estimating the transmissivity value. Trial and error calibration has been applied comparing calculated mean discharge value with measured mean discharge value.
The first group of simulations has allowed to identify a structural limit; the simulations evidence the impossibility of having a potential limit; therefore indicating that the two springs are indipendent.
The second group of simulations has been carried out using a new grid with 163 cells (17 rows and 12 columns).
The water input and the transmissivity distribution, that give best fitting between calculated mean discharge value and measured mean discharge value, has been used to interpolate the water table with the aquiclude surface. In this way, all cells beyond the intersection line have been deleted from the grid, and then a new simulation has been carried out to obtain a conceivable mean piezometric surface.
The last group of simulations has been carried out using a grid with 74 cells. The distribution of transmissivity values yielding the best fitting between calculated and measured discharge values has been used. The distribution of influx has been modified by assuming a zenithal and lateral recharge for the cells along the new limit, all the others having zenithal recharge only.
Model calibration has been carried out through relative deviation (1) of each balance zone and, when possible, also through topographic control of valley floor: the altitude of simulated water table must be under the altitude of dry valley floor.

$$(1)\ \frac{|Dcalc_i - Dmeas_i|}{Dmeas_i}$$

$Dcalc_i$ = calculate discharge
$Dmeas_i$ = experimental measurement discharge

A3-10 Poster Canepa, Paola

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A SIMULATION MODEL FOR ST PETERSBURG AREA AQUIFERS.

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Key terms: Modflow; oil pollution; inter-moreine aquifers

The work is a part of the European project "GEOINFORM-Integrating Geological Information in City Management to Prevent Environmental Risks-LIFE06 TCY/ROS/000267", which involves the environmental authorities of the Province of Milan and St. Petersburg. The main objective of Geoinform is to contribute towards the protection of the Baltic Sea environment by establishing the system for preventing risks and deterioration of the geosphere. Within the framework of the European project, the work analyses a pilot area characterized by groundwater oil pollution, using flow (Modflow) and transport (MT3D) mathematical models. The general objective is to prove the potential of groundwater models in decision-making. In particular the work aims:
°to simulate groundwater levels and flow rates in two main aquifers;
°to understand the relationships between two main aquifers;
°to simulate the contaminant transport;
°to define the contaminant plume extension.
The study area, called Shuvalovo, is in the North-Eastern part of St. Petersburg. A surface covering 25 Km2 includes green areas and some industrial activities. The Shuovalovo territory is quite flat and is composed of a hydrologic system with rivers, channels, streams, lakes and ponds. The hydrogeological framework is quite complex. There are two main aquifers, one superficial and one confined. The first is composed of various grain size deposits and the water level rises to the land surface. The second is hosted by inter-moreine deposits. The two units are separated by a boulder loam layer, which is discontinuous and in some parts there is perhaps a water exchange between the two aquifers. The pollution case concerns oil discharge in Shuvalosky pond, in the Southern part of the area. The mathematical model is implemented by Groundwater Vistas software, which includes Modflow and MT3D. The spatial domain is replaced by a discretized grid, which has 100 rows, 130 columns and 8 layers, with cells of 50 m x 50 m and variable thickness. All layers represent the first 50-70 m of depth:
°layers 1, 2 and 3 simulate the superficial aquifer: the first hosts the hydrologic system, the second is the central core of the unit, the third models the loamy sand lens which regulates the water exchange between the two aquifers;
°layer 4 represents the boulder loam layer;
°layer 5, 6 and 7 simulate the different grain size deposits in the inter-moreine aquifer;
°layer 8 represents the clayey bottom layer.
Top and bottom layer surfaces are built by geostatistical processing using the stratigraphy of 338 wells, placed in the study area. For the flow model, the selected boundary conditions represent real limits (rivers, ponds, lakes), inserted as Cauchy condition type (head-dependent flow), and artificial limits (isopiezometric line), inserted as Dirichlet condition type (specified head). For hydrogeological properties, the following have been defined: hydraulic conductivity (11 zones, min value=10-3 m/day, max value=10 m/day) and effective porosity (6 zones, min value=0.1, max value=0.22). The flow model calibration is carried out considering the difference between simulated head and observed head in the 200 targets. Targets represent the water level measurement in wells. Calibration gives more than 100 progressive simulations, which are improved by trial-and-error adjustment of parameters. In the transport model, three punctual pollution sources are considered. Inserted in the first layer, they represent constant concentration and continuous sources. The model considers only advective-dispersive transport, no reaction and no sorption. Dispersivity is defined by 2 zones. The absence of chemical analysis does not permit performing transport model calibration . Resultant flow model gives good results and shows the uncertain points, which have to be resolved in future works. Resultant transport model identifies the contamination's targets and defines the plume's spatial extension.

A3-11 Poster Carloni, Andrea

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ANALYSIS OF THE CONTAMINATION RISK USING FLOW AND TRANSPORT MODELLING IN A DEEP CARBONATE RESERVOIR: THE AUGUSTA AREA (SYRACUSE, ITALY) CASE.

