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# ***JPRS Report***

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# **Science & Technology**

***USSR: Earth Sciences***

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# Science & Technology

## USSR: Earth Sciences

JPRS-UES-89-002

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### Preparations Begin for Evacuating Arctic Station 'SP-28'

18650072 *Moscow IZVESTIYA in Russian*  
12 Jan 89 p 1

[Article by V. Kovneyev]

[Excerpt] The State Committee on Hydrometeorology (Goskomgidromet) has approved a plan of measures for evacuating the station "Severnny polyus-28" (SP-28). The problem is that this station's drift speed has increased considerably, to 20-30 kilometers a day or more. There is now a risk that the station's ice floe may break up. The consequences are unpredictable.

The ice floe is in a current which is carrying it out of the central ice basin. For the purpose of evacuating the "SP" station's personnel and equipment, Goskomgidromet has leased a nuclear-powered vessel from the Murmansk Shipping Line. The "Rossiya" is now leaving the Arctic and will stop in Murmansk in order to prepare for this cruise and take a group of associates of the Arctic and Antarctic Scientific Research Institute (AANII) on board. This group will take on the task of providing scientific support for the icebreaker's upcoming trip to "SP-28".

After removing the "SP" personnel and equipment from the ice floe, the nuclear-powered vessel will transport them to Murmansk.

N. Kornilov, deputy director of AANII, has announced that "SP-28" was located in the vicinity of 81 degrees North latitude and on the zero meridian as of January 12. The station's average drift speed is about 10 kilometers a day. The station's personnel, who are headed by Vladimir Stepanov, an experienced polar specialists, are preparing for evacuation. A portion of their equipment, chiefly aerological equipment, has already been packed. At the same time, oceanologic and meteorological observations are continuing, taking into account the unique area of the drift. This work will, incidentally, be conducted up until practically the last minute, when the nuclear-powered vessel is approaching. Regular observations of ice drift are also being conducted.

### International Conference on Coordination of Arctic Research

18650056b *Leningrad LENINGRADSKAYA PRAVDA*  
*in Russian* 13 Dec 88, No 286 (22428) p 2

[Article by A. Kozlovskiy]

[Excerpt] An International Conference of States Bordering on the Arctic began its work in Leningrad yesterday. The purpose of this conference is to coordinate scientific research in the Arctic. About 500 people, including 200 foreign researchers, will take part in the conference's meetings. In addition to Soviet scientists, representatives of the United States, Canada, Norway, Sweden, Finland, Denmark and Iceland will present papers.

Among the members of the conference's presidium are academician I. A. Glebov, chairman of the presidium of the USSR Academy of Sciences' Leningrad Research Center; Yu. A. Izrael, corresponding member of the USSR Academy of Sciences and chairman of the USSR State Committee on Hydrometeorology (Goskomgidromet); academician A. F. Treshnikov, president of the Geographic Society of the USSR; and prominent Soviet and foreign scientists.

This impressive scientific forum was initiated by the USSR Academy of Sciences, the State Committee for Science and Technology, USSR Goskomgidromet, and other institutions which are interested in comprehensive study of the Arctic and protection of its environment.

Main topics of scientific discussions include processes occurring in the upper layers of the atmosphere, the problem of studying the ozone 'hole' over the Arctic, the present-day state of land and sea ecosystems, heat exchange between the atmosphere and the ocean, and the geological history and structure of primary rocks of the Central Arctic Basin and its coasts and islands.

The convening of this conference was dictated by the necessity of focusing efforts of scientists who are conducting research in near-Arctic space. The effectiveness of this approach has already been confirmed by work in the Antarctic, where many scientific programs are being carried out by the efforts of several states.

### Southward Drift of Arctic Station "SP-30" Complicates Supply Problem

18650113c *Moscow PRAVDA in Russian* 22 Feb 89 p 1

[Article by V. Yermolayev, correspondent]

[Excerpt] A time of hard work has begun for pilots of the Kolyma-Indigirka Air Unit. They often make flights to islands and drifting [ice] fields of the Arctic Ocean. The termination of one of the longest air routes in the Arctic is the polar station "Severnny polyus-30" (SP-30). The already difficult flights have suddenly become even more complicated.

It is about 1,100 kilometers from the settlement of Cherskiy, the center of the Nizhnekolymskiy Rayon, to SP-30. The station was established 1 year ago on an ice floe 10 kilometers long and 5 kilometers wide. This winter's first flight here, in the polar night, was made by the crew of a well-traveled IL-14 under the command of Yu. Klepikov. But soon afterwards, the huge field of stable masses of pack ice sharply changed its course. Instead of slowly drifting to the north, as prescribed by nature, the ice floe headed south, and that with a speed of up to 10 kilometers an hour.

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## Arctic, Antarctic Research

It has probably gotten into a powerful current that had suddenly developed in the ocean. Under the influence of the current, the huge drifting field suddenly broke up. The runway, which had seemed to be so reliable, was destroyed. The cracks soon closed up, it is true, but an IL-14 can no longer be landed here. Now the cargo brought in by airplanes has to be air-dropped on the ice floe. Several flights were made by MI-8 [helicopters] piloted by V. Karpenko and V. Savinovskiy.

The helicopters bring in everything that is needed from Zhokhov Island, traveling 450 kilometers to the north-east.

Until spring, the winter research team on SP-30 will receive a large amount of foodstuffs, various materials, and fuel for the diesel power station and for the AN-2 airplanes which will be based there.

**Creation of International Arctic Scientific Committee Proposed**  
*18650067a Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 20 Dec 88 p 3*

[Article by M. Butkov, correspondent, Moscow and Leningrad]

[Excerpt] The first international conference on scientific research in the Arctic was held in Leningrad from December 12 to 15.\*

An event which took place in Leningrad on the day before this conference may not have been as prominent, but it was of fundamental importance for all countries bordering on the Arctic, and not solely for them. The event in question was talks among representatives of the "eight"—the USSR, the United States, Canada, Sweden, Norway, Denmark, Iceland and Finland—regarding the creation of an International Arctic Scientific Committee.

When this committee is formed, it will become not only the first international nongovernmental agency coordinating scientific research in high latitudes but also the first international-cooperation agency of its kind in the Arctic in general.

The work of all six sections of the conference provided food for thought and impetus for action; specific directions of cooperation and original ideas were proposed.

"Further development of scientific ties must, of course, lead to joint solution of such problems as utilization of natural resources and also of socioeconomic questions," thought D.K. Zotov, deputy chairman of the USSR Council of Ministers' State Commission on Arctic Affairs. "What forms will such cooperation take? Scientific-technical exchanges evidently will be organized. Creation of joint enterprises on the basis of advanced Soviet and foreign technology holds promise."

A. Egeland, an eminent Norwegian physicist and professor of the University of Oslo, told me: "Our basic research has a quite applied character as well. I am studying the upper atmosphere and near-Earth space.

This makes it possible to forecast conditions for long-distance radio communication and navigation, which is very important for shipping in high latitudes (I recall a Soviet proposal regarding use of the Northern Sea Route, which might become an important direction of Arctic cooperation)."

\*See the Daily SNAP, January 4, 1989, p 3, col. 2 FTD/SNAP

**Further USSR-U.S. Studies of Ozone Depletion Planned in Arctic**  
*18650067b Moscow SOVETSKAYA ROSSIYA in Russian 25 Dec 88 p 6*

[Article by P. Timofeyev]

[Excerpt] A group of American scientists headed by Jim Rosen, a leading U.S. specialist in study of the phenomenon called the 'ozone hole', has visited our country.

"Experiments in the Arctic which Soviet scientists and specialists of NASA conducted in February of 1987 demonstrated that the ozone layer has decreased considerably in recent years here, too," said V. Khattatov, deputy director of the Central Aerological Observatory of the USSR State Committee on Hydrometeorology.

"Preparations are now under way for the next large-scale experiment, which is scheduled for January-March 1989. Hayes Island, which is located at 81 degrees North latitude in the Franz Josef Land archipelago, will become the center of this experiment. We have an observatory and a rocket-probing station there. Jim Rosen's visit to our country was devoted to these preparations. We exchanged the latest scientific data and checked the readiness of equipment. It is proposed to conduct this research with the aid of modern spectrophotometers, lidar units and meteorological rockets launched to high altitudes, and also from laboratory airplanes.

"The main task is to verify a hypothesis regarding effects which polar stratospheric clouds produce on the ozone layer. The point is that chlorofluorocarbon wastes of industry condense in stratospheric clouds as they rise to a high altitude. Traveling with these clouds, they become a kind of trap which 'swallows up' ozone."

FTD/SNAP

UDC [551.345:551.524.34].001.57

**Evaluation of Permafrost Sensitivity to Change in Global Thermal Regime of Earth's Surface**

18650065c Moscow METEOROLOGIYA I  
GIDROLOGIYA in Russian No 1, Jan 89 (manuscript  
received 4 Dec 87) pp 79-84

[Article by O. A. Anisimov, candidate of physical and mathematical sciences, State Hydrological Institute]

[Abstract] The results of model investigations for detecting the conditions of a stable state, development and degradation of permafrost are examined. Particular attention is given to an analysis of the regional characteristics of the effect of climatic factors on permafrost, for whose evaluation the scenario of a possible change in climate is used. The principal mechanism of permafrost transformation is thermokarst phenomena resulting from changes in heat balance of the soil surface (such thermokarst phenomena can also develop independently of climatic change). A model was developed for research on a fundamentally different type of permafrost degradation attributable to a rapid change in the thermal regime of the Earth's surface. Emphasis is on study of vertical heat exchange using a one-dimensional model. The initial data used were cartographic materials on the existing geographic distribution of cryolithic zones with an indication of the approximate thickness of permafrost and its type, data on the distribution of mean annual air temperature near the surface and on the characteristic annual variation of temperature within the limits of the considered area and corresponding data on the distribution of precipitation and soil moisture content. The redistribution of the cryolithic zone was computed on the basis of changes in these parameters corresponding to the selected climatic scenario. Detailed measurements of the vertical profiles of temperature and soil moisture content to a depth of about 20 m for four heat balance stations (Yakutsk, Vorkuta, Syrdakh, Solenyy) were used; these differ with respect to climatic indices and soil thermophysical parameters. Approximate dependencies were derived. These expressions were derived on the

assumption that the duration of the snow period remains constant, whereas it actually decreases with an increase in mean air temperature. The model is used in an analysis of regional peculiarities in the climate-permafrost interrelationship. The results of numerical experiments for research on the joint influence of air temperature change and winter precipitation on permafrost evolution are given. Figure 1; references 9; 5 Russian, 4 Western.

UDC [504.453.054:621.039.58].001.18(477.41)

**Prediction of Secondary Radioactive Pollution of Rivers in 30-km Zone Around Chernobyl Nuclear Power Plant**

18650085a Moscow METEOROLOGIYA I  
GIDROLOGIYA in Russian No 2, Feb 89 (manuscript  
received 13 Apr 88) pp 5-13

[Article by V. A. Borzilov, candidate of physical and mathematical sciences, Yu. S. Sedunov, professor, M. A. Novitskiy and O. I. Vozzhennikov, candidates of physical and mathematical sciences, and A. K. Gerasimenko, Experimental Meteorology Institute, USSR State Committee for Hydrometeorology]

[Abstract] A mathematical model is given for the secondary radioactive pollution of rivers in a 30-km zone from the Chernobyl nuclear power plant. The model includes the processes of formation of pollution in river waters as a result of entry of radionuclides from bottom deposits and entry of polluted waters from watersheds adjacent to the rivers during rains or snow melting. The parameters of the model were determined by carrying out special field and laboratory experiments for study of the physicochemical characteristics of the radionuclides. The formation of river pollution during the low-water period occurs for the most part as a result of desorption of radionuclides from bottom deposits. Pollution due to suspended matter is insignificant and local in nature. In spring, with an increase in water discharge, the fraction of radionuclides in suspended matter increases substantially. This increase is associated with stirring-up of the bottom. The model was used in predicting conditions in rivers of the polluted zone and in organizing and implementing measures for reducing the transport of radionuclides during high water and in setting up a monitoring program. Observational data on river water pollution in the spring of 1987 indicated that the prediction was successful. The concentrations of radionuclides in the rivers were considerably lower than the admissible levels. Figures 3; references 7: 6 Russian, 1 Western.



