World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:14, No:03, 2020

Red-Tide Detection and Prediction Using MODIS Data in the Arabian Gulf of Qatar

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Abstract : Qatar is one of the most water scarce countries in the World. In 2014, the average per capita rainfall was less than 29 m3/y/ca, while the global average is 6,000 m3/y/ca. However, the per capita water consumption in Qatar is among the highest in the World: more than 500 liters per person per day, whereas the global average is 160 liters per person per day. Since the early 2000s, Qatar has been relying heavily on desalinated water from the Arabian Gulf as the main source of fresh water. In 2009, about 99.9% of the total potable water produced was desalinated. Reliance on desalinated water makes Qatar very vulnerable to water related natural disasters, such as the red-tide phenomenon. Qatar's strategic water reserve lasts for only 7 days. In case of red-tide outbreak, the country would not be able to desalinate water for days, let alone the months that this disaster would bring about (as it clogs the desalination equipment). The 2008-09 red-tide outbreak, for instance, lasted for more than eight months and forced the closure of desalination plants in the region for weeks. This study aims at identifying favorite conditions for red-tide outbreaks, using satellite data along with in-situ measurements. This identification would allow the prediction of these outbreaks and their hotspots. Prediction and monitoring of outbreaks are crucial to water security in the country, as different measures could be put in place in advance to prevent an outbreak and mitigate its impact if it happened. Red-tide outbreaks are detected using different algorithms for chlorophyll concentration in the Gulf waters. Vegetation indices, such as Normalized Difference Vegetation Index (NDVI) and Enhanced Vegetation Index (EVI) were used along with Surface Algae Bloom Index (SABI) to detect known outbreaks. MODIS (or Moderate Resolution Imaging Spectroradiometer) bands are used to calculate these indices. A red-tide outbreaks atlas in the Arabian Gulf is being produced. Prediction of red-tide outbreaks ahead of their occurrences would give critical information on possible water-shortage in the country. Detecting known outbreaks in the past few decades and related parameters (e.g. water salinity, water surface temperature, nutrition, sandstorms, ... etc) enables the identification of favorite conditions of red-tide outbreak that are key to the prediction of these outbreaks.

Keywords : Arabian Gulf, MODIS, red-tide detection, strategic water reserve, water desalination
Conference Title : ICSS 2020 : International Conference on Spatial Sciences
Conference Location : Prague, Czechia
Conference Dates : March 19-20, 2020