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Wind power evaluation around complex coastal area using WRF 3DVAR with inhomogeneous vertical data

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Wind power energy is one of the favorable and fast growing renewable energy. It is most important for exact analysis of wind to evaluate and forecast the wind power energy. The purpose of this study is to improve the performance of numerical atmospheric model around a complex coastal area. Three wind profiler sites used in this study are inhomogeneously situated near south-west coastal area. The strong point of the profiler is its high time resolution and dense observation data at the lower troposphere. The method of the data assimilation for using the profiler to the model simulation is the three-dimensional variational data assimilation. This method is the most useful for the numerical wether prediction(NWP) in these days.

Two experiments were conducted for how the wind profiler data effects on the model results. First, the observation system experiment was carried out. Second, the sensitivity test according to the data assimilation interval was implemented to apply an advantage of high time resolution of profiler. It was found that the result using both radio sonde and profiler data shows the lowest error when it was compared vertical observation and surface AWS(Automatic Weather Station) data. Although the effect of sonde data was better than profiler at higher altitude, the profiler data improves the model performance at lower atmosphere. When focus on surface results, the sensitivity to assimilation interval was different with synoptic condition. The sensitivity on the condition of weak synoptic effect was much larger than of strong synoptic effect. The hourly assimilated case shows the lowest RMSE(1.62m/s) and the highest IOA(0.82) on the weak synoptic condition. But, the statistics of 1, 3, and 6 hourly assimilation case were almost same on the strong synoptic condition. This results indicate that the profiler data represents the complex local circulation to the model performance with its high time and vertical resolution when the synoptic effect was weak. To examine the difference in wind power energy, the wind power density(WPD) was calculated and compared. The maximum WPD difference is 300Wm-2 over south-west sea at 100m above surface where a wind power generator is located. This differences are depend on wind direction .

In conclusion, the profiler data is expected to accurately evaluate and detailed forecast wind power energy. Moreover, further investigation using other observation data, the radar echo and the satellite data etc., is expected to improve the model performance by variational data assimilation.