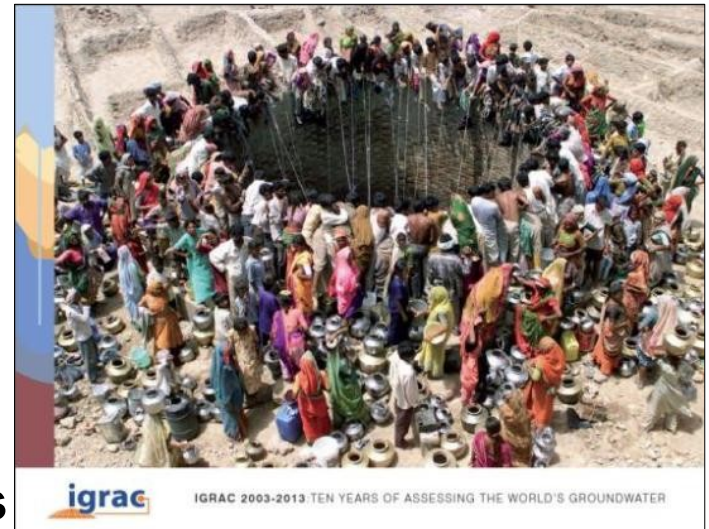


**Assessment of  
Transboundary Aquifers  
in Europe  
(and the rest of the world)**

# Groundwater from Global Perspective

- IGRAC - International Groundwater Resource Assessment Centre is (since 2003) UNESCO and WMO groundwater centre
- IGRAC facilitates and promotes global sharing of information and knowledge required for sustainable groundwater resources development and management
- Focused on information and knowledge management, transboundary aquifer assessment and groundwater monitoring
- Receives financial support from the Government of The Netherlands
- In-house partner of UNESCO-IHE in Delft, The Netherlands



# IGRAC Portal

## International Groundwater Resources Assessment Centre

### Welcome to the World of Groundwater



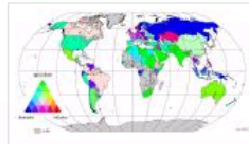
The World's groundwater resources are of key importance to sustainable development. However, making full benefit from the available groundwater resources and controlling effectively the ubiquitous groundwater-related problems are very demanding tasks. **Sharing groundwater information and experience** on a world-wide scale would be of great help in this respect. This is what IGRAC supports and promotes.

IGRAC is dedicated to groundwater information and knowledge in the widest sense, on a world-wide scale and on a non-commercial basis.

### Global Groundwater Information System-GGIS

GGIS is an interactive portal to groundwater-related information and knowledge.

[read more »](#)



### Transboundary Aquifers of the World

At WWF5 in Istanbul, IGRAC presented its latest product: Transboundary Aquifers Map of the World. His Royal Highness Prince Willem-Alexander, ...

[read more »](#)



### News & Events

#### March 26, 2009

- » Transboundary Aquifers of the World presented at the WWF5

#### February 23, 2009

- » IGRAC participation to World Water Forum 5

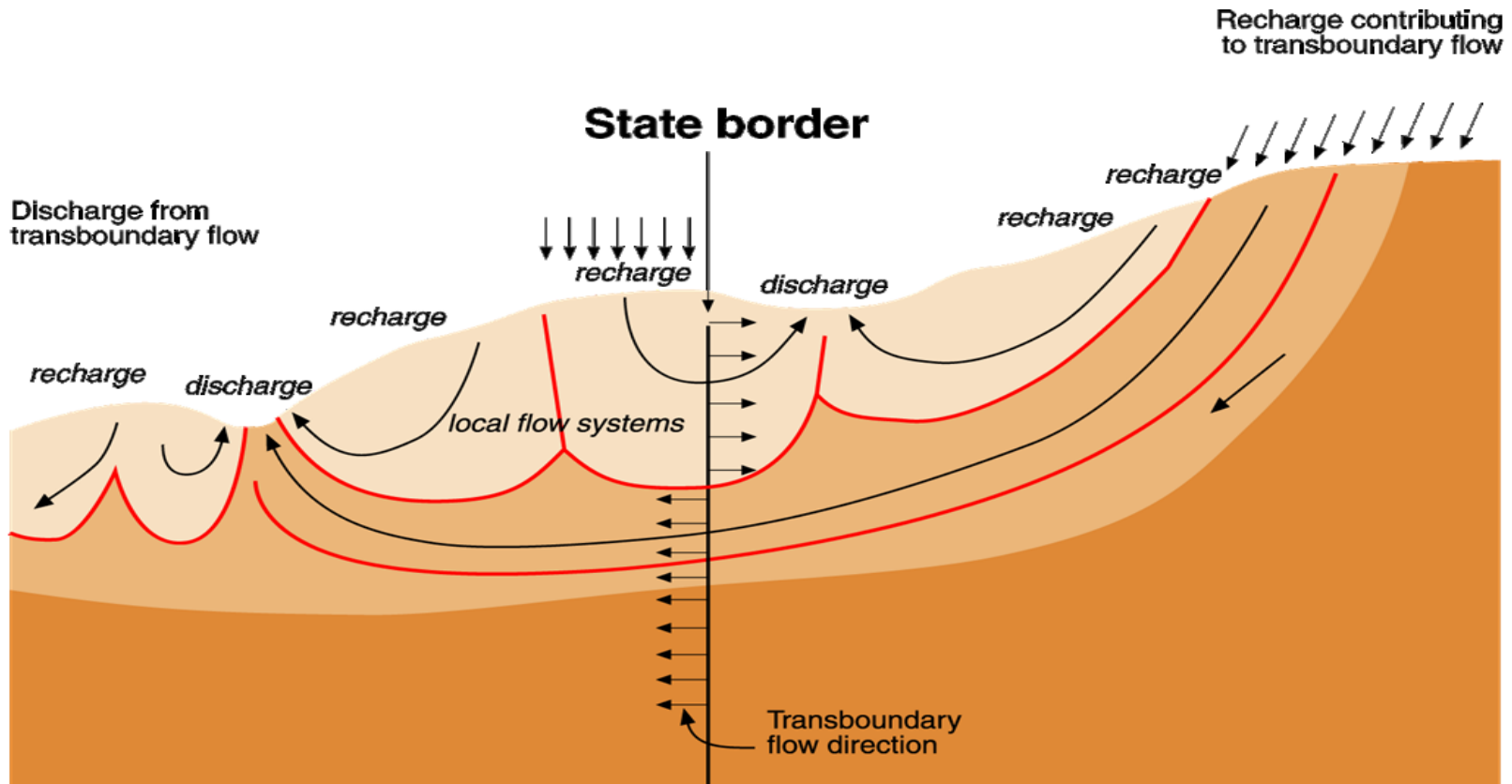
#### February 16, 2009

- » Benchmark papers on groundwater

[more news »](#)

# What is a Transboundary Aquifer?

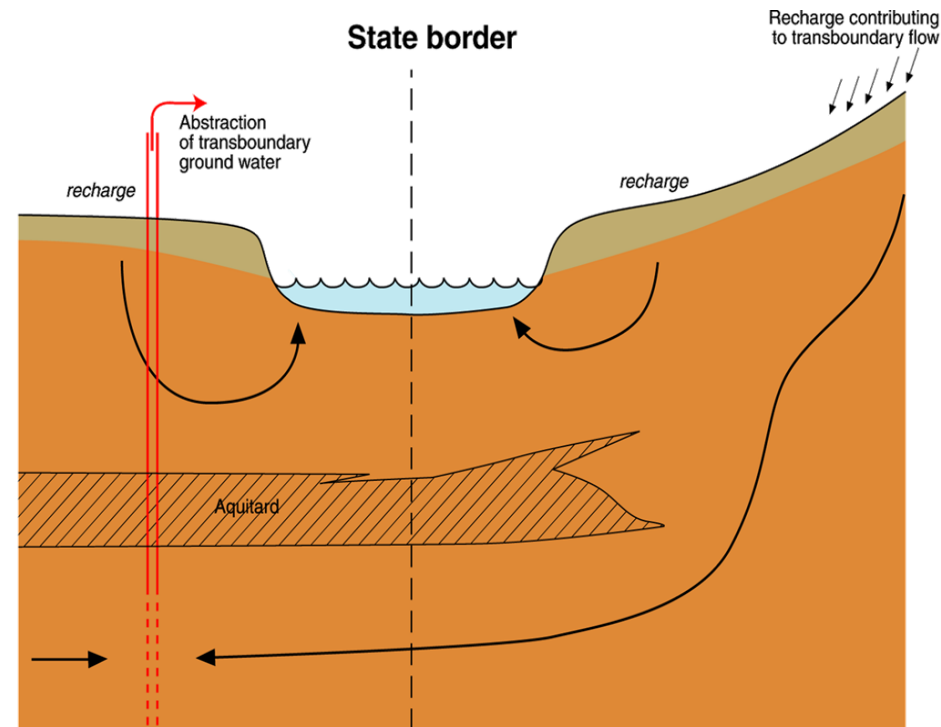
- Transboundary aquifer or transboundary aquifer system means, respectively, an aquifer or aquifer system, parts of which are situated in different States;



# Why do we need a TBA assessment?

- **The fact:** many aquifers cross the political borders
- **Potential cross-boundary problems:** changes in groundwater flow, levels, volumes (quantity) and dissolved substances (quality).

- **Actions:** TBA assessment, monitoring and appropriate management.
- **Benefits:** eliminating potential sources of conflict and improving the overall benefit from groundwater.



# Internationally Shared Aquifers

- ISARM Regional Activities, Core group, portal..



