The International Hydrogeological Map of Europe (IHME) at the scale of 1:1.5 Million

-

A coherent hydrogeological map for greater Europe and a model for the Rest of the World

- Historical Background
- State of the Art and Results
- Summary and Recommendations

Willi Struckmeier, BGR, IAH

Historical Background

19th – 20th Century

Systematic exploration of natural resources started; Growth and industrialisation (= increasing need for water) called for better planning and safe water supply from groundwater

After 1950

Strengthening of cooperation within the Eastern and Western Blocks = UNESCO as an international coordinating body and CGMW as a framework for cooperation of Geological Surveys

1961

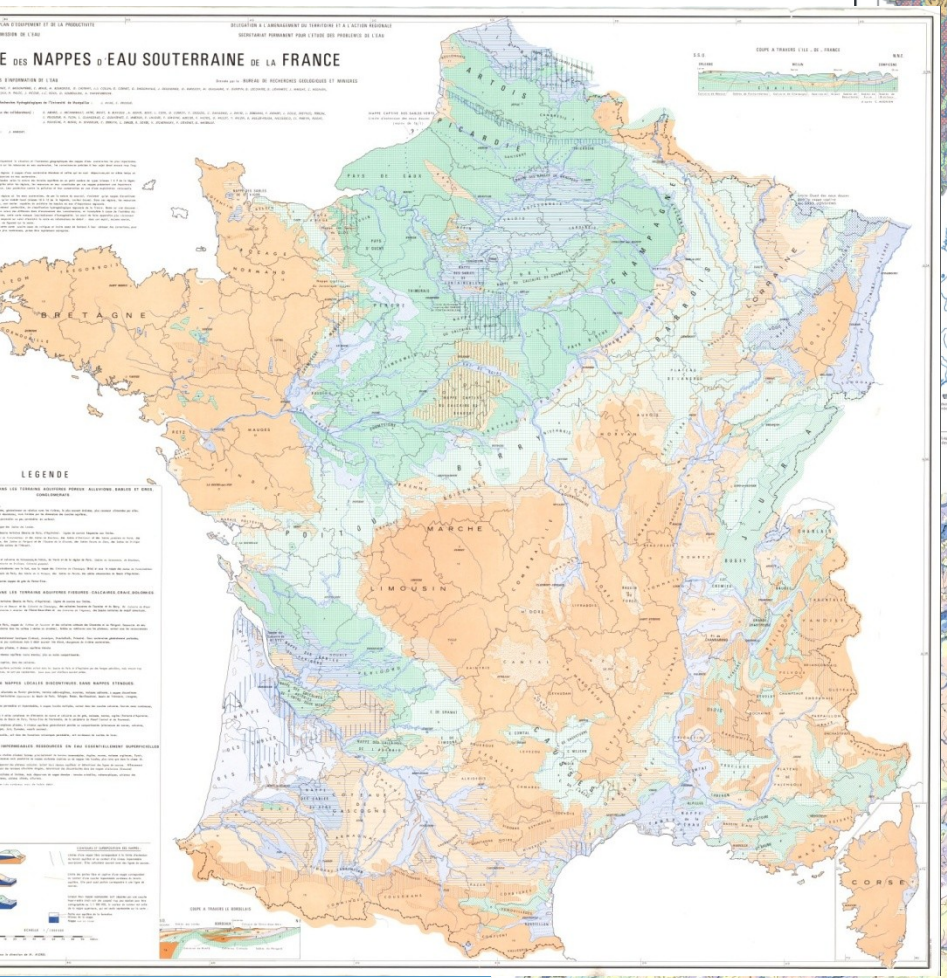
IAHS Congress Helsinki, with map exhibition
= need for harmonisation recognised

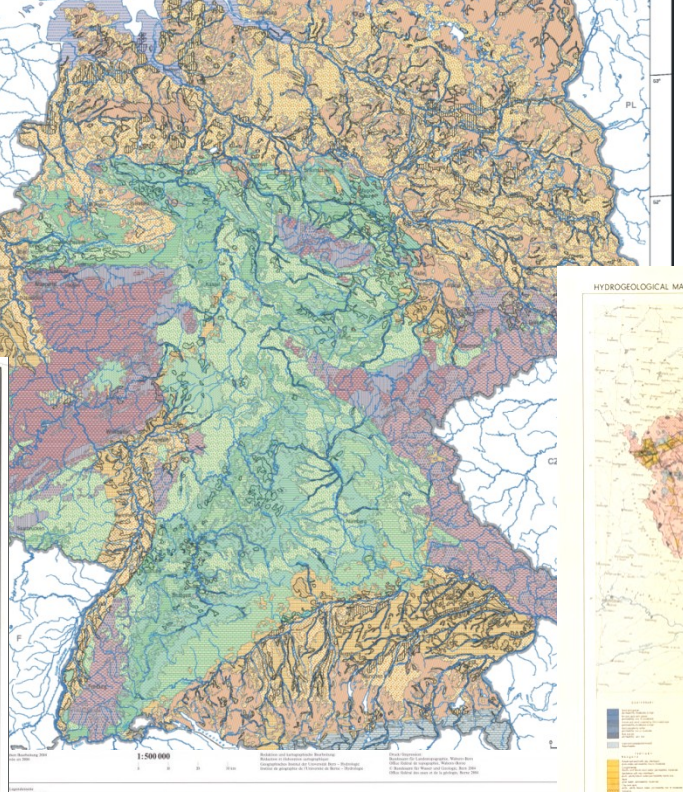
IAH Commission on Hydrogeological Maps (since 1959)

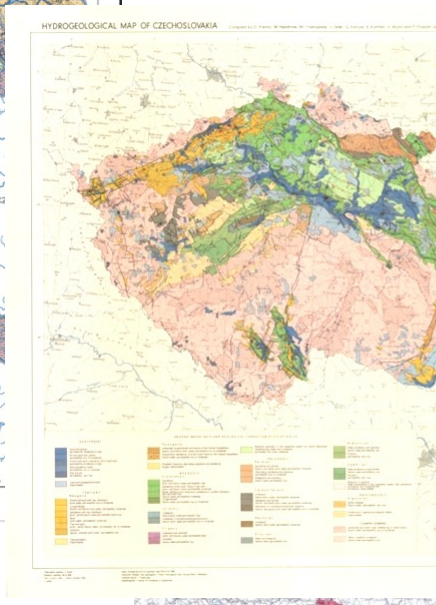
- common terminology
- mapping strategy and legend (attributes)
- + correct and up-to-date topo base map

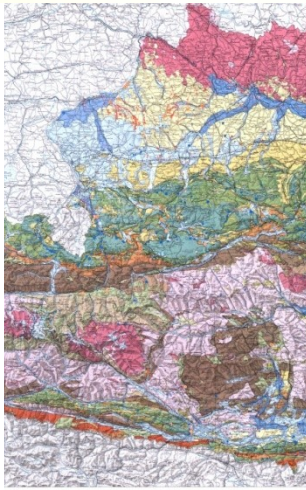
Existing national hydrogeological maps

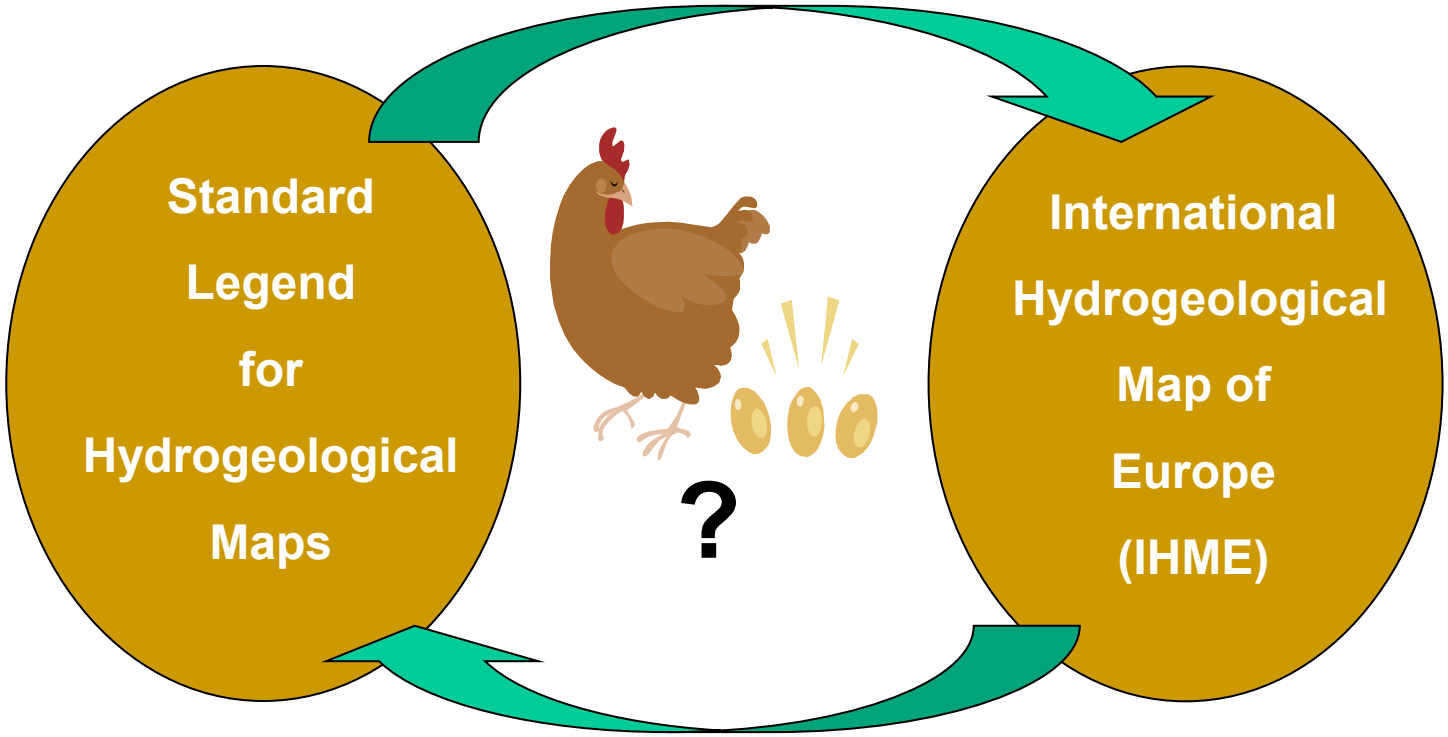
= no coherent picture











1959

IAH Commission on Hydrogeological Maps

IAHS Standing Committee on Hydrogeological Maps

Draft Legends (1962 – 1967)

