Environment and Natural Resources Trust Fund
2014 Request for Proposals (RFP)

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Project Title:

Characterizing Urban Metabolism to Help Manage Carbon Emissions

Category: E. Air Quality, Climate Change, and Renewable Energy

Total Project Budget: $ 189,523

Proposed Project Time Period for the Funding Requested: 3 Years, July 2014 - June 2017

Other Non-State Funds: $ 0

Summary:

This proposal will help the MPCA formulate CO2 emissions reduction and climate change adaptation by quantifying the fluxes of CO2, energy, and water from urban surfaces using innovative measurements

Name: Katsumi Matsumoto

Sponsoring Organization: U of MN

Address: 310 Pillsbury Dr SE
Minneapolis MN 55455

Telephone Number: (612) 624-0275

Email katsumi@umn.edu

Web Address

Location

Region: Metro

County Name: Hennepin

City / Township: Minneapolis

MP: 0613-2-106-proposa
Budget: 0613-2-106-bud
Qual: 0613-2-106-qualifi
Map: 0613-2-106-map-2
Resolution: 0613-2-10
List:

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base	
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency	
Capacity	Readiness	Leverage	Employment	TOTAL

PROJECT TITLE: Characterizing urban metabolism to help manage carbon emissions

I. PROJECT STATEMENT

The US EPA and the Minnesota Pollution Control Agency (MPCA) consider CO_2 a pollutant. The Next Generation Energy Act established a 2015 reduction goal of 15% below 2005 emissions of the greenhouse gases (GHG). In order for the MPCA to formulate and assess an approach to achieving this goal, it is necessary to understand the background carbon budget. As noted in the letter of support by the MPCA, this project will help the MPCA achieve this understanding for an urban setting and ultimately formulate a strategy of CO_2 emissions reduction.

In "urban metabolism," cities consume various materials and discard waste such as heat, aerosols, and GHG, which are released directly into the urban atmosphere, impacting the local climate and human health. The main thrust of this proposal is to characterize this metabolism through a set of innovative micrometeorological measurements. Presently such top-down atmospheric monitoring and evaluation are lacking in Minnesota cities. They would provide a more complete carbon accounting when combined with bottom-up carbon inventory.

We propose to set up two new weather stations on the University of Minnesota (U) Minneapolis campus on top of tall buildings in order to minimize wake effects and maximize the sampled footprint of the urban landscape, which will likely be an area with ~2.5 km radius. Our choice of sites is guided by experience that obtaining permission to access privately owned buildings and towers is often difficult and expensive. In this respect, the project leader has experience working with U that demonstrates feasibility of setting up a weather station on a U rooftop but lacks the appropriate site location for this project's aim. The measurements we make will yield innovative environmental quantities, namely, the vertical fluxes of energy, water, and CO_2 between the urban surface and the overlying atmosphere. A key question we will answer is: "How does the urban surface act as a source of carbon to the atmosphere?" Based on limited information available, we expect that with sufficient trees, the urban surface can actually draw down CO_2 from the atmosphere even as human activities are emitting CO_2. Whether the urban surface acts as a source or sink of CO_2 to the atmosphere is expected to have a significant implication on the MPCA as it formulates a plan to reduce CO_2 emissions.

This will be the first study to quantify the urban metabolism with micrometeorology within Minneapolis. In order to relate the limited footprint of our study to other scales, we can take advantage of a land classification scheme. For example, there is 37% vegetation within a 2.5 km radius around the East Campus of the U, compared to 31% in downtown Minneapolis and 56% in south Minneapolis residential area. This coverage offers one way to relate our findings on the strength of the vegetation to make the urban surface a possible sink of CO_2 to other and larger areas. Considering other information (e.g., economic, traffic) may offer other ways.

We emphasize that our findings will also include fluxes of energy and water coming from the surface, and they are also controlled by city canopy as well as by impervious surfaces and buildings. Our findings will thus shed light on urban runoff (e.g., stream pollution) and evapotranspiration (e.g., cooling of cities, green spaces). These are major urban and climate change adaptation issues that our project will help clarify and find solutions to.

