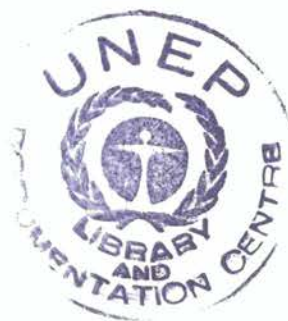
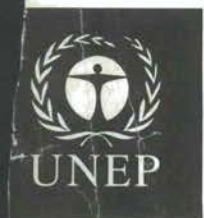


# Vital **Water** Graphics

An Overview of the State of  
the World's Fresh and Marine Waters



## About This Report

The United Nations Environment Programme (UNEP) has been at the forefront of assessing and monitoring global water resources and presenting information on their use and management for the past 30 years. UNEP, in collaboration with partners and collaborating centres, collates and analyses water resource data on a global basis. Despite a concerted effort to create a comprehensive database on global water use, however, there remain many gaps in the information available. Several projects and programmes are working to fill these gaps. Among them are the Global International Waters Assessment (GIWA), the Global Programme of Action for the Protection of the Marine Environment from Land Based Activities (GPA/LBA), and the Global Environment Monitoring System Freshwater Quality Programme (UNEP-GEMS/Water), as well as many other programmes dealing with fresh and coastal/marine waters within other United Nations agencies and partners. The current situation reveals that, while there is significant information on most aspects of water resources in Europe and North America, there are glaring gaps in some of the available data for Africa, South America and parts of Asia, particularly in water quality and quantity.

As was the case with its earlier publication on *Vital Climate Graphics*, UNEP has compiled this report in order to provide an easily accessible resource on the state of the world's waters. The goal of this publication is to produce a clear overview, through a set of graphics, maps and other illustrations, of the state of the world's fresh and marine waters. It also illustrates the causes, effects, trends and threats facing our water sources, with examples of areas of major concern and future scenarios for the use and management of fresh, coastal and marine waters.

It is hoped that this information will assist water users and professionals to make better decisions in order to protect our water resources for future generations.

Further graphics and links to relevant websites on topics presented in this publication are available on the accompanying CD-ROM or at [www.unep.org/vitalwater](http://www.unep.org/vitalwater).



### Disclaimer

The views expressed in this publication are not necessarily those of the United Nations Environment Programme. The presentations and the designations employed do not imply the expression of any opinion whatsoever on the part of the cooperating divisions concerning the legal status of any country, territory, city or area or of its authorities, or of the delineation of its frontiers or boundaries. Mention of a commercial company or product in this report does not imply endorsement by UNEP. The use of information from this publication concerning proprietary products for publicity or advertising purposes is not permitted. Trademark names and symbols are used in an editorial fashion with no intention of infringement on trademark or copyright laws. We regret any errors or omissions that may unwittingly have been made.

Copyright © 2002, United Nations Environment Programme

This publication may be reproduced in whole or in part and in any form for educational or non-profit purposes without special permission from the copyright holder, provided acknowledgement of the source is made. UNEP would appreciate receiving a copy of any material that uses this publication as a source. No use of this publication may be made for resale or for any other commercial purpose whatsoever without prior permission in writing from the United Nations Environment Programme.

United Nations Environment Programme  
P.O. Box 30552  
Nairobi, Kenya  
Tel: (254) 2 62 41 05  
Fax: (254) 2 62 42 69  
E-mail: [dewainfo@unep.org](mailto:dewainfo@unep.org)  
Web: [www.unep.org](http://www.unep.org)

ISBN: 92-807-2236-0

Further graphics and links to relevant websites on topics presented in this publication are available on the accompanying CD-ROM or at [www.unep.org/vitalwater](http://www.unep.org/vitalwater)



## Foreword

By Klaus Töpfer

United Nations Under-Secretary General and  
Executive Director, United Nations Environment Programme

Water-related problems have been recognised as the most immediate and serious threats to humankind. The new UNEP Water Policy and Strategy – which itself is part of a broader restructuring of UNEP that has taken the organisation away from addressing issues sectorally – recognises this need. At its core lie three components: assessment, management and co-ordination of actions. UNEP has long been involved in the field of fresh and marine water and has developed a number of programmes over the years. These, updated and revitalised, are being combined with newer programmes, such as the Global International Waters Assessment (GIWA) and Global Programme of Action to Protect the Marine Environment From Land-Based Activities (GPA), to produce an integrated, comprehensive and dynamic approach to priority water issues.

