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PRECIPITATION, EVAPORATION AND ENERGY EXCHANGE AT THE SURFACE OF THE SOUTHEAST ASIAN WATERS

by

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The full understanding of the distribution of the surface temperature and salinity requires the knowledge of the heat and water balance at the surface of the ocean as well as of the circulation. For southeast Asian waters the monthly averages of the climatological factors determining the heat and water balance are calculated and presented in the following for 15 regions. The positions of the 15 regions are given in fig. 1, the values are averages of 8 to 12 1° squares situated about in the centre of the region, to avoid disturbances by effects from the land.

The *precipitation* over the different regions has been taken from representations given by WYRTKI (1956) showing the annual variation of rainfall over the sea by means of an evaluation of the observations of coastal and island stations in the Indonesian Archipelago. For the regions outside the archipelago the same method has been applied for the determination of the annual variation of the rainfall, table 7.

The *evaporation* of the different regions has been calculated by means of the formula given by SVERDRUP (1946). In this formula the evaporation is proportional to the wind velocity v and to the vapour pressure difference between sea and air e_w — e_a,

$$E = k (e_w — e_a) v.$$

This formula is theoretically founded and has been used successfully for the calculation of the evaporation, so that not it, but the used observation material needs critical consideration. Besides the wind velocity and the water and air temperatures, the relative humidity enters the formula, which is difficult to determine, but plays on important role in the calculation. If E_a is the vapour pressure of the saturated air, and q the relative humidity, the evaporation is given by

$$E - k (e_w — q E_a) v \text{ or}$$

written in an other way

$$E = k (e_w — E_a + (1 — q) E_a) v$$

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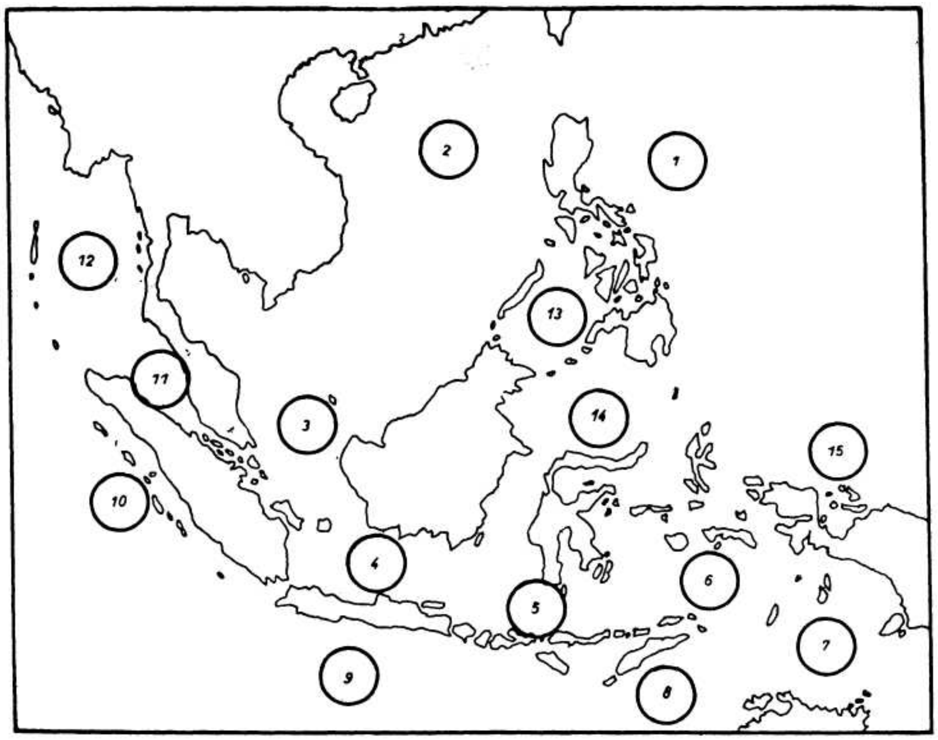

Fig. 1. Position of the regions for which the data of the water and energy balance have been computed. Numbers refer to those used in table 1 to 14.

Because the water and air temperatures over the sea are nearly equal, the difference e_w — E_a practically vanishes, and the evaporation depends effectively on the factor (1 — q), which is the deficit of the saturation. But this value varies considerably in the tropical monsoon climates because the humidity is high, between 90 and 70%. This means, that the factor (1 — q) varies as 1 to 3.

The factor k in the evaporation formula, which can be derived from the boundary layer theory, has to be considered carefully, because the formula is valid only for simultaneous values of wind velocity and vapour pressure differences. But because normally the product of averages differs from the average of single products, this theoretical calculation of k is only of limited value. This means, that the coefficient has to be determined empirically. If the wind velocity v is measured in m/sec, the vapour pressure in millibars and the evaporation in mm/day, the following values of k have been used by the named authors:

SVERDRUP	1946	0.103
BROGMUS	1952	0.104
ALBRECHT	1951	0.092
JACOBS	1951	0.143

For these calculations k = 0,100 has been taken, giving slightly smaller values than SVERDRUP, an effect which could perhaps be balanced because for the transformation of the wind velocity from Beaufort scale to m/sec the maritime convertion scale has been used, giving slightly higher values than the most other scales in use.

The *temperature* of the water and of the air has been taken from the Dutch climatological atlasses (1936, 1949). This material is not only very comprehensive, but is almost throughout based upon simultaneous observations of the water and the air temperature, which is of importance for our investigations. Therefore the values of the World Atlas of Sea Surface Temperatures (1950) have not been used. A comparison between this atlas and the Dutch atlasses shows deviations up to 1,0 °C in certain months and regions, of which the frequency distribution is shown in fig. 2a. On the average the temperatures of the US atlas are 0,10°C higher than those of the Dutch atlasses. The monthly values of the temperatures of the sea water and of the air are given in table 1 and 2.

The difference between water and air temperature varies in the different months and regions between 0,8° and -0,2 °C and has an average of 0,31 °C, fig. 2b. Negative values appear only over the regions of upwelling off the northwest coast of Australia during the southeast mon-

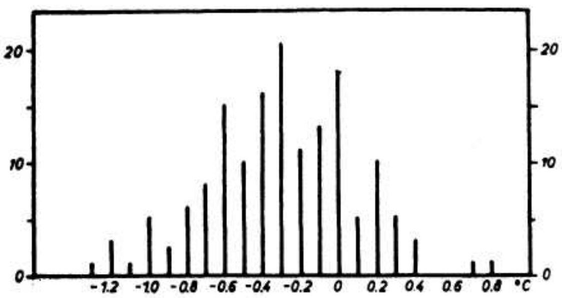

FIG. 2a.

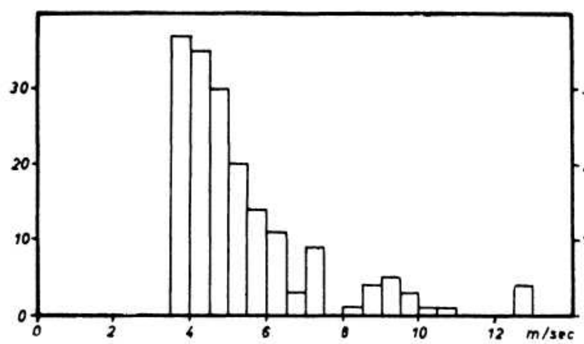

FIG. 2b.

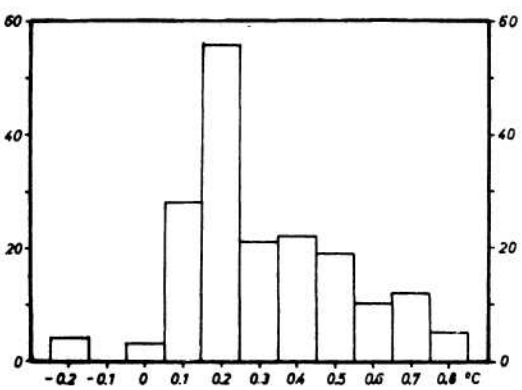

FIG. 2c.

Fig. 2a. Frequency of the average monthly difference of the sea surface temperature obtained from the Dutch climatological atlasses and from the World Atlas of Sea Surface Temperatures.

Fig. 2b. Frequency of the average monthly wind velocities in the 15 regions.

Fig. 2c. Frequency of the average monthly temperature difference between sea and air.

soon. The results of the Snellius Expedition, VISSER (1936), on the other hand have shown, that the temperature of the water is on the average 0,7 °C higher than that of the air, indicating a falsification of the observations of the merchant ships. Therefore these values can not be used to calculate the exchange of sensible heat between sea and atmosphere, while the values of the temperature may be considered to be representative for normal climatological conditions. The annual variation of the water and the air temperature are presented in figs. 3-9.

The *relative humidity* is necessary for the determination of the vapour pressure of the air, but its determination makes rather big difficulties, and effects considerably the results. The psychometric difference given in the Atlas of Climatic Charts of the Oceans (1938) can not be used in this case, because only values at Greenwich noon are used, corresponding to 18 to 21 hours local time. In the beginning of the night the humidity is often high because of rainfall in the afternoon. Therefore the direct climatological observations of the relative humidity at coastal and island stations have widely been used. The values of the weather side and leeside stations have been compared and it was accepted, that the weather side stations give the real values over the sea; they are given in table 3. The obtained vapour pressures of the air have been compared with those given by ALBRECHT (1951) and correspond with them with the exception of some explainable cases. Generally the variation of the humidity can be said to run parallel to that of the rainfall, allowing for the selection of the suitable values in some doubtful cases.