II. DESCRIPTION OF PROJECT ACTIVITIES

Activity 1: Construction of project infrastructure **Budget: $ 105,641**
Two telescoping tripods with a full set of sensors will be installed on the rooftops of two buildings on the U Minneapolis campus. Instruments will be secured, powered, grounded, and connected to the internet. Project infrastructure includes a new website for real time data display as well as acquisition by the public.

Outcome	Completion Date
1. Installation of two new weather stations with micrometeorological sensors	Summer, 2014
2. Construction of website for real time data display and access	October., 2014

Activity 2: Instrument maintenance, data management and analysis **Budget: $ 83,882**
Visits to the rooftops will be needed to maintain the instruments as they will be exposed to the elements of the weather all year round. In particular, the sensitive gas sensors will require calibration with reference gases on a regular basis. Measurements will be made at least 10 times a second, generating very large data set, which will be checked for quality, stored on reliable data server, and analyzed for fluxes of CO_2, energy, and water.

Outcome	Completion Date
1. Instrument maintenance and data management	Ongoing
2. Provision of teaching and research opportunities for U undergraduate students	Ongoing
3. Data analysis and reporting	Summer, 2015

III. PROJECT STRATEGY

A. Project Team/Partners

1) Katsumi Matsumoto, Associate Professor, Dept. Earth Sciences, U, project leader
   Will oversee the entire project, including equipment purchase and installation, project website construction, provision of opportunities of U students, data management and analysis, and reporting findings. All effort is provided as in-kind contribution and signifies a strong commitment to this project.
2) Tim Griffis, Professor, Dept. of Soils Water & Climate, U, project co-leader
   Will co-lead all aspects of the project with Matsumoto. All effort is provided as in-kind contribution.
3) Kathy Tokos, Research Fellow, Dept. Earth Sciences, U, project member
   Responsible for programming website and regular maintenance and calibration of instruments. Will request ENRTF to support four months of Tokos salary for each of the three years of funding.
4) Research staff, Dept. of Soils Water & Climate. U, project member (as yet unidentified)
   Responsible for programming datalogger, acquisition and preparation of CMDL standards and reference materials for instrument calibration. Will request ENRTF to support two months of salary for each year.

B. Timeline Requirements

By the summer of 2014, most equipment will be designed, purchased, and installed. By the fall of 2014, the project website will be constructed. Throughout the project period, significant work is required to maintain equipment, calibrate the sensors, manage and synthesize the voluminous data. Data and major finds will be reported on the website and presented at professional meetings and journals where appropriate.

C. Long-Term Strategy and Future Funding Needs

This project is partly environmental monitoring. Data from this project will thus become more valuable to the MPCA as the monitoring period is increased. For example, changes to the mode of transportation (e.g., new light rail system) within the footprint of the weather stations can possibly be detected in CO_2 flux changes with sufficiently long data coverage. The instruments that will be purchased with LCCMR funding can last years with regular maintenance. Although funding generally becomes difficult once a project becomes well established, the project team will make every effort to continue collecting data and anticipate seeking external funding.

