Thematic issue: water of the Erhai and Dianchi Lakes

Shengrui Wang¹ · Binghui Zheng¹ · Cui Chen² · Max Dohmann³ · Olaf Kolditz⁴

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Eutrophication of surface waters is a severe problem worldwide (Dimberg and Bryhn 2014; Harmon et al. 2014; Christia et al. 2014; Renjith et al. 2013; Sedlacek et al. 2013; Antunes et al. 2013; Rinke et al. 2013; Watchorn et al. 2013; George et al. 2013; Ivashechkin et al. 2004) but particularly important to China because of the use of water resources from the huge rivers originating in the Tibetan plateau flowing through the North China Plain into the Pacific Ocean. The water quality issue includes nutrients (Ji et al. 2014; Wu et al. 2013) and phosphorus (Chen et al. 2014; Yuan et al. 2014; Zhu et al. 2013; Liu and Chang 2013; Marjore et al. 2013).

Recent thematic Issues in EES were dealing with Integrated Water Resources Management under different hydrological, climatic and socio-economic conditions (Kalbus et al. 2012; Grathwohl et al. 2013) including topics like progress in monitoring and modelling concepts

(Beinhorn et al. 2005; Beyer et al. 2006; Kalbacher et al. 2012; Rink et al. 2012) and the aquatic ecosystem functions (the harm of microcystis aeruginosa, role of macrophytes in ecological water treatment (Li et al. 2015a, b, c), see below).

“Microcystis aeruginosa is a species of freshwater cyanobacteria which can form harmful algal blooms of economic and ecological importance (Huo et al. 2015). Microcystis are the most common toxic cyanobacterial bloom in eutrophic fresh water. Cyanobacteria produce several groups of toxins, neurotoxins and peptide hepatotoxins, such as microcystin and cyanopeptolin”.¹ Several case studies have been reported recently in EES. Huang et al. (2014) investigated algal bloom and factors influencing its formation in Taihu Lake from 2000 to 2011. Thi Thuy et al. (2014) studied the occurrence of cyanobacteria and microcystins in the Hoan Kiem Lake and the Nui Coc reservoir (North Vietnam).

Macrophytes are aquatic plants that grow in or near water and are emergent, submergent, or floating. In lakes and rivers macrophytes provide cover for fish and substrate for aquatic invertebrates, produce oxygen and act as food for some fish and wildlife.² Several case studies have been reported recently in EES from Brazil, India and Greece. Goldoni et al. (2014) investigated cytotoxic and genotoxic evaluation and chemical characterization of sewage treated using activated sludge and a floating emergent-macrophyte filter in a municipal wastewater treatment plant in Southern Brazil. Christia et al. (2014) studied seasonal and spatial variations of water quality, substrate and aquatic macrophytes based on side scan sonar, in an eastern Mediterranean lagoon (Kaiafas, Ionian Sea). Anshumali et al.

✉ Olaf Kolditz
ees-editor@ufz.de

¹ Chinese Research Academy of Environmental Sciences, Dayangfang 8, Anwai Beiyuan, Chaoyang District, 100012 Beijing, China

² Department of Environmental Informatics (ENVINF), Helmholtz Centre for Environmental Research (UFZ), Sino-German Research Centre for Environmental Information Science (RCEIS), Permoserstraße 15, 04318 Leipzig, Germany

³ Institute of Environmental Engineering RWTH Aachen, Kackertstr. 15-17, 52074 Aachen, Germany

⁴ Department of Environmental Informatics (ENVINF), Helmholtz Centre for Environmental Research (UFZ), Applied Environmental Systems Analysis (TU Dresden), Sino-German Research Centre for Environmental Information Science (RCEIS), Permoserstraße 15, 04318, Leipzig, Germany

¹ https://en.wikipedia.org/wiki/Microcystis_aeruginosa.

² <https://en.wikipedia.org/wiki/Macrophyte>.

(2014) investigated geochemical alterations in surface waters of Govind Ballabh Pant Sagar, Northern Coalfield, India. Bai et al. (2013) studied short-time response in growth and sediment properties of *Zizania latifolia* to water depth. Several EES works were discussing the role of algae communities in water treatment including biofilms (Wang et al. 2014; Elsersek et al. 2014; Li et al. 2014; Hallmann et al. 2013).

As one of the most important territorial resources, lakes play an important role during the economic and social development in China. In recent decades, due to irrational patterns of economic and social development, fast urbanization and under-developed facilities for pollution treatment, many lakes in China suffered from nitrogen and phosphorus pollution. The problems of water pollution and eutrophication are therefore increasingly severe. A large number of lakes remains in a state of high ecological risk, with frequent algal blooms.

