Correlation Functions of the Global Sea-level Pressure Field

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This study analyses if global sea level pressure fields are considered to be homogeneous and isotropic.

It is established that around any but given stations in choosen sectors of both hemispheres monthly mean sea level pressure fields — on the basis of sea level pressure isocorrelation curves — are not homogeneous and isotropic.

Of the representative stations of pressure centres pressure fields are in an increased degree not homogeneous and isotropic.

A globális tengerszinti légnyomási mező korrelációs függvényei. A dolgozat azt elemzi, hogy a globális tengerszinti légnyomási mező tekinthető-e homogén izotrópnak?

Az északi és déli féltekén választott szektorok tetszőlegesen rögzített állomásai körül a légnyomás izokorrelációs görbék alapján a havi közepes tengerszinti légnyomási mezők nem homogének és anizotrópok.

A légnyomási akciócentrumok reprezentatív állomásai körül pedig a légnyomási mező fokozottan ahomogén és anizotrop.

The correlation functions of the sea-level pressure field have already been studied by many, mainly in connection with the solution of optimal interpolational problems usual during the objective analysis of meteorological fields.

When studying the correlation functions and statistical structure of the sea-level pressure field, the homogeneity and isotropity of the fields studied are postulated for granted (e.g. **Gruza and Kaznaceeva, 1968**). In case of a fixed point M_0 and various points M, if the spatial correlation function between M_o and the points M does not depend on the coordinates of the point M_o, then the field is at the same time isotropic as well.

In this chapter, only spatial correlations are calculeted, temporal ones are not, for temporal correlatedness is covered to a certain degree, partly by coefficient time series obtained when decomposing sea-level pressure field to natural orthogonal components (**Makra, 1987**), partly by period analysis (**Makra, 1989**).

In order to find whether the sea-level pressure field can be considered a homogeneous isotropic, its monthly correlation functions have been examined. For that purpose, in the Northern Hemisphere in the regions of North America and Eurasia, as well as the oceanic basins, *4*, and in the Southern Hemisphere, *2* sectors have been separeted. The stations fixed sector by sector have been chosen optionally. These, with their serial numbers and coordinates, are the following: 60. Winly. These, with their serial numbers and coordinates, are the following: 60. Winnipeg, 49°54'N, 97°15'W; 65. D (a ship), 44°00'N, 41°00'W; 48. Kiev, 50°24'N, 30°27'E; 108. V (a ship), 34°00'N, 164°00'E; 201. Asuncion, 25°16'S, 57°38'W; 210. Alice Springs, 23°48'S, 133°53'E (*Fig 1*) (Makra, 1987). Around the stations (henceforth: poles) fixed, the decay of correlations are examined as far as the isocorrelation curves *0*.

On the basis of the correlation functions of the monthly mean sea level pressure fields (*Fig 2*), the following can be established: Mostly in the immediate neighbourhoods of the poles Kiev and Alice Springs, locally in almost every single monthly field (much more sparsely than in the ones of the others) can be found isotropic areas. In general, however, the isocorrelation curves notably stretch, that is level out, along the meridian — they are elliptic, as a consequence of the anisotropy of the individual monthly fields. From pole to pole and month to month, the decays of the isocorrelations are very different. Consequently, the individual monthly sea-level pressure fields are not homogeneous. Therefore, on the whole, the monthly mea ı sea-level pressure fields are not homogeneous and are anisotropic. The assumption of homogeneous isotropy can be regarded as a rather rough approach.

The isocorrelation curves associated with the individual poles, at the same time, demonstrate well — especially in the Northern Hemisphere, — the close connection of the winter Arctic high-pressure area with the sea-level pressure field over north America; in spring, with the decomposition of the polar anticyclone, the increasing zonality of the temperate-zone latitudes; as well as in autumn, the equalization of air pressure difference over the continental and oceanic surfaces.

It has been examined to what extent the above establishments are valid for the most characteristic ranges of the pressure field, the areas of pressure centres of action. The representative stations of the individual centres, with their map serial numbers and coordinates, are as follows: low-pressure station of Iceland — 23. Stykkisholm, 65°05'N, 22°46'W; Central Asian high pressure station — Irkutsk, 52°16'N, 104°19'E; Aleutic low-pressure station — 57. St. Paul, 57°09'N, 170°13'W; Azorean highpressure station — 92. Ponta Delgada, 37°45'N, 25°40'W; North Pacific high-pressure station — 109. Honolulu, 21°21'N, 157°56'W; South Pacific high-pressure station — 198. c (interpolated), 30°00'S, 100°00'W; South Atlantic high-pressure one -203. d (interpolated), 30°00'S, 10°00'W; Indian Ocean high pressure one — 208. e (interpolated), 30°00'S, 90°00'E (*Fig 1*) (Makra, 1987).

These stations having been fixed, it can, in general, be established that around them, the course of isocorrelation curves is even more deformed than in the preceding case. Thus, in the range of the action centres, the pressure field is ahomogeneous and anisotropic in an increased degree.

The influence area of the Iceland low-pressure centre is the greatest, which, in a considerable part of the year, extends over the whole Arctic zone, and all the year round, its connection is closest with the areas over Greenland and the Canadian archipelago. The high-pressure centre in Central Asia is well developed, with the exception of October, in the whole winter half-year (*Figs 3k, 1a, 1b, 1c*), and in the first three months of the year it extends to the Eastern Hemisphere's Arctic ranges (*Figs 3a, 3b, 3c*). The Azorian maximum has an effect, with exception of November, on a smaller area than the North Pacific. In the oceanic basins of the Northern Hemisphere, the barometric minimums have a much more strongly marked system of connections than their high-pressure equivalents have. Of the subtropical high-pressure action centres of the Southern Hemisphere, it seems that the South Pacific is the most developed and the stablest (*Fig 3*).

References

[1] Gruza, G. V.—Kaznaceeva, V. D., 1968: *Statisticeskaa struktura bariceskogo pola severnogo polusaria.* Trudy, S. A. R. N. I. G. M. I., 38/53

[2] Makra, L., 1987: *Examination of statistical structure of global sea-level pressure field* (Manuscript)

[3] Makra, L., 1989: *Cycles and quasi-peridicities in the global distribution of sea-level pressure.* Acta Clim. Univ. Szegediensis, Tom. XXI—XXIII, pp. 51—66.

