HEAT EXCHANGE PROCESSES BETWEEN THE EASTERN MEDITERRANEAN AND THE ATMOSPHERE

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ABSTRACT

Monthly heat exchanges between the Eastern Mediterranean and the atmosphere due to the solar radiation, the evaporation, the conductive heat exchange and the effective radiation were calculated using Timoviv's equations (1970, 1983).

These equations are given as the following:

The daily integral of total solar radiation is given by

$$Q_n = \gamma Q \left[1 + \xi_1 n + \xi_2 (0.25 n + 0.75 n^2) \right] \qquad (1)$$

where, Q- the daily integral of solar radiation when the sky is clear.

γ -parameter, indirectly accounts the real concentration of aerosole in the atmosphere over the sea and varies from 1.0 to 0.90.

n- amount of cloudness

ξ_1 , ξ_2-empirical coefficients are given by

ξ_1 =0.05-1.10 sin ϕ + (0.45-0.044 cos ϕ)hr

ξ_2 =0.47 + 0.66 sin ϕ + [0.044 cos ϕ + 0.009 cos (ϕ -47) -0.0517] hr.

ϕ -Latitude, hr - altitude of the sun at middy

The albedo of the sea surface is given by

$$A_n = A - (A-0.08) n \qquad (2)$$

The effective radiation was performed using equation (3).

$$E_n = 1.10\sqrt{\gamma^5}\ \delta\ \overline{B}\ \overline{T_a^4} (0.39 - 0.0502\sqrt{\overline{e}}) + \left[1.06 \left[1 - (1 - \mu)^{0.54} \right] + \overline{\Delta\nu(\Delta n)} + \frac{4 (\overline{t_w - t_a})}{\overline{T_a}\sqrt{\gamma^5} (0.39 - 0.0502\sqrt{\overline{e}})} \right] \qquad (3)$$

where t_w, t_a are the temperature of surface water and the air

Ta - absolute air temperature = 273 + t_a

e - absolute air humidity, δ = constant = 0.90

$\overline{B}$ = constant = 0.567 x 10^{-10} k.wt/m^2.$C^{\circ 4}$.

$\overline{\Delta\nu(\Delta n)}$-correction varies from-0.02 to 0.04 and can be calculated using tables. $\mu = \frac{Q_n}{\gamma Q}$

The heat exchange from equation (4)

$$\overline{P} = -0.212 (\overline{t_w - t_a}) . V \qquad (4)$$

and the heat loss due to the evaporation is given by

$$\overline{LE} = -0.326 (\overline{e_o - e}) . V \qquad (5)$$

e_o - Saturation vapour pressure at the temperature of the sea surface.

e - the actual vapour pressure. Both quantities are in mb.

In order to obtain the amount of heat budget in a month, it should be multiplied by N, where N the number of days in a month.

In the present work, the meteorological elements namely; sea surface temperature, air temperature, wind speed and direction, absolute and saturate values of humidity and the amount of cloudness were taken from the Atlas of the Atlantic Ocean (1977) at 26 stations covering the Eastern Mediterranean Sea.

RESULTS

The net results of these processes constitutes heat loss through the sea surface to the atmosphere or heat gain. The amount of heat loss through the sea surface due to the effective radiation is not more than -4.6 - -6.5 Kcal/cm^2/month. While due to the conductive heat exchange is not more than -1 Kcal/cm^2/month. The maximum amount of heat loss is due to the evaporation, where its maximum values are observed in October-January and its minimum values are in April-May (table 1).

The heat loss through the sea surface to the atmosphere exceeds the heat gain from the sun during the cold period (October to March). While the heat gain from the sun exceeds the heat loss through the sea surface from April to September.

Table 1

The heat loss through the sea surface due to evaporation in 10 point were selected to in different regions of the Eastern Mediterranean (Kcal/cm^2/month).

