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3D modelling of the permafrost development in the Paris basin to ascertain its hydrogeologic impact.

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The quaternary [2-0 My] is characterized by drastic climatic oscillations with a period of 100 ky yielding a succession of glacial interglacial stages. These stages of glaciation of the ground over substantial thickness and time periods can create perturbations on groundwater flow in the regional scale aquifers especially by an interruption of the recharge. The impact of these temporal alterations of the recharge can be traced at present day in a multi-layered systems such as those of the Paris basin as shown by Jost (2005 et Jost et al. in press) using a simplifying approach.
It is thus crucial to arrive to a better physical constrain on this process and to develop a quantitative approach to understand the permafrost dynamics within hydrogeological units. Then, this calculation could be used to evaluate the hydrodynamic impact of permafrost development. This calculation introducing the latent heat of fusion of ice in the porous media heat flow equation (diffusion or diffusion-advection) is implemented within the basin model NEWBAS (Belmouhoub, 1996). This model, already used in the case study of the Paris basin (Gonçalvès et al. 2005), simulates the geologic evolution, fluid, mass and heat transfers under the control of processes such as sedimentation, compaction or erosion. It calculates as a function of time the 3D geometry of the basin and the physical properties e.g. the thermal conductivity of the layers.
The calculation of the spatial and temporal permafrost evolution is performed over the last million years. The climatic forcings introduced in the simulations are provided by a GCM model with a refined resolution on Europe, the LMDZ from IPSL which produces regionalized maps of surface temperature. This implementation of permafrost calculation in the NEWBAS model, allows us to propose 3D extensions of the permafrost i.e geographical extension but also the vertical extension taking into account the heterogeneity of the geological layers.

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Darcy 114

Cenomanian Sands Aquifer - Groundwater Management Approach

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The Cenomanian Sands Aquifer is regarded as a strategic groundwater reserve within the Loire-Bretagne bassin. It has an area of 25 000 km2 and extends over 10 administrative departments and 4 regions (Centre, Pays de la Loire, Poitou Charente and Basse Normandie).

Over the past 30 years, the increase in groundwater abstraction has led to a regular drop in the groundwater level, particularly in the Tours area. This weakening of the aquifer has involved a decrease in borehole productivity and, locally, to direct contamination from the adjacent aquifers (in particular by chlorides from the Jurassic aquifer underneath). In addition, the threat that the aquifer may become unconfined in the central area has reinforced public concern over the need for concerted groundwater management.

With this objective, the Prefect of the Centre Region has set up a committee to manage the Cenomanian aquifer. This committee, made up of elected officials and local administration representatives as well as groundwater users, has decided to launch a study programme. This programme will result in the building and use of a groundwater management model to define guidelines for future management rules. The Loire-Bretagne water authority is responsible for supervising this programme carried out by Sogreah under the control of a steering committee. The latter is made up of the departmentsí technical staff.

Prior to the building of the hydrodynamic model, a thorough field investigation campaign was undertaken to improve knowledge of the aquifer system's behaviour. This 12-month data acquisition phase included a summary of all groundwater abstraction data, groundwater level measurements, the building of a geological model of all the associated geological layers, pumping tests and the collection of aquifer hydrodynamic characteristics, and assessment of recharge and groundwater/river exchanges.

Although this data acquisition phase was expected to produce valuable inputs for the model, it has already produced some useful results for the present groundwater management of the aquifer. Particularly, detailed determination of the elevations of the geological layers and the updated piezometric levels enabled the extent of the confined area of the Cenomanian sands aquifer to be determined and helped in defining the statutory "groundwater distribution zones".

In spite of these investigations, some uncertainties remain (such as the eastern extent of the marl formation separating the Cenomanian sands aquifer from the overlying Seno-turonian aquifer). The steering committee suggested that the modelling approach should take into account these uncertainties, making it possible to envisage any kind of conceptual model at any stage of the modelling process. The modelling approach was consequently adapted in such a way that it would be easy to make significant modifications to the initial conceptual model, taking advantage of finite-element spatial discretisation (for instance, with the use of finite-element supermesh objects and of constraint lines within the FEFLOWcode).