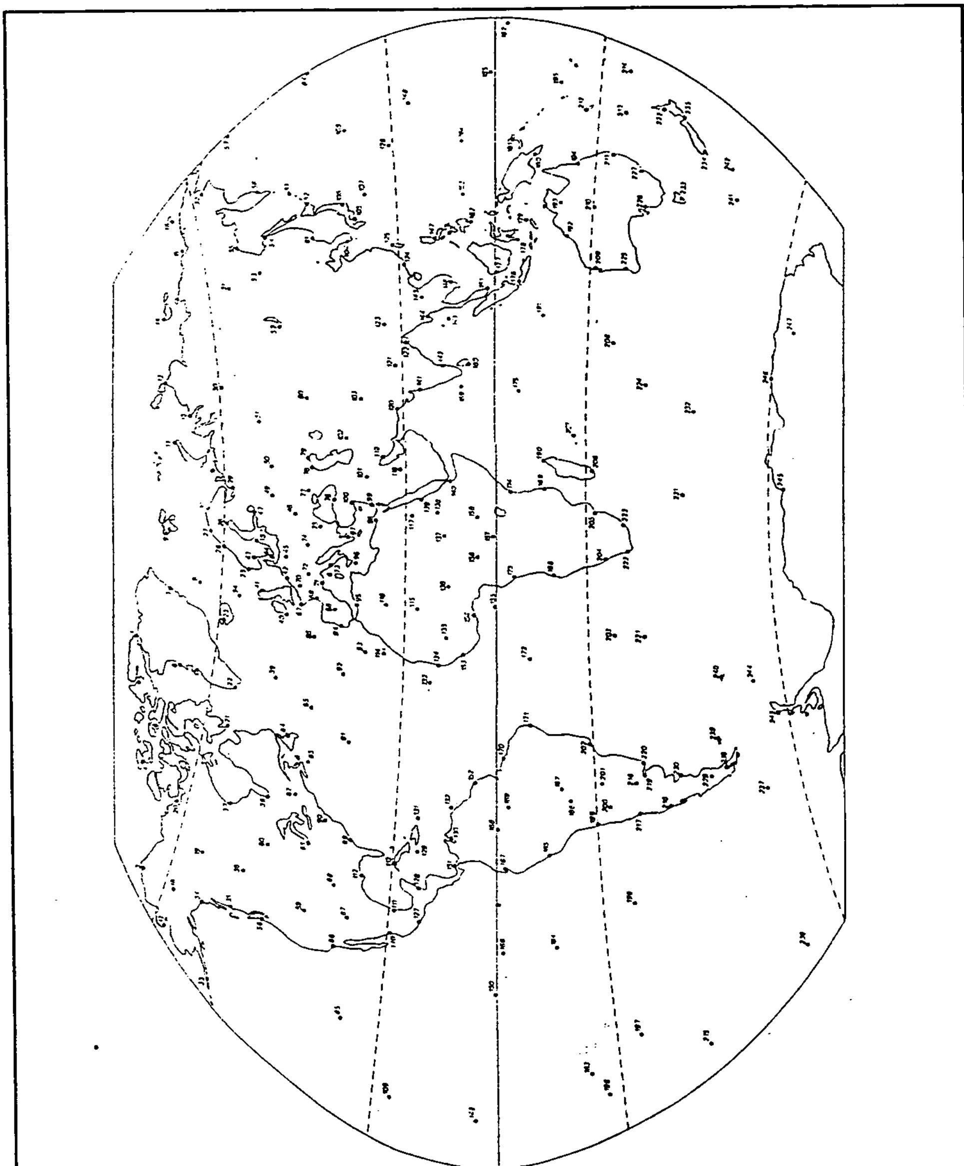

Figure 1 *Stations*

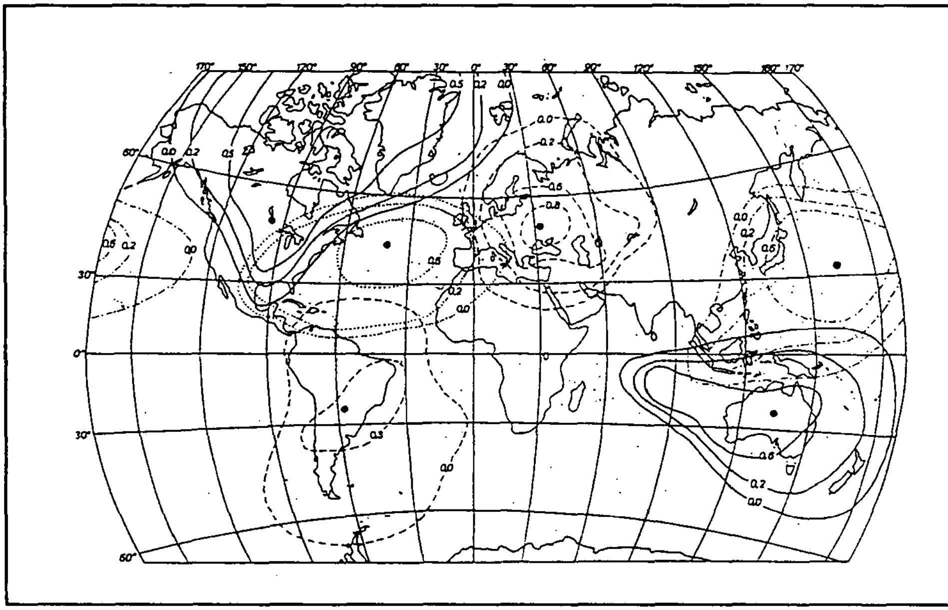

Fig. 2a. Correlation functions of sea-level pressure field, January

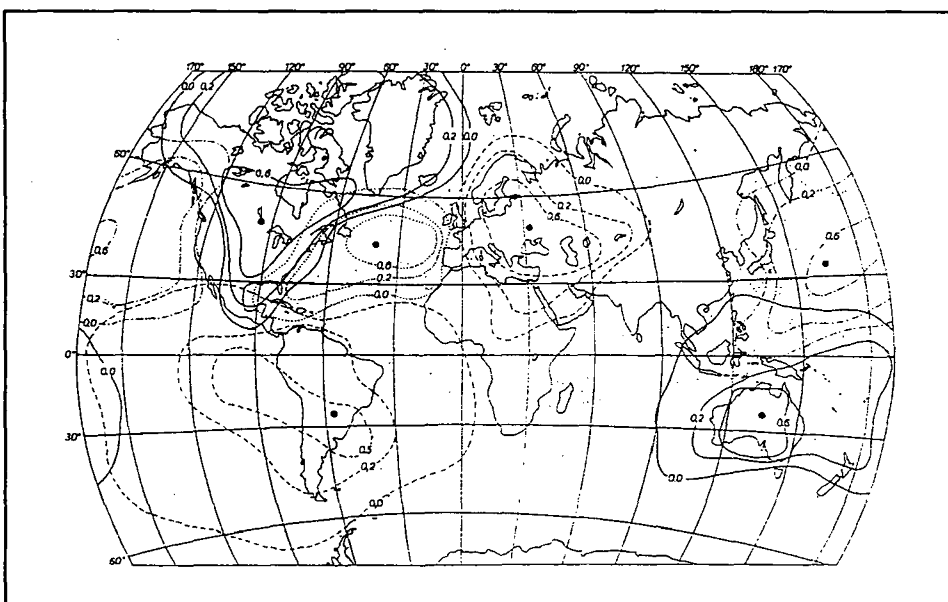

Fig. 2b. Correlation functions of sea-level pressure field, February

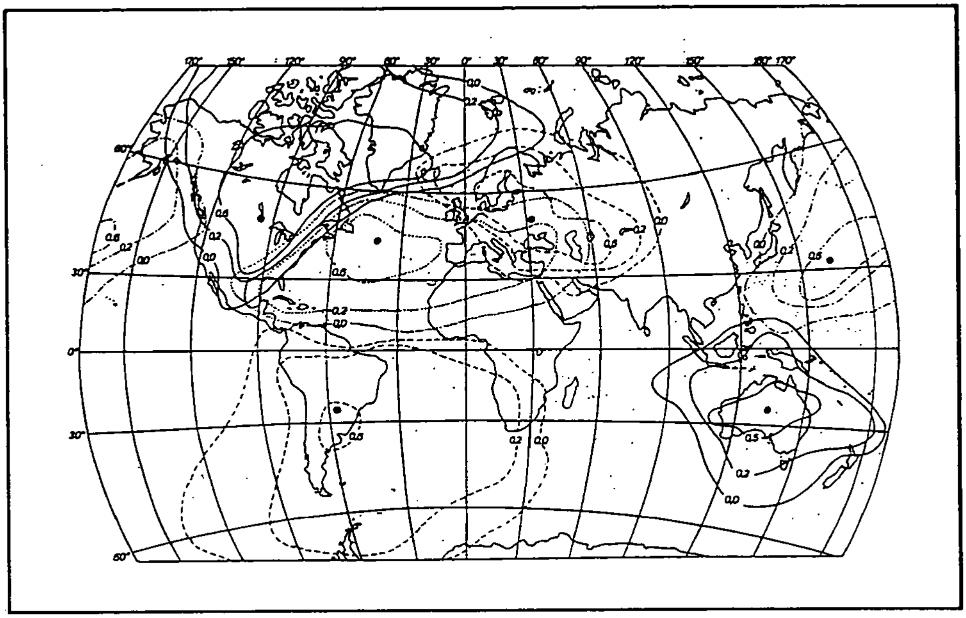

Fig. 2c. Correlation functions of sea-level pressure ,.eld, March

