Evaluation of RapidEye-3 Satellite Data for Assessing Water Turbidity of Lake Borabey

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INTRODUCTION

In water resources management, remote sensing data and techniques are essential in watershed characterization and monitoring, especially when no data are available. Water quality is usually assessed through in-situ measurements which require high cost and time. Water quality parameters help in decision making regarding the further use of water-based on its quality. Turbidity is an important water quality parameter and an indicator of water pollution. In the past few decades, remote sensing has been widely used in water quality research.

Aim of the study

Several remote sensing studies have quantified the relationship between actual and estimated turbidity from satellite remote sensing data. However, the use of middle or low spatial resolution data is not useful in monitoring small lakes, dams or rivers. Thus, in this study, we use high spatial resolution satellite data for estimating the correlation between the in situ turbidity, and turbidity estimated from Rapid-Eye sensor.

Specific objectives were:

to retrieve turbidity from RapidEye-3, and

to correlate satellite retrieved turbidity with in-situ turbidity measurements.

Borabey Lake which is located in Emirce Village on Bozdag slopes north of the Eskisehir city center was chosen as the study area in this paper. The lake covers an area of approximately 166.559 m2 at an altitude of approximately 924 m. Borabey Dam was built between 1991-1992 by the Provincial Directorate of Rural Services at the time in order to support the local agriculture. The lake, which was allocated to be used as the Water Sports Center of Anadolu University in 1999, later was planned to be used in order to contribute to the drinking and utility water network of Eskisehir.

Borabey Dam Technical Information

Barrage Crest Length	411 m
Dam Height	23 m
Fill Volume	368.000 m³
Irrigation Area	248 ha
Storage Volume	1.600.000 m³
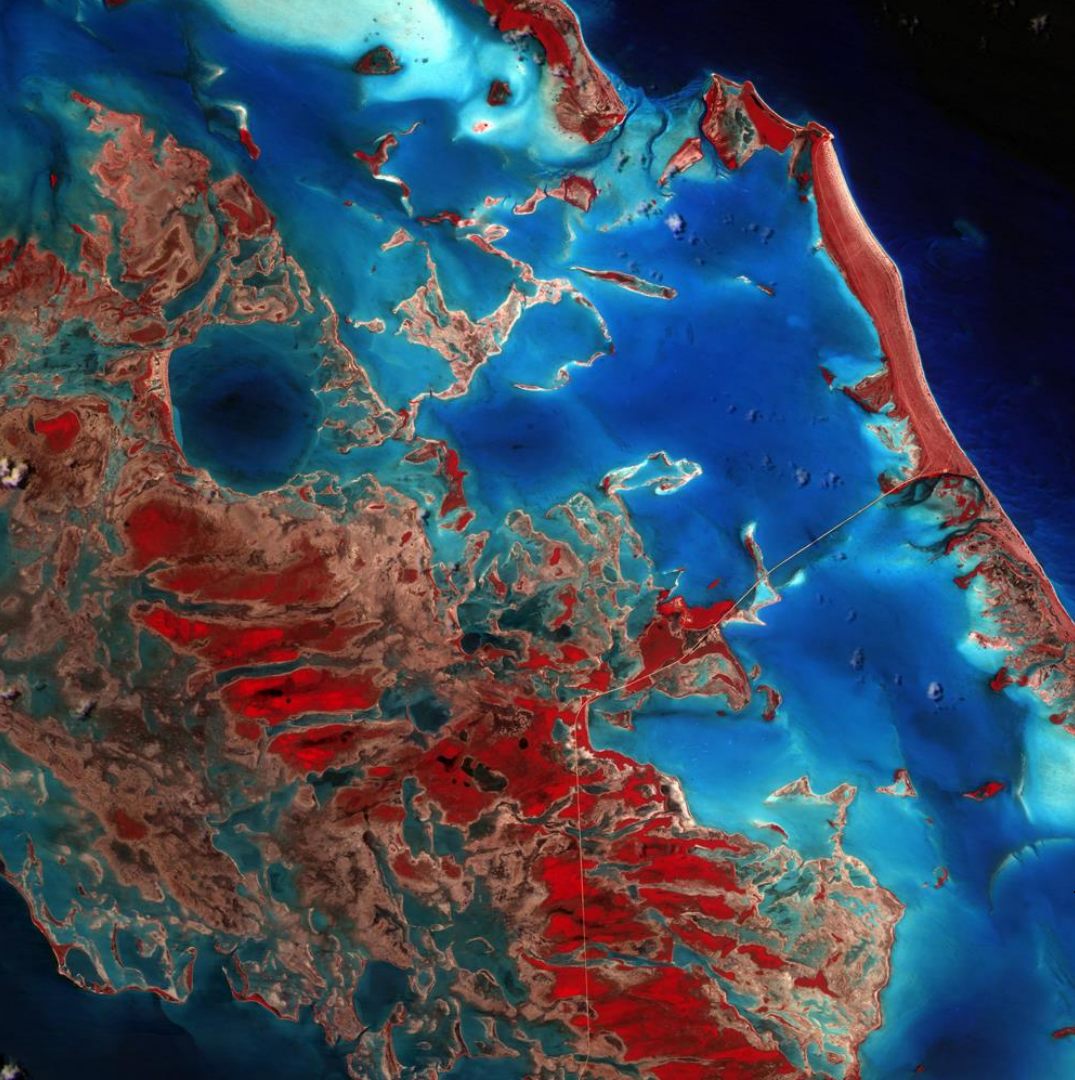
Data

