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No. 9, September 1981

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Translations or abstracts of all articles of the Russian-language monthly journal METEOROLOGIYA I GIDROLOGIYA published in Moscow by Gidrometeoizdat.

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* Denotes items which have been abstracted.

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UDC 551.513(215-17)

SEASONAL RESTRUCTURINGS OF CIRCULATION IN THE METEOR ZONE (80-100 KM) AND THEIR RELATIONSHIP TO STRATOSPHERIC PROCESSES

Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 9, Sep 81 (manuscript received 20 Feb 81) pp 5-11

[Article by L. S. Minina, doctor of geographical sciences, M. A. Petrosyants, professor, and Yu. I. Portnyagin, candidate of physical and mathematical sciences, USSR Hydrometeorological Scientific Research Center and Institute of Experimental Meteorology]

[Abstract] The authors, on the basis of an analysis of the results of long-term wind measurements by the method of radar observation of meteor trails, endeavored to clarify the most important patterns of the wind regime at altitudes 80-100 km for periods of seasonal restructurings of circulation. A study was also made of the problem of the relationship between the characteristic times of development of seasonal restructuring processes at the altitudes of the meteor zone and in the stratosphere. It was found that the spring restructuring of circulation occurs rather consistently at different altitudes. Characteristic changes in some wind regime parameters are observed in the middle latitudes at altitudes 80-100 km as early as March, that is, substantially earlier than in the corresponding latitude zone of the stratosphere. This is possibly associated with low atmospheric density at the altitudes of the meteor zone, and as a result, its low inertia. In such a case the considerably earlier spring restructuring in the meteor zone of the temperate latitudes in comparison with the stratosphere is evidence of its more rapid reaction to radiation conditions changing during the spring. In the meteor zone the transition from a stable summer regime of circulation to a winter regime is briefer and is expressed less clearly than the transition from winter to summer. In contrast to the spring regime, the autumn restructuring of circulation in the meteor zone lags by almost 1 1/2 months in comparison with the stratomesospheric circulation. The process of spring restructuring of circulation in the meteor zone is therefore of the greatest interest from the prognostic point of view. It can be surmised that a determination of the date of the spring restructuring at altitudes 80-100 km on the basis of data from radiometeor stations will be extremely useful in predicting the restructuring of stratospheric circulation and for further improvement in long-range weather forecasting methods. Figures 4; references: 10 Russian.

UDC 551.513.1(-062.4)

ANALYSIS OF VERY SIMPLE ZONAL MODELS OF CIRCULATION OF THE EQUATORIAL ATMOSPHERE

Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 9, Sep 81 (manuscript received 5 Mar 81) pp 12-22

[Article by Ye. M. Dobryshman, professor, Institute of Atmospheric Physics]

[Abstract] One of the features of atmospheric dynamics in the equatorial zone, where the role of nonlinear interaction and vertical movements even in the small terms of Coriolis acceleration is great, is a great diversity of possible circulation mechanisms. If there is a more or less clearly expressed zonal flow, the zonal velocity component u (usually easterly in the troposphere) varies with time and coordinates more weakly than the meridional v and vertical w components. Within the framework of zonal models, that is, with discarding of the derivatives of x (along the equator), there can be different regimes for v and w with one and the same zonal component u. Taking this into account, the author presents a qualitative analysis of a nonlinear system of equations describing very simple zonal models of circulation mechanisms in the equatorial zone. It is shown that the system has two stationary points. One, corresponding to a stationary geostrophic zonal flow, is an unstable saddle point, whereas the second, corresponding to a stationary easterly zonal flow in the presence of the meridional velocity component, is a degenerate node. The node is stable if in the case of an easterly flow the meridional component is directed toward the equator. This can be interpreted as stability of the Northeast Trades in the northern hemisphere and the Southeast Trades in the southern hemisphere. These findings are compared with data collected during the GATE program. There is a good agreement between the theory and observational data. Figures 5; references 9: 8 Russian, 1 Western.

UDC 551.515.8

NUMERICAL INVESTIGATION OF FRONTOGENESIS WITH ALLOWANCE FOR PHASE TRANSITIONS

Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 9, Sep 81 (manuscript received 24 Feb 81) pp 23-34

[Article by B. Ya. Kutsenko, Central Aerological Observatory]

[Abstract] The article describes a numerical model of formation of a front and frontal stratiform cloud cover in the entire thickness of the troposphere, including the tropopause layer and the stratospheric layer adjacent to it. The described model was formulated on the basis of a joint solution of a system of nonlinear equations of motion, heat transfer equations, equations for the balance of humidity and liquid water content. It is shown that the degree of influence of the phase transitions of moisture on circulation in the frontal zone is dependent on atmospheric stratification. With a decrease in the stability of a warm air mass the frontal zone is intensified. The region of increased gradients of temperature, specific moisture content and also vorticity has a much greater vertical extent. The following explains the influence of the heat of phase transitions on the formation and evolution of a frontal zone in dependence on atmospheric stability. As a result of temperature advection, under the influence of the macroscale deformational wind field there is formation of a corresponding vertical distribution of macroscale divergence, and accordingly, of ascending air movements. In addition to the macroscale wind field, a contribution to convergence at the lower levels of the atmosphere is also made by the boundary layer. Ascending movements lead to the appearance of a frontal cloud system with release of the heat of condensation. The degree of influence of phase transition processes on the characteristics of the frontal zone is dependent on atmospheric stability. In the case of a very stably stratified warm air mass the phase transition processes exert virtually no influence on circulation in the frontal zone, forming under the influence of the macroscale velocity field. With a decrease in atmospheric stability the influence of release of the heat of condensation on the dynamics of frontal processes increases. The ascending movements, creating a condensation zone, favor the appearance of a large additional energy source. This gives rise to a secondary closed transverse circulation which in the lower layers intensifies the effect of the macroscale wind field, creating an additional influx of heat and specific humidity. This leads to a considerable intensification of convergence, and accordingly, the velocity of ascending movements, as a result of which the release of the heat of condensation is intensified. The increasing temperature gradient causes an increase in the pressure gradient and a deepening of the disturbance. As a result, the frontal zone with time becomes increasingly sharper, there is an increase in the rate of its formation and an increase in the nonuniformity of meteorological elements in this zone. The intensification of the frontal zone will persist

until the influence of turbulence is counteracted by the influence of frontogenetic factors. Transverse circulations in the frontal zones lead to the formation of regions of strong cyclonic and anticyclonic wind shears in the zone of maximum temperature contrasts. A sharp front appears in the field of specific moisture content, whose position coincides with the region of maximum gradients of other characteristics of meteorological elements. The heights of the zones of increased gradients of temperature, specific moisture content, and also divergence and vorticity accordingly increase vertically upward with a decrease in atmospheric stability. Figures 3; references 11: 6 Russian, 5 Western.

UDC 551.509.313+551.509.323+551.576

USE OF OBSERVATIONAL DATA ON CLOUDS IN NUMERICAL FORECASTING OF SURFACE AIR TEMPERATURE

Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 9, Sep 81 (manuscript received 17 Feb 81) pp 35-40

[Article by I. A. Alekseyeva-Obukhova and I. A. Petrichenko, candidate of physical and mathematical sciences, USSR Hydrometeorological Scientific Research Center]

[Abstract] Data from visual and satellite observations of clouds are used extensively in synoptic work in short-range weather forecasting as necessary information in an examination of the thermal and humidity transformation of air masses. Despite this, observations of cloud cover are not used in a number of Soviet numerical schemes for the forecasting of meteorological elements. Certain numerical synoptic-hydrodynamic schemes are exceptions. However, in the latter data on the quantity of clouds are replaced by dew-point spreads by use of empirical expressions The use of this indirect method for taking cloud cover into account reduces the accuracy of the corresponding computations and this naturally has a negative effect on the final results of synoptic-hydrodynamic forecasts of meteorological elements. In order to determine the possible errors associated with the indirect method for taking data on the quantity of clouds into account in forecasting schemes the authors carried out numerical experiments for predicting air surface temperature. Among the different types of averaging of dew-point spreads at different levels in the atmosphere in the prediction of surface air temperature the best result was from a variant of use of the dew-point spread at the single level 850 gPa. The use of initial data on cloud cover in the prediction of air surface temperature during the summer gives an advantage of 11% and in winter even 40% in comparison with the use of the dew-pont spread at the 850-gPa level for these purposes. During the summer the accuracy in predicting air surface temperature increases considerably with the use of data on cloud cover or the dew-point spread for two observation times (0300 and 1500 hours) in comparison with one of these observation times. These and other data indicate the possibility of increasing the accuracy of short-range numerical forecasts of meteorological elements by including cloud cover information in the initial data. Under operational conditions the volume of data on cloud cover will be approximately twice as great as the volume of data used in the numerical experiments and accordingly it would be possible to obtain more precise results than obtained in this study. Figures 2, tables 1; references: 13 Russian.

UDC 551.509.616:551.509.617

SOME FEATURES OF STRUCTURE AND EVOLUTION OF HAIL-GENERATING CUMULONIMBUS CLOUDS

Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 9, Sep 81 (manuscript received 5 Jan 81) pp 41-49

[Article by L. A. Dinevich, candidate of physical and mathematical sciences, Moldavian Republic Administration of the Hydrometeorological Service]

[Text]

Abstract: Statistical observational data were used in determining the polarization characteristics of a radar signal reflected from droplets of shower precipitation and hail. It is demonstrated that it is possible to detect hail on the basis of depolarization of the reflected signal. On the basis of signals detected from cumulonimbus clouds in shower, hail-threatening and hail stages of development it is shown that it is possible to determine the hail-formation process with a reliability of 95% 10-15 minutes prior to the falling of hail to the ground. The collected data and the patterns established on their basis were used in developing a method for determining the danger of hail falling from clouds and modification schemes.

Formulation of Problem and Volume of Experimental Data

Numerous investigations of convective clouds carried out in the USSR and abroad applicable to the problems involved in the artificial modification of hail clouds have considerably broadened our knowledge concerning cloud physics and the processes transpiring in them [5, 6, 10, 14]. However, there is also a whole series of problems requiring further investigation. The most important of these is obtaining detailed information on the mechanisms of formation and growth of hail, as well as on differences in the structure of hail, hail-bearing, shower and cumulonimbus clouds.

Such a problem is related to the fact that despite the relatively high effectiveness of antihail protection, attempts at the modification of hail clouds in many cases are fruitless.

An analysis of cases with negative modification results indicated that their causes can be reduced to methodological and organizational-technical. The organizational-technical factors, despite their complexity, for the most part are understandable and in principle can be eliminated. The methodological factors for the most part are related to an inadequate knowledge of the structure of shower and hail clouds, which makes difficult the unambiguous determination of the degree of hail danger of clouds in an early stage in the hail-formation process and the places in the cloud where it is best to introduce artificial crystallization nuclei. A solution of these problems requires a deeper knowledge of the structure of clouds in different stages of their evolution.

Several models of cumulonimbus clouds have now been developed [5, 14, 17, and others]. However, despite considerable successes in the field of study of cumulonimbus hail clouds, there is still no final clarification of the problem as to the part of the cloud in which the processes of formation, growth and falling of hail begin and how they transpire.

In this article we give new data on the differences in structure of shower, hail-dangerous and hail cumulonimbus clouds. In order to clarify them we used the results of ordinary radar observations of these clouds in Moldavia, supplemented by a polarization analysis of radar signals reflected from clouds [9]. Supplementing the radar data we used the results of investigations of features of intracloud air currents using radioactive tracers [4, 15].

These data make it possible with a great accuracy to solve the problems involved in routine detection of the moment of transition of clouds from the nonhail-dangerous stage to the hail-dangerous stage and to find the places in a cloud into which it is most desirable that a reagent be introduced.

The essence of the polarization method for tracing the evolution of Cb for the most part is reduced to the following [18]: if the electric vector of an incident plane-polarized wave is parallel to one of the axes of the ellipsoid of the hydrometeor, a dipole moment component is excited only along this axis and there is no component along the axis perpendicular to the radio wave polarization plane. Accordingly, in this case the scattered wave will have the same polarization plane as the incident wave and there will be no transversely polarized component of the electromagnetic field scattered by hydrometeors.

If the ellipsoids of the hydrometeors are arbitrarily oriented relative to the polarization plane, a depolarized signal component also appears in the scattered field.

In general, the scattered energy is determined by the polarization plane of the incident wave, the spatial position of the reflecting particles and the degree of their asphericity, phase state and dielectric inhomogeneity.

In the case of a random distribution of particles in space

[CΦ = sph]

$$I_{\parallel} = \frac{1}{15\overline{g}^{2}_{\text{сф}}}\left(\overline{g}^{2} + \frac{4}{3}\,\overline{g}\,\overline{g}' + \frac{8}{3}\,\overline{g}'^{2}\right), \quad I_{\perp} = \frac{1}{15\overline{g}^{2}_{\text{сф}}}(\overline{g} - \overline{g}')^{2}.$$

Here $I_{\parallel}$ is the intensity of the energy scattered in the polarization plane of the incident wave, $I_{\perp}$ is the intensity of the energy scattered in the plane orthogonal to the polarization plane of the incident wave, g and g' are the functions of ellipticity of a particle and its dielectric constant.

At the same time it is known that cloud droplets, hailstones and raindrops differ considerably with respect to form and are oriented differently in space [1, 12]. Cloud droplets are spherical and their predominantly horizontal orientation in space remains characteristic for raindrops. According to the experimental data of Henry and McCormick [20], large flattened drops are oriented for the most part in the horizontal plane and the deviation of their vertical axis does not exceed 10-15°. At the same time, the hailstones have a random orientation.

Accordingly, the difference in the form of raindrops and hailstones, as well as anisotropy (change in density and size along the radius) of the latter hydrometeor should differently reflect a plane-polarized wave, creating an orthogonal component. Therefore, knowing the quantitative values of the orthogonal component of the reflected radar signal for hailstones and droplets, it is possible to solve the inverse problem, that is, determine the presence of hail in clouds.

On the basis of the data cited above, over a period of years radar stations of the ARS-3M and "Uragan" types and a polarimeter developed at the Central Aerological Observatory [19] have been used in carrying out investigations of the characteristics of hydrometeors in shower and hail clouds. The observations involved obtaining vertical and conical sections in clouds situated at a distance up to 50 km from the radar. The radar radiated waves with horizontal polarization and received both orthogonal components.

The method for such observations was described in detail in [9]. This complex of observations and registry of the signal occupies a time interval of not more than 2 minutes, that is, the time during which there are virtually no significant changes in cloud structure. The matching of series of photographs made it possible to determine the "relief" of intensity of the reflected signal and its depolarization structure in conical or vertical cloud sections.

