



Figure 1. The location of the Heihe River basin in red in the inset to provide its geographic context in Asia. The upper basin is outlined in purple, the middle basin in green and the lower basin in orange. The Badain Jaran Desert is labeled and is hydrologically connected to the basin. The gaged inlets between the upper and middle basin are in purple. The two river gages on the main stem of the Heihe River are in green and were used for calibration. The locations of the Beide and Heihe River outlets are shown in orange. The two terminal lakes are colored in blue at the end of the river network. Elevation ranges from ~ 5250 to 885 m and is shown in the legend to the right.

Table 1. Source data.

Starting variable	Data source	Original units	Spatial resolution	Time of data	Model input
Geolayers	Yao et al. (2015a)	m	1 km \times 1 km	2000	Vertical discretization
DEM	HPDMC	m	1 km \times 1 km	2008	X/Y slopes
Hydraulic conductivity (K)	Tian et al. (2015b)	m d^{-1}	1 km \times 1 km	2000	K
Specific storage (SS)	Tian et al. (2015b)	m^{-1}	1 km \times 1 km	2000	SS
Specific yield (SY)	Tian et al. (2015b)	[]	1 km \times 1 km	2000	Porosity (n)
Groundwater boundary condition (GWBC)	Tian et al. (2015b)	m d^{-1}	Boundary points	Average from 2000–2012 annual Data	GWBC
Surface water boundary condition (SWBC)	HPDMC	$\text{m}^3 \text{s}^{-1}$	14 stations	2000–2012 (daily and/or monthly)	SWBC
Land cover	HPDMC	NLUD-C groups	1 km \times 1 km	2011	Land cover, Manning values

data. The intention is for this region to be considered as bedrock.

The source data had information regarding specific yield but not the required variable, porosity. A majority of the domain acts as an unconfined aquifer, with only locally confining conditions (Yao et al., 2015a, b). This was confirmed by the source data, where the difference in conductivity be-

tween aquitard and aquifer layers was not noticeable across much of the domain and was consistently much less than the decrease in conductivity with depth. For our model, we assume that specific yield can be used as a reasonable estimate for porosity. This is of course an assumption, but it is likely that the difference between specific yield and porosity is less than the considerable spatial uncertainty in specific yield. We