KINDRA DELIVERABLE D1.3

EIGR (EUROPEAN INVENTORY FOR GROUNDWATER RESEARCH) GUIDANCE DOCUMENT

Summary:

This report describes the structure of the European Inventory of Groundwater Research (EIGR), the tool which allows the application of the Harmonised Terminology and Methodology for Classification and Reporting Hydrogeology related Research in Europe (HRC-SYS), previously elaborated during the KINDRA project (see D1.2). The report is intended as a methodological Guidance Document for EIGR users. The conceptual approach behind the EIGR, how it relates to HRC-SYS (D1.2) and the technical guidance on how to insert information in the EIGR (D1.5) are here described.

The EIGR is intended to be used in three different ways: i) for insertion of information pertaining to groundwater research and other available knowledge by the National Experts of the European Federation of Geologists (EFG); ii) for consultation during and after the project by people and organizations dealing with groundwater research, but also possibly by non experts; iii) for analysing collected and stored information to identify trends, challenges and gaps in groundwater research, by the KINDRA partners. The EIGR is intended to be a permanent resource, publicly available after the end of the KINDRA project.

The EIGR will not contain data itself, but rather metadata, referring and providing links to research that has been performed in Europe since 2000, and at the same time allowing their classification under the uniform proposed HRC-SYS. The EIGR allows for the insertion of different information products. In the process of inserting information in the EIGR, users are guided to classify the uploaded information and distinguish between 'research' and 'knowledge' according to four different classes of "knowledge" and "research" identified by the level of the performed quality assurance the uploaded work has received.

The EIGR Online Data Catalogue described in this Guidance document is an alpha version, which will be tested and checked during the trial phase, through the help of National Experts designated by the National Members of EFG. A final version will be released after appropriate tests are carried out at a later stage of the project.

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1. Executive Summary

This report deals with the description of the structure of the European Inventory of Groundwater Research (EIGR), the tool that allows the application of the Harmonised Terminology and Methodology for Classification and Reporting Hydrogeology related Research in Europe (HRC-SYS), elaborated during previous phases of the KINDRA project (see D1.2). The report is intended as a methodological Guidance Document for EIGR users. The conceptual approach behind the EIGR, how it relates to HRC-SYS (D1.2) and reference to technical guidance on how to insert information in the EIGR (D1.5) is addressed in the final section of this document.

Both the HRC-SYS and the EIGR are fundamental to achieve the main aim of the KINDRA project, which is to create an overview of the scientific knowledge covering European countries, by an accurate assessment of the state of the art in hydrogeology research in various geographical and geo-environmental settings, allowing for a direct comparison and exploitation of existing synergies. At the same time, the scope of the project includes identification of future trends, critical challenges and research gaps, to improve management and policy development for groundwater resources on a EU level, coherently with the Water Framework Directive (WFD) and Groundwater Directive (GWD).

In this framework, it is underlined that the EIGR must serve for three different purposes: i) for insertion of information pertaining to groundwater research and other available knowledge by the National Experts of the European Federation of Geologists (EFG); ii) for consultation during and after the project by people and organizations dealing with groundwater research, but also by non experts; iii) for analysing collected and stored information to identify trends, challenges and gaps in groundwater research, by the KINDRA partners.

Previously, a classification system (HRC-SYS) has been elaborated, compiling a list of about 240 keywords characterizing research on groundwater selected from the most important EU directives and documents and from related scientific literature. The categorization is based on three main categories: 1) Societal Challenges, 2) Operational Actions and 3) Research Topics. Each of these three main categories include 5 overarching groups allowing for an easy overview of the main research areas. These are, for Societal Challenges: 1. Health, 2. Food, 3. Energy, 4. Climate-Environment-Resources, 5. Policy-Innovation-Society; for Operational Actions: 1. Mapping, 2. Monitoring, 3. Modelling, 4. Water Supply, 5. Assessment & Management; for Research Topics: 1. Biology, 2. Chemistry, 3. Geography, 4. Geology, 5. Physics & Mathematics. Finally, the merged list of keywords has been organized in a tree hierarchy, where the overarching groups represent Level 1. In this way, the interaction among the three main categories requires a 3D approach, but allowing a more simple 2D representation for each of the five Societal Challenges, where Operational Actions and Research Topics intersect in a 5x5 matrix, which can be extended for lower levels (2 and 3). This is discussed in chapter 3 of this report.

Using and modifying previous digital platforms employed by REDIAM at a regional level, the EIGR is developed as a Online Data Catalogue which allows for geographically referencing uploaded information regarding groundwater research and knowledge in Europe. The EIGR will not contain data itself, but rather metadata referring and providing links to research that has been performed

in Europe since 2000, and at the same time allowing their classification under the proposed HRC-SYS. The role of the HRC-SYS is to provide guidance to users on how to classify resources to be inserted in the EIGR, and at the same time to allow for information analysis (trend, challenges, gaps) when the inventory has been populated. In addition, this HRC-SYS classification system will be implemented and tested during the first population of the EIGR and demonstrated at the orientation Workshop for the national EFG representatives (D2.1).

Information to be inserted in the EIGR includes official research results in peer reviewed scientific literature published in scientific journals registered in the two most important research databases "Scopus" and "Web of Science", which have been investigated for building the HRC-SYS as well as publications with no peer review or quality assurance. Hence, the scope of the project is to include also information about reports, databases, projects, which have not necessarily produced peer reviewed scientific literature, notably if they are published in national languages. These documents contribute to the "groundwater knowledge" part of the EIGR as a supplement to the "groundwater research" and are considered within the scope of KINDRA in order to provide a complete picture of the European groundwater research activities and data aggregation. Part of the "knowledge" information is reviewed, internally or externally, or otherwise quality assured, and other parts are not. Consequently, the EIGR allows for the insertion of different information products. In the process of inserting information in the EIGR, users will need to distinguish between 'research' and 'knowledge' and between quality assurance (QA) classes of "knowledge" and "research". Thus, the EIGR includes four classes for QA, as described in detail in chapter 4. In addition, other indicators have been adopted besides the classical bibliometric indexes (e.g. citations); in detail, Technology Readiness Levels (TRL) and patents released by the product are taken into account for quality evaluation.

Information on documents or products evaluated by the experts (but in the future also by other users) relevant for groundwater research, knowledge and innovation, have to be inserted and classified in the EIGR. The structure of the EIGR and the information to be provided, described in detail in chapters 3 and 5, includes:

i) Metadata Information, identifying the source of information (by whom and when information has been uploaded in EIGR);

ii) Resource Identification Information, which describes the document/report/project, including its geographical reference;

iii) Categorization of the uploaded research and knowledge within the main HRC-SYS overarching categories of the Societal Challenges, Operational Actions and Research Topics, including the provision of additional keywords primarily selected from the approved merged keywords list, but also new keywords that may not be listed;

iv) Data Quality Information, which describes its level of quality assurance, based on the above mentioned quality indicators. As additional information about the realization process, the

Technology Readiness Level (TRL) of the product can be added; this is further explained in section 3.2.

v) Distribution Information, related to the technical format of the product (e.g.: PDF, shape file, image, etc.) and internet links to where the resource (publication, project web site etc.) can be found.

Information inserted in the EIGR must be as complete as possible, to allow for the use of search engines for future user consultations and for information analysis. For this reason, several information fields are mandatory to be provided at the insertion phase; other data can be conditional (necessary only in case of sub-menu activation) and other are optional, as accessory information.

At this stage, the requirements for the EIGR have been evaluated and tested by means of the insertion of examples in the EIGR template of different products provided by the KINDRA partners. The adopted EIGR here described is intended as an alpha version, to be tested and checked during the trial phase, corresponding with the Information Workshop with the experts designated by the National Members of EFG. A final version will be released after appropriate tests at a later stage of the project.

2. Description of the groundwater research classification system (HRC-SYS)

The groundwater research classification system (HRC-SYS) was developed for deliverable 1.2 of the KINDRA project (KINDRA - D1.2, 2015). The main features of the classification system is the grouping of relevant research in overarching categories of 5 societal challenges - 5 operational actions and 5 research topics as illustrated in figure 2.1 below.

The overarching categories were selected by the KINDRA group in collaboration with the associated panel of experts and national members of the European Federation of Geologists. The selection was made based on the most important general research topics and operational actions in relation to the major natural science disciplines or research topics to which groundwater research primarily belongs and relates: 1. Biology, 2. Chemistry, 3. Geography, 4. Geology, 5. Mathematics and Physics (alphabetical order). For operational actions, the selection was made according to keyword searches in Web of Science, Scopus, Google Scholar, selected groundwater science journals and EU directives and guidances; primarily the Water Framework Directive, the Groundwater Directive and the Blueprint to Safeguard Europe's Water Resources as well as the KINDRA questionnaires completed by 20 experts of national geological societies / the European Federation of Geologists (KINDRA - D.1.4). The finally selected overarching operational actions were: 1. Mapping, 2. Monitoring, 3. Modeling, 4. Water supply, 5. Assessment and Management (Figure 2.1).

Further, it was decided to use the societal challenges of Horizon 2020 - the EU Framework Programme for Research and Innovation to make the classification as relevant as possible for the main challenges of the EU research programmes, and to facilitate the evaluation of groundwater research importance within the context of mainly the Horizon 2020 challenges and visions. There are originally 7 societal challenges in Horizon 2020, but one of them (SC4 = transport) has no

groundwater relevance and the last two SC6 and SC7 have many overlapping issues of relevance for groundwater research. Hence it was decided to merge these two. This therefore resulted in the following five societal challenges for groundwater research classification and evaluation: 1. Health, 2. Food, 3. Energy, 4. Climate/Environment/Resources (corresponds to SC5 of H2020), 5. Policy/Innovation/Society (corresponds to SC6 and 7 of H2020). Figure 2.1 and Table 2.1 below illustrates the overarching main keywords of the KINDRA groundwater research classification system.

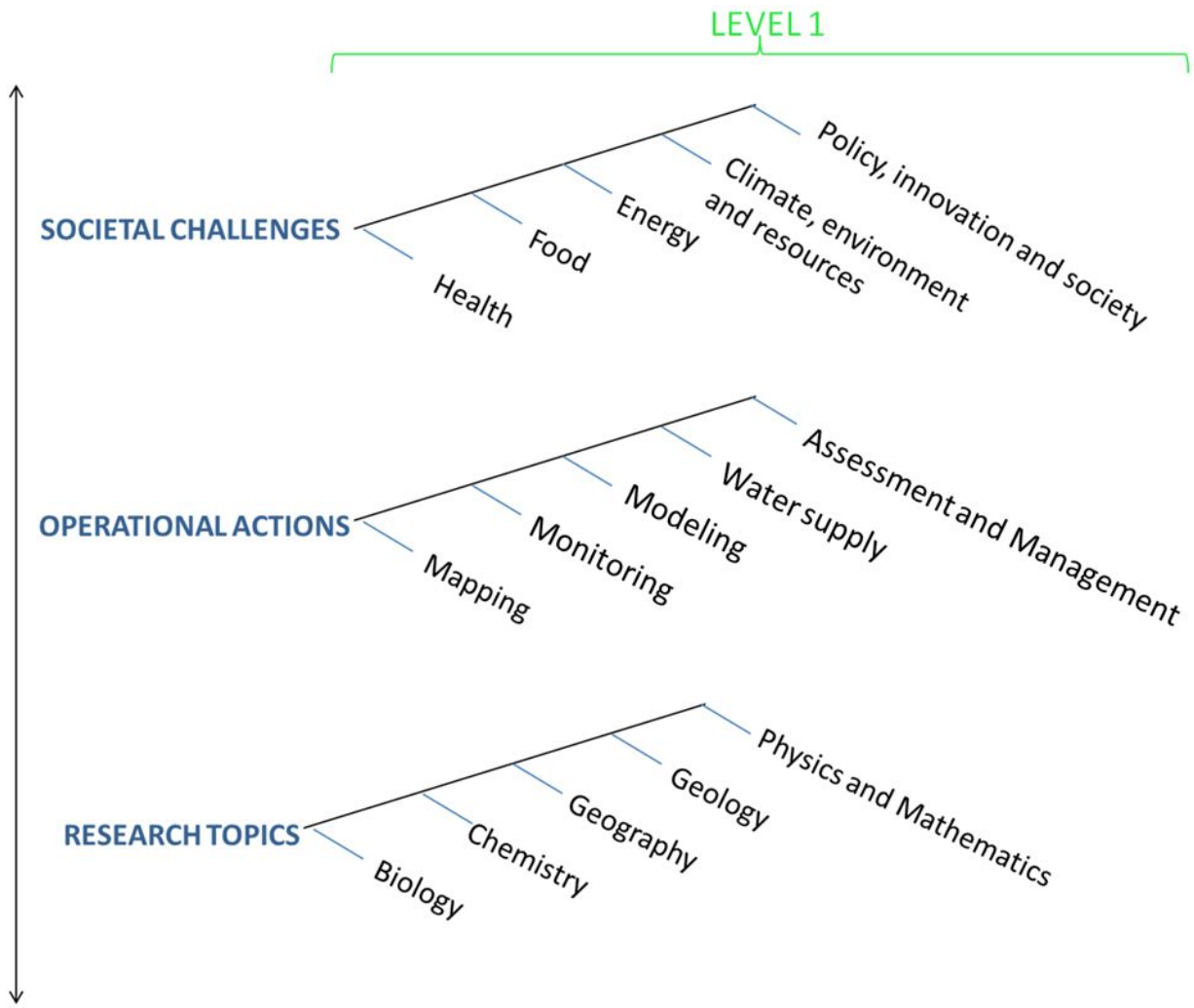


Figure 2.1. *Illustration of the five overarching societal challenges, operational actions and research topics as defined by the KINDRA project.*

Our approach is based on the assumption that most of the current and future research, defined by selected main keywords describing the most important topics of the classified research, should fit into at least one of these overarching societal challenges, operational actions and research topics, which will be the main entrance when classifying current or ongoing groundwater research in the developed European Inventory of Groundwater Research (EIGR) as described in chapter three of this report.

