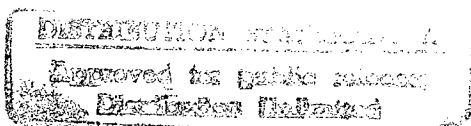FOREIGN
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CONTENTS

Kazakh Biologist Claims Development of Earthquake Prediction Method

937N0040A Alma-Ata KAZAKHSTANSKAYA PRAVDA in Russian 17 Oct 92 p 8

[Article by Eduard Krivobokov; "When Will 'X' Day Come? A Sensation: Alma-Ata Scientist Asserts That He Has Found an Algorithm Making Possible a Determination of the Time When an Earthquake Will Occur Many Months in Advance"; the first paragraph is an introduction]

[Text] Well, still another prophet has announced himself, says the reader. However many there already have been, but underground storms have shaken us out of our wits without any warning and they will continue to do so. The 19th of August, catching millions of inhabitants of the cities and villages of southern Kazakhstan unaware, is the most recent confirmation of this.

And despite being fully cognizant of the distrust existing in society toward different kinds of oracles of the future, I want to take on myself the bold assignment of introducing a man who nonetheless has been able to sort out the keys to the secrets of the underground kingdom and to find the secret code controlling tectonic processes in the Earth. The code makes it possible, on the basis of the state of underground weather during some period in the past, to compute quite precisely what will happen in the future. But speaking in simple terms, it makes it possible to learn in advance for a given region when something distressing us, in particular, a strong earthquake, will occur and in sufficient time to make preparations for it.

A fantasy? Nowhere has anyone in the world been able to do such a thing, and here is a prophet, and in our own country to boot! I admit that that's what I thought when a good acquaintance called my attention to a man who predicts earthquakes; for the time being I knew none of the facts with which I propose to familiarize primarily those who live in seismically dangerous regions. So that each can decide for himself whether or not to trust the latter-day prophet, especially since on the answer to this question his life or death are directly dependent.

I must immediately caution you that the excursion, or to be more precise, digression, which we are about to make in a rather specific and abstract field of science, passes along extremely rocky trails, and therefore the reader will require extra patience and at least some academic background.

In general Mark Dubyanskiy has no relationship to seismology. He is a doctor of biological sciences and his entire life has been occupied with a dangerous and until recently secret matter: study of the natural foci of the plague, as well as the regularities of its spread. One of the particular problems which he had to solve in the course of his work was related to the need for predicting the multiplication of rodents in the desert because the peaks of their population were usually associated with epizootics of frightful disease. Hard work has long been done on this problem in biology, but no one has yet been able to solve it. But Mark Dubyanskiy had success: he found a method making possible precise prediction of the course of development of events in colonies of dangerous small desert animals.

Most of the specialists concerned with the plague have related the possibility of prediction to a search for and discrimination of the natural factors exerting an influence on the multiplication of rodents. The Alma-Ata scientist did not involve himself with the intricacies of natural factors, but took on himself a task regarded as pointless in the scientific community and long abandoned by all others, that of analyzing the number of rodents by years: in one spring or another there are so many, in the following spring—a few more, in the following spring—a few less, etc. In a series of apparently random values he sought at least some regular relationship which it would be possible to extrapolate to the future. Such, strictly speaking, is in general the mechanics of scientific prediction. But Mark Dubyanskiy did not discover any order in the distribution of numbers.

Entering into a blind alley, the scientist did not abandon the search, in contrast to his colleagues. He decided to examine invariant models of dynamic series. That is, the same series, but expressed in a different form. First in a probabilistic form. After transformation the series of figures somehow "gained weight" and seemingly became inert. The explanation here was simple: mathematicians know that probabilities are not added and are not subtracted and accordingly the level of interactions among the numbers immediately drops sharply. Then Mark Dubyanskiy once again tried to transform a dynamic series, expressing the probability in odds over which it was possible to perform any arithmetical operations. And here in the distribution of odds for the first time he discovered a distinct regularity. The computer printouts, and especially the curves, clearly indicated that prior to any maximum in the development of the predicted processes there is an avalanche-like accumulation of odds. Does this mean that a true precursor of an onsetting event has been found?

Now it is possible to demonstrate to readers, using specific examples, how the algorithm proposed by the scientist is applied.

Mark Dubyanskiy prepared the first prediction in 1987. He took data on the population of the so-called "southern sand rodent" for 1957-1969 and on this basis made corresponding computations up to the year 2000. It followed from these computations that the next peaks in the multiplication of this little animal will occur in 1988 and 1994. And what happened? The prediction for 1988 has already been confirmed and the author of the algorithm is now sure that the second year also will be confirmed. Not much time remains before confirmation will be obtained.

Does Mark Dubyanskiy not overrate his method? One precisely guessed event still says nothing. In order to understand the reason for the confidence exhibited by this scientist I will report some other details. In making a prediction from the last computation year, 1969, applicable to 1988, the computer naturally provided data for that entire interval of years. For the computer the future began from 1970. On the printout, in addition to 1989 and 1994, the greatest clusterings of odds were noted for the years 1964, 1970, 1971, 1978, 1979 and 1980. Mark Dubyanskiy turned to the archives and found that bursts in the population of rodents occurred precisely in these years. Are you impressed? On the basis of the results of such checking I would immediately head for Stockholm and stand in line for the next Nobel Prize.

The scientist made similar computations based on the dynamics of multiplication of another rodent—the domestic mouse. The fantastic degree of coincidence of predictions with reality was the same.

And still another illustration of the predictive capability of the Mark Dubyanskiy algorithm. Before me is a number of a very special UNESCO journal for 1990. So special that it was printed in only 300 copies. But it is destined to become a bibliographic rarity for other reasons than the small number of copies. It contains a report by Mark Dubyanskiy at a scientific conference held in 1989 in Moscow at which the Alma-Ata biologist for the first time publicly spoke out with a prediction of solar activity.

Some readers may be surprised by the inconceivable jump of the scientist from biology to astrophysics. However, it is very simple to explain. Since the time of L. Chizhevskiy it has been known that an increase in the population of rodents and the outbreak of epidemics and epizootics are closely related to weather on our sun. And in order to investigate outbreaks of plague on our planet it is necessary, whether you want to or not, to turn your eyes toward the sun.

It must be noted that the periodicity of flares on the sun has an approximately 11-year cycle, and it would seem that there should be no problems in their prediction. In actuality, the times of appearance, rise, apogee and decline of solar activity last different times in different cycles and accordingly become nonidentical, are indistinct and it is not easy to predict their phases, especially the peak, characterized by the so-called Wolf number. When will the activity peak set in during the current cycle, the most anomalous during the 290-year period of regular scientific observations of the sun? The leading astrophysicist of the Main Astronomical Observatory of the Academy of Sciences of the former USSR, a scientist with world reknown, Yu. I. Vitinskiy, assumes that it, the peak (reference is to a journal article) "is expected in the first half of 1990."

The same number of the journal contained materials with predictions of solar activity by specialists of the key Institute of Applied Geophysics of the State Committee

for Hydrometeorology of the former USSR, who made computations "on the basis of the streams of galactic cosmic rays... making use of measurements from artificial earth satellites...." And they came to a conclusion consistent with the opinion of Yu. I. Vitinskiy.

And now visualize how an amateur in the field of astrophysics, a biologist known to no one, from an outside organization, and having no comprehension of solar processes, without any satellite data, costing billions of rubles, solely on the basis of an analysis of numbers characterizing solar activity in the past, comes to the podium and declares that in his opinion the solar activity peak will not occur in 1989, as his respected colleagues think, but in 1991.

At that time the professionals only laughed up their sleeves at this self-assured odd fellow from Kazakhstan. But today I don't think they are laughing: the prediction of the amateur astronomer has proven entirely correct. The sun "operated" precisely in conformity to his program.

An interesting detail. The retrospective series of Wolf numbers which was taken as the basis for the computations by Mark Dubyanskiy in one of the variants was limited to the period from 1700 through 1856. And now, from such an improbable distance in time, it appears that it is possible to see precisely and predict the peak of solar activity falling in the current year! And, to be sure, all those preceding it. In the time interval from 1856 to the present there have been 14 solar activity cycles and Mark Dubyanskiy, even without entering refining information into the computer memory, in the course of development of the events precisely indicated nine peaks in them, four were indicated with a deviation of one year and one with an error of two years. If one can be satisfied with a prediction accuracy of +/-1 year, the probable success of predictions made when using the Mark Dubyanskiy algorithm is 94%. Specialists know that this is a fantastically high prediction accuracy.

Now that the reader has grasped some idea concerning the new prediction method it is time to proceed to what is most important: discussion of the possibility of its application in seismology.

"So, is it possible or not?"

"It is necessary!" objected Mark Andreyevich.

And he explained why.

From the mathematical point of view a series of numbers characterizing seismic activity by years in no way differs from the dynamic series in which the solar activity phases, outbreaks of epizootics, etc. are quantitatively expressed. All the mentioned phenomena have a quasiperiodic ("quasi" means approximately) nature and therefore their mathematical description conforms to a single code. And this code is identically capable of operating successfully for both our planet and the sun and also beneath the Earth's surface.

"Give me information on the earthquakes for any seismogenic region of the world for the last 12 months," declared Mark Dubyanskiy, "and within a week I will tell you what to expect in the coming year."

I was interested, to be sure, primarily in the underground weather at Alma-Ata.

"When will the inhabitants of the capital of Kazakhstan," I asked the scientist, "be able to receive a prediction and be able to sleep placidly at night?"

Mark Dubyanskiy only sighed.

"I have no data for making a prediction...."

The situation had developed as follows.

Seismologists today are not able to predict earthquakes, but have a databank concerning them. And they talk as if they, like blind persons, are unable to say when an underground storm will break loose. And this means that all others, who are not blind persons, are certainly unable to do so. They do not believe that Mark Dubyanskiy is capable of computing the moment when an underground calamity will hit, much less months in advance, and therefore do not afford him access to their databank. And if there is no information there is no prediction.

Some departmental interests probably can justify such a logic. But from the point of view of the millions of people living in the zone of influence of the North Tien Shan seismic region such an approach is simply inadmissible. Accordingly, the editorial staff had to take upon itself the mission of "extraction" of information.

But first we decided to take a look at how the Dubyanskiy method works, or if it works, in application to tectonic processes. The editorial staff turned to Abdrakhman Kurskeyev, director of the Seismology Institute, Academy of Sciences of the Kazakh Republic, and he, who must be given his due, readily responded to our request to supply the information necessary for a well-conceived experiment. And we asked for information on earthquakes in the North Tien Shan region occurring in the arbitrarily selected year 1969. On the basis of the data received we proposed to Mark Dubyanskiy that he prepare a prediction for 1970. After three days the editorial staff compared the prediction provided by a computer with the real events of the year. The day 5 June when a scale-6 earthquake occurred was precisely printed out.

In order to preclude the possibility of a random guess of the date of the earthquake, we performed the same operation with a test prediction for the years 1977 and 1981 as well. In both cases the predicted dates of the earthquakes matched the real events day for day.