The described method was used in making observations of 123 hail and 117 shower clouds; the evolution of 50 clouds was considered with their transition from shower to hail-dangerous and hail stages.

Characteristics of Structure of Cumulonimbus Rain and Hail Clouds and Their Evolution According to Data Obtained by the Polarization Research Method

An analysis of the experimental data indicated that in all cases of the falling of hail in the vertical sections of Cb there were channels with an increased depolarization value $\Delta p \geqslant -10$ db, whereas among the 117 vertical sections of shower clouds there were only 5 such cases, accompanied by heavy showers without hail. Here the depolarization $\Delta p = 10 \lg P_{\perp}/P_{\parallel}$ is the ratio of the intensity of the orthogonal component of the reflected signal to the main component or

$$\Delta p = n_{\perp} - n_{\parallel},$$

where $n_{\perp}$ and $n_{\parallel}$ are the values of these components, db.

It should be noted that the maximum depolarization is created by water-encased aspherical hailstones. Although with a definite orientation of an individual particle the transverse component for it may be absent, in general for a cloud or zone of precipitation consisting of a great number of randomly arranged particles the mean depolarization value for the echo signal attains considerable levels.

In the experiments which were carried out the actual place of the falling of hail on the ground always coincided with the surface projection of an enhanced (characteristic for hail) zone of depolarization in a cloud, determined using a polarized radar. The typical vertical sections of hail and shower clouds are shown in Fig. 1, where R is the distance to the radio echo, H is the altitude of the radio echo, lg z is radar reflectivity, $T^{o}C$ is temperature read from the radiosonde measurement closest in time; the dashed lines correspond to the lg z isolines and the solid lines correspond to depolarization isolines.

According to research data, in hail clouds with a channel of increased depolarization extending to the earth's surface there was, in almost all cases, falling of hail to the ground. In shower clouds of a region of increased depolarization with $\Delta p \geqslant -10$ db the falling of hail was observed in only 10% of the cases. However, these regions, being situated randomly, that is, in different parts of the cloud above the $0^{o}C$ isotherm, did not undergo transition into a form characteristic for hail clouds. In 5% of the cases in shower clouds there was a channel of increased depolarization which touched the earth, but hail was not forthcoming from the clouds.

Thus, an analysis of the cited results of the investigations indicated that making joint use of the depolarization characteristics of signals reflected from the clouds and the radar reflectivity value it is possible to classify clouds as hail and shower clouds. The zone of ambiguity (that is, the Δp and lg z values at which both showers and hail can be observed) is extremely narrow and with a radar reflectivity lg $z > 3.2$ falls in the limits from -10 to -15 db. (The measurement accuracy is $\Delta p \quad \pm 2$ db.)

The results served as a basis for determining the hail danger of clouds on the basis of the polarization characteristics of the radar signal reflected from them. Then, for solving the formulated problem it was necessary:
-- to find an adequate method for predicting transition of a cloud from a nonhail state to a hail stage not less than 10-15 minutes in advance;
-- to find a method for routine radar determination of the region in the cloud in which the process of formation and growth of hail transpires most rapidly and intensively.

In order to solve these problems we used the data which we had accumulated on the evolution of the structure of cumulonimbus clouds in the course of their "lifetime." Experience in routine work on the modification of hail processes gives basis for speaking of the absence (with existing technical apparatus) of criteria which at any specific moment in cloud development would make possible an unambiguous determination of its hail danger. The radar criteria [2] adopted at the present time can only divide clouds into hail and nonhail or with a definite accuracy evaluate the probability of their transition into a hail state. Even in those cases when the thermodynamic and aerosynoptic characteristics of the atmosphere are favorable for the falling of hail, it falls only from some of the clouds observed in these cases. It is possible to cite many examples when during the most intensive hailfalls in the group of clouds there were those which although having the same hail danger criteria did not yield any hail at all.

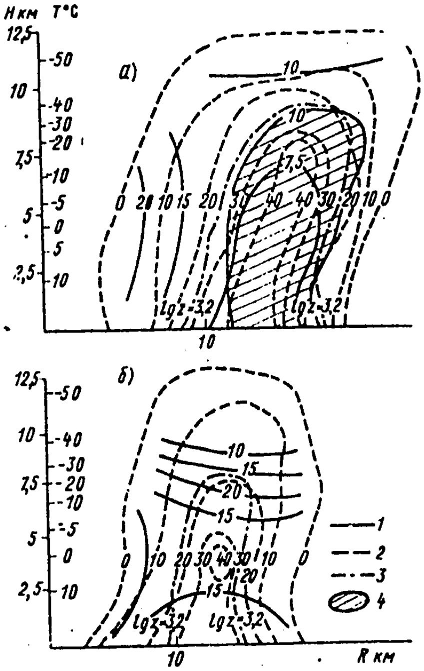

Fig. 1. Typical vertical sections of hail (a) and shower (b) clouds according to depolarization data. 1) isolines Δp; 2) isolines n, db; 3) isolines lg z = 3.2; 4) region with Δp = -10 db.

On the basis of the possibilities of detecting hail particles by means of depolarization characteristics of the echo signal we analyzed data on the evolution of cumulonimbus clouds with their transition from shower to hail stages. The results of these investigations indicated that zones of increased depolarization are usually formed in clouds 10 or more minutes prior to the onset of the falling of hail. However, it is highly difficult to evaluate the dynamics of the life cycle of a cloud prior to the beginning of hail formation in it on the basis of the depolarization characteristics of reflected signals. Moreover, in multicell clouds the different cells can be in different stages of development. Some of these may be in the hail stage already, whereas others may only be developing. Accordingly, prior to the onset of hail formation in clouds, in addition to the depolarization characteristics it is desirable that the hail danger of clouds be evaluated by the stochastic-statistical method [2, 6].

Thus, the method for determining the hail danger of clouds is based on the following:

1. The principal initial data for determining the hail danger of clouds are data on evolution of the structure of clouds, determined by changes in the degree of depolarization of radio echoes from regions within which $\lg z > 3.4$. Reference is to the appearance in the radio echo region where $\lg z > 3.4$ of considerable sectors of increased depolarization and the dropping of their lower boundary below the level of the isotherm 0°C. The value $\lg z > 3.4$ was selected because the investigations revealed the absence of cases of the falling of hail from clouds in which there are no regions with a value $\lg z > 3.4$.

2. Data on the values of six radar parameters -- $H_{\text{upper boun}}$; $H_{z_{\max}}$; $T_{H_{\text{upper boun}}}$; $T_{H_{z_{\max}}}$; $\lg z$; h_-/h_+ [2] should serve as additional characteristics in determining the stage of cloud development in the prehail period. These criteria are used in determining the complex hail danger criterion K_p% and P% -- the total probability of the hail state of a cloud:

$$K_p = \frac{1}{N}\sum_{i=1}^{N}\frac{n_{\text{Г}_i}}{n_{\text{Г}_i}+n_{\text{Л}_i}}\cdot 100\%,$$

[Г = hail; Л = shower]

where n_{hail_i}, n_{show_i} are the numbers of cases of the falling of hail or showers respectively for a given value of the i-th parameter. The $P = f(K_p)$ value is determined statistically. For this purpose, on the basis of experimental radar data for a specific orographic region and simultaneous visual surface observations of falling precipitation a statistical series of K_p values is prepared.

During the initial period of cloud development, when the clouds still contain no regions with a value $\Delta p > -10$ db, it is possible to trace the dynamics of the cloud or cell in it using the method set forth in [2, 6] by means of one of six parameters, the most convenient of which are $H_{\text{upper boun}}$, $H_{z_{\max}}$, $\lg z$ (recently in practical antihail protection work use has also been made of the H parameter at the level $\lg z = 4.0$) and the temperature at this level.

If the value of at least one of the parameters is not characteristic for an unambiguous determination of the stage of cloud development, it is necessary to employ the entire set of parameters.

3. In order to obtain the depolarization characteristics of a signal it is necessary to use a radar set with the possibility for radiation of a plane horizontally polarized electromagnetic wave, reception of two orthogonal components of the reflected signal and discrimination on the circular-scan display screen and "range-altitude" indicator of regions of isoechoes with stipulated devels of depolarization and radar reflectivity exceeding the values

$$\Delta p > -10 \text{ db}, \lg z > 3.4.$$

In order to study the evolution of the depolarization structure of a cloud in the region of maximum radar reflectivity we constructed series of horizontal and vertical sections each 1-2 minutes. An increase in the region with radar reflectivity $\lg z > 3.4$ in the zone with $\Delta p > -10$ db, a decrease in its lower boundary, an increase in the horizontal gradient Δp with a simultaneous decrease in the vertical gradient Δp constitute a basis for assuming that the focus is hail dangerous.

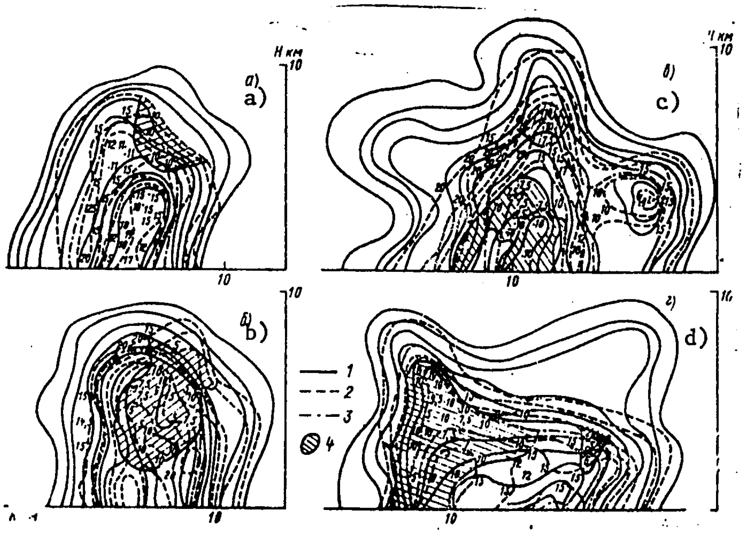

Fig. 2. Diagrams of development of cloud from shower to hail stage. 1) isolines $n_{\parallel}$ db; 2) isolines $n_{\perp}$ db; 3) isolines lg z = 3.2; 4) region $\Delta p \geqslant -10$ db, the figures denote the depolarization values.

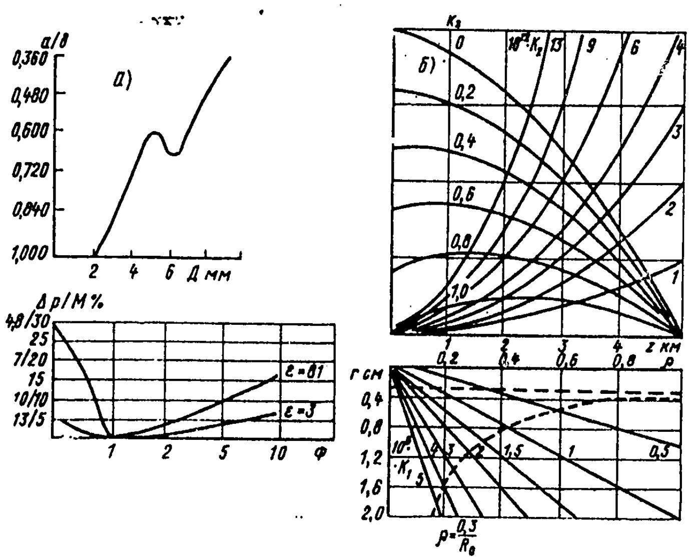

Fig. 3. Dimensions of axes of droplets freezing in the nucleus of a hailstone as a function of their diameter (a); nomograms for computing hailstone melting time (b) and dependence of coefficient of depolarization of a reflected signal on the configuration of ellipsoidal particles (c).

A typical scheme of development of a cloud from the shower to the hail stages is represented in Fig. 2. We note that already on the basis of the position of the zone $\Delta p > -10$ db, shown in Fig. 2b, with a guaranteed probability of 95% and with an advance time of 10 minutes it is possible to conclude that there is a transition of the cloud into a hail stage.

The advantage of the proposed method for determining hail danger of clouds is that it makes it possible to solve this problem with a high guaranteed probability 10-15 minutes prior to the beginning of falling of hail to the ground. The adequacy of such an advance time for practical artificial modification work can be demonstrated by using Fig. 3.

Figure 3a is a curve of the dependence of the ratios of the axes of droplets (a/b) freezing in the nucleus of a hailstone on their diameter D (constructed by G. S. Bartishvili).

Figure 3b shows the nomograms of E. A. Geyvandov and I. P. Mazin [7] for computing the melting time of hailstones during their falling in the warm part of the atmosphere ($T >$ °C) and under the condition that all the water forming during the melting is blown from it, as is characteristic, in the opinion of the authors, for hailstones with a radius exceeding 0.3 cm. Using the nomogram there is graphic solution of the equation

$$F_{(\rho)} = (1 - \rho^{7/4}) - k_3(1 - \rho^{5/4}) = k_1 H - k_2 H^2,$$

$$k_1 = \frac{3{,}5 \cdot 10^{-8}\,\theta_0 + 8{,}3 \cdot 10^{-2}\,(d_0 - d_{s_0})}{r_0}\,(1/\text{см}),$$

$$k_2 = \frac{1{,}7 \cdot 10^{-8}\gamma + 4{,}2 \cdot 10^{-2}\alpha}{r_0}\,(1/\text{см}^2),$$

$$k_3 = \frac{7 \cdot 10^{-4}u}{\sqrt{r_0}},$$

where $\rho = r/r_0$ shows by how many times there was a decrease in the radius of the hailstone during falling; H is the upper level from which hailstones, falling, begin to melt; α and γ are the humidity and temperature gradients respectively; θ_0 and d_0 are the temperature and humidity at the cloud base; d_{s0} is vapor elasticity at the hailstone surface; u is the velocity of ascending currents.

Using these nomograms and the computation method cited in [9], it can be demonstrated that a hailstone with a radius 10 mm, with falling from an altitude of 3 km, a temperature at this altitude 0°C, a velocity of the vertical flow 5 m/sec and with the meteorological conditions most frequently encountered during hail processes, would have a radius 7 mm. With these same atmospheric parameters a hailstone with a radius of 6 mm, falling from an altitude of 3 km, at the earth will have a radius r = 4 mm.

If we also take into account the increase in heat transfer as a result of turbulent exchange, it can be expected that hailstones with a diameter of 1 cm falling from an altitude of 3 km will reach the earth having a diameter less than 5 mm.