Table 2.1 *The overarching groups, for an easy overview of the main research dimensions:*

Societal Challenges	Operational Actions	Research Topics
1. Health 2. Food 3. Energy 4. Climate, environment and resources 5. Policy, innovation and society	1. Mapping 2. Monitoring 3. Modelling 4. Water supply 5. Assessment and Management	1. Biology 2. Chemistry 3. Geography 4. Geology 5. Physics and Mathematics

The keywords to be used in the classification system have been obtained from searches in the EU directives (Water Framework Directive, Groundwater Directive and Blueprint Document) and the scientific peer-reviewed journals dealing with groundwater resources. The considered groundwater journals have been those with the highest impact, based on an international ranking comparison (refer to D1.2).

Initial work in the KINDRA project defined a list of more than 200 keywords (see appendix A) related to groundwater research, which all could be grouped into sub-levels of the overarching categories in Figure 2.1, and which could be evaluated in terms of amount of existing research papers or publications for each keyword.

The occurrence of Groundwater related keywords in international research databases has been evaluated by performing searches using three search engines: Web of Science (WoS), Scopus and Google Scholar (GS). In all cases, we looked into the relationships between groundwater and each keyword.

The selected list of keywords has been organized by sub topics as described in tables. The adopted list of keywords can be extended during the project, following suggestions by the Joint Panel of Experts, the national experts, chosen by EFG among third parties and possibly other groundwater scientists uploading data to the EIGR.

The classification system maps the relation between the three main categories through a 3D approach (CUBE), where along each axis the 5 overarching groups are indicated (Fig. 2.2).

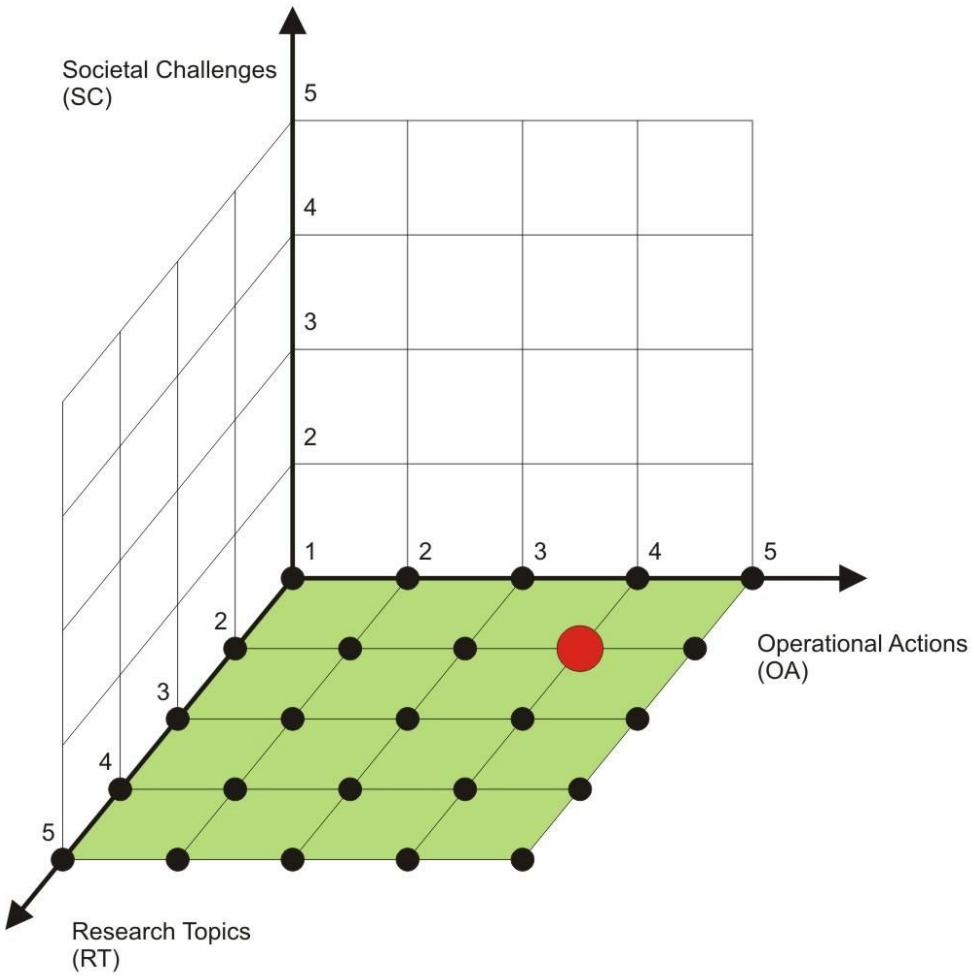


***Fig. 2.2**. 3-D representation of HRC-SYS (refer to KINDRA D1.2). In green the 2D field of SC1 (Health) and in red the field related to the intersection of OA4 (Water supply) & RT2 (Chemistry).*

This approach allows for a more simple 2D representation, for each of the Societal Challenges, where Operational Actions and Research Topics intersect in a 5x5 matrix (see example in Figure 2.3). The 2D approach renders the analysis and reporting of the relationships between groundwater research easier to perform and more comprehensible than a 3D analysis.

By this way, each one of the 2D graphs related to a single Societal Challenge, will include research and knowledge attributed to one RT and one OA. From each of these points (e.g. the red dot in Fig.2.2), a subordinated 2D graph representing the second order of keywords classified in the HRC-SYS can be carried out (see Fig.2.3), where along the axes the subordinated keywords for each RTs and OAs are identified, to provide additional information.

The adoption of the above mentioned classification system allows comparison of bibliometric and other indicators for each sub-field of research and knowledge, for trend and gap analysis.

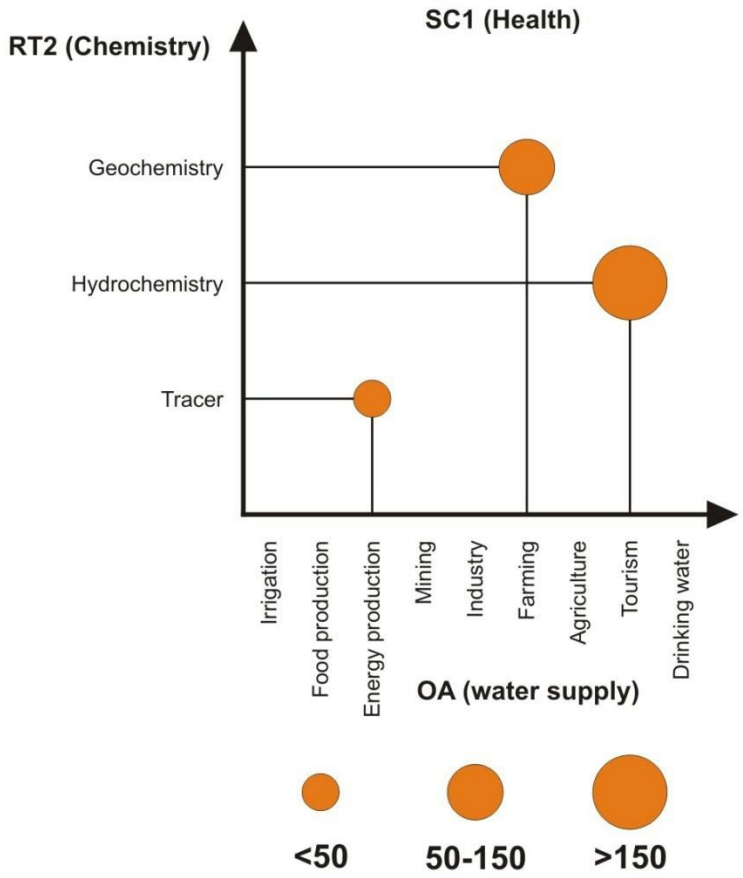


Figure 2.3. *Example of a 2D presentation of the performance of selected sub research topics (RTs) within RT2 "Chemistry" in combination with operational actions of OA4 "Water Supply" and Societal challenge 1 (SC1) "health" (Figure 3.1). The figure illustrates that the keyword "tracer" in combination with the keyword(s) "energy production" have less than 50 published papers for the investigated period, while the RT "Hydrochemistry" in combination with the OA "Tourism" has more than 150 papers for the same period. Note! The illustrated example just demonstrate the concept and does not represent real data. All combinations of RTs and OAs in this diagram will belong to one of the three groups >50, 50-100 and > 50. The grouping of the number of papers varies between the different combinations of Societal Challenge, Research Topic and Operational Activity some combinations will have many (e.g. > 1000 papers) others only few (e.g. < 10)*

The uniform EU-harmonised categorisation approach/terminology for reporting groundwater research (Hydrogeological Research Classification System – HRC-SYS) is also consistent with the review of previous and current international projects related to groundwater and will support and guide the population of the European Inventory of Groundwater Research and Innovation (EIGR) (see Chapter 2, Deliverable 1.2).

Consequently, the KINDRA project group proposes the adoption of this classification system, to classify and analyse the occurrence, performance and availability of groundwater research and knowledge in and outside Europe.

3. European Inventory of groundwater research (EIGR)

As part of the objectives of the KINDRA project, the creation of a European Inventory of Groundwater Research and Innovation, EIGR, supports the EU-assessment of current scientific hydrogeological knowledge, both theoretical and applied, focusing on EU, national and regional research and knowledge, but including also international (outside the EU) and EU-third party activities. The scope of the EIGR is threefold: (1) provide a tool and framework within which resources on groundwater resources can be uploaded and stored in a efficient and user friendly way; (2) populate the inventory with groundwater research resources; and (3) conduct an assessment of the state-of-the-art in groundwater research, identify gaps and trends and provide future research recommendations. In addition, the EIGR is intended to be used also after the end of the project, as a possible permanent public-access service for European hydrogeological research in progress.

3.1 Introduction to the EIGR

The EIGR consists of a web-service supported tool that enables users to overcome the difficulties to report and compare the research activities and derived knowledge at EU level. Operating mainly as a catalogue, the EIGR stores scientific information classified on the basis of the Harmonized Terminology and Methodology for Classification and Reporting Hydrogeology and groundwater related Research in Europe (HRC-SYS) documented in D1.2. At this stage, the HRC-SYS as described in the previous section and in D1.2 serves as guidance for the EIGR users in classifying documents to be inserted in the catalogue. Further details on how the classification system (HRC-SYS) forms the backbone of the EIGR are explained in the next sections. It should be noted that the EIGR is not intended as a catalogue of data produced by research, but as an inventory, where users can find and compare information about groundwater research and knowledge organised by keywords and geography (country, regions, ecoregions of the Water Framework Directive etc.) dependent on the application.

Information will be stored in the EIGR as metadata, including links and details on the person who populates the catalogue (see chapters 4 and 5). Consequently, the information itself will not be stored in the EIGR, but searches performed using the KINDRA database will provide links where the info can be retrieved. Refer to chapter 5 on the definition and use of metadata. The user who upload the information should have to verify the continued operability and maintenance of the links over time.

All metadata insertions will illustrate what research has been performed in Europe since the year 2000, where the products of the research can be found and how they can be classified under the harmonized HRC-SYS. In populating the EIGR, the user will be invited to classify the type of document under the classes of Knowledge or Research. The quality evaluation procedure is based on the type of review process undergone by the product to be inserted in the catalogue, but also it is based on several indicators such as Technology Readiness Level (TRL), and patents (see chapter 4, sections 4.2 and 4.3).

The above proposed procedure for populating the EIGR can be resumed as follows:

I) classify research and knowledge products (papers, reports, projects, maps etc.) into the five overarching categories of the Societal Challenges, Operational Actions and Research Topics, and identify appropriate keywords under the overarching categories, for detailed classification into the HRC-SYS (CUBE);

II) by using the research and knowledge classification criteria cited under i) and described in chapter 4.1, place the resource in the correct place inside the four peer review/quality assurance classes in the EIGR;

iii) identify the assessment criteria for future evaluation of groundwater research trends and gaps, by using the other proposed indicators.

The EIGR is intended to be used in different ways, addressing multiple user tasks. It is possible to populate the catalogue by the insertion of groundwater related research and knowledge by the EFG National Experts (Third Parties). During and after the project, the information stored in the catalogue can be consulted by individuals/organizations dealing with groundwater research and also by non technical users. At the final stage of this activity, the EIGR together with the HRC-SYS will allow in-depth data analysis for the identification of trends, challenges and gaps in groundwater research and knowledge, as a supplement to analyses that can be made within professional research analysis tools such as Scopus/SciVal and Web of Science/InCites.

