Analysis of the Long-term Meteorological Data at Kori Nuclear Power Plant for Environmental Impact Assessment

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1. Introduction

For an atmospheric dispersion assessment, reliable long-term accumulated meteorological data are the most important basis. In Korea, basic regulation rules for meteorological data measurements and interpretation are enforced by means of Nuclear Safety and Security Commission (NSSC) notifications [1-3], which are based on the U. S. NRC's Regulatory Guides [4, 5].

We analyzed the long-term meteorological data collected through 1997 to last year (August of 2014), to find and compare the long-term patterns with some essential elements of these data. For the past four years, relatively clear regular patterns were found in terms of wind and atmospheric stability. Wind direction, which is a very essential component for atmospheric dispersion, shows a strong seasonal dependency.

We expect that these findings will play a significant role in the enhancement of the accuracy and reliability for a long-term environmental impact assessment.

2. Methods and Results

2.1 Meteorological Data at Kori Site

Meteorological data have been collected by the weather observation post at the Kori nuclear power plant since March 22th, 1997. The data used were collected through the total period of March 22th in 1997 to August 31th in 2014 (18 years). These data consist of the ground level temperature, humidity, precipitation, wind direction, wind speed, maximum wind speed, temperature, and atmospheric stabilities based on NSSC notifications [1-3]. Wind data were measured at two elevations, 10 m and 58 m.

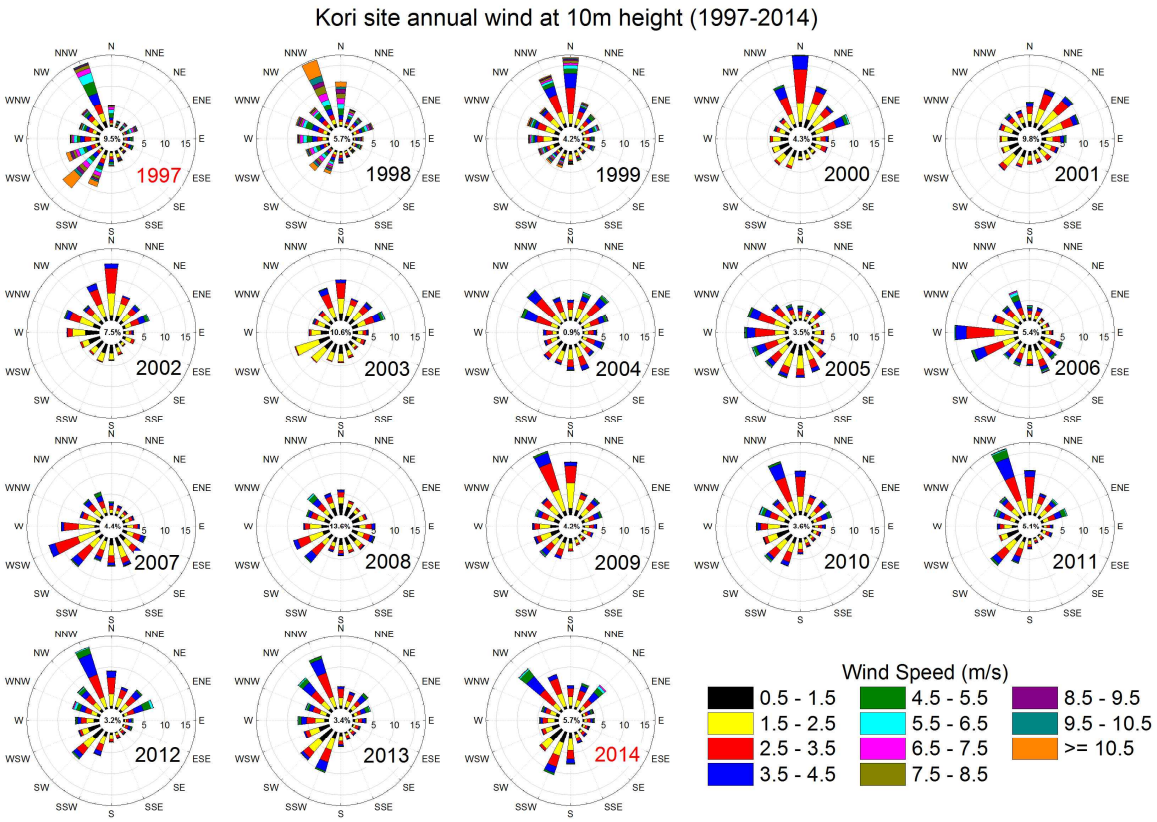

Fig. 1. Annual wind roses at 10 m height for the Kori site. Meteorological data were collected through 1997 to 2014.

