Karst Commission

Most Important Karst Aquifer's Springs – MIKAS

Project of the IAH Karst Commission (KC)

The project aims to bring together both the KC members and many national experts to work, on a voluntary basis, to:

1. develop criteria for the selection of most important karst springs, which inter alia should include historic, aesthetic, economic and scientific values;
2. establish the list of springs;
3. create the Code of Practice for these springs' utilisation and protection; and
4. promote these springs by their *in situ* labelling and internet publicising.

M I K A S

Project on selection, labeling and protecting the world's Most Important KArst Springs

MIKAS – Structure & Strategy

Project and Advisory Board *approved by the KC IAH* in Malaga, 24.06.2022

AB members – Regional Coordinators:

- **Western Europe, Australia and Oceania** **John Gunn**
- **Southeastern and Eastern Europe** **Zoran Stevanović**
- **Asia** **Junbing Pu**
- **Africa** **Seifu Kebede**
- **North America** **Neven Kresic**
- **South America** **Augusto Auler**

Project Coordinator (Team Leader) **Zoran Stevanović**

KC IAH:

- **Chairman** **Avi Burg**
- **Co-Chairs** **Peter Malik and Ben Tobin**

UNESCO IHP (Supervision):

- **Chair** **Alice Aureli (Aurelien Dumont)** (if UNESCO accept invitation and fully support project)

Selection of springs, data provision and implementation (communication with local administration) is taking place via invited national experts – primary members of the KC IAH, „friends of the KC“, local hydrogeologists and environmentalists. Work is mostly online.

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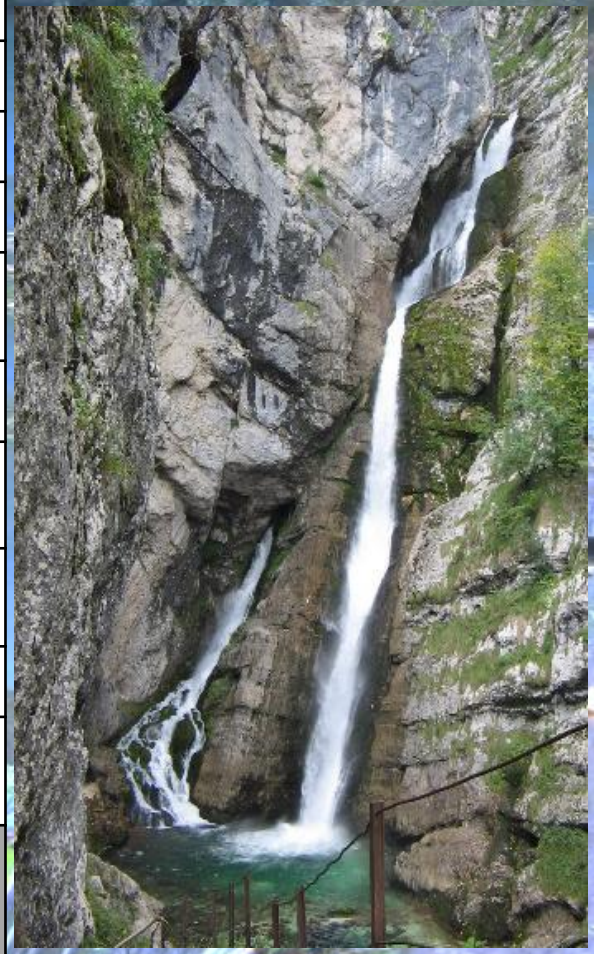
AB works on voluntary basis, possible funding will be used for the meetings, publications, web...
Project duration – tentativelly 36 months
Outputs: List of globally important springs, database, interactive map linked to WOKAM, labeling *in situ*, web site, promotion via Youtube movie (video clips, photos...), monograph.

