



Contribution of remote sensing and bacteriological analysis for the quality of bathing waters on the west coast of Tangier

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Abstract:

To have an idea about the impact of wastewater treatment station installed in west coast of Tangier a diagnostic study and bacteriological analysis have been done along this coast between Achekar beach and the Diplomatic Forest beach. The preparation of the inventory of environmental aspects shows that the west coast of Tangier is a zone of intense industrial activity represented by the two industrial zones; Tangier Free Zone and Industrial Zone Gzenaya (TFZ and IZG) and the surface temperature of bathing water remains stable at 16-18 ° C, contrariwise it reaches 22°C in Jbila and Sidikacem. Consequently, the bacteriological analysis shows that the concentrations of Escherichia Coli and Intestinal Enterococci germs are high in the two last beaches.

Keywords: Diagnostic, Industrial zone, Environment, Pollution, Wastewater treatment plant, Remote sensing.

1. Introduction

The West Atlantic coast of Tangier plays a socio-economic role of great importance. Firstly, this Moroccan coast has the advantage of being among the richest in the world with a wide diversity of ecosystems. Moreover, it is a privileged place for the installation of numerous agglomerations and industrial units, (CHAOUAY *et al.*, 2014). Along the coast of Cape Achekar to the beach of the Diplomatic Forest, there are several human activities, including unidentified urban and tourist areas, generating a large volume of polluted water, as well as the presence of a strong industrial activity represented by the two Large zones; Tangier Free Zone (TFZ) and Industrial Zone Gzenaya (IZG) presenting a large source of waste water that can cause an imbalance of the ecosystem in the west coast of Tangier. In these two zones (TFZ and IZG) industrial activity increased from 2% for Agri-Food Industries (AFI), 6% for the Chemical and Para-chemical Industries (CPI) and the Textile and Leather Industries (TLI), a strong increase in the Mechanical, Metallurgical, Electronics Industries (MMEI), to more than 20 % for other services in period from 2008 to 2016. The objective of this work is to carry out an inventory of the environmental aspects and to make a qualitative

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assessment of the bathing waters with the aim of evaluating the effects of seasonal variation on the state of contamination by bacteriological germs (*Escherichia Coli*, *Intestinal Enterococci*) and the use of the landsat_8 thermal bands for the evaluation of the temperature along the west coast of Tangier.

2. Study zone

Our study area is located in northwestern Morocco and occupies 150 km from Sol beach to the diplomatic forest beach between 35 ° N 40 'and 35 ° N 46' North latitude and W 5 ° 56 'and W 5 ° 57' west longitude (Figure 1). The site is actually a Boukhalef watershed, whose river meets near the coast to form the mouth of the river Boukhalef with the Atlantic coastline.

