JPRS L/10214

23 December 1981

USSR Report

EARTH SCIENCES

(FOUO 9/81)

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APPROVED FOR RELEASE: 2007/02/09: CIA-RDP82-00850R000500010012-2

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OCEANOGRAPHY

UDC 550.834

EXPERIMENT FOR DETERMINING VELOCITIES IN SEDIMENTARY LAYER OF SEA OF JAPAN USING SEISMOACOUSTIC RADIOBUOYS

Moscow OKEANOLOGIYA in Russian Vol 21, No 5, Sep-Oct 81 (manuscript received 12 May 80, after revision 8 Sep 80) pp 915-919

[Article by B. Ya. Karp, S. I. Medvedev and V. P. Karman, Pacific Ocean Oceanological Institute, Far Eastern Scientific Center, USSR Academy of Sciences, Vladivostok]

[Text]

Abstract: This article gives the results of experimental-methodological work by the reflected waves method carried out along five profiles in the Sea of Japan. The work was done using a highly correlated observation system and employing an instrument complex based on "Sprut" seismoacoustic radiobuoys. The objective of the work was a clarification of the possibilities of the developed apparatus in investigations in the deep sea and a determination of the velocities of seismic waves in the upper part of the earth's crust of the shelf, continental slope and deep-water basin of the Sea of Japan. The good capabilities of "Sprut" radiobuoys were established.

Extensive use of seismoacoustic radiobuoys (SARB) has come about during the last decade in oceanographic expeditionary work for clarifying the velocity structure of the earth's crust in the seas and oceans [4, 5 and others]. The principal advantage of seismic work with SARB is the possibility of using a single vessel for carrying out investigations with highly correlated observation systems over a relatively short period of time.

In the summer of 1979, during a geophysical expedition of the Pacific Ocean Oceanological Institute, Far Eastern Scientific Center USSR Academy of Sciences (TOI DVNTs AN SSSR) on the scientific research ship "Borey," specialists carried out experimental-methodological work by the seismic method of reflected waves using highly correlated observation systems and employing Soviet-produced SARB of the "Sprut" type [3]. The objective of the experimental-methodological work was the testing of the complex of apparatus developed at the Pacific Ocean Oceanological Institute, Far Eastern Scientific Center, USSR Academy of Sciences, the basis of which was standard-produced instruments, from the point of view of its suitability for carrying out investigations using the mentioned observation systems and determining

velocities in the sedimentary layer of the Sea of Japan for the purpose of interpreting continuous seismic profiling records.

The principles for constructing the apparatus complex for carrying out seismic work in the deep sea using highly correlated observation systems, using SARB and nonexplosive sources, are well known and are set forth in a number of studies [1, 6, and others]. These principles were used in creating a similar complex at the Pacific Ocean Oceanological Institute, Far Eastern Scientific Center, USSR Academy of Sciences. Figure 1 is a block diagram of the apparatus. The complex consists of three blocks: reception and relaying block, registry block and radiation block. SARB of the "Sprut" complex were used in the reception and relaying of seismic signals. In the radiobuoys there was a change in the suspension of the hydrophone, which made it possible to use them with sea depths greater than 120 m.

The reception of radio signals from a buoy and their conversion is accomplished using the radio receiver and demodulator (RD). The signal from the demodulator output is divided into three channels by means of the band filters BF1-BF3. The filters have transmission bands 5-35, 50-150 and 150-300 Hz, a flat frequency characteristic in the transmission band and a cutoff steepness 12 db/octave. The frequency separation of the signal makes it possible, using several automatic recorders simultaneously, to register the oscillations propagating only in the water layer (a so-called "direct" wave), reflections from deep discontinuities, and obtain a good resolution for the boundaries situated immediately below the sea floor [1].

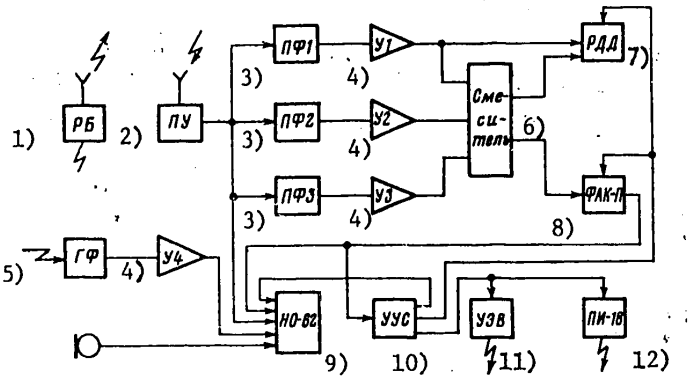

Fig. 1. Block diagram of instrument complex. Explanations in text.

KEY:

1. RB -- radiobuoy
2. RD -- receiver-demodulator
3. BF -- band filter
4. A -- amplifier
5. H -- hydrophone
6. M -- mixer
7. DOR -- discrete operation recorder
8. FA -- facsimile apparatus
9. NO-62 -- magnetograph
10. CSU -- control-synchronization unit
11. ESS -- electrospark source
12. PS -- pneumatic source

The signal is fed from the output of the band filters through the amplifiers A1-A3 and mixers to standard paper tape recorders: DOR (discrete operation recorder) and FAK-P (facsimile apparatus). With simultaneous operation of both recorders a signal from the low-frequency filter BF1 is fed to one of them and simultaneously, with a lesser amplification, the total signal from the BF2 and BF3 filters, whereas the second receives divided signals from the BF2 and BF3 filters.

In order to ensure the possibilities of further analog and digital processing of seismic information the signal from the output of the receiving unit is registered in one of the channels of the N062 magnetograph. The other channels are used in the registry of the oscillation radiated by the source and arriving at the magnetograph from the output of the towed hydrophone (H), as well as the moment of radiation and the synchronizing pulses with a frequency of 1200 Hz.

The control of radiation and signal registry is accomplished by a control and synchronization unit (CSU). The synchronization of operation of this unit is accomplished using the FAK-P tuning fork oscillator. In addition, provision is made for the possibility of operation from an external source of synchronization with a frequency of 1200 Hz and a voltage of 1.5 V. Using the CSU the operator can select the necessary duration of functioning of the recorders (2, 4 or 8 sec) and radiation interval (from 2 to 20 sec with a discreteness of 2 sec). The CSU makes possible simultaneous radiation by pneumatic and electrospark sources (PS, ESS).

Experimental method. The described instrument complex was used for seismic investigations on five profiles in the Sea of Japan (Fig. 2). Since the geophysical objective of the experimental-methodological work was a determination of the velocities of seismic waves in the upper part of the earth's crust for the purpose of interpreting data from continuous seismic profiling, the radiobuoys were situated on continuous seismic profiling profiles intersecting the shelf, continental slope and the abyssal basin of the Sea of Japan.

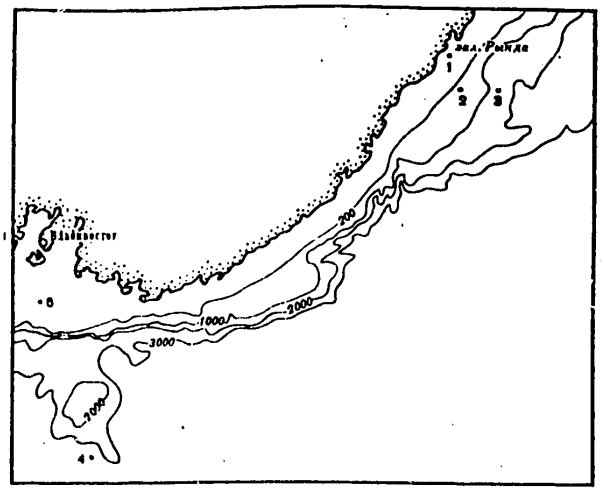

Fig. 2. Map of arrangement of profiles in Sea of Japan.

In the working of profiles with sea depths exceeding 120 m, a SARB was placed at the center of the profile, then the ship moved to one of the ends of the profile and moved along it at a speed of 4 knots, towing a pneumatic sound source. The observation system was intended for obtaining individual travel-time curves of reflected waves. The total length of the profile was dependent on the depth (H) of the acoustic basement, discriminated on the continuous seismic profiling records, from the sea surface; it was (5-6)H. With such a relationship between the length of the profile and the depth of the discontinuity it is possible with a high accuracy to determine the mean velocity to the discontinuity and its slope.

The radiobuoy hydrophone was suspended at a depth of 36 m, which approximately corresponds to one-quarter of the length of a wave with a frequency 10 Hz. For separation from the surface waves the hydrophone was connected to the buoy by a neutral buoyancy cable with a length of 15 m and an underwater "brake." This suspension method made it possible to carry out work with waves at sea up to 5 scale units.

A pneumatic source (PS) designed at the All-Union Scientific Research Institute of Geophysics with a volume of 2 dm^3, towed at a depth of 9 m, was used for the generation of elastic oscillations. In the experiments the radiation period was 8 sec, that is, with a ship speed of 4 knots the "shots" were set off each 16 m. The high density of the radiation points made it possible to carry out reliable correlation of regular seismic waves with a low signal-to-noise ratio.

The profiles on the shallow-water shelf (sea depths less than 120 m) were worked using two SARB placed at their opposite ends. In this case the hydrophone was situated on the bottom and the separation from surface waves was ensured by means of an anchor attached to the hydrophone cable at a distance of 20 m from the hydrophone. The radiation period was reduced to 4 sec, that is, the radiation points were situated at a distance of 8 m from one another. Otherwise the work method remained the same as in the first case.

A method was developed for processing the travel-time curves of reflected waves registered by means of radiobuoys. The method makes it possible with a greater accuracy and with a lesser expenditure of computer time than the known algorithm published by Le Pichon, et al. [6] to determine the velocity and structural parameters of the medium within the framework of this same model with plane slanting discontinuities. Another study has been devoted to a detailed validation and examination of this method. Here we briefly deal with the algorithm for the processing of travel-time curves of reflected waves based on this method.

The algorithm makes use of the perturbation and optimization methods. As the "perturbation" of the constant refractive index of the medium $n_0 = v_0^{-1}$ use is made of the small increment n_1 as a function of the coordinates x, z, where x is the horizontal coordinate directed along the line of observation; z is the vertical coordinate directed into the depth of the medium; v_0 is "unperturbed" constant velocity, that is, the refractive index of the medium is represented in the form

$$n = n_0 + n_1(x,z). \qquad (1)$$

A travel-time equation for a reflected wave for a refractive index in the form (1) was derived. On the basis of this equation it was possible to form a so-called "purpose function" whose minimum is separated by the choice of four parameters by means of the Fibonacci method [2].

As a result, it is possible to compute the depth of the reflecting boundary, its slope and time of propagation along the ray normal to the boundary (t_0). After determining these parameters for the upper and lower boundary for any individual layer it is possible to compute the mean velocity in the layer using a formula derived from simple geometrical reasonings.

Results of investigations. Among the five profiles worked on the voyage two were situated within the limits of the Primor'ye shelf, two on the continental slope and one in the abyssal basin of the Sea of Japan (Fig. 2). The seismic records to be interpreted were interpreted on all the profiles. Below, as an example, we give the results of processing of data along three profiles, each of which characterizes one of the studied morphostructures (shelf, continental slope and abyssal basin).

Profile I is on the Primor'ye shelf on the traverse of Rynda Gulf. Information on the velocity of seismic waves in the upper part of the earth's crust are completely absent here. According to continuous seismic profiling data which were obtained on this expedition, the rocks typical of the acoustic basement approach the real surface of the bottom in this region. The profile was worked by means of two anchored SARB situated at distances of 5.26 km from one another. The total length of the profile is 11.3 km. The following were registered: the wave refracted at the water-bottom surface (P_{refr}), the "direct" water wave (P_{dir}) and uninterpretable reflected waves from discontinuities below the bottom (Fig. 3). Along the bottom the profile is virtually flat and slightly inclined (sea depth under radiobuoy 1 -- 105 m, under radiobuoy 2 -- 75 m). The counter travel-time curves P_{refr} where processed by the constant difference method. A boundary velocity 4.4 km$\cdot$ sec^{-1} was obtained.

Profile 3 is situated along the continental slope of Primor'ye at sea depths 1.875 km. In working the profile the objective was to obtain a travel-time curve of reflected waves from the principal discontinuities discriminated on the continuous seismic profiling records and a determination of the velocity of seismic waves in the layer covering the acoustic basement. According to continuous seismic profiling data, here beneath the sea floor there is a stratified layer with a time "thickness" of 0.76 sec, underlain by an acoustically transparent layer with a "thickness" of 0.42 sec, and the bottom of this layer is the acoustic basement.

The investigations were made using a single SARB situated at the center of the profile. Travel times of waves reflected from the floor and the discontinuities below the bottom and the travel time of the "direct" wave were registered. The travel times of the reflected waves were registered along the entire length of the profile; the travel-time curve of the "direct" wave was registered only to a time 1.625 sec. On the record it is easy to discriminate the travel-time curves of the bottom reflection and the wave reflected from the acoustic basement. In addition, it was possible to discriminate the travel-time curve of a wave

reflected from the top of the acoustically transparent layer and the travel-time curve of the reflection from one of the discontinuities in the stratified thickness of sediments.

The travel-time curves of the reflected waves were processed using the algorithm cited above. The distances between the source and receiver were determined from the arrival times of the "direct" wave, whose travel-time curve was extrapolated to the maximum distances of registry of reflected waves. The mean speed of sound in the water was computed using data on temperature and salinity -- 1.51 km·sec^{-1}. The total length of the profile is 15.3 km (9.45 km -- left branch of the travel-time curve, 5.85 -- right branch of the travel-time curve). As a result of the processing it was possible to obtain the following section of the upper part of the crust. Immediately beneath the sea floor there is a layer with a thickness of 0.53 km with a stratum velocity 1.72 km·sec^{-1}; it is underlain by a layer with a thickness of 0.18 km with a velocity of 2.6 km·sec^{-1}. At the base of the section there is a layer with a thickness of 1.17 km and the stratum velocity is 4.0 km·sec^{-1}. The bottom of this layer (acoustic basement) slopes at an angle of 8.7° to the horizontal.

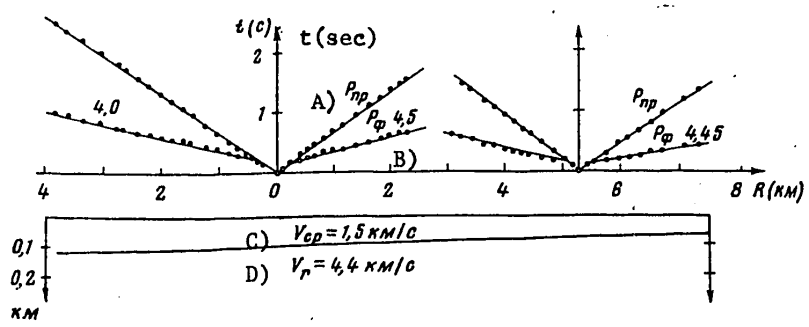

Fig. 3. Travel-time curves of seismic waves and section of upper part of earth's crust on shelf (profile 1, see Fig. 2). P_{dir} -- direct wave, P_{refr} -- the wave refracted at the water-bottom discontinuity.

KEY:

A) P_{dir}
B) P_{refr}
C) V_{mean} = 1.5 km/sec
D) V_{boun} = 4.4 km/sec

Profile 4 was worked in the abyssal basin of the Sea of Japan at sea depths 3.36 km. The observation system here was also intended for obtaining travel-time curves of reflected waves using one SARB. Along the entire profile it was possible to discriminate the travel-time curve of a bottom reflection and the travel-time curve of waves reflected from the acoustic basement and from the first boundary beneath the bottom. The distances, as on profile 3, were determined from the extrapolated arrival times of the "direct" wave. The total length of the profile is 20.5 km (8.7 km -- left branch of travel-time curve, 11.8 km -- right branch). The results of

processing on the basis of our algorithm are as follows: immediately below the bottom there is a layer with a thickness of 0.11 km and a mean velocity of 1.58 km·sec^{-1}; the mean velocity in the layer between the bottom of this layer and the acoustic basement is 2.12 km·sec^{-1} and the thickness of the layer is 1.26 km.

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UDC 550.834

INTERPRETATION OF DATA ON OCEANIC WAVE MOVEMENTS REGISTERED BY MOVING SENSORS

Moscow OKEANOLOGIYA in Russian Vol 21, No 5, Sep-Oct 81 (manuscript received 30 Jun 80, after revision 20 Jan 81) pp 911-914

[Article by S. V. Popov and K. D. Sabinin, Acoustics Institute imeni Akad. N. N. Andreyev, Moscow]

[Text]

Abstract: A study was made of some aspects of interpretation of evaluations of spatial-temporal spectra registered by moving sensors. A method is presented for comparing the measured spectra with the wave dispersion expression with movement taken into account. The method is illustrated by examples of measurements of internal waves with the drifting antenna of distributed temperature sensors and synoptic eddies in the POLIMODE polygon.

When measuring internal waves in the ocean it is customary to use sensors moving relative to the medium with the same velocity.

If the measurements are made from immobile or only slightly mobile bases, such as anchored buoys, bottom instruments, etc., it is assumed that the information obtained over the course of a more or less prolonged time will make it possible to evaluate the frequency spectrum of the waves. The spectra obtained in this way (moored spectra) will be denoted $S_m(f)$. The spectra computed using data from towed measuring systems (towed spectra) will be denoted $S_t(k)$.

The choice of frequency f as an argument in the first case and wave number k in the second case, as is usually done, is based on the assumption that in the first case it is time sections of the wave field which are involved, whereas in the second case it is spatial sections which are involved.

However, strictly speaking, in both cases it is some spatial-temporal field sections which are involved. In actuality, on the one hand, the velocities of the currents existing in the ocean are not much less than the phase velocities of the internal waves (especially the higher modes) and therefore it is essential to reckon with the effects associated with the transport of the wave field relative to the anchored sensors. On the other hand, the velocities of towing are not so much greater than the velocities of waves (especially the lower mode) that the sections can be considered purely spatial.

Accordingly, the need arises for developing methods for interpreting the results obtained when using moving sensors. It is by no means always necessary to know the "true" spectra, undistorted by movement, especially since obtaining such spectra from measurements is an ambiguous and quite complex procedure [1].

We will examine the situation arising during the movement of sensors, first from the theoretical point of view, and then in the example of measurements of internal waves and synoptic eddies.

The value of the "towed" spectrum is equal to the value of the "moored" spectrum in the plane $f = f_a + kV$ (where k is the wave vector, V is the velocity of towing; f_d is the Doppler frequency): $G_t(f_d, k) = G_m(f_d + kV, k)$. Here $G_t(f_d, k)$ is the "towed" three-dimensional spectrum, $G_m(f, k)$ is the "moored" three-dimensional spectrum.

The one-dimensional spectra are equal to:

$$S_t(k) = \int_{-\infty}^{\infty} G_t(f_d, k)\, df_d$$

and

$$S_t(f_d) = \int_{-\infty}^{\infty} G_t(f_d, k)\, dk.$$

In the case of great velocities of towing, when $v/c_{ph} \gg 1$, where c_{ph} is the phase velocity of the waves, $k = f_d/v$ and the relationship between $S_t(f_d)$ and $S_t(k)$ becomes equal to

$$S_t(f_d) = S_t(k). \tag{1}$$

However, with towing velocities comparable with the phase velocities of the waves, expression (1) is no longer satisfied and identification of the $S_t(f_d)$ and $S_t(k)$ spectra is inadmissible.