Karst Commission

Scheduled activities for first 30months	VII-VIII 2022	IX-X 2022	XI-XII 2022	I-II 2023	III-IV 2023	V-VI 2023	VII-VIII 2023	IX-X 2023	XI-XII 2023	I-II 2024	III-IV 2024	V-VI 2024	VII-VIII 2024	IX-X 2024	XI-XII 2024
Proposal, Approval of the KC, Info to the UNESCO															
Establishment of the Advisory Board, constitutional meeting															
National experts selection and completion of the team															
AB - Development of selection criteria, guidance and surves forms, web site KC															
NEs – Data collection, preliminary proposal of the springs															
AB – First evaluation of obtained data, analyses and preliminary selection															
AB – Development of Code of Practice															
AB – Statistics, mapping, Database creation, website															
AB and NEs - Promotional activities: photo albums, movies, design of informative plates															
AB and NEs – „Final „ but open lists of MIKAS, NIKAS; labelling *in situ*, reporting, preparation of common articles															
AB - preparation of common Monograph															



Agreement reached after the two online meetings of AB :

1. Number of springs per country must be restricted and proportional to their GLOBAL importance. ***Number of MIKAS to be limited on 200 springs.***

2. **The second rank list – NIKAS (Nationally Important Karst Springs) will also be established.** ***This list will also be published at MIKAS website.***

3. **Guidelines has been completed in January 2023.** ***Clear instructions how to identify and classify springs in the two categories.***

4. **Selection of national experts goes in parallel to provision of Guidelines.** ***The selection is still on going, new candidates are welcome.***

Criteria for the selection of most important karst springs:

- Historic, **H**
- Aesthetic, **A**
- Economic, **E**
- Scientific. **S**
- Ecological **Ec**

MIKAS

(Most Important Karst Aquifer Springs)

Guidelines for the Selection of Springs

iah kc 50 Karst Commission

Groups of information

Location and Hydrogeological Setting

Spring Importance / Criteria

References and Information Sources

Graphics

Optional Data

The grading of springs (by used 1-5 for each criteria);

Approximated size of the catchment (km^2);

Groundwater chemistry and threats to spring water quality;

Additional graphics (maps, preferably hydrogeological or geological);

In case of tapped (captured) springs:

Water distribution system

Purpose(s) for which water is used

Number and types of beneficiaries

Water treatment applied

Project MIKAS – Most Important Karst Aquifers' Springs

Spring Survey
Instructions for filling

1) Spring Location and Hydrogeological Information

Spring name		**Dominated aquifer's lithology and stratigraphy**	*limestones, dolostones, chalk, marbles, evaporites, complex lithology*
Country / Region			*karst aquifer (water bearing rocks) age (use Intern. stratigraphic chart)*
Nearest settlement		**Important or unique karst features in the catchment**	*e.g. caves, other springs, swallow holes, gorges, numerous sinkholes, etc.*
River/Hydrogeological basin		**Type of Spring**	*permanent or temporary; gravity or ascending; fresh or thermal; or use some of literature source for classification*
Coordinates	*Use World Geodetic System WGS84 standard – for N, E in degrees, minutes and seconds (check by pinned spring on Google Earth Map)*	**Regime of spring discharge (Q in l/s, min/av/max)**	*discharges according to available data*
Z(altitude)m asl		**Specific characteristics**	*if belongs to Natural reservation area or parks? Is it transboundary aquifer? It has special discharge mechanism (provide a representative hydrograph)?*
Intake structure*	*Tapped or not, if yes type of intake and construction*	*List of annexes and figures with authorship (to be attached or placed in document after this table). Annexes should include but not be limited on: - Location map (Geographical of a whole country and local topography map); - Extract of Google Earth map with pinned spring; - Sketch geological or hydrogeological map; - Cross-section. Fig. 1 Fig. 2 Fig. 3 Fig. 4 (after ...., 2017) Photo 1 ... (photo by....) Photo 2 ...*	
Amount of used water* and ecological flow*	*Average pumping hours (h/day) and rate (l/s). Average overflow - non-tapped yield as an ecological flow (l/s)*		
Water physical and chemical characteristics	*Average values of Temp (^{0}C); TDS (g/l) or EC (µS/cm); pH ( ) Hardness (^{0}dH)*		
Groundwater protection	*Established sanitary protection zones of the catchment (yes/no) or only protected spring site (fenced?), or free access to site (explain shortly)*		
Remarks (web pages)	*Information sources, web pages (preferably in English)*		

