

Water quality parameters estimation using satellite data

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Objective

**Chlorophyll-a estimation with Satellite Data
and the correlation of it with ground
measurement is presented**

Importance of water

- Water is one of the important resources for development of land
- It controls the environment & climate.
- 70% earth surface is covered with water.
- 70% Plants and animals live in water.
- Growth in population, Industries and utilization of chemical fertilizers and pesticides affect the quality of water.
- Water management is nothing but managing Quantity and Quality of Water.
- Quality management calls for measurement of Quality.

Water Quality parameters

Different quality parameters and levels are defined based on the uses. Important quality parameters & indicators are

Physical: Turbidity, color, Ph value

Chemical: Minerals like Phosphorus, nitrogen, dissolved oxygen, carbon-di-oxide

Biological: Phyto plankton (chlorophyll-a) , micro-organisms etc.

Information generation

- Information generation on various objects on the Earth is one of the important geospatial activities.

Popular methods used to estimate water quality parameters are

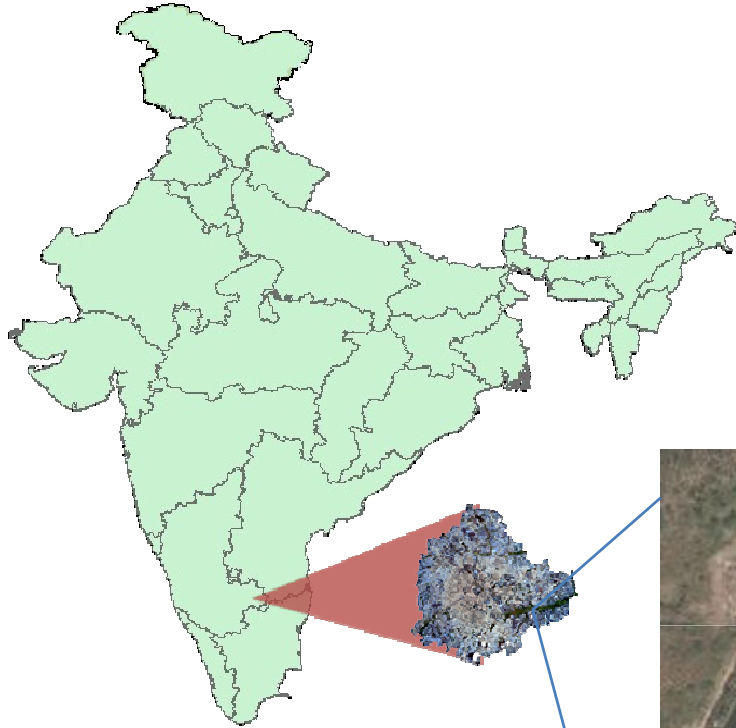
- Chemical methods
 - Spectro photo meter
 - Spectro-radiometer
 - Satellite data
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- The water quality information can be generated by in situ measurement.
 - Samples are collected from water bodies and tested in labs.
 - These methods are time consuming and collecting samples from interior water calls for more time and resources.
 - Laboratory test takes more time. testing more samples not possible.
 - Data collection using satellite is faster and gives more samples.
 - The satellite data is to be characterized with measured values.

