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

DRAFT
N

Project Title:

Minnesotas Methane Emissions: Potential Energy and Climate Benefits

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

Total Project Budget: $ 362,680

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

Other Non-State Funds: $ 0

Summary:

This project quantifies Minnesota's methane emissions. Results will indicate where reductions can be effective, evaluate the importance of natural and human-driven sources, and identify energy savings and climate mitigation opportunities.

Name: Dylan Millet

Sponsoring Organization: U of MN

Address: Soil, Water, & Climate Dept., 439 Borlaug Hall, 1991 Upper Buford Cir
St. Paul MN 55108

Telephone Number: (612) 626-3259

Email dbm@umn.edu

Web Address

Location

Region: Statewide

County Name: Statewide

City / Township:

MP: 0613-2-076-proposa
Budget: 0613-2-076-bud
Qual: 0613-2-076-qualifi
Map: 0613-2-076-map-V
Resolution:
List:

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

PROJECT TITLE: MINNESOTA'S METHANE EMISSIONS: POTENTIAL ENERGY AND CLIMATE BENEFITS

I. PROJECT STATEMENT

Motivation. Methane is the second-most important human-caused greenhouse gas, and is emitted to the atmosphere from a wide range of sources. Sources in Minnesota include natural gas leaks, landfills, livestock, sewers, and petroleum systems, along with natural sources such as peatlands, other wetlands, and lakes.

All of these emissions affect our climate, since methane is much more efficient at absorbing heat-trapping radiation compared to the same amount of CO_2. Because of the difference in emissions (more CO_2 is emitted), the overall climate forcing due to methane is 30% that of CO_2. However, while CO_2 stays in the atmosphere for many hundreds of years, methane is removed relatively quickly (~10 years). Reducing methane emissions can therefore be a strong lever for minimizing climate warming in the near-term future. Reducing methane emissions can also provide major opportunities for harnessing and saving energy. For example, a single landfill can emit enough methane to power more than 1,000 homes.

Our knowledge of human-caused methane emissions in Minnesota is based on extrapolating a small number of sparse point measurements, and is extremely uncertain. This limits our ability to understand whether, and where, source reductions can be useful from an economic or an environmental standpoint. Quantifying natural sources is also critical for understanding how different management decisions might increase or decrease our overall methane emissions.

Goals and Outcomes. This project combines ground-based and airborne measurements with atmospheric modeling to develop the first reliable estimate of methane emissions in Minnesota. The overall goals are to:

- Derive a new, robust estimate of current methane emissions in Minnesota.
- Quantify the relative importance of human-driven and natural sources.
- Identify where source reductions are likely to be most effective.

This work will yield important benefits for the state of Minnesota. It will provide needed information for understanding the importance of methane as a greenhouse gas in Minnesota, and for assessing the importance of different source types. This in turn will help stakeholders and policymakers to identify opportunities for energy savings and climate mitigation.

II. DESCRIPTION OF PROJECT ACTIVITIES

Project activities will include:

- Tower measurements to reveal how methane sources vary through time (season-to-season, year-to-year).
- Airborne and automobile-based measurements to map the spatial distribution of methane emissions in the state, discover source hotspots, and quantify the relative importance of various source types.
- Atmospheric modeling to interpret these measurements in terms of methane source strengths and opportunities for mitigation.

This combination of ground-based and airborne measurements will provide a decisive advance for quantifying and distinguishing urban, industrial, agricultural, and natural methane sources in the state.

Activity 1: Carry out continuous, sustained ground-based methane measurements in MN. Budget: $120,000
Results will provide crucial information for assessing methane sources in MN and their changes through time.

We will perform high-frequency, accurate and long-term measurements of atmospheric methane at our Tall Tower Observatory in Rosemount, MN and at a peatland site at the Marcell Experimental Forest (USFS) in North-Central MN throughout the duration of this project. The Tall Tower samples a large area, and will allow us to assess average emissions from the overall region. The peatland site will allow us to investigate the importance of natural methane emissions.

Outcome	Completion Date
1. Continuous, high-quality 1-year, 2-year, and 2.5-year datasets of methane measurements from the UMN Tall Tower and Marcell peatland.	7/30/2015; 7/30/2016; 1/31/2017

Activity 2: Map the spatial distribution of methane emissions across the state and within the Twin Cities using ground-based and airborne measurements. *Results will provide needed data for discovering emission hotspots and assessing the importance of different source regions and source types.* **Budget: $133,680**

We will carry out a series of 18 measurement flights onboard a Cessna Skyhawk C172P aircraft (2 flights/month for April-August in year 2, plus 2 test flights at outset). Flight tracks will be designed to sample the full range of methane sources across the state, and to characterize urban outflow from the Twin Cities region. We will also carry out a series of driving surveys to map the distribution of methane within the Twin Cities, and identify any source hotspots from natural gas leaks, landfills, etc.

