Request for the use of NSF Facilities for Education

Boundary Structure Experiments with Central Minnesota Profiling (BaSE CaMP)

submitted by

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1. Introduction

This proposal is requesting the use of a Mobile Integrated Sounding System (MISS) primarily in conjunction with the department's Radar and Satellite Meteorology course (EAS 468), but also with benefits for students enrolled in the concurrent Physical Meteorology course (EAS 465), the following semester's Meteorological Instrumentation course (EAS 364), and students talking the sequence of Senior Research Proposal (EAS 451) and Senior Research Project (EAS 452) at any point. Additionally, outreach opportunities are available to students just entering the department, to students in local high school physics courses, and to the general public.

The particular focus of the field deployments will be either on boundary layer structure in the presence of complex terrain and/or land surfaces, or weather permitting, on air mass boundaries, i.e. frontal passages. Additionally, the MISS will also be used for more general instrumentation experiments, such as intercomparison of the different profiling techniques available with and independent of MISS or data quality issues associated with one specific instrument. More general outreach will be in the form of classroom lectures, school visits, and public seminars.

2. Field Deployments

A remote site for MISS is available near the town of Richmond, MN, 1 km southwest of an approximately 50 m ridge. In the event of near-quiescent conditions, this site would be used for the investigation of thermally-driven circulations. The ridge makes up part of the north sidewall of the Sauk River Valley, which runs southwest of St. Cloud over a distance of approximately 20 miles and may contain slope and valley wind circulations. The relatively smaller areas and reliefs of these locations introduce the additional question of when these circulations will develop, as well as their eventual structure. Since the circulations would be driven by thermally-generated pressure gradients, the wind profiling abilities of MISS would be combined with department pressure and temperature instruments transported remotely by students.

In the case of more disturbed flow lacking an associated synoptic scale feature, the scientific focus would be dependent on the resulting wind direction. For a more northerly flow, the ridge may be capable of producing moderate leeside flow phenomenon, such as lee waves or enhanced downslope winds. In the case of a southerly wind, this ridge could be used to investigate upstream flow blocking and boundary layer separation. In the case of flow oriented along the valley access, MISS could be used to investigate enhancement via flow channeling, especially since the site is located near a constriction in the valley width. Since the flow would be more disturbed in this case, the complimentary department observations would be more reliant on portable anemometers.

In the not unlikely event of a frontal passage during the course of the campaign, great value could be obtained of MISS observations of the two-dimensional wind structure and evolution during this event, both through remote sensing and rapid radiosonde releases. This scenario especially will require an accurate forecast of the evolution of the synoptic scale flow field, which will necessarily be monitored by the AHS 468 students, but would also serve as an exercise for students in Synoptic Meteorology (EAS 385) and Current Weather Analysis I and II (EAS 480 and 481).

3. Additional Educational Activities

In addition to field deployments designed to monitor a particular type of atmospheric phenomenon, the MISS will also be used to conduct experiments related to general instrumentation principles. Students will have the opportunity to propose their own experiment along these lines, but there will also be a list of possible experiments they can choose from. These fall under the categories of intercomparing MISS's instrumentation, comparing MISS observations to independent observations, and testing the quality of a particular MISS instrument under varying parameters.

Because MISS contains both in-situ and remote sensing profiling abilities, a simple experiment is the comparison of the wind and temperature profile recorded by a radiosonde launch with the temperature profile from the Radio Acoustic Sounding System (RASS) and the wind profile from the boundary layer wind profile in different weather conditions. Also, if a video disdrometer is provided with MISS, these observations can be compared with reflectivity returns from the profiler and the department's laser disdrometer in the case of precipitation. In additions, SCSU has access to independent instrumentation which can be intercompared with MISS observations. Anemometers on a 500-foot radio tower can be compared with profiles from a radiosonde launch or used to fill the lowest level gap in data from the wind profiler. Another experiment would involve comparing wind data obtained from the GPS radiosonde with visual tracking observations of the balloon using phototheodolites of varying sophistication.

Besides intercomparisons, experiments could also be performed to assess the response of each individual instrument with MISS. The quality of the RASS instrument will be investigated as a function of the specific audio signal being used, while the surface station can take measurements over a small area at various non-WMO approved exposure sites. In addition to the hands-on educational activities, classroom lectures would be given by facility staff, particularly on wind profiling and RASS systems to the AHS 468 class and possibly on the application of atmospheric radiative transfer to radar systems. Also, the data collected during these field activities will be utilized as examples in the meteorological analysis software course (EAS 420).