The steering committee is closely associated throughout the development of the study programme: it provides valuable information on the local hydrogeological characteristics, it discusses and validates the main steps of the project (especially the choice of scenarios to be run in order to test the impact of different abstraction schemes on the groundwater table). This close association from the very beginning of the study programme could facilitate the later implementation of groundwater management rules.

POSTERS

DARCY 30

Hydraulic anisotropy of fractured rock masses and tunnelling

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Sustainable devlopment constraints and specific european rules make exigible that perturbations induced by civil engineering works should be managed in order to limit the impact on aquifers.
Forecasting of flow in a fractured rock mass around an underground excavation requires a geological and structural survey as much complete as allowed by the balance of cost and hazard and as justified by available modelling concepts and simulation tools. Using softwares for discontinuity network generation and hydraulic interpretation shows promise for anticipating difficulties raised by the insertion of an opening in the rock mass and its evolution. Thus, modelling comes to justify the prospecting effort.
Here we present a new hydraulic modelling approach of a fracture porosity medium whose geometry was previously well characterised. Flow is computed in a stochastic network of discs representing the fractured rock, in order to estimate the water inflow in a tunnel. Then, the 3D permeability tensor is calculated, rigorously, in view of an equivalent continuum at a greater scale. Our method is applied to the case of a tunnel bored in a quartzite rock mass during the preliminary phase of a transalpine project, the future French Italian Lyon-Turin railway link.
This approach based on explicit fracture network should lead at one and the same time to a better understanding of the rock mass behaviour around an opening and to a better informed decision regarding the appropriate design.

K

DARCY 47

Modelling the hard-rock aquifer of Plancoët (Brittany, France) with a finite difference model, taking into account the structural geometry

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We want here to model a hard-rock aquifer by a two-layer finite difference model, taking into account the geometry of the weathered fissured horizons. An example is taken on the Plancoët aquifer (Brittany, France), exploited by the Nestlé Waters company. The structural geometry of this site, already characterised by Durand et al. (2006), helps to construct the hydrogeological model. The first layer under the surface represents the weathered horizon, and the lower layer represents the fissured horizon. Their both thicknesses are deduced on each cell from the known structural geometry. The model, calibrated on hydrogeological field data, underlines the influence of spatial discontinuities as tectonic structures, variations in lithology and weathering on hydrogeological processes, and gives some elements to discuss about the hydrodynamic behaviour of each layer and their interrelations. The recharge is also discussed through the model, which leads to estimate the exploitable quantities of water on the site. Some prospective simulations help to optimize the management of the water resources.

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DARCY 52

Self-potential signals associated with preferential ground water flow pathways in sinkholes

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Self-potential surveys have been conducted at a test site located in Normandy, in the North-West of France, in a chalk karst. The Spring survey exhibits more or less circular negative self-potential signals associated with the position of sinkholes and crypto-sinkholes. The negative self-potential anomalies observed in Spring amount several tens of mV. In addition to these self-potential surveys, we also performed electrical resistively profile. Electrical resistivity tomograms are used to visualize the interfaces between the chalk and the overlying flint clay and loess covers. A linear relationship between the self-potential signals and the thickness of the loess layer is observed. This linear relationship is explained for the first time by solving the boundary-value problem for the coupled hydro-electric problem. We fixed the boundary condition at the ground surface in terms of hydraulic flux associated with the infiltration of the meteoric water. A finite element numerical simulation of ground water flow in this type of environment is performed to explain the observed self-potential signals. A fairly good agreement is obtained between the numerical simulation and the observed self-potential signals.