UDC 551.241(268.3)

### Deep Structure of Barents Sea Floor

18650052 Moscow GEOTEKTONIKA in Russian  
No 6, Nov-Dec 88 (manuscript received  
18 Mar 86 pp 96-100)

[Article by E. V. Shipilov and B. V. Senin, Soyuzmorgeo Scientific Production Association]

[Abstract] The deep structure of the Barents Sea was examined on the basis of the results of comprehensive geological and geophysical research (reflected and refractive waves methods, common depth point method) of recent years. A set of maps and diagrams, including of the thickness of the Earth's crust and its consolidated part, surface of the heterogeneous basement, nominal rigidity of the Earth's crust, etc., was compiled and analyzed. The totality of examined data is evidence of destruction of the continental crust in the South Barents depression, and by analogy with it, also in the North Barents depression. The findings indicative of this include: a reduction in thicknesses of the Earth's crust to 33-25 km in the South Barents depression with a substantial differentiation of relief of the mantle surface into individual domes under the central part of the depression; stratification of the upper mantle; anomalous character of velocity properties of both the mantle and the crust; uncertainty and blurring of the transition from the sedimentary mantle to a basement of unclear nature in the lowest-lying parts of the depression; broad development of faults and intensive block fragmentation of the basement of the sedimentary mantle; minimal values of nominal crustal rigidity. Destruction, expressed in fragmentation into blocks, thinning and subsequent fragmentation of the "granite" layer, and possibly the entire crust, is associated with marginal continental riftingogenesis. The last cycle of its activation, accompanied by an intensification of downwarping and accumulation, corresponds to the Late Permian-Mesozoic, judging from the fact that more than half the thickness of the sections in the depressions (up to 12-14 km) corresponds to deposits of this age. Late Permian-Mesozoic activation of destructive processes in the region agrees in time with the onset of active ocean formation in the Amerasian Basin of the Arctic Ocean and may be geodynamically conjugate with it. Figure 1; references: 8 Russian.

UDC [551.465.71:546.264-31].072(269.4)

### Three-Dimensional Advective-Diffusive Model of CO<sub>2</sub> Transport in South Atlantic

18650060a Moscow METEOROLOGIYA I  
GIDROLOGIYA in Russian No 11, Nov 88 (manuscript  
received 11 Dec 87) pp 101-107

[Article by A. Kh. Degterev and V. V. Guretskiy, candidate of physical and mathematical sciences, Marine Hydrophysics Institute; Arctic and Antarctic Scientific Research Institute]

[Abstract] Existing models describe the vertical transport of carbon in the ocean, but the computed geographic variability of the  $P_w$  (partial pressure of CO<sub>2</sub> in water) field is poorly represented in these models. Accordingly, CO<sub>2</sub> transport was modeled in the South Atlantic in the zone 35-75°S. A grid with a latitude interval 1° and a longitude interval 2° was used; vertically 23 levels were examined with a closer concentration toward the surface but with a minimal interval 25 m. Real bottom relief was taken into account; depth varied from 500 to 5500 m. The influence of biota was taken into account (the level of primary production varies from 0.3 mg C/m<sup>3</sup> at 30°S to 50 mg C/m<sup>3</sup> per day at 70°S during the warm half-year. A comparison of the computed seasonal distributions  $P_w$  and measurement data shows that whereas in the southern hemisphere winter the difference is small, the summer distributions differ appreciably to the north of 60°S. The computed  $P_w$  values are greater than the measured values. This is evidently attributable to an intensification of the biological consumption of CO<sub>2</sub> in water during photosynthesis. The maximal development of this process is in the warm half-year. The model does not take into account the variability of the biotic losses of CO<sub>2</sub> into the upper quasihomogeneous layer. Figures 3; references 18: 8 Russian, 10 Western.

UDC 504.4.054:665.6:531.715.27

### Optical Method for Monitoring Oil on Sea Surface

18650068b Moscow METEOROLOGIYA I  
GIDROLOGIYA in Russian No 11, Nov 88 (manuscript  
received 7 Dec 87) pp 121-124

[Article by T. Yu. Sheveleva, candidate of technical sciences, and N. B. Leus, Leningrad Electrotechnical Institute]

[Abstract] Experimental work on determination of the degree of oil pollution of water bodies has revealed that in the visual method no use is made of very valuable information: the interference pattern which is formed in reflected sunlight in the ship's track covered by an oil slick. In order for this information to be obtained it is only necessary that the visual method be modified slightly. First it is necessary to photograph the slick on color film. Second, the track covered by an oil slick must be photographed at the optimal moments in time when the clarity of the interference pattern is maximal. Third, the photographs must be analyzed, counting the number of maxima and minima of the reflection extrema and the distances between them and then computing film thickness. These additional operations are not time-consuming but make the measurements objective and reduce the error in thickness measurement. The proposed optical method makes it possible to obtain a photograph of the slick for ascertaining its area and the distribution of film thickness along the trajectory of a ship passing through an oil slick. If the oil slick is of a complicated shape it must be intersected in several

directions. Two directions suffice: with the wind and perpendicular to the wind through the center of the slick. The collected data make it possible to ascertain the quantity of oil spilled in the sea. The method is effective under a variety of hydrometeorological conditions. Figures 2; references: 2 Russian.

UDC 551.466.32

**Measurement of Wind Wave Slopes in Caspian Sea**  
*18650055c Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 24 No 11, Nov 88 (manuscript received 23 Jan 87; after revision 19 Oct 87) pp 1210-1217*

[Article by S. A. Kalinin and I. A. Leykin, Oceanology Institute, USSR Academy of Sciences]

[Abstract] A study was made of the slopes of a wave-covered surface in different stages of wave development and an analysis was made of the dependence of the dispersion of slopes on the dimensionless frequency of the spectral maximum and mean wave steepness. The experimental data used in the study were obtained using a three-string wave recorder in the course of an expedition in the Caspian Sea. Wave measurements were made in the autumn of 1974 from a fixed pile platform situated in the open part of the Caspian Sea 10 miles to the northeast of the Apsheron Peninsula in a sector with a depth of 40 m and a relatively flat bottom. The three string sensors were mounted in a frame suspended from the platform. Measurements could be made with a wave height up to 2 m. Fourteen records of wind waves developing with a northerly wind with speeds from 6.6 to 14 m/s were obtained. The principal data characterizing the conditions for making the measurements and their results are given in a table. It was found that the dispersion of slopes corresponding to the energy-bearing part of the wave spectrum decreases with wave development. Empirical expressions are derived which describe the dependence of slope dispersion on the dimensionless frequency of the spectral maximum characterizing the degree of wave development and mean wave steepness. Only the partial dispersion of slopes was determined. For radiophysical applications, involving computation of the scattering of radio and acoustic waves by the sea surface, it is necessary to know the total dispersion of slopes determined by integration of the slope spectrum in a broader frequency range. Figures 5; references 11: 8 Russian, 3 Western.

UDC 550.838

**Results of Detailed Geomagnetic Study of Submarine Baroni Ridge (Tyrrhenian Sea)**  
*18650057a IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 10, Oct 88 (manuscript received 25 Nov 87) pp 76-82*

[Article by I. I. Belyayev, Yu. V. Brusilovskiy, A. M. Gorodnitskiy, K. V. Popov, A. A. Shreyder and V. P. Shcherbakov, Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences; Earth Physics Institute imeni O. Yu. Shmidt, USSR Academy of Sciences]

[Abstract] The submarine Baroni Ridge is located in the eastern part of the Tyrrhenian Sea 30 km to the east of Sardinia and is part of the system of morphostructures typical for the eastern part of the West Tyrrhenian block-folded zone. It occupies a central position in a submeridional chain of blocks detached from the Sardinian-Corsican continental block. The ridge rises about 1800 m above the floor of the Tyrrhenian Basin. The ridge consists of several blocks: two central blocks with smoothed relief and a massive base and two marginal blocks with complex dissected relief and a high degree of fragmentation. A detailed geomagnetic survey of the ridge was made on the 12th cruise of the "Vityaz" research ship. Measurements were made with a proton magnetometer in two sectors: northern and central (test ranges 2 and 3). The geomagnetic survey was accompanied by a magnetic study of rock samples obtained by drilling from the "Argus" submersible and by geological sampling with corers and dredges. The anomalous magnetic field over the greater part of test range 2 has an even character and near-zero values, against whose background there is a clearly expressed sublatitudinal anomaly in the northern part. The intensity of the anomalous magnetic field over the southern peak in test range 2 is very small. Over the greater part of test range 3 magnetic field anomalies are virtually absent, but against this background there is a clearly expressed zone of strong magnetic anomalies on the eastern slope. These findings suggest that the magnetic field anomalies are related to magmatic activity along a system of sublatitudinal faults bounded on the west by the ridge. The complex nature of the anomalous magnetic field and relief of the eastern slope of the ridge indicate the development of intensive tectonic activity there, superposed on the main structural plan of the ridge, probably forming as a result of its detachment from Sardinia by meridional faults. Figures 3; references: 2 Russian.

### **Influence of Conducting Floor on Electromagnetic Field of Sea Currents**

*18650057b Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ZEMLI in Russian No 10, Oct 88 (manuscript received 18 Aug 86) pp 82-88*

[Article by I. G. Panteleyev and V. V. Sochelnikov, Southern Division, Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences]

[Abstract] The electromagnetic field of sea currents is not only interference in the implementation of marine geophysical research, but can also be used in electromagnetic sounding of the bottom. The influence of the bottom lessens with an increase in distance between the sea floor and the observation point. The details of this problem are examined in a specific example in which a study was made of a linear homogeneous current in the form of a circular cylinder in a plane-parallel layer. The resistivity of the cylinder and layer are considered identical. The following special cases are examined: high bottom resistivity, current in a homogeneous half-space;

current in a homogeneous space. A series of computations of the induced electromagnetic field was made. Computations were made for the three field components  $H_y$ ,  $E_x$ ,  $E_z$ . These computations revealed that under definite conditions a nonconducting bottom exerts a negligible effect on the induced field. For the maximal field strengths this influence is 0.65 percent for  $H_y$ , 0.4 percent for  $E_x$  and 0.006 percent for  $E_z$ . The results of change in the maximal values of the field components were tabulated. Figures 4; references: 6 Russian.

UDC 551.465.001.572(261.1)

### Modeling of Thermal Structure of North Atlantic Active Layer

18650062a Moscow METEOROLOGIYA I  
GIDROLOGIYA in Russian No 12, Dec 88 (manuscript received 28 Sep 87) pp 75-85

[Article by L. V. Nechvolodov, candidate of physical and mathematical sciences, State Oceanographic Institute]

[Abstract] Data for a 15-year observation period were used in analyzing the possibilities for modeling seasonal evolution of the North Atlantic active layer by means of an integral approach. A generalized two-layer model was used in which the Kolmogorov relations and conclusions from similarity theory for the scale and energy of turbulence are invoked for the parameterization of the rate of entrainment and turbulent heat exchange at the lower boundary of the mixing layer. Tests of the model using data from weather ships and numerical experiments for computing the spatial distribution of the characteristics of the North Atlantic active layer are used in determining the degree of influence of advection on formation of active layer structure and a method is proposed for taking it into account in active layer modeling. The effectiveness of the method is evaluated and practical recommendations are given on modeling of the active layer for the purpose of diagnosis and prediction of its vertical structure. Over a great part of the North Atlantic (about 60 percent of its total area) the seasonal variability of the characteristics of the active layer is reproduced quite adequately within the framework of simple integral models with a linear dependence of density on water temperature. The proposed parametric method for taking advection into account makes it possible to broaden the region of reliable computed results to 70-75 percent of the total area. Two regions of low effectiveness of computations were defined for which the formulation of bottom layer models (no less than 2) is required. In the northwestern part of the area, due to active water exchange with the Arctic Basin, salinity exerts a considerable influence on formation of the vertical structure of the active layer and this must be taken into account together with advective factors. The second, southeasterly region, is in the effective zone of the Tropical Cyclonic Circulation where there are considerable vertical velocities of motion of waters and the influence of salinity is equally substantial due to strong evaporation.

