Environment and Natural Resources Trust Fund
2011-2012 Request for Proposals (RFP)

LCCMR ID: 138-F1+2+5

Project Title: Addressing Ozone Pollution in Minnesota: Equity and Efficiency

Category: F1+2+5. Climate Change and Air Quality

Total Project Budget: $ $266,999

Proposed Project Time Period for the Funding Requested: 2 yrs, July 2011 - June 2013

Other Non-State Funds: $ 0

Summary:

This project combines satellite measurements, monitoring data, and air quality modeling to study ozone pollution and exposure in Minnesota, and examines the effectiveness and environmental equity of potential control options.

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Sponsoring Organization: U of MN

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Minneapolis MN 55455

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Email julian@umn.edu

Web Address

Location

Region: Statewide

Ecological Section: Statewide

County Name: Statewide

City / Township:

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

2011-2012 MAIN PROPOSAL

PROJECT TITLE: Addressing Ozone Pollution in Minnesota: Equity and Efficiency

I. PROJECT STATEMENT

Ground-level ozone is one of the six criteria pollutants defined in the federal Clean Air Act. Ozone exposure increases susceptibility to respiratory infections, medication use by asthmatics, and hospital admissions for individuals with respiratory disease. It may also contribute to premature death, especially in people with heart and lung disease. Ozone can also reduce crop yields and harm sensitive ecosystems. Ground-level ozone is harmful; stratospheric ozone, also known as the ozone layer, is beneficial in shielding us from ultraviolet radiation.

Minnesota is in attainment with the current federal ozone standard (75 ppb, 8-hour average) but is likely to violate stricter standards (60-70 ppb) currently being proposed by the Environmental Protection Agency. Ground-level ozone is not emitted directly, but instead is formed in the atmosphere via a series of complex chemical reactions involving precursor nitrogen oxides (NO_x) and volatile organic compounds (VOCs). The level of air quality improvement achievable by a given control strategy depends strongly on the relative abundance of those two precursors (NO_x; VOCs); in some cases, poorly-chosen emission reductions can worsen ozone pollution.

Designing and testing effective control strategies for Minnesota to meet the new federal standard will require a strong understanding of 1) the current state of regional ozone chemistry; 2) urban, industrial, and natural precursor emissions in the state and region; and 3) the extent that pollution from neighboring states affects air quality in Minnesota.

Knowing which socioeconomic populations are most impacted by exposure to high ozone, and how those distributions would shift under specific emission control options, is a critical aspect of pollution control strategy. This project will combine regional air quality modeling, satellite measurements, and MPCA monitoring data to ***study the current state of ozone pollution and precursor emissions in Minnesota, and examine the effectiveness and environmental equality of a range of potential control scenarios***. The research complements MPCA's work in this area: if Minnesota violates the stricter ozone standard, MPCA would be required to model potential control strategies; our project extends beyond MPCA's purview by evaluating satellite data to understand the chemistry of ozone formation in Minnesota [Activity 1], and investigating equity and environmental justice aspects of ozone exposure and control [Activity 2].

II. DESCRIPTION OF PROJECT ACTIVITIES

Activity 1: *Characterize current ozone levels and precursor emissions in Minnesota using ground-based observations, satellite data, and atmospheric modeling.*
Budget: $ 93,450

We will use a combination of ground-based observations, satellite measurements, and a high-resolution atmospheric model (CAMx, 4km grid) to develop a strong understanding of current ozone pollution in Minnesota. We will classify areas throughout the state based on the chemical regime they fall into (NO_x- or VOC-limited). This analysis represents fundamental information for effective ozone control, since controlling the wrong precursor pollutant can be ineffective in reducing ozone, and may even make things worse in some areas. ***The results from Activity 1 will provide valuable information for designing and testing ozone pollution control strategies most likely to be effective in Minnesota.***

Outcomes	Completion Date
1a. Model ozone concentrations using state-of-the-science model (CAMx). Evaluate CAMx output by comparing against MPCA measurements and against satellite observations of nitrogen dioxide and a VOC (formaldehyde).	4/30/2012
1b. Identify hotspot locations for ozone pollution and the specific populations that are impacted.	4/30/2012
1c. Test the accuracy of emission inventories by comparing model output against satellite observations of nitrogen dioxide and formaldehyde.	6/30/2012
1d. Use satellite measurements and model results to diagnose the sensitivity of ozone pollution in Minnesota to NO_x versus VOC emission control strategies.	6/30/2012

Activity 2: *Evaluate the effectiveness and environmental equality of ozone control strategies.*
Budget: $ 173,549

We will apply the CAMx regional air quality model to study the effectiveness of potential ozone control strategies in Minnesota and to identify the impacts to specific socioeconomic groups. We will consider, for example, scenarios that focus on light- or heavy-duty vehicle emissions, electric power plants, or light industry and those that only target sources in certain regions of the state (e.g., urban versus rural). We will evaluate the impact of out-of-state pollution sources on ozone in Minnesota - this informs what is achievable through Minnesota action alone.