DARCY 63

Forecasting the flow of the Touvre karstic spring by integration of a rainfall-runoff model and a karstic aquifer model

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Originality of the La Rochefoucauld karstic aquifer

The aim of this communication is to present a daily forecasting model for the outflow of the La Rochefoucauld karstic aquifer, based on the rainfall falling over the surface of its contributing catchment.
From a practical point of view, this is interesting because flow from the Touvre karstic spring is the sole water source for the city of Angoulême, and also because it represents an important part of the base-flow of the Charente River during dry periods.
From a theoretical point of view, the Touvre case study offers a unique opportunity to assess quantitatively the realism of the underground recharge term of the GR4J model, a surface rainfall-runoff model widely used in catchment engineering applications (Perrin, 2002; Perrin et al., 2001; Perrin et al., 2003)

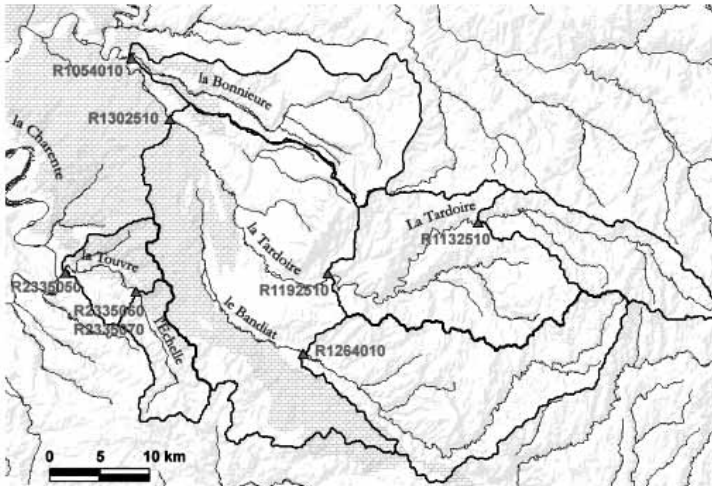
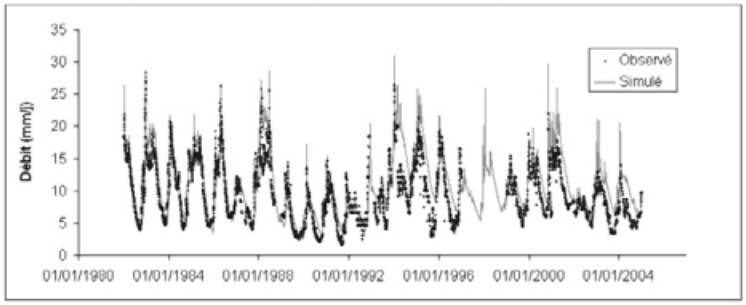


Figure 1 : Hydrographic network, gauging sites and extension of karstic system (brick pattern)

Modelling losses of the surface water system

We start our study with an attempt to model the catchments of the Tardoire, Bandiat and Bonnieure Rivers, which feed the Touvre spring through their losses in the La Rochefoucauld karst.
On these rivers, we test the ability of the GR4J rainfall-runoff model to simulate surface streamflow as well as underground losses to the karst aquifer. Then, we compare the underground losses quantities against the discharge of the Touvre spring, and we show that provided a simple assumption on the karstic aquifer behavior, we can reconstitute accurately the discharge at the spring.



Perspectives

Our work opens the way for a forecasting model of the Touvre spring. Further work is planned at the hourly time step, which will precise possible forecast lead-time.

