

# FOKS

## Workshop report

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et environment and technology

This paper belongs to the following section of FOKS work plan:

WP3 Technical tools to be developed and demonstrated

3.2 Demonstration of tools

3.2.3 Guidelines for tools for localization of sources (e.g. fingerprinting)

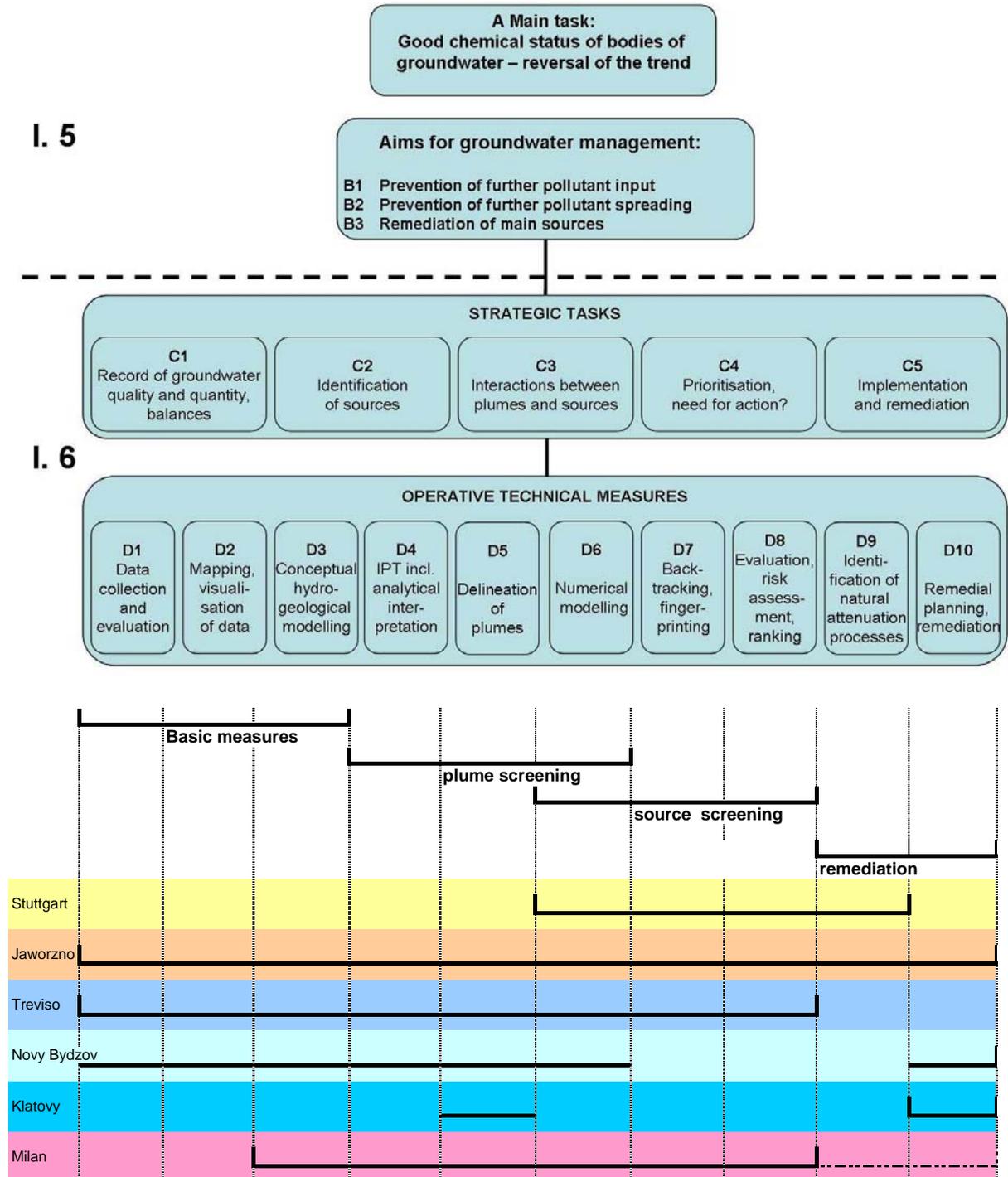
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## **1. FOKS Workshop on Innovative methodologies and techniques: the European approach for safeguard of groundwater, held in Treviso, 2nd April 2009.**

The FOKS project aims at facilitating the implementation of a comprehensive, integral groundwater risk management approach. With the project activities the partnership takes up innovative site characterisation and remediation tools recently developed. Their application and demonstration embedded in the strategic framework of the integral approach will pave the way for their transfer to daily practise in groundwater risk management and allows the water authorities to build their practical work on a sound scientific basis.