When with a certain degree of enthusiasm I telephoned the results of this testing to Abdrakhman Kurskeyev, director of the Seismology Institute, the latter did not approve of my optimism.

"The year 1970 and the other predicted years were not in the so distant past and Dubyanskiy simply has a good memory: he might also remember what occurred then. In addition, all the information on earthquakes for those years were published long ago in the open press...."

With all due respect for Abdrakhman Kurskeyev, it is difficult to agree with his objection. The use of a computer precludes any voluntary or involuntary influence of memory on the results of these computations. It can be seen from the printout what information was fed into the computer and what conclusions the machine drew by itself.

However, in order not to waste time on fruitless discussions, there is another variant of the experiment which will eliminate the "good memory" problem and we are ready to carry it out. Let's hand over to Mark Dubyanskiy data on any seismic region of the CIS, for any year, without any indication of the coordinates and time. We hope that such a variant of the experiment will help to put all doubts to a final rest.

Incidentally, the press recently contained a communication on a possible catastrophic earthquake in New York. Experiencing friendly feelings toward the American people, Mark Dubyanskiy was ready, completely without charge, to make a prediction of the New York seismic event. For this it was only necessary that he be supplied the essential data.

But how about a seismic prediction for Alma-Ata?

Since everything is dependent on the lack of information on seismic activity in the North Tien Shan region during the last nine months, once again I had the occasion to communicate with the director of the Seismology Institute. Abdrakhman Kurskeyev reported that at the institute they are only making the information more precise and are checking the incoming data and they will be processed by the end of the year. Then Mark Dubyanskiy also will be able to obtain them.

Well, we will wait until January and that is not far away. I only want to express one consideration on this score. As long as we were unable to predict underground weather the unhurried processing of seismic data was justified. Now when the possibility has appeared for precomputing underground storms it probably is necessary to think a little about how to accelerate the collection of seismic data.

On 19 August, when the Susamyr earthquake occurred, our theme took still another turn. This day became the moment of truth for the long expected event, and confirmation of the discovery was finally obtained. A hundred hours prior to the occurrence of the underground calamity the Commission on Extraordinary Situations of the Council of Ministers of the Kazakh Republic was telephoned by the specialist Professor Inyushin with a warning of a possible earthquake. The instruments which he developed for a unique biophysical seismic station 120 hours prior to the underground calamity had

begun to record a sprawling sine curve. Thus, the August tremor became the first in the history of seismology which was registered in advance by scientific instruments. Instrumental observation of tectonic processes at a short distance in combination with long-range prediction by the Mark Dubyanskiy method may become the basis for a reliable seismic service which once and for all will protect mankind from the unpredictable caprices of the underground dragon.

Exactly what is a biophysical seismic station? It is known that some animals react to an approaching underground storm. The writer and biologist Pavel Marikovskiy even attempted to predict an earthquake from the behavior of our smaller brothers. But it was a rather troublesome and complex matter to "take readings" from living "sensors." You have to figure out why a fox sets up a clamor: whether meat is not being shared, whether tourists had a radio turned on loudly, or whether an earthquake was really and truly imminent.

Viktor Inyushin also decided to use the capability of a living being to react to any, not in all respects understandable disturbances in the natural medium on the eve of an earthquake. And it was decided to register changes at the biophysical level by means of special instruments. As a "sensor" he selected wheat seeds and devised a device making possible continuous registry of the biocharacteristics of the tiny grain. The device was coupled to a recorder which automatically, around-the-clock, plots a diagram of "how the grain feels." As soon as anomalously great stresses arise in the crust many known and unknown physical characteristics of the Earth change, to which the grain immediately clearly reacts. And the automatic recorder begins to draw an alarm sine curve.

Two such experimental stations already are maintaining an around-the-clock watch at Alma-Ata. There are too few of them for a reliable prediction. Viktor Inyushin also is capable of indicating in advance the epicenter of an underground storm if he could "position" three or four stations in the capital and suburbs at a distance adequate for obtaining a direction-finding effect. Unfortunately, the city executive committee cannot find several small rooms for the placement of seismic stations. We will hope that those on whom a solution of the problem is dependent also want to live and never want to be buried beneath the ruins of their homes and will strive

to do something in the immediate future, if for no other reason than in their own interests. And this also means in our interests.

Fractality of Geophysical Fields Determined by Aerospace Methods

[Article by L. N. Vasilyev and A. S. Tyuflin, Geography Institute, Russian Academy of Sciences, Moscow; UDC 528.7:91]

[Abstract] Fractal geometry is an effective tool in the study of geophysical fields measured from spacecraft or aircraft. A natural phenomenon in large part has a fractal character but it is not so simple that it can be expressed as a self-similar dimension. In actuality, geophysical structures are self-affine and multifractal. With these and other considerations taken into account, the following questions are posed: will an adequate characteristic of structure of a geophysical field be conserved when it is measured with a different spatial resolution, or, more specifically, how are the fractal dimensions of the spatial structures related at the micro-, meso- and macrolevels? The fractality of radiation fields and surface elevation fields is examined in an effort to answer these questions. For a uniform approach and some algorithmic simplifications all measurements from spacecraft and aircraft were investigated by sections. The scaling properties of a geophysical field are different along the coordinate axes because the measurement units are independent. For horizontal sections they are self-similar, but for vertical sections they are self-affine. Whereas a self-similar fractal can be designated by a single number, in a self-affine case a great number of fractal dimensions appear. An experiment was carried out using space images from several satellites. An analysis of these materials revealed that the signatures of self-affine geophysical fields, determined from space and aircraft, are effective in compressing spatially distributed data. Any multistep conversion from local point measurements to evaluations of subgrid models of interaction between the surface and atmosphere on the basis of space imagery must take changes in the properties of fractal signatures into account. Figures 2; references: 5 Russian.

Generation of Modified Lamb Surface Wave in Atmosphere by Underwater Source

[Article by L. A. Gasilova, I. Yu. Gordeyeva and I. V. Petukhov, Applied Physics Institute, Russian Academy of Sciences; UDC 551.596.1]

[Abstract] A study was made of the dispersion properties of a modified Lamb surface wave propagating along the interface between an isothermic atmosphere and a "heavy" compressible fluid with a density and speed of sound constant in depth (simulating the ocean). The dependence of its generation coefficients on frequency are determined in the case of a point underwater source of mass. It is shown that allowance for the influence of gravity on wave processes in a fluid results in the following effects. First, a resonance frequency appears which is equal to the ratio of the acceleration of free falling to the speed of sound in the air at which in the coefficients of generation of a modified Lamb surface wave there is a narrow resonance maximum, but the curve of the frequency dependence of its phase velocity intersects the similar dependence curve for a surface hydrodynamic wave. Second, there is a distinct position of the corresponding points relative to the interface between the media with which the resonance maximum in the coefficient of generation of this wave is most expressed in amplitude. Third, a modified Lamb surface wave is propagated with a supersonic velocity only for frequencies below the critical frequency and above the resonance frequency; for the frequency range below resonance frequency this wave is propagated with a subsonic (relative to the air) velocity. Figures 2; references: 4 Russian.

Large-Scale Sea Gravimetric Survey

[Article by L. K. Zheleznyak and V. N. Koneshev, Earth Physics Institute imeni O. Yu. Shmidt, Russian Academy of Sciences; UDC 528.27.550.312]

[Abstract] The results of experimental-methodological work in a large-scale sea gravimetric survey, the results of which were used in plotting a map with an isoline interval 0.25 mgal, are given. The principles for constructing the apparatus employed is described. Work was done in two test ranges measuring 40 x 40 km using the MGK gravimetric outfit. The results indicate that the standard-produced sea shipboard gravimetric apparatus makes it possible to carry out a survey which in its accuracy is superior to bottom and ice surveys and approaches the accuracy of a surface survey. Since there are no limitations on the use of gravimetric instruments, such a survey can be made in any region of the world ocean under virtually any weather conditions with placement aboard almost any ship. The described work experience makes is possible to recommend replacement of a bottom survey by a shipboard survey wherever possible because the latter is more precise, productive and cheaper. The attained accuracy allows plotting of a map at 1:50,000 and larger. This in turn affords a possibility for the broad combining of different types of geophysical work in a study of structural features of the upper crustal layers, refinement of the boundaries of faults and direct search for oil- and gas-bearing structures. Whereas seismic prospecting can be used for constructing a vertical geological section, gravimetry can outline a structure in the horizontal plane with the corresponding accuracy. Since the strength of an anomaly over oil- and gas-bearing structures may be 1.5-2.0 mgal, the attained measurement accuracy makes possible reliable detection of such structures. A large-scale gravimetric survey can and should be used in combination with other methods in the search for oil- and gas-bearing structures and in collecting data for the planning of their drilling. The attained accuracy also affords new possibilities for other applications in geology, geophysics, geodesy, engineering, ballistics and sea navigation. Figures 3; references: 3 Russian.

Statistical Evaluations of Parameters of Nonlinear Long Internal Waves in Test Range Measurements

[Article by V. A. Ivanov, Ye. N. Pelinovskiy, Yu. A. Stepanyants and T. G. Talipova, Applied Physics Institute, Russian Academy of Sciences; UDC 551.466.6]

[Abstract] Data from hydrological measurements in a test range in the Levant Sea are used in studying the mean characteristics of nonlinear long internal waves and their variations. Fifty-three soundings were made with a hydrological probe to depths of about 600 m. These data were used for computing the mean vertical profile of the Vaisala-Brunt frequency and the standard deviation from it. A method is proposed for estimating nonlinear effects. In basins with a real stratification the nonlinear coefficient in the Korteweg-de Vries equation for long internal waves (nonlinearity parameter) is a monotonic function of depth. With definite depths it attains a maximum (in absolute value) level and then with an increase in depth smoothly decreases to zero. Estimates of the nonlinearity and dispersion parameters and the velocity of propagation made on the basis of the mean profile of the Vaisala-Brunt frequency are stable for virtually any depths (except a depth of about 40 m where the nonlinearity parameter is close to zero). The strong dependence of the parameters of the Korteweg-de Vries equation, as well as the "soliton" value of the Ursell parameter, should lead to prevalence of internal wave collapse processes of the "plunging breaker" type, accompanied by the formation of a wavelike bore. Figures 6; references 10: 9 Russian, 1 Western.

Features of Vertical Temperature and Humidity Distribution in Thin Near-Water Air Layer Under Free Convection Conditions Over Aerated Water

937N0033B Moscow IZVESTIYA AKADEMII NAUK: FIZIKA ATMOSFERY I OKEANA in Russian Vol 28 No 10-11, Oct-Nov 92 pp 1071-1076

[Article by Ye. P. Anisimova, A. A. Speranskaya and O. A. Speranskaya, Moscow State University; UDC 551.465.7]

[Abstract] A large series of experiments was carried out for studying the vertical distribution of temperature and humidity in the thin water-air boundary layer and for determining the heat budget components at the interface between these media under free convection conditions with different temperature drops in the water-air system. The experimental method and apparatus were described in an earlier article by the authors (IZV. RAN: FAO, Vol 28, No 1, pp 83-90, 1992). The experiments were carried out in such a way that the conditions can be considered quasistationary. In the immediate neighborhood of the water surface the measurements of water temperature, air temperature and humidity were made at 0.2-mm intervals, which made possible reliable determination of the gradients of these parameters at the water-air interface. The laboratory data were obtained under conditions when the measurements began 10-15 minutes after cutting off the heating element or filling of the experimental container with hot tap water so that the fluid had become completely calm and transparent. The data demonstrates that when free convection occurs over a heated water surface a mechanism prevails in which heat and moisture are transferred from the water, which is attributable to its aeration, a factor to which no attention has been previously directed. Figures 2; references 13: 9 Russian, 4 Western.

