Fundy Model Forest

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Report Title: Model Prediction of Deposit of Aerial Pheromone Application

Author: Mickle, R.E.

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Principal contact information: REMSpC Spray Consulting
12 Welsh Drive
Ayre, ON Canada
N0B 1E0

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"The Fundy Model Forest (FMF) is a partnership of 38 organizations that are promoting sustainable forest management practices in the Acadian Forest region."

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Canadian Institute of Forestry
Canadian Forest Service
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Conservation Council of New Brunswick
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REMSpC Report 2000-08
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Model Prediction of Deposit

from an Aerial Pheromone Application

Acadia, NB June,2000

Report to
Forest Protection Limited

prepared by

R.E Mickle
REMSpC Spray Consulting
12 Welsh Dr, RR3
Ayr, ON Canada
N0B 1E0

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On June 28, 2000, an evening application of 3M pheromone took place at Acadia, NB as part of a SERG research trial on testing formulations for use in early intervention management strategies of the Spruce budworm. This report documents the meteorology and application parameters during that trial. These parameters were then used as input variables to AgDISP (v7.0) to predict deposit from the application.

Meteorology

Meteorological readings (Fig 1) were taken from hand-held sensors at 2m above ground.

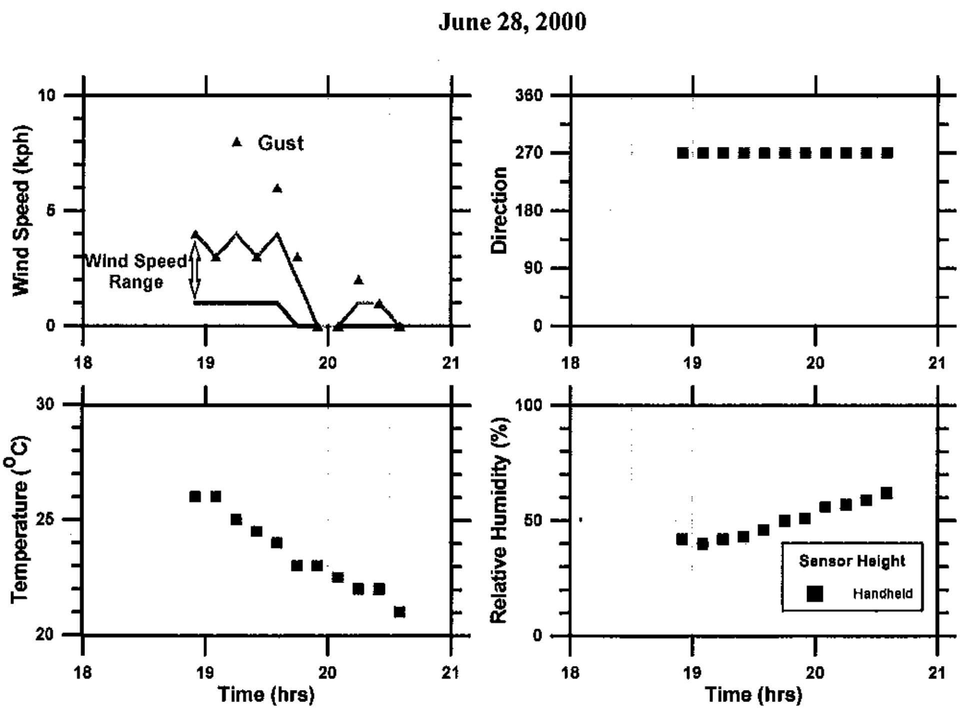

Figure 1. Surface meteorology during aerial application.

Leading up to the application (20:15 – 20:28), temperature rapidly decreased at the ground as a nocturnal inversion developed. With decreasing temperature, relative humidity characteristically increased. Although not measured, relative humidity at aircraft height would most likely have been around 40% or lower consistent with warmer temperatures near the top or above the deepening nocturnal inversion. Wind direction at 2m remained out of the west through out the sampling period. With increasing stability, surface winds slackened as the inversion decoupled surface winds from winds aloft. Gusts, indicative of winds aloft and ranging up to 8kph, were observed to decrease with time. Generally, gusts of 3kph dominated.