The integral groundwater risk management approach has been concisely described by the MAGIC project and is summarised in the following figure which synchronises to the FOKS partner activities and the correlation to operative technical measures.



**Fig. 1: The integral groundwater management approach and corresponding demonstration activities of FOKS partners**

The workshop included the participation of key actors from previous international projects, experts and national practitioners. Speakers were asked for their contribution to assessing the current state of the art of innovative tools for the integral groundwater investigation, according to their practical relevance, usefulness and applicability. Therefore the event had the goal of stimulating a wide discussion about these innovative tools and of identifying the main problems limiting their current application. Specific objectives were

- to inform about the state of art of innovative tools and to disseminate experiences
- to support discussion regarding presented tools
- to define main problems limiting application of presented tools
- to find the main focuses of development of presented tools
- to support further development of presented tools
- to introduce with applications planned in the framework of the FOKS project

The agenda of the workshop was

<b>9.30- 09.40</b>	<b>Welcome by the Provincial Authorities</b> Leonardo Muraro – President of the Province of Treviso Ubaldo Fanton - Councillor for the Environment of the Province of Treviso
<b>9.40 – 10.00</b>	<b>Presentation of the thematic workshop</b> Simone Busoni – Director of the Ecology Office of the Province of Treviso
<b>10.00 - 11.30</b>	<b>Integral Groundwater Investigation</b> Grzegorz Gzyl – Project manager Central Mining Institute, Katowice-Poland Maria Giovanna Tanda – Department of Civil Engineering , Environment, Territory and Architecture, University of Parma – Italy
<b>12.00-12.45</b>	<b>The Forensic Approach in Contaminant Hydrology – Background and Implementation.</b> Wolfgang Ufrecht – City of Stuttgart - Department for Environment Protection – Germany
<b>12.45 -13.30</b>	<b>Numerical modelling</b> Luca Alberti – Department of Hydraulic and Environmental Engineering, Road Infrastructures and Surveys – Politecnico of Milan – Italy
<b>14.40 – 16.00</b>	<b>Application of passive sampling methodology in integral groundwater investigation</b> Tomas Ocelka – Institute for Public Health of Ostrava – Czech Republic Branislav Vrana - Faculty of Chemical Technology, Slovak University of Technology, Bratislava –Slovakia Hansjörg Weiß – IMW Innovative Messtechnik, Tübingen – Germany
<b>16.00 – 17.15</b>	<b>Data evaluation: Application of Gnostic Data Analysis</b>

- Lubomir Pavlicka – Institute of Public Health of Ostrava – Czech Republic  
Pavel Kovanic - Institute of Public Health of Ostrava – Czech Republic
- 17.15 – 18.30** **Risk Assessment: Practical Use and Application**  
Jadwiga Gzyl – Institute for Ecology of Industrial Areas, Katowice – Poland  
Alba De Salvia – Remediation Planning Unit of Municipality of Milan - Italy
- 18.30 – 18.40** **Closing remarks**  
Chairman: Petr Kohout – Forsapi s.r.o., Prague - Czech Republic

The workshop programme was covering the aspects of plume and source screening, according to the sequence of operative technical measures from D4 to D8. The presentations are all available via the FOKS website, following the link [www.projektfoks.eu](http://www.projektfoks.eu)

G. Gzyl introduced the IPT integral pumping test to the participants, starting from practical aspects for implementation given in the MAGIC handbook. Main focus was on the analytical interpretation of the pumping tests, its advantages and limitations. The MAGIC software tool presented by G. Gzyl enables planning and interpretation of the IPT and allows the input of GIS information, visualization of the results and different means of export of data. MAGIC handbook and the software ( [www.magic-cadses.com](http://www.magic-cadses.com)) provide detailed guidance and equipment for proper application of the technology. Even its restrictions in low permeability or very rich aquifers are clearly described. Based on a decade of preceding research the IPT technology can be now considered as “ready for a wide application”. FOKS activities should focus on its demonstration and a series of knowledge transfer and education measures.