Measurable Water quality by satellite spectral information

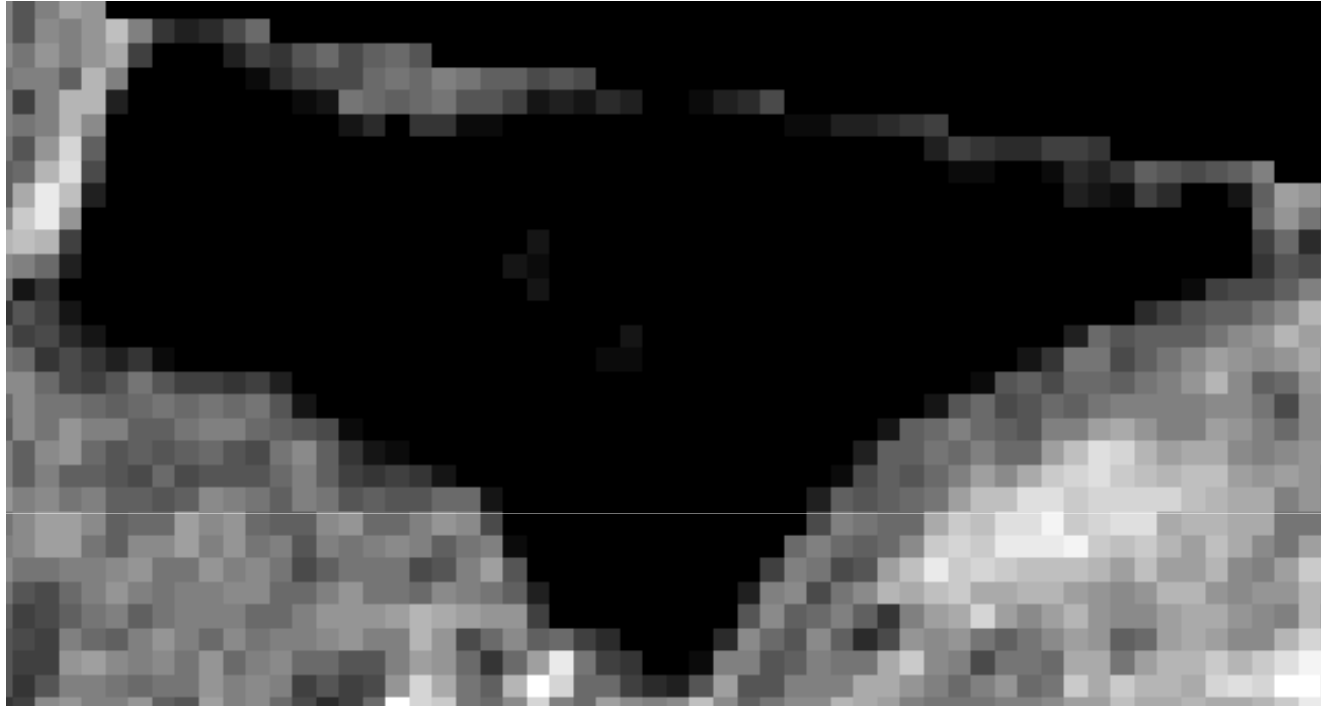
- Satellite observations are with optical radiation in different spectral bands. Basically the emission and the sun light reflectance of the water in different spectral channels.
- Parameters which can be measured by satellite data are
 - Chlorophyll
 - Turbidity
 - Coloured dissolved organic matter.
 - Total suspended solids.
 - Some chemical compound measurement through the hyper-spectral remote sensing is also reported.

Test location

The test location selected is K.R. Puram lake (Lat:13.01, Long: 77.69) in eastern region of Bangalore.



Study site as seen by Landsat 7 Band -1



Data acquired on 21st January 2015

Materials and method

The measurement was carried out by making in situ measurements using boat.

- Sample locations were identified with GPS instrument.
- Radiance from water water was recorded using spectro radiometer.
- Secchi disk depth was measured at each sampling locations (Used to avoid radiation from floor and find the correlation with Chlorophyll)
- Collected water samples and estimated the Chlorophyll, Turbidity values in Lab.
- Estimated the chlorophyll concentration from Landsat-7 data after atmospheric correction.