Application

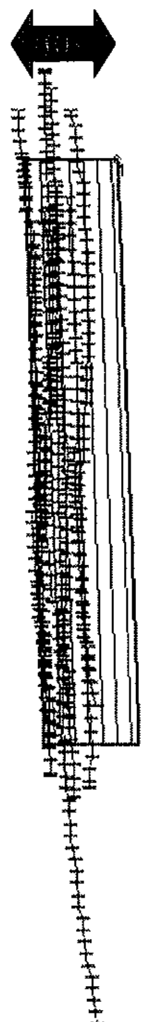

Figure 2. Treatment lines recorded by AGNAV®2

A 4ha block (500m x 80m wide) was designed to accommodate seven flight lines having a 12m separation. In response to westerly winds, all eight flight lines (Fig 2) were confined to the upwind half of the treatment block. Onboard logging (REMSpC ASM) of application parameters (Fig 3) indicated that the AU4000 atomizers turned at 6000 – 65000rpm. Comparison of rpm with ground speed recorded by the AGNAV®2 showed rpm changes were in response to ground speed changes in the slightly undulating terrain. Despite changes in ground speed, the AutoCal flow controller maintained application rate to within 5% of target (10L/ha) resulting in flows near 9.5L/min/atomizer. Minimum radar altimeter readings from each line produced distances from aircraft height to isolated tall trees that ranged from 20 – 36m. Detailed radar altimeter data (histogram developed from minimum height for each second along treatment lines) indicated that predominate heights above canopy ranged from 32-38m peaking near 35m. A comparison between average DGPS height (97m) and topographical maps (ground = 45-54m) confirmed aircraft height to be 43-52m above local ground. A canopy around 10m would result in consistent results from the two independent measurement techniques.