This approach will be useful to drive and fit future activities on groundwater research using the classification adopted within this Project. It will make it possible to directly identify and compare the actual research gaps, to exploit the existing synergies and to foster new research.

3.2 Resource types for population of EIGR

This section describes the resource types to be populated in the EIGR at the intersections of the five Operational Actions (OA) and Research Topics (RT) for each of the five overarching Societal Challenges (SC), as developed and described in the HRC-SYS classification system (chapter 2 and D1.2).

The resource types for the population of the EIGR are typically public metadata about research projects and peer reviewed publications (research *sensu stricto*) as well as general knowledge, which does not qualify as research *sensu stricto* (i.e. they have no peer reviewed papers like in Web of Science and Scopus ranked journals), but which still may provide important high quality information and data in e.g. research reports with or without quality assurance. Hence, the EIGR will be populated by scientific papers/articles, proceedings, books/book chapters, information on scientific or applied projects, including databases, reports, maps and information metadata. As previously mentioned, the actual data or publications are not stored, but rather the metadata describing the type of information (for instance, a paper/report/map/database), and if possible with a link to where the information can be retrieved.

The EIGR will contain different type of documents characterised as either research or knowledge and by the extent of quality assurance (QA). Quality assurance can be in the form of peer reviews conducted before publication in Web of Science and Scopus ranked journals, and thus easily searchable by search engines like Web of Science and Scopus (and to a lesser extent Google Scholar). This information belongs to the highest class of research (Class-1). Information that can be searched by the aforementioned search engines within the category “all documents”, but which is not peer reviewed in the strict sense of ISI, is still classified as research, but is belonging to the second category of research (Class-2). Examples are conference proceedings, book chapters, presentations or posters, all of which have been reviewed before being accepted, but not by the strict article peer review method with several independent reviewers. The other main class is adopted under the name ‘Knowledge’ (as opposed to ‘Research’). This class (Class-3) may contain information, which has been quality assured in some way, either internally, within research institutes (in-House), or externally. This type of information cannot be found by scientific search engines like WoS or Scopus, but could be found in Google Scholar or just by ‘googling’ information. Examples here are reports, usually but not necessarily in the English language, book chapters, and other documents. Finally, there is information which has not undergone any QA process. This class (Class-4) is everything that is not within the Class-1, Class-2 or Class-3 categories. Examples here are reports, many of which in the national language, data descriptions (but not the data itself) and the like.

The information about the research/knowledge product will be stored in the EIGR as *Metadata*, to be searchable using tags according to the HRC-SYS. In Chapter 5 practical help is provided in the use of the EIGR.

4. Criteria for classification of research, knowledge and innovation

As stated in the KINDRA workplan, in addition to the definition of the HRC-SYS, a set of indicators is required to allow the evaluation of the outputs and performance of research activities. The indicators are necessary to provide an objective evaluation, based on general criteria widely adopted in research and innovation classifications. Firstly, a Quality Assurance evaluation has to be adopted to distinguish "research" and "knowledge" by means of the review received by the products to be classified (see previous 3.2 and 4.1). Bibliometric indicators as citations will be also considered to evaluate the performances of the classified products. In addition, other indicators like Technology Readiness Level (TRL), grants received, number of patents and awards received are useful for evaluate the outputs and they are included in the EIGR (see 4.2 and 4.3).

Differently from the Quality Assurance evaluation and from indicators as TRL and patents, which have to be specified when a record is placed into the EIGR, bibliometric indicators will be considered during the following phase of trend and gap analysis (WP3), by the help of existing tools as WoS/InCites, Scopus/SciVal and Google Scholar are tools that are anticipated to be useful at a later stage in KINDRA.

4.1 Classification of 'research' and 'knowledge' based on the degree of Quality Assurance

As mentioned before (see 3.2), research and knowledge are classified and identified mainly by the use of Scopus and Web of Science: peer reviewed (i.e. research papers) and not peer reviewed but otherwise quality assured. The latter category includes research information which cannot be retrieved from WoS and Scopus.

A. Research: Peer- reviewed papers (research articles) and NON peer-reviewed papers (book chapters, proceedings etc.), classified as Class-1 and Class-2 ;
B. Knowledge: Reports and papers and other sources of knowledge that are not searchable in Scopus or WoS. The documents could be reviewed (internally or externally), and then characterized by some quality assurance standard, adopted at national or international scale, or not reviewed (grey literature). Information which has not been subject to any review still may contain useful information and data for the groundwater community, and consequently has to be analysed and included in the EIGR.

The classification described above is resumed in Figure 4.1 below.

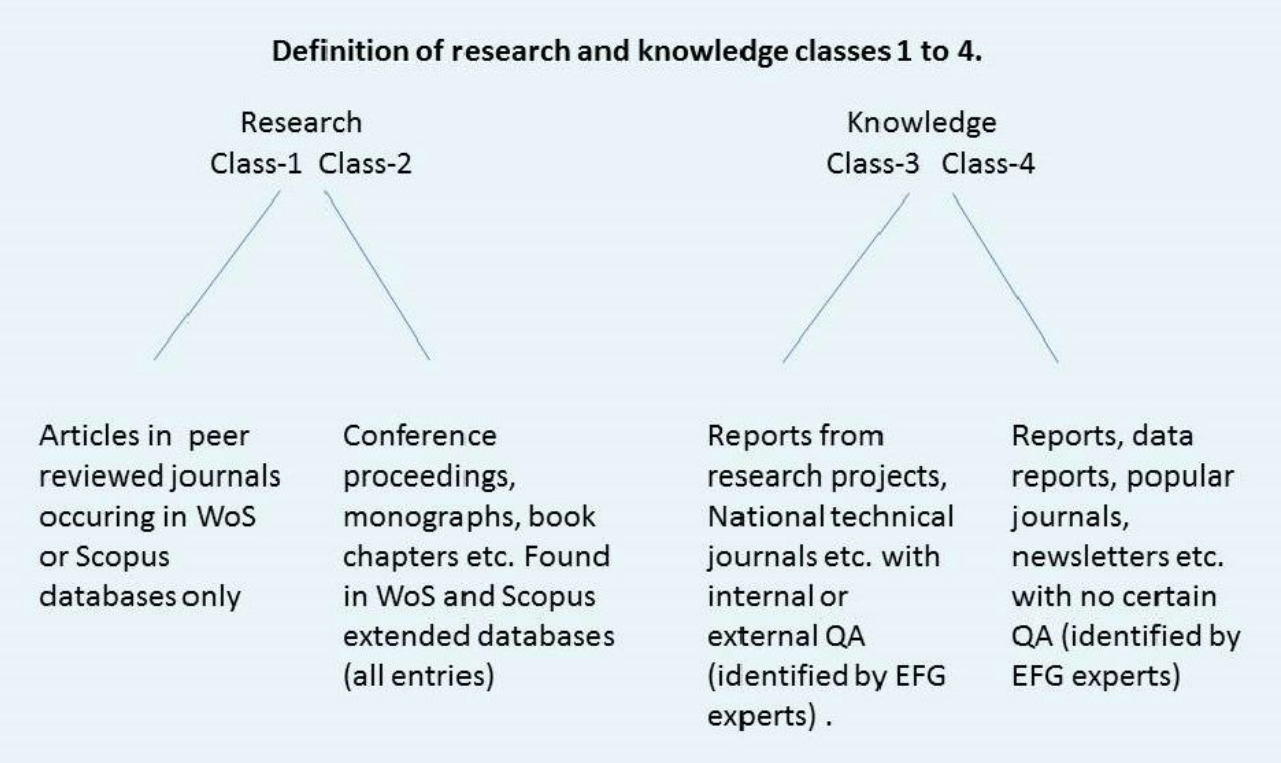


Fig. 4.1. *Research and Knowledge classes in EIGR based on extent of peer review/Quality Assurance.*

The type of documents that will be considered for the population of the EIGR are, to resume: papers, proceedings, books/book chapters, projects, maps, databases, reports. It can include peer-reviewed papers and non peer-reviewed papers (both searchable in WoS/Scopus) and non peer-reviewed not searchable in WoS/Scopus, but to some degree quality assured by internal or external review. Finally there is a group (Class-4) not in the previous groups (Class-1,2,3), including reports in English or national languages which have not been subjected to any formal quality assurance, but contain relevant information in the context of KINDRA, see also section 3.2.

Maps archives, as well as the research projects, are considered part of Class-2 Research. The papers related to such project if reviewed will be found both in Knowledge (Class-3) and in Research (Class-1 and 2) as metadata in the Project (national or international) label.

The applied concept of Knowledge and Research classification can be captured in the table 4.1 below.

NOTE! Both Google Scholar and the EIGR contain information about all types of groundwater research and knowledge, however, the two databases will not contain the same information and hence they will supplement each other.

***Table 4.1**. Research and knowledge classes in the different databases*

	Google Scholar	Scopus		Web of Science		EIGR
		Document type: 'all'	Document type: 'Article'	Core Collection (Advanced search - 'all document types')	Core Collection (Advanced search - 'articles')	
(1) Research	Class-1,2	Class-1,2	Class-1	Class-1,2	Class-1	Class-1,2
(2) Knowledge	Class-3,4	Class-3	None	Class-3	None	Class-3,4

Legend: Class-1) Research: Peer-reviewed papers (in woS or Scopus) (HQA); Not peer-reviewed papers, Class-2, (Books, Proceedings and others searchable in WoS or Scopus) (HQA); 2) Knowledge: Quality assured papers, Class-3, (not in WoS or Scopus); Reviewed papers (QA); Not reviewed papers, Class-4; Projects; Maps archives; others.

4.2 Indicators for Technology Readiness Level (TRL)

Technology Readiness Levels (TRL) is a classification method for estimating technology maturity of Critical Technology Elements (CTE) of a program during the acquisition process (DOE G 413.3-4A 9-15-2011), to be considered as an indicator of innovation. TRLs are based on a scale from 1 to 9 with 9 being the most mature technology. The use of TRLs enables consistent, uniform, discussions of technical maturity across different types of technology. For this reason, it has been adopted as an additional standard indicator of quality, supporting comparison with other TRL categories in groundwater science within the scope of KINDRA.

TRL is included in the HORIZON 2020, WORK PROGRAMME 2014-2015 General Annexes, (Extract from Part 19 -Commission Decision C(2014)4995) (H2020/WP2014-2015). All H2020 projects must consider the TRL indicator. Where a topic description refers to a TRL, the following definitions apply, unless otherwise specified:

- TRL 1: basic principles observed
- TRL 2: technology concept formulated
- TRL 3: experimental proof of concept
- TRL 4: technology validated in lab
- TRL 5: technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 6: technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 7: system prototype demonstration in operational environment

- TRL 8: system complete and qualified
- TRL 9: actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space).

According to the EC practice:

- Level 1-3 corresponds to the research phase;
- Level 4-5 corresponds to the technology development phase;
- Level 6-7 correspond to the prototype and testing phase;
- Beyond level 7 is very close to market and commercialisation.

To include these indicators, each entry related to research and knowledge populating the EIGR has to be identified by a corresponding level of TRL.

4.3 Groundwater patents indicator

Based on existing groundwater patent indicators the KINDRA gap analysis may identify knowledge gaps needed for obtaining more patents within EU. For this reason, existing patents connected with research have to be identified when adding information to the EIGR.

The EC (Eurostat) uses the PATSTAT database and its classification system. The Europa Patent Office works with PATSTAT, also known as the EPO Worldwide Patent Statistical Database, which is a snapshot of the EPO master documentation database (DOCDB) with worldwide coverage. It contains more than 20 tables of bibliographic data, citations and family links of 90 million applications of more than 80 countries.

PATSTAT uses the International Patent Classification, IPC. IPC being a means for obtaining an internationally uniform classification of patent documents, has as its primary purpose maintaining an effective search tool for the retrieval of patent documents by intellectual property offices and other users, in order to establish the novelty and evaluate the inventive step or non-obviousness (including the assessment of technical advance and useful results or utility) of technical disclosures in patent applications.

The classification, furthermore, has the important purposes of serving as:

(a) an instrument for the orderly arrangement of patent documents in order to facilitate access to the technological and legal information contained therein;

(b) a basis for selective dissemination of information to all users of patent information;

(c) a basis for investigating the state of the art in given fields of technology;

(d) a basis for the preparation of industrial property statistics which in turn permit the assessment of technological development in various areas.

Further assistance in the use of the Classification is provided on the WIPO IPC website (www.wipo.int/classifications/ipc/); details about the classification structure are included in Appendix B.