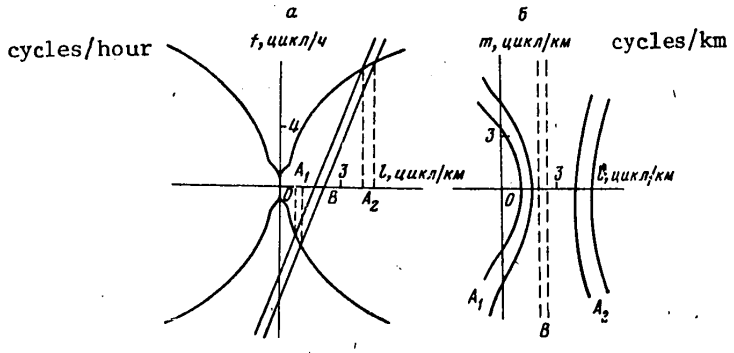

Fig. 1. Section of dispersion surface of first mode of internal waves by planes (2) with $f_d = -8$ cycles/hour, $v = 3.5$ km·hour^{-1}. a) projection onto the plane f, l; b) projection onto the plane l, m. A_1 and A_2 -- projections of the spectral corridors with a towing velocity comparable to the phase velocity of waves; B) projection of spectral corridor with $v/c_{ph} \gg 1$.

Since in actual practice the spectrum is evaluated on the basis of limited records in some frequency band $f_d \pm \Delta f$, determined by the width of the time spectral window $2\Delta f = 1/T$, where T is the length of the record in time, the spectrum $G_m(f, K)$ must be integrated by frequencies between the planes:

$$f_{1,2} = fd + KV \pm \Delta f, \tag{2}$$

that is

$$G_l(f_d, K) = \frac{1}{2\Delta f} \int_{f_d+KV-\Delta f}^{f_d+KV+\Delta f} G_m(f, K)\, df.$$

In this case each observed frequency f_d is assigned the entire spectral density situated in the volume of phase space which is bounded by the planes (2) and is some "plate" which can be called the "spectral section." This section is illustrated in Fig. 1,a together with the dispersion curve for internal waves of the lower mode. Here and in the text which follows as a simplification we will examine only $f_d < 0$.

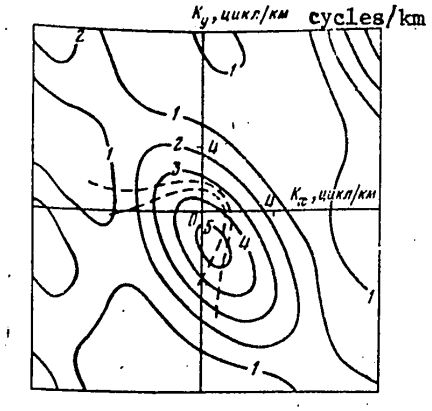

Fig. 2. Evaluation of spatial spectrum of internal waves and spectral corridor for first mode (dashed curve). Mean drift velocity u = -0.74 km·hour^{-1}; v = -0.71 km·hour^{-1}; doppler frequency f_d = -5.2 cycles/hour.

If we now impose a limitation on the time frequency in the form of a dispersion expression, then, solving the system of equations

$$\begin{cases} f_{1,2} = f_d + KV \pm \Delta f, \\ f = \varphi_i(\sqrt{l^2 + m^2}), \end{cases} \tag{3}$$

(where $f = \varphi_t(\sqrt{l^2 + m^2})$ is the dispersion surface of the i-th mode, l and m are components of the K vector), we obtain regions of phase space within which there should be concentration of the spectral density of waves of one mode or another. We will call these regions "spectral corridors."

Figure 1,b shows the projection of such a spectral corridor for the lower mode of internal waves onto the plane of horizontal wave numbers obtained by numerical solution of system (3). In this case V is directed along o l. We note that for spectral evaluations from the half-space $f > 0$ the signs on l and m must be reversed in

order that the position of the point on the l, m plane indicate where the corresponding spectral component is directed. This same figure shows the corridor in the case of a towing velocity greatly exceeding wave velocity. It can be seen that it differs greatly from the spectral corridor for the case of lesser velocities. These differences are evidently also reflected in the form of the one-dimensional spectrum, which graphically shows the illegitimacy of identifying the one-dimensional spectrum of doppler frequencies $S_t(f_d)$ with the one-dimensional spectrum of wave numbers $S_t(k)$ if the velocity of movement of the sensors is not much greater than the phase velocities of waves (compare (1)).

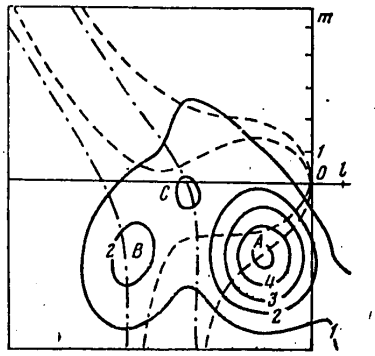

Fig. 3. Evaluation of the spatial spectrum of kinetic energy of synoptic eddies and spectral corridors for barotropic (dashed curves) and first baroclinic modes (dot-dash curves). Mean velocity of transport u = -2.1 cm·sec^{-1}, v = -0.8 cm·sec^{-1}; observed period 64 days; one graduation corresponds to $1 \cdot 10^{-3}$ cycle/km.

It can be expected that in the case of linear internal waves the peaks of the evaluations of the spatial spectra should "gravitate" toward the spectral corridors of some mode. In Fig. 2 the evaluation of the spatial spectrum of internal waves was obtained using the drifting antenna of distributed temperature sensors and the spectral corridor for the first mode. The method for measurements and analysis is similar to that described in [4]. These measurements were made on the scientific research vessel "Sergey Vavilov" in the POLIMODE polygon [3].

A similar approach facilitates the interpretation of spectral analysis data for synoptic currents in the POLIMODE polygon [2]. Although the measurements were made using the antenna of moored buoys the mean transport cannot be neglected due to the small phase velocities of the Rossby waves. Assuming that the observed current fluctuations are caused by linear Rossby waves, it is possible to construct spectral corridors using the method considered above.

For Rossby waves system (3) is written in the form

$$\begin{cases} f_{1,2} = f_d + \mathbf{KV} \pm \Delta f, \\ f = \dfrac{\beta l}{l^2 + m^2 + A}. \end{cases}$$

where $\beta = \partial f_0/\partial y$, $f_0 = 2\Omega\cos\theta$ is the Coriolis parameter; θ is local latitude; Ω is the frequency of the earth's rotation; $A = f_0^2/gh$; h is equivalent depth; g is the acceleration of free falling; the vector V has the components $\{u, v\}$. By excluding f, we obtain $vm^3 + (f_d \pm \Delta f + u\ell)m^2 + v(\ell^2 + A) + \ell^2(u\ell + f_d \pm \Delta f) + \ell(\beta + Au) + A(f_d \pm \Delta f) = 0$. Solving the derived equation with the necessary values f_d, we obtain the projections of the spectral corridors onto the plane of wave numbers.

Figure 3 shows an evaluation of the spatial spectrum of kinetic energy of synoptic currents at 700 m together with the spectral corridors for the barotropic and first baroclinic modes. In the figure peak A lies within the spectral corridor for the barotropic mode and two lesser peaks B and C within the corridor for the first baroclinic mode. It can be seen that the spatial-temporal parameters of the synoptic currents agree well with the parameters of linear Rossby waves carried by the mean current (for further details see [3]).

The described method for comparisons of experimental data with the conclusions of the linear theory of waves is simple and does not require carrying out a complex procedure for restoration of the true spectrum undistorted by the movement of sensors relative to the medium.

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CSO: 1865/28

UDC 551.463.228

INFLUENCE OF SOUND SCATTERING ON DEPTH DEPENDENCE OF LOW-FREQUENCY OCEANIC NOISE

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 260, No 4, 1981 (manuscript received 27 Feb 81) pp 1009-1012

[Article by B. I. Klyachin and B. F. Kur'yanov, Institute of Oceanology imeni P. P. Shirshov, USSR Academy of Sciences, Moscow]

[Text] Acoustic noise in the ocean is dependent on many oceanological conditions and during recent years a whole series of theoretical and experimental studies have been devoted to a clarification of these dependences [1-6]. It is of particular interest to examine low-frequency noise, which as a result of low attenuation is collected from an extensive area of the ocean and on whose characteristics oceanological conditions exert the greatest influence. In particular, for typical conditions of the open ocean the theory predicts the following characteristic depth dependence: noise minimum -- on the axis of the acoustic channel, maximum -- at a depth somewhat below the critical depth, decrease -- with direct approach to the bottom [4, 6]. However, there are experimental data which contradict such a dependence; for example, according to [1, 2] the noise on the channel axis is greater than the noise at the critical depth. A number of authors have postulated that the increase in the noise level on the channel axis can be caused by sound scattering in the ocean depths [3, 5], but no theoretical basis for computing this effect has been presented.

In this article the problem of making allowance for the influence of scattering on oceanic noise is solved by the method of the theory of transfer in an inhomogeneous medium [6]. In addition to the assumptions in [6], specifically the assumption of homogeneity and isotropicity of the sources at the surface, their dipole character, stratification of the medium and depth constancy, we will also make the following assumptions concerning sound scattering.

1. The scatterers are concentrated in a quite thin sound-scattering layer with the constant thickness h and the constant scattering coefficient m; the scattering is considered isotropic.

2. Attenuation of the direct wave as a result of single scattering in the layer is small, but it is considerably greater than the absorption in the length of the cycle.

3. Losses as a result of reflection from the bottom are much greater than attenuation due to single scattering in the layer.

Under the conditions mentioned above the solutions of the radiation transfer equations with allowance for the effects of multiple scattering and refraction can be obtained in closed form.

We will write a system of equations for the ray intensities I_1 and I_2 incident in the direction θ_s from above and below on the sound-scattering layer situated at the depth z_s. The effect of the scattering layer is reduced to two effects: attenuation of the wave as a result of scattering as $\exp(-\beta)$, where $\beta(\theta_s) = 4\pi m/\cos\theta_s$, and the total effect of scattering of waves arriving from all directions, in the direction θ_s.

If we denote the mean ray intensity of sound incident on the layer in all directions by $\bar{I}(z_s)$,

$$\bar{I}(z_s) = \frac{1}{4\pi}\int [I_1(\theta_s, z_s) + I_2(\theta_s, z_s)]\, d\Omega, \tag{1}$$

and take into account assumption 1 concerning the isotropicity of scattering, the ray intensity of the scattered component will be equal to $\beta\bar{I}$ and the equations for I_1 and I_2 are written as follows:

$$I_1(\theta_s, z_s) = \left(\frac{c_1}{c_s}\right)^2 J(\theta_1) + \bar{I}(z_s)\beta + I_2(\theta_s, z_s)\exp(-\beta), \tag{2}$$

$$I_2(\theta_s, z_s) = V(\theta_2)(\bar{I}(z_s)\beta + I_1(\theta_s, z_s)\exp(-\beta). \tag{3}$$

Here $J(\theta_1) = J_0\cos\theta_1$ is the ray intensity of the dipole surface sources, V is the coefficient of reflection from the bottom and the subscripts 1, 2, s on the velocities, angles of incidence and depths correspond to the horizons: surface, bottom and scattering layer. Equations (2)-(3) were derived for those directions θ_s along which the ray intersects the surface and bottom. If the ray does not reach the bottom, in equation (3) it must be assumed that $V \equiv 1$, whereas if it also does not reach the surface, in equation (2) it must be assumed that $J \equiv 0$. By solving the system of equations (1)-(3) for the ray intensities in the scattering horizon, we obtain

$$I_1(\theta_s, z_s) = [(c_1/c_s)^2 J + \beta\bar{I}(z_s)(1 + V\exp(-\beta))]/(1 - V\exp(-2\beta)), \tag{4}$$

$$I_2(\theta_s, z_s) = V[(c_1/c_s)^2 J\exp(-\beta) + \beta\bar{I}(z_s)(1 + V\exp(-\beta))]/(1 - V\exp(-2\beta)), \tag{5}$$

$$\bar{I}(z_s) = (J_0/6mh)[1 - (c_1/c_2)^2]^{3/2}/[1 - (1 - (c_s/c_2)^2)^{1/2}]. \tag{6}$$

For an arbitrary horizon z the ray intensities $I_{1,2}(\theta, z)$ are easily found from the expression $c^2(z)I(\theta, z) = \text{const}$, which is correct along any ray [6]. Using this expression and taking into account assumption 2 concerning the smallness of scattering, it is possible to find the mean ray intensity $\bar{I}(z)$, proportional to the volumetric energy density of sound, for any depth z:

$$\bar{I}(z) = \frac{1}{2}\left(\frac{c_1}{c(z)}\right)^2 \int_{\Omega_1} \frac{1+V}{1-V} J\sin\theta\, d\theta + \left(\frac{c_s}{c(z)}\right)^2 \bar{I}(z_s) \int_{\Omega_1} \frac{1+3V}{1-V}\sin\theta\, d\theta + \tag{7}$$

$$+ \frac{1}{2}\left(\frac{c_1}{c(z)}\right)^2 \int_{\Omega_1} \frac{J}{\beta}\sin\theta\, d\theta + \left(\frac{c_s}{c(z)}\right)^2 \bar{I}(z_s) \int_{\Omega_1} \sin\theta\, d\theta .$$

The integration region for the Ω_1 angles corresponds to bottom rays, Ω_2 corresponds to rays incident on the surface and not incident on the bottom, Ω_3 corresponds to all rays not incident on the bottom. It follows from formula (7) that the dependence on z enters only by means of the dependence c(z), that is, the law of conjugate depths [4] is also satisfied in the presence of scattering.

In expression (7) the first and second terms correspond to the contribution of the bottom rays. The first coincides with the similar term in formula (5) in [6]. The third term characterizes water waves, but in contrast to [6], instead of the attenuation value in the length of the ray cycle α S the denominator contains attenuation due to scattering β. The second and fourth terms in (7) correspond to the contribution of secondary sources of sound caused by scattering which disappear in the absence of scattering. Using assumption 3 (smallness of scattering β in comparison with losses during reflection 1 - V), we will neglect the first and second terms in formula (7) and after transformation of the angular variables we obtain

$$\bar{I}(z) = I'(z) + I''(z) = \frac{J_0}{2mh} \int_{\theta_1'}^{\pi/2} \frac{\cos^2\theta_1 \sin\theta_1 \sqrt{1-(c_s/c_1)^2 \sin^2\theta_1}\, d\theta_1}{\sqrt{1-(c(z)/c_1)^2 \sin^2\theta_1}} + \\ + \bar{I}(z_s) \int_{\theta_s'}^{\pi/2} \frac{\cos\theta_s \sin\theta_s\, d\theta_s}{\sqrt{1-(c(z)/c_s)^2 \sin^2\theta_s}}. \qquad (8)$$

Here θ_1' and θ_s' are the angles of emergence of the rays from the surface and from the scattering layer for those rays touching the bottom. Formula (8) is suitable for depths z less than the critical depth $z_0(c(z_0) = c_1)$; for greater depths as the upper integration limits it is necessary to use $\theta_1'' = \arcsin(c_1/c(z))$ and $\theta_s'' = \arcsin(c_s/c(z))$.

The integral describing the I'(z) value and representing the contribution of the primary sources of sound at the surface is not expressed in known functions and can be computed only numerically. The second term I''(z) represents the contribution of the secondary sources situated in the sound-scattering layer; for it we obtain

$$I''(z) = \bar{I}(z_s) \left(\frac{c_s}{c(z)}\right)^2 \begin{cases} \sqrt{1-(c(z)/c_2)^2} - \sqrt{1-(c(z)/c_s)^2}, & c(z) < c_s; \\ \sqrt{1-(c(z)/c_2)^2}, & c(z) > c_s. \end{cases} \qquad (9)$$

As an illustration of the derived depth dependences in Fig. 1 we show the results of computations using formulas (8)-(9) for the hydrological conditions of the Morris experiment [2] on the assumption that the sound-scattering layer is on the axis of the acoustic channel (Fig. 1a) and at a depth of 150 m (Fig. 1b). As the zero level of noise intensity we use the value $\bar{I}(z_s)$ at the depth of the scattering layer. The dashed lines at the right side of the figure represent the depth dependences I'(z). It is interesting to note that the shape of these curves has virtually no dependence on the depth of the scattering layer, and in addition, coincides with adequate accuracy with the form of the distribution of mean intensity with depth in the absence of scattering [6]. Such an agreement is attributable to the fact that for the deep ocean the beam of water rays within which there is a noise accumulation is quite narrow and the distribution of intensity with depth has little dependence on the direction of the sources and is almost entirely determined by the geometry of the rays. The solid curves at the left side of the figure show the depth

dependences for the term I"(z) in accordance with formulas (9).

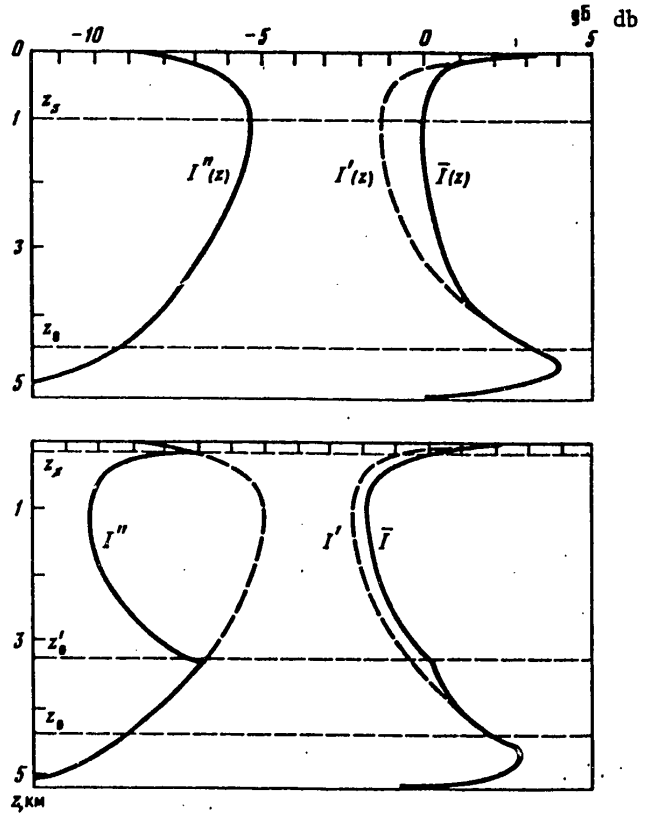

Fig. 1. Depth dependence of oceanic noise: a) sound-scattering layer at the depth of the channel axis, z_S = 1000 m; b) sound-scattering layer at a depth of 150 m.

The maximum I"(z) value is attained at the depth of the scattering layer; if the layer is not situated on the channel axis, there are two maxima -- at the horizon of the z_S layer and at the depth z'_0 for which $c(z'_0) = c(z_s)$ and which it is natural to call the second kinetic depth. As indicated by the curves of the total distribution of noise with depth $I(z) = I'(z) + I''(z)$, allowance for the term I"(z) increases the noise level near the axis of the acoustic channel.

