MEASUREMENT OF ENVIRONMENTAL AND POLLUTANT GRADIENTS IN THE FOREST CANOPY

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Objectives

The goal of this research is to improve our knowledge of variation in canopy-atmosphere interactions within the forest canopy using the 22 m research tower in a mature hardwoood stand at the Proctor Maple Research Center (PMRC). At each of five heights from ground-level to above the canopy we will:

1. monitor ambient environmental conditions (ozone concentration, temperature relative humidity, wind speed and direction, and surface wetness; total solar radiation, photosynthetically active radiation (PAR), and ultraviolet radiation will also be monitored above the canopy;

2 measure leaf area distribution (LAI), foliage distribution and PAR;

3. relate these data (1 and 2) to evaluate the relationship between in-canopy ozone concentrations, meteorology and canopy structure;

4. measure wind speed and direction in three dimensions and calculate ozone deposition at several heights using eddy flux correlation techniques.

Methods:

In 1991, the tower was constructed, planning for this project was conducted, and supplies and equipment were ordered. All canopy measurements will commence by May and extend through October. Ambient meteorology and ozone measurements will be conducted continuously at five sampling points between the ground and tower top. Ozone measurements will be made with an automatic switching valve (Scan Co. ScaniValve) alternately sampling each location using a TECO ozone monitor. Meteorological variables will be measured at the same locations for temperature and relative humidity (CSI model 207), wind speed and direction (R.M. Young AQ wind monitors), and surface wetness (CSI model 237). Solar radiation will also be measured at the top of the canopy as PPFD, solar irradiance (400-1100 nm), and UV-B irradiance (Licor models 190SA, 200SA, and Solar Light Co. UV Biometer, respectively). Meteorological data signals will be routed to a CSI model 21X data logger and a microcomputer for collection as half-hour means.

Micro-meteorological wind data will be collected utilizing three dimensional anemometers (R.M. Young UVW monitors). These data and the ozone data will be used in eddy correlation calculations to estimate gas flux to the canopy at

three heights. Typically these calculations require fast (< 1 s) gas data acquisition, but we anticipate being able to make meaningful calculations with our present standard monitors.

Phenology of leaf-out in spring and canopy structural changes through the season will be estimated by taking periodic measurements of leaf area distribution frequently during May and June and periodically through the growing season. Leaf area index and foliage distribution will be estimated at each height using several techniques: a LiCor LAI 2000 canopy analyzer (LiCor Lincoln, NE), PAR attenuation using a Ceptometer PAR wand (Decagon Devices Inc., Pullman WA), hemispherical photograpy, and a photographic sight-obstruction technique, both using image analysis hardware and software.

Significant Findings

At this time there are no research results. Much of the preliminary experimental design and procedure work has been accomplished. In the course of this planning, possible collaborative research relationships have been identified with the SUNY Albany Atmospheric Science Research Center, the US Forest Service Rocky Mountain Forest and Range Experiment Station, and NOAA.

Future Plans

This research project will run for at least two years and may be expanded if pending grant proposals are funded. In addition, year-around basic forest meteorological data will be summarized on a regular basis. Possible future work involves adding multiple measurements in the horizontal direction in order to expand our data base to three dimensions for the purpose of scaling physiological responses from the leaf to the whole stand level. Discussions are currently underway (April 1992) with several research groups to cooperate on (1) enhancing the micro-meteorological studies, (2) measuring mercury deposition to the canopy, (3) measuring nitric acid vapor and other forms of N deposition to the canopy, and (4) developing dry deposition measurement capabilities at the site.

Funding Sources:

Support from this project comes from the UVM Research Advisory Council, the VMC, the US Forest Service Northeastern Forest Experiment Station, and the UVM School of Natural Resources.