The *wind velocity* has been determined in two independent ways. First the ships' observations collected at the Institute of Marine Research in Djakarta were examined statistically, but the cover only a period of 7 years. Second, the Atlas of Climatic Charts of the Oceans has been used. It gives charts of the wind velocity only for every season, but besides that charts of the frequency of the wind velocity for every month. The evaluation of these data was favoured by the fact that in this region the average wind velocity is about 3 Beaufort, and the atlas gives information about the percentage of winds above and below 3 Beaufort. By means of a statistic of the wind velocities in this region, it could be determined, which average wind velocities belong to a certain frequency in the atlas. These results correspond very close to the direct ships' observations, so that they were used without further critical consideration. The transformation into m/sec was made using the maritime conversion scale, which gives relatively high values. The monthly averages of the wind velocity are given in table 5, their frequency is shown in fig. 2c and indicates the high percetage of weak winds.

By means of the temperature of the water and of the air and of the relative humidity the vapour pressure difference between sea and air could be calculated, table 4. Multiplication of these values with the wind velocity v, the factor k and the number of days in the different months gives the evaporation, table 6. The annual variations of all these factors are presented in figs. 3-9, and the annual variation of the rainfall, table 7, of the difference between rainfall and evaporation, table 8, and of the surface salinity have been added.

The *energy exchange* at the surface of the ocean satisfies the equation

$$Q_r - r\,Q_r - Q_b - Q_e + Q_{conv} + Q_{adv} + Q_h$$

and the different symbols have the following meaning:

Q_r total radiation from sun and sky.
r percentage of reflected radiation.
Q_b back radiation from the sea surface.
Q_e energy used for evaporation.
Q_{conv} convection of sensible heat to the atmosphere.
Q_{adv} advection of heat by currents and mixing.
Q_h heat used for heating of the water, cooling negative.

The total incoming radiation is easy to calculate from the values given by KIMBALL (1928), if the average cloudiness is known. Information on the cloudiness have been taken from the Atlas of Climatic Charts of the Oceans (1938) and from SCHOTT (1935), from which the annual variation of the cloudiness has been interpolated, table 9. The values of the incoming radiation at clear sky Q_o according to KIMBALL have been interpolated for the average latitude of the region and reduced according to the cloudiness C with the formula

$$Q_r, = Q_o\ d — 0,071\ c)$$

The percentage of reflected radiation has been considered to be 3%. The back radiation is determined by means of the diagram given by SVERDRUP (1946) as a function of sea surface temperature and relative humidity. It is reduced according to the cloudiness C with the formula

$$Q_b = Q_{bo}\ (1 — 0,083\ C)$$

From these three values the total effective radiation at the sea surface Q_{eff} is calculated by

$$Q_{eff} = Q_r - r\,Q_r - Q_b$$

These values are given in tables 10, 11 and 12. They show in nearly all regions two maxima during the course of the year, which is due to the position between both tropics. The influence of the cloudiness modifies this distribution only a little, because in large areas the cloudiness varies only between 50 and 65%. Only during the southeast monsoon the cloudiness decreases in its range to below 40%.

Opposite to this effective radiation are the energies used for evaporation, heating or cooling, for the exchange with the atmosphere and for advective processes. In tropical regions the evaporation surely plays the domineering role, and its energy consum is calculated by multiplying the evaporation with the heat of vaporisation (582 cal/g at 28°C), table 13. The exchange of sensible heat amounts in the tropics to about 5 to 10% of the heat used for evaporation, and temporarily it may become negative. Its calculation is difficult because of the small temperature difference between sea and air, which is not known exactly enough. Therefore its calculation has been omitted.

For a representation of the energy balance of the different regions, figs. 4-9, the total effective radiation Q_{eff} is shown and the difference Q_{eff} — Q_e, being the heat available for heating and cooling of the sea and the atmosphere as well as for advective processes, table 14. A comparison between the difference Q_{eff} — Q_e and the annual variation of the water temperature shows in most of the regions a strong correlation between the available heat and the increase or decrease of the temperature. Numerically a heat surplus of 100 cal/cm^2/day heats during one month a water layer of 30 meters by 1°C. But for an exact comparison of both values a complete knowledge of the thermal structure of the water masses would be necessary, because advective processes might play an important role. To gain an impression of their magnitude, a short estimation might be valuable. In the discontinuity layer of the Atlantic Ocean MONTGOMERY (1939) calculates the vertical eddy diffusivity at about 0,4 gem/sec. With this value and with a temperature gradient of 10 °C within 100 meters depth a heat transport of 36 cal/cm^2/day results. This rather high amount of heat transport into the depth might be an essential factor in the energy balance, but it is relatively difficult to obtain exact values. The effect of this vertical heat transport on the other hand is easy to recognize in the continuous increase of the temperature in the core layer of the intemediate water, which is situated below the discontinuity layer. The horizontal heat transports on the other hand seem to be less important because of the small horizontal temperature gradients in this region,

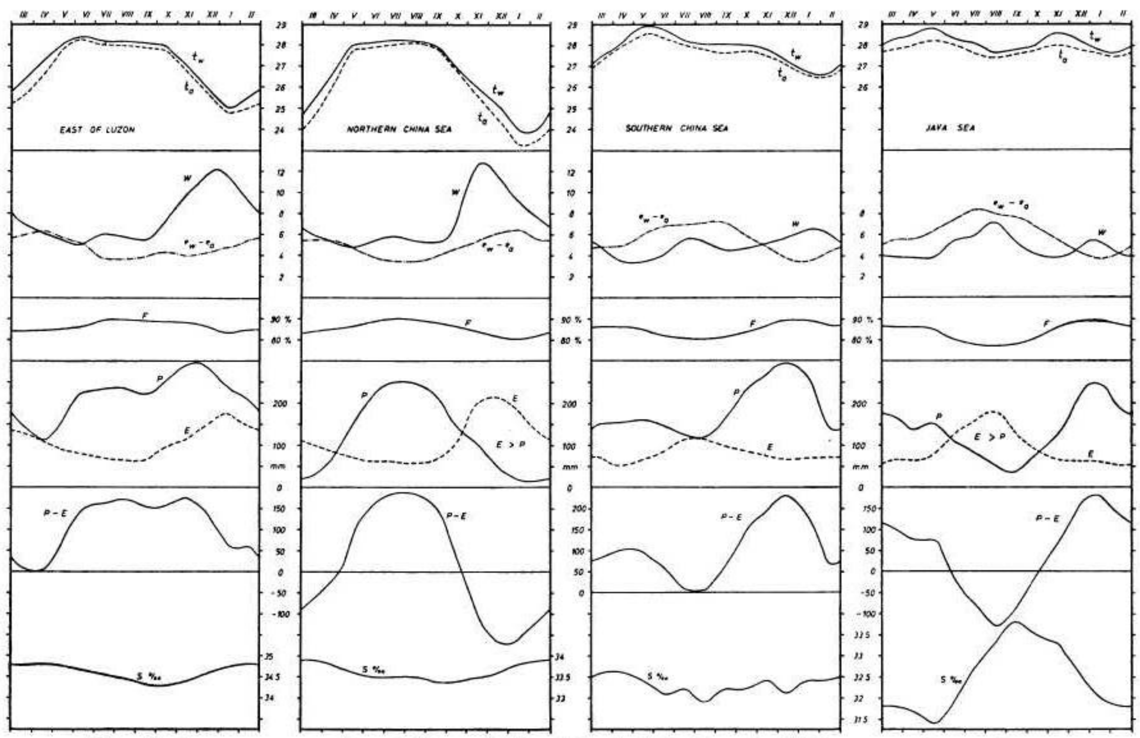

Fig. 3. Average annual variation of climatological factors in different regions of the southeast Asian waters.

Symbols used:

- t_w water temperature in centigrade.
- t_a air temperature in centigrade.
- w wind velocity in m/sec.
- $e_w - e_a$ vapour pressure difference in millibars.
- F relative humidity in %.
- P precipitation in millimeters.
- E evaporation in milimeters.
- S salinity at the surface in $^0/_{00}$.

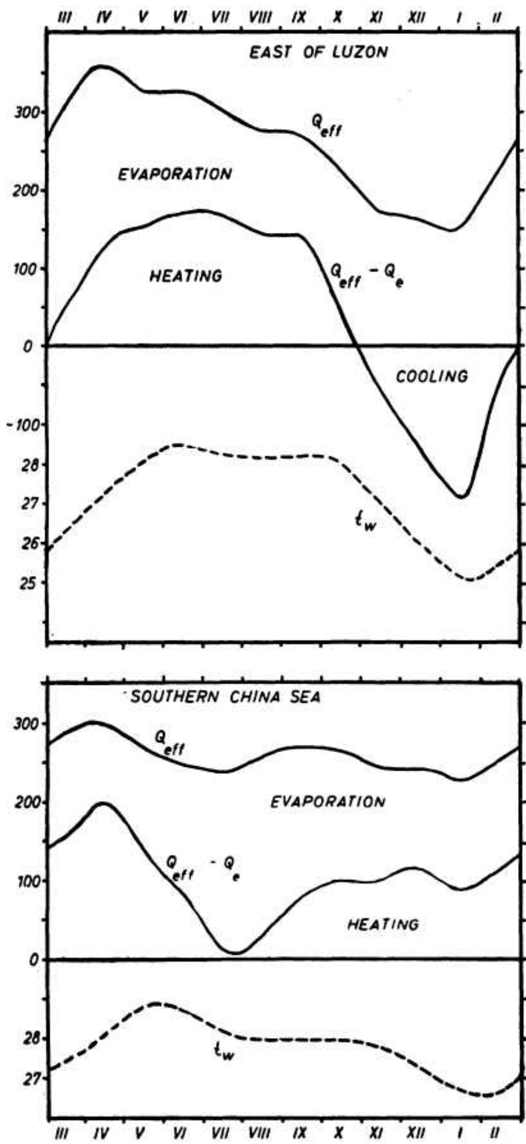

Fig. 4. Average annual variation of climatological factors in different regions of the southeast Asian waters.