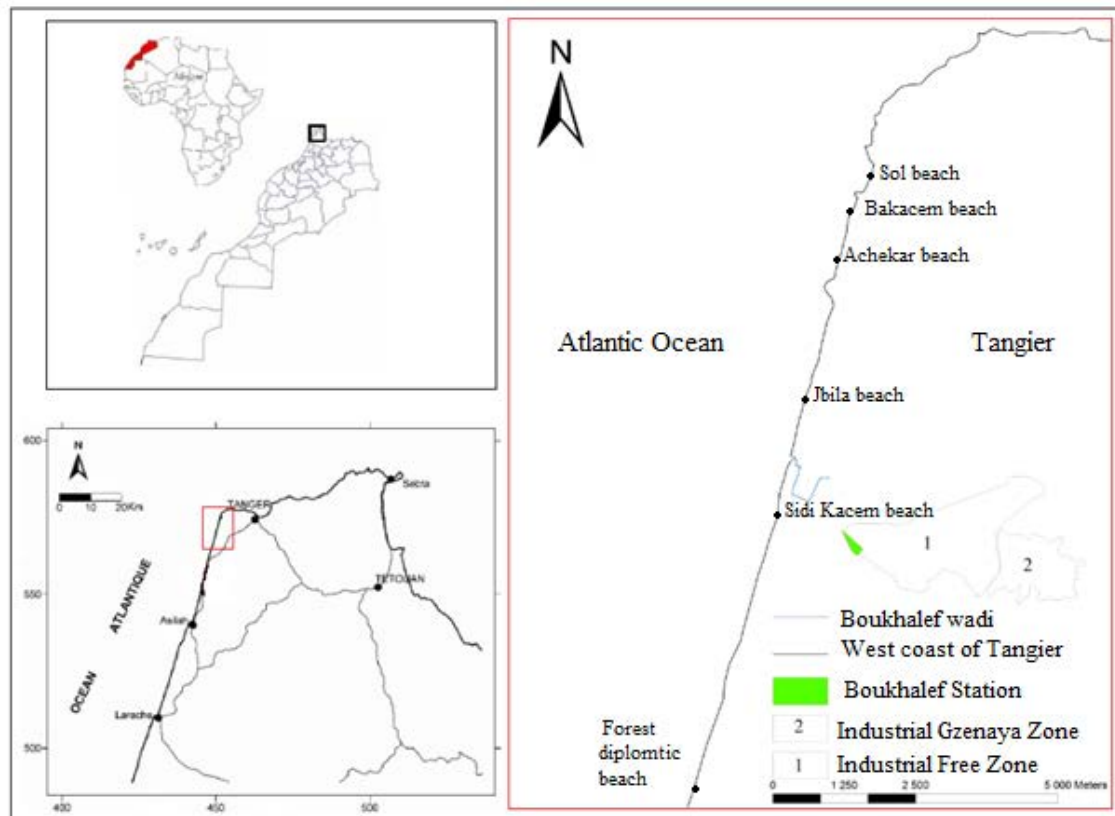


Figure 1: The geographic location of the study zone.

3. Methodology

Our work is divided into two main sections: the inventories of environmental aspects (Diagnostic) and bacteriological analysis. the inventories of environmental aspects that consist of collecting, organizing, processing and manipulating data on the coast using (ArcGis) software for cartography and (ENVI) software for thermal treatment from the landsat_8 data. Two images of the thermal infrared sensor (TIRS) and the operational

land imager (OLI) sensor were acquired covering the west coastal of Tangier: 05/2016, 06/2016. These images were then projected into the Lambert compliant conical Moroccan projection system (WGS84) and the pixels of two thermal bands of landsat_8 (10 and 11) converted into units of absolute radiance, (then from the top of atmosphere (TOA) radiance to the temperature) using the thermal constants provided in the metadata file (FAOUR *et al.*, 2004). The bacteriological analysis was performed following the standard methods; Escherichia Coli according to the Moroccan standard (NM 9308-1, 2014) and Intestinal Enterococci according to the Moroccan standard (NM 7899-2, 2007) and classified according to (NM 03.7.200, 1998).

4. Results

4.1 Diagnostic

The surface temperature of bathing water remains stable at 16-18 ° C, contrariwise it reaches 22°C in Jbila and Sidikacem. In relation with the presence of liquid and solid effluents from industrial units and urban areas, affecting consequently the quality of bathing water, see after figure 2.

4.2 Bacteriological analyzes

The bacteriological analysis and analytical reports of the Ministry of the Environment (MINISTERE, 2013; 2014; 2015; 2016) shows that in recent years, the quality of bathing waters is generally of good quality in Sol, Bakacem, Achekar and Diplomatic Forest beaches (A); is momentarily polluted in Jbila beach (C); and in Sidikacem beach it is generally of good quality to medium quality (A-B), see after table 1.

Table 1: Quality of the bathing waters of the west coast of Tangier from 2012 to 2016.