One of the goals of the new UNEP Water Policy and Strategy is to identify and promote the tools that will address the critical water issues facing humanity. Many already exist. New technologies and water management demands can improve efficiency in irrigation and encourage cleaner production in industry. The harmonisation of water policies with land and forestry policies can improve soil and water conservation and halt land degradation. International co-operation, especially among countries sharing water resources, can address the transboundary nature of many water issues.

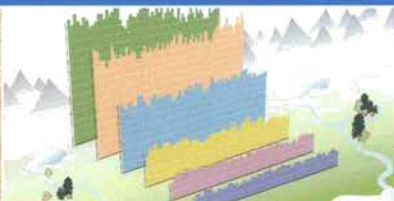
*Vital Water Graphics* is a valuable and timely addition to existing assessments of the state of the world's water resources. It focuses

on our most 'vital' and pressing water issues – issues that will determine the very future of life on Earth.

A total of 40 graphics, together with accompanying texts and maps, highlight how the quantity, quality and availability of fresh and marine waters play a major role in determining levels and patterns of poverty, land degradation, pollution, sanitation, health, and rural and urban development around the world.

It also documents water trends in our fast changing environment, with examples from the past two decades revealing present trends and providing potential scenarios for the future. By recounting the latest chapter in the history of our fresh and marine water resources, the publication demonstrates how rapidly these are being depleted and polluted – and how urgently we must work for their conservation.

By providing a clear synthesis between water usage and social, economic and environmental factors, *Vital Water Graphics* will contribute through UNEP's Water Policy and Strategy to the achievement of the relevant goals (coastal, marine and freshwater) of its implementation plan of the World Summit on Sustainable Development. We know that this document will provide valuable messages for the public and the media, as well as being an effective tool for decision-making in water use and management during the years to come.



# Vital Water Graphics

An Overview of the State of  
the World's Fresh and Marine Waters

## Executive Summary

Published 10 years after the Rio Summit of 1992, *Vital Water Graphics* focuses on the critical issues of water quantity, quality and availability – issues that are vital to the quality of life on Earth. The assessment of global water resources and the provision of early warnings on water issues are enshrined in the mandate, vision and mission of the United Nations Environment Programme. UNEP, UN agencies, and collaborating centres and partners monitor and analyse water resources on a global scale. This partnership enables a wider involvement in assessing the status of the implementation of Chapters 17 and 18 of Agenda 21, which address coastal and marine waters and freshwater, respectively.