Symbols used: Q_{eff} total effective radiation at the sea surface.
Q_e energy used for evaporation,
t_w water temperature in centigrade.

only in special cases they will have some influence and one of them is discussed in connection with the Malacca Strait.

Although the character of this investigation of the energy balance of the southeast Asian waters might be preliminary, so it gives an impression of the combined action of the different factors. This may be discussed in some detail, when dealing with the conditions in the different regions in the following.

Over the *northern parts of the China Sea* there is a rainy and a dry season, and in the latter the evaporation essentially exeeds the rainfall. The high evaporation during the months from November to March is chiefly a result of the strong winds during the northeast monsoon, but is intensified by the lower relative humidity in this season. The maximum of the relative humidity occurs in the rainy season. With the beginning of the northeast monsoon the water temperature decreases because more energy is used for evaporation than available from the radiation. The variation of the surface salinity corresponds to that of the difference between evaporation and precipitation.

The region *east of Luzon,* which is about in the same latitude and has similar wind conditions lacks the dry season, because also during the northeast monsoon wet air masses are domineering and lead to high rainfall throughout the year. These exceed the evaporation in every month. Also in this region during the northeast monsoon the temperature falls by 4°C.

The energy balance of both regions shows a similar pattern. The maximal radiation is available in the months from April to July, that is just the season with weak evaporation. During the months November to February on the other hand the energy consumption of the evaporation is bigger than the effective radiation, causing a cooling of the water. The total energy used for evaporation during these four months in the northern China Sea amounts to 21000 cal/cm^2 which is sufficient to cool a layer of 50 meters by 4°C. But the cooled layer is about 70 meters thick, which follows, that advective processes must be effective. This is in agreement with the advance of cool water masses through the Formosa Strait.

Over the *southern parts of the China Sea* a strong rainy season is developed from October to January, but a real dry season is lacking, so that the rainfall exceeds the evaporation during the whole year. Since winds are always weak, the evaporation is low, only in the months July/August, when the humidity is low, it exceeds 100 mm/month. The energy balance shows the effective radiation exceeding the energy needed for evaporation in every month. From this results a continious warming of the water, even if a part of the energy is given off to the atmosphere. Because in this region a heat transfer to the depth is possible only in a limited scale, horizontal transports must carry the surplus of heat out , of the region. In the months from November to February a cooling of 1° is noted, which must be caused by the advancing of cooler water masses from the north. The warmed water masses move with the north monsoon into the Java Sea. Afterwards a warming takes place coinciding with the maximum of the incoming radiation. The stronger evaporation in July/August causes a weak decrease of the temperature because besides the evaporation sensible heat is given off to the dryer airmasses of the southeast monsoon.

Over the *Java Sea* again a rainy and dry season is found. In the dry season during the southeast monsoon the evaporation exceeds the rainfall. High wind velocities and a low relative humidity cause an evaporation of more than 100 mm/month. During the months from June to August the energy necessary for the evaporation exceeds the avialable radiation and a cooling takes place. The deficit amounts to 5700 cal/cm^2 within these three months, corresponding to a cooling of a 40 meters deep layer by 1.4°C, which is in accordance with the observations. The cooling in December and January is not in accordance with the energy balance, but during both these months the north monsoon is most strongly developed and brings with relatively strong winds cool and rainy air masses into this region. Perhaps the evaporation might be underestimated in these months. Remarkable in this connection is the variation of the temperature in the Java Sea, showing a semiannual period well developed. The maxima occur in May and November, just during the kentering of the monsoons if the wind velocities are lowest. The minima of the temperature occur together with the full development of both monsoons in August and February.

In the *Flores Sea a*, similar variation of the temperature exists, but the cooling during the southeast monsoon is stronger. The evaporation exceeds during four months the rainfall, and is caused chiefly by the small relative humidity. The energy balance shows from June to August an excess of the energy for the evaporation over the effective radiation. This amounts to 7500 cal/cm^2 and is sufficient to cool a homogeneous layer 40 meters thick by 2°C, which is in agreement with the observations. From September the temperature rises again, the maximum is reached in December. At the time of the full development of the west monsoon over the Flores Sea in January the temperature drops again, in spite of

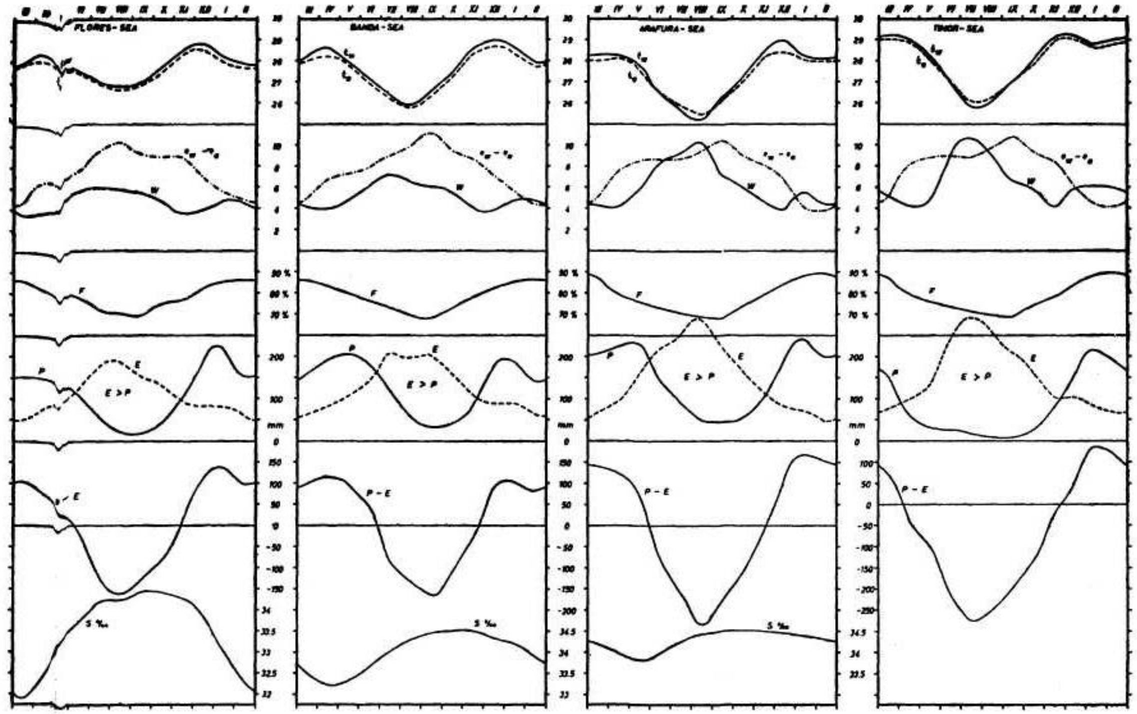

Fig. 5. Average annual variation of climatological factors in different regions of the southeast Asian waters.

Symbols used:

- t_w water temperature in centigrade.
- t_a air temperature in centigrade.
- w wind velocity in m/sec.
- $e_w - e_a$ vapour pressure difference in millibars.
- F relative humidity in %.
- P precipitation in millimeters.
- E evaporation in milimeters.
- S salinity at the surface in $^0/_{00}$.