Prof. M.G. Tanda presented a few years experience in research and application of IPTs in combination with numerical groundwater models. She clearly stated her conclusions as follows:

- The method determines the distribution of pollutants and corresponding was flow rates along control planes
- Such results cannot be obtained with traditional monitoring networks
- In combination with numerical backtracking the sources of the pollution can be roughly identified

- For aquifers with transmissivity  $< 10^{-5}$  m<sup>2</sup>/s the method could be not economically advantageous

Further she indicated additional tools linked to advanced modelling techniques. The recovery of the release history enables to determine the time, duration and total mass of a pollutant release by using high sophisticated inverse transport modelling and a geostatistical approach. Although the demands on data quality about hydrogeological, hydraulic and transport properties seem to be significantly high, the method is to be considered as an interesting variety of backtracking. One possibility to obtain detailed data about hydraulic conductivity fields of larger areas even in heterogeneous aquifer is given by hydraulic tomography, which only requires a few wells.

The discussion of the two presentations about IPT concluded, that for many contaminated site investigations the application of analytical procedures for the interpretation of the IPTs will be appropriate to localise the plume and identify concentrations and mass flow rates. However if sufficient data are available for numerical processing of IPT results, it provides opportunities for interpretative results reaching far beyond the analytical solutions.

Taking up the traces from the previous presentations Prof. W. Ufrecht set the frame for the term “backtracking”, which is to be understood as following tracks and traces like pollutants or source specific markers backwards to their source with the aim, to reliably identify the source and clarify liabilities. This can be done via advanced modelling or environmental forensics. Both approaches are valid for themselves, but their combination supports visualisation and quantification of processes, hence leading to coherent chains of evidence.

With respect to organic pollutions with CHC the so-called <sup>13</sup>C-method proved to be a reliable tool. It enables to

- Distinguish if TCE and DCE are primary pollutants or the result of biodegradation
- Identify and quantify degradation and natural attenuation processes
- Estimate the time of pollutant release in some cases
- Identify source-plume relationships and decode overlapping plumes

With the lab infrastructure established in recent years in central Europe and numerous research publications in this field the forensic approach can be considered well developed for application in daily practice. A large range of parameters can be used for a broad variety of pollutants and problems. The combination with advanced modelling techniques offers great potential for the future, to reliably identify the contaminant sources and their liable polluters enabling water authorities to apply the polluter pays principle.

Prof. L. Alberti presented a perfect overview on numerical groundwater modelling like a helicopter flight, tackling all aspects from conceptual modelling as the most important basic task to backtracking with highly sophisticated reactive transport modelling. He clearly stated, that groundwater modelling is a powerful and accepted tool, if it is build on a scientific sound and accurate conceptual model and if all relevant information about the numerical model as there are hypothesis and approximations, limitations, reliability and uncertainty etc. are reported and presented in a clear and open minded way, allowing customers to enter in a dialogue with the modeller.

The examples of his work of recent years impressively illustrated the opportunities provided by competent modelling. They also indicated, that most of the work is not the modelling itself but the underground characterisation efforts in order to provide appropriate data sets and their interpretation in a consistent conceptual model. Nevertheless, such a conceptual model is not a specific requirement for modelling, but it is a must for any detailed characterisation of a groundwater contamination. Therefore modelling can be considered as a valuable ingredient of a risk management strategy, which will in a continuous process

- Stimulate characterisation activities and improve their interpretation
- Allow predictional assumptions and prognosis
- Support the design of interventions and forecast of impacts
- Give valuable input to risk analysis and scenario modelling.

