



















function was still used to fit those profiles. When the hill bottom radius changed. The equation was little more complicated, since the parameter  $a$  and  $b$  changed significantly with the slope  $D/H$  changed. It can be expressed as follow

$$\begin{aligned}
 w &= U_0 \exp(az / H + b) \\
 a &= -0.05(D / H)^2 + 0.46(D / H) - 1.68 \\
 b &= 0.27(D / H)^3 - 2.09(D / H)^2 + 4.02(D / H) - 4.20
 \end{aligned}
 \tag{10}$$

The fitting result were as follows:

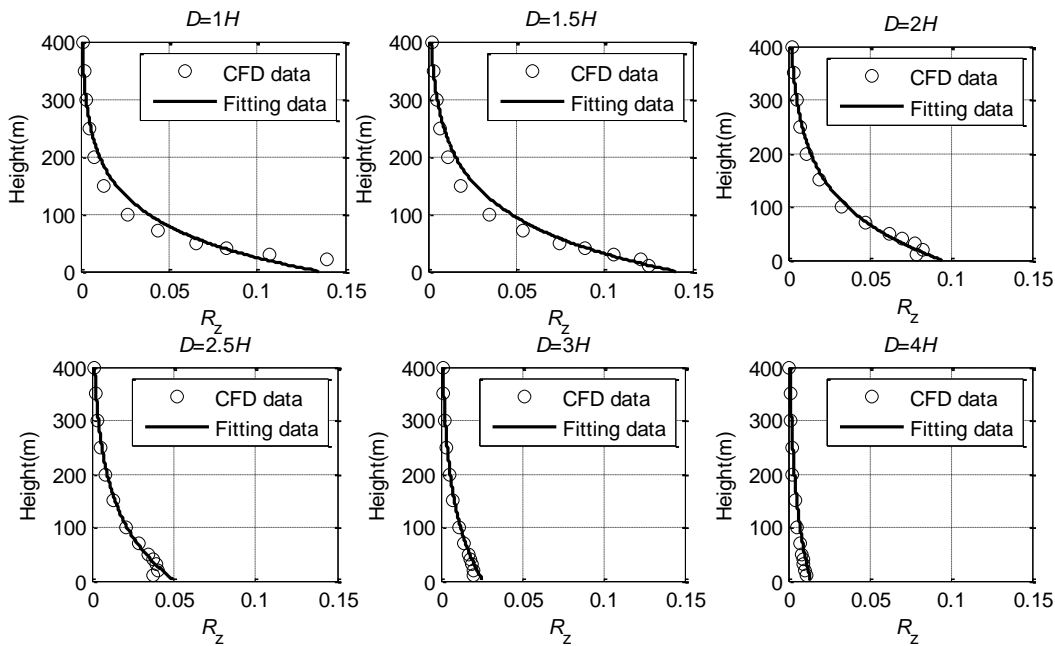


Fig.12 Comparison between fitting and numerical simulation under different hill bottom radius

#### 4.3. The effect of length of ridge

This section focused on the influence of the length of ridge on vertical wind velocity distribution. Table 1 showed the cases of numerical simulation. Two wind direction angles were studied respectively. The hill height  $H$  was 100 m and the hill bottom radius  $D$  was 150 m for those cases.

Table 1 Cases of numerical simulation with different hill ridge

Wind angle	Length of ridge
90°	0.0H, 0.5H, 1.0H, 2.0H, 3.0H, 4.0H, 5.0H, 8.0H
0°	0.0H, 1.0H, 3.0H, 5.0H, 8.0H

When the wind angle was 90°, where the wind direction was normal to the ridgeline, the over-hill effect became more obvious with the increase of the ridge length at the middle of the ridge. As was shown in Table 2, with the increase of ridge length, the

maximum vertical wind velocity ratio  $R_z$  increased both at the hillside and crest, especially at the middle of ridge, the  $R_z$  doubled when the  $L$  became  $8H$ .

Table 2 Updraft velocity ratio at the height of 10m under  $90^\circ$  wind angle

Ridge length $L$	$0.0H$	$0.5H$	$1.0H$	$2.0H$	$3.0H$	$4.0H$	$5.0H$	$8.0H$
Maximum $R_z$ on upwind slope	0.62	0.67	0.68	0.69	0.69	0.69	0.70	0.71
Maximum $R_z$ at middle of ridge	0.13	0.19	0.23	0.26	0.27	0.28	0.28	0.29