↓

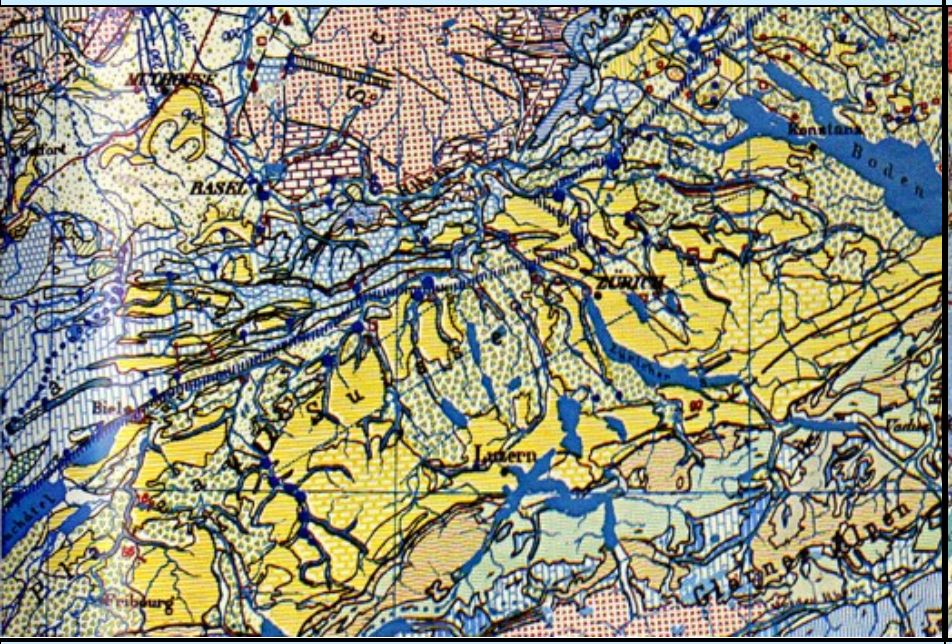
Final version Printed 1970

Models 1 - 4 (1962 – 1964)

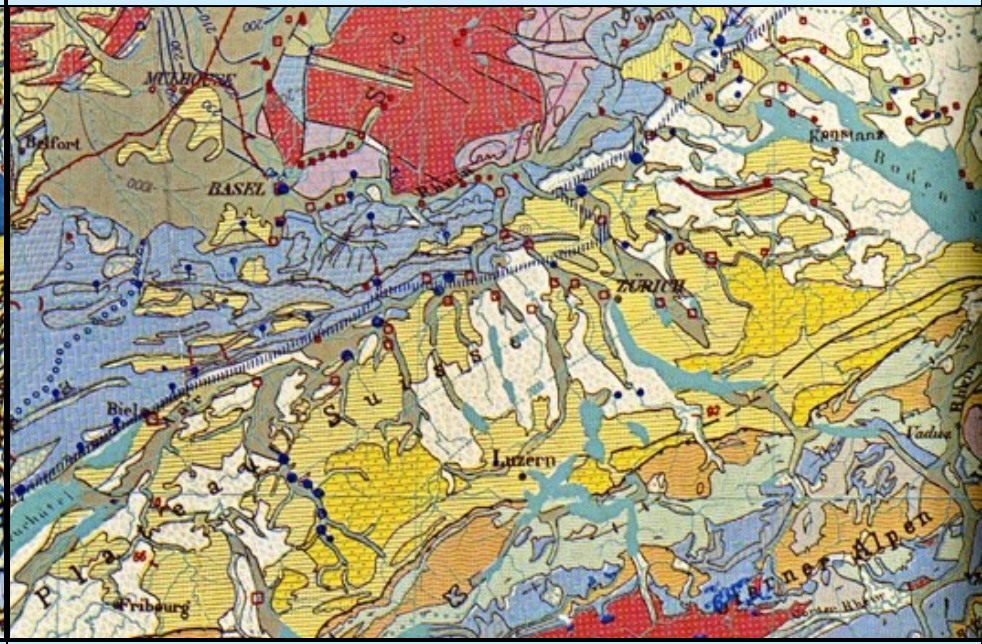
↓

Sheet C 5 Bern Printed 1970

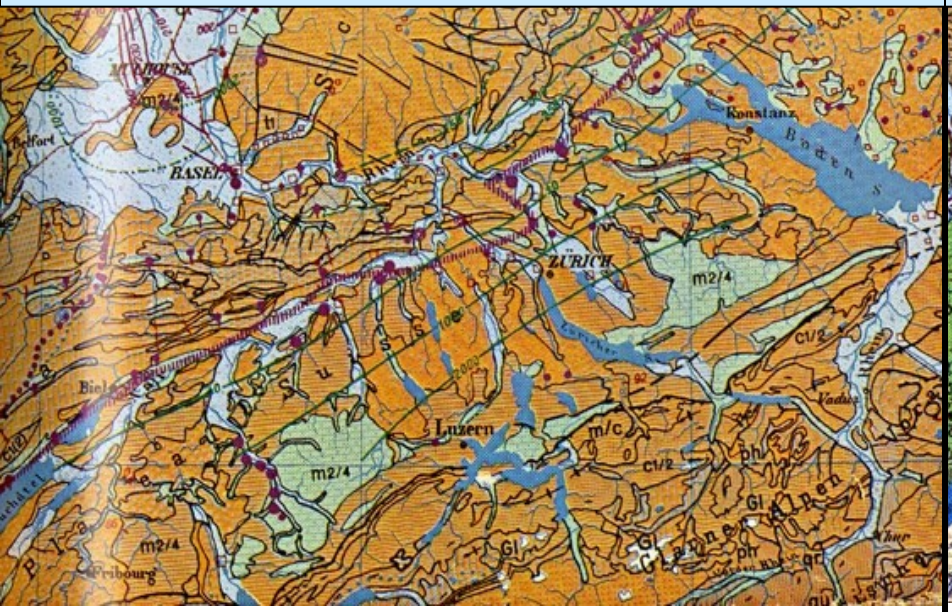
Model 1 Lithology, stratigraphy and porosity



Model 2 Lithology, stratigraphy and aquifer yield



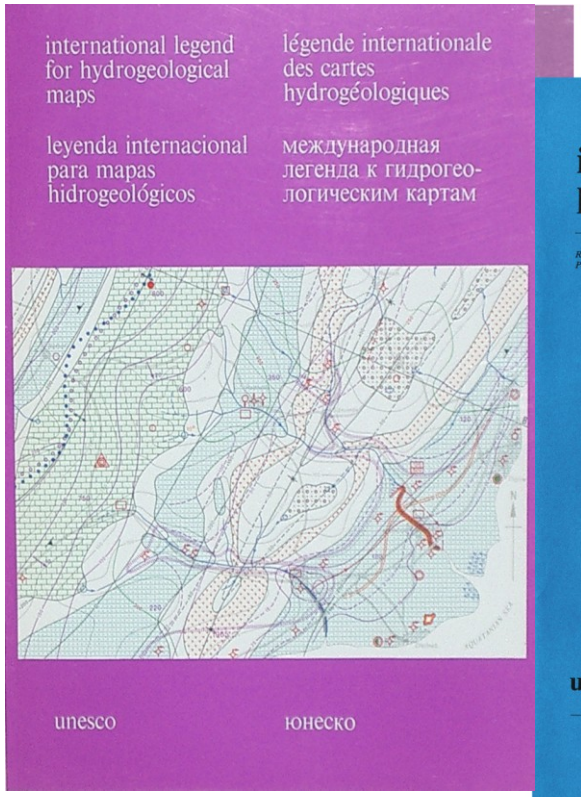
Model 3 Lithology and aquifer yield



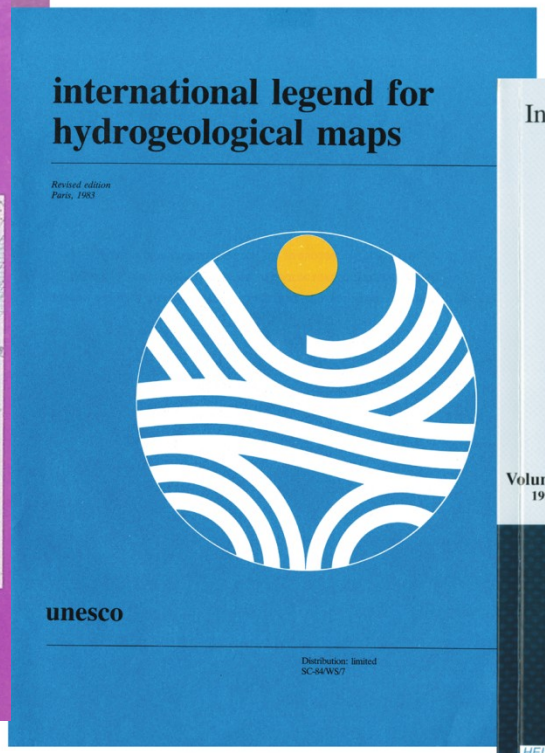
Model 4 Lithology and groundwater characteristics

Towards Common Standards

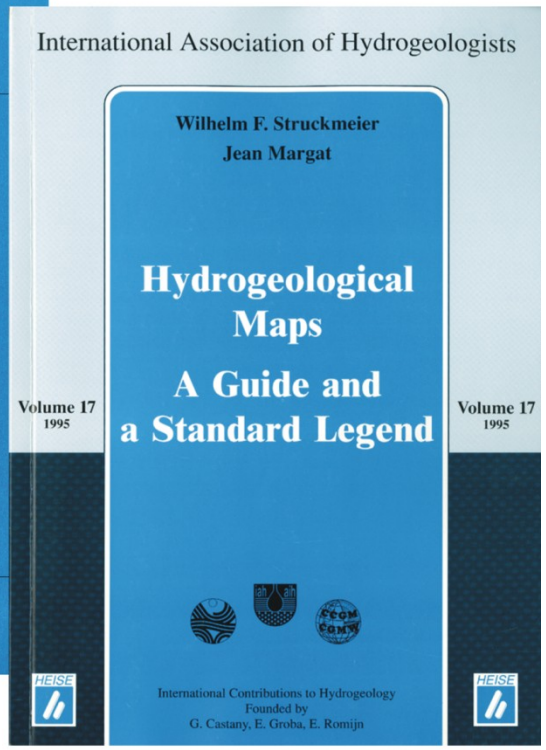
(IAH, IAHS, UNESCO, CGMW)



