مجلة جامعة تشرين للدراسات والبحوث العلمية _ سلسلة العلوم الأساسية المجلد (26) العدد (2)2004
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# The Influence of Wind on Sea Waves Over Lattakia Coast

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## ☐ ABSTRACT ☐

There are many reasons for developing our knowledge of the marine sciences.

First because of their importance as sources of food, chemicals and power. They are exploited to a very minor degree. On the other hand, oceans and sea are still a vital important avenue of transportation. They form a sink into which industrial waste (radioactive waste) is dumped.

Our basic goal of sea waves and wind is to obtain a clear and systematic description of the direction which such wastes may follow. This work aims at analyzing wave and wind data for Lattakia coast.

We obtained some important results, which are hereby tabulated from three months measurements in this field. The analysis of the data showed that the most severe wave storms occurred in December 2002 at Lattakia Coast.

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# تأثير الرياح على أمواج البحر في شاطئ اللاذقية

الدكتور بدر الأعرج*
الدكتور بهجت إبراهيم**

(قبل للنشر في 2004/1/4)

## □ الملخّص □

توجد أسباب عديدة لتطوير معرفتنا في مجال علوم البحار، لكونها مصادر هامة للأغذية، والمواد الكيميائية والطاقة...الخ. ولقد استثمرت هذه المصادر بدرجة قليلة حتى وقتنا الحاضر.

علاوة على ذلك، تعتبر المحيطات والبحار بيئة حيوية هامة في عمليات النقل المختلفة.

بالنسبة إلى الدول الصناعية الكبرى تشكل المحيطات والبحار أحواض ومستودعات للتخلص من النفايات الصناعية (النفايات ذات النشاط الإشعاعي).

ويكمن هدفنا الأساسي في دراسة الأمواج وتأثير الرياح عليها للحصول على وصف واضح متناسق لاتجاه حركة الرياح الأمواج التي تحمل النفايات وفق اتجاه حركتها.

يهدف هذا العمل لتحليل معطيات الأمواج والرياح في شاطئ اللاذقية.

ومن خلال دراستنا وأبحاثنا المستمرة لمدة ثلاثة أشهر في هذا المجال حصلنا على بعض النتائج الهامة والتي تم عرضها في هذه النشرة. وقد بينت القياسات أن اشد العواصف التموجية في شاطىء اللاذقية حصلت في شهر كانون الأول لعام 2002.

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# INTRODUCTION :

As we know the marine sciences are sub-branches of the oceanography. The development of interest in oceanography in recent years has led to an increasing demand for information on this subject.

The goal of the marine scientist is to obtain a clear and systematic description of the character of the sea-waters and of their movements to permit us to predict their behavior in the future with some certainty [1].

The character of the sea –water includes temperature and salt content (salinity) which together determine density and hence vertical movement.

The basic physical law which is considered to apply to the situation is then used to set up an equation between the forces acting and the motions observed.

The forces acting on sea –water come from four sources: pressure force p, gravity force g, coriolis force c, and frictional force f .

According to Newton's second law of motion we can write the acceleration a as the vector sum [2].

$$a=p+g+c+f \qquad (1)$$

Where all forces were taken to the unit mass.

Ocean waves are a derived form of solar energy where the wind transfers the sun energy to the sea surface [3].

Sun rays heat the earth and hence generate wind and in turn wind blowing over water generates sea waves [4]. It is necessary to define some physical properties of sea –water. Sea –water is a complicated solution and contains chlorine ion 55.0% of the total dissolved material, sulphate ion 7.7%, sodium ion 30.6%, magnesium ion 3.7% and potassium ion 1.1%.

The salinity S has been defined as the total amount of solid materials in grams contained in one kilogram of sea –water when all the carbonate has been converted to oxide, the bromine and iodine replaced by chlorine and all organic matter completely oxidized. For example, the average salinity of sea –water is about 39 gram of salts per kilogram of sea –water (g/kg) or as 39 ‰ .

There is the following relation between salinity and chlorinity .

$$\text{Salinity} = 1.80655 \times \text{chlorinity} \qquad (2)$$

The waves of sea are classified according to the forces, which generated them. For example, wind-, ship-, earthquake- and tide waves.

The wave height H has been defined as the difference in surface elevation between the wave crest and the wave trough, and the wave period T as the time required for a bottle to return to its original position. Another important physical characteristic of sea –water is its temperature .

