Scientia Iranica A (2015) 22(1), 30–46

SCIENTIA IRANICA

Sharif University of Technology
Scientia Iranica
Transactions A: Civil Engineering
www.scientiairanica.com

Developing water quality maps of a hyper-saline lake using spatial interpolation methods

S. Sima* **and M. Tajrishy**

Department of Civil Engineering, Sharif University of Technology, Tehran, Iran.

Received 7 July 2013; received in revised form 27 May 2014; accepted 25 October 2014

KEYWORDS
Urmia Lake;
Water quality;
Interpolation methods;
Kriging;
Cations;
Anions.

Abstract. Urmia Lake, the second largest hyper-saline lake in the world, has experienced a significant drop in water level during the last decade. This study was designed to examine the water quality of Urmia Lake and to characterize the spatial heterogeneity and temporal changes of the physiochemical parameters between October 2009 and July 2010. Two spatial interpolation methods, Inverse Distance Weighting (IDW) and Ordinary Kriging (OK), were used and compared with each other to derive the spatial distribution of ionic constituents as well as TDS and density along the lake. Results showed that the main dominant cations and anions in Urmia Lake were Na^+, Mg^{++}, K^+, Ca^{++}, Cl^-, SO_4^{--}, and HCO_3^-, respectively. Although water quality of the lake is homogeneous with depth, it differs between the northern and southern parts. Water quality also varies seasonally, determined by river inflows and the lake bathymetry. Moreover, with the present salinity level, salt precipitation is likely in Urmia Lake and is becoming one of the principal factors determining the distribution of solutes within the lake. This study shows that the combined use of temporal and spatial water quality data improves our understanding of complex, large aquatic systems like Urmia Lake.

1. Introduction

Lakes are valuable water resources supporting a various range of human activities including agriculture, commerce, transportation, recreation, tourism, and the production of food and energy. They also provide unique habitats for a diverse array of organisms and play a key role in the meteorological conditions of their surrounding environments. Monitoring water quality is crucial to the proper management and restoration of many lakes particularly in large lakes.

Urmia Lake is located in north-west Iran and is the second most saline lake in the world [1]. It is a shallow terminal lake which lies between 37°04′N to 38°17′N latitude and 45°E and 46°E longitude. Its surface area has been estimated to be 6059 km^2 in 1995 [2], but since then it has been declining [3] and was estimated to be only 2366 km^2 in August of 2011 [4]. Urmia Lake has been divided by a 15.4 km dike-type causeway which provides road access between the western and eastern provinces (Figure 1). A 1.25 km long opening was left in the causeway to hydraulically connect the northern and southern parts of the lake. Because of its high salinity, Urmia Lake has a low diversity of flora and fauna, and except *Artimia Urmiana Salina* and some algae species, no other living organisms exist [5]. Urmia Lake has been designated as a Ramsar Convention Site of international importance (since 1971), Biosphere Reserve (since 1976), and a national park and is one of the largest natural biotopes of *Artemia* in the world [6]. The locations of the four major islands, Kabudan, Arezu, Ashk, and Espir, which are considered as protected areas by the

*. *Corresponding author. Tel.: +98 21 66164185*
E-mail addresses: Sima@civil.sharif.ir (S. Sima); Tajrishy@sharif.ir (M. Tajrishy)