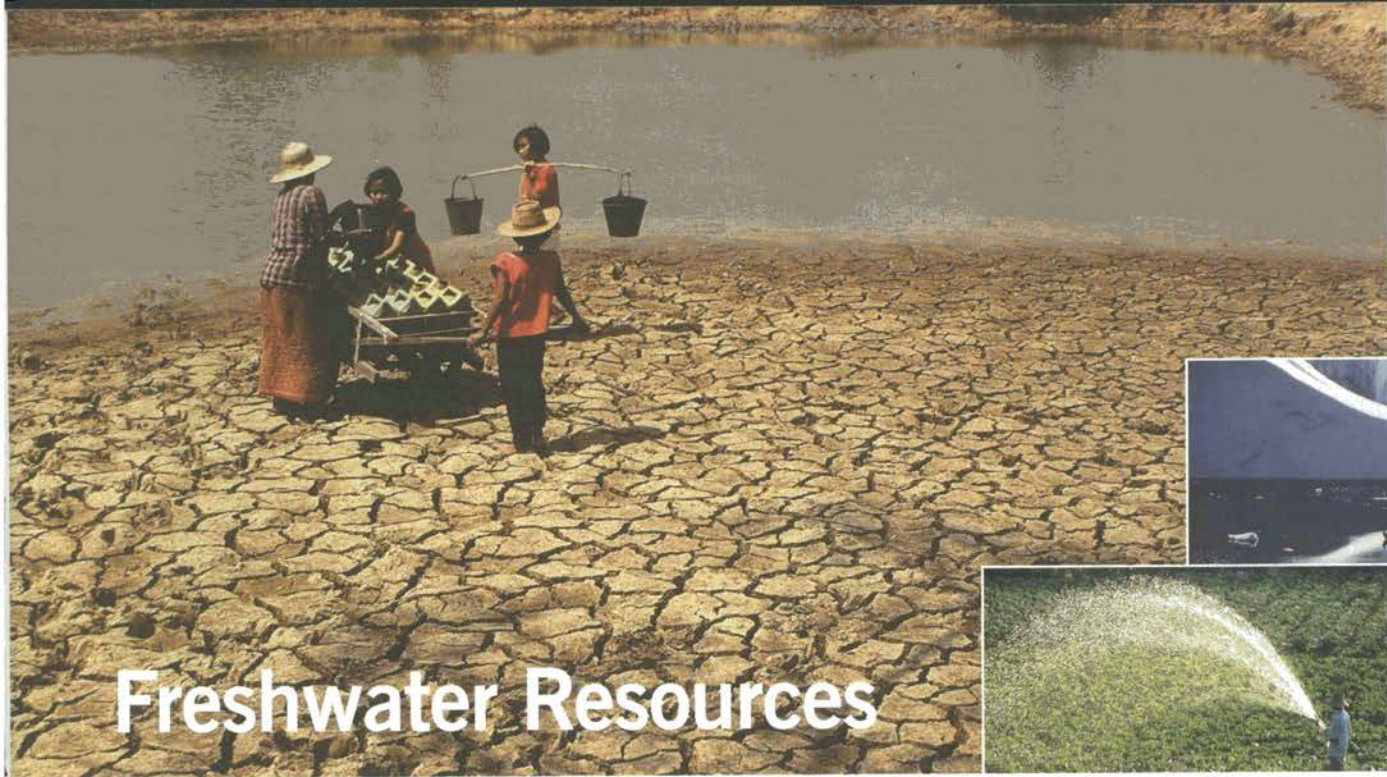
Highlights from assessment activities over the past two decades, which are used to establish present and future water trends, reveal that:

1. Freshwater resources are unevenly distributed, with much of the water located far from human populations. Many of the world's largest river basins run through thinly populated regions. There are an estimated 263 major international river basins in the world, covering ~231 059 898 km<sup>2</sup> or 45.3% of the Earth's land surface area (excluding Antarctica).
2. Groundwater represents about 90% of the world's readily available freshwater resources, and some 1.5 billion people depend upon groundwater for their drinking water.
3. Agricultural water use accounts for about 75% of total global consumption, mainly through crop irrigation, while industrial use accounts for about 20%, and the remaining 5% is used for domestic purposes.
4. It is estimated that two out of every three people will live in water-stressed areas by the year 2025. In Africa alone, it is estimated that 25 countries will be experiencing water stress (below 1,700 m<sup>3</sup> per capita per year) by 2025. Today, 450 million people in 29 countries suffer from water shortages.
5. Clean water supplies and sanitation remain major problems in many parts of the world, with 20% of the global population lacking access to safe drinking water. Water-borne diseases from faecal pollution of surface waters continue to be a major cause of illness in developing countries. Polluted water is estimated to affect the health of 1.2 billion people, and contributes to the death of 15 million children annually.