It is known that hailstones with a diameter of less than 5 mm will not inflict substantial damage on agricultural crops [10]. Accordingly, we will use a diameter d = 5 mm of hailstones falling to the earth as the minimum size of dangerous hail. As stated above, at an altitude of 3 km these hailstones have a diameter d = 1 cm. According to the G. S. Bartishvili curve, such hailstones are aspherical and the ratio of the axes of the droplets freezing in their nucleus can exceed 0.3-0.4. With a random spatial orientation of these freezing droplets and assuming correctness of the wet growth hypothesis, using computations and the A. B. Shupyatskiy curve, taken from [9] and shown in Fig. 3c, it can be demonstrated that the depolarization coefficient for the reflected signal is M = 15-17%, where $M = P_{\perp} / P_{\parallel}$, which corresponds to $\Delta p \geqslant -10$ db. According to this same curve, the minimum ratios of the axes of ellipsoidal particles, for which Δp remains greater than -10 db, is approximately equal to 0.7, which according to Fig. 3a corresponds to a hail diameter d = 4 mm. It follows from these approximate computations that in a cloud it is sufficient for there to be hailstones with a radius greater than 2 mm and by means of polarization techniques and the developed method it is possible to detect them and proceed to modification without awaiting an increase in the hailstones to dangerous sizes ($d > 10$ mm).

Using information on cloud structure, employing data on the depolarization of reflected signals it is possible to determine the region of formation and growth of hail, and on the basis of the results of the investigations cited in [3, 4, 6, 8], select the optimum scheme for introducing the reagent in order to prevent large hail.

The generalized schemes for introducing the reagent can be represented in the following way:

1. With the discovery of individual small foci in a cloud in the region of the isotherms -10,..., -15°C with the value $\Delta p \geqslant -10$ db the reagent must be introduced at the level of the isotherms -4,..., -6°C in the entire region described by the isoline $\lg z > 3.4$.

2. If the zone of increased depolarization is situated in the leading or central part of the cloud $\lg z > 3.4$, and its lower boundary has reached the level of the isotherm 0°C and continues to drop, the reagent must be introduced directly into this region, at the level of the isotherms -10,..., -15°C, closer to the level of the maximum rate of the ascending flow. The lower the lower boundary of the region $\Delta p \geqslant -10$ db drops down, the more important it is to introduce the reagent under the level of the maximum velocity of the ascending flow, determined as the level of maximum radar reflectivity.

3. If the zone of increased depolarization takes in the entire region $\lg z > 3.4$, including its rear part, and reaches the ground level, it is not necessary to introduce reagent into such a cell, since hail is already falling from it and the hail formation process ceases.

In this case it is very important to note the formation of new cells near the decaying cell. These new cells are usually formed in a leading part of the cloud (relative to the direction of movement), but sometimes they can develop in the rear. If such cells, described by the isoline $\lg z > 3.4$ appear, and especially at the level of the isotherms -10,,...,-15°, the reagent must be introduced directly into them, without awaiting the appearance of regions of increased depolarization.

In conclusion the author expresses sincere appreciation to Doctors of Physical and Mathematical Sciences A. B. Shupyatskiy and S. M. Shmeter for valuable advice in the work and to R. P. Tychin and T. Ye. Sizova for assistance given in the collection and processing of data.

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UDC 551.509.314+551.509.325

PREDICTION OF RADIATION AND RADIATION-ADVECTIVE FOGS

Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 9, Sep 81 (manuscript received 24 Dec 80) pp 50-57

[Article by P. K. Dushkin, candidate of physical and mathematical sciences]

[Abstract] In an earlier article (METEOROLOGIYA I GIDROLOGIYA, No 2, 1980) the author developed a method for the statistical alternative forecasting of radiation and radiation-advective fogs at Moscow. Independent observational data were used in checking the success of the forecasts for various Moscow airports. On the average estimates of the forecasts were at the level $Q = 0.60$, where $Q = 1 - \alpha - \beta$, α and β are errors of the first and second kinds. A major series of observations has now made it possible to separate the sample data into three groups, rather than into two groups, as in the earlier study: No 1 -- January, November, December, No 2 -- February, October, No 3 -- March, April, May, September. The number of the group is in essence a component of the vector-predictor. The other components used are: quantity of clouds in tenths in the form of two gradations $N < 5$ and $N > 5$, where N is the mean total quantity of clouds during the period from 1800 to 0600 hours; dew-point spread Δ_{18} at 1800 hours; averaged wind velocity $\bar{V}_{22} = 0.8\ V_{22} + 0.16\ V_{20} + 0.04\ V_{18}$, V_{20}, V_{22} are the wind velocities at the height of the vane. The alternative forecast of fog is made using the discriminant analysis method. The analysis shows that the proposed method has a clearly expressed regional character; for example, the graphs constructed for Moscow cannot be used for Khar'kov and Minsk. At present the methods employed in predicting fogs are based on initial data for evening observations. It is important to have a method making it possible to predict fog formation on the basis of initial data obtained at earlier observation times. This problem is solved. It was found that the series of hourly meteorological observations necessary for constructing the discriminant functions graphs should be approximately 15 years. As a first approximation it is possible to use a sample of a lesser volume: 5- and 10-year series, combining groups Nos 1 and 2. This and other simplifications lessen the quality of the forecasts by 10-15%. The necessary accuracy in measuring air temperature must be 0.1°C. The area for which the forecast is valid is dependent on the physiographic character of the region. It must be determined experimentally. Figures 1, tables 7; references: 3 Russian.

UDC 551.509.325+551.573(268.3)

PREDICTION OF EVAPORATION FOGS BY THE QUADRATIC DISCRIMINANT ANALYSIS METHOD

Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 9, Sep 81 (manuscript received 2 Feb 81) pp 58-66

[Article by A. P. Polkhov and F. S. Terziyev, candidates of geographical sciences, Murmansk Affiliate, Arctic and Antarctic Scientific Research Institute, and State Oceanographic Institute]

[Abstract] The author proposes a new approach to the prediction of evaporation fogs based on the use of asynchronous correlations between the effect (the meteorological phenomenon) and its cause (thermodynamic state of the atmosphere). As the initial data for the forecast this makes it possible to use data taken from actual weather maps characterizing the thermodynamic state of the atmosphere (synoptic situation) on the eve of the considered phenomenon. Quadratic discriminant analysis is used as the mathematical approach. The investigated region was the northern coast of the Kola Peninsula, where during the cold half of the year (October-March) evaporation fogs are formed rather frequently. The study was based on the meteorological archives of the Murmansk Administration of the Hydrometeorological Service for the periods 1960-1965 and 1975-1979 in the form of surface and high-altitude weather charts and also TM-1 meteorological tables. In the formulated problem synoptic situations are divided into two classes: class of fog-forming situations and class of non-fog-forming situations. In turn, there are subclasses: a subclass of situations causing a strong fog with a horizontal visibility < 50 m; a subclass of situations causing moderate or weak fogs with horizontal visibilities < 500-50 m and < 1000-500 m. Such a forecast, involving preparation of initial information, its input into the computer, forecast and printout, is completely automated and requires 5 minutes. This fog forecasting scheme provides for operations similar to those performed by a weatherman. The weatherman, like the "decision rule" derived in this study, analyzes the initial and future synoptic situations, scrutinizing the actual and predicted information for the fields P, H_{850}, H_{500}, T_{surf}, T_{850} in order to draw a conclusion concerning the possibility of development of an evaporation fog. However, the possibilities of the weatherman are more limited because he is unable to make an objective evaluation of the enormous volume of data handled by the computer. Figures 1, tables 3; references: 17 Russian.

UDC 551.515.2

NUMERICAL MODELING OF TROPICAL CYCLONE LANDFALL

Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 9, Sep 81 (manuscript received 12 Jan 81) pp 67-74

[Article by A. P. Khain, candidate of physical and mathematical sciences, USSR Hydrometeorological Scientific Research Center]

[Abstract] A study was made of the reaction of a model tropical cyclone to a change in surface roughness. The model was based on the solution of primitive equations in z-coordinates. It includes a parameterization of convective and macroscale precipitation, convective transport of heat and moisture and parameterization of the boundary layer. Macroscale precipitation falls when the mixing ratio at the points of intersection of the finite-difference grid exceeds a saturating value. The moisture excess is condensed and forms macroscale precipitation. Convective precipitation is caused by condensation in cumulus clouds. Boundary layer parameterization was carried out by the Deardorff method, whose suitability for the conditions of a tropical cyclone has been confirmed. The method makes it possible, using the mean values of potential temperature, mixing ratio, velocity in the mixing layer, its height, surface temperature and roughness parameter to determine the fluxes of heat, moisture and momentum at the surface. It was found that the principal reason for attenuation of the model cyclone was a limitation of evaporation from the land surface. Attenuation of a tropical cyclone (TC) occurs when the moisture flows from the land surface do not exceed the moisture flows from the ocean surface which prevailed in the TC zone prior to its movement onto land. The attenuation of the TC occurs the more rapidly the lesser the quantity of evaporation from the land surface. Without a limitation on evaporation an increase in roughness leads to an increase in the flows of heat and moisture, an increase in the convergence of moisture into the eye of the TC, and thus, an intensification of the TC. At the time of movement of the TC onto the land there is a brief increase in precipitation as a result of moisture convergence in the lower troposphere. In the first few hours after the TC moves onto the land the eye of the TC disappears and ascending movements develop at the center of the TC. With movement of the TC onto the land the radius of the maximum winds somewhat increases. An increase in pressure, decrease in integral moisture flows and attenuation of the TC begin when the land occupies the central zone under the TC. The central region therefore plays a decisive role in the attenuation of the TC over the land. Figures 6; references 13: 3 Russian, 10 Western.

UDC 551.521.1

ALLOWANCE FOR HEAT RECEIPTS FROM SOLAR RADIATION ON SLANT SURFACES

Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 9, Sep 81 (manuscript received 2 Dec 80) pp 75-78

[Article by V. A. Pataleyev, Far Eastern Scientific Research Institute of Hydroengineering and Land Improvement]

[Abstract] In connection with construction of the Baykal-Amur Railroad and the increased volume of construction in the northeastern part of the country a precise allowance for the solar radiation balance on slopes is becoming especially important. Radiation computations are also necessary for determining photosynthetically active radiation used by the plant cover in the photosynthesis process, that is, in evaluating the suitability of the territory for cultivation of agricultural crops, since in the northern regions the southern slopes, in contrast to a horizontal surface, often receive the quantity of photosynthetically active radiation necessary for the harvesting of stable yields. The author therefore has developed a method suitable for practical application which makes it possible to ascertain the quantity of heat from solar radiation incident on slant surfaces. The basis for the method is a generally accepted expression for the radiation balance of a slope which by means of the heat transfer coefficient and the temperature components for the slant surface is transformed into a linear algebraic equation with an unknown value of heating due to the effect of solar radiation. The solution of this equation is a formula making it possible to compute the receipts of solar energy on the slant surfaces of artificial structures. Figures 1; references: 6 Russian.

UDC 551.465.5

SPATIAL VARIABILITY OF CURRENT FIELDS IN THE SHALLOW WATER PART OF THE SHELF

Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 9, Sep 81 (manuscript received 22 Dec 80) pp 79-84

[Article by Yu. G. Zotov and Yu. F. Masterov and S. Ye. Saks, candidates of technical sciences, Soyuztekhmorneftegaz]

[Text]

Abstract: A study was made of the problem of determining the spatial variability of current fields constructed on the basis of data from a survey of currents in a polygon in the coastal zone of the sea. The method for evaluating the variability of the current fields is based on an analysis of the random vectors, which are represented in a complex form Recommendations are given on the choice of an optimum network of hydrological stations when carrying out geological engineering work in one of the regions of Southern Primor'ye, and an evaluation of the proposed method is presented.

The matter of validating methods for hydroengineering work is assuming a timely importance in connection with the exploitation of mineral resources in the shelf zones of USSR seas. The results of such engineering field work are necessary both for the designing of petroleum and gas structures and in supporting construction and diving work and measures for preserving the environment. Waves and currents are the most important hydrological factors for technical work on the shelf. Due to the lack of reliable computation methods for studying the characteristics of currents, the principal method in specific sectors is in situ measurements.

The problem of choosing the optimum distance between stations for observing currents is the most difficult in the planning of hydrological field work in the coastal zone of the shelf. This zone is characterized by an extremely differentiated and complex pattern of circulation of water masses with considerable spatial and temporal variability. A statistical analysis of the spatial characteristics of currents in characteristic polygons is the most acceptable method for validating the optimum distance between stations.

At the present time the State Oceanographic Institute [4-6], on the basis of aerial photographic survey work for the measurement of currents by means of dyes, has discovered some statistical patterns of change in current velocity in regions with straight shorelines far from capes and bays in the absence of islands and banks. In particular, in the coastal zone (up to 4 km from the shore) it is recommended that observation points be placed at an interval of 2 km in order to obtain a synchronous pattern of distribution of currents [4]. Directly near capes it is common to discover small circulatory systems (with a scale of about 10 km) [5].

These recommendations and conclusions were based on a correlation analysis of absolute current velocity values [4] without allowance for change in current direction. Such an approach is legitimate when determining absolute current velocities but the mathematical approach employed by the authors does not make it possible to evaluate the variability of current directions.

Other methods are also known for evaluating the correlation and spectral characteristics of the current fields [7]. For example, in [1], for evaluating the spatial variability of the vector field the authors propose that the cosine of the angle between the vectors $\vec{V}_1$ and $\vec{V}_2$ be used as the parameter of degree of correlation. However, this parameter determines only the degree of variability of the directions of the vectors $\vec{V}_1$ and $\vec{V}_2$ and does not take into account the variability of the absolute values. Accordingly, for obtaining more generalized characteristics of variability of the vector field it is desirable to carry out processing of the parameters of currents not separately by components (direction, absolute value or two projections), but on the basis of the total velocity vectors.

In this article we examine one of the possible variants of this evaluation and the first results of its testing in specific polygons. The linear variability of the current was determined by evaluating the correlations between two time series of observations carried out at two stations situated at different distances ΔL from one another. An evaluation of the spatial variability of currents was made by finding the correlations for all possible pairs of stations.

The basis for the method is an analysis of random vectors represented in complex form [2]. This makes it possible, using one complex correlation coefficient, to express the degree of interrelationship between current direction and velocity. The current vector can be represented in complex form as

$$\vec{V}_i = v_i \cos\alpha_i + i v_i \sin\alpha_i,$$

where v_i is the absolute value of the current vector, α_i is current direction.