Beach ↓ - Year →	2012	2013	2014	2015	2016
Sol	A	A	A	A	A
Bakacem	A	A	A	A	A
Achekar	A	B	A	A	A
Jbila	C	C	B	C	B
Sidi Kacem	A	A	B	B	C
Diplomatic Forest	A	A	A	A	A

Note: CLASS A: Water of good quality; CLASS B: Medium quality water; CLASS C: Water temporarily polluted; CLASS D: Poor quality water.

The results of bacteriological analysis of bathing waters show that the similar qualities in 2016 except for Sidikacem beach were water quality decrease (C). This is demonstrated by the presence of two zones Industrial activities, see table 1.

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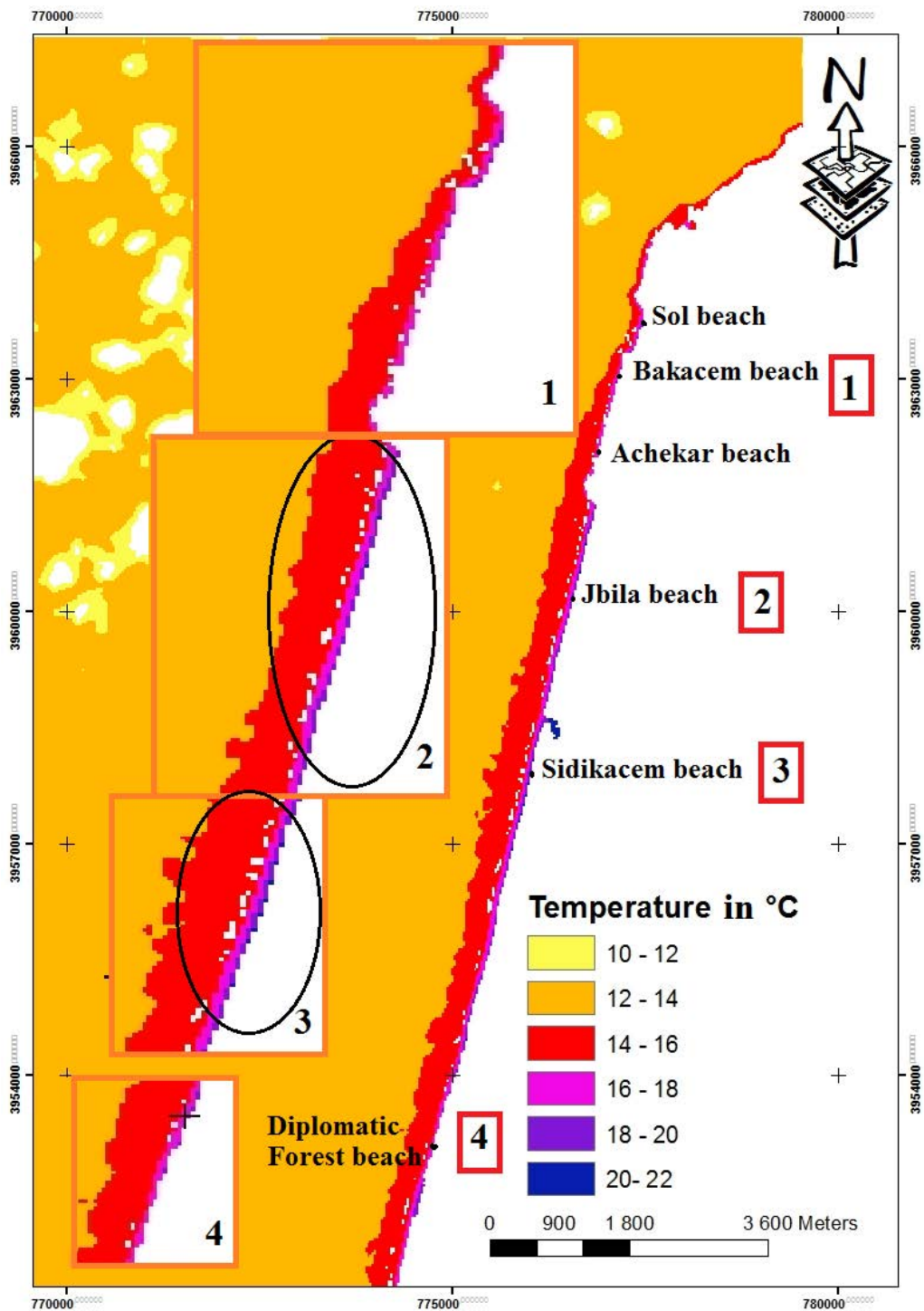