A wide variety of human activities also affect the coastal and marine environment. Population pressures, increasing demands for space and resources, and poor economic performances can all undermine the sustainable use of our oceans and coastal areas. Serious problems affecting the quality and use of these ecosystems include:

1. Alteration and destruction of habitats and ecosystems. Estimates show that almost 50% of the world's coasts are threatened by development-related activities.
2. Severe eutrophication has been discovered in several enclosed or semi-enclosed seas. It is estimated that about 80% of marine pollution originates from land-based sources and activities.
3. In marine fisheries, most areas are producing significantly lower yields than in the past. Substantial increases are never again likely to be recorded for global fish catches. In contrast, inland and marine aquaculture production is increasing and now contributes 30% of the total global fish yield.
4. Impacts of climate change may include a significant rise in the level of the world's oceans. This will cause some low-lying coastal areas to become completely submerged, and increase human vulnerability in other areas. Because they are highly dependent upon marine resources, small island developing states (SIDS) are especially vulnerable, due to both the effects of sea level rise and to changes in marine ecosystems.

UNEP is involved in promoting Integrated Coastal Management (ICM) through a broad variety of initiatives, as a way of resolving current and future problems at a local/ecosystem-based level. Through its different assessment activities, UNEP focuses on highlighting key areas to promote policy recommendations.



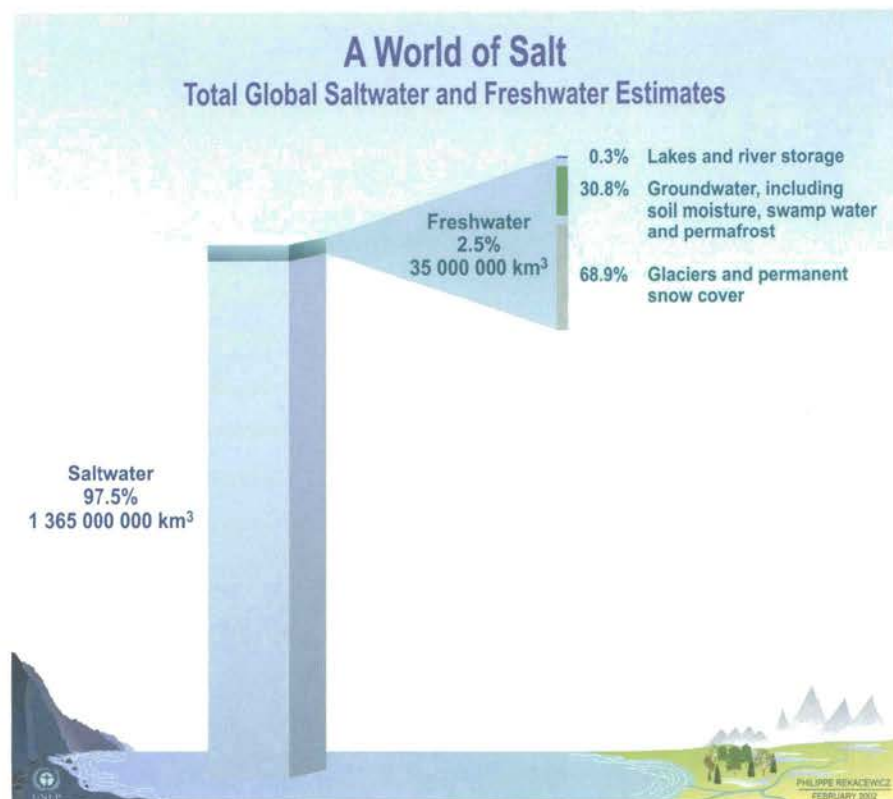
# Freshwater Resources

Over the past decade, efforts based on Agenda 21's freshwater management guidelines in Chapter 18, which address the protection of the quality and supply of freshwater and the application of integrated approaches for the development, management and use of water resources, have focused on the following areas:

- Integrated water resources development and management;
- Water resources assessment;
- Protection of water resources, water quality and aquatic ecosystems;
- Drinking-water supply and sanitation;
- Water and sustainable urban development;
- Water for sustainable food production and rural development; and
- The impact of climate change on water resources.