Even today it continues to be easier to observe temperature and its vertical profile than other properties where studying of temperature profile alone has yielded valuable insights into circulation features [5,6,7].

# DESCRIPTION OF THE STUDY AREA:

During four months our study covered the coastal region near the High Institute for Marine Research locating (N $35^0$ $35'$ $515''$ ; E $35^0$ $44'$ $491''$) at the Blue Beach, of Lattakia Coast is.

This area is considered as a coast directly open to sea and in which there are a repository for sewage and a tourism is flourishing.

## MATERIAL & METHODS:

We consider this area as one of the stations we intend to study .

Various equipments and instruments are used in order to obtain the results. The following parameters were measured: sea surface temperature, salinity and conductivity at the same depth 15cm by means of ORION 140 instrument.

The speed and direction of wind are taken in terms of wind device. Concerning the height, period and direction of the sea waves we used suitable shield and telescope for watching them. The shield was fixed at the distance of 20 m in the sea.In addition, we also used a compass to determine the directions and a digital watch to measure the period of the waves.

## RESULTS :

Our measurements were carried out at High Institute for Marine Research. We have conducted regular daily wave and wind measurements in a near shore site of Lattakia area during the period October 2002 --- January 2003.

Our results are presented in the tables 1,2,3 and 4.

*Table 1: October 2002*

| Date 2002 | **Sea water Temp.(c˚)** | **Air Temp.(c˚)** | **Sal. (‰)** | **Wave Per. (s)** | **Wave Hei. (cm)** | **Wind Dir.** | **Wind Sp.(m/s)** | **Clouds /10** | **Cond. (ms/cm)** |
|---|---|---|---|---|---|---|---|---|---|
| Mon.14/10 | 25.9 | 22.7 | 39.4 | 3.9 | 60 | E.N | 2 | - | - |
| Wen.16/10 | | | | 5 | 50 | N.E | 4 | 3 | - |
| Thu.17/10 | 24.9 | 27.4 | 39.4 | 4.3 | 80 | E.N | 0.8 | - | - |
| Sat.19/10 | 25.8 | 25.4 | 39.6 | 2.06 | 40 | E. | 0.9 | - | - |
| Sun.20/10 | 25.3 | 26.5 | 39.4 | 3.3 | 40 | E. | 1 | - | - |
| Wen.23/10 | 25.1 | 26.9 | 39.5 | 4 | 300 | E. | 0.65 | - | - |
| Thu.24/10 | 24.9 | 22.4 | 39.6 | 4.2 | 50 | N.E | 0.36 | - | - |
| Sat.26/10 | 23.4 | 24.9 | 39.1 | 3 | 40 | N.E | 0.23 | - | - |
| Mon.28/10 | 25 | 24.3 | 39.6 | 4.99 | 40 | N.E | 0.93 | - | - |
| Wen.30/10 | 25 | 26.4 | 39.6 | 5.75 | 300 | N. | 1.45 | 1 | - |
| Thu.31/10 | 23.4 | 23.9 | 39.4 | 3.75 | 150 | N. | 2.45 | - | - |