(1970)



(1983)



(1995)

International Hydrogeological Map of Europe

International Association of Hydrogeologists Commission for the Geological Map of the World Subcommission for Hydrological Maps

Published by Bundesanstalt für Bodenforschung und UNESCO

Carte Hydrogéologique Internationale de l'Europe

Association Internationale des Hydrogéologues Commission pour la Carte Géologique du Monde Sous-Commission pour des Cartes Hydrogéologiques

Publiée par la Bundesanstalt für Bodenforschung et l'UNESCO

Internationale Hydrogeologische Karte von Europa

Internationale Assoziation der Hydrogeologen Kommission für die Geologische Weltkarte Unterkommission für Hydrogeologische Karten

Herausgegeben von der Bundesanstalt für Bodenforschung und der UNESCO

Sheet / Feuille / Blatt **C 5 Bern**

Scientific Editor: / Rédaction scientifique: / Wissenschaftlicher Bearbeiter: H. KARRENBERG, Geologisches Landesamt Nordrhein-Westfalen, Krefeld

Nappes d'eau souterraine – Groundwater – Grundwasservorkommen

I. dans des roches poreuses / in porous rocks / in porösen Gesteinen

II. dans des roches compactes fissurées / in jointed massive rocks / in geklüfteten Festgesteinen

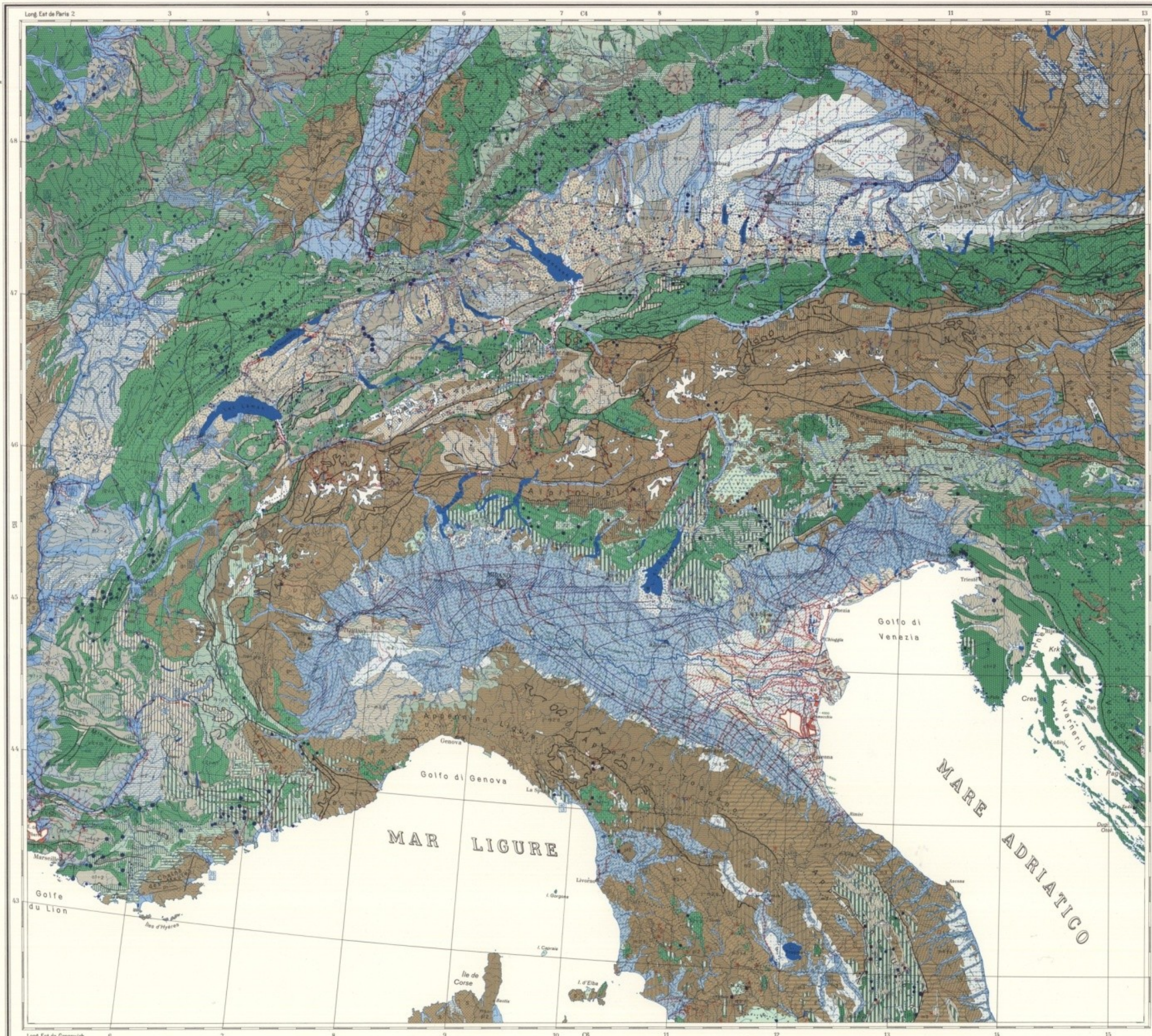
III. Régions généralement sans nappes ou à nappes locales / Regions generally without or only with local groundwater / Gebiete ohne oder mit nur örtlichen Grundwasservorkommen

IV. Indications particulières relatives à l'eau souterraine et aux sources / Particular notes on groundwater and springs / Spezielle Angaben zu Grundwasser und Quellen

V. Eaux de surface / Surface waters / Oberflächengewässer

VI. Aménagements artificiels / Artificial works / Künstliche Anlagen

VII. Signes géologiques / Geologic signs / Geologische Zeichen



Hannover 1970

1 : 1 500 000

Methodology, content and colour system of the IHME

- **colour wash (for type and hydrogeological significance of rock bodies)**

  Blue: intergranular aquifers

  Green: fissured and karst aquifers

  Brown: non-aquifers or only local potential

- **background ornament for lithological rock type**

  various types in grey

- **line and point symbols for special features**

  full blue for surface water, springs and karst

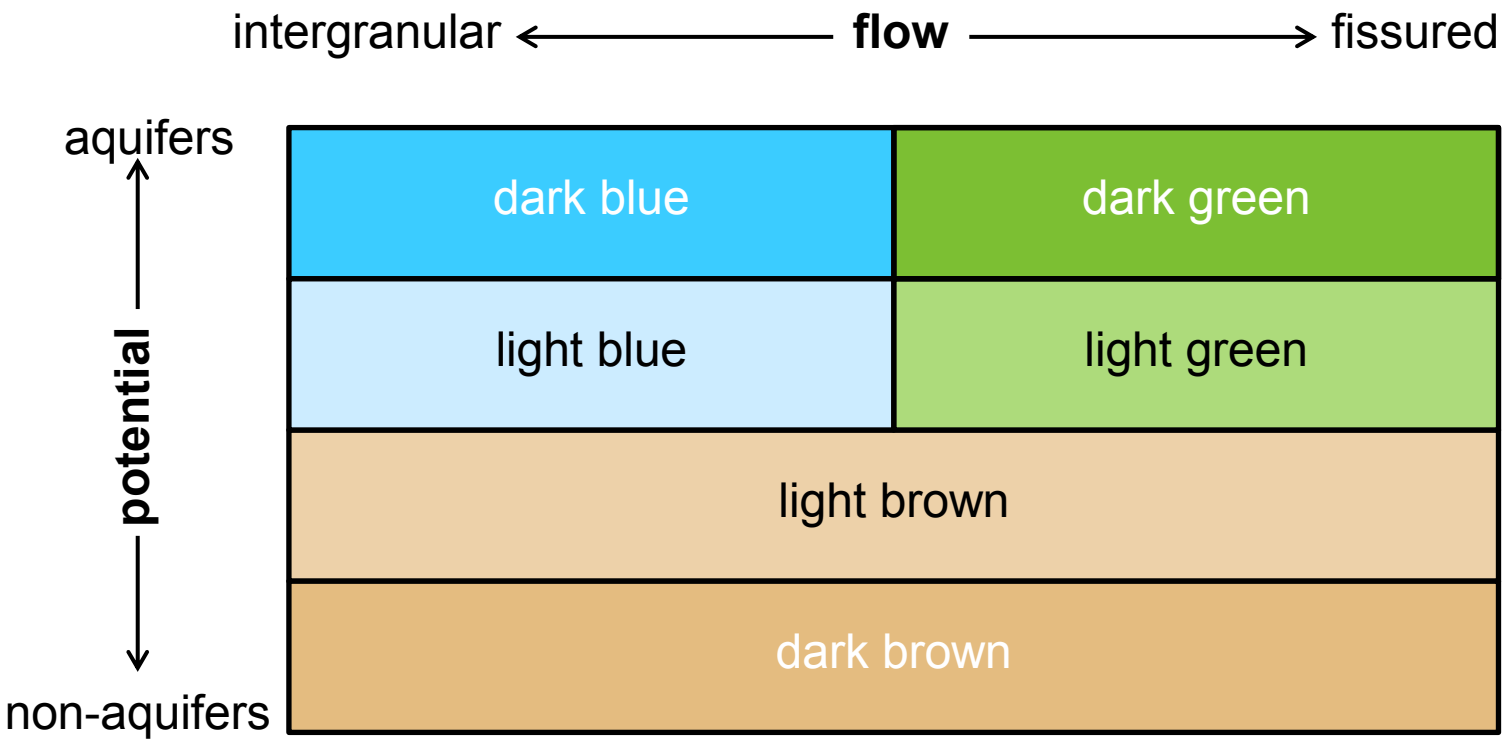
  violet for groundwater features, e.g. groundwater contours

