Vol. No. 1 October 5, 2004

United States Environmental Protection Agency

HIRI NEWS

Heat Island Reduction Initiative

The Mitigation Impact Screening Tool (MIST), Update on Urban Heat Island Modeling in CA, ICLEI Workshops a Success!

Call participants

Hashem Akbari, LBNL (H_Akbari@LBL.gov)
Drew Ballensky, Duro-Last (drewballensky@hotmail.com)
Hallie Comer, Philadelphia Air Management Services (Hallie.Comer@phila.gov)
Nicole Davis, ISSRC (nicoledavis@verizon.net)
Kathy Diehl, EPA R9 (diehl.kathy@epa.gov)
Rosalie Green, EPA (green.rosalie@epa.gov)
Lucie Griggs, Atlanta Cool Communities (lwgriggs@hotmail.com)
David Hitchcock, HARC (dhitchcock@harc.edu)
Paul J. Hollar, Phoenix (Phollar@phelpsdodge.com)
Vinnie Hunt, Tucson (Vinnie.Hunt@tucsonaz.gov)
Cheryl Kortemeier, Trees Atlanta (cheryl@treesatlanta.org)
Julie K. Magee, EPA R5 (magee.julie@epa.gov)
Dennis Minks, City of Louisville (dminks@louky.org)
Craig Muccio, Florida Power and Light (C_V_Craig_Muccio@fpl.com)
Joyce Rosenthal, Columbia University (jr438@columbia.edu)
David Sailor, Portland State University (sailor@cecs.pdx.edu)
Stephen Stetson, Global Environmental Management, Inc. (Sws@rsat.com)
Brian Stone, University of Wisconsin (Bjstone@wisc.edu)
John J. Sullivan, Portland Cement Association (jsullivan@cement.org)
Kathy Sykes, EPA (sykes.kathy@epa.gov)
Harold Taft, AL Forestry (TaftH@forestry.state.al.us)
Ashwani Vasishth, University of Southern California (Vasishth@scag.ca.gov)

Mitigation Impact Screening Tool (MIST)

Dr. David Sailor, Associate Professor in the Department of Mechanical Engineering at Portland State University, joined the call to speak on the new Mitigation Impact Screening Tool (MIST). MIST is a program used to estimate the impacts of urban heat island mitigation strategies on urban air temperatures, ozone, and energy consumption. MIST evaluates the following measures: increasing urban albedo, increasing urban vegetative cover, or the combination. It also allows users to specify a particular temperature change.

There are three basic steps involved in running MIST

1. Select the city to model
2. Define the mitigation strategy to test
3. Estimate impacts on meteorology, air quality, and energy

Data necessary to run the MIST code are available for approximately 240 cities in the default data file. For a subset of 19 cities the data file is complete. For the remaining cities the MIST code must make some form of interpolation/curve-fit. This data file can be substituted with a different file or or can be modified by the user.

Whether the user selects a vegetation, albedo, or combined mitigation strategy to model, the mitigation level represents a fractional increase over the entire city. The distribution of the change is assumed to be uniform over all urban areas. For example, if a city surface is 40% rooftop, 30% paved surface, and 30% vegetated surface and the user specifies an increase of 0.1 in vegetative fraction, the modification corresponds to the assumption that total vegetative cover in the city increases uniformly from 30% to 40%. Likewise a specified increase of 0.10 in city albedo is assumed to be applied uniformly over the entire city.

In practice, of course, this could be accomplished in many ways. For example, consider the hypothetical case where city albedo is increased by 0.10 by modifying ONLY rooftops. Since rooftops account for only 40% of the surface area one would need to increase rooftop albedo by 0.25 to affect a city-wide increase of albedo of 0.10 (ie., 0.25*0.40= 0.10). The MIST code is not capable of discerning spatial differences in application of either mitigation strategy, however – all mitigation is assumed uniform over the city.

At the present time MIST limits the range to -0.5 < 0 < 0.5 for changes in either albedo or vegetation. In either case the level of mitigation specified by the user is converted directly to projected changes in near-surface air temperatures using results from mesoscale atmospheric modeling studies. Alternatively the user may simply input a uniform temperature perturbation. This option directly affects a change in near-surface air temperature which is assumed uniform in space and time.

Urban heat island mitigation strategies can impact the urban environment in two distinct ways – directly and indirectly. The direct impacts of mitigation strategies are those that result from modification of the surface energy balance of buildings. For example, when a rooftop albedo (reflectivity) is increased the roof remains cooler under the hot summer sun and as a result the cooling load (and air conditioning energy consumption) is reduced.

