Japan Geoscience Union Meeting 2012
(May 20-25 2012 at Makuhari, Chiba, Japan)

AAS02-05 会場:101A 時間:5 月 25 日 10:00-10:15

台風域の海面粗度長と抵抗係数に関する数値シミュレーション
Numerical simulations on surface roughness lengths and drag coefficients under typhoons

和田 章義 [1*]
WADA, Akiyoshi[1*]

[1] 気象研究所
[1]Meteorological Research Institute

Numerical simulations for Typhoons Choi-wan in 2009 and Fanapi in 2010 were performed using a nonhydrostatic atmosphere model coupled with wave and multi-layer ocean models to investigate the variation in surface roughness length under typhoons. Surface roughness lengths were calculated by the formulation which is a function of wave steepness proposed by Taylor and Yelland (2001). This study addresses surface roughness lengths and drag coefficient under the two typhoons.

The computational domain was 3240 km x 3960 km with a horizontal grid spacing of 6 km for Choi-wan and was 2000 km x 1800 km with a horizontal grid spacing of 2 km for Fanapi. The model had 40 vertical levels with variable intervals from 40 m for the lowermost (near-surface) layer to 1180 m for the uppermost layer for both typhoon simulations. The model had maximum height approaching nearly 23 km. The time step of the nonhydrostatic atmospheric model was 15 s for Choi-wan and 6 s for Fanapi. The length of the time step of the ocean model was six times that of the nonhydrostatic atmospheric model. The initial depth of the mixed layer was determined from oceanic reanalysis data, calculated using the MRI ocean variational estimation (MOVE) system (Usui et al., 2006). The integration time was 96 hours for Choi-wan and 72 hours for Fanapi.

The dependency of 10-m wind speed indicated that surface roughness lengths and drag coefficients were saturated or leveled off when a 10-m wind speed was high. These saturated or capped level of surface roughness lengths and drag coefficients varied on the intensity of the typhoon and its phase. This implies that the saturated or capped level of surface toughness lengths and drag coefficients are not determined from the magnitude of 10-m wind speed but the structure and phase of (simulated) typhoon.

During the intensification of Fanapi (at 24-hour integration), surface roughness lengths and drag coefficients were high where both 10-m wind velocity and wave heights were high. Each horizontal distribution of 10-m wind velocity, surface roughness lengths, drag coefficients and hourly precipitation had a wave-number-1 pattern. When Fanapi approached the Miyako island, south of Japan, at 48-hour integration, surface roughness lengths and drag coefficients were high on the north side from the Fanapi's center, while 10-m wind velocity and 1-hour precipitation were high on the east from the center, against the moving direction of the storm. Wave heights were high along and on the right side of the track behind the storm, probably due to wave-near-inertial current interactions. A difference of the location between high surface roughness lengths/drag coefficients and high wave heights was also found at 60-hour integration when the storm approached the Ishigaki island.

In fact, simulated central pressures tended to be low compared with the best track central pressures for Choi-wan. In addition, simulated tracks had a northward bias and simulated central pressures tended to be high compared with the best track and its central pressures for Fanapi. Nonetheless, it is of importance that surface roughness lengths are closely related to drag coefficients in spite that the drag coefficients are calculated not only by surface roughness length, but also by wave heights and 10-m wind velocity. However, we need to validate the results of numerical simulations for Choi-wan and Fanapi using the in situ observations.

キーワード: 台風, 抵抗係数, 高風速, 海面粗度長, 大気波浪海洋結合モデル
Keywords: Typhoon, Drag coefficient, High wind, Surface roughness length, Atmosphere-wave-ocean coupled model