4. K-12 and public outreach

During the 2012-2013 school year, the AHS department will have a physics teacher point of contact at a local high school. This makes a school visit for a science class particularly easy to arrange. If there is interest at other area high schools, additional visits can also be arranged. Facilities at SCSU also exist for giving seminars which are open to the public. A seminar on the topic of MISS in general or the use of MISS in a particular program should be given, ideally by facility staff or as a backup by the PI.

Table 1: Summary of student participation

Course Title and Name	Description of involvement	Number enrolled or future number of seats
EAS 468: Radar and Satellite Meteorology	Primary focus; in-class lecture on MISS operation and participation of students in field experiments	19
EAS 420: Meteorological Analysis Software	Using collected data to learn how to manipulate certain software (i.e. IDV, GrADS)	19
EAS 385: Synoptic Meteorology	Forecasting support for field experiments, particularly for the Richmond deployment	12
EAS 480/481: Current Weather Analysis I/II	Discussions in briefing format of the expected weather for the various field deployments	10
EAS 465: Physical Meteorology	Possible in-class lecture on applications of radiative transfer to MISS and disdrometers	18
EAS 364: Meteorological Instruments	Spring semester; can still benefit from data collected by radiosondes and surface station	20

Table 2: Proposed Timeline

September 28	SCSU campus	9 am: In-class lecture for radar and satellite meteorology class on MISS operation by EOL staff
September 29	Richmond Town Hall	Max 8 hour period: Field experiment studying dynamics of frontal passage or appropriate complex terrain problem
October 1	SCSU campus	1 pm: In-class lecture for physical meteorology class on radiative transfer applications and disdrometer principles
October 1	St Cloud Airport (KSTC)	5 pm: Instrumentation experiments involving RASS, radiosonde wind derivations, and ASOS comparisons
October 2	KVSC Radio Tower	5 pm: Instrumentation experiments involving radiosonde-tower wind comparisons and combined profiler-tower wind profiles
October 3	SCSU Brown Auditorium	7 pm: Seminar for general public on MISS in general or MISS in a particular field campaign by EOL staff
October 4	SCSU campus	5 pm: Instrumentation experiments involving comparisons of EOL video disdrometer, SCSU laser disdrometer, and MISS reflectivities
October 5	St. Cloud Tech High School	Classroom visit for senior physics class

Facility Request Form for Educational Activities

Part I: General Information

Requestor Name	Brian J. Billings
Institution and Address	St. Cloud State University, St. Cloud, MN 56301-4498
Phone and Email	bjbillings@stcloudstate.edu 320-308-3298
Faculty Advisor Name (if student requestor)	

Part II: Project Description

Project Title	Boundary Structure Experiments with Central Minnesota Profiling (BaSE CaMP)
Project Location	St. Cloud, Minnesota, vicinity
Start and End Dates of Field Deployment	27 September – 4 October 2012
NSF Facilities requested (type and # of systems)	1 MISS
Number of Expendables requested (if applicable)	12 radiosondes

Part III: Educational Activities Description

Number of students actively involved	Graduate: 0 Undergraduate: 25 to 100
Desired training activities conducted by Facility Staff including time in the field	Oversight of various field and instrument experiments, 20 hours
Desired teaching activities conducted by Facility Staff including time in the field	One lecture for radar meteorology class and one public outreach lecture
Additional special requirements that pertain to Facility support	
Ancillary/Opportunistic Outreach Activities	University Students: K-12:One visit to local high school physics Public:

Part IV: Operational Requirements

Please specify data access needs (e.g., real time)	Real time data transfer
Please specify data analysis needs	
Please specify communications needs	

BaSE CaMP Feasibility
Educational Request

Title: Boundary Structure Experiments with Central Minnesota Profiling (BaSE CaMP)
PI: Brian Billings (Saint Cloud State University, St Cloud, MN)
Facilities: Mobile Integrated Sounding System (MISS)
12 Soundings
Dates: 27 September to 4 October, 2012
Location: St. Cloud, MN

This request proposes to use the EOL/ISF MISS for one week of educational activities at St. Cloud State University in the fall of 2012. A series of undergraduate classes and public outreach activities are planned at 2 or 3 different sites in the St. Cloud area (see attached request document). The activities include demonstrating the equipment and launching up to 12 radiosondes.