The results of these computations indicate that allowance for scattering has the following effect: the total noise level is not determined by sound absorption in the length of the cycle but by the intensity of the sound-scattering layer mh. In addition, this somewhat smooths the minimum near the axis of the acoustic channel but the general character of the depth dependence persists.

We note in conclusion that the influence of sound scattering on the depth dependence for oceanic noise can be more significant for the high frequencies and also in cases when bottom reflections play a more substantial role.

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CSO: 1865/40

UDC 550.510.535;550.338;523.76;550.37

EPM MARINE ELECTRIC FIELD METER

Moscow ISSLEDOVANIYA KOSMICHESKOY PLAZMY in Russian 1980 (signed to press 18 Jul 80) pp 143-151

[Article by V. V. Novysh]

[Text] During recent years specialists in the Section on Marine Electromagnetic Research have been developing a marine electric field meter (the EPM) for measuring electric fields in the sea.

It is based on a determination of the strength of the electric field existing in the sea by means of measurement of the potential difference in the sea between the ends of a measurement base by use of salt bridges and nonpolarizing electrodes [1, 2].

The scheme for measuring one of the electric field components is represented in Fig. 1. АБ is a tubular salt bridge, filled with sea water, connecting the electrodes ЭЭ with the external sea medium at the points A and Б. The segment А-Б is the measurement base of the electric probe. The tubes and housing with the electrodes are made of an electrically insulating material. The chamber with the electrodes is separated by a moving electrically insulating switch K by means of which the tubular parts of the salt bridge A and Б can be joined together or separated.

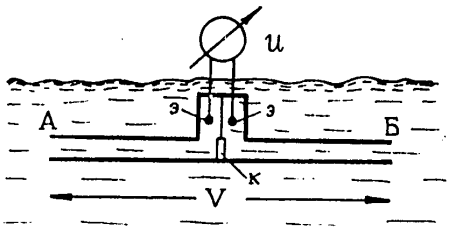

Fig. 1.

The main housing of the developed electric field meter is fabricated of plastic material. Attached to the housing are three pairs of orthogonal polyethylene tubes by means of which the external sea medium is joined to the measuring electrodes placed in special cells of this housing. Thus, this instrument can measure the three components of the electric field. The electrode cells of each pair of electrodes are brought as close as possible to one another, which creates a uniformity

of the physical conditions for the functioning of these electrodes, favoring a greater stability of the characteristic emf of each pair of electrodes. The general appearance of the instrument at the time of its lowering over the ship's side is shown in Fig. 2. The equivalent scheme of measurements of one field component is shown in Fig. 3.

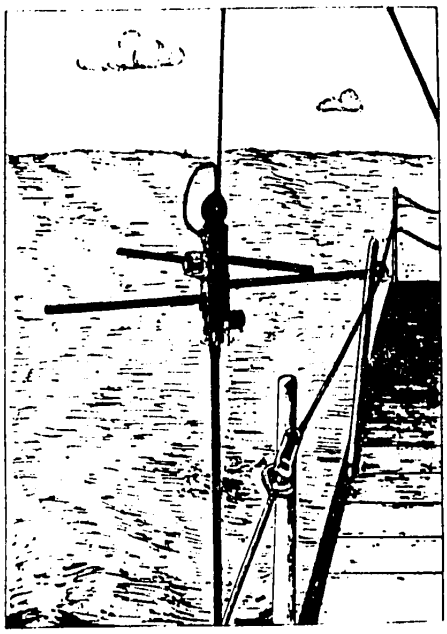

Fig. 2.

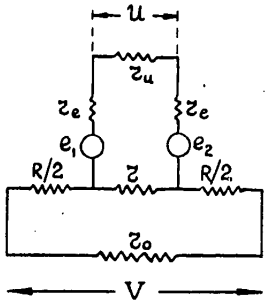

Fig. 3.

The following notations have been used in this diagram: V is the potential difference measured in the sea, U are the readings of the measurement instrument, e_1 and e_2 are the characteristic emfs of the electrodes; z_e is the internal resistance of the electrodes, z_0 is the resistance of the external measurement circuit, R/2 is the resistance of the water circuit of each of the two tubes of the measurement base; z is the resistance of the electrically insulating switch; (z_1 -- with a closed electrically insulating switch and z_2-- with an open switch; z_u is the input resistance of the measuring (recording) instrument.

We note that in the cited scheme no attention was given to current leakage through the instrument housing and the tube walls of the measurement base, this because they were made from materials with a very high bulk resistivity and their geometrical dimensions ensure a high total resistance to leakage currents.

If one measurement of U_1 is made with closing of the electrically insulating switch and a second measurement is made with the switch open, as follows from this equivalent circuit and allowing some simplifications not giving rise to large errors

In measurements with the developed design of the electric field meter [3, 4], it is possible to exclude the characteristic emf of the electrodes and determine the electric field strength V_0 using the following formula [4]

$$V_0 = \frac{U_1 - U_2}{l} \frac{(z_1' + R)(z_2') + R)}{R(z_1' - z_2')} \quad (1)$$

where l is the length of the measurement base and

$$z_1' = \frac{z_1 z_u}{z_1 + z_u} \qquad z_2' = \frac{z_2 z_u}{z_2 + z_u}$$

For the successful implementation of measurements with this instrument it is necessary to ensure an adequately high and constant degree of insulation z_1 of the closed electrically insulating switch. Since this switch must operate in sea water, the development of its design is the most important and difficult task in producing the entire electric field meter.

In the first variant of the instrument both electrode chambers were joined together by a rubber tube, by squeezing which it is possible to attain a high degree of insulation of the closed switch. The squeezing was accomplished using a knifelike plate controlled by the armature of an electromagnet. Using this switch design the instrument was successfully employed in the Black Sea in making measurements of the electric field of the ship from aboard this ship [3]. Vertical measurements of the ship's field were made over the side from the horizon 5 m, where its horizontal component was about 600-900 μV/m, to the horizon 30 m, where this component was 20-30 μV/m. The vertical component had values 40-50 μV/m and 1-2 μV/m. The measurement response threshold was about 1 μV/m.

However, the described design of the switch, although according to laboratory test data it ensured an adequately high degree of insulation, was nevertheless inefficient and of a low reliability because the rubber tube required a rather complex design for its installation and could easily be contaminated by sand particles entering it during work at sea. In addition, during the entire time of work with an open valve it was necessary to keep a current flowing through the electromagnet, and this could create interference. Accordingly, in its next design we used a different type of electrically insulating valve as shown in Fig. 4. It consists of a rod 1 with a conical rubber tip 2 closing and opening a cylindrical channel connecting the chambers with the electrodes 3 and the salt bridge tubes 4. In a closed position the rubber valve is clamped by a spring on the rod, this closing the upper aperture of the cylindrical channel. The cylindrical aperture was opened by means of the armature of the electromagnet 5, acting upon the rod and compressing the spring. The entire system was maintained in an open state by a special catch 6 which was set free by another electromagnet 7.

Using this variant of the electric field meter (EPM-2) measurements were made of the three components of the electric field from aboard an iron ship in the western part of the Caspian Sea. Here, as before, the ship's field was registered, the strength of whose horizontal vector near the ship at the sea surface attained about 1000 μV/m with gradual attenuation to a value 10-20 μV/m at the horizon 40-60 m and below. The strength of the vertical component was from 80 μV/m to 1-4 μV/m at the horizons 20 m and below respectively.

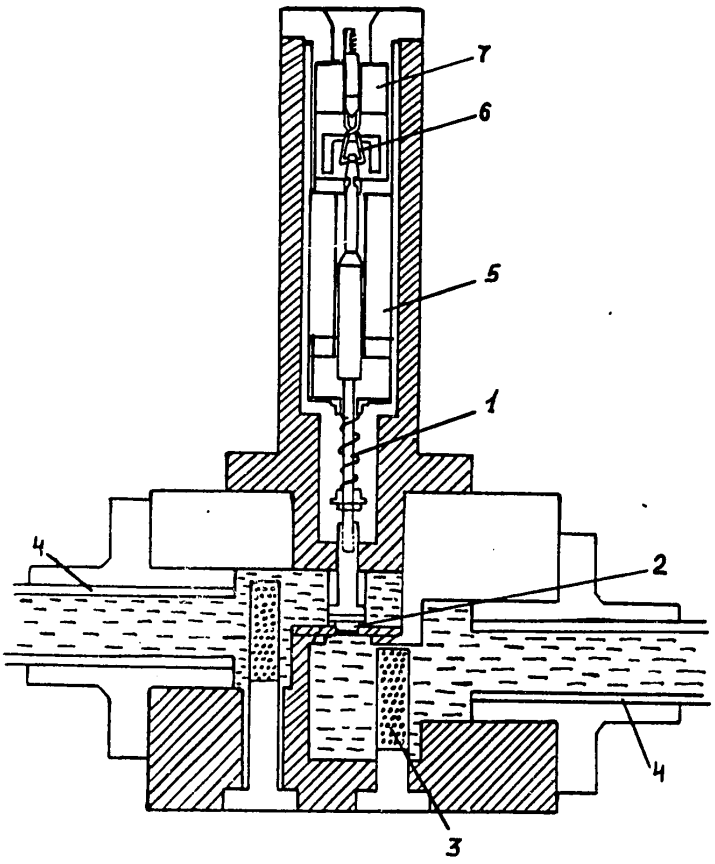

Fig. 4.

However, sea tests revealed that this electrically insulating valve had substantial design shortcomings: the upper compression device was not always triggered properly and the need for insulating the lower rod in the valve by means of an oil-filled elastic rubber sleeve led to technical difficulties in assembling the valve and worsened the reliability of its operation. Accordingly, a new variant of an electrically insulating valve was developed in which there were several design improvements in the assembly of the electrode chambers and a strengthening of the electrodes (EPM-3); a schematic section of this is shown in Fig. 5. In this design the compressing of the rubber valve 1 is accomplished by a flat spring 2 and in this process the connecting cylindrical aperture 3 is shut off. This aperture 3 is opened by means of a rubber valve 4, rigidly coupled to the rod, and the armature of the electromagnet 5 with excitation of its winding. The winding and the magnetic drive were in an oil-filled sealed housing 6 which at its top has a compensatory rubber diaphragm 7 for equalizing the inside and outside pressures. The rod 4 was made of plastic and the spring 2 and the armature 5 were covered with insulating lacquer. With compressing of the spring by a force of 0.5 kg there was a value

of the insulation resistance to closing of the valve of about 1 megohm, after presence of the entire complex in sea water for 24 hours.

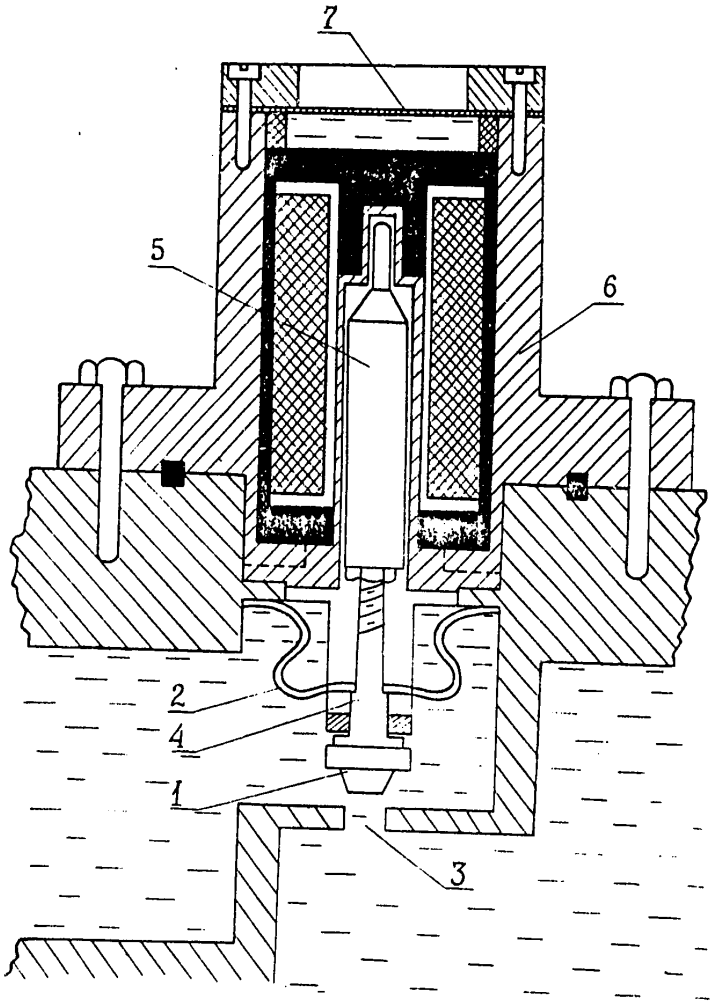

Fig. 5.

With this instrument in the following year in the eastern part of the Caspian Sea measurements were made of the electric field of a ship and the natural electric field in the sea in the coastal sector at Avaza near Krasnovodsk. In this region it was possible to register rather high values of the natural electric field at 15-20 m and at 50-75 m from the shore at the time of a storm attaining about 100 μV/m and decreasing gradually to near-zero values after cessation of the storm.

The implementation of field tests of this design of electric field meter (the EPM-3) confirmed the complete reliability and fault-free character of its operation. However, the need for feeding a rather high voltage across the coil for exciting the electromagnet (about 50 V) during the time of registry of the electrode zero (electrode with open valve) created the danger of influence of leakage currents on the results of registry of the values of this zero. In addition, according to available data, the use of a rubber valve for great depths was unpromising because with an increase in pressure it loses its elasticity and at a depth of more than 4 km becomes rigid and brittle [5].

In this connection, a new, more perfect design of the electric field meter is now being developed.

Yu. A. Goryachev participated in the development of all the designs. Some of the sea tests of the electric field meter and processing of their results were carried out by M. M. Bogorodskiy.

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CSO: 1865/7

ELECTROKINETIC INTERFERENCE IN ELECTROMETRIC WORK IN SEA AREAS

Moscow ISSLEDOVANIYA KOSMICHESKOY PLAZMY in Russian 1980 (signed to press 18 Jul 80) pp 152-157

[Article by M. M. Bogorodskiy]

[Text] Electrometric work in sea areas is carried out for solving a whole series of scientific and practical problems. Among the types of interference acting on electric measurement sensors with a frequency close to the frequency of the measured useful signal is the movement of water relative to the elements of the measurement complex and is important. This is manifested most clearly with the movement of an electrolyte near the surface of the conductor of an electrode [1], which causes a change in the concentration of ions near the surface of the conductor and a change in the electrode potential value. In order to safeguard the conductor from the influence of the medium, including from flow around it, the sea electric measurement electrodes are enclosed in a housing of some type [2], but a convection current, filtration currents and other electrokinetic phenomena [3] arise during the movement of the fluid along the surface of virtually any material and interference associated with the movement of water relative to such electrodes occurs in both fresh water [4] and in marine [5] areas, especially when making measurements near the sea surface [6] or when using measurement complexes with short bases [7]. It should be noted that in the special literature proper attention has not been devoted to electrokinetic interference when carrying out electrometric work in sea areas. Several examples of tribopolarization of a towed electrode are given by Aleksandrov and Zaytsev [4], who employed electrodes with a housing of porous ceramic. With a change in the ship's speed from 0 to 9 knots the difference in the electrode potentials of two electrodes of the same type changed by approximately 6 mV. The authors note that the "potential level is directly proportional to the velocity of movement," which leads to the evaluation

$$\varphi_{trib} \simeq (1.4\ \text{mV} \cdot \text{м}^{-1} \cdot \text{sec}) \cdot (V_{\infty}\ \text{м} \cdot \text{sec}^{-1}) \qquad (1)$$

where φ_{trib}, V_{∞} are the potential of electrode tribopolarization and the velocity of the oncoming flow of water.

2. An examination of the mechanism of formation of tribopolarization potentials was made using two models: a solid housing of the electrode in the form of an elongated ellipsoid of revolution, streamlined along the axis (Fig. 1), with the electrode cavity communicating with the housing surface by a single channel and in the computations is not taken into account, and in a model of a porous thin-walled housing of the same configuration (Fig. 2), with the electrode cavity communicating with the external medium over the entire surface of the housing through the pores of the housing and filled with an electrolyte of the same concentration as the surrounding medium. The overall dimensions -- ϕ 2 cm, l = 12 cm and the velocity of the oncoming flow -- V_∞ = 5 m·sec^{-1} were selected as being characteristic for towed IELAN-IZMIRAN electrodes. The value of the electrokinetic potential-- ζ = -0.1V and the conductivity of the medium -- $\varkappa$ = 7.5·10^{-3} ohm^{-1}m^{-1} were selected for comparability with [4]. The kinematic characteristic of the water ν and its dielectric constant ε were adopted corresponding to 20°C.

Computations of the field of shearing τ_u and normal p stresses acting on the surface of the housing from the direction of the oncoming flow were made using the empirical method for computing the turbulent boundary layer with a stipulated distribution of pressure in the external flow, taking into account flow around the body of revolution, including computations of the point of detachment of the boundary layer [8]. It is easy to see that for the model with the solid housing the correlation between the convective surface current j_τ and the local value of shearing stresses τ has the form

$$j_\tau = 0.5\varepsilon r_0 T \cdot \eta^{-1} \cdot \zeta \qquad (2)$$

where r_0 is the momentary radius of the ellipsoid.

The spreading currents of the convective surface current create a tribopolarization potential φ_{trib} whose variation along the body of the electrode is represented in Fig. 1. The asymmetry in the distribution of shearing stresses and accordingly the tribopolarization potential is related to an increase in the thickness of the boundary layer with the advance of the flow along the body of the electrode and with detachment of the boundary layer in the intake part. Fixing the intake position of the electrometric tube at the surface of the housing [9] and bearing in mind that the shearing stress, and with it, also the tribopolarization potential, are proportional, taking into account the influence of the Reynolds number and the velocity of flow in the power 13/7, we have an estimate of tribopolarization for the model with the solid housing in the form

$$\varphi_{trib} \simeq K_1 \cdot \zeta \cdot \varkappa^{-1} \cdot V_\infty^{13/7}; \quad K_1 \simeq 2 \cdot 10^{-6} \mu^{20/7}{}_{sec} r^{13/7}{}_{ohm^{-1}} \qquad (3)$$

where K_1 is a proportionality factor dependent on the choice of positioning of the electrometric tube and the electrode configuration.