A view of Lake and measurement instruments



Sacchi depth Measurement

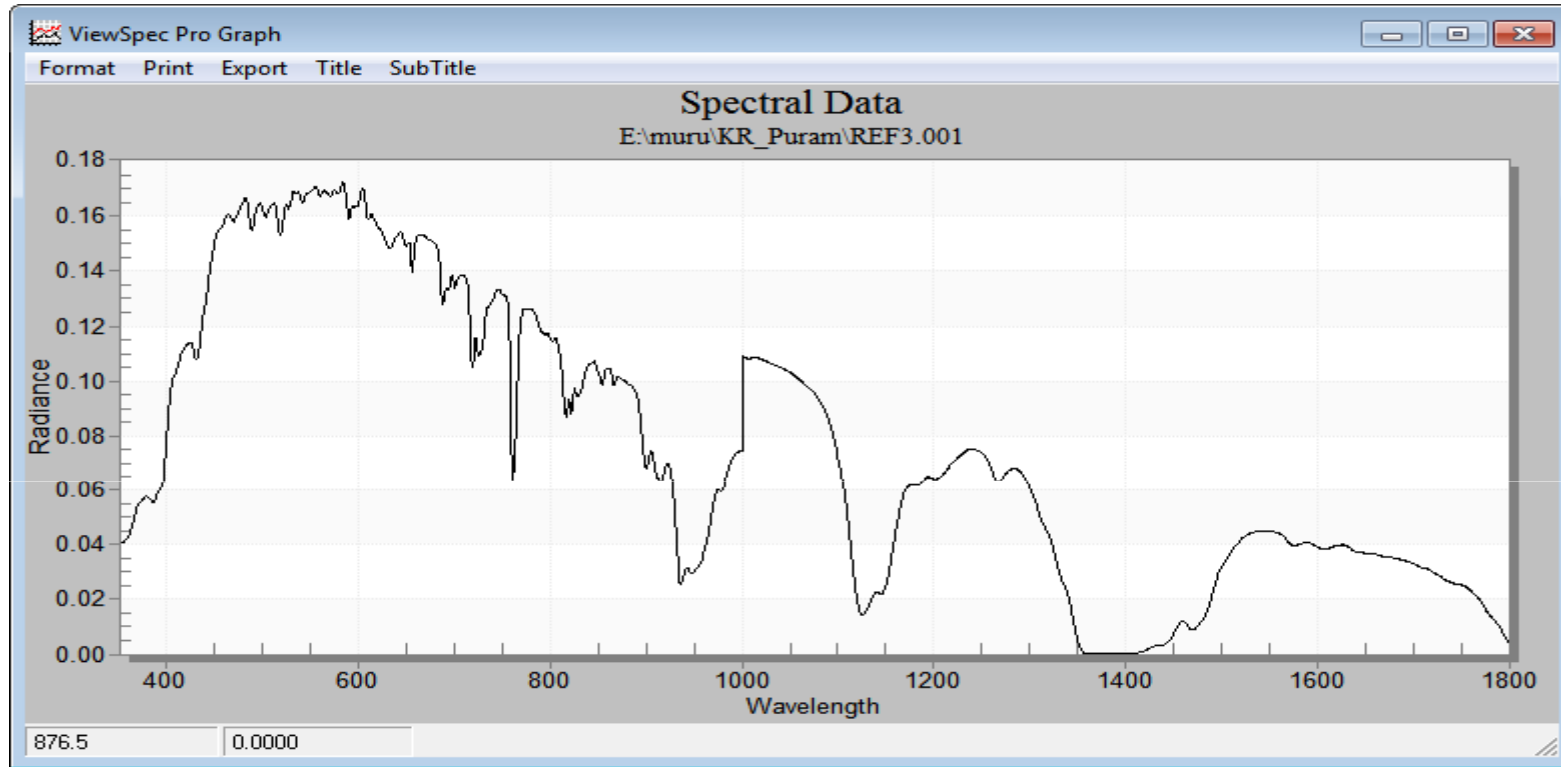


The depth is measured to ensure that the upwelling radiation is not from floor. The secchi depth can be correlated with Chl-a concentration.

