

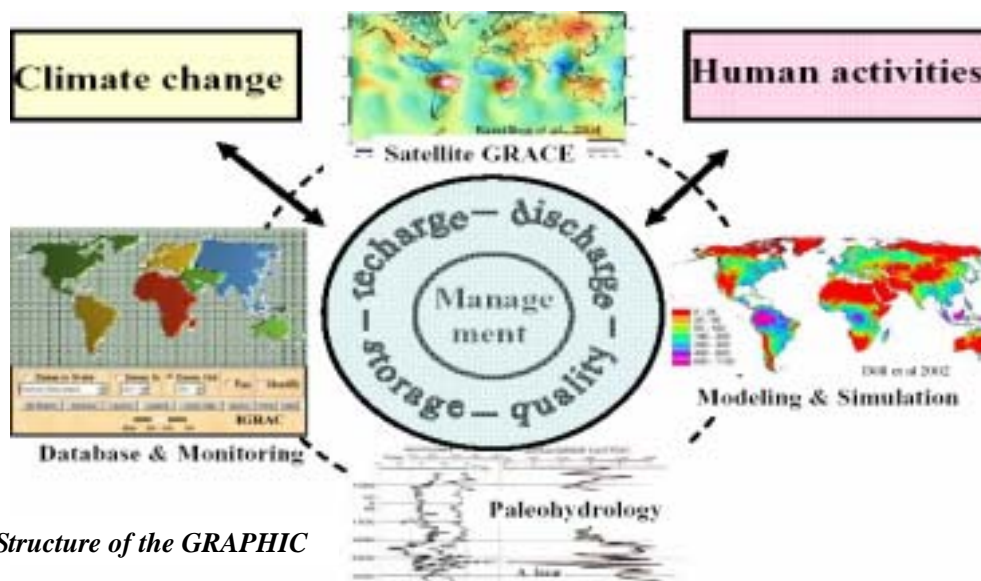
## **GRAPHIC (Groundwater Resources Assessment under the Pressures of Humanity and Climate Change)**

### **Purpose of the project**

Groundwater is an extremely important natural resource as a primary source for agriculture, domestic and industrial water supplies in many countries. The groundwater also acts as a precious environmental component for humanity. However, the recent increase in population on the earth causes deterioration of groundwater resources. In addition to this, recent global warming will cause changes in groundwater recharge rates, and increasing sea levels will cause saltwater intrusion. In order to maintain the sustainable uses of groundwater resources, evaluations of changes in not only groundwater storage but also groundwater fluxes (recharge rates and discharge rates) are necessary and extremely important. This project will deal with groundwater resources assessment and future forecasting under the various pressures of humanity and climate changes.

### **Structure of the project**

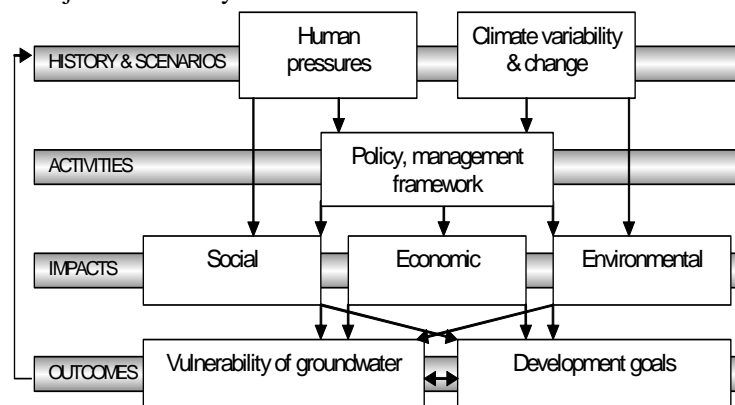
To make the **GRAPHIC** project and its sub-elements manageable, the structure of the project will be divided into; (A) **Subjects**; thematic, cross-region issues (1:Recharge, 2:Discharge, 3:Storage, 4:Quality, 5:Management), (B) **Methods**; methodological approaches (1:Database and Monitoring, 2:Satellite GRACE, 3:Modeling and Simulation, 4:Paleohydrology), and (C) **Regions**; representative geographical areas, where pilot studies will be made. (1:North and South America, 2:Europe and Russia, 3:Asia and Oceania, 4:Africa).



*Structure of the GRAPHIC*

### Targets and plans of the project

The **GRAPHIC** project has identified the following problems and research needs related to groundwater **recharge** and **discharge**: 1) spatial and temporal scaling issues; 2) quantitative plant physiology and succession for environmental stress responses; 3) hydrological boundary conditions affecting recharge and discharge; 4) feedbacks associated with societal adjustments in land/water resource management; and 5) coupled atmospheric – hydrologic - oceanographic processes. Nutrient and material transports through groundwater recharge and discharge are the keys for groundwater **quality**. Reduction of available groundwater storage due to contamination and ecological impacts are keys of the GRAPHIC, as well as groundwater **storage** change due to vigorous human activities. Systematic analysis of stakeholders and groundwater-related policies is a crucial part of GRAPHIC. Groundwater **management** is typically characterized by a many objectives, impacts, policies, and stakeholders, and of variables that are known with a low or very low level of accuracy. Those variables are strongly interconnected, and belong traditionally to different scientific disciplines. The *basin-scale pilot studies* will be made in each region by the subject experts and local scientists. We will operate “intercomparisons” using four methods to evaluate each subject intensively.



**Management framework of the GRAPHIC project**

### Expected products of the project

The project will not only provide a better understanding of the functioning and change of groundwater resources under the pressures of humanity and climate changes, but also address scenarios and future developments for regional scales to the global groundwater assessment and synthesis effort. Products will include: (1) Database of the magnitude of changes in groundwater resources, (2) Methodology for evaluating groundwater resources due to climate change and human impacts; (3) Regional synthesis for evaluation in the global network; (4) Protocols for integrated assessment, modeling and forecasting for dissemination in training workshops.

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