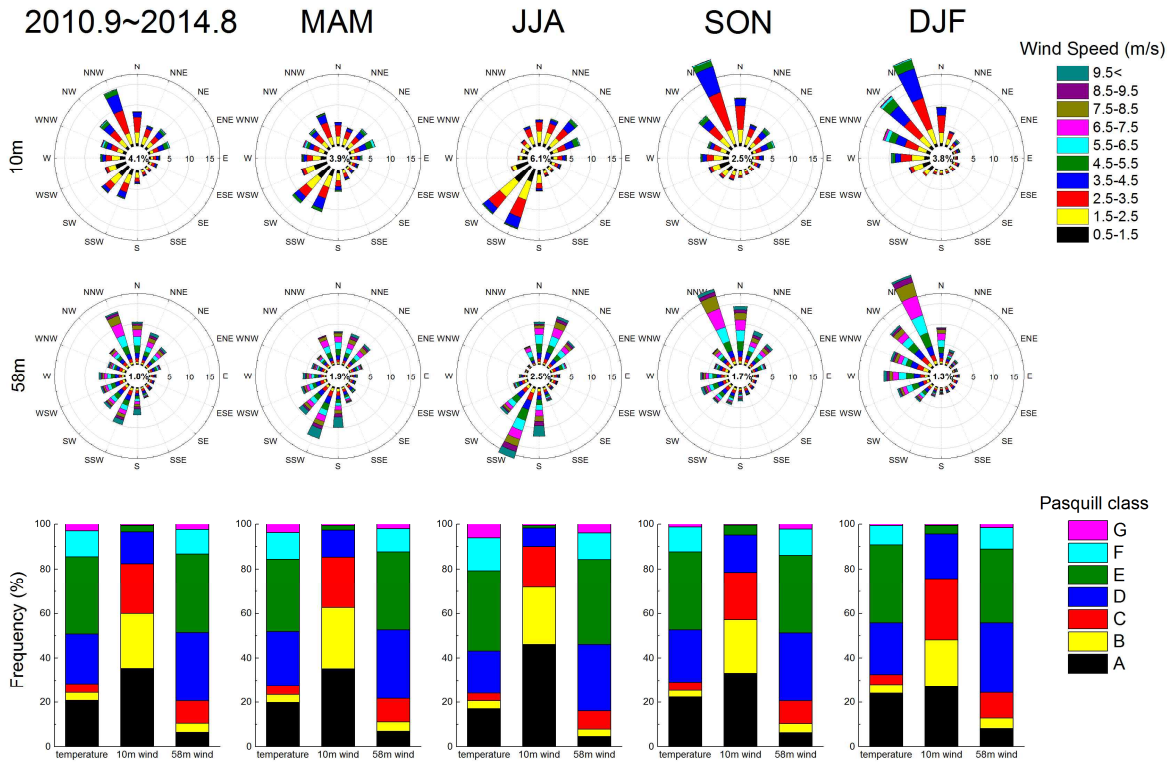

Fig. 2. Overall seasonal wind and atmospheric stability at the Kori site for the past four years.

With respect to the observation time interval, we can divide the whole measurement period into two parts: 30 minute-interval observations (1997.3.22~2010.7.7) and 10 minute-interval observations (2010.7.8~2014.8.31).

2.2 Annual Wind at 10 m Height

At first, the annual wind tendency was analyzed for the whole period of data collection. In figure 1, annual wind roses are displayed for the wind data at a 10 m height above ground level (AGL), which is considered as a ground level release height for an accidental atmospheric dispersion evaluation where a short-term atmospheric dispersion factor is calculated using 10 m height wind data [1-3, 5].

The percentile values in the center circle of each annual wind rose indicate the annual rate of calm-conditions, which is defined by a wind speed less than 1 knot (~0.5 m/s). Other wind speed intervals were chosen arbitrarily rather than introducing the U. S. NRC's criteria.

In terms of the annual main wind (direction), a regular pattern arose since 2009 with a north-northeast (NNE) directional main wind. Before this year, diverse and complicated wind patterns appeared. Note that, for 1997 and 2014, the measured data only contain a part of the corresponding year, which cannot cover the whole annual period.

2.3 Seasonal Meteorological Data for Recent Years

We made a further analysis for the data of the past four years (from September 1st in 2010 to August 31th in 2014), which showed a consistent annual tendency. For this period, the overall seasonal wind roses at 10 m and 58 m heights and atmospheric stabilities (classified by the Pasquill stability category) are shown in figure 2. Here, we assigned four seasons as follows: spring is designated as MAM (March-April-May), the acronym of the corresponding months. Similarly, summer, fall, and winter are designated as JJA (June-July-August), SON (September-October-November), and DJF (December-January-February), respectively.