For the model with the porous housing we examined the tribopolarization currents arising in the housing as a result of the hydrodynamic difference in pressures inside and outside the housing. Using for the density of the leakage currents j_n [3] the expression:

$$j_n = -0.79W\varepsilon(4\pi\eta\alpha)^{-1} \cdot \zeta \cdot (P_\zeta - \overline{P}) \qquad (4)$$

where W, α are the porosity and thickness of the housing shell, P_ζ , $\overline{P}$ is

pressure outside and inside the housing, we note that the dipole density of the currents $j_n \cdot \alpha$ is not dependent on the thickness of the housing shell, which makes it possible to find the potential created by the leakage currents as the potential of a double layer of a known thickness using the electrostatic analogues method. In the computations we used the value $W \simeq I$, which corresponds to a considerable porosity; the $\overline{P}$ value was adopted on the assumption of a homogeneity of the housing:

$$\overline{P} = \frac{1}{S} \cdot \int_S P_J \, dS \qquad (5)$$

where S, dS is the surface area of the housing and its increment. Assuming that a central positioning of the conductor in the housing is typical and bearing in mind that the external pressure is proportional to the square of flow velocity, we have an estimate for the porous housing:

$$\varphi_{trib} \simeq K_2 \cdot \zeta \cdot \varkappa^{-1} \cdot V_\infty^2; \; K_2 \simeq 7.5 \cdot 10^{-5} \mu^{-3} sec^2 ohm^{-1} \qquad (6)$$

Additional effects may arise with changes in the rate of towing due to a change in P (barosensitivity) [10] and the leakage potentials accompanying them [3].

3. The electrokinetic characteristic for material of the housing enters explicitly into the estimates (3), (6) and implicitly into the estimate (1). All other conditions being equal, the tribopolarization error is the smaller the lesser the absolute value of this characteristic. Despite a broad search in the patent and special literature [3, 11], information on any investigation of ζ, the potential of the materials entering into the construction of the electrodes in solutions of the sea water type, could not be found. In carrying out the investigations we selected the current potential method, regarding it as more precise [3, p 83].

The apparatus for determining ζ (potential) by the leakage potential method, whose diagram is shown as Fig. 3, consists of the vessels 1 and 2, containing the electrolyte 3 and movably joined to the measuring cell 4, containing a powder of the investigated substance 5 and the gaskets 6. Due to the difference in the heights h_1 and h_2 of the vessels, an electrolyte is pressed through the substance to be investigated 5, creating between the vessels 2 and 1 an electrokinetic potential difference ($\varphi_2 - \varphi_1$); the electrodes 7, protected by the casings 8 and the potentiometric device 9, make it possible to register this difference. The connecting lines 10 and the electrolytic switches 11 are set in a screen 12 and placed on a hinged parallelogram 13, which makes it possible to change the relative height of the vessels ($h_2 - h_1$) within the range ± 2 m, and with reversing change the pressure drop to 4 m H_2O.

The value ζ -- the potential, is determined using the formula [3, p 81]:

$$\zeta = 4\pi\varkappa\eta \cdot \varepsilon^{-1} \cdot (\varphi_2 - \varphi_1) \cdot [(h_2 - h_1) \cdot \rho g]^{-1} \qquad (7)$$

where ρ, g are the density of the electrolyte and the acceleration of gravity. In the measurements use was made of solutions of sea water of a stipulated salinity and the temperature in the cell was monitored. The other characteristics of sea water entering into (7) were tabulated [11 + 13], which makes it possible in processing the experiment to use (7) in the form

$$\zeta = K \frac{\Delta(\varphi_2 - \varphi_1)}{\Delta(h_2 - h_1)} \qquad (7')$$

where $K = K(S^o/oo, t^o)$ is a function of salinity S^o/oo and temperature t^o. The K values for solutions of the sea water type were tabulated and are cited in Table 1, where they have the dimensionality m^1. It was found that this coefficient has a very weak dependence on temperature.

Table 1

Computed Values of Coefficient K (S^o/oo, t^o) for Solutions of the Sea Water Type

^oC	S^o/oo	0.5	1.33	4	12	36
0		11.6	31.0	92.4	260	721
5		11.6	31.1	92.6	260	725
10		11.7	31.3	93.1	262	734
15		11.8	31.5	94.1	266	738
20		11.9	31.7	95.1	269	746
25		12.0	32.2	96.5	272	756
30		12.1	32.3	96.9	273	758

In the processing corrections were introduced into the experimental ζ values for taking into account the characteristic electrokinetic characteristics of the measurement system, influence of the gaskets and measurement cells if the material of the latter did not coincide with the investigated material, for which the necessary auxiliary measurements were made. Table 2 gives a summary of the ζ (potential) values for a number of materials.

4. A summary of tribopolarization estimates is given in Fig. 4, where the φ_{trib} values have been normalized to the value $(\zeta/\varkappa)$. For ceramic electrodes Aleksandrov used the values ζ = -37 mV [3, p 160]. As a comparison, Fig. 4 shows the tribopolarization effects for three electrode pairs which we observed in the Caspian Sea ($S = 12^o/oo$, $t^o = 10°$) in a specially formulated experiment using electrodes of the IELAN-IZMIRAN type [5] in shallow waters; the velocities of water flow around the electrodes were estimated on the basis of the depth of the site and the wave parameters [14]; the ζ value ζ = -9mV was adopted in accordance with Table 2 as the mean between the values for AgCl (packing) and plexiglas (electrode housing).

Figure 4 shows that the data published by Aleksandrov and Zaytsev under those conditions under which they were obtained (noted by an asterisk) are close to our estimate (3) for a porous housing, which indicates a successful use of the potentialities of this electrode. The IELAN-IZMIRAN electrodes, close to an electrode with a porous housing, due to the presence of numerous openings in the housing [2, 15], have a tribopolarization considerably greater than the computed value. In these cases the source of interference in the electrodes is evidently other mechanisms, such as instability of the composition of the electrode chamber, entry of fresh portions of oxygen and other dissolved gases under the influence of hydrodynamic pressure, especially under conditions of transverse flow around the housing, customary with stationary placement [16]. At the same time, it can be seen that rejection of a porous housing in favor of a solid housing or in favor of an electrolytic switch filled with sea water [17] can result in a decrease in electrokinetic

interference by 1 1/2-2 orders of magnitude. In addition, interference can be reduced by an optimum choice of housing material (or material for the salt switch).

Table 2

Electrokinetic Potentials ζ (mV) of Some Materials in Solutions of Sea Water Type

S°/oo	0.58	1.34	4.08	12.2	36.2
cambric (fabric)	-11.1	-8.5	-6.7	-4.9	-3.4
vinyl plastic (shavings)	-39.7	-31.5	-22.2	-15.0	-9.9
caprylon (shavings)	-24.7	-19.2	-15.9	-13.7	-9.5
foamglass (shavings)	-21.0	-16.6	-12.8	-10.9	-6.6
polyamide-12	-26.8	-19.0	-13.2	-11.0	-7.5
polyvinyl chloride (hard)	-8.8	-9.9	-10.7	-7.9	-7.6
polymethyl acrylate (shavings)	-16.8	-10.6	-7.8	-7.0	-6.0
polystyrene (shavings)	-17.2	-9.3	-7.3	-6.1	-5.1
polyethylene v density	-16.9	-12.5	-9.9	-8.7	-6.2
polyethylene n density	-24.7	-19.0	-13.8	-11.0	-6.8
silver chloride chemically pure	-30.6	-29.6	-19.6	-11.2	-11.0
rock glass (from electrode)	-19.6	-17.3	-14.7	-11.6	-6.6
fluoroplastic-3	-18.6	-15.3	-11.2	-9.4	-6.2
fluoroplastic-4 (shavings)	-30.4	-23.0	-14.3	-10.7	-6.3
mean temperature	19.7°	18.6°	17.2°	15.3°	14.8°

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CSO: 1865/7

ARTICLES ON DYNAMICS OF FLUID WITH FREE BOUNDARIES

Novosibirsk DINAMIKA ZHIDKOSTI SO SVOBODNYMI GRANITSAMI in Russian No 46, 1980 (signed to press 4 Jul 80) pp 172-175

[Abstracts from collection of articles "Dynamics of a Fluid With Free Boundaries", edited by L. D. Estrina, Institut gidrodinamiki SO AN SSSR, 500 copies, 177 pages]

[Text] Abstracts

UDC 517.945

MIXED PROBLEM FOR THREE-DIMENSIONAL SYSTEM OF ACOUSTIC EQUATIONS WITH SHOCK WAVE BOUNDARY CONDITIONS

[Abstract of article by Blokhin, A. M.]

[Text] The article gives the derivation of a dissipative energy integral in the mixed problem for a three-dimensional system of acoustic equations with shock wave boundary conditions.

UDC 532.69

THERMOCAPILLARY EQUILIBRIUM INSTABILITY OF A FLUID LAYER BOUNDED BY FREE SURFACES

[Abstract of article by Badratinova, L. G.]

[Text] A linear formulation is used in examining the problem of the occurrence of thermocapillary convection in a weightless fluid layer bounded by free nondeformable surfaces.

UDC 556.3.001.57

ONE CLASS OF HYDROMECHANICAL PROBLEMS FOR REGIONS WITH MOVING BOUNDARIES

[Abstract of article by Verigin, N. N.]

[Text] The article defines the conditions under which there are self-similar solutions of one-dimensional filtering problems in the case of moving boundaries. Also examined is the problem of the need for and adequate number of independent conditions at a moving boundary. The author gives a review of solutions of such

problems for moving boundaries of three different types. Some timely problems with a moving boundary for which the solutions are not self-similar are indicated.

UDC 533.07:533.527

ONE MODEL OF GAS DYNAMICS IN THE AXIAL ZONE OF EDDY APPARATUS

[Abstract of article by Zelenyak, T. N., Kislykh, V. I. and Provorova, O. G.]

[Text] An adequately complete mathematical description of heat and mass exchange in an eddy chamber meets with fundamental difficulties. The authors demonstrate the possibility of a quantitative description of the axial zone on the basis of an axisymmetric eddy model.

UDC 517.9

DETERMINING EQUATIONS OF CONSERVATION LAWS FOR EVOLUTIONARY EQUATIONS

[Abstract of article by Kaptsov, O. V.]

[Text] In this article a method is proposed for systems of evolutionary equations which makes it possible to find conservation laws by solution of determining equations. A study is made of the correlation between the determinants of the equation for the conservation laws and for the admissible Lie-Backlund operators.

UDC 517.9-532.5

VARIATION METHOD FOR INVESTIGATING STATIONARY PLANE SUBCRITICAL GAS FLOWS

[Abstract of article by Kucher, N. A.]

[Text] The article represents an investigation of a variational inequality related to a nonlinear degenerate elliptical operator of the second kind arising in the theory of plane stationary gas flows. The theorem of existence and uniqueness is demonstrated, and an approximation of solution of the inequality of a series of solutions of some unlimited elliptical problems is obtained.

UDC 517.946

SOLUBILITY OF THE BOUNDARY-VALUE PROBLEM FOR A STATIONARY WT EQUATION

[Abstract of article by Lar'kin, N. A.]

[Text] A study was made of the boundary-value problem for a nonlinear equation in partial derivatives of the third order describing small perturbations in a viscous stationary transonic gas flow. The theorem of existence and uniqueness of a "small" solution of the formulated problem is demonstrated by the "compressive mapping" method.

UDC 517.53

SOME CLASSES OF LIMITED REGULAR FUNCTIONS REPRESENTING A RING IN A DOMAIN WITH A QUASICONFORMAL BOUNDARY

[Abstract of article by Mityuk, I. P. and Tul'chiy, V. V.]

[Text] On the basis of the concept of a k-quasiconformal curve, the authors introduce some new classes of functions, regular in a ring, representing this ring in a domain whose outer boundary is a k-quasiconformal curve. Using the symmetrization method in these classes it was possible to obtain some coverage theorems and precise upward and downward evaluations of the absolute value of the function.

UDC 518:517.91/94

VALIDATING THE FITTING METHOD ON GRAPHS FOR SYSTEMS OF DIFFERENCE EQUATIONS WITH CONSTANT COEFFICIENTS

[Abstract of article by Ovcharova, A. S.]

[Text] A variant of the "parallel fitting" method is proposed for solving systems of linear algebraic equations with constant coefficients determined in a complex (graph). Evaluations of the fitting coefficients are obtained and the correctness of the method is demonstrated for systems of implicit difference equations whose matrix has a three-diagonal structure.

UDC 517.946

A PRIORI EVALUATIONS OF SOLUTIONS OF DEGENERATE QUASILINEAR PARABOLIC EQUATIONS

[Abstract of article by Papin, A. A.]

[Text] The author obtained a priori evaluations of limited solutions of degenerate parabolic equations in the form

$$-u_t + \operatorname{div}(a(t,x,u)\nabla u) + f(t,x,u,u_x) = 0,\ x \in \Omega \subset R^n,\ t \in [0,T].$$

For example, in the case of a very simple equation with $a(t,x,u) = u$, $n = 2$, an evaluation is given of the Hölder constant of the function $u(x,t)$.

UDC 532.546;519.632

NUMERICAL SOLUTION OF PROBLEM OF HORIZONTAL SYSTEMATIC DRAINAGE FROM ZONE OF INCOMPLETE SATURATION

[Abstract of article by Sabinin, V. I.]

[Text] The stationary filtration problem is examined. It constitutes a mixed boundary-value problem in a rectangle, close to the Neumann problem, for a quasilinear equation of an elliptical type. The article describes a numerical solution method

and a method for applying it to the nonstationary problem. For finding the difference solution the author proposes a modification of one of the variants of an iteration method for incomplete factorization. Examples are given which provide some idea concerning the effectiveness of the solution method.

UDC 517.947

SOLUBILITY OF SOME CLASSES OF PROBLEMS WITH AN UNKNOWN BOUNDARY FOR EQUATIONS OF THE PARABOLIC TYPE

[Abstract of article by Yakubov, S.]

[Text] A study was made of the following problems with an unknown boundary

$$a(t,x)u_{xx} + b(t,x)u_x + c(t,x)u - u_t = \psi(t,x),$$

$$u_x(t,0) = \mu(t),\ u(t,h(t)) = A(h),\ u_x(t,\ h(t)) = 0,$$

where A is some operator. The uniqueness theorem is demonstrated. When A is an integral operator it is possible to establish the existence theorem and the asymptotic behavior of the unknown boundary $x = h(t)$, with $t \to +\infty$. If boundary conditions of the first kind are stipulated along the known boundary this will give the local and nonlocal theorems of existence for the considered problems.

UDC 517.9

HUYGENS PRINCIPLE OF THE ORDER (p,q)

[Abstract of article by Zaytsev, V. A.]

[Text] The problem of the presence of the Huygens principle was studied for equations breaking down into linear factors.

UDC 519.46

BACKLUND TRANSFORMS FOR SYSTEMS OF EQUATIONS IN PARTIAL DERIVATIVES

[Abstract of article by Krendelev, S. F. and Talyshev, A. A.]

[Text] A class of systems of equations in partial derivatives allowing Backlund transforms is formulated.

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CSO: 1865/246

UDC 551.461.2+526+551.465.15+532.59

COLLECTION OF ARTICLES ON OCEAN DYNAMICS

Moscow TRUDY GOSUDARSTVENNOGO OKEANOGRAFICHESKOGO INSTITUTA: VOPROSY DINAMIKI MORYA in Russian 1981 (signed to press 6 Apr 81) pp 120-124

[Abstracts from collection of articles "Transactions of the State Oceanographic Institute: Problems in Dynamics of the Sea", edited by B. Kh. Glukhovskiy, doctor of technical sciences, Moskovskoye otdeleniye Gidrometeoizdata, 530 copies, 124 pages]

[Text] ABSTRACTS

UDC 551.466.31

DETERMINING TWO-DIMENSIONAL SPECTRUM OF MOVING FIELD OF WAVES

[Abstract of article by Trubkin, I. P.]

[Text] A method is proposed for determining the two-dimensional (frequency-directed) spectrum of wind waves on the basis of data from measurements of the rises and slopes of the wave-covered sea surface. It is shown that it is possible to find an evaluation of the two-dimensional spectrum of the moving field of waves by subjecting the initial records to narrow-band filtering and determining the angular distribution function of the mean square absolute value of the slope and the spatial filtering function introduced into consideration. The article gives experimental data characterizing the relatively high resolution of the described method using a space variable. Figures 2, references 5.

UDC 551.466.31

CROSS-SPECTRA OF SLOPES AND RISES OF WAVE-COVERED SEA SURFACE

[Abstract of article by Trubkin, I. P.]

[Text] On the basis of experimental data obtained by the author it was possible to evaluate a linear theoretical model of wind waves for describing the cross-spectral characteristics of slopes and rises of the wave-covered sea surface. The results of the evaluation indicated the possibility for this case of a use of linear theory in the first approximation. An approximating expression is proposed for the two dimensional spectrum of the moving field of waves, by means of which expressions are derived for the considered characteristics in relation to the parameters of the

angular distribution of energy and the frequency spectrum of waves. The evaluation of the function introduced into consideration, obtained on the basis of experimental data, characterizes the movement of the wave field in space and is expressed through the spectra of slopes and rises of the wave-covered sea surface. Figures 1, references 4.

UDC 551.466.31:551.465.7

SPATIAL STRUCTURE OF WIND WAVES AND ITS CORRELATION WITH WIND-WAVES ENERGY EXCHANGE

[Abstract of article by Makova, V. I. and Trubkin, I. P.]

[Text] Using evaluations of the two-dimensional spectra of waves it was possible to determine the energy distribution of waves by frequencies and directions. There was found to be movement of a part of the wave energy in the general direction of wave propagation. It was also possible to ascertain the features of energy exchange between the wind and waves on the forward slope of the wave spectrum and its relationship to evaluations of the moving field of waves. The values of the kinetic and potential energy of wind waves obtained on the basis of spectral data were close to one another. Tables 3, figures 2, references 15.

UDC 551.466.78

VARIABILITY OF TIDAL HARMONIC CONSTANTS AS A RESULT OF NONLINEAR EFFECTS

[Abstract of article by Sgibneva, L. A.]

[Text] A study was made of the possible reasons for the observed variability of the harmonic constants of tides on the basis of their numerical computations for Penzhinskaya Bay in the Sea of Okhotsk within the framework of a nonlinear model of tidal movement in the shallow-water bay. It is shown that the nonlinear effects caused by the shallow water, the nonlinear form of bottom friction and convective accelerations cause the appearance of secondary waves and change the characteristics of the main tidal components. In addition, these effects are a cause of the seasonal variability of the harmonic constants. Cotidal charts are given, as well as the results of numerical computations for Penzhinskaya Bay in the Sea of Okhotsk. Tables 2, figures 4, references 4.

UDC 551.465

COMPUTATIONS OF REGIME-STATISTICAL CHARACTERISTICS OF LEVEL VARIATIONS IN THE SEA SHELF ZONE

[Abstract of article by German, V. Kh., Rybak, B. Kh. and Filippov, Yu. G.]

[Text] A method is proposed for computing the distribution functions of extremal levels (frequency of recurrence once in T years) and the distribution functions (guaranteed probabilities) of all levels on the basis of data obtained by the hydrodynamic method. The Khips model was used in computing the levels. Computations for the northwestern part of the Black Sea were made as an example. The Langbein

expression was used for conversion from the distribution function (guaranteed probability) of all levels to the distribution functions for extremal levels. Figures 2, references 13.

UDC 551.461.2

COMPUTATIONS OF DURATION OF SEA LEVEL POSITION DURING ITS RISE AND FALL

[Abstract of article by Zotin, M. I.]

[Text] On the basis of an analysis of a great volume of data it was possible to establish the peculiarities of distribution of level variations in three guaranteed probability ranges. A method is proposed for evaluating the duration of level position for the upper and lower parts of the guaranteed probability curves. Tables 2, figures 2, references 5.