Outcome	Completion Date
1. Airborne dataset mapping atmospheric methane levels across the state, and targeting key source regions and categories.	6/30/2016
2. Ground-based dataset mapping atmospheric methane levels in the Twin Cities, and identifying significant emission hotspots.	6/30/2016

Activity 3: Derive a robust, top-down estimate of Minnesota methane emissions from natural and human-driven sources. *Results will provide critical information for diagnosing where source reductions can provide the most environmental and economic benefit.* **Budget: $109,000**

We will employ high-resolution atmospheric modeling to interpret the ground-based and aircraft-based methane measurements in terms of their implications for methane sources in Minnesota. We will use the measurement-model comparisons to arrive at an accurate, top-down estimate of methane emissions from the different sources in the state.

Outcome	Completion Date
1. Model simulation of methane concentrations across Minnesota.	12/31/2016
2. New methane emission inventory based on the ground-based and aircraft observations.	6/30/2017

III. PROJECT STRATEGY

A. Project Team/Partners. Research will be carried out at UMN by Dr. Dylan Millet and Dr. Tim Griffis. Millet is an atmospheric chemist with expertise in interpreting aircraft and ground-based data. Griffis is a micrometeorologist with expertise in methane measurements. Millet and Griffis will co-lead the research and supervise the postdoctoral researcher and undergraduate researcher during all aspects of the project.

B. Timeline Requirements. Work will be completed in 3 years. This includes tower measurements (years 1-3), developing and testing the airborne methane system (year 1), aircraft flights and driving surveys (year 2), and modeling and analysis (years 2-3). A major component, and the core of the postdoctoral researcher's effort, will be the extensive modeling work to interpret the atmospheric data in terms of methane source estimates.

C. Long-Term Strategy and Future Funding Needs. This project fits into the scope of Millet and Griffis's broader research program investigating the sources and impacts of atmospheric pollutants, both within Minnesota and beyond. Most of this overall research is funded through non-state sources, and this project will provide leverage in that regard. Our overall goal is to improve scientific understanding of pollutant sources to help inform decision-making by Minnesota stakeholders and regulators.

2014 Detailed Project Budget

Project Title: Minnesota's methane emissions: Potential energy and climate benefits

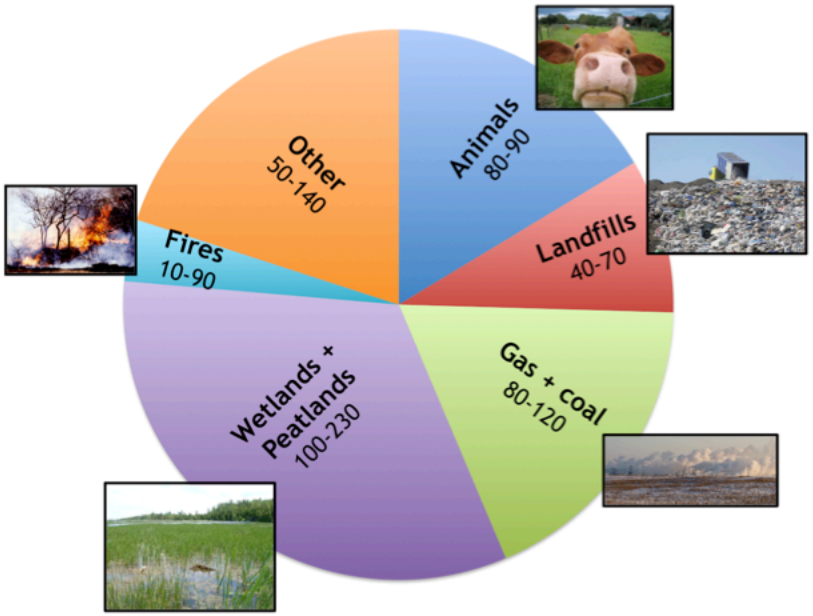
IV. TOTAL ENRTF REQUEST BUDGET (3 years)