The correlation moment of the two complex variables $\vec{V}_1$ and $\vec{V}_2$ is represented as

$$K_{\vec{v}_1\vec{v}_2} = K_{x_1x_2} + K_{y_1y_2} + i(K_{y_1x_2} - K_{x_1y_2}); \tag{1}$$

where
$$x_1 = v_1\cos\alpha_1;\ y_1 = v_1\sin\alpha_1;\ x_2 = v_2\cos\alpha_2;\ y_2 = v_2\sin\alpha_2,$$

and $K_{x_1x_2}$, $K_{y_1y_2}$, $K_{y_1x_2}$, $K_{x_1y_2}$ are the correlation moments of the values (x_1x_2), (y_1y_2), (y_1y_2), (y_1x_2), (x_1y_2).

The dispersion of the complex value is determined as

$$D_{\vec{V}_1} = D_{x_1} + D_{y_1};\quad D_{\vec{V}_2} = D_{x_2} + D_{y_2}. \tag{2}$$

Expanding formula (1) by parts, we obtain

[cp = mean]

$$K_{x_1 x_2} + K_{y_1 y_2} = \frac{\sum_{i=1}^{n} v_{1i} v_{2i} \cos(\alpha_{1i} - \alpha_{2i})}{n} - |\vec{V}_{1cp}||\vec{V}_{2cp}| \cos(\alpha_{1cp} - \alpha_{2cp}),$$

$$K_{y_1 x_2} - K_{x_1 y_2} = \frac{\sum_{i=1}^{n} v_{1i} v_{2i} \sin(\alpha_{1i} - \alpha_{2i})}{n} - |\vec{V}_{1cp}||\vec{V}_{2cp}| \sin(\alpha_{1cp} - \alpha_{2cp}),$$

where $|\vec{V}_{1\ \mathrm{mean}}|$ is the modulus of the mean current vector, $\alpha_{1\ \mathrm{mean}}$ is the mean current direction.

The correlation coefficient is

$$r = \frac{K_{\vec{V}_1 \vec{V}_2}}{\sqrt{D_{\vec{V}_1} D_{\vec{V}_2}}} = Re^{-i\varphi}, \tag{3}$$

where R is the modulus of the complex correlation coefficient; φ is an argument characterizing the mean deviation of current directions with transition from one station to another.

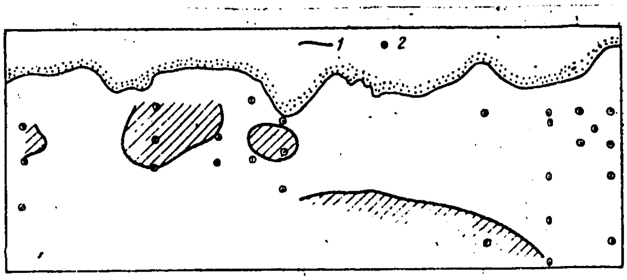

Fig. 1. Polygon of current measurements and diagram of zones of coastal circulation. 1) boundaries of circulation zones; 2) hydrological stations.

A numerical experiment was carried out for obtaining a physical understanding of the essence of these complex correlation coefficients. The dispersion σ^2 of the random value of the angle between two current velocity unit vectors was a variable. We selected the following σ gradations: 15, 30, 45, 60, 90 and 120°. It was assumed that the random value of current direction was distributed in conformity to a normal law. Below we give the relationship between the modulus R and the standard deviation σ obtained in a numerical experiment:

$$R \approx e^{-\frac{\sigma^2}{7039}}. \tag{4}$$

It can be seen from (4) that, for example, with R = 0.6 the standard deviation is $\sigma = \pm 60^\circ$, but with R = 0.1 $\sigma = \pm 127^\circ$.

The method presented above was tested in the coastal zone of the Sea of Japan. As the experimental polygons we selected two morphologically different parts of the shelf. The first sector (Southern Primor'ye) is characterized by a complex configuration of the shore (Fig. 1), whereas the second sector (southwestern coast of Sakhalin) is characterized by a straight shore.

In evaluating the spatial variability of currents in the first sector we used the method of a survey of currents at fixed points situated at different distances from one another. We used: a) squares with sides 250, 500 and 1000 m (the surveys were made at the corners and centers of the squares); b) profiles perpendicular to the shoreline, the distances between which were 250, 500, 1000 and 2000 m (on each profile there were three measurement points: at depths 10, 20 and 30 m). The total number of measurement points for variant (a) was 11, and for variant (b) — 18.

It was impossible to set out the appropriate number of automatically recording instruments. Accordingly, we used the method of single depth measurements at fixed points with the VMM current meter. The network of profiles or squares was broken down by means of theodolite tie-in with the shore. A high-speed boat was used in making the measurements. The full cycle for surveying one square (with depth measurements at each of five points) required from 2 to 2.5 hours. It was assumed that during this period the general pattern of currents does not essentially change and the collected data can be interpreted approximately as the results of a simultaneous survey.

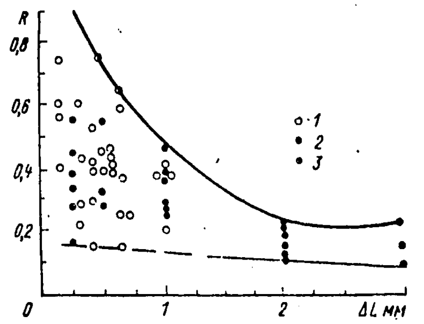

Fig. 2. Dependence of modulus of correlation coefficient on distance ΔL between observation stations. 1, 2) values of R modulus for variants (a) and (b) respectively; 3) value of R modulus $R_{1(2...5)}$.

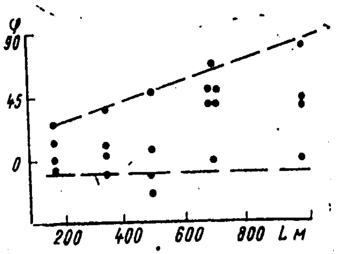

Fig. 3. Dependence of φ argument of complex correlation coefficient on distance ΔL.

In accordance with variant (a), in each square we carried out 20 measurement cycles and in accordance with variant (b) -- 18 cycles. We studied the characteristics of bottom currents, which are especially important for geological engineering problems and at the same time are the least studied.

In the second sector (Sakhalin) there were six measurement cycles, each with 14 points. The distances between profiles were 10 km, and between points on the profile -- up to 4 km.

The results of processing of the series of observations of currents for three squares for the sector shown in Fig. 1 are represented in Figures 2 and 3. The moduli of the complex correlation coefficients vary in the range 0.16-0.72 and the corresponding values of their argument φ vary from 10 to 80°. The series of observations of currents at points situated not more than 200 m from one another are most closely correlated. The correlation coefficient modulus is 0.6 for this same distance. Its variation characteristic does not exceed 2%.

Figure 2 also shows the results of processing of current measurements along six profiles (variant (b)). With an increase in the distance ΔL between profiles the modulus of the correlation coefficient R decreases and at a distance greater than 2 km attains 0.1-0.15. With such distances between observation stations it is impossible to determine the presence of an interrelationship between individual points of the current field, that is, discriminate zones with a transport of water masses which is sustained in direction.

Using the curve of the dependence of the correlation coefficient modulus R on distance ΔL, similar to the graph shown in Fig. 2, and expression (4), it is possible to select the optimum distance between stations in accordance with the required accuracy and engineering problem. For example, in the considered sector in the case of large-scale reconnaissance work in order to determine positions on the plan of circulatory movements of water masses the distance between adjacent stations must not exceed 200-300 m. On the other hand, when it is necessary to clarify the qualitative picture of the field of currents, that is, to determine the general direction of transport of water masses (the standard deviation of current direction is about ±60°), it is possible to hold the interval between stations in the range 600-700 m.

In this same sector, using the R value, it is possible to discriminate characteristic zones of interrelated movement of bottom water masses (circulation, eddies, stationary currents). Two such zones are located in the region of capes (Fig. 1) and are evidently determined by the influence of the shoreline. A third zone, situated in a seaward direction, is in a region adjacent to the stationary Primor'ye Current.

The spatial and alongshore variability of currents in the second sector (Sakhalin Island) differs considerably from the variability of the coastal zone of Southern Primor'ye and is characterized by a transport of water masses which is sustained over the entire polygon. The correlation coefficient modulus R is not below 0.6 with a distance between measurement points up to 30-40 km.

In addition to the processing of results by the method described above, in order to determine the reciprocal influence of the entire group of measurement points we carried out processing of observations using the multiple correlation approach [3]. As the experimental polygon we selected a sector in accordance with variant (a). The multiple correlation coefficient [3] is

$$R_{1(2\ldots p)}=[1-(1-R_{1.2}^2)(1-R_{13.2}^2)\ldots(1-R_{1p.23\ldots(p-1)}^2)]^{\frac{1}{2}},$$

where p is the number of variables; $R_{ij,\ kL}$ is the special correlation coefficient between the variables X_i and X_j with exclusion of the influence of X_k and X_L.

Special coefficients of three or more variables are determined using the formula

$$R_{12.34\ldots p} = \frac{R_{12.4\ldots p} - R_{13.4\ldots p} \cdot R_{23.4\ldots p}}{[(1 - R^2_{13.4\ldots p})(1 - R^2_{23.4\ldots p})]^{0{,}5}}. \quad (5)$$

It can be seen from formula (5) that the special correlation coefficient of p variables is determined by the coefficients of p - 1 variables. Accordingly, knowing the coefficients of two variables, it is possible to determine all the special correlation coefficients of three or more variables. The special correlation coefficients of two variables among all the combinations of series of observations at the corners and at the center of the square were computed using the formula (3).

The values of the total multiple correlation coefficient $R_{1(2\ldots5)}$ are given in Fig. 2. The correlation coefficients computed earlier using formula (3) can be regarded as special coefficients relative to $R_{1(2\ldots5)}$ for the case p = 2. It can be seen from Fig. 2 that the total coefficients give an upward limit of the field of scatter of the special coefficients, whereas the latter give more complete information on the spatial variability of the field of currents. Due to the great amount of work involved in computing the multiple correlation coefficients the problem of the need for using them requires further study and testing on the basis of adequately representative data.

Thus, after analyzing the results, the following conclusions can be drawn:

1. The necessary density of the network of points where currents are observed is essentially dependent on the region where reconnaissance is carried out.

2. In each new region when determining the method for carrying out hydrological work it is necessary to perform preliminary work for determining the optimum network of hydrological stations in dependence on the tasks to be executed and on the requirements for final information.

3. The described method for studying the spatial variability of currents is the basis for carrying out preliminary work for validating the density of hydrological stations in geological engineering work on the shelf.

4. An evaluation of the spatial variability of the current field also requires further investigations of applicability of multiple correlation methods.

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UDC 551.482.2(47)

HEAT RUNOFF OF RIVERS IN EUROPEAN TERRITORY OF USSR

Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 9, Sep 81 (manuscript received 19 Dec 80) pp 85-93

[Article by Yu. A. Yelshin, Murmansk Territorial Administration of Hydrometeorology and Environmental Monitoring]

[Abstract] Until now proper attention has not been given to the heat runoff in rivers. In the territory of the USSR the heat runoff characteristics have not been determined and have not been published, nor are there any special studies in this field. During 1979-1980 the author made computations of heat runoff in all the studied rivers of the Kola Peninsula and many rivers in Karelia, Arkhangel'skaya, Vologodskaya Oblasts and the Komi ASSR, rivers of the Baltic Sea basin and a number of rivers in the lower Volga region, Moldavia and Western Ukraine. For rivers in the White Sea basin, in addition to for individual rivers, the total heat runoff was computed for consolidated regions (Kola Peninsula, Karelia, Severnyy Kray) and for the basin as a whole. The total heat runoff for Lake Onega and Lake Ladoga was also determined. Heat runoff was computed for 248 hydrological posts on rivers with a little-impaired regime having long (more than 10 years) observation series. It was possible to ascertain the dependence of the mean long-term heat runoff and the influence exerted on the heat runoff by a series of factors; a formula is derived for computing the heat runoff; methods are given for computing the long-term variability and intraannual distribution of the heat runoff of rivers. The dependence of the mean seasonal water temperature of rivers on their volume is established. Figures 3, tables 4; references: 10 Russian.

UDC 556.16.01(571.14)

USE OF A PROBABILISTIC TRAVEL-TIME MODEL IN COMPUTING THE HIGH-WATER HYDROGRAPH (IN THE EXAMPLE OF THE CHULYM RIVER)

Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 9, Sep 81 (manuscript received 28 Nov 80) pp 94-100

[Article by N. G. Inishev, Tomsk State University]

[Abstract] In this article, in the example of the Chulym River basin, the author develops a method for computing the high-water hydrograph. The method is based on an evaluation of lateral inflow on the basis of observations of water discharges and the transformation of lateral inflow into the discharge at the lowest-lying gaging station with the use of a probabilistic interpretation of travel time. Formulas are derived for the travel time distribution moments which are convenient for use with an electronic computer. Other formulas are proposed for the lateral inflow probability density function along the length of the stream, taking into account the peculiarities of structure of the channel network, on the basis of which expressions are obtained for the travel time moments. The degree of detail considered for different parts of a basin is determined by the uniformity of the conditions for the formation of runoff and the pattern of the hydrographic net. The greater the detail for the parts of the basin (segments of the channel network), the more complete is the allowance for the peculiarities of the channel net. However, if only a limited volume of information is available for the basin as a whole, it makes no sense to break the basin down into any detailed scheme. Thus, for each river basin an individual judgment must be made concerning the detail of basin breakdown. The solution of this problem for the Chulym River, which has mountainous, hilly and lowland reaches, is discussed. A model for computing the hydrograph of spring high water is formulated on the basis of the total inflow of water into the channel network with the use of the derived expressions. The validity of the formulas was checked on the basis of data for 12 high-water periods (1962-1973). There was found to be a satisfactory agreement between the computed and actual high-water hydrographs. The same parameters of the model can be used in years with different water discharge. Tables 2; references: 14 Russian.