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DARCY 85

Feasibility of a peak flood water storage above a heavily man modified alluvial aquifer~: hydrogeological aspects

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After the famous 1910 partial flooding of Paris, four large reservoirs, having a total storage capacity of 0.8 billions cubic meters, were constructed. On the other hand, recent simulations have revealed an increased risk related to some recent engineering works upstream of Paris. The peak flow of the Seine and theYonne, a major tributary, would arrive concomitantly at Montereau, their confluence. In order to prevent such an event, the << institution des barrages--réservoirs >> plan to store 50 millions cubic meters of Seine's peak flood water inside a large system of dikes to be erected a few kilometrers upstream of Montereau. The stored water would be released into the Seine once the maximum flow of the Yonne would have outreached Montereau. In the storage area, the alluvial plain has a gently sloping soil surface and an extent of two tfour kilometers in width. Two distinctive features of the alluvial plain are now the existence of a large canal having replaced the natural Seine and of 150 lakes (gravel pits) connected to the aquifer system. These lakes would occupy a significant proportion of the storage area.

The local aquifer system consists on thin layers of low permeability (modern alluviums, soft disagregated chalk) alternating with relatively thick aquifers (ancient alluviums, fractured hard chalk). The main aquifer, made of sand and gravel, is a well defined hydrogeological unit characterised by a very high permeability. Pumping tests indicate a fairly uniform distribution of the transmissivity over a narrow range of values.The origin, continuity and hydrogeological status of the disagragated soft chalk is not well established.

To assess the hyrogeological aspects of the project, a mathematical model of the physical system, including the surface storage basins, 150 lakes and the aquifer system itself, has been constructed. The model was used to predict, for various replenishment curves, the leakage flows from the storage basins, through the underlying aquifer system. As the actual behavior of the storage system may not be observed, the main challenge of the model was to represent the different components of the system as realistically as possible. The model evaluates the hydraulic head in each cell, in reponse to natural boundary conditions and varying injection yields. The superposition principle is applied. As the perturbed system behavior would be largely different from the natural one, a classical calibration of the model would be meaningless. Instead, we used a Monte--Carlo approach, based on conditionnal simulations of the permeability and transmissivity fields. Unfortunately, the transmissivity data does not allow to estimate reliable variograms. For that reason,results are to be considered only as preliminary ones. Logically, the next step would be to achieve intensive field measurements.

Though we always tried to select pessimistic parameter values, the simulations results suggest a high overall efficiency of the projected storage system. They also provide detailed distributions, in time and space, of the exfiltration flows outside of the dikes. These flows could be easily collected and reinjected into the basins, allowing a very high efficiency at the expense of a relatively low additionnal cost.

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DARCY 96

Geometrical Analysis of water Annaba-Bouteldja bearing: Consequence on its working modelization

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A continuous series from the Miocene to the Quaternary constitutes the aquiferous system of Annaba-Bouteldja, located in the north oriental part of Algeria. Although it presents a homogeneous facies, it is affected by geometry of the two pits; Ben-Ahmed and Ben-M'Hidi. The analysis of the boring section and the hydrogeological data, enables one to modelize the groundwater flows and to highlight three sectors with different transmissivities. The structural map built with the help of well log data, allows to define two hydrogeological basins delimited by faults, each sector having different hydrodynamic behaviours.
The statistical analysis of the observed transmissivity values shows a large dispersion ranging from 1.10^{-3} m_.s^{-1} to 4.5×10^{-2} m_.s^{-1} with a mean of 4.9×10^{-3} m_.s^{-1} and a standard deviation of 6.9×10^{-3} m_.s^{-1}. Using hydrodynamic model in steady state to the water bearing system gives the same results as obtained with geostatistical method and enables to distinguish three large multivariable classes which characterizing a hydrogeological situation geometrically and dynamically well defined. Results indicate that a good coincidence exists between observed and calculated surface-water flows. Moreover, the structural study of transmissivity variability of the system by variography makes clear that the heterogeneity of the aquiferous field, in our case, does not present the transmissivity from being structured. The transmissivity estimation and the calculation of the variance at the grid knots of 1 km large is carried out using kriging. The maps so obtained have a practical interest since they enable a reliable transmissivity estimation at every point by associating to it standard deviation. They also enable checking the fit of the model and testing quickly possible change in transmissivity.
Thus, the superposition of the results issued from the calibration of the model and from the interpretation of the stratigraphic data proves that the aquiferous system can no longer be considered as homogeneous, but divided in two hydrogeological basins of differentiated hydraulic properties. Structural informations may now be considered as a mean of a partial indirect identification of the behaviour of the alluvial aquifer system.
The strong correlation between the tectonic features and the spatial variability of the calibrated transmissivity values is significant. In the near future, it is logical that structural information will provide, in an indirect manner, a means of improving the predictability of the alluvial aquifers.