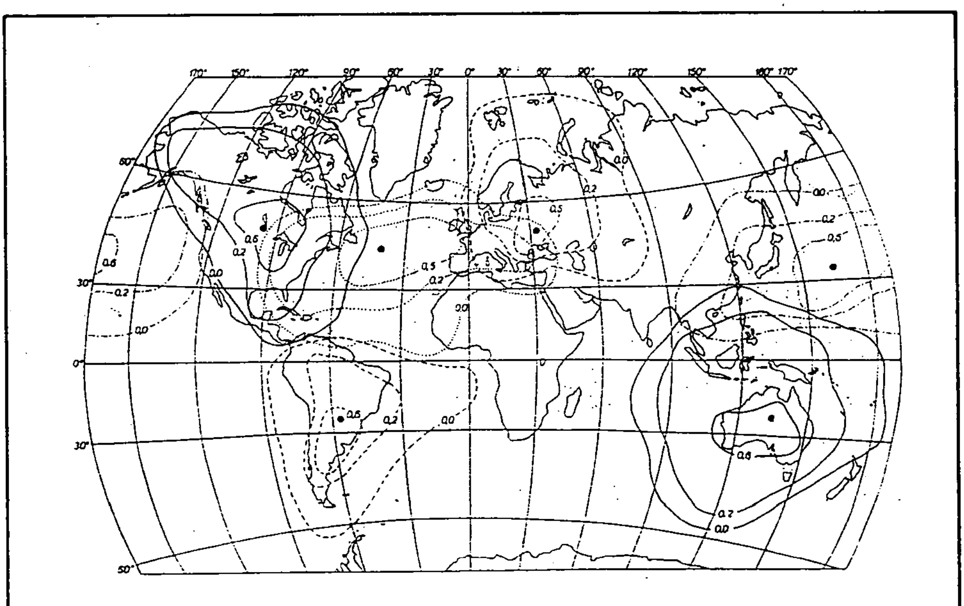

Fig. 2d. Correlation functions of sea-level pressure field, April

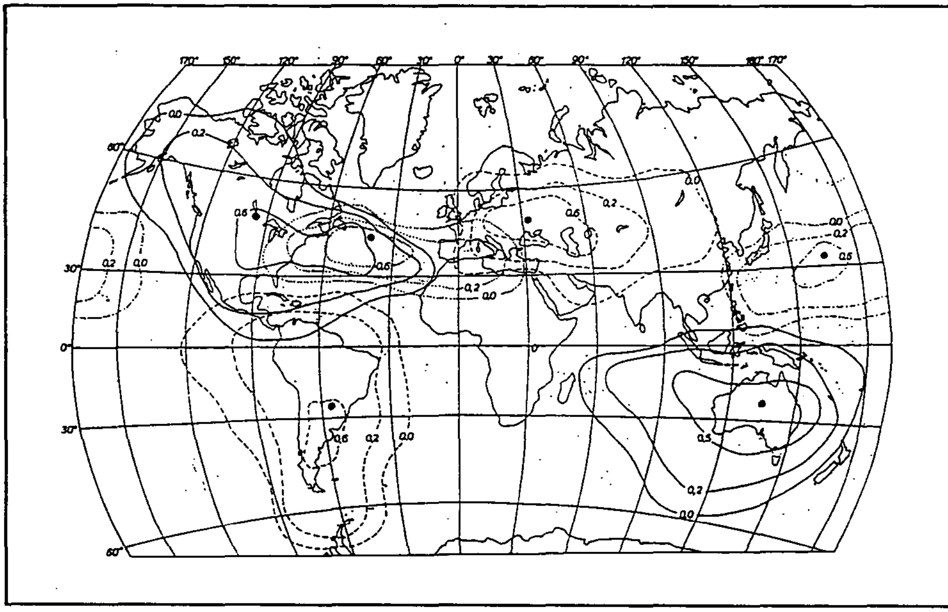

Fig. 2e. Correlation functions of sea-level pressure field, May

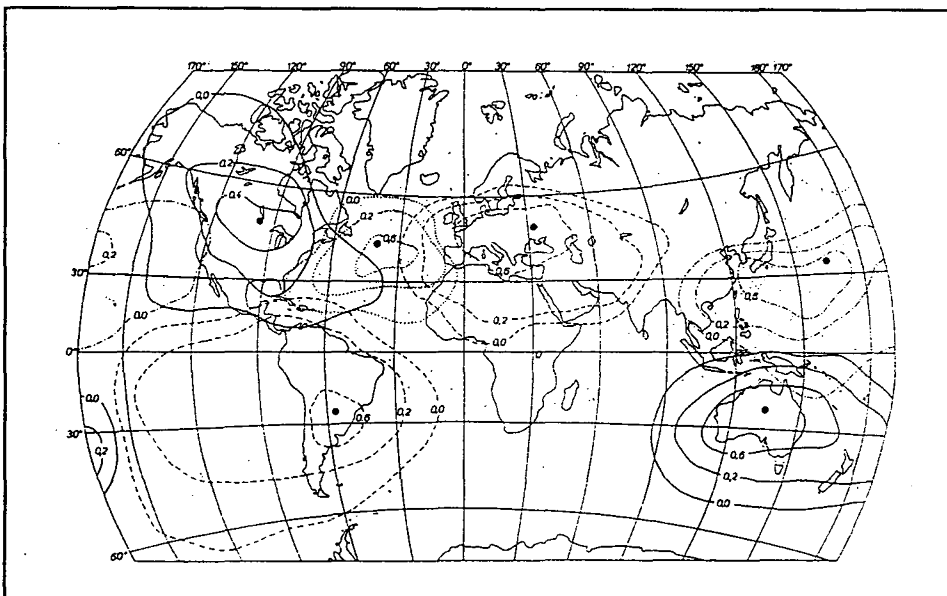

Fig. 2f. Correlation functions of sea-level pressure field, June

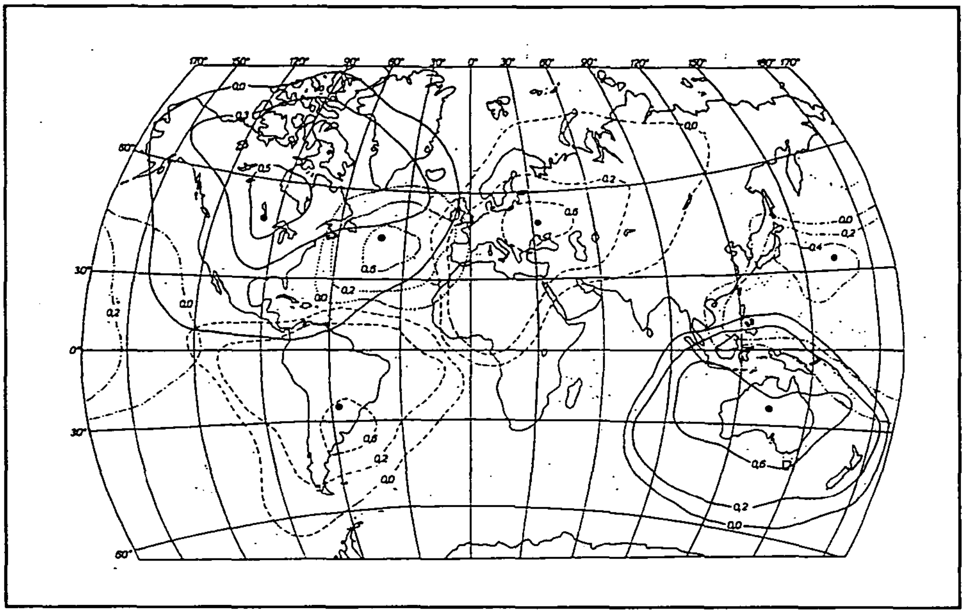