*/ in case of spring tapped

2) Spring Importance / Criteria

Criterion	Justification / Facts	Criteria order
Historic, H Aesthetic, A Economic, E Scientific, S Ecological, Ec	*Provide justification following principal or all of selection criteria.* **H:** *Numerous springs in the world have historic and cultural or spiritual significance for local nations or community development. Many cities were also built nearby large springs. Explain in few words, if applicable.* **A:** *The aesthetic criterion is always problematic. However, something like a waterfall, a huge cliff or a cave behind a spring should commonly be judged as a natural wonder or nice feature acceptable for the list.* **E:** *The economic-management value should primarily consider a spring's use. Spring water can be used for potable water supply, irrigation, or for supplying the local industry. Even if not utilized spring can be still of great importance at regional or national level as representative water point with prospect for utilization.* **S:** *The scientific value may consider specific discharge mechanisms of the springs such as large maximal yield, intermittent flowing, gas bubbling, changing water quality in coastal areas (fresh, brackish and saline) or some other properties that could be of scientific interest.* **Ec:** *Water of karst springs and ecological flow sustains ecosystems, maintain the baseflow of rivers or fill large reservoirs. Presence of protected and endangered species in already protected area, Ramsar site, or some other properties in interest of the biology, ecology, hydrogeology could also be evaluated.*	*List criteria according to their relevancy / importance for spring in question. e.g:* **H** **S** **E** **A** **Ec**
Current status of spring	*Statement if the spring is already recognised by the authorities as a nature reserve and/or deserves protection due to its importance for the nation*	
Final proposal for list MIKAS or NIKAS	***Write your proposal hereto***	

3) References and source

References, which validate spring importance	*Provide not more than 10 main references, which include historical facts, some older references (first appearance in literature), main technical references, which provide insight to the spring and catchment characteristics (geomorphology, hydrology, geology, hydrogeology), popular literature about spring (fairy tales, legends, travelogues, guidebooks...)* *If possible follow this style:* *Jacobsen T., Lloyd S. (1935) Sennacherib's aqueduct in Jerwan. The University of Chicago, Oriental Institute Publ. (Breadost J.H., ed.), vol XXIV, Chicago, 140 p.* *Reade J. (1978) Studies in Assyrian geography, Part 1: Sennacherib and the waters of Ninveh.- Revue D'Assyriologie Orientale, 72:157-175*
Data collected by:	
Assisted by (collaborators):	
Remarks	*Every remark, suggestion, not presented above that may strength proposal and support MIKAS project. Please use additional sheet for explanation, if needed.*

4) Optional data

Grading criteria for proposing the spring	*Optionally, you may grade each of criteria (grades from 1 lowest grade to 5 "first class"; e.g. H = 4;S = 4;E = 3;A = 3;Ec = 3*
Surface of catchment area (km^2)	
Water distribution system*	*If spring is captured and data is available provide technical information about pump (if any), its capacity, or gravity pipeline; local using – tap; any other tapping structure close to spring or in same aquifer (e.g. wells), all briefly described.*
Purpose of water used*	*Human consumption, animal watering, irrigation, small industry, water for nature.*
Sort and number of beneficiaries*	*Approx.no of people, livestock (big/small), orchards (type & ha), agriculture land (crop & ha), number of industrial objects connected, energy produced*
Groundwater chemistry	*Low mineralized, brackish, saline, mineral, etc. Dominant and specific ions for spring in question and their content (e.g: Ca, HCO_3, Cl in mg/l). If possible, attach typical analysis.*
Water treatment*	*All processes applied and capacity of water treatment plant (if any)*
Threats to spring water quality	*Main kind of pollutants, (type and distance to sewage discharge points, landfills, pesticides used in area...).*

MIKAS project promotion example – article in journal of the Bulgarian Academy of Science

Karst Commission

БЪЛГАРСКА АКАДЕМИЯ НА НАУКИТЕ. BULGARIAN ACADEMY OF SCIENCES
ИНЖЕНЕРНА ГЕОЛОГИЯ И ХИДРОГЕОЛОГИЯ, 36
ENGINEERING GEOLOGY AND HYDROGEOLOGY, 36
София, 2022. Sofia

Project "Most Important Karst Aquifer Springs" (MIKAS) and Bulgaria's participation in it

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Проект „Най-важни извори от карстови водоносни хоризонти" (MIKAS) и участието на България в него

Алексей Бендерев

Benderev, A. 2022. Project "Most Important Karst Aquifer Karst Springs" (MIKAS) and Bulgaria's participation in it. *Engineering Geology and Hydrogeology*, 36, 45–57.