Estimates of global water resources based on several different calculation methods have produced varied estimates. Shiklomanov in Gleick (1993) estimated that:

- The total volume of water on Earth is ~1.4 billion km<sup>3</sup>.
- The volume of freshwater resources is ~35 million km<sup>3</sup>, or about 2.5% of the total volume.
- Of these freshwater resources, ~24 million km<sup>3</sup> or 68.9% is in the form of ice and permanent snow cover in mountainous regions, the Antarctic and Arctic regions.
- Some 8 million km<sup>3</sup> or 30.8% is stored underground in the form of groundwater (shallow and deep groundwater basins up to 2 000 metres, soil moisture, swamp water and permafrost). This constitutes about 97% of all the freshwater that is potentially available for human use.
- Freshwater lakes and rivers contain an estimated 105 000 km<sup>3</sup> or ~0.3% of the world's freshwater.
- The total usable freshwater supply for ecosystems and humans is ~200 000 km<sup>3</sup> of water, which is < 1% of all freshwater resources, and only 0.01% of all the water on Earth (Gleick, 1993; Shiklomanov, 1999).

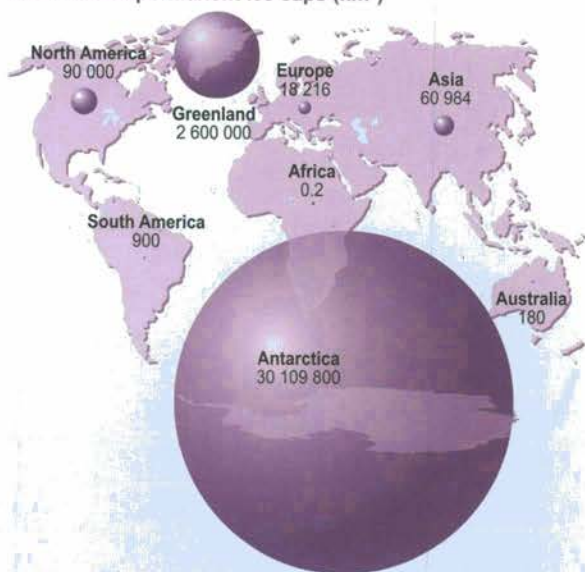


T1

Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational, Scientific and Cultural Organisation (UNESCO, Paris), 1999.

# Global Freshwater Resources Quantity and Distribution by Region

Glaciers and permanent ice caps (km<sup>3</sup>)



Groundwater (km<sup>3</sup>)

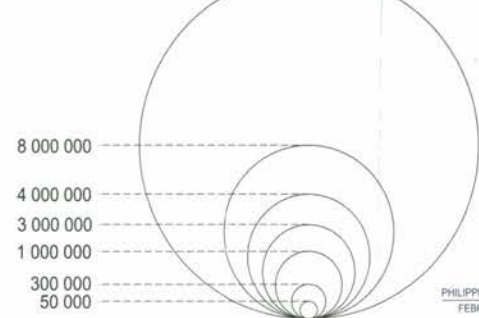


Wetlands, large lakes, reservoirs and rivers (km<sup>3</sup>)



km<sup>3</sup>

30 000 000



T2  
PHILIPPE REKACEWICZ  
FEBRUARY 2002

**Note:** Estimates refer to standing volumes of freshwater.  
Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational, Scientific and Cultural Organisation (UNESCO, Paris), 1999; World Meteorological Organisation (WMO); International Council of Scientific Unions (ICSU); World Glacier Monitoring Service (WGMS); United States Geological Survey (USGS).

**Glaciers and icecaps** cover about 10% of the world's landmass. These are concentrated in Greenland and Antarctica and contain ~70% of the world's freshwater. Unfortunately, most of these resources are located far from human habitation and are not readily accessible for human use.

According to the United States Geological Survey (USGS), 96% of the world's frozen freshwater is at the South and North poles, with the remaining 4% spread over 550 000 km<sup>2</sup> of glaciers and mountainous icecaps measuring about 180 000 km<sup>3</sup> (UNEP, 1992; Untersteiner, 1975; WGMS, 1998, 2002).