UDC 551.465.53(263)

SPATIAL-TEMPORAL VARIABILITY OF CURRENT DISCHARGES IN THE FGGE ATLANTIC EQUATORIAL POLYGON

Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 9, Sep 81 (manuscript received 16 Feb 81) pp 101-108

[Article by V. A. Burkov, doctor of geographical sciences, A. B. Zubin and V. B. Titov, candidates of geographical sciences, and A. I. Kharlamov, Institute of Oceanology, USSR Academy of Sciences]

[Abstract] In 1979, during the FGGE, the Institute of Oceanology and its divisions carried out extensive hydrophysical measurements in an Atlantic equatorial polygon. The basic objective was a further investigation of the variability of currents (Southern Trades Current, Lomonosov Current and Westerly Equatorial Intermediate Current) and associated oceanological characteristics. The observations in the polygon included current measurements along the merdians 23°30'W and 18°30'W in spring (10 March-2 May) and in summer (20 June-12 August) in the northern hemisphere, hydrological sections along these meridians and a summer hydrological survey within the polygon and beyond its limits to the west and east. All the observations were made on the spring and summer voyages of the scientific research ships "Akademik Kurchatov" and "Professor Shtokman." Both in spring and in summer the total duration of current measurements at automatic buoy stations was about 50 days -- this being one of the longest such series of equatorial currents in the Atlantic. This article gives an analysis of the spatial-temporal variability of discharges and some other current characteristics. The mean daily values of the zonal and meridional components of currents were computed for each observation horizon. Then these values were used in computing the mean discharges of zonal and meridional currents. The zonal discharges were determined along the meridians 23°30' and 18°30'W for sections bounded by 1 1/2 degress north and south latitude and the horizons 15 and 250 m. The meridional discharges were determined along the parallels 1°30'S, 0°40'S, 0°00, 0°40'N and 1°30'N for sections bounded by 23°30' and 18°30'W and the horizons 15 and 250 m. It was found that the discharges of zonal currents vary irregularly with time and asynchronously along the flow with periods exceeding 30 days. The discharges of meridional currents with periods close to the periods of meandering of the Lomonosov Current vary consistently along the meridians. The computed vertical velocity values do not exceed $1000 \cdot 10^{-5}$ cm/sec. The role of meridional flows in the weakening or strengthening of the Lomonosov Current is demonstrated. Figures 4, tables 3; references 11: 10 Russian, 1 Western.

UDC 556.011+556.515

CONSIDERATIONS ON DETERMINING MEAN WATERSHED SLOPES

Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 9, Sep 81 (manuscript received 15 Sep 80) pp 109-111

[Article by A. P. Kopylov, candidate of geographical sciences, State Hydrological Institute]

[Abstract] The inadequate mathematical validity of the formulas proposed in the UNESCO publication REPRESENTATIVE AND EXPERIMENTAL BASINS (1971) and in various studies published by G. A. Alekseyev has been clearly pointed out by the author of this critical communication in his article in METEOROLOGIYA I GIDROLOGIYA, No 7, 1978. The principal reason for the negative evaluation of the formulas was that they do not take into account the degree of dissection of the watershed surface. The hypsographic curve for a watershed and the equivalent rectangular watershed used in connection with these formulas do not carry information on slopes and therefore their use in computations is without justification. Nevertheless, this matter has been raised anew in an article by D. M. Kudritskiy in METEOROLOGIYA I GIDROLOGIYA, No 1, 1980. This author endeavored to defend these poorly substantiated formulas on the basis of assumptions for which there is no backing and sought to discredit the Kopylov formulas on the basis of false assertions. Accordingly, this communication deals with the most important of these errors in Kudritskiy's article. The communication appears to successfully refute the Kudritskiy thesis. References: 9 Russian.

UDC 556.011+556.515

FURTHER CONSIDERATIONS ON MEAN WATERSHED SLOPES

Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 9, Sep 81 (manuscript received 13 Feb 81) pp 111-114

[Article by N. A. Bagrov, professor, USSR Hydrometeorological Scientific Research Center]

[Abstract] This article supplements the article by A. P. Kopylov in this same number of METEOROLOGIYA I GIDROLOGIYA (pp 109-111). The author outlines several schemes for which the mean slope of a watershed is easily computed. The examples cited are for clarifying the geometrical concept of mean slope. The author fully supports the thesis presented by A. P. Kopylov with respect to the validity of his concepts. He completely rejects the arguments presented on this subject by D. M. Kudritskiy in METEOROLOGIYA I GIDROLOGIYA, No 1, 1980; he feels further that debate on the subject should come to an end. In this short communication the author notes that mean slope characterizes well only uniform basins. He stresses that if the parts of the basin differ from one another with respect to orography, forest cover, etc., the examination of slopes must be made separately for uniform parts of the basin; these individual findings can then be brought together by use of a special parameter characterizing the orographic nonuniformity of the basin. The problems involved in obtaining such a parameter are discussed. Figures 3.

UDC 551.509.33

WORK OF AN UNOFFICIAL CONFERENCE OF WMO EXPERTS ON LONG-RANGE WEATHER FORECASTING

Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 9, Sep 81 (manuscript received 6 Feb 81) pp 115-118

[Article by Sh. A. Musayelyan, doctor of physical and mathematical sciences, USSR Hydrometeorological Scientific Research Center]

[Text]

Abstract: The author briefly examines materials from an unofficial conference of WMO experts on long-range weather forecasting (Geneva, 1-5 September 1980). This report gives some data on the status of research on this problem in a number of countries. Information is given on the measures which will be carried out in the future for further development of investigations of the considered problem.

An unofficial conference of WMO experts on long-range weather forecasting (LRWF) for a month and a season in advance was held in Geneva during the period 1-5 September 1980. The conference, organized by the WMO, was attended by the following persons: the General Secretary of the WMO Wiin-Nielsen, Miyakoda, Somerville, Epstein and Gilman from the United States, Bengtsson from the European Center for Medium-Range Weather Forecasts, Parker from the Meteorological Service of Great Britain, Koflan from the Meteorological Bureau of Australia, Kikuchi from the Japanese Meteorological Agency, the Director of the Department of Scientific Research at the WMO A. S. Zaytsev, the Director of the GARP Joint Planning Group Deyes, a consultant of the WMO World Climate Program Beauville, and also specialists of the WMO Secretariat Bozhkov and Suzuki. Sh. A. Musayelyan of the Soviet Union participated in the work of the conference.

The conference was opened by the General Secretary of the WMO Wiin-Nielsen, who in his opening address stated, in particular, "Despite the fact that significant results have not been obtained in the field of LRWF up to the present time over the course of a number of decades, nevertheless there is hope that long-range weather forecasting is possible. When we speak of a limit of predictability of 1-2 weeks, reference is to existing models. If it is found that this is actually so, one must proceed in another direction: develop a new, more realistic strategy and for attaining the final objective travel a long and difficult path. The LRWF problem is a problem which must be solved by all working together. The representatives of the governments of many countries are very interested in the development of new, more perfect LRWF methods. We have met in order to discuss the present status of the problem, to evaluate existing methods and outline further research and formulate a new strategy."

The principal objective of the conference was a discussion, on the basis of review reports of WMO experts, of the status of the LRWF problem and the formulation of preliminary measures which are necessary for the further development of research on the considered problem. With respect to these measures, it was decided to plan a publication TECHNICAL NOTES OF THE WMO on LRWF which should deal with the following problems: empirical, statistical, dynamic and combined methods of LRWF, interaction between the ocean and atmosphere and allowance for these in the development of LRWF methods, and also the problem of atmospheric predictability. In addition, it was decided to organize and carry out a research conference on LRWF.

Then the floor was given to Deyes. He told of the World Climatic Research Program in precise conformity to the report of the first session of the special committee which met in Amsterdam during the period 26 March-3 April 1980. He noted that a number of factors (cloud cover and radiation, ocean processes, sea ice, hydrological processes, etc.), playing an important role in the genesis of climate, are also exceptionally important in developing LRWF methods.

Then the review reports of the experts were presented.

Gilman told of the work of the Climatic Research Center of the United States National Weather Service. The Center gives monthly and seasonal (four times a year) weather forecasts. Numerical forecasts for five days, and also forecasts for intermediate times are used in determining the onset of the period for the preparation of monthly forecasts. These forecasts are disseminated to the United States Department of Energy and other organizations. In the preparation of monthly forecasts use is made for the most part of mean five-day pressure pattern charts (surface charts are used less frequently). Particularly great attention is given to AT_{700} pressure pattern charts. Sometimes on these charts there are macroscale peculiarities of meteorological fields which change little with time. This makes it possible to employ the extrapolation procedure. The seasonal peculiarities of meteorological elements and fields are also taken into account. Temperature and precipitation anomalies are predicted. This year the predictions for summer were very poor. Earlier almost always only the kinematics of pressure formations was used. Investigations are now being made for taking other factors into account. Particularly great significance is being given to checking of the Namias hypothesis. Work is continuing on a detailed study of the relationship between anomalies of water temperature at the ocean surface and deviations of the altitude of the 700-mb isobaric surface from the norm.

Kikuchi presented a review of investigations made by the Japanese Meteorological Agency. In Japan experimental LRWF were first prepared in 1907 in order to supply interested organizations with information on summer weather conditions in the northern part of the country where rice fields are situated. Since 1942 LRWF have been compiled for the entire territory of the country and are published almost regularly (the only exception being 1949-1952).

The Japanese Meteorological Agency regularly, on a routine basis, is issuing the following LRWF: monthly, three-monthly, for the cold and warm half-years.

The monthly forecasts for each month are issued on the tenth day of the preceding month and are made more precise on its last day.

Predictions are made for anomalies of mean temperature and the quantity of precipitation for each of the regions in Japan and the synoptic situation is predicted for each subsequent 10-day period.

Three-month forecasts are issued on the 20th of each month. These same elements and mean weather conditions for each of the three subsequent months are predicted, including summer and winter respectively. A forecast for the warm half-year is issued on 20 March, and for the cold half-year on 10 October. These forecasts give the general characteristics of the anticipated weather, such as late spring, early autumn, etc.

The following methods are used at the present time in the preparation of LRWF:

Analogues Method

The forecast is prepared in two stages:

1) Selection of analogues for circulation conditions at the 500-mb isobaric surface.

In choosing the analogues as a measure of similarity use is made of the percentage of coincidence with respect to the sign of the AT_{500} anomaly in the current field and in the archival fields during this same calendar period of past years (a geographical grid for the northern hemisphere with a uniform interval in latitude and longitude equal to 10° is used). Three groups of such evaluations are considered:
a) for hemispherical mean monthly fields this evaluation must be greater than the critical value;
b) for fields averaged for 2, 4 and 6 five-day periods this evaluation must be over 50% [(only those points of intersection at which the current values of the AT AT_{500} anomalies are greater than 1.28σ are used (σ is computed on the basis of archival data at the selected point of intersection during this same calendar period of past years)];
c) this evaluation must be greater than the critical value for the mean monthly fields when the computations include only points of intersection exerting an influence on the specific object of the forecast (the asynchronous correlation coefficient between the AT_{500} anomaly at this point of intersection and the deviation of the mean monthly temperature or the precipitation total from the norm at a station in the considered region for the considered calendar period and a stipulated time in advance: one, two or three months -- more than 0.3).

The best variant of all the three enumerated analogues is used in the final stage of the forecast.

2) Preparation of monthly forecasts of temperature and precipitation anomalies.

In predicting the mean monthly temperature or the monthly sums of precipitation in a stipulated region use is made of data on the above-mentioned characteristics with a time shift of one, two or three months, after the analogues of atmospheric circulation have been selected for this case.

Correlation Method

Use is made of asynchronous relationships with a time shift of one, two and three months between the mean monthly values of the altitude of the 500-mb isobaric surface at each point of intersection of a 5^0 geographical grid for the northern hemisphere and the anomaly of mean monthly temperature for a particular meteorological station. Regions with the highest correlation coefficient are selected and a prognostic multiple regression equation is written for predicting the temperature anomaly at a particular station where the AT_{500} anomalies are the predictors.

Extrapolation of Periodic Components Method

a) A harmonic analysis of the mean 10-day zonal circulation indices is made at the 500-mb level for the past 36 10-day periods. The two prevailing periods are discriminated and on this basis there is a prediction of the mean 5-day index of zonal circulation for one or even for three months. [In the USSR similar work has been done over a period of years by V. D. Reshetov.]

b) A similar analysis is made for mean 10-day anomalies of altitudes of the 500-mb isobaric surfaces with use of data on 66 elapsed 10-day periods applicable to each point of intersection of the employed grid. This procedure is used for predicting the mean 10-day anomalies of altitudes of the 500-mb isobaric surface for regions in the Far East.

c) The above-mentioned harmonic analysis procedure with subsequent extrapolation of the periodic components is also used in computing the prognostic charts of the mean monthly anomaly of altitudes of the 500-mb surface for the northern hemisphere. The mean monthly anomalies of the mentioned fields for the 29 successive elapsed months are used. The computations are made for each point in the employed geographical grid in the northern hemisphere.

d) Employing the results in a)-c), his synoptic experience and common sense, the forecaster makes a final decision.

Forecasts of temperature anomalies for the period from 1977 through 1979 have the following guaranteed probability with respect to sign in percent:

	1st 10 days	2d 10 days	3d 10 days
Monthly forecasts	66	62	42
	1st month	2d month	3d month
Three-month forecasts	58	58	58

During this same period the precipitation forecasts have the following guaranteed probability:

	1st month	2d month	3d month
Three-month forecasts	66	65	66

The following scientific research work is being done in order to improve the quality of LRWF:

-- A four-level spectral model intended for monthly forecasts is being developed.
-- Existing methods are being improved by making use of three-dimensional data, in particular, for study of the vertical propagation of the blocking process, etc.
-- Investigations are being made on the use of water temperature at the ocean surface, snow cover and cloud cover distribution.
-- Forecasting methods are being developed for the southern hemisphere. This, in the opinion of the speaker, should assist in improving the precipitation forecast.

A review of LRWF investigations in the Soviet Union was given by the author almost completely on the basis of articles by N. A. Bagrov, Ye. N. Blinova, D. A. Ped', K. A. Vasyukov and N. I. Zverev, included in the collection of articles PYAT'DESYAT LET TSENTRU GIDROMETEOROLOGICHESKIKH PROGNOZOV (Fifty Years at the Hydrometeorological Forecasting Center), 1979, and in accordance with an article published by Academician G. I. Marchuk entitled "Hydrodynamic Models in the Dynamics of the Atmosphere and Ocean," included in the collection of articles PROBLEMY SOVREMENNOY GIDROMETEOROLOGII (Problems in Modern Hydrometeorology) (Leningrad, Gidrometeoizdat, 1977). In addition, the review included some results obtained at the Hydrometeorological Center using the cloud cover of the oceans in LRWF. The review was supplied with an extensive bibliography of LRWF investigations of Soviet authors.

In the review by Parker (Meteorological Service of Great Britain) it was pointed out that in Great Britain LRWF have been issued since 1963 but soon such forecasts will be suspended because no funds will be available for such work. For the time being the service will continue to issue forecasts for 5-15 and 16-25 days, which are being used by petroleum workers. Seasonal forecasts are prepared each three months and are issued by private organizations. These forecasts for the region, taking in the territory of Great Britain and part of the territory of Europe, are prepared making use of the following methods:

1. Analogues method. The review gave an analysis of the actual observational data, which, in the opinion of the speaker, demonstrates the basic possibility of preparing forecasts using analogues. It is shown that this method has a statistically significant prognostic capability, although the results are not always satisfactory. The quality of analysis of mean monthly aerological charts, especially over the oceans, can exert an influence on the process of selecting analogues.

