, in some cases, conflicting interests between countries are the major factors behind the slow progress in this area. The transition to a market-based economy and the pursuit of economic development have also meant that sustainability-related issues are given low priority by Governments.

With regard to cooperation on transboundary groundwaters, a low level of knowledge and understanding about this type of water resource is adding to the difficulties of transboundary cooperation. Regionally, there seems to be less information available about aquifers (compared to surface waters), in terms of quantity and quality. This is particularly true for karst systems, widespread in the Balkans, for which the delineation of the aquifers boundaries is an additional challenge.

A number of agreements on water resource management and joint bodies do exist in South-Eastern Europe, but poor implementation has so far hindered tangible results. At the same time, some positive examples of transboundary cooperation should be highlighted. Cooperation agreements for the Lake Skadar/Shkoder, Prespa Lakes and Sava River Basin have been established, with the Sava cooperation proving the most advanced so far, covering most aspects of water management as well as navigation. Another promising example is the initiation of a multi-stakeholder dialogue process between countries in the “extended” Drin River Basin aiming to create a sound framework for cooperation in the whole basin. Also, cooperation in the Danube River Basin is an example to follow: more than half of the countries in South-Eastern Europe participate in this effort and can use the experience gained in this framework for cooperation in other river basins.

At the subregional level, the EU WFD and the UNECE Water Convention are the two main frameworks that support water management and cooperation. At the national level, progress in law-making has been considerable over recent years, with new laws on water being adopted, or in the process of being adopted, in a number of countries. Nevertheless, there is still an uneven level of advancement in the implementation and enforcement of relevant water legislation across the subregion. While in EU member States water resource management is practised at the basin level pursuant to the WFD, IWRM at the basin level has only been partially adopted in countries that are not EU member States.

Levels of Government investment and financial resources allocated to wastewater treatment and collection systems vary from country to country: in general, in the areas to the north, in the Danube Basin, wastewater treatment is more efficient than in the south, where the risk of water pollution and related health hazards remain considerable. The major challenge that countries

[6] Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources.

TRANSBOUNDARY SURFACE WATERS IN SOUTH-EASTERN EUROPE

Map produced by ZOÏ Environment Network, July 2011

* United Nations administered territory under Security Council Resolution 1244 (1999).

face in this regard is the significant level of financial resources needed. Nevertheless, in several countries, municipal authorities have undertaken measures to improve wastewater treatment. Also, measures to improve urban waste management and to close down unauthorized waste disposal sites have been put into place. However, further effort is necessary in these areas.

Agricultural production remains an important source of income and employment in South-Eastern Europe. However, current methods of irrigation and farming across the subregion are placing increasing pressure on water resources. In the Aegean Sea Basin, where crop production is significant, low efficiency in agricultural water use and the loss of water through degraded networks account for a considerable part of water wastage. Furthermore, the chemical pollution of water resources, as a result of agricultural activities, is undermining the quality of waters across the subregion.

Steady growth in the subregion's manufacturing, mining and hydropower sectors has emerged as a particular environmental challenge. The uncontrolled, and often illegal, discharge of industrial wastewater from factories, mines and other manufacturing facilities is a negative consequence of this rapid period of economic development and can undermine environmental protection efforts in the subregion. Past and ongoing mining activities in many countries also contribute to the release of hazardous substances into shared water resources. Most importantly, mine-related accidents, typically resulting from heavy rains and landslides, pose significant environmental risks.

Alongside problems stemming from industrial and agricultural pressures, an increase in the burgeoning regional tourism sector has also placed additional - albeit highly seasonal - stress on water resources by increased water use, and generated higher levels of sewage and water pollution.

The extensive hydropower production constitutes another significant pressure factor in the subregion. Hydropower is a key source of energy in South-Eastern Europe, particularly in countries such as Albania, where it contributes to over 90% of the country's energy production, and where it is now a major export commodity, e.g., in Bosnia and Herzegovina.

The poor management of ageing hydropower infrastructure, notably dams, have in some cases resulted in flooding. Dam construction is also a major cause of the hydromorphological alteration of rivers and can disrupt the flow and the continuity of aquatic habitats. In addition to dams, the construction of water regulation structures such a flood protection systems - in combination with the abstraction of surface water and groundwater for agricultural, municipal and industrial use - have in many cases caused hydromorphological alterations with different impacts.

Finally, climate change is an important aspect to be taken into account for the management of water resources in the subregion. South-Eastern Europe is predicted to become increasingly affected by climate change in numerous ways. Indeed, the subregion is currently one of the most at risk of water scarcity in Europe. The Intergovernmental Panel on Climate Change (IPCC) has predicted decreased amounts of summer rainfall for the region and an increase in the frequency and severity of droughts and other extreme weather events. According to IPCC, 100-year floods are projected to occur less frequently in large parts of the region. At the same time, the frequency of flash floods is likely to increase in the Mediterranean because of the projected increased intensity of rainfall.

The way forward

There is a great potential for sharing the benefits of transboundary waters in South-Eastern Europe. However, the current level of cooperation is not suited to support such development, to ensure long-term sustainability or to prevent possible negative transboundary impacts in most of the basins.

In order to encourage political will and trust among riparian countries in South-Eastern Europe, more cooperation between countries and open dialogue between stakeholders is needed. Enhanced cooperation in the areas of water resource monitoring and assessment with a harmonized approach can be an important starting point. Joint fact-finding exercises fostering a common understanding of water issues, and their root causes, can also create a good basis upon which to build trust and to develop commonly agreed objectives and solutions.

Regional cooperation is currently facilitated by various initiatives; the support from donor countries, the EU and international organizations, in particular the Global Environment Facility (GEF), plays an important role (an example is the Petersberg Phase II/Athens Declaration Process). While support by international actors is a important driver of change, care should be taken to ensure there is no duplication of work.

The ownership of countries is also of paramount importance. While international actors help to initiate cooperation, empower institutions and establish coordination mechanisms, the responsibility remains with the riparian countries to secure the continuation of efforts and the sustainability of outcomes.

Development plans at the national level should balance the need for development with the need for the sustainable use of natural resources and environmental protection. Governments should take into account both upstream and downstream considerations factoring in, for example, the possible negative impacts on the surrounding ecosystem and evolving climatic conditions when planning new dam infrastructure and making other development plans.

The EU Accession Process has played an important role in calling for the integration of policies and supporting water management-related investments across the subregion. The transposition of EU legislation into national law, as an important mechanism through which to improve national legal frameworks, should be continued. Furthermore, the implementation of the transposed legislation should be strengthened.

However, as the process of approximation to the standards of the EU in recent years has attracted most of the limited human resources available in the countries, it has, in some instances, had adverse effects on transboundary cooperation.

The UNECE Water Convention has a special role to play in South-Eastern Europe, as it offers a common platform for EU and non-EU countries, including for exchange, knowledge transfer and creation of a common understanding. It is also a useful tool for assisting the implementation of EU water legislation by non-EU countries. Countries that have not yet done so should consider accession to the Water Convention.

EASTERN AND NORTHERN EUROPE

Background, water management issues and responses

The majority of the water resources in Eastern and Northern Europe are of a transboundary nature, with many countries in the subregion highly dependent on flows generated outside their boundaries. Such interconnectedness and related vulnerability emphasize the importance of good transboundary cooperation.

Most of the existing agreements for transboundary water cooperation were signed in the late 1990s or in the 2000s, a major exception being the Finnish-Russian agreement operating since 1960s. As the Water Convention has provided the basis for these agreements, most of them involve the establishment of joint bodies, which, in many cases, have seen their scope and mandate expand progressively with time and trust. The need to take into account the provisions of the WFD, the principles of IWRM and the obligations under the Water Convention has also triggered recent revisions and new agreements. However, on some major transboundary rivers - for instance the Bug, Daugava, Dnieper and Neman - there is still neither an agreement covering the whole basin nor an established river basin commission.

In the western part of the subregion, there are well functioning cooperation frameworks at the basin level, whereas in the eastern part, even if in many cases the legal basis for cooperation has been established, transboundary institutions are less effective and the level of cooperation is lower. The International Commission for the Protection of the Danube River (ICPDR) and the Finnish-Russian Commission stand as positive models for cooperation between EU and non-EU countries.

There are great differences in the water resources management frameworks in EU countries and their Eastern neighbours. In EU countries, requirements for the status of water resources are defined through the environmental objectives of the WFD, which also sets the schedule of measures to be taken. The obligation to publish by December 2009 the first River Basin Management Plans has been a strong driver for EU member States to strengthen water management.

In Eastern Europe — Ukraine and the Republic of Moldova stand out as examples — the water resources policy emphasizes meeting the economic needs of the society. Even if water management continues to be influenced by the Soviet legislative and institutional legacy, non-EU countries are progressively making efforts to align their legislation to EU standards and to acknowledge the importance of IWRM. But implementation in practice is limited. National institutional problems remain to be solved and little coordination and integration between national organizations involved in the management of water resources exists, for example, between the agencies managing

TRANSBOUNDARY SURFACE WATERS IN EASTERN AND NORTHERN EUROPE

Map produced by ZOÏ Environment Network, July 2011

surface waters and groundwaters. Weak institutions and legislation also make the application of IWRM difficult. Another challenge is the shortage of funding for the water sector: the preparation of river basin management plans has been mostly supported by external donors, and monitoring is commonly inadequately funded.