Rapid Eye
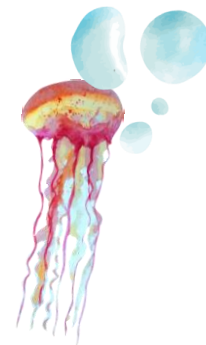
Table 2. Spectral bands for the RapidEye Satellite Constellation

Band No	Band Name	Spectral Range [μm]
1	Blue	440 – 510
2	Green	520 – 590
3	Red	630 – 685
4	Red-Edge	690 – 730
5	Near Infra-red	760 – 850
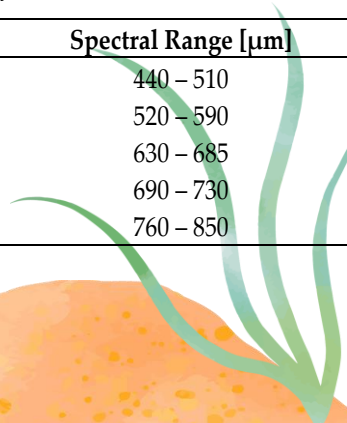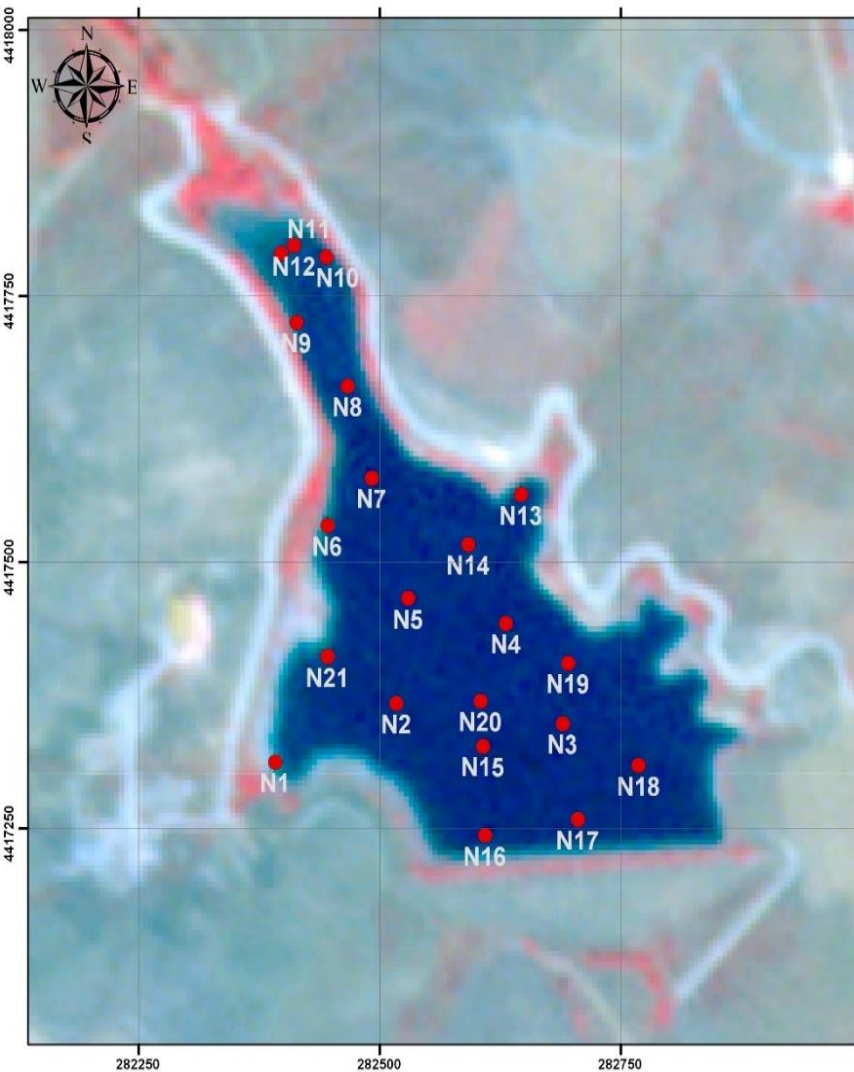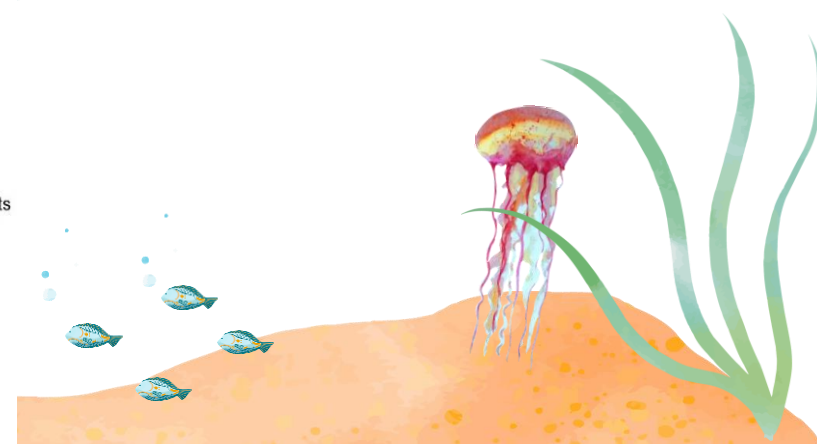
Methods