*Table 2: November 2002*

| Date 2002 | **Sea water Temp.(c°)** | **Air Temp.(c°)** | **Sal. (‰)** | **Wave Per. (s)** | **Wave Hei. (cm)** | **Wind Dir.** | **Wind Sp.(m/s)** | **Clouds /10** | **Cond. (ms/cm)** |
|---|---|---|---|---|---|---|---|---|---|
| Sat.2/11 | 24.3 | 25.5 | 39.6 | 4.3 | 40 | N. | 0.85 | - | - |
| Mon.4/11 | 23.1 | 24.7 | 39.6 | 3.83 | 100 | N. | 0.42 | - | 59.9 |
| Wen.6/11 | 24 | 26.9 | 39.5 | 5.45 | 100 | S | 1.5 | - | 59.2 |
| Sat.9/11 | 24.3 | 24 | 39.5 | 3.9 | 30 | N.E | 1.14 | 8 | 59.2 |
| Mon.11/11 | 24 | 20.7 | 39.6 | 5.68 | 200 | E.N | 2.7 | 10 | 59.3 |
| Wen.13/11 | 23.6 | 27 | 39.1 | 4.6 | 200 | S. | 1.82 | 5 | 59.1 |
| Thu.14/11 | 23.4 | 22.1 | 39.4 | 4 | 100 | N.E | 2.8 | 4 | 59.4 |
| Sat.16/11 | 23.4 | 19.5 | 39.6 | 3.88 | 120 | E. | 3.55 | 2 | 59.3 |
| Sun.17/11 | 23.6 | 24.6 | 39.6 | 3.52 | 80 | S. | 0.63 | - | 59.2 |
| Mon.18/11 | 23.1 | 22.2 | 39.2 | 3.72 | 100 | E. | 0.89 | - | 58.9 |
| Wen.20/11 | 23.8 | 25.8 | 39.1 | 4 | 80 | S. | 1.35 | - | 58.9 |
| Sat.23/11 | 23 | 21.8 | 39.1 | 4.35 | 120 | N.E | 0.73 | 3 | 58.9 |
| Sun.24/11 | 21.8 | 20.3 | 39.1 | 5 | 200 | S. | 1.44 | 8 | 58.7 |
| Mon.25/11 | 23 | 19.5 | 39.1 | 5.68 | 250 | N. | 0.48 | - | - |
| Wen.27/11 | 23.2 | 20.2 | 39.2 | 4.65 | 30 | N. | 0.1 | 10 | 58.9 |
| Thu.28/11 | 20.2 | 18.8 | 39.1 | 4 | 200 | N. | 5.9 | - | 59 |
| Sat.30/11 | 19.9 | 17.8 | 39.2 | 3.6 | 160 | N. | 5.5 | 8 | 59.1 |

***Table 3: December 2002***

| Date 2002 | **Sea water Temp.(c °)** | **Air Temp.(c °)** | **Sal. (‰)** | **Wave Per. (s)** | **Wave Hei. (cm)** | **Wind Dir.** | **Wind Sp.(m/s)** | **Clouds /10** | **Cond. (ms/cm)** |
|---|---|---|---|---|---|---|---|---|---|
| Sun.1/12 | 22.4 | 18.8 | 39.2 | 3.52 | 50 | N. | 1.15 | - | 59 |
| Mon.2/12 | 19.8 | 18.5 | 39.3 | 4.75 | 100 | N. | 4.07 | 4 | 59.2 |
| Wen.4/12 | 22.3 | 19.8 | 39.2 | 3.5 | 50 | N. | 1.5 | - | 59.1 |
| Sun.8/12 | | | | 5 | 50 | N. | 0.5 | - | - |
| Mon.9/12 | 20.6 | 16.9 | 39.1 | 6.05 | 160 | W.S | 5.2 | 10 | 58.8 |
| Wen.11/12 | 20.3 | 19.1 | 39.1 | 5.2 | 400 | W.S | 3.07 | 7 | 59 |
| Sat.14/12 | 15.1 | 9 | 39.2 | 4.33 | 80 | N. | 4.5 | 8 | 59.6 |
| Sun.15/12 | 15.3 | 10.9 | 39.1 | 4 | 100 | N. | 6 | 10 | 59.6 |
| Mon.16/12 | | | | 3.82 | 220 | N.E | 7.72 | - | - |
| Tue.17/12 | 15.6 | 11.6 | 39.1 | 4.6 | 100 | N. | 1.5 | 6 | 59.8 |
| Thu.19/12 | | | | | 700 | | 27 | 10 | - |
| Sat.21/12 | 18.5 | 11.9 | 39.1 | 7 | 700 | N. | 9 | 3 | 59 |
| Sun.22/12 | 19.8 | 10.2 | 39.1 | 6 | 100 | N. | 1.9 | 8 | 59 |
| Mon.23/12 | 16.1 | 12.2 | 38.7 | 5.28 | 60 | N.E | 2.72 | - | 58.8 |
| Tue.24/12 | 14.9 | 11.2 | 38.7 | 5 | 100 | N. | 5.14 | 8 | 59 |
| Thu.26/12 | 18.5 | 10.9 | 39.1 | 5 | 200 | N. | 7.6 | 2 | 59 |
| Mon.30/12 | 17.8 | 12.8 | 39.1 | 6.4 | 160 | E | 8.26 | 8 | 59.1 |