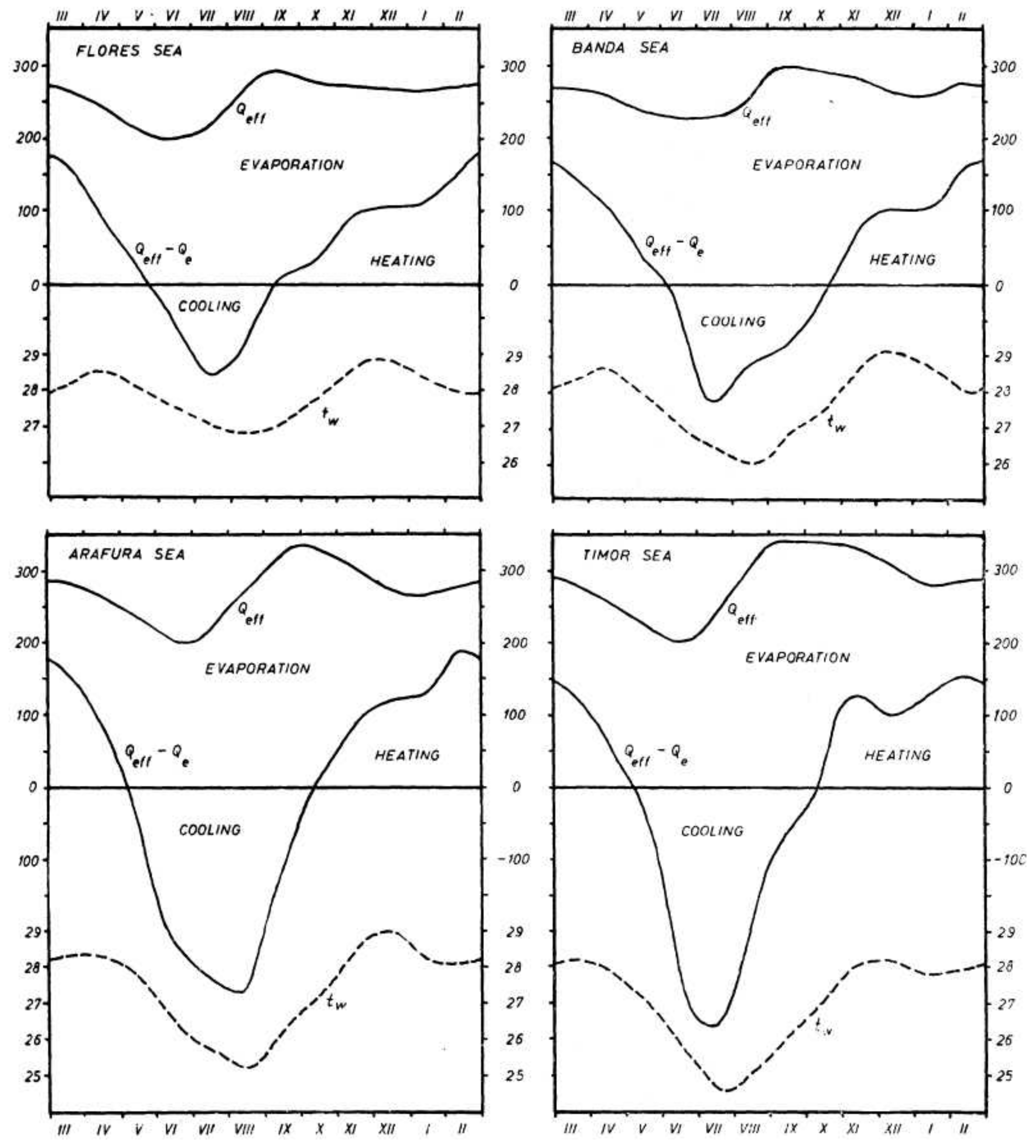

Fig. 6. Average annual variation of climatological factors in different regions of the southeast Asian waters.

Symbols used: Q_{eff} total effective radiation at the sea surface.
Q_e energy used for evaporation,
t_w water temperature in centigrade.

the positive energy balance during this time. This cooling effect in the Flores Sea might be interpreted as an vertical extension of the homogeneous layer due to the increase of the wind velocity during the west monsoon. If the homogeneous layer is deepened by mixing, the average temperature must decrease. But to show this requires a detailed knowledge of the variation of the thermal structure of the water masses during the year, which can not yet be given.

In the *Banda Sea* the conditions are similar to those in the Flores Sea, but the excess of evaporation and the cooling during the southeast monsoon are stronger. The maxima of the surface temperatures occur in April and December at the time of the kentering of the monsoons.

The *Arafura Sea* and the *Timor Sea* are closest to the region of origin of the southeast monsoon, and are most strongly influenced by its dry cool air masses. The wind velocities over these open seas are high and the humidity of the offshore winds is low, causing extremely high values of the evaporation. But the Atlas of Climatic Charts of the Oceans shows in this region during the whole year depressions of the wet bulb of only 0,5 to 1,0°C, which certainly must be an error during the southeast monsoon season. In the Arafura Sea the evaporation exceeds the rainfall during five months; in the Timor Sea even during seven months. Maximal values of the evaporation of nearly 300 mm/month are reached as a combined effect of strong winds and dry air. During July and August the water temperature is lower than that of the air, which might be due to upwelling processes. The rainy season in the Timor Sea is only short and takes place at the time, when the equatorial trough lies over this region. The Arafura Sea has two rainfall maxima, occuring when the equatorial trough passes the region, but the secondary minimum is only weakly developed.

The energy balance shows two maxima of the radiation, which is an effect of the position inside the tropics. The curves of the effective radiation are strongly modified by the cloudiness, which is very small during the southeast monsoon and above 60% during the rainy season. In the months from May to September, when the energy needed for evaporation exceeds the effective radiation, a strong cooling of the water takes place. The required energy during this time is about 27000 cal/cm^2, sufficient to cool a 90 meters deep layer by 3°C.

The region *south of Java* shows qualitatively the same conditions as the other regions in the southeast of the Archipelago. From May to October it is under the influence of the southeast monsoon, from December to February the equatorial trough lies over the region and brings the

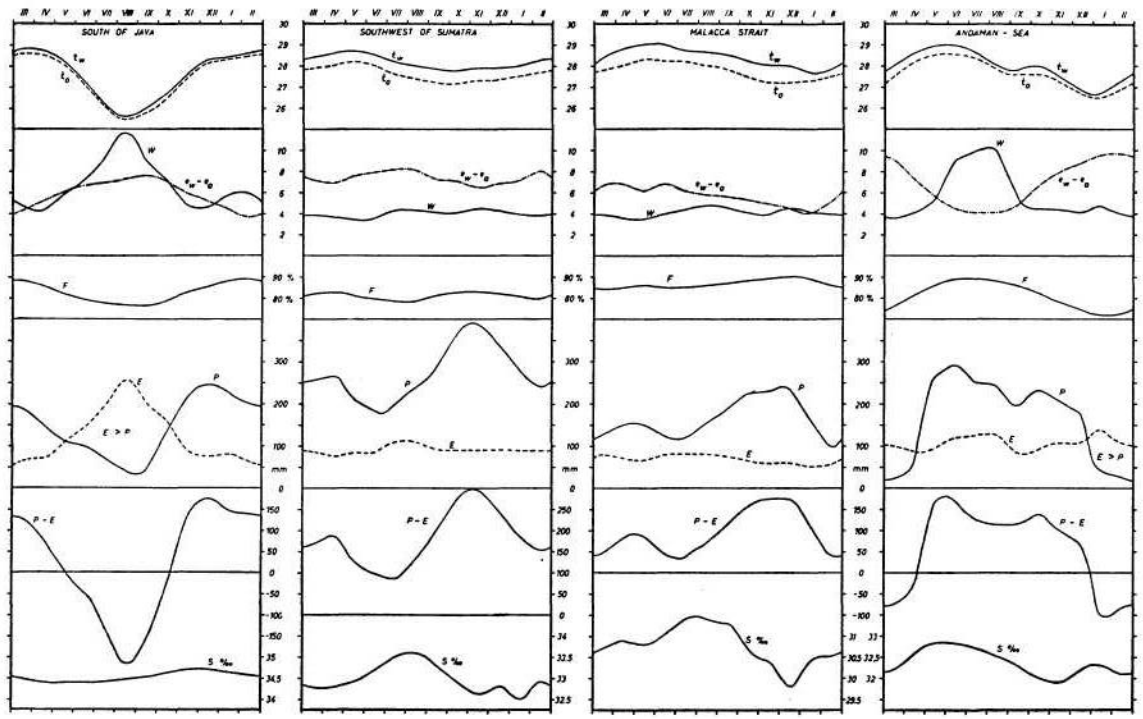

Fig. 7. Average annual variation of climatological factors in different regions of the southeast Asian waters.

Symbols used:

- t_w water temperature in centigrade.
- t_a air temperature in centigrade.
- w wind velocity in m/sec.
- $e_w - e_a$ vapour pressure difference in millibars.
- F relative humidity in %.
- P precipitation in millimeters.
- E evaporation in milimeters.
- S salinity at the surface in $^0/_{00}$.

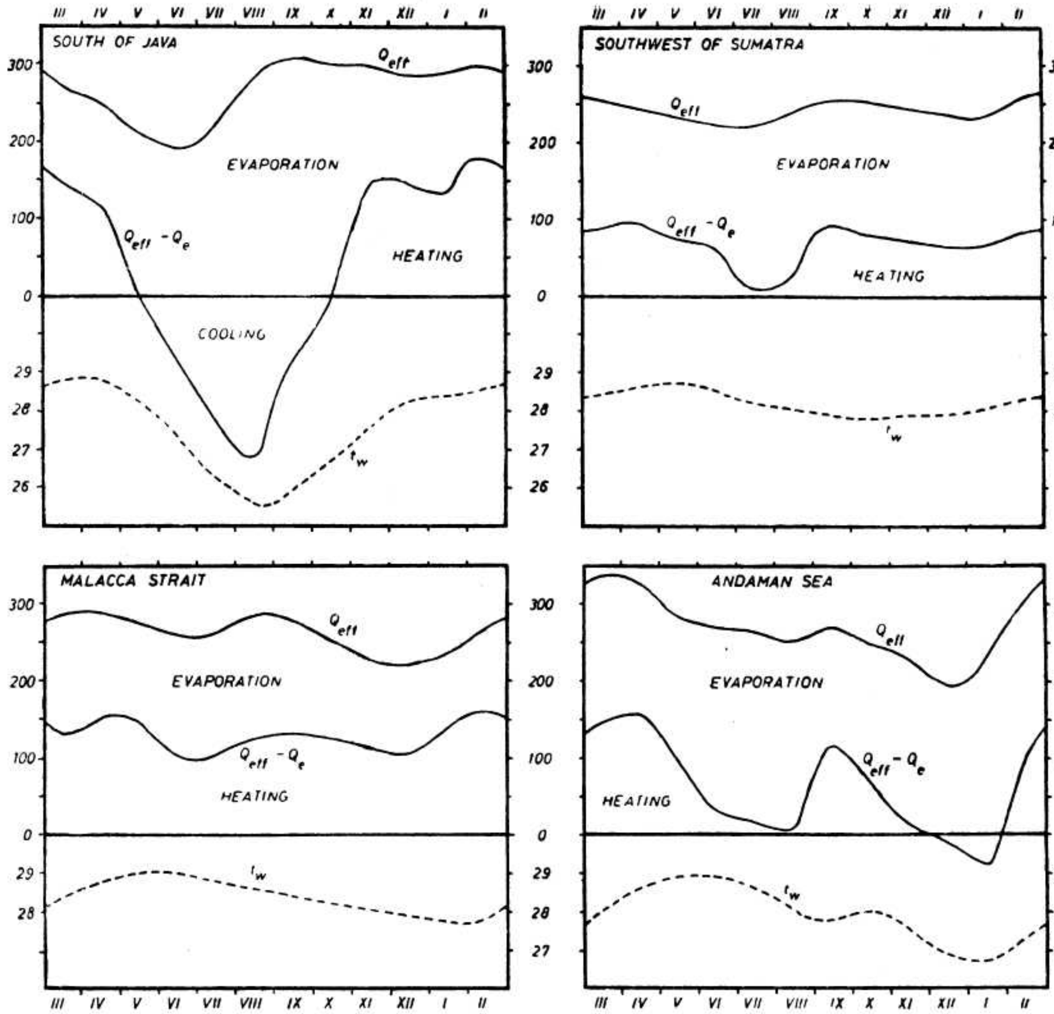

Fig. 8. Average annual variation of climatological factors in different regions of the southeast Asian waters.

