Wind Condition Analysis of Siberia

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ABSTRACT: The feasibility study for a wind system in the Siberia region has been conducted. In order to access wind resources in Siberia, the author processed meteorological data of upper air and surface data, which could obtain for this study. In Siberia, the northern coastline where large-scale wind systems such as westerlies exist parallels with coastline and the eastern coastline where the medium-scale wind system by the monsoon, etc. exists as well as Japan. The Siberian inland is covered by an anticyclonic wind system during the winter, and the wind does not blow strongly. Small-scale wind systems, which are caused by differences in land topography, are formed in regions such as Lake Bikal which is surrounded by several mountains and rivers.

Key words: wind power, Siberia

1. Introduction

When we think about a complex future state of energy, we need to consider importing natural energy from foreign countries. For that reason the important thing is to find and research natural energy near Japan clear.

By reason of scale, landform and small population, Siberia is the best place from which Japan can obtain natural energy. So in this study the author investigated wind resources in Siberia which are hardly known.

2. Parameter for analysis of the upper air

The first material that revealed the wind character in Siberia and which led to the investigation of wind conditions in Siberia was related to the upper air in Siberia. The sample wind velocity of the upper air was supplied by the National Oceanic and Atmospheric Administration (NOAA) in U.S.A.

A measuring instrument called the radiosonde is used to obtain the data. This balloon-like measurement system flies up to approximately 30 km and is lost once transmission is cut off. The wind velocity is measured everyday and is plotted on a vector map after being decomposed in each direction. The height of the observation point is slightly changed during the day in order to obtain the data using the balloon, and the sea level is usually defined to be the lowest observation point.

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This material seems difficult to utilize for preferring a wind atlas since it is not obtained for a wind mill height data. First of all, the observation point of NOAA data is 1000～1500 m high. The NOAA data is too high to obtain meaningful results, because the height of the center of the rotor of the windmill is about 60 m. The data may be useful to some extent in case there is a mountain near the observation point and the windmill is constructed in such place. Furthermore, the wind velocity on the land surface is related to the upper wind condition.

Unfortunately, there is no site that has an annual average wind velocity of over 5 m/s. However, for the data computed for the years 1995–97, six places with an annual average wind velocity over 5 m/s are observed.

Table 1 Average wind velocity obtained using the NOAA upper air data[(1)]

	KIRENSK	VLADIVOSTOK	BLAGOVESCENSK
January	5.1	6.5	4.8
February	5	6	5.2
March	4.3	5.4	5.7
April	3.3	3.8	3.3
May	3	2.5	2.4
June	2	2.3	1.8
July	2.3	2.3	1.8
August	2.6	1.8	1.7
September	3.3	2.7	3.3
October	6	5	4.4
November	7.6	6.3	6
December	6.8	7	4.8
Average	4	4.1	3.8

Unit: (m/s)

Among the 40 sites that were investigated, the 3 sites having high average wind velocity were selected. In Blagoveshchensk, Kirensk, and Vladivostok, which are comparatively closer to the interior of Japan, the average wind velocity that was computed using the graph of wind velocity is shown in table1 and figure1.

The author selfishly imagine with there was plenty of wind resources, because it was the data of upper air which does not receive the effect of the surface friction, and it was surprised a little at the case in which the analytical result shows. It does be not anticipated that there is very much no wind. However, the many observation point is placed the inland, it is considered little earlier to decide the Siberia's bad wind condition only with this upper air data.

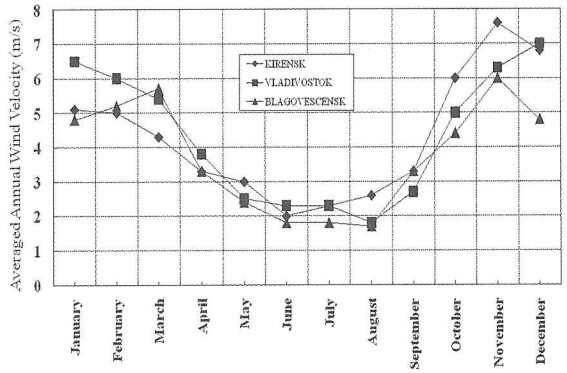

Fig. 1 Monthly wind velocity for Blagoveshchensk

3. Data of the terrestrial atmosphere

Meteorological stations are located around the world. Each country has a meteorological organization that manages the meteorological stations in its territory. In addition, there is the World Meteorological Organization (WMO) located in Geneva, Switzerland, that manages these meteorological organizations in each country.

