

MANPORIVERS
Management policies for priority water pollutants and their effects on foods and human health:
General methodology and application to Chinese river basins
(2002 – 2005)

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<http://hjxy.nju.edu.cn/manporiver/index1.htm>

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Main Objectives

With the rapid development of economy with China's open policy, more and more surface and ground waters have suffered from serious pollution due to discharge of waste waters, use of pesticides and fertilisers, landfill disposal of solid waste and others. This starts affecting the food production (concentration of pollutants in crops due to irrigation with polluted water, fish breeding, etc) and, in medium range, is detrimental to human health. This, together with the well-known deficit and mal distribution of water resources in China, constitutes one of the priorities of Chinese authorities at different levels of political decision. The objective of this project is to develop methodologies to identify effective and sustainable policies for the management of surface and groundwater, taking account of their quality and relationships with food production and human health. The aim is the definition of methodologies with a very broad range of applicability: it is expected that they could be used for many river basins, and not only in China, because they are developed in such a way as to possess two important and useful properties. First, they can be used interactively for different basins exchanging water. Second, they can be used at different scales in a recursive manner, from small tributary basins to large ones. Based on scientific methods for the evaluation of pollutant input and transport by water, of sanitation techniques, of the use of water for human needs, food production and industrial activities, and on the analysis of the relationships between pollutants (e.g. nitrates, pesticides, etc.) and human health, fuzzy logics, multicriteria decision and geographical water protection zoning approaches are applied to define priority policies for water management. The expected result is a comprehensive and rigorous methodology to define water pollution management policies with a wide range of applicability. However, in order to verify their effectiveness, applications in the Huai river basin and the Pearl river delta will be chosen as examples to allow the proposers to evaluate the results of this project.

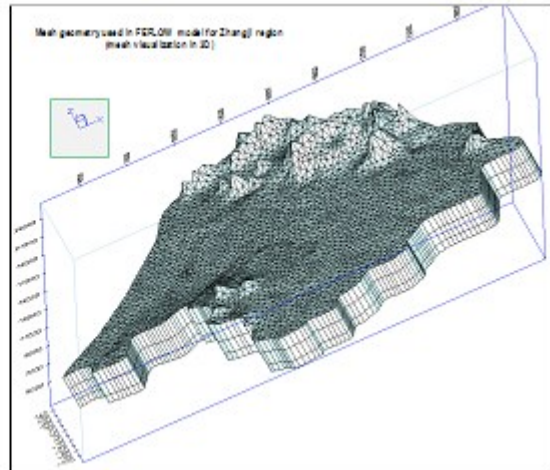
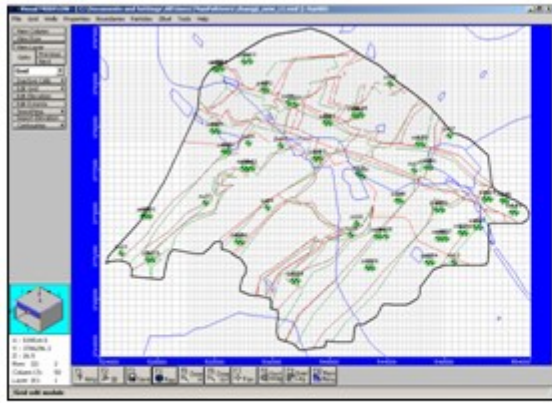
SCIENTIFIC ACTIVITIES DEVELOPED BY LNEC

Transport of pollutant by groundwater

The objective of this work package was to evaluate existing models for pollutant transport in groundwater in relation with the goals of pollutant management policies. Towards this aim a benchmark application of groundwater flow and transport of pollutants models available at LNEC was conducted. The final objective of the benchmarking application was to compare the mathematical results of each model with analytical solutions available at LNEC.

During 2003, LNEC published the 113 pp WP2b Final Report containing all information, benchmark essays and discussion of results on Generic Characterization of Mathematical Models to Simulate the Pollutant Transport in Groundwater.

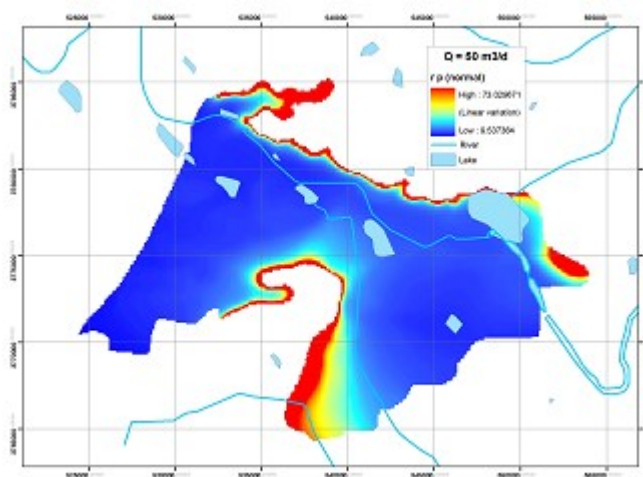
MODFLOW groundwater flow and transport model applied to the Zhangji case-study area (2D)



FEFLOW groundwater flow and transport model applied to the Zhangji case-study area (3D)

This report presents the results of a comparative analysis of several mathematical codes, suitable for the solution of the convection dispersion equation, which are based on the following mathematical methods: analytical solutions, finite state mixing cell, method of characteristics, random-walk, finite elements and (only as an introduction) boundary elements. A table containing the rankings of the codes, for several comparison criteria, and the presentation of general conclusions for the selection of computer codes finalizes the reports.

