Towards integrated, connected, intelligent and intelligible management of regional groundwater resources

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This talk represents a personal perspective on the potential future orientation of regional water resources management based on a career dedicated to the development of knowledge about groundwater resources in Quebec, Canada, but which has not yet led to the use of that knowledge to adequately manage water resources, especially groundwater. Still, in Quebec many developments have been made or are being made towards regional water resources management. Concerted efforts over the last 20 years have provided the base upon which the approach to regional water management described in this talk could be developed, even though important efforts are still needed. This talk will provide some examples of the main developments.

The management of regional water resources, both surface water and groundwater, must benefit from data providing a good knowledge of the resources, the understanding of flow systems based on representative numerical models, and the formulation of sound management plans based on this understanding. Sustainable water resource management must consider the evolution of water needs, requires indicators of the state of resources and their response to management actions, and the progressive and continuous development of the knowledge and understanding of the resources.

Such management ought to be "integrated", first by considering surface water and groundwater together, then by protecting both municipal and private residential water supplies, and also by combining a wide range of interrelated tools. These tools include 1) data and maps of the flow system, 2) observation networks (weather, surface water and groundwater), 3) coupled numerical models considering surface water and groundwater, 4) a management plan benefiting from a decision-support system, 5) participative decision-making involving water stakeholders, and 6) sustainable management indicators. This management must also be "connected" by being continuously fed by data defining the state of water resources, notably on the basis of monitoring networks and sustainable management indicators. This management should also be "intelligent" and thus based on an in-depth understanding of the flow system, notably through the use of representative numerical models. These models have to be maintained "alive" over decades and improved through the assimilation of monitoring data in order to continuously improve the understanding of the flow system and ensure plausible predictions. Finally, this management has to be "intelligible" through careful "translation" of technical concepts, prompt dissemination of studies to stakeholders and general open access to data and metadata. Such democratization of information should empower stakeholders to allow their active participation to the management of the resources they depend upon.