- UNECE Assessments in Europe and Asia



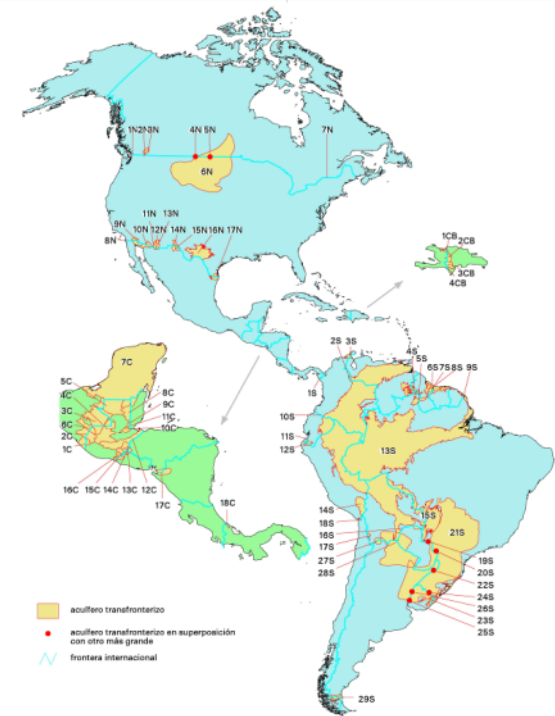
UNECE

- Participation in GEF (Global Environment Facility) projects



Development of a TBA Methodology and a TBA Course, contribution to UNILC, WW

- Transboundary Aquifers of the World Map



# ISARM Programme

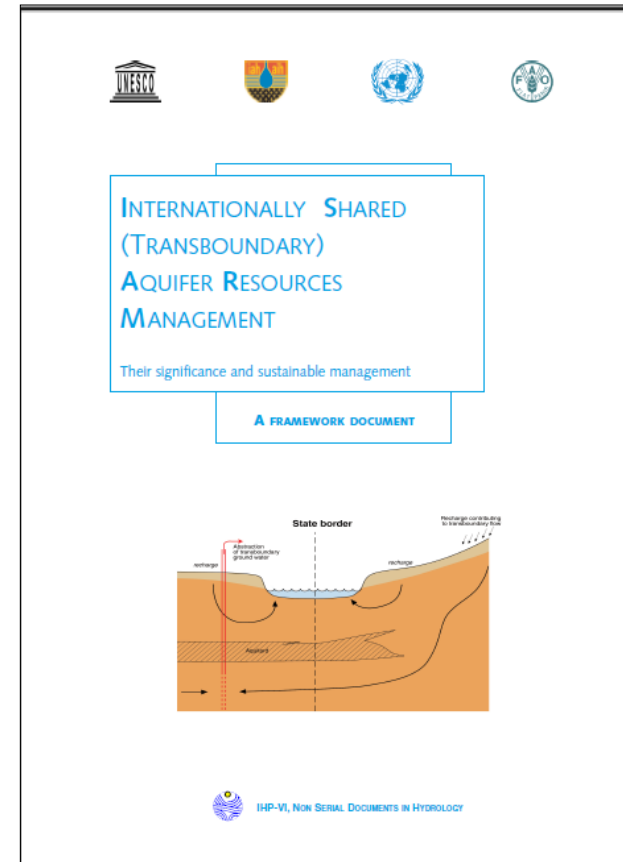
- The worldwide **ISARM** (Internationally Shared Aquifer Resources Management) Initiative is an **UNESCO** led multi-agency effort aimed at improving the understanding of hydrogeological, socio-economic, legal, institutional and environmental issues related to the management of transboundary aquifers.



- ISARM operates as an umbrella programme, (co)organising various TBA-related activities around the world.

# ISARM Background

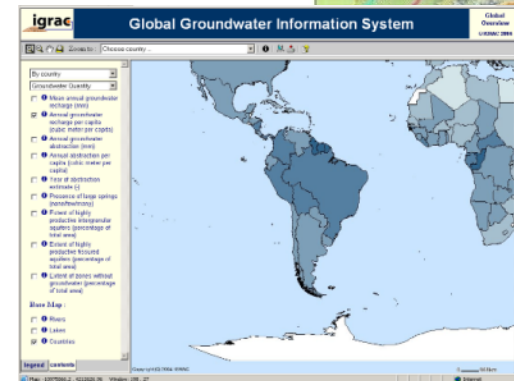
- **June 2000:** in recognition of the importance of transboundary aquifer systems as a source of freshwater in certain regions of the world, **UNESCO IHP Council** decided to **launch an ISARM initiative** to promote studies on transboundary aquifers.
- A cooperation was established with **IAH (TARM commission)**, **UNECE**, **FAO** and other regional and international institutions.
- A **framework document** in **2001**, describing the main aspects of the internationally shared aquifers and setting up the basis for the **TBA assessment**



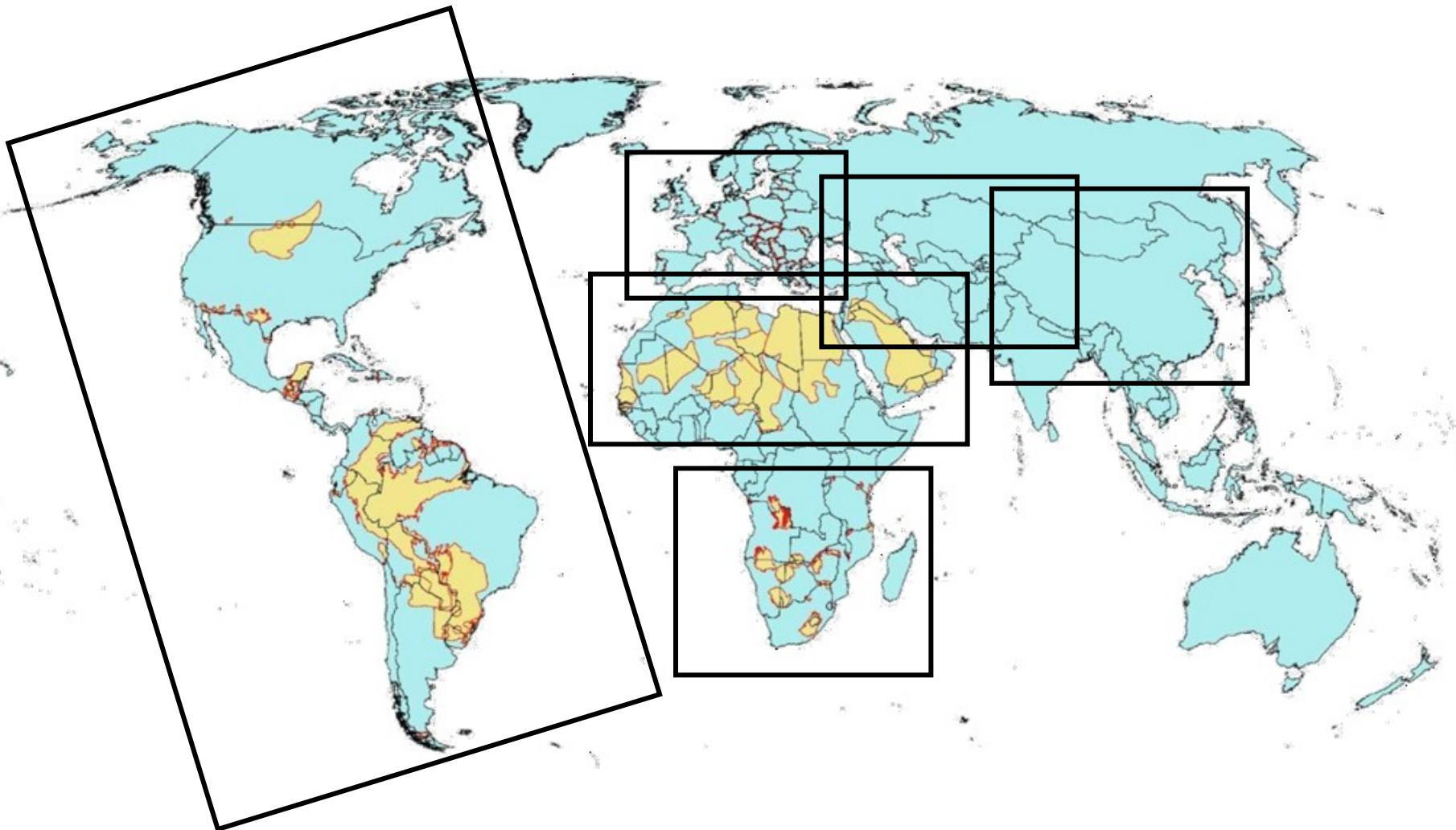


# TBA Assessment Methodology

- **Hydrogeological Aspect**
  - Delineation and description
  - Classification, diagnostic analysis and zoning
  - Data harmonisation and information management
  
- **Environmental issues**
- **Socio-economic framework**
- **Institutional settings**
- **International legal framework**