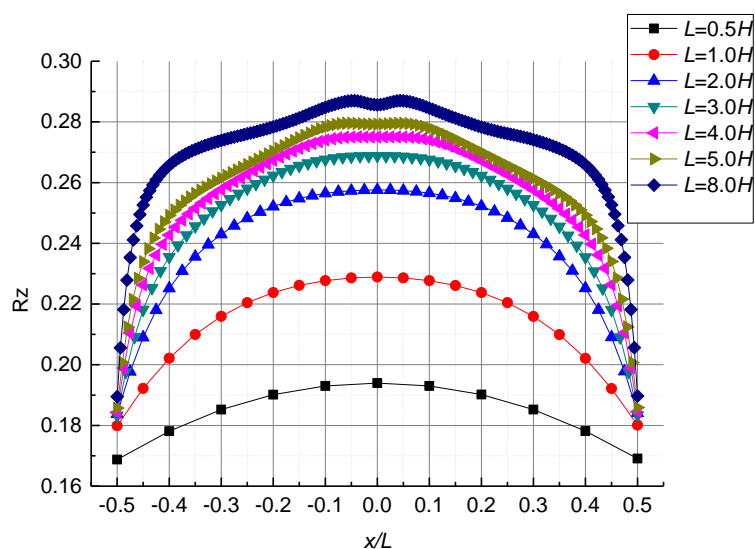


Fig.13 Updraft velocity ratio changes along the ridge at the height of 10m under  $90^\circ$  wind angle

When wind flow over the ridge, the vertical wind velocity presents a certain distribution as shown in Fig. 13. While  $x$ , as shown in Fig. 2, meant the distance to the middle of hill. That made  $x/L$  present the location along ridge. When  $x/L$  was  $-0.5$  or  $0.5$ , it located at left or right crest of the hill. Since the over-hill effect was more obvious at the middle of ridge, velocity ratio was larger at middle of ridge than at crest of the hill. And the velocity ratio changed within  $1/10L$  range around the crest.

When the wind direction angle was  $0^\circ$ , where the wind direction was perpendicular to the ridgeline, the maximum vertical wind speed was significantly decreased with the increase of the length of ridge, and the vertical wind speed ratio at crest was almost remain the same, as shown in Table 3

Tab 3 Updraft velocity ratio at the height of 10m under  $0^\circ$  wind angle

Length of ridge	$0.0H$	$1.0H$	$3.0H$	$5.0H$	$8.0H$
Maximum $R_z$ on upwind slope	0.62	0.62	0.50	0.36	0.36
Maximum $R_z$ at middle of ridge	0.13	0.15	0.15	0.15	0.15

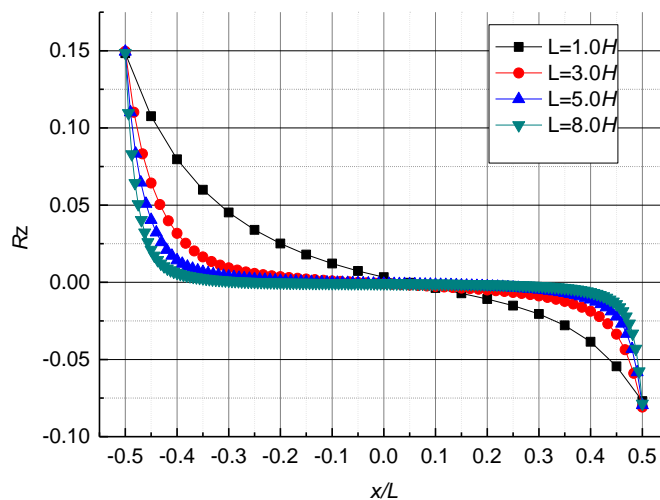


Fig.14 Updraft velocity ratio changes along the ridge at the height of 10m under 0° wind angle

As shown in Fig. 14,  $x$  equated to -0.5 and 0.5, respectively, representing the upwind and leeward crest of the hill. Vertical wind velocity in the top of hill near windward slope was updraft flow, in the middle region of the ridge was almost zero, when at the proximity of the leeward slope, it changed to downdraft flow. Same as 90° wind angle, the velocity ratio changed within  $1/10L$  range around the crest.

## 5. Conclusions

This paper revealed the distribution of vertical wind speed in hill terrain. Studied the influence of topographic features including hill height, hill slope and length of ridge. Fitted the profiles of vertical wind velocity ratio at the crest with varied hill heights and hill slope. And came to conclusions as follows:

1. Vertical wind speed on the upwind side, could up to about 60 percent of the income flow speed and maximum vertical wind velocity located at about two thirds height of the hill on upwind slope.
2. Vertical wind velocity ratio profiles satisfied exponential law at the top of the hill and equations were fitted to profiles with the change of hill height and slope.
3. In the case of 90° wind angle, the maximum updraft velocity on upwind slope and mountaintop both increased with the length of ridge. While at 0° wind angle, the maximum updraft velocity on upwind slope decreased with the length of ridge.

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