  orange for chemical and thermal features, e.g. thermal and mineral springs

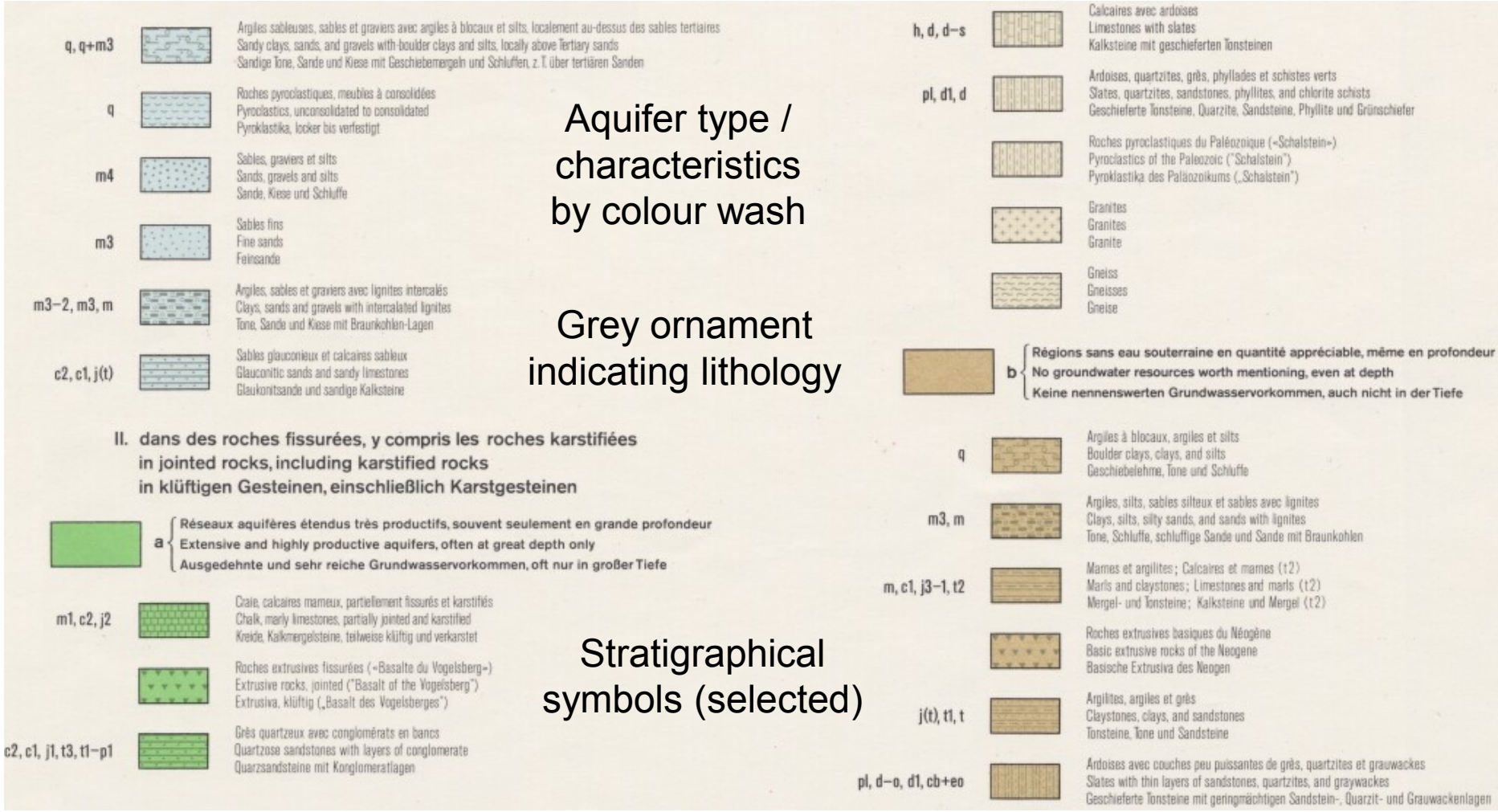
  red for man-made changes of the natural GW regime

  black for geological features, e.g. lithological boundaries, faults

Principles of colour wash on the IHME and General Legend



Legend IHME

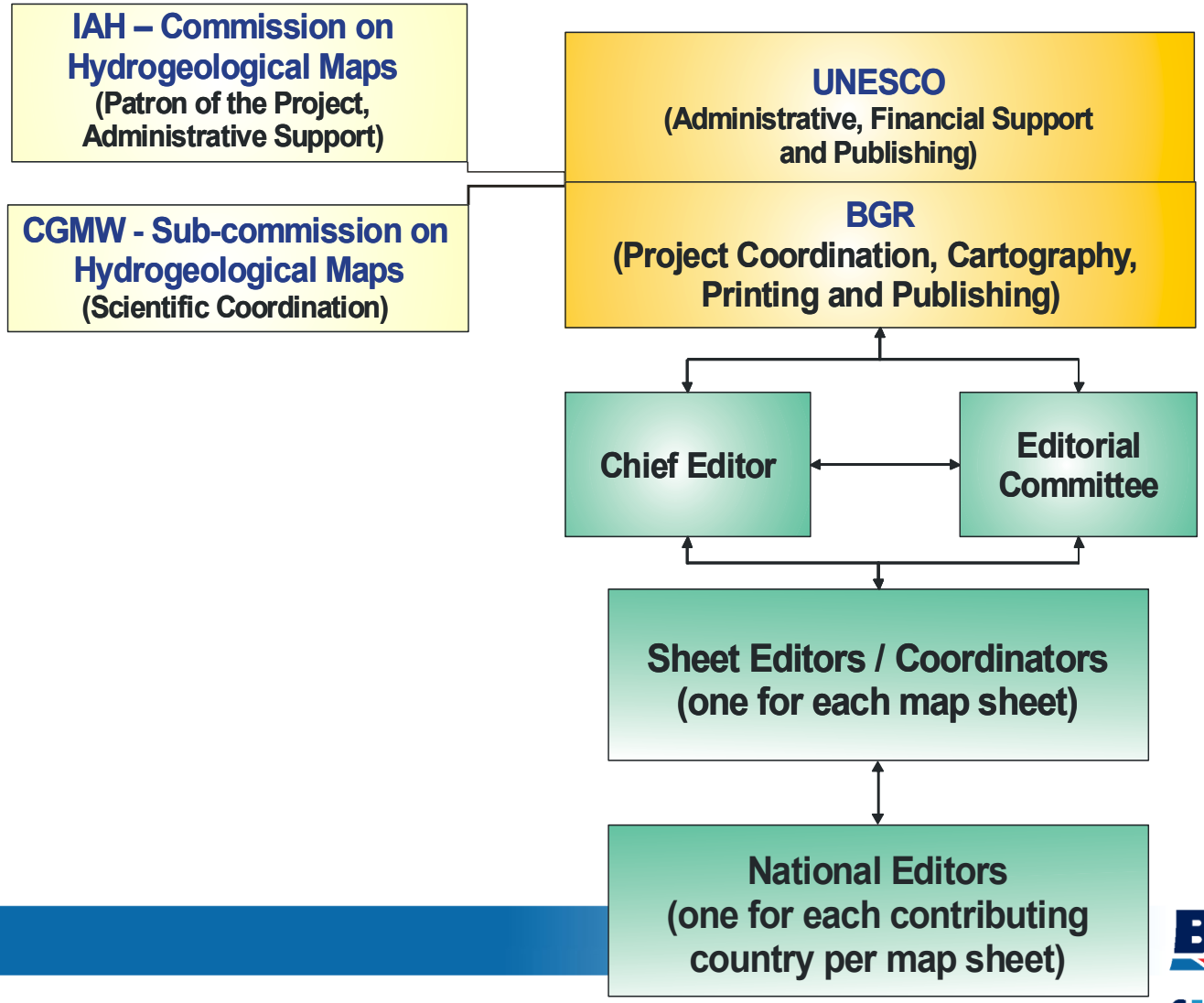

q, q+m3
Argiles sableuses, sables et graviers avec argiles à blocaux et silts, localement au-dessus des sables tertiaires
Sandy clays, sands, and gravels with boulder clays and silts, locally above Tertiary sands
Sandige Tone, Sande und Kiese mit Geschiebemergeln und Schluffen, z.T. über tertiären Sanden
q
Roches pyroclastiques, meubles à consolidées
Pyroclastics, unconsolidated to consolidated
Pyroklastika, locker bis verfestigt
m4
Sables, graviers et silts
Sands, gravels and silts
Sande, Kiese und Schluffe
m3
Sables fins
Fine sands
Feinsande
m3–2, m3, m
Argiles, sables et graviers avec lignites intercalés
Clays, sands and gravels with intercalated lignites
Tone, Sande und Kiese mit Braunkohlen-Lagen
c2, c1, j(t)
Sables glauconieux et calcaires sableux
Glauconitic sands and sandy limestones
Glaukonitsande und sandige Kalksteine
Aquifer type / characteristics by colour wash
Grey ornament indicating lithology
II. dans des roches fissurées, y compris les roches karstifiées
in jointed rocks, including karstified rocks
in klüftigen Gesteinen, einschließlich Karstgesteinen
a
Réseaux aquifères étendus très productifs, souvent seulement en grande profondeur
Extensive and highly productive aquifers, often at great depth only
Ausgedehnte und sehr reiche Grundwasservorkommen, oft nur in großer Tiefe
m1, c2, j2
Craie, calcaires marneux, partiellement fissurés et karstifiés
Chalk, marly limestones, partially jointed and karstified
Kreide, Kalkmergelsteine, teilweise klüftig und verkarstet
Roches extrusives fissurées (»Basalte du Vogelsberg«)
Extrusive rocks, jointed ("Basalt of the Vogelsberg")
Extrusiva, klüftig („Basalt des Vogelsberges")
c2, c1, j1, t3, t1–p1
Grès quartzeux avec conglomérats en bancs
Quartzose sandstones with layers of conglomerate
Quarzsandsteine mit Konglomeratlagen
Stratigraphical symbols (selected)
h, d, d–s
Calcaires avec ardoises
Limestones with slates
Kalksteine mit geschieferten Tonsteinen
pl, d1, d
Ardoises, quartzites, grès, phyllades et schistes verts
Slates, quartzites, sandstones, phyllites, and chlorite schists
Geschieferte Tonsteine, Quarzite, Sandsteine, Phyllite und Grünschiefer
Roches pyroclastiques du Paléozoïque (»Schalstein«)
Pyroclastics of the Paleozoic ("Schalstein")
Pyroklastika des Paläozoikums („Schalstein")
Granites
Granites
Granite
Gneiss
Gneisses
Gneise
b
Régions sans eau souterraine en quantité appréciable, même en profondeur
No groundwater resources worth mentioning, even at depth
Keine nennenswerten Grundwasservorkommen, auch nicht in der Tiefe
q
Argiles à blocaux, argiles et silts
Boulder clays, clays, and silts
Geschiebelehme, Tone und Schluffe
m3, m
Argiles, silts, sables silteux et sables avec lignites
Clays, silts, silty sands, and sands with lignites
Tone, Schluffe, schluffige Sande und Sande mit Braunkohlen
m, c1, j3–1, t2
Marnes et argilites; Calcaires et marnes (t2)
Marls and claystones; Limestones and marls (t2)
Mergel- und Tonsteine; Kalksteine und Mergel (t2)
Roches extrusives basiques du Néogène
Basic extrusive rocks of the Neogene
Basische Extrusiva des Neogen
j(t), t1, t
Argilites, argiles et grès
Claystones, clays, and sandstones
Tonsteine, Tone und Sandsteine
pl, d–o, d1, cb+eo
Ardoises avec couches peu puissantes de grès, quartzites et grauwackes
Slates with thin layers of sandstones, quartzites, and graywackes
Geschieferte Tonsteine mit geringmächtigen Sandstein-, Quarzit- und Grauwackenlagen