UDC 551.465

COMPUTATIONS OF REGIME CHARACTERISTICS OF SEA CURRENTS ON BASIS OF RESULTS OF USE OF NUMERICAL HYDRODYNAMIC METHODS

[Abstract of article by Belov, V. P., Filippov, Yu. G. and Shkudova, G. Ya.]

[Text] The article describes a method for determining the regime characteristics of currents on the basis of statistical processing of the results of hydrodynamic computations. A detailed examination is made of the problems involved in ensuring computations of the initial hydrometeorological information. The fundamental formulas for ascertaining two-dimensional density are cited, as well as the distribution functions for currents. The organization of the program on an electronic computer is discussed. The results of statistical computations for the Sea of Azov are given as an example. Tables 3, references 8.

UDC 551.466.3

STRUCTURE OF EMPIRICAL DISTRIBUTION FUNCTIONS FOR WIND VELOCITY AND OTHER HYDROMETEOROLOGICAL ELEMENTS

[Abstract of article by Rzheplinskiy, G. V.]

[Text] A study of the distribution functions for hydrometeorological elements is of great practical importance. Using them it is possible to determine the quantiles of the elements, allowance for which is necessary in the planning and implementation of different economic measures and studies. Also examined are typical distortions of the functions caused by imperfections in the series of observations and leading to erroneous evaluations of the quantiles. Procedures are proposed for constructing and extrapolating the functions. These procedures are intended for elimination of the mentioned distortions and make it possible to determine the values of the quantiles closer to their mean long-term values. Under the condition that

the long-term distribution of the element is known, by means of simple logical constructions it was possible to compute the probability of appearance of the long-term maximum of the element as a phenomenon in any stipulated time interval. Examples of such computations are given. Figures 1, references 7.

UDC 551.465

INVESTIGATING CURRENTS IN THE SHELF ZONE OF A DEEP SEA

[Abstract of article by Shkudova, G. Ya. and Yeremeyeva, G. V.]

[Text] The authors analyze the vertical structure of waters in the shelf zone of of the sea. A study was made of the influence of stratification on the circulation of waters during the period of winter convection for the purpose of taking it into account in a hydrodynamic computation model. Figures 3, references 25.

UDC 551.465.55

STOCHASTIC GENERALIZATION OF THE DYNAMIC METHOD FOR COMPUTING CURRENTS

[Abstract of article by Sokolov, V. A.]

[Text] The proposed generalization within the framework of a geostrophic model of ocean currents makes it possible to compute evaluations of the mathematical expectations and dispersions of current velocities on the basis of the first two statistical moments of the density field of sea waves, stipulated from observations, bottom relief and the approximate values of currents at the reading horizon. The computations of velocities at a fixed depth are made from a solution of an overdetermined system of linear algebraic equations containing information on horizontal currents at the reading depth and the equation for the conservation of total flows. The use of a priori information on the errors in stipulating the initial data and the equations of conservation of total flows makes it possible on the basis of the generalized least squares method to stabilize the sought-for results relative to the errors in stipulating the input parameters. Computations at each investigated horizon are represented in the form of evaluations of the mathematical expectations and the standard deviations of current velocities. Tables 3, references 5.

UDC 551.48.018

SOME RESULTS OF SPECTRAL ANALYSIS OF CURRENT FLUCTUATIONS IN THE ATLANTIC OCEAN

[Abstract of article by Lyashenko, A. F.]

[Text] The article gives the results of a spectral analysis of current fluctuations in the frequency range of internal gravitational waves on the basis of measurements made in two regions of the Atlantic Ocean. The modal composition of the tidal semidiurnal fluctuations is investigated. Figures 2, references 9.

UDC 551.465.635

SHORT-TERM VARIABILITY OF GULF STREAM DYNAMIC CHARACTERISTICS

[Abstract of article by Baranov, Ye. I. and Mel'nichuk, N. S.]

[Text] A study was made of the short-term variability of the positions of the front, axis, southern boundary and width of the Gulf Stream, as well as the front of slope waters along the line New York-Bermuda on the basis of the results of bathythermographic measurements made on a frequent schedule during the period 1 June 1973 through 10 October 1974. Tables 3, figures 1, references 4.

UDC 651.465.752:551.510.522

METHOD FOR QUANTITATIVE EVALUATION OF MACROSCALE DYNAMIC INTERACTION BETWEEN THE PLANETARY BOUNDARY LAYER OF THE ATMOSPHERE AND THE OCEAN SURFACE

[Abstract of article by Tarnopol'skiy, A. G. and Shnaydman, V. A.]

[Text] The authors discuss different methods for stipulating the boundary conditions in problems of sea dynamics. It is proposed that the parameters of dynamic interaction between the air flow and the underlying surface be computed using the improved model of the atmospheric planetary boundary layer proposed by the authors. Also examined is a method for determining wind stress at the sea surface and the friction coefficient on the basis of data from standard hydrometeorological observations. The article gives the results of computations of the principal parameters of interaction between the ocean and the atmosphere with different combinations of the thermal and dynamic state of the moving air flow. Tables 2, figures 2, references 14.

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CSO: 1865/41

UDC 551.542.1+551.552(261)+551.465.15(261)+551.576

COLLECTION OF ARTICLES ON ATMOSPHERE-OCEAN INTERACTION IN ATLANTIC OCEAN

Moscow ATMOSFERNAYA TSIRKULYATSIYA I YEYE VZAIMODEYSTVIYE S OKEANOM V TROPICHESKIKH I VNETROPICHESKIKH SHIROTAKH ATLANTIKI in Russian 1981 (signed to press 13 Apr 81) pp 286-287

[Abstracts from collection of articles "Atmospheric Circulation and Its Interaction With the Ocean in the Tropical and Extratropical Latitudes of the Atlantic", responsible editor V. S. Samoylenko, professor, Izdatel'stvo "Nauka", 1000 copies, 288 pages]

[Text] ABSTRACTS

UDC 551.579

EVALUATION OF ACCURACY AND REPRESENTATIVENESS OF METEOROLOGICAL DATA FROM THE TROPICAL EXPERIMENT

[Abstract of article by Romanova, N. A. and Samoylenko, V. S.]

[Text] The authors give a comparison of evaluations of the errors in measuring atmospheric pressure, wind direction and velocity under marine conditions obtained by different authors on the basis of observational data from ships. A study was made of problems relating to the choice of a representative place on a ship for observations of the wind, the influence of the operating regime of the ship (on course, at drift) and its rolling on the readings of wind-gaging instruments. Figures 3, tables 1, references 15.

UDC not stated

EMPIRICAL INVESTIGATION OF THE RELATIONSHIP OF FORCES DETERMINING THE WIND FIELD IN THE TROPICAL ZONE OF THE OCEAN

[Abstract of article by Romanova, N. A. and Romanov, Yu. A.]

[Text] On the basis of scheduled meteorological and aerological observations of atmospheric pressure and wind at island and shore stations located in the tropical latitudes (25°S-25°N) the authors determined the values of individual terms of the

equations of motion as a function of latitude. At the earth's surface and aloft in the zone from the equator to 15° latitude the force of the pressure gradient is decisive and exceeds by an order of magnitude the value for the horizontal advection of the wind. The possible reasons for the results obtained are analyzed. An evaluation of the terms in the equations of motion on the basis of observational data from the TROPEKS-72 expedition indicated that in the equatorial Atlantic the role of advective acceleration is substantial; its individual terms are only 3 or 4 times less than the pressure gradient values. Figures 3, tables 8, references 29.

UDC 551.511.465

THERMAL ENERGY OF ATMOSPHERIC PROCESSES IN THE TROPICAL LATITUDES OF THE OCEANS. HEAT BALANCE IN THE OCEAN AND ATMOSPHERE

[Abstract of article by Lunyakova, L. G. and Samoylenko, V. S.]

[Text] On the basis of materials from a thorough aerological sounding of the atmosphere from Soviet ships participating in the tropical experiments of 1972 and 1974 it was possible to determine all types of heat flows penetrating the atmosphere at different levels in different spatial averaging scales as well as to establish the dependence of the heat flows on atmospheric circulation. All the heat balance components in the atmosphere and ocean are determined for different types of atmospheric circulation. Figures 25, tables 9, references 79.

UDC 551.521.31

CLOUDS AS A REGULATOR OF THE RADIATION AND HEAT BALANCE IN THE TROPICAL LATITUDES OF THE OCEANS

[Abstract of article by Voytova, K. V.]

[Text] On the basis of continuous registry of the influx of solar radiation at the ocean surface, radiation from the surface and hourly visual determinations of cloud forms and the extent of their coverage of the heavens, made on shipboard on vessels participating in the tropical experiments of 1972 and 1974, it was possible to establish the degree to which clouds in the tropical zone of the ocean regulate its radiation and heat balance. Figures 19, tables 5, references 17.

UDC 551.571

TURBULENT AND ADVECTIVE TRANSPORT OF WATER VAPOR IN TROPICAL LATITUDES OF OCEANS

[Abstract of article by Yevseyeva, L. S., Samoylenko, V. S. and Snopkov, V. G.]

[Text] On the basis of materials from frequent aerological sounding of the atmosphere, carried out from vessels participating in the tropical experiments of 1972 and 1974, a study was made of the vertical distribution of water vapor in the atmosphere, its full vapor content is determined and the reasons for its variability

in different polygons in the tropical zone of the ocean are clarified. For this purpose computations are made of the advection and divergence of water vapor in the free atmosphere. Computations are given for the turbulent flow of water vapor from the ocean surface, condensation and the falling of moisture in the form of precipitation, which makes it possible to determine the moisture balance within the limits of each polygon. Figures 13, tables 10, references 14.

UDC 551.555.1

CONVECTION, CONVECTIVE CLOUDS AND PRECIPITATION OVER THE OCEAN IN TROPICS

[Abstract of article by Zavel'skaya, N. A. and Lebedeva, N. V.]

[Text] On the basis of hourly observations of clouds by Soviet ships participating in the tropical experiment of 1974, on the basis of aerological sounding of the atmosphere from these ships and records of pluviographs aboard them it was possible to determine the degree of propagation and development of the process of atmospheric convection in the Trades zone and the ICZ, the thermodynamic factors generating it and the degree to which it is subject to diurnal variation. Figures 4, tables 10, references 15.

UDC 551.521

DAY-TO-DAY VARIABILITY OF SOLAR RADIATION FLUXES IN TROPICS, MACROSCALE CLOUD COVER VARIATIONS AND ATMOSPHERIC TRANSPARENCY

[Abstract of article by Kislov, A. V.]

[Text] A study was made of the day-to-day variations in the radiation regime in the tropical latitudes of the Atlantic Ocean with a period of 2-3 weeks and variations with a period of 4-5 days caused by changes in the cloud cover at different scales and the transport of aerosol mist from the arid regions of Africa. Figures 7, references 20.

UDC 551.571

SEASONAL CHANGES IN VAPOR CONTENT OVER THE ENTIRE ATLANTIC OCEAN

[Abstract of article by Snopkov, V. G.]

[Text] Information on the total content of water vapor in the atmosphere over the Atlantic Ocean is generalized. Computations of the transport of water vapor across the equator are presented. Maps of atmospheric vapor content over the ocean were constructed for February, May, August and November. IR observations were also used for constructing these maps. Figures 5, tables 5, references 35.

UDC 551.555

NATURE OF EQUATORIAL WESTERLY WINDS IN INDIAN OCEAN

[Abstract of article by Krivelevich, L. M. and Romanov, Yu. A.]

[Text] Within the framework of a zonal model of equatorial circulation of the atmosphere the authors made computations of the components of wind velocity in the lower troposphere near the equator on the basis of stipulated meridional profiles of surface atmospheric pressure. The analysis reveals that with whatever meridional profile of surface pressure actually observed in the Indian Ocean it is impossible to obtain a westerly flow at the equator of such an intensity as is observed in nature. The conclusion is drawn that a zonal pressure gradient should not play a significant role in the formation of equatorial westerly winds in the Indian Ocean. Figures 3, references 13.

UDC 551.555

ATMOSPHERIC CIRCULATION IN ICZ AT 23.5°W DURING TROPEKS-74 PERIOD

[Abstract of article by Romanov, Yu. A. and Romanova, N. A.]

[Text] The article gives an analysis of day-to-day changes in surface atmospheric pressure, divergence and velocity components of the surface wind along a run 23.5° from 6°S to 12°N during three phases of the TROPEKS-74 expedition. Figures 1, tables 1, references 17.

UDC 551.542.1:551.552(261)

VARIABILITY OF THE EQUATORIAL WIND FIELD AND ATMOSPHERIC PRESSURE FIELD AND THEIR INTERRELATIONSHIP ACCORDING TO TROPEKS-74 DATA

[Abstract of article by Romanov, Yu. A.]

[Text] On the basis of observational data from Soviet ships during the TROPEKS-74 expedition a study was made of the spatial and temporal variability of wind velocity components, atmospheric pressure and atmospheric pressure gradients. An analysis was made of the correlation between wind velocity and the pressure gradients at different distances from the equator. Figures 8, tables 10, references 22.

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CSO: 1865/44

UDC 551.46

TASKS OF DEPARTMENT OF OCEANOLOGY, ATMOSPHERIC PHYSICS AND GEOGRAPHY, USSR ACADEMY OF SCIENCES, IN CONFORMITY TO RESOLUTIONS OF 26th CPSU CONGRESS

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 10, Oct 81 pp 46-53

[Article by L. M. Brekhovskikh, academician]

[Text] The 26th CPSU Congress summarized the achievements of our country, outlined the program for its development during the next five-year plan and for the more distant future. The attainments have been impressive, but the tasks are serious, requiring the unleashing of all forces. A highly important role will continue to be played by science, and especially by the scientific directions dealt with by the Department of Oceanology, Atmospheric Physics and Geography.

In this connection it is fitting to review our achievements during the last five-year plan, during 1980, and also to analyze the tasks for the next five-year plan.

In the "Principal Directions for the Economic and Social Development of the USSR During 1981-1985 and During the Period to 1990" in the section "Development of Science and Acceleration of Technical Progress" it is mentioned, in particular, that it is necessary to concentrate efforts on study of the structure, composition and evolution of the earth, biosphere, climate and the world ocean, including the shelf, for the purpose of rational use of their resources, improvement of methods for weather forecasting and other natural phenomena, an increase in the effectiveness of measures in the field of preservation of the environment; development of ecology.

Soviet scientists are carrying on work in all these directions on a broad front.

Investigations of the ocean. The ocean is the largest natural planetary formation. Attention to the ocean is dictated by its ever-increasing importance in the life of mankind. In actuality, almost four-fifths of all world transportation of cargo is by sea. The output of petroleum and gas from the bottom of the shelf zones of the world ocean and the seas adjacent to it at the present time is about one-quarter of the total output. In the very near future an expansion of the output of many mineral resources from the floor of the world ocean, especially ferromanganese nodules, will occur. The time is evidently not far off when the extraction of uranium from sea water will become justifiable.

One-sixth of the food protein consumed by mankind comes from the ocean. Unfortunately, this fraction is increasing slowly. The reason is the incorrect, not scientifically validated catching of traditional species of fish in many regions of the ocean, which has led to overfishing. As a result, the existing volume of the catch -- about 70 million tons annually, is not far from the maximum. In marine biology the direction associated with the cultivation of fish and other marine organisms in the coastal zones of the oceans and seas suitable for this purpose (aquaculture) is becoming promising.

The ocean also exerts an enormous influence on the life of man because it determines weather and climate on the earth. Meteorologists know that weather forecasting for (for example) more than 10 days in advance requires allowance for processes transpiring in the ocean. This applies to a still greater degree to the formulation of the theory of climate of our planet.

During the elapsed five-year plan investigations of the ocean developed successfully. They were brought together in a multisided interdepartmental program consisting of 16 projects (nine of these were international). Each project provided for the solution of a definite problem; the work was done under the direction of and with coordination by a key organization. Participating in the projects were 17 ministries and departments and 80 scientific organizations in the country. The key organization for implementing the entire program was the USSR Academy of Sciences.

Much attention was devoted to investigations of synoptic variability and frontal zones in the ocean. Extensive investigations were made under the POLIMODE project (Institute of Oceanology imeni P. P. Shirshov, USSR Academy of Sciences, Marine Hydrophysical Institute, Ukrainian Academy of Sciences, Acoustics Institute). It became clear that in the upper kilometer of the ocean synoptic variability for the most part is governed by the presence of macroscale quasigeostrophic turbulence. Smaller eddies than before were discovered. In the deeper layers of the ocean the nature of the variability was governed for the most part by processes of the Rossby waves type. The investigations were made in cooperation with scientists of the United States and other countries. The results are still being processed.

Interesting work was carried out by the Arctic and Antarctic Scientific Research Institute for study of the Circumpolar Antarctic Current. It was possible to clarify its structure, meandering and also eddy formation in this zone. It was found that contrary to the earlier and less reliable results the Circumpolar Antarctic Current does not have any well-expressed deep countercurrent.

The scientists of the Soviet Union actively participated in the First Global Experiment GARP (Program for Investigating Global Atmospheric Processes). In the course of this experiment the state of the ocean and atmosphere and their interaction was investigated on a broad scale.

Interesting results were obtained as a result of study of structure of the ocean floor. Soviet scientists participated in the international project for deep-water drilling aboard the "Glomar Challenger." During the last 10-15 years these investigations gave results of outstanding importance and made it possible to discover much new information concerning the geological history of our planet. In particular, work has continued on refinement of the hypothesis of the tectonics of

lithospheric plates. However, it should be noted that deep-water drilling is not the only method for studying the history of the earth's crust under the ocean. Results of comparable importance can be obtained by the ordinary collection of samples on underwater ranges and in underwater rift zones. This research method has become especially effective when the scientists acquired underwater vehicles making it possible to descend to the ocean floor and work at great depths like geologists work on the land, that is, visually examine samples, take samples, measure heat flows on the ocean floor, etc. An example of such effective work is the Red Sea Expedition of the Institute of Oceanology, USSR Academy of Sciences, employing the "Paysis" underwater vehicle.* Incidentally, these and other investigations indicated that hydrothermal processes play a decisive role in the formation of metal-bearing ores on the ocean floor.

Significant results were obtained relating to the presence of petroleum and gas on the ocean floor. This problem could be tied in to the tectonics of lithospheric plates. In particular, it was demonstrated at the Institute of Oceanology that for an understanding of the presence of petroleum and gas in the arctic regions of our northern shelf the tectonics of plates in this region in the Cenozoic is of considerable importance, and specifically the tectonics of the zone of underthrusting of plates in this epoch. The regions of presence of both petroleum and gas deposits are evidently related precisely to these zones. Important geological investigations of the floor of the Sea of Okhotsk, Kurile-Kamchatka trench and Sea of Japan have been carried out by the Pacific Ocean Oceanological Institute, Far Eastern Scientific Center, USSR Academy of Sciences.

With respect to the use of the biological resources of the ocean, here interest has increased in the open ocean. This is understandable. On the one hand, most countries have declared the 200-mile zones adjacent to their shores to be zones of their national interest and the carrying out of fishing in these zones requires special permission and signed agreements. On the other hand, in the open ocean fair results can be obtained by fishing at great depths or in zones of upwelling associated with synoptic eddies. In addition, great attention is being given to less traditional objects of the catch -- Antarctic krill. The institutes of the Ministry of the Fishing Industry are concerned with all these problems. Our biologists have devoted great attention to experimental investigations and the formulation of mathematical models of life cycles and food chains of biological communities in the ocean.