Figure 2: Surface water temperature of the west coast of Tangier

5. Conclusion

All activities, including industrial, touristic and human activities, prove to have an adverse impact on the quality of bathing waters on the west coast of Tangier, especially in Jbila and Sidikacem beaches.

Therefore, the control and continuous monitoring by various tools have become vital to minimize the human impact on the natural environment, and thus to protect and preserve our environment.

Thus, the thermal treatment of the bands 10 and 11 of the landsat_8 image presents seem to be an excellent indicator tools for the evaluation of quality of bathing water.

6. Références bibliographiques

- CHAOUAY A., BAZZI L., HILALI M., AIT ALLA A. EL MOUADEN K. (2014). *Etude de la contamination bactériologique de la Baie d'Agadir. Impact sur la résistance à la corrosion du cuivre (Study of bacterial contamination of the Bay of Agadir Impact on the resistance of copper's corrosion)*. Journal of Materials and Environmental Sciences, Vol.5 (S2), pp. 2472-2477. ISSN: 2028-2508, CODEN: JMESCN.
- FAOUR G., SHABAN A., JAQUET J. (2004). *Apport de la bande infrarouge thermique du capteur Etm+ De Landsat-7 dans la détection de la pollution de l'eau de mer sur le littoral libanais*. Télédétection, vol. 4, n° 2, pp. 197–209.
- MINISTERE. (2013). *Surveillance de la qualité des eaux de baignade, 2012-2013*. Rapport analytique du Ministère délégué auprès du Ministre de l'Energie, des Mines, de l'Eau et de l'Environnement, chargé de l'Environnement et le Ministère de l'Equipement, du Transport et de la Logistique du Maroc.
- MINISTERE. (2014). *Surveillance de la qualité des eaux de baignade, 2013-2014*. Rapport analytique du Ministère délégué auprès du Ministre de l'Energie, des Mines, de l'Eau et de l'Environnement, chargé de l'Environnement et le Ministère de l'Equipement, du Transport et de la Logistique du Maroc.
- MINISTERE. (2015). *Surveillance de la qualité des eaux de baignade, 2014-2015*. Rapport analytique du Ministère délégué auprès du Ministre de l'Energie, des Mines, de l'Eau et de l'Environnement, chargé de l'Environnement et le Ministère de l'Equipement, du Transport et de la Logistique du Maroc.
- MINISTERE. (2016). *Surveillance de la qualité des eaux de baignade, 2015-2016*. Rapport analytique du Ministère délégué auprès du Ministre de l'Energie, des Mines, de l'Eau et de l'Environnement, chargé de l'Environnement et le Ministère de l'Equipement, du Transport et de la Logistique du Maroc.
- NM 03.7.200. (1998). *Standards for monitoring bathing water quality*. Ministère de l'Industrie, du Commerce et de l'Artisanat, Service de normalisation industrielle marocaine, pp. 4-8.
- NM 7899-2. (2007). *Water quality-research and enumeration of intestinal Enterococci. Part 2: membrane filtration method for waters*. Ministère de l'Industrie, du Commerce, Ministère de l'Equipement et du Transport et du Ministère de la Santé, Service de normalisation industrielle marocaine, pp. 2-6.
- NM 9308-1. (2014). *Water quality-enumeration of Escherichia Coli and coliform bacteria. Part 1: membrane filtration method for waters with low bacterial background*

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flora. Ministère de l'Industrie, du Commerce, Ministère de l'Équipement et du Transport et du Ministère de la Santé, Service de normalisation industrielle marocaine, pp. 2-6.