# Global Overview of ISARM activities

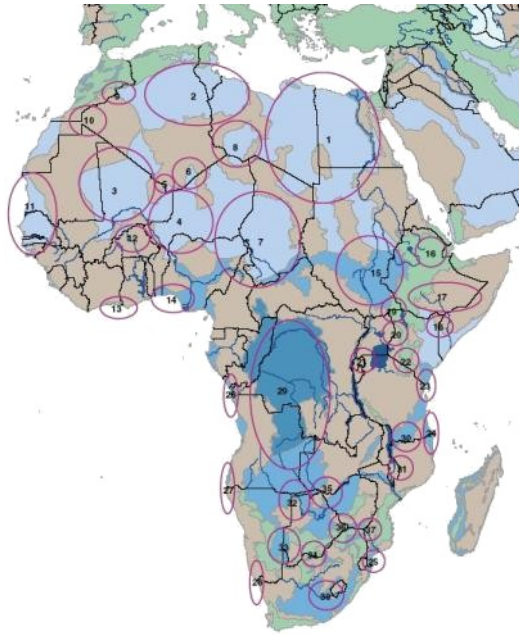


# ISARM Regional Activities

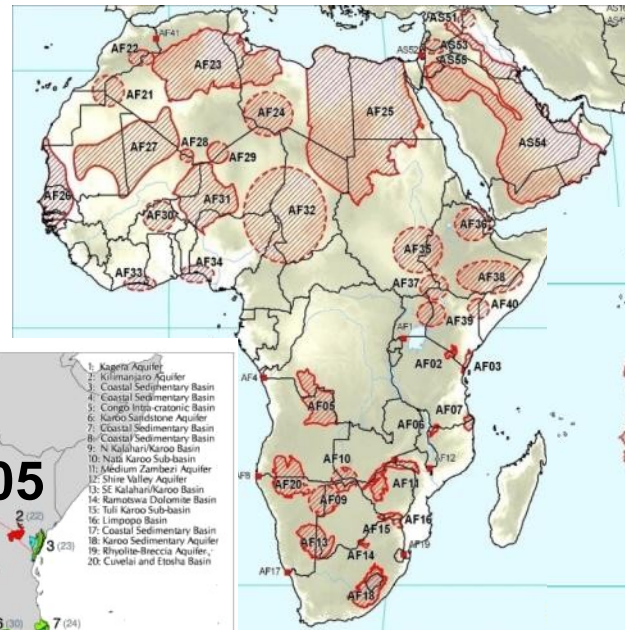
- Since its start in 2000, ISARM launched a number of regional initiatives designed to assess transboundary aquifer systems and to encourage aquifer sharing states to work cooperatively toward mutually beneficial and sustainable aquifer development.
- Cooperation with regional organisations is crucial for success of ISARM activities.
- The most numerous initiatives carried out in Africa (Tripoli 2002 , Cape Town 2005, 2007, Tripoli 2008, Nairobi 2010, 2011, Duala 2011, 2012...)
- The most advanced assessment so far is of ISARM Americas (hydrogeology, legal and institutional frameworks, socio-economic framework...)
- South East Europe Caucasus and Central Asia in cooperation with UNECE
- ISARM Western Asia in cooperation with Geological Survey of China



# TBA assessment in Africa



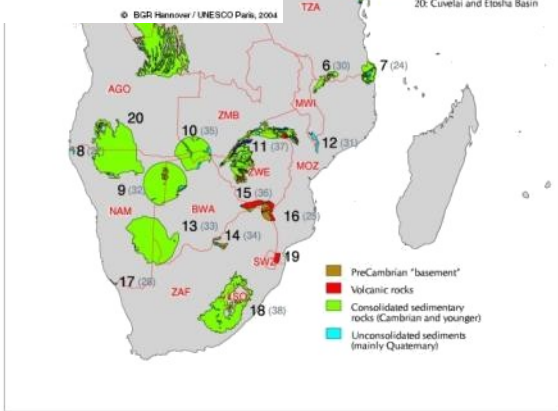
2009



2012



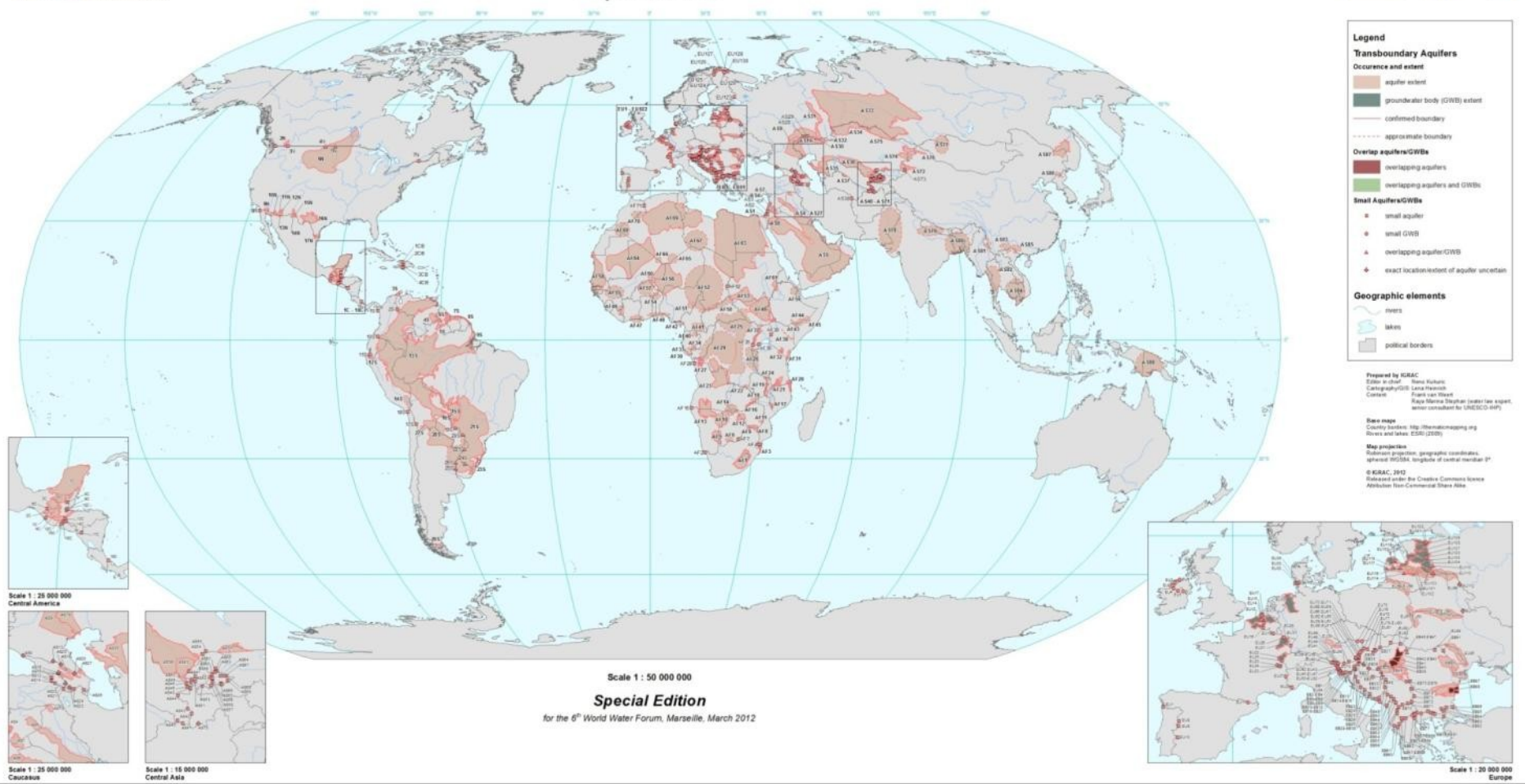
- 005**
- 1: Kagera Aquifer
  - 2: Kilimanjaro Aquifer
  - 3: Coastal Sedimentary Basin
  - 4: Coastal Sedimentary Basin
  - 5: Congo Intra-cratonic Basin
  - 6: Karoo Sandstone Aquifer
  - 7: Coastal Sedimentary Basin
  - 8: Coastal Sedimentary Basin
  - 9: N. Kalahari/Karoo Basin
  - 10: Nati Karoo Sub-basin
  - 11: Medium Zambesi Aquifer
  - 12: Shire Valley Aquifer
  - 13: SE Kalahari/Karoo Basin
  - 14: Ramotswa Dolomite Basin
  - 15: Tuli Karoo sub-basin
  - 16: Limpopo Basin
  - 17: Coastal Sedimentary Basin
  - 18: Karoo Sedimentary Aquifer
  - 19: Rhyolite-Breccia Aquifer
  - 20: Cuvetia and Etoha Basin



© BGR Hannover / UNESCO Paris, 2004

# TBAs of the World - 2012

## Transboundary Aquifers of the World - Update 2012 -



# Atlas of Transboundary Aquifers

- Includes basic info about aquifers, regional cooperation and references
- The first global publication (other than a map – delineation process)
- Very limited info/no analysis

Regional and Local Inventories

**258 CAUCASUS and CENTRAL ASIA TRANSBOUNDARY AQUIFERS INVENTORY**

OVERVIEW

Caucasus and Central Asia	
1	Osh Aravoj
2	Almoe-Vorzin
3	Moiansuv
4	Sokh
5	Kizilart-Kochka
6	Sapir
7	Middle and Lower Araks
8	Proshchani
9	Chir-Bashi
10	Yuzbaki-Sabul
11	Agdshah-Yagubch
12	Yuzbaki-Sapir
13	Karabag
14	Davran
15	Zaravshan
16	Zaravshan
17	Shirak-Khatun - Nalocher
18	Chakir-Kulman

Source: UNEP, 2006.

**257 Lake Balkhal, Kyrgyzstan**  
UNESCO World Site

**Uzbekistan-Kyrgyzstan**

**Osh Aravoj**

- Lithology: Sandy gravel.
- Pressure factors: Agriculture, industry, waste disposal (Uzb.) Agriculture (Krgz.)
- Future trends: Expected decreases on the water resources due to economic growth and climate change.

**Sokh**

- Expected pressure on the water resources due to economic growth and climate change.

**Moiansuv**

- Area: 1,760 km<sup>2</sup> (Uzbekistan).
- Lithology: Boulders, pebbles, sands, loams.
- Pressure factors: Industry (Uzb.) Agriculture (Krgz.)
- Future trends: Improvement of the monitoring of groundwater quantity and quality.

Caucasus and Central Asia

UNESCO-IHP  
**ISARM Programme**

# ATLAS

## OF TRANSBOUNDARY AQUIFERS

Global maps, regional cooperation and local inventories

Edited by S. Puri and A. Aureli

International Hydrological Programme  
Division of Water Sciences

# ISARM Portal

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HOME
ISARM IN BRIEF
PROGRAMME
REGIONAL ACTIVITIES
INFORMATION SYSTEMS
NEWS

## ISARM - Internationally Shared Aquifer Resources Management

The worldwide ISARM (Internationally Shared Aquifer Resources Management) Initiative is an UNESCO and IAH led multi-agency effort aimed at improving the understanding of scientific, socio-economic, legal, institutional and environmental issues related to the management of transboundary aquifers.

