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**Abstract**

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# NEW COTIDAL CHARTS OF THE DIURNAL TIDAL WAVES ($K_1$ and $O_1$) OF THE AUSTRALO-ASIAN SEAS

*(Presented by Academician V. V. Shuleikin, 7 February 1962)*

The tides in the region of the Australo-Asian seas (the Andaman, South China, Sulu, Celebes, Java, Banda, Timor, and Arafura seas, and the Gulf of Carpentaria) have been poorly studied. It is known, however, that the tides in this region of the World Ocean are of great practical importance, since tidal heights reach large values (from 1 to 8 m), and their character varies substantially from point to point throughout the water area under study.

At present there are very few generalizing works on the tides of the Australo-Asian seas. Among them are the work of Van der Stok ([4]), in which only cotidal lines are given for certain coasts; the work of Ogura ([5]), which gives cotidal charts of the waves $M_2$ and $K_1$ for the eastern part of the Australo-Asian seas, excluding the Timor and Arafura seas. The most recent and most complete work is that of Dietrich ([6]), in which cotidal charts of the waves $M_2$ and $K_1$ are given for the entire water area of the Australo-Asian seas, as well as characteristics of tidal level oscillations. Apparently, these works exhaust all the generalized information on the distribution of tidal waves and tidal level oscillations in the Australo-Asian seas. A substantial shortcoming of the works mentioned is the outdated methodology of research and construction of cotidal charts, which were constructed by the method of cotidal hours at coastal stations, without investigating or taking into account the propagation of tidal waves in the open sea. Apparently, this partly explains the fact that the cotidal charts of the first two authors were constructed only for the part of the water area studied where the propagation of tidal waves has a simpler character.

With the increase in the amount of observational material on the coasts and numerous islands of the Australo-Asian seas, and with the development of a more advanced methodology for constructing cotidal charts, it became possible to

Fig. 1. Cotidal chart $K_1$

Figure 1: Fig. 1. Cotidal chart $K_1$

construct more accurate cotidal charts for the entire water area of the Australo-Asian seas and to try to fill the gaps present in earlier charts.

For the construction of cotidal charts of the diurnal waves in the present work, the method of isogyres ([3]) was used, which had repeatedly been applied earlier to the construction of cotidal charts of various seas. When applied to seas, this method has sufficiently high accuracy ([1]). In the same way, cotidal charts of the semidiurnal waves were constructed for this region ([2]). A great advantage of the isogyre method is the possibility of obtaining an instantaneous picture of the state of the level surface of the water area under study and of tracing its successive change over time, as well as its considerable simplicity.

The Australo-Asian seas are an ideal region for applying the isogyre method. The comparatively small area of the seas, the great length of the coastline, and the numerous islands create excellent conditions for its application.

The source material for this work consisted of the harmonic constants of tidal sea-level oscillations for the constituent waves $K_1$ and $O_1$ for 650 stations located along the coasts and on the numerous islands of the water area under study. These data were taken from various foreign sources ([7,8]) and reduced to a single system for measuring position angles. For ease of comparison with other charts and with other regions of the World Ocean, all calculations and the construction of cotidal charts were carried out in solar time for the Greenwich meridian. The prediction of level heights for each wave separately was carried out with the following values of the corrections: $B = 1$, $b = 0$, $C = 1$, and $c = 0$.

**Fig. 1. Cotidal chart $K_1$**

The predicted level heights for each hour for all stations served as the basis for constructing maps of the cotidal lines of the instantaneous sea-level surface of the Australo-Asiatic seas. The maps of the cotidal lines of the waves $K_1$ and $O_1$ served as the basis for constructing new cotidal charts of $K_1$ and $O_1$.

On the new cotidal charts, isolines of the amplitudes of the corresponding waves are plotted with dashed lines. The material for constructing the amplitude charts consisted of the values of the harmonic constants $H$ (the semi-amplitude of the wave), selected for stations located along the coasts and on the islands of the Australo-Asiatic seas. The amplitude charts were constructed by linear interpolation of the values of $H$ over the water area of the Australo-Asiatic seas, taking into account zero amplitude values at amphidromic points. The charts constructed in this way were combined with the corresponding

**Fig. 2. Cotidal chart $O_1$**

cotidal charts. In the process of constructing the cotidal charts, substantial dif-

Fig. 2. Cotidal chart $O_1$

Figure 2: Fig. 2. Cotidal chart $O_1$

ficulties were encountered in interpreting the propagation of tidal waves, caused by the great complexity of the phenomenon being studied.

**Table 1**

**Coordinates of the centers of amphidromic systems**

| Wave | Index of amphidromic system | Coordinates of center |
|---|---|---|
| $K_1$ | A | $17°30'N,\ 108°00'E$ |
| $K_1$ | | $09°00'N,\ 102°00'E$ |
| $K_1$ | | $14°00'S,\ 138°40'E$ |
| $O_1$ | A | $09°00'N,\ 102°40'E$ |
| $O_1$ | | $10°50'S,\ 139°45'E$ |

Figs. 1 and 2 present new cotidal charts of the component waves $K_1$ and $O_1$. From them it is evident that tidal waves enter the waters of the Australo-Asian seas from the east from the Pacific Ocean, and from the west and south from the Indian Ocean, as a result of which interference of tidal waves occurs in the waters of the Australo-Asian seas. This circumstance, as well as the complex form of the seas, sharp depth gradients, and the large number of bays and straits, create complicated conditions for the propagation of tidal waves within the area under study. On the cotidal charts this is expressed in the uneven distribution of cotidal lines and in the presence of amphidromic systems.

Table 1 gives the coordinates of the centers of amphidromic systems, taken from the corresponding cotidal charts.

The new cotidal charts differ substantially from earlier charts by other authors. They indicate new amphidromic systems

previously never observed in the waters of the Australo-Asiatic seas. The existence of these systems is confirmed by a number of factual observations, and there can be no doubt as to their reliability.

Verification of the correctness of the construction and of the accuracy of the new cotidal charts was carried out by predicting the heights of the diurnal tide for several stations on islands that have tidal harmonic constants and were not included in the processing used to construct the cotidal charts. The sea-level curves predicted for a given date from the actual harmonic constants and from the values of the harmonic constants taken from the new cotidal charts almost coincide with one another. It follows from this that the accuracy of the new cotidal charts may be considered sufficiently high.

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*Note: Figure translations are in progress. See original paper for figures.*