DARCY 99

Studing of dynamic of groundwater intruding at working off gas dip osit using mathematical modelling

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This mathematical model is focused on studying dynamic of head decrease in intruding ground water flow, while the rise of gas-water contact occurs during working off gas deposit.
In this case the process of head decreasing can't be considered as a result of water withdrawal during exploitation of water supply systems that often is specified on the model as boundary conditions of the second type with determined negative discharge. Thus, studying of groundwater penetration occurs in two steps.
On the first step the process of movement of gas-water contact was reproduced. As criteria of the model adequacy with reference to the studying process the following factors were controlled:
• The rate of gas-water contact raise;
• The volume of intruded water including total and annual.
Due to negligible values of plane flow, the raise of gas-water contact can be described by the following equation:

$$(Z_b - H)G_{III} = \hat{\mu}\frac{\partial H(x,y)}{\partial t},$$

where $Q = (Z_b - H)G_{III}$ is an annual intruding water volume (this volume is a result of vertical flow affluent, assigned on the model by the boundary condition of the third type); GIII is the hypothetical parameter of conductivity, received by solving of the inverse task. The data of absolute values of the surface of gas-water contact seams to be more reliable whereas the second parameter is a calculated value. So, only the order of such value can be reflected on the model but not it exact value
On the second step the head decreasing process was reproduces. It occurred as a result of filling of empty underground area by confined groundwater flow during gradual gas-water contact moving. Negative capacity flows for each calculated time-step, being received as a result of the modeling on the first step, were determined as a boundary condition of the second type. The adequacy of the model to the reproducing process was controlled according to regime data by observations wells situated below initial gas-water contact. This modeling was carried out by the use of author's special software "Aquasoft".

DARCY 108

Gestion des systèmes aquifères alluviaux dans le Bassin Adour-Garonne : Modélisation de la nappe alluviale de la Garonne

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Résumé
Les nappes alluviales de la Garonne présentent un enjeu majeur du fait de leur grande accessibilité et de leur relation avec le débit du cours d'eau, considéré comme déficitaire dans le SDAGE Adour-Garonne. Afin de gérer plus finement la réserve en eau souterraine en fonction des différents besoins et d'améliorer la connaissance du fonctionnement des aquifères alluviaux, des programmes de modélisation hydrodynamique des écoulements de la nappe alluviale de la Garonne ont été lancés dans les départements de Lot-et-Garonne, de Tarn-et-Garonne, de la Haute-Garonne et de l'Ariège. Les résultats des modélisations en régime transitoire seront utilisés pour concevoir un outil de gestion destiné aux services de la Police de l'Eau et permettant de rationaliser les autorisations de prélèvements pour les usages agricoles, industriels et d'alimentation en eau potable. Le modèle permettra également de revoir la délimitation des nappes d'accompagnement de la Garonne et de ses principaux affluents.

Contexte

Les aquifères alluviaux du bassin Adour-Garonne constituent des ressources importantes pour deux (2) raisons principales :

- leur abondance, leur facilité et leur faible coût de mobilisation les rendent économiquement intéressantes, notamment pour l'activité agricole fortement développée dans les plaines alluviales,
- leur relation étroite avec la rivière dans un sens (recharge de la nappe par la rivière en période hautes eaux) comme dans l'autre (alimentation de la rivière par la nappe et soutien de son débit en période d'étiage).