As most of the water bodies concerned are shared by EU and non-EU countries, specific implications for the implementation of the WFD arise. EU countries are encouraged to jointly prepare River Basin Management Plans with the non-EU countries with which they share waters. However, the development of River Basin Management Plans on the basis of the WFD across the EU border is not a common practice: for the non-EU countries it entails many changes in their legislation and water management practices; and for the EU countries the risk of not respecting the deadlines of the WFD discourage a strong engagement of non-EU countries in the process. A remarkable exception is the Danube River Basin Management Plan which was jointly developed by EU and non-EU countries in the Danube River Basin District.

Although an improvement of water quality has been observed over the past decade, problems persist. Discharges of non-treat-

ed or insufficiently treated wastewater, municipal and industrial, still remains a major widespread pressure factor, in particular in the eastern part of the subregion. This is particularly critical for industrial wastewaters with hazardous substances that are not treated before being discharged into surface waters or are not pretreated before being discharged into the public sewer systems.

Apart from the lack of sufficient funding for the maintenance and upgrading of industrial and/or municipal wastewater treatment plants in non-EU countries, there is the need to connect more people, particularly in rural areas and small towns, to wastewater and sanitation systems.

In EU member States, the transposition of EU environmental legislation and the significant investments and infrastructure projects carried out to renovate existing wastewater treatment plants and build new ones have contributed to the reduction of the pollution load to surface waters and have had a positive impact on water quality. Due to the magnitude of this effort, transitional periods for compliance with the requirements of the Urban Wastewater Treatment Directive were granted to many countries that acceded to the EU in the 2004 and 2007 enlargements.

Agriculture is another pressure factor: as a significant water user it has impacts on water quantity, and through the use of pesticides, manure and/or nitrogen and phosphorus fertilizers it has impacts on the quality of surface waters or groundwaters. Draining of agricultural land has also intensified nutrient emissions from the soil into groundwaters.

Diverse industries operate in the subregion, including food-processing, pulp and paper, chemical (e.g., oil refining), metallurgical and metal processing industries. Compared with other sectors, industry is not a big water user due to progress in water saving, but the industry's environmental impact depends heavily on the type of industry, the processes used and the efficiency of wastewater treatment. Heavy metals and hydrocarbons from industrial wastewater discharges are a concern in a number of basins. The mining industry can be a pressure factor too, commonly with a local impact.

Also, hydromorphological changes impact on water resources, even though the extent has not been assessed much apart from the Danube. Infrastructure for flood protection, hydropower generation and water supply cause river and habitat continuity interruptions, disconnection of adjacent wetlands/flood-plains, hydrological alterations and problems of fish migration in many river basins. A considerable number of future infrastructure projects are at different stages of planning in the subregion, and further construction could aggravate hydromorphological pressures if not managed responsibly.

The above pressures also have an impact on wetlands. Additional challenges for wetlands in the subregion include: the reduction of the wetland area by the construction of agricultural polders and fishponds (that reduce biodiversity and alter natural flow); forestry operations (e.g., drainage, clear-cutting, replacement of natural communities with monocultures); peat extraction and associated drainage; agricultural practices (e.g., transformation of naturally flooded meadows into cultivated lands); abandonment of traditional agricultural lands and subsequent overgrowing of previously open areas; fires (in forests, on peat-lands and grasslands). All together, these processes lead to degradation of valuable wetland biotopes and the subsequent loss of biodiversity and certain ecosystem services. Invasive plant and animal species that out-compete native ones pose another threat.

Climate change is projected to cause increases in annual run-off in Northern Europe, and decreases in Eastern Europe. Seasonal variability of discharge is predicted to increase in Eastern Europe, together with drought risk and flood frequencies, with increasing extremes, both high and low, as well as extended dry periods. In Northern Europe, IPCC predicts the risk of winter flooding to increase by 2020s and present day's 100 year floods to occur more frequently.

Efforts are being made to address concerns related to climate change, and the need to develop better intersectoral and international cooperation is widely acknowledged. Many countries have adopted or are developing national strategies for climate change. The 2010 Integrated Tisza River Basin Management Plan, developed under the framework of the ICPDR, is a good example of how climate change is being increasingly factored into water management strategies. Many other initiatives concerning the detailed study of climate change and potential adaptation measures are under way in the subregion, and a number of research projects, funded in particular by the EU, have been initiated to improve the knowledge and understanding of the impacts of climate change as well as the basis for adaptation and mitigation measures.

The way forward

Much progress has been made in water protection in the subregion, but much still remains to be done especially in the eastern part.

In order to enhance transboundary cooperation on water management, greater political will is needed, together with additional resources. More long-term support for transboundary cooperation should be provided, and efforts to shift away from the current trend of ad hoc project approaches should be supported.

Even if the Eastern European countries are not bound by the WFD and its objectives and deadlines, it is expected that they will progressively move towards the implementation of the WFD and its principles. The bilateral agreements in the eastern part of the subregion should be further revised to take into account provisions of WFD.

The creation of River Basin Councils to provide advice to the respective water management authorities is a commendable and welcome step forward. These councils should now build on their progress and look to expand their representation to include interested parties and experts from non-governmental organizations, other professional organizations and indigenous groups. Current limitations on funding could, however, prove a constraint in this regard.

Despite considerable progress, there is a clear need in the Eastern European countries to increase the level of national investment in sewerage systems and wastewater treatment facilities both for municipal and industrial wastewater. Agriculture practices also need to be further reviewed and improved, and a stricter application of good practices to control and reduce pollution loads is an important area in which more progress is needed. Access to water and sanitation still needs to be increased, especially in rural areas.

An increase of water demand is expected, especially in the southern part of the subregion. Thus demand management measures and control on the abstraction of surface water and groundwater need to be put in place.

The exchange of data, the harmonization of approaches to water management, including monitoring and joint assessments, still need to be further strengthened, especially in the eastern part of the subregion. Networks for monitoring transboundary groundwaters also require further development. While the use of information technology and geographic information systems (GIS) in monitoring and data management has rapidly developed in the northern countries of the subregion, the related capacities still need strengthening in many countries.

THE CAUCASUS

Background, water management issues and responses

In the Caucasus, a number of unresolved political conflicts and the legacy of the Soviet era continue to influence the institutional and legal setting and impact on the management of and cooperation over transboundary waters resources. The level of transboundary cooperation between States is still low, and a prevailing sense of uncertainty and mistrust – if not the total absence of diplomatic relations - is often a hindrance to the establishment of effective formal agreements and stable cooperation frameworks for transboundary waters management.

A number of bilateral agreements have been established, mainly throughout the 1990s, but in general the implementation of these agreements remains weak and a lack of political will is proving detrimental to progress on effective water management, cooperation and information sharing. The absence of stable, long-term cooperation in the Kura River Basin, the main transboundary river in the Caucasus, shared by Armenia, Georgia, Azerbaijan, the Islamic Republic of Iran and Turkey, is the main challenge for transboundary cooperation in the subregion.

International assistance is moving regional cooperation in the right direction, particularly in the field of joint monitoring and assessment, which, following a decline in the early post-Soviet era, has started to show some improvement.

In general, IWRM is not applied but there are a number of positive developments, in particular a progressive approximation towards the WFD and other international frameworks, including the UNECE Water Convention and the Framework Convention for the Protection of the Marine Environment of the Caspian Sea. An important driver is the EU Neighbourhood Policy, under which Armenia, Azerbaijan and Georgia signed agreements committing themselves to bring new environmental laws closer to EU legislation and to cooperate with neighbouring countries regarding transboundary water management.

Thus, across the subregion, countries are in the process of gradually reforming their existing environmental legislation. Recent examples of advancement include the adoption of a series of environmental laws in Turkey, stronger enforcement of environmental regulation in Georgia (with a reduction in violations), and new environmental legislation in Iran which is expected to reduce impacts on water resources. A move towards more progressive water legislation is also illustrated by Armenia's 2002 Water Code, which refers to, among others, the development of water basin management plans, introduced since 2005, and an intersectoral advisory body.

However, economic development is clearly the priority at present and efforts to improve economic performance have influenced legislation, including environmental and water legislation.

The natural availability of water in the Caucasus is quite variable, with abundant resources in the mountainous areas of Georgia and Armenia and scarcity in Azerbaijan. Growing economic development and an increase in population could lead to an increase in both consumptive and non-consumptive water use, and thus to growing scarcity.

TRANSBOUNDARY SURFACE WATERS IN THE CAUCASUS

0 100 200 300 400 km

Map produced by ZOÏ Environment Network, July 2011

The agricultural sector constitutes the largest consumer of water in the Caucasus, also due to substantial water losses (as much as 30 per cent) through inefficient and poorly maintained irrigation systems. Since 1991, there has been a marked increase in agricultural production and irrigation in some parts of the subregion, and the over-abstraction of groundwater resources for irrigation purposes is a problem across the Caucasus. The over-abstraction of groundwater, coupled with inefficient drainage systems, have in many cases led to the salinization of soils, especially in more arid areas, which affects plant growth and yield.