Radiometric Determination of Temperature of Sea Surface With Thermal Film

937N0033C Moscow IZVESTIYA AKADEMII NAUK: FIZIKA ATMOSFERY I OKEANA in Russian Vol 28 No 10-11, Oct-Nov 92 pp 1100-1105

[Article by A. N. Reznik, Applied Physics Institute, Russian Academy of Sciences; UDC 551.465.6]

[Abstract] In the ocean surface layer there is usually a thermal film in which a temperature drop of 0.3-1.5 K is observed in the interval 0.1-0.5 cm. Since outgoing thermal emission of the water medium in the microwave range is formed in a layer of the same thickness there should be an appreciable influence of the thermal film on thermal radio emission. Accordingly, a theory of thermal radio emission of a water medium with a nonuniform subsurface temperature profile (thermal film) was developed which takes into account the reflection of radiation in the surface layer, stratified with respect to permittivity. The influence of variations of the parameters of the thermal film on the radio emission of the ocean surface as a function of wavelength, observation angle and polarization of radiation, was analyzed. It was found that the presence of a thermal film results in an error in radiometric determination of the subfilm temperature in the microwave range of more than 0.5 K. In the narrow spectral range 11-15 cm an accuracy of about 0.5 K can be attained. The possibility of compensating for the reflection of radiation in the film by the screening method was investigated. Figures 4; references 7: 5 Russian, 2 Western.

Experiment With Accumulation of Seismic Signals in Baltic Sea

937N0035B Moscow DOKLADY AKADEMII NAUK RAN in Russian Vol 326 No 4, Oct 92 pp 622-625

[Article by A. A. Ostrovskiy, S. B. Sokolov, B. V. Kholopov, G. A. Semenov and A. A. Burovkin, Oceanology Institute imeni P. P. Shirshov, Russian Academy of Sciences, Moscow; UDC 550.34]

[Abstract] The results of an experiment with accumulation of signals from pneumatic sources (PS) in the Baltic Sea, where the great thickness of the crust limits the possibility of using traditional methods, are presented. Seismic waves were excited by two types of PS with chamber volumes 30 and 120 dm^3. The working pressure was 100-150 atm and the radiation intervals were three and eight minutes. The PS were triggered by pulses from a quartz clock with an error 10^{-8}. Radiations occurred when the ship was anchored and the PS was submerged to the optimal depth. The PS signals were received by bottom seismographs (BS) located at different distances from the ship (from 28 to 158 km) at depths 25-45 m. The frequency range of registry was 4-25 Hz and the dynamic range with registry at two amplification levels was 65 db. Testing of the accumulation method in the Baltic Sea revealed its effectiveness. A signal completely cluttered by noise was successfully discriminated at a distance 113.8 km. New methodological procedures were used for improving the signal-to-noise ratio. A method for automatic phasing of individual paths for PS sources partially cluttered by noise was proposed and tested. In the case of work at distances when the signals are completely cluttered by noise the possibility of effective use of the paired placements of bottom seismographs was demonstrated. Figures 3; references 6: 5 Russian, 1 Western.

Spatial-Temporal Characteristics of Internal Waves at Edge of Arctic Basin Shelf

937N0030A Moscow OKEANOLOGIYA in Russian Vol 32 No 5, Sep-Oct 92 pp 844-850

[Article by S. V. Pisarev, State Oceanographic Institute, Moscow; UDC 551.46]

[Abstract] The results of two experiments for determining the spatial-temporal characteristics of internal waves (IW) under drifting ice at the edge of the Arctic

Basin shelf are presented. The IW records were registered in the spring of 1988 and 1989 in a region with an inertial period 12.2 hours. The instruments were positioned on floes moving at rates 3-13 and 5-18 cm/s in an area with an ice coverage seven-eight-tenths. The length of the measurement period in 1988 was 16 days and in 1989 was 14 days. Like other high-latitude and ice-covered regions of the world ocean, the experimental frequency spectra are lower in level than in the Garrett-Munk model. However, due to the specifics of the conditions near the shelf edge the resulting spectra have one of the highest levels in the Arctic and a slope similar to the model spectrum. The experiments revealed substantial differences between the background part of the IW spectrum in the Arctic Basin and in the middle-latitude ocean. It was ascertained once again that the shelf edge in the Arctic is characterized by a relative increase in IW energy. It was observed for the first time that the width of the band of wave numbers at the edge of the Arctic shelf exceeds the similar picture for the "mean" ocean. A relatively broad band of wave numbers is therefore a characteristic feature of the IW field in the Arctic Basin. Figures 4; references 13: 6 Russian, 7 Western.

Reduction in Limit of Direct Atomic Absorption Detection of Silver, Bismuth, Indium and Thallium in Marine and Fluvial Suspended Matter

[Article by V. N. Oreshkin, Soil Science and Photosynthesis Institute, Russian Academy of Sciences, Pushchino, Moscow Oblast; UDC 551.46.08]

[Abstract] A new specialized electrothermic two-chamber atomizer of the crucible-cell type is proposed for use in the direct atomic absorption (AA) method for determining Ag, Bi, In and Tl in marine, fluvial and eolian suspended matter collected on membrane filters. An annotated diagram is given which serves as a basis for the textual description. In this atomizer the crucible and cell have their own electric contacts and are heated independently of one another, which makes it possible to separate and optimize the process of sample decomposition, to evaporate and atomize the vapors of the individual elements. Due to the suppression of noise and the localization of vapors in the light absorption zone the limits of determination of Ag, Bi, In and Tl in the samples are lowered by a factor of at least 3-10 in comparison with the single-chamber variant proposed earlier by the authors (OKEANOLOGIYA, Vol 20 No 4, pp 736-742, 1980; Vol 25 No 6, pp 1034-1039, 1985). A table gives the limits of direct AA determination of the studied elements in samples of suspended matter. There also is a significant increase in the productivity of analytic work in comparison with extremely labor-intensive analysis methods with filtering of vapor through graphite membranes. Some results of the analysis are given for specific samples. Figures 2; references: 6 Russian.

Deep-Water Multiray Echo Sounder

[Article by K. V. Avilov, S. A. Dremuchev, V. V. Krasnoborodko and V. G. Selivanov, Oceanology Institute imeni P. P. Shirshov, Russian Academy of Sciences, Moscow; UDC 534.6.08:551.463.26]

[Abstract] The described multiray echo sounder is intended for echo sounding of the sea floor for obtaining detailed information on its surface. At depths up to 6000 m the sounder can be used in constructing a map of bottom relief of a definite width while the ship is proceeding on course, in measuring the signal backscattering level for different angles, in detecting and determining the size of objects both in the water layer and at the bottom and in plotting a sea floor map in geographic coordinates. It can be used in the mode of a side-looking sonar, as well as in a narrow-ray echo sounder mode. Such broad capabilities make it possible to use this sounder as a precise tool for a detailed mapping survey of the sea floor, highly precise depth measurements, search for underwater objects and minerals and in the laying of cables. The combination of a high accuracy and speed of the computers used and the high reliability of its analog devices makes this instrument highly efficient in acoustic study of the sea floor, making it possible to obtain on-line results. The sounder consists of three principal parts: transmitter, receiver and computer system for data processing and display. A block diagram is given with 24 components identified; this diagram serves as a basis for a description of structure and functioning of the sounder. An important feature is the use of a multichannel (128 channels) analog-to-digital converter and a digital shaper of rays based on a PC/AT computer. Figure 1; references: 3 Russian.

Correlation Between Internal Sea Waves and Crustal Deformations in Coastal Zone

[Article by A. M. Zapolskiy and U. Kh. Kopvillem (deceased), Pacific Ocean Oceanological Institute, Russian Academy of Sciences; UDC 551.466:550.34]

[Abstract] The results of synchronous measurements of oscillations of the seasonal thermocline and movements of the upper part of the crust in the coastal zone of the Sea of Japan carried out in 1988 are presented. The measurements were made using a laser deformation meter and a system of distributed temperature sensors. A model of the transfer of the energy of internal waves to elastic oscillations of the ground is presented. There is a

definite interrelationship between the deformations of the upper crustal layer and internal waves in the coastal zone. Processes in the LF range are characterized by a greater stationarity and stability in contrast to the HF range, the oscillations in which bear a train and variable character. In this sense it can be said that in the first case the interrelationship is expressed more strongly than in the second case. The relationships between spectral density and laser deformation meter measurements do not reveal a clearly expressed dependence on frequency and fall in the range 10^{-11}-10^{-13}. Joint research on processes in boundary media are extremely informative and make possible a more complete and broader insight on already known effects and an improved understanding of still poorly understood phenomena. Figures 8; references 12: 9 Russian, 3 Western.

Method for Processing Data From Gradient-Distributed Temperature Sensor

[Article by V. V. Fomin, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol; UDC 551.466]

[Abstract] A gradient-distributed temperature sensor (GDTS) is used in measuring the parameters of internal waves (IW) in the thermocline. In order to increase the information yield of in situ experiments for evaluating IW parameters a numerical algorithm is proposed for processing temperature measurements made using such a GDTS. This algorithm is based on the regularization method. The input information is measurements of the mean temperature of the layer, data on temperature at its boundaries, as well as the vertical temperature profile at the initial moment in time. With some limitations this algorithm makes it possible to compute the position of isotherms within the layer occupied by the sensor. Examples of computations are given which illustrate the adequacy of the proposed algorithm. Illustrative computations confirm that this numerical procedure can be used in estimating the amplitudes of internal waves when using a distributed temperature sensor. This favors an increased information yield from experiments without employing additional sensors. An important consideration in the proposed method is the a priori assumption of a monotonic character of the temperature profile in the thermocline layer and the availability of information on the errors in the measured parameters. Figures 3; references: 4 Russian.

Degeneration of Layered Structures in Temperature- and Salinity-Stratified Fluid in Presence of Velocity Shear

[Article by V. I. Nikishov, Hydromechanics Institute, Ukrainian Academy of Sciences, Kiev; UDC 532.529+532.517.4]

[Abstract] The decay of small-scale perturbations in a temperature-salinity stratified shear flow of a fluid is investigated. A fundamental system of equations is derived for determining the predominant influence of viscosity forces (an asymptotic method is used). It is shown that the nature of decay of perturbations of velocity and scalar quantities changes substantially in comparison with the behavior of these quantities in a case without shear. This is attributable to an intensification of diffusion processes (due to a decrease in the thicknesses of the interlayers under the influence of a velocity shear) and also to the appearance of a mechanism of exchange of energy with the external flow. The influence of this exchange is manifested differently in the process of interaction with different perturbations. According to the model of degeneration of turbulence proposed by Gregg, the perturbations of scalar quantities disappear simultaneously with a degeneration of perturbed velocity. When shear is present there are two types of velocity perturbations. The first decay considerably more rapidly than the perturbations of scalar quantities. However, the amplitude of the second (slowly decaying) is considerably less than the amplitude of temperature and salinity perturbations. As a result of the behavior of perturbations in a stratified medium, in the process of degeneration in a fluid there are perturbations of both temperature and salinity; the velocity perturbations are small in comparison with them. The described pattern of development of perturbations corresponds to the model of evolution of turbulence proposed by Gibson, according to which in the final stage perturbations of scalar quantities remain in the stratified fluid, whereas velocity perturbations have already degenerated ("relict turbulence"). References 12: 8 Russian, 4 Western.