**Groundwater** is by far the most abundant and readily available source of freshwater, followed by lakes, reservoirs, rivers and wetlands:

- Groundwater represents over 90% of the world's readily available freshwater resource (Boswinkel, 2000). About 1.5 billion people depend upon groundwater for their drinking water supply (WRI, UNEP, UNDP, World Bank, 1998).
- The amount of groundwater withdrawn annually is roughly estimated at ~600-700 km<sup>3</sup>, representing about 20% of global water withdrawals (WMO, 1997).
- A comprehensive picture of the quantity of groundwater withdrawn and consumed annually around the world does not exist.

Most **freshwater lakes** are located at high altitudes, with nearly 50% of the world's lakes in Canada alone. Many lakes, especially those in arid regions, become salty through evaporation, which concentrates the inflowing salts. The Caspian Sea, the Dead Sea, and the Great Salt Lake are among the world's major salt lakes.

**Rivers** form a hydrological mosaic, with an estimated 263 international river basins covering 45.3% (~231 059 898 km<sup>2</sup>) of the land surface area of the Earth, excluding Antarctica (UNEP, Oregon State University et al., in preparation). The total volume of water in the world's rivers is estimated at 2 115 km<sup>3</sup> (Groombridge and Jenkins, 1998).

## Major River Basins of the World



DELPHINE DIDOUT  
MAY 2002

North America	Europe	Asia and Australia
1 Yukon	25 Danube	13 Volga
2 Mackenzie		14 Ob
3 Nelson	<b>Africa and West Asia</b>	15 Yenisey
4 Mississippi	8 Niger	16 Lena
5 St. Lawrence	9 Lake Chad Basin	17 Kolyma
	10 Congo	18 Amur
<b>South America</b>	11 Nile	19 Ganges and Brahmaputra
6 Amazon	12 Zambezi	20 Yangtze
7 Paraná	26 Orange	21 Murray Darling
	24 Euphrates and Tigris	22 Huang He
		23 Indus

Source: United Nations Environment Programme (UNEP); World Conservation Monitoring Centre (WCMC); World Resources Institute (WRI); American Association for the Advancement of Science (AAAS); *Atlas of Population and Environment*, 2001.

**Reservoirs** are artificial lakes, produced by constructing physical barriers across flowing rivers, which allow the water to pool and be used for various purposes. The volume of water stored in reservoirs worldwide is estimated at 4 286 km<sup>3</sup> (Groombridge and Jenkins, 1998).