Fig. 2g. Correlation functions of sea-level pressure field, July

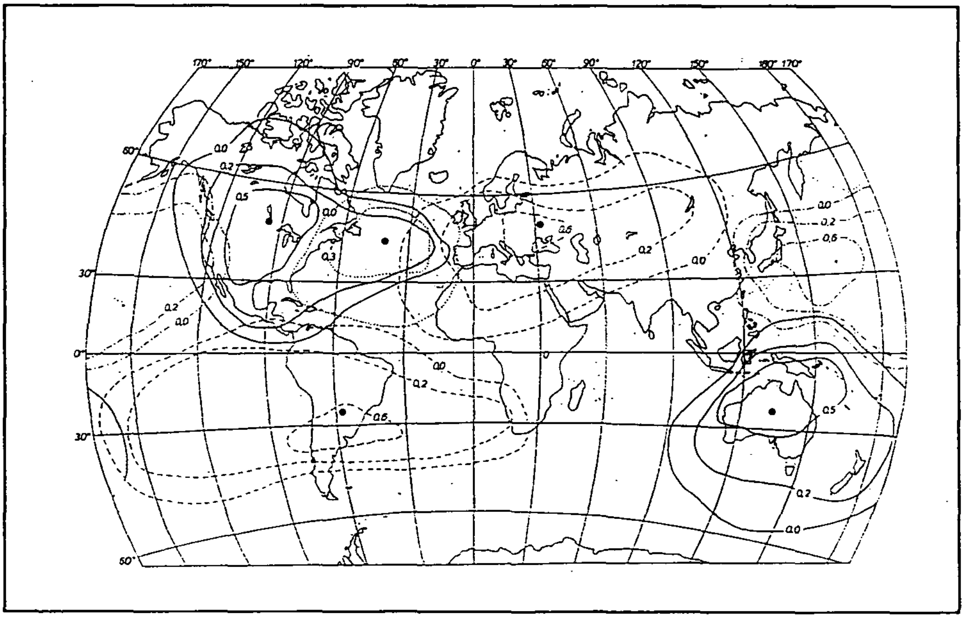

Fig. 2h. Correlation functions of sea-level pressure field, August

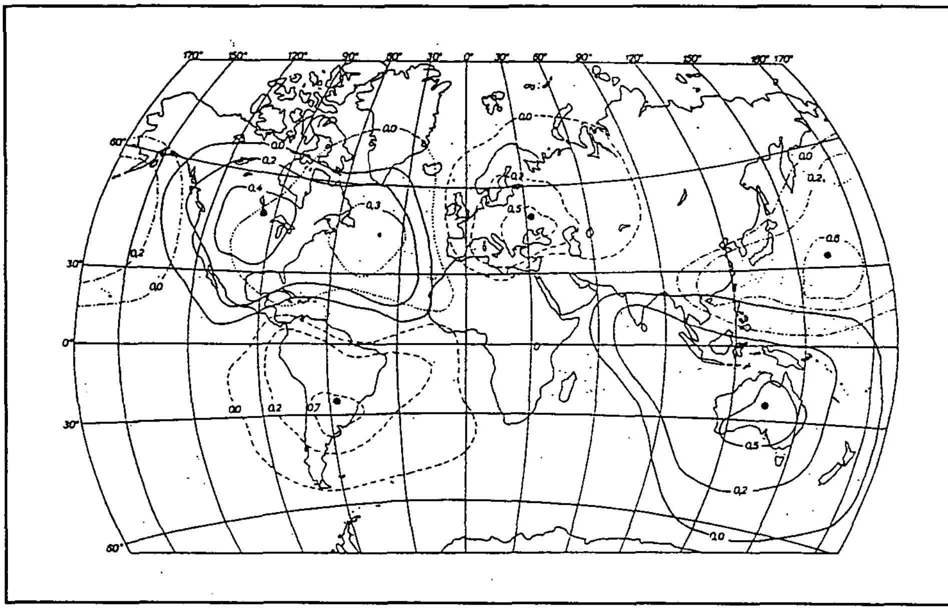

Fig. 2i. Correlation functions of sea-level pressure field, September

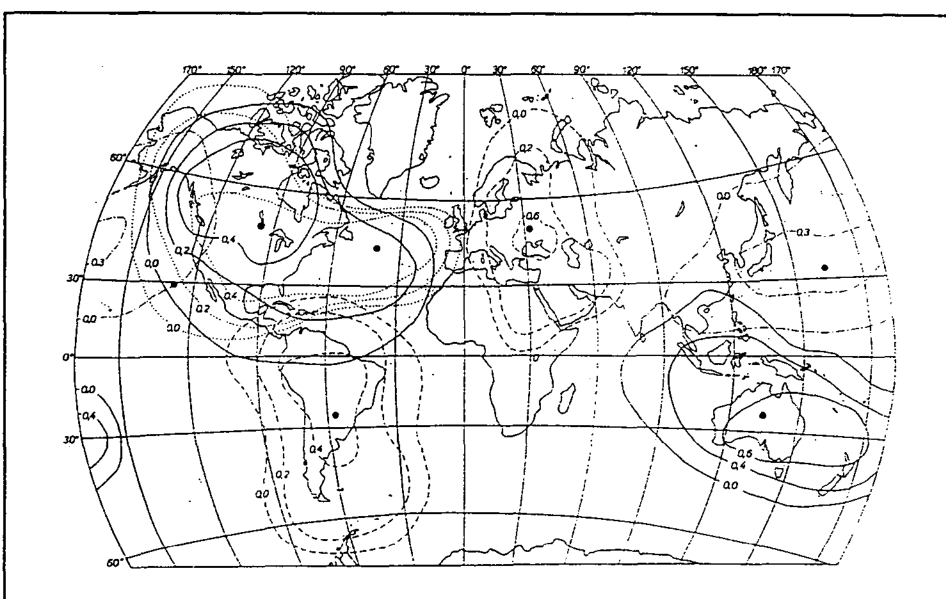

Fig. 2j. Correlation functions of sea-level pressure field, October