Results

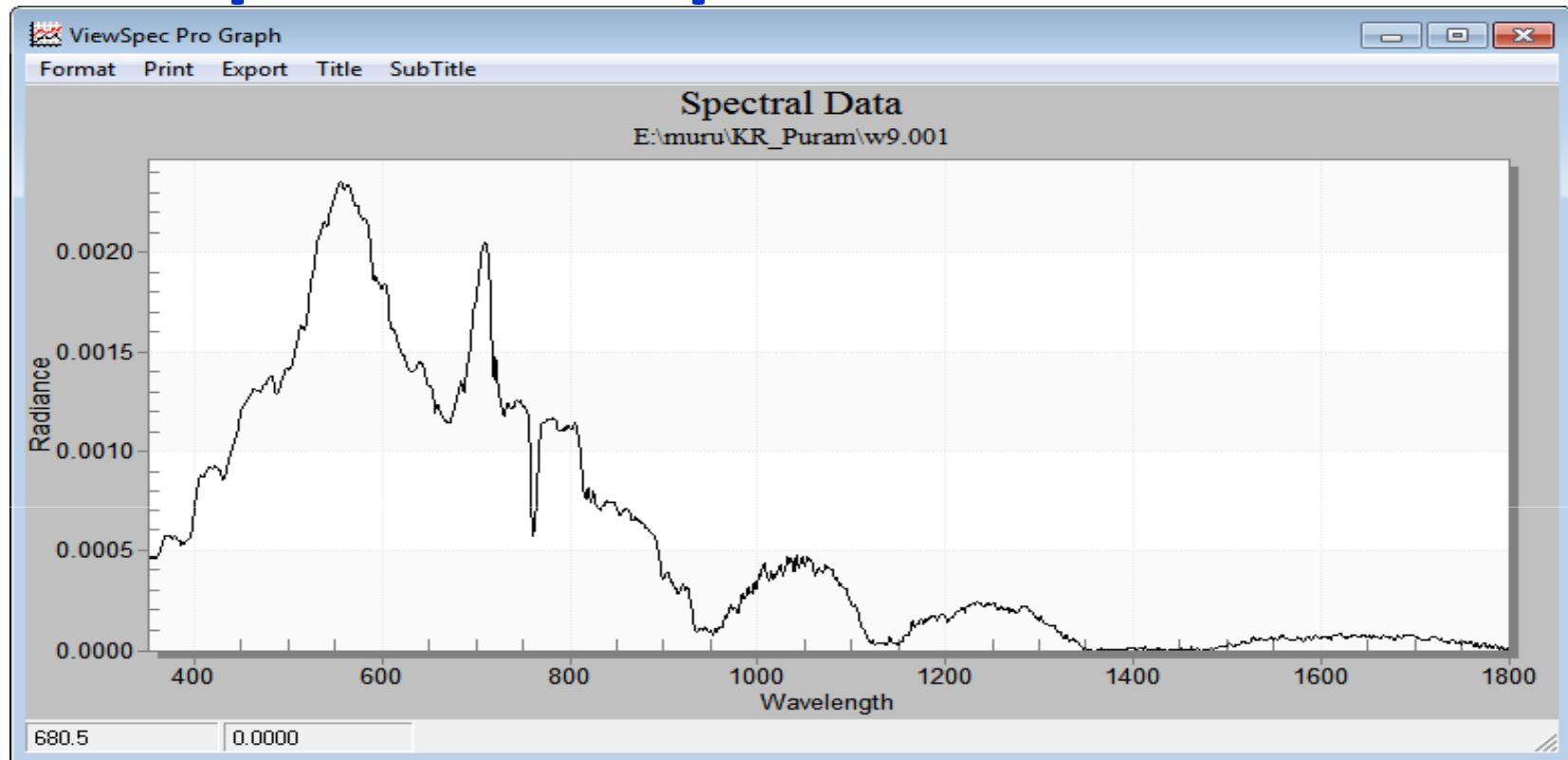
- The turbidity values are varying from 24 to 30 NTU
- The Sacchi disk depth varies from 32 cm to 38 cm
- The Chlorophyll Values from lab spectrophotometer method varies from 54 to 63 mg/m³
- The Values estimated from spectro radiometer varies from 57.5 to 64 mg/m³
- The correlation between the Landsat bands and band ratios are calculated and presented.
- The correlation between measurement and band ratio (R^2) is better than 0.6

