Analysis of Dissolved Oxygen

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Introduction

- Dissolved oxygen is the amount of oxygen that is present in a water body.
- Water bodies receive oxygen from the atmosphere and from aquatic plants.
  moving rivers have more oxygen than stagnant bodies.
- Hence, DO is directly linked to the marine ecosystem and even a little change can cause a negative impact.
- Dissolved oxygen in open ocean has been declining in the past centuries according to a study conducted in 2010 [Keeling et al.[1]]
- Be it due to natural causes / increase in temperature [Keeling et al.[1]]

SO2 requirements

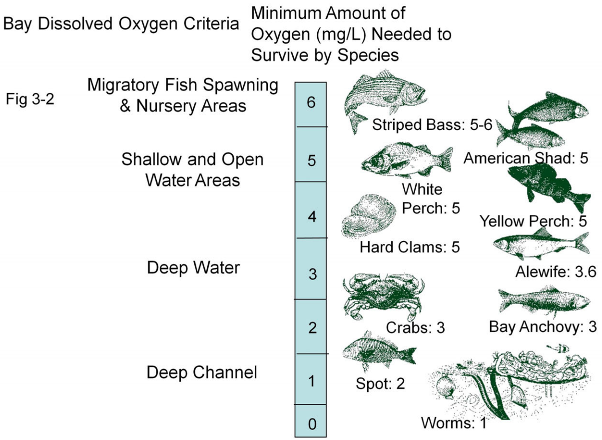

Figure: https://en.wikipedia.org/wiki/Oxygen_saturation

Motivation

- traditionally, the water quality is determined by collecting samples from the field then analysing them.
- this method is accurate however, it is very time and labour intensive and can result in spatial and temporal error. [Mohammad Haji Gholizadeh et al.[2]]
- the idea of this project is to verify a correlation between DO, temperate, salanity, chlorophyll content(+other relevant parameters) and develop an analysis of DO for different seasons.

Methodology

- The idea is to use the ocean color dataset(NASA OBPG) and get spectral fingerprints for water, chlorophyll, sediments, colored dissolved organic matter(CDOM) etc.
- Generally,
  - chlorophyll appears as green
  - water as blue
  - CDOM as black
  - sediments as browns and whites.
- Every element has a spectral fingerprint, a unique absorption/reflectance pattern at varying wavelengths of the electromagnetic spectrum, which can help in the identification of these different parameters
- Then using regression a relationship can be developed b/t DO and other parameters.
- Although, quantitative mesurements will require in-situ/field data for calibration and validation and without which only qualitative relationship can be presented.

some satellites which can be used for water quality

Table 1. List of the more commonly used spaceborne sensors in water quality assessments.

Category	Satellite—Sensor	Launch Date	Spectral Nands (nm)	Spatial Resolution (m)	Swath Width (km)	Revisit Interval (Day)
High Resolution	Digital Globe WorldView-1	18 September 2007	Pan	0.5	17.7	1.7
	Digital Globe WorldView-2	8 October 2009	8 (400–1040)-1 Pan (450–800)	1.85–0.46	16.4	1.1
	NOAA WorldView-3	13 August 2014	8 (400–1040)-1 Pan(450–800)-8 SWIR (1195–2365)	1.24–3.7–0.31	13.1	1–4.5
	Digital Globe Quickbird	18 October 2001	4 (430–918)-1 Pan (450–900)	2.62–0.65	18	2.5
	GeoEye Geoeye-1	6 September 2010	4 (450–920)-1 Pan (450–800)	1.65–0.41	15.2	<3
	GeoEye IKONOS	24 September 1999	4 (445–853)-1 Pan (526–929)	3.2–0.82	11.3	~3
	SPOT-5 HRG	4 May 2002	3 (500–890)-1 Pan (480–710)-1 SWIR (1580–1750)	2.5 and 5–10–20	60	2–3
	CARTOSAT	5 May 2005	Pan (500–850)	2.5	30	5
	ALOS AVNIR-2	24 January 2006	4 (420–890)-1 Pan (520–770)	2.5–10	70	2
Moderate Resolution	Landsat-8 OLI/TIRS	11 February 2013	5 (430–880)-1 Pan (500–680)-2 SWIR (1570–2290)-1 cirrus cloud detection (1360–1380)-2 TIRS (10,600–12,510)	30–15–100	170	16
	Landsat-7 ETM+	15 April 1999	6 (450–1750)-1 Pan (520–900)-1 (2090–2350)-1 (1040–1250)	30–15–60	183	16
	Landsat-5 TM	1 March 1984	5 (450–1750)-1 (2080–2350)-1 (1040–1250)	30–120	185	16
	Landsat-5 MSS	1 March 1984	4 (450–1750)-1 Pan (1040–1250)	80	185	18
	EO-1 Hyperion	21 November 2000	242 (350–2570)	30	7.5	16
	EO-1 ALI	21 November 2000	9(433–2350)-1 Pan (480–690)	10–30	185	16
	Terra ASTER	18 December 1999	3 VNIR (520–860)-6 SWIR (1600–2430)-5 TIR (8125–11,650)	15–30–90	60	16
	PROBA CHRIS	22 October 2001	19 in the VNIR range (400–1050)	18–36	14	7
	HICO	10 September 2009	128 (350–1080)	100	45–50	10
Regional-Global Resolution	Terra MODIS	18 December 1999	2 (620–876)-5 (459–2155)-29 (405–877 and thermal)	250–500–1000	2330	1–2
	Envisat-1 MERIS	1 March 2002	15 (390–1040)	300–1200	1150	daily
	OrbView-2 SeaWiFS	1 August 1997	8 (402–885)	1130	2806	16
	NIMBUS-7 CZCS	24 October 1978	6 (433–12,500)	825	1556	6
	ERS-1 ATSR-1	17 June 1991	1 SWIR (1600), 1 MWIR (3700), 2 TIR (10,850–12,000), Nadir-viewing Microwave Sounder with channels at 23.8 and 35.6 GHz	1000 (MW sounder: 20 km)	500	3–6
	ERS-2 ATSR-2	22 April 1995	3 VIS-NIR (555–865), 1 SWIR (1600), 1 MWIR (3700), 2 TIR (10,850–12,000)	1000	500	3–6
	ENVISAT AATSR	1 March 2002	3 VIS-NIR (555–865), 1 SWIR (1600), 1 MWIR (3700), TIR (10,850–12,000)	1000	500	3–6
	Suomi NPP VIIRS	28 October 2011	5 I-bands (640–1145), 16 M-bands (412–12,013), DNB (500–900)	375–750	3060	1–2 times a day
	NOAA-16 AVHRR	21 September 2000	6 (650–1230)	1100–4000	3000	9

