

BC Clean Air Research Fund

Final Report

April 1, 2015 to Mar 31, 2016

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Dr. Hans D. Osthoff
Department of Chemistry
University of Calgary
2500 University Drive NW
Calgary, AB T2N 1N4
phone: 403-220-8689
email: hsthoff@ucalgary.ca

PROJECT OVERVIEW

Abstract

The rate of ozone (O_3) formation in the atmosphere is highly non-linear and depends critically on "background O_3 ", which along the BC south coast is the concentration of O_3 entering from the Pacific Ocean. McKendry and coworkers [Atmosphere Ocean 52(3), 271-280, 2014] have reported nocturnal O_3 depletion events (ODEs) at the Amphitrite Point Observatory (APO) on the West coast of Vancouver Island whose cause(s) has (have) remained unclear. O_3 removal in the upwind marine boundary layer influences downwind production of it and secondary particulate matter and ultimately affects visibility and human health in the greater Vancouver area and the Lower Fraser Valley. An improved understanding of the ODE phenomenon is hence relevant for air quality management in BC.

The Osthoff group's mobile laboratory was deployed to APO from July 6 to 31, 2015. In addition to the long-term measurements, concentrations of individual monoterpenes, molecular halogens (i.e., Cl_2 , I_2), and a complete suite of nitrogen oxides were quantified. During westerly flow of relatively clean marine air, O_3 was generally conserved at night, indicating that deposition to the ocean surface is a minor loss pathway. During episodes of nocturnal ODEs, mixing ratios of biogenic VOCs (which rapidly react with O_3) were generally enhanced. In many of those cases, the upwind air had been in contact with terrestrial vegetation via land-sea breeze circulations but also had been in contact with emission from kelp fields. The results suggest that nocturnal ODEs at APO are mainly driven by local or regional processes involving near-shore vegetation.

FINANCIAL OVERVIEW

Revenue Description

Table 1 Projected Total Project Revenue (cash and in-kind)

Organization	2015/16		Total
	Cash	In-kind	
BC CLEAR - Fraser Basin Council	\$15,000	\$0	\$15,000
Environment Canada	\$26,265	\$0	\$26,265
U Calgary*	\$0	\$36,762	\$36,762
UBC	\$0	\$5,000	\$5,000
NSERC CREATE IACPES	\$22,000	\$0	\$22,000
NSERC USRA	\$4,500	\$0	\$4,500
NSERC Discovery	\$1,666	\$0	\$1,666
TOTAL	\$69,431	\$41,762	\$111,193

* consists of a teaching assistantship for Natasha Garner April and Sept-Dec 2015 (\$8,381) and of a teaching assistantship for Nick Yordanov (\$6,286) and use of mobile laboratory (\$20,000)

Table 2 Actual Revenue for Reporting Period (cash and in-kind)

Organization	2015/16		Total
	Cash	In-kind	
BC CLEAR - Fraser Basin Council*	\$15,000	\$0	\$15,000
Environment Canada	\$26,265	\$0	\$26,265
U Calgary	\$0	\$36,762	\$36,762
UBC**	\$0	\$0	\$0
NSERC CREATE IACPES	\$22,000	\$0	\$22,000
NSERC USRA	\$4,500	\$0	\$4,500
NSERC Discovery **	\$3,050	\$0	\$3,050
TOTAL	\$70,815	\$36,762	\$107,577

Note: Please attach copies of letters or agreements confirming additional funds.

Please explain revenue discrepancies (if any)

* The final installment of \$3,750 has been included in the above table (though it has not yet been received).