Reference spectral signature



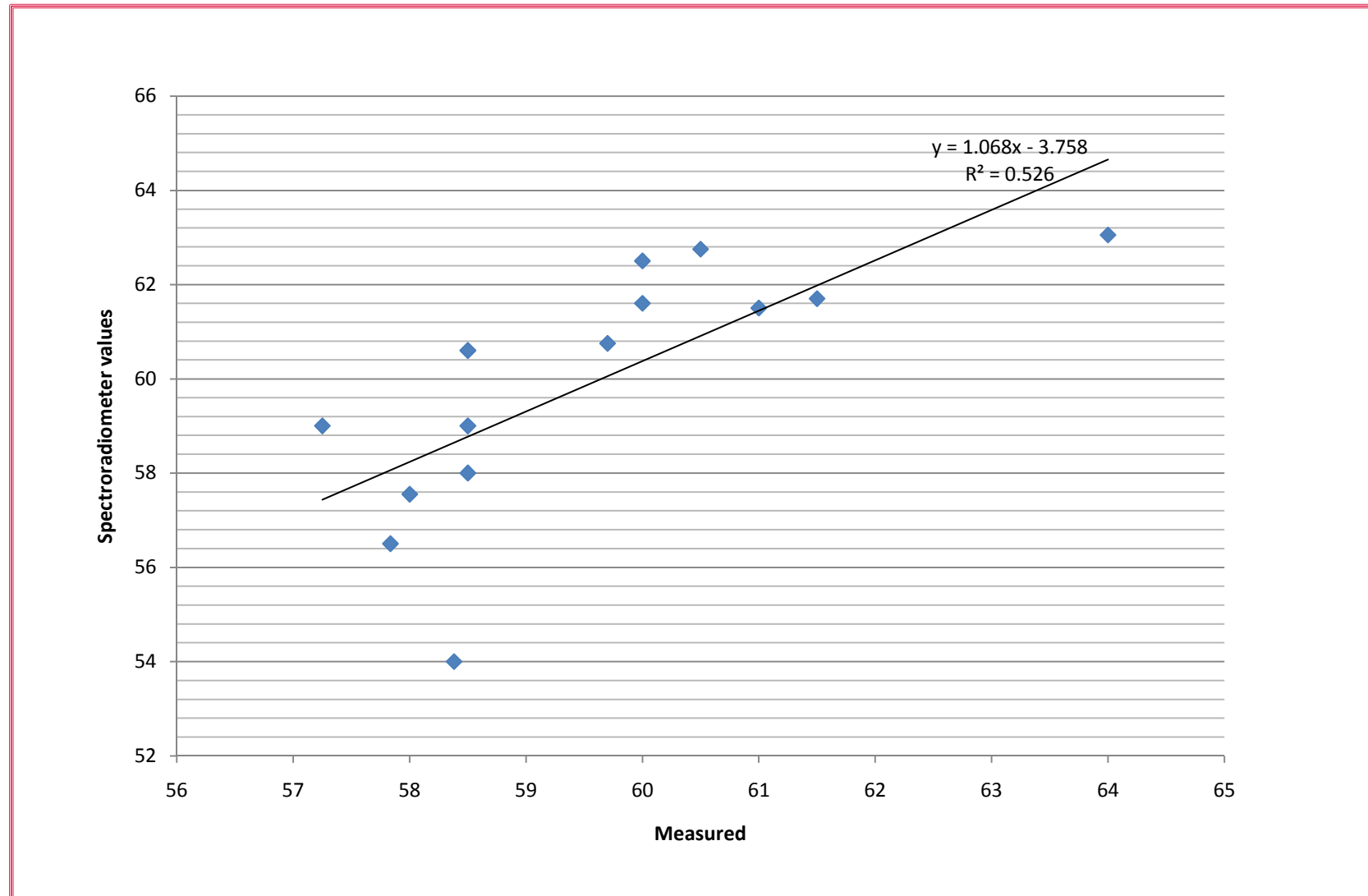
Radiance from reference plate is recorded in the range of 350 nm to 1800 nm