Milestones for the IHME

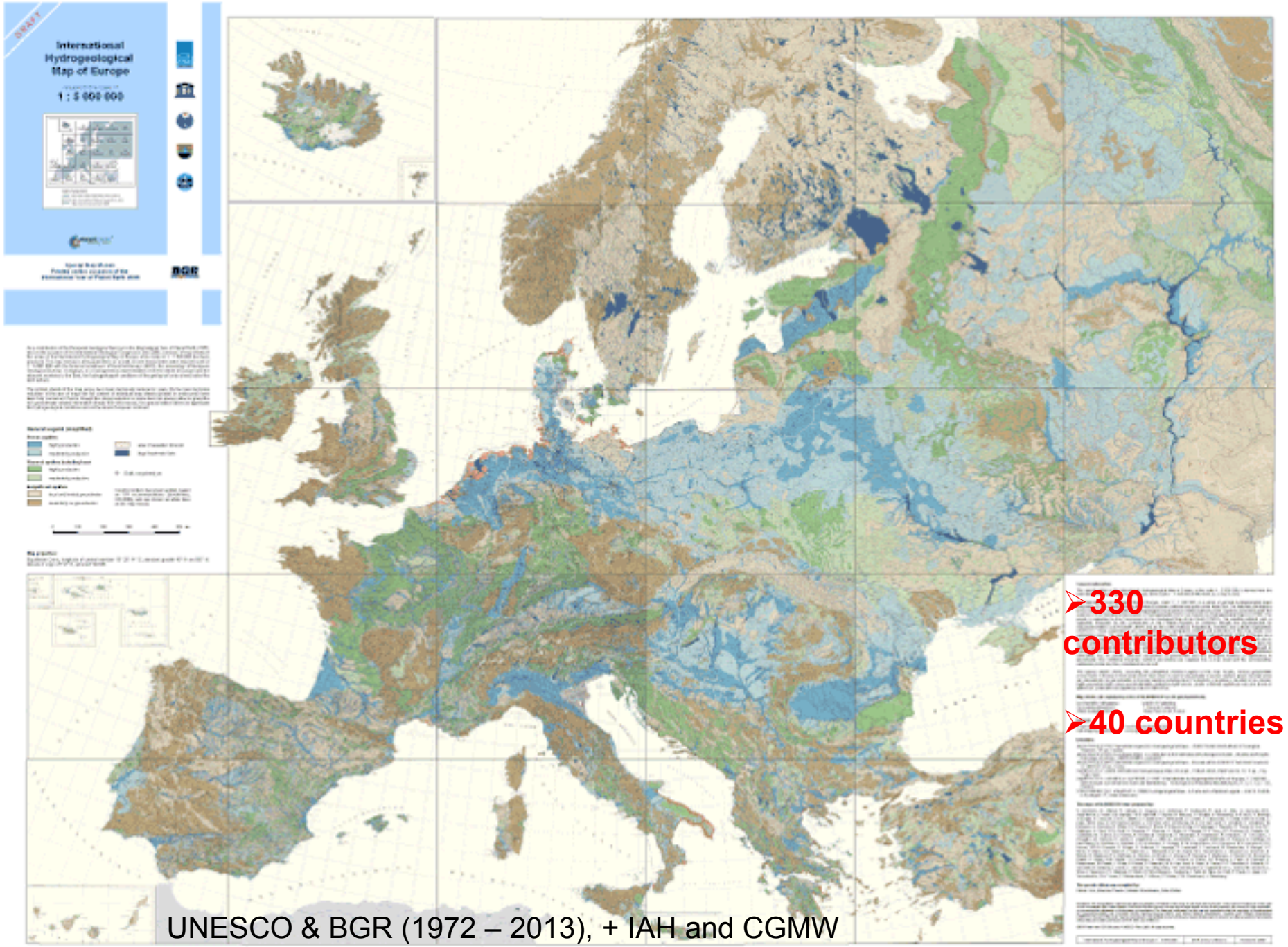
- **German Science Foundation and BGR** assured funding of a **scientific editor and the cartographic work** in Krefeld and Hannover
- **IAH = scientific lead** (Prof. Herbert Karrenberg)
- **Support of Geological Surveys** via the Sub-Commission on Hydrogeological Maps of the **CGMW** (Commission for the Geological Map of the World)
- **Growing interest** in Europe and the Eastern Countries

- **1970** : **Contract between UNESCO and BGR** for the publication of the IHME (addendum for each sheet and explanatory note)