Diffuse pollution from agriculture, viniculture and animal husbandry is also a significant pressure factor in many basins. Water pollution generated by the agricultural use of pesticides, nitrogen, phosphorus and other substances is a challenge, including agricultural pollution in irrigation return flows containing residues of agrochemical waste, pesticides, nutrients and salts. However, in recent years, the application of fertilizers has been relatively limited and efforts to minimize the impact of agricultural activities on water resources are increasingly taking hold in a number of countries in the subregion.

Organic and bacteriological pollution from discharge of poorly treated or untreated wastewater is a widespread problem. In particular, water quality in the Kura Basin has been severely affected. Wastewater treatment is commonly lacking for municipal wastewater and investments in wastewater treatment infrastructure are not enough. Even though many urban areas are connected to sewerage networks, few wastewater treatment plants have been set up. In rural settlements, even sewers are often lacking.

There is also room for improvement in solid waste management, as official landfills are often lacking and pollution from illegal landfills is a concern. Controlled dumpsites are reported to exert pressure on water quality, too.

Despite the general decrease in industrial activities since the 1990s, water pollution from the industrial sector remains a significant environmental problem, and the efficient management of industrial wastewater continues to be a challenge for many countries in the Caucasus. Although the significance of mining as a pressure factor has substantially decreased in the past 20 years, the mining of commodities such as copper still generates heavy metal pollution due to acid drainage from tailing dams.

Water-related infrastructure and development projects are often seen as key drivers for socio-economic development in the subregion. The construction of weirs, dams, hydropower plants and related structures for electricity generation, irrigation and water supply purposes is continuing apace, notably in Georgia, the Islamic Republic of Iran and Turkey. The rise of the hydropower sector in the subregion has raised particular concerns about changes to the natural river flows and other detrimental impacts on river dynamics, morphology and the transport of sediments.

Climate change is predicted to have a significant impact on the subregion, particularly in terms of water scarcity and the drying up of rivers. Increased summer temperatures have also been predicted and the variability of flows and the risk of extreme weather events are predicted to increase. Natural disasters like landslides and mudflows are perceived as common problems in certain areas of the Caucasus. Some studies on the impact of climate change have been carried out for the Caucasus, but actual adaptation measures are mostly only starting to be considered. Turkey, for example, developed a "National Climate Change Strategy" in 2009, but the actual implementation of measures is still to be carried out. The Islamic Republic of Iran has also been developing a national plan for tackling climate change. Yet, in general, little has so far been done to better understand the potential impacts of climate change on the subregion.

The way forward

Greater political commitment to transboundary cooperation is needed to improve the institutional framework and the management of transboundary water resources in the Caucasus. The technical cooperation established under various projects should evolve in a more long-term, sustainable framework for cooperation to be able to tackle the variety and complexity of problems.

Also, the capacities of national institutions in the field of water management remain insufficient, and will need further improvement and support to meet the challenges faced by the subregion.

Economic development is clearly a priority for countries in the subregion, but efforts should be made to ensure that water resources and environmental protection are not overlooked or neglected if the region wants to guarantee its long-term and sustainable growth. In particular with regard to the development of infrastructure projects, ecological flows have to be considered to avoid straining relations between co-riparians and to ensure sustainability of use of the water resources.

This risk of water scarcity experienced downstream and seasonally/periodically elsewhere calls for an overall improvement in water management and irrigation efficiency. Water saving measures, as well as the conjunctive use of surface water and groundwater, the reuse of drainage and return waters, should become matters of priority for Governments in the Caucasus.

In terms of agricultural pollution, tighter regulation and control of the use of pesticides, fertilizers and other pollutants will not only reduce the harmful effects on water quality in rivers, but also improve the potential for reusing return waters.

More comprehensive and collaborative research into the impacts of climate change is needed at the subregional level. Initiatives to develop a common understanding of major challenges and to collate existing knowledge should be developed, and moves to establish joint or coordinated adaptation strategies should be accelerated.

Donors currently providing financial support to water management, monitoring and protection programmes in the subregion should ensure that their interventions do not overlap or duplicate each other and that they respond to the priority needs of the countries in the Caucasus. The impact and progress of funded activities should be monitored at the national level, and recipient countries should take responsibility for following up on projects in the long term.

CENTRAL ASIA

Background, water management issues and responses

In the past 20 years of political transition since the break-up of the Soviet Union, countries in Central Asia have each created their own distinct political and economic systems and focused on their own areas of national priority. Levels of socio-economic development and the availability of infrastructure and resources vary greatly from country to country. The uneven political and economic development and distribution of resources (especially of fossil fuel reserves and hydropower capacity) has created a complex and challenging context for cooperation on water resources.

Population growth has been rapid in the past 20 years and has consequently added additional pressure on water resources. The population in the Aral Sea Basin, for example, has more than doubled from 1960 to 2008, to almost 60 million.

Water resources in Central Asia are predominantly of a transboundary nature. Most of the region's surface water resources are generated in the mountains of the upstream countries Kyrgyzstan, Tajikistan and Afghanistan, eventually feeding Central Asia's two major rivers, the Syr Darya and the Amu Darya, which flow through the downstream countries Kazakhstan, Turkmenistan and Uzbekistan, and are a part of the Aral Sea Basin.

These resources are of critical importance to the subregion's economy, people and environment. Due to the arid regional climate, irrigation water is an indispensable input for agricultural production. An estimated 22 million people depend directly or indirectly on irrigated agriculture in Tajikistan, Turkmenistan and Uzbekistan. Water is also important for energy production: hydropower covers more than 90% of total electricity needs in Kyrgyzstan and Tajikistan, and is also an export commodity.

Yet, the subregion does not have an overarching legal framework for the management and protection of shared water resources. The legal framework for cooperation on the Amu Darya and Syr Darya, put into place in the early 1990s, is increasingly considered to have become outdated, resulting in generally poor implementation. In the past few years, the agreed arrangements on water allocation have not been fully implemented or it has proven impossible to agree on water allocation. Another shortcoming of the existing cooperation is that it does not include Afghanistan. Thus a holistic, rational, equitable and sustainable approach to the use of transboundary water resources supported by all riparian countries is lacking. This has resulted not only in tensions and suspicions over water allocation and energy generation, but also in social and economic problems, as well as environmental degradation.

A positive development is the cooperation between Kazakhstan and the Kyrgyzstan on the Chu and Talas Rivers: the Chu-Talas Commission,[7] established in 2006, is an example of a functioning joint body under a bilateral agreement. Over the years, the cooperation in the framework of the Chu-Talas Commission

[7] The Commission of the Republic of Kazakhstan and the Kyrgyz Republic on the Use of Water Management Facilities of Intergovernmental Status on the Rivers Chu and Talas.

TRANSBOUNDARY SURFACE WATERS IN CENTRAL ASIA

Map produced by ZOÏ Environment Network, July 2011

has expanded, and such a model has been evoked as a means for downstream countries to participate in managing dams and other hydraulic facilities located in upstream countries.

Other positive developments for transboundary cooperation in the subregion are the recently signed bilateral agreements between the Russian Federation and China (2008) concerning the rational use and protection of transboundary waters, and between Kazakhstan and China (2011) on the protection of the water quality of transboundary rivers.

On the multilateral level, there seems to be a general problem of interpretation and application of international law on the sharing and management of transboundary water resources by Central Asian countries. The commitment by Turkmenistan to accede to the UNECE Water Convention is a positive development for strengthening the international legal framework for water cooperation in the subregion.

IWRM is generally weakly applied in Central Asia. However, during the past decade, national water legislation and the organization of water resources management have been reformed in many countries and this development continues. Nevertheless, implementation is limited by the lack of resources and the weakness of institutions. Another major obstacle to an integrated approach to water resources management is the frequent lack of intersectoral coordination.

The Soviet legacy of industrial pollution and environmental degradation remains a problem and is now being compounded by the modern-day prioritization of national economic development and profit. The interests of big business and the needs of large-scale agricultural and water users still tend to override national and regional environmental concerns, and the prioritization of environmental issues is generally low across Central Asia.

The agricultural sector constitutes the largest (consumptive) water user. The reduction of river flows due to excessive irrigation has contributed to land degradation and desertification, while the absence of efficient drainage systems has increased soil and water salinity. There is a pressing need to improve water use efficiency. Lack of maintenance and damage are common problems for the irrigation infrastructure in the subregion. Specific water consumption is high because of losses, evaporation and overwatering. Efforts have been made in many countries to enhance irrigation systems and their efficiency; however, a shortage of financial resources for renovation and maintenance persists.

The Aral Sea catastrophe is the clearest example of the negative impacts on human health and ecosystems of water over-abstraction, land degradation and desertification. Once the fourth largest inland lake in the world, the Aral Sea has drastically shrunk after decades of extensive irrigation and ineffective management and use of water, losing 80% of its volume. In recent years, both Kazakhstan and Uzbekistan have put in place measures to mitigate the environmental degradation of the Aral Sea, and the recent increase of the level of the North Aral Sea, thanks to the Kok-Aral Dam built by Kazakhstan, is an important result. The intense crop cultivation, water diversions and industrial development along the Ili River and in the Lake Balkhash Basin in general raise concerns that a new environmental disaster may be looming, with a pattern similar to that of the Aral Sea.