2. Sea water temperature. At the present time work is being done in Great Britain for improving the quality of analysis of the water temperature fields at the ocean surface. This can assist in improving the method for selecting analogues and investigations on the basis of numerical modeling.

3. Numerical modeling. LRWF forecasts are precomputed for a month in advance using a five-level model with primitive equations. This model takes into account water temperature at the ocean surface, moist convection and also the radiation effects of clouds and the snow cover (using seasonal climatological data). The model was developed for the northern hemisphere. However, these forecasts are used in practical work with great caution. Excessive polar anticyclogenesis creates great difficulties.

The decision on the anticipated types of weather is made on the basis of prognostic charts of surface pressure and the 500-mb surface averaged for 10 days.

4. Autoprojection method. This method is similar to the Japanese method for the extrapolation of periodic components with use of the main components of the considered meteorological fields. Before conclusions can be drawn concerning the possibilities of the method it must be tested for a long time under routine conditions.

5. Understanding of physical climatic system. Work has begun on implementation of the joint project of the Meteorological Service of Great Britain, one of the universities and the European Center for Medium-Range Weather Forecasts. The purpose of this project is the creation of a specialized archives of global meteorological data and diagnostic data on a number of energy characteristics and study of the main climate-forming factors on the basis of a physical analysis of these data. It is proposed that the understanding of the physical climatic system be improved in this way. The project has still not been completed.

6. Interpretation of pressure formations in weather terms. The analogues method, numerical models and the autoprojection method in the best case make it possible to obtain the prognostic fields of surface pressure and/or geopotential of the upper levels. The interpretation of these prognostic pressure fields in weather terms (precipitation, temperature) is not always obvious. The circulation types developed by Lamb in 1972 are used for solution of this problem.

Koflan gave a review of LRWF investigations carried out at the Australian Meteorological Service. Empirical, statistical and numerical LRWF methods are being developed in Australia. In particular, a study is made of the correlation between the field of velocities and the distribution of precipitation (the correlation coefficient is about 0.6-0.7). However, the inadequacy of observational data is sensed acutely. Two or three years are required in order to collect all the available useful data.

The Australian Bureau of Meteorological Experimental Forecasts operated during 1954-1971. This period is divided into two parts: first -- from 1954 through 1967; second -- from 1968 through 1971. During the first period LRWF work was directed by Karelski, an adherent to the Soviet Mul'tanovskiy school. Karelski began his investigations of the considered problem for the Australian region in 1951. The concepts "cyclonality" and "anticyclonality" were introduced; particular attention was devoted to month-to-month anomalies of pressure formation systems. Investigations have indicated that some types of circulation have a definitely conservative character in the course of natural periods up to a season or more. Beginning in 1968 the LRWF work was headed by Mafotti.

The procedure of preparing a forecast involves the following stages:
1. Analysis of atmospheric circulation on the basis of AT_{500} and a surface pressure chart.
2. Analysis of "cyclonality" and "anticyclonality" anomalies of the current month.
3. Forecasting of atmospheric circulation in the coming month with an indication of the types of anticipated circulation.

4. A general description of the anticipated weather in the coming month for large geographical regions of Australia.

For all years the mean evaluation of the forecasts for temperature is 56% and for precipitation 51%. In 1971 this work was suspended.

During recent years, in connection with the awakening interest in the problem of climatic change, there have been a number of studies (Walker, Lamb, Nichols and others) whose results make it possible to hope for the development of a new, more perfect LRWF method.

During the discussion the position of the Soviet representative could be summarized as follows: at the present time one of the most promising directions in LRWF research is a deeper study of the processes of interaction between the ocean and the atmosphere on the basis of the theoretical studies of Academician G. I. Marchuk and Soviet proposals made within the framework of the "Razrezy" (Profiles) program. This position agrees with the corresponding resolution of the WMO executive committee. Wiin-Nielsen spoke out in support of the Soviet proposal, after which it was adopted.

Then the conferees were informed by WMO officials that by way of preparation of the program for the working conference on time series of oceanographic sections (Tokio, 1981) there would be a conference of experts in the fourth quarter of 1980.

In the course of further discussion of the LRWF problem the Soviet representative expressed his opinions concerning the importance of the problem of discriminating and parameterizing the most important nonadiabatic factors and on a new interpretation of the problem of atmospheric predictability. The conferees expressed their agreement with these ideas. An address by Somerville was of particular interest. He expressed most categorically that the principal efforts should be directed to the development of a new strategy on the LRWF problem different from that which is based on modern models of general circulation of the atmosphere. Using a model of general circulation he carried out numerical experiments with inclusion and exclusion of the principal physical processes taken into account in the model. It was found that the results of these experiments differ little from one another. Accordingly, Somerville concluded that in modern models there is poor representation of the principal physical processes. Therefore, such models cannot be used in LRWF.

In discussing the problems relating to preparation of the WMO TECHNICAL NOTES on LRWF it was decided that the section entitled "Empirical and Statistical LRWF Methods" would be written by Soviet specialists.

The work of this conference revealed that although with respect to some problems the opinions of the experts somewhat diverged (which is inevitable in discussing such problems as LRWF), with respect to the main problem of international cooperation in solution of the considered problem the opinion of all the conferees was unanimous. It is felt that for success in carrying out investigations in this field, directed to the development of new LRWF methods which are better, more perfect than those in existence, there is need for a good businesslike and mutually advantageous international cooperation among all the interested countries.

SIXTIETH BIRTHDAY OF GIVI GEDEONOVICH SVANIDZE

Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 9, Sep 81 pp 119-120

[Article by board members of the USSR State Committee on Hydrometeorology and Environmental Monitoring and personnel of the Transcaucasian Regional Scientific Research Institute]

[Abstract] Professor Givi Gedeonovich Svanidze, doctor of technical sciences, corresponding member of the Georgian Academy of Sciences, marked his 60th birthday on 20 September. G. G. Svanidze, director of the Transcaucasian Regional Scientific Research Institute, is an outstanding scientist in the field of hydrology of the land, hydroelectric power and multisided use of water resources. Beginning in 1950 he worked at the Power Institute, where during 1958-1970 he headed the Division of Multisided Use of Water Resources, which he organized. Since 1971 he has headed the Hydrology Department at Tbilisi State University. In 1976 he was designated director of the Transcaucasian Scientific Research Hydrometeorological Institute (now the Transcaucasian Scientific Research Institute). He was elected a corresponding member of the Georgian Academy of Sciences in 1979. G. G. Svanidze is the author of 150 scientific studies, including seven monographs. In his monographs OSNOVY RASCHETA REGULIROVANIYA RECHNOGO STOKA METODOM MONTE-KARLO (Principles for Computing Regulation of River Runoff by the Monte Carlo Method) and MATEMATICHESKOYE MODELIROVANIYE GIDROLOGICHESKIKH RYADOV (Mathematical Modeling of Hydrological Series) he thoroughly investigated the possibilities of using statistical tests in the field of water management computations and theories of regulation of river runoff and developed new methods for computing reservoirs. For the first time he generalized stochastic computation methods for the case of a system of reservoirs. The methods which he proposed have been adopted into the practice of planning of a number of hydroelectric power stations in the USSR. G. G. Svanidze is one of the authors of the monographs VODOKHOZYAYSTVENNYY KADASTR SSSR. METODIKA SOSTAVLENIYA (Water Management Inventory of the USSR. Compilation Method), GIDROENERGETICHESKIYE RESURSY GRUZINSKOY SSR (Hydroelectric Power Resources of the Georgian SSR), OPASNYYE GIDROMETEOROLOGICHESKIYE YAVLENIYA NA KAVKAZE (Dangerous Hydrometeorological Phenomena in the Caucasus) and others. He directed preparation of the fundamental 10-volume work KOMPLEKSNOYE ISPOL'ZOVANIYE VODNYKH RESURSOV GRUZINSKOY SSR (Multisided Use of Water Resources in the Georgian SSR). The studies of Svanidze in the field of modeling of hydrological processes have laid the basis for a new scientific direction in the theory of regulation of river runoff which is successfully being developed at the scientific and planning institutes of the USSR and also abroad. G. G. Svanidze is one of the founders of modern stochastic hydrology. His reports have been presented at 30 international symposia and his works have been published in many languages.

SIXTIETH BIRTHDAY OF ARKADIY YEFREMOVICH CHERENKOV

Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 9, Sep 81 pp 120-121

[Article by board members of the USSR State Committee on Hydrometeorology and Environmental Monitoring and personnel of the Northern Caucasus Territorial Administration of Hydrometeorology and Environmental Monitoring]

[Abstract] Arkadiy Yefremovich Cherenkov, head of the Northern Caucasus Territorial Administration of Hydrometeorology and Environmental Monitoring, marked his 60th birthday on 30 September 1981. Since his graduation from the Rostov Hydrometeorological Technical School in 1940 he has been constantly affiliated with the Northern Caucasus Administration. Under his direction and with his direct participation there was restoration of the hydrological network of the Lower Don. Later, in the 1950's, he carried out a hydrographic investigation of the Don River and the rivers of the Sea of Azov area. In 1956 he was designated deputy head and in 1965 head of the Northern Caucasus Administration of the Hydrometeorological Service. Under his direction the administration is solving major problems in the hydrometeorological support of the developing national economy of important regions: Don, Kuban, Lower Volga and Northern Caucasus regions. He has always devoted special attention to agricultural production. Arkadiy Yefremovich has done much in supplying the required information to major construction projects: the Great Stavropol' Canal, Krasnodarsk Reservoir and rice systems, Atommash, and others. He has produced a number of important reference aids based on the results of study of the hydrometeorological regime. Major studies are being carried out for investigation of dangerous and especially dangerous hydrometeorological phenomena, especially in the mountains of the Northern Caucasus. Recently the administration has solved a number of complex problems related to the technical reconstruction of the service, automation of the collection, processing and dissemination of hydrometeorological information and organizing observations and monitoring of environmental contamination. Such successes of the administration are largely attributable to the outstanding leadership of A. Ye. Cherenkov.

AWARDS GIVEN TO SOVIET METEOROLOGISTS AND OCEANOGRAPHERS

Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 9, Sep 81 pp 121-126

[Unsigned article]

[Text] For implementation of the goals of the Tenth Five-Year Plan and for the successes attained in hydrometeorological support of the national economy, orders and medals of the USSR have been awarded to the following workers of institutes and organizations of the State Committee on Hydrometeorology and Environmental Monitoring:

Order of Lenin

Nikolay Nikolayevich Aksarin: Head of the Uzbek Republic Administration of the Hydrometeorological Service and Director of the Central Asian Scientific Research Institute.

Galina Alekseyevna Mishina: engineer at the Yakutsk Aviation Meteorological Center of the Yakutsk Territorial Administration of the Hydrometeorological Service.

Order of the October Revolution

Petr Prokof'yevich Laptiyev: former Head of the Transbaykal Territorial Administration of the Hydrometeorological Service.

Sergey Konstantinovich Cherkavskiy: Head of Administration at the State Committee on Hydrometeorology and Environmental Monitoring.

Order of the Red Banner of Labor

Liya Vasil'yevna Alekseyeva: Director of the Tallin Hydrometeorological Observatory of the Estonian Republic Administration of the Hydrometeorological Service.

Shatly Babayev: Head of the Chagyl Meteorological Station of the Turkmen Republic Administration of the Hydrometeorological Service.

Tofa Lyutfulla Bayramova: Section Head at the Azerbaydzhan Republic Administration of the Hydrometeorological Service.

Dmitriy Petrovich Bespalov: Section Head at the Main Geophysical Observatory.

Konstantin Yegorovich Vlasov: Head of the Buguruslan Aviation Meteorological Station of the Volga Territorial Administration of the Hydrometeorological Service.

Anatoliy Makarovich Grishchenko: Head of the Omolon Aviation Meteorological Station of the Kolyma Territorial Administration of the Hydrometeorological Service.

Tamara Fedorovna Zhevnyak: Head of the Aviation Meteorological Station of Kustanayskaya Hydrometeorological Observatory of the Kazakh Republic Administration of the Hydrometeorological Service.

Semen Pavlovich Koznov: Head of the Northwestern Territorial Administration of the Hydrometeorological Service.

Nikolay Nikolayevich Kolesnichenko: Head of the Northern Territorial Administration of the Hydrometeorological Service.

Valentina Petrovna Krasnyanskaya: Senior Scientific Specialist of the Far Eastern Scientific Research Institute.

Galina Petrovna Kupchinskaya: Section Head, Weather Bureau of the Black Sea and Sea of Azov of the Ukrainian Republic Administration of the Hydrometeorological Service.

Zinanda Georgiyevna Kurakova: Head of the Yelizovo Aviation Meteorological Station of the Kamchatkan Territorial Administration of the Hydrometeorological Service.

Vadim Viktorovich Larin: Deputy Head of Administration of the State Committee on Hydrometeorology and Environmental Monitoring.

Trofim Vasil'yevich Li: Head of the Novosibirsk Aviation Meteorological Center of the West Siberian Territorial Administration of the Hydrometeorological Service.

Mikhail Mikhaylovich Masalev: Head of the Kostroma Hydrometeorological Bureau of the Upper Volga Territorial Administration of the Hydrometeorological Service.

Yegor Vasil'yevich Mesyats: Head of the Service of the Automated System for Data Transmission for the Far Eastern Territorial Administration of the Hydrometeorological Service.

Vasiliy Grigor'yevich Pavlenko: Head of the Sakhalin Territorial Administration of the Hydrometeorological Service.

Arvid Antonovich Pastors: Section Head in the Riga Weather Bureau of the Latvian Republic Administration of the Hydrometeorological Service.

Yakov Pavlovich Popov: Head of the Murmansk Territorial Administration of the Hydrometeorological Service.

Vennamin Aleksandrovich Semenov: Head of the Data Center at the All-Union Scientific Research Institute of Hydrometeorological Information.

Viktor Petrovich Teslenko: Director of the Institute of Experimental Meteorology.

Grigoriy Petrovich Tsyganov: Head of the Rostov Aviation Meteorological Center of the Northern Caucasus Territorial Administration of the Hydrometeorological Service.

Lidiya Prokof'yevna Shevchik: senior engineer at the Bratsk Aviation Meteorological Station of the Irkutsk Territorial Administration of the Hydrometeorological Service.

Pavel Yakovlevich Yukhta: senior engineer at the Hydrometeorological Observatory of the Ukrainian Republic Administration of the Hydrometeorological Service.

Order of Friendship of Peoples

Dmitriy Ivanovich Berezkin: Deputy Head of the Belorussian Republic Administration of the Hydrometeorological Service.