BUDGET ITEM	AMOUNT
Personnel:	
Prof. Dylan Millet, PI (1 mo. summer salary/year for 3 years, $35,481, $2,352 fringe, 6.63% fringe rate)	$ 37,833
Prof. Tim Griffis, co-PI (1 mo. summer salary/year for 3 years, $41,899, $2,778 fringe, 6.63% fringe rate)	$ 44,677
Postdoctoral researcher (full support for 3 years, $150,000 salary, $31,125 fringe, 20.75% fringe rate)	$ 181,125
Undergraduate researcher - 16 hours/month for 1 year in Year 2 for driving surveys ($2,304 salary, $41 fringe, 7.04% fringe during summer only)	$ 2,345
Contracts:	
Flight hours for airborne methane measurements in Year 2 (2 test flights + 16 measurement flights)	$ 21,120
Equipment/Tools/Supplies:	
Ultraportable methane analyzer for aircraft measurements. We have methane analyzers for the tower measurements but require an additional portable unit for the mobile sampling.	$ 34,770
Supplies and consumables for aircraft and tower-based methane analyzers ($4,000/year)	$ 12,000
Certified methane gas standard for accurate measurements	$ 2,500
Travel:	
In-state travel to maintain and service instruments for this project ($2,000/year)	$ 6,000
Car rental for ground-based methane surveys in Year 2 ($40/day, includes fuel + insurance; 2 days / mo. for 1 year)	$ 960
Additional Budget Items:	
Machine Shop machining costs (to construct flight and tower racks for methane analyzers)	$ 2,500
MN Super Computer Institute storage fees during project ($750/year). Data will be archived once project is complete.	$ 2,250
Tall tower rent (50% for 3 years. Total tower rent = $8,400/year).	$ 12,600
Charges to publish peer-reviewed journal articles (crucial for scientific acceptance of the work). Work will be published in Journal of Geophysical Research or comparable scientific journal (cost is $1000 per article).	$ 2,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 362,680

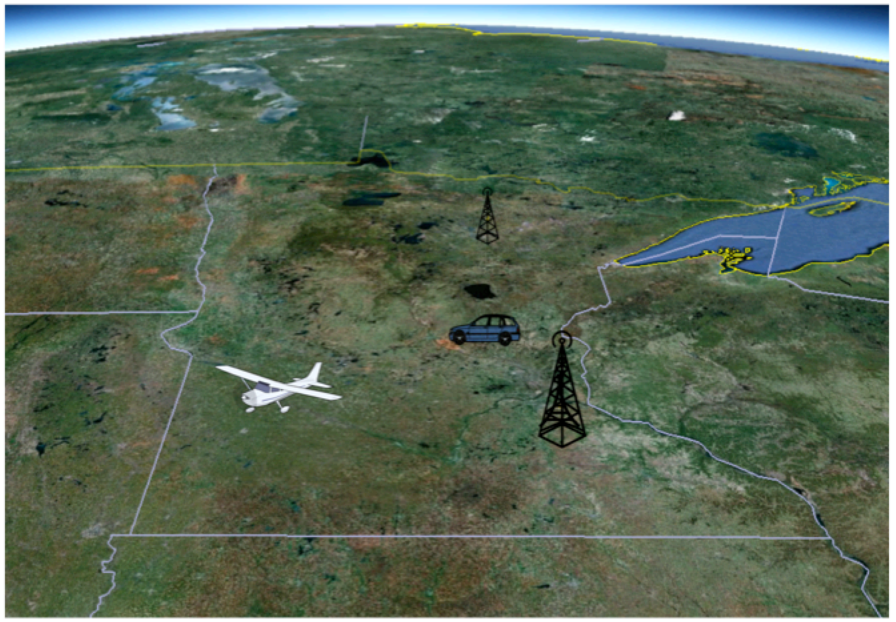
V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
In-kind Services During Project Period:		
Computational expenses at the Minnesota Supercomputing Institute (MSI does not charge us for the use of the resources, this is the estimated value of the use of the resources)	$15,000	Secured
Unrecovered IDC at the rate of 52% MTDC	$170,513	Secured
Professor Dylan Millet (additional salary paid by the University of Minnesota for effort put forth on this project)	$3,783	Secured
Professor Tim Griffis (additional salary paid by the University of Minnesota for effort put forth on this project)	$4,467	Secured

Minnesota's methane emissions: Potential energy and climate benefits



Methane is the 2nd most important human-caused greenhouse gas and a strong lever for reducing near-term climate warming and for saving energy



Ground-based and airborne measurements

↓

Map methane levels over Minnesota

↓

Identify emission hotspots and major source sectors

↓

Opportunities for greenhouse gas reduction and energy savings

PROJECT TITLE: Minnesota's methane emissions: Potential energy and climate benefits

PROJECT MANAGER QUALIFICATIONS & ORGANIZATION DESCRIPTION

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

B.Sc., 1997, University of British Columbia
Ph.D., 2003, University of California, Berkeley
Postdoctoral, Harvard University

Dr. Dylan Millet will lead the overall project and advise the postdoctoral and undergraduate researchers. His research focuses on atmospheric chemistry, and understanding the impacts of human activity and natural processes on the atmosphere.

Dr. Tim Griffis
Professor, Department of Soil, Water, and Climate, University of Minnesota

B.Sc., 1995, Brock University
Ph.D., 2000, McMaster University
Postdoctoral, University of British Columbia

Dr. Tim Griffis will co-lead the project and will provide specific expertise related to measuring atmospheric methane. His research focuses on understanding sources of trace gases to the atmosphere.

Organization Description. The University of Minnesota is one of the top research universities in the nation with extensive scientific and computational resources, making it an ideal location to carry out this research.