Alongside agriculture, hydropower is an increasingly important sector in the mountainous countries of Central Asia, where it generates a large proportion of domestic electricity. Rapid population growth over the past 20 years in combination with low energy prices has increased the demand for energy. Construction of a number of new dams, mainly for hydropower but also to store water for irrigation, was initiated in the late 2000s. However, hydropower generation has placed pressure on water resources and dam infrastructure disrupts water flow, with consequences for other uses and ecosystems.

Concerns about the safety of more than 100 large dams and other water control facilities, located mostly on transboundary rivers, have grown in recent years. Ageing dams and their inadequate maintenance, coupled with population growth and development in flood-plains downstream from the dams, have resulted in increased risks. The inadequate and uncoordinated management of dams and reservoirs can pose a serious risk of flooding, as illustrated by the failure of the Kyzyl-Agash Dam, in Kazakhstan in March 2010.

Since 1991, the level of hydrological monitoring, forecasting and data collection has experienced a significant decline across the subregion. With the exception of Kazakhstan, where investment in water monitoring and assessment have increased in recent years, and the Russian Federation and Uzbekistan, where the water monitoring networks have been generally well preserved, the capacity of national authorities to effectively monitor water resources is low and requires greater investment. A specific challenge is the monitoring of water quality, which is almost non-existent in some countries.

Finally, the negative impact of climate change is of mounting concern for the subregion. Despite the limited amount of data made available thus far, a significant number of predictions stress the vulnerability of water resources in Central Asia. An increase in air temperature and a short-term increase in river flows, due to the melting of glaciers, is one such likely consequence. In the long term, river flows are predicted to decrease, and the levels of aridity and evapotranspiration to rise, which would increase irrigation requirements for water and increase the risk of scarcity and droughts.

The way forward

A sustainable solution for cooperation on transboundary waters in Central Asia will require a careful balance between water use for irrigation, human consumption, the generation of electricity and the protection of ecosystems. The willingness of all the riparian countries to cooperate, establish an open dialogue and compromise to find a consensus between their positions is necessary for agreement. By enhancing transboundary water cooperation, Central Asian countries can also pave the way for future cooperation in other fields like transport, trade, transit and energy, moving towards building consensus and away from the current politization and polarization of the water debate.

The recognition by the Heads of Central Asian Governments in April 2009 of the need to improve institutional and legal frameworks for regional water cooperation under the umbrella of the International Foundation for Saving the Aral Sea (IFAS) was a promising step forward. Yet, its actual and effective implementation remains a challenge for the future.

The lack of an overarching legal framework for the region continues to undermine progress and needs to be addressed on the basis of international law. In particular, the involvement of Afghanistan in regional cooperation needs to be considered.

The entry into force of articles 25 and 26 of the Water Convention is particularly important for Central Asia, as it will allow accession by countries outside the UNECE region (i.e., in this subregion Afghanistan, the Islamic Republic of Iran, China and Mongolia) and contribute to the creation of a common legal basis for bilateral and multilateral agreements.

The development of transboundary cooperation will need strengthened institutions, the crucial one being IFAS. Central Asian States and the donor community need to undertake serious joint efforts to increase its capacities, sustainability and effectiveness.

The steps taken under the framework of the EU Strategy for Central Asia, including the joint approval of a Cooperation Platform on Environment and Water in November 2009, as well as the activities carried out within the National Policy Dialogues on IWRM under the EU Water Initiative can contribute to the exchange of experiences and joint undertakings between EU and Central Asia countries, with the aim to develop efficient and integrated management of water resources.

Further efforts are also needed to improve water efficiency, increase effectiveness of irrigation systems - including by repairing and maintaining existing infrastructure - switch to less water demanding crops and limit the irrigated land area. Such efforts become even more urgent in the light of the projected increases in water scarcity.

With the current prioritization of economic development, it is a serious concern that water-dependent ecosystems get little attention. Countries need to identify and apply best practices in the management of water resources and ecosystems, in particular ensuring minimum environmental flows. Also, more effective land management policies, such as limiting deforestation and encouraging a shift away from unsustainable agricultural and grazing practices, are needed.

Environmental impact assessments of planned transboundary projects should be carried out in a more systematic manner, with involvement of affected countries and populations. This is particularly relevant for planned hydropower projects in Kyrgyzstan and Tajikistan. Also, cooperation on the management of reservoirs can bring benefits by addressing the needs of different sectors; different reservoirs in a cascade can have complementary operating modes. Developing small-scale hydropower projects, which do not disrupt water flows and are less damaging to the environment, could be considered as an option for energy generation.

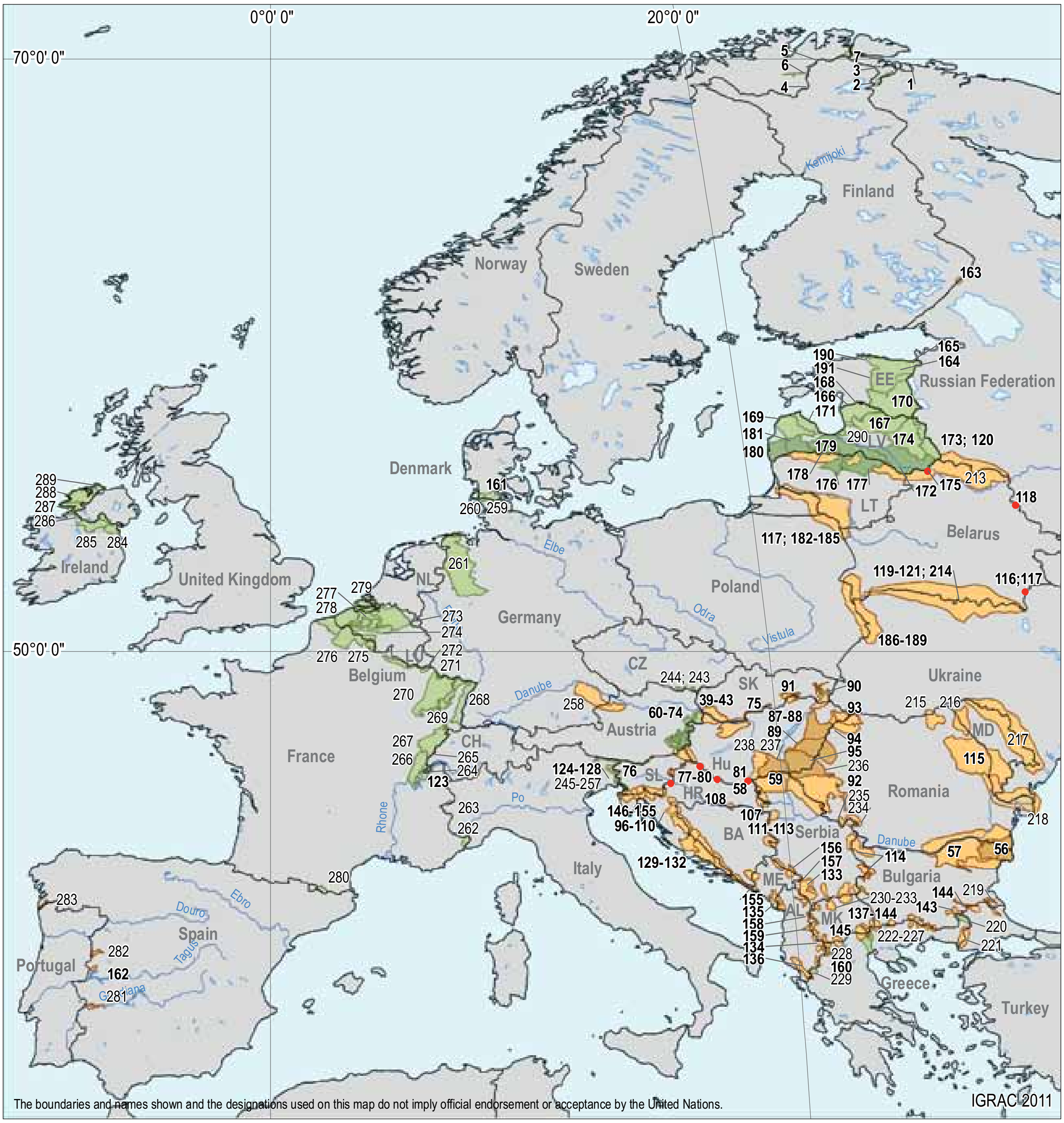
Transboundary monitoring needs to be significantly strengthened, especially that of water quality. Research on groundwater, which plays a potentially important role in sustaining ecosystems and limiting land degradation, should also be intensified.

Improved regional cooperation to develop scenarios and adaptation measures for climate change would be beneficial for all countries. More also needs to be done to ensure that impacts of climate change are taken into account when national plans for water use and management are being formulated. Better monitoring of the status of glaciers and snow reserves in the mountains will provide indications about how water availability will develop.