The issue of shared international waters is as old as the national borders that make those waters international. During the last century, a significant progress has been made in regulation of joint management of surface watercourses; many international river-, lake- or basin commissions have been set up and the legal treaties signed. Although some of these activities address "a groundwater component" as well, major comparable efforts related to the invisible groundwater have started just a several years ago with the ISARM Programme.

Since its start in 2002, ISARM has launched a number of global and regional initiatives. These are designed to delineate and analyse transboundary aquifer systems and to encourage riparian states to work cooperatively toward mutually beneficial and sustainable aquifer development.

### Transboundary aquifer systems of Americas

The UNESCO-IHP/OAS/ISARM Americas Programme is a regional initiative launched in 2002 at Mar del Plata, Argentina, and results from the joint...

[read more »](#)

### Managing Shared Aquifer Resources in Africa

3rd International Conference co-organized by The General Water Authority Libyan Arab Jamahiriya UNESCO-IHP and Sahel and Sahara Observatory...

[read more »](#)

### News & Events

**September 9, 2008**

- International Symposium on Transboundary Waters

**January 4, 2008**

- Roundtable on management of shared groundwater in South Eastern Europe in Slovenia

[more news »](#)

### Partners

**IAH**

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INTERNATIONAL SHARED AQUIFER RESOURCE MANAGEMENT

# Global TBA Information System



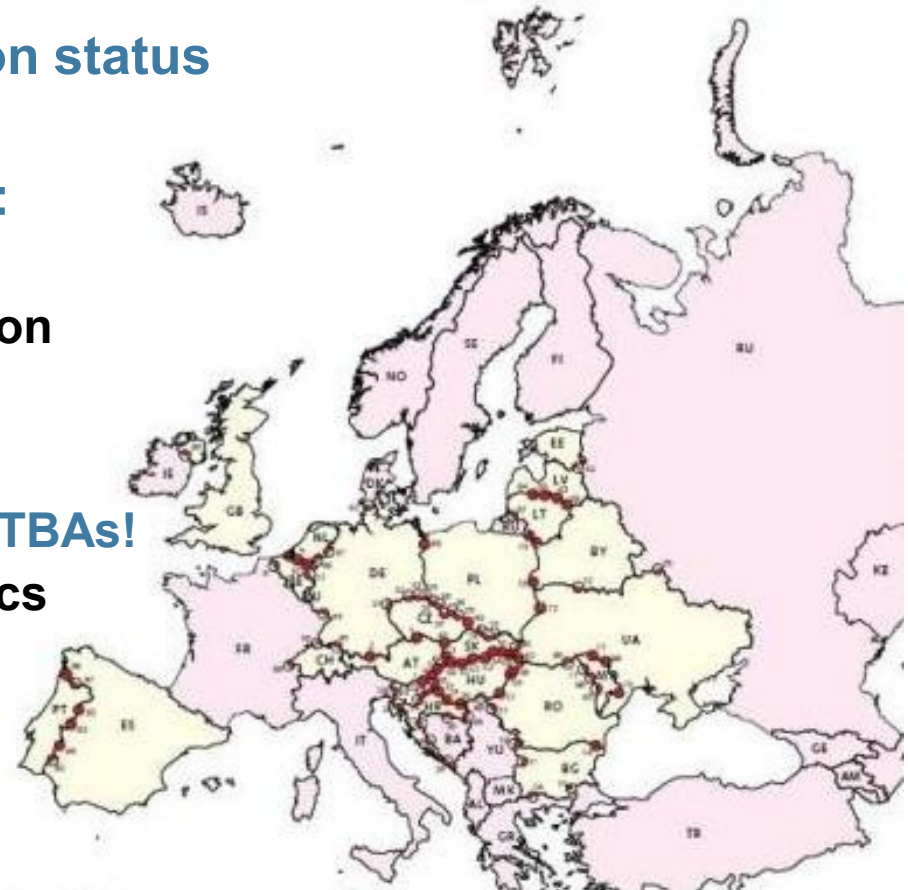


# **Overview of Global Transboundary Aquifer Assessment Activities**

# Inventory of TB Groundwaters 1999

The UNECE Task Force on Monitoring & Assessment

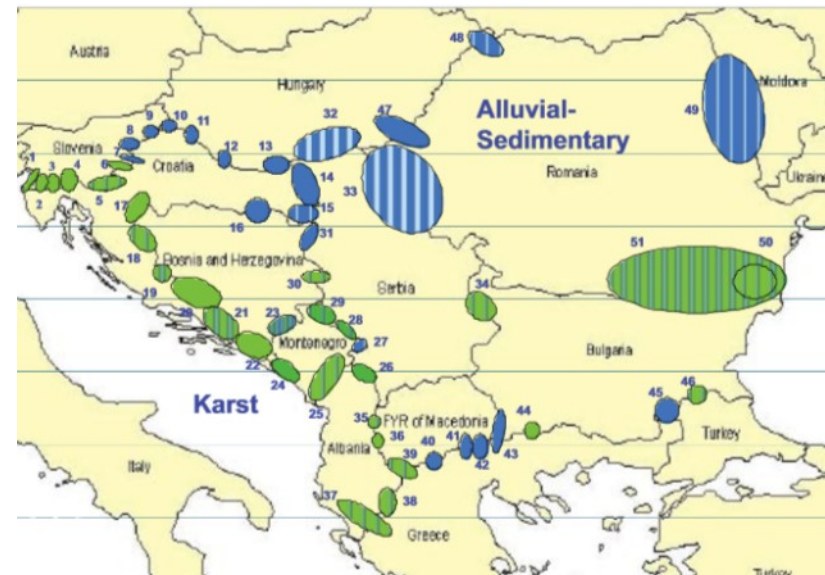
- Only locations and a recognition status
- Lesson learned - challenges of:
  - TB groundwater assessment
  - international data harmonisation
- Added value:
  - Pioneering role in addressing TBAs!
  - Formulating TBA characteristics
  - Pan European overview



# The First UNECE Assessment 2007

## First Assessment of Transboundary Rivers, Lakes and Groundwaters

- Only South-Eastern Europe and Caucasus & Central Asia
- Approximate delineation (circles & ovals)



# The First UNECE Assessment 2007

## First Assessment of Transboundary Rivers, Lakes and Groundwaters

- followed the Driving Forces-Pressures-State-Impact-Responses (DPSIR) framework also adopted by the EEA
- a clear regional overview of current groundwater status (including the transboundary impact and management measures), of pressures and of future trends and prospects.
- Facts and Figures for each aquifer

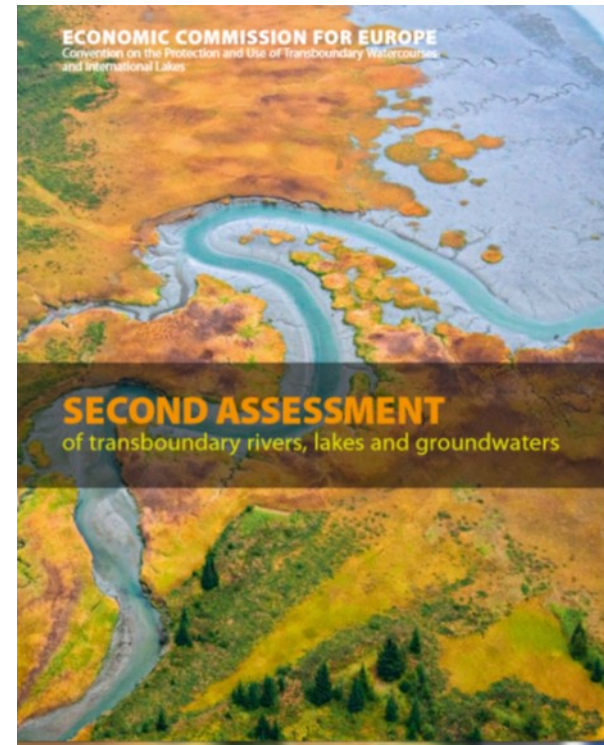


No. 5 Groundwater: Cerknica/Kupa <sup>a</sup>		Shared by: Slovenia and Croatia
Type 5, Triassic and Cretaceous limestones and dolomites with some alluvium in the river valley, weak to medium links to surface water systems, groundwater flow from Croatia to Slovenia and Slovenia to Croatia	Black Sea basin Border length (km): 32	
	Slovenia	Croatia
Area (km <sup>2</sup> )	238	137
Water uses and functions	Local drinking water supply, first karst spring of the Ljubljana River (a karstic river with 7 surface and 6 underground stretches)	Drinking water supply
Pressure factors	None, sparsely populated, forested with some extensive agriculture and pasture	None, very scattered population
Problems related to groundwater quantity	None	None
Problems related to groundwater quality	None, good chemical status	Occasional bacteriological pollution
Transboundary impacts	None for quantity or quality	None
Groundwater management measures	None	Existing protection zones
Trends and prospects		
CWB identification	GWS ID 11823	HR 343 and HR 344
Status and what is most needed	Not at risk. It is unclear which groundwater systems in the two countries correspond to each other; delineation of transboundary groundwaters needs common research and bilateral decision to propose a transboundary groundwater, if appropriate	