Initial searches have been provided for the main keywords related to KINDRA aims. For instance, searching for Groundwater in the WIPO IPC website, only one patent has been found (pat: C02F 103/06, Contaminated groundwater or leachate [2006.01]), as reported below:

Section: C. CHEMISTRY

Class: C02. TREATMENT OF WATER, WASTEWATER, SEWAGE, OR SLUDGE

Subclass: C02F. TREATMENT OF WATER, WASTEWATER, SEWAGE, OR SLUDGE (processes for making harmful chemical substances harmless, or less harmful, by effecting a chemical change in the substances A62D 3/00; separation, settling tanks or filter devices B01D; special arrangements on vessels of installations for treating water, wastewater or sewage, e.g. for producing fresh water, B63J; adding materials to water to prevent corrosion C23F; treating radioactively-contaminated liquids G21F 9/04)
Group: C02F 103/00. Nature of the water, waste water, sewage or sludge to be treated [2006.01]
Subgroup: C02F 103/06. Contaminated groundwater or leachate [2006.01]

By other preliminary searches, the following results have been obtained:

- searching for Hydrogeology, no results have been found in the existing database.
- searching for Water pollution, one patent in the section B PERFORMING OPERATIONS; TRANSPORTING; six patents in the section E FIXED CONSTRUCTIONS; and one patent in the section G PHYSICS, have been found.
- searching for the wider field of Water, many patents in the section A HUMAN NECESSITIES, especially in AGRICULTURE, and in B PERFORMING OPERATIONS; TRANSPORTING, have been found.

5. EIGR: concepts of an online Data Catalogue

The EIGR is being developed through the use and modification of the Open Source platform GeoNetwork (http://geonetwork-opensource.org/). It is being tailored to the specific needs and requirements of the KINDRA Project, in order to be able to properly serve as an Online Data Catalogue (EIGR). The resources identified by the user community, who will cooperate in its testing phase throughout 2016, will be included in the EIGR repository by completing a metadata template drafted from the ISO 19139 multilingual template, as it contains the most fitting model according to the project's cataloguing purposes.

As mentioned earlier, the EIGR will not contain data itself, but metadata of research efforts and topic related knowledge deliverables (scientific reports, articles, projects, maps, databases, etc...) illustrating and providing links to research efforts carried out through Europe since 2000, indicating where they can be found, and at the same time allowing their classification according to the adopted classification system for groundwater research HRC-SYS.

This will be done by completing information requested by the EIGR Online Data Catalogue which, on one hand will be dedicated to detailing the contents according to the resource background (brief summary, acknowledgements from contributing parties and programs, funding sources, reference dates, geographical extension or area of influence, etc.) while on the other it will request information which complies with the HRC-SYS (defining the overarching categories, associating and identifying specific keywords which have been listed and organized according to the merged list of keywords selected for classification).

For the population process of the EIGR Online Data Catalogue according to the premises listed above, these lines will serve to set the basic support for the development of the data exploitation application and tools. All the efforts are carried out in order to follow the classification model defined by the HRC-SYS and its 3D CUBE classification representation.

The KINDRA EIGR is a data catalogue based on Geonetwork 2.10.4. To have access to the KINDRA EIGR a user will require a username and password, which will be provided upon registration through the KINDRA Project website www.kindraproject.eu

5.1 Requirements for guidance

This section describes what to include and how populate the Database in general terms. A more specific guidance for populating the Inventory is described by the deliverable D1.5, which illustrates the content of the help-on-line of the EIGR.

Metadata describe the contents, the quality, the format and other characteristics linked to specific resources allowing users to properly identify precise information and services available as well as on how to locate them.

They provide the answers to the basic questions, Who, What, When, Where, Why and How providing users with the characteristics of the resources registered in a catalogue. They provide information concerning:

- The title and overall description of the resources;
- The purpose of the resources and their usefulness;
- The date of creation of resource and, whenever applicable, the update process it is subject to;
- The geographical extension of the resource;
- The owner of the resource;
- The criteria and constraints, or restrictions, that applies to their use and exploitation;
- The quality of the resource.

With all this information, users have further access on the data available and are able to locate and select resources which are more suited to their needs and requirements. This allows for a more efficient exploitation of the resources and the information they contain or provide.

The purpose for creating metadata is to organize and maintain the information created by institutions; they seek to promote the availability and use of data.

When resources are published by means of a data catalogue, it provides other organizations the opportunity to find, use and add to the information; it allows them to identify other organizations with which they can share information, share the efforts of maintaining information and develop clients for users to be able to access and use the information in a more efficient manner.

Metadata should always accompany a resource as they provide information for accessing and obtaining it and making it interoperable. They help users and organizations in better processing, interpreting and storing data in their own internal registers.

Metadata and the application of metadata are the responsibility of who create the resources, of who provide the resources and of the users of the resources.

The information inserted in the EIGR must be as complete as possible, as this will allow the search engines and future user consultations to carry out thorough information analysis. The EIGR will serve as a repository of this knowledge, functioning as a tool that will allow for queries and searches to be carried out by selecting keywords, generating statistics, diagrams and other functions to help support the exploitation of the catalogued information.

The EIGR offers two possibilities for browsing the catalogue; one of which is the default viewer in HTML5 (Fig. 5.1), which all users find when accessing the catalogue through the following address:

http://kindra.kindraproject.eu:8080/geonetwork/srv/eng/search

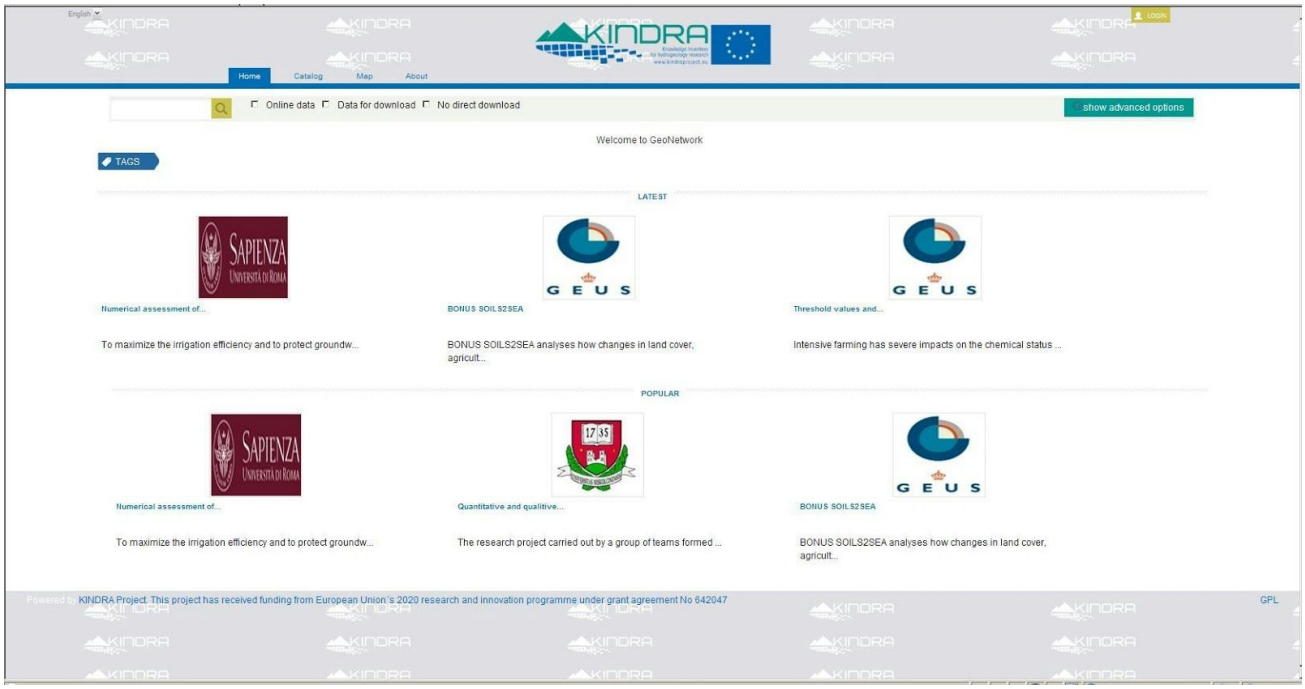


Figure 5.1. *Access page for browsing the EIGR by default viewer in HTML5*

The other option for viewing and browsing the catalogue is accessing the traditional Geonetwork interface (Fig.5.2). For users already familiar with the Geonetwork web catalogues you will recognize it immediately. When you access the catalogue's administration through the HTML5 view, it will switch to this one. It can also be accessed through the following address:

http://kindra.kindraproject.eu:8080/geonetwork/srv/eng/main.home

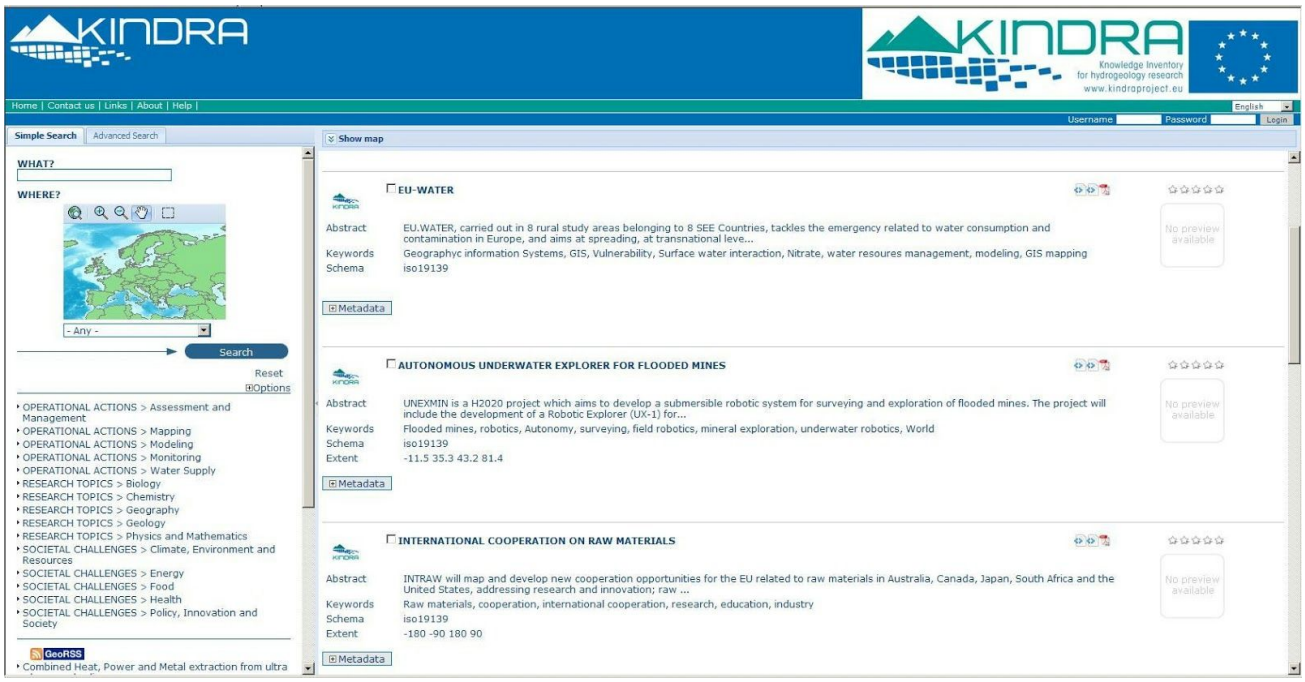


Figure 5.2. *Access page for browsing the EIGR by the traditional Geonetwork interface*

5.2 Populating the EIGR Online Data Catalogue

The inclusion of resources into the EIGR is carried out by completing a template, which has been tailored to the requirements of the KINDRA Project and according to the items discussed by the HRC-SYS. The template consists of a number of fields which are to be filled out by users.

The EIGR Metadata template is divided into four Main Sections:

1. RESOURCE IDENTIFICATION INFORMATION: The section where users will be able to find or report specific information related to the resource uploaded to the Online Data Catalogue, depending on whether they are browsing or populating the EIGR. It will include information concerning the title, acronym (when applicable), abstract, the authors and their contact details, collaborating organizations and/or programs, funding sources and amount, geographical extent covered as well as other relevant identification details (e.g. ISBN, ISSN) and if there are any existing legal constraints related to the resource. At the same time, in this section is where the HRC-SYS keywords and overarching categories (within Societal Challenges, Operational Actions and Research Topics) are defined for each resource.

2. DISTRIBUTION INFORMATION: The section will indicate users the delivery or distribution methods available for the resource which is included in the EIGR. At the same time, it is where any user who is uploading a resource to the EIGR describes if there are any online or physical distribution methods existing for the resource. Contents distributed online may be downloadable.

3. DATA QUALITY INFORMATION: Following the HRC-SYS criteria which have been defined by KINDRA, this section will serve to classify the resources according to the quality assurance criteria KINDRA has adopted by distinguishing “research” and “knowledge” resources, by identifying if they belong to the RESEARCH category and are peer reviewed (i.e. research papers) or not peer reviewed (book chapters, proceedings etc.) but otherwise quality assured, or if they belong to the KNOWLEDGE category (reports, papers and other sources of knowledge that are not searchable in Scopus or WoS but could be reviewed and characterized by some quality assurance standard, adopted at national or international scale, or not reviewed). This is detailed in the lineage and by specifying in each cases, when available, the process to which the resource has been subject to and specific dates.

4. METADATA INFORMATION: Here is where the references will be detailed concerning the person or organization responsible for uploading a specific resource to the EIGR Online Data Catalogue, such as the contact email, telephone, organization website.