OVERVIEW MAP OF MAIN TRANSBOUNDARY SURFACE WATERS IN WESTERN, CENTRAL AND EASTERN EUROPE

OVERVIEW MAP OF MAIN TRANSBOUNDARY SURFACE WATERS IN EASTERN EUROPE, THE CAUCASUS AND CENTRAL ASIA

TRANSBOUNDARY GROUNDWATERS IN EUROPE



WFD groundwater body (GWB)/set of GWBs

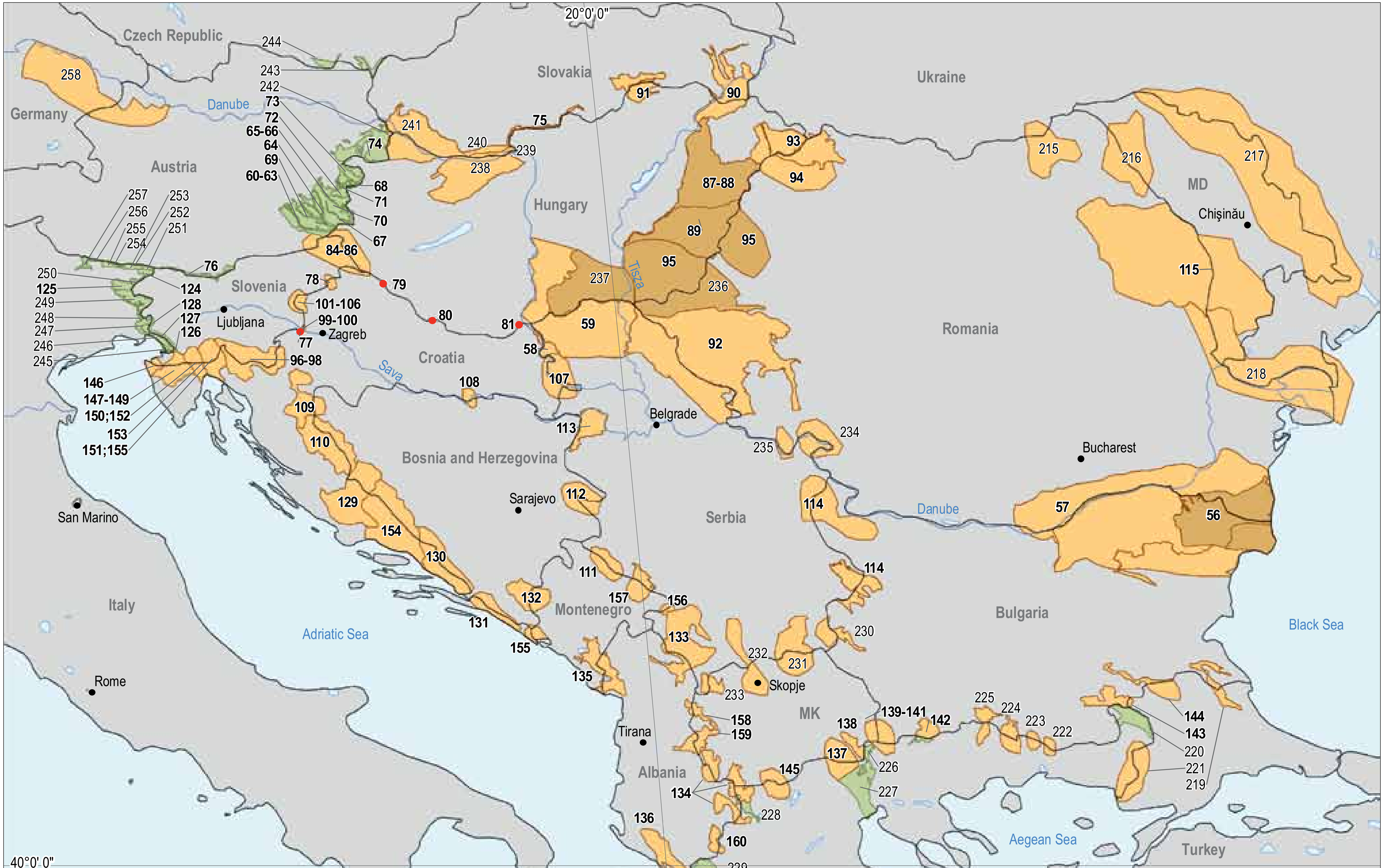
GWB (partially) overlapping with aquifer

Aquifer

(Partially) overlapping aquifers

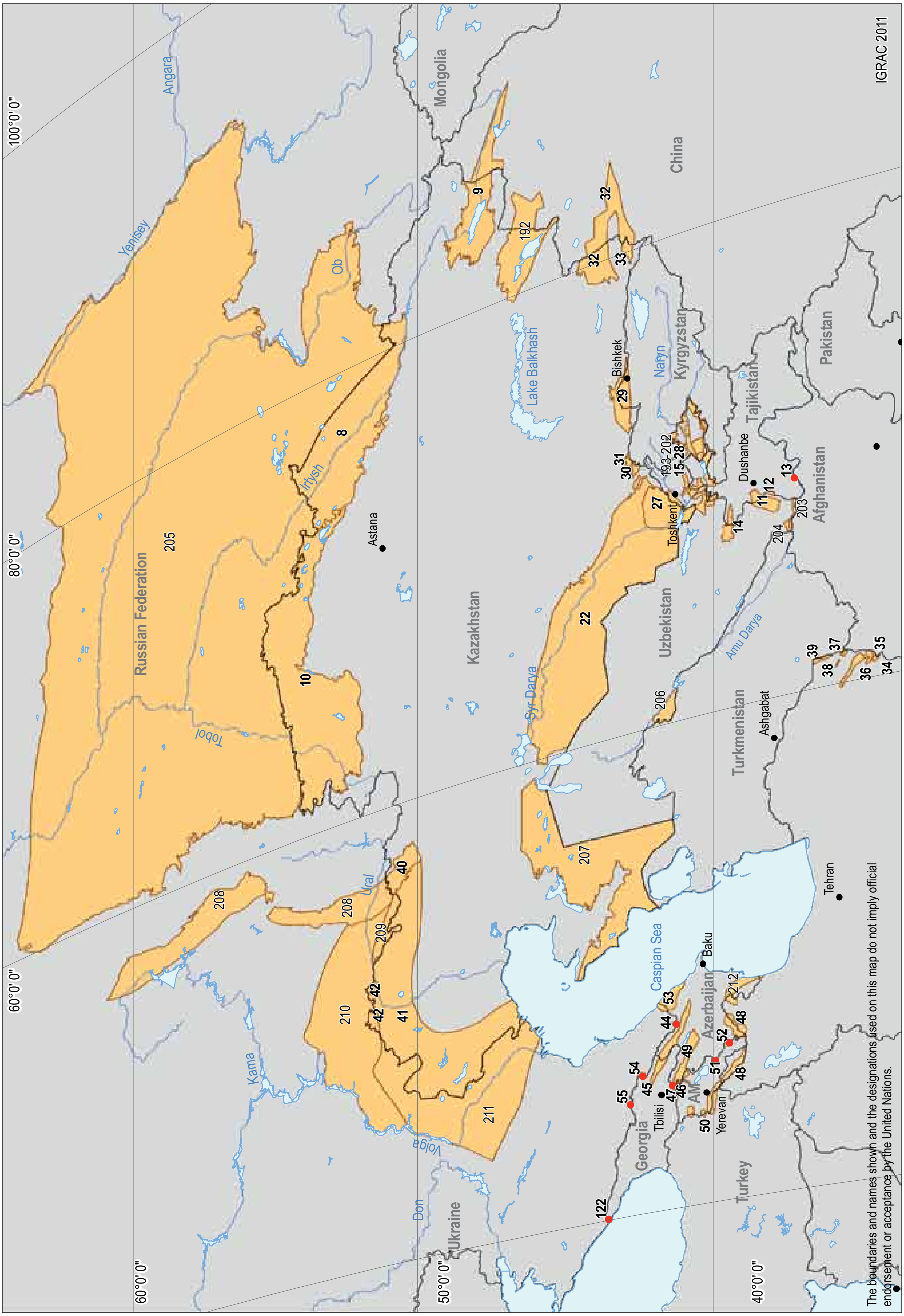
• Exact location/extent of aquifer uncertain