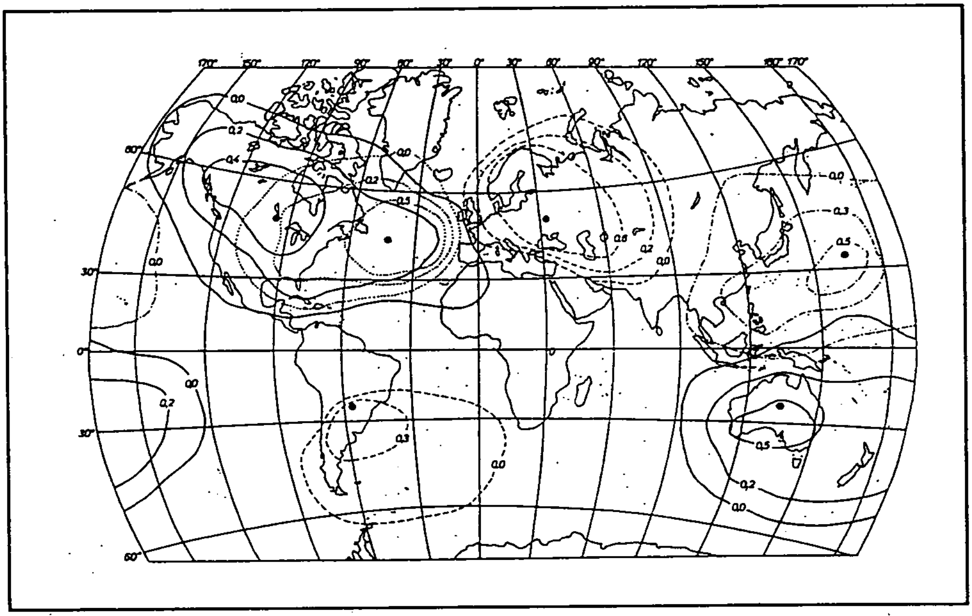

Fig. 2k. Correlation functions of sea-level pressure field, November

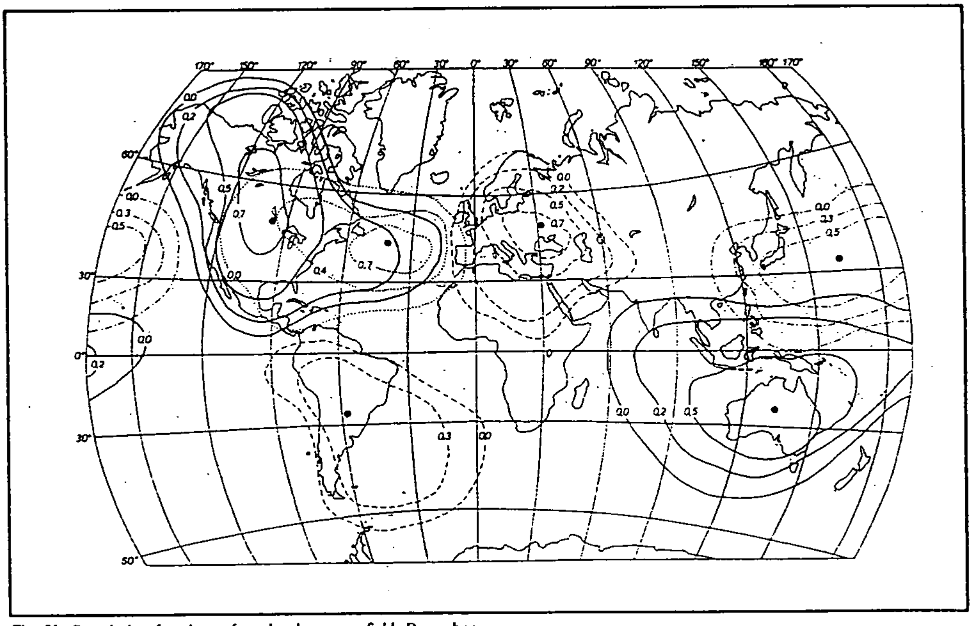

Fig. 2l. Correlation functions of sea-level pressure field, December

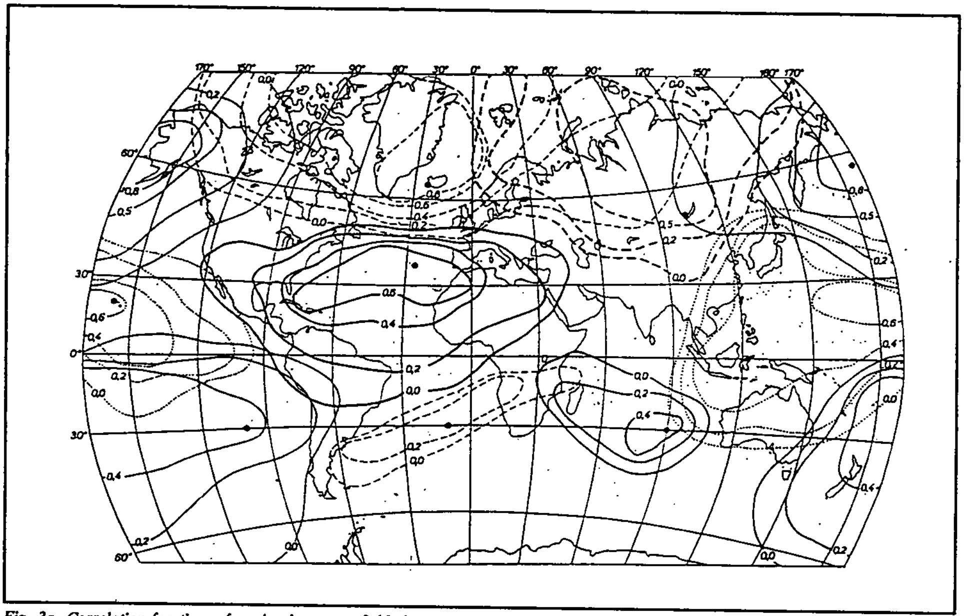

Fig. 3a. Correlation functions of sea-level pressure field, January

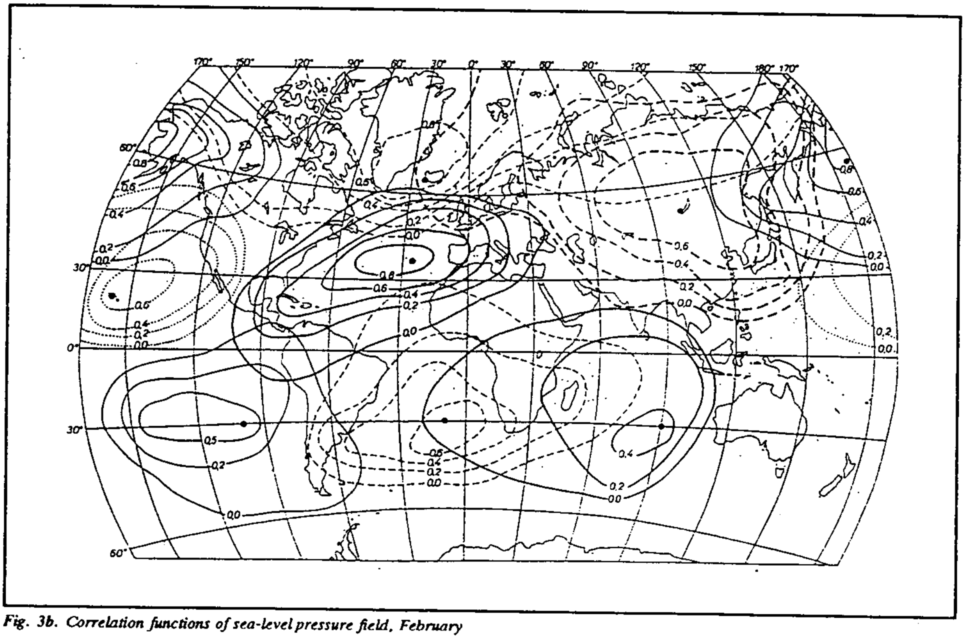

