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Mapping chlorophyll-a in upper lake, Bhopal using Irs-1C data

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Field Sampling

Field sampling in the lake has been conducted on Nov 7, 1997. The date was fixed keeping in mind the pass of the satellite over the study area during field sampling so that accurate relationship of chlorophyll -a with sensor records may be established. IRS-IC passes over the same area after 24 days.

Water samples were collected from various points inside the lake and brought for laboratory sampling. To accurately mark the location of sampling station inside the lake, a Global Positioning System (GPS) (SOKKIA-Spectrum) was used. Water samples from 45 different locations were collected. These samples were then tested in laboratory for chl-a concentration. The chl-a concentration has been determined by the spectrophotometric method (APHA-AWWA-WPCF, 1985).

Methodology

In this study ILWIS 2.1 GIS package has been used. Different bands of IRS-IC data were initially geo-referenced with the help of Survey of India (SOI) toposheet (1:50,000) of Bhopal. The lake from toposheet is digitized using ALTEK A0 size digitizer. This map is overlain on digital image data and the portion of the lake is extracted for each band. Knowing the co-ordinates (lattitude, longitude) of the sampling stations from the GPS observations, reflectance values were extracted for a 2*2 grid of pixels and the mean value was taken for all the mean reflectance values of the four bands and the correspondence chl-a concentrations at the corresponding location. Of the three bands it was found that chl-a gives best correlation with band 2 (0.52-0.58um). The image of the lake in band 2 (green band) is shown in the Figure 1. Green band has also been found to give best correlation for determination of chl-a in productive lakes by George (1987). The model obtained is of the form

Chl-a=3.73565 R2 - 230.6679

Where, chl-a is chlorophyll -a concentration in mg/cu.m. and R2 is reflectance in band2. This model has offered coefficient of correlation of 0.895. The model was found to yield satisfactory result at 5 percent confidence level in Chi-square test.

The Chlorophyll model was applied on the band2 image of the lake. This produced a map of the lake (Figure 2) with chl-a values at every point. This map was then density sliced to give four zones of chlorophyll -a distribution.

Conclusion

As can be seen in the Figure 2, the highly polluted zones are appearing in red colour. The areas showing high concentration of chl-a are the areas which are receiving untreated sewage from a hospital (Hamidia hospital) and some densely populated slum dwellings (in Karbala, Koh-e-fiza, and Khanugaon area) of adjoining areas of lake. It is also observed that near the outfalls severe algal bloom occurs. The prolific growth of macrophytes are observed near upper left banks of lake due to agricultural runoff. It is observed that a large area in middle right portion of the lake is showing very low chlorophyll - a concentration as it is away from point and non - point sources of incoming nutrients.

The conventional GIS approach of mapping chl-a distribution may be the point interpolation method. But, it is realised that this method gives poor results for points situated at a larger distance from the sampling station. Hence to get an accurate estimate fairly large number of samples are required . Whereas the methodolgy adopted in this study is based on satellite sensor records and needs fewer sampling points and offers very accurate regional picture of the whole lake for chl-a distribution.

Similarly other water quality parameters such as SSC, total dissolved solids (TDS) and several other chemicals may be modelled and a regional map may be generated using the reflectance data from spaceborne sensors.

Acknowledgement

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