Simulation on Rapid intensification of Hurricane Kenna (2002) using WRF model

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Abstract

Hurricane Kenna was developed from a disturbance that moved westward across Central America and entered the eastern north pacific basin on 19 October 2002 and became a tropical depression on 0000UTC 22 October. Kenna moved around the periphery of mid-level high pressure over Mexico, turned to the west-northwest. The flow ahead of a large mid-to upper-level trough west of Baja California turned Kenna to the northeast on 24 October and made landfall near the fishing village of San Blas, Mexico, as a category 4 hurricane with 120kt winds (Fig 1a).

Kenna experienced its rapid intensification (with 30kts decreasing of maximum surface winds within 24h) from 0000UT 23 Oct. through 1800UTC 24 Oct. with 85hPa (100kts) decrease of minimum sea level pressure (maximum surface wind) as shown in Fig1b. The NCEP reanalysis dada were used to analyze the large-scale characteristics which attributed to Kenna's rapid intensification. The results show that the changes

of mid to upper level circulation initialized the onset of the rapid intensification of Kenna as shown in Fig 2: the increase of upper level strong divergence to the north-west of Kenna and the strong convergence to the west of this divergence made the convection concentrated closer to the center (also could be found in the SSM/I images). Kenna continued rapid development until 1800 UTC 24 Oct. when it moved to northeast under the influence of mid-upper level trough.

Sensitive studies on the rapid intensification of Kenna were carried out using WRF model. The results show:

1. Sensitivity to the horizontal resolution: 27km and 9km WRF were used to simulate Kenna's rapid intensification. The results show that WRF with 27km resolution could reproduce the deepening of the minimum sea level pressure but with much weak maximum surface winds. When the horizontal resolution was increased to 9km with the same physical packages, WRF over-simulated the central sea level pressure with the minimum value at 854 hPa, the maximum surface winds are comparable to the observed. The WRF model tends to over-simulate the minimum sea level pressure but with weak surface maximum winds. This may be caused by the lower horizontal resolution (Fig.3).

2. The different boundary layer schemes were tested. Mellor-Yamada-Janjic (Eta) TKE scheme tends to produce a much intense Kenna compared with YUS scheme.

(a) (b)

