

Precise Forecasting Model of Meteorological Fields Affected by Land Topography



1. Forecasting Model of Meteorological Fields with High Precision

Meteorological condition is predominant to all phenomena occurred in the ocean except tsunami. Ocean wave and current are generated by wind blowing to sea surface. When typhoon approaching, atmospheric pressure drops which generates the sea level rise so called storm surge.

Highly precise prediction of high waves and storm surge needs the high quality data of winds and atmosphere pressure.

The local meteorological model, which is named **WRF** (W e a t e r R e s e a r c h and F o r e c a s t i n g Model) developed by NCAR (N a t i o n a l C e n t e r f o r A t m s p h e r e R e s e a r c h), can carry out an meteorological calculation considering various phenomena, including wind, rain of water vapor and generation of cloud, as well as sea surface heating and cooling. Therefore, it is utilized in various researches and studies engaging meteorological phenomena, such as heat island, unexpectedly strong rain, predictions of wind power generation, and so on (Figure 1).

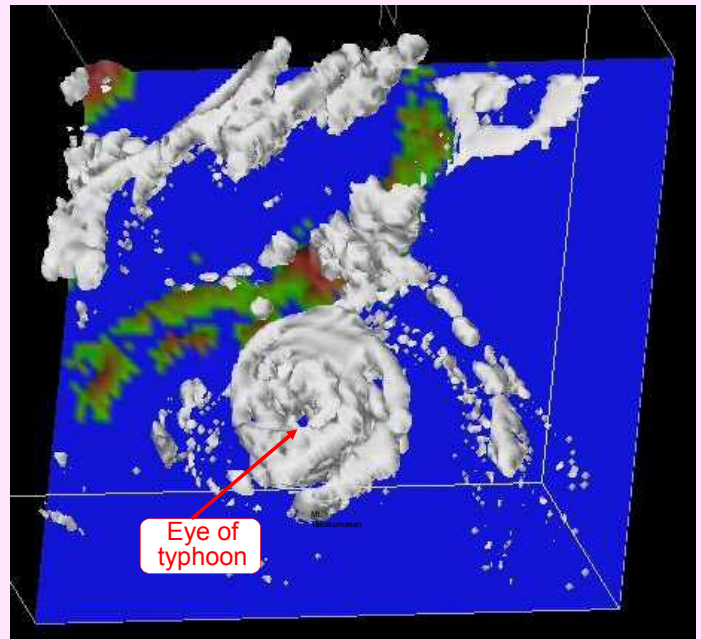


Figure 1: Example of Estimating Typhoon (Cloud Distribution)

2. Meteorological Field Forecasting to Improve Precision in Wave and Storm Surge

One advantage of WRF is that the simulation of meteorological fields can include the effects of land topography.

Various methods and models, especially in wind fields, are examined and proposed in the past, in order to consider the effect of land topography. But there is a restriction in the computation capability under a complicated topographic condition, because the past methods do not have detailed physical principles and laws of weather in the parameter of calculation process of the model. Figure 2 shows an example of wind fields around Kagoshima Bay simulated under Typhoon by using WRF. It is reproduced that the wind blows through the flat land between Mt. Takakumasan and Mt. Hoyoshidake, from Shibushi Bay to Kanoya City, and the strong wind blows locally near Kiire inside the bay. And the attenuation of wind speed by Yakushima Island is also reproduced. By using WRF, the calculation of meteorological fields can be applied in the sea areas with complicated coastline and surrounded by land. The precision of wave and storm surge generated by the external forces originated from the meteorological fields, is remarkably improved.

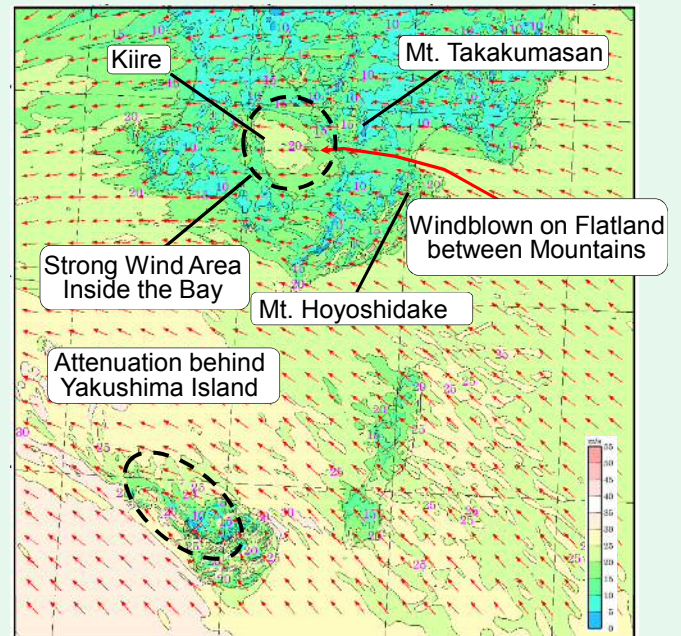


Figure 2 : Example of Wind Fields Simulated by WRF

3. Performance and Application

WRF has been already utilized as a simulation tool of external meteorological forces in planning and design for port facilities. Erosion control of beach in Shibushi Port is an examined that is listed as a representative achievement. WRF as for 100 disturbances is carried out to evaluated the external forces necessary for the design condition, which is a part of the business work. This simulation model is expected to contribute to precise forecast of wave and storm surge at time of Typhoon disaster.