Since in the discriminated regions a nonstandard distribution of temperature (density) in the active layer is frequently noted (absence of an upper quasihomogeneous layer and emergence of the thermocline) it is preferable to use differential models with allowance for all the defined structural and dynamic features of the waters in these regions. Figures 3; references 17: 10 Russian, 7 Western.

UDC 551.526.6.6:551.515.23(265.72)

### Surface Temperature of South China Sea and Tropical Cyclones

18650062b Moscow METEOROLOGIYA I  
GIDROLOGIYA in Russian No 12, Dec 88 (manuscript received 14 Dec 87) pp 118-121

[Article by V. D. Pudov, candidate of physical and mathematical sciences, and S. A. Petrichenko, Tayfun Scientific Production Association]

[Abstract] The Fourth Joint Soviet-Vietnamese Marine Research Expedition was carried out during the period May-September 1987 in the South China Sea. Experimental data on surface temperature of the sea, its characteristic spatial scales and its rms variability values were obtained. The amplitude of the diurnal variation of water temperature at a depth of 2 m was 0.14°C when there was a slight cloud cover and 0.1°C when there was a total cloud cover. In general the northeastern part of the sea is warmer than the southwestern part by more than 1°. The isotherm 29.5°C divides the sea almost diagonally from northwest to southeast. In the southwestern part the sea surface temperature attains minimal values at 11°N, 111°E. An effort was made to clarify the reasons for the occurrence of this minimum. It was found that there is an upwelling of waters from a depth of 40-45 m along the Indochinese coast, a typical manifestation of a coastal upwelling determined by the orography of the shoreline and the southwesterly monsoon. Since the coastal upwelling in the southwestern part of the South China Sea has a climatological character, existing annually during the southwesterly monsoon, an analysis was made of the trajectories of TC (tropical cyclones) during the period May-September for a period of 23 years. These TC did not affect the Vietnamese coast (except for one). The TC reaching the coast were in autumn-winter when the southwesterly monsoon ceases and the coastal upwelling is weakened. Figures 3; references 7: 6 Russian, 1 Western.

UDC 550.834:551.214

### Structure of Kovachi (Solomon islands) Submarine Volcanic Group Revealed by Continuous Seismic Profiling Data

18650063a Moscow VULKANOLOGIYA I  
SEISMOLOGIYA in Russian No 5, Sep-Oct 88  
(manuscript received 4 Mar 86) pp 15-22

[Article by V. I. Bondarenko, Volcanology Institute, Far Eastern Department, USSR Academy of Sciences]

[Abstract] About 1500 km of continuous seismic profiling (CSP) profiles were run on the seventh cruise of the "Vulkanolog" scientific research ship in Kovachi test range, taking in the region of Kovachi submarine volcano and Bruam bank, situated to the east. Interpretation of these data revealed the principal structural features of the sedimentary mantle and tectonics of this region. Kovachi volcano is situated in the Solomons Islands island arc, is known as one of the most active centers of submarine volcanism and has erupted many times during recent years. A different structure of the western and eastern parts of the test range was determined from CSP data. It was found that the development of the Bruam Bank region was determined by tectonic movements close to the direction of movement of the Solomons Islands arc as a whole. After formation of the lower sedimentary complex, whose top is now noted on CSP profiles as an acoustic basement, there was some gap in sedimentation; the rocks were evidently bent into folds and consolidated. A downwarp was later formed on this basement on which a sedimentary stratum was accumulated. The maximal thickness, up to 1 km, is at the northeastern edge of the downwarp near a fault of NW strike bounding it. Then these rocks were slightly bent and the dome-shaped rise of Bruam Bank began. The rising, possibly still continuing, had a block character. The rise was broken into three blocks by faults of NW and SE strike. At this same time grabenlike depressions were formed as a result of movements along faults of NW strike. No manifestations of volcanic activity have been discovered in the neighborhood of Bruam Bank. The structure of the western part of the test range is determined by volcanic activity. There are three volcanic peaks with relative elevations up to 1000 m. At the present time volcanic activity is evidently associated with the southern and northeastern peaks. The western peak is now evidently inactive. The process of deposition of unconsolidated products of eruption and products of destruction of volcanic structures is controlled by currents and underwater slumping prevailing in this region. Figures 4; references 7: 3 Russian, 4 Western.

UDC 550.834:551.214

### Seismoacoustic Image of Underwater Volcanic Formations

18650063b Moscow *VULKANOLOGIYA I SEISMOLOGIYA* in Russian No 5, Sep-Oct 88 (manuscript received 16 Apr 86) pp 23-34

[Article by A. M. Nadezhnyy, Volcanology Institute, Far Eastern Department, USSR Academy of Sciences]

[Abstract] The nature of continuous seismic profiling (CSP) seismograms is determined by two groups of factors: seismogeological conditions in the research region and CSP methodological parameters. This article gives an evaluation of the contribution of each of the mentioned groups of factors to the formation of the seismoacoustic image of a section of volcanic rocks. The possibilities of CSP in studying submarine volcanoes are

evaluated. The materials examined were obtained on cruises of the "Vulkanolog" scientific research ship. It was found that the seismological conditions of zones of submarine volcanism are determined by the history of their development and the nature of the volcanic manifestations. The study of complexly structured media by seismic methods assumes the use of statistical methods for processing of the materials. To a considerable degree this corresponds to an interpretation of CSP seismograms by visualization of seismoacoustic images of the medium. Using the seismoacoustic image under favorable conditions it is possible to discriminate volcanic structures with respect to their nature and the history of their formation. Effusive abyssal volcanism is characterized by the presence of seismic scatterers on the sea floor. Heterogeneous volcanic and volcanogenic-sedimentary strata are represented on CSP seismograms by "reverberation layers." The CSP method can be used in studying details of the internal structure of volcanic formations at a shallow depth. The quality of interpretation of CSP materials on submarine volcanoes is largely dependent on the methodological parameters of the research. The sounding interval exerts a particularly strong influence on the nature of the seismoacoustic image of volcanogenic formations. Figures 5; references: 40: 30 Russian, 10 Western.

UDC 551.465.71:551.461.25(261.81)

### Water Balance and Modern Changes in Caspian Level

18650065b Moscow *METEOROLOGIYA I GIDROLOGIYA* in Russian No 1, Jan 89 (manuscript received 15 Jan 88) pp 57-64

[Article by G. S. Golitsyn, academician, G. N. Panin, doctor of geographical sciences, Water Problems Institute; Atmospheric Physics Institute]

[Abstract] During the period 1930-1939 the level of the Caspian Sea fell by 175 cm, whereas from 1977 through 1986 it rose by 117 cm and is continuing to rise; in 1987 the level was 9 cm above the 1986 level. This article examines different methods for determining Caspian Sea level. Changes in the elements of its water balance are analyzed. A considerable correlation was established between river runoff and apparent evaporation from its surface, negative during periods of sharp changes in sea level and positive during periods of weak changes. The reasons for the discrepancies between the determinations of different authors, using different methods, are analyzed. The analysis indicates that modern changes in Caspian level were caused by corresponding changes in components of the water balance equation and for the most part by fluctuations of river runoff. Discrepancies can be attributed to errors in computing water balance components and errors in direct determination of level

by observations. Moreover, the water balance equation has been calculated on the assumption of a constancy of inflow from ground water, which very possibly is not always the case. This indicates a need for organizing a data bank of water balance equation components with special attention being devoted to the checking of the leveling of level observation posts and more precise determination of the quantity and temporal variability of ground water inflow into the sea. There is also need for a bank of hydrometeorological data obtained by observations from ships and systematized by area and in time (at least by 1° squares with averaging for a month). Figures 2; references: 9 Russian.

UDC 551.463.288

#### **Asymptotic Theory of Low-Frequency Oceanic Noise With Allowance for Impedance**

18650064d Moscow *IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA* in Russian Vol 24 No 10, Oct 88 (manuscript received 17 Aug 87) pp 1066-1076

[Article by S. S. Abdullayev and P. K. Khabibullayev, Nuclear Physics Institute, Uzbek Academy of Sciences]

[Abstract] The asymptotic correlation method was used in a study of the correlation properties and vertical distribution of the mean intensity of the noise field generated by surface noise sources in a stratified ocean with an impedance bottom. Asymptotic formulas were derived for the spatial correlation function and the mean intensity of the noise field, taking into account the finite nature of the correlation scale of the noise sources, sound absorption in the water layer and the ocean floor. Specific vertical dependencies are derived for the intensity of the noise field in isospeed and underwater sound channels. In channels with an isospeed speed of sound profile or a profile decreasing monotonically with depth the amplitude of intensity oscillations in the middle part of the channel is considerably suppressed in comparison with a subsurface sound channel. In contrast to a channel with a "stiff" bottom, in a channel with an impedance bottom there is no intensity doubling of the noise field at the bottom. The  $I(h)$  value is determined by the bottom parameters. The intensity of the noise field at the bottom is also dependent on the parameters of the water medium: on the the speed of sound profile and absorption in water. However, the dependence on these parameters is considerably weaker than on the bottom parameters themselves. Although far from the ocean floor the noise intensity distributions are highly dependent on the speed of sound profile, they differ little near the bottom and at the bottom. Figures 5; references 14: 12 Russian, 2 Western.

UDC 551.466.44

#### **Counter Interaction of Surface Waves Over Periodically Uneven Bottom**

18650064e Moscow *IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA* in Russian Vol 24 No 10, Oct 88 (manuscript received 20 Nov 86, after revision 11 Jan 88) pp 1077-1088

[Article by K. I. Volyak and A. S. Gorshkov, General Physics Institute, USSR Academy of Sciences]

[Abstract] The satisfaction of conditions of three-wave synchronism can be satisfied for gravity waves propagating over an undulating bottom. The averaged Lagrangian method is used in deriving equations for slowly changing amplitudes and phases of interacting waves. The stationary interaction of counter waves was investigated in detail. At the surface of a heavy fluid over an undulating bottom, as in a periodically inhomogeneous nonlinear medium, there can be various kinds of interactions among counter waves, including those which are randomly modulated. A sinusoidal bottom eliminates a prohibition on the quadratic interaction of waves and nonlinear processes transpire quite effectively, causing an appreciable "reflection" of waves with frequency retuning. A distinguishing feature of some counteractions is the generation of return waves with zero boundary conditions, indicating an absolute instability of the medium. Another important feature of the interaction of waves over a periodic bottom is the generation of an almost monochromatic return wave by powerful randomly modulated waves with a broad frequency spectrum. Figures 3; references 20: 7 Russian, 13 Western.

#### **Research on High-Frequency Wind-Induced Sea Waves**

18650064f Moscow *IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA* in Russian Vol 24 No 10, Oct 88 (manuscript received 10 Nov 86, after revision 25 Jan 88) pp 1089-1099

[Article by I. I. Strizhkin, Moscow Institute of Geodetic and Cartographic Engineers]

[Abstract] An analysis of the spectral structure of high-frequency sea waves in the range of wind speeds 3.0-15 m/s, determined by the processing of photo images of the sea surface at 1:160, indicated that the spectra of wave slopes have a polymodal structure whose form is dependent on wind speed. Secondary maxima correspond to real wave systems. The polymodal structure of the spectrum reflects the existence of different systems of high-frequency waves on the surface of the main wave and their anisotropic character. In the range 1.2-50.0 cm and 3.0- 15 m/s the number of spectral maxima does not

exceed 17. Their spectral density values and corresponding wave length values are dependent on wind speed. For a given wind speed the wave lengths for the maxima in the spectrum of slopes of high-frequency waves coincide with the corresponding wave lengths for the maxima of probability of appearance of different wave systems. With an increase in wind speed a change in the position of the maxima has a definite oscillatory character. With an increase in wind speed for narrow wave length ranges the change in the secondary maxima has an oscillatory character. The values of the secondary spectral maxima are dependent on the nature and the time of development of waves. Figures 6; references 9: 6 Russian, 3 Western.