Abstract. Karst has a wide distribution, both throughout the world and in Bulgaria. The groundwater formed in it are important for providing water for the population and for the existence of a number of ecosystems. Considering the importance of karst springs, an international project "Most Important Karst Aquifer Springs" – MIKAS was started. The project aims to bring together the joint efforts of scientists from different countries in order to characterize and promote the most important springs in the respective countries. Its organization is carried out by an international Advisory Board, and National experts from the respective country are involved in its implementation. The main task is to prepare Global and National lists of karst springs representing world and national natural heritage for each country. Determining the importance of each source is carried out after applying historical, aesthetic, economic, scientific and ecological criteria. In order to unify the selection of representative springs by the experts from the different countries, the Advisory Board has proposed a methodology for preparing accompanying forms with complex information, including maps, photos, graphics and others. As a sample, two completed forms are attached to the adopted Methodology – for the Khanis spring, Iraq, proposed for inclusion in the Global List and for the Vrelo Mlave – for the National List of Serbia. In Bulgaria, it has been established that there are over 150 karst springs of regional and local importance on its territory. Part of the accepted general criteria is applicable to each of them with different weight. From these springs, after review and discussion of the existing information, it is planned to select a part of them for a more detailed evaluation and possibly their inclusion in an extended National list. The weighting of the various criteria will be determined and a summary assessment and ranking will be made based on it. On this basis, a National list will be prepared, which will include the most highly rated karst springs with the necessary illustrative material for each spring. This list will be presented to the Project Advisory Board and it will be discussed with them which of the springs could be included in the Global List.

Keywords: karst spring, karst, Project MIKAS, Bulgaria.

Резюме. Карстът има широко разпространение както по света, така и в България. Формираните в него подземни води имат важно значение за осигуряване вода за населението и за

https://doi.org/10.52321/igh.36.1.45

Фиг. 3. Древен каптаж при с. Мусина, област Велико Търново (https://uspelite.bg/otkriha-misteriozna-podvodna-zala-ot-rimsko-vreme-krai-musinskata-peshtera-1).
Fig. 3. Ancient tape near the village of Musina, Veliko Tarnovo Region (https://uspelite.bg/otkriha-misteriozna-podvodna-zala-ot-rimsko-vreme-krai-musinskata-peshtera-1).

Фиг. 4. Изворът „Клептуза", Велинград.
Fig. 4. Kleptuza Spring, the town of Velingrad.

Фиг. 8. Извор „Хубча", използван за хидроенергийни цели, Централни Родопи.
Fig. 8. Hubcha Spring, used for hydropower purposes, Central Rhodopes.

Фиг. 9. Басейн върху субтермален извор „Мосомище", Южен Пирин.
Fig. 9. Pool on the subthermal spring Mosomishte, South Pirin Mountain.

Continent	Number of covered countries	Number of experts confirmed
Africa	9	7
Americas	9	14
Asia	23	20
Australia & Oceania	4	4
Europe	28	43
Total	**73**	**88**