Symbols used: Q_{eff} total effective radiation at the sea surface.
Q_e energy used for evaporation.
t_w water temperature in centigrade.

rainy season. The highly balanced annual variation of the meteorological conditions causes an also smooth run of the surface temperature and salinity in this region far from influences of the land. Both effects agree numerically with the calculated values.

The region *southwest of Sumatra* has with 3000 mm/year an extremely high rainfall, which drops in no month below 180 mm, meaning, that a real dry season does not exist. The two periods of especially strong rainfall occur when the equatorial trough passes the region. During these two times also the maxima of the relative humidity are found. The curves of the wind velocity and of the vapour pressure difference show only small variations, and cause a relatively constant evaporation of about 90 mm/month. An exception is found in July and August, when the southeast monsoon has some influence and the evaporation reaches 110 mm.

Also the energy balance is rather equalized, and gives during the whole year a contribution to a heating of the water. This heat is given off partly to the atmosphere, which follows from the relatively high difference between sea and air temperature. Another part might be transferred by advection horizontally and vertically. The annual variation of the temperature is less than 1°C, an indication for the stability of the conditions.

In the *Malacca Strait* the conditions are rather similar. Also there two rainy seasons are found without a real dry season between them. The relative humidity is extremely high, and because of the weak winds the evaporation is small. Only a part of the effective radiation will be used for evaporation and so a continious heating of the water would occur, if advective processes would not transfer the exess heat. It might be useful to estimate the numerical value of this energy transfer. At a horizontal temperature gradient dt/dx of 1°C in 2000 km and a velocity of the current of v = 25 cm/sec the heat Q transported in a layer of a depth D = 40 meters will be Q = c v D dt/dx, and numerically 44 $cal/cm^2/day$. Such an amount already has to be considered in the energy balance. Also the difference between sea and air temperatures reaches relatively high values in the Malacca Strait, indicating a large transfer of sensible heat to the atmosphere.

Over the *Andaman Sea* the regime of the Indian monsoon is already met. It brings from May to November a continious strong rainy season, in the other month a nearly rainless dry season. The evaporation has two weak maxima, one during the dry season, caused by the small relative humidity, the other during the rainy season, when the wind is strongest. Because both factors are counteracting, the variation of the evaporation

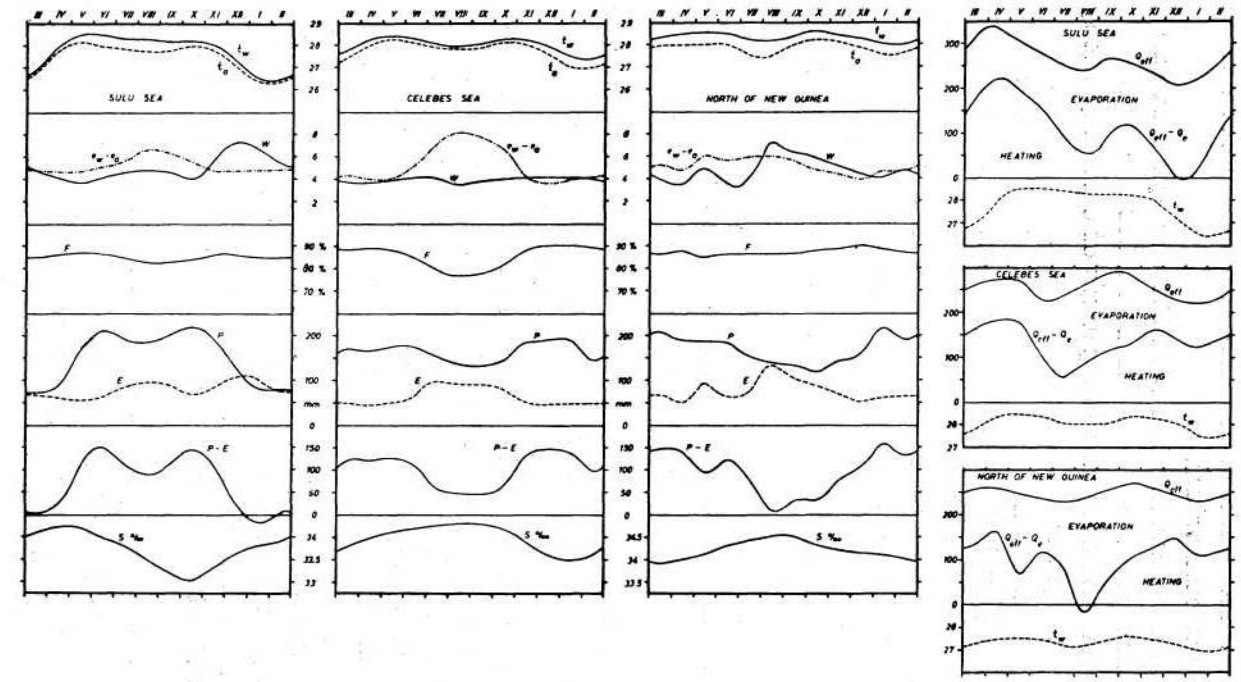

Fig. 9. Average annual variation of climatological factors in different regions of the southeast Asian waters.

Symbols used:

t_w	water temperature in centigrade.
t_a	air temperature in centigrade.
w	wind velocity in m/sec.
$e_w - e_a$	vapour pressure difference in millibars.
F	relative humidity in %.
P	precipitation in millimeters.
E	evaporation in millimeters.
S	salinity at the surface in $^0/_{00}$.
Q_{eff}	total effective radiation at the sea surface.
Q_e	energy used for evaporation.

is only small. In spite of that it exeeds the rainfall considerably during the dry season. The energy balance indicates the effective radiation normally exeeding the energy used for evaporation. Also a small transfer to the atmosphere must take place. The curve of the surface temperature corresponds to the available energy, during the periods of strongest energy surplus a heating takes place, during the periods of maximal evaporation the cooling occurs.

Over the *Sulu Sea* an extended rainy season occurs from May to November, but also in the other months the rainfall is considerable. The humidity is high and its variation small, while the wind reaches a maximum during the northeast monsoon. This causes in January and February higher values of evaporation, which correspond to the rainfall. The energy balance shows the effective energy always exceeding the energy required for evaporation, causing a continious heating of the water and of the atmosphere. Under consideration of the magnitude of the heat surplus horizontal heat transfer must be assumed. The heating of the water occurs from February to May at the time of maximal heat surplus, the cooling from November to January, when the evaporation requires all available energy.

In the *Celebes Sea* and in the region *north of New Guinea* completely equalized conditions are found in agreement with its position close to the equator. The rainfall is high and occurs during the whole year with about 150 mm/month. Over the Celebes Sea from July to October a branch of the southeast monsoon is observed, bringing dryer air masses and smaller rainfall. The smaller relative humidity causes a higher evaporation. The energy balance indicates, that considerable amounts of heat are available for the heating of the water and of the atmosphere. The deep homogeneous layer, 100 and more meters north of New Guinea, absorbs this energy and the strong currents in this region transfer the heat out of it. The fact, that the temperature in this region always exceeds 28 °C is indicative of this large heat exeess. In the Celebes Sea the temperature drops from January to March below 28°C, indicating a supply of cooler water from the Mindanao current.