UDC 551.465.4

**Mathematical Simulation of Thermal Boundary Layer Forming in Water in Sunny Calm Weather**  
18650064g Moscow IZVESTIYA AKADEMII NAUK  
SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 24 No 10, Oct 88 (manuscript received  
26 Jun 87) pp 1100-1106

[Article by Yu. G. Verevokhin and S. A. Startsev,  
Physics Institute, USSR Academy of Sciences]

[Abstract] Different types of thermal boundary layer forming during calm weather as a result of the absorption of solar radiation in water cooled from the surface are simulated. The conditions for their existence were determined and their dynamic characteristics were investigated. The basis for the investigation was a three-dimensional nonstationary model of a fluid layer, infinite in a horizontal direction, with plane nondeformable boundaries, proposed by T. D. Foster. The choice of this model was made because it is relatively simple but describes clearly the dynamics of the thermal boundary layer in the water in the absence of incident solar radiation. Three thermal regimes of the layer (observed in earlier experiments) were obtained within the framework of a single mathematical model, with a change in the solar radiation flux  $J_0$  and the total heat outflow  $Q$  from the water. The  $J_0$  values at which, first of all, an unstable cold film becomes stable and convection in the layer becomes stationary, and second, convection in the layer completely ceases, were found. The distributions of temperature and other characteristics of layers in these regimes were determined. Figures 3; references 11: 7 Russian, 4 Western.

UDC 551.467

**Generation of Electromagnetic Field During Fracturing of Sea Ice Cover**  
18640064j Moscow IZVESTIYA AKADEMII NAUK  
SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 24 No 10, Oct 88 (manuscript received  
6 Feb 87) pp 1113-1116

[Article by L. G. Kachurin, V. Ya. Androsenko, V. B. Loginov, V. F. Psalomshchikov, K. K. Ovanesyan and A. A. Kharkov, Leningrad Hydrometeorological Institute]

[Abstract] During the 1986 navigation season measurements of electrical and electromagnetic fields arising during fracturing of the ice cover during ship conveying

were made from the "Arktika" atomic icebreaker. A dynamic electrometer was used as the primary transducer for the electrical (electrostatic) field in the range from 10 to  $10^5$  V/m. The modulus of field strength was registered. A maximal electrical field, exceeding 50 kV/m, was noted during the fracturing of young ice. All other conditions being equal, the strength of the generated fields was proportional to the rate of icebreaker movement and therefore was proportional to the intensity of ice fracturing. Only the electrostatic field was registered during the movement of the icebreaker through ice slush. With total stoppage of the icebreaker or during its movement through open water the field strength decreased virtually to the background levels. Registry of the electrostatic field is not promising with respect to information on the intensity of deformations and fracturing of the ice cover because field strength is dependent on a great many other factors of both meteorological and cosmic origin. During snowfalls and blizzards field strength can increase to tens of kV/m. Nonthermal electromagnetic radiation in the radio range is a quite informative characteristic of deformation and fracturing of the ice cover and in combination with radar methods for remote determination of ice cover thickness it can be used in ice reconnaissance of the optimal track for ships. Figures 3; references: 6 Russian.

UDC [504.4/.53.054:621.039.58].001.57(477.41)

**Physicomathematical Simulation of Processes Determining Washout of Long-Lived Radionuclides From Watersheds of Thirty-Kilometer Zone Around Chernobyl Nuclear Power Station**  
18650065a Moscow METEOROLOGIYA I  
GIDROLOGIYA in Russian No 1, Jan 89 (manuscript  
received 13 Apr 88) pp 5-13

[Article by V. A. Borzilov, candidate of physical and mathematical sciences, Yu. S. Sedunov, professor, M. A. Novitskiy and O. I. Vozzhennikov, candidates of physical and mathematical sciences, A. V. Konoplev, candidate of chemical sciences, and I. V. Dragolyubova, Experimental Meteorology Institute, USSR State Committee for Hydrometeorology]

[Abstract] A mathematical model of the process of washout of long-lived radionuclides (strontium 90 and cesium 137) from watersheds in a 30-km zone around the Chernobyl nuclear power station is described. The model parameters are determined on the basis of standard field observations and laboratory measurements of the physicochemical properties of radionuclides. Field and laboratory experiments revealed the following findings (among others) concerning the formation of the concentration of these radionuclides in the surface runoff of rain and meltwater. The radionuclides in the soil

are in nonexchangeable and exchangeable states; radionuclides in a nonexchangeable state are in the upper soil layer with a thickness 0.5 cm and do not migrate in the soil profile; the washout of radionuclides with soil particles occurs in irreversibly sorbed and exchange forms, whereas insoluble forms are not washed out; the washout of radionuclides in a dissolved state is caused by the filtering of the entire volume of surface waters through a soil layer about 1 cm thick and the desorption of exchangeable forms in this volume; during spring, with the formation of meltwater runoff through the frozen soil, the reduced coefficient of "fluid" washout decreases by an order of magnitude as a result of a decrease in the effective volume of water interacting with the soil. During the first years after the Chernobyl accident the coefficients of "fluid" washout will annually decrease by a factor of 3-5, depending on the distribution coefficient. Later the total washout coefficients will stabilize at a level determined only by "solid" washout. Figures 3; references 7: 5 Russian, 2 Western.

UDC 551.465.7:551.5.(261.5)

**Features of Variability of Cloud Cover and Precipitation Fields in Tropical Atlantic**  
*18650073a Kiev MORSKOY GIDROFIZICHESKIY ZHURNAL in Russian No 5, Sep-Oct 88 (manuscript received 1 Jan 87) pp 33- 37*

[Article by G. S. Dvoryaninov, M. V. Shokurov and T. A.-Kh. Barri, Marine Hydrophysics Institute, Ukrainian Academy of Sciences]

[Abstract] The spectral processing of satellite data on cloud cover for the tropical Atlantic and precipitation in Guinea was carried out and the temporal variability of precipitation was ascertained. The cloud cover field was studied on the basis of satellite data for 1966- 1982. It was found that the maximal cloud cover occurs almost parallel to the equator and its concentration is expressed to a greater degree in the eastern Atlantic. In the summer the region of maximal cloud cover is displaced into higher latitudes. The scales of temporal variability of cloud cover were estimated using the maximal entropy method and the annual and quasi-biennial components of cloud cover variability were tabulated. Everywhere there was a clearly expressed positive trend, a tendency to an increase in mean annual cloud cover during approximately the last 15 years. However, the change in mean annual precipitation does not conform to variations in mean annual cloud cover. During the last 15 years the quantity of precipitation has decreased, a phenomenon for which several explanations can be advanced. An increase in total cloud cover with a decrease in precipitation can occur when long-term global processes transpire in the atmosphere resulting in a qualitative change in cloud cover in the direction of an increase in the quantity of non- rain-bearing clouds. Dust storms may also play a role. Data for a 64- year

period were used in determining precipitation cycles in Guinea; periods close to 11 and 5 years were detected (periods close to solar activity cycles). Figures 4; references: 5 Russian.

UDC 551.46.06:551.466.3

**Spatial-Temporal Characteristics of Wind Waves**  
*18650073b Kiev MORSKOY GIDROFIZICHESKIY ZHURNAL in Russian No 5, Sep-Oct 88 (manuscript received 8 Jun 87, after revision 10 Nov 87) pp 45-51*

[Article by M. U. Vapnyar, S. V. Dotsenko, K. V. Dudka and I. V. Kireyev, Sevastopol Instrument Making Institute; Pacific Ocean Oceanological Institute, Far Eastern Department, USSR Academy of Sciences; State Oceanographic Institute, USSR State Committee for Hydrometeorology]

[Abstract] A theory was developed showing that with extremely general assumptions the line of constant correlation of the field of rises of random surface waves in the range of small spatial scales is an ellipse which characterizes this field. The parameters of the spatial-temperature field structure can be determined directly from the results of synchronous measurements for a set of spaced points. Such a method, used in measurements in the Caspian Sea, is described. The parameters of spatial-temporal variability of the wave field were computed using a special set of interrelated computer programs which included programs for determining the correlation functions and spectra of processes registered at each point, cross-correlation functions between all pairs of processes, programs for computing a number of intermediate experimental coefficients, and on their basis, the parameters of spatial-temporal variability. The results were fed out in the form of tables; the ellipse of spatial field anisotropy and the vector of the rate of transport of its inhomogeneities were sent to a curve plotter which can also be used in representing the spectra, correlation and cross-correlation functions. Estimates of the characteristics of wind waves are given. The method is applicable for determining the parameters of the spatial-temporal structure of any homogeneous stationary wave fields and is especially effective in test ranges. Figures 3; references: 10 Russian.

UDC 551.465.73

**Influence of Temperature Inversion in Atmospheric Boundary Layer on Ocean-Atmosphere Heat and Mass Exchange**  
*18650073c Kiev MORSKOY GIDROFIZICHESKIY ZHURNAL in Russian No 5, Sep-Oct 88 (manuscript received 23 Jun 87) pp 59- 61*

[Article by G. G. Khundzhua, Ye. G. Andreyev, A. A. Budnikov and A. N. Romanchenko, Moscow State University imeni M. V. Lomonosov]

[Abstract] A study was made of the mechanism governing the effect of the thermal structure of the atmospheric near-water layer on heat and mass exchange in the



ocean-atmosphere system. Data on temperature and relative humidity were used in computing the distribution of absolute humidity and air density in the near-water layer and in demonstrating that an increase in ocean surface temperature results in an increase in the density of the total heat flow from the ocean to the atmosphere and especially an increase in the density of the water vapor flow. This results in an increase in heat loss from the ocean surface and heat inflow in the atmospheric near-water layer due to the thermal effect of mixing, which results in an increase in the temperature difference in the inversion layer. An increase in the temperature difference ensures an increase in stability of stratification of the initial part of the near-water atmospheric layer. An increase in stable stratification in turn results in difficulty in the turbulent transfer of water vapor. The temperature inversion layer is therefore a singular negative feedback mechanism regulating the rate of entry of heat and moisture into the atmosphere. Figures 3; references: 4 Russian.

UDC 551.466.81

#### Mass Transport by Slightly Nonlinear Internal Waves

18650076d Moscow *IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian* Vol 25 No 1, Jan 89 (manuscript received 1 Sep 87) pp 64-72

[Article by A. A. Belobrov, A. A. Slepyshev, V. S. Shamov and A. N. Shcherbakov]

[Abstract] A study of the spatial-temporal structure of the field of internal waves in the seasonal thermocline in the Tropical Atlantic was made during the 33d cruise of the "Akademik Vernadskiy." An analysis of spectra of the zonal and meridional current velocity components indicated that the field of internal waves is characterized by spatial-temporal intermittence. The short-period internal waves have a packet structure. The mean movements induced by a solitary packet of such waves are determined. A two-layer model is used in investigating the deformation of the jump layer in the packet field. Estimates of the horizontal transport of mass are made using data from in situ measurements in the packet field and in a slightly nonlinear plane wave without the Boussinesq approximation. Mean movements are induced, for example, with the passage of 20-minute internal waves. The jump layer rises slightly and the free surface is bent. The horizontal mass flow in the packet field is non-zero and is directed in the direction of packet propagation. For a slightly nonlinear plane wave, since the envelope is not dependent on the horizontal coordinate, the vertical velocity of the induced movement is equal to zero and a horizontal drift of fluid particles is present everywhere in the wave field. Figures 5; references: 7 Russian.