*Table 4: January 2003*

| Sea water Temp.($c^{\circ}$) | Air Temp.($c^{\circ}$) | Sal. (‰) | Wave Per. (s) | Wave Hei. (cm) | Wind Dir. | Wind Sp.(m/s) | Clouds /10 | Cond. (ms/cm) |
|---|---|---|---|---|---|---|---|---|
| 19.1 | 15.5 | 39.1 | 6.6 | 160 | E | 6.33 | 8 | 59 |
| 18.8 | 17.3 | 38.8 | 6.62 | 150 | SW | 3.07 | 8 | 64.1 |
| | | | 6.66 | 200 | E | 5.06 | 2 | |
| 16.8 | 16.8 | 40.1 | 7.18 | 80 | E | 1.08 | 6 | 60.2 |
| 19.0 | 17.7 | 38.3 | 3.53 | 30 | N | 0.94 | 1 | 58 |
| 18 | 16.4 | 38.3 | 5.8 | 180 | E | 5.88 | 1 | 58.4 |
| 15.8 | 17.7 | 39.8 | 5 | 150 | N | 6.98 | - | 59.1 |
| 15.9 | 16 | 36.4 | 5 | 40 | W | 2.11 | 9 | 55.8 |
| | | | 4.62 | 300 | N | 3.88 | 9 | |

Tables 1,2,3 and 4 contain sea surface temperature (SST), air temperature, salinity, period and height of wave, direction and speed of wind, clouds, sea surface conductance.

Note$_1$: symbols E,W,N,S in fifth column indicate the directions of wind related to the north.

Note$_2$: clouds are taken as a portion from ten.

The distribution of wind speeds and their directions from the east are presented in table 5.

**Table 5: distribution of wind speeds vs. wind direction according to data measurements in Lattakia area. All values are given in percentage. (vs. ≡ versus )**

| Speed (m/s) / direction (deg.) | 0≤1 | 1≤2 | 2≤3 | 3≤4 | 4≤5 | 5≤6 | 6≤7 | 7≤8 | 8≤9 | 0-9 |
|---|---|---|---|---|---|---|---|---|---|---|
| 0≤30 | 7.27 | 1.82 | | 3.64 | | 3.64 | 1.82 | | 1.82 | 20.01 |
| 30≤60 | 9.09 | 5.45 | 5.45 | | | 1.82 | | 1.82 | | 23.63 |
| 60≤90 | 10.89 | 9.09 | | | 3.64 | 5.45 | 1.82 | 1.82 | 1.82 | 34.63 |
| 90≤120 | | | 1.82 | | | | | | | 1.82 |
| 120≤150 | | | | | | | | | | |
| 150≤180 | | 1.82 | | 1.82 | | | 1.82 | | | 5.46 |
| 180≤210 | | | | | | | | | | |
| 210≤240 | | | | | | 1.82 | | | | 1.82 |
| 240≤270 | | | | 1.82 | | | | | | 1.82 |
| 270≤300 | 1.82 | 7.27 | | | | | | | | 9.09 |
| 300≤330 | | | | 1.82 | | | | | | 1.82 |
| 330≤360 | | | | | | | | | | |
| 0-360 | 29.07 | 25.45 | 7.27 | 9.10 | 3.64 | 12.73 | 5.46 | 3.64 | 3.64 | 100% |

# DISCUSSION:

Figures 1,2 illustrate a polar diagram of measured significant wind speed and wave height vs. wind direction at Lattakia Coast.

The wind speed and wave height variations follow a very similar pattern except for few cases.

