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Effect estimation of environmental factors and soil property on topografical variation on soil respiration

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Studies on the spatial variation of soil respiration on slopes have been performed in many forest types. The slope heights in these studies varied widely between 7 and 120 m, and most of the studies reported that soil respiration rates were lower on the lower parts of the slopes. Contrary to these previous studies, Some study reported that soil respiration was lower in areas of higher topography due to drier soil in deciduous forests of the weathered granite region. To address this issue, we examined the effect of soil temperature and moisture on the difference in soil respiration between ridge and valley bottom locations in a deciduous forest in the weathered granite region of Japan. The observations took place in the Yamashiro Experimental Forest in southern Kyoto Prefecture, Japan(34O47'N, 135O50'E). In 1999, Goto et al. (2003) determined the total basal area and aboveground biomass of stems with a diameter at breast height (DBH) greater than 3 cm to be 20.7 m2 ha–1 and 105.05 t ha–1, respectively. The average litter fall from 1999 to 2002 was 5.16 t ha–1 year–1, with a mean air temperature of 15.5oC, warmth index of 125.6oC month, and annual precipitation of 1,449.1 mm. Tamai et al. (2005a) recorded soil respiration for 360 colors of soil in the Yamashiro Experimental Forest and reported that the approximated equation could be adapted to whole of this experimental forest, regardless of topography: The Yamashiro Experimental Forest is located in a hilly mountainous area and includes an approximately 10-m-wide valley with a 30-m-high ridge. Plot V was located at the bottom of the valley, while plot R was on a ridge above the valley. Table 1 provides information on plots V and R. The distances between the plots were around 70 m and 30 m, horizontally and vertically, respectively. Soil respiration, soil temperature, and soil moisture ratio were monitored in both plots using an automated chamber system, The effects of soil temperature and moisture on the difference of soil respiration were estimated. The annual soil respiration rate in plots V and R were almost the same at approximately 6.2 tC ha–1 year–1. However, this rate at Plot R includes the effects of acceleration by warm soil temperature (0.68 tC ha–1 year–1) and deceleration by soil drying (0.62 tC ha–1 year–1). The values of 0.68 tC ha–1 year–1 and 0.62 tC ha–1 year–1 represent about one tenth of the annual soil respiration rate. The minimum value of effect by soil temperature and the maximum value of effect of soil moisture reached as large as –0.77 and 0.98 gC m–2 day–1, respectively, throughout the year. These differences were large compared to the daily soil respiration rate, indicating that daily differences in the soil respiration rate cannot be ignored.