Generation of Vertical Fine Structure of Inertial-Gravity Internal Waves in Nonuniform Flow

[Article by A. A. Belobrov, A. A. Slepyshev and V. S. Shamov [deceased], Marine Hydrophysics, Ukrainian Academy of Sciences, Sevastopol; UDC 551.466.81]

[Abstract] Slightly nonlinear packets of internal waves exert an influence on the medium through which they propagate, expressed in the generation of a vertical fine structure of the density and current velocity fields. These deformations have a reversible character and after the passage of the packet the undisturbed profile of the velocity of the mean current and the stratification are restored. Physically the generation of the mean fields is caused by the influence of wave stresses which are non-zero due to the dependence of the envelope on the space-time coordinates. This phenomenon has now been investigated in greater depth. A study was made of generation of the mean fields of density and current velocity with allowance for the Earth's rotation and the

nonuniform mean current. In contrast to an earlier study (A. A. Slepyshev, et al., IZV. AN SSSR: FAO, Vol 25, No 10, pp 1082-1088, 1989), in which a study was made of a narrow-band packet with an envelope dependent on the horizontal coordinate along which the wave is propagated, in this study an analysis is made of the influence of a plane wave on the medium in which propagation occurs, the presence of whose envelope is governed by the horizontal nonuniformity of the mean current velocity. Corrections are found for the vertical distribution of mean density and current velocity, nonoscillating at the time scale of a wave, in a quadratic (relative to wave steepness) approximation. It is shown that the horizontal flow of mass, both of an induced current and Stokes drift in the Boussinesq approximation, integrated for depth, is equal to zero. Figures 4; references 9: 6 Russian, 3 Western.

Synoptic Variability of Acoustic Characteristics of Tropical Atlantic Waters

[Article by N. P. Bulgakov and P. D. Lomakin, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol; UDC 551.463.256]

[Abstract] In the Tropical Atlantic synoptic processes represent one of the most significant factors exerting an influence on the structure of the speed of sound field and the parameters of the underwater sound channel (USC). The relative contribution of this type of variability to the total time dispersion of the speed of sound at a scale one month is 7-71 percent. The synoptic variations penetrate deeper than 800 m, exerting an influence on the characteristics of the axis of the USC, which in this region is at a depth 700-1000 m. In the layer 0-800 m the most probable synoptic deviations from the mean monthly norm are 0.3-2 m x s^{-1}. Temporal synoptic variations of the speed of sound in the active layer of the ocean cause deformation of the underwater sound channel. In regions of abyssal basins the channel may be narrowed and widened with a most probable amplitude of about 100 m and a maximum amplitude up to 800 m. The modal temporal synoptic speed of sound deviations on the underwater sound channel axis from the mean monthly norm is about 0.3 x s^{-1}. The fraction of synoptic oscillations in the spatial total speed of sound dispersion varies in the course of the year from 22 to 14 percent. Their relative contribution decreases during the warm half-year and increases in the cold half-year. The spatial synoptic speed of sound dispersion in the water layer 0-1000 m exceeds the temporal synoptic dispersion by a factor of 2-4. Figures 2; references 8: 3 Russian, 5 Western.

Seasonal Wind Shearing Stress Fields Over Black Sea

[Article by Yu. N. Golubev, A. Yu. Kuftarkov and Z. A. Golubeva, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol; Sevastopol Division, State Oceanographic Institute; UDC 551.465(26)]

[Abstract] Data on the distribution of atmospheric pressure over the Black Sea for a 10-year period (1970-1980—total of about 30 000 charts) were used in computing wind stress fields with a spatial interval 40 x 60' and in investigating their spatial-temporal variability. The first stage in computing the wind was a classification of synoptic processes over the Black Sea. The sea was arbitrarily divided into five regions: northwestern, southwestern, central, northeastern and southeastern. The type of wind in each of them was determined by the wind direction and the subtype using the wind speed intervals 0-5, 5-10 and 10-15 m/s. The total number of synoptic situations defined as a result of an analysis of archives of synoptic charts was 46. For all the types of wind situations their frequency of recurrence was computed for each of the months. The nature of the spatial distribution of wind stress over the Black Sea for each season of the year is described. It is shown that the maximum wind stresses during all seasons of the year are observed in regions to the southwest of the Crimea and to the south of the Taman Peninsula. The wind stresses computed on the basis of the measured wind and determined from the atmospheric pressure field are compared. Figures 3; references 23: 19 Russian, 4 Western.

Influence of Rotation of Intrathermocline Lenses on Sound Propagation in Ocean

[Article by Yu. P. Lysanov and V. Ye. Ostashev, Acoustics Institute imeni N. N. Andreyev, Russian Academy of Sciences; UDC 551.463]

[Abstract] The influence of intrathermocline lenses on the phase of an acoustic wave and its propagation is examined. A method is proposed which makes it possible to detect these lenses and to determine some of their parameters (such as diameter, current velocity and direction of rotation). A possible experiment is described in which two ships move along parallel courses with a distance between them exceeding the maximum diameter of the lens. At certain points the ships lie at drift, lower sending-receiving systems to the thermocline depth, radiate acoustic waves in counter directions and register the dependence of the phase difference or the time of signal arrival on the distance traversed by the ships ("phase tomography on reciprocal paths"). Intrathermocline lenses, in contrast to mesoscale eddies, are situated near the axis of the underwater sound channel.

It therefore can be expected that if the sound source also is situated near the axis of the underwater sound channel there will be rays intersecting an intrathermocline lens at small glancing angles. It is evident that rotation of an intrathermocline lens results in a maximum additional phase difference precisely along such rays and that this phase difference in order of magnitude can be determined using the formulas derived in this article. Figures 2; references 11: 7 Russian, 4 Western.

Characteristics of Radiation of Acoustic Waves in Turbulent Medium by Fast Moving Sources

[Article by V. I. Pavlov and O. A. Kharin, Moscow State University imeni M. V. Lomonosov; UDC 534.222]

[Abstract] The radiation of acoustic waves by fast moving sources in a turbulent medium and the possibility of generation of Cerenkov radiation under these conditions are examined. It is shown that with sufficiently well-developed turbulence the Cerenkov radiation channel may be closed. In the study a number of approximations were adopted. Among these were the following: turbulence was considered to be stipulated (it was assumed that the propagation of acoustic waves occurs against the background of given turbulent velocity pulsations); the radiation exerts no influence on the structure of well-developed turbulence; the field of velocities of turbulent movements satisfies the incompressibility condition; the characteristic time scale of pulsations is much greater than the time scale of the radiated waves. An equation is derived for the coherent field component. It was found that the critical Mach number at which the channel is opened for Cerenkov radiation is dependent on the level of turbulent pulsations. It was possible to obtain a precise analytic solution for the selected model of well-developed turbulence. A model correlation tensor was used which is close to the Kolmogorov tensor in the inertial turbulence interval. The condition of suppression of Cerenkov radiation found in this study is approximate because it is based on the mentioned simplifying assumptions. Figures 3; references 12: 11 Russian, 1 Western.

Influence of Baroclinicity on Sound-Scattering Properties of Fine Structure of Hydrophysical Fields in Ocean

[Article by V. P. Shevtsov and A. S. Salomatin, Pacific Ocean Oceanological Institute, Far Eastern Department, Russian Academy of Sciences, Vladivostok; UDC 551.463;551.46.08]

[Abstract] During August-September 1987 Soviet research ships investigated the North Subarctic Front in the Pacific Ocean where observations were made on meridional profiles with stations occupied each 20 miles. Temperature and conductivity (salinity) measurements were made with continuous vertical sounding to a depth 1500 m with particular attention to research on sound scattering in the fine structure of hydrophysical fields. Remote measurements of acoustic backscattering at a frequency 12 kHz and soundings of the speed of sound to the 500-m horizon also were made. The collected data were used in defining characteristic regions with an extent of ten miles with a well-developed system of thin sound-scattering layers associated with sound scattering on the fine structure of hydrophysical fields. It was found that the sound-scattering properties of the hydrophysical inhomogeneities formed in the course of intrusive stratification are intensified with an increase in the isopycnic gradient of hydrophysical characteristics and decrease sharply with an increase in the degree of medium baroclinicity. Acoustic data in general confirm the hypothesis expressed earlier that the mechanism of suppression of intrusion processes in a baroclinic medium is realized through turbulence generated by means of shear instability. Figures 5; references: 3 Russian.

Forecasting Ocean Temperature Using Mean Data for Preceding Time Period

[Article by V. V. Shelukhin, Hydrodynamics Institute imeni M. A. Lavrentyev, Siberian Department, Russian Academy of Sciences, Novosibirsk; UDC 517.958]

[Abstract] A determination of the principal factors operative against the background of seasonal and diurnal fluctuations is the principal objective of long-range forecasting of ocean temperature. One of the possible methods for filtering random variations is the time averaging of data obtained during some observation period. In practical work forecasting using such data is usually based on solution of the Cauchy problem in which these averaged data are accepted as the initial values of the predicted functions. An alternative approach is now proposed in which the mentioned data are interpreted as information on the mean values of the sought-for functions for the observation period. Using the equations of oceanic dynamics as a point of departure, an algorithm is written for solution of the problem with a detailed presentation of the pertinent lemmas and theorems. Some methodology applied in the solution is based on innovative mathematical techniques published earlier by the author which are invoked here in solving the forecasting problem: "Some Applications of Functional Analysis in Problems of Mathematical Physics" and "Boundary Value Problems for Equations With Partial Derivatives." References: 8 Russian.

Detailed Mapping of Abyssal Bottom Sediments Using Towed Geophysical Instruments

[Article by A. E. Vishnyakov, V. D. Kaminskiy, Ye. D. Lisitsyn, A. L. Piskarev, N. V. Savchenko, G. A. Cherkashev and M. Yu. Yanevich, All-Union Scientific Research Institute of Geology and Mineral Resources of World Ocean, St. Petersburg; UDC 551.352: 550.83(265)]

[Abstract] Bottom sediments were studied in a sector of the Northeastern Basin of the Pacific Ocean on the eighth cruise of the Geology Fersman research ship in 1990 using an ensemble of geophysical instruments, a towed system devised for studying the physical properties, composition and structure of the upper part of the section of bottom formations at abyssal depths. The test range was about 100 km^2 in area; the floor was a hilly plain with a depth range 4970 to 5310 m and with steep (up to 10°) slopes of narrow grabenlike depressions. All morphostructural elements were drawn out in a NNW direction. The collected materials were used in constructing sections and maps of bottom formations. A schematic diagram of the lithophysical types of bottom sediments is given; another figure illustrates the petrophysical characteristics of typical cores of bottom sediments. Ten types of geoelectric sections were discriminated using petrophysical data. More than 90 percent of the studied sector is represented by two types of section; the other eight types of sections are observed in narrow local zones. The high and clearly differentiated levels of natural radioactivity of bottom sediments made this parameter extremely important in map compilation. Natural gamma activity was determined. In a small sector in the pelagic zone of the ocean there was a considerable variability in the composition and properties of the sediments and mean rates of their accumulation in the Pleistocene. Figures 2.

