WIND SPEEDS WITHIN THE TRUNK SPACE OF A PINE FOREST

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1. INTRODUCTION

In recent years a good deal of data have been collected on the shapes of the wind profile within forests. Several papers (e.g. Lemon et al. 1970; Landsberg and James 1971; Martin 1971; Oliver 1971) present results showing that, at least on some occasions, a 'bulge' is found in the profile within the fairly open trunk space region of the forest. Such findings have sometimes been explained as being caused by some blow-through phenomenon associated with edge effects, large gaps in the forest or a non-horizontal site. This explanation cannot however be applied to all such results and certainly very few sites are more nearly perfectly suited to such measurements than that of the Institute of Hydrology at Thetford Forest, Norfolk.

2. PROFILE MEASUREMENTS AT THEFTORD

In order to investigate the occurrence of a bulge in the trunk space wind profile, seven days of readings obtained during June 1973 were analysed, a total of 80 sets of hourly averages obtained under lapse conditions being used. It was found that the ratio of the wind speeds measured at 4.3m and 18m (the middle of the trunk space and just above the top of the canopy), increased from around 20% for speeds at 18m in excess of 2m s⁻¹ to over 30% for speeds between 1 and 2m s⁻¹. The stability of the air layer above the forest was also determined for each hour of measurements and Fig. 1 shows a plot of these wind speed ratios against Richardson number. It is clear that the ratios increase with greater instabilities, i.e. larger negative Richardson numbers. At night the wind speeds within the forest are usually very low and below the stalling speed of the cup anemometers, but for the hours when this was not the case the ratio between the 4.3m and 18m speeds averaged out at about 11%.
3. DISCUSSION

Observations of smoke trails at Thetford have shown that there are large and frequent fluctuations in wind speed and direction below the canopy, the direction in the trunk space sometimes being in totally the opposite direction to the wind above (Oliver 1973). The Richardson number variation within the upper part of the forest canopy is very conducive to thermal plume formation (Thom et al. 1975), and such plumes have certainly been demonstrated by the smoke trails. As the bulge in the trunk space profile is found to increase with increasing instability, it therefore seems likely that it may be associated with convective activity.

It is suggested that when a convective plume leaves the top of the canopy at least some of the air taking its place will be drawn up through the canopy from below and this mechanism will set up enhanced air motions within the trunk space. As cup anemometers measure only the total run of wind, air flows from any direction will be integrated over the hour to give the indicated increase in mean wind speed.

A similar dependence for trunk space speeds upon the wind speed above the canopy has been observed for other forests, but it would be interesting to know whether similar results to those shown here have been found for other sites which may lend further support to the explanation proposed. This paper is published by permission of the Director, Institute of Hydrology.

REFERENCES


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