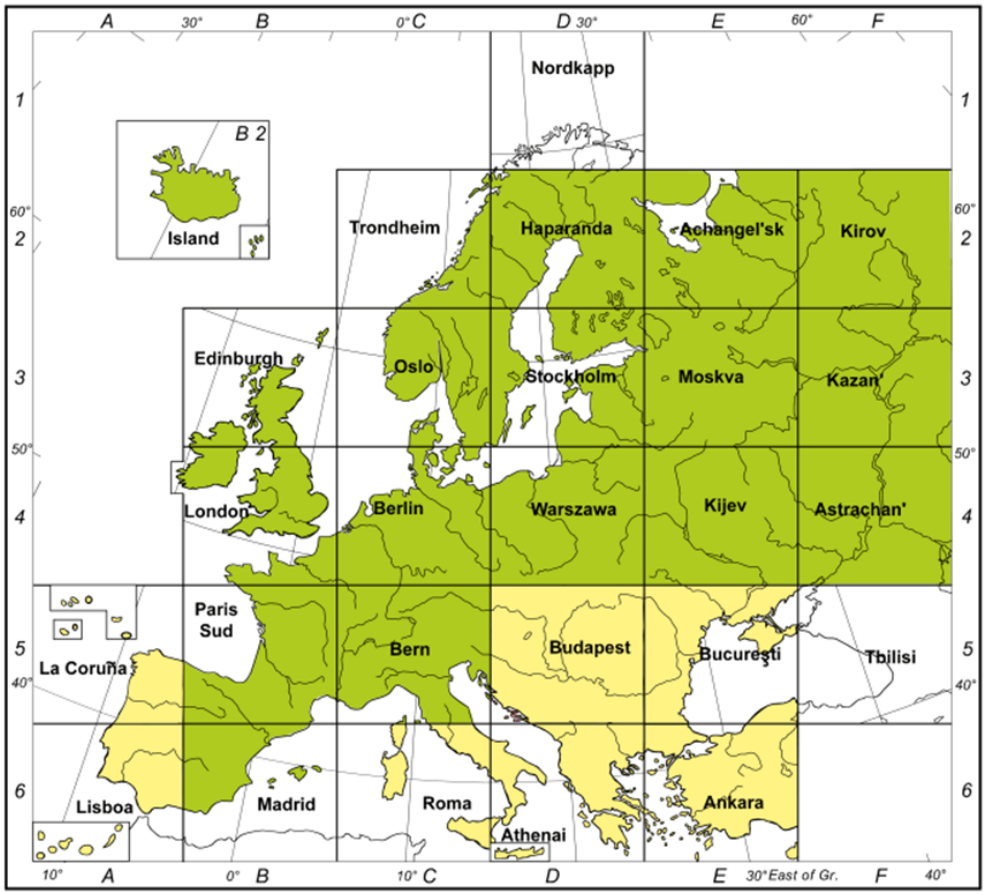
Organisational Structure



International Hydrogeological Map of Europe, scale 1:1,500,000



International Hydrogeological Map of Europe, scale 1:1,500,000



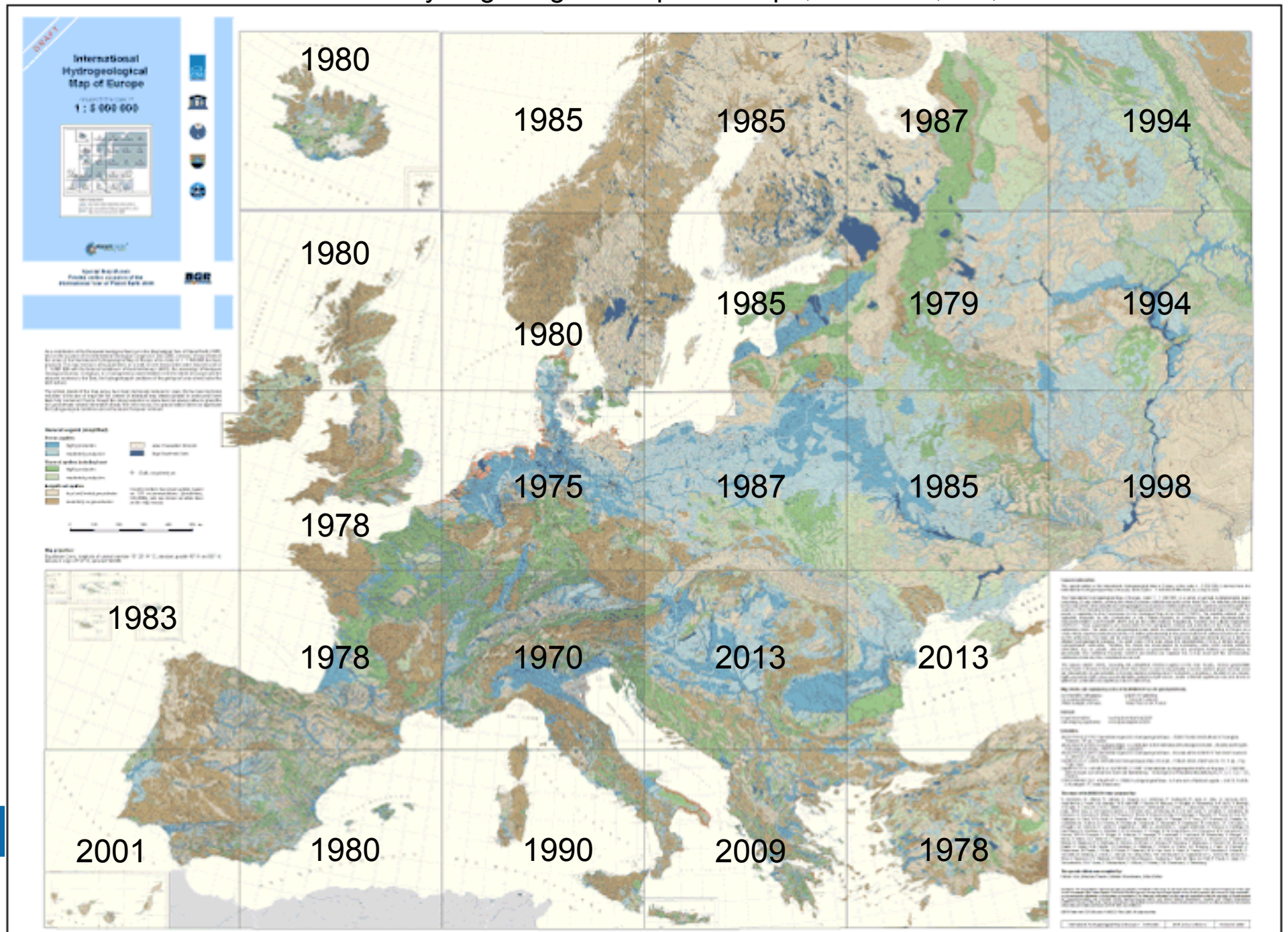
State of preparation

map sheet and explanatory notes printed

map sheet printed without explanatory notes

Date: August 2013

International Hydrogeological Map of Europe, scale 1:1,500,000



IHME Explanatory Notes (18 map sheets)

International Hydrogeological Map of Europe 1 / 1 500 000

Explanatory notes

(French or English)

- **Introduction on geographic setting**
- **Geological outline**
- **Hydrogeological regionalisation**
- **Description of hydrogeological regions**
  - characteristics of rock and groundwater bodies
  - hydrochemistry
  - groundwater use and water management
- **Bibliography**

International Hydrogeological Map of Europe 1 / 1 500 000

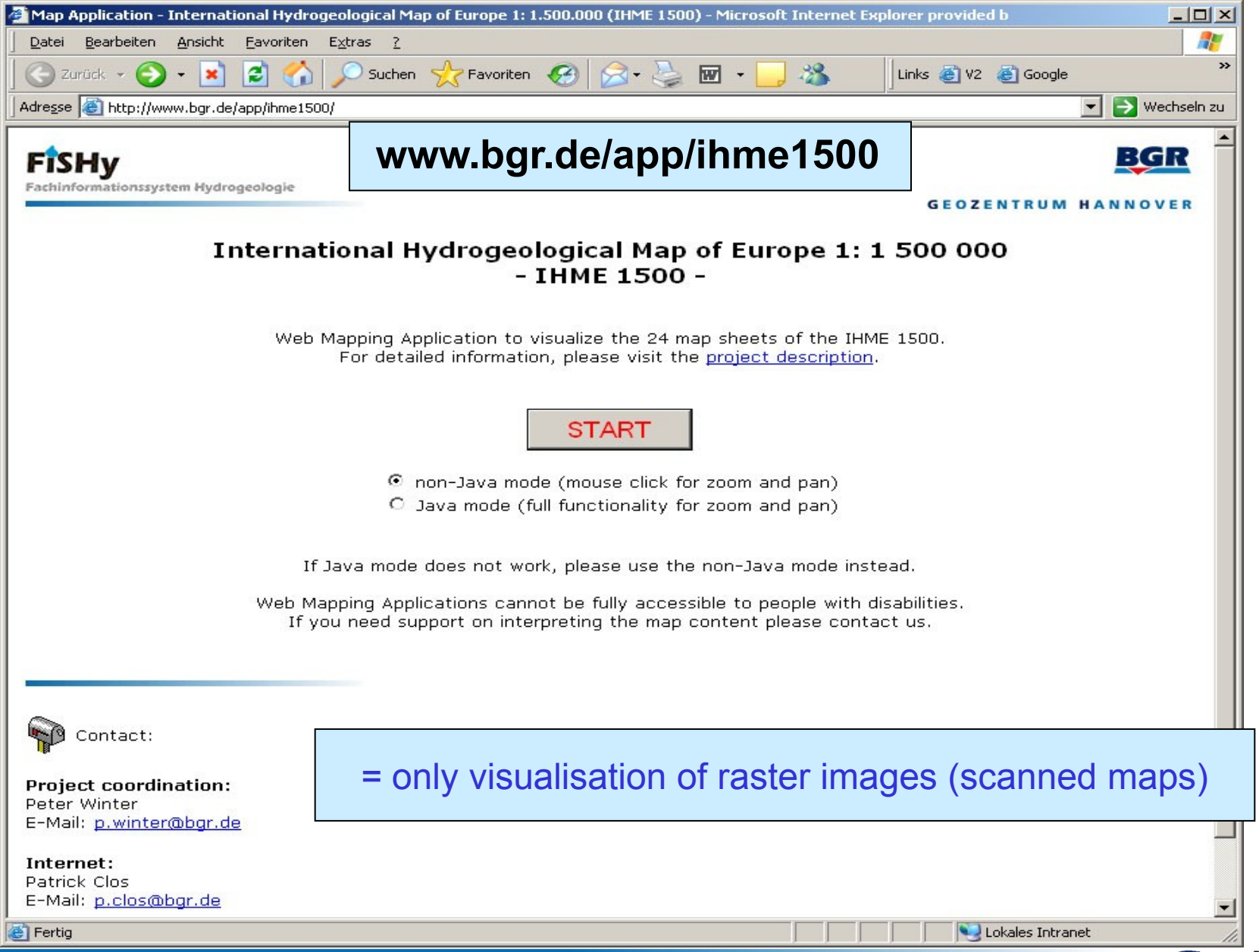
- harmonised trans-boundary representation for entire Europe and areas adjacent to the East (= future EU states)
- long-term scientific cooperation of experts (> 330) from all countries concerned
- good knowledge and expertise about mapping hydrogeology and groundwater
- complex information on lithology, aquifer characteristics, surface catchments and groundwater divides, springs, special features etc.
- hydrogeological regionalisation (explanatory notes)

….., but

- rather old, may require updates
- until 2010 only raster images available

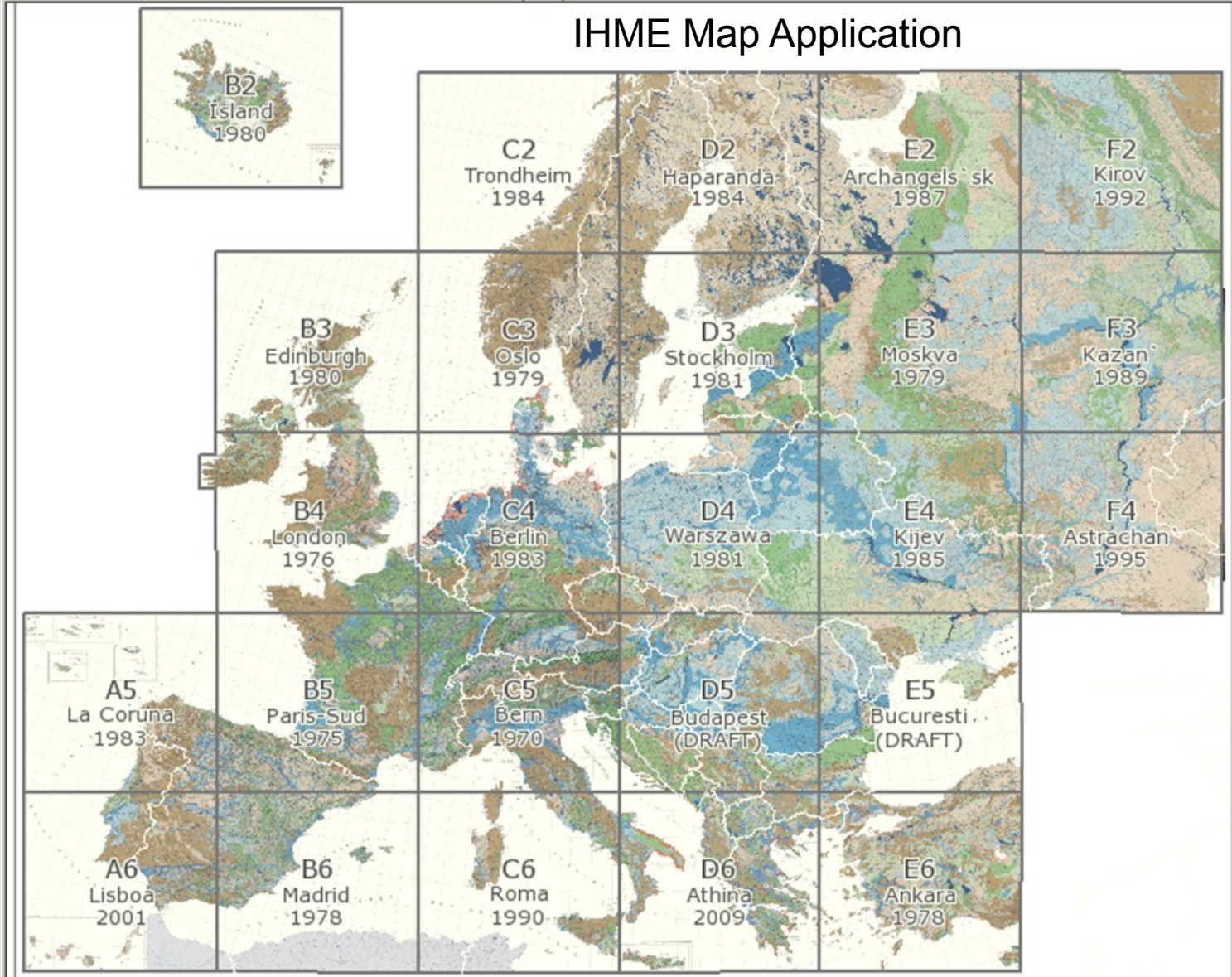
Applications of the International Hydrogeological Map of Europe 1 / 1 500 000