Spectral Response of Water

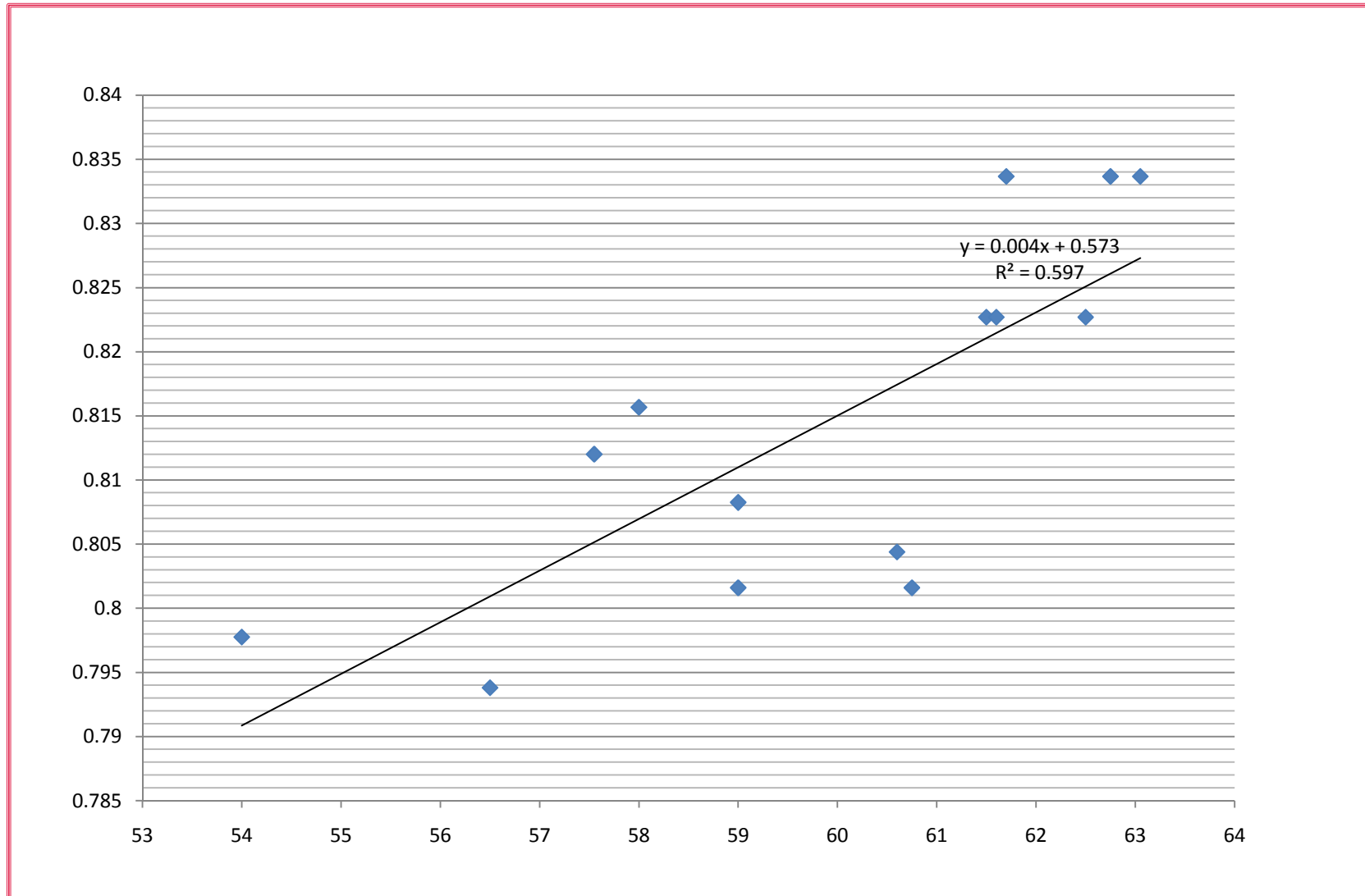


Radiance from Water obtained from Spectroradiometer (ASD Fieldspec pro) In the spectral range of 350 nm to 1800 nm.