Groundwater protection and zoning and extension to surface water
 The main goal of Manporivers project was to identify effective and sustainable policies for the management of surface and groundwater problems, taking account their relationships with food production and human health. Considering this main goal, Zhangji area, with intense human activity and food production, was selected as the groundwater case study area. In practice the envisaged aim was that of adding experience towards better decision making on land use planning, sustainability of agricultural practices, parameters related to the soil, aquifer system types (unconfined vs. confined and porous vs. karstic), topography, piezometric heads evolution related to groundwater recharge and irrigation values.



Questions answered can be considered as the following: Are there any relations that can be established among groundwater indicators that may be useful for decision making regarding surface water protection? Can we establish regression lines or trend curves? Are mathematical models useful in this special area?

Upstream groundwater protection zoning computed with Krijgsman and Lobo-Ferreira method for Zhangji case study area

The work at LNEC may be summarized in the following items:

A literature review of international methods for Groundwater Protection and Zoning and extension to surface water, taking into account the specificities of surface waters and the importance of land use, land planning and land change for surface water protection.

A literature review on the impact of diffuse pollution on ground- and surface waters.

Groundwater vulnerability assessment using DRASTIC method.

Groundwater flow and transport computations in the three layers of the Zhangji case-study aquifer system using MODFLOW (quantity) / MT3DMS (quality) model, and, introductorily, the FEFLOW model.

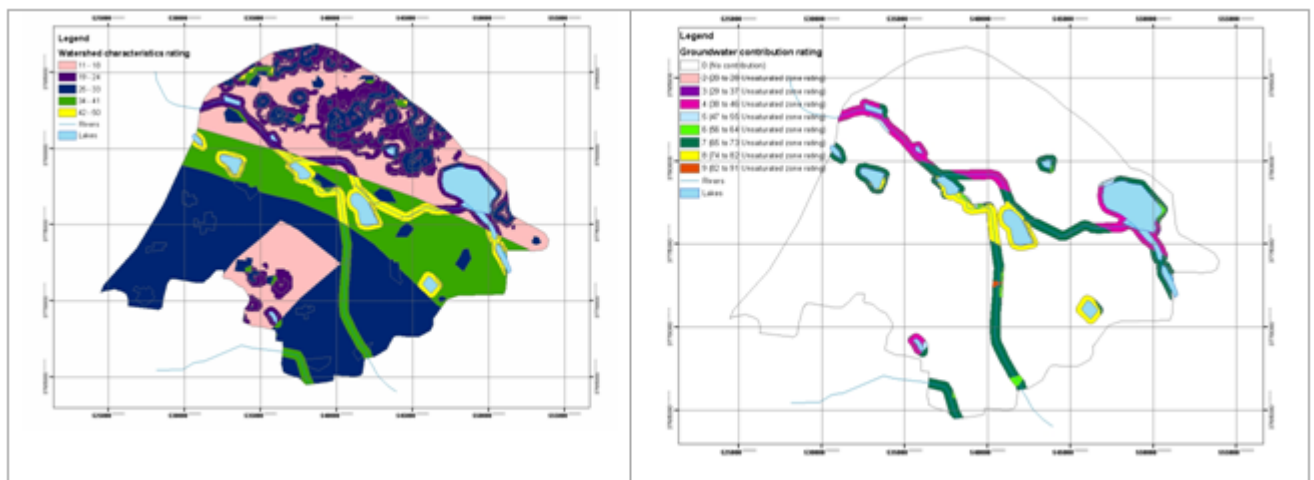
Application of Krijgsman and Lobo-Ferreira method for the assessment and mapping of geographical groundwater protection zoning of Zhangji case-study area.

Application of USGS method for groundwater risk assessment of Zhangji case-study area.

Review on methods for assessing surface water vulnerability and risk to pollution and geographical surface water protection zoning to pollution, such as a USGS method and WRASTIC index.

Development of two original decision flow charts for better groundwater and surface water risk assessment and management (cf. Flowcharts 1 and 2). Flowchart 1 represents groundwater resource protection methodologies, while Flowchart 2 considers surface water resource protection methodologies.

Policies for the Application of Pollutant Transport Models in Groundwater
LNEC published POLICIES FOR THE APPLICATION OF POLLUTANT TRANSPORT MODELS IN GROUNDWATER: Decision making methodology for the application of pollutant transport models. This report presents a detailed analysis for selection of appropriate pollutant transport models. Application of USGS method for surface water pollution risk assessment of Zhangji case study area



Contribution of groundwater for the assessment of surface water pollution risk assessment of Zhangji case study area PARTNERS

LNEC (Portugal) <http://www.dha.lnec.pt/nas/> ; <http://www.lnec.pt>
University of Liège (Belgium) <http://www.ulg.ac.be/>
Dalian University of Technology (PR China) <http://www.dlut.edu.cn/dutn/dut-e/main.htm>
South China University of Technology (PR China) <http://www.scut.edu.cn/home.html>
Nanjing University (PR China) <http://www.nju.edu.cn/cps/site/NJU/njue/>
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