- **Science, teaching and public information**
  - cooperation of hundreds of geo-scientists
  - triggering national hydrogeological mapping
  - printed maps and explanatory notes
  - www based viewing system
- **EU Water Framework Directive**
- **UN-ECE studies on transboundary aquifers**



= only visualisation of raster images (scanned maps)

IHME Map Application



IHME1500

- ☑ General Legend (simplifie
- ☑
  - POROUS AQUIFERS
    - highly productive
    - moderately productive
  - FISSURED AQUIFERS incl. KAR
    - highly productive
    - moderately productive
  - INSIGNIFICANT AQUIFERS
    - local and limited groundwater
    - essentially no groundwater
  - area of seawater intrusion
  - large freshwater lake

Topography

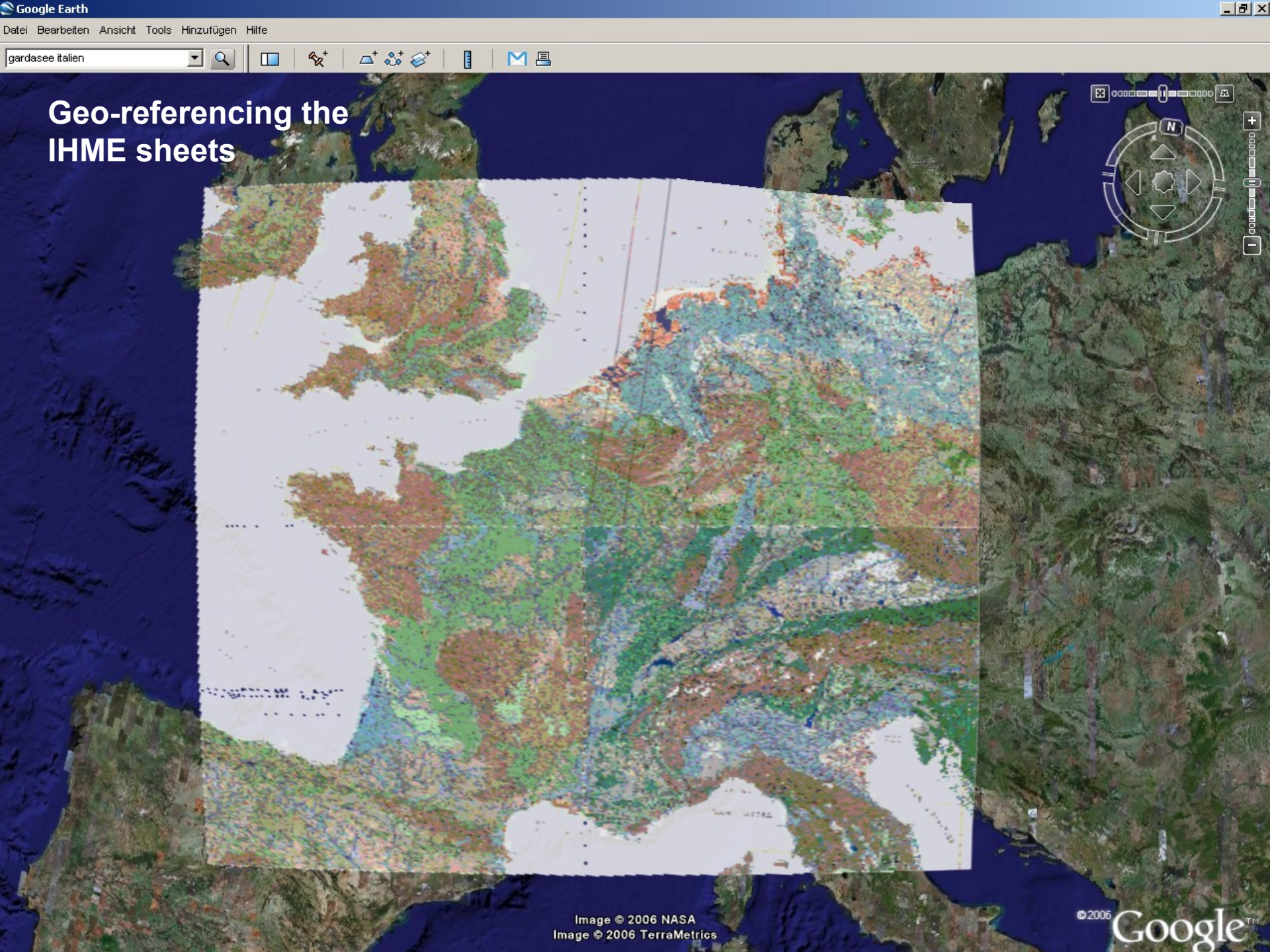
- ☑ country borders

Index

- ☑ sheet index
- ☑ sheet number
- ☑ sheet name
- ☐ state of preparation
  - Map sheet and explanatory no
  - Map sheet printed without expl
  - Map sheet print in preparation
- ☑ year of publication

0 340 680 1020 1360 km

Scale 1:18573300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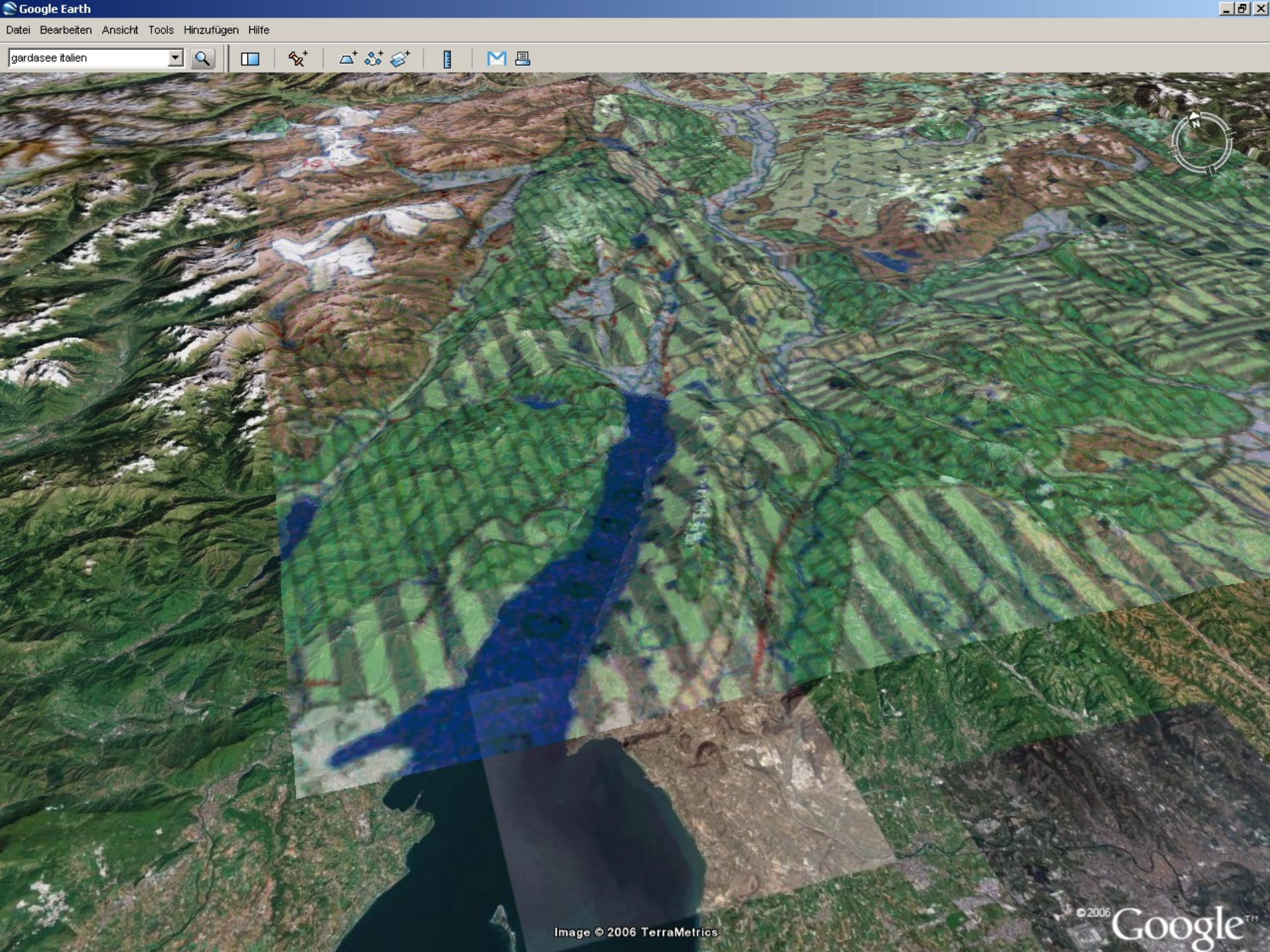
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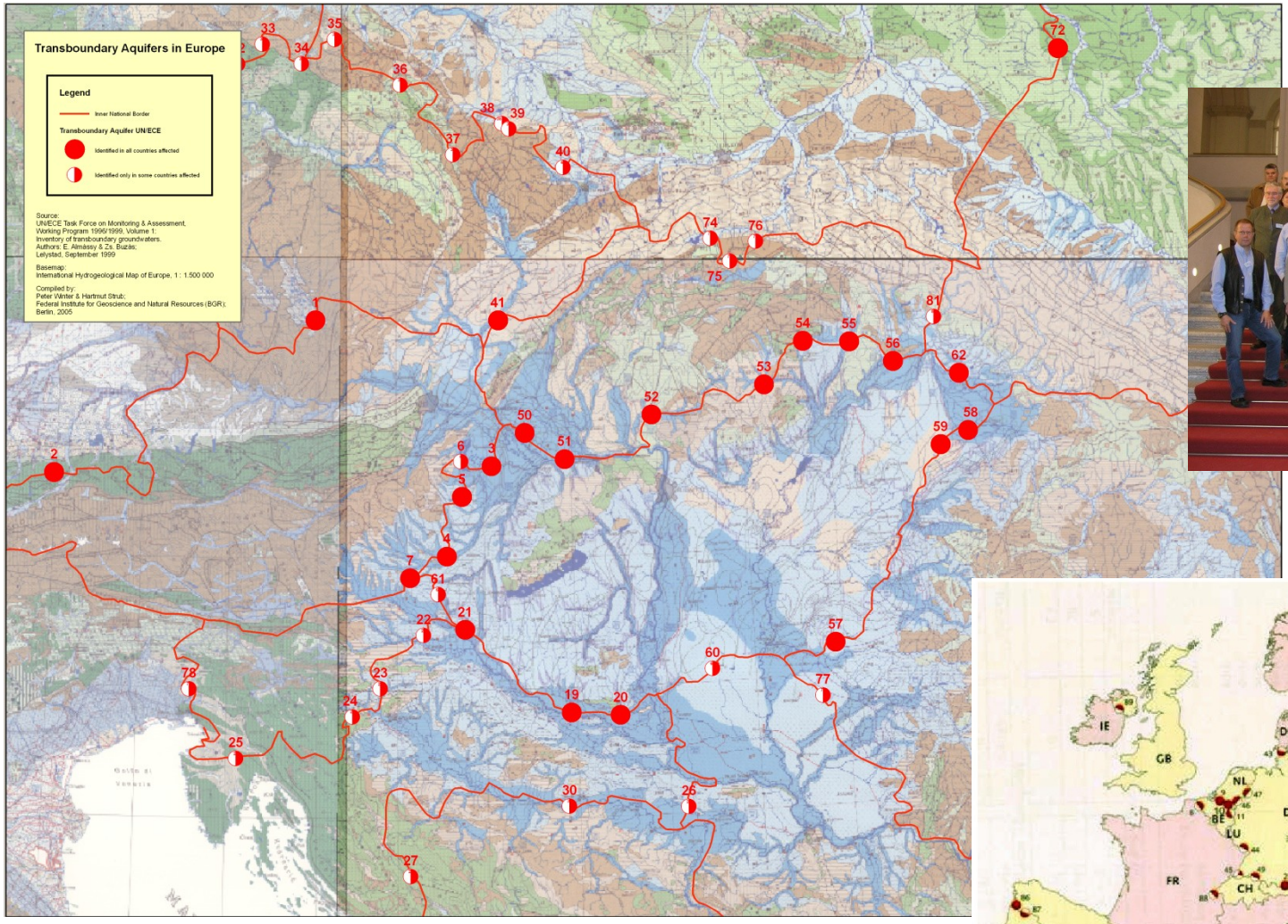
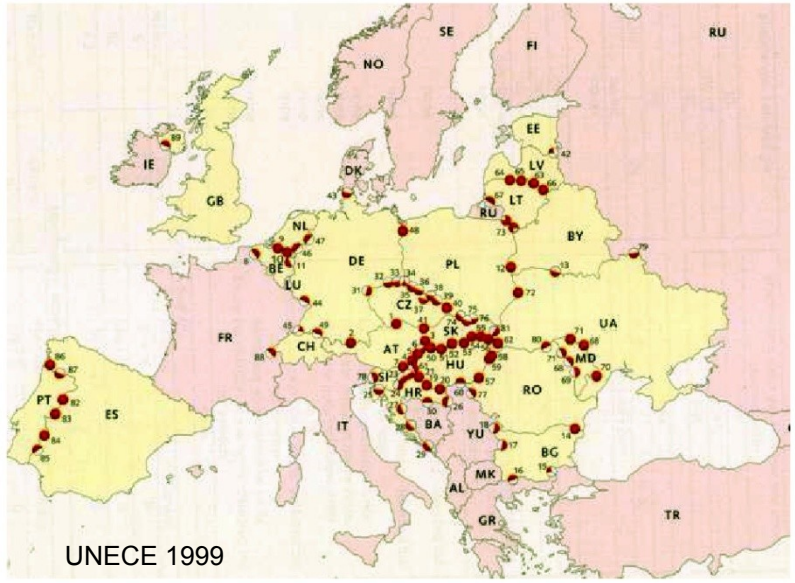