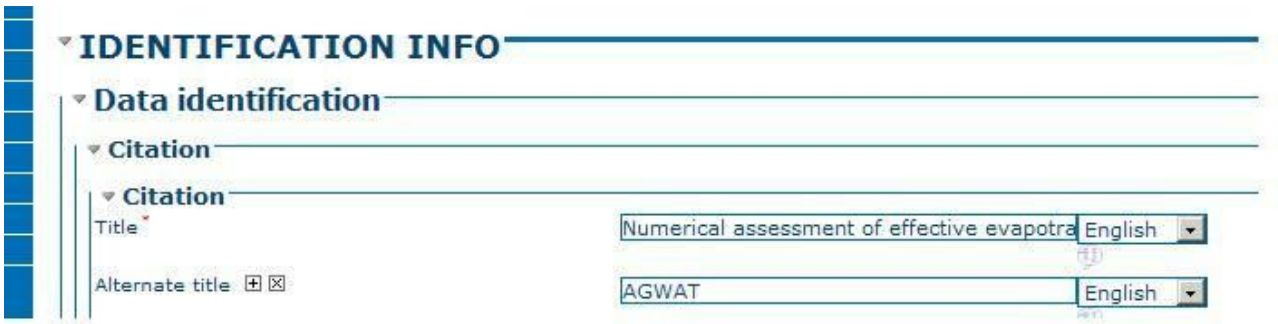
Each one of these sections in turn is also subdivided into different fields or tags which define the level of detail for the content which is being included, where the fields or tags marked with a * indicate that it is mandatory for them to be completed. Below the list of fields to be inserted for each record is listed, among the four Main Sections cited before.

Some examples of records filled in the EIGR are provided in Appendix C.

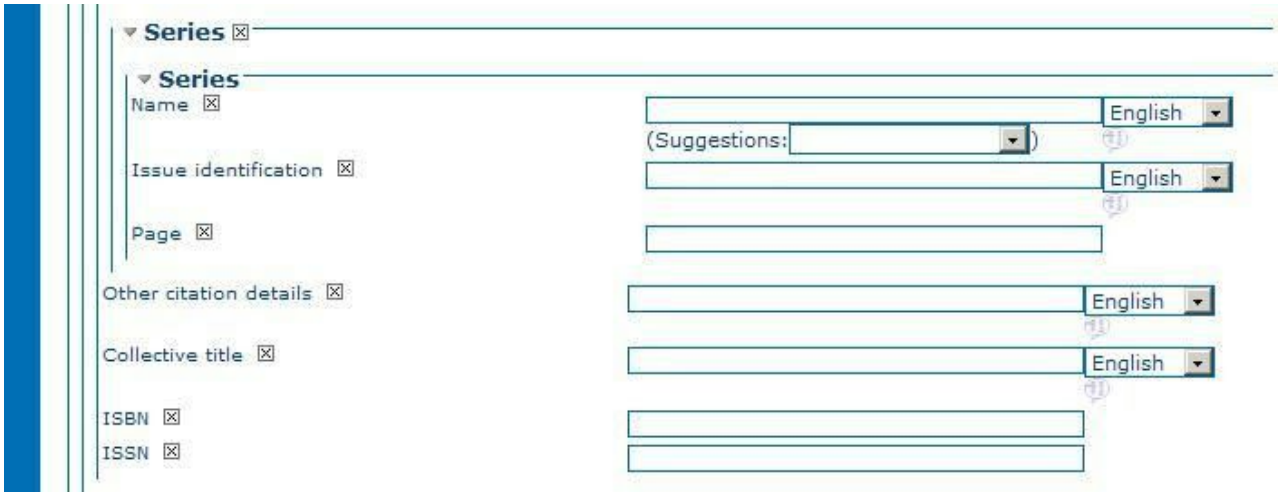
5.2.1 RESOURCE IDENTIFICATION INFORMATION

This section details the basic information of the resources uploaded to which the metadata applies, and this will be according to the following fields, all of which will not be mandatory but rather dependent on the type resource uploaded to the EIGR. The HRC-SYS (CUBE) selection, both for keywords and overarching categories, is due into this section.

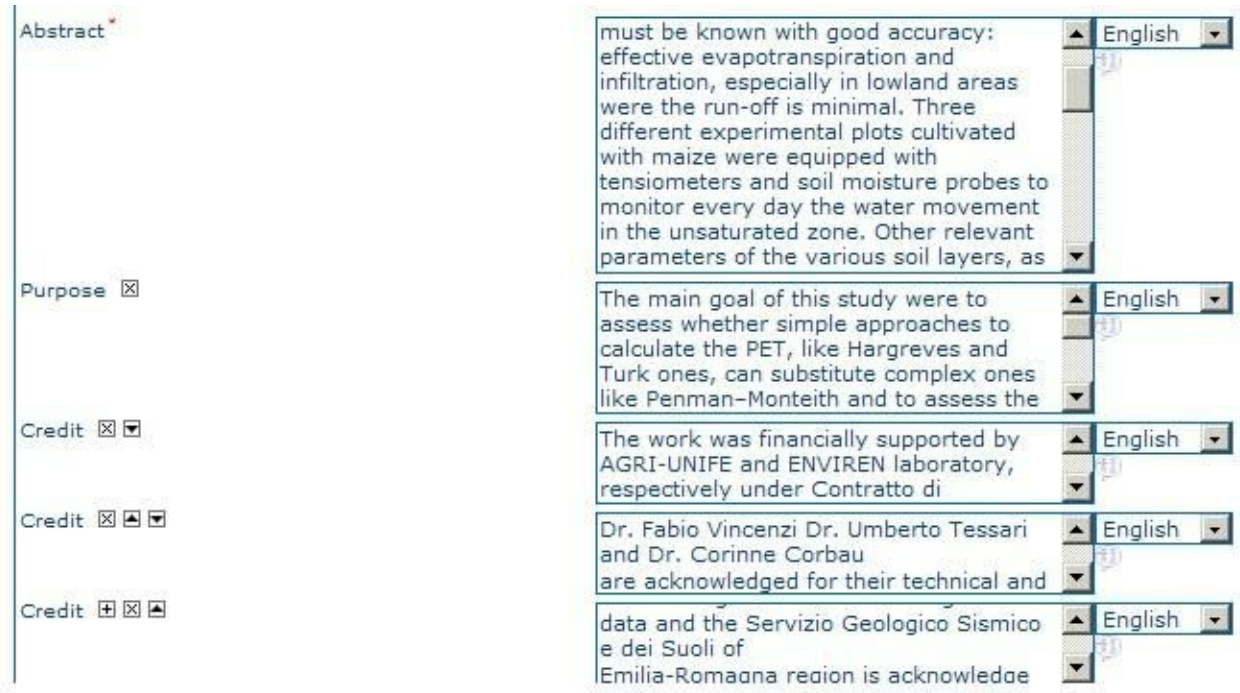
Title*: (Name by which the resource is known)
Alternative Title: (Acronym)
Date - creation*: (Reference date of creation of the resource)



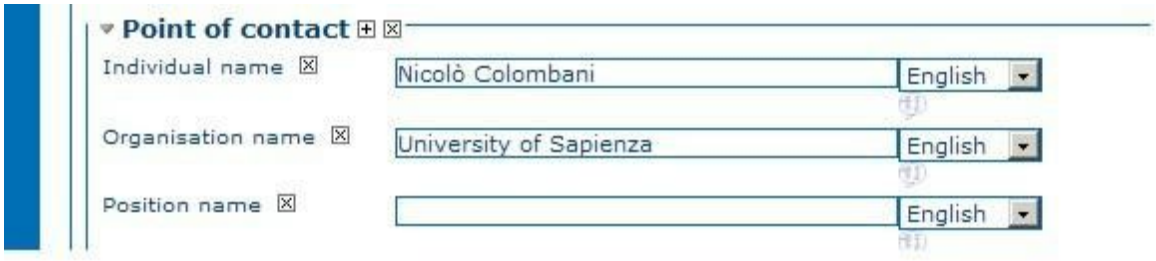
Series: (Information concerning the series or collection to which the resource belongs to.)
Name: (Name of the series or collection to which the resource belongs to.)
Issue identification: (Issue of the series or collection to which the resource belongs to.)
Page: (Details on which pages of the publication the resource was published.)
Collective title: (Title of the collective series or collection to which the resource belongs to.)
ISBN: (International Standard Book Number.)
ISSN: (International Standard Serial Number.)



Abstract*: (a brief narrative summary of the content of the resource)
Purpose: (Purpose for which the resource was created)
Credit: (Recognition of the organizations or programs who contributed to the resource and/or are responsible for funding, amount of funding or total budget. The field may be included as many times as may be required according to the amount of existing organizations)



Point of contact: (Identification of the person and organization responsible of the resource)
Organization's name*:
Contact's position:

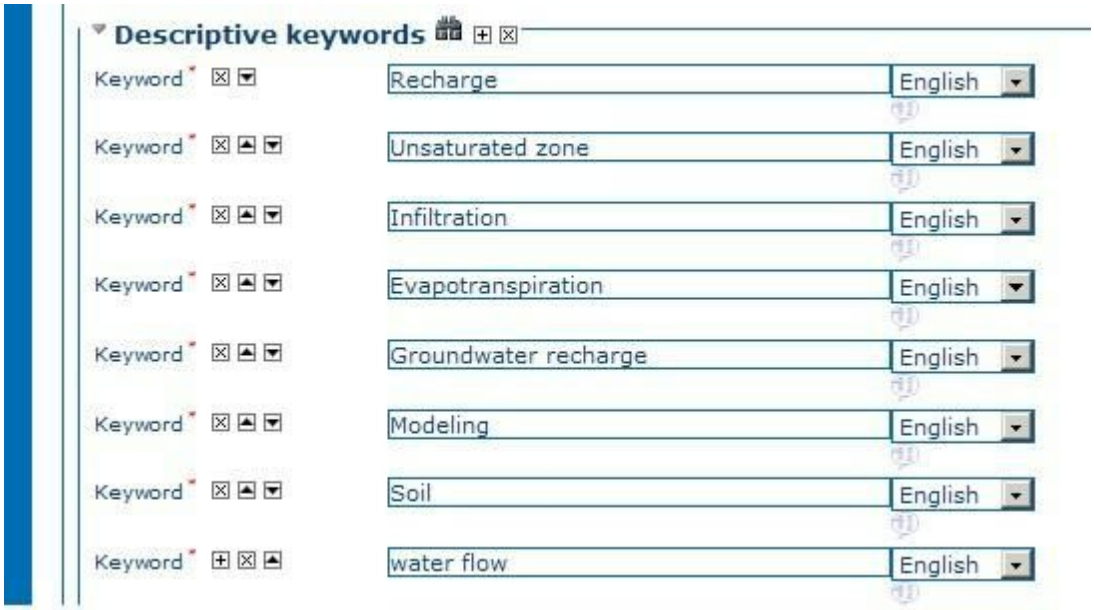


Contact information: (Phone and/or Fax numbers)
Address: (Street, City, Administrative area, Postal code, Country)
e-mail address:

Descriptive Keywords*: (The keyword value is a commonly used word, formalized word or phrase used to describe the subject. They help narrowing a full text search and allow for structured keyword search)

NOTE! Insertion of keyword is mandatory and it drives the allocation of the record into the subcategories of the HRC-SYS. Consequently, it is recommended to carefully choose the keywords,

from the selected list (see Appendix 1); nevertheless, adoption of new keywords not included in the Appendix 1 will be possible if necessary.



Resource constraints: (Provides information about constraints that apply to the resources)
Legal constraints: (Restrictions and legal prerequisites for accessing and using the resource or metadata)
Use limitations: (Limitation affecting the fitness for use of the resource, for example if it is not apt to be employed for further research efforts due to specific conditions)
Access constraints: (Restrictions to assure the protection of privacy or intellectual property, and any special restrictions or limitations on obtaining the resource: License, Patent, Pending Patent, restricted, Trademark, Copyright)
Use constraints: (Restrictions to assure the protection of privacy or intellectual property, and any special restrictions or limitations on using the resource: License, Patent, Pending Patent, restricted, Trademark, Copyright)
Other constraints: (Other constraints or legal prerequisites for accessing and using the resource)

Topic categories*: These are the overarching categories defined by the HRC-SYS: Societal Challenges (SCs), Operational Actions (OAs) and Research Topics (RTs). It is mandatory to classify the record individuating at least one main SC, one main OA and one main RT. This classification will help group and search through all the available resources included in the EIGR.