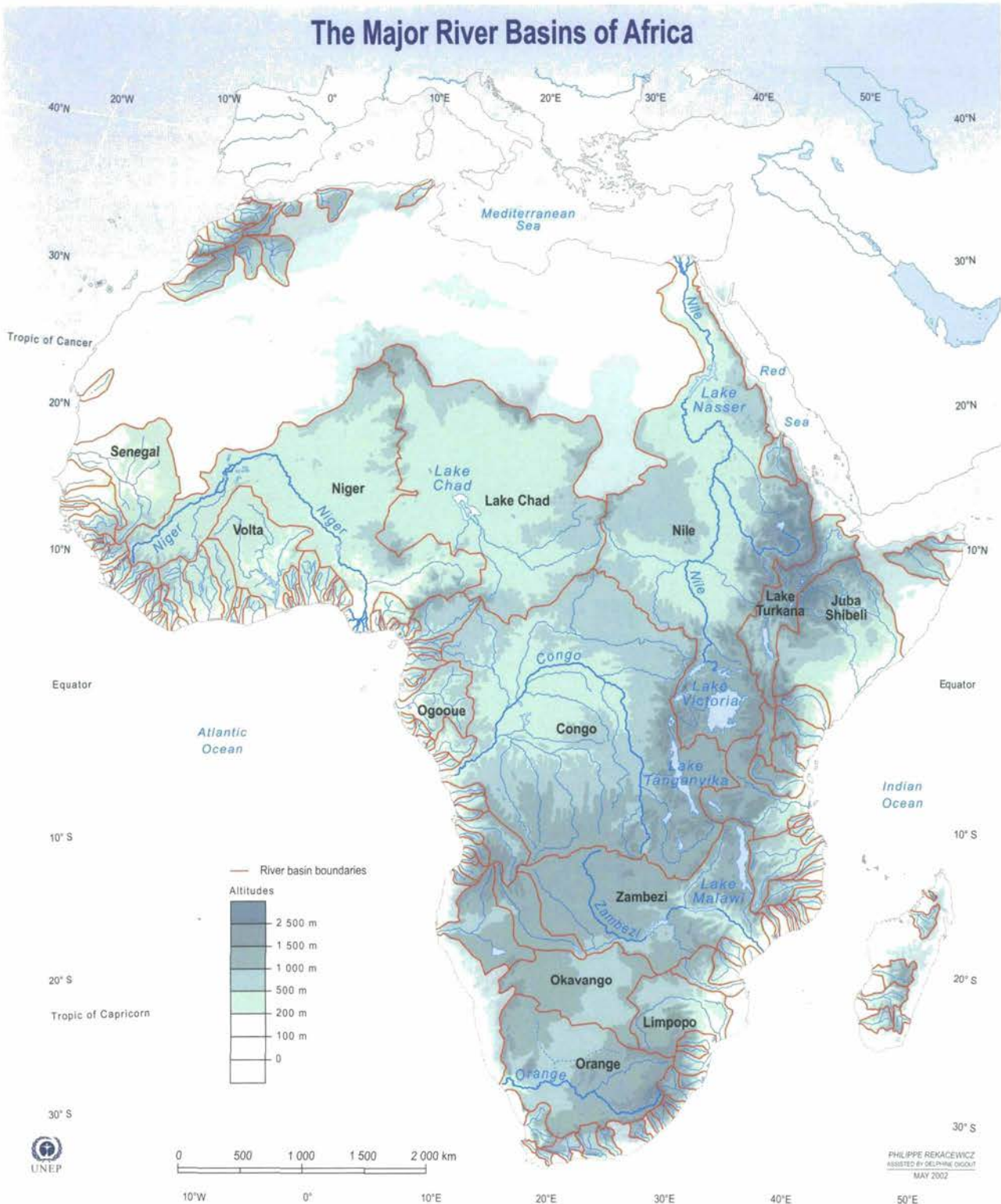
**Wetlands** include swamps, bogs, marshes, mires, lagoons and floodplains. The 10 largest wetlands in the world by area are: West Siberian Lowlands (780 000-1 000 000 km<sup>2</sup>), Amazon River (800 000 km<sup>2</sup>), Hudson Bay Lowlands (200 000-320 000 km<sup>2</sup>), Pantanal (140 000-200 000 km<sup>2</sup>), Upper Nile River

(50 000-90 000 km<sup>2</sup>), Chari-Logone River (90 000 km<sup>2</sup>), Hudson Bay Lowlands in the South Pacific (69 000 km<sup>2</sup>), Congo River (40 000-80 000 km<sup>2</sup>), Upper Mackenzie River (60 000 km<sup>2</sup>), and North America prairie potholes (40 000 km<sup>2</sup>) (Pidwiny, 1999).

The total global area of wetlands is estimated at ~2 900 000 km<sup>2</sup> (Groombridge and Jenkins, 1998). Most wetlands range in depth from 0-2 metres. Estimating the average depth of permanent wetlands at about one metre, the global volume of wetlands could range between 2 300 km<sup>3</sup> and 2 900 km<sup>3</sup>.