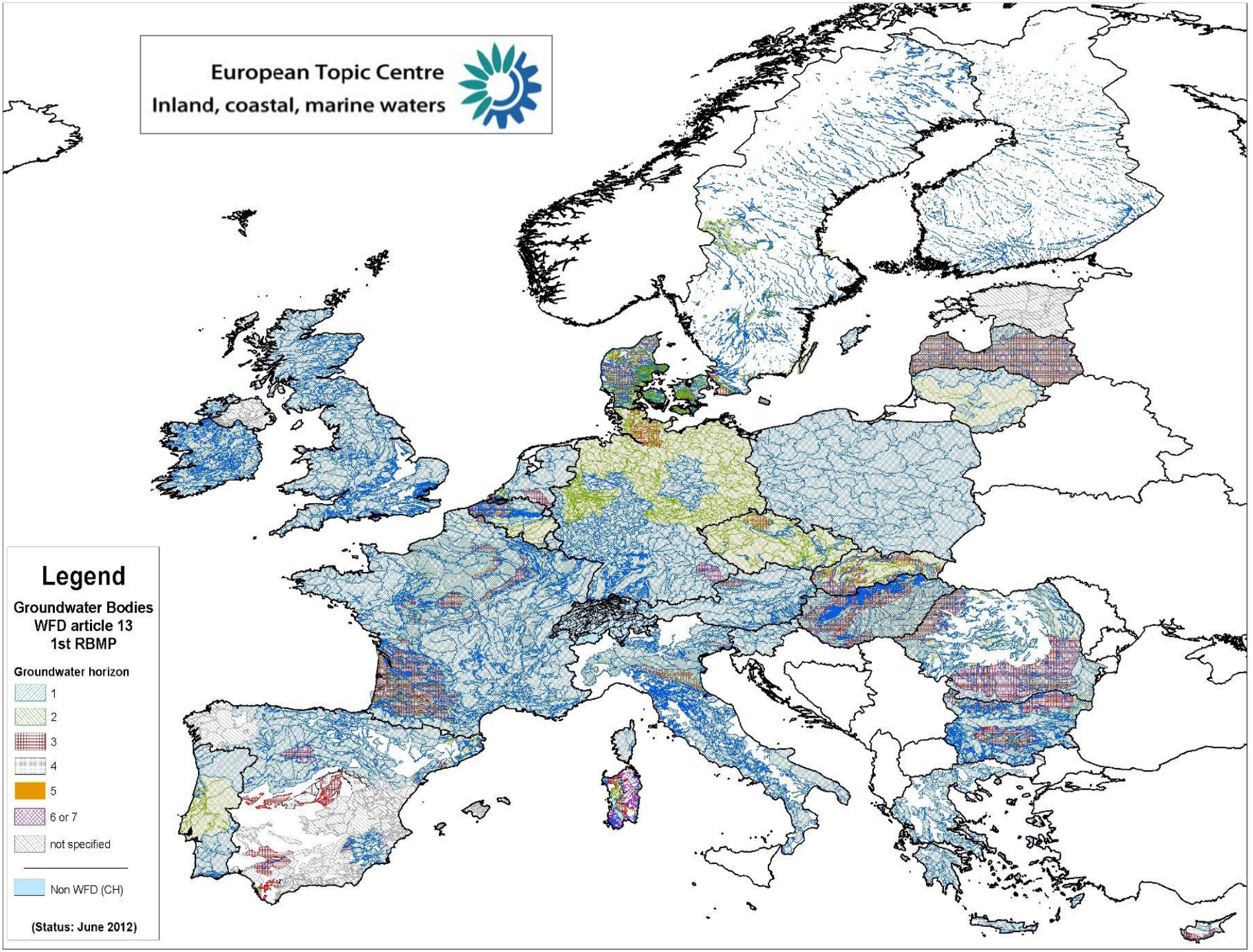
UNECE 1999

Workshop on Groundwater Bodies in Europe
Berlin, 25 - 26 October 2005

BGR Bundesanstalt für Geowissenschaften und Rohstoffe

GEOZENTRUM HANNOVER

European Topic Centre
Inland, coastal, marine waters



IHME results

- **25 printed map sheets at scale 1:1.5 Million**
- **18 Explanatory booklets**
- **IHME map application system and viewer** (static)
- **Scanned sheet data for download** (total 1.5 GB, 17-90 MB/sheet)
- **Integration of the map-app-sys into the WHYMAP map application and embedded WHYMIS** (scans of larger scale national maps and links to national map servers)
- **Digitisation of pertinent IHME map content** (aquifers and groundwater characteristics, lithology of near surface layers, lithological boundaries, faults etc, seawater salinisation, springs)
- **Geo-referencing and transformation of data sets and matching with modern topography** (European V-map 1.1 M)
- **Analysis of lithology data** (cf Andreas Günther)
- **Comparison with EU-WFD Groundwater Body layer** (cf Klaus Duscher)

- **PEACEFUL COOPERATION of hundreds of European scientists !**

Potential applications of IHME GIS data, eg.

- Superficial deposits mapping (EGS task force)
- Land slide modelling (JRC cooperation)
- Geochemical characterisation (EGS Expert Group)
- Hydrochemical background values (EGS Water Expert Group)
- Transboundary aquifer assessment (TWAP, UNECE, EU-WFD)
- Water accounting and water balance modelling (EEA, JRC)
- Integration of GW in IWRM in Europe (WFD, RBD)

…. so this Workshop concludes the „traditional IHME“ and may open the door into the digital IHME era, finally ….

International Hydrogeological Map of Europe 1 / 1 500 000 (IHME)

Conclusions & Recommendations

- Harmonised background information for greater Europe
- Generally suitable for pan-European projects
- e. g. EU Water Framework Directive
  (Groundwater Daughter Directive)
- e. g. UN-ECE study on transboundary aquifers
- Digital Map soon available
- INSPIRE (INfrastructure for SPatial InfoRmation in Europe)
- Subsidiarity: European data sets and nested national data

BGR

United Nations Educational, Scientific and Cultural Organization

International Hydrological Programme

EuroGeoSurveys European Geoscience for Society

The Geological Surveys of Europe

Thank you for your attention

… and thanks to the whole IHME team:

Herbert Karrenberg, Deike Bollhagen, Patrick Clos, Klaus Duscher, Andreas Günther, Martin Krombholz, Sepp Krüger, Solveig Mix, Christian Neumann-Redlin, Uta Philipp, Andrea Richts, Bernhard Schmidt, Hartmut Strub, Wilfried Weinmann, Peter Winter

… and of course biggest thanks to more than 330 national IHME contributors

iah aih

CCGM CGMW

European Topic Centre Inland, coastal, marine waters

igrac