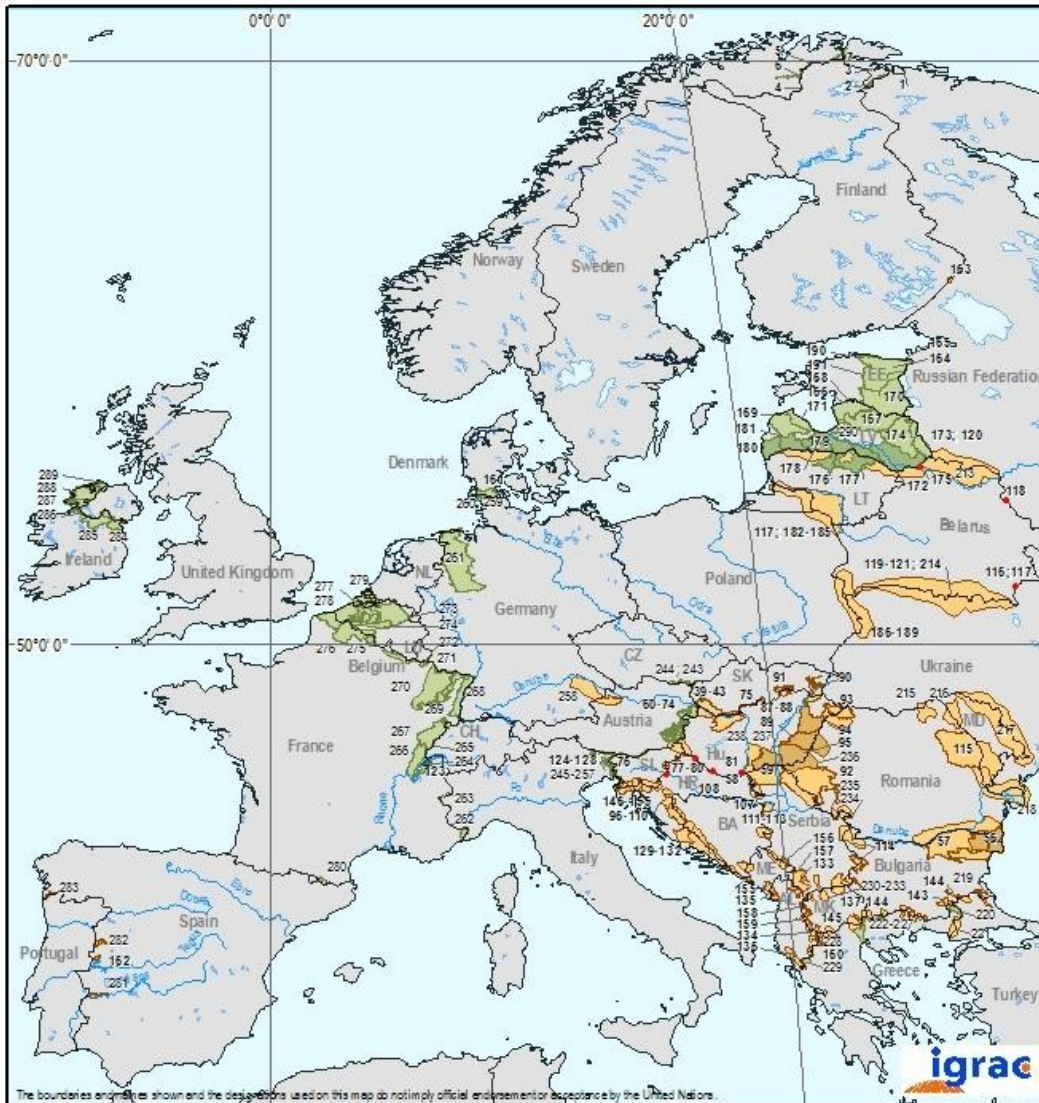
# The Second UNECE Assessment 2011

## Second Assessment of Transboundary Rivers, Lakes and Groundwaters

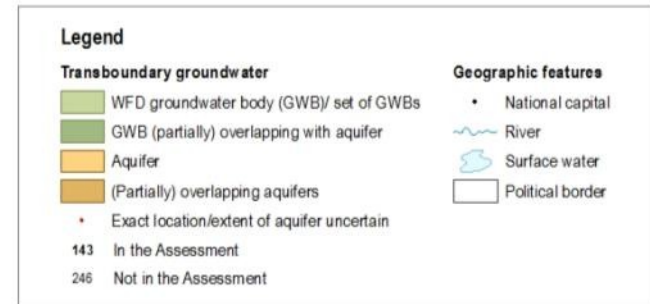
- A river catchment approach – no separate descriptions of aquifers
- It is difficult to implement a balanced (IWRM) assessment, especially in areas with large rivers (groundwater easily remains insufficiently addressed).
- EU WFD defines groundwater bodies (GWBs) rather than aquifers, causing the harmonisation difficulty at the borders of the EU.
- Country-based questionnaires contain still unprocessed information that is potentially useful for further TBA assessment



# The Second UNECE Assessment 2011

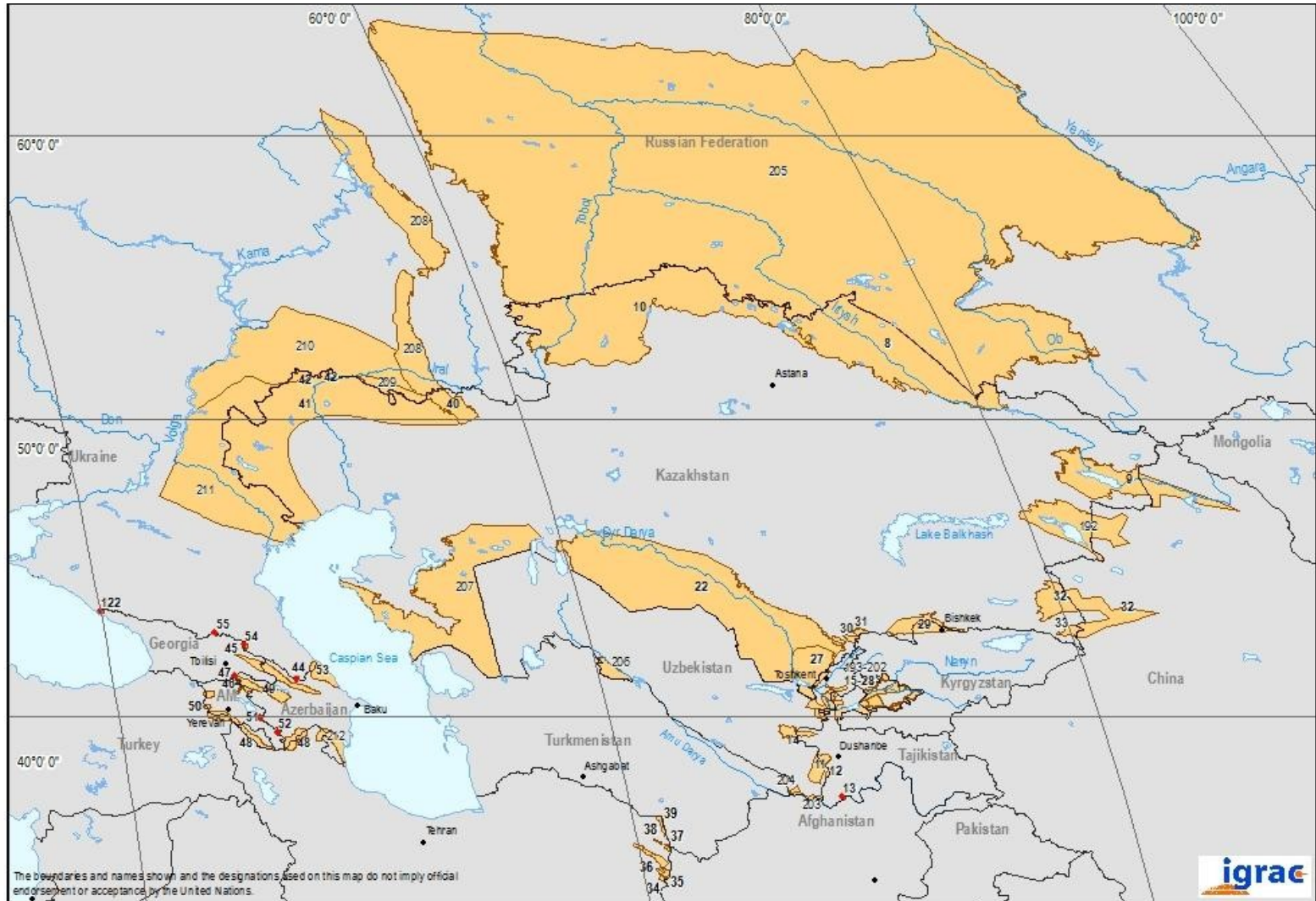


## Second Assessment of Transboundary Rivers, Lakes and Groundwaters

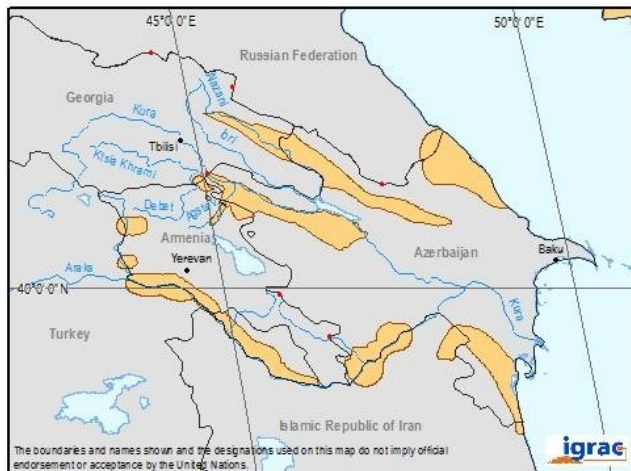
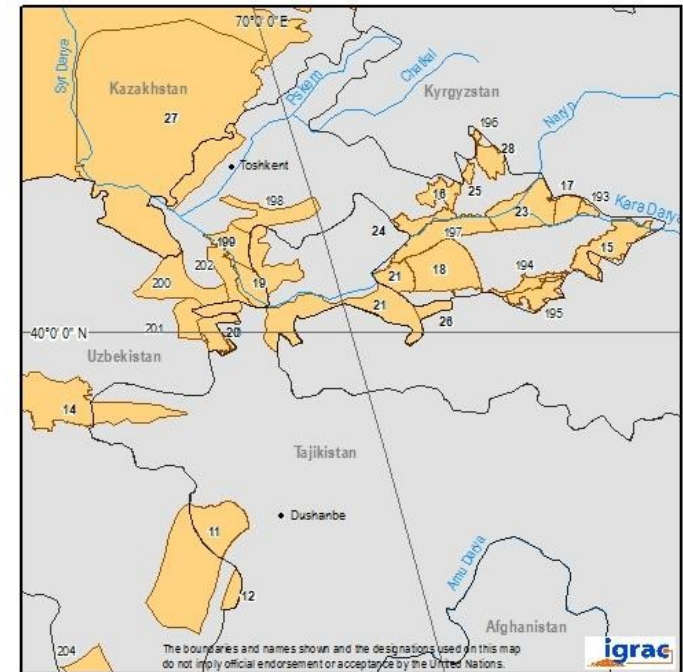