UDC 551.463.5

#### Change in Attenuation Index of Sea Water Under Influence of Solar Radiation in Ultraviolet Spectral Region

18650076f Moscow *IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian* Vol 25 No 1, Jan 89 (manuscript received 22 Oct 85, after revision 29 Dec 86) pp 98-102

[Article by I. A. Samokhina and A. S. Tibilov]

[Abstract] Not all the factors involved in formation of the spatial-temporal structure of optical characteristics of sea water have been well studied. This article is devoted to the earlier uninvestigated influence of solar radiation in the UV spectral region as a natural factor affecting the formation of the diurnal variation of the sea water extinction index in the surface layer by the photochemical effect exerted on organic matter dissolved in sea water. The data used were obtained in laboratory experiments for purifying sea water from dissolved organic matter, indicating that under the influence of hard UV radiation of arc lamps yellow matter is destroyed and the extinction index decreases. The laboratory investigations had to be confirmed by in situ observations because the radiation spectra of the sun and a mercury lamp with light filters could differ appreciably, seriously affecting the quantitative characteristics of the phenomenon. Daylong stations were occupied in the Black Sea (from aboard a drifting ship) with samples taken at three horizons. The samples were filtered and their optical characteristics were measured using a spectrophotometer with a 5-nm interval. The article gives the results of observations at 44 stations on cloudless or cloudy days. It was found that the index of light extinction by yellow matter in the surface layer changes substantially under natural conditions under the influence of UV radiation, exhibiting a periodic diurnal variation related to transition from light to dark and the change in the spectral composition of irradiating sunlight in the course of the day. The change in light extinction by sea water under the influence of UV radiation has a photochromic character. A diurnal photochemical layer arises in the surface layer due to the influence of solar UV radiation. Figures 3; references 7: 5 Russian, 2 Western.

#### Finnish-Built Vessel "Ioffe" Joins Oceanology Institute's Fleet

18650113a Moscow *SOVETSKAYA ROSSIYA in Russian* 19 Feb 89 p 2

[Article by Zh. Azarova, Kaliningrad]

[Text] A new scientific ship, the "Akademik Ioffe," has been berthed in the Kaliningrad commercial seaport. This vessel has been added to the fleet of the Institute of Oceanology.



"This scientific research vessel (NIS) is the 'twin brother' of another of our recent acquisitions—the NIS 'Akademik Sergey Vavilov,' which was received in February of last year," related V. Paka, director of the oceanology institute's Atlantic branch. "These vessels were ordered as a pair from Finnish shipbuilders, and they will work together. Their main specialty is acoustic research of the ocean, and their scientific equipment accordingly is designed so that the first vessel can receive information that is gathered from the second—the 'Akademik Ioffe.'

"The 'Akademik Ioffe' carries the most modern equipment. Its central computer control station is connected directly with computers in laboratories, of which there are several on the vessel. This permits immediate processing of data that is obtained.

"In a few days, the 'Akademik Ioffe' will depart on its first cruise to the Atlantic, where its first meeting with the 'Vavilov' will also take place; the two vessels will work together. This expedition will be headed by Professor Yu. Zhitkovskiy, and the ship will be commanded by sea captain N. Apekhtin."

**Research Ship Detained in Sierra Leone for Carrying "Submarines"**  
*18650113b Moscow SOVETSKAYA ROSSIYA in Russian 24 Feb 89 p 6*

[Unattributed article]

[Excerpt] Navigator N. Serov of Kaliningrad writes: "As has become known, the research vessel 'Akademik Mstislav Keldysh' will return from a cruise several weeks later than was planned. This is said to be connected with an incident which occurred in Sierra Leone. Equipment intended for military operations allegedly was discovered there on board the Soviet ship, during a customs inspection. Rumors are circulating that authorities of this country arrested a portion of the crew and tortured them. Can your newspaper clarify this matter?"

Our correspondent Zh. Azarova asked V. Paka, director of the Atlantic branch of the USSR Academy of Sciences' Institute of Oceanology, to respond to this reader's query:

"The purpose of the cruise of the vessel 'Akademik Mstislav Keldysh' was to test deep-diving 'Pisces' craft following repairs and refitting of these craft which had been done in Poland with the participation of specialists of a West German firm. The crew had to take these specialists on board to perform additional work. The place appointed for this meeting was Freetown, and the 'Keldysh' arrived there on 3 February, precisely in accordance with the agreement. On the following day, however, while departure formalities were in progress, the port authorities of Freetown declared the vessel under arrest, stating: 'You have submarines on board; your ship is therefore a military one and differently accountable.'

"The absurdity of this declaration is obvious.

"The Soviet government addressed a note of protest to the government of Sierra Leone. A commission of this country was authorized to work on board the 'Keldysh.' The vessel was cleared of all suspicion as a result of this inspection, as was to be expected.

"Our crew was on board its ship all this time. No repressions, threats, or force were used against the participants of the expedition and seamen. V. Kazmin, Captain of the 'Keldysh,' has reported that the crew displayed self-control and observed public order. The story could end here; the incident is closed. The detainment of the research ship has altered the expedition's program, however, the representatives of the West German firm returned home without waiting for the results of the inspection. It has therefore been necessary to extend the period of the cruise."

UDC 551.511.6

**Nonlinear Mechanism for Development of Atmospheric Turbulence**

18650055a Moscow IZVESTIYA AKADEMII NAUK  
SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 24 No 11, Nov 88 (manuscript received  
29 Jun 87 pp 1155-1162

[Article by Lyu Shida and Chzhen Tzuguan, Kiev State University]

[Abstract] The fundamental systems of equations of atmospheric motion and their spectral models used for studying turbulence are examined. The concepts and methods of the modern qualitative theory of nonlinear dynamic systems are applied for this purpose. The problems involved in the generation of turbulence and some physical processes in the atmospheric surface layer are discussed. In a spectral model of a stipulated dynamic system there are states of mean O, periodic P, random (turbulent) T and transient T-P movements, depending on the values of the control parameters  $Re$  and  $Ri$  and initial conditions, with allowance for the vertical transport of motion and temperature (heat). The distribution of states of motion is represented graphically. The phase trajectories for the states P, T and T-P corresponding to different regions on the graph are examined. In the case of stochastic processes use is made of spectral analysis for obtaining the integral characteristics of dynamic equations. The theoretical analysis agrees well with computation of phase trajectories and the results of spectral analysis, which confirms the conclusion that there is stochasticity in a deterministic system. A physical interpretation of the generation of turbulence is given. The interactions of the O, P and T fields and the variability of turbulence in the atmospheric boundary layer are discussed. Figures 3; references 7: 6 Russian, 1 Western.

UDC 551.521.31:551.591

**Atmospheric Transparency Under Conditions of Sharply Continental Climate**

18650055b Moscow IZVESTIYA AKADEMII NAUK  
SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 24 No 11, Nov 88 (manuscript received 28 Apr 87,  
after revision 21 Oct 87) pp 1170-1174

[Article by D. Ganbaatar, D. Khaltar and G. F. Sitnik, Mongolian State University; Moscow State University]

[Abstract] A study was made of the results of experimental investigations of the characteristics of atmospheric transparency in the Mongolian People's Republic, characterized by a sharply continental climate. The role of the principal factors exerting an influence on atmospheric transparency is analyzed and the statistical characteristics of the temporal variability of transparency are

investigated. Between 1970 and 1982 there was a tendency to an increase in atmospheric turbidity, evidently associated with a continuous increase in the influence of anthropogenic factors. Against the background of a general decrease in atmospheric transparency there were years with anomalous transparency due to the influence of natural factors. It was found that the change in atmospheric transparency is related for the most part to the replacement of air masses and the influence of anthropogenic factors. An increase in atmospheric transparency occurs in periods of anticyclonic weather, whereas a decrease is associated with the passage of fronts. Seasonal changes in aerosol and most atmospheric turbidity factors indicated that the influence of urban aerosols on atmospheric transparency is expressed to the greatest degree during winter. Analysis of these investigations made it possible to prepare maps of atmospheric transparency and to refine computations of the receipts of solar radiation over the territory in different seasons of the year. Figures 2; references: 9 Russian.

**Tropical-Storm Research Expeditions Yield Mixed Results**

18650056a Moscow VOZDUSHNYY TRANSPORT in  
Russian 20 Dec 88, No 152 (1712) p 3

[Article by V. Torishniy]

[Abstract] The article reports on results of research of tropical storms which was conducted recently by expeditions to Vietnam and Cuba. Personnel of the Central Aerological Observatory (TsAO) of the USSR State Committee on Hydrometeorology were among the members of these expeditions. Laboratory airplanes assigned to the flight-testing complex of the State Scientific Research Institute of Civil Aviation (GosNII GA) were used in the tropical-storm studies.

Test-pilot V. Fedotov was the senior member of the crew which piloted the IL-18D "Tsiklon" airplane of the expedition to Vietnam. V. Yaroshenko, an engineer of GosNII GA, and a group of technicians under the direction of engineer V. Krivchenko took part in this expedition. Yaroshenko's task was to determine effects of precipitation on the airplane's aerodynamic characteristics. Vladimir Ostrovskiy and Yuriy Kopylov, specialists of TsAO, related that the IL-18D carried a great variety of scientific research equipment which can provide practically every parameter for judging tropical storms which is possible at the present time. This equipment was tested in conditions which were close to those of an actual typhoon. However, no such storm developed during the cyclone season in Vietnam, owing to a rare weather abnormality. Test-pilot Viktor Brylistyy mentioned that further expeditions to this area are planned.

The Cuban expedition was headed by G. Beryulev. This expedition's AN-12 "Tsiklon" airplane was flown by test-pilots Valentin Nikolayevich Shutov and S. Altukhov. During a flight into the center of Hurricane Gilbert, the airplane was guided by instrument readings which a scientific group provided. This group consisted of TsAO associates and Cuban researchers. Aleksandr Litinetskiy, deputy scientific director of the expedition, related that the rotational velocity of the wind around the area of atmospheric depression in the hurricane exceeded 150 kilometers per hour. Special methods for flights into tropical storms are to be developed, with the participation of aviators, on the basis of unique data gathered during the expedition to Cuba.

UDC 551.576.11:551.521.3

#### Remote Determination of Liquid-Water Content of Droplet Clouds by Spectroscopic Method

18650064a Moscow IZVESTIYA AKADEMII NAUK  
SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 24 No 10, Oct 88 (manuscript received  
5 Nov 87) pp 1011-1016

[Article by S. V. Dvoryashin and V. I. Dianov-Klokov (deceased), Atmospheric Physics Institute, USSR Academy of Sciences]

[Abstract] A spectroscopic method is described for determining the liquid-water content of clouds. It is based on measurement of optical density in the water droplet absorption continuum near wavelength 2.06  $\mu\text{m}$  when using the sun as a radiation source. The multiple scattering effect in cloud cover is taken into account by measuring the effective path length of photons in the cloud cover when using the  $\text{CO}_2$  absorption band, overlapping with the water droplet continuum, as a "probe." The measurement results, obtained for single-layer cloud cover, are consistent with similar data from radiometric measurements. Figure 1; references: 14: 13 Russian; 1 Western.

UDC 551.510.42:551.521.31

#### Correlation Between Polarization of Radiation Scattered in Twilight Atmosphere and Vertical Distribution of Aerosol

18650064b Moscow IZVESTIYA AKADEMII NAUK  
SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 24 No 10, Oct 88 (manuscript received  
24 Sept 87) pp 1041-1048

[Article by N. F. Yelanskiy, A. S. Yelokhov, Ye. A. Kadyshevich, O. V. Makarov and S. A. Sitnov, Atmospheric Physics Institute, USSR Academy of Sciences]

[Abstract] This is essentially a continuation of earlier work by the authors (IZV. AN SSSR: FAO, Vol 23, No 3, pp 256-263, 1987) on the polarization of solar radiation scattered at the zenith under twilight conditions. Observations with two instruments indicated that by the

autumn of 1986 the level of disturbances resulting from the eruption of El Chichon volcano in 1982 had virtually quieted. These observations revealed the fine structure of polarization profiles. Data are given characterizing the process of gradual restoration of the polarization level and aerosol content. Measurements of the degree of polarization confirm the conclusion drawn earlier that it is closely dependent on the mass and position of the aerosol layer. The  $P(h_T)$  variations with a vertical scale 2-4 km registered at twilight are not measurement errors but a manifestation of vertical stratification of aerosol distribution in both the stratosphere and troposphere. This conclusion is confirmed by a comparison with lidar observations and with vertical temperature profiles. It is therefore postulated that simple and widely accessible polarization measurements can evidently be used not only for monitoring the stratospheric aerosol layer, but also for more detailed investigations of the vertical distribution of aerosol in the atmosphere from the surface to 30 km or more and also for estimating the horizontal extent of aerosol inhomogeneities in the troposphere and stratosphere. Figures 6; references 9: 4 Russian, 5 Western.