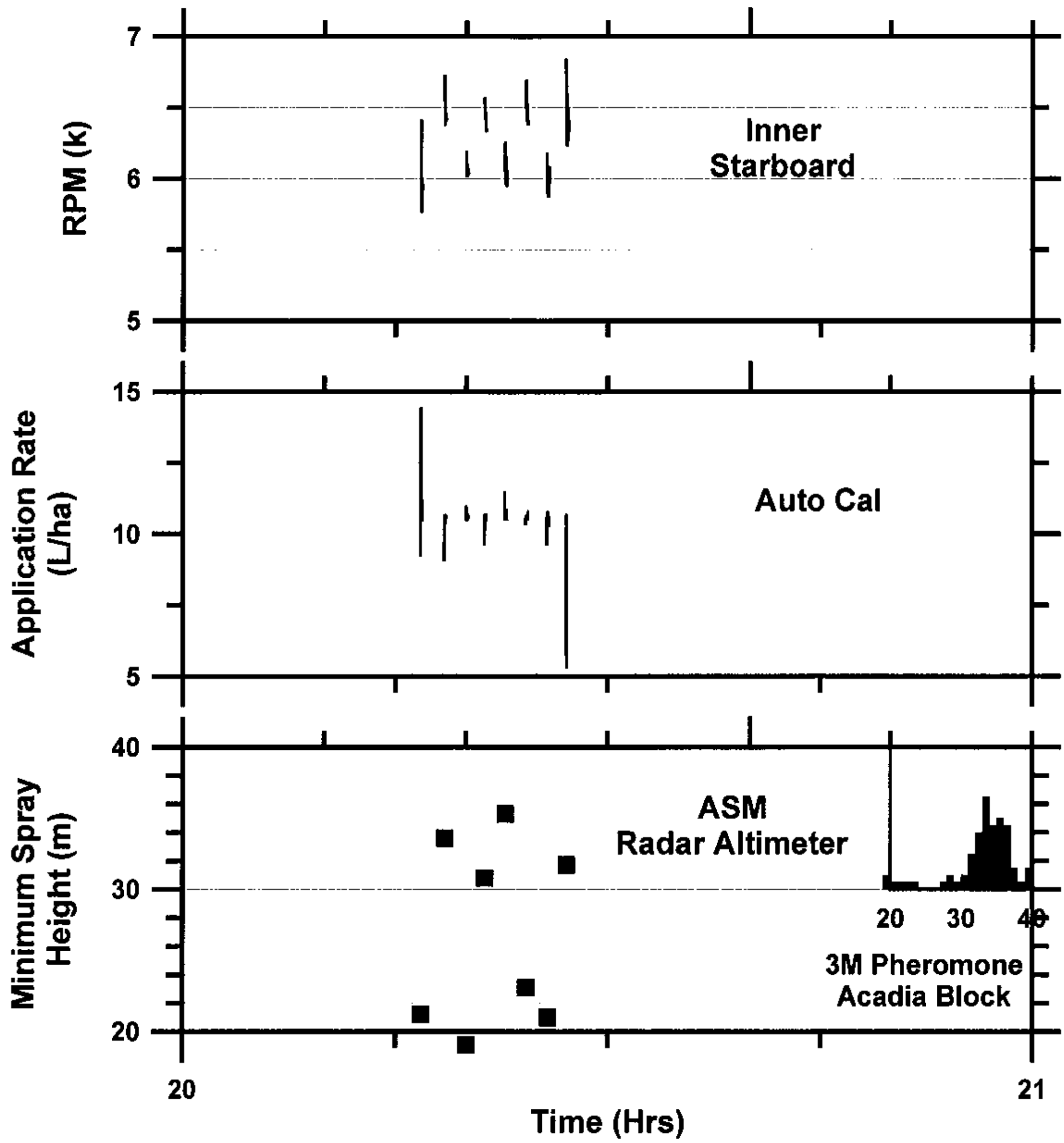

Figure 3. Application parameters recorded by the REMSpC ASM and AGNAV®2.

Modeled Deposit

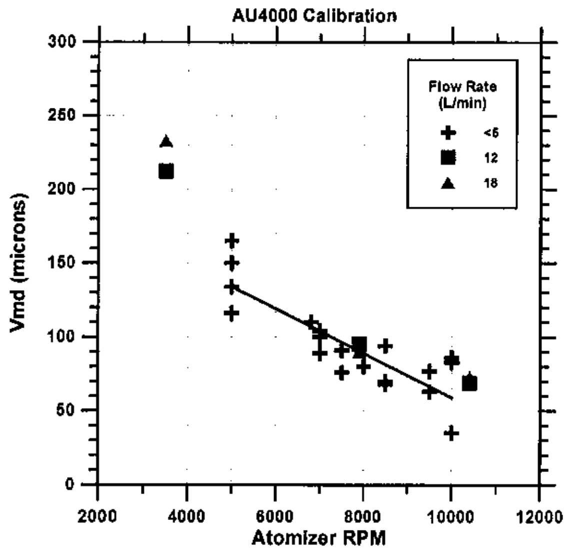

Figure 4. Relationship of Vmd and RPM for an AU4000.

Previous wind tunnel tests on different formulations have shown that atomizer rpm most strongly influences emission Vmd with minimal differences due to flow rate. Although wind tunnel tests specific to this 3M pheromone formulation were not completed, an emission spectrum with a Vmd of 115µm was used to reflect the average recorded AU4000 rotational speed of 6300rpm.

An AgDISP (v7.0) run was made for the average height of each flight line. Other input parameters are listed in table 1. Due to the high release height and relatively small drop size distribution, maximum deposit (Fig 5) was predicted to peak at only 2-4% of target

Parameter	Model Input
AC Height	30 – 38m above canopy
Formulation	
Non-Vol Frac	0.11 (7L pheromone and 55L water)
Vmd	115µm
Meteorology	
Ta, RH	25°, 40%
Wind (spd,drn)	3kph, westerly (at AC ht)

Table 1. Input parameters for AgDISP model runs.

application rate and at distances of 100-200m downwind of the flight line i.e. at distances beyond the downwind boundary of the treatment block. (The shaded green area represents the width of the block. For these model runs, the flight line is along the upwind boundary.) The high height-small DSD results in deposit over an extended downwind distance. It is interesting to note that the optimized track spacing (for uniform deposit)