Fig. 3b. Correlation functions of sea-level pressure field, February

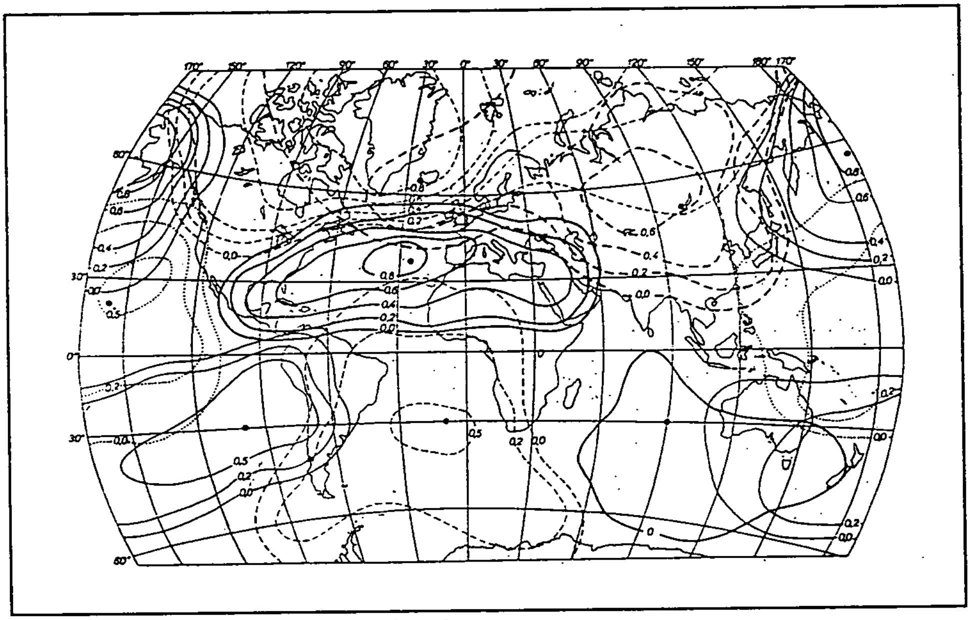

Fig. 3c. Correlation functions of sea-level pressure field, March

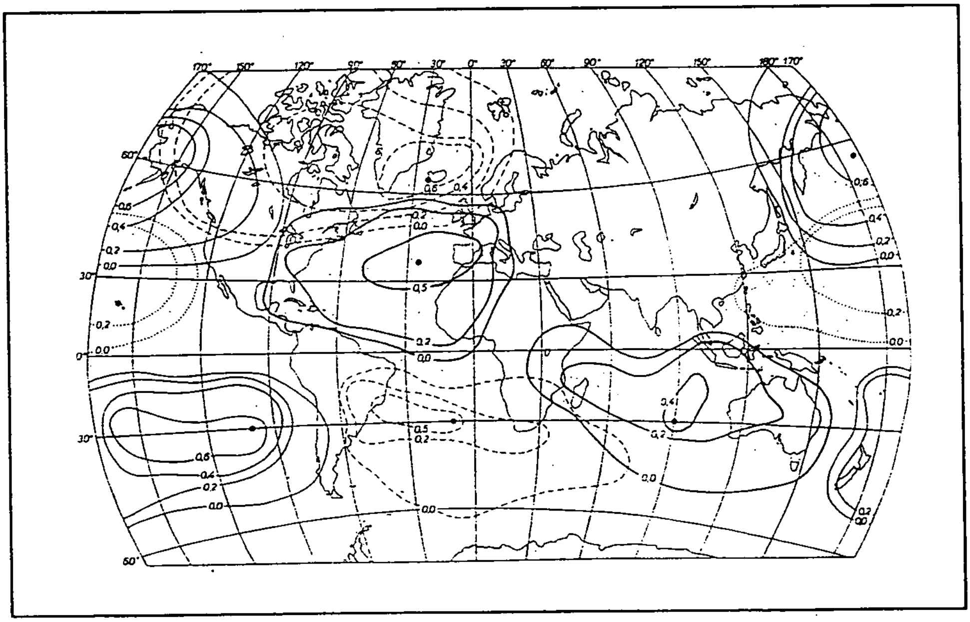

Fig. 3d. Correlation functions of sea-level pressure field, April

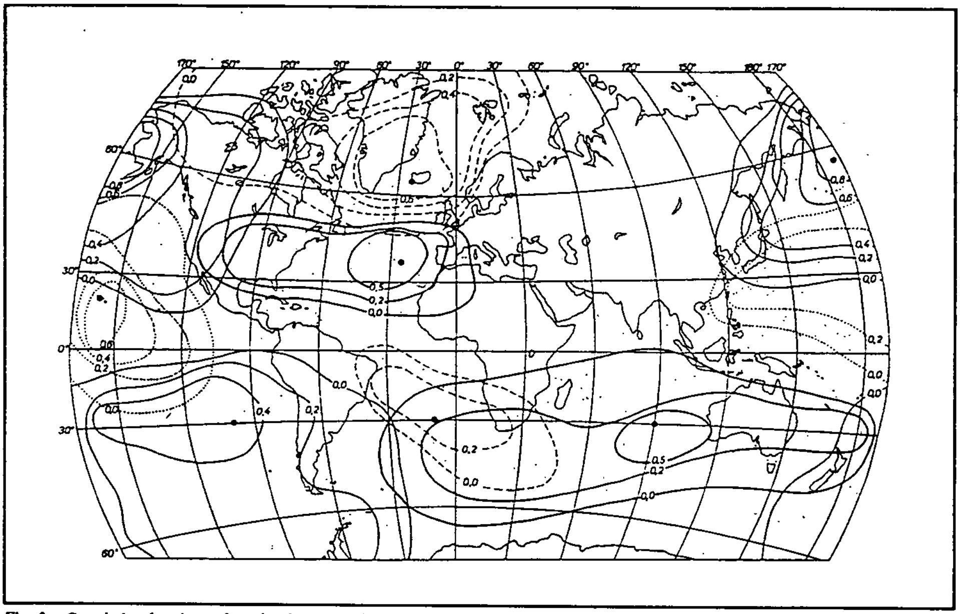

Fig. 3e. Correlation functions of sea-level pressure field, May