EOL scientific and technical staff will travel to St. Cloud to support the request. Two lectures will be given, one to classes and another at a public outreach event. An EOL scientist would present the lectures and work with Dr. Billings and other university staff on the various educational activities. An EOL technician is required to assist in the activities and provide necessary technical support. A temporary hire will drive the MISS truck and trailer to St. Cloud to reduce the impact of the request on staff resources.

The MISS facility and appropriate staff are available in the requested time-frame so the proposed activities are feasible.

Boundary Structure Experiments with Central Minnesota Profiling (BaSE CaMP)

Earth Observing Laboratory

OFAP Mtg:

Version Dated: 14-Aug-12

EOL Facility:	**MISS**							
Project Title:	Boundary Structure Experiments with Central Minnesota Profiling (BaSE CaMP)							
Principal Investi	Brian J. Billings, St. Cloud State University, Minnesota							
No. of Operatior	8 Days							
Project Location	St. Cloud, MN							
Time Period:	27-Sep-12	-	04-Oct-12					
Funding Agency	NSF-Deployment							
EOL Staffing:	25	**Eng:**	-	**Sci:**	13	**Tech:**	12	
(Cumulative		**Eng/Sci:**	-	**SE Eng:**	-	**Temp:**	-	

SALARIES & BENEFITS						Direct Cost	Modified Direct Cost
Overtime	$44.05	per hour	9	hours		$396	$396
Field Reimbursement	$30.50	per day	-	days		$0	$0
Holiday Pay	$52.54	per hour	-	hours		$0	$0
Subtotal Regular Salaries						$396	$396
Regular Benefits (FY12 Rate)	50.5%					$200	$200
					Total Salaries & Benefits:	$993	$993

MATERIALS & SUPPLIES	Unit Cost	Number of Units		Direct Cost	Modified Direct Cost
Balloons	$25	15	(12 sondes plus spares)	$375	$375
Radiosondes	$205	15		$3,075	$3,075
Helium	$200	3		$600	$600
Data Archiving				$200	$200
Misc. Supplies				$891	$891
			Total Materials & Supplies:	$5,141	$5,141

PURCHASED SERVICES	Unit Cost	Months	Number of Units		Direct Cost	Modified Direct Cost
Temp Driver	$2,500	1	1		$2,500	$2,500
GSA Vehicle & Fuel	$1,200		1		$1,200	$1,200
				Total Purchased Services:	$3,700	$3,700

TRAVEL

Operations:			Rate	Unit		Direct Cost	Modified Direct Cost
Per diem domestic - St. Cloud, MN			$46	25	Cumulative	$1,150	$1,150
Lodging domestic - St. Cloud, MN			$77	25	Cumulative	$1,925	$1,925
Round Trip Airfare - Minneapolis, MN			$250	1	Trips	$250	$250
One Way Airfare - Minneapolis, MN/Boulder, CO			$110	2	Trips	$220	$220
Vehicle Rental - Minneapolis, MN	2.5	weeks	$410	1	No. of Vehic	$1,025	$1,025
Misc. Travel Costs			$15	25	Cumulative	$375	$375
					Subtotal Operations:	$4,945	$4,945
					Total Travel:	$4,945	$4,945

TOTAL DIRECT COST		$14,779	
MODIFIED TOTAL DIRECT COST (MTDC)*			$14,779
INDIRECT COST (FY12 Rate)	**50.5%**	$7,463	
Total Cost		**$22,242**	

*MTDC is based on total estimated expenditures excluded from overhead

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Type Trip	Begin Date	End Date	Total Days	Field Pay?	Who?	Title	Type Airfare	Holiday?
Operations	9/27/12	10/3/12	7	No	Cohn	Sci	Round Trip	No
Operations	9/27/12	10/8/12	12	No	Lou	Tech	One Way	No
Operations	10/3/12	10/8/12	6	No	Bill	Sci	One Way	No
	days	11.00						
	weeks	1.57						

Sum of Total Days	
Title	Total
Sci	13
Tech	12
(blank)	
Grand Total	25

Count of Holiday?	
Holiday?	Total
No	3
(blank)	
Grand Total	3

Sum of Total Days	
Field Pay?	Total
(blank)	
Grand Total	

Sum of Total Days	
Type Trip	Total
Operations	25
(blank)	
Grand Total	25

Count of Type Airfare	Type Airfare			
Type Trip	Round Trip	(blank)	One Way	Grand Total
Operations	1		2	3
(blank)				
Grand Total	1		2	3