2014 Detailed Project Budget

Project Title: Characterizing urban metabolism to help manage carbon emissions

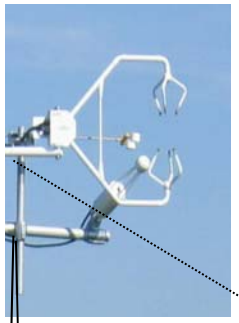
IV. TOTAL ENRTF REQUEST BUDGET 3 years

BUDGET ITEM	AMOUNT
Personnel:	
Kathy Tokos, Research Fellow, Dept. Earth Sciences, University of Minnesota. Tokos will construct and maintain the project website. She will regularly maintain and calibrate the instruments. For each year, we request 4 months/year, which is $20,229. This includes $16,663 salary and $3,566 benefits.	$60,687
Research staff, Dept. Soil, Water, and Climate , University of Minnesota. A staff, as yet unidentified but in the Griffis research group, will help with instrument setup, maintenance, and programming. The preparation of reference gases for CO2 sensor calibration is a special need. For each year, a salary of $8,000 plus $1,712 benefits for a total of $9,712 is requested for 2 months/year of labor.	$ 29,136
Contracts:	
University of Minnesota Facilities. Tasks include physically mounting and securing two weather stations on building rooftops and wiring new power lines and cables for data transmission. The amount requested considers the estimated time required, current Facilities rate (variable depending on type of trade, but maximum is $100/hour), and materials.	$ 4,000
Equipment/Tools/Supplies:	
Instruments (telescoping tripod $2,600; CR3000 data logger $3,000; IRGASON 3D anemometer-thermometer w/ CO2 and H2O sensors $21,000; Kipp and Zonen 4 compent radiation sensors $6,000) and miscellaneous items (weather proof enclosure, data transmitter, shipping, others $3000). X2 for two sets of weather station.	$ 71,200
General hardware (power cords, data transmission cable, basic tools)	$ 500
Consumables and CMDL standards and calibrations ($5,000/year)	$ 15,000
One laptop computer and special software for on-site instrument maintenance and calibration	$ 3,000
Two sets of computer, hard disk, and softwares, one set for each project co-leader, will be dedicated to this project to manage and analyze the voluminous data. A set of measurements taken 10 times per second produces enormous amount of data over the period of this study.	$ 6,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 189,523

V. OTHER FUNDS

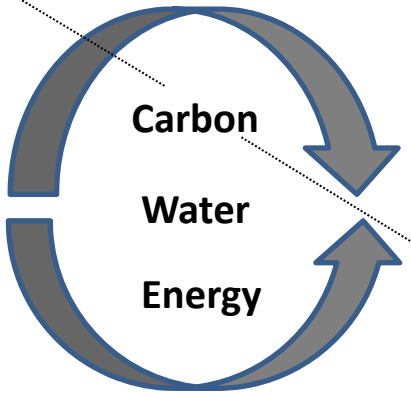
SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ Being Applied to Project During Project Period:	NA	
Other State $ Being Applied to Project During Project Period:	NA	
In-kind Services During Project Period:		
Katsumi Matsumoto, Associate Professor, Dept. Earth Sciences, UM. Matsumoto will oversee the entire project including production of annual reports. All effort and time, estimated to be approximately 2 months/year of Matsumoto's labor, are in-kind services.	$ 17,600	Secured
Tim Griffis, Professor, Dept. Soil, Water & Climate, UM, will co-lead all aspects of this project. In kind salary and fringe for Tim's effort =1,489, $10,622 costshare provided by U of MN for unrecovered ICR.	$ 12,111	Secured
Remaining $ from Current ENRTF Appropriation (if applicable):	NA	
Funding History:	NA	

Characterizing Urban Metabolism to Help Manage Carbon Emissions



flux measurements of carbon, water, and energy in an urban environment

new knowledge of urban metabolism



Next Generation Energy Act
reduce CO_2 emissions to MPCA target values

Project Manager Qualifications & Organization Description

2014 LCCMR Proposal: *Characterizing urban metabolism to help manage carbon emissions*

Project Manager: Katsumi Matsumoto, Ph.D.
Associate Professor
Department of Earth Sciences
University of Minnesota

Project Manager Qualifications:

(1) Professional Training:

Research Associate, Princeton University, NJ, 2000-2003
Ph.D., Columbia University, NY, 2000
M.S., University of Chicago, IL, 1996
B.S., Brown University, RI, 1992

(2) Professional Activities

Expert of the carbon cycle and the climate system
Author of 49 peer-reviewed scientific publications
Contributing author of the 2007 Science Report (Working Group I) of the Intergovernmental Panel on Climate Change (IPCC was awarded the 2007 Nobel Peace Prize) Project Manager Matsumoto is the only author from Minnesota.
Visiting Fellow/Scholar at: Univ. New South Wales (Australia), Univ. Tasmania (Australia), Univ. Tokyo (Japan), and Univ. of Bern (Switzerland)

Organization: University of Minnesota, Twin Cities