Mikhail Mikaylovich Danilyuk: Head of the Transcarpathian Hydrometeorological Bureau of the Ukrainian Republic Administration of the Hydrometeorological Service.

Mikhail Chokkayevich Zalikhanov: Director of the High-Mountain Geophysical Institute.

Nikolay Yefimovich Zakharchenko: Head of the Latvian Republic Administration of the Hydrometeorological Service.

Stanislav Iosifovich Zachek: laboratory head at the Main Geophysical Observatory.

Yevgeniy Mikhaylovich Ivanov: captain of the scientific research ship "Akademik Shirshov" of the Far Eastern Scientific Research Institute.

Nikolay Petrovich Ivanov: senior electromechanic of the scientific research weather ship "Ernst Krenkel'" of the Odessa Division, State Oceanographic Institute.

Mikhail Petrovich Koretskiy: Deputy Head of the Transbaykal Territorial Administration of the Hydrometeorological Service.

Yevgeniy Georgiyevich Lomonosov: Deputy Director of the USSR Hydrometeorological Center.

Galina Mikhaylovna Petrova: laboratory head at the Institute of Applied Geophysics.

Yevgeniya Abramovna Red'ko: Head of the Service of the Automated System for Data Transmission of the Kazakh Republic Administration of the Hydrometeorological Service.

Feliks Yakovlevich Rovinskiy: Section Head in the Laboratory for Monitoring the Environment and Climate.

Givi Gedeonovich Svanidze: Director of the Transcaucasian Regional Scientific Research Institute.

Vladimir Fedorovich Suslov: Section Head at the Central Asian Scientific Research Institute.

Boris Sergeyevich Tatarinov: Section Head at the Georgian Republic Administration of the Hydrometeorological Service.

Yuriy Ivanovich Teterin: Section Head at the Computation Complex of the State Scientific Research Center for the Study of Natural Resources.

Tamaz Ivanovich Turmanidze: Head of the Georgian Republic Administration of the Hydrometeorological Service.

Aleksandr Petrovich Fedoseyev: Section Head at the All-Union Scientific Research Institute of Agricultural Meteorology.

Sergey Stepanovich Khodkin: Head of Administration at the State Committee on Hydrometeorology and Environmental Monitoring.

Sof'ya Vaginakovna Shaginyan: Head of the Armenian Republic Administration of the Hydrometeorological Service.

Grigoriy Innokent'yevich Shcherbakov: Head of the Khomutovo Agrometeorological Station of the Irkutsk Territorial Administration of the Hydrometeorological Service.

Order "Emblem of Honor"

Agabek Sogomonovich Avetisyan: senior technician of the Martuni Meteorological Station of the Armenian Republic Administration of the Hydrometeorological Service.

Anna Nikitichna Akop'yants: technician at the Sevastopol' Hydrometeorological Observatory of the Northern Caucasus Territorial Administration of the Hydrometeorological Service.

Leonid Petrovich Anan'yev: Head of the Tiksi Territorial Administration of the Hydrometeorological Service.

Nikolay Mikheyevich Artyukhov: senior engineer of the Novokuznetsk Aviation Meteorological Station of the West Siberian Territorial Administration of the Hydrometeorological Service.

Petr Anatol'yevich Bibinov: Head of the Service of the Automated System for Data Transmission of the Uzbek Republic Administration of the Hydrometeorological Service.

Liliya Antonovna Borisova: senior engineer at the Gor'kiy Aviation Meteorological Station of the Upper Volga Territorial Administration of the Hydrometeorological Service.

Mariya Matveyevna Bondar': Head of the "Sovkhoz Kara-Su" Hydrometeorological Station of the Kirgiz Republic Administration of the Hydrometeorological Service.

Nikolay Alekseyevich Bochin: Section Head at the State Committee on Hydrometeorology and Environmental Monitoring.

Mikhayl Vasil'yevich Buykov: laboratory head at the Ukrainian Scientific Research Institute.

Mariya Alekseyevna Verevkina: laboratory head at the Northern Caucasus Territorial Administration of the Hydrometeorological Service.

Roman Solomonovich Golubov: laboratory head at the Kazakh Scientific Research Institute.

Vladimir Dmitriyevich Grishchenko: junior scientific specialist at the Arctic and Antarctic Scientific Research Institute.

Leonid Abramovich Dinevich: Head of the Antihail Service in the Moldavian Republic Administration of the Hydrometeorological Service.

Fishel' L'vovich Dlikman: laboratory head at the Institute of Applied Geophysics.

Ivan Sergeyevich Yeremin: Head of the Irkutsk Territorial Administration of the Hydrometeorological Service.

Yuriy Timofeyevich Zheltikov: Head of the Volga Territorial Administration of the Hydrometeorological Service.

Oleg Georgiyevich Zhernovoy: senior engineer of the engineering team at the Kamchatka Administration of the Hydrometeorological Service.

Saveliy Ivanovich Zhidkov: Head of the Leninabad Hydrometeorological Bureau of the Tadzhik Republic Administration of the Hydrometeorological Service.

Amirgali Zhusupkaliyev: Head of the Opornaya Meteorological Station of the Kazakh Republic Administration of the Hydrometeorological Service.

Aron L'vovich Zlatin: Section Head at the Scientific Research Institute of Instrument Making.

Irina Konstantinovna Ivanova: senior engineer at the Saratov Hydrometeorological Observatory of the Volga Territorial Administration of the Hydrometeorological Service.

Zoya Mikhaylovna Izmaylova: Chairman of the Joint Trade Union Committee of the Kirgiz Republic Administration of the Hydrometeorological Service.

Vladimir Ivanovich Il'yashenko: engineer at the Omsk Hydrometeorological Observatory of the Omsk Territorial Administration of the Hydrometeorological Service.

Agrippina Grigor'yevna Kibereva: technician at the Ul'zutuyevskaya Meteorological Station of the Transbaykal Territorial Administration of the Hydrometeorological Service.

Vladimir Mikhaylovich Klimovich: Head of the Calculations and Reports Bureau of the Amderma Territorial Administration of the Hydrometeorological Service.

Leonid Dmitriyevich Kolesnikov: Section Head at the Arkhangel'sk Weather Bureau of the Northern Territorial Administration of the Hydrometeorological Service.

Ivan Fomich Konoplin: Head of the Verkhne-Dubrovo Aerological Station of the Ural Territorial Administration of the Hydrometeorological Service.

Vladimir Aleksandrovich Krupennikov: senior engineer at the Sverdlovsk Weather Bureau of the Ural Territorial Administration of the Hydrometeorological Service.

Yekaterina Grigor'yevna Kulik: engineer at the Cherkessk Hydrometeorological Bureau of the Northern Caucasus Territorial Administration of the Hydrometeorological Service.

Petr Mikhaylovich Lur'ye: Head of the Turkmen Republic Administration of the Hydrometeorological Service.

Lyudmila Alekseyevna Matveyeva: Section Head at the Khabarovsk Hydrometeorological Observatory of the Far Eastern Administration of the Hydrometeorological Service.

Bakitzhan Kudaybergenovich Maubasov: Head of the Ayak-Kum Meteorological Station of the Kazakh Republic Administration of the Hydrometeorological Service.

Yuriy Vasil'yevich Mel'nichuk: Section Head at the Central Aerological Observatory.

Mikolas Mikolovich Mikalayunas: Head of the Lithuanian Republic Administration of the Hydrometeorological Service.

Tamara Ivanovna Mikhaylova: Head of the Leningrad Aviation Meteorological Station of the Northwestern Territorial Administration of the Hydrometeorological Service.

Yuriy Nikiforovich Molokoyedov: senior engineer of the communications center at the Upper Volga Territorial Administration of the Hydrometeorological Service.

Nikolay Romanovich Myarikyanov: Section Head at the Yakutsk Territorial Administration of the Hydrometeorological Service.

Adella Andreyevna Nazarova: senior scientific specialist at the Hydrochemical Institute.

Boris Aleksandrovich Nebogatikov: senior engineer at Sadgorod Aerological Station of the Primor'ye Territorial Administration of the Hydrometeorological Service.

Tamilla Gasanovna Nedoshivina: Chief Editor of the State Scientific-Technical Hydrometeorological Publishing House.

Nonna Alekseyevna Nikiforova: engineer at the Zhdanov Hydrometeorological Bureau of the Ukrainian Republic Administration of the Hydrometeorological Service.

Aleksandra Vasil'yevna Nikolayeva: printer at the printing house of the State Committee on Hydrometeorology and Environmental Monitoring.

Fedor Vasil'yevich Oblakov: Director of the Tuapse Hydrometeorological Technical School.

Robert Surenovich Ovsepyan: Head of the Antihail Service of the Armenian Republic Administration of the Hydrometeorological Service.

Nikolay Gavrilovich Potulov: Head of the Aerological Station of the Ural Hydrometeorological Observatory of the Kazakh Republic Administration of the Hydrometeorological Service.

Petr Yurevich Pushistov: Director of the West Siberian Regional Scientific Research Institute.

Gennadiy Vital'yevich Rumyantsev: Head of the Kolyma Territorial Administration of the Hydrometeorological Service.

Aleksey Alekseyevich Rybnikov: Section Head at the State Oceanographic Institute.

Viktor Sergeyevich Ryazanov: Head of the Upper Volga Territorial Administration of the Hydrometeorological Service.

Valentina Aleksandrovna Safonova: technician at the Baku Weather Bureau of the Azerbaydzhan Republic Administration of the Hydrometeorological Service.

Vera Afanas'yevna Semenova: senior engineer of the Domodedovo Affiliate of the Main Aviation Meteorological Center.

Anna Fedorovna Skokova: senior engineer of the Yuzhno-Sakhalinsk Weather Bureau of the Sakhalin Territorial Administration of the Hydrometeorological Service.

Nikolay Mikhaylovich Skurikhin: Section Chief Designer of the Central Design Bureau of Hydrometeorological Instrument Making.

Raisa Prokof'yevna Sosnovskaya: Section Head at the Ukrainian Weather Bureau of the Ukrainian Republic Administration of the Hydrometeorological Service.

Liya Ivanovna Stasevich: Head of the Pruzhany Meteorological Station of the Belorussian Republic Administration of the Hydrometeorological Service.

Ninel' Aleksandrovna Sumina: senior engineer at the Donetsk Aviation Meteorological Station of the Ukrainian Republic Administration of the Hydrometeorological Service.

Rimma Semenovna Sukhacheva: Section Head at the State Committee on Hydrometeorology and Environmental Monitoring.

Margarita Il'inchinichna Sukhova: senior engineer of the Igarka Aviation Meteorological Station of the Krasnoyarsk Territorial Administration of the Hydrometeorological Service.

Nina Ivanovna Tayurskaya: Head of the Leningrad Weather Bureau of the Northwestern Territorial Administration of the Hydrometeorological Service.

Yuriy Petrovich Teplov: Director of the Pavlodar Hydrometeorological Observatory of the Kazakh Republic Administration of the Hydrometeorological Service.

Aleksandra Ivanovna Ushakova: senior engineer at the Crimean Hydrometeorological Observatory of the Ukrainian Republic Administration of the Hydrometeorological Service.

Vladimir Yakovlevich Fedorov: Director of the Tyumen Hydrometeorological Observatory of the Omsk Territorial Administration of the Hydrometeorological Service.

Yuriy Sarkisovich Tsaturov: Head of Administration at the State Committee on Hydrometeorology and Environmental Monitoring.

Ivan Vasil'yevich Tsvetkov: Deputy Head of Administration at the State Committee on Hydrometeorology and Environmental Monitoring.

Vladimir Afanas'yevich Cheban: Head of the Communications Center at the Moldavian Republic Administration of the Hydrometeorological Service.

Marina Aleksandrovna Cherkesova: Section Head of the Weather Bureau at the West Siberian Territorial Administration of the Hydrometeorological Service.

Adam Valeriyevich Sheynov: Head of the Bakhta Radiometeorological Station at the Krasnoyarsk Territorial Administration of the Hydrometeorological Service.

Ninel' Nikitichna Shekhanina: Head of the Belgograd Hydrometeorological Bureau of the Territorial Administration of the Hydrometeorological Service of the Central Chernozem Oblasts.

Igor' Alekseyevich Shiklomanov: Deputy Director of the State Hydrological Institute.

Natal'ya Ivanovna Shuleykin: Chief Engineer of the State Committee on Hydrometeorology and Environmental Monitoring.

Tat'yana Aleksandrovna Ershtadt: engineer at the Murmansk Territorial Administration of the Hydrometeorological Service.

Medal "For Illustrious Work"

Khacik Vardanovich Abramyan: technician at the Aparan Meteorological Station of the Armenian Republic Administration of the Hydrometeorological Service.

Raisa Aleksandrovna Antokhina: Section Head at the Krasnoyarsk Territorial Administration of the Hydrometeorological Service.

Viola Isaakovna Aunin': senior engineer at the Riga Weather Bureau of the Latvian Republic Administration of the Hydrometeorological Service.

Genriyetta Vol'demarovna Balyakina: Division Head at the Moscow Hydrometeorological Technical School.

Nadezhda Falaleyevna Boyeva: Chief Bookkeeper at the State Committee on Hydrometeorology and Environmental Monitoring.

Nina Ivanovna Budnik: Deputy Section Head at the Kazakh Republic Administration of the Hydrometeorological Service.

Lyudmila Vladimirovna Butalova: senior engineer at the Computation Center of the Main Geophysical Observatory.

Anatoliy Tarasovich Buyalo: mechanic on the steamer at the Kiev Lake Station of the Ukrainian Republic Administration of the Hydrometeorological Service.

Svetlana Aleksandrovna Vasil'yeva: Head of the Ishim Aviation Meteorological Station at the Omsk Territorial Administration of Hydrometeorology.

Anatoliy Alekseyevich Velikodnyy: senior engineer at the Dikson Territorial Administration of the Hydrometeorological Service.

Nazim Gayazov: driver at the Western Kazakhstan Hydrometeorological Observatory of the Kazakh Republic Administration of the Hydrometeorological Service.

Ismet Khemdiyevich Diasamidze: Director of the Batumi Hydrometeorological Observatory of the Georgian Republic Administration of the Hydrometeorological Service.

Valentina Vasil'yevna Dolgopolova: technician at the Kuban Mouth Station of the Northern Caucasus Territorial Administration of the Hydrometeorological Service.

Vera Aleksandrovna Yelizarova: senior engineer at the State Committee on Hydrometeorology and Environmental Monitoring.

Lidiya Ivanovna Yemchenko: senior engineer of the Gor'kiy Weather Bureau of the Upper Volga Territorial Administration of the Hydrometeorological Service.