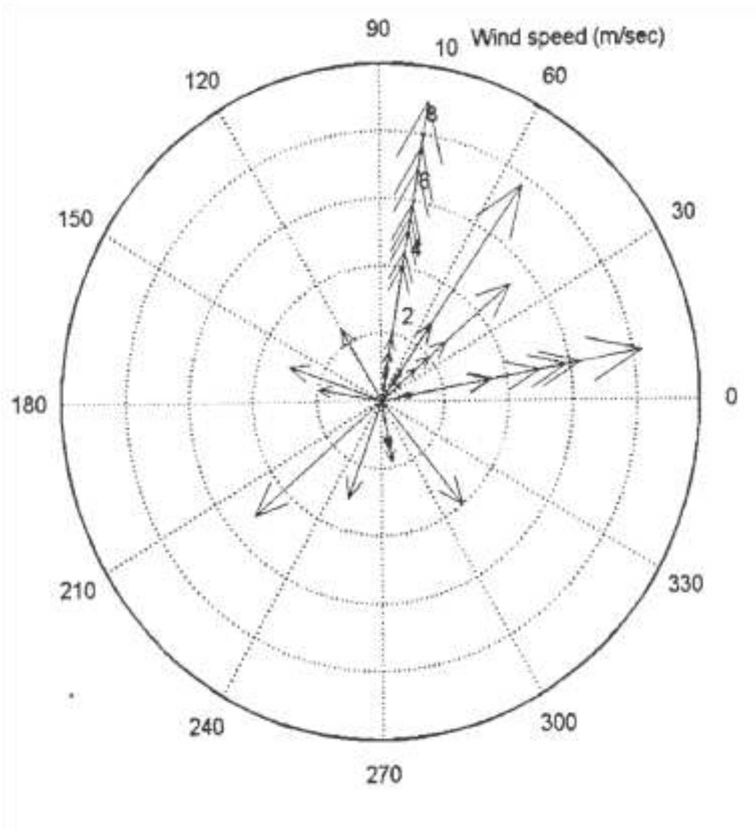



**Fig.1: polar diagram of measured wind speed vs. wind direction at Lattakia Coast.**

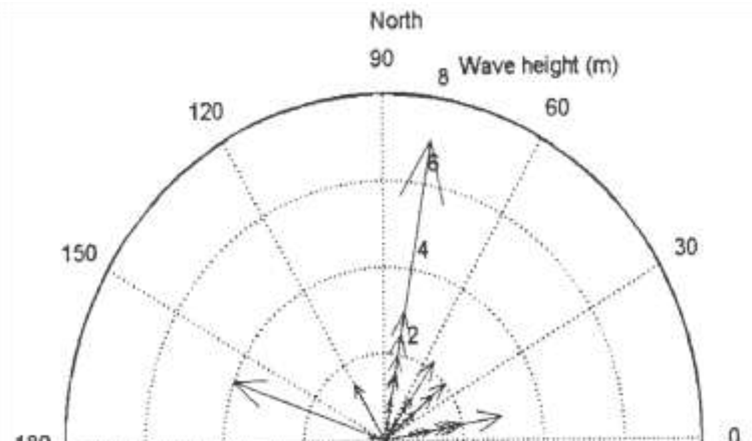


**Fig.2: polar diagram of measured wave height vs. wind direction at Lattakia Coast.**

The dominant wind directions lie within the sectors 0-90$^0$ and 160-260$^0$(see fig.1).

The correlation between wave height and wind speed for this location is linear.

Therefore the dominant waves in this area must be mostly wind waves .

It is found that the daily wave height and wind speed variations follow similar behavior except for few cases figures 3,4.