UDC 551.510.42:551.521.31

#### Optical Thickness of Aerosol in Characteristic Sea Regions

18650064c Moscow IZVESTIYA AKADEMII NAUK  
SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 24 No 10, Oct 88 (manuscript received  
29 Oct 87) pp 1058-1065

[Article by V. M. Volgin, O. A. Yershov, A. V. Smirnov and K. S. Shifrin, Leningrad Hydrometeorological Institute; Leningrad Section, Oceanology Institute, USSR Academy of Sciences]

[Abstract] The results of measurements of aerosol optical thicknesses in the visible and near-IR spectral regions are given for different regions of the world ocean. It is shown that only three characteristic regions are statistically distinguishable: 1) regions of the open ocean, 2) coastal regions (together with internal seas), 3) Atlantic Ocean subject to African dust storms. The optical state of the atmosphere in each region is characterized by two parameters:  $\tau_a(500)$  and the Angstrom parameter. The first characterizes the turbidity value and the second characterizes the mean spectral variability  $\tau_a(\lambda)$  in the studied spectral range. An analysis of the spectral curve of aerosol optical thickness indicated that the observational data differ at the center of the visible region and also with respect to the Angstrom parameter. The results of the analysis and the established statistical correlations can be used as a priori information in remote sensing problems. The atmosphere over the ocean is substantially (by a factor greater than 2) more transparent than the atmosphere over other regions. The standard deviations are also less by a factor of 4-5. Regression relations were established between  $\tau_a$  in the blue and red spectral regions. These can be used in algorithms for excluding

the atmospheric influence. Two eigenvectors are adequate for modeling the characteristics of the spectral variation  $\tau(\lambda)$  in the marine atmosphere. Figure 1; references 8: 6 Russian, 2 Western.

UDC 551.578.11

**Characteristics of Attenuation and Scattering of Microwave Radiation by Spheroidal Precipitation Droplets**

18650064h Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 24 No 10, Oct 88 (manuscript received 23 Mar 87, after revision 23 Mar 88) pp 1107-1111

[Article by S. Yu. Matrosov and Yu. M. Timofeyev, Leningrad State University]

[Abstract] One of the methods for computing the characteristics of attenuation and scattering of radiation by a spheroidal particle is the perturbations method in which the sought-for solution is found in the form of a series for the parameter of elongation of a spheroid, constituting half the difference between the semiminor and semiaxes of a spheroid normalized to the radius of a sphere equivalent in volume to the particular spheroid. This method can be used in computing the characteristics of propagation of microwave radiation in rain, which is simulated by an ensemble of independent spheroidal droplets with a vertical symmetry axis. Computations of the polarization characteristics of propagation of microwave radiation in rain indicated that radiation with horizontal polarization is attenuated to a greater degree than is vertical polarization. With horizontal polarization reflectivity is also greater than with vertical polarization. For both polarizations the absolute values of the characteristics of propagation of microwave radiation in the rain are considerably dependent on the droplet-size distribution function. Empirical expressions were derived relating the characteristics of propagation and the intensity of precipitation. It is shown that the information yield of meteorological radar observations can be increased by allowance for the dependence of the characteristics of reflection of microwave radiation by spheroidal particles on polarization. The absorption coefficients of microwave radiation in precipitation with horizontal polarization are greater than with vertical polarization. These and other findings are useful in research on hydrometeors. References 7: 3 Russian, 4 Western.

UDC 551.574.13

**Ice-Forming Activity of Atmospheric Aerosol**

18650064i Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 24 No 10, Oct 88 (manuscript received 11 May 87) pp 1111-1113

[Article by V. G. Khorguani, Geophysical Institute, Georgian Academy of Sciences]

[Abstract] An empirical formula is derived for determining the ice-forming activity of atmospheric aerosol. The ratio of the number of crystals formed on active nuclei at

a given temperature to the total number of aerosol particles for a selected size interval is considered the measure of aerosol ice-forming activity. The experimental dependence is:  $N_{ice}/N = K\Delta S d^{\alpha} e^{\beta\Delta T}$ , where  $\Delta S = E/E_{ice} - 1$  is the supersaturation of water vapor relative to the ice surface,  $E$  is water vapor pressure,  $E_{ice}$  is the pressure of saturated water vapor over the ice surface,  $k$ ,  $\alpha$  and  $\beta$  are coefficients,  $K = 1.1 \text{ cm}^{-\alpha}$ ,  $\alpha = 1.5$ ,  $\beta = 0.4 \text{ degree}^{-1}$ ,  $d$  is the diameter of aerosol particles-ice nuclei. The range of applicability of this expression is discussed. For example, if  $E_{ice}/E$  is less than 1, that is, there is incomplete saturation of water vapor relative to ice, the formation of crystals on nuclei does not occur. A series of examples is given, however, indicating that this expression with a high accuracy can be used in ascertaining the ice-forming activity of atmospheric aerosol and for modeling microphysical processes in clouds. Figures 2; references 7: 5 Russian, 2 Western.

UDC 551.513(47)

**Winter Atmospheric Circulation in European USSR and Its Climate-Forming Role**

18650070 Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA: SERIYA 5—GEOGRAFIYA in Russian No 1, Jan-Feb 89 (manuscript received 6 May 88) pp 51-58

[Article by L. V. Klimenko, Moscow University]

[Abstract] Winter atmospheric circulation in the European USSR and its climate-forming role are analyzed using a classification developed earlier by the author. The basis for this classification is the uniformity of development of an atmospheric process within the framework of a natural synoptic period both at the surface and at  $AT_{500}$  altitudes. The average development of such a process is usually 5-6 days. Eighteen standard synoptic processes, combined into five related groups, are defined. The alternation of these synoptic processes gives rise to the climatic background, whose nature must be clear for a meaningful understanding of year-to-year changes. Prolonged periods of warmings and coolings are observed in the European USSR. The synoptic structure of periods of predominance of cold and warm winter seasons for the considered period (1891-1984) is given in Tables 5 and 6 respectively. During this time the number of years in periods of predominance of cold winter (38) and warm winter (56) seasons is evidence that the continuing process of global warming is definitely occurring in the European USSR. Figure 1; references; 8 Russian.

UDC 528.11+528.74:69.058.001.42

**Optimization of Parameters in Stereophotogrammetric Survey for Checking Structural Deformations**

18650071 Moscow GEODEZIYA I KARTOGRAFIYA in Russian No 1, Jan 89 pp 29-32

[Article by V. I. Starodubtsev and V. V. Didenko]

[Abstract] In contrast to known approximate methods for determining the optimal geometric parameters of a

stereophotogrammetric survey, more applicable for a survey of plane objects, a method is proposed for solving this problem quite precisely when checking deformations of three-dimensional structures. This involves determining the coordinates of survey points  $S_1$  and  $S_2$  and the convergence angle  $\gamma$  for making a final survey. The optimal geometric measurement scheme will be one for which the actual accuracy in determining the coordinates of all points is close to (but not below) the stipulated accuracy in checking deformations. The limitations are the accuracy in stereophotogrammetric measurements of the space coordinates as a function of the range and angle of the field of view of the survey camera. The initial data used in developing the method for optimization of the geometric parameters of the stereophotogrammetric survey were obtained from investigations of the patterns of distribution of errors in determining the coordinates of points of structures in the planes XY, YZ, XZ for different focal lengths, errors in orientation elements and convergence angles (a total of 36 variants). The investigations were made using formulas for evaluating the accuracy in direct stereophotogrammetric intersection, taking into account all the principal sources of errors for the general case of a stereophotogrammetric survey. The principal results of this research are given and the essence of the method for the optimization of the geometrical parameters of such a stereosurvey are outlined. Figures 3; references: 3 Russian.

UDC 551.521.32

**Analysis of Aerosol Attenuation of Radiation With Allowance for Atmospheric Moisture Content**  
18650076a Moscow IZVESTIYA AKADEMII NAUK  
SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 25 No 1, Jan 89 (manuscript received  
27 Apr 87) pp 31-39

[Article by K. A. Tavartkiladze and G. A. Mestiashvili, Geography Institute, Georgian Academy of Sciences]

[Abstract] A study was made of the dynamics of an optical-meteorological model of aerosol attenuation of radiation as a function of a wide range of water vapor elasticity and relative humidity values. The model used is that proposed earlier by M. S. Malkevich and the instrumentation and method are described elsewhere. The problem was solved using observational data for 1979-1982 collected on the shores of the Black Sea. Research was in the visible spectral range over the continent, over the land-sea zone and over the sea. Significant differences were found in the dependence between aerosol optical density and relative humidity over the continent and over the sea surface. A variety of reasons are advanced for the wide range of dependencies observed between aerosol attenuation of radiation and relative humidity. Therefore, in the modeling of aerosol attenuation of radiation in the real atmosphere as a function of relative humidity there must either be a quantitative determination of the component composition of aerosol and the known dependence between the

optical parameters of individual components and relative humidity must be used in determining the total effect of attenuation of radiation by aerosols or the regional climatic state of this dependence must be determined. Figures 6; references; 11 Russian.

**Research on Microphysical and Optical Characteristics of Dust Aerosols in Different Regions of USSR**

18650076b Moscow IZVESTIYA AKADEMII NAUK  
SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 25 No 1, Jan 89 (manuscript received 12 Nov 87,  
after revision 2 Mar 88) pp 40-44

[Article by A. V. Andronova, V. M. Minashkin, I. Ye. Cherlina, K. V. Glagolev and S. Latyfov, Physical Chemical Scientific Research Institute imeni L. Ya. Karpov]

[Abstract] There has been no comprehensive research on the optical and microphysical properties of samples of different kinds of dust and soil in a wide range of the spectrum of electromagnetic radiation making it possible to carry out their comparative analysis. Such a study was made in a special chamber with a volume of  $10 \text{ m}^3$  outfitted with instruments and devices for measuring the necessary parameters. Simultaneous measurements were made of the spectral variation of the attenuation coefficient by the base method in the range  $0.4\text{-}1.2\mu\text{m}$  and  $2.5\text{-}14\mu\text{m}$  with a scanning time of 3 minutes; particle size distribution was determined by a photoelectric counter; mass concentration was ascertained by the aspiration method; samples were taken on a backing for ascertaining probability of survival of a photon with a photometer operating in the range  $0.4\text{-}2.5\mu\text{m}$ . The spectral variation of the complex refractive index of dust and soil particles in the range  $2.5\text{-}14\mu\text{m}$  was determined using the results of measurements of the transmission spectra of these particles. Soils from different regions of the USSR were investigated. Computations of the measured parameters were computed using the Mie theory. A good agreement between the measured and computed characteristics made it possible to use the computed characteristics in the absence of experimental data. In addition, such data are useful in evaluating the noise immunity of various optical instruments operating under very dusty conditions and in computations of atmospheric heat and mass exchange during dust storms and volcanic eruptions. Figures 4; references 10: 8 Russian, 2 Western.

UDC 551.510.534:551.501.71

**Multiwave Method for Measuring Atmospheric Ozone Content With Optimization of Parameters Based on Observation Results**

18650076c Moscow IZVESTIYA AKADEMII NAUK  
SSSR: FIZIKA ATMOSFERY I OKEANA in Russian  
Vol 25 No 1, Jan 89 (manuscript received  
23 Oct 87) pp 45-52

[Article by A. M. Lyudchik, V. V. Zhuchkevich, A. N. Krasovskiy and L. N. Turyshev, Applied Physical Problems Scientific Research Institute imeni A. N. Sevchenko]

[Abstract] A multiwavelength method is proposed for determining the total content of ozone by photometric measurement of direct UV solar radiation reaching the

Earth's surface, making it possible to increase the accuracy in measuring total ozone content. It is assumed that the instrument registers the density of the flux of direct solar radiation in quite narrow spectral intervals in the ozone absorption region 280-340 nm, that the atmospheric model is based on a linear dependence of aerosol attenuation on wavelength and that there are no other atmospheric impurities making a significant contribution to absorption of UV radiation in the considered wavelength region. Procedures and formulas are proposed for reducing the systematic error in total ozone content by accumulation of the results of observations by means of more precise determination of the parameters of the method. During the course of work the systematic errors in the values of the exoatmospheric constants and the effective ozone absorption coefficient are eliminated. The effectiveness of the method is demonstrated in a mathematical model. The practical application of the method for a specific spectrometer involves overcoming certain additional difficulties not adequately reflected in the model. References 14: 4 Russian, 10 Western.

