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Integrated optimal allocation model for complex adaptive system of water resources management (II): Case study

Yanlai Zhou [a,b,*], Shenglian Guo [b], Chong-Yu Xu [b,c], Dedi Liu [b], Lu Chen [d], Dong Wang [a]

[a] Changjiang River Scientific Research Institute, Wuhan 430010, China
[b] State Key Laboratory of Water Resources and Hydropower Engineering Science, Wuhan University, Wuhan 430072, China
[c] Department of Geosciences, University of Oslo, Norway
[d] College of Hydropower & Information Engineering, Huazhong University of Science & Technology, Wuhan 430074, China

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SUMMARY

Climate change, rapid economic development and increase of the human population are considered as the major triggers of increasing challenges for water resources management. This proposed integrated optimal allocation model (IOAM) for complex adaptive system of water resources management is applied in Dongjiang River basin located in the Guangdong Province of China. The IOAM is calibrated and validated under baseline period 2010 year and future period 2011–2030 year, respectively. The simulation results indicate that the proposed model can make a trade-off between demand and supply for sustainable development of society, economy, ecology and environment and achieve adaptive management of water resources allocation. The optimal scheme derived by multi-objective evaluation is recommended for decision-makers in order to maximize the comprehensive benefits of water resources management.

1. Introduction

This is part 2 of the paper on integrated optimal allocation model (IOAM) for complex adaptive system of water resources management. It presents case study, results and discussion in accordance to the application of IOAM described in Part 1. The Dongjiang River basin located in the Guangdong Province of China is selected as a case study. The main objective of this application is to determine the capability of the proposed methods to adaptively manage water resources allocation.

2. Case study description

The Dongjiang River basin is one of the main sources for available surface water in the Guangdong Province of China found in numerous reservoirs and rivers. The river tributaries contain Lijiang river, Xinfengjiang river, Qiuxiangjiang river, Gongzhuangshui river, Xizhijiang river and Zengjiang river from upstream to downstream in Dongjiang River basin. The administrative cities include Meizhou city Heyuan city, Shaoguan city, Huizhou city, Dongguan city, Shenzhen city, and Zengcheng city in Dongjiang River basin. Three kinds of nodes including reservoir node, water user node and hydrological station node are used to generalize the elements of Dongjiang river basin. Three reservoirs with strong regulation capacity, i.e., Xinfengjiang reservoir, Fengshuba reservoir and Baipenzhu reservoir are selected as reservoir nodes. Four hydrological stations, i.e., Heyuan, Xizhijiang, Boluo and Guanhaikou are selected as hydrological station nodes. The behaviors of water user nodes include water intake from river and water return to river. The Dongjiang River basin in the Guangdong province is divided into six water use regions with water-intakes No. 1–6 according to the locations of reservoir node, water user node and hydrological station node. Sketch of the Dongjiang River basin is shown in Fig. 1. Characteristics of Dongjiang River basin and reservoirs are shown in Tables 1 and 2.

3. Results and discussion

3.1. Calibration of integrated optimal allocation model

3.1.1. Model inputs, boundary conditions and algorithm parameters

The meteorology, hydrology, reservoir and hydropower station parameter, production and domestic water use and demand, ecological water demand, sewage treatment, population, economic growth rate as well as optimal algorithm parameter data, etc., are required for input of integrated optimal allocation model. The data includes: (1) meteorological and hydrological data extracting

* Corresponding author at: Changjiang River Scientific Research Institute, Wuhan 430010, China. Tel./fax: +86 27 68773568.
E-mail address: zyl23bulls@whu.edu.cn (Y. Zhou).