Geoacoustic Model of Bottom Deposits of Baltic and Barents Seas

[Article by A. V. Ilin and I. Shurko, Acoustics Institute imeni N. N. Andreyev, Moscow; UDC 551.35]

[Abstract] A unified geoacoustic model of the upper layer of bottom deposits in the Baltic and Barents Seas was constructed on the basis of extensive observational data. Maps of granulometric composition were among the sources used in constructing the model. Four principal types of sediments were discriminated in both seas: pelitic oozes, silty oozes, sands and gravelly-pebbly deposits. In the Baltic Sea these types of sediments are distributed in conformity to the nature of bottom relief. The pelitic oozes occupy deep basins in the central part of the sea. The silty oozes are distributed on bottom rises and on the coastal slope. Sands and gravelly-pebbly material is found along the coastal parts of the slope. Silty sediments predominate in the Barents Sea. Pelitic oozes occupy primarily the northwestern abyssal part of the basin. Sand and gravel are found in the coastal regions and on the tops of underwater rises. (Maps of granulometric types of bottom deposits for both seas accompany the text.) Comparison of geoacoustic models of the two seas reveals that they are significantly different. In the Barents Sea most of the bottom is covered by silty oozes with a mean density 1.5-1.7 cm^3 and a speed of sound 1.5-1.6 km/s. A complex pattern of different types of sediments is characteristic for the inner Baltic Sea. In contrast to the Barents Sea the total areas occupied by each type of sediments are equivalent. The Baltic and Barents Seas were filled primarily with terrigenous sediments. The proposed geoacoustic model of bottom deposits possibly also is applicable to other shallow regions of the ocean where terrigenous sedimentation predominates. Figure 1; references: 6 Russian.

Weather Control: Scientific Breakthrough or Mystification?

937N0031A Moscow NEZAVISIMAYA GAZETA in Russian 18 Nov 92 p 6

[Article by Nikolay Ulyanov]

[Text] A mysterious whisper about secret development work on a military superpowerful weapon for climatic warfare, and, on the other hand, the recent appearance of clever fellows who have announced that they have developed "weather control instruments"—all this is a consequence of the shortage of information on the real attainments of national and world science in the field of artificial modification of hydrometerological processes. Just how far have experiments with exerting an influence on weather gone?

"Unintentionally man has acted upon the weather to all intents and purposes from the moment of his appearance, but as a result of the small number of people on the globe this was scarcely noticed," states Professor Yevgeniy Borisenkov, director of the Main Geophysical Observatory imeni A. I. Voyeykov (St. Petersburg). "A qualitative jump occurred in the time interval between 1820 and our day, during which world population began to increase sharply: from one to five billion people. At the same time there was an increased impact on the environment. For example, as a result of fuel combustion at industrial centers the heat loads in such cities as Moscow and St. Petersburg have attained intensities 40-50 W per square meter. As a result, so-called "heat islands" with a temperature 3-4 degrees Celsius higher than the mean statistical level. This phenomenon reduces solar radiation and changes the entire wind regime. By annually burning (scaled to carbon) more than 5.5 billion tons of fossil fuel and in addition, about 2-3 billion tons of wood, man facilitates the annual formation in the atmosphere of more than 20 billion tons of carbon dioxide, giving rise to a greenhouse effect. If one also recalls the change in the chemical composition of the atmosphere, one invariably arrives at the conclusion that the unpremeditated impact, despite its inconspicuousness and seeming naturalness, is entirely perceptible.

At the press center of the Russian Committee for Hydrometeorology your NEZAVISIMAYA GAZETA correspondent was told about intentional modification of some atmospheric processes.

For example, specialists of the Russian Committee for Hydrometeorology state that special militarized subdivisions have attained an efficiency in hail prevention work at the 80 percent level.

Artificial regulation of precipitation in Russia is carried out most frequently in Moscow, St. Petersburg and Stavropol Kray by specially outfitted aircraft laboratories (Il-18, An-12, An-30, and others) using solid carbon dioxide, silver iodide and coarsely dispersed loose matter as reagents. In Moscow airports are cleared of

fogs by specialized subdivisions of the Russian Committee for Hydrometeorology at Sheremetyevo, Domodedovo and Vnukovo using surface nitrogen generators and aircraft laboratories equipped for dumping solid carbon dioxide.

The man-induced weather changes described above are possible when two conditions prevail. The first is use of the moment of an unstable state of the process; the second is relatively small spatial and temporal modification scales. Naturally, research in this direction is continuing, but it is of a rather moderate character: ideas like "stopping tsunamis," "reversing the wind" or "augmenting solar brightness" are not investigated at all. Nevertheless, more and more frequently reports are heard about successful experiments for large-scale weather control, undocumented, but nonetheless sensational. For example, not so long ago three enterprising Muskovites reported to mankind that they had constructed an instrument which was capable, simply by throwing a switch, of exerting an influence on cyclones and anticyclones. This evoked a smile among professionals. The fact is that for the modification of large-scale processes (cyclones, anticyclones, and others) the energy expenditures would have to be not less than 3-5 W/square meter under the condition that the process is in an unstable state. For an average cyclone with a radius 2000-3000 km the energy expenditures capable of exerting an influence on the dynamics of such formations are about 50-200 billion kW. This is comparable to all the annual energy expenditures of the Earth's entire population.

Optical Characteristics of Cloud Particles of Complex Composition

937N0035A Moscow DOKLADY AKADEMII NAUK RAN in Russian Vol 326 No 4, Oct 92 pp 617-621

[Article by L. S. Ivlev, K. Ya. Kondratyev, academician, and O. M. Korostina, Ecological Safety Center, St. Petersburg; UDC 551.521]

[Abstract] Numerical simulation of the optical characteristics of cloud particles was carried out to collect information important for developing possible methods for optical identification of the microstructural state of cloud systems. An effort was made to determine the distribution of absorbing matter (such as soot and iron oxides) in droplets. A number of assumptions made by various authors was checked using two models (I and II), consisting of several modes (fractions), each of which is described in detail. Five modes are examined; for example, mode 1 is condensation nuclei, mode 2 is very old particles, mode 3 is chemical and photochemical reactions in a polluted atmosphere. The angular characteristics of scattering examined in the study make it possible to some degree to draw conclusions on the type of particle. The polarization characteristics of scattering are given particular attention. With small scattering angles ($<60°$) intensity for the most part is dependent on the diffraction parameter, but with an increase in the

scattering angle the dependence on the value of the complex refractive angle and internal structure becomes substantial. An asymmetry of scattering arises, the intensity of scattering acquires a more complex form and additional scattering minima appear in the region of large scattering angles. The first minimum for the considered models appears in the range of refraction angles 120-130°; the second minimum arises in the dependence on the refractive index in the range of angles 160-170°. Figures 2; references: 10 Russian.

Some Features of Formation of Ocean Floor Acoustic Image Using Multielement Antenna Arrays]

[Article by A. V. Bunchuk, V. I. Volovov and A. I. Govorov, Acoustics Institute imeni N. N. Andreyev, Russian Academy of Sciences; UDC 534.26]

[Abstract] A method has recently been developed for investigating the ocean floor, especially for remote search for ferromanganese nodules, using plane spatially separated receiving antennas. In earlier studies, giving the first experimental samples of acoustic images of the deep ocean floor, the method employed was use of a two-dimensional Fourier transform and the square of its modulus. The registry of these images and the images themselves were inadequately analyzed in the earlier publications. Accordingly, the problems involved in obtaining acoustic images of the ocean floor using multielement plane receiving antenna arrays are examined in greater detail. The interrelationship between two-dimensional Fourier transforms and the formation of the antenna directional diagram is considered. The limits of applicability of the method are determined and the physical sense of the resulting acoustic images is explained. The factors exerting an influence on the reliability of the registered images, the reasons for their appearance and measures for their elimination are discussed. Examples of acoustic images of the ocean floor obtained in situ during both one-time soundings and with integration of the results of subsequent sounding of more extensive seafloor sectors are given. Figures 2; references: 11 Russian.

Influence of Scattering on Uneven Bottom on Transformation of Mode Spectrum of Low-Frequency Acoustic Wave in Near-Bottom Oceanic Waveguides

[Article by N. S. Gorskaya, M. A. Rayevskiy and I. M. Starobinets, Applied Physics Institute, Russian Academy of Sciences; UDC 534.28]

[Abstract] A study was made of mode spectrum transformation of a low-frequency acoustic wave and sound attenuation in near-bottom waveguides with a rough bed. A diffusive character of multiple sound scattering on a rough bottom is assumed. Analytic formulas (based on the WKB approximation for acoustic modes) are derived for the diffusion coefficient and the attenuation decrement of a mode. These expressions are true for arbitrary ocean near-bottom channels. It is shown that the dependence of the mode spectrum on frequency is determined only by the dependence of the excited mode coefficients on frequency. In this case a frequency dependence is shown to exist at great distances where all modes have the same exponential damping. The computations reveal that scattering results in a strong mode spectrum change already at a short distance. In this case the mode spectrum form may be essentially dependent on the relationship between scattering and damping effects. The computations also confirmed that sound energy attenuation in a channel increases greatly due to scattering. The influence of the relationship between scattering and damping effects on the long-range evolution of the mode spectrum is described. Figures 2; references 11: 7 Russian, 4 Western.

Influence of Air Content of Water on Appearance of Cavitation Noise of Tip Vortex

[Article by A. V. Chalov, Central Scientific Research Institute imeni A. N. Krylov; UDC 534.2:532.528]

[Abstract] The dependence of the critical cavitation number corresponding to cavitation noise inception of a tip vortex on the concentration and spectrum of cavitation nuclei is considered. It is shown that with an increase in the nuclei concentration the critical cavitation number tends asymptotically to a constant value corresponding to a zero tensile stress value which is characteristic for the specific conditions of a flow around a body. The critical cavitation number decreases gradually when the nuclei concentration decreases. This fact corresponds to the growth of tensile stresses in a flow. Physically this is attributable to a high probability of large low-strength nuclei entering into the tensile stress region, which is the vortex core. On the other hand, the stability of high-strength small nuclei plays the main role in vortex formation when there is a low concentration of nuclei. On the basis of the results it is concluded that a scale effect is observed which is attributable to different contents of cavitation nuclei in the water with the registry of the inception moment of tip vortex cavitation noise. In order to obtain correct results it is necessary to introduce corrections into measurements of the cavitation critical number controlling the spectrum of nuclei. Figures 2; references: 8 Russian.