UDC 551.551.8

**Influence of Wind Shear on Admixture Scattering**

18650076e Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 25 No 1, Jan 89 (manuscript received 18 Feb 87, after revision 18 Feb 88) pp 95-98

[Article by M. I. Pekar, Applied Geophysics Institute]

[Abstract] Wind shear in combination with vertical turbulent exchange affects the increase in horizontal extent of clouds of admixture scattering in the atmospheric boundary layer (ABL). Earlier studies have shown that with a linear wind profile  $u(z)$  and a constant vertical diffusion coefficient  $K_z(z)$  there is a cubic regime of increase in shear dispersion with time. However, the question arises of the role of wind shear for arbitrary  $u(z)$  profiles at different levels from the Earth's surface, including the relationship between the components of shear and turbulent dispersion. This problem can be solved only by numerical integration. The article gives the results of such computations for several types of wind shear. An analytical study made it possible to evaluate the dependence of horizontal dispersion on wind shear. The study was made specifically for the case of a neutrally stratified ABL. The principal result of the computations was the finding that a cubic regime of increase in shear dispersion with time is unrelated to a constant wind shear. It is characteristic in the initial stage of the process for arbitrary  $u(z)$  profiles. This conclusion is supported by analytical investigations. Figure 1; references 7: 3 Russian, 4 Western.

UDC 551.521.32

**Computation of Characteristics of Atmospheric Thermal Radiation Transfer on Basis of Direct Integration Method**

18650076g Moscow IZVESTIYA AKADEMII NAUK SSSR: FIZIKA ATMOSFERY I OKEANA in Russian Vol 25 No 1, Jan 89 (manuscript received 20 Jul 87, after revision 2 Mar 88) pp 106-109

[Article by A. N. Trotsenko and B. A. Fomin]

[Abstract] There has been a need for a substantial increase in the accuracy of description of the transfer of IR radiation in the atmosphere. This can be done only using computations based on the direct integration method (DIM). The authors developed an effective DIM making it possible to overcome computation difficulties attributable to the complexity of molecular spectra (about  $10^5$  lines). This article is devoted to correct allowance for optical inhomogeneity of the atmosphere. The procedure involves discarding of the traditionally used breakdown of the atmosphere into a series of homogeneous layers since such a method for approximating the vertical profiles of important properties has a poor convergence, resulting in appreciable errors in computing IR characteristics. Formulas are derived which were used in computing detailed (27 levels from 0 to 100 km) profiles of ascending and descending fluxes in a narrow spectral interval for cloudless atmospheric conditions. The method for taking stratification into account exerts the most appreciable influence on the accuracy in computing fluxes. Rather significant discrepancies are observed in regions of strong absorption and a high gradient of the temperature profile because in these cases there is a considerable distortion of the dependence of atmospheric absorptive-emissive properties on altitude. Allowance for stratification does not exert such a significant influence in a region of a slight change in temperature with altitude. The latter applies to different degrees to cases of a low content of absorbents. The described method can be easily generalized to take cloud cover and aerosol into account. References 11: 5 Russian, 6 Western.

UDC 681.3:528.7

**Cloud Type Classification Using Spatial Image Spectra**

18650079a Tomsk OPTIKA ATMOSFERY in Russian Vol 1 No 11, Nov 88 (manuscript received 13 Jul 88) pp 38-45

[Article by N. I. Arzhenenko and V. G. Bondur]

[Abstract] The article gives the results of optical-digital processing of photoimages of cloud cover, a classification of the corresponding forms of two-dimensional spatial spectra (SS) and an evaluation of the statistical separability of cloud groups on the basis of the informative criteria of two-dimensional SS. This is illustrated by fragments of photoimages of cloud cover obtained from "Salyut-6" and "Salyut-7" and the corresponding two-dimensional spatial spectra. The images were processed using a special optical-digital processor. The analyzed surface sectors measured 96 x 96 km. Different cloud structures correspond to different SS forms. The classification and quantitative description of forms of two-dimensional spectra are discussed in detail. A table gives the informative criteria for two-dimensional SS corresponding to the eight illustrated photoimages. The procedures and formulas for statistical separation of cloud

groups (based on the maximum distance test in five-dimensional Euclidean space of cloud characteristics) on the basis of two-dimensional spectra criteria are presented. These criteria can be used in processing space images for classifying cloud types. Figures 2; references; 8 Russian.

UDC 551.593.5:510.67

**Photodissociation of Optically Active Gases in Mesosphere and Lower Thermosphere**

18650079b Tomsk OPTIKA ATMOSFERA in Russian Vol 1 No 11, Nov 88 (manuscript received 10 Jun 88) pp 46-54

[Article by V. L. Dvortsev and S. G. Zvenigorodskiy, Leningrad Hydrometeorological Institute]

[Abstract] Photodissociation plays a highly important role in forming atmospheric optical properties. Photolysis is most clearly manifested in the altitude range 50-120 km (mesosphere and lower thermosphere). Since some of the literature is now outdated, this review gives a systematic exposition of the present status of this problem. It summarizes the principal factors exerting an influence on the accuracy of computations of the photodissociation constants (the method for computing the photodissociation constants is that developed in various publications by M. Nicolet) and gives parametrizations making possible a considerable simplification of these computations. Vertical profiles of the photolysis constants are given for the principal optically active gas components of the upper atmosphere. Figures 4; references 17: 3 Russian, 14 Western.

UDC 551.510.7

**Choice of Optimal Time Interval Between Image Registries in Correlation-Extremal Measurements of Optical Inhomogeneity Drift Velocity**

18650079c Tomsk OPTIKA ATMOSFERA in Russian Vol 1 No 11, Nov 88 (manuscript received 4 May 88) pp 62-67

[Article by Ye. V. Stoykova, E. S. Ferdinandov and V. A. Mitev, Electronics Institute, Bulgarian Academy of Sciences, Sofia]

[Abstract] A study was made of the influence of the time interval between the moments of registry of images in a correlation-extremal determination of the velocity of horizontal drift of atmospheric inhomogeneities. The computations of measurement errors were made analytically and using statistical simulation. The experimental results of measurement of the velocity of drift of cloud fields by a system with a CCD sensor are given. Series of correlated images of cloud fields were obtained which were registered at identical time intervals with a constant drift rate during the measurement time. These data were used in experimental checking of formulas derived in the article. It is shown that with an increase in the time

interval between the moments of registry of images the fluctuations are smoothed and a good agreement is obtained between the results obtained using correlation and structural algorithms. The results can be used for optimizing the characteristics of the working mode of correlation-extremal systems with respect to the accuracy in measuring the velocity of horizontal drift of randomly inhomogeneous atmospheric fields and also in designing such systems. Figures 4; references 11: 4 Russian, 7 Western.

UDC 535.3

**Quantitative Remote Diagnosis of Oil Pollution in Water Volume**

18650079d Tomsk OPTIKA ATMOSFERA in Russian Vol 1 No 11, Nov 88 (manuscript received 18 Aug 88) pp 99-103

[Article by A. G. Abroskin, S. Ye. Nolde and V. V. Fadeyev, Moscow State University imeni M. V. Lomonosov]

[Abstract] Lidars aboard ships and aircraft have already been used for 15 years in research on petroleum pollution in the ocean, but their use in monitoring is restricted due to the lack of reliable algorithms for solving the inverse sensing problem: determining the pollutant concentration from the echo signal. This problem is difficult because the petroleum in the ocean is in different degrees of degradation (film, emulsion, water-soluble fraction). Little progress has been made in solving this problem. This article reports on investigations of the fluorescent characteristics of different petroleum products. Algorithms useful in solving the problem by remote laser fluorescent determination of water-soluble and emulsified fractions are proposed. Particular attention is given to the UNESCO method for fluorescent determination of petroleum products with preliminary extraction by hexane. The results of research on solutions of petroleum in hexane make it possible to propose an excitation wavelength 220 nm and a registry wavelength 290 nm for determining the concentration of petroleum pollution by the extraction method. This greatly reduces the error in the method outlined in UNESCO-IOC handbooks when working with a very broad class of petroleum pollutants. Measurement data for hexane solutions of different petroleum products and the spectral characteristics of different forms of petroleum products reveal the possibility for a quantitative determination of emulsified light petroleum products and the water-soluble fraction of petroleum products directly in the water with excitation at a wavelength 222 nm. Figure 1; references 13: 9 Russian, 4 Western.

UDC 537.876.23.029.7:551.510.52

**Water Vapor Absorption of  $^{13}\text{C}^{16}\text{O}_2$  and  $^{12}\text{C}^{18}\text{O}_2$  Laser Radiation**

18650079e Tomsk OPTIKA ATMOSFERA in Russian Vol 1 No 11, Nov 88 (manuscript received 11 Aug 88) pp 104-107

[Article by R. M. Akimenko, V. N. Arefyev, Yu. I. Baranov, A. M. Seregin, N. I. Sizov and N. V. Cheburkin, Tayfun Scientific Production Association, Obninsk]

[Abstract] There is increased interest in lasers using



carbon dioxide isotopes, making it possible to broaden the range of wavelengths and for some generation lines to reduce absorption in comparison with a laser using the main isotope  $^{12}\text{C}^{16}\text{O}_2$ . This article gives the results of measurements of water vapor transmission of the lines of  $^{12}\text{C}^{18}\text{O}_2$  and  $^{13}\text{C}^{16}\text{O}_2$  lasers (for which other information is lacking or unreliable) in comparison with data for a  $^{12}\text{C}^{16}\text{O}_2$  laser. Laboratory experiments were made using a multipass optical cell on a path 3.16 km at room temperature, at pressures  $2 \times 10^{-3}$ -1 atm and humidities 2-20 g/m<sup>3</sup>. A universal tunable CO<sub>2</sub> laser was used in the work. The article gives a comparative analysis of the role of absorption of atmospheric gases for the strongest laser lines of the three CO<sub>2</sub> isotopes (Table 2). The results obtained for the two new laser variants agree with the model of the water vapor continuum proposed earlier on the basis of measurements using a laser with the main isotope. In the presence of selective absorption the experimental data differ from the computed data. Figures 3; references 3: 1 Russian, 2 Western.

UDC 538.574

**Propagation of Nonlinear Waves in Media With Fluctuating Parameters**

18650080 Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 301 No 5, Aug 88 (manuscript received 19 May 87) pp 1100-1103

[Article by Ye. S. Benilov and Ye. N. Pelinovskiy, Applied Physics Institute, USSR Academy of Sciences, Gorkiy]

[Abstract] Research on the scattering of nonlinear waves in slightly dispersive media with random inhomogeneities is an important aspect of the general theory of waves, but the effects of inhomogeneities in a nonlinear medium have been inadequately studied. Three different approaches have been used in their investigation: the Born approximation, perturbation theory for systems close to integrable and the mean field method. However, the Born approximation is suitable only in small space-time intervals; the use of the second approach assumes integrability of the "homogeneous" problem by the inverse scattering problem method; the widely used mean field method, based on "additive" allowance for nonlinearity and inhomogeneity, has been proven incorrect. The mean field method has therefore been modified. The modification allows a rigorous asymptotic validation. The modification essentially involves a change to a reckoning system moving with a fluctuating velocity, which makes it possible to filter out phase fluctuations and to describe wave profile evolution. It is shown that by conversion to this new reckoning system secular terms are absent at all levels of perturbation theory. References 6: 5 Russian, 1 Western.