Dans le bassin, un plan de gestion des étiages (PGE) pour la Garonne a été élaboré en 2004. Il fait le constat que le fleuve et ses affluents sont classés par le Schéma Directeur d'Aménagement et de Gestion des Eaux (SDAGE) en cours d'eau déficitaires, voire très déficitaires. Il prévoit de restaurer les débits d'étiage et de concilier les usages entre eux en garantissant une solidarité de bassin versant, ainsi que le bon fonctionnement des écosystèmes.

Compte tenu des relations d'échanges existants entre ces cours d'eau et les nappes alluviales, les autorités des différents départements chargées de la Police de l'Eau doivent gérer au mieux les différentes demandes en eau (Alimentation en Eau Potable (AEP), Irrigation, Industries…) tout en préservant le débit d'étiage des rivières. Pour cela, il est nécessaire

d'achever la délimitation de la nappe d'accompagnement, et de fournir aux gestionnaires les outils permettant d'ajuster au mieux les autorisations de prélèvement aux capacités du milieu.

En effet, les différentes terrasses alluviales contiennent des aquifères libres en connexion hydraulique, majoritairement drainées par les grands cours d'eau. La connaissance du fonctionnement de ces systèmes en vue de leur préservation et de leur gestion implique de mettre en œuvre une modélisation hydrodynamique des écoulements.

Objectifs

La volonté commune des services de la Police de l'Eau et de l'Agence de l'Eau d'adapter au mieux les prélèvements à l'état de la ressource en eau souterraine a conduit le BRGM à proposer des programmes d'étude pour la mise en place d'une gestion maîtrisée des nappes alluviales le long du cours de la Garonne et de ses principaux affluents.
Ces projets sont mis en œuvre à l'échelle du bassin Adour-Garonne. Ils concernent, en Aquitaine, le département de Lot-et-Garonne (47) et en Midi-Pyrénées, ceux de Tarn-et-Garonne (82), de l'Ariège (09) et de Haute-Garonne (31). Leurs avancements sont variables selon les secteurs : l'étude est en voie d'achèvement en Tarn-et-Garonne, en cours de réalisation en Lot-et-Garonne et en Ariège, et va prochainement démarrer dans le département de la Haute-Garonne (cf. Figure 1).
Pour chaque secteur, la conception du modèle hydrodynamique s'appuie sur les données collectées lors de la réalisation de la synthèse géologique et hydrogéologique. Sur la base des résultats fournis par le modèle en régime transitoire, un outil de gestion des ressources alluviales est développé pour répondre aux besoins des services chargés de la Police des Eaux. Il présente le double objectif de mise en adéquation des ressources et des besoins et de compréhension du fonctionnement des aquifères dans un souci de préservation quantitatif et qualitatif.
Ces outils sont conçus sur une structure commune aux différents départements du bassin concernés, mais peuvent ponctuellement répondre aux spécificités locales.