There are a number of advances in marine chemistry. The most important of these, possibly, are methods for the sorption of different metals from sea water proposed by scientists of the Institute of Oceanology. These methods, as asserted by their authors, make it possible, for example, to obtain rubidium from sea water less expensively than by other available methods.

Investigations of the ocean from space have been broadened. It appears that very much interesting information can be obtained from manned space stations by means of simple visual observation and photographing of the ocean. Frontal zones, meanders, eddies, and sometimes also internal waves are visible in the ocean from

* See V. I. Voytov and A. S. Monin, "Investigations of the Red Sea Rift," VESTNIK AN SSSR (Herald of the USSR Academy of Sciences), No 10, pp 125-135, 1980.

space. The study of the ocean by means of artificial earth satellites is becoming more extensive. Four oceanological satellites have now been launched in our country, two of them under the "Intercosmos" program. Artificial earth satellites are used in obtaining data on the temperature of the ocean surface, waves, surface wind, in determining the color of the sea, and in this connection, the biological productivity of waters, ice conditions, integral moisture content of the atmosphere, liquid-water content of clouds and many other parameters. The importance of subsatellite polygon investigations has increased, especially for the uppermost meter layer. The scientists of the Institute of Oceanology have obtained many new results relating to the dynamics of this layer.

Work has ended on publication of the multivolume monograph OKEANOLOGIYA (Oceanology). With respect to the breadth of coverage of the material and the drawing upon the talents of the best specialists in the creation of the monograph this event is of outstanding importance in world science. The first volumes of GEOGRAFIYA OKEANA (Geography of the Ocean), begun on the initiative of the late Akademician K. K. Markov, have now been published.

During the new five-year plan Soviet scientists will work on a new complex program for investigating the ocean and the use of its resources. This program will bring together 38 projects, and again the Academy of Sciences will be the key organization. Among the new projects is the "Razrezy" ("Profiles") program, this directed to the implementation of monitoring over those zones of the ocean which exert the most effective influence on weather and climate. It is based on modern concepts concerning macroscale circulation of the atmosphere and ocean and their relationship to one another, with the use of mathematical models and representations following from the theory of conjugate equations developed by Academician G. I. Marchuk. Soviet scientists are making efforts to involve the world scientific community in this sort of investigations and this will make possible a considerable increase in their effectiveness. The ocean is great and experience shows that the most useful results are obtained with the joining together of the efforts of scientists of different countries.

The "Dyumand" project is also new in the multisided program. It is directed to implementation of investigations preparatory for a major experiment in which the ocean would play the role of an optical and acoustic detector of muons and high-energy neutrinos. A third new project is "Ocean Acoustics." Although the maximum information concerning the state of the ocean evidently can be obtained only by the use of space vehicles, the state of the ocean layer can be determined remotely only by the use of acoustic instruments, since only acoustic waves can propagate significant distances under the water. At the present time plans are being considered for the carrying out of preparatory work for creating systems for acoustic tomography of the ocean. As is well known, a system for x-ray computer tomography of the human body is extremely effective. Something of this sort can also be done with the ocean using relatively low-frequency acoustics. Over ocean areas of millions of square kilometers it is possible to obtain remote information on synoptic variability of ocean waters, that is, concerning the movement of fronts and eddies in these zones, to determine the structure of the ocean along profiles, both horizontally and vertically, etc.

Finally, investigations of the ocean from space will be considerably developed under the new multisided program. There will be an increase in the role of investigations which on the basis of the state of the surface layer, monitored from space

vehicles, will provide information on the structure of the deep layers. In particular, in the field of marine geology there will be a broadening of study of ferromanganese nodules.

Professional oceanologists have an excellent scientific research fleet, but its instrumental outfitting leaves much to be desired. In order to fill this gap it will be necessary to proceed as follows.

Meteorology and atmospheric physics. Here it is possible to mention the following intensively developing fundamental directions. One of these is improvement in the reliability of forecasts of different types and for different times in advance (forecasts of weather, ice conditions, productivity, etc.). Another is study of climate, the theory of climate and the prediction of changes in climate. The prediction of climatic changes is highly important. This can be demonstrated in an example. We are evaluating the feasibility and necessity for shifting part of the runoff of rivers from the north to south both in the European USSR and in Siberia. The shifting of part of the runoff of Siberian rivers to Central Asia is a grandiose undertaking which can evidently be fully implemented no sooner than in 20 years and the principal expenditures on its implementation will pay for themselves during the subsequent decades. It is clear that a reliable prediction of the feasibility of accomplishing the shifting of this runoff can be made only by knowing what the climate will be like after 20-40 years.

There are two other directions -- investigation of elementary physical processes in the atmosphere, integration of the results of these investigations in mathematical models of circulation of the atmosphere and its interaction with the ocean; work on the artificial modification of hydrometeorological processes.

Studies for improvement of forecasts were coordinated by the interdepartmental Scientific Council, USSR Academy of Sciences, on the problem "Weather Forecasting," the chairman of which was Academician G. I. Marchuk. There are a number of significant attainments. I will mention only some of them.

At the USSR Hydrometeorological Center specialists have developed methods for the long-range forecasting of the fields of meteorological elements (wind, geopotential) based on solution of the conjugate equations of hydromechanics within the framework of a barotropic model with a source. The Hydrometeorological Center, together with other institutes of the State Committee on Hydrometeorology, has improved synoptic methods for predicting the mean monthly temperature anomaly for the European USSR and Western Siberia.

At the Main Geophysical Observatory specialists have developed a physicostatistical method for the long-range forecasting of multisided meteorological parameters determining the yield of agricultural crops for 15 consolidated economic regions of the Soviet Union. Specialists there have also developed a hydrodynamic-statistical model for predicting pressure, temperature, cloud cover and precipitation over the territory of the northern hemisphere for intermediate times. At the Arctic and Antarctic Scientific Research Institute specialists have developed a method for predicting atmospheric circulation and weather for three-ten days for the polar regions.

The attack of our scientists on the climate problem is expanding. An all-union program has been developed for the investigation of climate, its possible changes and the influence of these changes on the national economy. The program has been approved by the State Committee on Science and Technology, the Presidium USSR Academy of Sciences and the USSR Gosplan. The key organization is the State Committee on Hydrometeorology and Environmental Monitoring. It is also possible to mention some results of investigations made last year.

Semiempirical methods for evaluating the response of climate to change in CO_2 content in the atmosphere have been proposed and tested (Institute of Atmospheric Physics, USSR Academy of Sciences, State Hydrological Institute). In order to determine the present trend in global climate, specialists at the Geography Institute, USSR Academy of Sciences, have reconstructed the spatial distribution of paleometeorological parameters for different epochs for which the state of the climatic system was comparable with its present-day state.

At the scientific institutes of the USSR Academy of Sciences and the State Committee on Hydrometeorology and Environmental Monitoring (Computation Center, Siberian Department, USSR Academy of Sciences, Main Geophysical Observatory, Institute of Oceanology, USSR Academy of Sciences) specialists have created and tested modern hydrodynamic models of climate. Using these models it was possible to obtain a series of results of practical importance.

Investigations of atmospheric energetics have continued for the purpose of clarifying the role of different atmospheric components in the formation of climate: aerosol absorption (Institute of Atmospheric Physics, USSR Academy of Sciences, Main Geophysical Observatory), nitrogen oxides, carbon halogens (Main Geophysical Observatory, Institute of Applied Geophysics). General theoretical investigations of the formation of climate have developed. For example, specialists at the Institute of Atmospheric Physics have proposed theoretical evaluations of the year-to-year fluctuations of global surface temperature. Important studies carried out for determining the structure of the monitoring of climate were initiated in the Laboratory for Monitoring the Environment and Climate of the State Committee on Hydrometeorology and Environmental Monitoring and the USSR Academy of Sciences.

These and other investigations have made it possible to obtain preliminary evaluations of possible changes in climate caused by human activity. In general the evaluation coincides with similar evaluations made in the United States. These indicate the presence of a definite probability of an increase in mean global temperature at the earth's surface. At the same time, neither in the USSR nor in the United States has it yet been possible to obtain substantiated quantitative conclusions concerning the anthropogenic changes in climate possible in the future. In order to obtain a reliable evaluation of the influence of anthropogenic factors on climate it is necessary to broaden still further investigations made with modern models (including joint models of the atmosphere-ocean-cryosphere).

There must be a considerable strengthening of investigations of the effect of possible changes in global climate on economic activity at the scale of our country, on the world economy and on the natural resources of our planet.

With respect to study of individual physical processes in the atmosphere and the integration of the results in mathematical models, I would like to note the following studies. At the Institute of Atmospheric Physics a study has been made of the mechanism of generation of eddies in very simple systems. A model with few parameters was formulated describing the results of experiments modeling cyclogenesis processes. A study was made of the phenomenon of parametric resonance in the atmosphere in relation to the problem of quasi-two year cyclicity.

At the USSR Hydrometeorological Center work has been completed on numerical experiments for modeling of general circulation of the atmosphere in the northern hemisphere for different seasons on the basis of a finite-difference hydrodynamic model. A model of circulation of the atmosphere and ocean was developed at the center with their interaction taken into account. Studies of this type are also being developed at the Computation Center, Siberian Department, USSR Academy of Sciences, and at the Institute of Oceanology, USSR Academy of Sciences.

Interesting investigations of internal gravitational waves in the atmosphere with the use of radiometeor data have been made at the Institute of Physics and Mathematics, Kirghiz SSR Academy of Sciences.

The use of space vehicles for obtaining routine data on the atmosphere and the earth's underlying surface is expanding (State Scientific Research Center for the Study of Natural Resources). At the Central Asian Regional Hydrometeorological Institute of the State Committee on Hydrometeorology and Environmental Monitoring recommendations have been developed on the multisided use of satellite and surface data for routine determination of the productivity of agricultural crops.

Geography, natural resources and their rational use; preservation of the environment. Investigations in these fields are of primary importance. For the first time a special section "Preservation of the Environment" has appeared in the "Principal Directions." The Institutes of the USSR Academy of Sciences and the Academies of Sciences of the union republics, State Committee on Hydrometeorology and Environmental Monitoring and colleges of the country are making investigations on a broad front.

The Geography Institute, USSR Academy of Sciences, in collaboration with the geography institutes of the Academies of Sciences of Bulgaria, Hungary, Poland, Czechoslovakia and Yugoslavia have prepared methodological recommendations on the economic and noneconomic evaluation of the consequences of man's effect on nature for use in the countries of the Soviet Economic Bloc.

As a result of studies carried out by the institutes of the State Committee on Hydrometeorology and Environmental Monitoring during 1978-1980 it was possible to determine the principal characteristics of a national system for observing and monitoring the state of the environment. A standard program for physical, chemical and biological observations is being developed and introduced at the background stations entering into this system.

At the Laboratory for Monitoring the Environment and Climate of the State Committee on Hydrometeorology and Environmental Monitoring and the USSR Academy of Sciences specialists have created the fundamental structure of ecological monitoring making

it possible to evaluate and predict changes in ecosystems under the influence of anthropogenic activity. The laboratory has also formulated principles and approaches to geochemical monitoring of the influence of anthropogenic activity on the natural cycles of some structural chemical elements. Specialists at the Institute of Applied Geophysics have proposed and improved methods for monitoring the content of different organic and inorganic pollutants in natural media, including highly sensitive methods for determining toxic metals, chlorinated and aromatic hydrocarbons in sea water, soils and other media. Scientific principles have been developed for expert environmental protection for plans for major national economic structures.

A number of institutes have carried out much work for studying the natural, economic and social conditions in the region of creation of the Kansk-Achinsk Fuel-Energy Complex. A prediction of the anticipated environmental changes in this region has been developed. At the Institute of Geography of Siberia and the Far East, Siberian Department, USSR Academy of Sciences, a prediction has been made of the changes in water quality along the route of the Baykal-Amur Railroad for the period up to the year 2000. At the Pacific Ocean Institute of Geography, Far Eastern Scientific Center, USSR Academy of Sciences, specialists have formulated a balance ecological-economic model of an industrial complex. A method has been developed for a cost estimate of the transportation-geographical position of complexes of importance to the national economy. The Geography Institute, USSR Academy of Sciences, in collaboration with the institutes of the Academies of Sciences of the union republics, on the basis of a study of the anthropogenically caused spreading of the desert in the Aral region, proposed a complex of water, land and phytomelioration measures for contending with this process.

The study of the environment by means of space vehicles is expanding. At the Geography Institute, USSR Academy of Sciences, on the basis of materials from space surveys, specialists have created a method for landscape-typological regionalization of the Mongolian People's Republic. There also, using materials obtained from space vehicles, a geomorphological map of the USSR on 16 sheets was created. At Moscow State University a method has been developed for visual instrumental and automated interpretation of multizonal aerospace photographs.

Geocryology occupies a highly important place in the geographical sciences, both with respect to fundamental and practical importance. It is known that permafrost exists over almost half the territory of our country. It is also known that allowance for the characteristics of the cryolithozone in the economic exploitation of territories is a highly important matter. The ignoring of the characteristics of permafrost can lead to extremely sorrowful consequences. At the Permafrost Institute, Siberian Department, USSR Academy of Sciences, specialists have prepared a map of permafrost-hydrogeological regionalization of Eastern Siberia. This is intended for solution of problems related to the rational use of ground water. A geocryological map of the zone of the Baykal-Amur Railroad compiled there has also been published and a "Manual on Protection of Landscapes When Laying Gas Pipelines in the Far North" (RUKOVODSTVO PO ZASHCHITE LANDSHAFTOV PRI PROKLADKE GAZOPROVODOV NA KRAYNEM SEVERE) has been prepared. At Moscow State University specialists have developed a method for permafrost-engineering-geological interpretation of aerospace photographs in engineering field work for pipeline

construction in the cryolithozone. Specialists there have also carried out investigations of the spatial patterns of the lithospheric permafrost zone in Western Siberia.

Water problems in their importance are becoming of equal rank with energy problems. The problem of supplying water to industrial enterprises, for agriculture and household needs in adequate quantities and of sufficiently high quality (stated simply, pure), in many parts of the earth and in our country is becoming very acute.

A great number of institutes (several dozen) of different departments are engaged in an examination of different variants of shifting of part of the runoff of northern rivers to the south both in the European USSR and in Siberia. An evaluation has been made of the influence of this measure on natural climatic conditions in the region affected by the shifting, on the hydrology of rivers, in their mouth zones and along the entire course, on the biological (fish reserves), economic and social conditions.

The Institute of Water Problems, USSR Academy of Sciences, was the key organization for all this work. It carried out a great amount of work, all under rather complex conditions. The shifting of runoff is very expensive. A demonstration of the feasibility of such shifting of runoff and an analysis of possible negative consequences is a very complex matter. This is dependent on the possible variants adopted for change in climate in the coming decade, on the different scenarios adopted for the development of the national economy in the coming decade and on many other factors. It is also necessary to take into account the possibility of alternative means for supplying the national economy with water, in particular, improvement in the technology of water use.

In the light of all these considerations we feel that what is written in the "Principal Directions" is extremely far-sighted and reasonable: proceed to the implementation of preparatory work on shifting of part of the runoff of northern rivers into the basin of the Volga River, and also continue scientific and planning work on the shifting of part of the waters of Siberian rivers into Central Asia and Kazakhstan. At the same time, provision is made for the implementation of necessary measures for the rational expenditure of water in agriculture, on improvement in the meliorated state of irrigated and drained lands, for increasing responsibility for their loss from the crop rotation cycle, for eliminating salinization and enhanced acidity of soils.

A number of significant studies have been carried out on other, not so fundamental, but nevertheless very important aspects of the water problem. At the Limnological Institute, Siberian Department, USSR Academy of Sciences water balances have been determined for the Bratskoye and Ust'-Ilimskoye Reservoirs from the time of their formation, indicating a reduction in the inflow of water from Baykal during recent years. The "Principal Directions" called for the continuation of work on the preservation and rational use of unique natural complexes, especially Baykal. We know that the threat to Baykal has by no means been removed, but on the contrary, is increasing. And the role of the Limnological Institute in the preservation of this unique complex from destructive anthropogenic effects is very great. At the Lake Science Institute, USSR Academy of Sciences, specialists have obtained the

characteristics of the ten largest lakes in the USSR and their anticipated natural resource changes up to the year 2000.

Everything stated above indicates that at the institutes of the USSR Academy of Sciences and the Academies of Sciences of the union republics, at the USSR State Committee on Hydrometeorology and Environmental Monitoring, at colleges and in other departments there has been extensive development of scientific research work directed to the solution of problems outlined in the "Principal Directions."

In the "Principal Directions" there is mention of the need for broadening the automation of planning-design and scientific research work with the use of electronic computers; timely determination and modification of the direction of research and development; the organizational structure of scientific institutes in accordance with the requirements of the scientific and technical revolution. This is a very important indication. An inadmissible practice is when new directions at our institutes can be formed and expanded only with an increase in personnel and outdated themes for years continue to be developed by tradition and custom. The institutes of the Department of Oceanology, Atmospheric Physics and Geography must very responsibly discuss the "Principal Directions" and note the necessary measures which each must take in its sphere of activity.

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CSO: 1865/49

UDC 551.55+524

COLLECTION OF PAPERS ON MARINE METEOROLOGY

Moscow TRUDY ZAPADNO-SIBIRSKOGO REGIONAL'NOGO NAUCHNO-ISSLEDOVATEL'SKOGO INSTITUTA: MORSKAYA METEOROLOGIYA. VETROVOY I TEMPERATURNYY REZHIM SHEL'FOVYKH ZON MOREY SOVETSKOGO SOYUZA in Russian No 50, 1981 (signed to press 10 Mar 81) pp 127-132

[Abstracts of articles from collection "Transactions of the West Siberian Regional Scientific Research Institute: Marine Meteorology. Wind and Temperature Regime of Shelf Zones of Soviet Union Seas", edited by S. D. Koshinskiy, doctor of geographical sciences, Moskovskoye otdeleniye Gidrometeoizdata, 430 copies, 132 pages]

ABSTRACTS

UDC 551.501:551.582

STATISTICAL ANALYSIS OF BARENTS SEA WIND REGIME OBTAINED BY DIFFERENT METHODS

[Abstract of article by Zykova, G. G.]

[Text] A comparative analysis of the statistical characteristics of wind directions and velocities obtained on the basis of observations by ships in the open sea, at shore and island stations using a vane (with the Beaufort scale) and also by computations for the surface atmospheric pressure field is presented. An evaluation of the errors is made when using series of observations of different duration. Tables 3, figures 2, references 11.

UDC 551.553:551.582

INDIRECT METHODS FOR COMPUTING LOW-PROBABILITY WIND VELOCITIES OVER SEA

[Abstract of article by Zykova, G. G.]

[Text] On the basis of data from shipboard observations in the southern part of the Barents Sea it was possible to determine the regional dependences between the statistical characteristics of the distribution of wind velocities, by means of which, using known methods, indirect computations are made of maximum wind velocities of different guaranteed probability over the sea. An evaluation of the errors in indirect computations of wind velocities is given. Tables 3, figures 2, references 6.