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TABLE 1. AVERAGE MONTHLY SEA SURFACE TEMPERATURE IN CENTIGRADE. t_w

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Δt
1. East of Luzon	25.0	25.5	26.2	27.2	28.0	28.4	28.2	28.2	28.1	28.0	27.0	26.0	3.4
2. Northern China Sea	24.0	24.0	25.2	26.5	28.0	28.1	28.2	28.2	28.0	27.0	26.0	25.2	4.2
3. Southern China Sea	26.7	26.7	27.5	28.2	28.9	28.7	28.2	28.0	28.0	28.0	27.8	27.2	2.2
4. Java Sea	27.8	27.7	28.3	28.5	28.8	28.3	28.1	27.6	27.8	28.0	28.6	28.3	1.2
5. Flores Sea	28.2	27.9	28.0	28.5	28.0	27.6	27.0	26.8	27.0	27.7	28.5	28.8	2.0
6. Banda Sea	28.6	27.9	28.2	28.6	27.9	27.0	26.4	25.9	26.7	27.4	28.6	29.0	3.1
7. Arafura Sea	28.2	28.1	28.3	28.3	27.8	26.5	25.7	25.2	26.3	27.2	28.4	29.0	3.8
8. Timor Sea	28.8	29.0	29.2	29.0	28.2	27.0	25.8	26.0	27.0	28.0	29.1	29.2	3.4
9. South of Java	28.4	28.6	28.8	28.8	28.2	27.3	26.2	25.6	26.0	26.7	27.6	28.3	3.2
10. Southwest of Sumatra	28.0	28.3	28.4	28.6	28.7	28.5	28.2	28.0	27.9	27.8	27.9	27.9	0.9
11. Malacca Strait	27.7	27.8	28.4	28.8	29.0	29.0	28.7	28.6	28.5	28.2	28.3	28.0	1.3
12. Andaman Sea	26.7	27.3	28.0	28.6	28.9	28.9	28.6	28.0	27.8	28.0	27.5	26.9	2.2
13. Sulu Sea	26.5	26.5	27.0	28.0	28.5	28.5	28.3	28.3	28.2	28.2	28.0	27.2	2.0
14. Celebes Sea	27.5	27.4	27.8	28.3	28.4	28.3	28.0	28.0	28.0	28.3	28.2	28.0	1.0
15. North of Irian	28.0	28.0	28.3	28.5	28.5	28.5	28.2	28.2	28.4	28.6	28.4	28.3	0.6

TABLE 2. AVERAGE MONTHLY AIR TEMPERATURE AT SEA LEVEL IN CENTIGRADE. t_L

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Δt
1. East of Luzon	24.8	25.0	25.5	26.5	27.8	28.2	28.0	28.0	27.9	27.7	26.8	25.8	3.4
2. Northern China Sea	23.3	23.5	24.5	26.0	27.8	27.9	28.0	28.1	27.9	26.8	25.6	24.5	4.8
3. Southern China Sea	26.6	26.5	27.3	28.0	28.5	28.3	28.0	27.8	27.6	27.7	27.4	27.0	2.0
4. Java Sea	27.6	27.5	27.8	28.0	28.2	28.0	27.6	27.4	27.6	27.8	28.0	27.8	0.8
5. Flores Sea	27.9	27.7	27.9	28.1	27.9	27.5	26.9	26.6	26.9	27.5	28.3	28.5	1.9
6. Banda Sea	28.3	27.8	28.0	28.2	27.8	26.9	26.3	25.8	26.4	27.2	28.3	28.6	2.8
7. Arafura Sea	28.0	28.0	28.0	28.2	27.6	26.5	25.9	25.4	26.2	27.0	28.1	28.4	3.0
8. Timor Sea	28.6	28.8	29.0	28.8	28.0	27.0	26.0	26.2	27.0	27.8	28.9	29.0	3.8
9. South of Java	28.3	28.5	28.6	28.5	28.1	27.2	26.1	25.5	25.8	26.5	27.4	28.2	3.1
10. Southwest of Sumatra	27.6	27.7	27.9	28.0	28.2	28.0	27.6	27.4	27.2	27.2	27.3	27.3	1.0
11. Malacca Strait	27.3	27.5	27.7	28.0	28.3	28.2	28.2	28.0	27.8	27.4	27.2	27.2	1.1
12. Andaman Sea	26.5	26.9	27.5	28.2	28.5	28.5	28.3	27.8	27.6	27.6	27.2	26.7	2.0
13. Sulu Sea	26.4	26.4	26.9	27.9	28.2	28.0	27.9	27.8	27.8	28.0	27.8	27.0	1.8
14. Celebes Sea	27.0	27.0	27.5	28.0	28.3	28.1	27.9	27.8	27.9	28.2	28.0	27.6	1.3
15. North of Irian	27.5	27.7	28.0	28.0	28.0	28.0	27.5	27.5	28.0	28.2	28.1	27.9	0.7

TABLE 1. AVERAGE MONTHLY SEA SURFACE TEMPERATURE IN CENTIGRADE. t_w

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Δt
1. East of Luzon	25.0	25.5	26.2	27.2	28.0	28.4	28.2	28.2	28.1	28.0	27.0	26.0	3.4
2. Northern China Sea	24.0	24.0	25.2	26.5	28.0	28.1	28.2	28.2	28.0	27.0	26.0	25.2	4.2
3. Southern China Sea	26.7	26.7	27.5	28.2	28.9	28.7	28.2	28.0	28.0	28.0	27.8	27.2	2.2
4. Java Sea	27.8	27.7	28.3	28.5	28.8	28.3	28.1	27.6	27.8	28.0	28.6	28.3	1.2
5. Flores Sea	28.2	27.9	28.0	28.5	28.0	27.6	27.0	26.8	27.0	27.7	28.5	28.8	2.0
6. Banda Sea	28.6	27.9	28.2	28.6	27.9	27.0	26.4	25.9	26.7	27.4	28.6	29.0	3.1
7. Arafura Sea	28.2	28.1	28.3	28.3	27.8	26.5	25.7	25.2	26.3	27.2	28.4	29.0	3.8
8. Timor Sea	28.8	29.0	29.2	29.0	28.2	27.0	25.8	26.0	27.0	28.0	29.1	29.2	3.4
9. South of Java	28.4	28.6	28.8	28.8	28.2	27.3	26.2	25.6	26.0	26.7	27.6	28.3	3.2
10. Southwest of Sumatra	28.0	28.8	28.4	28.6	28.7	28.5	28.2	28.0	27.9	27.8	27.9	27.9	0.9
11. Malacca Strait	27.7	27.8	28.4	28.8	29.0	29.0	28.7	28.6	28.5	28.2	28.3	28.0	1.3
12. Andaman Sea	26.7	27.3	28.0	28.6	28.9	28.9	28.6	28.0	27.8	28.0	27.5	26.9	2.2
13. Sulu Sea	26.5	26.5	27.0	28.0	28.5	28.5	28.3	28.3	28.2	28.2	28.0	27.2	2.0
14. Celebes Sea	27.5	27.4	27.8	28.3	28.4	28.3	28.0	28.0	28.0	28.3	28.2	28.0	1.0
15. North of Irian	28.0	28.0	28.3	28.5	28.5	28.5	28.2	28.2	28.4	28.6	28.4	28.3	0.6

TABLE 2. AVERAGE MONTHLY AIR TEMPERATURE AT SEA LEVEL IN CENTIGRADE. t_L

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Δt
1. East of Luzon	24.8	25.0	25.5	26.5	27.8	28.2	28.0	28.0	27.9	27.7	26.8	25.8	3.4
2. Northern China Sea	23.3	23.5	24.5	26.0	27.8	27.9	28.0	28.1	27.9	26.8	25.6	24.5	4.8
3. Southern China Sea	26.6	26.5	27.3	28.0	28.5	28.3	28.0	27.8	27.6	27.7	27.4	27.0	2.0
4. Java Sea	27.6	27.5	27.8	28.0	28.2	28.0	27.6	27.4	27.6	27.8	28.0	27.8	0.8
5. Flores Sea	27.9	27.7	27.9	28.1	27.9	27.5	26.9	26.6	26.9	27.5	28.3	28.5	1.9
6. Banda Sea	28.3	27.8	28.0	28.2	27.8	26.9	26.3	25.8	26.4	27.2	28.3	28.6	2.8
7. Arafura Sea	28.0	28.0	28.0	28.2	27.6	26.5	25.9	25.4	26.2	27.0	28.1	28.4	3.0
8. Timor Sea	28.6	28.8	29.0	28.8	28.0	27.0	26.0	26.2	27.0	27.8	28.9	29.0	3.8
9. South of Java	28.3	28.5	28.6	28.5	28.1	27.2	26.1	25.5	25.8	26.5	27.4	28.2	3.1
10. Southwest of Sumatra	27.6	27.7	27.9	28.0	28.2	28.0	27.6	27.4	27.2	27.2	27.3	27.3	1.0
11. Malacca Strait	27.3	27.5	27.7	28.0	28.3	28.2	28.2	28.0	27.8	27.4	27.2	27.2	1.1
12. Andaman Sea	26.5	26.9	27.5	28.2	28.5	28.5	28.3	27.8	27.6	27.6	27.2	26.7	2.0
13. Sulu Sea	26.4	26.4	26.9	27.9	28.2	28.0	27.9	27.8	27.8	28.0	27.8	27.0	1.8
14. Celebes Sea	27.0	27.0	27.5	28.0	28.3	28.1	27.9	27.8	27.9	28.2	28.0	27.6	1.3
15. North of Irian	27.5	27.7	28.0	28.0	28.0	28.0	27.5	27.5	28.0	28.2	28.1	27.9	0.7

TABLE 3. AVERAGE MONTHLY RELATIVE HUMIDITY, %. F

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1. East of Luzon	83	84	84	84	85	86	89	89	89	88	88	86
2. Northern China Sea	80	82	84	85	86	89	90	89	88	86	84	82
3. Southern China Sea	89	87	86	86	85	82	81	80	81	84	87	89
4. Java Sea	89	87	86	86	85	80	78	77	78	81	87	89
5. Flores Sea	85	86	86	82	80	78	72	70	69	75	76	82
6. Banda Sea	85	86	86	83	79	77	72	70	68	74	77	82
7. Arafura Sea	88	89	87	79	76	73	71	69	68	74	78	84
8. Timor Sea	88	89	87	79	76	73	71	69	68	74	78	84
9. South of Java	88	89	88	86	82	80	78	77	76	79	83	85
10. Southwest of Sumatra	81	80	82	83	81	80	79	79	82	82	83	82
11. Malacca Strait	89	86	84	85	86	85	85	86	87	88	89	90
12. Andaman Sea	72	73	76	82	86	89	89	88	86	82	78	75
13. Sulu Sea	85	85	85	86	87	87	85	83	83	84	86	86
14. Celebes Sea	90	89	88	89	88	85	79	77	78	81	88	90
15. North of Irian	88	87	86	88	85	86	86	86	86	88	88	90