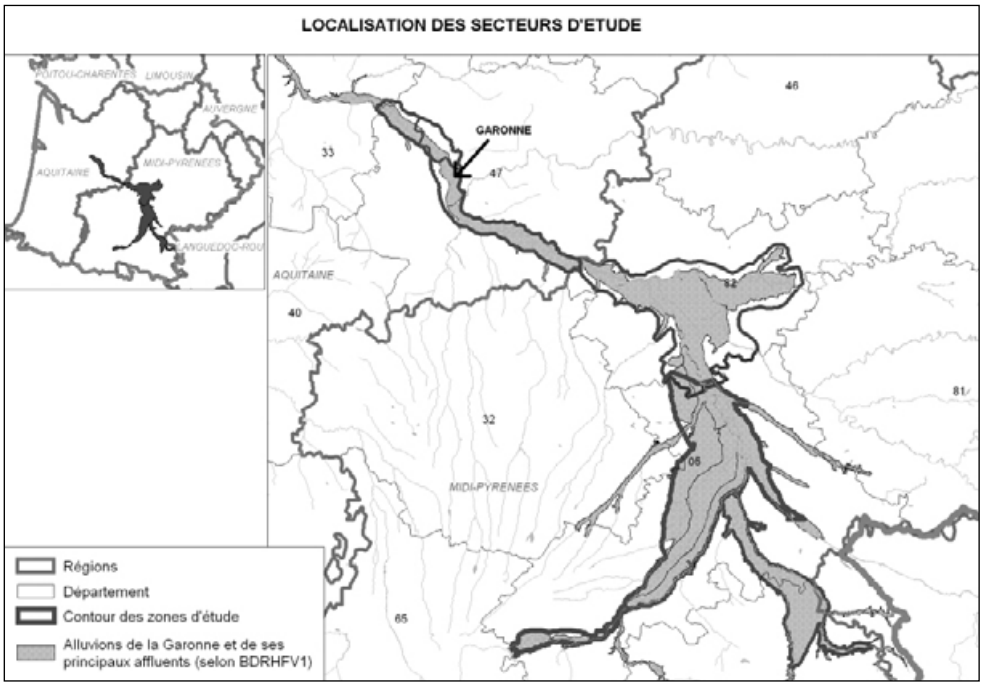

Figure 1 : Carte des secteurs d'étude concernés par la nappe alluviale de la Garonne

Programme général et avancements des études

Le programme commun aux études mises en œuvre dans l'ensemble des départements concernés par ces aquifères alluviaux est subdivisé en trois (3) étapes principales, à savoir :**Phase 1 :** Réalisation de synthèses géologiques et hydrogéologiques des secteurs d'étude. La construction du modèle nécessite de connaître un certain nombre de paramètres pour chaque maille de calcul, tels que la géométrie de l'aquifère, la piézométrie, la transmissivité ou les volumes prélevés. Cette phase est ainsi pour partie consacrée à la réalisation d'un modèle géologique définissant la géométrie de l'aquifère alluvial et permettant de cartographier le toit du substratum et l'épaisseur des formations alluviales.
En fonction de l'importance des données existantes sur les différents secteurs d'étude, des informations complémentaires sont recueillies d'une part dans la bibliographie du BRGM mais aussi auprès des acteurs intervenant, dans les départements concernés (Chambres d'Agriculture, MISE, Conseils Généraux, DDASS…) ou à l'échelle du bassin (Agence de l'Eau, DIREN…). Cette collecte porte principalement sur :

- le recensement de l'ensemble des ouvrages captant les nappes alluviales (forages, puits, piézomètres, gravières…) et les volumes prélevés correspondants,
- les données pluviométriques et hydrologiques (débits et hauteurs d'eau des rivières),
- les paramètres hydrodynamiques déterminés lors d'études localisées (transmissivité, coefficient d'emmagasinement, perméabilité, débit spécifique…),
- des suivis piézométriques.

Parallèlement, il est prévu d'acquérir sur le terrain de nouvelles données indispensables à la compréhension du fonctionnement des systèmes alluviaux tels que :

- des cartes piézométriques de référence en période de hautes eaux et de basses eaux,
- des chroniques piézométriques sur un (1) ou plusieurs cycles hydrologiques à partir de points de contrôle répartis sur la zone d'étude,
- des mesures des fluctuations des niveaux d'eau des cours d'eau concernés également sur un (1) ou plusieurs cycles annuels,
- des paramètres hydrodynamiques des nappes par la mise en œuvre de pompages d'essais,
- des recensements des sources présentes et évaluations des volumes extraits à la nappe par ce biais.

Phase 2 : Elaboration et calage de modèles de simulation des écoulements souterrains en régime transitoire.

