

Replies to the comments and suggestions

Dear editor and Anonymous Referee #1:

Thank you for your letter and for the reviewers' comments concerning our manuscript entitled "Recognition of spatial framework for water quality and its relation with land use/cover types from a new perspective: A case study of Jinghe Oasis in Xinjiang, China". Those comments are all valuable and very helpful for revising and improving our paper, as well as important guiding sense to our researches. The authors have studied comments carefully and have made correction which we hope meet with approval. Revised portions are marked in red in the paper and authors have tried our best to revise the manuscript based on their suggestions. The point-by-point responses to each of the comments are presented as follows.

Anonymous Referee #1

Q: The abstract should not only include the methodology, but also the novelty of this paper, so the authors should add innovation clearly in the Abstract.

Reply: Thanks to Reviewers for their suggestions in improving the manuscript. Authors have taken reviewers' comments and suggestions seriously. The abstract is revised by authors. Modified parts have been marked in red in the revised paper. Please see the article on page 1, lines to 9-29 in revised manuscript with obviously marked. Please see as follows:

To understand the relation between spatial water quality patterns and changes in land use/cover types in the Jinghe Oasis, this study divided 47 water sampling sites, which were measured in May and October 2015, into 6 cluster layers using the self-organizing map (SOM) method based on non-hierarchical *k*-means classification. Next, it determined the distribution characteristics of water quality indices for the time sequence. The water quality indices included the chemical oxygen demand (COD), biological oxygen demand (BOD), suspended solids (SS), total phosphorus (TP), total nitrogen (TN), ammonia nitrogen (NH₃-N), chromaticity (SD), and turbidity (NUT). Based on the results, we collected data on the changes in the farmland, forest-grass land, water body, salinized land, and other land types during the wet and dry seasons and combined these data with the classification results of the GF-1 remote sensing satellite data obtained in May and October 2015. We then discussed the influences of land use/cover type on water quality for different layers and seasons. The results indicate that Clusters 1 to 3 included monitoring samples from the wet season (May 2015), whereas Clusters 4 to 6 included monitoring samples from the dry season (October 2015). In general, the COD, SS, NUT, TN, and NH₃-N values were high in Clusters 1 and 2. The SD values for Clusters 1, 4, and 6 were high. Moreover, high BOD and TP values were mainly concentrated in Clusters 4 and 6. In the discussion on the relation between the different water quality

parameters and land use/cover type changes, we determined that farmland, forest-grassland, and salinized land significantly influenced the water quality parameters in the Jinghe Oasis. In Clusters 1, 2, and 6, the size of the water area, to a certain extent, also influenced changes in the water quality parameters. In addition, the influences of various land use/cover types on the water quality parameters in the research zone during the different seasons exhibited the following descending order of magnitude: farmland → forest-grass land → salinized land → water body → others. Moreover, their influences were lower during the wet season than the dry season. In conclusion, developing research on the relation between the spatial framework of the water quality in the Jinghe Oasis and land use/cover type changes is significant for the time sequence distribution of water quality in arid regions from both theoretical and practical perspectives.

Q: It is noted that your manuscript needs careful editing by someone with expertise in technical English editing, paying particular attention to English grammar, spelling, and sentence structure so that the goals and results of the study are clear to the reader.

Reply: Thanks to Revivers for encouraging Authors to revise the manuscript. Thanks to Reviewers for their suggestions in improving the manuscript. Authors have taken reviewers' comments and suggestions seriously. Authors have answered and have addressed all the concerns and questions mentioned by the reviewer. Professor Hsiang-te Kung (University of Memphis) has helped us improve the grammar and edit the manuscript carefully. Please see the revised version of the paper.

Q: In my opinion, maybe the "Discussions" as an independent part is better. Also, the authors should improve the Discussions in the section "conclusions and discussions" The subject is interesting and meaningful. I think it can be published after minor revision.