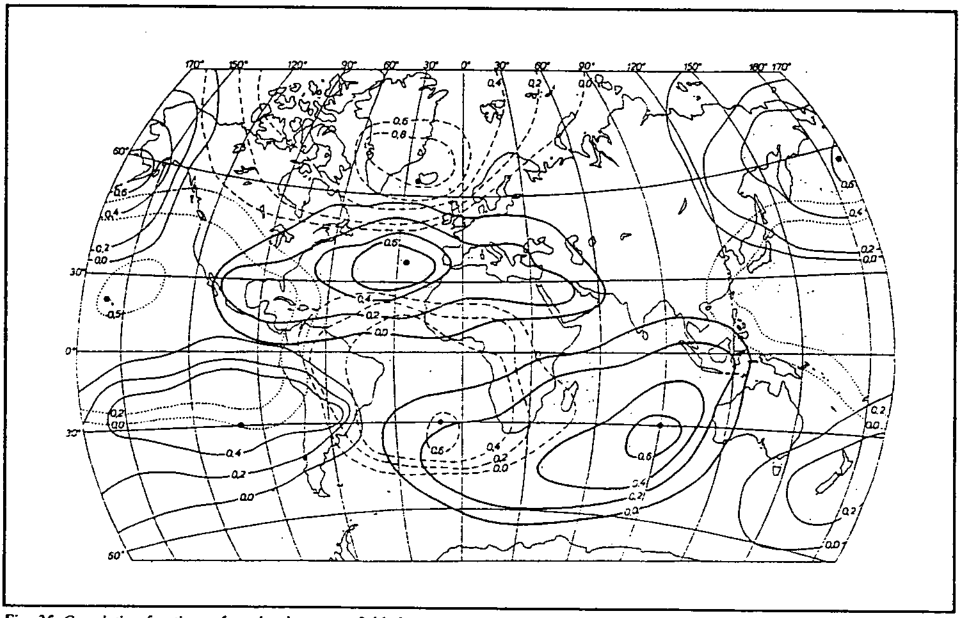

Fig. 3f. Correlation functions of sea-level pressure field, June

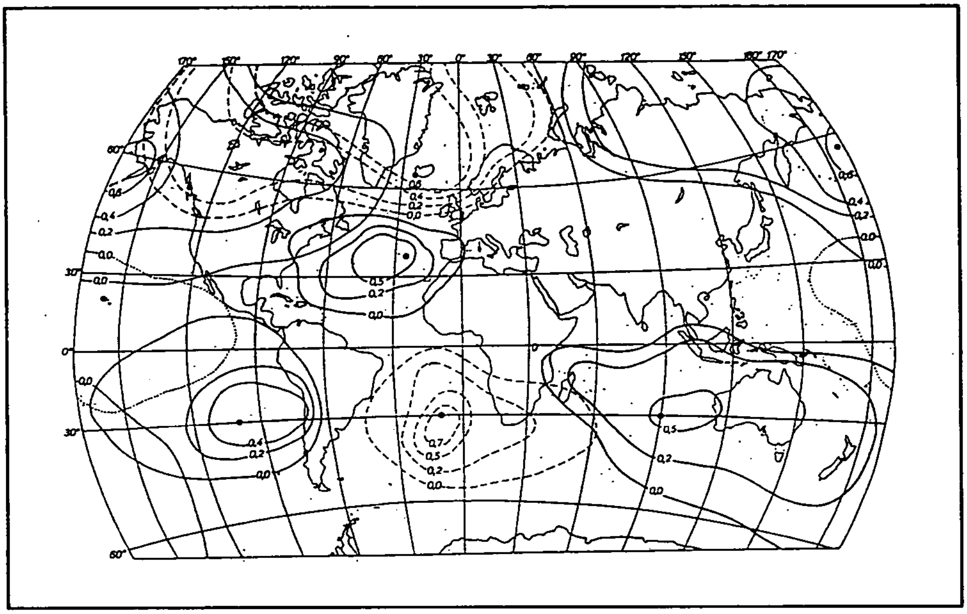

Fig. 3g. Correlation functions of sea-level pressure field, July

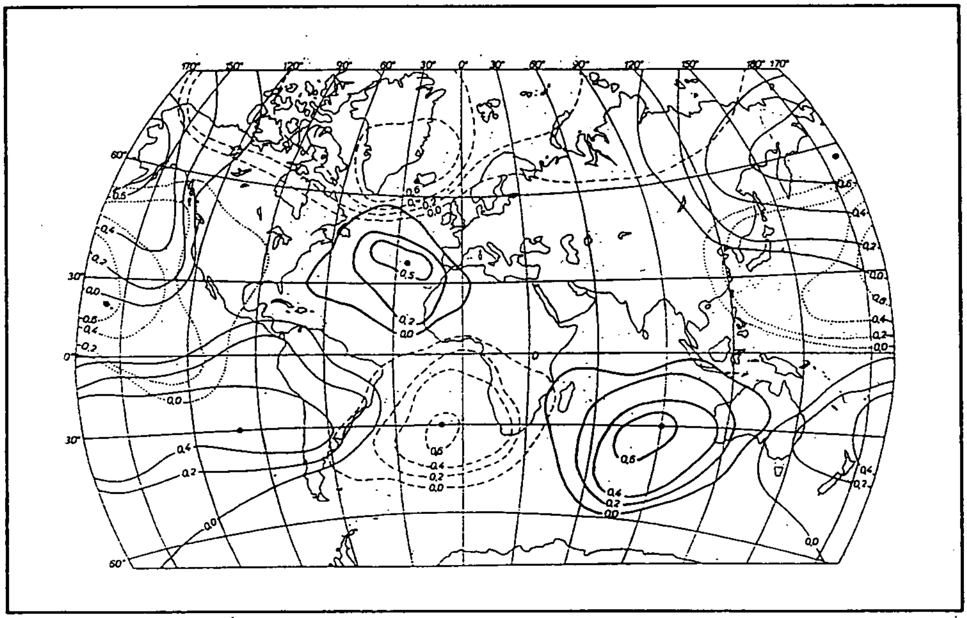

Fig. 3h. Correlation functions of sea-level pressure field, August

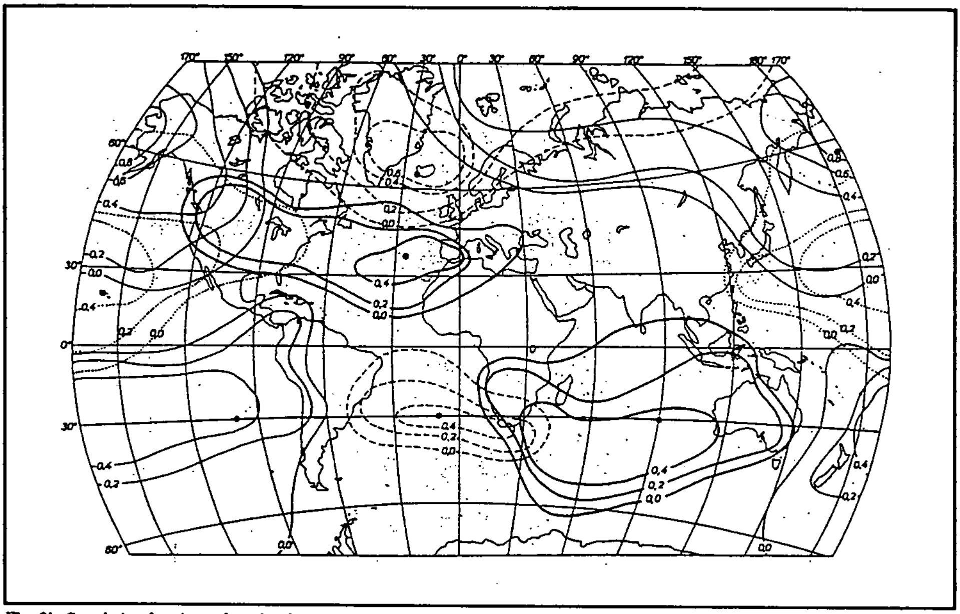

