1. Introduction

Launched in 2012 by Potsdam Institute for Climate Impact research (PIK, Germany), the Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP) aims to establish a long-term, community-driven process of cross-sectoral climate-impact model. The primary purpose of ISI-MIP is to reduce the uncertainty associated with the predictions of global models by creating standardized scenarios and datasets. ISI-MIP is currently in the phase 2b¹ which proposal is to elicit the contribution of climate change to impacts arising from low-emissions climate-change scenarios. The three scenarios provided by ISI-MIP2b were implemented into the H08 model,² a global scale water resource model. Six modules implemented in the H08 model (land surface hydrology, river routing, crop growth, reservoir operation, environment flow requirements estimate, and anthropogenic water withdrawal) are used to simulate both natural and anthropogenic water flow globally with water and energy balance closure. In this study, the ISI-MIP2b framework is applied to the H08 model to evaluate: (1) the quantify pure climate-change effects of the historical warming compared to pre-industrial reference levels; (2) the impacts associated for low (RCP2.6) and high (RCP6.0) greenhouse gas emissions assuming present day socioeconomic conditions; and (3) future impact for low (RCP2.6) and high (RCP6.0) greenhouse gas emissions assuming dynamic future socio-economic conditions.¹

2. Material and methods

The latest version of the H08 model was supplied with bias-corrected general circulation models (GCMs) output from three GCMs (IPSL, MIROC, and GFDL) and for the representative concentration pathways (RCPs) 2.6 and 6.0 for 2005-2299 and 2005-2099, respectively. The socio-economic conditions were fixed at 2005 levels while other input data provided by ISI-MIP consisted of land-use patterns, population data, and other human influence data (including information about dam and water use) for the duration of the simulations.¹ The simulations were conducted daily at a spatial resolution of 0.5 ° × 0.5 ° (longitude and latitude). The predicted variables including river discharge, evapotranspiration, irrigation water demand were extracted and analyzed.

3. Results

In general, the magnitude of the outputs predicted by the H08 model (such as: surface and subsurface runoff, recharge, evapotranspiration, total discharge) were of similar magnitude across different GCMs. Figure 1 shows annual mean

Figure 1: Annual mean precipitation (left) and temperature (right) for different GCMs and RCPs experiments
precipitation and temperature for different combinations of GCMs and RCPs. Note that for the GFDL simulation sets, for the pre-industrial (in red) and the RCP26 (in green) experiments, the simulated period 2100-2299 is missing due to technical difficulties. Predicted annual mean for evapotranspiration (ET) and water discharge for the world are displayed in figure 2. The range of the predicted average ETs were similar across GCMs for all RCPs, the minimum and maximum predicted annual mean ET were 393 mm and 493 mm, respectively. The ETs predicted using RCP6.0 experiment were the highest, followed by the predictions using RCP2.6 experiment. In addition, the predicted ETs using MIROC dataset were the highest possibly the result of the overall high precipitation and temperature dataset present in MIROC (Fig. 1). Such contrasted trends were however not always observed as illustrated by the predicted average total discharge (Fig. 2). The predicted average river discharge for the IPSL and MIROC GCMs were similar. In contrast, the predicted river discharge using the GFDL dataset was higher and unveiled high inter-annual variability compared with the predicted discharge using IPSL and MIROC (Fig. 2).

4. Conclusion
By providing a unified modeling framework for climate-impact model, ISI-MIP aims to reduce the uncertainty associated with the predictions of global models. In this study the outputs of the H08 model, a global scale water resource model, using ISI-MIP 2b were analyzed. The different GCMs had significant effects on the outputs of the H08 model such as ET and river discharge. The effects of the RCPs were consistent across the different GCMs and the simulations using RCP6.0 always produced clear increasing (surface runoff, subsurface runoff, discharge, ET) or decreasing (water recharge) trends as well as extrema values. Future research directions include: (1) a region based data analysis to better characterize the effect of different combinations of GCMs and RCPs, (2) a Bayesian change-point analysis to compare change-point models, and (3) the investigation of the targeted 1.5 °C increase on global water resources.

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1) ISIMIP2b Simulation Protocol (Published on 9 March 2017), url: https://www.isimip.org/; accessed 26 April 2017

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