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Key terms: Monte Carlo simulation; Geostatistic; Groundwater Protection

Simulation of groundwater flow in fractured aquifers modelling implies coping with the problem of strong soil heterogeneity of the medium. Different systems of faults and fractures intersect a highly heterogeneous soil matrix in which clay alternates with carbonates, vulcanites and other soil textures. The main problem is to find a compromise between simplifying assumptions making the problem amenable, and preservation of the main characteristics of the ongoing flow and transport processes. The reliability and the effectiveness of the approximations made directly impact on the quality of the modelling and on the risk analysis for estimating maximum contaminant spreading and travel times.
In this context, our study focused on the risk assessment of the potential contamination zones in the deep Miocenic carbonate aquifer of Augusta coastal area (Syracuse, Italy), by estimating scenarios of contamination risk of drinking water wells.
The zone under study is constituted by a complex geological framework characterized by horst and graben structures, that have been included in the numerical code for the main geological formations. However, to further transfer soil and rock characteristics into the model we had to implement a geostatistical approach for conditioning hydraulic conductivity. From the mathematical point of view, we assume that solute migration is governed by the classical flow and transport equations for porous media. Thus, flow simulations have been performed using the MODFLOW-2000 code (Harbaugh et al., 2000), and the pollutants transport has been simulated using the MT3DMS code (Zhang & Wang, 1998). Much effort was devoted to calibration of hydrodynamic parameters, mainly hydraulic conductivity, in order to minimize the gap between simulated and measured hydraulic heads.
The aquifer under study was conceptually schematized using the CDC (Combined Discrete and Continuum) approach (Kiraly, 1998). This means that, on the one hand, the aquifer is both continuum and equivalent with primary porosity. On the other hand, the main fracture system that is related to tectonic lineaments is conceptualized by a set of explicit discrete hydraulic entities whose characteristics are derived through during inverse modelling. The statistical component of the hydraulic conductivity values was assigned by a specific procedure written in PERL language through a proper algorithm acting directly on the MODFLOW simulator input file. A stochastic distribution Monte Carlo type (Rubinstein et al., 2007), based on a properly formulated gaussian probability density function was used for generating the statistical component of the hydrodynamic properties of the model. Then these values were assigned keeping into account the main geological structures of the zone, according to both the literature and the three-dimensional model reconstruction.
After calibration of the flow field against field measurements, we have performed a preliminary contamination risk analysis for the aquifer. This approach represents a flexible procedure for formulating risk analysis in terms of contamination probability.
Harbaugh, A., et al, 2000. MODFLOW-2000, the U.S.G.S Modular Ground-Water Model - User guide to modularization concepts and the Ground-Water Flow Process, Open File Report 00-92, USGS, Denver, CO.
Kiraly, L., 1998. Modeling karst aquifers by the combined discrete channel and continuum approach. Bulletin du Centre d'Hydrogeologie, Neuchatel. 16, 77-98.
Rubinstein, R. Y., Kroese, D. P., 2007. Simulation and the Monte Carlo Method (2nd ed.). New York: John Wiley & Sons.
Zheng, C. & Wang, P.P. 1998. A modular three-dimensional multispecies transport model for simulation of advection, dispersion and chemical reactions of contaminants in groundwater systems. Documentation and User's Guide. Dept. of Geology and Mathematics, University of Alabama, USA.

A3-12 Poster Cultrera, Matteo

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3D HYDROSTRATIGRAPHIC MODEL USING A MULTIMETHOD APPROACH

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Key terms: hydrostratigraic model; Venice aquifers; mode; passive seismic

INTRODUCTION
The safeguard of Venice is linked to the relative sea level (RSL). The subsidence of Venice Area was caused mainly by three factors: the natural land subsidence, the eustatic rise and, during the last century, the groundwater exploitation to supply the Industrial Area (Porto Marghera).
The piezometric head of the exploited deep aquifers went down and the average head decline in the industrial zone reached more than 22 meters. This deep aquifer system (100-350 m asl) is hydraulically separated from shallows aquifers (0-80 m asl).
In 1971 after the imposed stop of exploitation decided by Water Venice Authority (Magistrato alle Acque di Venezia, MAV), the hydraulic head started to rise up until almost the original potential (about +3 m asl).
In 70s the Italian National Research Institute (Consiglio Nazionale delle Ricerche, CNR) promoted a study of hydrogeological sequence of Venice area by a continuous coring well up to 951 m deep: VE 1 - CNR.
PROBLEM ANALYSIS
During these last years a mathematical model describing the groundwater dynamic in shallow and deep aquifers is implementing for the Environment Reclamation of Porto Marghera.
The remarkable rising of hydraulic head in deep aquifers would give rise to a leakage in shallow aquifers through the abandoned wells.
The quantitative estimation of phenomenon by an adequate mathematical code needs a reliable hydrostratigraphic model
METODS
All previous hydrostratigraphic sketches in the interest area were realized using coarse data from numerous full hole drillings until 70s.
The aim of present study has been to develop a new hydrostratigraphic structure of Venetian subsoil after the basic studies performed on continuously cored samples in VE 1 - CNR, published between 1996 - 2004.
The data have been uniformed and organized by a series of algorithms to get the statistical mode for each selected cluster of full hole drilling. The mode is a