Coordinate N.	Coordinate E.	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
38°	18°	- 9,35	- 6,79	- 4,95	- 4,10	- 4,70	- 6,58	- 7,72	- 6,84	- 5,32	-10,71	-11,91	-11,54	- 95,51
36°	15°	-10,04	- 7,06	- 4,55	- 6,02	- 4,87	- 4,51	- 6,07	- 6,33	- 7,23	- 9,31	-11,57	-10,65	- 88,21
36°	20°	-11,91	- 8,36	- 5,55	- 5,09	- 4,12	- 4,63	- 7,04	- 6,96	- 7,21	- 8,39	-12,40	-11,89	- 93,35
35°	25°	-13,18	-13,72	-10,28	- 5,24	- 4,39	- 6,58	- 7,22	- 8,73	- 7,64	- 8,85	-12,93	-12,17	-110,93
35°	30°	-10,25	- 9,90	- 8,49	- 6,97	- 6,13	- 8,46	-11,77	-11,32	- 9,10	- 7,66	- 9,67	-10,46	-110,18
34°	34°	- 8,10	- 8,10	- 7,41	- 5,63	- 6,25	- 8,86	-12,17	-11,64	-10,10	- 8,31	- 8,27	- 8,99	-103,83
33°	15°	- 9,92	- 8,29	- 7,41	- 6,94	- 4,12	- 4,07	- 6,77	- 6,11	-10,15	-12,52	-14,15	-12,36	-102,81
33°	20°	-10,22	- 9,03	- 8,31	- 5,79	- 3,14	- 3,71	- 6,58	- 6,89	-10,42	-13,52	-13,86	-13,21	-104,68
33°	25°	- 9,33	-11,06	- 9,93	- 6,77	- 4,28	- 4,62	- 7,34	- 8,70	- 9,31	-11,11	-11,29	-12,92	-106,66
32°	30°	- 9,54	-10,41	- 8,26	- 6,34	- 5,31	- 6,94	- 9,20	- 9,42	- 8,71	- 8,49	-11,14	-10,65	-104,71

REFERENCES

Atlas of Oceans (1977). Atlantic and Indian Oceans. the main Oceanography and nevigation mangement, Ministry of defence USSR, 306 P. (In Russian).

Timoviv N.A. (1970). On the external components of the heat balance in Oceans. In the marine hydrophysical investigation, No. 1: 148-165, Sevastopol, MGE AN OVSSR. (In Russian).

Timoviv N.A. (1983). Radiation regime of oceans. Kiev, 247 P. (In Russian).

THE TIME VARIATIONS OF MONTHLY MEANS OF SEA SURFACE TEMPERATURE AND METEOROLOGICAL PARAMETERS IN THE EASTERN MEDITERRANEAN

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This paper is an effort towards a better understanding of the variability of the hydrometeorological factors in the Eastern Mediterranean which is not yet well known. The monthly mean time series of several parameters; sea-surface temperature, air temperature, dewpoint temperature, the difference between air and sea-surface temperatures, atmospheric pressure and evaporation, during the period 1961-1967 are investigated. Three marine zones are considered in the area: the South East of Sicily, the South West of Crete Island, North of Egypt and at the coastal meteorological Station Ras El-Tin (Alexandria, Egypt). The preliminary inspection of the time series indicates more smooth records of the air and the sea-surface temperatures and the most disturbed records belong to the atmospheric pressure, which becomes smoother towards the east. The spectral analyses of the different parameters, at the different considered series in the area, manifest the dominance of the seasonal cycle with a significant peak at 12 motnhs period. The spectral density distribution for the different parameters at the different places are identical at low frequencies (less than 2 c.p.y.) but they are somewhat different in the higher frequencies due to local factors. The low frequencies are mostly related to large scale va. iations which have similar effects on the whole area. However, the atmospheric pressure has a significant spatial evolution. In the Ionian Sea (SE of Sicily) the energy density is nearly similar for high and low frequencies with no significant peaks, while going to the east, the energy density increases in the low frequencies and decreases in the high frequencies. This evolution is due to the fact that the Ionian Sea has stronger depressions activity.

The coherences between the different sites, for the same parameter, were found to be significant at the oscillation with less than 5 c.p.y.. Higher coherence existed at the low frequencies and the coherence decreases with increasing the distance between the two positions. The atmospheric pressure shows, again the least coherence.

The amplitudes and phases of the general monthly averages for the different parameters in the three marine areas, are determined.

The relation between the monthly mean sea-surface and air temperatures were found to be linear with quite high significant correlation coefficients. The equations relating these two factors are nearly identical at the Area South East of Sicily and North of Egypt. The equations were calculated in two separate periods: One from April to August, when the air temperature is higher than that of the sea-surface, and the other during the rest of the year, when air temperature is less than that of the sea-surface temperature. These equations could be used to calculate the monthly mean sea-surface temperature with accurary of about + 0.7 deg. C.