Each potential control strategy can yield differing health costs or benefits for different groups. Air quality legislation aims not only to safeguard public health but also to do so equitably across the population. Understanding these choices and tradeoffs is a necessary precursor to making informed and equitable policy decisions. **O*ur investigation will explore the extent to which ozone exposures would increase or decrease for specific socioeconomic or demographic groups*.**

Outcomes	Completion Date
1. Compare the effectiveness of statewide controls on emissions.	9/30/2012
2. Determine the effectiveness of region-specific controls.	11/30/2012
3. Evaluate the impact of out-of-state emissions on ozone in Minnesota.	2/28/2013
4. Compare the inequity of ozone exposure under each control strategy.	5/30/2013

III. PROJECT STRATEGY

A. Project Team/Partners

This project will be carried out by a team of scientists at the University of Minnesota. Dr. Julian Marshall is an expert in exposure to air pollution and environmental equality. Dr. Dylan Millet is an expert in atmospheric chemistry and satellite data. Dr. Kristina Wagstrom is an expert in regional air quality modeling. This group has extensive experience with the modeling and other tools proposed here. Modeling and data analysis will be performed on the Minnesota Supercomputing Institute at University of Minnesota.

B. Timeline Requirements - The project will be completed in two years.

C. Long-Term Strategy and Future Funding Needs

This is a standalone project that complements ongoing work at the University of Minnesota. The ultimate goal is to provide information and tools to be used by MPCA and state regulators to improve air quality in Minnesota for the betterment of human and ecosystem health.