Refraction Sounding, Atmospheric Fine Structure

937N0042A Moscow PRIRODA in Russian No 5,
May 92 pp 12-15

[Article by G. S. Golitsyn, academician, director, Atmospheric Physics Institute, Russian Academy of Sciences, member of editorial council of journal PRIRODA]

[Text] Fifteen years ago cosmonaut G. M. Grechko visited our institute and showed some interesting photographs which he took from aboard the Salyut orbital station. Prior to this it was known that because of refraction (the curvature of light rays in the atmosphere due to a change in the refractive index with altitude) the setting sun looks like an oval and at the horizon its disk is greatly flattened. This effect was theoretically computed and has been repeatedly observed by many cosmonauts, but Grechko noted a surprising fact to which other observers had not drawn attention: on both sides the disk has almost symmetric "notches."

Since our institute has long been concerned with problems relating to the propagation of different waves (light, radio, acoustic) this phenomenon was not immediately explicable: at altitudes where light rays are propagated during the observation of the sunset by cosmonauts there must be atmospheric layers of different density, causing appearance of the "notches" on the photographs. Their symmetry shows that these layers are quite extended. The altitude at which they are observed is from 10 to 40 km; this is that part of the stratosphere where the temperature increases due to an increase in ozone content.

The figure of the disk can be used in computing the dependence of the refraction angle on altitude of the ray perigee and then the inverse problem can be solved: retrieving the vertical profile of atmospheric density. Next, using the equation of state and the hydrostatics approximation relating changes in pressure and density with altitude it is possible to compute the temperature and pressure distribution.

The results obtained by such a method coincide fairly well with radiosonde data (radiosondes usually measure temperature to altitudes 15-20 km). Accordingly, the idea arose of using the refraction effect for organizing a global network for measuring atmospheric meteorological parameters. Later computations were made which revealed that if the navigation satellites developed at that time for altitudes about 22,000 km (now there already is the American Navstar system consisting of approximately 20 satellites and a system of slightly smaller number in our country) were supplemented by at least four in lower orbits (about 1,000 km), by processing the radio signals of one satellite, received by another, it would be possible to obtain atmospheric profiles at many points and with such a coverage which would be comparable to that of the aerological sounding network on the continents. Such a network is virtually absent over the oceans (where radiosondes are launched only from island stations). This would greatly increase the volume of data necessary for weather predictions and would enhance their quality.

During the 1990's the United States launched hundreds of commercial satellites for communication purposes. Their use for the registry of atmospheric meteorological parameters in combination with navigation satellites will make it possible to organize a system in which the "density" of data sampling will be many times greater than in the aerological network of altitudes from 1 to 35 km. Then the problem of collecting initial data for prediction purposes can be considered virtually solved. Computers of far greater capabilities than now should appear by the end of the decade and therefore it is possible to count on a sharp increase in weather prediction quality. In October 1991 an agreement was reached with American scientists on coordinated actions on the theoretical development of such a system and the implementation of the necessary methodological research.

However, we will return to the stratospheric layers. The processing of observational data shows that their thickness is hundreds of meters (up to a kilometer). The density profile has a stepped form, that is, there are layers with a thickness of several hundreds of meters in which the density and temperature change little, and far thinner layers where the rate of change of these parameters with altitude is substantially greater. The temperature in them may vary by about a degree and therefore in standard measurements from radiosondes, which are carried out at fixed time and altitude intervals, but with a measurement error due to heating of the sensor in the probes, also of about 1 degree, these stepped structures in the temperature and density field usually simply have not been noted. Precise measurements made during the first half of the 1980's at Boulder, Colorado, in the United States at 40°N, under stable stratification conditions when the temperature changes little with altitude, revealed the presence of such a stepped structure in the troposphere as well. (However, working meteorologists already long ago knew of the existence of multiple inversions in the troposphere, that is, those zones where the temperature changes sharply with altitude and through which it is difficult for impurities to penetrate from below.)

Oceanologists were the first to draw attention to a stepped structure in the density field. The upper (approximately 50-m) oceanic layer is rather well mixed (it also is called the upper mixed or upper quasi- homogeneous layer). Here both temperature and density change little with depth. The so-called main thermocline, the layer where the temperature decreases sharply with depth (in the equatorial latitudes from 25°C at the surface to 4°C at greater depths), is located at greater depths. Twenty years ago, using precise instruments, oceanologists discovered that the temperature and density profiles in it have a stepped structure. The distance between the steps is 20-30 m, the density and temperature in these intervals change little and there are sharp jumps in these parameters in a distance of a half-meter or less.
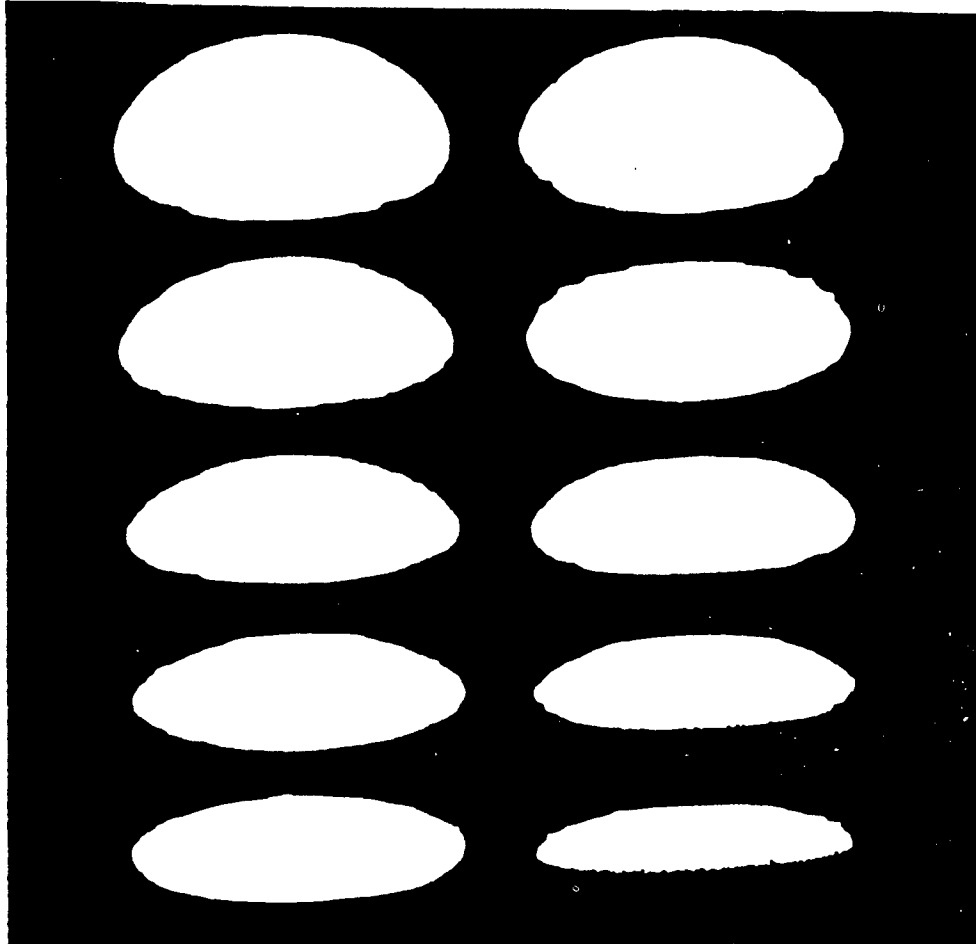
Figure 1. Successive Photographs of Sun During Its Setting Below the Horizon Taken by G. M. Grechko From Soyuz Spacecraft

A flattening of the solar disk due to refraction and an intensification of this effect with approach of the sun to the horizon are clearly expressed. Some photographs clearly show symmetric notches on both sides of the disk: a reflection of a layered structure of the atmosphere.
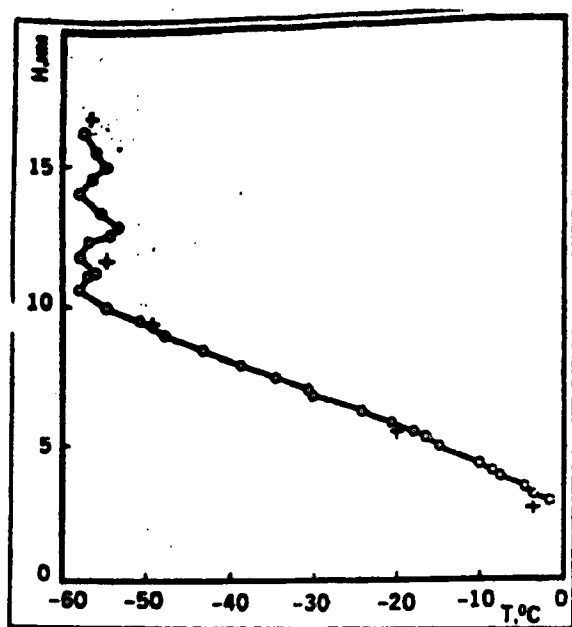
Figure 2. Profile of Temperature T Retrieved From Refraction Measurements at Different Altitudes

The "+" symbols indicate aerological sounding data.

During the last decade, on a number of flights in manned spacecraft,under a program drawn up at our institute, in addition to observations of the solar and lunar disks, measurements were made of the brightness of point sources, of such stars, for example, as Arcturus, Vega and Deneb. The strength of the signal received from them fluctuates greatly at the moment when they are near the horizon. The light flux in fractions of a second may change by many times, which also gives evidence of structural inhomogeneity of the layers through which the flux passes. When the star sets beneath the horizon directly along the vertical the fluctuations are noted very briefly (the time interval can be spatially scaled), but if almost tangentially, with a time (and space) scale tens and hundreds of times greater. This confirms that the inhomogeneities have the structure of the horizontal layers. The spatial separation of these layers also agrees well with data computed on the basis of the figure of the solar and lunar disks. All this is the manifestation of the very same effect: a layered structure of the atmosphere.

Research of such a type is being carried out at our institute in the Section on Atmospheric Wave Propagation, which is headed by A. S. Gurvich, and in the Radio Acoustics Laboratory, where the atmospheric transmission of acoustic signals has long been studied.

In general, the acoustic field in the atmosphere is very interesting and reflects many processes transpiring in it, especially in the LF part of the spectrum, that is, in the infrasound range (frequency of oscillations below 20 Hz). These oscillations with a period measured in seconds or even tens of seconds, generate storms and there are sharp temperature restructurings in the atmosphere.

Now the institute has a network of points for the registry of LF pressure oscillations at Murmansk, on Kamchatka and near Zvenigorod. These stations pick up signals of storms in the Atlantic and other remote places. Work has been carried on for approximately 10 years under the special "Massa" program whose purpose is study of the properties of the upper atmosphere, as well as in an attempt to determine whether or not there are earthquake precursors manifested in the atmosphere.