The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

# The Second UNECE Assessment 2011

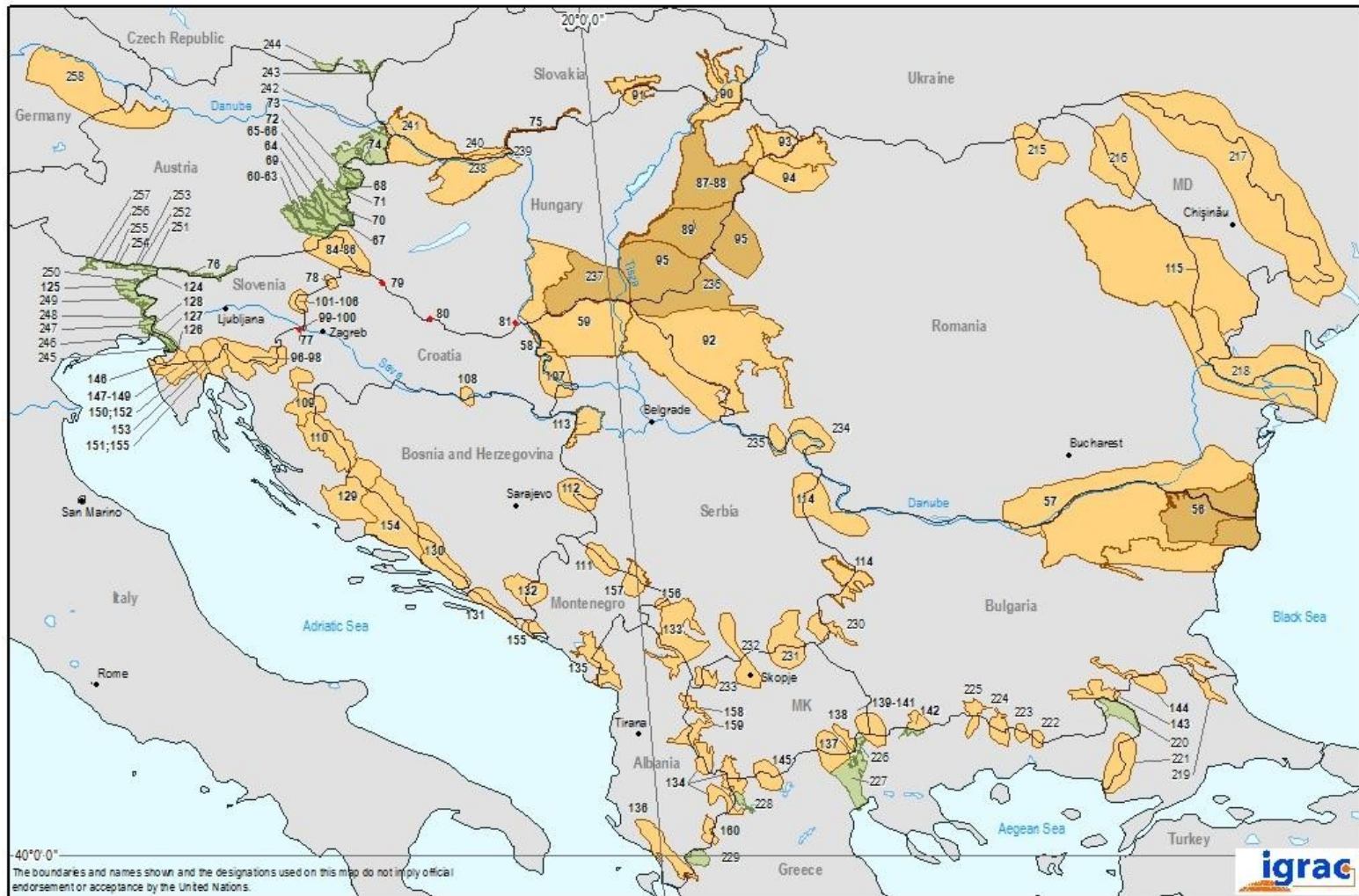


# The Second UNECE Assessment 2011



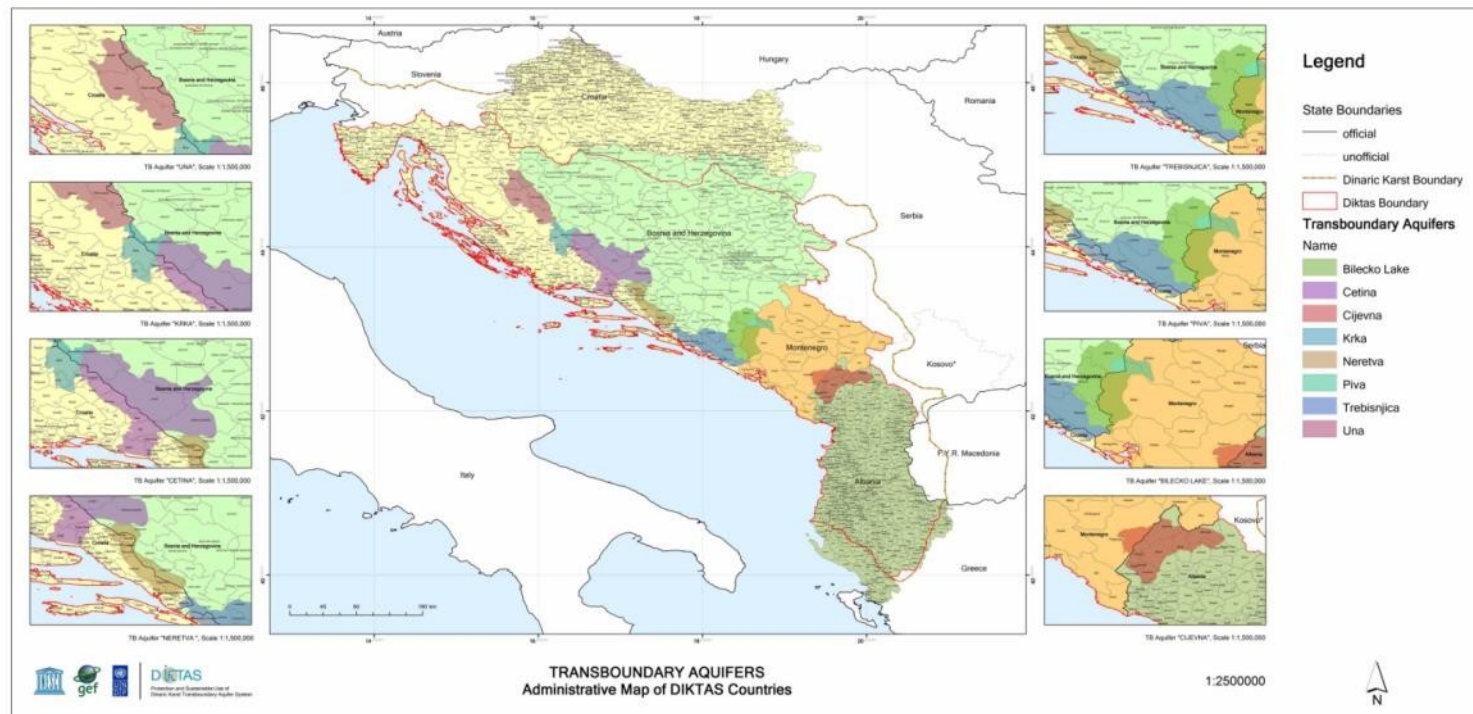


# The Second UNECE Assessment 2011



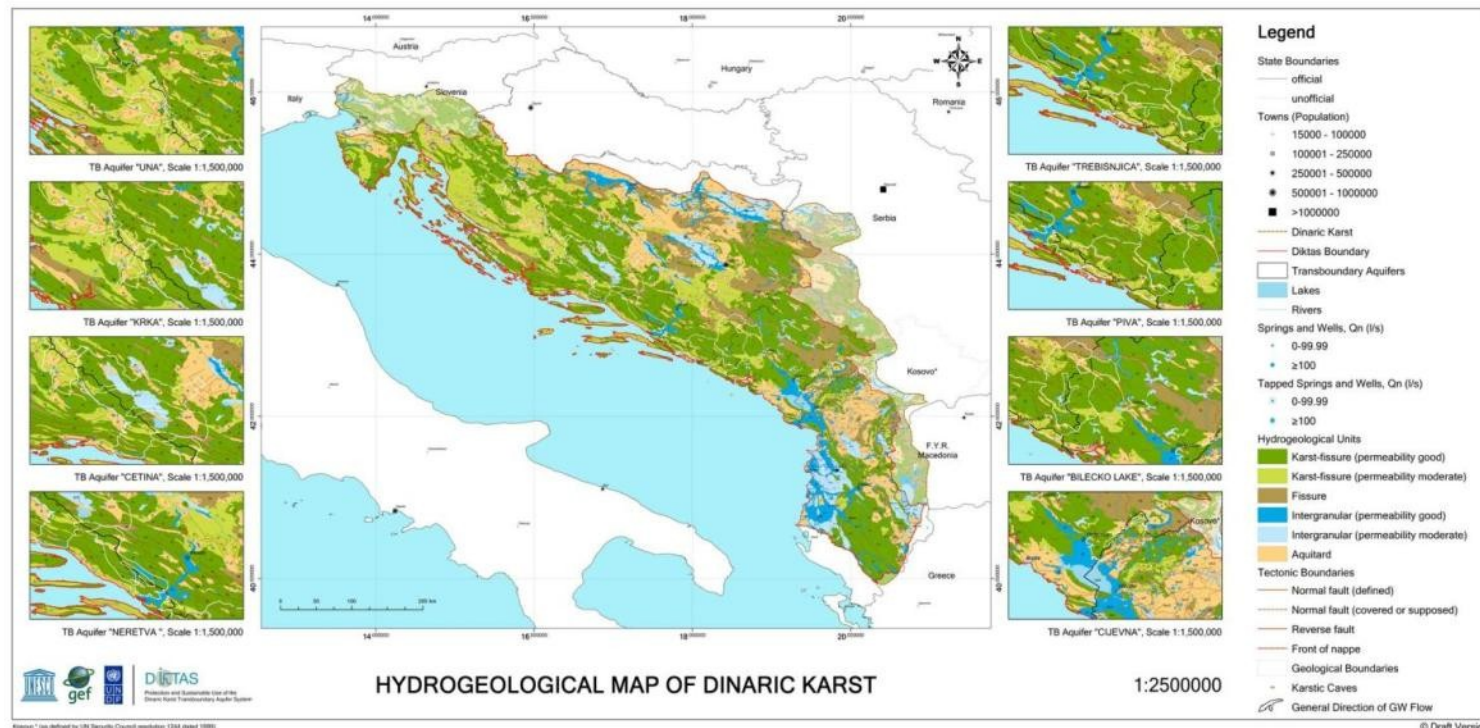
# GEF DIKTAS Project in SEE

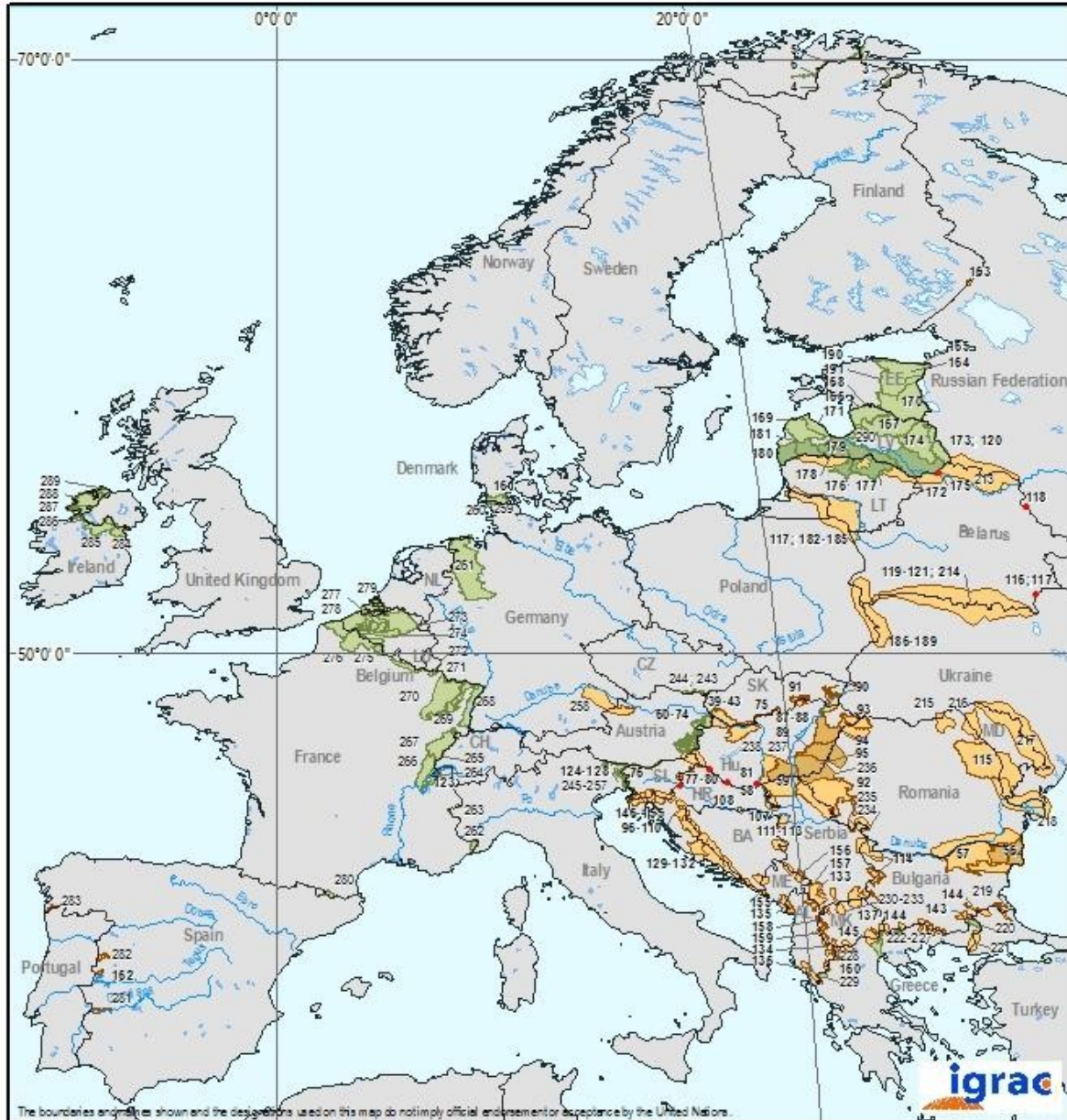
- In the last decade, Global Environment Facility co-funded several large TBA assessment projects