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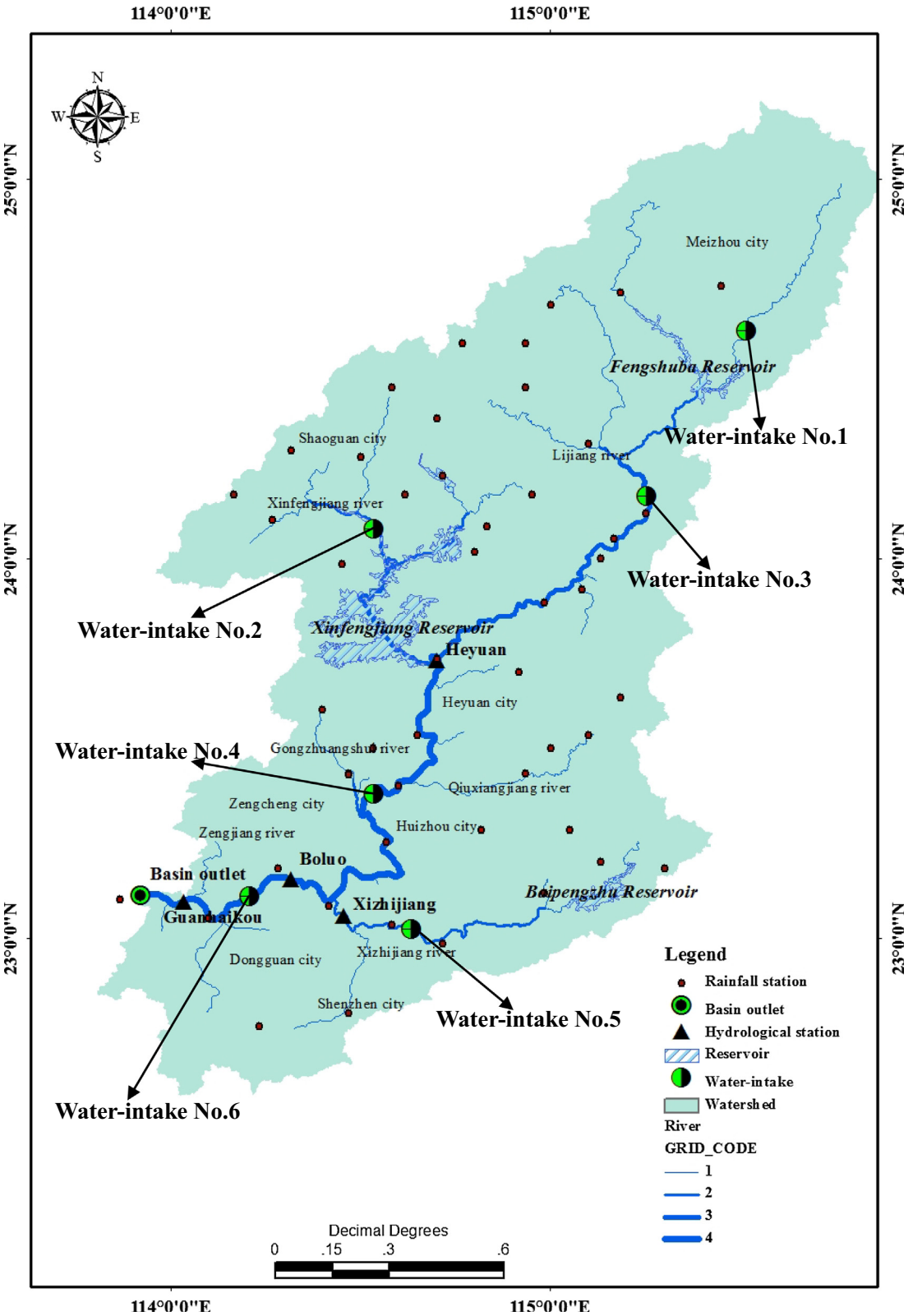

Fig. 1. Sketches of Dongjiang River basin in the Guangdong Province of China.

from Portal of Chinese Science and Technology Resource (http://www.escience.gov.cn), rainfall of 2010 year selected as typical year is close to annual average rainfall in Dongjiang river basin; (2) the characteristic parameters of Xinfengjiang reservoir, Fengshuba reservoir and Baipenzhu reservoir in Dongjiang river basin, as shown in Table 2, extracting from Dongjiang River Basin Administration (http://www.djriver.cn); (3) production and domestic water use and demand, as well as sewage treatment parameters, extracting from Water Resources Department of Guangdong Province (http://www.gdwater.gov.cn); (4) Tennant described an