UDC 551.55

USE OF NORMAL DISTRIBUTION OF RANDOM VECTOR LAW IN CHARACTERIZING WIND REGIME ON SHELF USING WIND GRADIENT DATA

[Abstract of article by Bot'yanov, V. Ye.]

[Text] The article gives the results of evaluation of applicability of a normal circular law for computing the standard deviations of wind velocities and their frequency of recurrence by directions on the basis of data on the regime of wind velocities and directions computed from the surface pressure fields. It is shown that there is an adequate consistency of the theoretical and empirical characteristics. An exception is the theoretical frequency of recurrence of directions, whose values, even with allowance for the ellipticity of the dispersion, can substantially differ from the actual values; the influence of the shore is evidently reflected to a strong degree. Tables 2, figures 3, references 8.

UDC 551.553.8

COMPUTATION OF WIND VELOCITIES WITH LOW GUARANTEED PROBABILITY

[Abstract of article by Koshinskiy, S. D.]

[Text] The article examines the problem of optimizing the computation of wind velocities which occur infrequently (possible once in a stipulated number of years) by indirect methods. For these purposes use is made of the mean annual wind velocity and the mean annual number of days with a storm wind, that is, with a velocity $V \geqslant$ 15 m/sec. An analysis is given of the reasons for the large errors allowed earlier in preparation for the publication of the SPRAVOCHNIK PO KLIMATU SSSR, CHAST' III. VETER (Handbook on USSR Climate, Part III. Wind). Approximate computations of V_g and an evaluation of the reliability of such computations were made using observational data for stations located on the shore and on islands of the Far Eastern seas of the Soviet Union. Such methodological studies are assuming particular value in connection with the work carried out by the Service on the "Shel'f" theme. Tables 2, figures 3, references 13.

UDC 551.553.8

COMPUTING WIND VELOCITIES OF INFREQUENT FREQUENCY OF RECURRENCE OVER OPEN PART OF SEA

[Abstract of article by Koshinskiy, S. D.]

[Text] A method is proposed for computing the extrema of wind velocities with a low guaranteed probability (possible once in a stipulated number of years) over the open part of the sea where there is virtually always a complete absence of any observations. For this purpose it is recommended that use be made of the results of earlier computations of gradient wind velocities at the earth on the basis of the pressure field in accordance with the recommendations of the State Oceanographic

Institute prepared by S. V. Rzheplinskiy in 1973. The proposed computation method was tested in the example of the Kara Sea. The results were entirely acceptable and objective. In this connection the author assumes that such computations can also be made over other areas of the internal and marginal seas of the Soviet Union. Tables 4, figures 2, references 10.

UDC 551.51

INDIRECT COMPUTATION OF CONTINUOUS DURATION OF STRONG WINDS OF DIFFERENT GUARANTEED PROBABILITY OVER KARA SEA WATERS

[Abstract of article by Rudova, L. S.]

[Text] The maximum continuous duration of the effect of wind velocities of different probability cannot be computed directly over the waters of seas due to the absence of information. An indirect procedure is proposed for computing this characteristic by the correlation analysis method. The resulting correlation dependence between the computed maximum continuous duration of the effect of great wind velocities and their guaranteed probability makes it possible to compute the extrema of the continuous duration on the shore and islands, as well as over the sea surface. Tables 7, figures 2, references 9.

UDC 551.583

STATISTICAL MODELS OF LOCAL CLIMATOLOGICAL FORECAST OF BREEZES

[Abstract of article by Burman, E. A. and Stupina, F. Ya.]

[Text] A study was made of the possibility of modeling conditions favorable for the development of breezes by means of statistical modeling of series of the amplitude of diurnal variation of air temperature with subsequent computation of the characteristics of "surges" for definite levels. The article gives a comparison of the characteristics of a time regime of breeze circulations obtained from modeled series and by means of direct samples. Tables 5, references 10.

UDC 551.509.322

PREDICTION OF WIND VELOCITY IN THE VOLGA DELTA

[Abstract of article by Voznesenskaya, L. M.]

[Text] Wind forecasting occupies a special place in the hydrometeorological support of the merchant marine and fishing industry. The basis for the proposed method is known dependences of wind velocity on different components. The article gives curves of the dependence of maximum wind velocity in the region of the Volga delta on mean velocity in the layer ground - 900 m, on the sign and intensity of temperature advection in the layer ground - 850 mbar. Practical recommendations are given which can be used in preparing a short-range forecast of the wind and storm warnings for the Volga delta and the northwestern part of the Caspian Sea. Tables 1, figures 2, references 7.

UDC 551.51

FLOODING CONDITIONS IN THE NORTHWESTERN CASPIAN 10-13 NOVEMBER 1952

[Abstract of article by Koshinskiy, S. D. and Ryzhkova (Kravets), L. M.]

[Text] The authors give an analysis of the meteorological conditions for the setting-in of a severe southeasterly storm on 10-13 November 1952 in the Caspian Sea, this resulting in flooding in the northwestern part of the Caspian. On 12 November the sea water spread over a series of sectors of the land into the depths of the continent for a distance of about 20-35 km. The article includes a map of the zone of limiting flooding. These materials are of great value in light of the work impending in the 11th Five-Year Plan for study of the hydrometeorological regime of the Caspian Sea. Tables 5, figures 5.

UDC 551.55

CLIMATIC PARAMETERS OF WIND ENERGY ON THE SEASHORE

[Abstract of article by Borisenko, M. M. and Sokolova, S. N.]

[Text] A study was made of the climatic parameters of the wind used for evaluating its energy resources: velocity norms and annual amplitudes -- in the example of the shore and sectors of the Black Sea adjacent to it. It is shown that on the coast the mean long-term velocities are 10-40% greater than on the adjacent sectors of the land. On the other hand, the amplitude of the annual variation of wind velocity on the shore is substantially less than in the depths of the land. The results obtained in this study can be used in evaluating the wind energy resources of sea areas. Tables 2, figures 1, references 8.

UDC 551.582

ERRORS IN WIND VELOCITIES READ FROM SURFACE SYNOPTIC CHARTS

[Abstract of article by Kravchenko, I. K.]

[Text] The author has evaluated the errors in wind velocities read from annular synoptic maps. A comparison was made of more than 2,000 wind velocity values computed from maps with TM-1 data for meteorological stations on the shores of the Gulf of Finland and the Gulf of Riga. It is shown that there are rather substantial differences between the wind velocity values. In the case of low wind velocities it is easy to trace a tendency to an exaggeration of the velocities read from synoptic charts in comparison with the TM-1, and with high velocities, on the other hand, an understatement. The principal reason for the differences is the peculiarities of coding when plotting wind velocity on the map. Tables 1, figures 1.

UDC 551.524.36(268.5)

MINIMUM AIR TEMPERATURES OVER SOVIET ARCTIC SEAS

[Abstract of article by Petrov, L. S.]

[Text] Maps of the distribution of minimum temperatures over Soviet arctic seas are represented. The patterns of the regime of minimum temperatures for different time averaging scales are considered. A graphic form of representation of the generalizing information on minimum temperatures is proposed on the basis of data for individual stations. Such schemes make it possible to give approximate evaluations of the regime of minimum temperatures at any point in the Arctic. Tables 2, figures 1, references 4.

UDC 551.524

RECOMMENDATIONS ON COMPUTING THE CONTINUOUS DURATION OF PERIODS WITH AIR TEMPERATURE BELOW STIPULATED LIMITS USING "LOW-LEVEL" AUTOMATION METHODS

[Abstract of article by Luchitskaya, I. O.]

[Text] Due to the reoutfitting and replacement of electronic computers at the West Siberian Regional Computation Center, the introduction of programs for the computer processing of meteorological information on electronic computers in the years immediately ahead cannot be accomplished. Accordingly, a simplified method is proposed for determining the continuous duration of periods with an air temperature below (above) the stipulated limits with respect to the minimum, maximum and mean daily air temperatures. This method will make it possible to carry out computations using "low-level" automation methods and manually. It is adequately reliable and less time-consuming in comparison with the method based on use of the earlier proposed empirical formula. Tables 3, figures 1, references 6.

UDC 551.574.42

SOME REGIME CHARACTERISTICS OF CONDITIONS FOR ICING OF ABOVE-WATER FEATURES IN SHELF ZONE OF ARCTIC SEAS

[Abstract of article by Kolosova, N. V. and Panov, V. V.]

[Text] Maps of the empirical probability of sea breeze icing for October in the example of the Kara Sea are given. Data are given on the duration of cases of icing, thickness and mass of deposited ice from atmospheric icing according to observations on a glaze wall at polar stations. Tables 4, figures 2, references 6.

UDC 551.551.8

FEATURES OF STRUCTURE OF ATMOSPHERIC NEAR-WATER LAYER IN NORTHERN SEAS

[Abstract of article by Garbuzov, A. V.]

[Text] On the basis of long-term data from shipboard observations the author examines stratification conditions in the atmospheric near-water layer in northern seas. It is shown that it is necessary to take into account stratification conditions in the atmospheric near-water layer when computing exchange characteristics for different averaging periods. It is shown that allowance for humidity stratification when computing exchange characteristics in northern seas is necessary only for small averaging periods. It was established that the relative variability of the parameters of the near-water layer of the atmosphere in the northern seas is close to the values obtained for the North Atlantic region. The author gives evaluations of the errors in computing climatic values of heat flows when using information on the mean values of meteorological elements governed by the variability of these elements. Tables 2, figures 4, references 11.

UDC 551.577.2.(268.5)

FREQUENCY OF RECURRENCE AND INTENSITY OF PRECIPITATION IN SOVIET ARCTIC SEAS

[Abstract of article by Bryazgin, N. N.]

[Text] For the first time for arctic seas, on the basis of data from island and coastal stations and shipboard observations for 1936-1965, it was possible to construct maps of the frequency of recurrence of precipitation. For the poorly observed areas of the seas, when constructing the mentioned maps, in addition to shipboard observations use was made of the empirical correlations of the probability of precipitation with meteorological elements. The computed values of precipitation intensity are cited. The annual variation and patterns of distribution of their frequency of recurrence are given. An evaluation of the accuracy of the constructed maps is given. Tables 5, figures 1, references 9.

5303
CSO: 1865/53

TERRESTRIAL GEOPHYSICS

UDC 550.83

COLLECTION OF ARTICLES ON APPLIED GEOPHYSICS

Moscow PRIKLADNAYA GEOFIZIKA in Russian No 100, 1981 (signed to press 14 Apr 81) pp 191-192

[Abstracts of articles from collection "Applied Geophysics", responsible editor Ye. V. Karus, Izdatel'stvo "Nedra", 1490 copies, 192 pages]

[Text] Abstracts

UDC 550.834.5

DIFFERENTIAL PARAMETERS OF SURFACE TRAVEL-TIME CURVES OF REFLECTED WAVES

[Abstract of article by Levin, A. N.]

[Text] It is shown that the differential parameters of the travel-time curve of reflected waves are interrelated to surface wave fronts and fictitious surfaces. Expressions are derived for the curvatures of the surface travel-time curve, fictitious surface and surface of the front of a reflected wave. Figures 1, references 5.

UDC 550.834.05

FEATURES OF PROCESSING OF EXCHANGE WAVE SEISMOGRAMS BY THE D-TRANSFORMS METHOD

[Abstract of article by Kondrat'yev, O. K. and Orlov, V. P.]

[Text] The article examines an algorithm for D-transformation of records of the x-components in the transmitted exchange waves method into the image of a deep section. It is shown that in the "reconstruction" of inhomogeneous media it is desirable that an algorithm for the automatic regulation of the summation base be introduced into the D-transform procedure. Figures 4, references 5.

UDC 550.834.53

INVESTIGATION OF WAVEGUIDE SURFACE NOISE IN SEISMIC PROSPECTING BY THE COMMON DEEP POINT METHOD

[Abstract of article by Gil'bershteyn, P. G., Pochtovik, V. S. and Kopilevich, Ye. A.]

[Text] A study was made of the spectral and energy characteristics of P_l interference waves in the case of different filtration parameters as a function of source-receiver distance and shot depth. On the basis of a study of the properties of P_l interference it was possible to develop a method for its subtraction. Figures 4, tables 2, references 9.

UDC 550.834

ANALYSIS OF CONCEPTS ON EXTENT OF EFFECTIVE REFLECTION REGION

[Abstract of article by Zavalishin, B. R.]

[Text] This is a discussion of the contradiction arising in estimation of the extent of the effective reflection region in frequency and time representations. The author demonstrates the arbitrariness of defining the concept of "effective reflection region" on the basis of allowance for the role of edge diffraction. The frequency dependence of diffraction creates the impression that the extent of the effective reflection region is also dependent on frequency. In actuality, this extent is not determined by frequency, but by the duration of the wave process. Figures 4, references 8.

UDC 550.834.5

AUTOMATED SYSTEM FOR PROCESSING SPATIAL OBSERVATIONS BY THE COMMON DEEP POINT METHOD

[Abstract of article by Staykov, P. P., Minkovskiy, Kh. S., et al.]

[Text] The article examines an automated system for the processing of spatial observations in the common deep point method. The results of processing of field observations make it possible to conclude that in the case of spatial observations there is an increase in the reliability of discrimination of reflected waves due to the collection of wave energy in space. The principal advantage of spatial processing is the possibility of obtaining data on the behavior of the reflecting boundary in space. Figures 5, references 4.

UDC 550.834.04

EVALUATING GROUND EFFECT TIME FOR SOURCE OF SEISMIC VIBRATIONS AT SURFACE

[Abstract of article by Mayorov, V. V.]

[Text] On the basis of a diagram relating deformation of the ground and stresses, it was possible to calculate the time t for introduction of the shock mechanism of a surface source into the ground. It is shown that t is determined by the

momentum of the shock mechanism and reaction of the ground. Figures 1, tables 1, references 4.

UDC 550.83.05:519

USE OF GEOLOGICAL-GEOPHYSICAL DATA FOR DELINEATING PETROLEUM DEPOSITS IN THE SALYMSKOYE DEPOSIT USING THE POISK PROGRAM

[Abstract of article by Khomenyuk, Yu. V., Maksimov, A. B. and Guseva, V. S.]

[Text] The authors describe experience with the use of surface geological-geophysical data in delineating petroleum deposits in the argillites of the Bazhenovskaya suite of the Salymskoye deposit (Western Siberia) using the POISK program for the identification of images. The preliminary evaluation of the reliability of the forecasts is not less than 70%. Figures 3, tables 1, references 5.

UDC 550.837.81

POSSIBILITY OF USE OF CONCEPTS OF QUANTUM PHYSICS IN INDUCED POLARIZATION THEORY

[Abstract of article by Balasanyan, S. Yu. and Kobyl'skiy, V. A.]

[Text] A study was made of the possibility of using the concepts of quantum physics in the theory of induced polarization. It is shown that in this case it is quite easy to explain such phenomena observed in actual practice in the induced polarization method as negative polarizability and polarizability exceeding 100%. Figures 3, references 12.

UDC 550.831.01

DEPENDENCE OF DIFFERENTIATION OF MASSES ON THE EARTH'S GRAVITATIONAL FIELD

[Abstract of article by Veselov, K. Ye.]

[Text] It is demonstrated that any lengthening of the terrestrial day, secular shortening of the terrestrial year, periodic and irregular changes in the length of day and some geological phenomena can explain generation and change of mass. It is proposed that this effect be taken into account in computing the flight trajectories of space vehicles. Tables 1, references 14.

UDC 550.831.017

ITERATION-ANALYTICAL METHOD FOR SOLVING INVERSE PROBLEM OF GRAVIMAGNETIC EXPLORATION FOR VERTICAL, CYLINDRICAL AND STRATAL BODIES BY NONLINEAR OPTIMIZATION

[Abstract of article by Lyubimov, A. A., Abramov, A. N., D'yachkov, N. P. and Ivanov, S. N.]

[Text] This paper gives an iteration-analytical solution of the inverse problem in gravimetric and magnetic prospecting in a class of vertical, cylindrical and stratal bodies on the basis of the totality of the most informative points which is

obtained using an electronic computer by the trial-and-error method by minimizing a nonlinear functional. Tables 4, references 4.

UDC 550.831.017

COMPUTATION OF REDUCED POTENTIAL FIELDS WITH A PHYSICAL SURFACE ON A HORIZONTAL PLANE IN THE NEIGHBORHOOD OF THE KURSK MAGNETIC ANOMALY

[Abstract of article by Lyubimov, G. A. and Lyubimov, A. A.]

[Text] A method is described for the reduction of magnetic and gravity observations with an arbitrary surface to a plane, which makes it possible to increase the accuracy in reduction and reduce the expenditures of computer time in computations of any class. Figures 3, tables 2, references 4.

UDC 550.831.05:519

REALIZATION OF FULL GRADIENT METHOD WITHOUT SPECTRAL EXPANSION OF INITIAL DATA

[Abstract of article by Berezkin, V. M. and Otroshko, Ye. N.]

[Text] The authors propose a computation scheme for the full gradient method without spectral expansion of the initial data by means of transforming a Fourier series into a contraction integral. A program for a BESM-6 electronic computer is prepared on its basis. Figures 3, references 4.

UDC 550.831.016

SEPARATION OF GRAVITY ANOMALIES FROM BODIES SITUATED ABOVE ONE ANOTHER

[Abstract of article by Antonov, Yu. V.]

[Text] A method is proposed for the separation of complex gravity anomalies for the case of two anomalous bodies situated one below the other. Numerical schemes are developed for determining local anomalies from the distribution of a complex anomaly on the observation profile. Figures 3, tables 3, references 6.

UDC 550.831.017

APPROXIMATE METHOD FOR SOLVING THE PLANE INVERSE PROBLEM IN STRUCTURAL GRAVIMETRY

[Abstract of article by Fedorova, N. V.]

[Text] An approximate method is examined for solution of the two-dimensional inverse problem in potential theory for the purpose of determining discontinuities which is based on use of an approximation of the observed fields of a new class of potentials. An algorithm for constructing a family of equivalent discontinuities is described and is tested in model and practical examples. Figures 4, references 7.

UDC 550.831

REDUCTION OF THE OBSERVED GRAVITY FIELD

[Abstract of article by Mikhaylov, I. N.]

[Text] In a theoretical example the author examines the problems involved in reduction of the observed gravity field. The possibilities of reduction with the use of the apparent rock density values, determined from the results of gravitational logging, are pointed out. Figures 2, references 5.

UDC 550.831

ERRORS IN TRIGONOMETRIC APPROXIMATIONS AND USE OF SHORTENED FOURIER SERIES WHEN USING FILON METHOD

[Abstract of article by Yeliseyeva, I. S.]

[Text] It has been established that the degree of nonequal accuracy in computing the coefficients of a Fourier series by the Filon method is dependent on the number of reading points at which the initial function is stipulated. It is proposed that the optimum length of a series be determined in the case of shortened approximations on the basis of finding of the limiting expansion errors. Figures 2, references 3.