- Comparing with ISARM and UNECE, GEF projects concentrate often on one aquifer (system) allowing in depth analysis.
- TDA - Transboundary Diagnostic Analysis



# GEF DIKTAS Project in SEE

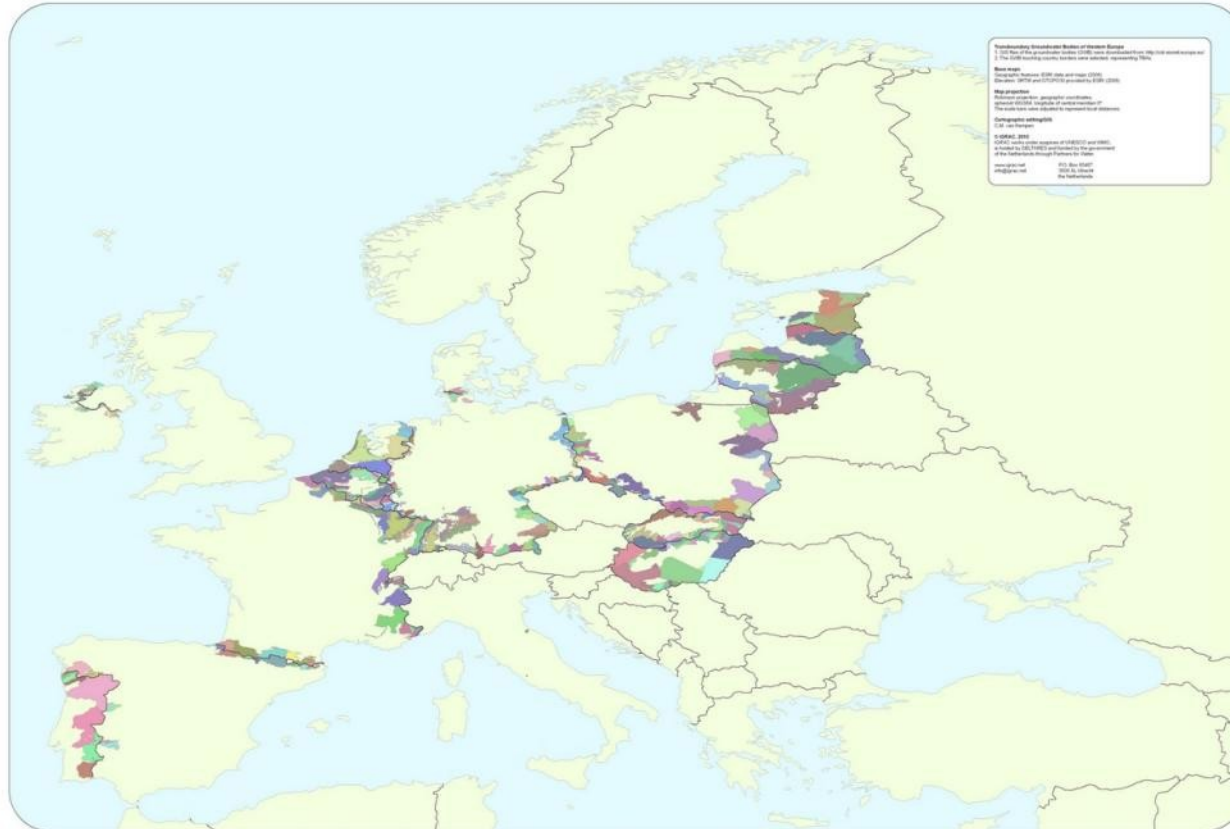
- **Transboundary specifics are usually found in (hydro)geological classifications, data and information management, legislation, organisational structure, etc.**
- **Further than an assessment: consultation/cooperation mechanisms and agreeing on joint strategic actions (SAP)**