The meteorological organizations in each country share the earth weather data via a Global Telecommunication System (GTS). The data sent to Japan is processed statistically. Although it is misconverted during transition, it is deciphered and handled as an "error" without confirming to the country of partner. And by region or age, information may be sent in the telegraphy. The members of the Meteorological Agency statistics room consider that the data sent to Japan cannot be trusted like the data of the Automated Meteorological Data Acquisition System (AMeDAS) in Japan and they might have a 10% error. Moreover, they have also stated that "accurate data should be obtained from meteorological organizations that are supervised in a manner similar to the AMeDAS in Japan."

The abovementioned data is averaged in the Meteorological Agency statistics room on a daily basis (the day statistic) and depending on the monthly basis (the moon statistic), and the data from 1982–1998 is sold by the Japan Meteorological Agency. The wind condition analysis for Siberia is carried out on the basis of this material. For the calculation, the monthly averaged data was used. In search of the average of every month each point of the data is 11, some of them was broken with a few numbers of the data. The arithmetic mean was obtained for the years 1988 to 1998. The world meteorological data were stored in the form of text files. This data was processed by spreadsheet software and the average wind velocity was calculated. A computer program was developed in order to automatically carry out the calculations as follows.

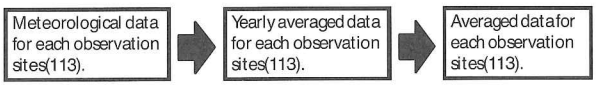

Fig. 2 Data process scheme

The calculation result is shown on the map in figure3. The centers of the circles on the map are the observation points, and it is easier to obtain the annual average wind velocity for an observation point by calculating the area of the circle. The legend shows the annual average wind velocity in units of m/s. The observation points at 113 sites were processed. East Siberia, which is close to Japan, was considered the observation point for the entire Siberian region. The annual average wind velocity exceeded 5 m/s at 17 sites in Siberia. By percentage, this amounted to around 15% of the sites.

From the results of the analysis for inland Siberia, it was proved that the wind velocity was mostly in the range of 1–2 m/s. The Kuril Islands and Kamchatka have strong winds along their coastlines, and it is also known that the coastlines in the north and east of Siberia have strong winds.