In addition to natural sources of excitation of infrasound in the atmosphere, studies also have been made of artificial sources (from explosions with a power up to 1 ton TNT equivalent). In many cases these were not special explosions for scientific purposes: studies were made of industrial explosions set off, for example, for the excavation of basins and canals. Our instruments make it possible to register atmospheric pressure disturbances from explosions at a distance up to 1,000 kilometers. In addition to a direct acoustic signal traveling along the surface there are signals propagating through higher layers of the atmosphere, stratosphere and lower layers of the thermosphere, that is, to altitudes of about 100 km. This research revealed that the received signals (especially at distances of hundreds of kilometers) have a complex structure and consist of series of individual pulses. The interpretation of these results is such that the acoustic waves passing, let us assume, through the stratosphere, are reflected from some layers. These layers are layers of increased temperature gradients (which is sometimes accompanied by changes in wind direction and force) and also are distant from one another by approximately a half-kilometer (up to a kilometer).

So that all three types of observations confirm the existence of a fine layered structure of the atmosphere.

During the last three years we acquired the possibility of using very interesting sources of explosions. As is well known, in accordance with a Soviet-American agreement our country must destroy many medium-range SS-20 missiles. They are blown up using rather powerful charges, the signals form which we could register. Sometimes the explosions were in series—over the course of several days—and these signals revealed that a layered structure is traced stably throughout the series. Such disarmament has brought additional advantage to science.

It can be seen that a fine structure is characteristic for the atmosphere and ocean and also is easily created in the laboratory in stably stratified media in which density decreases with altitude. Most likely this is a universal natural phenomenon. The presence of sharp boundaries makes difficult exchange between the layers. This year rather weak explosions were set off at altitudes of about 140 km. The signals from them show that this structure also exists at such altitudes.

Thus, the use of the refraction phenomenon makes possible successful research on the fine structure of the atmosphere and organisation of a global system of observations of its state.

Estimate of Spatial Distribution of Animals as Function of Environmental Parameters on Basis of Data From Aerospace and Surface Observations

[Article by G. I. Belchanskiy, G. M. Aleshchenko, Ye. N. Bukvareva and L. V. Fedorov, Institute of Evolutionary Morphology and Animal Ecology imeni A. N. Severtsov, Russian Academy of Sciences, Moscow; UDC 528.7:681.3:581.55:629.78]

[Abstract] A possible approach is proposed to clarification of the pattern of spatial distribution of animals as a function of the territorial distribution of habitat parameters on the basis of multisided processing of aerospace and surface measurements and the results of aerospace tracking with the use of radio transmitters for a monitorable sample of animals. The formulated problems and the programs developed for their solution make it possible to use data from sample counts and the known distributions of habitat parameters in making an analysis of the spatial distribution of animals needed for a more precise estimate of their density and population, the nature of use of the territory and migration routes, as well as for evaluating the quality of biotopes and in making ecological expert evaluations of economic decisions. An algorithm is given for estimating the distribution of the relative density of animals. A special set of programs was prepared for the principal procedures involved in processing of the primary data. A block diagram of the dialogue interface is given, accompanied by a rather detailed description of the principal subsystems. Figures 5; references: 2 Russian.

Monitoring of Acid Fallout Loads

[Article by V. N. Vasilenko, I. M. Nazarov and Sh. D. Fridman, Institute of Global Climate and Ecology, Russian Committee for Hydrometeorology and Environmental Monitoring, Russian Academy of Sciences; UDC 551.506:[504.37+546.226]

[Abstract] New approaches are proposed for the use of data from the monitoring of acid fallout loads in programs for improving the quality of the environment and ensuring the preservation of ecosystems. A method is proposed for determining the ecological capacity of natural ecosystems, as well as a method for taking into account the neutralization of strong acids in fallout (many studies are flawed by the failure to take the latter factor into account, although the neutralized portion exerts no harmful effect). The ecological capacity for the fallout of sulfates, which is compared with fallout from local sources, was determined in the example of the most vulnerable natural ecosystem of the Arctic region of Russia: the Kola Peninsula and northern Karelia. This area is distant from the main industrial regions of Russia and the Ukraine but is open to the influence of transport of pollutants from adjacent European countries and suffers pollution from local enterprises, especially mining. Hard data are given on the loads from sulfur and other compounds, revealing considerable anthropogenic stress in these areas. It is suggested that the ecological capacity approach is useful in defining ecological disaster zones on the basis of quantitative estimates. References: 7 Russian, 2 Western.

Washout of Pollutants From Arctic Atmosphere

[Article by L. P. Burova, Arctic and Antarctic Scientific Research Institute; UDC 551.510.42:551.57(98)]

[Abstract] Arctic data obtained using an empirical model are given on the total atmospheric moisture content in the layer from the surface to 500 gPa and precipitation during the period 1959-1985 for the region situated to the north of 65°N. The work provided information on: the principal features of moisture exchange, number of cycles and duration of one water vapor renewal in the Arctic during different seasons. In January and April there is a maximum spatial nonuniformity in which the number of cycles varies from 15 to three with a lifetime of one cycle two-10 days. Favorable conditions for moisture exchange are observed in a region of active cyclonic activity with a frequent recurrence of precipitation. In summer, in July, and in autumn, in September, in the north polar region there are quite uniform conditions for a reduction in the number of moisture renewal cycles to one-three with a duration of one cycle from 30 to 10 days. The most unfavorable region, in which stagnant situations predominate, is the eastern part of the Arctic Basin and adjacent seas because there, with a stable stratification, a minimum quantity of precipitation falls. However, for an extensive territory of the Arctic the intensity of summer precipitation is three times greater than in winter, which favors the fallout of pollutants with it. The fact that the minimum content of tropospheric aerosol is observed during the summer months warrants attention. Figures 2; references 10: 8 Russian, 2 Western.

Use of Climatic Data for Optimizing Multiyear Agronomic and Ecological Observations and Experiments

[Article by O. D. Sirotenko and S. Ye. Varcheva; All-Russian Scientific Research Institute of Agricultural Meteorology; UDC (551.582.2+551.506):631.5]

[Abstract] Climate determines the status and productivity of natural and agricultural ecosystems. Since the Earth is expected to experience unprecedented climatic changes in the coming decades it is essential to have effective methodologies for predicting the reactions of

ecological systems to these changes and efficient agriculture is impossible without continuous field experimentation ensuring adaptation of progressive technology to environmental conditions undergoing substantial changes. The basic thrust of this study is the representation of climate as a generator of conditions for multiyear ecological and agricultural experiments. The modern theory of planning of an experiment is invoked as the mathematical tool for optimizing ecological monitoring. A considerable temporal variability of the quality of plans generated by climate is evident. It is shown that the proposed approach makes it possible to evaluate the effectiveness of current multiyear experiments and to identify the most informative groups of years and individual years. The concept of D-optimality used in the study can serve as a basis for optimizing spatial-temporal observation networks such as aerometeorological networks. Figures 3; references: 5 Russian.

Annual Variation of Tropospheric Ozone and Evaluation of Tropospheric-Stratospheric Exchange in Arctic and Antarctica Based on Ozone Sounding Data

[Article by A. N. Gruzdev and S. A. Sitnov, Atmospheric Physics Institute, Russian Academy of Sciences; UDC 551.510.4]

[Abstract] Data from ozone soundings at Resolute station in the Arctic for a 15-year period and Amundsen-Scott station in Antarctica for a seven-year period were used in an analysis of the intraannual variability of tropospheric ozone in the two polar zones. The ozone content in the Antarctic troposphere during the entire year is lower than in the Arctic region. The phase of the annual variation of O_3 over Resolute gradually changes (increases) with transition from the stratosphere to the troposphere. In contrast, the phase of the annual harmonic O_3 over the south pole exhibits a discontinuity in the neighborhood of the tropopause. The stratospheric-tropospheric relationships above both stations are manifested most clearly during winter and early spring. Over Arctic stations they are reflected in the evolution of ozone in the lower troposphere. Over the south pole the influence of stratospheric-tropospheric relationships is limited to the levels of the upper troposphere. In winter over the south pole there is no correlation between ozone content and tropopause altitude, whereas in the remaining seasons, as in all seasons in the Arctic, in the vertical distribution of the correlation coefficients there are high negative values with maxima in the neighborhood of the tropopause. Figures 5; references 19: 4 Russian, 15 Western.

Changes in Ionic, Aerosol and Gas Composition of Air Medium With Its Radioactive Pollution

[Article by V. V. Smirnov, Experimental Meteorology Institute; UDC 551.510.7]

[Abstract] It was experimentally demonstrated that high levels of ionizing radiations under normal atmospheric conditions are not only an additional source of light atmospheric ions and the cause of increased air conductivity, but also a stimulus for formation of heavy fractions of aeroions, individual admixture gases (O_3, NO_x, N, O, HNO_3 and others), as well as finely dispersed radiolytic aerosols. In ordinary air the latter are predominantly aqueous solutions of nitric acid. In polluted ionized air there may be generation of the production of gaseous and aerosol products on the basis of nitric, sulfuric, chloric and other acids, as well as other substances whose molecules have significant dipole moments or a high affinity to an electron or proton. The chemical composition and condensational activity of both background aerosol particles and those being formed, which may differ considerably from the composition of the background particles, are analyzed. The observed deformations of air components in the case of radioactive contamination of the soil, especially if they are of a large-scale character, must be taken into account in models of the consequences of nuclear cataclysms such as accidents at nuclear power plants or a nuclear war. Figures 3; references 9: 8 Russian, 1 Western.

Effective Diffusion, Localization and Predictability of Dynamics of Lagrangian Particles of Admixture in Eddy Fields Over Orographic Features

[Article by S. G. Chefranov, Atmospheric Physics Institute, Russian Academy of Sciences; UDC 551.515:551.510.42]

[Abstract] Explicit expressions are derived for the effective diffusion coefficient D_{eff} in eddy fields over an orographically nonuniform underlying surface (for example, with isolated peaks or extended scarps). The possibility of the blocking of particles of an impurity is demonstrated when their Lagrangian trajectories on the average do not diverge but are localized when $D_{eff} < 0$ during finite time intervals. In all the considered examples the dispersion level (in the absence of molecular diffusion) for any directions and with any t always remains finite with finite and nontrivial values of the parameters of the impurity transport problem. This indicates a relatively nontrivial role of molecular diffusion when investigating the mixing of an impurity in such eddy fields over sufficiently long time intervals. In

this case it is important to take into account the discovered anisotropy of diffusion of impurities over an orographic prominence along the x and y axes. With these factors taken into account, the finite character of the dispersion of the distribution of the field of concentration of an impurity makes possible a good prediction of its structure as a whole because the corresponding jboundaries of the region of localization experience only periodic and finite variations with an increase in t. References 18: 13 Russian, 5 Western.

