CFD Simulations of the Wind Environment at Shonai Airport Integrated with Weather Prediction Data

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Abstract: The wind environment at an airport is affected by the geographic features. Shonai Airport is known to have wind shear over the runway due to the wake of the neighboring hill frequently in winter. In this research, large eddy simulation (LES) around Shonai Airport was performed. The initial and boundary conditions were given according to the weather prediction data obtained by the Down-Scaling Simulation System (DS^3), which was developed in the Atmospheric Science Laboratory, Tohoku University. The simulation results confirm the strong influence of the neighboring hill to the wind environment over the runway.

Keywords: LES, Weather Prediction, Wind, Airport.

1 Introduction

The wind environment at an airport is affected by the geographic features. Shonai Airport is known to have wind shear over the runway due to the wake of the neighboring hill frequently in winter. Figure 1 shows the satellite photo of the airport, indicating the neighboring hill [1]. Figure 2 indicates the wind shear reconstructed from the flight data of ANA [2]. In this research, large eddy simulation (LES) around Shonai Airport was performed.

Figure 1: Shonai Airport.

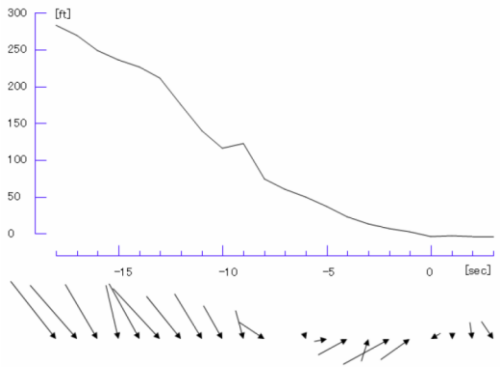

Figure 2: The wind shear case of Shonai Airport.

2 Problem Statement

In this research, large eddy simulation (LES) of the wind around Shonai Airport was performed [3]. The initial and boundary conditions were given according to the weather prediction data obtained by the Down-Scaling Simulation System (DS^3) [4], which was developed in the Atmospheric Science Laboratory, Tohoku University. DS^3 can analyze weather factors such as wind velocity, pressure, density, etc., in high-resolution grid.

Figure 3 shows the contour line map near Shonai Airport. The neighboring hill is indicated by the red contour. Figure 4 shows the wind velocity magnitude at altitude of 45 m when the wind blows

from the west. Figures 5 and 6 show the wind velocity magnitude at altitude of 45 m when the wind blows 30 and 60 deg tilted from the west, respectively. The simulation results suggest the strong influence of the neighboring hill to the wind environment over the runway.

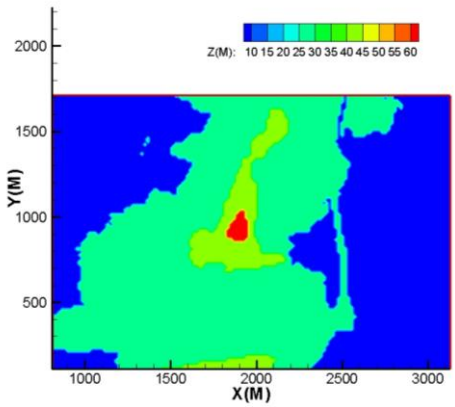

Figure 3: Contour line map near Shonai Airport.

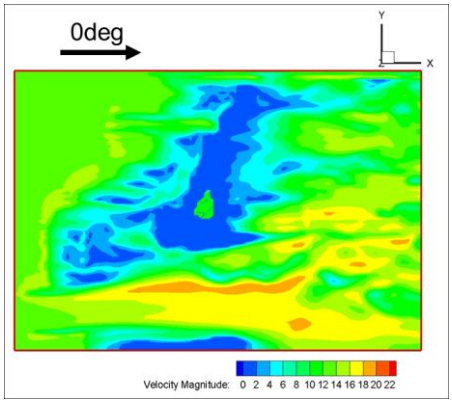

Figure 4: Wind magnitude at altitude of 45 m when the wind blows from the west.

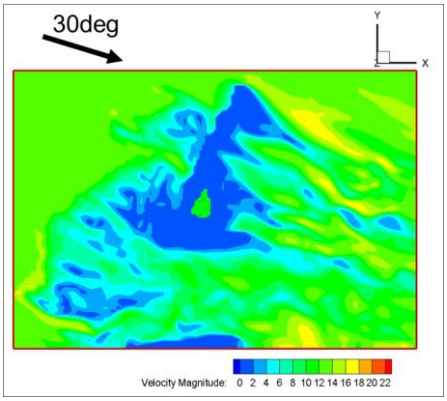

Figure 5: Wind magnitude at altitude of 45 m when the wind blows 30 deg tilted from the west.

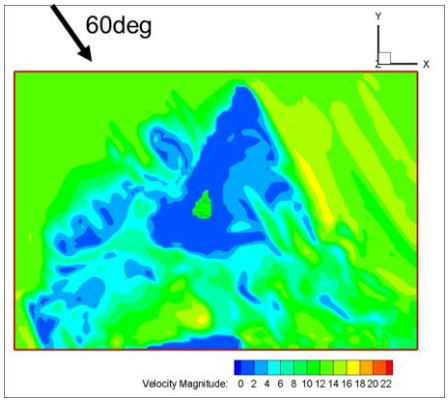

Figure 6: Wind magnitude at altitude of 45 m when the wind blows 60 deg tilted from the west.

3 Conclusion and Future Work

CFD simulations of the wind environment at Shonai Airport were performed by integrating the weather prediction data. The results confirmed the strong influence of the neighboring hill to the wind variations. The vertical structures of the flow filed will be investigated in detail in the final paper.

References

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