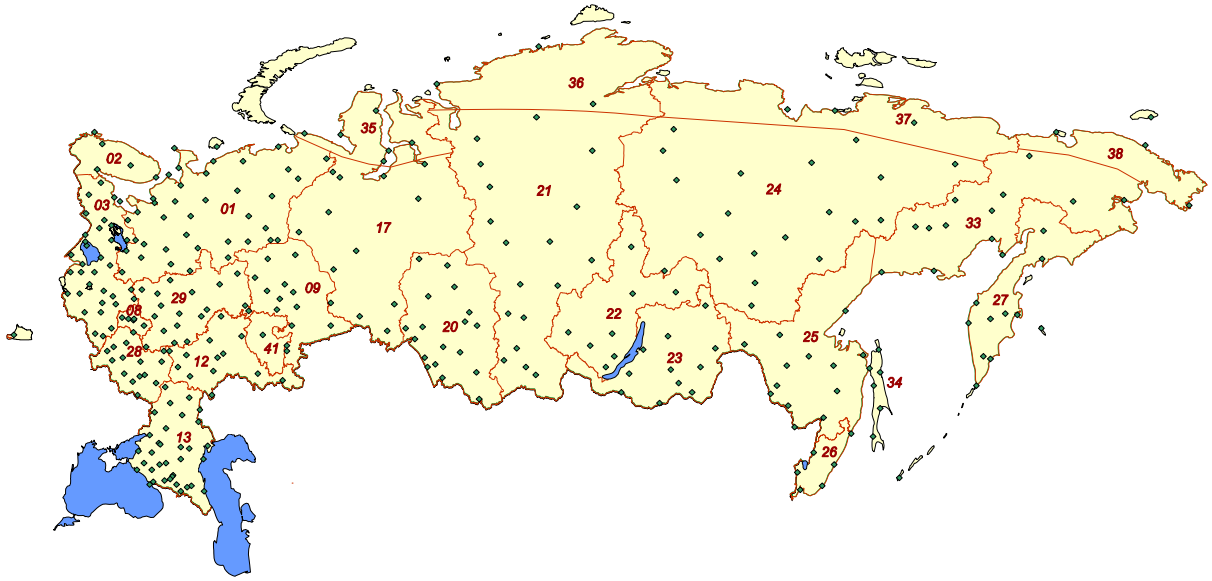
Russian Wind Atlas



Map of stations and meteorological districts. From the Russian Wind Atlas (Starkov et al., 2000).

Starkov, A.N., L. Landberg, P.P. Bezroukikh and M.M. Borisenko (2000). *Russian Wind Atlas*. Russian-Danish Institute for Energy Efficiency, Moscow; Risø National Laboratory, Roskilde. Hardback book of 551 pages with six colour maps and a data disk. ISBN 5-7542-0067-6.

The Russian Wind Atlas is:
• A *data bank* of Russian wind climate: it contains wind statistics from more than 300 stations covering the entire land area of Russia, plus colour maps of the wind energy resource of Russia.

• A *handbook* for regional wind resource assessment and the local siting of wind turbines, including computational procedures for the effects of shelter, roughness and orography on power production.

• The *basis* for reliable estimates of the wind resources in Russia, whether on a regional scale or at a specific site.

Contents of the Russian Wind Atlas
The Atlas is divided into four parts, each intended for readers with different areas of interest – from laymen to professional meteorologists. Note, that Parts 1 and 4 are presented in both Russian and English, Parts 2 and 3 are given in Russian only.

Part 1: Estimation of the Wind Energy Resource of Russia (Russian and English) provides an overall view of the wind climate and the magnitude and distribution of wind resource in Russia. This part of the Atlas is intended to be useful to politicians, planners and laymen in general. The descriptions, figures, tables and colour maps permit a first, rapid identification of regions with favourable wind resources. Special attention is given to the long-term variation of the wind resource over Russia and to a historical survey of wind-measuring methods.

Introduction to the wind atlas • The wind resource of Russia • Wind resource maps

Part 2: Application of the Wind Atlas (in Russian only) gives explanations and information needed for the purpose of regional wind resource assessments and the local siting of wind turbines. It also includes methods for calculating the influence on the wind resource of various features in the landscape such as coastlines, forests, hills, and buildings.

General concepts • The roughness of a terrain • Shelter behind obstacles • The effect of height variations in the terrain • Assessment of regional wind potential • Use of the wind resource maps • Wind energy potential in coastal zones • Wind energy potential in mountainous areas • Siting • Selection of wind climatology for a site • Roughness classification and calculation of statistics for a site • Calculation of mean power density • Calculation of Weibull parameters • Calculation of shelter • Orography • Power production • Determination of mean power production • Power density function • Power duration curve • Optimisation of power production.

Part 3: The Models and the Analysis (in Russian only) explains in detail the meteorological background for the Wind Atlas. It describes how the analysis was performed from the data and station information, and discusses the physical and statistical basis for the Wind Atlas

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models. The validity of the models and the analysis is demonstrated through a number of comparisons between measured and modelled wind statistics.

The physical basis • Surface-layer similarity laws • The geostrophic drag law and the geostrophic wind • The stability model • The roughness change model • The shelter model • The orographic model • The statistical basis • The Weibull distribution • The Wind Atlas analysis model • The Wind Atlas application model • Limitations of data and models.

Part 4: Data for Determining the Wind Energy Resource (Russian and English) contains the long-term data for 200 meteorological stations and the regional climatological statistics derived from the station data. Furthermore, a list of all 332 stations used in the Atlas is given.

Input and output data for meteorological stations • Meteorological and topographic data • List of stations • Station descriptions and statistical data • List of symbols • Auxiliary tables • The data disk • References.

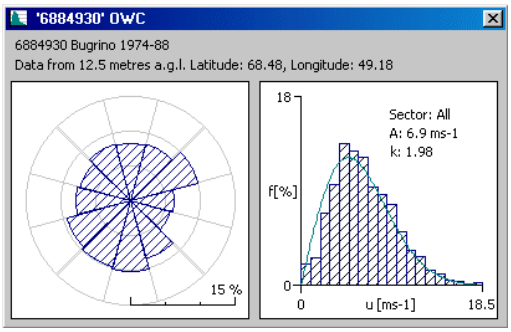
Application of the Atlas

The Atlas is the meteorological basis for estimating the wind climate and wind energy resources of any particular site in Russia. The application of the Atlas as a siting handbook is explained in detail in the Atlas.

To facilitate resource calculations and specific siting of wind turbines, the Wind Atlas is furnished with a disk containing all the regional statistics. The disk files can be used directly with the "Wind Atlas Analysis and Application Program" (WAsP), which was especially developed for the production of the European Wind Atlas and for use in practical siting. The WAsP program is not included in the Atlas, but can be obtained from Risø National Laboratory.

Data disk

The observed and model-derived wind statistics from the 332 meteorological stations are furnished on a CD-R or a 3½" floppy disk together with the Atlas – for use with an IBM PC or compatible computer. The data consists of the observed and modelled wind rose and wind speed distributions for each station; an example of the wind climate observed at the Russian station of Bugrino is given below.



www.WINDPOWER.org

For general information about wind power, as well as links to other web sites related to wind power, a good place to start is the award-winning home page of the Danish Wind Industry Association: windpower.org.

Further information

Please visit windatlas.dk and wasp.dk for more information on the wind atlas methodology and wind atlases of the world.

The Russian Wind Atlas, as well as the European Wind Atlas, may be ordered from Risø National Laboratory, Technical University of Denmark (DTU), see the reverse side for contact details.