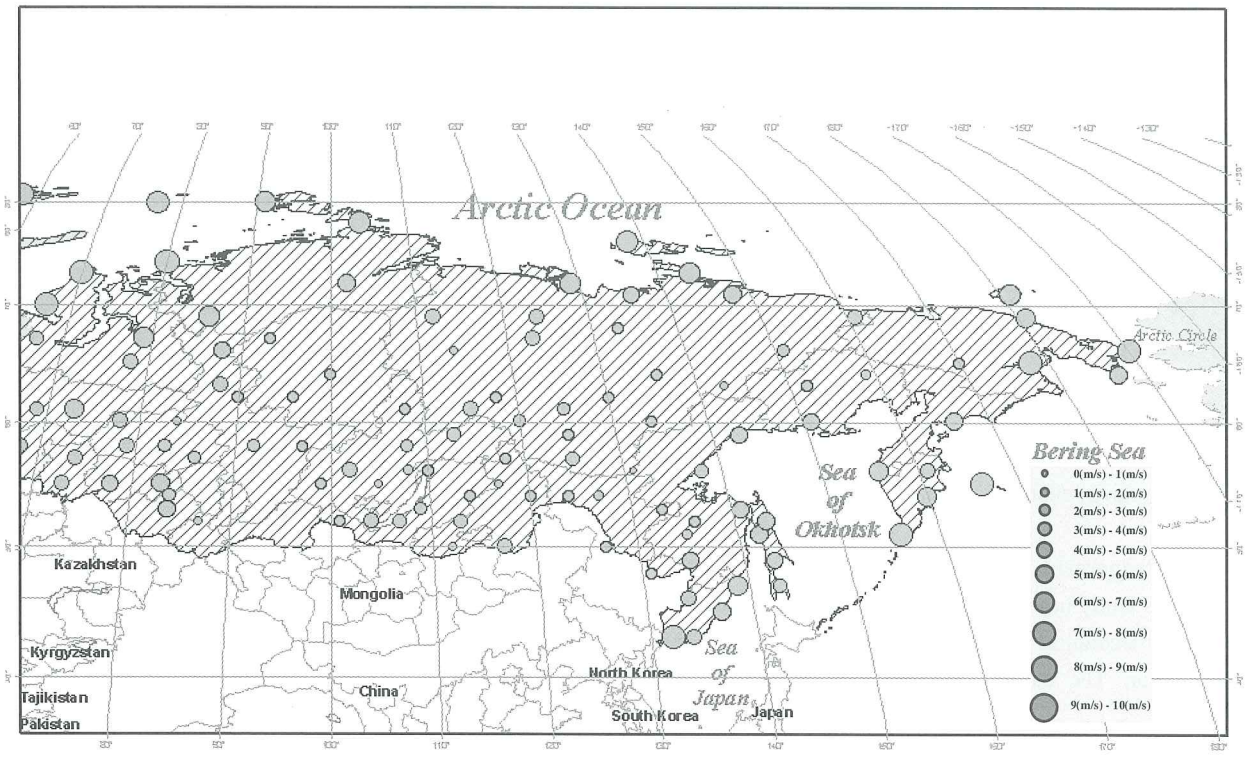

Fig. 3 Annual average wind velocity at the observation points in East Siberia

4. Other resources for study of wind

Another resource that played an important role was the book "The world of the wind" by Dr. Masatoshi Yoshino, who is an authority on local wind characteristics. The wind condition at Lake Baikal has been described in detail in this book.

Lake Baikal is a large lake in southern Siberia. The most important feature is its size. The maximum water depth has been shown to be approximately 1741 m. Therefore, the lake, with an area of 31500 km^2, ranks second in the world in terms of the impoundment area. The lake is 700 km in length when measured along the longer direction of its moon-like form and 10 km along the shorter length. The circumference of the lake is 2100 km. Further, the transparency exceeds 40 m, and it is a wonderful lake for the Baikal seals even it is a fresh water lake. Lake Baikal is a region with significant presence of local winds. There are eight types of local winds such as Angara, Barguchin, etc.[3] The most common wind type is called the Bora. When cold air is stopped by mountains, the overhang of cold air suddenly starts flowing down the mountain like an avalanche. This phenomenon is called the Bora Wind, and it should be distinguished from the Foehn phenomena because it is caused by cold winds.

The strong wind days during the year in the region are shown in figure 4.

Lake Baikal is surrounded by mountains. It is observed that these mountains cause cold air flows toward the lake like an avalanche and sometimes a strong wind is generated.

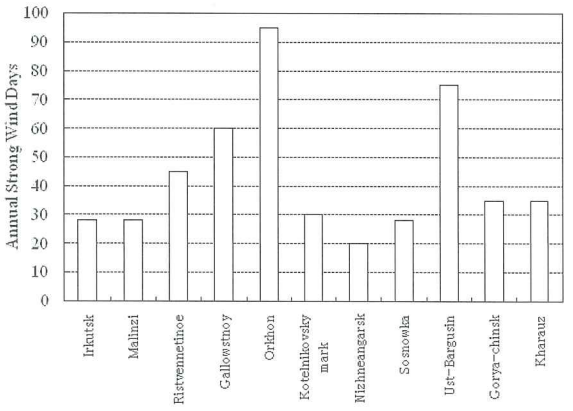

Fig. 4 Strong wind days during the year around Lake Baikal[3]

5. Result of wind condition analysis of Siberia

The author have investigated the wind conditions in Siberia. The results have concluded as follows:

(1) The wind blows strongly near ocean area. Particularly northern part of ocean area such as Yamar peninsula and eastern part of ocean area such as Kuril Islands and Kamchatka has good condition for the wind power development.
(2) Inner Siberia, the wind blow is less than ocean area because the atmosphere is covered with an anticyclone and stable.
(3) The lake Baikal has good wind conditions for its topographic features even being inner Siberia.

Acknowledgement

This study has partly been granted by the budget of MNCT mechanical engineering department for 2009 fiscal year. The authors express our gratitude to the support.

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(Received November 6, 2009)