Reply: The authors have revised in the section "conclusions and discussions" based on Revivers suggestion, the "Discussions" as an independent part, and it's impovered by authors. Modified parts have been marked in red in the revised paper. Please see the article on page 9-10, lines to 339-389 in revised manuscript with obviously marked. Please see as follows:

3 Discussion

Given the seasonal differences, the unbalanced distribution of precipitation resulted in an apparent variation in the surface runoff and further imbalanced the spatial distribution of the water quality in the research zone (Fan et al.,2012; Prathumratana et al.,2008; Li et al.,2015). During the wet season (May) in the Jinghe Oasis, melted water from mountain ice and snow promote the flow in the Jing River, thereby resulting in a significant increase in surface runoff leading to an improved water quality in the rainy season compared to the dry season. During the

dry season, the aquatic plants in rivers and lakes grow as the temperature rises, which can, to a certain degree, absorb and purify part of the water quality parameters. Therefore, significant and seasonal changes in the surface runoff at the research zone are important factors resulting in noticeable differences in the spatial distribution of water quality characteristics during the wet and dry seasons. Another major factor that causes differences in the spatial distribution of water quality is the change in land use/cover, especially farmland. During the dry season, farmland areas have a greater influence on more water quality variables than they do during the rainy season because of their intensive fertilization and agricultural runoff from soil erosion (Ngoye et al, 2004;Li et al., 2009; Tran et al., 2010). Multiple factors threaten the ecological safety of the Jinghe Oasis system. Especially in recent years, the lakeside desertification zone has rapidly expanded because of the decrease in the Ebinur Lake area and the degradation of lakeside vegetation under influence of the strong winds in Alashankou. In the current overall situation, the human activities influencing land use/cover changes are directly related to the development of the vulnerable ecological area that surrounds Ebinur Lake.

Recent statistics indicate that the annual growth rate of the population in the Jinghe Oasis is approximately 2.49%, which is slightly higher than previous growth rates (Li, 2006). Under the stress of a large population, the amount of inappropriate activities that negatively impact land use/cover in the Jinghe Oasis will increase. For the last 30 years, cotton has been the major crop in the Jinghe Oasis. The results of the current study indicate that the sampling points surrounding the farmland in the research zone have lower water quality values than the other studied regions. The primary livelihoods of the urban residents around the Ebinur Lake area are agricultural and animal husbandry industries. Pollutants that result in high TP and $\text{NH}_3\text{-N}$ contents in water include the excessive application of chemical fertilizers on farmlands, the production of livestock manure in rural villages, randomly stocked garbage, and domestic wastewater. The improper application of chemical fertilizers and pesticides to a vast area leads to high water nitrogen and phosphorus contents, resulting in the spread of algae in river sections. Consequently, the amount of dissolved oxygen in the river may decrease, the water quality may deteriorate, and eutrophication may occur. Furthermore, this scenario poses a serious salinization problem. Certain measures have been implemented for the ecological protection of Ebinur Lake, such as returning farmland to forest, cultivating ecological forests, and promoting efficient irrigation and water-saving technologies. However, these measures promote the gradual expansion of the lake area and result in different degrees of negative consequences. The most apparent result has been the rise of the underground water level, which has aggravated land salinization in the lowland areas and resulted in vast expanses of uncultivated former agricultural lands. Statistics indicate that soil salinization in the Ebinur Lake area mainly occurs in Bortala River, Jing River, the villages and towns surrounding Ebinur Lake, areas downstream of the Daheyanzi River, and areas north of Bole City (Mi et al.,2010). Severe soil

salinization has seriously affected the farming of crops; therefore, some farmers have increased the amount of chemical fertilizers they apply to increase yield, which also increases the pollution of the water and soil. Others have even abandoned their land, thereby causing land use/cover change.

Most rivers in Xinjiang are characterized by a low water yield, short flow, small water environmental capacity, poor self-cleaning capability, and low tolerance to pollution. Hence, an artificial change in the land use and exploration of resources in lake regions lead to an evident correlation between land use/cover types and water quality. In addition, the scientific utilization and protection of the water resources of Ebinur Lake and the scientific application of chemical fertilizers and improvement of their application rates are important actions and should be addressed to achieve sustainable development in the agricultural irrigation zones of the Jinghe Oasis and rivers of Xinjiang.

In addition, authors have revised the figures and tables as well as words expression in the entire manuscript, please see the text.

Authors tried our best to improve the manuscript and made some changes in the manuscript. Authors appreciate for Editors/Reviewers' warm work earnestly, and hope that the correction will meet with approval. Once again, thank you very much for your comments and suggestions.

All in all, if you have any questions about our paper, please contact with me as follow address:

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Thanks very much.

Best wishes and warmly regards for you.

Sincerely yours Fei ZHANG

11th, Jan., 2017