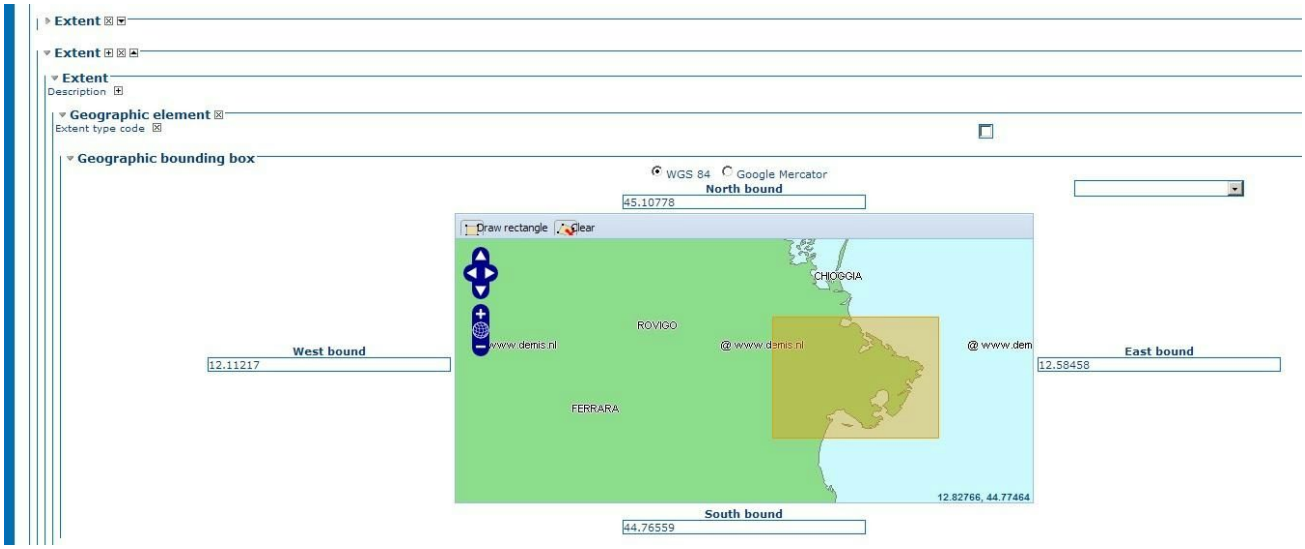
It is understood that there can exist overlaps between these general categories and users are encouraged to select the most appropriate and relevant ones. If the uploaded work relates to, e.g. more than one societal challenge, the rapporteur decides which category is most important and reports them as the main one. However, he/she should also list the other SCs of relevance. It is encouraged to add other relevant SCs when appropriate, taking into account the very significant societal involvement of groundwater resources. If for instance, a project primarily on climate change impacts on groundwater also has relevance and/or overlaps with other SCs such as food and geo-energy, the Societal Challenges should be listed as follows: SC5 (climate change, environment and resources) are reported as the main SC, while the societal challenges SC2 (food) and SC3 (geo-energy), are listed as additional subordinate SCs.

This selection must be done at least individuating one of each of the overarching categories (SCs, OAs and RTs). In all cases in addition to a main overarching category, other categories are encouraged to be included as subordinated.

Extent: (Spatial reference of the resource)
Geographic Element: (The geographic component of the extent referring to the resource)
Geographic bounding box: This is the geographic position of the resource given as a bounding box where the following items can be specified:

West longitude:
East longitude:
North latitude:
South latitude:

Supplemental information: (Any other descriptive information regarding the resource location or area)



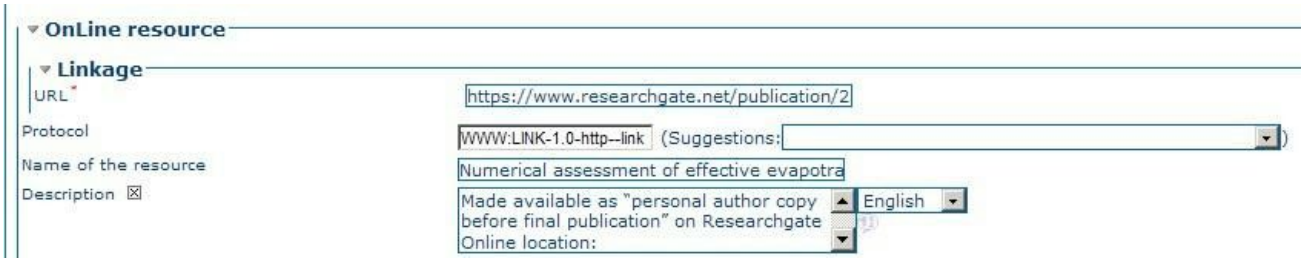
5.2.2 DISTRIBUTION INFORMATION

This section serves to provide information about the distributor of the resource and the options for obtaining it.

Distribution format: (Provides a description of the format of the data to be distributed)
Format*: (Description of the availability of the resource, be it either a file, message, storage device or transmission method)
Name*: (name of the data transfer format)
Version*: (version of the format)

Online resource: (defines the online sources or link(s) from which the resource can be obtained)
Linkage: (Location (address) for online access using a Uniform Resource Locator (URL) address)
Protocol: (Connection protocol to be used)

Name of the resource
Description: (Detailed text description of what the online resource is/does)



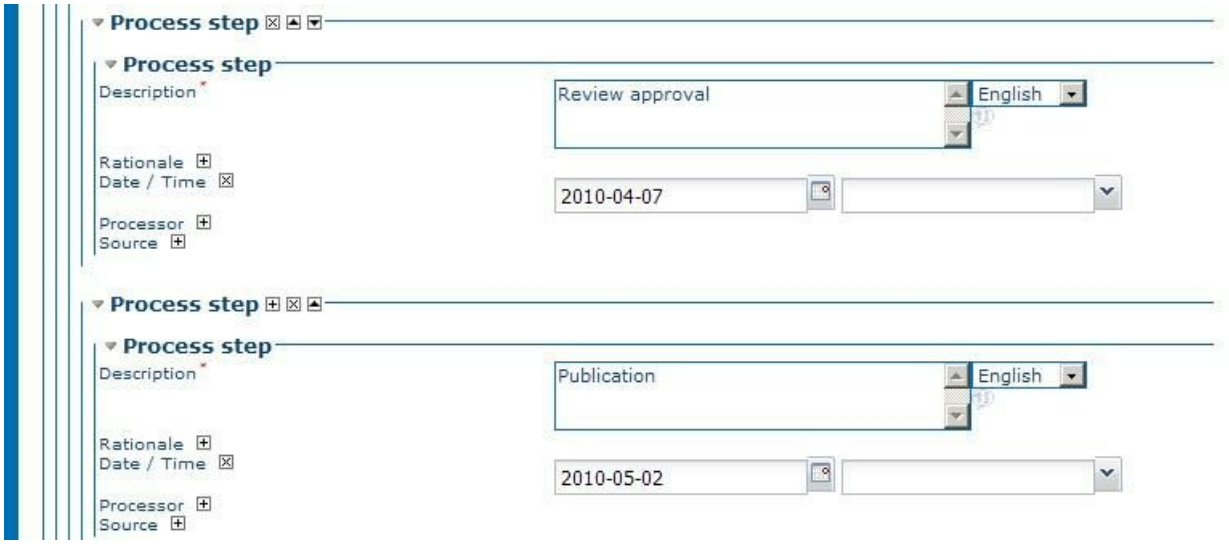
5.2.3 DATA QUALITY INFORMATION

This section provides an overall assessment regarding the quality of the resources uploaded into a data catalogue, primarily by classifying the work according to the quality assurance of the uploaded work (papers, reports, maps etc.).

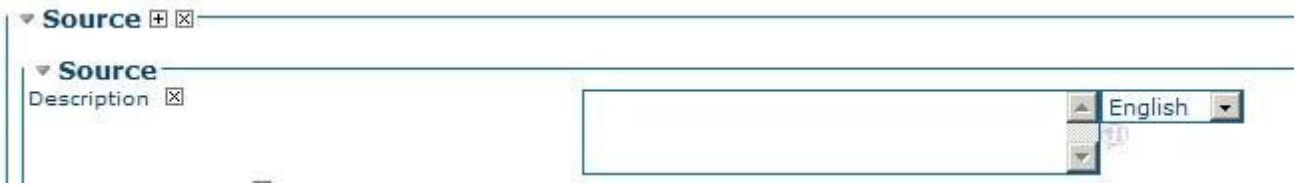
Hence, the rapporteur has to classify the uploaded resources according to the four classes of Quality Assurance, i.e. whether it has been through a peer review for a scientific journal etc., in order to classify research and knowledge categories, as described in chapter 4.

Lineage: (Information about the events and procedures to which the resource was subject)
Statement: (generic description from the resource producer's knowledge concerning the lineage)

Process step: (Information concerning a specific event in the creation process of the resource)
Description: (Detailed text description of the process step)



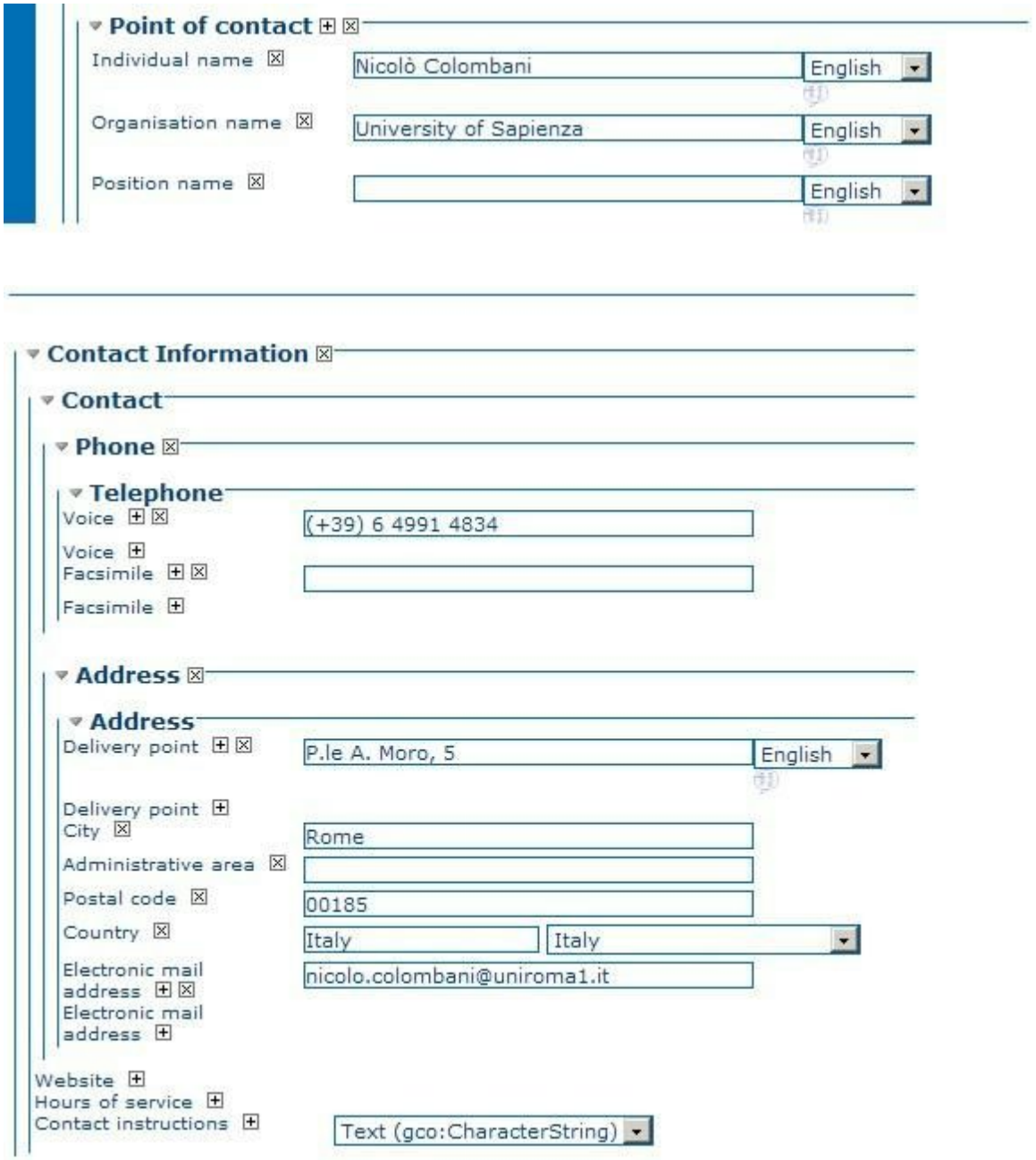
Source: (Information about the source data employed in creating the resource)



5.2.4 METADATA INFORMATION

This section provides overall information concerning the metadata about the resource, i.e. about the people/organization who insert the record related to the research/knowledge product. The interface provides the exact same fields and tags to be completed, just as in the Resource Identification Information.

Contact: (Identification of the party responsible for the metadata information)
Individual name*
Organization name*:
Position name: (Role or position of the responsible person)
Role: (Function performed by the responsible party)
Contact information: (Phone and/or Fax numbers)
Address: (Street, City, Administrative area, Postal code, Country)
e-mail address:
Website:



6. References

DOE G 413.3-4A 9-15-2011: (http://www2.lbl.gov/dir/assets/docs/TRL%20guide.pdf)

(H2020 / WP2014-2015): https://www.google.com/url?q=http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/annexes/h2020-wp1415-annex-ga_en.pdf&sa=D&ust=1446451076918000&usg=AFQjCNEjsVlf6dcryGNx8tCZMppDywT4jg).