TRANSBOUNDARY GROUNDWATERS IN SOUTH-EASTERN EUROPE



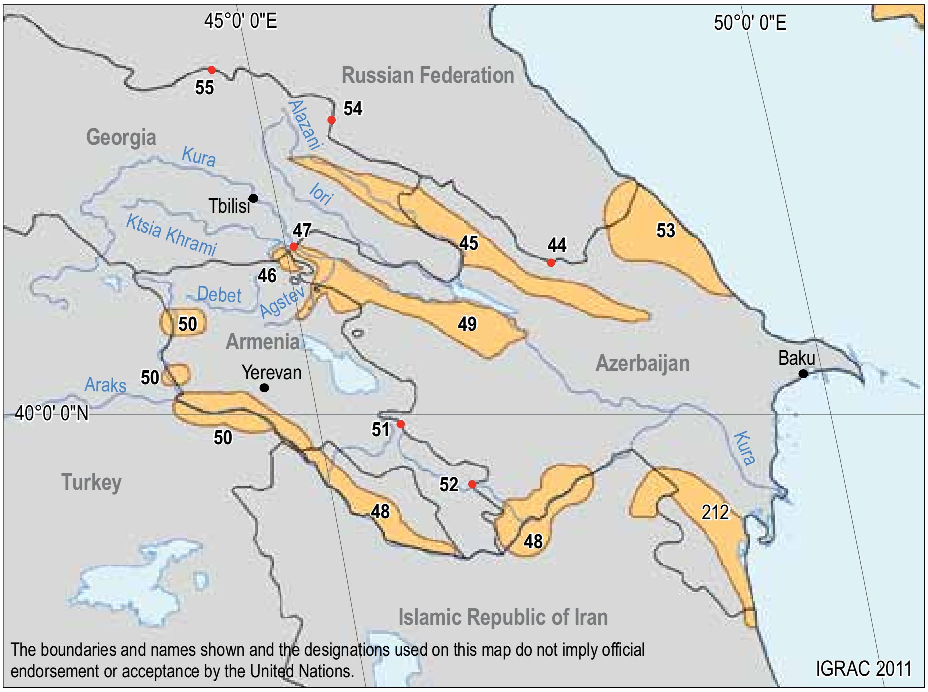
The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

TRANSBOUNDARY GROUNDWATERS IN THE CAUCASUS AND CENTRAL ASIA

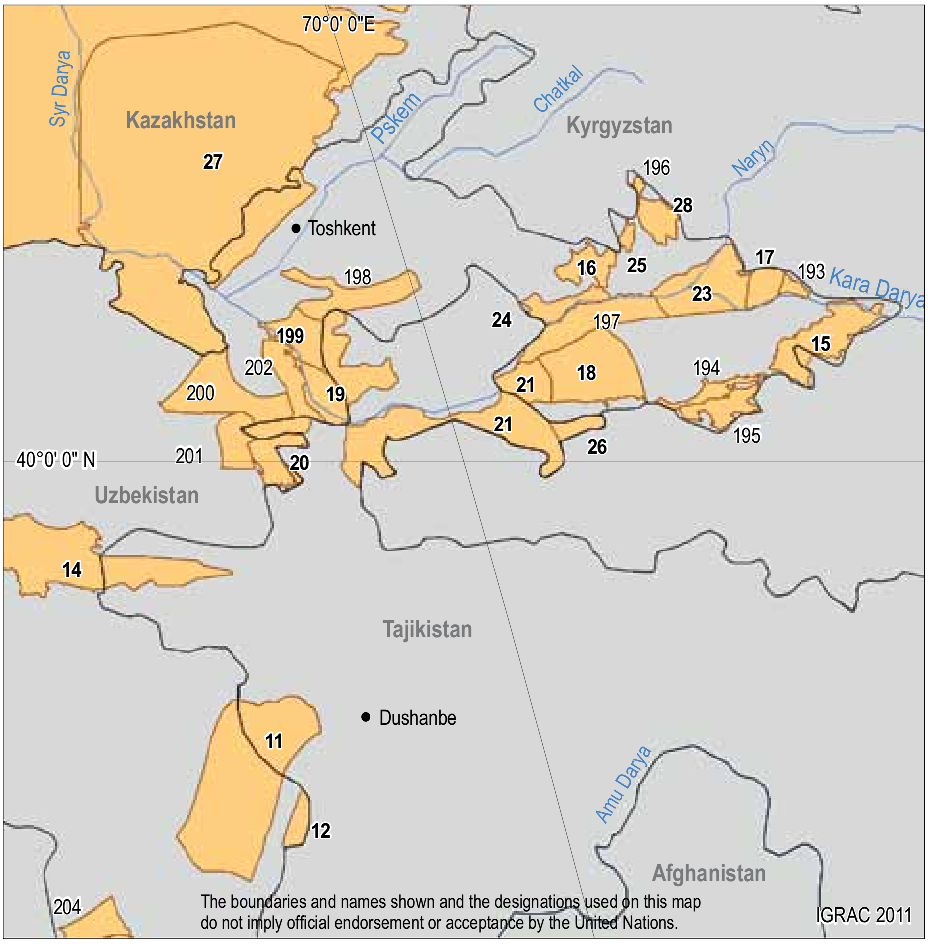


WFD groundwater body (GWB)/set of GWBs
GWB (partially) overlapping with aquifer
Aquifer
(Partially) overlapping aquifers
Exact location/extent of aquifer uncertain

TRANSBOUNDARY GROUNDWATERS IN THE CAUCASUS



TRANSBOUNDARY GROUNDWATERS IN CENTRAL ASIA: BORDER AREAS OF KAZAKHSTAN, KYRGYZSTAN, TAJIKISTAN AND UZBEKISTAN



Aquifer

• Exact location/extent of aquifer uncertain

TRANSBOUNDARY GROUNDWATERS IN THE UNECE REGION

NUMBER	NAME/CODE	SHARED BY	INFORMATION SOURCE
1	Grense Jakobselv aquifer	NO, RU	EEA
2	Pasvikeskeren aquifer	NO, RU	EEA
3	Neiden aquifer	FI, NO	EEA
4	Aquifer Anarjokka	FI, NO	EEA
5	Levajok-Valjok aquifer	FI, NO	EEA
6	Karasjok aquifer	FI, NO	EEA
7	Tana Nord	FI, NO	EEA
8	Preirtysh aquifer	KZ, RU	Earlier inventories
9	Zaisk aquifer	CN, KZ	Earlier inventories
10	North-Kazakhstan aquifer	KZ, RU	Earlier inventories
11	Karatag/North-Surhandarya aquifer	TJ, UZ	Earlier inventories
12	Kofarnihon aquifer	TJ, UZ	Earlier inventories
13	Vakhsh aquifer	AF, TJ	Earlier inventories
14	Zeravshan aquifer	TJ, UZ	Earlier inventories
15	Osh-Aravan aquifer	KG, UZ	Earlier inventories
16	Almos-Vorzik aquifer	KG, UZ	Earlier inventories
17	Maylusu aquifer	KG, UZ	Earlier inventories
18	Sokh aquifer	KG, UZ	Earlier inventories
19	Dalverzin aquifer	TJ, UZ	Earlier inventories
20	Zafarobod aquifer	TJ, UZ	Earlier inventories
21	Sulyukta-Batken-Nau-Isfara aquifer	KG, TJ, UZ	Earlier inventories
22	Syr-Darya 1 aquifer	UZ, KZ	Earlier inventories
23	Naryn aquifer	KG, UZ	Earlier inventories
24	Chust-Pap aquifer	TJ, UZ	Earlier inventories
25	Kasansay aquifer	KG, UZ	Earlier inventories
26	Shorsu aquifer	TJ, UZ	Earlier inventories
27	Pretashkent aquifer	UZ, KZ	Earlier inventories
28	Iskovat-Pishkaran aquifer	KG, UZ	Earlier inventories
29	Chu/Shu aquifer	KG, KZ	Earlier inventories
30	South Talas aquifer	KG, KZ	Earlier inventories
31	North Talas aquifer	KG, KZ	Earlier inventories
32	Zharkent aquifer	CN, KZ	Earlier inventories
33	Tekes aquifer	CN, KZ	Earlier inventories
34	Karat aquifer	AF, IR	Second Assessment
35	Taybad aquifer	AF, IR	Second Assessment
36	Torbat-e-jam aquifer	AF, IR	Second Assessment
37	Janatabad aquifer	AF, IR, TM	Second Assessment
38	Aghdarband aquifer	IR, TM	Second Assessment
39	Sarakhas aquifer	IR, TM	Second Assessment
40	South-Pred-Ural aquifer	KZ, RU	Earlier inventories
41	Pre-Caspian aquifer	KZ, RU	Earlier inventories
42	Syrt aquifer	KZ, RU	Earlier inventories
43	Kura aquifer	AZ, GE	Second Assessment
44	Iori/Gabirri aquifer	AZ, RU	Second Assessment
45	Alazan-Agrichay aquifer	AZ, GE	Earlier inventories
46	Debet aquifer	AM, GE	Earlier inventories
47	Agstev–Akstafa/Tavush–Tovuz aquifer	AM, AZ	Earlier inventories
48	Ktsia-Khrami aquifer	AZ, GE	Earlier inventories
49	Nakhichevan/Larijan and Djebrail aquifer	AZ, IR	Second Assessment