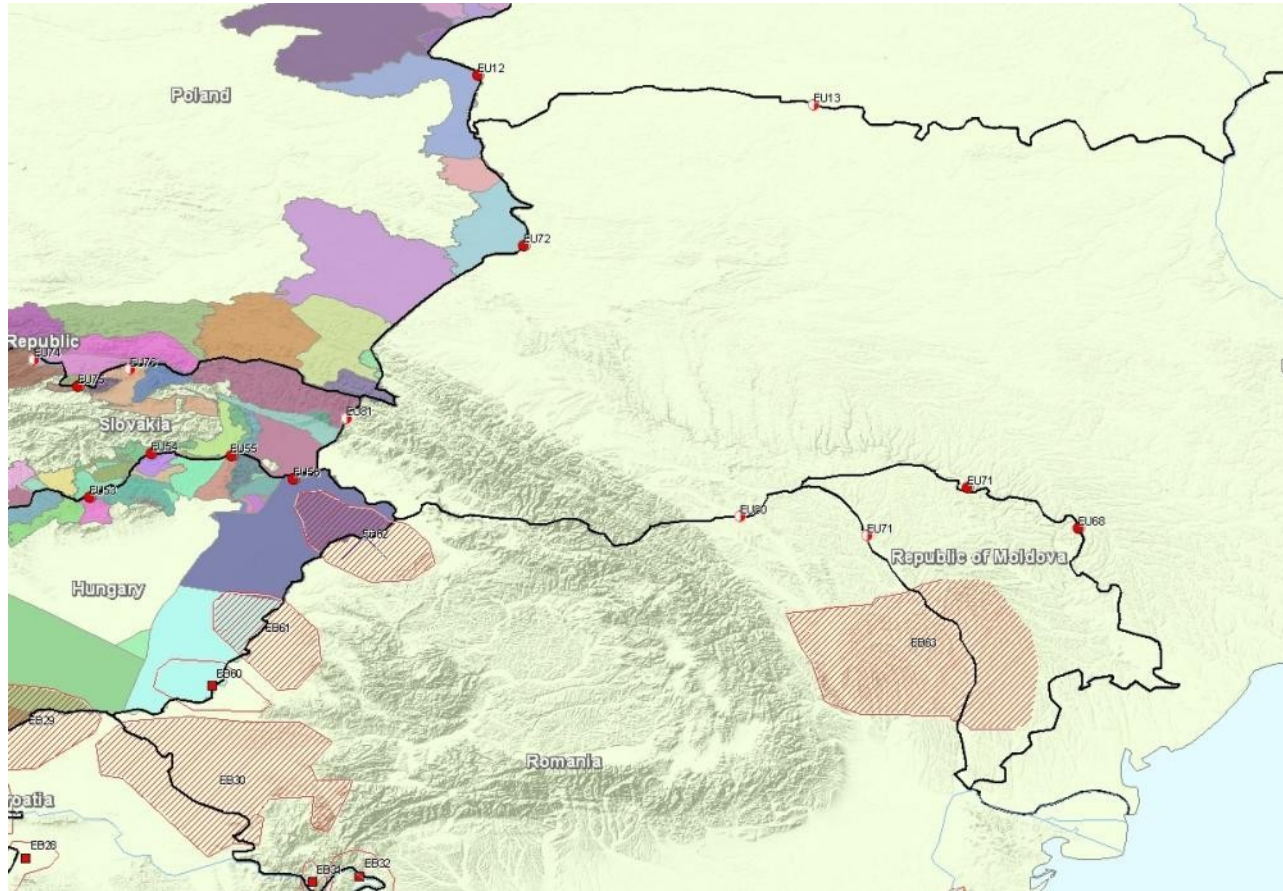
The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the United Nations.

# Transboundary GWB 2011



Out of 7019 GWBs in total holding specifications related to TBA attribute, only 124 transnational GWBs have been reported . In case of 4588 datasets the column is left empty.

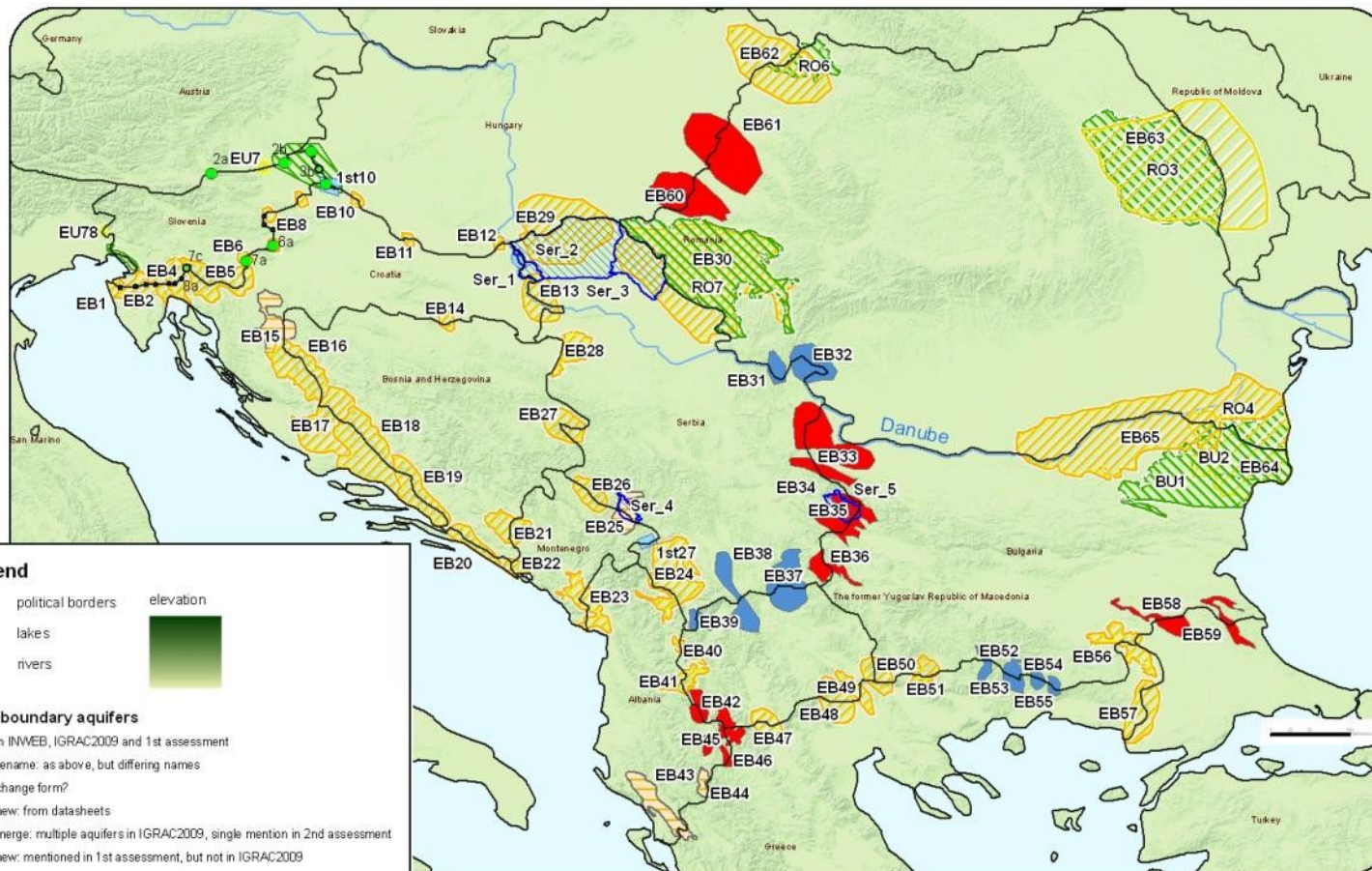
# Transboundary GWB vs Aquifers



# Transboundary Aquifers of South East Europe

- Update 2010 - DRAFT

30°E



**Legend**

- political borders
- elevation
- lakes
- rivers

**Transboundary aquifers**

- in INWEB, IGRAC2009 and 1st assessment
- rename: as above, but differing names
- change form?
- new: from datasheets
- merge: multiple aquifers in IGRAC2009, single mention in 2nd assessment
- new: mentioned in 1st assessment, but not in IGRAC2009
- new: mentioned in IGRAC2009, but not in 2nd assessment
- new: mentioned in UNECE 1999
- TBAs from Serbia

**TBAs from Slovenia**

- dot
- polygon
- small dot

Map project from  
 Publications Office, geographic coordinates:  
 45°55'N 19°55'E, in a scale of 1:100 000 000.  
 The scale does not apply to regions of local interest.

Cartographic editing/215  
 C. B. 2010 10 pages

© IGRAC 2010  
 IGRAC is a project of the European Union and UNECE,  
 it is funded by UNECE and managed by the government  
 of the Netherlands through Panteon in Rotterdam.

www.igrac.net P.O. Box 95487  
 info@igrac.net 30084L Utrecht  
 the Netherlands

# Closing remarks

- **TBAs: hydrogeological maps vs aquifer maps**
- **TBA representation in 2D (multilayer, inclination, depth, etc)**
- **Aquifers vs Ground Water Bodies**
  - **Aquifers: hydrogeological units; no vertical delineation (inclination of layers or presence of aquifer systems not taken in account)**
  - **GWBs: managerial units ('distinct volume of water within an aquifer or aquifers'); distinction of GWB layers (horizons).**
- **Transboundary aquifers and transboundary GWBs at the (current) borders of the European Union**
- **Transboundary aquifers within the European Union**
- **Mapping is just a first step!**
- **Main obstacles: invisible groundwater – lack of knowledge, 'strategic information', insufficient cooperation among countries and among international organisations**



# Assessment of Transboundary Aquifers

- It's all about people....



# Thank you for your attention



International Groundwater Resources Assessment Centre



Government of  
The Netherlands



United Nations Educational,  
Scientific and Cultural Organization



World Meteorological  
Organization