T4

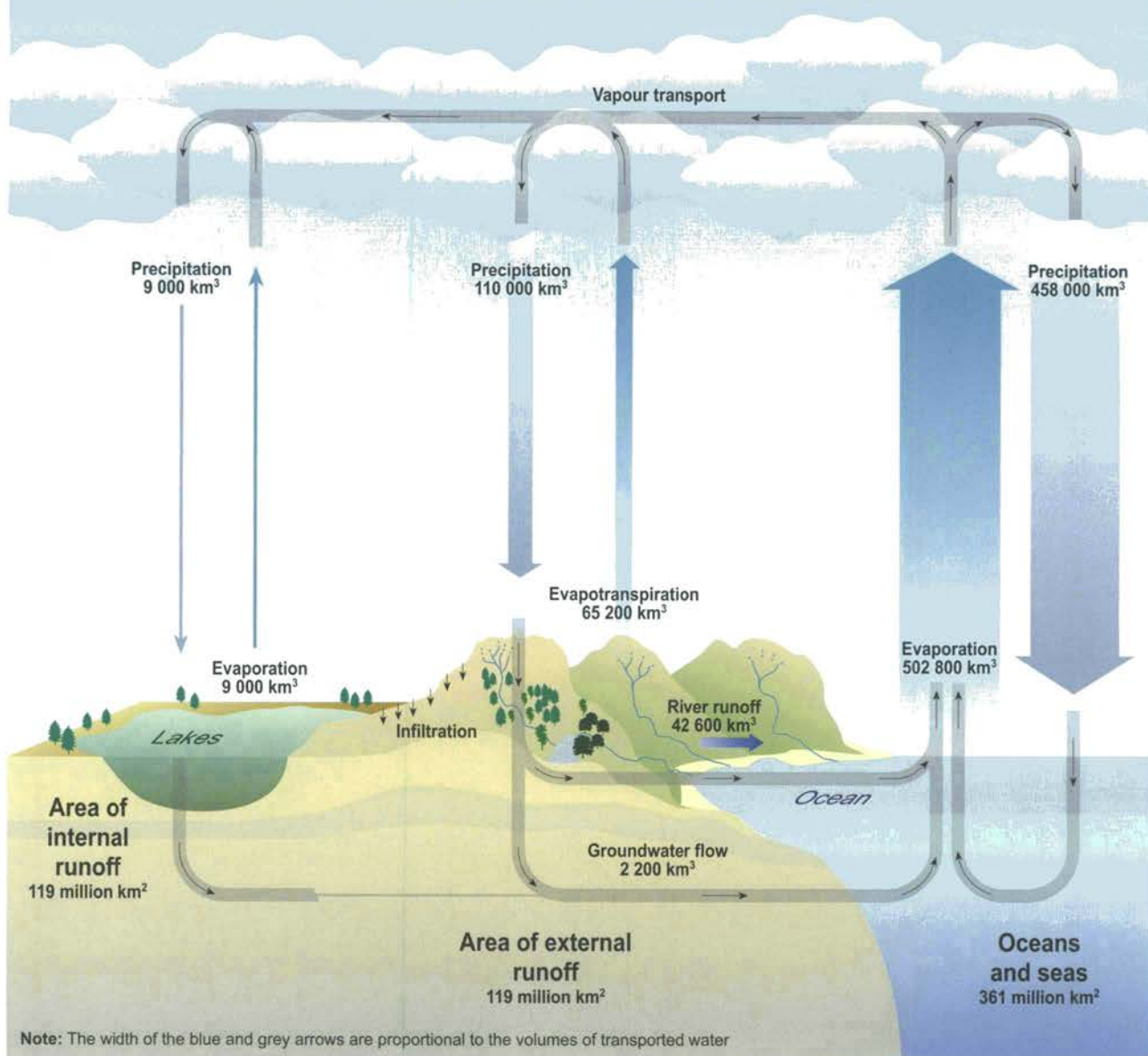
## The Major River Basins of Africa



Source: Aaron T. Wolf et al., 1999; Revenga et al., *Watersheds of the World*, World Resources Institute (WRI), Washington DC, 1998; Philippe Rekacewicz, *Atlas de poche*, Livre de poche, Librairie générale française, Paris, 1996 (revised in 2001).

# The World's Water Cycle

## Global Precipitation, Evaporation, Evapotranspiration and Runoff



### Estimated Residence Times of the World's Water Resources

Biospheric water | 1 WEEK

预览已结束，完整报告链接和二维码如下：

[https://www.yunbaogao.cn/report/index/report?reportId=5\\_13489](https://www.yunbaogao.cn/report/index/report?reportId=5_13489)

