Groundwater storage and management in Songliao Plain

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1.Introduction

Water scarcity is a serious challenge under the climate change and rapidly growing water demand. In the recent 20 years, it has seen large increases in groundwater exploitation in China, principally driven by population growth. Due to the accessibility of groundwater, it has been blindly developed in some areas which has caused a series of adverse effects such as groundwater resources depletion and economic recession. Therefore, it is of great significance to reasonably evaluate the dynamic changes of groundwater as well as groundwater safe yield for the reasonable utilization of groundwater in the later stage. The purpose of this study is to deeply understand the relationship between land surface processes and groundwater systems and management groundwater resources with different water demand and climate change in the future.

2.Study area

Songliao Plain covers an area of over 350,000 square kilometers which located in Northeast China. It is including Sanjiang Plain, Songnen Plain and Liaohe plain, the aquifers contain approximately are 5.24 billion m^3, 15.02 billion m^3 and 10.99 billion m^3 of groundwater, respectively. Groundwater discharge includes 74% precipitation infiltration discharge, 23% surface water discharge, and 3% lateral flow discharge in the mountain (Yu et al., 2019). The region with annual mean precipitation between 500 mm to 600 mm and annual mean temperatures ranging from 1.4 to 4.3℃(Gou et al., 2020).

Songliao Plain is an important agricultural region which widespread groundwater exploitation for irrigation of crops. Groundwater exploitation of study area assumes 45 percent or so of total water supply, and this has been providing guarantee for regional population and food supplies. In recent 20 years, the exploitation degree of groundwater is 68.97% ~ 88.11%, which is close to the exploitable amount of groundwater. The groundwater level in some areas of Songliao Plain has continued to decline due to overexploitation and climate change.

3.Data and Methods

The groundwater level, discharge, resources data from the China Groundwater Bulletin and Songliao basin water resources Bulletin.

Water use, water supply and water management data from Jilin, Heilongjiang and Liaoning Province water resources Bulletin.

Temperature(Max,Min,Mean) and Precipitation (Total amount and Mean) station data from National Centers for Environmental Information.

First, Analyze and process the basic hydrological, meteorological and water use data and analyze the tendency. Second, the surface runoff and base flow are calculated by using SIBUC model. Through hydrological and water use data analyze the proportion of base flow in groundwater storage. Then social data is used to analyze and predict water demand in the future. At last, to calculate the groundwater exploitation with the climate change and different water demand in the future.

4.Results

4.1 Land use

The region was mainly dominated by forests and grasslands before 2000 (Land use map based on Global Land Cover Characterization information, shown as Fig.1). From 1990 to 2015, the area of 3.2906 million hm^2 which the forests and grasslands transformed into crop area. With the development of urbanization, the area of 1.0565 million hm^2 which the crop area transformed into urban area by 2020(Yan et al., 2019). Hydrology land surface processes have tremendous influence from the land use changes.

4.2 Temperature and Precipitation

The mean precipitation shows an upward trend in Anda station (shown as Fig.2) and extreme

temperature days obviously increased under the climate change. Therefore, more attention should be paid to climate change when forecasting future weather.

4.3 Water use and groundwater exploitation

We have analyzed on water use data from 2000 to 2020(shown as Fig.3). Animal husbandry-sideline and fishery production are stable, and domestic water and industrial water have a decreasing trend. On the contrary, the proportion of agricultural irrigation is more than 60%, and continue to increase in the future. Groundwater exploitation has been at a high level and has an increasing trend (shown as Fig.4).

5.Future work

Using more stations of data for meteorological analysis and SIBUC model for simulation (Tanaka.,2004).

References

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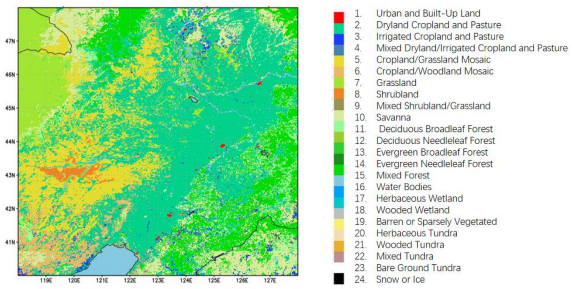

Fig.1 Land use map in Songliao plain based on Global Land Cover Characterization information

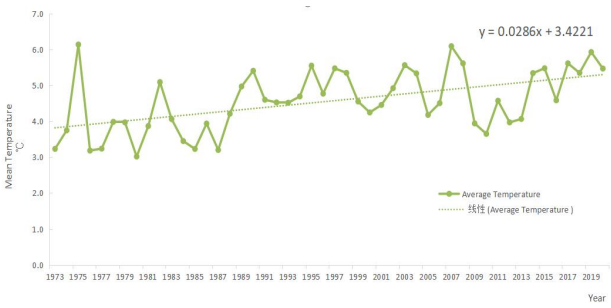

Fig.2 Mean precipitation in Anda station from 1973 to 2020

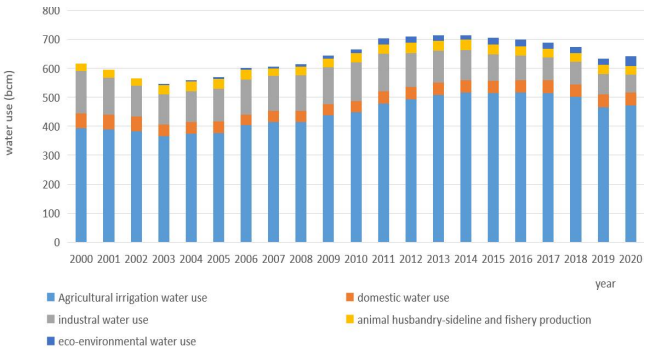

Fig.3 Water use Statistics in Songliao plain from 2000 to 2020

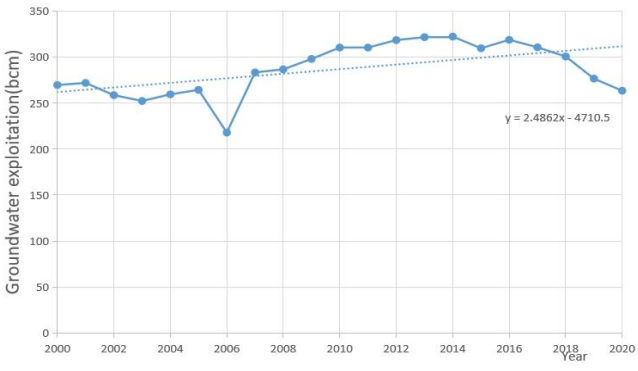

Fig.4 Groundwater exploitation Statistics in Songliao plain from 2000 to 2020