5303
CSO: 1865/13

COLLECTION OF ARTICLES ON DYNAMIC THEORY OF SEISMIC WAVE PROPAGATION

Leningrad VOPROSY DINAMICHESKOY TEORII RASPROSTRANENIYA SEYSMICHESKIKH VOLN in Russian No 21, 1981 (signed to press 5 Aug 81) pp 195-196

[Abstracts from collection of articles "Problems in the Dynamic Theory of Seismic Wave Propagation", edited by G. I. Petrashen', Leningradskoye otdeleniye, Izdatel'stvo "Nauka", 1150 copies, 196 pages]

[Text] ABSTRACTS

UDC 550.344

RAY METHOD AND POLARIZATION OF SEISMIC BODY WAVES

[Abstract of article by Petrashen', G. I.]

[Text] The author introduces the concept of a natural base $e_k(\tau)$ of a ray system of coordinates constructed at points (smooth segments) of a ray defining constant directions of polarization of longitudinal and transverse waves during their propagation in isotropic inhomogeneous media. On the basis of such a concept the article sets forth the formalism of the ray method in the mentioned media and this formalism is compared with the formalism of the ray method in cases of anisotropy of the medium. As a result it is clarified that with a tendency of the parameters of anisotropy to zero the directions of the polarization of quasilongitudinal and quasitransverse waves at each point on the (limiting) ray tend to the specific direction of some natural base. A simple algorithm is given for constructing the base $e_k(\tau)$ simultaneously with construction of the ray. References 6.

UDC 550.344

SOME PROBLEMS IN STUDYING SEISMIC WAVE FIELDS ON THE BASIS OF THREE-COMPONENT OBSERVATIONS

[Abstract of article by Kashtan, B. M., Kovtun, A. L. and Petrashen', G. I.]

[Text] General information is given on the propagation of body waves in inhomogeneous seismic media close to real media and on its basis there is clarification of the problem of approach to a description of the polarization of seismic oscillations arising when waves of different types are superposed. The results are applied

to the problem of discriminating useful waves (and determination of their parameters) on the basis of computer processing of material from three-component registry of wave fields under seismic prospecting conditions. Figures 7, references 19.

UDC 550.344

INVESTIGATION OF DISPERSION EQUATION ROOTS IN CASE OF PACKET OF TRANSVERSELY ISOTROPIC ELASTIC LAYERS

[Abstract of article by Molotkov, L. A. and Baymagambetov, U.]

[Text] Analytical methods are used in investigating the roots of a dispersion equation for a packet of transversally isotropic elastic layers with free outer boundaries. In the investigation use is made of matrix representations of dispersion equations. On the basis of asymptotic expressions for the left-hand sides of the equations it was possible to derive approximate formulas for the roots for small and large wave numbers. These results make it fully possible to trace the movement of the roots with an increase in wave numbers and to clarify the nature of the change in phase velocities of normal waves as a function of frequency. References 8.

UDC 550.344

HEAD WAVE RADIATED BY A THIN ELASTIC LAYER

[Abstract of article by Molotkov, L. A. and Smirnova, N. S.]

[Text] The low-frequency head wave from an elastic layer in a fluid is related to the longitudinal-lamellar wave in an elastic layer. If the elastic layer is in rigid contact with the surrounding elastic medium, a longitudinal-lamellar wave cannot propagate in such a system. However, as indicated by an analysis of the corresponding dispersion equation, at some low frequencies a highly attenuating head wave is also possible. Figures 3, references 6.

UDC 534.213.4, 550.934.013

THEORETICAL-EXPERIMENTAL INVESTIGATION OF WAVES GLANCING ALONG A CONCAVE BOUNDARY

[Abstract of article by Krauklis, P. V., Koptev, V. I., Krauklis, L. A. and Yakubov, V. A.]

[Text] The article gives a comparison of asymptotic and precise solutions of the problem of waves glancing along the concave boundary of an elastic medium. Theoretical seismograms are compared with experimental data in the case of a wave on the circular boundary of a plane model. There is a good agreement between the observed and theoretical travel-time curves and amplitude curves. Figures 6, references 5.

UDC 550.834

DEPENDENCE OF INITIAL PARTS OF SEISMOGRAMS OF REMOTE EARTHQUAKES ON PARAMETERS OF THREE-LAYER MODEL OF EARTH'S CRUST

[Abstract of article by Gal'perina, R. M., Ledovskaya, Ye. M. and Volin, A. P.]

[Text] The article presents an extremely effective method for computing the initial parts of full theoretical seismograms of remote earthquakes under the "Krat-3" and "Krat-5" programs. The authors discuss new possibilities afforded by the programs in the interpretation of seismic observations. On the basis of the results of computation of the theoretical seismograms under the "Krat-3" program it is possible to analyze the dependence of the structure of the initial parts of the seismograms on the parameters of the three-layer model of the earth's crust. Figures 7, tables 2, references 7.

UDC 550.834

SPATIAL MODEL OF ANOMALOUS UPPER MANTLE ZONE IN ALTAY AND SAYAN REGION AS A RESULT OF SEISMIC PROBING

[Abstract of article by Matveyeva, N. N., Rogozhina, V. A. and Antonova, L. N.]

[Text] On the basis of data on earthquakes registered along the profile Pamirs-Lena River it was possible to study a zone of reduced velocity in the upper mantle. With deviations Δt in the travel time of seismic waves from the standard Jeffreys-Bullen travel-time curve it was possible to ascertain the spatial position of the zone and the velocities within it. In this procedure only $\Delta t \geqslant 2.0$ sec are taken into account. A theoretical probing of the zone is carried out. The travel times of waves in a three-dimensional medium are computed for different sources. It was found that the zone extends for approximately 2,000 km and plunges in a NE-SW direction. The minimum depths are 150-200 and the maximum depths are 750-800 km; the propagation velocity of longitudinal waves on the average decreased by 0.5-0.8 km/sec. Figures 7, tables 2, references 18.

UDC 550.834.5

FEATURES OF THE WAVE FIELD FOR TRANSFORMED FAULT ZONE IN CASE OF THREE-DIMENSIONAL MODEL OF MEDIUM

[Abstract of article by Tsymbal, T. M., Neprochnov, Yu. P. and Antonova, L. N.]

[Text] A study was made of the kinematic and dynamic features of the wave field in a three-dimensional model of a transformed fault having a curvilinear bottom (fault canyon). It is shown that the curvilinear bottom, focusing the energy of the refracted and reflected waves, exerts a substantial influence on the wave pattern. For the purpose of refining the nature of some observed waves the authors compared theoretical computations with experimental data. Figures 8, tables 1, references 3.

UDC 550.834

EVALUATION OF EFFECTIVENESS OF COMMON DEEP POINT OBSERVATION SYSTEMS AND CHOICE OF OPTIMUM FIELD WORK METHOD ON BASIS OF EFFECTIVE SEISMIC MODEL METHOD

[Abstract of article by Kurbanov, R. K. and Mametov, K. M.]

[Text] An interpretation system is proposed which makes it possible to evaluate the effectiveness of accumulation systems in the common deep point method, to ascertain the optimum spacing of shot points and the optimum length of the travel-time curve. In the example of the Middle Syr-Dar'ya Depression of Southern Kazakhstan a study is made of all stages in investigations by the proposed method and the optimum field work method by the common deep point method is defined. Figures 6, tables 1, references 8.

UDC 550.834.05

EXPERIENCE IN USING THE DYNAMIC CHARACTERISTICS OF REFLECTED WAVES IN SELECTING CHARGE SIZE

[Abstract of article by Pershina, R. A., Kosarev, V. K., Loginov, V. T. and Makokin, V. I.]

[Text] It is demonstrated experimentally that using the dependence of the effective absorption coefficient on the frequency characteristics of seismic waves it is possible to exert an influence on the structure of the observed field. In particular, within the limits of the Moscow syneclise in this way it is possible to achieve a relative attenuation of the most intensive group of multiple reflected waves with three reflection events, one of which occurs in the near-surface part of the section. The attenuation of the mentioned group of waves causes a change in the dynamic characteristics of the registered field of reflected waves. Figures 3, references 3.

UDC 550.834

SEISMOGRAM TRANSFORMATION WITH USE OF CHANGE IN TIME SCALE OF PATHS

[Abstract of article by Latyshev, K. P. and Ozerov, D. K.]

[Text] A procedure is proposed for seismogram transformation which involves the linear extension and compression of the paths along the time axis. It is shown that this procedure considerably reduces the sharply changing part of the wave form and this can be used in separating oscillations. Figures 8, references 1.

UDC 550.834

CONVERGENCE OF AN ITERATION ALGORITHM FOR SEPARATING INTERFERING SEISMIC WAVES

[Abstract of article by Troyan, V. N.]

[Text] The convergence of the iteration procedure for finding evaluations of parameters of interfering seismic waves is demonstrated for the special (but of

practical interest) case of separation of two waves. The author examines two variants of stipulation of signal shape: the shape is known with an accuracy to the amplitude factor; the shape is unknown but the effective duration of the signal is stipulated. Formulas are derived for the residual term. These can be used for practical evaluations of the accuracy of the n-th approximation and maximum probability evaluations. References 2.

5303
CSO: 1865/38

PHYSICS OF ATMOSPHERE

UDC 551.593+551.510.536

COLLECTION OF PAPERS ON ATMOSPHERIC OPTICS

Moscow TRUDY INSTITUTA EKSPERIMENTAL'NOY METEOROLOGII: OPTIKA ATMOSFERY in Russian No 10, 1981 (signed to press 28 Jan 81) pp 103-105

[Abstracts of articles from collection "Transactions of the Institute of Experimental Meteorology: Atmospheric Optics", edited by V. N. Lebednits, doctor of physical and mathematical sciences, Moskovskoye otdeleniye Gidrometeoizdata, 430 copies, 105 pages]

[Text]

ABSTRACTS

UDC 535.345.67

APPARATUS FOR FABRICATING WEDGE INTERFERENCE FILTERS

[Abstract of article by Vasil'yev, A. S. and Davletshina, R. A.]

[Text] Apparatus is described which makes it possible to employ the UVN-71P-3 standard-produced vacuum apparatus for the fabrication of wedge interference filters of an annular shape. The article gives the spectral characteristics of a metallodielectric wedge filter in the spectral region 380-680 nm, fabricated using such apparatus. Tables 1, figures 2, references 4.

UDC 535.214.4

POSSIBLE ERRORS IN RADIOMETRIC APPARATUS

[Abstract of article by Allenov, M. I., Mamonova, I. G. and Tret'yakov, N. D.]

[Text] The article gives the results of computations of the errors in radiometric apparatus for different spectral intervals of radiant energy detectors PbS, PbTe, InSb, different interference filters with λ = 0.04, 0.54, 1.54, 2.04μm and with a background level outside the transmission band 10^{-3} and 10^{-4} relative to transmission at the maximum for different temperatures T of the radiation source (from 273 to 6000°K). Tables 3, figures 1, references 2.

UDC 535.853.225

SPECTROMETER FOR LOW-ENERGY ELECTRONS

[Abstract of article by Kal'sin, A. V., Klimentov, A. M. and Mikheyev, Yu. P.]

[Text] The authors describe an electron spectrometer intended for investigations aboard geophysical rockets for determining the intensities of electron fluxes, their angular and energy distributions in the energy range 5-70 eV. The instrument field of view is 10 x 20°, energy resolution is 5%, the geometry factor is $4 \cdot 10^{-3}$ $cm^2 sr$, the spectral scanning period is 1 sec. The spectrometer electronics system was developed on a modern component base. Figures 5, references 8.

UDC 550.380

DETERMINING ANGLES OF ORIENTATION OF RAPIDLY ROTATING GEOPHYSICAL ROCKETS BY MEANS OF SOLAR AND MAGNETIC SENSORS

[Abstract of article by Kal'sin, A. V. and Mikheyev, Yu. P.]

[Text] A method is given for determining the orientation of a rapidly moving geophysical rocket relative to the vector of strength of the geomagnetic field and the direction to the sun, developed for a case when there is regular nutation of the longitudinal axis of the rocket. A method was developed for in-flight calibration of magnetic field sensors. Figures 1, references 4.

UDC 535.241.624

ENERGY CALIBRATION OF A SPECTROMETER FOR OBSERVING TWILIGHT SKY EMISSION

[Abstract of article by Gusev, S. V. and Tereb, N. V.]

[Text] A method and apparatus are described for carrying out energy calibration of a spectrometer complex. The apparatus is an outfit in which the standard radiation source used is an SI8-200 U light-measuring lamp. MS-14 milk glass is used for filling the field of view. The computation error in energy calibration is 10-14%. Tables 3, references 5.

UDC 551.593.65

STUDY OF BRIGHTNESS FLUCTUATIONS OF STRATOCUMULUS CLOUDS

[Abstract of article by Allenov, M. I., Bulgakov, V. G., Ivanova, N. I. and Tret'yakov, N. D.]

[Text] The authors analyze the results of investigation of the stochastic structure of brightness fluctuations of stratocumulus clouds simultaneously in the spectral intervals 1.50-1.80, 204-2.32, 1.60-286 and 2.60-286μm. Also given are the moments

and differential distribution functions, autocorrelation functions and spectral densities for all four channels. Tables 2, figures 2, references 6.

UDC 551.576.12

STATISTICAL STRUCTURE OF EFFECTIVE THICKNESSES OF FIELD OF CUMULUS CLOUDS

[Abstract of article by Allenov, M. I. and Bulgakov, V. G.]

[Text] A study was made of the statistical structure of effective thicknesses of the field of cumulus clouds. The field is simulated on a YeS-1050 electronic computer by the Monte Carlo method. The authors give the moments and differential distribution functions of effective thicknesses for different zenith angles and absolute scale units. Tables 1, figures 2, references 9.

UDC 551.510.535.001.57

FORMATION OF STABLE LAYERS OF METAL IONS IN THE UPPER ATMOSPHERE

[Abstract of article by Tereb, N. V.]

[Text] The author carried out numerical modeling of the process of transport of metal ions at altitudes 85-119 km under the influence of tidal components and the prevailing wind. It is shown that the tidal components cannot be responsible for the formation of stable layers of ions of metals at altitudes 90-95 km. Tables 1, references 7.

UDC 551.510.536

MEASUREMENTS OF Ca II EMISSION IN KIRGIZIYA

[Abstract of article by Tereb, N. V.]

[Text] Measurements of the emission of ionized calcium, carried out in 1977-1979 in Kirgiziya, indicate that as a rule the intensity of the emission does not exceed the threshold of response of the apparatus, but sometimes attains extremely high values corresponding to $1.5 \cdot 10^9$ ions/cm^2 of the total content of calcium ions; the days when the emissions were observed (only 11 cases of the appearance of the Ca II emission were registered in 243 measurements) do not coincide with the periods of the most powerful meteor streams; the probability of the appearance of a powerful emission in evening is greater than in the morning. Figures 3, references 9.

UDC 551.521.17

INFLUENCE OF A SERIES OF FACTORS ON THE LEVEL OF SOLAR UV RADIATION SCATTERED BY THE OZONOSPHERE

[Abstract of article by Barysheva, V. I. and Troyanov, N. M.]

[Text] This is a discussion of the problems involved in numerical modeling of the process of transfer of solar UV radiation in the atmosphere. The article gives quantitative estimates of the influence of different factors on the level of scattered

radiation. Allowance for single scattering alone leads to an underevaluation of the intensity of scattered radiation to~40%. Comparable to the influence of multiple scattering processes on the level of scattered radiation is the influence of the temperature dependence of the ozone absorption coefficient, which attains 12% under some conditions of atmospheric illumination and wavelengths. Measures are proposed for optimizing the selected model of the atmosphere from the point of view of the reliability of reconstructing the characteristics of the ozonosphere on the basis of scattered radiation from artificial earth satellites. Tables 3, figures 1, references 19.

UDC 551.510.5

EXPERIMENTAL INVESTIGATIONS OF ATMOSPHERIC CARBON DIOXIDE (REVIEW)

[Abstract of article by Kamenogradskiy, N. Ye. and Shashkov, A. A.]

[Text] This is a review of the principal results of experimental investigations of the atmospheric carbon dioxide concentration. The author describes modern measurement apparatus (nondispersion IR optical-acoustical gas analyzer) and the measurement method. Also discussed are the prospects for further development of experimental methods for studying atmospheric CO_2 associated with the use of the spectroscopic method for the mean CO_2 concentration in a column of the atmosphere weighted by altitude. Figures 10, references 75.

UDC 551.593.5

MOLECULAR ABSORPTION OF RADIATION IN THE WINDOW OF RELATIVE ATMOSPHERIC TRANSPARENCY 3.5-4.1μ m (REVIEW)

[Abstract of article by Aref'yev, V. N. and Visheratin, K. N.]

[Text] This is a review of the principal publications of recent years on the molecular absorption of IR radiation in the window of relative atmospheric transparency 3.5-4.1μ m. Tables 4, figures 3, references 46.

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CSO: 1865/52

UDC 550.388

MONOGRAPH ON GEOPHYSICAL PARAMETERS OF IONOSPHERE

Alma-Ata GEOFIZICHESKIYE PARAMETRY IONOSFERY in Russian 1979 (signed to press 10 Jul 79) pp 2, 116

[Annotation and table of contents from monograph "Geophysical Parameters of the Ionosphere", by Mariya Petrovna Rudina and Nina Fedorovna Solonitsyna, Izdatel'stvo "Nauka" Kazakhskoy SSR, 1000 copies, 117 pages]

[Text] In this monograph the authors examine the state of the ionosphere on the basis of data from the world network of stations over a long period of observations. It is shown that at latitudes 35-45° the state of the upper atmosphere, determined by a series of geophysical parameters, has features not fitting into known theories. A hypothesis is advanced that at these latitudes, with a special state of the interplanetary magnetic field, an effect is exerted by corpuscular streams and that long-period fluctuations of the solar system are transmitted to the earth's atmosphere through the interplanetary magnetic field. Thus, the discovered features make necessary a new approach to formulation of a theory of the formation and behavior of the upper atmosphere and diagnosis. Computations, graphs and tables are cited which are necessary in preparing short- and long-range forecasts of radio wave propagation. The book is of interest for specialists concerned with the problems of solar-terrestrial physics and geophysicists, graduate students and students at the corresponding colleges. Figures 33, tables 16, references 137.

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ARTIC AND ANTARCTIC RESEARCH

UDC 550.83(99)

COLLECTION OF ARTICLES ON GEOPHYSICAL RESEARCH IN ANTARCTICA

Leningrad GEOFIZICHESKIYE ISSLEDOVANIYA V ANTARKTIDE in Russian 1980 (signed to press 31 Dec 80) pp 2-3

[Annotation and table of contents from collection of articles "Geophysical Research in Antarctica", edited by M. G. Terekhanova, Nauchno-issledovatel'skiy institut geologii Arktiki (NIIGA), 295 copies, 75+ pages]

[Text] Annotation. This collection of articles gives the principal results of Soviet geological-geophysical research in Antarctica carried out during 1970-1980. The articles examine the deep structure of the two largest rift zones -- the Filchner Ice Shelf in Western Antarctica and Lambert Glacier in Eastern Antarctica. The leading role of riftogenic processes in the formation of extensive pericontinental sedimentation basins is demonstrated. The high effectiveness of the airborne magnetometer method under Antarctic conditions is demonstrated for detecting structures in the basement and determining its paleotectonic nature. Brief communications discuss methodological problems involved in carrying out seismic soundings by the reflected waves method and the use of radiogeodetic systems for the tie-in of aerogeophysical surveys.

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