TABLE 4. AVERAGE MONTHLY VAPOR PRESSURE DIFFERENCE BETWEEN SEA SURFACE AND AIR IN MILLIBARS, $e_w - e_a$.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1. East of Luzon	4.9	5.5	5.9	6.3	5.2	5.1	3.7	3.7	3.9	4.3	4.0	4.3
2. Northern China Sea	6.4	5.5	5.5	5.5	4.8	3.9	3.5	3.5	4.0	4.7	5.3	6.1
3. Southern China Sea	3.5	4.3	4.8	4.9	6.0	6.8	6.8	7.1	7.1	5.7	4.8	3.7
4. Java Sea	3.7	4.4	5.5	5.6	6.3	7.5	8.4	8.0	7.7	6.7	5.5	4.4
5. Flores Sea	5.5	4.8	4.7	6.8	6.9	7.5	9.5	10.2	9.1	8.8	8.8	6.9
6. Banda Sea	5.6	4.5	4.8	6.7	7.2	7.5	9.1	9.5	11.1	9.2	8.7	7.2
7. Arafura Sea	4.1	3.7	4.8	7.5	8.4	8.7	8.7	9.1	10.4	8.9	8.1	6.8
8. Timor Sea	4.3	4.1	4.9	8.0	8.7	8.9	8.8	9.5	10.7	9.3	8.5	6.1
9. South of Java	4.4	3.7	4.3	5.3	6.1	6.7	6.9	7.1	7.6	7.1	5.9	5.2
10. Southwest of Sumatra	7.1	8.0	7.2	6.9	7.6	7.9	8.1	8.1	7.2	7.1	6.5	6.9
11. Malacca Strait	4.0	5.1	6.7	6.7	6.1	6.8	6.1	5.7	5.5	5.2	4.9	4.5
12. Andaman Sea	9.5	9.6	9.1	7.1	5.6	4.4	4.1	4.1	4.8	6.7	8.0	8.5
13. Sulu Sea	4.8	4.8	4.8	4.7	4.8	5.2	5.7	6.7	6.4	5.6	4.8	4.7
14. Celebes Sea	4.0	4.1	4.3	4.0	4.0	5.3	7.3	8.1	7.7	6.7	4.1	3.7
15. North of Irian	4.7	4.7	5.2	4.8	6.0	5.6	5.9	5.9	5.5	4.7	4.4	3.9

TABLE 5. AVERAGE MONTHLY WIND VELOCITY IN METERS PER SECOND. W

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1. East of Luzon	11.6	9.2	7.2	6.2	5.5	5.1	6.0	5.8	5.5	7.2	9.7	11.6
2. Northern China Sea	9.2	8.5	6.0	5.3	4.7	5.3	5.8	5.3	5.3	7.2	12.6	11.6
3. Southern China Sea	6.5	6.0	4.7	3.5	3.5	4.1	5.5	5.3	4.5	4.7	5.1	5.8
4. Java Sea	5.3	4.1	3.9	3.9	3.9	5.5	6.0	7.2	5.3	4.1	3.2	4.7
5. Flores Sea	4.7	4.5	3.5	3.9	4.5	5.5	6.0	5.8	5.5	4.7	3.5	3.9
6. Banda Sea	4.7	4.7	4.1	3.9	4.7	6.0	7.2	6.5	6.0	5.5	4.1	3.9
7. Arafura Sea	5.5	4.3	4.3	4.1	5.8	8.3	9.2	10.2	7.2	6.0	4.7	3.9
8. Timor Sea	6.0	5.8	5.1	4.1	4.7	8.8	10.6	8.8	6.5	5.8	4.1	5.8
9. South of Java	5.8	5.8	4.7	4.3	5.8	7.2	9.2	11.6	8.8	7.2	4.7	4.7
10. Southwest of Sumatra	3.9	3.9	3.9	3.7	3.5	3.5	4.3	4.3	4.1	4.1	4.5	4.3
11. Malacca Strait	4.1	3.9	3.9	3.5	3.5	3.9	4.3	4.7	4.5	4.1	3.9	4.5
12. Andaman Sea	4.7	3.9	3.5	4.1	5.5	9.2	9.9	9.9	5.5	4.5	4.5	4.1
13. Sulu Sea	6.8	5.5	4.7	4.1	3.7	4.1	4.7	4.7	4.7	4.1	6.0	7.2
14. Celebes Sea	4.1	4.1	3.7	3.7	3.9	4.1	4.1	3.5	3.9	3.9	4.1	4.1
15. North of Irian	4.1	4.7	3.9	3.5	4.9	3.7	4.1	7.2	6.2	5.8	5.1	4.3

TABLE 6. AVERAGE MONTHLY EVAPAROTION IN MM. E

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	YEAR
1. East of Luzon	176	143	132	117	88	78	69	66	64	96	116	150	1295
2. Northern China Sea	182	132	102	87	70	62	63	57	64	105	200	212	1336
3. Southern China Sea	71	73	70	51	65	84	116	117	96	83	73	64	963
4. Java Sea	61	51	66	65	76	124	156	178	122	85	64	62	1110
5. Flores Sea	80	61	51	79	96	124	176	183	150	128	92	81	1301
6. Banda Sea	82	60	61	78	105	135	203	191	200	157	107	84	1463
7. Arafura Sea	70	45	64	92	151	216	248	284	225	165	114	79	1753
8. Timor Sea	80	67	77	98	127	234	289	259	209	167	105	106	1818
9. South of Java	79	61	63	68	110	145	196	255	200	158	83	73	1491
10. Southwest of Sumatra	86	88	87	76	82	83	108	108	89	90	88	89	1074
11. Malacca Strait	51	56	81	70	66	79	81	83	74	66	57	60	824
12. Andaman Sea	138	106	99	87	95	121	126	126	79	93	108	105	1283
13. Sulu Sea	101	75	70	58	55	64	83	97	90	71	86	105	955
14. Celebes Sea	51	47	49	44	48	65	93	88	90	81	50	45	751
15. North of Irian	60	62	63	50	91	62	75	132	101	84	67	50	897

TABLE 7. AVERAGE MONTHLY PRECIPITATION IN MM. P

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	YEAR
1. East of Luzon	235	205	144	112	166	227	230	237	218	250	290	286	2600
2. Northern China Sea	22	17	32	68	154	220	250	244	220	145	104	49	1525
3. Southern China Sea	251	141	153	153	160	145	124	121	164	233	270	295	2210
4. Java Sea	244	185	171	140	150	107	79	49	39	81	128	217	1590
5. Flores Sea	216	152	154	148	139	108	54	20	18	41	100	190	1340
6. Banda Sea	183	140	156	189	203	179	118	59	32	42	70	170	1540
7. Arafura Sea	238	198	205	220	229	143	91	48	44	53	94	187	1750
8. Timor Sea	241	184	153	63	30	24	17	6	7	27	73	152	950
9. South of Java	226	200	192	148	113	99	67	40	46	133	215	246	1725
10. Southwest of Sumatra	273	241	255	263	210	182	194	239	288	366	383	336	3230
11. Malacca Strait	163	95	124	149	151	122	119	152	187	224	230	234	1950
12. Andaman Sea	38	25	26	65	263	290	250	240	195	230	202	176	2000
13. Sulu Sea	81	78	70	83	164	212	190	184	202	218	190	128	1800
14. Celebes Sea	188	143	170	166	175	174	148	136	134	145	183	188	1950
15. North of Irian	214	191	206	187	182	182	149	138	132	114	140	155	1990

TABLE 8. AVERAGE MONTHLY DIFFERENCE BETWEEN PRECIPITATION AND EVAPORATION IN MM. P - E

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	YEAR
1. East of Luzon	59	62	12	—5	78	149	161	171	154	154	174	136	1305
2. Northern China Sea	—160	—115	—70	—19	84	158	187	187	156	40	—96	—163	189
3. Southern China Sea	180	68	83	102	95	61	8	4	68	150	197	231	1247
4. Java Sea	183	134	105	75	74	—17	—77	—129	—83	—4	64	155	480
5. Flores Sea	136	91	103	69	43	—16	—122	—163	—132	—87	8	109	39
6. Banda Sea	101	80	95	111	98	44	—85	—133	—168	—115	—37	86	77
7. Arafura Sea	168	153	141	128	78	—73	—157	—236	—181	—112	—20	108	—3
8. Timor Sea	134	117	76	—35	—97	—210	—272	—253	—202	—140	—32	46	—868
9. South of Java	147	139	129	80	3	—46	—129	—215	—154	—25	132	173	234
10. Southwest of Sumatra	187	153	168	187	128	99	86	131	199	276	295	247	2156
11. Malacca Strait	112	39	43	79	85	43	38	69	113	158	173	174	1126
12. Andaman Sea	—100	—81	—73	—22	168	169	124	114	116	137	94	71	717
13. Sulu Sea	—20	3	0	25	109	148	107	87	112	147	104	23	845
14. Celebes Sea	137	96	121	122	127	109	55	48	44	64	133	143	1199
15. North of Irian	154	129	143	137	91	120	74	6	31	30	73	105	1093

Table 9. Average monthly cloudiness in tenth of the sky.