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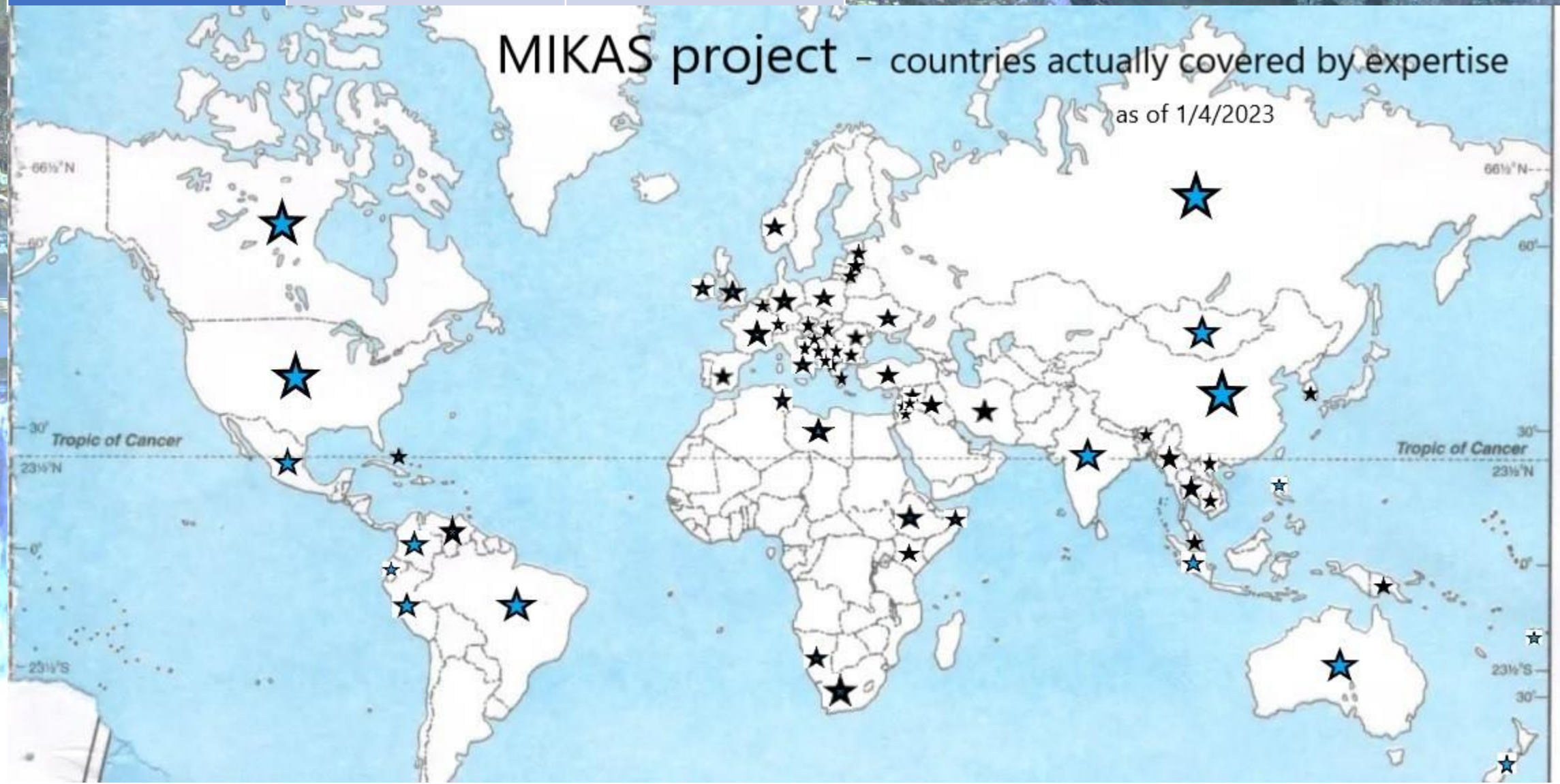
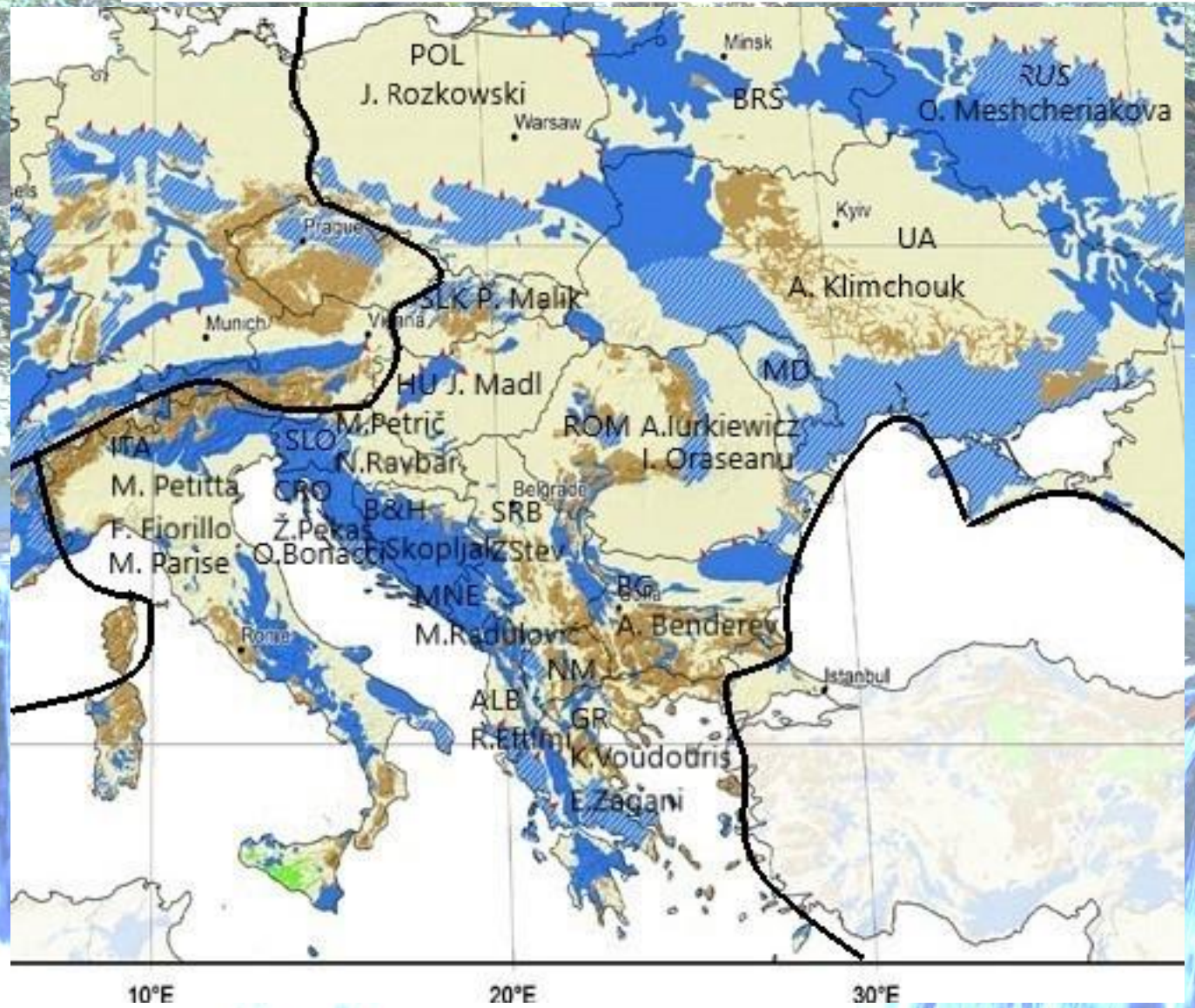