$$NDTI = \frac{Red - Green}{Red + Green}$$

Results

In order to evaluate the relationships between the actual water turbidity collected in situ and the corresponded turbidity in reflectance values estimated from remote sensing data with the NDTI statistical analyses were made.
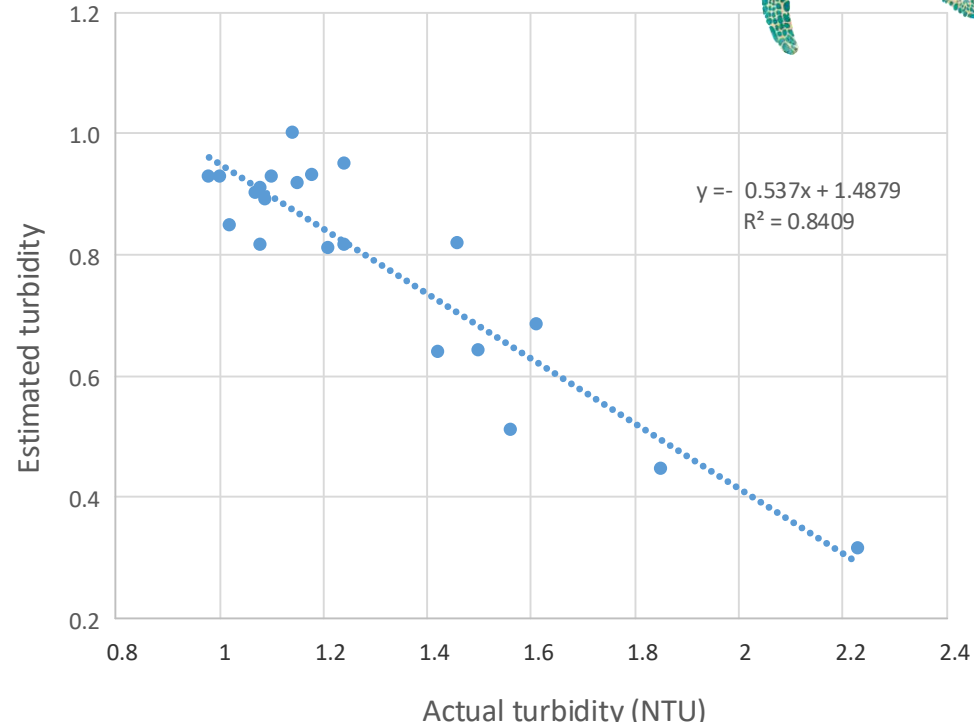
The results of the study show that the NDTI provided strong positive correlation with the actual turbidity in Borabey Lake ($R2 = 0.84$).

Pearson correlation analysis showed that the correlation coefitient (r) is 0.92, with high level of significance ($p < 0.05$).

$y = - 0.537x + 1.4879$
$R^2 = 0.8409$

Estimated turbidity

Actual turbidity (NTU)

DISCUSSION

The results of the study show that the NDTI provided strong positive correlation with turbidity in Borabey Lake (R2 = 0.84). The results are similar to other investigations where, Masocha et. al [4], found that blue/red ratio provided strong positive relation between measured and retrieved turbidity in two different lakes (R2 = 0.81; R2 = 0.65). Different turbidity retrieval approach showed a good correlation for two different study areas (R2 = 0.87; R2 = 0.66) [12]. However, the use of NDTI showed higher correlation with the actual turbidity.

This study represents another study case that confirms the use of satellite remote sensing in water quality mapping and monitoring. The essence of the paper is the use of high-resolution satellite imagery for monitoring water turbidity in small water areas.

For future studies, we recommend investigating different water quality parameters with high-resolution satellite imagery, as well as different approaches for estimating water turbidity.

THANKS!

Does anyone have any questions?

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