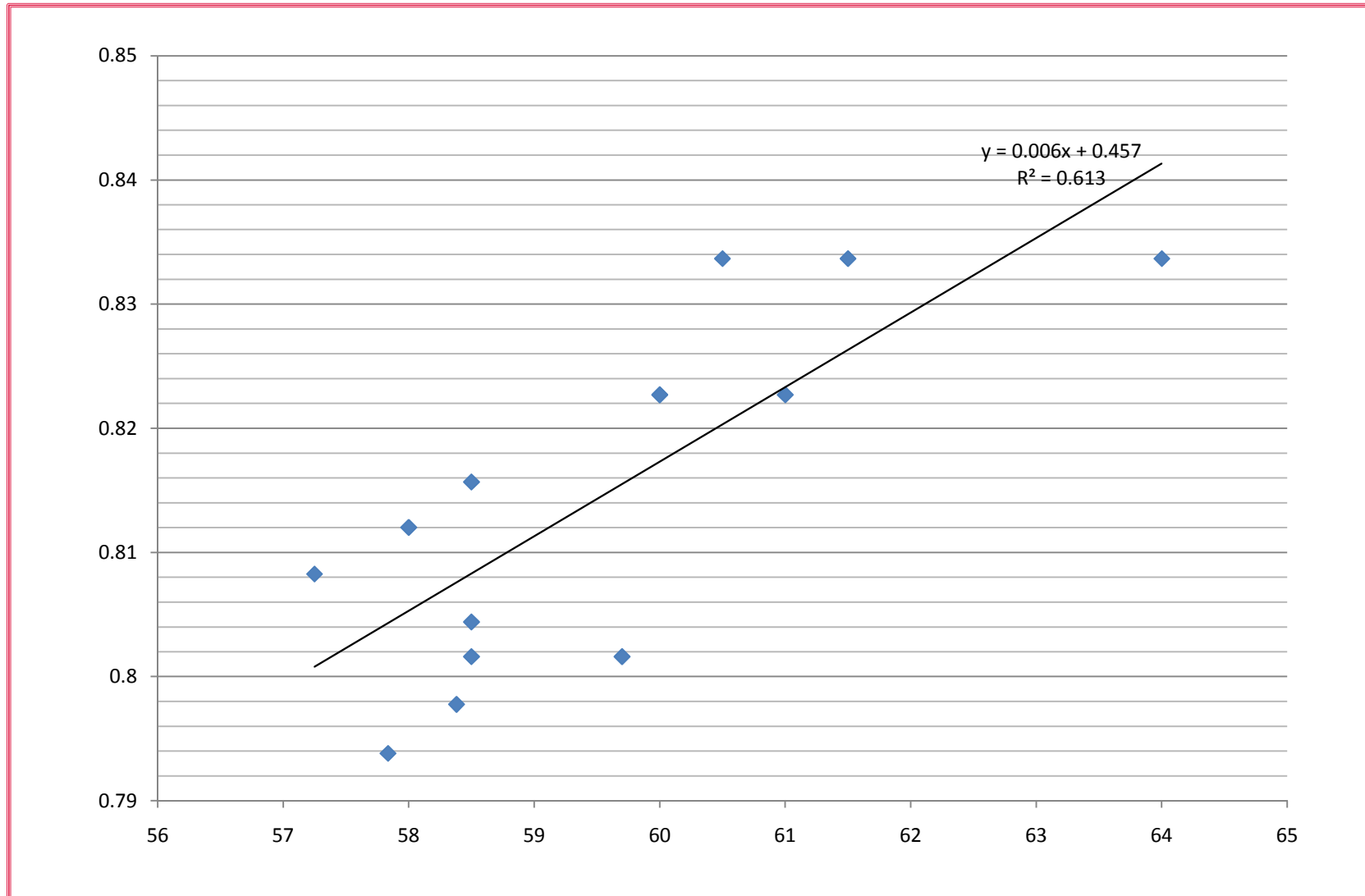
Estimated from spectrophotometer Vs Measured



Band2/Band1 ratio vs Spectroradiometer



Band2/Band1 ratio vs measurement



Chl-a estimation using Hyperspectral data

- The constructed equation can be used to estimate the chl-a at other locations
- In 2013 similar exercise was carried out with Hyperion data without spectroradiometer. The study site was sadaramangala Lake in Bangalore.
- The additional operations done on the data was noise removal and registration.
- The measured chlorophyll-a values were 26 to 38 mg/m³.

Constraints & Challenges

- Reflectance of water is very small compared with vegetation.
- Effect of Atmosphere can not be neglected. Better correction methods are required.
- Most of Indian water bodies are shallow. Radiation from bottom/floor is to be modeled and eliminated.
- Most of Indian water bodies are small so better spatial resolution data is required. (Near bank mixed pixels gives wrong info).
- To get accurate measurement more narrow spectral bands (hyperspectral) are required.
- At present satellite Hyperpsectral data is not available.
- Present algorithms/models provide moderate correlation between satellite data and in-situ measurement data.
- Band and band ratios are compared with measured.
- As Multispectral bands are wider, small variations cannot be estimated.

Thank you