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Green Parking Lots: Can Trees Improve Air Quality?

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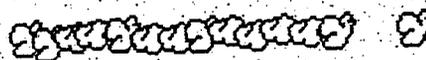
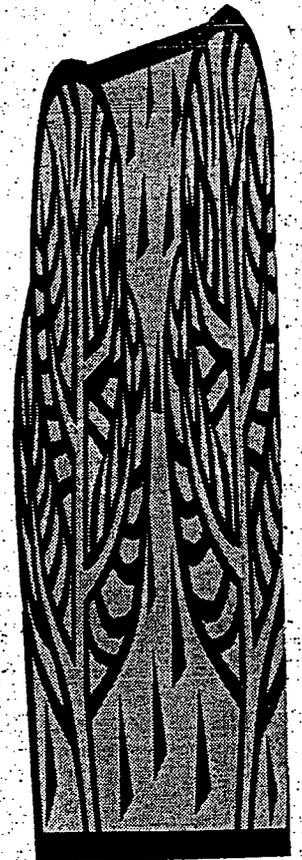
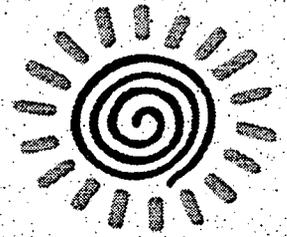
Recently Greg McPherson presented at the Western Chapter ISA conference some preliminary results from the parking lot microclimate study conducted by Klaus Scott, Jim Simpson, and himself. The following is a one page summary of those results and even though the study was conducted for one small parking lot in Sacramento, the results are already generating a great deal of interest and excitement. It needs to be noted however that these results are very preliminary and shouldn't be generalized to apply to all other areas of California. There is also a caveat: some tree species emit biogenic hydrocarbons, such as isoprene. These "BVOC's" are very reactive and can play a role in ozone formation, thus contributing to air pollution. So, before anyone rushes out to plant trees in parking lots, a lot more measurements, modeling and benefit/cost analyses have to be done in order to find the right mix of appropriate tree species, planting designs and maintenance programs, which achieve cooling and reduce vehicle emissions, without adding BVOC's or doing other deleterious things (e.g. appropriate water use, low nuisance litter, etc.)

1. Background. Ozone is a serious air pollution problem in most large U.S. cities. In the Sacramento County metropolitan area, motor vehicles are a major source of ozone precursors, contributing approximately 59 tons per day (tpd)(68% of total) nitrogen oxides (NO_x) and 59 tpd (49% of total) anthropogenic hydrocarbon (HC) emissions.

While the bulk of HC emissions are from tailpipe exhaust, approximately 9.7 tpd (16%) are from evaporative emissions that occur during daytime heating of fuel delivery systems of **parked vehicles**. Evaporative emissions, as well as exhaust emissions during the first few minutes of engine operation (primarily NO_x), are sensitive to local microclimate.

Many municipalities in the west also have parking lot shade tree ordinances, which require that parking lots be designed to achieve 50% tree canopy cover within 15 years of construction. While originally viewed by ordinances as an aesthetic amenity, parking lot trees may provide important environmental benefits. *In the pilot study described here, we posit a relationship between tree cover, parking lot microclimate and vehicle emissions.*

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2. Experiment Overview. Microclimate measurements were taken to quantify the moderating influence of tree canopy on parking lot microclimate via shading and evaporative cooling from leaves. These estimates were used to calculate potential temperature-dependent emissions reductions from parked vehicles using the California Air Resources Board MVEI7G model.

3. Measurements. Two automated weather stations and instrumented passenger cars were located in unshaded and shaded portions of a parking lot in Davis, CA for a week in August 1997. Air temperature, solar and net radiation, wind speed and direction, and vehicle cabin and fuel tank temperatures were measured.

Peak daytime air temperatures at the shaded parking lot averaged 1 to 2°C cooler than the unshaded site; fuel tank temperatures of the shaded car were 2 to 4°C cooler than fuel tank temperatures of the unshaded car.

Larger temperature differences between fuel tanks of shaded and unshaded cars, compared to air temperature differences between shaded and unshaded lots, indicate that direct shading of the vehicle influenced fuel tank temperature (hence HC evaporation rates) as much as, or more than, the aggregate effect of trees on air temperature.

4. Emissions Modeling. Observed air temperature regimes at the Davis parking lot were used to design "base case" and "treatment" cases for hypothetical changes in parking lot tree canopy. These temperature regimes were used as input to the MVEI7G model to simulate vehicle emissions in Sacramento County. ROG emissions (reactive organic gases) were reduced by 2% (0.85 tpd) for an increase in canopy cover from 8% to 50%. NO_x emissions from cooler engine starts were reduced by 0.1 tpd (0.2%).

Though modest, projected ROG reductions were equivalent to projected hydrocarbon emission reductions for existing Sacramento

Metropolitan Air Quality Management District control measures for graphic arts, ethylene oxide sterilizers, alternative fuel stations and waste burning (totaling 0.89 tpd). Projected NO_x emission reductions (0.1 tpd) were equivalent to reductions projected from the district's light-duty vehicle scrappage program (0.1 tpd).

This study is helping to foster new partnerships between air quality agencies, non-profit volunteer groups, landscape professionals, local government and businesses. As a result, the livability of our communities is improving through better design and stewardship of "green parking lots."

Call for nominations

Nominations are now being accepted for the California Urban Forests Council Board of Directors. CUFC has 9 board members, three each from the north, central, and southern part of the state. Each term is for three years and the terms are staggered. Members of the Board are required to attend a minimum of 2 meetings per year (usually one in the north and one in the south) and be willing to serve on at least two committees.

The terms of the following board members will expire this year: **Linda Wilgus/Tom Chiosso** (jointly serve as one position) in the northern region, **Tim O'Keefe** in the central region, and **Herb Spitzer** in the southern region.

Nominations may be made by submitting the nominee's name, address, phone number and E-mail address (if available) to the CUFC office via mail or E-mail before August 1, 1998. Ballots will be sent to all CUFC members in the next newsletter. New board members will be announced at the annual meeting in October.