The application of passive sampling methodology was presented by Prof. B. Vrana and H.J. Weiß, who covered with their presentations basic and applied research, demonstration and technology verification aspects, quality assurance in lab and

field, technical aspects of field application and commercialisation of various devices. It is the key advantage of this technology to basically avoid many of the potential errors and efforts which can occur and are needed with active sampling and monitoring, e.g. losses of volatiles, cross contamination via equipment, disposal of contaminated water. Further it enables a time integrative sampling, a vertical characterisation of wells by sampling without influencing hydraulic flow conditions and an accumulation of pollutants.

Although extensive monographic literature is available, practical guidance documents are lacking both for chemical labs and suppliers of equipment as well as for the end-users as hydrogeological service providers and water authorities. As so far no international standardisation is set in place, some of the technology suppliers are seeking for technology verification, either in Europe or US. As a first step towards regulation quality control will be soon standardised with the ISO 5667 standard. As so far the integral approach is based on active sampling, it is to be investigated for which parts or which operative technical measures these innovative smart tools will be beneficial. For sure they offer great opportunities to easily receive vertical profiles of aquifer contamination. It will be an important task to explore, how this time integrating measurements could accomplish or partly replace mass flux calculations by IPT.

Advanced data analysis with mathematical Gnostics was presented by Prof. Kovanic and L. Pavliska as an emerging possibility for data analysis of small sets of environmental data. The lack of large numbers of data to be processed and the big uncertainties are key problems by applying traditional statistic methods for environmental projects. Compared to the other tools presented in the workshop Gnostics is not as close to wider application and daily practice as the others. Due to its highly complex mathematical basics significant academic efforts will still be needed to ensure widespread recognition. Nevertheless the software tool to be developed based on an open source code within the frame of FOKS will support these activities and vice versa it will stimulate the data processing and interpretation of the local projects to which it will be applied. These demonstration efforts require close interaction between research and practice.

E. Wcislo presented current state of the art in risk assessment as a 2-step approach. Where as in step 1 assessment is mainly done against national standards or guidance values, step 2 favourably follows the risk-based approach, considering site specific actual and future land use and refers to human receptors. Recent examples demonstrated the applicability and basic processes of health risk assessment procedures. Although for the integral consideration of larger urban areas the application of standardised values seems preferable, the role of health risk assessment in decision making processes for pollution source areas and for single site treatment is obvious. Based on some real case applications in FOKS, the incorporation of the risk based approach and the contribution of environmental and health risk assessment procedures to the decision support for the integral groundwater risk management is an important issue to be described in respective guidance documents.

These considerations formed the bridge to the final presentation of the workshop given by L. Pizzol about decision support systems for risk-based management of contaminated sites. State of the art is summarised in a monography by Marcomini, Antonio; Suter II, Glenn Walter; Critto, Andrea (Eds.) "Decision Support Systems for Risk-Based Management of Contaminated Sites", 2009. Although regulatory requirements are obvious, the DSS presented were all at academic level and waiting for a wider implementation. The presentation outlined key features of the decision support systems DESYRE, ERA-MANIA DSS, MODELKEY, SYRIADE and CMCC.

The discussion concluded that even complex systems can only support decision making, but not doing the job itself. It will be a challenging task for the FOKS partnership to set-up and describe their decision support for the implementation of the integral approach

- Comprehensive but specific
- Short and concise, but including all details required
- Easy to understand but scientific sound
- Applicable for administrators, water authorities, hydrogeologists and all kinds of service providers involved in groundwater risk management.

## 2. Conclusion

The workshop represented the first open meeting of the project FOKS oriented for specialists, administrators and water authorities. It introduced the main focuses of project innovation purposes in development of Integral groundwater investigation tools. The workshop enabled the project partners to determine a current state of the art of innovative tools and inspired them looking for their most productive application in the frame of the project. An excellent organization of the Conference and of the Workshop together with a very inventive environment of all participants helped to fulfil the expectations of the organizers, especially to clarify further tasks of the partners in tool development process and to prepare a platform of specialists and administrators for evaluation, assessment and dissemination of the results of technology demonstrations based on web pages of FOKS

<http://projectfoks.eu/>