In light of the significant role lakes play in economic and social development of China and the severity of the contamination and eutrophication of these lakes, the Chinese government attached great importance to protecting Lake Environment and continued to commit increasing volumes of manpower and funds to this undertaking. Especially since the 11th five-year plan, the government has carried out major scientific programmes, such as the National Water Pollution Control and Treatment programme, to lead and drive the water pollution treatment of

water basins. And some progress had been achieved. However, since China remains in a special stage during its fast social and economic development, the contradiction created by economic development and environmental protection cannot be eliminated in a short-time period. Therefore, the water pollution and eutrophication of lakes remains one of the major environmental issues in China (Wang et al. 2015b).

As one of the lake districts where the water pollution and eutrophication hit their worst, there are about 60 lakes larger than 1000 squares kilometres in Yunnan–Guizhou Plateau. The eutrophication problem of these lakes has become one of the major environmental issues that restrict local economic and social development. Due to its unusual geological and environmental conditions, the eutrophication mechanism in Yunnan–Guizhou Plateau is rather unique.

Dianchi Lake, the largest lake in Yunnan–Guizhou Plateau, was one of the most polluted shallow lakes in China (Fig. 1). It has a surface of 298 km² at 1886 above sea level. The lake extends 39 km long from north to south with a width of 13.5 km and has an average depth of 4.4 m. Lake Dianchi is the eighth largest lake in China, it is also denoted as the lake of Kunming, the capitol of the Yunnan province (Lu et al. 2013; Hou et al. 2014). Located in the lower reach of the cities and at the bottom of the valley, Dianchi Lake is situated in an area which is characterized with developed local economy, dense population, high

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Fig. 1 Location of the study areas Lake Dianchi and Lake Erhai (see also China Maps statement on the journals webpages at <http://www.springer.com/earth+sciences+and+geography/geology/journal/12665>). Sources: *Left*: Wikipedia, https://upload.wikimedia.org/wikipedia/commons/c/c9/China_administrative.png, *Right*: China Yunnan location map“von NordNordWest—Eigenes Werk, using United

States National Imagery and Mapping Agency data World Data Base II data Yunnan province administrative regions GIS data: 1:1.000.000, County level, 1990. Lizenziert unter CC BY-SA 3.0 de über Wikimedia Commons—http://commons.wikimedia.org/wiki/File:China_Yunnan_location_map.svg#/media/File:China_Yunnan_location_map.svg

level of urbanization and severe water shortage. These make Dianchi Lake as one of the most difficult to treat in China. After years of effort, results have gradually been achieved in the treatment of Dianchi pollution (Liu et al. 2015a, b). The quantity of major water pollutants such as nitrogen and phosphorus has significantly dropped. The lake is highly polluted (worst water quality Grade V) as a result of pumping untreated water into the lake for many years. Another problem is the agricultural runoff into the lake (Ma and Wang 2015).

Lake Erhai is an alpine lake (at 1972 metres elevation above sea level) in the Yunnan province in China (Fig. 1). The lake stretches 40 kilometres length in North–South direction and is 7–8 km wide. With an area of about 250 km² Lake Erhai is the second largest highland lake of China after Dianchi Lake. The lake contains about 2.5 billion cubic metres of water. Overall it has a high water quality. But high levels of nitrogen and phosphorus content exist in sediment. Its main biological groups have changed (Wang et al. 2015c). Currently, it is in the initial stage of eutrophication (He et al. 2015a, b) (Fig. 1).

In order to report the latest researching results on lake water pollution and eutrophication, and promote the prevention and treatment of Lake water pollution, supported by the “National Water Pollution Control and Treatment” programme, this thematic Issue of 26 articles took Dianchi and Erhai Lakes as examples to focus on the process and mechanism of aspects such as their water quality and evolution, sediment contamination (Li et al. 2015a, c; Wang et al. 2015c; Xue and Lu 2015; Zhang et al. 2015b), plankton (Ma et al. 2015b) and algae blooms (Ma et al. 2015a; Yang et al. 2015), fishery industry structure and aquatic plants (Yan et al. 2015). It systematically analysed the pollution process, stages characteristics and major biological group changes of Dianchi and Erhai Lakes (He et al. 2015a). It also analysed the major problems such as the evolution of the basin’s water environment, and its protection and treatment, in order to further promote and enhance the protection and treatment of Dianchi, Erhai and other lakes in China (Wang et al. 2015a; Zhang et al. 2015a, b; Zhu et al. 2015).

Acknowledgments Chinese lakes—here the Dianchi Lake became an important research object worldwide. Within the German research initiative CLIENT (International Partnership for sustainable climate protection as well as environmental technologies and services) funded by German Federal Ministry of Education and Research (BMBF) several projects started recently to support China in solving the water problems, e.g. SinoWater (coordinated by RWTH Aachen), SIGN (coordinated by TZW Karlsruhe) and Urban Catchments (coordinated by Helmholtz Centre for Environmental Research UFZ and TU Dresden). The funding of the German–Chinese cooperation projects by BMBF and Chinese Ministry of Science and Technology based on the joint declaration of 07.05.2015 is very much appreciated.

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