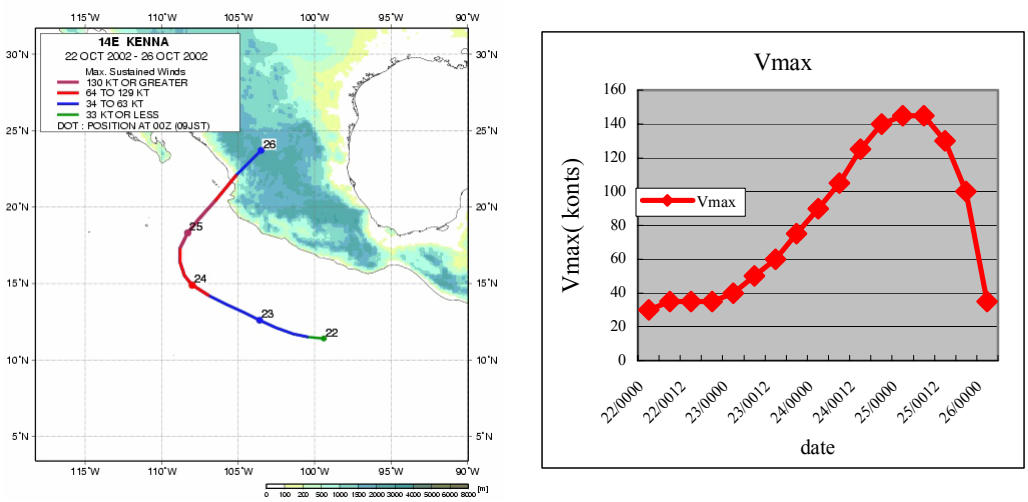


Fig1a, best track from National Hurricane Center,1b: Maximum sur

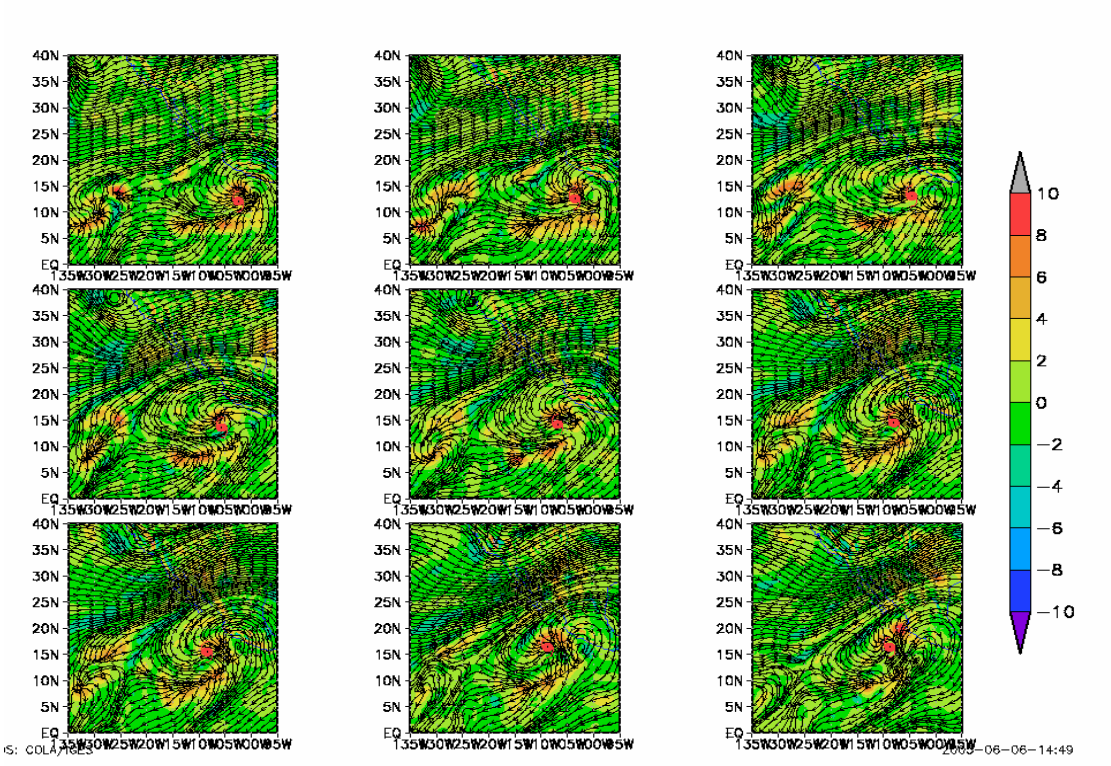
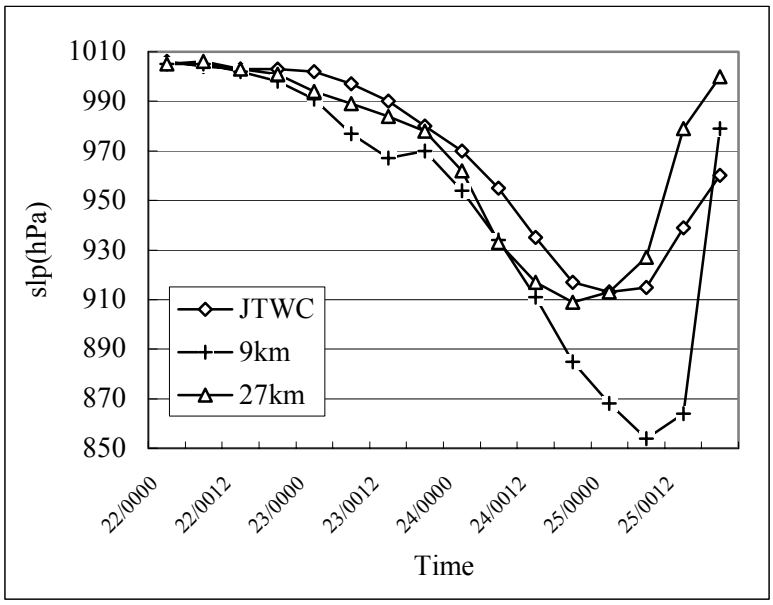


Fig2 Stream line and divergence at 200hPa. Divergence is shaded. The left top is for 1800UTC

22 Oct. and the right bottom is for 1800UTC 24 Oct. Time interval is 6h, and time increases from left to right

3a



3b

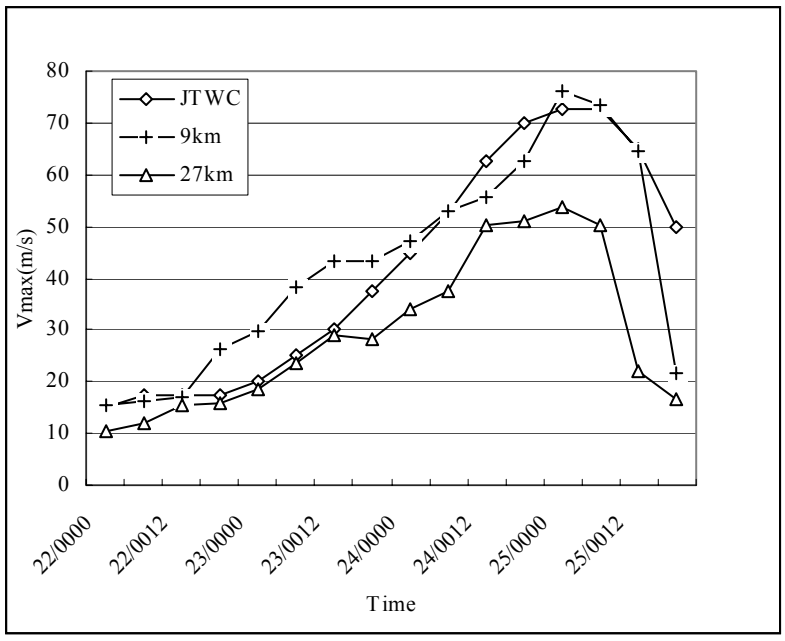


Fig3. Simulation from 27km and 9km WRF. 3a is for the minimum central sea level pressure and 3b is for the maximum surface wind