Figure: Mohammad Haji Gholizadeh et al.

Overall, NASA Ocean Biology Processing Group (OBPG) provides plenty of tools & data sources like

- SeaDAS for data processing
- In-situ data from SeaBASS
- Global Seawater Oxygen-18 Database
- Oceancolor gsfc NASA

Similar studies

Application of satellite remote sensing in monitoring dissolved oxygen variabilities: A case study for coastal waters in Korea

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A R T I C L E   I N F O

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A B S T R A C T

Dissolved oxygen (DO) is one of the critical parameters representing water quality in coastal environments. However, it is labor- and cost-intensive to maintain monitoring systems of DO since *in situ* measurements of DO are needed in high spatial and temporal resolution to establish proper management plans of coastal regions. In this study, we applied statistical analyses between long-term monitoring datasets and satellite remote sensing datasets in the eastern coastal region of the Yellow Sea. Pearson correlation analysis of long-term water quality monitoring datasets shows that water temperature and DO are highly correlated. Stepwise multiple regression analysis among DO and satellite-derived environmental variables shows that the *in situ* DO can be estimated by the combination of the present sea surface temperature (SST), the chlorophyll-*a*, and the SST in the month prior. The high skill score of our proposed model to derive DO is validated by two error measures, the Absolute Relative Error, 1-ARE (89.2%), and Index of Agreement, IOA (78.6%). By applying the developed model to the Moderate Resolution Imaging Spectroradiometer (MODIS) and Visible Infrared Imaging Radiometer Suite (VIIRS) products, spatial and temporal changes in satellite-derived DO can be observed in Saemangeum offshore in the Yellow Sea. The analysis results show that there is a significant decrease in estimated DO between summer of 2003 versus 2012 indicating summer coastal deoxygenation due probably to the Saemangeum reclamation. This study shows the potential capability of satellite remote sensing in monitoring *in situ* DO in both high temporal and spatial resolution, which will be beneficial for effective and efficient management of coastal environments.

Figure: Yong Hoon Kim et al [3]

Similar studies cont...

sensors

MDPI

Review

A Comprehensive Review on Water Quality Parameters Estimation Using Remote Sensing Techniques

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Figure: Mohammad Haji Gholizadeh et al [2]

R. F. Keeling, A. Krtzinger, and N. Gruber, "Ocean deoxygenation in a warming world," *Annual Review of Marine Science*, vol. 2, no. 1, pp. 199–229, 2010, pMID: 21141663. [Online]. Available: https://doi.org/10.1146/annurev.marine.010908.163855

M. H. Gholizadeh, A. M. Melesse, and L. Reddi, "A comprehensive review on water quality parameters estimation using remote sensing techniques," *Sensors (Switzerland)*, vol. 16, 8 2016.

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Thank you!
Questions?