Fig. 3i. Correlation functions of sea-level pressure field, September

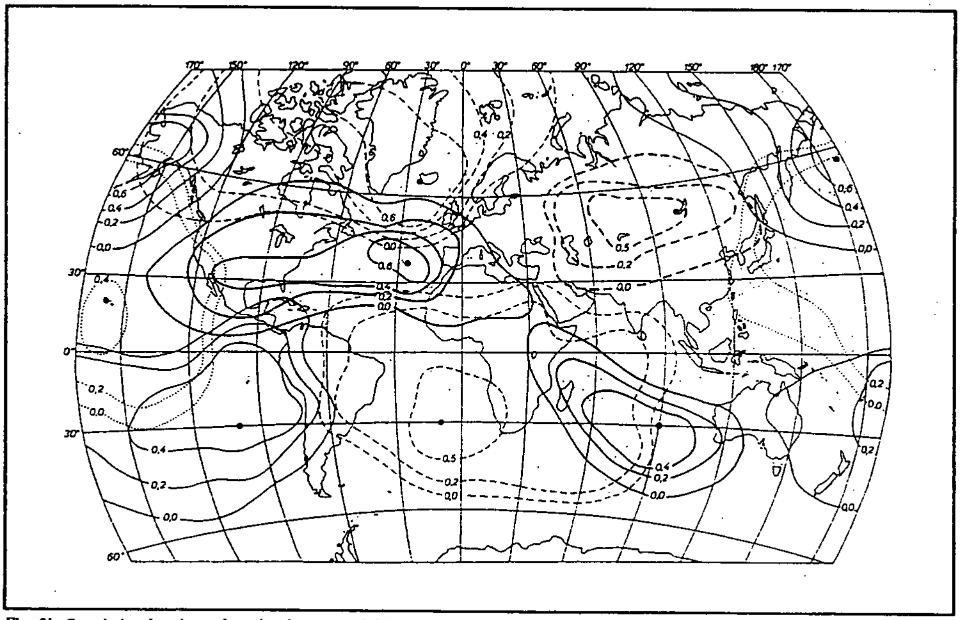

Fig. 3j. Correlation functions of sea-level pressure field, October

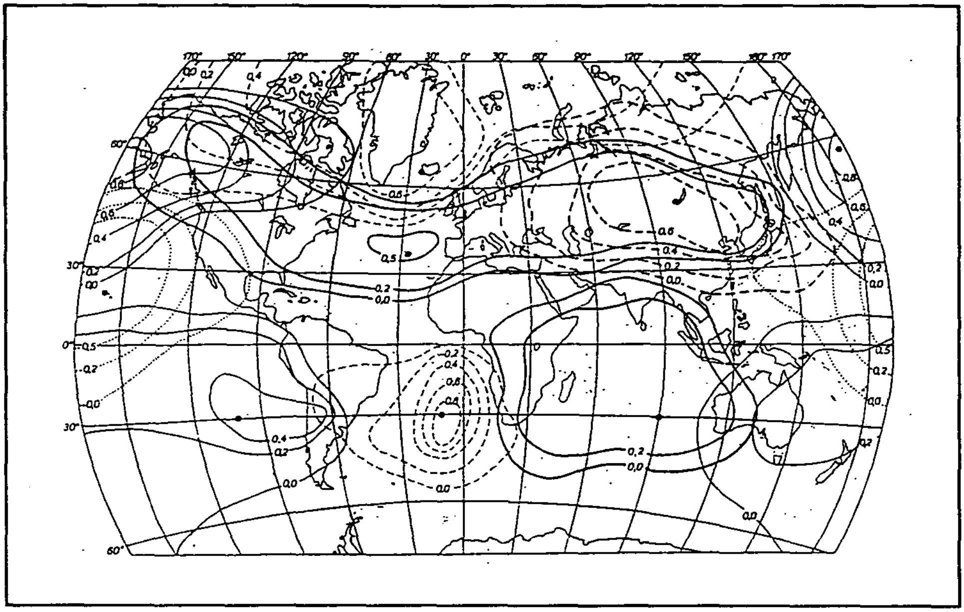

Fig. 3k. Correlation functions of sea-level pressure field, November

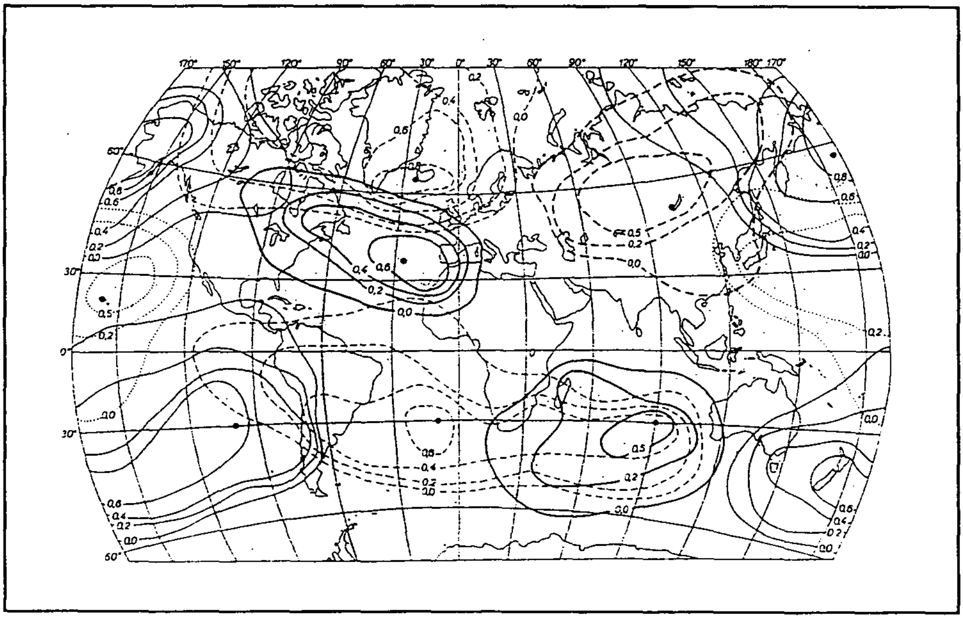

Fig. 3l. Correlation functions of sea-level pressure field, December