Geophysical Research Abstracts
Vol. 16, EGU2014-16230, 2014
EGU General Assembly 2014

Towards a climate impact assessment of the Tarim River, NW China: integrated hydrological modelling using SWIM

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The Tarim River is the principle water source of the Xinjiang Uyghur Autonomous Region, NW China and the country's largest endorheic river, terminating in the Taklamakan desert. The vast majority of discharge is generated in the glaciated mountain ranges to the north (Tian Shan), south (Kunlun Shan/Tibetan Plateau) and west (Pamir Mountains) of the Taklamakan desert. The main water user is the intensive irrigation agriculture for mostly cotton and fruit production in linear river oases of the middle and lower reaches as well as a population of 10 Mil. people. Over the past 40 years, an increase in river discharge was reported, assumed to be caused by enhanced glacier melt due to a warming climate. Rapid population growth and economic development have led to a significant expansion of area under irrigation, resulting in water shortages for downstream users and the floodplain vegetation.

Water resource planning and management of the Tarim require integrated assessment tools to examine changes under future climate change, land use and irrigation scenarios. The development of such tools, however, is challenged by sparse climate and discharge data as well as available data on water abstractions and diversions.

The semi-distributed, process-based hydrological model SWIM (Soil and Water Integrated Model) was implemented for the headwater and middle reaches that generate over 90% of discharge, including the Aksu, Hotan and Yarkant rivers. It includes the representation of snow and glacier melt as well as irrigation abstractions. Once calibrated and validated to river discharge, the model is used to analyse future climate scenarios provided by one physically-based and one statistical regional climate model (RCM).

Preliminary results of the model calibration and validation indicate that SWIM is able simulate river discharge adequately, despite poor data conditions. Snow and glacier melt account for the largest share in river discharge. The modelling results will devise sustainable management options for given climate change scenarios with the aim to balance water availability and water use for the basin as a whole and specifically for the riparian ecology.