Impending Changes in Regional Climate

937N0015A Moscow IZVESTIYA AKADEMII NAUK: SERIYA GEOGRAFICHESKAYA in Russian No 4, Jul-Aug 92 pp 36-52

[Article by M. I. Budyko, I. I. Borzenkova, G. V. Menzhulin and K. I. Selyakov, State Hydrological Institute; UDC 551.583:911.1]

[Abstract] The limits of predictability and accuracy in prediction of the principal meteorological elements are examined. It is clear that the prediction of modern climatic changes is possible. However, as in any prediction, allowance must be made for the limits of predictability due to the inevitable errors in both the method and evaluations of the changes in climate-forming factors. A real prediction of the changes in meteorological elements is possible primarily up to the middle of the 21st century. The modern level of knowledge gives no hope for making reliable predictions of climatic changes up to the end of the next century. The accuracy in evaluations of climatic conditions of the future is limited by inevitable errors in estimates of change in the content of greenhouse gases and other factors. The reliability of predictions of changes in winter temperature in the coming decades is close to the accuracy in computing climate of the future according to both climate models and with use of empirical methods. It is possible that this also will be correct for summer temperature anomalies. In those cases when the absolute magnitude of these anomalies is small, it is possible to replace predictive evaluations by the conclusion that they fall within the limits of the natural variability of meteorological elements and therefore allowance for them is without practical importance. The prediction of precipitation changes is most difficult. It is possible to speak of the sign and in part the magnitude of precipitation changes only for the next few decades. Paleoclimatic materials are the most reliable basis for such a prediction and can be used in constructing scenario-analogues of precipitation changes during the next 20 years. Figures 3; references 50: 22 Russian, 28 Western.

Acid Precipitation in Moscow Metropolitan Area

937N0015B Moscow IZVESTIYA AKADEMII NAUK: SERIYA GEOGRAFICHESKAYA in Russian No 4, Jul-Aug 92 pp 75-82

[Article by A. Yu. Grigoryev, M. M. Serebryanyy and Ye. A. Shvarts, EKOTEST Laboratory; Main Botanical Garden, Russian Academy of Sciences; Geography Institute, Russian Academy of Sciences; UDC 550.501.79(470.311)]

[Abstract] The results of three cycles of snow cover surveyed in the territory of the Moscow metropolitan area in 1988-1990 have revealed a constant, ecologically substantial (pH of snow 4.7 and below) acidic pollution of precipitation in the western and northern parts of the region during the winter. The research methodology is described. In 1988 acidity was registered in approximately 45 percent of the area, in 1989 in 32 percent of the area and in 1990 in 31 percent. In 1988 the minimum snow cover pH was 3.9, in 1989—4.2 and in 1990—4.1. The spatial distribution was identical in all three years and was the same as in 1986-1987 (a distribution map is given for each of the three years). Future plans call for continuing monitoring of snow cover acidity, especially in the western and northern parts of Moscow Oblast, and study of the chemical composition of the snow cover for the detection of specific substances responsible for an increase in snow acidity. The monitoring of acidity of precipitation falling in the western and northern parts of the oblast will be organized during the warm season for an analysis of the influence of snow melt water on the acidity of surface waters and a study of possible hydrobiological effects. Figures 3; references 24: 9 Russian, 15 Western.

Behavior of Lead, Cadmium and Mercury in River-Sea System (Ecological Problems)

937N0006A Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA: GEOLOGIYA in Russian No 4, Jul-Aug 92 pp 59-64

[Article by V. A. Filonov and S. A. Mamontova, Moscow State University; UDC 550.424.6]

[Abstract] The behavior of lead, cadmium and mercury in the river-sea system was studied in a number of gulfs, bays, large and small rivers in the Far East. The background concentrations used were those observed in areas free of industrial pollution. Data were tabulated on the contents of these elements in dissolved and suspended forms and in bottom sediments. Their abundances in suspended form in coastal waters of Peter the Great Bay and in plankton also were ascertained. Data on the forms of migration of heavy metals are presented which indicate that most of the ligands bearing a positive charge are sorbed negatively by charged colloidal particles of clay minerals and hydroxides, other than mercury, forming a chloride complex bearing a negative charge. A similar conclusion can be drawn for some other metals (Cu, Mn, Ni, Zn). Natural geochemical systems substantially transform the forms of migration and behavior of heavy metals. In the zone of mixing of river and sea waters a considerable fraction of the heavy metals, as a result of sorption processes, is extracted from natural solutions and is concentrated on the sea floor. Plankton actively participates in the extraction of heavy metals from the natural solutions and they are incorporated in the

organic chain of the seas. Taking into account that plankton is food for fish and other marine organisms, man also is drawn into this chain and heavy metals thereby constitute a danger which must not be ignored in examining ecological problems. Figure 1; references: 8 Russian.

Physical Processes Arising During Channeling of Powerful Microwave Radiation in Atmosphere

[Article by Ye. T. Protasevich, Tomsk Polytechnic University; UDC 533.951.3]

[Abstract] Experimental data on the breakdown thresholds of air in the microwave range are generalized and the priority directions in such research are defined which will make it possible to increase the electric strength of air. At the present time there are no reliable experimental data on the limiting power which can be carried in a beam or on the breakdown strength of the electric field as a function of pulse duration. The discovered slowing of the rate of breakdown of the plasma of a microwave discharge in moist air prevents an increase in the repetition rate of radio pulses in the microwave range. In order to increase the efficiency of transmission of microwave radiation through the atmosphere it is necessary that the wavelength be greater than 2-3 cm and the number of HF periods in the pulse be less than 100, which corresponds to a duration of a single pulse 100 ns. The breakdown thresholds in the microwave range increase with the propagation of radiation in moist air and when working with individual pulses; the repetition rate in a periodic train of pulses must not exceed a few Hz. A series of figures and a table summarize some of the pertinent data, such as: gas temperature as a function of duration of ionizing radiation; vibrational temperature change as a function of duration of the microwave pulse at different pressures and change in breakdown time of plasma at normal atmospheric pressure as a function of relative humidity. Figures 7; references 17; 12 Russian, 5 Western.

Evaluation of Dynamics of Permafrost Zone in Northern Eurasia During Global Climatic Warming

[Article by A. A. Velichko and V. P. Nechayev, Geography Institute, Russian Academy of Sciences, Moscow; UDC 551.583]

[Abstract] Several methodological procedures make it possible to reconstruct the ancient region of permafrost for specific chronological sections, including for epochs of warmings whose duration ranged from several centuries to several millenia. Applying paleoclimatic reconstructions, specialists in the Evolutionary Geography Laboratory at the Geography Institute determined that an increase in the mean global air temperature by 1°C, close to that expected by 2000, occurred at the Holocene optimum (5500-6000 years ago) and an increase by 2°C, expected by 2025-2030, occurred at the optimum of the Mikulin interglacial period, about 125,000 years ago. The regions of permafrost in Northern Eurasia were reconstructed for conditions corresponding to the mentioned epochs of global warmings. These can be regarded as equilibrium models of the state of the permafrost region for the mentioned levels of global anthropogenic warming of climate. Results obtained using nonequilibrium models based on both paleogeographic data and empirical indices for the current century give the following estimates of changes in the permafrost zone in the coming decades. With a global warming by 1-2°C in the southern part of this zone in a band with a width of several hundred kilometers there will be an active reduction of high-temperature insular areas of permafrost and a gradual increase in ground temperature to positive values. The zone of insular permafrost therefore will move northward in the direction of the modern zone of continuous permafrost, but there will be an increase in the area with a relict permafrost layer, such as in the Pechora and Ob basins. In more northerly regions with a global warming by 1° the increase in the temperatures of permafrost will be close to 1-2°C and the thickness of the layer of seasonal thawing for sandy loam-clayey loam ground on interfluves will be 20-30 cm in comparison with now. With a temperature rise of 2°C the layer of seasonal thawing will increase to 40-50 cm. Such evaluations are essential in order to plan for future development of the region. Figure 1; references: 13 Russian.

Powerful Dust Storms in Aral Basin During 1985-1990

[Article by Al. A. Grigoryev and M. L. Zhogova, Russian State Pedagogic University imeni A. I. Gertsen, St. Petersburg; UDC 551.515.3]

[Abstract] New information is available on the intensity and frequency of dust storms originating on the desiccated floor of the Aral Sea. The dust raised during storms changes radiation conditions and accordingly influences climate. The precipitation of salt dust results in soil salinization and in a decrease in the natural potential of lands in the oases of the Amudarya and in the pastures of the Ustyurt. The effects from salt and dust deposition on vegetation can be observed for hundreds of kilometers around the sea. Between 1982 and 1990 the Aral Sea fell an additional 5.8 m, making previous dust storm data obsolete. Imagery from the satellites Meteor 30 in the spectral range 0.5-0.7 and 0.7-1.1 µm, Cosmos 1939 in the range 0.6-0.7 and 0.8-1.1 µm and Okean in the range 0.5-0.7 and 0.7-1.0 µm for 1985-1990 was used. A map

accompanying the text shows the centers of genesis of dust storms. There has been no change in the predominant direction of movement of dust storms (southwestward) in comparison with earlier years. For example, 12 dust storms from the eastern shore reached the opposite shore of the sea. The mean extent of dust storms was 250 km; the maximum was 500 km. Space imagery, however, reveals only the strongest dust turbidity in the atmosphere and the real transport of dust in a finely dispersed state is observable for far greater distances. Specific information is given on the most important centers of dust storm genesis. Approximate annual estimates of the total mass of dust transported over the Aral Sea are given. The estimate for 1990 is about 90 million tons; the estimate for 1975 was 45 million tons. Dust storms, formerly originating on the eastern shore, now also originate on the southern and northern shores. All these centers are now tending to merge. All this emphasizes the need for serious measures to stabilize the Aral Sea level. Figure 1; references: 7 Russian.

Riftogenesis, Ozone Layer and World Ocean Level

[Article by V. L. Syvorotkin and N. A. Sadovskiy, Moscow State University imeni M. V. Lomonosov, UDC 551.242.23]

[Abstract] The overwhelming part of the Earth's population and the principal airways are in the northern hemisphere and this clearly contradicts the hypothesis of technogenesis of ozone holes (because this phenomenon is manifested most clearly over Antarctica). It must be taken into account that the southern hemisphere mantle in virtually its entire thickness is heated to a considerably greater degree than the mantle in the northern hemisphere. The principal regions of reduced density and heating of the mantle are concentrated around Antarctica and extend from it in four symmetrically positioned lobes which are projected onto the southern segments of the mid-oceanic ridges. There is evidence of a high degree of tectonomagmatic activity in the southern half of the planet, clearly manifested in rift systems. Hydrogen and methane are among the gases released in rift zones. The main contention of the authors is that these gases, in great quantities being released into the atmosphere in the southern hemisphere, are the principal agents responsible for ozone layer destruction. Ozone holes are a result of the Earth's endogenous activity. Their appearance in the stratosphere in the mid-1980's was probably associated with the unusual intensification of solar activity which occurred at the end of this century and coincided with a whole series of natural cataclysms (earthquakes, volcanic eruptions, epidemics, which correlate with the solar activity cycles). The intensification of solar activity, in addition to the direct impact of sunlight on ozone, somehow (the mechanism for the time being remains unclear) results in an increase in the flow of endogenous (rift zone) gases, which also favors ozone layer destruction. The increase in the concentration of atmospheric hydrogen since the mid-1980's coincides in time with the appearance of the ozone hole over Antarctica. This hypothesis, in addition, also helps to explain such recurring global-scale phenomena as outbreaks of tholeiitic volcanism, changes in ocean level, mass death of biota and genesis of new species of organisms. References 13: 9 Russian, 4 Western.

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