Implementing heat island mitigation strategies can also have an indirect impact on the city. For example, when rooftops are cooled through the implementation of a high albedo strategy they convect less heat to the air that flows over them. The result is a city-scale cooling of near-surface air temperatures. If the mitigation strategy has sufficient spatial extent this indirect cooling can impact city-scale temperatures, air quality, and energy consumption. This effect has been demonstrated in regional scale simulations of various mitigation strategies.

It should be emphasized that this tool is intended for screening purposes only. The research upon which it is based necessarily incorporated a number of assumptions and MIST makes further assumptions and interpolation/extrapolation in order to make the results widely applicable for a large number of cities and a wide range of mitigation strategies.

MIST is currently in peer review for the EPA. For more information, call Nikolaas Dietsch at (202) 343-9299.

Update on Urban Heat Island Modeling in CA

Haider Taha, President of Altostratus, Inc., joined the call to talk about his work evaluating the impact of urban heat island strategies on ambient air quality standards and energy use. Dr. Taha's research is funded by the California Energy Commission's Public Interest Energy Research (PIER). The research agency is interested in heat island mitigation because of its potential to improve ozone air quality, lower peak energy demand, and improve public health. The primary objective for Haider's work is to produce a heat island reduction model that is scientifically reasonable, and supported by the EPA and the California air districts.

The study includes six broad tasks. The first task is to obtain the necessary input data, air quality data, emission inventories, and any other special meteorological data. This task also includes setting up the models, testing the models and model setups, and identifying the processors or models that may be needed.

Next, any available or existing regional data and sources will be reviewed and evaluated. The most suitable and useful data sets will be reviewed and integrated into the project. Relevant data includes geophysical, land-cover, albedo, vegetation, and soil moisture. This task involves developing a gridded database to represent existing conditions in California air basins and correlating surface conditions to heat island mitigation scenarios.

The next task is to perform detailed mesoscale meteorological modeling using the most recent version of the PSU-NCAR MM5. The simulations include baseline and a number of control scenarios for each region and episode. Several modeling configurations are tested and evaluated until performance is deemed reasonable and the surface-modification signal is clear and noise-free. The meteorological model output is used to pre-process emissions in each region and drive the air quality model simulations. Results are used to estimate the large-scale impacts of control strategies on energy use in California.

Air quality modeling includes recasting area-source emissions to reflect the modified simulations and photochemical air quality modeling of base and control scenarios corresponding to each meteorological episode. The photochemical modeling is performed using the CAMx model and conforms to the domains and episodes used by California air districts in their SIP demonstration modeling.

The air quality modeling results (e.g. changes in ozone concentrations) are converted into NOx and/or VOC emission reduction equivalents. These are used to estimate the benefits of urban heat-island control by itself and as a supplement to other air quality improvement strategies that are planned or already in place. Lastly, the results are recast into specific metrics or formulae. The objective is to translate the results into metric or statements that can then be directly incorporated into SIP and related incentives in the future.

For more information, see: http://www.altostratus.com

ICLEI Workshops A Success!

Ryan Bell, from International Council for Local Environmental Initiatives (ICLEI) – Local Governments for Sustainability, spoke on the HIRI call about their recent workshops. Three one-day events were held during September and October in the jurisdictions of San Diego, Philadelphia, and San Antonio (hosted jointly by the City, Bexar County and the MPO, along with the City of Austin and Austin Energy, and the Houston Advanced Research Center and the City of Houston). These events brought together a diverse collection of local government staff, elected officials and members of the public to discuss the causes of heat islands, mitigation opportunities, and how to advance cool communities concepts in the local regions.

Although the approach varied between the three events, each helped promote heat island mitigation in local municipal operations. San Diego used the event to launch a comprehensive "cool communities" program in the City. The Texas event brought together organizations from around the state to discuss how to advance local-level programs and bring together stakeholders into a region-wide initiative. Finally, the Philadelphia event focused on creating synergies between local groups to create a multi-faceted program for community health and revitalization.

Response to these workshops has been enthusiastic. Jurisdictions replying to the initial RFP, industries that exhibited at the events, and community members all benefitted from the discussion. In all, over 200 people took part in the worksiops. ICLEI looks forward to building on this momentum by hosting events in additional jurisdictions and continuing to work with communities in the organization's *UHI Policy Adoption and Peer Exchange Initiative*.

More information about these workshops, along with copies of the presentations made, are available at http://www.hotcities.org

The next conference call is TBD. Stay tuned for the date, call-in number, and access code.