Kuz'ma Petrovich Yermak: Head of the Onor Meteorological Station of the Sakhalin Territorial Administration of the Hydrometeorological Service.

Alla Nikolayevna Zavodtsova: senior engineer at the Svetlovodsk Hydrometeorological Observatory of the Ukrainian Republic Administration of the Hydrometeorological Service.

Gertruda Borisovna Zakharova: senior engineer of the Krasnoyarsk Hydrometeorological Observatory of the Krasnoyarsk Territorial Administration of the Hydrometeorological Service.

Lidiya Stepanovna Zvyagintseva: senior technician of the Bina Aviation Meteorological Station of the Azerbaydzhan Republic Administration of the Hydrometeorological Service.

Zoya Mikhaylovna Ivanova: senior engineer at the Leningrad Hydrometeorological Observatory of the Northwestern Territorial Administration of the Hydrometeorological Service.

Tat'yana Prokof'yevna Ivanova: senior engineer of the Kuybyshev Weather Bureau of the Volga Territorial Administration of the Hydrometeorological Service.

Valentina Ivanovna Ignat'yeva: senior engineer of the Mary Aviation Meteorological Station of the Turkmen Republic Administration of the Hydrometeorological Service.

Ninel' Sergeyevna Kazantseva: Section Head at the Ukrainian Republic Administration of the Hydrometeorological Service.

Galina Nikolayevna Klyukvina: senior economist of the State Committee on Hydrometeorology and Environmental Monitoring.

Taisiya Yermolayevna Kovaleva: laboratory head at the West Siberian Scientific Research Institute.

Galina Stepanovna Kopytova: senior technician of the Rybinsk Hydrometeorological Observatory of the Upper Volga Territorial Administration of the Hydrometeorological Service.

Lyudmila Ivanovna Krasnovskaya: laboratory head at the Central Aerological Observatory.

Khabil Tushevich Kudayev: specialist at the Northern Caucasus Antihail Service.

Lyudmila Pavlovna Kuz'mina: Head of the Bukhara Aviation Meteorological Station of the Uzbek Republic Administration of the Hydrometeorological Service.

Valeriy Vladimirovich Lukin: senior engineer at the Arctic and Antarctic Scientific Research Institute.

Aleksandr Nikolayevich Martynov: radio station head at the Gur'yev Hydrometeorological Observatory of the Kazakh Republic Administration of the Hydrometeorological Service.

Valeriya Nikolayevna Michurina: senior engineer in the Bureau of Calculations and Reports at the Ural Territorial Administration of the Hydrometeorological Service.

Anna Mikhaylovna Nozhenko: Section Head at the Kirgiz Republic Administration of the Hydrometeorological Service.

Nina Ivanovna Nosacheva: Head of the Pyandzh Aviation Meteorological Station of the Tadzhik Republic Administration of the Hydrometeorological Service.

Irina Georgiyevna Orlova: senior scientific specialist at the Odessa Division of the State Oceanographic Institute.

Natal'ya Dmitriyevna Pal'tseva: technician at the Pervomayskoye Hydrometeorological Station of the West Siberian Territorial Administration of the Hydrometeorological Service.

Tamara Aleksandrovna Perlova: Chairman of the Joint Committee of Moscow Trade Unions of the State Committee on Hydrometeorology and Environmental Monitoring.

Galina Stepanovna Podshivalova: senior engineer of the Birobidzhan Hydrometeorological Bureau of the Far Eastern Territorial Administration of the Hydrometeorological Service.

Klavdiya Nikolayevna Polyakova: senior scientific specialist at the USSR Hydrometeorological Center.

Yuriy Ivanovich Portnyagin: laboratory head at the Institute of Experimental Meteorology.

Yekaterina Dmitriyevna Redikortseva: senior engineer of the communications center at the Ural Territorial Administration of the Hydrometeorological Service.

Varvara Alekseyevna Samokhvalova: Section Head at the Kura Weather Bureau of the Territorial Administration of the Hydrometeorological Service of the Central Chernozem Oblasts.

Aleksandra Lazarevna Sedinina: Head of the Teplyy Klyuch Aviation Meteorological Station of the Yakutsk Territorial Administration of the Hydrometeorological Service.

Tat'yana Yevgen'yevna Sizova: engineer of the Antihail Service of the Moldavian Republic Administration of the Hydrometeorological Service.

Boris Vladimirovich Solodkov: Head of the Kolva Hydrometeorological Station of the Northern Territorial Administration of the Hydrometeorological Service.

Linda Yukhanovna Tartu: technician at the Pyarnu Meteorological Station of the Estonian Republic Administration of the Hydrometeorological Service.

Nikolay Ignat'yevich Tutubalin: senior engineer at the Pevek Hydrometeorological Observatory of the Pevek Territorial Administration of the Hydrometeorological Service.

Lyudmila Ivanovna Usova: junior scientific specialist of the State Hydrological Institute.

Zinanda Ivanovna Khazova: senior technician of the Karelian Hydrometeorological Observatory of the Northwestern Territorial Administration of the Hydrometeorological Service.

Tat'yana Petrovna Khozyaykina: shop foreman at the Novosibirsk Computer Station.

Mikhail Ivanovich Tsukanov: senior technician at the Gomel Hydrometeorological Observatory of the Belorussian Republic Administration of the Hydrometeorological Service.

Yelena Mikhaylovna Chesnokova: senior synoptic engineer at the Ulan-Ude Aviation Meteorological Station of the Transbaykal Territorial Administration of the Hydrometeorological Service.

Lyudmila Grigor'yevna Shinegina: senior technician at the Anadyr' Hydrometeorological Observatory of the Kolyma Territorial Administration of the Hydrometeorological Service.

Galina Ivanovna Shmotova: senior engineer at the Irkutsk Hydrometeorological Observatory of the Irkutsk Territorial Administration of the Hydrometeorological Service.

Larisa Grigor'yevna Shtan'ko: senior engineer of the Astrakhan Hydrometeorological Observatory of the Northern Caucasus Territorial Administration of the Hydrometeorological Service.

Medal "For Distinction in Work"

Galina Sergeyevna Abakumova: senior technician at the Voroshilovgrad Hydrometeorological Bureau of the Ukrainian Republic Administration of the Hydrometeorological Service.

Raisa Ivanovna Aksenova: senior technician at the Yemetsk hydrometeorological station of the Northern Territorial Administration of the Hydrometeorological Service.

Valentina Petrovna Alekseyeva: photooperator at the Communications Center of the Volga Territorial Administration of the Hydrometeorological Service.

Yelizaveta Il'inichna Anitskaya: Section Head at the Kuybyshev Hydrometeorological Observatory of the Volga Territorial Administration of the Hydrometeorological Service.

Amalya Zavenovna Asatryan: senior technician at the Yerevan "Yuzhnaya" Aviation Meteorological Station of the Armenian Republic Administration of the Hydrometeorological Service.

Tamara Basagadayeva: junior technician at the Burgen' Meteorological Station of the Transbaykal Territorial Administration of the Hydrometeorological Service.

Tat'yana Ivanovna Bezrukova: junior technician at the Uch-Akty Meteorological Station of the Kazakh Republic Administration of the Hydrometeorological Service.

Vladimir Leonidovich Belov: senior technician at the Vyborg Hydrological Station of the Northwestern Territorial Administration of the Hydrometeorological Service.

Vladislav Ramazanovich Bolov: laboratory head at the High-Mountain Geophysical Institute.

Lidiya Andreyevna Bulavinova: senior laboratory technician of the Kazakh Republic Administration of the Hydrometeorological Service.

Abram Isayevich Buz: Section Head of the Vil'nyus Weather Bureau of the Lithuanian Republic Administration of the Hydrometeorological Service.

Lidiya Innokent'yevna Vanteyeva: observer at the Shankhar Gaging Station of the Irkutsk Territorial Administration of the Hydrometeorological Service.

Nikolay Alekseyevich Voyt: Head of the L'gov Meteorological Station of the Territorial Administration of the Central Chernozem Oblasts.

Nadezhda Petrovna Vorob'yeva: senior laboratory technician of the Krasnoyarsk Territorial Administration of the Hydrometeorological Service.

Valentina Fedorovna Glinskaya: Section Head at the Vladivostok Hydrometeorological Observatory of the Primor'ye Territorial Administration of the Hydrometeorological Service.

Mariya Kuz'minichna Gordeyeva: senior scientific specialist of the Far Eastern Scientific Research Institute.

Nina Fedorovna Gorchak: senior engineer of the All-Union Scientific Research Institute of Hydrometeorological Information.

Murodmamad Davlyatmamadov: observer at the Khorogskoy Hydrological Post of the Hydrometeorological Observatory of the Tadzhik Republic Administration of the Hydrometeorological Service.

Vasiliy Semenovich Dmitriyev: metal worker at the Central Design Bureau of Hydrometeorological Instrument Making.

Lyudmila Ivanovna Dotsenko: technician at the Nikopol'skaya Meteorological Station of the Ukrainian Republic Administration of the Hydrometeorological Service.

Kim Ivanovich Yepishin: Head of the Sverdlovsk-Uktus Aviation Meteorological Station of the Ural Territorial Administration of the Hydrometeorological Service.

Lidiya Fedorovna Yermakova: senior scientific specialist at the Sevastopol' Division of the State Oceanographic Institute.

Zinanda Mikhaylovna Zabara: senior technician at the Klepinino Agrometeorological Station of the Ukrainian Republic Administration of the Hydrometeorological Service.

Nasiba Usmanovna Iskhakova: engineer at the Tashkent-Observatoriya Hydrometeorological Station of the Uzbek Republic Administration of the Hydrometeorological Service.

Amaliya Vaganovna Karmir-Marukyan: senior technician at the Georgian Republic Administration of the Hydrometeorological Service.

Nikolay Sergeyevich Kim: senior scientific specialist of the Institute of Experimental Meteorology.

Vera Vasil'yevna Klabukova: senior laboratory engineer at the Northwestern Territorial Administration of the Hydrometeorological Service.

Boris Kuz'mich Korolev: metalsmith-mechanic in the Experimental-Production Workshop of the Central Aerological Observatory.

Valentina Vasil'yevna Leshkova: senior engineer at the Weather Bureau of the Belorussian Republic Administration of the Hydrometeorological Service.

Yuriy Konstantinovich Martynyuk: Head of the Hydrometeorological Training Station of the Vladivostok Hydrometeorological Technical School.

Inna Linovna Medvedeva: laboratory head at the Ural Territorial Administration of the Hydrometeorological Service.

Nina Petrovna Mezentseva: Head of the Dvinskoy Bereznik Aviation Meteorological Station of the Northern Territorial Administration of the Hydrometeorological Service.

Muzaffar Mamed ogly Mirzoyev: junior technician of the Yardymly Hydrometeorological Station of the Azerbaydzhan Republic Administration of the Hydrometeorological Service.

Zhaniya Ivanovna Miroshnikova: senior engineer at the Ukrainian Scientific Research Institute.

Galina Aleksandrovna Mishina: senior engineer at the Khabarovsk Weather Bureau of the Far Eastern Territorial Administration of the Hydrometeorological Service.

Inna Alekseyevna Moiseyenko-Ivanova: senior section engineer at the West Siberian Territorial Administration of the Hydrometeorological Service.

Nadezhda Borisovna Moskaleva: engineer at the State Committee on Hydrometeorology and Environmental Monitoring.

Nadezhda Borisovna Moskaleva: engineer of the State Committee on Hydrometeorology and Environmental Monitoring.

Vol'f Yeselevich Osherov: Chief Inspector of the Gor'kiy Regional Meteorological Center.

Nikolay Makarovich Petrov: observer at the Yatyrakha Post of Yakutsk Hydrological Station of the Yakutsk Territorial Administration of the Hydrometeorological Service.

Zinanda Vasil'yevna Podol'skaya: Secretary to the Deputy Chairman of the State Committee on Hydrometeorology and Environmental Monitoring.

Margarita Vasil'yevna Pozdeyeva: Deputy Chief Bookkeeper of the State Scientific Research Center for Study of Natural Resources.

Nonia Ivanovna Polkanova: senior technician at the Petropavlovsk-Kamchatskiy Hydrometeorological Station of the Kamchatka Territorial Administration of the Hydrometeorological Service.

Margarita Yegorovna Popova: radio operator at the Kzyl-Orda Hydrometeorological Bureau of the Kazakh Republic Administration of the Hydrometeorological Service.

Tat'yana Ivanovna Popova: photooperator at the Gor'kiy Regional Meteorological Center.

Anna Petrovna Rozova: Section Head at the Central Volga Hydrometeorological Observatory.

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Anna Iosifovna Skvortsova: technician at the Slavgorod Hydrometeorological Station of the West Siberian Territorial Administration of the Hydrometeorological Service.

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Boris Leonidovich Sokolov: senior scientific specialist at the State Hydrological Institute.

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OBITUARY OF PETR KARPOVICH YEVSEYEV (1911-1964)

Moscow METEOROLOGIYA I GIDROLOGIYA in Russian No 9, Sep 81 pp 127-128

[Article by personnel of the USSR Hydrometeorological Scientific Research Center]

[Abstract] Petr Karpovich Yevseyev, an outstanding worker of the USSR Hydrometeorological Service, who died in 1964, would have been age 70 on 1 September. He made a major contribution to development of the Soviet weather service. During the period 1939-1943 he worked as deputy director of the Central Weather Institute. In that post he staffed the institute with carefully selected young specialists and strengthened direction of the short-range weather forecasting division. During the Great Fatherland War he did much for organizing continuous meteorological support of operations of the Red Army. During 1942-1943 he was assigned to London for discussions of exchange of meteorological data with the British. After discharging increasingly responsible tasks, in 1945 he was named to the post of deputy director of the Central Institute of Forecasts. Under his direction, in 1945-1947 the Central Institute of Forecasts for the first time was outfitted with a powerful communications center for collecting data from outlying administrations of the Hydrometeorological Service. In 1945 he became director of the Scientific Research Institute of Aeroclimatology where he directed work on preparation of an aeroclimatic handbook of the USSR and laid the basis for a new direction in the field of climatology of the free atmosphere and aviation climatology with the use of mechanized processing of observational data. As director of this institute P. K. Yevseyev was chairman of the Working Group on Meteorology of the Soviet Interdepartmental Committee on Conduct of the International Geophysical Year, as well as a member of the WMO Commission on Climatology. In April 1961 he was designated director of the newly created Joint Meteorological Computation Center, USSR Academy of Sciences, and the Main Administration of the Hydrometeorological Service, transformed in early 1964 into the World Meteorological Center. Transforming the center into an exceedingly well-regarded institute, he died on 20 June 1964 with brilliant plans still unfulfilled but with an outstanding legacy.

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