NUMBER	NAME/CODE	SHARED BY	INFORMATION SOURCE
50	Leninak-Shiraks aquifer	AM, TR	Earlier inventories
51	Herher, Malishkin and Jermuk aquifers	AM, AZ	Second Assessment
52	Vorotan-Akora aquifer	AM, AZ	Second Assessment
53	Samur aquifer	AZ, RU	Earlier inventories
54	Sulak Aquifer	GE, RU	Second Assessment
55	Terek aquifer	GE, RU	Second Assessment
56	Dobrudja/Dobrogea Neogene – Sarmatian aquifer	BG, RO	Second Assessment
57	Dobrudja/Dobrogea Upper Jurassic – Lower Cretaceous aquifer	BG, RO	Second Assessment
58	South Western Backa/Dunav aquifer	HR, RS	Second Assessment
59	Northeast Backa/Danube -Tisza Interfluve or Backa/Danube-Tisza Interfluve aquifer	HU, RS	Second Assessment
60	Rába shallow aquifer	AT, HU	Second Assessment
61	Rába porous cold and thermal	AT, HU	Second Assessment
62	Rába Köszeg mountain fractured aquifer	AT, HU	Second Assessment
63	Raabtal aquifer	AT, HU	EEA checked
64	Lafnitztal aquifer	AT, HU	EEA checked
65	Pinkatal aquifer	AT, HU	EEA checked
66	Pinkatal 2 aquifer	AT, HU	EEA checked
67	Stremtal aquifer	AT, HU	EEA checked
68	Rabnitztal aquifer	AT, HU	EEA checked
69	Groundwaterbody Hügelland Raab West	AT, HU	EEA checked
70	Groundwaterbody Hügelland RaabOst	AT, HU	EEA checked
71	Günstal aquifer	AT, HU	EEA checked
72	Group of groundwater bodies Günser Gebirge Umland	AT, HU	EEA checked
73	Group of groundwater bodies Hügelland Rabnitz	AT, HU	EEA checked
75	Ipoly völgy/Alúvium Ipla aquifer	HU, SK	Second Assessment
76	Karstwasser-Vorkommen Karawanken/Karavanke	AT, SI	EEA checked
77	Ormoz-Sredisce ob Drava/Drava-Varazdin aquifer	HR, SI	Second Assessment
78	Dolinsko-Ravensko/Mura aquifer	HR, SI	Earlier inventories
79	Mura aquifer	HR, HU	Earlier inventories
80	Drava/Drava West aquifer	HR, HU	Earlier inventories
81	Baranja/Drava East	HR, HU	Earlier inventories
82	Cerneško- Libeliško aquifer, Kucnica aquifer	AT, SI	Second Assessment
83	Kučnica aquifer	AT, SI	Second Assessment
84	Goričko aquifer	HU, SI	Earlier inventories
85	Mura – Zala basin/Radgona – Vaš aquifer	AT, HU, SI	Earlier inventories
86	Kot aquifer	HR, HU, SI	Earlier inventories
87	Körös – Crisuri holocene, pleistocene transboundary aquifer	HU, RO	Second Assessment
88	Hortobágy, Nagykunság, Bihar Northern Part	HU, RO	Second Assessment
89	Körös-valley, Sárrét, shallow/Crisuri aquifer	HU, RO	Second Assessment
90	Bodrog aquifer	HU, SK	Second Assessment
91	Slovensky kras/Aggtelek aquifer	HU, SK	Second Assessment
92	North and South Banat or North and Mid Banat aquifer	RO, RS	Second Assessment
93	Somes/Szamos alluvial fan aquifer	HU, RO	Second Assessment
94	Nyírség, keleti rész/Nyírség, east margin aquifer	HU, RO	Second Assessment
95	Pleistocene-Holocene Mures/Maros alluvial fan aquifer	HU, RO	Second Assessment
96	Cerknica/Kupa aquifer	HR, SI	Earlier inventories
97	Kocevje Goteniška gora aquifer,	HR, SI	Earlier inventories
98	Radovica-Metlika/Zumberak aquifer	HR, SI	Earlier inventories
99	Bregana-Obrezje/Sava- Samobor	HR, SI	Second Assessment
100	Bregana aquifer,	HR, SI	Second Assessment

NUMBER	NAME/CODE	SHARED BY	INFORMATION SOURCE
101	Bizeljsko/Sutla aquifer	HR, SI	Earlier inventories
102	Boč aquifer	HR, SI	Earlier inventories
103	Rogaška aquifer	HR, SI	Earlier inventories
104	Atomske toplice aquifer	HR, SI	Earlier inventories
105	Bohor aquifer	HR, SI	Earlier inventories
106	Orlica aquifer	HR, SI	Earlier inventories
107	Srem-West Srem/Sava aquifer	HR, RS	Earlier inventories
108	Posavina I/Sava aquifer	BA, HR	Earlier inventories
109	Kupa aquifer	BA, HR	Earlier inventories
110	Pleševica/Una aquifer	BA, HR	Earlier inventories
111	Lim aquifer	ME, RS	Second Assessment
112	Tara Massif	BA, RS	Second Assessment
113	Macva-Semberija aquifer	BA, RS	Second Assessment
114	Stara Planina/Salasha Montana aquifer	BG, RS	Second Assessment
115	Middle Sarmantian Pontian aquifer	MD, RO	Second Assessment
116	Paleogene-Neogene terrigenous aquifer	BY, UA	Second Assessment
117	Cenomanian carbonate-terrigenous aquifer	BY, UA	Second Assessment
118	Upper Devonian terrigenous-carbonate aquifer	BY, RU	Second Assessment
119	Paleogene-Neogene terrigenous aquifer	BY, UA	Second Assessment
120	Cenomanian terrigenous aquifer	BY, UA	EEA
121	Upper Proterozoic terrigenous aquifer	BY, UA	Second Assessment
122	Psou aquifer	GE, RU	Second Assessment
123	Genevese aquifer	FR, CH	Second Assessment
124	Rabeljski rudnik aquifer	IT, SI	Second Assessment
125	Kobariški stol aquifer	IT, SI	Second Assessment
126	Osp-Boljunec groundwater body	IT, SI	Second Assessment
127	Brestovica groundwater body	IT, SI	Second Assessment
128	Vrtojbensko polje aquifer, (Aquifer system of Gorica-Vipava valley, Alluvial gravel aquifer of Vipava and Soca rivers)	IT, SI	Second Assessment
129	Krka aquifer	BA, HR	Earlier inventories
130	Neretva Right coast aquifer	BA, HR	Earlier inventories
131	Trebišnjica/Neretva Left coast aquifer	BA, HR	Earlier inventories
132	Bileko Lake aquifer	BA, ME	Earlier inventories
133	Beli Drim/Drini Bardhe aquifer	AL, RS	Earlier inventories
134	Prespa and Ohrid Lake aquifer	AL, GR, MK	Earlier inventories
135	Skadar/Shkoder Lake, Dinaric east coast aquifer	AL, ME	Earlier inventories
136	Nemechka/Vjosa-Pogoni aquifer	AL, GR	Earlier inventories
139	Sandansky-Petrich aquifer	BG, GR, MK	Earlier inventories
140	Sandansky valley aquifer	BG, GR	Earlier inventories
141	Petrich valley aquifer	BG, MK	Earlier inventories
142	Orvilos-Agistros/Gotze Delchev aquifer	BG, GR	EEA checked
143	Orestiada/Svilengrad-Stambolo/Edirne aquifer	BG, GR, TR	Earlier inventories
144	Topolovgrad Massif aquifer	BG, TR	Earlier inventories
145	Pelagonia- Florina/Bitolsko aquifer	GR, MK	EEA checked
146	Secovlje-Dragonja/Istra aquifer	HR, SI	Earlier inventories
147	Mirna/Istra aquifer	HR, SI	Earlier inventories
148	Mirna aquifer	HR, SI	Earlier inventories
149	Obmocje izvira Rižane aquifer	HR, SI	Earlier inventories
150	Opatija/Istra aquifer aquifer	HR, SI	Earlier inventories
151	Rijecina – Zvir aquifer	HR, SI	Earlier inventories
152	Notranjska Reka aquifer (part of Bistrica-Snežnik in Slovenia)	HR, SI	Earlier inventories

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153	Novokračine aquifer	HR, SI	Earlier inventories
154	Cetina aquifer	BA, HR	Earlier inventories
155	Dinaric Littoral (West Coast aquifer)	HR, ME	Earlier inventories
156	Metohija aquifer	ME, RS	Second Assessment
157	Pester aquifer	ME, RS	Earlier inventories
158	Korab/Bistra – Stogovo aquifer	AL, MK	Earlier inventories
159	Jablanica/Golobordo aquifer	AL, MK	Earlier inventories
160	Mourgana Mountain/Mali Gjere aquifer	AL, GR	Earlier inventories
161	Wiedau aquifer	DK, DE	EEA
162	Moraleja aquifer	PT, ES	Second Assessment
163	Kanunkankaat aquifer	FI, RU	Second Assessment
164	Ordovician Ida-Viru groundwater body	EE, RU	Second Assessment
165	Ordovician Ida-Viru oil-shale basin groundwater body	EE, RU	Second Assessment
166	Groundwater body D5	EE, LV	EEA
167	Groundwater body D6	EE, LV	EEA
168	Groundwater body P	EE, LV	EEA
169	Middle-Lower-Devonian groundwater body (D2-1)	EE, LV, LT	EEA
170	Middle-Devonian groundwater body (D2)	EE, LV, RU	EEA
171	Upper-Devonian groundwater body (D3)	EE, LV, RU	EEA
172	D10/Polotsk and Lansky terrigenous complex of Middle and Upper Devonian aquifer	BY, LV, LT	EEA
173	D9/Upper Devonian terrigenous-carbonate complex aquifer, Cenomanian terrigenous aquifer	BY, LV, RU	EEA
174	Groundwater body D8	EE, LV, RU	EEA
175	Quaternary sediment aquifer	BY, LV	EEA
176	Groundwater body D4/Upper Devonian Stipinai LT002003400	LV, LT	EEA
177	Upper – Middle Devonian LT001003400	LV, LT	EEA
178	Groundwater body F3	LV, LT	EEA
179	Groundwater body A	LV, LT	EEA
180	Aquifer F1/Permian-Upper Devonian	LV, LT	EEA
181	Aquifer F2/Permian-Upper Devonian	LV, LT	EEA
182	Aquifers in Quaternary deposits shared by Belarus and Lithuania	BY, LT	Second Assessment
183	Oxfordian-Cenomanian carbonate-terrigenous aquifer	BY, LT	Second Assessment
184	Mazursko-Podlashi region aquifer	BY, LT, PL, RU	Earlier inventories
185	Upper Cretaceous aquifer	LT, RU	Second Assessment
186	Bug aquifer	BY, PL	Earlier inventories
187	Alluvial Quaternary aquifer shared by Belarus and Poland	BY, PL	Second Assessment
188	Paleogene-Neogene aquifer shared by Belarus and Poland	BY, PL	Second Assessment
189	Oxfordian-Cenomanian aquifer shared by Belarus and Poland	BY, PL	Second Assessment
190	Cambrian-Vendian Voronka groundwater body	EE, RU	EEA
191	Ordovician-Cambrian groundwater body	EE, RU	EEA
192	Tacheng Basin/Alakol	CN, KZ	Earlier inventories
193	Karaungur	KG, UZ	Earlier inventories
194	Yarmazar	KG, UZ	Earlier inventories
195	Chimion-Aval	KG, UZ	Earlier inventories
196	Nanay	KG, UZ	Earlier inventories
197	Syr-Darya 2	TJ, UZ	Earlier inventories
198	Ahangaran	TJ, UZ	Earlier inventories
199	Kokaral	TJ, UZ	Earlier inventories