National experts – Status of SE/E Europe



National experts – Status of Asia

ASIA	Junbing Pu	
Eastern Asia		
China, Hong Kong SAR, Macao SAR		Junbing Pu, Xubo Gao, Chengcheng Li
Republic of Korea		Heejun Kim
South-Central Asia		
Central Asia		
Kazakhstan		Olga Meshcheriakova * Nikolay Maximovich *
Southern Asia		
Afghanistan		Sayed Sharif Shobair *
Bhutan		Zoran Stevanovic
India		Jerome Perrin Farooq A. Dar
Iran (Islamic Republic of)		Zargham Mohammadi
Nepal		Jerome Perrin
Pakistan		Jerome Perrin
Sri Lanka		Jerome Perrin
South-Eastern Asia		
Cambodia		Men Ratana
Indonesia		Eko Haryono
Lao People's Democratic Republic		Vongphachanh Sinxay
Malaysia		Othman Bin Kangsar
Myanmar		Thida Oo
Philippines		Ross Dominic Darang Agot
Thailand		Chaiporn Siripornpibul
Viet Nam		Vu Thi Minh Nguyet
Western Asia		
Iraq		Zoran Stevanović
Israel		Avihu Burg
Jordan		Elias Salameh * Joanna Doummar
Lebanon		Joanna Doummar
State of Palestine		Amer Marei
Syrian Arab Republic		Nazeer Asmael * Joanna Doummar
Turkey		Mehmet Ekmekci
United Arab Emirates		Abdel Khareem Ghata *

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Further steps

Code of Good Practice

The idea of identifying and protecting selected springs does not imply prevention of their further use. On the contrary, the aim of the initiative is to:

- highlight their importance,
- defend them from possible devastation, and
- ensure that any further intervention takes into account their protected status.

In case a spring is actively used for water supply, which would necessitate its greater protection, there would still be space for visits of organised groups during designated time slots.

Join us !

Further steps

Unique Informative Plaque (Plate)

- Basic information (in local language(s) and English) about the springs,
- The history and importance,
- Morphological characteristics,
- Geology and HG settings,
- Discharge mechanisms,
- Eco-system,
- Other specific facts.

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