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A measurable assessment of the connections between surface- and ground-water in redoes plateau, china's hailiutu river basin

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Abstract

As for the Erdos Plateau, its "Since surface water and groundwater are so intricately connected, hydrological processes are notoriously difficult to understand. The more we learn about hydrology, the better we can manage the water sources that are accessible at the same time. Long-term economic growth and poverty reduction depend on a thriving ecosystem and the responsible use of water supplies. There haven't been many studies done here to determine if groundwater withdrawal affects stream flow, and that's likely because of how intricate the water systems here are. To maintain the long-term viability of water resources management, a deeper understanding of the interconnections between groundwater and surface water is required. This study seeks to further our understanding of the groundwater-surface water exchange occurring on Erdos Plateau "with regards to how the Erdos Plateau's groundwater and surface water interact with one another.

Keyword: Plateau, Groundwater, Water Resource Management

INTRODUCTION

Hydrological cycles have long been thought of as separate entities, yet groundwater and surface water interact with each other in a number of different ways depending on the physiographic conditions (e.g. Winter, 1999, Sophocleous, 2002). Social and economic advancements across the world depend on the availability of groundwater and surface water. These interactions have been largely ignored in the development of water resource management policies because they are difficult to assess or quantitate (Winter, 1999). Findinglay (1995) said that groundwater and surface water interactions have a significant influence in stream ecosystems, and this has implications for ecology, river restoration and conservation (Boulton, et al., 2010), and the preservation of groundwater-dependent ecosystems (Zhou, et al., 2013, Bertrand, et al., 2014). There is still a lot of confusion about how groundwater interacts with surface water bodies such as rivers, lakes and reservoirs. Climate and human activities have been cited by hydrologists and hydrogeologists as the two most relevant elements, although the differentiation for them on individual situations remains difficult and contested (Milliman, et al., 2008, Uhlenbrook, 2009, Zhao, et al., 2009, Xu, 2011).

With the aim of promoting sustainable development, water resources management has been undertaken in a number of places in China (Ministry of Water Resources, China, 2005). For those who live in the arid/semi-arid regions where groundwater plays a major role in the water supply for the community and ecology, there are both institutional and technical obstacles. In arid and semi-arid regions, groundwater and surface water interactions are critical to the water cycle because the ecosystem is extremely vulnerable to water resource development. Water shortage in northwest China has been shown to be a limiting factor in the region's socioeconomic growth. Surface and groundwater resources have been managed separately in China for decades. Recently, Erdos City's municipal government has been increasingly concerned with environmental issues, sustainable development, and river basin protection. Even though surface and groundwater are two distinct resources, water management has tended to segregate them. Furthermore, the needs of ecosystems for groundwater are not well recognised and are frequently ignored or inadequately managed. Water quality and quantity can be significantly impacted by these interactions (Bordie, et al., 2007). Water resources management in terms of quantity and quality will be greatly aided by a knowledge of the Erdos plateau's groundwater-surface water interactions.

LITERATURE REVIEW

Direct field investigations (e.g. Oxtobee and Novakowski 2002) and measurements (Anderson, Anderson, and colleagues, 2005) have been used in recent studies of groundwater-surface water interactions to identify hydraulic head differences as well as chemical and isotopic tracers (Conant, 2004, Schmidt, et al., 2007). In hydrological research, remote sensing and field observations have been frequently used by means of upscaling processes (e.g. Ford, et al., 2007). It is because of this flexibility that numerical modelling approaches have been used to study the interactions between groundwater and surface water for transition zone water, as well as the importance of water balance in a mesoscale lowland river catchment, in order to conduct water resources assessments (Gauthier, 2009), and to conduct water resources assessments in different scenarios (Krause et al. 2007, Krause et al. 2007). (Scibek, et al., 2007). In an assessment of the geographical and temporal interactions between groundwater and surface water, anthropogenic impacts cannot be ignored. In prior investigations, it was found that numerous approaches were needed to quantify human influences on groundwater-surface water interactions. On the basis of synthesising scientific results on groundwater-surface water interactions, this thesis is formed.

STATEMENT OF THE PROBLEM

Erdos City in Inner Mongolia and Yulin City in Shaanxi province administer the Erdos plateau, which has an area of around 200,000 square kilometres. Deserts and barren rocks cover half of the region. Approximately 26 million people live in the country. Arid to semi-arid conditions are typical in the country's interior. The annual average precipitation varies from 400 mm/year in the east to 200 mm/year in the west, making it a dry region. The annual evaporation rate might be as high as 3500 millimetres, which is a lot. Surface water supplies are restricted because the potential evaporation is greater than the precipitation. Groundwater is the primary source of water on the plateau (Gao, et al., 2004). Groundwater is the primary source of life for most terrestrial ecosystems. Overgrazing and cultivating operations, however, worsened the ecosystem's decline. The Erdos plateau is plagued by desertification, soil erosion, and other forms of land degradation (Wang, 2008). One of China's new energy bases, Erdos is situated inside China's Yellow River watershed and is a priority location for China's western development plan in the 21st century. Economic growth has been accelerated by the extraction of coal, natural gas, oil, and minerals in the region. Increasing water demands from business, agriculture, society, and the ecology provide a challenge to local governments that must be met in order for them to meet their mandates. This has already put undue strain on already-fragile water infrastructure, with potentially fatal results. Surface water balance management has always considered Erdos plateau groundwater as a loss term or static storage. Because to the omission of groundwater-surface water interactions, streams, aquifers, and groundwater-dependent ecosystems have been depleted and degraded. Groundwater and surface water interactions occur in a variety of ways depending on the physiographic and hydro-climatic circumstances in which they take place. However, these relationships are frequently influenced by human activity to an extent that is little unknown.