KINDRA D1.2: Harmonized Terminology and Methodology for Groundwater Research Classification. http://www.kindraproject.eu/wp-content/uploads/D1_2_HRCSYS.pdf

APPENDIX A: _ LIST OF KEYWORDS

1	Abstraction				
2	Adaptation				
3	Agriculture				
4	Airborne measurements				
5	Alluvial aquifer	or	alluvium aquifer		
6	Ammonium				
7	Analytical solution				
8	Aquatic ecosystem				
9	Aquiclude				
10	Aquifer				
11	Aquifer vulnerability				
12	Aquitard				
13	Arid region				
14	Arsenic				
15	Artesian				
16	Artesian water				
17	Artificial recharge	or	managed aquifer recharge		
18	Asia				
19	Assessment				
20	Australia	or	New Zealand		
21	Baseline				
22	Biological status				
23	Biology				

24	Bioremediation				
25	Borehole logging	or	Well logging	Or	Geophysical logging
26	Cadmium				
27	Capping				
28	Carbonate rocks				
29	Carbonatic aquifer				
30	Characterisation				
31	Chemical oxidation				
32	Chemical status				
33	Chemistry				
34	Chloride				
35	Chlorinated hydrocarbons				
36	Climate				
37	Climate change				
38	Coastal aquifer				
39	Coastal waters				
40	Compaction				
41	Conceptual model				
42	Cone penetration test				
43	Containment				
44	Contamination				
45	Coupled groundwater-surface water modelling				
46	Crystalline rocks				
47	Density dependent modelling				

48	Dependent ecosystem				
49	Deterioration				
50	Developing country				
51	Drinking water				
52	Drought				
53	Earthquake				
54	Ecohydrology				
55	Ecological status				
56	Ecology				
57	Ecoregion				
58	Ecosystem				
59	Ecotoxicology				
60	E-flow	or	Ecological flow	or	Environmental flow
61	Electrical conductivity				
62	Electromagnetic methods				
63	Emerging contaminants				
64	Energy				
65	Energy production				
66	Environment				
67	Environmental tracer				
68	Europe				
69	Excavation				
70	Extraction				
70	Farming				
71	Faults				

72	Floodplain				
73	Flood				
74	Flow				
75	Flow regime				
75	Food	or	Food Production		
76	Fracture				
77	Fractured rocks				
78	Geochemistry				
79	Geographic information systems	or	GIS		
80	Geography				
81	Geohazard				
82	Geology				
83	Geomorphology				
84	Geophysical methods				
85	Geophysic				
86	Geostatistic				
87	Geothermal Energy				
88	Governance				
89	Groundwater Age				
90	Groundwater body				
91	Groundwater dating				
92	Groundwater Directive				
93	Groundwater resources				
94	Hazard				
95	Health				
96	Heterogeneity				

97	Human health				
98	Human toxicology				
99	Hydraulic property				
100	Hydraulic parameter				
101	Hydraulic conductivity				
102	Hydrochemical modeling	or	Hydrochemical modelling		
103	Hydrochemistry				
104	Hydrogeological cycle				
105	Hydrologic cycle	or	Hydrological cycle		
106	Hydrology				
107	Incineration				
108	Indicator				
109	Industry				
110	Infiltration				
111	Innovation				
112	Integrated hydrological modelling				
113	Integrated management				
114	Integrated water resources management				
115	Intrusion				
116	Investigation well				
117	Island hydrology				
118	Karst				
119	Karst aquifer				
120	Laboratory experiment				

121	Laboratory measurement				
122	Land use				
123	Landfill	or	land fill	Or	dump site
124	Lead	or	Pb		
125	Legislation				
126	Management				
127	Mapping				
128	Marine waters				
129	Mathematics				
130	Matrix diffusion				
131	Measure				
132	Mercury				
133	Metals	or	Heavy metals		
134	Microbial processes				
135	Middle East				
136	Mining				
137	Mitigation				
138	Modeling	or	Modelling	or	Model
139	Monitoring				
140	Multiphase flow				
141	Multi-screen well				
142	Natural attenuation				
143	Natural background				
144	Nitrate				
145	Noble gases				
146	North America				

147	Numerical modeling	or	numerical modelling		
148	Organization				
149	Overuse	or	Over-use		
150	Paleohydrology				
151	Paleowater	or	Palaeowater		
152	Patent				
153	Permeability				
154	Permeable Reactive Barrier				
155	Pesticide				
156	Pharmaceutical				
157	Physics				
158	Physical conditions				
159	Policy				
160	Pollution				
161	Porosity				
162	Protection				
163	Pumping test				
164	Pump & Treat				
165	Qualitative monitoring network				
166	Quantitative monitoring network				
167	Quality				
168	Quantitative status				
169	Quantity				
170	Radon				
171	Rainfall	or	rain fall		

172	Recharge				
173	Remediation				
174	Remote sensing				
175	Removal				
176	Resources				
177	Review				
178	River Basin District				
179	River basin	or	catchment	or	watershed
180	River				
181	Runoff				
182	Russia				
183	Salinity				
184	Salinization				
185	Saltwater	or	salt water		
186	Saltwater intrusion modeling	or	Saltwater intrusion modelling		
187	Sand aquifer				
188	Sandstone				
189	Saturation				
190	Scale effect	or	Scaling effect		
191	Scarcity				
192	Shale gas				
193	Slug test				
194	Society				
195	Soil Vapor Extraction				
196	Solute transport				
197	Solute transport modeling	or	Solute transport modelling		

198	South America				
199	Stable isotopes				
200	Status				
201	Status assessment				
202	Storage				
203	Stygofauna				
204	Subsidence				
205	Sulphate	or	sulfate		
206	Surface geophysics				
207	Surface water interaction				
208	Survey				
209	Sustainable				
210	Sustainable water use				
211	Synthetic substance				
212	Technique				
213	Terrestrial ecosystem				
214	Territorial waters				
215	Tetrachloroethylene	or	perchloroethylene	Or	PCE
216	Threshold				
217	Tourism				
218	Tracer test				
219	Tracer				
220	Transboundary				
221	Transitional waters	or	estuary		
222	Treatment				
223	Trend				

224	Trichloroethane	or	TCA		
225	Trichloroethylene	or	TCE		
226	Unsaturated zone				
227	Urban areas				
228	Urban groundwater				
229	Volcanic aquifer				
230	Vulnerability				
231	Waste				
232	Waste disposal				
233	Water budget				
234	Water Framework Directive				
235	Water services				
236	Water supply				
237	Water table				
238	Wetland				
239	Yield				

APPENDIX B: _ IPC Layout of Classification Symbols

The complete classification IPC for patents includes 5 levels: Section; Class; Subclass; Group; and Subgroup. A complete classification symbol comprises the combined symbols representing the section, class, subclass and main group or subgroup, as follow:

1. Sections:

Section Symbol – Each section is designated by one of the capital letters A through H.

Section Title – The section title is to be considered as a very broad indication of the contents of the section. The eight sections are entitled as follows:

- A HUMAN NECESSITIES
- B PERFORMING OPERATIONS; TRANSPORTING
- C CHEMISTRY; METALLURGY
- D TEXTILES; PAPER
- E FIXED CONSTRUCTIONS
- F MECHANICAL ENGINEERING; LIGHTING; HEATING; WEAPONS; BLASTING
- G PHYSICS
- H ELECTRICITY

Within sections, informative headings may form subsections, which are titles without classification symbols.

2. Class:

Each section is subdivided into classes, which are the second hierarchical level of the Classification. Each class includes symbol and title, consisting of the section symbol followed by a two-digit number.

Example: H01 BASIC ELECTRIC ELEMENTS

3. Subclass:

Each class comprises one or more subclasses, which are the third hierarchical level of the Classification. Subclass symbol and title consists of the class symbol followed by a capital letter, completed by a title.

Example: H01S DEVICES USING STIMULATED EMISSION

4. Group:

Each subclass is broken down into subdivisions referred to as “groups”, which are either main groups (i.e., the fourth hierarchical level of the Classification) or subgroups (i.e., lower hierarchical levels dependent upon the main group level of the Classification).

Main Group Symbol and Title consists of the subclass followed by a one- to three-digit number, the oblique stroke and the number 00. The main group title precisely defines a field of subject matter within the scope of its subclass considered to be useful for search purposes. Main group symbols and titles are printed in bold in the Classification.

Example: H01S 3/00 Lasers

5. Subgroup

Each subgroup symbol consists of the subclass symbol followed by the one- to three-digit number of its main group, the oblique stroke and a number of at least two digits other than 00. The subgroup title precisely defines a field of subject matter within the scope of its main group considered to be useful for search purposes. The title is preceded by one or more dots indicating the hierarchical position of that subgroup. The subgroup title is often a complete expression, in which case it begins with a capital letter.

Examples: H01S 3/00 Laser

H01S 3/14 • characterised by the material used as the active medium

APPENDIX C: _ Examples of records filled in the EIGR

PEER REVIEWED RESEARCH EXAMPLE

THRESHOLD VALUES AND MANAGEMENT OPTIONS FOR NUTRIENTS IN A CATCHMENT OF A TEMPERATE ESTUARY WITH POOR ECOLOGICAL STATUS

No preview available

Abstract	Intensive farming has severe impacts on the chemical status of groundwater and streams and consequently on the ecological status of dependent ecosystems. Eutrophication is a widespread problem in lak...
Keywords	Nitrogen, Phosphorus, Threshold, Modelling, Status, Groundwater, Aquatic Ecosystem, World
Schema	iso19139
Extent	-11.5 35.3 43.2 81.4

Metadata | Create | Edit | Delete | Other actions | Owner: REDIAM

IDENTIFICATION INFO

Title

Threshold values and management options for nutrients in a catchment of a temperate estuary with poor ecological status

Abstract

Intensive farming has severe impacts on the chemical status of groundwater and streams and consequently on the ecological status of dependent ecosystems. Eutrophication is a widespread problem in lakes and marine waters. Common problems are hypoxia, algal blooms, fish kills, and loss of water clarity, underwater vegetation, biodiversity and recreational value. In this paper we evaluate the nitrogen (N) and phosphorus (P) concentrations of groundwater and surface water in a coastal catchment, the loadings and sources of N and P, and their effect on the ecological status of an estuary. We calculate the necessary reductions in N and P loadings to the estuary for obtaining a good ecological status,

which we define based on the number of days with N and P limitation, and the corresponding stream and groundwater threshold values assuming two different management options. The calculations are performed by the combined use of empirical models and a physically based 3-D integrated hydrological model of the whole catchment. The assessment of the ecological status indicates that the N and P loads to the investigated estuary should be reduced to levels corresponding to 52 and 56% of the current loads, respectively, to restore good ecological status. Model estimates show that threshold total N (TN) concentrations should be in the range of 2.9 to 3.1 mg l−1 in inlet freshwater (streams) to Horsens

estuary and 6.0 to 9.3 mg l−1 in shallow aerobic groundwater (27–41 mg l−1 of nitrate), depending on the management measures implemented in the catchment. The situation for total P (TP) is more complex, but data indicate that groundwater threshold values are not needed. The stream threshold value for TP to Horsens estuary for the selected management options is 0.084 mg l−1. Regional climate models project increasing winter precipitation and runoff in the investigated region resulting in increasing runoff and nutrient loads to the Horsens estuary and many other coastal waters if present land use and farming practices continue. Hence, lower threshold values are required in many coastal catchments in the future

to ensure good status of water bodies and ecosystems.

Development of methodology for the assessment of groundwater chemical status according to the Water Framework and Groundwater directives based on good status objectives for a groundwater associated aquatic ecosystem

European Regional Development Fund

North Sea Region and the Danish Council for Strategic Research

This article is an outcome of the EU Interreg

IVB project CLIWAT. It has been co-funded by the North Sea

Purpose	Development of methodology for the assessment of groundwater chemical status according to the Water Framework and Groundwater directives based on good status objectives for a groundwater associated aquatic ecosystem
Credit	European Regional Development Fund
Credit	North Sea Region and the Danish Council for Strategic Research
Credit	This article is an outcome of the EU Interreg IVB project CLIWAT. It has been co-funded by the North Sea Region Program 2007–2013 under the ERDF of the European Union, and supported by the Danish Strategic Research Foundation projects MONITECH (104-08-0050) and MAFIA / IMAGE (09-067259). We acknowledge Lauren Paige Seaby for linguistic assistance, and Dirk-Ingmar M¨uller-Wohlfeil for his constructive review, which improved the manuscript.

Status **Completed**: Production of the data has been completed

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		OnLine resource	www.geus.dk

Extent

Geographic bounding box

WGS 84 Google Mercator

North bound 81.40000

West bound -11.50000

East bound 43.20000

South bound 35.30000

DISTRIBUTION INFORMATION

Transfer options

OnLine resource **Interactive open access journal of the European Geosciences Union for the publication of original research in hydrology, placed within a holistic Earth system science context.**

DATA QUALITY INFO

Statement

This is a peer reviewed articled listed in the core article collections of both Web of Science and Scopus.