UDC 531.536

**Variational Method for Interpolation in Radiation Transfer Theory**

18650083a Tomsk OPTIKA ATMOSFERI in Russian Vol 2 No 1, Jan 89 (manuscript received 11 Jul 88) pp 36-40

[Article by V. V. Uchaykin and V. A. Litvinov, Altay State University, Barnaul]

[Abstract] The problem of extraction of a maximum of information with a minimal quantity of computations is examined. One of the methods which makes it possible to reduce the volume of computations is the perturbation method, widely employed in transfer theory, suitable for approximating the solution of close problems on the basis of the results of solution of one problem. This article describes a new method for extending the results of solution of individual problems to a region broader than in perturbation theory, in complexity not exceeding its first approximation algorithm. The application of the method is examined for solution of wave and kinetic equations describing the propagation of radiation in the atmosphere. It is shown that the new method makes it possible to describe change of the sought-for functionals by more than an order of magnitude. Figures 2; references: 3 Russian.

UDC 535.317.1

**Research on Probabilistic Approach to Attainment of Diffractive Resolution of Optical Systems Under Atmospheric 'Seeing' Conditions**

18650083b Tomsk OPTIKA ATMOSFERI in Russian Vol 2 No 1, Jan 89 (manuscript received 31 Aug 88) pp 41-48

[Article by P. A. Bakut, S. D. Polskikh, K. N. Sviridov and N. Yu. Khomich]

[Abstract] The possibility of attaining diffractive resolution of an atmosphere-telescope system with short-exposure registry of the image of an isoplanatic stationary object is analyzed. The concept of an instantaneous spatial correlation radius of atmospheric distortions of the field of light radiation is introduced and the statistical methods of computer simulation are used in obtaining a gamma distribution of its probability. The resulting distribution is used in studying the probability of good "seeing" and the required number of short-exposure registries of images of the object is found for different relations of telescope diameter D and the Fried parameter  $r_0$  for obtaining among them at least one diffractively limited solution. The difficulties in practical realization of the probabilistic approach are examined. Figures 2; references 7: 1 Russian, 6 Western.

UDC 535.3

**Influence of Strong Optical Radiation on Relaxation Processes in Molecular Gas in Resonance and Nonresonance Interaction**

18650083c Tomsk OPTIKA ATMOSFERI in Russian Vol 2 No 1, Jan 89 (manuscript received 4 Oct 88) pp 49-54

[Article by B. G. Ageyev, O. Yu. Nikiforova, Yu. N. Ponomarev, V. A. Sapozhnikova and L. K. Chistyakova, Atmospheric Optics Institute, Siberian Department, USSR Academy of Sciences, Tomsk]

[Abstract] An experimental study was made of the dependence of the time of vibrational-translational relaxation in CO<sub>2</sub> and in H<sub>2</sub>O in nonresonance interaction with strong



pulsed radiation (10.6 $\mu$ m) of a CO<sub>2</sub> laser causing both saturation of absorption in the resonance transition in CO<sub>2</sub> and "clearing" (decrease in absorption) of the line wing in H<sub>2</sub>O. Measurements of the dependence of the time of VT relaxation in CO<sub>2</sub> and H<sub>2</sub> on the intensity of radiation at a wavelength 10.6 $\mu$ m were made by an optoacoustic method (represented in a diagram). The radiation source used was a TEA-CO<sub>2</sub> laser with a nonselective cavity whose emission spectrum consisted of two-three components with an energy maximum in the P20 line of the 00<sup>0</sup>1- 10<sup>0</sup> band. The laser generated a monopulse with a duration of 300 ns at the level 0.5 of the maximum amplitude. It was found that with the excitation of CO<sub>2</sub> the relaxation time decreases, whereas in the case of H<sub>2</sub>O it increases with an increase in radiation intensity. Figures 3; references 13: 11 Russian, 2 Western.

UDC 621.373.826.038.823:537.874.7

#### Laser Excitation of Molecular Vibrational Transitions With Dense Rotational Structure of Spectrum

18650083d Tomsk OPTIKA ATMOSFERA in Russian  
Vol 2 No 1, Jan 89 (manuscript received  
27 Sep 88) pp 55-62

[Article by S. V. Ivanov and V. Ya. Panchenko, Scientific Research Center for Technological Lasers, USSR Academy of Sciences, Moscow]

[Abstract] A study was made of linear and nonlinear absorption of laser radiation in the vibrational transitions of molecules with a dense rotational structure of the spectrum such as is typical for curved triatomic atmospheric components. The influence of a number of factors (instability of radiation frequency, its spectral width, irregularity of rotational structure of band spectrum, shape of absorption line contour) on the probability of optical excitation of the vibrational transition is investigated in the quasistationary approximation of incoherent kinetic equations for the populations of energy levels. Criteria are formulated for linear and nonlinear collective absorption of band radiation. The conditions under which there is a square-root dependence of the probability of excitation on emission intensity are defined. Figures 3; references 8: 6 Russian, 2 Western.

#### Influence Functions in Problem of Adaptation of Pressure and Wind Fields on Plane

18650085c Moscow METEOROLOGIYA I  
GIDROLOGIYA in Russian No 2, Feb 89 (manuscript  
received 1 Mar 88) pp 110- 113

[Article by N. I. Manuylova, Atmospheric Physics Institute]

[Abstract] Research on the process of adaptation of the pressure and wind fields on a  $\beta$  plane indicates that the adaptation process occurs over a far longer period than is described by models with a constant Coriolis parameter. The influence of the Earth's curvature is manifested primarily in that the already adapted (geostrophic) pressure and wind fields slowly change their configuration. The isobars tend to be drawn out along the circles of latitude so that at

the time limit a purely zonal geostrophic flow remains. Numerical results have been published only for the single influence function describing the behavior of disturbance of the zonal component of wind speed. This article gives the results of computations of all the influence functions, which make it possible to ascertain the influence of initial disturbances of both horizontal components of wind speed and geopotential. As a simplification, the problem is solved using a barotropic model. A final working formula is derived for computing the influence functions. The calculation algorithm is outlined. The results of computations of the influence functions are given for  $m = 0, 1, 2$  for different moments in time. There is an increase in anisotropy with an increase in distance from the disturbance point and with time. The influence function with  $m = 2$  attenuates most rapidly, whereas the influence of the initial disturbance of the geostrophic meridional wind has the longest effect. Figure 1; references: 5 Russian.

UDC 551.510.42:551.510.522

#### Dispersion of Pollutant From Stationary Sources in Atmospheric Surface Layer

18650085b Moscow METEOROLOGIYA I  
GIDROLOGIYA in Russian No 2, Feb 89 (manuscript  
received 18 Mar 88) pp 37- 47

[Article by V. P. Gavrilov, candidate of physical and mathematical sciences, and Yu. K. Gormatyuk, Tayfun Scientific Production Association]

[Abstract] A study was made of the dispersion of light and heavy pollutants from continuous stationary sources of pollution in the atmospheric surface layer. The dispersion of pollution from such sources is described by a semiempirical turbulent diffusion equation. Analytical solutions were obtained for the field of concentration in the atmospheric surface layer with power-law vertical wind speed and mixing coefficient profiles. The solutions were obtained with allowance for the background concentration of pollutant in the environment, dry precipitation of pollutant onto the underlying surface, the rising of dust or evaporation of the pollutant from the underlying surface and a continuously operative source (that is, with boundary conditions of the third kind). Dispersion, transport, the rising of dust and precipitation of a heavy pollutant are examined only for conditions of atmospheric neutral stratification. These solutions can be used in an analysis of numerous practical ecological problems. References 6: 3 Russian, 3 Western.

#### Spring-Summer Atmospheric Ozone Variations Determined Using Data From Soviet Antarctic Stations

18650085d Moscow METEOROLOGIYA I  
GIDROLOGIYA in Russian No 2, Feb 89 (manuscript  
received 8 Feb 88) pp 113- 116

[Article by A. I. Voskresenskiy, candidate of geographical sciences, V. V. Nesterov, A. M. Sveshnikov, and A. M. Shalamyanskiy and L. N. Yurganov, candidates of physical and mathematical sciences, Arctic and Antarctic Scientific Research Institute]

[Abstract] Preliminary data are given on the total ozone content registered in 1987 at Soviet Antarctic stations and the dynamics of total ozone content for Mirnyy

station are analyzed for the period 1976-1987 (Fig. 1 gives these data for Mirnyy for the months September-February during that decade). This station has a seasonal ozone content maximum in November, at the time of destruction of the winter stratospheric cyclonic circumpolar vortex. Recent measurement data (September-December 1987) indicate a continuing decrease in ozone content, even in comparison with 1985. The year-to-year ozone content decrease is characteristic for all months of the light period of the year. During recent years a quasi-biennial periodicity has appeared in September-November: in odd years the ozone content was lower than in even years. A decrease is observed not only in spring, but in summer as well, when the vortex has already been destroyed. The total ozone content was lower in Antarctica in the spring of 1987 than in any preceding year. The nature of the ozone variations in different regions of Antarctica was different and was dependent on the position of the station relative to the winter stratospheric vortex. The minimal ozone contents were observed at Novolazarevskaya and Vostok stations (160 Dobson units). At Novolazarevskaya the ozone decrease was observed in the layer from 12 to 22 km. Figures 4; references 8; 5 Russian, 3 Western.

UDC 911.2.577.47+330.15:629.78

**International Geosphere-Biosphere Program. Key Aspects of Requirements on Observational Data From Space**

18650086 Moscow *IZVESTIYA AKADEMII NAUK SSSR: SERIYA GEOGRAFICHESKAYA in Russian No 1, Jan-Feb 89 (manuscript received 15 Apr 88) pp 20-27*

[Article by K. Ya. Kondratyev and O. M. Pokrovskiy, Limnology Institute, USSR Academy of Sciences]

[Abstract] The principal fields of research being pursued under the International Geosphere-Biosphere Program are outlined. The importance of organizing a global observation system by both surface and space systems is stressed. Emphasis is on problems related to the optimization of planning of space observation systems with allowance for the requirements of the informational approach, the capabilities of instrumentation and cost factors. The requirements of users of space information in different fields are defined. A comparison of such requirements with the characteristics of currently used instrumentation on meteorological and natural resources satellites revealed that these characteristics are not optimal. Optimization using the criterion of maximal information yield made it possible to determine an appropriate set of spectral sensing channels in the interests of four

groups of problems: oceanology, hydrology, geology, forestry and agriculture (particular attention is given to the requirements of oceanology). It is clear that the maximizing of the integral economic efficiency index, taking into account the multiband nature of space information and its multipurposes for each group of problems, will make it possible to differentiate the spectral sensing channels on the basis of their information yield. Table 1 lists the characteristics of satellite instrumentation (MSS, TM, CZCS, HRV) operating in the visible and near-IR ranges; Table 2 gives the choice of spectral intervals for the four mentioned groups of problems by the factor analysis method; Table 3 gives the optimal spectral sensing channels corresponding to the main groups of problems. References: 10 Russian.

UDC 550.834.05

**Interpretation of Travel-Time Curves of Refracted Waves**

18650087 Moscow *IZVESTIYA VYSSHIKH UCHEBNIKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA in Russian No 2, Feb 89 pp 73-81*

[Article by A. I. Kobrunov and S. A. Kirillov, Ivanovsk Petroleum and Gas Institute]

[Abstract] This article describes a computation scheme for interpreting the kinematic parameters of refracted waves. It is based on optimization principles within the framework of a criterial approach to expression of a priori information on the solution. The method proposed for solution of the inverse problem in seismic prospecting by the refracted waves method to some extent is related to an algorithm described earlier, but differs in that in the solution of the direct kinematic problem a method is used which is based on an approximation of the medium by fragments with a linear law of velocity change. More importantly, the solution applies a flexible test of optimality relative to medium parameters which can be "adjusted" in advance to an optimal type of a priori information or rules can be introduced for its "self-adjustment." These differences in the initial stage result in substantially different computation schemes. The inverse problem is formulated, the algorithm for its solution is described and the results of interpretation of travel-time curves of refracted waves are illustrated for the case of exploration of a sulfur deposit. Agreement between the computations, real geological situation and exploratory drilling data indicates that the described optimization method can be used in interpreting the kinematic parameters of refracted waves in a study of geological media characterized by velocity differentiation when there are no rigid reflecting boundaries. Figures 4; references: 14 Russian.

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