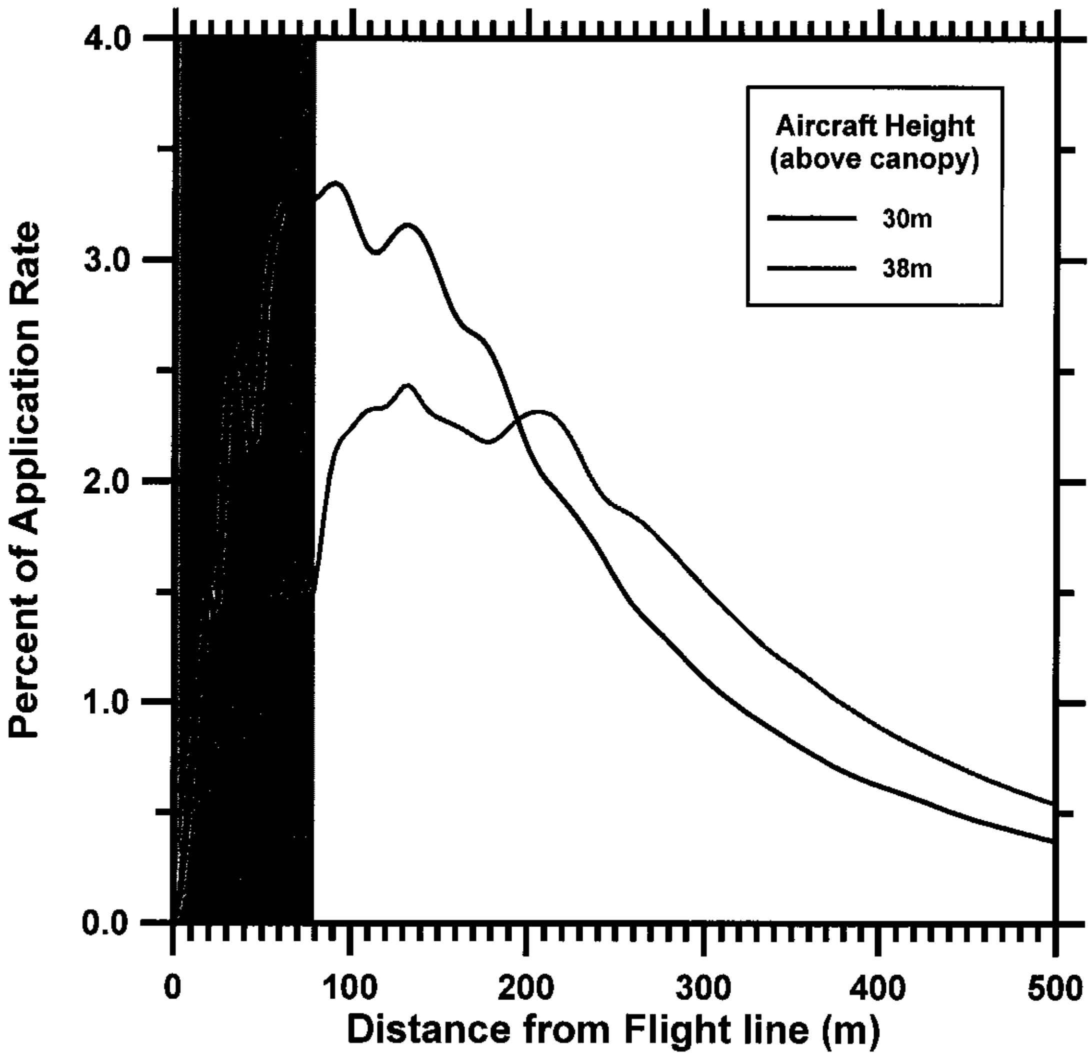

Figure 5. Predicted downwind deposit for two aircraftr heights.

associated with these deposit profiles is greater than 200m, nearly 17 times greater than the 12m swath used.

