ABSTRACT

Maintaining water quality in inland and coastal water bodies in good condition is of the highest priority tasks in the implementation of the EU Water Framework Directive, and a key component in water resources management. This is of great importance for Cyprus, too, since a large number of reservoir water bodies have been developed to address drought, thus calling for systematic monitoring of water quality. Conventional methods for assessing water quality rely on sampling campaigns which are costly and time consuming. Aiming to fill the gap of the conventional field methods this PhD thesis is focused on providing novel methods for monitoring large surface Case-2 (inland and coastal) water bodies in the Mediterranean region using satellite images which can provide data on a systematic basis and offer synoptic coverage. To reach this goal, ground truth data measurements (spectroradiometric, turbidity and Secchi Disk Depth) were conducted simultaneously to satellite overpasses. Afterwards, statistical analysis and modelling techniques were employed to analyse and correlate the available data.

The first goal is to identify a suitable spectral region from which turbidity can be retrieved based on the field spectroradiometric measurements obtained during an extensive 3-years field campaign over Asprokremmos Reservoir, the main study area. Secondly, the aim is to provide the suitable bands for monitoring turbidity using different satellite sensors such as Landsat, Envisat MERIS and Chris-Proba. To test the derived algorithm eight available Landsat-5 TM and Landsat-7 ETM+ satellite images which were acquired at the same time as the field campaigns were processed; and the correlation between the satellite-derived data to the ground-based measurements was found statistically significant.

The third objective is to develop an algorithm which can be used for estimating the Trophic State Index over large surface Case-2 water bodies in the Mediterranean region on a systematic basis using remotely sensed data. All the data acquired during

the field campaigns over different water bodies inland and coastal were processed in order to examine and retrieve the 'best-fit' algorithm. This algorithm is of great importance since it can be applied for a wide range of water bodies with different trophic state values based on the band ratio values of the available Landsat satellite data. As a fourth objective the diffuse attenuation coefficient for Asprokremmos Reservoir was calculated and used in order to study its optical properties. Diffuse attenuation coefficient over the Reservoir was calculated for different bandwidths. The objective was to identify the optimal bandwidth which shows the best correlation with the TSI and SDD readings. For the calculation of the Diffuse Attenuation Coefficient values, field spectroradiometric data collected at different water depths below the water surface during the field campaigns in Asprokremmos were used.

Finally, this thesis provides a reference spectral library covering a wide range of Case-2 water bodies including oligotrophic and eutrophic inland water bodies, a shallow salt-lake and several coastal areas. This can assist the characterization of any water body based on its spectral characteristics being retrieved from the available satellite data.

All the above applications can become a very valuable tool for water quality monitoring of large reservoirs in Cyprus. This tool can be used on a systematic basis by the stakeholders, such as the Cyprus Water Development Department in the near future. All the field data can be further used to develop new algorithms based on the spectral resolution of any other satellite providing the opportunity to select satellites with different temporal and spatial resolution depending on the purpose of the application and the availability of satellite images.

Keywords: water quality; field spectroscopy; remote sensing; inland; coastal