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Reference atmospheres

ADDENDUM 1 : Wind supplement

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It has been approved by the member bodies of the following countries :

Austria	India	Romania
Belgium	Italy	South Africa, Rep. of
Brazil	Japan	Spain
Canada	Korea, Rep. of	Turkey
Czechoslovakia	Libyan Arab Jamahiriya	United Kingdom
France	Mexico	USA
Germany, F.R.	Netherlands	USSR

No member body expressed disapproval of the document.

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Contents

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0 Introduction

A specification summarizing the characteristics of the wind is required for many practical problems, such as aircraft design, the planning and operation of air routes and airfields, estimates of the global transport of atmospheric contaminants, etc., in which the wind is one of the primary factors.

Air motions in the atmosphere occur as a result of phenomena related to air temperature and atmospheric pressure, the nature of the surface over which the air is moving, the rotation of the earth, etc. Such a complex relationship leads to large wind variations in time and space, including the seasonal variation of the general circulation of the atmosphere and the formation of disturbances on a wide range of scales from that of cyclones and anticyclones to that of small-scale turbulence.

The observed features of the wind distribution in the meridional plane are as follows :

a) a predominantly easterly component in the airflow of the lower and middle troposphere of tropical latitudes, and in the whole of the atmosphere in equatorial latitudes;

b) the existence of systematic meridional components in the zone 0 to 30° N — a northerly component in the lower troposphere and a southerly component in the middle troposphere;

c) a predominantly westerly flow in sub-tropical latitudes (30 to 40°); the wind speed increases sharply with altitude, reaching a maximum at altitudes of 10 to 13 km in the sub-tropical jet stream;

d) in temperate latitudes (40 to 60°), a generally westerly flow having a wave-like form; jet streams with axes at altitudes of about 8 to 9 km are associated with systems of mobile cyclones and are therefore more variable than the sub-tropical jet stream and much of the detail of their structure and location is lost in the averaging process;

e) in the stratosphere, the air flow is characterized by a seasonal of monsoon-type of direction change; to the north of 30° N, westerly winds occur in winter, changing to easterly in summer, with negative wind shears (wind speed decreasing with height) prevailing in the altitude range 9 to 20 km; to the north of 60 to 65° N, abrupt positive wind shears prevail in winter, and there is a strong westerly jet stream in the polar stratosphere.

The World Meteorological Organization (WMO) and several countries have published detailed tables and atlases of the wind characteristics[1, 2, 7], and these can be used to provide information in the form required for a given purpose. However, it would probably be wrong to expect the specialist user, who may not be a meteorologist, to extract the required information from the huge store of climatological material available.

It seems reasonable, therefore, the present wind data, averaged over major regions, in the form of this addendum to ISO 5878.

1 Scope and field of application

The addendum presents data on spatial distribution of wind characteristics, for use in estimating the performance of aircraft in the design stage or of aircraft already in service, for planning air routes and for estimating the global transport of atmospheric contaminants.

2 Methodological aspects and analysis of the data

The tables and graphs given are based on a comprehensive study and statistical analysis of wind data for the earth's surface and eight isobaric surfaces over the northern hemisphere.

The analysis is based on a large and uniform statistical sample, the major part of which has been published[3, 4]. About two million observations from 369 aerological stations for the nine-year period 1957 to 1965 were processed. In addition, statistical data from 50 further stations[5, 6] were included in the analyses. Other works[1, 2] were also used.

The following maps were compiled on the basis of the average monthly wind characteristics at the main isobaric surfaces :

a) mean scalar wind speed, $\overline{V}_s$;

b) mean zonal component (zonal component of the vector mean wind), $\overline{V}_x$;

c) mean meridional component (meridional component of the vector mean wind), $\overline{V}_y$;

d) standard deviation of the zonal component of the wind, σ_x;

e) standard deviation of the meridional component of the wind, σ_y.

The seasonal changes of the wind characteristics at the different isobaric surfaces and the effects of topography and surface roughness were taken into account in the analysis of the maps and in drawing isotachs.

The information read off at the grid points at intervals of 10° of longitude and 10° of latitude for the earth's surface and for the 850, 700, 500, 300, 200, 100, 50 and 30 mbar isobaric surfaces served as a basis for the calculation of the average wind characteristics within each of the latitude zones.