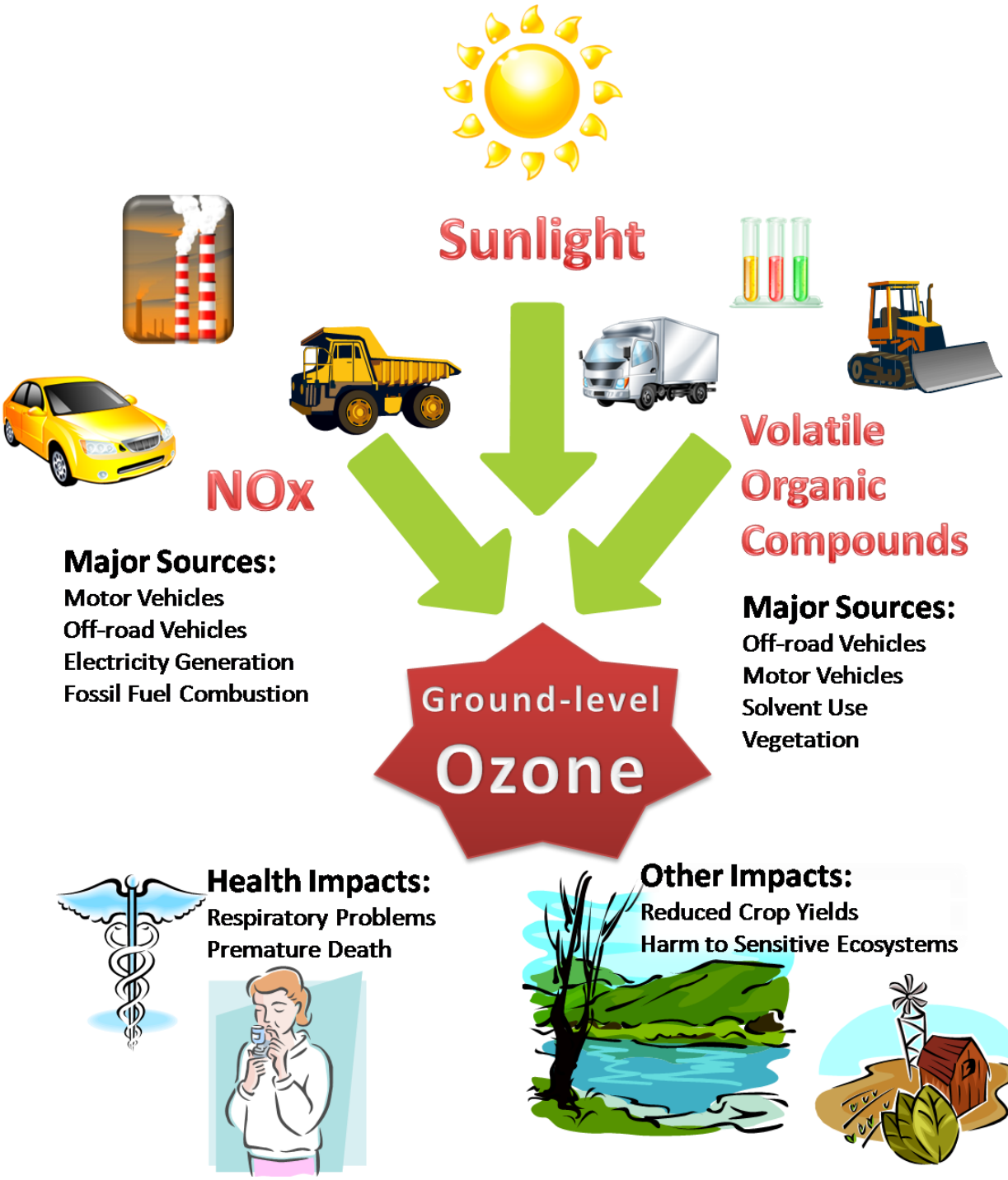
2011-2012 Detailed Project Budget

IV. TOTAL TRUST FUND REQUEST BUDGET (*2 years*)

BUDGET ITEM	AMOUNT
Personnel:	
Professor Julian Marshall, PI *(1 month summer salary per year for two years, $33,052 salary, $15,769 fringe, 32.3% fringe rate)*	$ 48,821
Professor Dylan Millet, Co-PI *(1 month summer salary per year for two years, $17,778 salary, $5,742 fringe, 32.3% fringe rate)*	$ 23,520
Dr. Kristina Wagstrom, Co-PI *(full support for two years, $88,000 salary, $17,494 fringe, 19.9% fringe rate)*	$ 105,494
Graduate Research Assistant, Master's Student *(full support for two years, $43,410 salary, $31,754 fringe - includes health care and tuition)*	$ 75,164
Summer Undergraduate Research Assistant *(3 months per year for two years)*	$ 13,000
Additional Budget Items: Page charges for a published peer-reviewed journal article in the second year (important to the scientific acceptance of the work).	$ 1,000
TOTAL ENVIRONMENT & NATURAL RESOURCES TRUST FUND $ REQUEST	$ 266,999

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
In-kind Expenses Being Applied to Project During Project Period:		
Computational Expenses at the Minnesota Supercomputing Institute (MSI does not charge us for the use of the resources, this is an estimate of the value of the use of the resources)	$ 15,000	


Sunlight
NOx
Major Sources:
Motor Vehicles
Off-road Vehicles
Electricity Generation
Fossil Fuel Combustion
Volatile Organic Compounds
Major Sources:
Off-road Vehicles
Motor Vehicles
Solvent Use
Vegetation
Ground-level Ozone
Health Impacts:
Respiratory Problems
Premature Death
Other Impacts:
Reduced Crop Yields
Harm to Sensitive Ecosystems

Project Manager Qualifications and Organizational Description

Dr. Julian Marshall
Assistant Professor, Department of Civil Engineering, University of Minnesota

B.S., 1996, Chemical Engineering, Princeton University
M.S., 2002, Energy and Resources, University of California, Berkeley
Ph.D., 2005, Energy and Resources, University of California, Berkeley

Dr. Julian Marshall will be the overall coordinator of this project. His research focuses on exposure to air pollution, including pollution dispersion modeling and environmental justice aspects of air quality management.

Dr. Dylan Millet
Assistant Professor, Department of Soil, Water and Climate, University of Minnesota

B.S., 1998, Chemistry, University of British Columbia
Ph.D., 2003, Ecosystem Science, University of California - Berkley

Dr. Dylan Millet's research applies measurements and models to understand the impacts of human activity and natural processes on the chemical composition of the atmosphere. His current research combines ground-based and satellite measurements to better understand air quality and atmospheric composition.

Dr. Kristina Wagstrom
Postdoctoral Associate, Department of Civil Engineering, University of Minnesota

B.S., 2004, Chemical Engineering, Illinois Institute of Technology
Ph.D., 2009, Chemical Engineering, Carnegie Mellon University

Dr. Kristina Wagstrom's research applies regional air quality modeling (using CAMx) and source apportionment approaches to study the origins, transport, and fate of air pollutants.

University of Minnesota
The University of Minnesota is one of the top research universities in the nation with extensive computational resources, making it an ideal location to carry out this research. Specific resources to be used in this study include the Minnesota Supercomputing Institute (http://www.msi.umn.edu) and the Department of Soil, Water, and Climate High Performance Computing Cluster.