** UBC didn't provide their in-kind support measurements of boundary layer heights (\$5,000 in-kind contribution).

Expenses Description

Table 3 Projected Expenses for Reporting Period (cash and in-kind)

Project Costs	Expenses		
	All Sources		
	<i>Cash</i>	<i>In-kind</i>	<i>Total</i>
Salaries	\$44,000	\$16,762	\$60,762
Fees	\$5,092	\$0	\$5,092
Travel and accommodation	\$14,079	\$0	\$14,079
Equipment and supplies	\$4,260	\$25,000	\$29,260
Communications and outreach	\$2,000	\$0	\$2,000
Analysis	\$0	\$0	\$ 0
TOTAL PROJECT COSTS	\$69,431	\$41,762	\$111,193

Table 4 Actual Expenses for Reporting Period (cash and in-kind)

Project Costs	Expenses		
	All Sources		
	<i>Cash</i>	<i>In-kind</i>	<i>Total</i>
Salaries	\$43,533	\$16,762	\$60,295
Fees	\$5,092	\$0	\$5,092
Travel and accommodation*	\$11,773	\$0	\$11,773
Equipment and supplies**	\$10,416	\$20,000	\$30,416
Communications and outreach	\$0	\$0	\$ 0
Analysis	\$0	\$0	\$ 0
TOTAL PROJECT COSTS	\$70,814	\$36,762	\$107,576

Please explain expense discrepancies (if any)

* Travel and accommodation were lower than anticipated.

** Material and supply expenditures were higher than anticipated.

RESULTS OVERVIEW

Activity Description

Table 5 Summary of Activities for the Reporting Period

Activity*	Completion Date	Description of Results
Planning of field campaign	July 1, 2015	Everything went as planned.
Collection of field data	Aug 2, 2015	We achieved our objective to collect a continuous data set of individual monoterpenes and halogen mixing ratios at APO.
Data analysis	ongoing	Key data (monoterpenes, O ₃ , and CO ₂) have been finalized (NO ₂ was finalized today - March 31, 2016), and analysis of additional data (iodine, ClNO ₂) is ongoing. As the students involved in this project will continue to work towards their degrees after the above "end date", all of the data will be finalized in the end. Supporting measurements (CO, ACSM, SO ₂) are expected to have been validated by the end of April, 2016.
Dissemination	ongoing	We presented a poster with preliminary results at the 2015 AGU Fall Meeting in San Francisco. A manuscript has been drafted and has been submitted to the co-authors for feedback. We expect to draft one or two additional manuscripts later this year.

*As outlined in the project contribution agreement or contract.

Please explain activity discrepancies (if any)

Deliverable Description

Please include copies of all deliverables with the final report (e.g. publications, presentations, research reports, etc.). The final report will be considered incomplete without copies of the project deliverables.

Table 6 Summary of Key Deliverable Accomplishments for the Reporting period

Deliverable*	Description	Description of Results
Data	Dissemination of final data set to project partners (due Dec 31, 2015)	Key data (monoterpenes, O ₃ , NO ₂ , and CO ₂) have been finalized, and analysis of additional data (NO ₂ , iodine, ClNO ₂) is ongoing. As the students involved in this project will continue to work towards their degrees after the above "end date", all of the data will be finalized in the end. Supporting measurements (CO, ACSM, SO ₂) are expected to have been validated by the end of April, 2016.
Report	Dissemination of final project report, which will form the basis for a peer-reviewed manuscript (due March 31, 2016)	please see Appendix 4
Manuscript draft	Draft of a manuscript to co-authors, to be submitted to a peer-reviewed journal (due March 31, 2016)	please see Appendix 4

*As outlined in the project contribution agreement or contract.

Please explain deliverables discrepancies (if any)

DELIVERABLES

Appendix 4: Manuscript draft. Filenames: "Atmosphere-Ocean Ucluelet 160331c.pdf" and "Atmosphere-Ocean Ucluelet supplemental 160331b.pdf"

Already filed with the interim report:

Appendix 1: Contribution agreement with Environment Canada (2015). Filename: "1034584- Osthoff - EC- FE Agreement.pdf"

Appendix 2: NSERC IACPES contributions 2015-16 (for Natasha Garner and Duncan Brownsey). Filename: "IACPES 2015-16.pdf"

Appendix 3: NSERC USRA notice to Duncan Brownsey 2015. Filename: "NSERC USRA Duncan Brownsey.pdf"