OBJECTIVE OF THE STUDY

We are trying to understand and measure how groundwater and surface water interact on the Erdos Plateau as part of this project.

These are the specific goals:

- To identify and quantify the spatial and temporal variations of GW-SW interactions

Research Questions

- How GW-SW domninate the proess of interaction?

RESEARCH METHODOLOGY

The flow simulation will becarried out using the well-known numerical model code MODFLOW (McDonald and Harbaugh, 1984). Since each numerical model grid cell is 50 by 50 m in size, the total number of rows and columns in the model grid is 310. A Digital Elevation Model (DEM) with a resolution of 30 x 30 metres is used to obtain the model's highest point. The lowest elevation of the model is derived from a little amount of borehole data. Based on the lithology, the hydrogeological factors such as hydraulic conductivity, specific yield and storage will be separated into three groups. For the Hailiutu River, MODFLOW's General-Head Boundary (GHB) package will be used to simulate deep groundwater discharge. The flow into or out of a GHB cell is estimated in proportion to the difference between the head in the model cell and the stage of the Hailiutu River in this case study. Since the Bulang stream operates as a drain and constantly receives groundwater flow, the MODFLOW Drain package will be utilised to simulate groundwater discharge. It will be necessary to model the net recharge, which will be determined by subtracting precipitation from evapotranspiration using the Recharge programme.

RESEARCH DESIGN

P, evapotranspiration (ET), discharge of the Bulang River (Q), deep groundwater circulation (D), and change in storage (dS/dt) in the watershed may be used to compute the catchment water balance:

$$P - ET - Q - D = ds/dt$$

ET and deep circulation fluxes can't be directly monitored in the field, but precipitation, discharge of the Bulang River, and changes in groundwater levels can. Based on observations of sap flow from maize, salix shrub, and willow tree sap flow at the field site, the area ET will be determined using the NDVI produced plant cover using remote sensing data to estimate the area's ET.

DATA ANALYSIS

In 2006, Ge and Boufadel "Moreover, Wagner and Harvey (2007) investigated the precision of tracer approaches for monitoring the movement of water between underground and above ground (2001). At high baseflow levels, they found that the stream tracer approach would be immune to surface-to-subsurface exchange. It is clear from the hydraulic gradients and thermal approaches that groundwater discharge to the surface water predominates along this 180 m reach, mitigating the danger of overestimating groundwater discharge due to the loss of solute. Seepage calculation uncertainty may be affected by a number of factors in this case study, including the EC value of groundwater along the stream bank, EC measurement errors along the reach, and discharge measurement errors. Using a hypothetical error distribution, we will investigate the impact of potential EC and discharge measurement errors on the calculated seepage. Groundwater monitoring wells in the stream valley show a large variation in EC values (510 S/cm), which is likely due to irrigation. The projected electrical conductivity (EC) values for natural stream water are lower than those for groundwater. Thus, a 5% variation in the mean is used in the sensitivity analysis. An EC increase or reduction of 5% at various points along the river will be utilised to evaluate the "groundwater seepage and discharge rate estimation influenced by measurement inaccuracies.

CONCLUSION

In light of this, "The Erdos Plateau, located in northwest China, will be the focus of study on the relationship between underground and above-ground water. Through a multidisciplinary approach, we will quantify groundwater-surface water interactions in the Hailiutu River catchment. The water cycle, chemical composition (including stable isotopes), temperature, and modelling can all be investigated. Chemical and isotopic profiles in a river's tributary will be collected by fieldwork, in-situ data from the past and present, and sub- and watershed-scale numerical modelling will be utilised to draw conclusions "these methods. The results of this study may be used to support many hypotheses.

LIMITATIONS OF THE STUDY

Groundwater-surface water interactions have been studied using a variety of ways. Rather of relying just on field measurements to detect and quantify groundwater-surface water interactions, this thesis utilised a variety of approaches, including numerical modelling, isotope analysis, temperature monitoring, and a variety of other techniques. Both groundwater and surface water can be impacted by the exchange of solutes between soil, rocks, and the water. Because of the evaporation and artificial release of solutes, salt builds up on the top soil, further complicating the chemistry of the various constituents. As a result, this study's approach of estimating groundwater seepage rates using the chemical profile along the stream provides a novel and efficient method to directly measure seepage rates along the river at a low cost and high level of dependability.

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