Obviously, there are strong seasonal tendencies on the wind directions and atmospheric stabilities obtained from 10 m height wind data. Mainly, two distinct and opposite tendencies can be found for warm (spring and summer; NNE wind) and cold seasons (fall and winter; SW and SSW wind). The annual main wind for this period is strongly affected by that of the cold seasons. In addition, atmospheric stability shows a seasonal influence relatively well.

In figure 3, we demonstrate the winds and atmospheric stabilities during the winter season for each of the past four years. During this period, even with slight differences, one can see that steady seasonal winds and atmospheric stabilities were sustained.

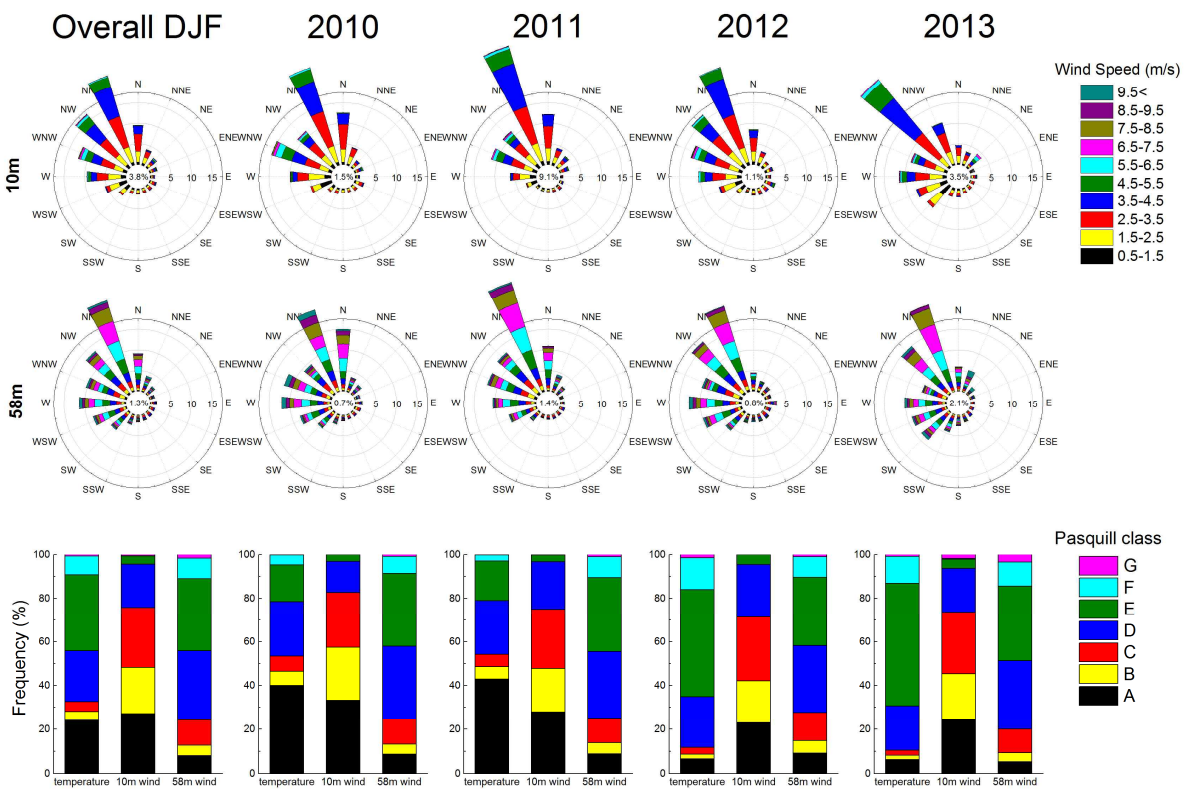

Fig. 3. Wind and atmospheric stability at the Kori site during the winter season for each of the past four years.

3. Conclusions

We analyzed the long-term meteorological data collected since 1997 at the Kori nuclear power plant. The annual wind tendency shows irregular patterns before 2009. However, for the past four years, clear regular patterns are found in terms of the wind and atmospheric stabilities. Especially, the main wind direction, which is a very essential component for an atmospheric dispersion, shows a strong dependency on the season. During spring and summer, south-west and south-southwest winds are the main winds, whereas north-northeast wind dominates during fall and winter. The annual wind is strongly affected by that of winter.

Consequently, this seasonal dependency should be considered and reflected in any atmospheric dispersion assessment for the Kori site. Seasonal influence should be examined further with other weather data around (near) the Kori site, such as automatic weather station (AWS) data. Moreover, further investments are necessary in detail. Finally, these will lead a remarkable enhancement in a long-term environmental impact assessment.

ACKNOWLEGEMENT

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