Accumulated deposit from the full application (Fig 6) was developed by projecting the line-average deposit profile from the aircraft position at each 10m step (DGPS position 5 times/second) along each treatment line. Measured application rate (AutoCal) was used to modify the deposit profile for each calculation. The resultant deposit reflects accumulated deposit as a percent of target application rate (1.13L/ha of pheromone). Given the height of the aircraft, little deposit was found within the block. Maximum deposit of only 10% of target application was predicted on the downwind side of the block. Peak deposit of around 20% was predicted outside the block. In fact, given the height of the aircraft and

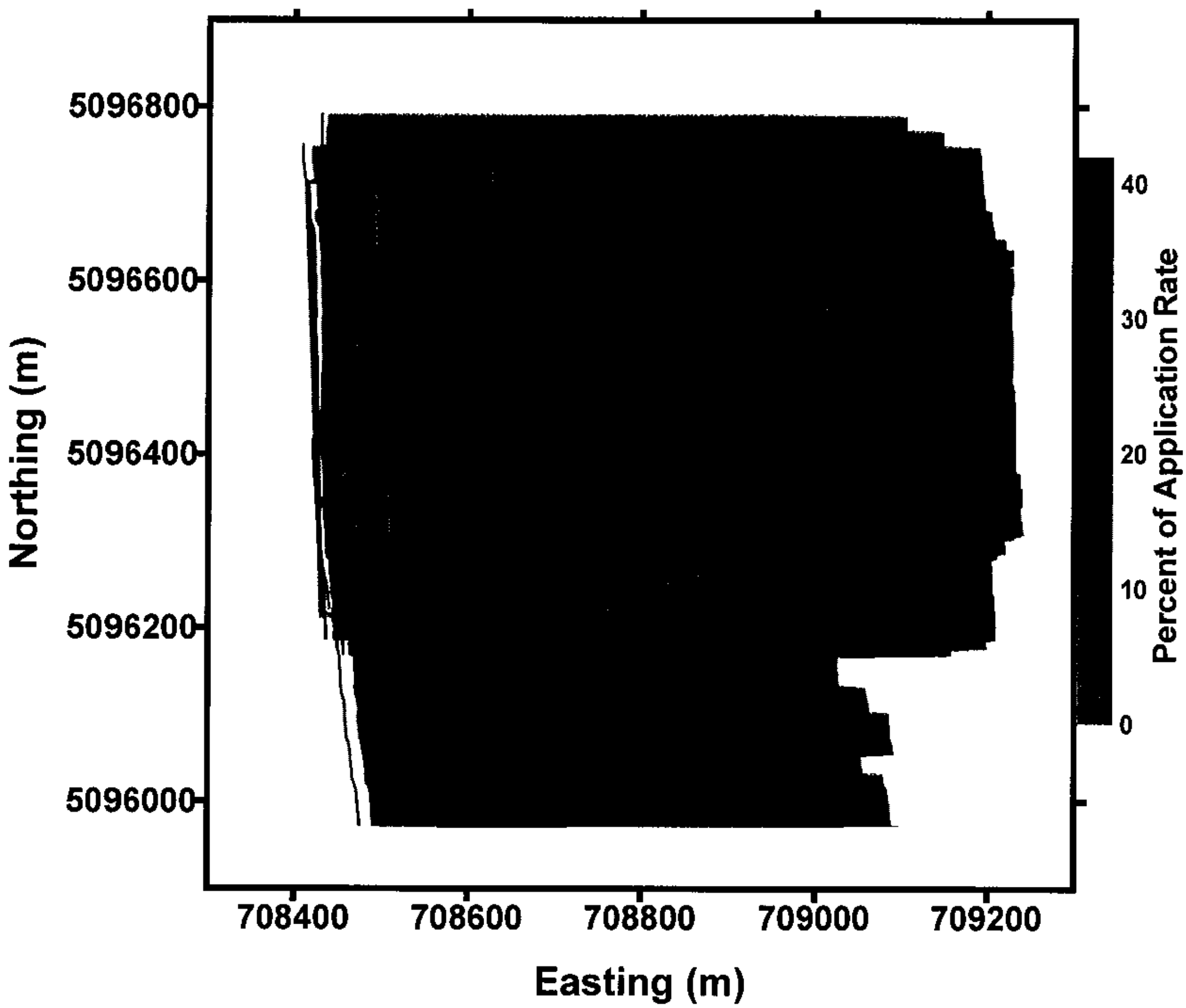

Figure 6. Predicted deposit from pheromone application.

DSD used, the limited number of flight lines would have resulted in a maximum deposit of 27% of the target application rate. In order to achieve deposits approaching target application rate for these small-drop applications, aircraft height above canopy needs to be less than 15m and block widths along the wind direction need to be considerably larger.