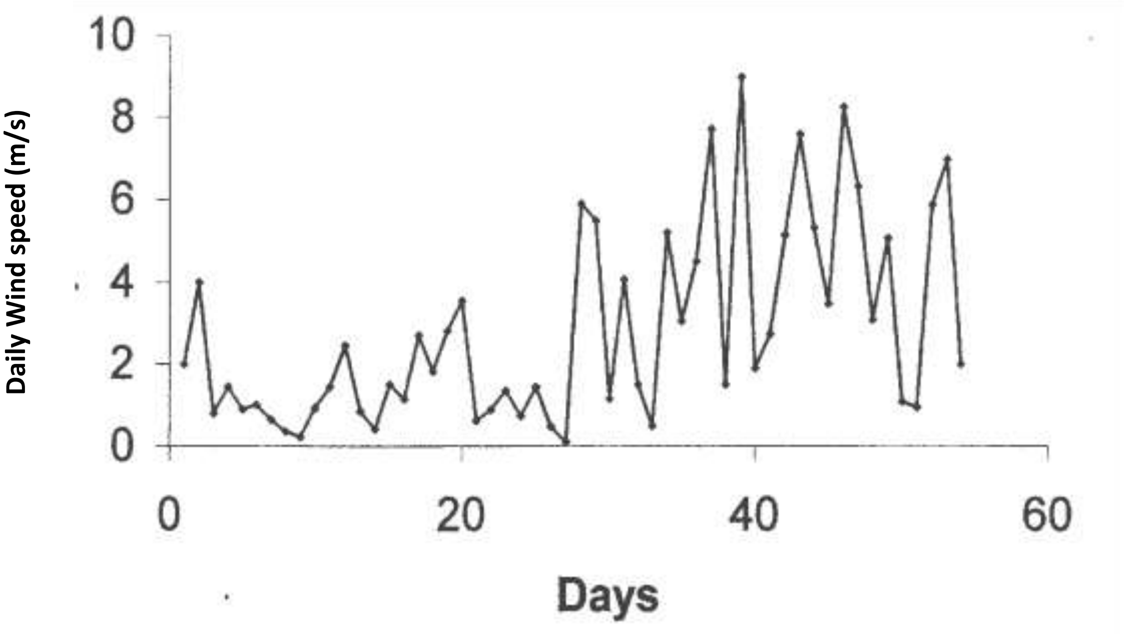
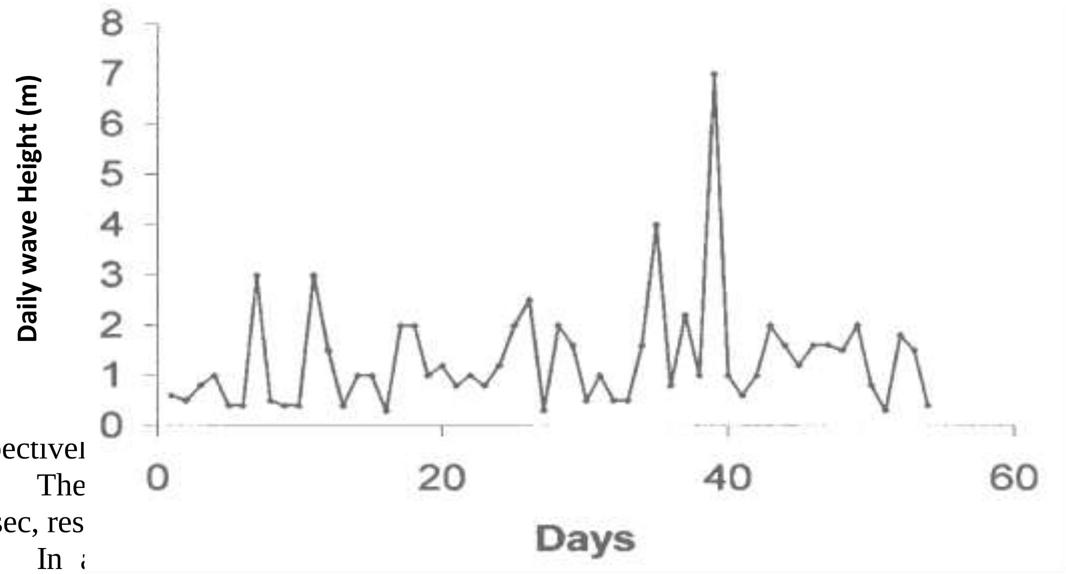



**Fig.3: Time series of daily wind speed as obtained from measurements at Lattakia Coast beginning from November 2002.**

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associated to high wave period. Nowadays we will continue our research in studying the sea wave energy and its dependence on wave height, and would also elaborate our work in the field of sea currents (surface currents, deep currents) by using current meters.

# REFERENCES:

…………………………

[1] G.L.Pickard and W.J.Emery,1990- Descriptive Physical Oceanography, Great Britain, BPCC Wheatons by Ltd, Exeter.

[2] Blair Kisman, 1965- Wind Waves their Generation and Propagation on the Ocean Surface, Jan Hahn, Woods Hole Oceanographic Institution, USA.

[3] Richard Golob and Eric Brus, 1993- the Almanac of renewable Energy, New York, Henry Holt.

[4] George Hagerman, 2001 – Southern New England Wave Energy Resources Potential, Tufts University, Boston, MA.

[5] Gary S.E., Lagerloef, San Diego, 1988-J.of Geophy.Res. ,Vol.93,No.$c_6$, California.

[6] Kathryn A. Kelly, 1988 – December 15, J. Geoph..Res., vol.93, No.$c_{12}$ ,Woods hole, Massachusetts.

[7] N.Kabbara, X.H. Yan, V.V. Klemas and J.Pan, 2002 Int.J. Remote Sensing, Vol.23, No.18, Temporal and Spatial Variability of the Surface Temperature Anomaly in the Levantine Basin of the Eastern Mediterranean .