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200	Dustlik	TJ, UZ, KZ	Earlier inventories
201	Havost	TJ, UZ	Earlier inventories
202	Syr-Darya 3	TJ, UZ	Earlier inventories
203	Amudaryia	AF, TJ, UZ	Earlier inventories
204	Sherabad	TM, UZ	Earlier inventories
205	RU1	KZ, RU	Earlier inventories
206	Xorezm	TM, UZ	Earlier inventories
207	Amu-Darya	KZ, TM, UZ	Earlier inventories
208	Ural	KZ, RU	Earlier inventories
209	RU4	KZ, RU	Earlier inventories
210	RU2	KZ, RU	Earlier inventories
211	RU3	KZ, RU	Earlier inventories
212	Lenkoran/Astara	AZ, IR	Earlier inventories
213	Daugava	BY, LV, LT, RU	Earlier inventories
214	Pripyat	BY, UA	Earlier inventories
215	Siret	RO, UA	Earlier inventories
216	Prut	MD, RO	Earlier inventories
217	Dniester	MD, UA	Earlier inventories
218	Danube-Prut	MD, RO, UA	Earlier inventories
219	Malko Tarnovo kasrt waterbearing massif	BG, TR	Earlier inventories
220	Orestiadas System	BG, GR, TR	EEA checked
221	Evros/Meric	GR, TR	Earlier inventories
222	Erma Reka	BG, GR	Earlier inventories
223	Rudozem	BG, GR	Earlier inventories
224	Smolyan	BG, GR	Earlier inventories
225	Nastan-Trigrad	BG, GR	Earlier inventories
226	Systima Doiranis	GR, MK	EEA checked
227	Systima Axiou	GR, MK	Earlier inventories
228	Systima Triklariou Kastorias	AL, GR	EEA checked
229	Systima Pogonianis	AL, GR	EEA checked
230	Zemen	BG, RS	Earlier inventories
231	The former Yugoslav Republic of Macedonia - SW Serbia	MK, RS	Earlier inventories
232	The former Yugoslav Republic of Macedonia - Central Serbia	MK, RS	Earlier inventories
233	Tetovo-Gostivar	MK, RS	Earlier inventories
234	Dacian basin	RO, RS	Earlier inventories
235	Miroc & Golubac	RO, RS	Earlier inventories
236	Upper Pleistocenesomes alluvial fan	HU, RO, RS	Second Assessment
237	Danube-Tisza-interflowe/Backa aquifer	HU, RS	Second Assessment
238	Dunántúli középhegység északi rész/ Komarnanska Vysoka Kryha	HU, SK	Second Assessment
239	Komarnanska Vysoka Kryha/Dunántúli – középhegység északi rész	HU, SK	Second Assessment
240	Komarnanska Vysoka Kryha/Dunántúli – középhegység északi rész	HU, SK	Second Assessment
241	Szigetköz, Hanság-Rábca/Podunajska basin, Zitny Ostrov	AT, HU, SK	Second Assessment
242	Heideboden [DUJ]	AT, HU	EEA checked
243	CZ_GB_16520	AT, CZ, SK	Second Assessment
244	CZ_GB_16410	AT, CZ	Second Assessment
245	Flysch triestino	IT, SI	Second Assessment
246	Carso classico (isontino e triestino): falda freatica sviluppata in ambiente altamente carsificato, con circolazione per condotte/fessure	IT, SI	Second Assessment

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247	Alta pianura isontina	IT, SI	Second Assessment
248	Flysch goriziano	IT, SI	Second Assessment
249	Cividalese	IT, SI	Second Assessment
250	Canin	IT, SI	Second Assessment
251	Gail	IT, SI	Second Assessment
252	Massicci carbonatici della catena paleocarnica 3	AT, IT	Second Assessment
253	Catena paleocarnica orientale - Val Canale	AT, IT	Second Assessment
254	Massicci carbonatici della catena paleocarnica 2	AT, IT	Second Assessment
255	Catena paleocarnica centrale	AT, IT	Second Assessment
256	Massicci carbonatici della catena paleocarnica 1	AT, IT	Second Assessment
257	Fleons-Cimon	AT, IT	Second Assessment
258	Deep groundwater body – thermal water	AT, DE	Second Assessment
259	DE_GB_Ei23	DK, DE	EEA
260	DE_GB_Ei22	DK, DE	EEA
261	DE_GB_3_03	DE, NL	EEA
262	Domaine plissé BV Roya, Bévéra	FR, IT	EEA checked
263	Domaine plissé BV Cenise et Pô	FR, IT	EEA checked
264	Calcaires jurassiques sous couverture du Pays de Gex	FR, CH	EEA checked
265	Calcaires jurassiques BV de la Jougnena et Orbe	FR, CH	EEA checked
266	Calcaires et marnes jurassiques chaîne du Jura	FR, CH	EEA checked
267	Calcaires jurassiques chaîne du Jura - BV Doubs	FR, CH	EEA checked
268	Pliocène de Haguenau et nappe d'Alsace	FR, DE, CH	EEA
269	Grès vosgien en partie libre	FR, DE	EEA
270	Grès vosgien captif non minéralisé	FR, DE	EEA
271	Grès du Trias inférieur du bassin houiller	FR, DE	EEA
272	Grès du Lias inférieur d'Hettange Luxembourg	FR, BE, LU	EEA
273	cks_0200_gwl_1	BE, NL	EEA
274	Socle du Brabant	BE, FR	EEA
275	Calcaires de l'Avesnois	BE, FR	EEA checked
276	Sables du Landenien d'Orchies	BE, FR	EEA
277	cvs_0160_gwl_1	BE, FR, NL	EEA
278	Sables du Landenien des Flandres	BE, FR, NL	EEA
279	Zout grondwater in ondiepe zandlagen	BE, NL	EEA
280	Domaine plissé Pyrénées axiales et alluvions IVair	AD, FR, ES	EEA checked
281	Vegas Bajas	PT, ES	Second Assessment
282	Ciudad Rodrigo	PT, ES	Second Assessment
283	LOW MIÑO	PT, ES	Second Assessment
284	IEGBNI_NB_G_007	IE, GB	EEA
285	IEGBNI_NW_G_028	IE, GB	EEA
286	IE_NW_G_082	IE, GB	EEA
287	IE_NW_G_082	IE, GB	EEA
288	IEGBNI_NW_G_048	IE, GB	EEA
289	IEGBNI_NW_G_050	IE, GB	EEA
290	Quaternary sediment aquifer	LV, LT	Second Assessment

Note: The inventory of transboundary groundwaters is based on different sources of information. "EEA checked" information derives from the reporting by EU member States under the WFD which has been processed by EEA but not fully quality assured by the time of publication. "EEA" information was submitted to the EEA under the WFD but has not been processed by EEA. "Earlier inventories" information is based on the inventories carried out by the International Network of Water-Environment Centres for the Balkans for South-Eastern Europe in 2008, the one carried out by UNESCO and IGRAC in 2009 for the Caucasus and Central Asia, and the ones carried out under the Water Convention in 2007 (First Assessment) and in 1999. "Second Assessment" refers to information that was provided by countries in the process of preparation of the Second Assessment.

Because of the large number of individual groundwater bodies (GWB), they have in some cases been grouped to form sets of GWBs.

The locations and extent of a number of aquifers are only approximate because the information provided by the countries was limited.

Numbers in bold in the maps indicate groundwaters assessed in the present publication.