Data extracted from the National Danish Groundwater and Geology Database "Jupiter"

METADATA

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PEER REVIEWED RESEARCH EXAMPLE

NUMERICAL ASSESSMENT OF EFFECTIVE EVAPOTRANSPIRATION FROM MAIZE PLOTS TO ESTIMATE GROUNDWATER RECHARGE IN LOWLANDS

Abstract	To maximize the irrigation efficiency and to protect groundwater from agrochemical pollution, two variables must be known with good accuracy: effective evapotranspiration and infiltration, especially...
Keywords	Recharge, Unsaturated zone, Infiltration, Evapotranspiration, Groundwater recharge, Modeling, Soil, water flow
Schema	iso19139
Extent	12.11217267886532 44.76558991335419 12.584584788239596 45.107780219816526

No preview available

Metadata | Create | Edit | Delete | Other actions

Owner: REDIAM

IDENTIFICATION INFO

Title	Numerical assessment of effective evapotranspiration from maize plots to estimate groundwater recharge in lowlands
Alternate title	AGWAT
Date	2009-10-30
Date type	**Creation**: Date identifies when the resource was brought into existence
Presentation form	**Digital document**: Digital representation of a primarily textual item (can contain illustrations also)
Abstract	To maximize the irrigation efficiency and to protect groundwater from agrochemical pollution, two variables must be known with good accuracy: effective evapotranspiration and infiltration, especially in lowland areas were the run-off is minimal. Three different experimental plots cultivated with maize were equipped with tensiometers and soil moisture probes to monitor every day the water movement in the unsaturated zone. Other relevant parameters of the various soil layers, as hydraulic conductivity and water retention curve, were obtained in laboratory experiments, while boundary conditions, as precipitations, temperature and root growth, were obtained on site. Inverse modeling was performed using HYDRUS-1D to assess the degree of uncertainty on model parameters. Results showed a good model fit of water content and head pressure at various depths, in each site, using Penman–Monteith formula for daily potential evapotranspiration calculation, but poor fit applying the Hargreves and Turk formulas. Best performance of model fit was observed for S-shaped equation employed to simulate the root water-uptake reduction with respect to Feddes equation. The soil parameters uncertainty was limited and remained within analytical errors, thus a robust estimation of cumulative infiltration and evapotranspiration has been derived. This study points out that evapotranspiration is the most important variable in defining groundwater recharge for maize crops in lowlands.
Purpose	The main goal of this study were to assess whether simple approaches to calculate the PET, like Hargreves and Turk ones, can substitute complex ones like Penman–Monteith and to assess the variability of the groundwater recharge estimated with different PET formulas. The same assessment was performed for root water uptake reduction functions. In addition, simulations were run with minimum and maximum observed saturated hydraulic conductivities, to quantify its influence on groundwater recharge flux.
Credit	The work was financially supported by AGRI-UNIFE and ENVIREN laboratory, respectively under Contratto di Programma (Delib. CIPEn◦ 202) and PRIITT funds.
Credit	Dr. Fabio Vincenzi Dr. Umberto Tessari and Dr. Corinne Corbau are acknowledged for their technical and scientific support.
Credit	The Emilia–Romagna ARPA SIMC is acknowledge for the meteorological data and the Servizio Geologico Sismico e dei Suoli of Emilia-Romagna region is acknowledge for the pedological classification.

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Descriptive keywords	Recharge, Unsaturated zone, Infiltration, Evapotranspiration, Groundwater recharge, Modeling, Soil, water flow.
Access constraints	**Intellectual property rights**: Rights to financial benefit from and control of distribution of non-tangible property that is a result of creativity
Use constraints	**Intellectual property rights**: Rights to financial benefit from and control of distribution of non-tangible property that is a result of creativity
Other constraints	Limited access publication from Elsevier by subscribers or pay per view.

Extent

Geographic bounding box

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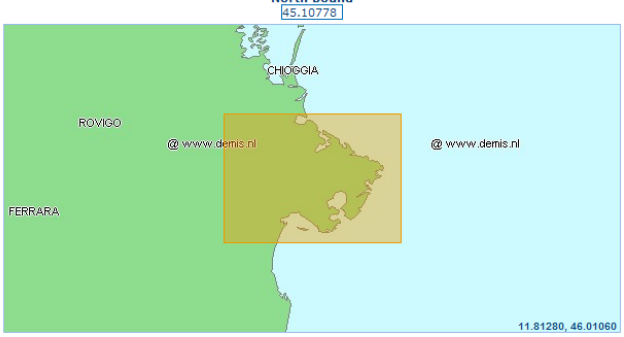

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East bound 12.58458

South bound 44.76559

DISTRIBUTION INFORMATION

Name	PDF

Transfer options

OnLine resource	Made available as "personal author copy before final publication" on Researchgate Online location:

DATA QUALITY INFO

Hierarchy level	**Dataset**: Information applies to the dataset
Statement	PEER REVIEWED
Description	Resource created
Date / Time	2009-10-30
Description	Resource submitted to review
Description	Review approval
Date / Time	2010-04-07
Description	Publication
Date / Time	2010-05-02

METADATA

File identifier	fbcb5f8f-0428-490f-97d4-07c3def16aca
Metadata language	English (Other language:French, German, Chinese(Other), Arabic, Spanish; Castilian, Russian)
Character set	**UTF8**: 8-bit variable size UCS Transfer Format, based on ISO/IEC 10646
Date stamp	2015-10-29T12:08:14
Metadata standard name	ISO 19115:2003/19139
Metadata standard version	1.0

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NON PEER REVIEWED PROJECT EXAMPLE

GEO.POWER

Abstract	GEO.POWER project is part funded by the Interreg IVC Programme. The Interregional Cooperation Programme INTERREG IVC, financed by the European Union's Regional Development Fund, helps Regions of Euro...
Keywords	Shallow geothermal energy, Action plan, Ground coupled heat pumps, Geothermal energy, OA D1.2.2 Extraction
Schema	iso19139
Extent	-11.5 35.3 43.2 81.4

Metadata | Create | Edit | Delete | Other actions — Owner: REDIAM

IDENTIFICATION INFO

Title
GEO.POWER

Abstract
GEO.POWER project is part funded by the Interreg IVC Programme. The Interregional Cooperation Programme INTERREG IVC, financed by the European Union's Regional Development Fund, helps Regions of Europe work together to share experience and good practice in the areas of innovation, the knowledge economy, the environment and risk prevention. EUR 302 million is available for project funding but, more than that, a wealth of knowledge and potential solutions are also on hand for regional policy-makers. The general objective of GEO.POWER project, 2 years long, is exchange best practices related to low enthalpy energy supply and - after a technical and cost/benefit assessment to evaluate the potential of reproducibility - to prepare the ground to the transfer some of the selected best practices within the Mainstreaming Programmes of the regions participating into the project during the current programming period 2007-13 as well as in the future regional framework instruments. The main results of the project are the development of one action plan per each involved region that provides an organized set of legal/regulatory, economical and technical / technical and best-technological proposals that-through the inclusion into the regional operation programmes, address long-term investments strategy for GCHP application at wide scale. On the basis of a pool of best practices on GCHP application developed in urban, rural and industrial sector, all partners and local delegation of experts & stakeholders go through an evaluation of the best practices reproducibility potential in each recipients region, according to technical, economical and environmental parameters, in order to design the optimum performance conditions for GCHP systems and the capacity to fit with the territorial context. The consequent preparation of the action plans and its inclusion into the Regional Operational Programmes could represent a milestone for the future introduction of massive GCHP investments in the concerned regions. A strong communication strategy aims at increasing awareness, improving knowledge and better understanding of the GCHP merit and benefits and push investments towards such green-economy.

Purpose
The specific objectives are listed as follow:

- investigation over the present status and future potential towards reducing greenhouses emissions and primary energy consumption / demand by spreading geothermal energy option in the regions involved in the project;

- evaluation of some of the most representatives best practice experienced all over Europe and analyses of their potential contribution/adaptation at local scale in line with EU environmental and sustainable energy legislation

- development of legislative, technical, economic and marketing initiatives and measures to address the introduction and/or spread of the heat pump techniques in the housing & industrial sector within every regional operational plans; and improvement of the expertise and capacity building of policymakers, local technicians & professionals by delivering training actions and by sharing knowledge based on the best practices under evaluation;

- realization of a broad promotional campaign addressing the awareness and attitudes of key public and private stakeholders and professional groups (e.g. energy agencies, technicians, representatives of the managing authorities, house-yards associations, chamber of commerce, urban planners etc..) towards the potentialities of GCHP as effective instruments to improve the local energy balance and reduce greenhouses emissions.

Credit
Funding body: Interreg –IVC European Regional Development Fund (ERDF)

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Extent

Geographic bounding box

WGS 84 | Google Mercator

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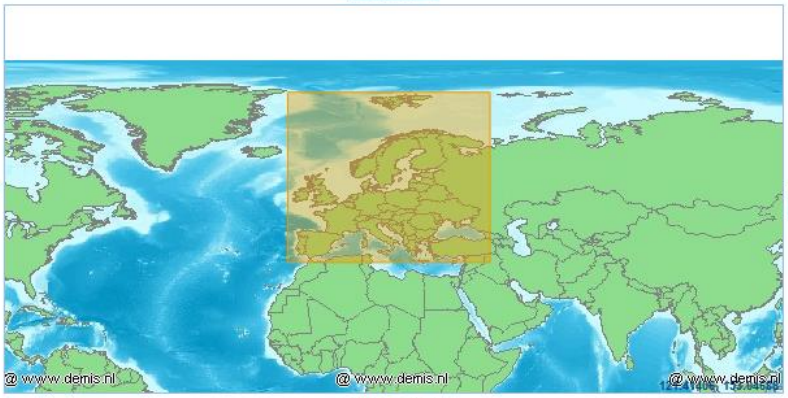
West bound -11.50000



East bound 43.20000

South bound 35.30000

DISTRIBUTION INFORMATION

Name: Regional strategies for the large scale introduction of geothermal energy in buildings regional answer for South East Europe

Transfer options

OnLine resource: **Regional strategies for the large scale introduction of geothermal energy in buildings regional answer for South East Europe**

Transfer options

OnLine resource: **http://www.geopower-i4c.eu/Objectives**

DATA QUALITY INFO

Statement: NON PEER REVIEWED

Source data. online data on climate surface water quality data (Environmental agency), soil maps (Geological survey).

METADATA

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RESEARCH PROJECT EXAMPLE

QUANTITATIVE AND QUALITIVE HYDROGEOLOGICAL STUDY OF THE ALLUVIAL AQUIFER OF SOMES-SZAMOS (ROMANIA-HUNGARY)

Abstract	The research project carried out by a group of teams formed by Belgium, Romanian and Hungarian partners, in the scope and supported by the NATO Science for Peace programme, was intended to develop co...
Keywords	Groundwater, numerical modeling, quality, quantity, alluvial aquifer, modelling, flow
Schema	iso19139
Extent	17.223455404534096 43.94677459692549 28.077947592033492 48.56153870949176

Metadata | Create | Edit | Delete | Other actions

Owner: REDIAM

IDENTIFICATION INFO

Title	Quantitative and qualitive hydrogeological study of the alluvial aquifer of Somes-Szamos (Romania-Hungary)
Alternate title	Project SQUASH
Date type	**Publication**: Date identifies when the resource was issued
Presentation form	**Digital map**: Map represented in raster or vector form
Abstract	The research project carried out by a group of teams formed by Belgium, Romanian and Hungarian partners, in the scope and supported by the NATO Science for Peace programme, was intended to develop common tools and guidelines for local end-users (water sully companies and regulatory authorities from Romania and Hungary) in order to be able to manage the groundwater quantity and quality. The project focused on improving the previous understanding of the groundwater conditions including flow and pollutant transport across many scales, using data acquisition techniques and computer simulation models.
Purpose	The development of the transboundary groundwater resources has generated, and will continue to generate, acrimony among states, nations and provinces. But groundwater resources can also promote peace and accommodation, as jurisdictions and decision-makers, who share a common groundwater resource realize that cooperation is the only way to ensure resource protection and sustainability. The Somes-Szamos aquifer, which extends on both sides of Romanian-Hungarian border, supplies drinking water to a population of about 395.000 inhabitants in Romania and 50.000 inhabitants in Hungary. The project focused on improving the previous understanding of the groundwater conditions including flow and pollutant transport across many scales, using data acquisition techniques and computer simulation models.
Credit	NATO Science for Peace Programme
Status	**On going**: Data is continually being updated

Extent

Geographic bounding box

WGS 84 | Google Mercator

North bound 48.56154

West bound 17.22346

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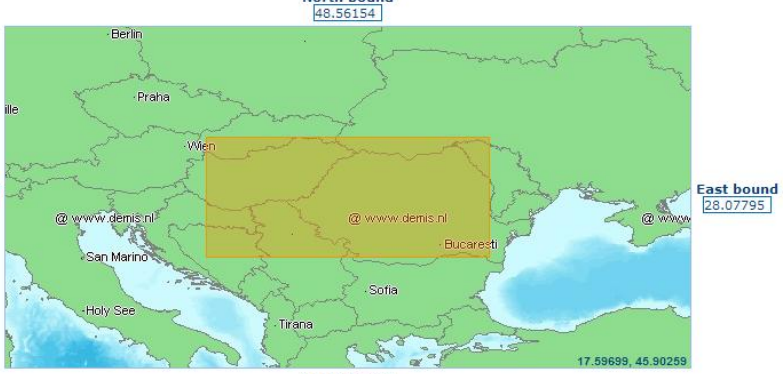
South bound 43.94677



Supplemental Information: Total Budget: 1.600.000,00€

DISTRIBUTION INFORMATION

Transfer options

OnLine resource: **PDF Document with presentation and details concerning the final Project Conference**

METADATA

File identifier	720b8de4-8a11-4b56-a418-38bda96260f9
Metadata language	English (Other language:French, German, Chinese(Other), Arabic, Spanish; Castilian, Russian)
Character set	**UTF8**: 8-bit variable size UCS Transfer Format, based on ISO/IEC 10646
Date stamp	2015-10-13T09:58:40
Metadata standard name	ISO 19115:2003/19139
Metadata standard version	1.0

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