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1. East of Luzon	6.5	5.5	4.5	4.0	5.0	5.5	6.0	6.5	6.0	6.0	6.0	6.0
2. Northern China Sea	6.0	6.5	5.5	4.5	5.0	5.5	6.0	6.5	6.0	5.5	5.0	5.5
3. Southern China Sea	6.0	6.0	5.5	5.0	5.5	5.5	6.0	6.0	6.0	6.0	6.0	5.5
4. Java Sea	6.5	6.5	6.0	5.5	5.0	5.0	5.0	4.5	5.0	5.5	6.0	6.5
5. Flores Sea	6.0	6.5	6.0	5.5	5.5	5.0	4.5	4.0	4.5	5.5	6.0	6.0
6. Banda Sea	6.5	6.5	6.0	5.0	4.5	4.0	4.0	4.5	4.5	5.0	5.5	6.0
7. Arafura Sea	6.5	6.5	5.5	4.5	4.0	3.5	3.5	3.5	3.5	4.0	5.0	6.0
8. Timor Sea	6.5	6.5	5.5	4.5	3.5	3.0	2.5	2.0	2.5	3.5	4.5	5.5
9. South of Java	6.0	6.0	6.0	5.0	4.5	4.0	3.5	3.0	4.0	5.0	5.5	6.0
10. Southwest of Sumatra	6.5	6.5	6.5	6.5	6.0	5.5	6.0	6.5	6.5	6.5	6.5	6.5
11. Malacca Strait	5.5	5.5	5.5	5.5	5.5	5.0	5.0	5.5	6.0	6.5	6.5	6.0
12. Andaman Sea	4.0	3.0	4.0	5.0	6.0	6.0	6.5	7.0	6.5	6.0	5.0	5.5
13. Sulu Sea	5.5	5.5	5.0	4.5	5.0	5.5	6.5	7.0	6.5	6.0	5.5	5.5
14. Celebes Sea	6.5	7.0	6.5	6.0	5.5	6.0	6.0	6.0	5.5	5.5	5.5	6.0
15. North of Irian	6.5	7.0	6.5	6.0	5.5	5.5	6.0	6.5	6.5	6.0	6.0	6.0

TABLE 10. AVERAGE MONTHLY AMOUNTS OF RADIATION FROM SUN AND SKY IN cal/cm²/day. Q_r

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	YEAR
1. East of Luzon	270	365	470	532	480	460	428	388	394	352	296	288	394
2. Northern China Sea	285	323	420	502	480	463	428	388	394	378	333	298	391
3. Southern China Sea	352	381	421	441	403	384	364	387	398	392	364	378	389
4. Java Sea	373	389	393	396	384	365	371	435	441	426	400	372	395
5. Flores Sea	398	389	393	391	354	352	388	453	470	426	405	400	401
6. Banda Sea	378	389	393	416	402	404	410	428	470	448	426	394	414
7. Arafura Sea	383	394	421	428	410	396	412	464	518	511	460	405	433
8. Timor Sea	394	400	421	421	412	402	442	524	556	532	496	445	454
9. South of Java	416	422	393	396	375	367	405	481	490	454	445	416	421
10. Southwest of Sumatra	351	373	373	362	358	366	348	356	372	372	362	356	363
11. Malacca Strait	372	403	427	427	409	410	416	421	400	367	340	348	395
12. Andaman Sea	410	504	510	466	404	393	378	355	383	376	377	335	408
13. Sulu Sea	360	396	454	490	448	409	368	350	383	382	372	341	396
14. Celebes Sea	335	335	373	393	403	358	365	388	426	421	390	353	378
15. North of Irian	346	345	373	382	384	372	353	356	372	394	382	371	369

TABLE 11. AVERAGE MONTHLY AMOUNTS OF BACK RADIATION IN cal/cm²/day. Q_b

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	YEAR
1. East of Luzon	119	140	163	174	153	135	125	115	125	125	125	125	135
2. Northern China Sea	130	119	140	164	147	135	125	115	125	135	153	140	136
3. Southern China Sea	125	125	135	147	140	140	130	130	130	130	125	135	133
4. Java Sea	115	115	125	135	153	153	153	163	153	140	125	115	137
5. Flores Sea	130	115	125	140	140	153	170	181	170	146	130	130	144
6. Banda Sea	119	115	125	153	163	174	181	170	170	159	140	130	150
7. Arafura Sea	115	115	135	164	174	192	192	192	192	181	153	130	161
8. Timor Sea	115	115	135	164	185	202	213	224	213	192	163	140	172
9. South of Java	125	125	125	147	163	174	185	195	181	153	140	130	153
10. Southwest of Sumatra	119	119	119	119	130	140	130	119	119	119	119	119	123
11. Malacca Strait	135	135	140	140	135	153	153	135	125	115	115	125	134
12. Andaman Sea	181	202	174	143	125	125	115	105	115	130	153	146	143
13. Sulu Sea	140	140	143	158	147	135	119	109	119	130	135	135	134
14. Celebes Sea	115	105	115	125	135	130	130	130	140	140	135	125	127
15. North of Irian	115	105	115	125	140	135	125	115	115	125	125	125	122

TABLE 12. AVERAGE MONTHLY AMOUNTS OF TOTAL RADIATION AVAILABLE AT THE SEA SURFACE IN cal/cm²/day. Q_{eff}

$$Q_{eff} = Q_r - r\ Q_r - Q_b$$

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	YEAR
1. East of Luzon	151	225	307	358	327	325	303	273	269	227	171	163	259
2. Northern China Sea	155	204	280	338	333	328	303	273	269	243	180	158	255
3. Southern China Sea	227	256	286	294	263	244	234	257	268	262	239	243	256
4. Java Sea	258	274	268	261	231	212	218	272	288	286	275	257	258
5. Flores Sea	268	274	268	251	214	199	218	272	300	280	275	270	257
6. Banda Sea	259	274	268	263	239	230	229	258	300	289	286	264	264
7. Arafura Sea	268	279	286	264	236	204	220	272	326	330	307	275	272
8. Timor Sea	279	285	286	257	227	200	229	300	343	340	333	305	282
9. South of Java	291	297	268	249	212	193	220	286	309	301	305	286	268
10. Southwest of Sumatra	232	254	254	243	228	226	218	237	253	253	243	237	240
11. Malacca Strait	237	268	287	287	274	257	263	286	275	252	225	223	261
12. Andaman Sea	229	302	336	323	279	268	263	250	268	246	224	189	265
13. Sulu Sea	220	256	311	332	301	274	249	241	264	252	237	206	262
14. Celebes Sea	220	230	258	268	268	228	235	258	286	281	255	228	251
15. North of Irian	231	240	258	257	244	237	228	241	257	269	257	246	247

TABLE 13. AVERAGE MONTHLY AMOUNTS OF ENERGY USED FOR EVAPORATION IN cal/cm^2/day. Q_e

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	YEAR
1. East of Luzon	343	279	257	228	172	152	135	129	125	187	226	293	211
2. Northern China Sea	355	257	199	170	137	121	123	111	125	205	390	413	217
3. Southern China Sea	138	142	137	99	127	163	226	228	187	162	142	125	156
4. Java Sea	119	99	129	127	148	241	304	347	238	176	125	121	181
5. Flores Sea	156	119	99	154	187	241	343	357	293	250	179	158	211
6. Banda Sea	160	117	119	152	205	263	396	372	390	306	209	164	238
7. Arafura Sea	137	87	125	179	294	421	484	554	439	322	222	154	285
8. Timor Sea	156	131	150	191	248	456	564	505	408	326	205	207	296
9. South of Java	154	119	123	133	215	283	382	497	390	308	162	142	242
10. Southwest of Sumatra	168	172	170	148	160	162	211	211	162	176	172	174	174
11. Malacca Strait	99	109	158	137	128	154	158	162	144	128	111	117	134
12. Andaman Sea	269	207	193	170	185	236	246	246	154	181	211	205	209
13. Sulu Sea	197	146	137	113	107	125	162	189	176	138	168	205	155
14. Celebes Sea	99	92	96	86	94	127	181	171	176	158	98	88	122
15. North of Irian	117	121	123	98	177	121	146	257	197	164	131	98	146

TABLE 14. AVERAGE MONTHLY AMOUNTS OF ENERGY MADE AVAILABLE FOR HEATING THE SEA AND FOR EXCHANGE WITH THE ATMOSPHERE IN cal/cm²/day.

$$Q_t = Q_{eff} - Q_e$$

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	YEAR
1. East of Luzon	—192	—54	50	130	155	173	168	144	144	40	—55	—130	48
2. Northern China Sea	—200	—53	81	168	196	207	180	162	144	38	—210	—255	38
3. Southern China Sea	89	114	149	195	136	81	8	29	81	100	97	118	100
4. Java Sea	139	175	139	134	83	—29	—86	—75	50	110	150	136	77
5. Flores Sea	112	155	169	97	27	—42	—125	—85	7	30	96	112	46
6. Banda Sea	99	157	149	111	34	—33	—167	—114	—90	—17	77	100	26
7. Arafura Sea	131	192	161	85	—58	—217	—264	—282	—113	8	85	121	—13
8. Timor Sea	123	154	136	66	—21	—256	—335	—205	—65	14	128	98	—14
9. South of Java	137	178	145	116	—3	—90	—162	—211	—81	-7	143	144	26
10. Southwest of Sumatra	64	82	84	95	68	64	7	26	91	77	77	63	66
11. Malacca Strait	138	159	129	150	146	103	105	124	131	124	114	106	127
12. Andaman Sea	—40	95	143	153	94	32	17	4	114	65	13	—16	56
13. Sulu Sea	23	110	174	219	194	149	87	52	88	114	69	1	107
14. Celebes Sea	121	138	162	182	174	101	54	87	110	123	157	140	129
15. North of Irian	114	119	135	159	67	116	82	—16	60	105	126	148	101