Cette phase 1 aboutit à une synthèse hydrogéologique à partir de laquelle un modèle hydrodynamique des écoulements est construit. Celui-ci est établi avec un maillage adapté à la densité d'informations et au problème de gestion à traiter. Ainsi ceux définis pour les aquifères alluviaux du Tarn-et-Garonne (82) et de l'Ariège (09) présentent des mailles de deux cent cinquante (250) mètres de côté.
Cette construction est elle-même polyphasées par :

- la définition de la géométrie et des limites du modèle,
- le calage en régime permanent puis en transitoire,
- la simulation de plusieurs scenarii d'exploitation permettant d'identifier les secteurs les plus vulnérables à une exploitation intensive.

Selon les cas, une zonation de l'aquifère est effectuée, en vue de la construction de l'outil d'aide à la gestion de la ressource alluviale simple, rapide et conversationnel. Cette délimitation est réalisée sur la base de critères géologiques, hydrogéologiques, et d'exploitation de la nappe, ainsi que des résultats du modèle.

Phase 3 : Développement d'outils de gestion et définition des nappes d'accompagnement.

A partir des simulations du modèle mathématique et de la zonation de l'aquifère alluvial, un programme d'aide à la gestion de la ressource alluviale est élaboré en étroite concertation avec les services chargés de la Police des Eaux. Le choix s'est porté sur le développement d'un outil à partir d'une interface Excel considérée comme plus ergonomique, conviviale et de prise en main rapide.

En 2005, un prototype a été élaboré pour le département de Lot-et-Garonne. Celui-ci prend en compte des situations climatiques différentes de façon à moduler les Volumes Prélevables Admissibles (VPA) en fonction de l'état de la ressource.

L'objectif est donc de fournir un outil de planification et d'aide à la décision. Celui-ci sera structuré de façon à offrir deux (2) possibilités de gestion :

- Gestion « anticipée » : Des Volumes Prélevables Admissibles (VPA) dans la nappe seront définis sur la base d'une recharge hivernale et printanière du système alluvial correspondant à année moyenne. Cette option permettra en comparant les VPA aux volumes demandés lors de la délivrance des autorisations de déterminer les secteurs risquant la surexploitation.
- Gestion « régulée » : Elle fournira des Volumes Prélevables Admissibles dans la nappe en fonction d'une part de la recharge hivernale observée et d'autre part d'une évolution printanière choisie par l'utilisateur. Si les prévisions se confirment, celui-ci aura la possibilité de vérifier l'adéquation entre les prélèvements autorisés en un premier temps et la capacité de la ressource. Dans le cas contraire, des restrictions de prélèvements pourront être envisagées par l'utilisateur.

L'élaboration de l'outil est actuellement en cours de finalisation pour le secteur du Tarn-et-Garonne. Dans un souci d'homogénéisation à l'échelle du bassin, celui-ci reprendra les mêmes principes de fonctionnement.

Par ailleurs, les contours de la nappe d'accompagnement de l'ensemble alluvial de la Garonne peuvent être définis à partir du modèle mis en place et des données recueillies, telles que les valeurs de transmissivité, de coefficient d'emmagasinement et de débit d'étiage.

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Hydrogeological conceptualisation using stratigraphic and petrophysic modelling Development of a nested hydrogeological model Paris basin / Meuse-Haute Marne

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Spatial variability of the permeability and the porosity is of importance for far and near field groundwater modelling to identify the flow pathways and to estimate the water residence with the aim of characterising potential nuclear waste repository area. The acquisition of the permeability and porosity parameters which are sparsely distributed is costly. Approaches are applied, to develop a nested conceptual model at regional and local scale that incorporate the hydrogeological units characterized by petrophysic parameters spatial distributions resulting from the litho-stratigraphic simulations constrained by oil boreholes, Andra Boreholes and physiographic data. The groundwater flow model is calibrated against the measured hydraulic head (at local scale Meuse/Haute-Marne region) and hydrostatic pressure (700 measures over the Paris Basin from Trias to Cretaceous). The discrepancy between the computed and measures is about 12 % and 4 % respectively at regional and local scale, is assumed to be good result for a model constrained by the lithologic variability and calibrated against measured hydraulic head and hydrostatic pressure

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