Preface

This IAHS publication has been compiled in the light of the main theme of the IAHS Scientific Assembly in Maastricht in 2001, entitled "A New Hydrology for a Thirsty Planet", which addresses the rapidly increasing global demand for freshwater and the high vulnerability of freshwater resources. The still increasing pressure of human activities on hydrological systems has in many cases resulted in depleted water supplies, falling water tables, diminished stream flows, and a widespread contamination of surface water and groundwater.

Human activities are intricately linked to the evolution and dynamics of groundwater quantity and quality. For example, groundwater abstraction has increased to complement the increasing water demand of a continuously increasing population. Water quality of abstracted water is affected by irrigation and additions of agrichemicals to infiltrated water, especially in regions where groundwater is the major source of potable and agricultural water supply. Given the alarming rate of land-use change globally, it is important to understand the linkages between land-use change and groundwater dynamics, as land use affects the quantity and chemical quality of recharge water. The recharge directly determines the natural dynamic behaviour of the groundwater system, and is (hence) often the most important driving force in groundwater systems. In many areas, groundwater is the major source of surface water, and in other areas, surface water infiltration is a major source of recharge. Consequently, understanding the interaction of groundwater and surface water is important to the understanding of groundwater dynamics. In addition, geochemical aquifer characteristics have to be quantified to enable prediction of both the movement and contamination of groundwater.

In this volume, the impact of a number of human activities on groundwater resources and dynamics, such as urbanization, land-use change and groundwater contamination is evaluated. In addition, several hydrological processes that need to be known to adequately assess the impact of these activities, such as methods for quantifying recharge, for geochemical characterization of aquifers, and for the modelling of contamination transport, are investigated. The volume is subdivided into five themes:

Quantification of groundwater recharge

Quantification of recharge rates is essential in any water balance study. Calibration of groundwater model parameters is only meaningful if the recharge rate and its uncertainty are known. Recharge may be estimated from tracer studies, hydrometric measures of soil water content, groundwater levels, and micrometeorological measurements. In this volume, papers are included that address methods for groundwater recharge measurement for both arid and temperate conditions. A number of papers address the formulation of upper boundary conditions in groundwater flow models. Also included are papers that investigate changes in recharge due to human interference in the hydrological system.

Urbanization and land use change

Urbanization and land use change affect groundwater dynamics by inducing changes in recharge rates, abstraction rates, etc. Groundwater quality is determined by the changes

in the quality of infiltrating water as a result of urban activities and changes in land use. Papers in this section address these consequences of human interference. Monitoring of changes is addressed as well as water management measures to counteract the negative effects.

Groundwater-surface water interaction

In many hydrological systems, the surface water and groundwater components are intricately linked, especially in lowlands and shallow aquifers. The modelling of surface water and groundwater, however, is generally carried out separately. A number of papers in this section describe modelling approaches to integrate surface water and groundwater flow components at a regional scale. Other papers investigate the interaction between surface water and groundwater at the scale of a streambed.

Aquifer characterization and transport modelling

To be able to adequately predict changes in groundwater quality, information is needed not only about groundwater quality, but also about the biogeochemical reactivity of the aquifer. Increasingly, aquifers are being sampled for the determination of biogeochemical characteristics. Specific sampling and analytical strategies are needed to obtain a representative estimate of the aquifer "reactivity". This section includes papers that address aquifer reactivity, sampling strategy of aquifer materials, transport properties, and the modelling of flow and transport.

Groundwater contamination

Human activities have resulted in contamination of regional groundwater and surface water resources. Groundwater contamination is the resultant of physical mass transfer and flow processes together with biogeochemical reactions. This section includes case studies in which the fate of a number of contaminants is investigated. Several papers focus on the modelling of nitrate and pesticide leaching.

The three-day symposium in Maastricht was jointly convened by the IAHS International Commissions on Water Quality (ICWQ), Groundwater (ICGW), Water Resources Systems (ICWRS), Tracers (ICT), Atmosphere–Soil–Vegetation Relations (ICASVR), and the International Atomic Energy Agency (IAEA). The editors would like to thank the authors for the high scientific standard of their contributions.

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